T1000

AIRLINE DIVISION

T1020

MAINTENANCE MANUAL

CARD 1 OF 5

PA-31-350 T1020

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 768)

INTRODUCTION.

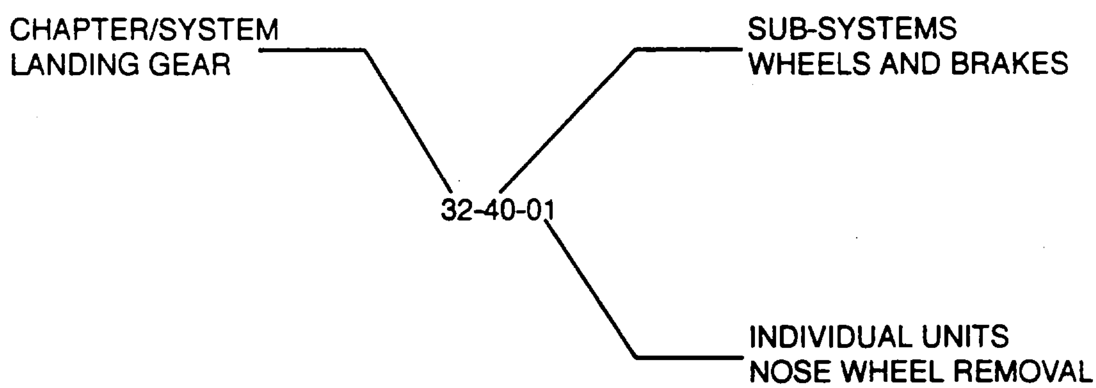
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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 Maintenance Manual is provided to support and maintain the Piper Model PA-31-350 T-1020 aircraft manufactured by the Piper Aircraft Corporation of Lakeland, Florida.

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 T-1020 Parts Catalog P/N 761 775, 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. 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 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, or 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 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:

SAMPLE EFFECTIVITY CODES

First Revision:	Month and Year (11-80)
Second Revision:	Revision Indication, Month and Year (2R 12-80)
Third Revision:	Revision Indication, Month and Year (3R 1-81)
Fourth Revision:	Revision Indication, Month and Year (4R 2-81)
Added Subject:	Identification, Month and Year (A 3-80)

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Revisions	Publication Date	Aerofiche Card Effectivity
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IR860430	April 30, 1986	1
IR860920	September 20, 1986	1
IR871009	June 15, 1988	3
IR900313	March 13, 1990	2
IR941007	October 7, 1994	1 and 4

INTERIM REVISION

Revisions appear in chapter 5 of card 1 and chapters 61 and 71 of card 4. Please dispose of your current cards 1 and 4, and replace with the revised one. DO NOT DISPOSE OF CARDS 2, 3, or 5.

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VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual =	AVCO LYCOMING = OVERHAUL MANUAL DIRECT DRIVE ENGINE - P/N 60294-7 Avco Lycoming Division Williamsport, PA 17701
Parts Catalog =	AVCO LYCOMING - P/N PC-315 Avco Lycoming Division Williamsport, PA 17701
Operators Handbooks =	AVCO LYCOMING T1O-540 and LT1O-540 SERIES AIRCRAFT ENGINES - P/N 60297-23 Avco Lycoming Division Williamsport, PA 17701

PROPELLER:

Overhaul Instructions =	HARTZELL CONSTANT SPEED AND FEATHERING PROPELLER- P/N 117D Hartzell Propeller Inc. P.O. Box 1458, 1800 Covington Avenue, Piqua, Ohio 45356

MAGNETOS:

Installation, Operation and Maintenance Instructions =	S-1200 SERIES MAGNETO IGNITION SYSTEM - P/N-L-609-3 Bendix Electrical Components Division Sidney, New York 13838

WHEELS AND BRAKES:

PARTS CATALOGS and Maintenance Instructions =	CLEVELAND WHEEL AND BRAKE Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011

VENDOR-SUPPLIER INFORMATION.

Refer to the following list of manufactures, to obtain Service Manual and field service data:

Autoflite	BENDIX AVION1CS DIVISION 2100 N. W. 62nd Street Fort Lauderdale, Fla. 33310 (305) 776-4100 TWX 510-995-8884

VENDOR-SUPPLIER INFORMATION (cont.)

Autoflite (cont.)

EDO-CORPORATION
AVIONICS DIVISION
Box 610
Municipal Airport
Mineral Wells, Texas 76067
(817) 325-2517

SPERRY FLIGHT SYSTEMS
AVIONICS DIVISION
7500 Balboa Blvrd.
P.O. Box 9028 Van Nuys, Ca. 91409
(213) 894-8111 Telex: 65-1367

COLLINS GENERAL AVIATION
DIVISION
Rockwell International
Cedar Rapids, Iowa, 52406
(319) 395-3625 Telex: 46-4421

KING RADIO CORPORATION
400 N. Rodgers Rd.
Olathe, Kansas, 66061
(813) 782-0400 Telex: 4-2299
Kingrad

GLOBAL NAVIGATION
2144 Michelson Drive
Irvine, Ca. 92715
(714) 851-0119

PIPER PUBLICATIONS.

PA-31-350 T-1020
Parts Catalog - 761 775
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, FL 32960

CONTINUOUS
INSPECTION - 761 770
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, FL 32960

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CHAPTER

4

AIRWORTHINESS LIMITATIONS

CHAPTER 4 - AIRWORTHINESS LIMITATIONS

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AIRWORTHINESS LIMITATIONS.

GENERAL.

The airworthiness limitations section is FAA approved and specifies inspections and maintenance required under Parts 91.163 and 135 of the Federal Aviation Regulations.

—NOTE—

Refer to the LIMITATIONS in the Pilot's Operating Handbook and FAA Approved Flight Manual or 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—

CHAPTER

5

TIME LIMITS/MAINT CHECKS

CHAPTER 5- TIME LIMITS/MAINTENANCE CHECKS

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GENERAL.

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

—*CAUTION*—

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

TIME LIMITS.

INSPECTION REQUIREMENTS.

The required inspection procedures are outlined in the Piper Continuous Inspection Manual. Additional copies are available through the Piper Service Department. This inspection consists of Routine and Detailed (Event) inspections performed every 50 hours of aircraft service time, thus providing a complete airworthiness inspection of the airplane every 200 hours (one complete cycle). Also included are various special inspections required at specific service times other than those arriving on the 50 hour events.

This type of inspection was selected by Piper Aircraft Corporation to provide greater utilization of the aircraft through the use of this planned inspection program.

—*NOTE*—

In addition to inspection intervals required in Chart 501 a preflight check must be performed.

PREFLIGHT CHECK.

The airplane must be given a thorough preflight and walk-around check. The pilot and/or mechanic must include the preflight check as a normal procedure necessary for the safe operation of the aircraft.
Refer to the Pilot's Operating Handbook 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.

CONTINUOUS INSPECTION.

The Piper Continuous Inspection Program provides for continuous aircraft inspection and meets the FAA continuous inspection requirements of F. A. R. 135.60 (d) (1) (2) (3) (e) for use in the corporation's transportation and personnel, i. e., air taxi purposes, air freight, air mail, etc. This inspection program is also available in manual form through the Piper Airline Division under Part Number 761 770.

INTRODUCTION

The Piper Continuous Inspection meets the F. A. A. continuous inspection requirements of F. A. R. 135.60 (d) (1) (2) (3) (e) for use in the corporation's transportation and personnel; i. e., air taxi purposes, air freight, air mail, etc.

FACTS YOU SHOULD KNOW

Every two weeks the Federal Aviation Administration (FAA) publishes Airworthiness Directives (ADs) that apply to specific groups of aircraft. They are mandatory changes and are to be complied with within a time limit set by the FAA. When an AD is issued, it is sent to the latest registered owner of the affected aircraft and also to subscribers of the service. The owner should periodically check with his service representative or A & P mechanic to see whether he has the latest issued AD against his airplane. The owner is solely responsible for keeping up with ADs.

Piper Aircraft Corporation takes a continuing interest in having the owner get the most efficient use from his airplane and keeping it in the best mechanical condition. Consequently, Piper Aircraft from time to time issues Service Bulletins, Service Letters, and Service Spares Letters relating to the aircraft.

Service Bulletins are of special importance and should be complied with promptly. These are sent to the latest registered owners and Piper Airline Division Service Representative.

Service Letters deal with product improvements and service hints pertaining to the aircraft. They are sent to registered owners so they can properly service the aircraft and keep it up to date with the latest changes. Owners should give careful attention to the Service Letter information.

Service Spares Letters, which are usually sent to Airline Division Service Representatives, offer improved parts, kits and optional equipment which were not available originally and which may be of interest to the owner.

An owner should periodically check with a Piper Airline Division Service Representative to find out the latest information to keep his aircraft up to date.

Piper Aircraft Corporation has a Subscription Service for the Service Bulletins, Service Letters and Service Spares Letters. This service is offered to interested persons such as owners, pilots and mechanics at a nominal fee, and may be obtained through Piper Airline Division. Owners residing outside of the United States are urged to subscribe to this service since Piper can seldom otherwise obtain the addresses of foreign owners. Service Product Support Manuals and revisions are available through a Piper Service Center.

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SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

PROCEDURE MANUAL

The Piper Continuous Inspection is recommended by Piper Aircraft Corporation and meets the requirements outlined in the Federal Aviation Regulations Part 43 and Part 91 Subpart D.

The purpose of the Piper Continuous Inspection is to allow maximum utilization of the aircraft, reduce maintenance inspection cost, and maintain a maximum standard of continuous airworthiness.

Owners and operators of the T-1020 are reminded that certain requirements must be met before the Piper Continuous Inspection Procedures can be utilized. These requirements are contained in the Federal Aviation Regulations Part 43, Maintenance Preventive Inspection, rebuilding and alteration and Part 91, General Operating and Flight Rules.

The inspection frequency used in the Piper Continuous Inspection is based on previous Operating experience. However, adjustments to the inspection intervals can be made only by Piper Aircraft Corporation.

Discrepancies found during inspections will be entered on the Discrepancy Record. The person conducting the inspection will advise the Owner and/or Operator of the discrepancies found during the inspection and entered on the Discrepancy Record. Discrepancies which affect the airworthiness of the airplane will require the necessary corrective action to be accomplished before the airplane is returned to service.

The Piper Continuous Inspection has the following basic features:

1. Piper Continuous Inspection
2. The four (4) Event Inspections
3. The Special Inspections
4. The Operational Inspection
5. The Event Inspection Record and Sign Off Sheet
6. The Continuous Cycle Inspection Record and Sign Off Sheet
7. The Discrepancy Record
8. Service Publication Compliance Record
9. The Federal Aviation Airworthiness Directives Compliance Record
10. The ECR - Equipment Change Record
11. Access Plate and Panel Locations

1. Piper Continuous Inspection

2. Event Inspections

   Each Event Inspection consists of a predetermined number of location inspections as indicated on each event sample. The Event Inspection is conducted each 50 hours and must be done in sequence, and recorded on the Event Inspection Record and Sign Off Sheet, which is the running log or current status of the aircraft inspections.

Late compliance with the Event Inspection Interval of 50 hours may be extended by not more than five (5) flying hours (10% of Event Inspection Interval). This ten (10) percent shall only be used to return the aircraft back to the maintenance base which is performing the inspection. The excess time is included in computing the next 50 flying hours of service.

Early compliance can be accomplished at the owner/operator's discretion for convenience of scheduling. However, where early compliance is accomplished, the 50 flying hour interval for the next event inspection will be maintained.

The Event Inspections are arranged so that the 200 flying hour cycle results in a complete inspection. When the four Events are complete and recorded, an entry is made in the Event Record and Cycle Inspection Record which are the running logs or current status of the aircraft inspections.

Each event will be recorded in the Event Inspection Record and Sign Off Sheet.

EVENT #l

To be performed at the 50-250-450-650-850 Flying Hour Intervals

Consists of -

1. Left Propeller, Detailed
2. Left Engine, Detailed
3. Left Turbocharger, Detailed
4. Right Propeller, Routine
5. Right Engine, Routine
6. Right Turbocharger, Routine
7. Landing Gear, Detailed
8. Right Wing, Routine
9. Empennage, Routine
10. Cabin, Routine
11. Electrical, Detailed
12. Lubrication

EVENT #2

To be performed at the 100-300-500-700-900 Flying Hour Intervals

Consists of -

1. Right Propeller, Detailed
2. Right Engine, Detailed
3. Right Turbocharger, Detailed
4. Left Propeller, Routine
5. Left Engine, Routine
6. Left Turbocharger, Routine
7. Landing Gear, Routine
8. Left Wing, Detailed
9. Fuselage Forward, Routine
10. Fuselage Main, Routine
11. Cabin Cockpit, Detailed
12. Lubrication

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #3

To be performed at the 150-350-550-750-950 Flying Hour Intervals

Consists of -

1. Left Propeller, Detailed
2. Left Engine, Detailed
3. Left Turbocharger, Detailed
4. Right Propeller, Routine
5. Right Engine, Routine
6. Right Turbocharger, Routine
7. Right Wing, Detailed
8. Landing Gear, Detailed
9. Empennage, Detailed
10. Cabin, Detailed
11. Lubrication

EVENT #4

To be performed at the 200-400-600-800-1000 Flying Hour Intervals

Consists of-

1. Right Propeller, Detailed
2. Right Engine, Detailed
3. Right Turbocharger, Detailed
4. Left Propeller, Routine
5. Left Engine, Routine
6. Left Turbocharger, Routine
7. Left Wing, Routine
8. Landing Gear, Routine
9. Fuselage, Detailed
10. Cockpit, Routine
11. Lubrication

3. Special Inspections - inspections to be performed and recorded with the appropriate Event Inspection.

4. Operational Inspection - to be performed prior to each Event Inspection.

5. Event Inspection Record and Sign Off Sheet - is a permanent record and contains the following:

   1. Event Inspection Number
   2. Aircraft Hours - Tach
   3. Date Accomplished
   4. Work Order Number - FAA approved repair stations only.
   5. Signature and Certificate Number of person conducting inspection.

6. The following Certification Statement:

I have inspected this aircraft in accordance with Piper Aircraft Corporation's Continuous Inspection Procedures and a list of discrepancies if any, have been given to the owner/operator, and appropriate entries have been made in the aircraft and engine logbooks.

6. Continuous Cycle Inspection Record and Sign Off Sheet - is conducted upon completion of four (4) event inspections (200 flying hours). The cycle inspection consists of ten (10) items, which determine that the cycle paperwork and inspection records are in order before starting on the next cycle. The cycle record has the aircraft registration number, serial number, and columns for recording each cycle inspection.

7. Discrepancy Record (DR) - is a log of discrepancies which require corrective action. FAA Airworthiness Directives and/or manufacturer's service publications, not requiring immediate action may be entered on the (DR) providing complying with the A. D. or service publication at the next event will be within the time allowance permitted. Certain FAA or manufacturer's mandatory inspections may have to be accomplished before further flight, in which case, their compliance should be recorded on the appropriate record.

8. Service Publication Compliance Record - is used to record the compliance of all manufacturer's service publications, and contains the following information:

   1. Name of Manufacturer
   2. Publication - Bulletin - Letter - etc.
   3. Number
   4. Compliance Date
   5. Aircraft Hours
   6. Work Order Number - FAA approved repair stations only.
   7. Signature and Certificate Number of person accomplishing the compliance.

9. FAA Airworthiness Directives Compliance Record - is used to record the compliance of applicable A. D. Notes and contains the following:

   1. A. D. Note Number
   2. A. D. Date
   3. Aircraft Hours
   4. Method of Compliance
   5. One Time
   6. Recuring
   7. Next Date or Hours
   8. Work Order Number - FAA approved repair stations only.
   9. Signature and Certificate Number of person accomplishing the compliance.

10. ECR - Equipment Change Record - is a form to record equipment changes, which allows the control of equipment times for inspection or overhaul replacement. By use of the ECR the "Out of Sequence" equipment can be reviewed to permit a projection of equipment "due" times in relation to the aircraft tachometer times.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO. Left:	PROPELLER SERIAL NO. Left:
		Right:	Right:

DEFINITIONS

1. Inspections - Must be performed only by Certified Mechanics who are qualified on this aircraft, utilizing acceptable methods, techniques, and practices to determine physical condition and detect defects

2. Checks - Can be performed by pilots and/or mechanics who are qualified on this aircraft, and consists of examinations in the form of comparisons with stated standards for the purpose of verifying condition, accuracy and tolerances.

3. Detailed Inspections - Consists of a thorough examination of the appliances, the aircraft, and the components and systems with such disassembly as is necessary to determine condition.

4. Approved Inspection - Means a continuing airworthiness inspection of an airplane and its various component and systems at scheduled interval in accordance with procedures approved by the Administrator of the Federal Aviation Administration.

5. Inspection Time Limitations - Inspection intervals called out in the inspection schedule shall not be exceeded by more than ten (10)percent and will be deducted from the next inspection. This ten(10) percent shall only be used to return the aircraft back to the maintenance base when inspection intervals fall due and the aircraft is away from home base.

6. Tests - Operation of aircraft components, appliances, or systems to evaluate functional performance.

7. Operational Test - This test is used to ascertain that a system component is in operable condition and can be performed with the equipment installed in the aircraft. In addition, each operational test must be performed by an FAA Certificated Repair Station appropriately rated or by a Certified Mechanic who is qualified on this aircraft. The recording of the above function must be made in the permanent aircraft records by the authorized individual performing the test.

8. Functional Test - This test is used to ascertain that a system or component is functioning properly in all aspects in conformance with minimum acceptable design specifications. This test may require the use of supplemental ground support of bench test equipment. In addition, each functional test must be performed by an FAA Certificated Repair Station with appropriate ratings or by a Certified Mechanic who is qualified on this aircraft. The recording of the above function must be made in the permanent aircraft records by the authorized individual performing the test.

DEFINITIONS (cont.)

9. Bench Check - Means removal of component from aircraft for a visual inspection for cleanliness, impending failure, need for lubrication, repair or replacement of parts, correction of items found by that visual inspection, calibration to at least the manufacturer's specifications using the manufacturer's recommended test equipment or standards or the equivalent.

Each bench test will be performed by the manufacturer or by an FAA Certified Repair Station with appropriate rating or by a Certificated mechanic. This test will be performed at the scheduled interval regardless of any bench test performed on a particular component while being repaired/overhauled before scheduled interval bench test. The authorized person re-installing component in aircraft will perform necessary operational test to ascertain that the system is functioning properly. This person will log bench test and operational test in the permanent aircraft records. Serviceable parts that were issued to the component will be filed in the aircraft permanent records.

10. Maintenance - The word maintenance as defined by FAR I means "inspection, overhaul, repair, preservation, and the replacement of parts, but excludes preventive maintenance." However, where referenced in this inspection program the word "maintenance" means inspection and the replacement of time life limited parts as listed in FAA approved data.

11. Routine Inspections - Consists of a visual examination or check of the appliances, the aircraft, and its components and systems insofar as practicable without disassembly.

12. Special Inspections - Involve those components, systems, or structure which by their application or intended use require an inspection peculiar to, more extensive in scope or at a time period other than and beyond that which is normally accomplished during the 200 hour cycle of events.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

PROGRAM RESPONSIBILITY

The person responsible for scheduling the inspections required under this program must enter his or her name below and forward the original copy of this form to their local FAA-GADO office. A duplicate copy should be maintained in this manual.

Name ______________________________

Address ______________________________
Street

____
City State Zip

Telephone Number ______________________________

Any change in personnel responsible for scheduling the inspection program, will be added with the appropriate information on a separate sheet of paper and the original copy sent to the local FAA-GADO office, while a duplicate copy is attached behind this page. The previous information sheet will be left in the booklet and the word "CHANGED" will be written across the deleted information.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

REVISIONS

All necessary revisions to this Inspection Program will be the direct responsibility of the manufacturer. No changes can be made to this Inspection Program unless prior notice is given to the responsible F. A. A. District Office — who, in turn, must approve of the change prior to its enactment. A record of all revisions will be maintained by the owner/operator on the revision of this manual.

RECORD OF NORMAL REVISIONS

REV. NO.	REV. APPROVAL DATE	PAGE NO.	INSERTED BY/DATE

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

AWAY FROM HOME STATION REQUIREMENTS

If the airplane is to be away from the home location at the time an inspection is due, the Pilot-in-Command of the flight will take with him all Sign Off Sheets which will be required for the inspection, and a copy of this manual. The inspection will be conducted or supervised by one of the following:

1. An appropriately certified repair station.
2. An appropriately rated certified mechanic, qualified on this type aircraft.

The results of the inspection will be noted on the proper Sign Off Sheets which are then brought back to the home base. The pilot will be responsible for all inspection forms and work sheet entries with mechanics and/or inspector's signature and identification.

Discrepancies affecting the airworthiness of the airplane, when the airplane is away from the local station, will be corrected by either 1 or 2 above. The pilot will be responsible for all work sheet entries with mechanics and/or inspector's signature and identification.

The Pilot-in-Command should also ascertain that the appropriate logbook entries have been made in the aircraft and engine logbooks.

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SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 1

POWER PLANT
LEFT PROPELLER, DETAILED (See Chapter 61 maintenance manual)

- ☐ 1. Remove and inspect spinner and back plate.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Lubricate per lubrication chart.
- ☐ 5. Inspect propeller mounting bolts and safety (check torque if safety is broken).
- ☐ 6. Inspect hub parts for cracks and corrosion.
- ☐ 7. Rotate blades and inspect for tightness in hub pilot tube.
- ☐ 8. Check propeller air pressure. Refer to pressure temperature chart (check at least once a month).
- ☐ 9. Inspect condition of propeller deicer system.
- ☐ 10. Inspect condition of synchrophaser (if installed).

LEFT ENGINE, DETAILED (See chapter 71 maintenance manual) (Refer to VSP 69)

—WARNING—

Ground magneto primary circuit before working on engine.

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and check cowling for cracks, distortion, and loose or missing fasteners.
- ☐ 3. Drain oil sump. Drain while engine is warm.
- ☐ 4. Clean suction oil strainer at oil change (check strainer for foreign particles).
- ☐ 5. Change full flow (cartridge type) oil filter element (inspect element for foreign particles).
- ☐ 6. Inspect oil temperature sender unit for leaks and security.
- ☐ 7. Inspect oil lines and fittings for leaks, security, chafing, dents, and cracks.
- ☐ 8. Inspect cylinder head temperature probe and wires for security.
- ☐ 9. Clean and inspect oil radiator cooling fins.
- ☐ 10. Fill engine with oil per lubrication chart in service manual.
- ☐ 11. Clean engine.
- ☐ 12. Inspect condition of spark plugs. (Clean and adjust gap as required; adjust per latest Lycoming Service Instruction 1042.)

—NOTE—

If fouling of spark plugs has been apparent, rotate bottom plugs to upper plugs.

- ☐ 13. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 14. Inspect cylinder compression (refer to AC 43.13-1A).

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #1 (cont.)

- ❒ 15. Inspect cylinder for cracked or broken fins.
- ❒ 16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds.
- ❒ 17. Inspect wiring to engine and accessories. Replace damaged wires and clamps. Inspect terminals for security and cleanliness.
- ❒ 18. Inspect ignition harnesses and insulators (high tension leakage and continuity).
- ❒ 19. Inspect magneto main points for clearance.
- ❒ 20. Inspect magneto retard points for proper retard angle.
- ❒ 21. Inspect magnetos for oil leakage.
- ❒ 22. Inspect breaker felts for proper lubrication.
- ❒ 23. Inspect distributor blocks for cracks, burned areas or corrosion, and height of contact springs.
- ❒ 24. Check magnetos to engine timing (20 degrees BTC).
- ❒ 25. Remove air cleaner filter and clean.
- ❒ 26. Remove and clean fuel injector inlet line screen. (Clean injector nozzles as required.) (Clean with acetone only.) Flow check nozzles.
- ❒ 27. Inspect induction alternate air system for condition and operation.
- ❒ 28. Inspect intake seals for leaks and clamps for tightness.
- ❒ 29. Inspect condition of flexible fuel lines.
- ❒ 30. Inspect fuel system for leaks.
- ❒ 31. Inspect fuel pump for leakage under pressure.
- ❒ 32. Replace hydraulic filter element (check element for contamination).
- ❒ 33. Inspect hydraulic pump and gasket for leaks. (Replace pump at engine T. B. O.)
- ❒ 34. Inspect condition of pneumatic pump and security of lines.
- ❒ 35. Inspect throttle, alternate air, injector, mixture and propeller governor controls for travel and operating condition.
- ❒ 36. Inspect exhaust stacks and gaskets. (Replace gaskets as required.)
- ❒ 37. Inspect breather tube for obstructions and security.
- ❒ 38. Inspect crankcase for cracks, leaks, and security of seam bolts.
- ❒ 39. Inspect engine mounts for cracks and loose mounting.
- ❒ 40. Inspect all engine baffles for cracks and condition of seals.
- ❒ 41. Inspect rubber engine mount bushings for deterioration.
- ❒ 42. Inspect fire walls for cracks.
- ❒ 43. Inspect condition of fire wall seal.
- ❒ 44. Inspect condition and tension of alternator drive belt (65 lbs.).
- ❒ 45. Inspect condition of alternator and starter. (Replace at engine T.B.O.)
- ❒ 46. Replace pneumatic inlet filter.
- ❒ 47. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)

LEFT TURBOCHARGER, DETAILED (See Chapter 81 Maintenance Manual.)

- ❒ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition. (Replace turbocharger at engine T. B. O.
- ❒ 2. Inspect the compressor wheel for nicks, cracks or broken blades.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 1 (cont)

- ☐ 3. Inspect for excess bearing drag or wheel rubbing against housing.
- ☐ 4. Inspect turbine wheel for broken blades or signs of rubbing.
- ☐ 5. Inspect oil inlet and outlet ports in center housing for leaks.
- ☐ 6. Inspect turbine heat blanket for condition and security.
- ☐ 7. Inspect linkage between bypass valve and actuator.
- ☐ 8. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks, and leaks.
- ☐ 9. Inspect the turbocharger mount for cracks, condition and security to engine and turbocharger.
- ☐ 10. Inspect fuel injection nozzle reference manifold for deteriorated hose, loose connections, leaks, or obstructions.
- ☐ 11. Inspect fluid power lines for leaks and security.
- ☐ 12. Inspect for oil leakage from controllers.
- ☐ 13. Inspect condition of cowl fastener locked indicator stripes. Touch-up or restore as necessary. Refer to Maintenance Manual, Chapter 71
- ☐ 14. Reinstall engine cowl.

RIGHT PROPELLER, ROUTINE (see chapter 61 maintenance manual.)

- ☐ 1. Inspect spinner and back plate.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Inspect condition of deicer boots (if applicable).
- ☐ 5. Inspect propeller air pressure (at least once a month).

RIGHT ENGINE, ROUTINE (see chapter 71 maintenance manual) (refer to VSP 69)

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and inspect cowling for cracks, distortion, loose or missing fasteners.
- ☐ 3. Drain oil sump. Drain while engine is warm.
- ☐ 4. Inspect suction oil strainer at oil change. (Inspect strainer for foreign particles.)
- ☐ 5. Change full flow (cartridge type) oil filter element. (Inspect for foreign particles.)
- ☐ 6. Fill engine with oil per lubrication chart.
- ☐ 7. Inspect oil temperature sender unit for leaks and security.
- ☐ 8. Inspect oil lines and fittings for leaks, security, chafing dents and cracks. (Replace oil lines at engine TBO per latest Lycoming Service Bulletin 240.)
- ☐ 9. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 10. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket. Tighten screws to a torque of 50 inch-pounds. (Refer to latest Textron Lycoming Service Bulletin No. 301.)
- ☐ 11. Clean and inspect oil radiator cooling fins.
- ☐ 12. Remove air cleaner filter and clean.
- ☐ 13. Inspect condition of alternate air door and box.
- ☐ 14. Remove and clean fuel injector inlet line screen and fuel inlet strainers (clean with acetone only).
- ☐ 15. Inspect intake seals for leaks and clamps for tightness.
- ☐ 16. Inspect exhaust gaskets for leaks.
- ☐ 17. Inspect condition of flexible lines.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 1 (cont)

- ☐ 18. Inspect fuel system for leaks.
- ☐ 19. Inspect throttle, alternate air, injector, mixture and propeller governor for travel and operating conditions.
- ☐ 20. Inspect breather tube for obstruction and security.
- ☐ 21. Inspect crankcase for cracks, leaks and security of seam bolts.
- ☐ 22. Inspect all engine baffles.
- ☐ 23. Inspect engine rubber mount bushings for deterioration.
- ☐ 24. Inspect condition and tension of alternator belt (65 lbs.).
- ☐ 25. Inspect condition of alternator and starter. (Replace or overhaul at engine T. B. O.)
- ☐ 26. Inspect condition and tension of compressor (air conditioner) drive belt. (60-65 lbs. used, 100 lbs. new
- ☐ 27. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)

RIGHT TURBOCHARGER, ROUTINE (See Chapter 81, Maintenance Manual.)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition. (Replace turbocharger at engine T. B. O.)
- ☐ 2. Inspect turbine heat blanket for condition and security.
- ☐ 3. Inspect linkage between bypass valve and actuator.
- ☐ 4. Inspect vent line from bypass valve for oil leaks.
- ☐ 5. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks.
- ☐ 6. Inspect fluid power lines for leaks and security.
- ☐ 7. Inspect for oil leakage from controller.
- ☐ 8. Inspect condition of cowl fastener locked indicator stripes. Touch-up or restore as necessary. Refer to Maintenance Manual, Chapter 71
- ☐ 9. Reinstall engine cowl.

RIGHT WING, ROUTINE (See Chapter 57, Maintenance Manual.)

- ☐ 1. Check surfaces, skins and tip for damage and loose rivets.
- ☐ 2. Inspect aileron and tab hinges for security of attachment and operation.
- ☐ 3. Inspect aileron balance weight and arm for security and condition.
- ☐ 4. Inspect flap and attachment for damage and operation.
- ☐ 5. Remove, drain and clean fuel filter bowl and screen (drain and clean at least every 90 days).
- ☐ 6. Check fuel tanks for marked capacity, fuel caps for proper seal and quick drains for proper operation.
- ☐ 7. Inspect condition of pneumatic deicer, if installed.
- ☐ 8. Inspect fuel cells and lines for leaks and water.
- ☐ 9. Inspect air conditioning condenser air scoop rigging and operation.
- ☐ 10 Inspect condition of fuel cells material.
- ☐ 11 Inspect wing tip navigation and strobe lights for broken lenses.

LANDING GEAR, DETAILED (See Chapter 32, Maintenance Manual.) (Refer to Piper Service Bulletin 822.)
RIGHT GEAR

- ☐ 1. Check oleo struts for proper extension. (Check for proper fluid level as required.)
- ☐ 2. Inspect wheel for alignment.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #1 (cont.)

- ❐ 3. Place airplane on jacks.
- ❐ 4. Inspect tire for cuts, uneven or excessive wear and slippage.
- ❐ 5. Remove wheel, clean, inspect and repack bearings per lubrication chart in Service Manual.
- ❐ 6. Inspect wheel for cracks, corrosion and broken bolts.
- ❐ 7. Check tire pressure.
- ❐ 8. Inspect brake lining and disc for wear.
- ❐ 9. Inspect condition and security of brake backing plates.
- ❐ 10. Inspect brake and hydraulic lines for condition, mounting, security and leaks.
- ❐ 11. Inspect gear fork for damage.
- ❐ 12. Inspect oleo struts for fluid leaks and scoring.
- ❐ 13. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.
- ❐ 14. Inspect downlock for operation and adjustment.
- ❐ 15. Inspect main gear lock rod or cable assemblies for corrosion, freedom of movement, spring tension and security of anti-rotation clip.
- ❐ 16. Inspect gear doors and attachments for security.
- ❐ 17. Check warning horn and light for operation.
- ❐ 18. Retract gear - inspect operation.
- ❐ 19. Retract gear - inspect doors for clearance and operation.
- ❐ 20. Inspect anti-retraction system operation.
- ❐ 21. Inspect actuating cylinder for leaks and security.
- ❐ 22. Inspect position indicating switches and electrical wires for condition and security.

LEFT GEAR

- ❐ 1. Check oleo struts for proper extension. (Check for proper fluid level as required.)
- ❐ 2. Inspect wheel for alignment.
- ❐ 3. Inspect tire for cuts, uneven or excessive wear and slippage.
- ❐ 4. Remove wheel, clean, inspect and repack bearings per lubrication chart in Service Manual.
- ❐ 5. Inspect wheel for cracks, corrosion and broken bolts.
- ❐ 6. Check tire pressure.
- ❐ 7. Inspect brake lining and disc for wear.
- ❐ 8. Inspect condition and security of brake back plates.
- ❐ 9. Inspect brake and hydraulic lines for condition, mounting, security and leaks.
- ❐ 10. Inspect gear fork for damage.
- ❐ 11. Inspect oleo struts for fluid leaks and scoring.
- ❐ 12. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.
- ❐ 13. Inspect downlock for operation and adjustment.
- ❐ 14. Inspect main gear lock rod or cable assemblies for corrosion, freedom of movement, spring tension and security of anti-rotation clip.
- ❐ 15. Inspect gear doors and attachments for security.
- ❐ 16. Check warning horn and light for operation.
- ❐ 17. Retract gear - check operation.
- ❐ 18. Retract gear - inspect doors for clearance and operation.
- ❐ 19. Inspect anti-retraction system operation.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #l (cont.)

- ☐ 20. Inspect actuating cylinder for leaks and security.
- ☐ 21. Inspect position indicating switches and electrical wires for condition and security.

NOSE GEAR

- ☐ 1. Check oleo strut for proper extension. (Check for proper fluid level as required.)
- ☐ 2. Inspect nose gear steering control and travel.
- ☐ 3. Inspect wheel for alignment.
- ☐ 4. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 5. Remove wheel, clean, inspect and repack bearings per lubrication chart in Service Manual.
- ☐ 6. Inspect wheel for cracks, corrosion and broken bolts.
- ☐ 7. Check tire pressure.
- ☐ 8. Inspect shimmy dampener operation.
- ☐ 9. Inspect gear fork for damage.
- ☐ 10. Inspect oleo strut for fluid leaks and scoring.
- ☐ 11. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.
- ☐ 12. Inspect downlock for operation and adjustment.
- ☐ 13. Inspect nose gear lock rod or cable assembly for corrosion, freedom of movement and spring tension.
- ☐ 14. Inspect gear doors and attachments.
- ☐ 15. Check gear warning horn and light for operation.
- ☐ 16. Retract gear - inspect operation.
- ☐ 17. Retract gear - inspect doors for clearance and operation.
- ☐ 18. Inspect actuating cylinder for leaks and security.
- ☐ 19. Inspect position of indicating switches and electrical lead for security.
- ☐ 20. Remove airplane from jacks.

EMPENNAGE TAIL, ROUTINE (See Chapter 27 Maintenance Manual.)

- ☐ 1. Inspect vertical fin and rudder surfaces for damage (and attachments for operation).
- ☐ 2. Inspect horizontal stabilizer and elevator surfaces for damage (and attachments for operation.)
- ☐ 3. Check position light, strobe light for security, damage.
- ☐ 4. Check condition of pneumatic deicers (If applicable).

CABIN MAIN, ROUTINE

- ☐ 1. Check upholstery for damage.
- ☐ 2. Check condition of oxygen mask. (If applicable.)
- ☐ 3. Check seat belts for security, operation and condition.
- ☐ 4. Check all lights and air vents for operation.
- ☐ 5. Inspect cabin entrance door for damage and operation.

ELECTRICAL, DETAILED (See Chapter 39 Maintenance Manual)

FUSELAGE FORWARD, DETAILED

- ☐ 1. Inspect electronics installation of wire harness, cannon plugs, ground bus bar, diplexer for condition and security.
- ☐ 2. Inspect battery box and cables for corrosion and security. (Check at least every thirty (30) days and clean as required.
- ☐ 3. Inspect voltage regulators, wiring, harnesses and relays for corrosion and condition.
- ☐ 4. Inspect circuit breakers for condition and security of installation.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT # 1 (cont.)

APPLY EXTERNAL POWER CABIN, COCKPIT

- ❒ 1. Check annunciator lights for operation.
- ❒ 2. Check cockpit lighting for operation.
- ❒ 3. Check electric trim and trim indications.
- ❒ 4. Check flap operation.
- ❒ 5. Check heater operation.
- ❒ 6. Check fan operation.
- ❒ 7. Check cabin and smoking/seat belt lights.
- ❒ 8. Check cabin reading lights and air vents for operation.
- ❒ 9. Check cabin entry light for operation from both cockpit and entrance.
- ❒ 10. Check gear warning horn and lights while on jacks.

LEFT WING

- ❒ 1. Check wing tip navigation and strobe lights.
- ❒ 2. Check wing inspection light.
- ❒ 3. Check prop deice boots.
- ❒ 4. Check operation and pressure of electric fuel pumps.
- ❒ 5. Check inlet air duct for operation.

NOSE

- ❒ 1. Check operation of landing and taxi lights.
- ❒ 2. Check operation of pitot heat.

RIGHT WING

- ❒ 1. Check inlet air duct for operation.
- ❒ 2. Check operation of electric fuel pumps.
- ❒ 3. Check prop deicer boots.
- ❒ 4. Check heated stall warning indicator.
- ❒ 5. Check wing tip navigation and strobe lights.

TAIL

- ❒ 1. Check strobe light, recognition light, and navigation light for operation.
- ❒ 2. Check logo light for operation. (If installed)

SIGN OFF ELECTRICAL SECTION OF CHECK.

LUBRICATION

Using MIL-L-7870 General Purpose Low Temperature lubricating oil, lubricate the following:

RIGHT WING

- ❒ 1. Nacelle locker latch and hinges.
- ❒ 2. Flap transmission pivot bolts and sender arm.
- ❒ 3. Flap transmission and screw.
- ❒ 4. Flap track rollers. (Tracks must be clean and dry.)
- ❒ 5. Aileron bellcrank cable ends, pivot bearing and control rod ends.
- ❒ 6. Aileron and aileron trim tab hinges and control rod ends.

JACK AIRCRAFT

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #l (cont.)

MAIN LANDING GEAR

☐ ☐ 1. Outboard gear door hinges and control rods.
☐ ☐ 2. Gear down lock hook, hook actuating cable ends and bellcrank.
☐ ☐ 3. Gear uplock hook, control rod or cable ends, and cylinder ends.
☐ ☐ 4. Inboard gear door hinges and cylinder ends.
☐ ☐ 5. Uplock bushings.

NOSE GEAR

☐ 1. Steering arm rollers, bellcrank retraction rod ends, and steering rod ends.
☐ 2. Nose gear door actuator, retraction rod end, and cylinder rod end.
☐ 3. Uplock hook and uplock rod or cable.
☐ 4. Door hinges.
☐ 5. Upper and lower torque link connecting bolt and shimmy dampener.
☐ 6. Uplock bushing.
☐ 7. Forward baggage door hinges and latches.

EMPENNAGE

☐ 1. Elevator and elevator trim tab hinges and control rod ends.
☐ 2. Rudder and rudder trim tab hinges and control rod ends.
☐ 3. Rudder horn cable ends.
☐ 4. Elevator bellcrank, pivot bolts and cable ends.

FUSELAGE

☐ 1. Lower cabin door latch, hinges and step mechanism.
☐ 2. Upper cabin door hinges and latch.
☐ 3. Cargo door hinges and latch.. (If installed.)
☐ 4. Pilot door latch and hinges.

COCKPIT

☐ 1. Control wheel, rollers, link and flexible joint.
☐ 2. Rudder pedals, torque tube bearings and block control cable ends, and brake cylinder ends.
☐ 3. Fuel panel control levers.

With All-Purpose Slip Spray (DuPont No. 6611), lubricate the following:

WINGS

☐ ☐ 1. Flap tracks.

With aircraft and instrument grease MIL-G-23827, lubricate the following:

MAIN LANDING GEAR

☐ ☐ 1. Gear side brace link bushings and housing bushings.
☐ ☐ 2. Gear torque link fittings.

NOSE GEAR

☐ 1. Drag link assembly and idler link.
☐ 2. Upper and lower torque link.
☐ 3. Gear housing bushings.
☐ 4. Cam bearing surface (special fitting required).
☐ 5. Center steering support bearing (special fitting required).

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT # 1 (cont.)

Clean the following with quick drying solvent and lubricate with Mobil Bearing Grease 77 or Mobilus EP2:

☐ ☐ MAIN WHEEL BEARINGS

☐ ☐ NOSE WHEEL BEARINGS

REMOVE THE AIRCRAFT FROM JACKS.

☐ 1. Replace all inspection plates and covers.

☐ 2. Sign off lubrication section of check form.

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SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 2

POWER PLANT

RIGHT PROPELLER, DETAILED (See chapter 61 maintenance manual.)

- ☐ 1. Remove and inspect spinner and back plate.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Lubricate per lubrication chart.
- ☐ 5. Inspect propeller mounting bolts and safety. (Check torque if safety is broken.)
- ☐ 6. Inspect hub parts for cracks and corrosion.
- ☐ 7. Rotate blades and inspect for tightness in hub pilot tube.
- ☐ 8. Check propeller air pressure. Refer to Pressure Temperature Chart. (Check at least once a month.)
- ☐ 9. Inspect condition of propeller deicer system.
- ☐ 10. Inspect condition of synchronizer (if installed).

RIGHT ENGINE, DETAILED (See chapter 71 maintenance manual.) (Refer to VSP 69.)

— WARNING—

Ground magneto primary circuit before working on engine.

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and check cowling for cracks, distortion, and loose or missing fasteners.
- ☐ 3. Drain oil sump. Drain while engine is warm.
- ☐ 4. Clean suction oil strainer at oil change (check strainer for foreign particles).
- ☐ 5. Change full flow (cartridge type) oil filter element (inspect element for foreign particles).
- ☐ 6. Inspect oil temperature sender unit for leaks and security.
- ☐ 7. Inspect oil lines and fittings for leaks, security, chafing, dents, and cracks.
- ☐ 8. Inspect cylinder head temperature probe and wires for security.
- ☐ 9. Clean and inspect oil radiator cooling fins.
- ☐ 10. Fill engine with oil per lubrication chart in service manual.
- ☐ 11. Clean engine.
- ☐ 12. Inspect condition of spark plugs. (Clean and adjust gap as required: adjust per latest Lycoming Service Instruction 1042.)

—NOTE—

If fouling of spark plugs has been apparent, rotate bottom plugs to upper plugs.

- ☐ 13. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 14. Inspect cylinder compression (refer to AC 43.13-1A).
- ☐ 15. Inspect cylinder for cracked or broken fins.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #2 (cont.)

- ☐ 16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds.
- ☐ 17. Inspect wiring to engine and accessories. Replace damaged wires and clamps. Inspect terminals for security and cleanliness.
- ☐ 18. Inspect ignition harnesses and insulators (high tension leakage and continuity).
- ☐ 19. Inspect magneto main points for clearance.
- ☐ 20. Inspect magneto retard points for proper retard angle.
- ☐ 21. Inspect magnetos for oil leakage.
- ☐ 22. Inspect breaker felts for proper lubrication.
- ☐ 23. Inspect distributor blocks for cracks, burned areas or corrosion, and height of contact springs.
- ☐ 24. Check magnetos to engine timing (20 degrees BTC).
- ☐ 25. Remove air cleaner filter and clean.
- ☐ 26. Remove and clean fuel injector inlet line screen. (Clean injector nozzles as required.) (Clean with acetone only.) Flow check nozzles.
- ☐ 27. Inspect induction alternate air system for condition and operation.
- ☐ 28. Inspect intake seals for leaks and clamps for tightness.
- ☐ 29. Inspect condition of flexible fuel lines.
- ☐ 30. Inspect fuel system for leaks.
- ☐ 31. Inspect fuel pump for leakage under pressure.
- ☐ 32. Replace hydraulic filter element (check element for contamination).
- ☐ 33. Inspect hydraulic pump and gasket for leaks. (Replace pump at engine T. B. O.)
- ☐ 34. Inspect condition of pneumatic pump and security of lines.
- ☐ 35. Inspect throttle, alternate air, injector, mixture and propeller governor controls for travel and operating condition.
- ☐ 36. Inspect exhaust stacks and gaskets. (Replace gaskets as required.)
- ☐ 37. Inspect breather tube for obstructions and security.
- ☐ 38. Inspect crankcase for cracks, leaks, and security of seam bolts.
- ☐ 39. Inspect engine mounts for cracks and loose mounting.
- ☐ 40. Inspect all engine baffles for cracks and condition of seals.
- ☐ 41. Inspect rubber engine mount bushings for deterioration.
- ☐ 42. Inspect firewalls for cracks.
- ☐ 43. Inspect condition of firewall seal.
- ☐ 44. Inspect condition and tension of alternator drive belt (65 lbs.).
- ☐ 45. Inspect condition of alternator and starter. (Replace at engine T. B. O.)
- ☐ 46. Replace pneumatic inlet filter.
- ☐ 47. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)
- ☐ 48. Inspect security of air conditioning compressor mount. (If installed.)
- ☐ 49. Inspect air conditioning compressor oil level. (If installed.)
- ☐ 50. Inspect condition and tension of compressor (air condition) drive belt. (60-65 lbs. used, 100 lbs. new)
- ☐ 51. Inspect compressor clutch security and wiring. Clean any traces of oil from the clutch surface.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 2 (cont.)

RIGHT TURBOCHARGER, DETAILED (See chapter 81 maintenance manual.)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition (replace turbocharger at engine TBO).
- ☐ 2. Inspect the compressor wheel for nicks, cracks, or broken blades.
- ☐ 3. Inspect for excess bearing drag or wheel rubbing against housing.
- ☐ 4. Inspect turbine wheel for broken blades or signs of rubbing.
- ☐ 5. Inspect oil inlet and outlet ports in center housing for leaks.
- ☐ 6. Inspect turbine heat blanket for condition and security.
- ☐ 7. Inspect linkage between bypass valve and actuator.
- ☐ 8. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks.
- ☐ 9. Inspect the turbocharger mount for cracks, condition and security to engine and turbocharger.
- ☐ 10. Inspect fuel injection nozzle reference manifold for deteriorated hose, loose connections, leaks, or obstructions.
- ☐ 11. Inspect fluid power lines for leaks and security.
- ☐ 12. Inspect for oil leakage from the controllers.
- ☐ 13. Inspect condition of cowl fastener locked indicator stripes. Touch-up or restore as necessary. Refer to Maintenance Manual, Chapter 71
- ☐ 14. Reinstall engine cowl.

LEFT PROPELLER, ROUTINE (See chapter 61 maintenance manual.)

- ☐ 1. Inspect spinner and back plate.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Inspect condition of deicer boots (if applicable).
- ☐ 5. Inspect propeller air pressure (at least once a month).

LEFT ENGINE, ROUTINE (See chapter 71 maintenance manual.) (Refer to VSP 69.)

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and inspect cowling for cracks, distortion, loose or missing fasteners.
- ☐ 3. Drain oil sump. Drain while engine is warm.
- ☐ 4. Inspect suction oil strainer at oil change (inspect strainer for foreign particles).
- ☐ 5. Change full flow (cartridge type) oil filter element (inspect for foreign particles).
- ☐ 6. Fill engine with oil per lubrication chart.
- ☐ 7. Inspect oil temperature sender unit for leaks and security.
- ☐ 8. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks. (Replace oil lines at engine TBO per latest Lycoming Service Bulletin 240.)
- ☐ 9. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 10. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket. Tighten screws to a torque of 50 inch-pounds.
- ☐ 11. Clean and inspect oil radiator cooling fins.
- ☐ 12. Remove air cleaner filter and clean.
- ☐ 13. Inspect condition of alternate air door and box.
- ☐ 14. Remove and clean fuel injector inlet line screen and fuel inlet strainers (clean with acetone only).
- ☐ 15. Inspect intake seals for leaks and clamps for tightness.
- ☐ 16. Inspect exhaust gaskets for leaks.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #2 (cont.)

- ☐ 17. Inspect condition of flexible lines.
- ☐ 18. Inspect fuel system for leaks.
- ☐ 19. Inspect throttle, alternate air, injector, mixture and propeller governor for travel and operating conditions.
- ☐ 20. Inspect breather tube for obstructions and security.
- ☐ 21. Inspect crankcase for cracks, leaks and security of seam bolts.
- ☐ 22. Inspect all engine baffles.
- ☐ 23. Inspect engine rubber mount bushings for deterioration.
- ☐ 24. Inspect condition and tension of alternator belt (65 lbs.).
- ☐ 25. Inspect condition of alternator and starter. (Replace at engine T. B. O.)
- ☐ 26. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)

LEFT TURBOCHARGER, ROUTINE (See Chapter 81, Maintenance Manual.)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition. (Replace turbocharger at engine T. B. O.)
- ☐ 2. Inspect turbine heat blanket for condition and security.
- ☐ 3. Inspect linkage between bypass valve and actuator.
- ☐ 4. Inspect vent line from bypass valve for oil leaks.
- ☐ 5. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks.
- ☐ 6. Inspect fluid power lines for leaks and security.
- ☐ 7. Inspect oil leakage from controller.
- ☐ 8. Reinstall engine cowl.

LEFT WING, DETAILED (See Chapter 57 Maintenance Manual.)

- ☐ 1. Remove inspection plates and panels.

-CAUTION-

The access panel on the upper outboard surface of the wing which covers the Flux Detector is secured with brass screws and must be reinstalled with brass screws only.

- ☐ 2. Inspect plug connection from Flux Detector for corrosion and tightness.
- ☐ 3. Inspect surfaces, skins and tips for damage and loose rivets.
- ☐ 4. Inspect aileron hinges for security of attachment and operation.
- ☐ 5. Inspect aileron cables, pulleys and bellcrank for damage and operation.
- ☐ 6. Inspect all rod end bearings for freedom of ball movement. Use a 10X magnifying glass to check thread end of bearing for cracks and damage. Replace bearing if ball is frozen or hard to move.
- ☐ 7. Inspect aileron balance weight and arm for security and condition.
- ☐ 8. Inspect flaps and attachments for damage and operation.
- ☐ 9. Inspect wing flap transmission.
- ☐ 10. Inspect flap actuator cable.
- ☐ 11. Inspect flap actuator motor.
- ☐ 12. Inspect wing attachment bolts and brackets for security.
- ☐ 13. Inspect engine mount attaching structure for security and condition.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #2 (cont.)

- ☐ 13. Inspect engine exhaust shield for cracks, severe buckling, or loose rivets at the flange area.
- ☐ 14. Remove, drain and clean fuel filter bowl and screen (drain and clean at least every 90 days).
- ☐ 15. Inspect fuel cells and lines for leaks and water.
- ☐ 16. Check to ascertain that the fuel tanks are marked for capacity and minimum octane rating.
- ☐ 17. Inspect condition of pneumatic deicer, if installed.
- ☐ 18. Inspect pneumatic inline filter for security. (Replace per Special Instructions - Grid 1D2.)
- ☐ 19. Inspect wing tip navigation and strobe lights for broken lenses.
- ☐ 20. Reinstall inspection plates and panels.

LANDING GEAR ROUTINE (See Chapter 32 Maintenance Manual.) (Refer to Piper Service Bulletin 822.)

LEFT GEAR

- ☐ 1. Check oleo strut for proper extension.
- ☐ 2. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 3. Check tire pressure (psi).
- ☐ 4. Inspect brake and hydraulic lines for damage and security.
- ☐ 5. Check gear leg for damage.
- ☐ 6. Inspect gear doors and attachments for cracks and corrosion.
- ☐ 7. Inspect actuating cylinder for leaks and security.
- ☐ 8. Inspect condition of up and downlock springs.
- ☐ 9. Wipe exposed strut with clean cloth and hydraulic fluid MIL-H-5606.

RIGHT GEAR

- ☐ 1. Check oleo strut for proper extension.
- ☐ 2. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 3. Check tire pressure (psi).
- ☐ 4. Inspect brake and hydraulic lines for damage and security.
- ☐ 5. Check gear leg for damage.
- ☐ 6. Inspect gear doors and attachments for cracks and corrosion.
- ☐ 7. Inspect actuating cylinder for leaks and security.
- ☐ 8. Inspect condition of up and downlock springs.
- ☐ 9. Wipe exposed strut with clean cloth and hydraulic fluid MIL-H-5606.

NOSE GEAR

- ☐ 1. Check oleo strut for proper extension.
- ☐ 2. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 3. Check tire pressure (psi).
- ☐ 4. Check gear fork for damage.
- ☐ 5. Inspect gear doors and attachments for cracks and corrosion.
- ☐ 6. Inspect actuating cylinder for leaks and security.
- ☐ 7. Inspect condition of up and downlock springs.
- ☐ 8. Wipe exposed strut with clean cloth and hydraulic fluid MIL-H-5606.

FUSELAGE FORWARD, ROUTINE

- ☐ 1. Inspect baggage door latch and hinges for operation and security.
- ☐ 2. Inspect fluid in brake reservoir (fill as required).
- ☐ 3. Inspect battery, box and cables. (Check at least every 30 days. Flush box as required and fill per instructions on box.)

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #2 (cont.)

- ☐ 4. Check hydraulic power pack fluid level (fill as required).
- ☐ 5. Inspect heater for fumes and leaks.
- ☐ 6. Inspect condition of skins for visible damage.

FUSELAGE MAIN, ROUTINE

- ☐ 1. Inspect external skin for condition and damage.
- ☐ 2. Inspect windshield for condition and cleanliness.
- ☐ 3. Inspect all windows for condition, security and cleanliness.
- ☐ 4. Inspect antennas for security.
- ☐ 5. Inspect entrance and cargo doors for damage, operation and security. Inspect latches and hinges for operation, condition and security.

CABIN COCKPIT, DETAILED

- ☐ 1. Remove inspection panels and plates and floor panels.
- ☐ 2. Inspect pilot entry door. (If installed).
- ☐ 3. Inspect upholstery for tears.
- ☐ 4. Inspect pilot and copilot seats and seat belts for damage, security and operation.
- ☐ 5. Inspect trim operation and indication for full travel. (See Chapter 27 Maintenance Manual.)
- ☐ 6. Inspect rudder pedals and brake cylinders for security and operation. (See Chapter 32 Maintenance Manual.)
- ☐ 7. Inspect parking brake for operation. (See Chapter 32 Maintenance Manual.)
- ☐ 8. Inspect control wheels, column, pulleys and cables for damage, operation and full travel. (See Chapter 27 Maintenance Manual.)
- ☐ 9. Inspect instruments and attachments for security, proper markings and placards. (Refer to Pilot's Operating Manual.)
- ☐ 10. Inspect compass correction card for correct data. Recalibrate as required.
- ☐ 11. Inspect communications systems for condition and security of switches and knobs.
- ☐ 12. Inspect pitot and static lines for condition and security.
- ☐ 13. Inspect altimeter in accordance with AC 43.13-1A, and certified in accordance with FAR 23 to comply with FAR 91.170 (this applies to each altimeter installed).
- ☐ 14. Inspect condition of heater ducts.
- ☐ 15. Inspect oxygen outlets for defects and corrosion. (If installed.)
- ☐ 16. Inspect oxygen system operation and condition of components and masks. (If installed.)
- ☐ 17. Inspect condition of environmental system ducts.
- ☐ 18. Check portable fire extinguisher for proper service and service time.
- ☐ 19. Check each life preserver condition, service time, locator light attachment and operation. (If applicable.)
- ☐ 20. Inspect all flight control cables and pulleys for damage and tension. (See Chapter 27 Maintenance Manual .)
- ☐ 21. Inspect Autopilot roll servo for security and condition of bridle cables and wiring. (Refer to approved Autopilot Manual.)

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #2 (cont.)

LUBRICATION
Using MIL-L-7870 General Purpose Low Temperature Lubricating Oil, lubricate the following:
LEFT WING
- ▢ 1. Nacelle locker latch, rod and hinges.
- ▢ 2. Flap transmission pivot bolts and sender arm.
- ▢ 3. Flap transmission and screw.
- ▢ 4. Flap track rollers. (Tracks must be clean and dry.)
- ▢ 5. Aileron bellcrank cable ends, pivots bearing and control rod ends.
- ▢ 6. Aileron hinges and control rod ends.

MAIN LANDING GEAR
- ▢ ▢ 1. Outboard gear door hinges and control rods.
- ▢ ▢ 2. Gear downlock hook, hook actuating cable ends and bellcrank.
- ▢ ▢ 3. Gear uplock hook, control rod or cable ends, and cylinder ends.
- ▢ ▢ 4. Inboard gear door hinges and cylinder ends.
- ▢ ▢ 5. Uplock bushings.

NOSE GEAR
- ▢ 1. Steering arm rollers, bellcrank retraction rod ends, and steering rod ends.
- ▢ 2. Nose gear door actuator, retraction rod end, and cylinder rod end.
- ▢ 3. Uplock hook and uplock rod or cable.
- ▢ 4. Door hinges.
- ▢ 5. Upper and lower torque link connecting bolt and shimmy dampener.
- ▢ 6. Uplock bushing.
- ▢ 7. Forward baggage door hinges and latches.

FUSELAGE
- ▢ 1. Lower cabin door latch, hinges and step mechanism.
- ▢ 2. Upper cabin door hinges and latch.
- ▢ 3. Cargo door hinges and latch. (If installed.)
- ▢ 4. Pilot door latch and hinges.

COCKPIT
- ▢ 1. Control wheel, rollers. Iink and flexible joint.
- ▢ 2. Rudder pedals, torque tube bearings and block control cable ends, and brake cylinder ends.
- ▢ 3. Fuel panel control levers.

With All-Purpose Slip Spray (DuPont No. 6611), lubricate the following:
WINGS.
- ▢ ▢ 1. Flap tracks.

With aircraft and instrument grease MIL-G-23827 lubricate the following:
MAIN LANDING GEAR
- ▢ ▢ 1. Gear side brace link bushings and housing bushings.
- ▢ ▢ 2. Gear torque link fittings.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #2 (cont.)

NOSE GEAR

- ☐ 1. Drag link assembly and idler link.
- ☐ 2. Upper and lower torque link.
- ☐ 3. Gear housing bushings.
- ☐ 4. Cam bearing surface (special fitting required).
- ☐ 5. Center steering support bearing (special fitting required).

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SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 3

POWER PLANT

LEFT PROPELLER, DETAILED (See chapter 61 maintenance manual.)

- ☐ 1. Remove and inspect spinner and back plate.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Lubricate per lubrication chart.
- ☐ 5. Inspect propeller mounting bolts and safety (check torque if safety is broken).
- ☐ 6. Inspect hub parts for cracks and corrosion.
- ☐ 7. Rotate blades and inspect for tightness in hub pilot tube.
- ☐ 8. Check propeller air pressure. Refer to pressure temperature chart (check at least once a month).
- ☐ 9. Inspect condition of propeller deicer system.
- ☐ 10. Inspect condition of synchronizer (if installed).

LEFT ENGINE, DETAILED (See chapter 71 maintenance manual.) (Refer to VSP 69.)

—WARNING—

Ground magneto primary circuit before working on engine.

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and check cowling for cracks, distortion, and loose or missing fasteners.
- ☐ 3. Drain oil sump. Drain while engine is warm.
- ☐ 4. Clean suction oil strainer at oil change (check strainer for foreign particles).
- ☐ 5. Change full flow (cartridge type) oil filter element. (Inspect element for foreign particles.)
- ☐ 6. Inspect oil temperature sender unit for leaks and security.
- ☐ 7. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks.
- ☐ 8. Inspect cylinder head temperature probe and wires for security.
- ☐ 9. Clean and inspect oil radiator cooling fins.
- ☐ 10. Fill engine with oil per lubrication chart in service manual.
- ☐ 11. Clean engine.
- ☐ 12. Inspect condition of spark plugs. (Clean and adjust gap as required; adjust per latest Lycoming Service Instruction 1042.)

—NOTE—

If fouling of spark plugs has been apparent, rotate bottom plugs to upper plugs.

- ☐ 13. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 14. Inspect cylinder compression (refer to AC 43.13-1A).
- ☐ 15. Inspect cylinder for cracked or broken fins.
- ☐ 16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; tighten cover screws to a torque of 50 inch-pounds.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #3 (cont.)

- ❐ 17. Inspect wiring to engine and accessories. Replace damaged wires and clamps. Inspect terminals for security and cleanliness.
- ❐ 18. Inspect ignition harnesses and insulators (high tension leakage and continuity).
- ❐ 19. Inspect magneto main points for clearance.
- ❐ 20. Inspect magneto retard points for proper retard angle.
- ❐ 21. Inspect magnetos for oil leakage.
- ❐ 22. Inspect breaker felts for proper lubrication.
- ❐ 23. Inspect distributor blocks for cracks, burned areas or corrosion, and height of contact springs.
- ❐ 24. Check magnetos to engine timing (20 degrees BTC).
- ❐ 25. Remove air cleaner filter and clean.
- ❐ 26. Remove and clean fuel injector inlet line screen. (Clean injector nozzles as required.) (Clean with acetone only.) Flow check nozzles.
- ❐ 27. Inspect induction alternate air system for condition and operation.
- ❐ 28. Inspect intake seals for leaks and clamps for tightness.
- ❐ 29. Inspect condition of flexible fuel lines.
- ❐ 30. Inspect fuel system for leaks.
- ❐ 31. Inspect fuel pump for leaks under pressure.
- ❐ 32. Replace hydraulic filter element. (Check element for contamination.)
- ❐ 33. Inspect hydraulic pump and gasket for leaks. (Replace pump at engine T. B. O.)
- ❐ 34. Inspect condition of pneumatic pump and security of lines.
- ❐ 35. Inspect throttle, alternate air, injector, mixture and propeller governor controls for travel and operating condition.
- ❐ 36. Inspect exhaust stacks and gaskets. (Replace gaskets as required.)
- ❐ 37. Inspect breather tube for obstructions and security.
- ❐ 38. Inspect crankcase for cracks, leaks, and security of seam bolts.
- ❐ 39. Inspect engine mounts for cracks and loose mounting.
- ❐ 40. Inspect all engine baffles for cracks and condition of seals.
- ❐ 41. Inspect rubber engine mount bushings for deterioration.
- ❐ 42. Inspect fire walls for cracks.
- ❐ 43. Inspect condition of fire wall seal.
- ❐ 44. Inspect condition and tension of alternator drive belt (65 lbs.).
- ❐ 45. Inspect condition of alternator and starter. (Replace at engine T. B. O.)
- ❐ 46. Replace pneumatic inlet filter.
- ❐ 47. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)

LEFT TURBOCHARGER, DETAILED (See Chapter 81 Maintenance Manual.)

- ❐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition. (Replace turbocharger at engine T. B. O.)
- ❐ 2. Inspect the compressor wheel for nicks, cracks or broken blades.
- ❐ 3. Inspect for excess bearing drag or wheel rubbing against housing.
- ❐ 4. Inspect turbine wheel for broken blades or signs of rubbing.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 3 (cont.

- ☐ 5. Inspect oil inlet and outlet ports in center housing for leaks.
- ☐ 6. Inspect turbine heat blanket for condition and security.
- ☐ 7. Inspect linkage between bypass valve and actuator.
- ☐ 8. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks, and leaks.
- ☐ 9. Inspect the turbocharger mount for cracks, condition, and security to the engine and turbocharger.
- ☐ 10. Inspect fuel injection nozzle reference manifold for deteriorated hose, loose connections, leaks, or obstructions.
- ☐ 11. Inspect fluid power lines for leaks and security.
- ☐ 12. Inspect for oil leakage from the controller.
- ☐ 13. Inspect condition of cowl fastener locked indicator stripes. Touch-up or restore as necessary. Refer to Maintenance Manual, Chapter 71
- ☐ 14. Reinstall engine cowl.

RIGHT PROPELLER, ROUTINE (See chapter 61 maintenance manual.)

- ☐ 1. Inspect spinner and back plate.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Inspect condition of deicer boots (if applicable).
- ☐ 5. Inspect propeller air pressure (at least once a month).

RIGHT ENGINE, ROUTINE (See chapter 71 maintenance manual.) (Refer to VSP 69.)

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and inspect cowling for cracks, distortion, loose or missing fasteners.
- ☐ 3. Drain oil sump. Drain while engine is warm.
- ☐ 4. Inspect suction oil strainer at oil change. (Inspect strainer for foreign particles.)
- ☐ 5. Change full flow (cartridge type) oil filter element. (Inspect for foreign particles.)
- ☐ 6. Fill engine with oil per lubrication chart.
- ☐ 7. Inspect oil temperature sender unit for leaks and security.
- ☐ 8. Inspect oil lines and fittings for leaks, security, chafing, dents, and cracks. (Replace oil lines at engine TBO per latest Lycoming Service Bulletin 240).
- ☐ 9. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 10. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket. Tighten screws to a torque of 50 inch-pounds.
- ☐ 11. Clean and inspect oil radiator cooling fins.
- ☐ 12. Remove air cleaner filter and clean.
- ☐ 13. Inspect condition of alternate air door and box.
- ☐ 14. Remove and clean fuel injector inlet line screen and fuel inlet strainers (clean with acetone only).
- ☐ 15. Inspect intake seals for leaks and clamps for tightness.
- ☐ 16. Inspect exhaust gaskets for leaks.
- ☐ 17. Inspect condition of flexible lines.
- ☐ 18. Inspect fuel system for leaks.
- ☐ 19.Inspect throttle, alternate air, injector, mixture, and propeller governor for travel and operating condition.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #3 (cont.)

- ☐ 20. Inspect breather tube for obstruction and security.
- ☐ 21. Inspect crankcase for cracks, leaks and security of seam bolts.
- ☐ 22. Inspect all engine baffles.
- ☐ 23. Inspect engine rubber mount bushings for deterioration.
- ☐ 24. Inspect condition and tension of alternator belt (65 Ibs.).
- ☐ 25. Inspect condition of alternator and starter. (Replace at engine T. B. O.).
- ☐ 26. Inspect condition of compressor (air conditioner) drive belt. (60-65 Ibs. used, 100 lbs. new)
- ☐ 27. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)

RIGHT TURBOCHARGER, ROUTINE (See Chapter 81 Maintenance Manual)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition. (Replace turbocharger at engine T. B. O.)
- ☐ 2. Inspect turbine heat blanket for condition and security.
- ☐ 3. Inspect linkage between bypass valve and actuator.
- ☐ 4. Inspect vent line from bypass for oil leaks.
- ☐ 5. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks.
- ☐ 6. Inspect fluid power lines for leaks and security.
- ☐ 7. Inspect for oil leakage from controller.
- ☐ 8. Inspect condition of cowl fastener locked indicator stripes. Touch-up or restore as necessary. Refer to Maintenance Manual, Chapter 71
- ☐ 9. Reinstall engine cowl.

RIGHT WING, DETAILED (See Chapter 57 Maintenance Manual)

- ☐ 1. Remove inspection plates and panels.
- ☐ 2. Inspect surfaces, skins and tips for damage and loose rivets.
- ☐ 3. Inspect aileron and tab hinges for security of attachment and operation.
- ☐ 4. Inspect aileron and trim cables, pulleys and bellcrank for damage and operation.
- ☐ 5. Inspect all rod end bearings for freedom of ball movement. Use a 10X magnifying glass to check thread end of bearing for cracks and damage. Replace bearing if ball is frozen or hard to move.
- ☐ 6. Inspect aileron balance weight and arm for security and condition.
- ☐ 7. Inspect flaps and attachments for damage and operation.
- ☐ 8. Inspect wing flap transmission.
- ☐ 9. Inspect flap actuator cable.
- ☐ 10. Inspect flap actuator motor.
- ☐ 11. Inspect wing attachment bolts and brackets for security.
- ☐ 12. Inspect engine mount attaching structure for security and condition.
- ☐ 13. Inspect engine exhaust shield for cracks, sever buckling, or loose rivets at the flange area.
- ☐ 14. Remove, drain and clean fuel filter bowl and screen (drain and clean at least every 90 days).
- ☐ 15. Inspect fuel cells and lines for leaks and water.
- ☐ 16. Ascertain that the fuel tanks are marked for capacity and minimum octane rating.
- ☐ 17. Inspect condition of pneumatic deicer, if installed.
- ☐ 18. Inspect air conditioning condenser air scoop rigging and operation.
- ☐ 19. Inspect pneumatic inline filter for security. (Replace per Special Instructions - Grid 1D2.)
- ☐ 20. Inspect wing tip navigation and strobe light for broken lenses.
- ☐ 21. Reinstall inspection plates and panels.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #3 (cont.)

LANDING GEAR, DETAILED (See Chapter 32 Maintenance Manual.) (Refer to Piper Service Bulletin 822.)

RIGHT GEAR

- ☐ 1. Check oleo struts for proper extension. (Check for proper fluid level as required.)
- ☐ 2. Inspect wheel for alignment.
- ☐ 3. Place airplane on jacks.
- ☐ 4. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 5. Remove wheel, clean, inspect and repack bearings per lubrication chart in Service Manual.
- ☐ 6. Inspect wheel for cracks, corrosion and broken bolts.
- ☐ 7. Check tire pressure.
- ☐ 8. Inspect brake lining and disc for wear.
- ☐ 9. Inspect condition and security of brake backing plates.
- ☐ 10. Inspect brake and hydraulic lines for condition, mounting, security and leaks.
- ☐ 11. Inspect gear fork for damage.
- ☐ 12. Inspect oleo struts for fluid leaks and scoring.
- ☐ 13. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.
- ☐ 14. Inspect downlock for operation and adjustment.
- ☐ 15. Inspect main gear lock rod or cable assemblies for corrosion, freedom of movement and spring tension.
- ☐ 16. Inspect gear doors and attachments for security.
- ☐ 17. Check warning horn and light for operation.
- ☐ 18. Retract gear - inspect operation.
- ☐ 19. Retract gear- inspect doors for clearance and operation.
- ☐ 20. Inspect anti-retraction system operation.
- ☐ 21. Inspect actuating cylinder for leaks and security.
- ☐ 22. Inspect position indicating switches and electrical wires for condition and security.

LEFT GEAR

- ☐ 1. Check oleo struts for proper extension. (Check for proper fluid level as required.)
- ☐ 2. Inspect wheel for alignment.
- ☐ 3. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 4. Remove wheel, clean, inspect and repack bearings per lubrication chart in Service Manual.
- ☐ 5. Inspect wheel for cracks, corrosion and broken bolts.
- ☐ 6. Check tire pressure.
- ☐ 7. Inspect brake lining and disc for wear.
- ☐ 8. Inspect condition and security of brake backing plates.
- ☐ 9. Inspect brake and hydraulic lines for condition, mounting, security and leaks.
- ☐ 10. Inspect gear fork for damage.
- ☐ 11. Inspect oleo struts for fluid leaks and scoring.
- ☐ 12. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.
- ☐ 13. Inspect downlock for operation and adjustment.
- ☐ 14. Inspect main gear lock rod or cable assemblies for corrosion, freedom of movement and spring tension.
- ☐ 15. Inspect gear doors and attachments for security.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #3 (cont.)

- ☐ 16. Check warning horn and light for operation.
- ☐ 17. Retract gear - check operation.
- ☐ 18. Retract gear - inspect doors for clearance and operation.
- ☐ 19. Inspect anti-retraction system operation.
- ☐ 20. Inspect actuating cylinder for leaks and security.
- ☐ 21. Inspect position indicating switches and electrical wires for condition and security.

NOSE GEAR

- ☐ 1. Check oleo strut for proper extension. (Check for proper fluid level as required.)
- ☐ 2. Inspect nose gear steering control and travel.
- ☐ 3. Inspect wheel for alignment.
- ☐ 4. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 5. Remove wheel, clean, inspect and repack bearings per lubrication chart in Service Manual.
- ☐ 6. Inspect wheel for cracks, corrosion and broken bolts.
- ☐ 7. Check tire pressure.
- ☐ 8. Inspect shimmy dampener operation.
- ☐ 9. Inspect gear fork for damage.
- ☐ 10. Inspect oleo strut for fluid leaks and scoring.
- ☐ 11. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.
- ☐ 12. Inspect downlock for operation and adjustment.
- ☐ 13. Inspect nose gear lock rod or cable assembly for corrosion, freedom of movement and spring tension.
- ☐ 14. Inspect gear doors and attachments.
- ☐ 15. Check gear warning horn and light for operation.
- ☐ 16. Retract gear- inspect operation.
- ☐ 17. Retract gear - inspect doors for clearance and operation.
- ☐ 18. Inspect actuating cylinder for leaks and security.
- ☐ 19. Inspect position of indicating switches and electrical lead for security.
- ☐ 20. Remove airplane from jacks.

EMPENNAGE TAIL, DETAILED (See Chapter 27, Maintenance Manual.)

- ☐ 1. Remove all inspection plates and panels.
- ☐ 2. Inspect condition of skin, interior bulkheads, formers, stringers for damage and condition.
- ☐ 3. Inspect vertical fin and rudder surfaces for damage.
- ☐ 4. Inspect rudder and tab hinges, horns and attachments for damage and operation.
- ☐ 5. Inspect security of vertical fin attachments.
- ☐ 6. Inspect rudder and tab hinge bolts for excess wear.
- ☐ 7. Inspect rudder balance weight for security.
- ☐ 8. Inspect rudder trim mechanism condition and operation.
- ☐ 9. Inspect horizontal stabilizer and elevator surfaces for damage.
- ☐ 10. Inspect elevator and tab hinges, horns and attachments for damage and operation.
- ☐ 11. Inspect elevator balance weight for security.
- ☐ 12. Inspect horizontal stabilizer attachments.
- ☐ 13. Inspect elevator and tab hinge bolts and bearings for excessive wear.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #3 (cont.)

- ☐ 14. Inspect elevator stop screws and nuts for damage, looseness or evidence of movement, check for proper torque of jam nuts.
- ☐ 15. Inspect elevator balance spring tension.
- ☐ 16. Inspect elevator trim mechanism condition and operation.
- ☐ 17. Inspect rudder, elevator cables and trim cables for correct tension and condition, turnbuckles, guides, and pulleys for safeties, damage and operation.
- ☐ 18. Inspect all rod end bearings for freedom of ball movement. Use a 10X magnifying glass to check thread end of bearing for cracks and damage. Replace bearing if ball is frozen or hard to move.
- ☐ 19. Inspect anti-collision light for security and operation.
- ☐ 20. Inspect condition of pneumatic deicer, if installed.
- ☐ 21. Inspect antenna mounting for security.
- ☐ 22. Inspect security of autopilot servo bridle cable clamps.
- ☐ 23. Inspect electronic installations for security of mounting and operation.
- ☐ 24. Inspect emergency locator transmitter battery for replacement date or time.
- ☐ 25. Reinstall inspection plates and panels.

CABIN MAIN, DETAILED

- ☐ 1. Check that the appropriate certificates are in the airplane and properly displayed.
- ☐ 2. Check upholstery for tears.
- ☐ 3. Check seats, seat belts for security of brackets and bolts.
- ☐ 4. Check all lights and air vents for damage.
- ☐ 5. Inspect oxygen outlets and masks for defects and corrosion (if installed).
- ☐ 6. Check oxygen system for operation (if installed).
- ☐ 7. Check portable fire extinguisher for service and service time (if applicable).
- ☐ 8. Check each life preserver condition service time, locator light attachment and operation (if applicable).

LUBRICATION

Using MIL-L-7870 General Purpose Low Temperature lubricating oil, lubricate the following:

WINGS

- ☐ 1. Nacelle locker latch and hinges.
- ☐ 2. Flap transmission pivot bolts and sender arm.
- ☐ 3. Flap transmission and screw.
- ☐ 4. Flap track rollers. (Tracks must be clean and dry.)
- ☐ 5. Aileron bellcrank cable ends, pivot bearing and control rod ends.
- ☐ 6. Aileron and aileron trim tab hinges and control rod ends.

MAIN LANDING GEAR

- ☐ ☐ 1. Outboard gear door hinges and control rods.
- ☐ ☐ 2. Gear down lock hook, hook actuating cable ends and bellcrank.
- ☐ ☐ 3. Gear up lock hook, control rod or cable ends, and cylinder ends.
- ☐ ☐ 4. Inboard gear door hinges and cylinder ends.
- ☐ ☐ 5. Up lock bushings.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #3 (cont.)

NOSE GEAR

- ☐ 1. Steering arm rollers, bellcrank retraction rod ends, and steering rod ends.
- ☐ 2. Nose gear door actuator, retraction rod end, and cylinder rod end.
- ☐ 3. Uplock hook and uplock rod or cable.
- ☐ 4. Door hinges.
- ☐ 5. Upper and lower torque link connecting bolt and shimmy dampener.
- ☐ 6. Uplock bushing.
- ☐ 7. Forward baggage door hinges and latches.

FUSELAGE

- ☐ 1. Lower cabin door latch, hinges and step mechanism.
- ☐ 2. Upper cabin door hinges and latch.
- ☐ 3. Cargo door hinges and latch (if installed).
- ☐ 4. Pilot door latch and hinges.

COCKPIT

- ☐ 1. Control wheel, rollers, link and flexible joint.
- ☐ 2. Rudder pedals, torque tube bearings and block control cable ends, and brake cylinder ends.
- ☐ 3. Fuel panel control levers.

With All-Purpose Slip Spray (DuPont No. 6611), lubricate the following:

WINGS

- ☐ ☐ 1. Flap tracks.

With aircraft and instrument grease MIL-G-23827 lubricate the following:

MAIN LANDING GEAR

- ☐ ☐ 1. Gear side brace link bushings and housing bushings.
- ☐ ☐ 2. Gear torque link fittings.

NOSE GEAR

- ☐ 1. Drag link assembly and idler link.
- ☐ 2. Upper and lower torque link.
- ☐ 3. Gear housing bushings.
- ☐ 4. Cam bearing surface (special fitting required).
- ☐ 5. Center steering support bearing (special fitting required).

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 4

POWER PLANT

RIGHT PROPELLER, DETAILED (See chapter 61, maintenance manual.)

- ☐ 1. Remove and inspect spinner and back plate.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Lubricate per lubrication chart.
- ☐ 5. Inspect propeller mounting bolts and safety (check torque if safety is broken).
- ☐ 6. Inspect hub parts for cracks and corrosion.
- ☐ 7. Rotate blades and inspect for tightness in hub pilot tube.
- ☐ 8. Check propeller air pressure. Refer to pressure temperature chart (check at least once a month).
- ☐ 9. Inspect condition of propeller deicer system.
- ☐ 10. Inspect condition of synchrophaser (if installed).

RIGHT ENGINE, DETAILED (See chapter 71, maintenance manual.) (Refer to VSP 69.)

—WARNING—

Ground magneto primary circuit before working on engine.

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and check cowling for cracks, distortion, and loose or missing fasteners.
- ☐ 3. Drain oil sump. Drain while engine is warm.
- ☐ 4. Clean suction oil strainer at oil change (check strainer for foreign particles).
- ☐ 5. Change full flow (cartridge type) oil filter element (inspect element for foreign particles).
- ☐ 6. Inspect oil temperature sender unit for leaks and security.
- ☐ 7. Inspect oil lines and fittings for leaks, security, chafing, dents, and cracks.
- ☐ 8. Inspect cylinder head temperature probe and wires for security.
- ☐ 9. Clean and inspect oil radiator cooling fins.
- ☐ 10. Fill engine with oil per lubrication chart in service manual.
- ☐ 11. Clean engine.
- ☐ 12. Inspect condition of spark plugs. (Clean and adjust gap as required; adjust per latest Lycoming Service Instruction 1042.)

—NOTE—

If fouling of spark plugs has been apparent, rotate bottom plugs to upper plugs.

- ☐ 13. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 14. Inspect cylinder compression. (refer to AC 43.13-1A).
- ☐ 15. Inspect cylinder for cracked or broken fins.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #4 (cont.)

- ☐ 16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds.
- ☐ 17. Inspect wiring to engine and accessories. Replace damaged wires and clamps. Inspect terminals for security and cleanliness.
- ☐ 18. Inspect ignition harnesses and insulators (high tension leakage and continuity).
- ☐ 19. Inspect magneto main points for clearance.
- ☐ 20. Inspect magneto retard points for proper retard angle.
- ☐ 21. Inspect magnetos for oil leakage.
- ☐ 22. Inspect breaker felts for proper lubrication.
- ☐ 23. Inspect distributor blocks for cracks, burned areas or corrosion, and height of contact springs.
- ☐ 24. Check magnetos to engine timing (20 degrees BTC).
- ☐ 25. Remove air cleaner filter and clean.
- ☐ 26. Remove and clean fuel injector inlet line screen. (Clean injector nozzles as required.) (Clean with acetone only.) Flow check nozzles.
- ☐ 27. Inspect induction alternate air system for condition and operation.
- ☐ 28. Inspect intake seals for leaks and clamps to tightness.
- ☐ 29. Inspect condition of flexible fuel lines.
- ☐ 30. Inspect fuel system for leaks.
- ☐ 31. Inspect fuel pump for leakage under pressure.
- ☐ 32. Replace hydraulic filter element (check element for contamination).
- ☐ 33. Inspect hydraulic pump and gasket for leaks. (Replace pump at engine T. B. O.)
- ☐ 34. Inspect condition of pneumatic pump and security of lines.
- ☐ 35. Inspect throttle, alternate air, injector, mixture and propeller governor controls for travel and operating condition.
- ☐ 36. Inspect exhaust stacks and gaskets. (Replace gaskets as required.)
- ☐ 37. Inspect breather tube for obstructions and security.
- ☐ 38. Inspect crankcase for cracks, leaks, and security of seam bolts.
- ☐ 39. Inspect engine mounts for cracks and loose mounting.
- ☐ 40. Inspect all engine baffles for cracks and condition of seals.
- ☐ 41. Inspect rubber engine mount bushings for deterioration.
- ☐ 42. Inspect fire walls for cracks.
- ☐ 43. Inspect condition of fire wall seal.
- ☐ 44. Inspect condition and tension of alternator drive belt (65 lbs.)
- ☐ 45. Inspect condition of alternator and starter. (Replace at engine T. B. O.)
- ☐ 46. Replace pneumatic inlet filter.
- ☐ 47. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)
- ☐ 48. Inspect security of air conditioning compressor mount (if installed).
- ☐ 49. Inspect air conditioning compressor oil level (if installed).
- ☐ 50. Inspect condition and tension of compressor (air conditioner) drive belt, (60-65 lbs. used, 100 lbs. new).
- ☐ 51. Inspect compressor clutch security and wiring. Clean any traces of oil from the clutch surface.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT 4 (cont)

RIGHT TURBOCHARGER, DETAILED (See chapter 81, maintenance manual)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition (replace turbocharger at engine TBO).
- ☐ 2. Inspect the compressor wheel for nicks, cracks, or broken blades.
- ☐ 3. Inspect for excess bearing drag or wheel rubbing against housing.
- ☐ 4. Inspect turbine wheel for broken blades or signs of rubbing.
- ☐ 5. Inspect oil inlet and outlet ports in center housing of leaks.
- ☐ 6. Inspect turbine heat blanket for condition and security.
- ☐ 7. Inspect linkage between bypass valve and actuator.
- ☐ 8. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks, and leaks.
- ☐ 9. Inspect the turbocharger mount for cracks, condition and security to the engine and turbocharger.
- ☐ 10. Inspect fuel injection nozzle reference manifold for deteriorated hose, loose connections, leaks, or obstructions.
- ☐ 11. Inspect fluid power lines for leaks and security.
- ☐ 12. Inspect for oil leakage from the controllers.
- ☐ 13. Inspect condition of cowl fastener locked indicator stripes. Touch-up or restore as necessary. Refer to Maintenance Manual, Chapter 71Reinstall engine cowl.
- ☐ 14. Reinstall engine cowl.

LEFT PROPELLER, ROUTINE (See chapter 61, maintenance manual)

- ☐ 1. Inspect spinner and back plate.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Inspect condition of deicer boots (if applicable).
- ☐ 5. Inspect propeller air pressure (at least once a month).

LEFT ENGINE, ROUTINE (see chapter 71, maintenance manual) (refer to VSP 69)

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and inspect cowling for cracks, distortion, loose or missing fasteners.
- ☐ 3. Drain oil sump. Drain while engine is warm.
- ☐ 4. Inspect suction oil strainer at oil change (inspect strainer for foreign particles).
- ☐ 5. Change full flow (cartridge type) oil filter element (inspect for foreign particles).
- ☐ 6. Fill engine with oil per lubrication chart.
- ☐ 7. Inspect oil temperature sender unit for leaks and security.
- ☐ 8. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks. (Replace oil lines at engine TBO per latest Lycoming Service Bulletin 240, or on condition.)
- ☐ 9. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 10. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket. Tighten screws to a torque of 50 inch-pounds.
- ☐ 11. Clean and inspect oil radiator cooling fins.
- ☐ 12. Remove air cleaner filter and clean.
- ☐ 13. Inspect condition of alternate air door and box.
- ☐ 14. Remove and clean fuel injector inlet line screen and fuel inlet strainers (clean with acetone only).
- ☐ 15. Inspect intake seals for leaks and clamps for tightness.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #4 (cont.)

- ☐ 16. Inspect exhaust gaskets for leaks.
- ☐ 17. Inspect condition of flexible lines.
- ☐ 18. Inspect fuel system for leaks.
- ☐ 19. Inspect throttle, alternate air, injector, mixture and propeller governor for travel and operating conditions.
- ☐ 20. Inspect breather tube for obstruction and security.
- ☐ 21. Inspect crankcase for cracks leaks and security of seam bolts.
- ☐ 22. Inspect all engine baffles.
- ☐ 23. Inspect engine rubber mount bushings for deterioration.
- ☐ 24. Inspect condition and tension of alternator belt (65 lbs.).
- ☐ 25. Inspect condition of alternator and starter. (Replace at engine T. B. O.)
- ☐ 26. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)

LEFT TURBOCHARGER, ROUTINE (See Chapter 81, Maintenance Manual.)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition. (Replace turbocharger at engine T. B. O.)
- ☐ 2. Inspect turbine heat blanket for condition and security.
- ☐ 3. Inspect linkage between bypass valve and actuator.
- ☐ 4. Inspect vent line from bypass valve for oil leaks.
- ☐ 5. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks.
- ☐ 6. Inspect fluid power lines for leaks and security.
- ☐ 7. Inspect oil leakage from controller.
- ☐ 8. Inspect condition of cowl fastener locked indicator stripes. Touch-up or restore as necessary. Refer to Maintenance Manual, Chapter 71
- ☐ 9. Reinstall engine cowl.

LEFT WING, ROUTINE (See Chapter 57, Maintenance Manual.)

- ☐ 1. Inspect surfaces, skins and tip for damage and loose rivets.
- ☐ 2. Inspect aileron hinges for security of attachment and operation.
- ☐ 3. Inspect aileron balance weight and arm for security and condition.
- ☐ 4. Inspect flap and attachment for damage and operation.
- ☐ 5. Remove, drain and clean fuel filter bowl and screen (drain and clean at least every 90 days.)
- ☐ 6. Check fuel tanks for marked capacity, fuel caps for proper seal and quick drains for proper operation.
- ☐ 7. Inspect condition of pneumatic deicer, if installed.
- ☐ 8. Inspect fuel cells and lines for leaks and water.
- ☐ 9. Inspect condition of fuel cell material.
- ☐ 10. Inspect wing tip navigation and strobe lights for broken lenses.

LANDING GEAR, ROUTINE (See Chapter 32, Maintenance Manual.) (Refer to Piper Service Bulletin 822.)
LEFT MAIN

- ☐ 1. Check oleo strut for proper extension.
- ☐ 2. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 3. Check tire pressure (psi).
- ☐ 4. Inspect brake and hydraulic lines for damage and security.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #4 (cont.)

- ☐ 5. Check gear leg for damage.
- ☐ 6. Inspect gear doors and attachments for cracks and corrosion.
- ☐ 7. Inspect actuating cylinder for leaks and security.
- ☐ 8. Inspect condition of up and downlock springs.
- ☐ 9. Wipe exposed strut with clean cloth soaked in hydraulic fluid MIL-H-5606.

RIGHT MAIN

- ☐ 1. Check oleo strut for proper extension.
- ☐ 2. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 3. Check tire pressure (psi).
- ☐ 4. Inspect brake and hydraulic lines for damage and security.
- ☐ 5. Check gear leg for damage.
- ☐ 6. Inspect gear doors and attachments for cracks and corrosion.
- ☐ 7. Inspect actuating cylinder for leaks and security.
- ☐ 8. Inspect condition of up and downlock springs.
- ☐ 9. Wipe exposed strut with clean cloth soaked in hydraulic fluid MIL-H-5606.

NOSE

- ☐ 1. Check oleo strut for proper extension.
- ☐ 2. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 3. Check tire pressure (psi).
- ☐ 4. Check gear fork for damage.
- ☐ 5. Inspect gear doors and attachments for cracks and corrosion.
- ☐ 6. Inspect actuating cylinder for leaks and security.
- ☐ 7. Inspect condition of up and downlock springs.
- ☐ 8. Wipe exposed strut with clean cloth soaked in hydraulic fluid MIL-H-5606.

FUSELAGE FORWARD, DETAILED (See Chapter 53, Maintenance Manual.)

- ☐ 1. Remove inspection plates and panels.
- ☐ 2. Inspect baggage door latch, hinges, door ajar switch and compartment light for wear, proper rigging and operation.
- ☐ 3. Check fluid in brake reservoir (fill as required).
- ☐ 4. Inspect antenna mounts and electrical wiring for security and corrosion in plugs.
- ☐ 5. Within the Radome inspect the radar and glide slope antenna, wave guide and receiver transmitter for condition and security of mounting (if installed).
- ☐ 6. Inspect bulkheads and stringers for damage, condition and corrosion.
- ☐ 7. Inspect left and right pitot mast security of mounting.
- ☐ 8. Inspect heater and heater fuel pump for fuel or fume leaks.
- ☐ 9. Inspect heater fuel lines and valve for leaks.
- ☐ 10. Check recommended time for overhaul of heater.
- ☐ 11. Inspect hydraulic power pack fluid level (fill as required).
- ☐ 12. Inspect hydraulic power pack, flexible control cable and lines for damage and leaks.
- ☐ 13. Inspect landing and taxi lights for broken lenses.
- ☐ 14. Inspect external skins for condition, damage and corrosion.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #4 (cont.)

FUSELAGE MAIN, DETAILED (See Chapter 53, Maintenance Manual.)

- ☐ 1. Remove inspection plates, panels and floor panels.
- ☐ 2. Inspect external skin for condition, damage and corrosion.
- ☐ 3. Inspect windshield and all windows for cracks and condition.
- ☐ 4. Inspect windshield wiper for security of mounting, condition and operation (do not operate on dry windshield).
- ☐ 5. Inspect fuel lines and crossfeed valve for damage and operation.
- ☐ 6. Inspect all fuel and hydraulic lines for security.
- ☐ 7. Inspect all flight control cables and pulleys for damage and tension.
- ☐ 8. Inspect all electrical wiring for security.
- ☐ 9. Inspect antenna mounts and connections for security and corrosion.
- ☐ 10. Inspect autopilot roll servo for security and condition of bridle cables and wiring (refer to approved autopilot manual).
- ☐ 11. Inspect cabin door for damage, condition of door seal and proper rig and operation.
- ☐ 12. Replace inspection plates, panels and floor panels.

COCKPIT, ROUTINE

- ☐ 1. Check pilot seat for operation and damage.
- ☐ 2. Check copilot seat for operation and damage.
- ☐ 3. Check condition of oxygen mask.
- ☐ 4. Check control wheel for operation. (See Special Inspection.)
- ☐ 5. Check pilot and copilot seat belts and shoulder harnesses for proper security, operation and condition.

LUBRICATION

Using MIL-L-7870 General Purpose Low Temperature lubricating oil, lubricate the following:

WINGS

- ☐ 1. Nacelle locker latch and hinges.
- ☐ 2. Flap transmission pivot bolts and sender arm.
- ☐ 3. Flap transmission and screw.
- ☐ 4. Flap track rollers. (Tracks must be clean and dry.)
- ☐ 5. Aileron bellcrank cable ends, pivot bearing and control rod ends.
- ☐ 6. Aileron and aileron trim tab hinges and control rod ends.

MAIN LANDING GEAR

- ☐ ☐ 1. Outboard gear door hinges and control rods.
- ☐ ☐ 2. Gear downlock hook, hook actuating cable ends and bellcrank.
- ☐ ☐ 3. Gear uplock hook, control rod or cable ends, and cylinder ends.
- ☐ ☐ 4. Inboard gear door hinges and cylinder ends.
- ☐ ☐ 5. Uplock bushings.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT #4 (cont.)

NOSE GEAR

- ▢ 1. Steering arm rollers, bellcrank retraction rod ends, and steering rod ends.
- ▢ 2. Nose gear door actuator, retraction rod end, and cylinder rod end.
- ▢ 3. Uplock hook and uplock rod or cable.
- ▢ 4. Door hinges.
- ▢ 5. Upper and lower torque link connecting bolt and shimmy dampener.
- ▢ 6. Uplock bushing.
- ▢ 7. Forward baggage door hinges and latches.

EMPENNAGE

- ▢ 1. Elevator and elevator trim tab hinges and control rod ends.
- ▢ 2. Rudder and rudder trim tab hinges and control rod ends.
- ▢ 3. Rudder horn cable ends.
- ▢ 4. Elevator bellcrank, pivot bolts and cable ends.

FUSELAGE

- ▢ 1. Lower cabin door latch, hinges and step mechanism.
- ▢ 2. Upper cabin door hinges and latch.
- ▢ 3. Cargo door hinges and latch (if installed).
- ▢ 4. Pilot door latch and hinges.

COCKPIT

- ▢ 1. Control wheel, rollers, link and flexible joint.
- ▢ 2. Rudder pedals, torque tube bearings and block control cable ends, and brake cylinder ends.
- ▢ 3. Fuel panel control levers.

With All-Purpose Slip Spray (DuPont No. 6611), lubricate the following:

WINGS

- ▢ 1. Flap tracks.

With aircraft and instrument grease MIL-G-23827 lubricate the following:

MAIN LANDING GEAR

- ▢ ▢ 1. Gear side brace link bushings and housing bushings.
- ▢ ▢ 2. Gear torque link fittings.

NOSE GEAR

- ▢ 1. Drag link assembly and idler link.
- ▢ 2. Upper and lower torque link.
- ▢ 3. Gear housing bushings.
- ▢ 4. Cam bearing surface (special fitting required).
- ▢ 5. Center steering support bearing (special fitting required).

Clean the following with quick drying solvent and lubricate with Mobil Bearing Grease 77 or Mobilus EP2:

- ▢ ▢ Main wheel bearings.
- ▢ ▢ Nose wheel bearings.

Remove the aircraft from jacks.

- ▢ Replace all inspection plates and covers.
- ▢ Sign off lubrication section of check form.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

SPECIAL INSPECTIONS

400 HOUR

LEFT AND RIGHT ENGINE

- ☐ 1. Lycoming requires a valve inspection be made after every 400 hours of operation.

NOTES

- ☐ 1. At every 400 hours of engine operation, remove the rocker box covers and check for freedom of valve rockers when valves are closed. Look for evidence of abnormal wear or broken parts in the area of the valve tips. valve keeper, springs and spring seat. If any indications are found the cylinder and all of its components should be removed (including the piston and connecting rod assembly) and inspected for further damage. Replace any parts that do not conform with limits shown in the latest revision for Lycoming Service Table of Limits No. SSP-1776.

500 HOUR

LEFT AND RIGHT ENGINE

- ☐ 1. Remove and flush oil radiator.
- ☐ 2. Replace pneumatic system inline filters.
- ☐ 3. Replace rubber engine mount bushings. (See Note 1.)

LEFT AND RIGHT MAIN GEAR

- ☐ 1. Inspect torque link assembly, bolts and bushings (rebush as required).
- ☐ 2. Inspect drag and side brace link assembly and bolts (replace as required).

NOSE GEAR

- ☐ 1. Inspect torque link assembly, bolts and bushings (rebush as required).
- ☐ 2. Inspect drag link assembly and bolts (replace as required).

EMPENNAGE

- ☐ 1. Clean and lubricate elevator and rudder trim drum screw.

LEFT AND RIGHT WING

- ☐ 1. Inspect fuel cell vents for obstruction.

NOTES

- ☐ 1. It is required that all rubber engine mount bushings be replaced every 500 hours.
- ☐ 2. Inspect fuel cells every 2 years.

1000 HOUR

LEFT AND RIGHT ENGINE

- ☐ 1. Replace flexible oil, fuel, hydraulic, and pneumatic lines at 1000 hours or 8 years, whichever comes first.

LEFT AND RIGHT WING

- ☐ 1. Inspect condition of bolts used with flap and aileron hinges (replace as required).

FORWARD FUSELAGE AND EMPENNAGE

- ☐ 1. Overhaul or replace heater fuel valve (as required).
- ☐ 2. If installed, overhaul or replace *aft* heater fuel valve (as required).

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

SPECIAL INSPECTIONS (cont.)

1000 HOUR (CONT.)

LEFT, RIGHT AND NOSE GEAR

- ☐ 1. Inspect drag and side brace link bolts for wear. Replace as required. (Initial inspection; repetitive inspection each 100 hours time-in-service.) (Refer to latest revision of Piper Service Bulletin 845A.)

LEFT AND RIGHT PROPELLER

- ☐ 1. Remove propeller; remove sludge from propeller and crankshaft.

LEFT AND RIGHT WING

- ☐ 1. Inspect all exterior bearings, clean and lubricate (replace as required).
- ☐ 2. Drain main fuel cells and inspect knots and tension of nylon support cords.
- ☐ 3. Inspect security of baffles and free operation of flapper valve.

2000 HOURS

LEFT AND RIGHT WING

- ☐ 1. Inspect fuel cells every 2 years or after 2000 hours time-in-service, whichever comes first.

ENGINE TBO MAINTENANCE

LEFT AND RIGHT ENGINE

- ☐ 1. Overhaul or replace magnetos at engine T. B. O. or 4 years per latest Bendix S/B 586.
- ☐ 2. Overhaul or replace fuel pumps (engine driven and electric) (per latest revision of Lycoming Service Bulletin No. 240 for engine driven).
- ☐ 3. Overhaul or replace hydraulic pump at engine T. B. O.
- ☐ 4. Overhaul or replace pneumatic pump at engine T. B. O.
- ☐ 5. Overhaul or replace alternator at engine T. B. O.
- ☐ 6. Overhaul or replace starter at engine T. B. O.
- ☐ 7. Overhaul or replace fuel injector at engine T. B. O.
- ☐ 8. Complete overhaul or replacement of turbocharger at engine T. B. O.
- ☐ 9. Complete overhaul or replacement of engines (per engine mfg. recommendations; see latest Lycoming Service Instruction No. 1009).

MISCELLANEOUS INSPECTIONS

RIGHT ENGINE

- ☐ 1. Inspect air conditioner, compressor oil level whenever system must be charged.

FUSELAGE AFT

- ☐ 1. Perform oxygen bottle hydrostatic inspection. (Refer to AC 43.13-1A, Section 3, Paragraph 363 for details.)

LEFT AND RIGHT PROPELLER

- ☐ 1. Overhaul or replace propeller. (Refer to latest revision of Hartzell Service Letter No. 61.)
- ☐ 2. Overhaul or replace propeller governor per latest revision of Hartzell Service Letter No. 61.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

SPECIAL INSPECTIONS AS REQUIRED, UPON CONDITION

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:

- ☐ 1. Wings - for wrinkled skins, loose or missing rivets.
- ☐ 2. Fuel leaks around the fuel tanks and fuel fittings throughout the wings.
- ☐ 3. Wing spar webs, bulkheads, nacelle skins and attachments, fire wall skin and wing and fuselage stringers for any signs of overstress or damage.
- ☐ 4. A possible alignment check to clarify any doubt of damage.

SEVERE TURBULENCE INSPECTION. The same items and locations should be checked as stated in Hard or Overweight Landings along with the following:

- ☐ 1. Top and bottom fuselage skins for loose or missing rivets and wrinkled skins.
- ☐ 2. Empennage skins and attachments.

ENGINE OVERSPEED, SUDDEN STOPPAGE, LOSS OF OIL AND LIGHTNING STRIKE

- ☐ 1. Refer to Chapter 5 Maintenance Manual.

COMPONENT OVERLIMITS INSPECTION

- ☐ 1. Check with the appropriate manufacturer for the necessary corrective action.

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SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO. Left:	PROPELLER SERIAL NO. Left:
		Right:	Right:

OPERATIONAL INSPECTION

PRE-RUN UP

- ☐ 1. Check fuel supply.
- ☐ 2. Drain all fuel sumps.
- ☐ 3. Check engine oil level.
- ☐ 4. Check fire wall valve operation and return to ON position.
- ☐ 5. Move aircraft to run up area.

RUN UP AND OPERATIONAL CHECKS

- ☐ 1. Set parking brake.
- ☐ 2. Check fuel selector valve and crossfeed system operation.
- ☐ 3. Check fuel pumps (electric) for proper operation and warning light function.
- ☐ 4. Check fuel quantity indicators for proper reading.
- ☐ 5. Check all warning lights.
- ☐ 6. Check outside air temperature gauge for proper reading.
- ☐ 7. Check all circuit breakers.
- ☐ 8. Check flight controls for freedom of movement, proper travel and proper response.
- ☐ 9. Check cowl flap operation and indication.
- ☐ 10. Check wing flap operation and indication.
- ☐ 11. Check heater operation.
- ☐ 12. Check air conditioner operation (if installed).
- ☐ 13. Check propeller deicer operation.
- ☐ 14. Engine Run Up:
  - a. Propeller and mixture levers - full forward.
  - b. Throttle- 1500 RPM.
  - c. Propeller feather check - maximum 500 RPM decrease.
  - d. Throttle - 2300 RPM.
  - e. Magneto check - 175 RPM maximum drop - 50 RPM decrease.
  - f. Propeller governing check.
  - g. Alternator output check.
  - h. Check all engine temperature and pressure gauges.
  - i. Perform right engine hydraulic pump check.
  - j. Check manifold pressure indication (see latest Lycoming Service Instruction No. 1187).
  - k. Check gyro pressure and pressure operated flight instruments.
  - l. Check surface deice system.
  - m. Check alternate air.
  - n. Return aircraft to maintenance area.
  - o. Check idle RPM - 600 to 650 RPM.
  - p. Magneto safety check.
- ☐ 15. Perform left engine hydraulic pump check.
- ☐ 16. Secure aircraft.
- ☐ 17. Autopilot and/or electric pitch trim. Refer to Flight Manual Supplement for preflight and flight check, for intended function in all modes.

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

OPERATIONAL INSPECTION (cont.)

POST-INSPECTION RUN UP

- ☐ 1. Return aircraft to maintenance area.
- ☐ 2. Check engine for general condition, fuel and oil leaks.
- ☐ 3. Reinstall engine cowlings.

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SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

EVENT INSPECTION RECORD AND SIGN OFF SHEET

I certify that this aircraft has been inspected in accordance with Piper Aircraft Corporation Continuous Inspection Program and found it to be in airworthy condition.

NOTES

1. Proper inspection procedures are the responsibility of the individual performing the inspection and must be made in accordance with all applicable current Federal Aviation Regulations, Piper Service Manuals and Publications.
2. Work order column is applicable only to FAA approved repair stations.
3. Always check and use only current information.
4. The signatures signify that this aircraft has been thoroughly inspected and found airworthy in accordance with all current Federal Aviation Regulations, Piper Service Manuals and Publications; also that appropriate entries have been made in the aircraft and engine logbooks, cycle inspection record, discrepancy record, publication record, ECR record and FAA airworthiness record sections of this manual.

EVENT #	INSP	A/C TIME	DATE	W. O. #	SIGNATURE - CERTIFICATE #
1	50				
2	100				
3	150				
4	200				
1	250				
2	300				
3	350				
4	400				
1	450				
2	500				
3	550				
4	600				
1	650				
2	700				
3	750				
4	800				

EVENT #	INSP	A/C TIME	DATE	W. O. #	SIGNATURE - CERTIFICATE #
1	850				
2	900				
3	950				
4	1000				
1	1050				
2	1100				
3	1150				
4	1200				
1	1250				
2	1300				
3	1350				
4	1400				
1	1450				
2	1500				
3	1550				
4	1600				
1	1650				
2	1700				
3	1750				
4	1800				
1	1850				
2	1900				
3	1950				
4	2000				
1	2050				
2	2100				
3	2150				
4	2200				
1	2250				
2	2300				
3	2350				
4	2400				

EVENT #	INSP	A/C TIME	DATE W. O. #	SIGNATURE - CERTIFICATE #
1	2450			
2	2500			
3	2550			
4	2600			
1	2650			
2	2700			
3	2750			
4	2800			
1	2850			
2	2900			
3	2950			
4	3000			

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SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

CONTINUOUS CYCLE INSPECTION RECORD AND SIGN OFF SHEET

1. CURRENT FAA APPROVED FLIGHT AND OWNER'S MANUAL ARE IN THE AIRCRAFT.
2. AIRCRAFT AND ENGINE LOGBOOKS ARE IN THE AIRCRAFT AND APPROPRIATE ENTRIES MADE IN THESE LOGBOOKS.
3. REGISTRATION CERTIFICATE IN AIRCRAFT AND PROPERLY DISPLAYED.
4. AIRWORTHINESS CERTIFICATE IN AIRCRAFT AND PROPERLY DISPLAYED.
5. RADIO STATION F. C. C. LICENSES IN AIRCRAFT AND PROPERLY DISPLAYED.
6. AIRCRAFT EQUIPMENT LIST- WEIGHT AND BALANCE - FAA FORM 337 (IF APPLICABLE) ARE IN AIRCRAFT AND IN PROPER ORDER.
7. APPLICABLE MANUFACTURER'S SERVICE INFORMATION HAS BEEN COMPLIED WITH.
8. APPLICABLE FAA AIRWORTHINESS DIRECTIVES ARE COMPLIED WITH.
9. PIPER CONTINUOUS INSPECTION RECORDS IN ORDER AND PROPERLY SIGNED OFF.
10. OUTSTANDING CONDITIONS HAVE BEEN CORRECTED AS LISTED ON CONDITION RECORD.

CYCLE #	DATE	TACH	REMARKS	SIGNATURE - CERTIFICATE #
1 200 Hr				
2 400 Hr.				
3 600 Hr				
4 800 Hr.				
5 1000 Hr.				
6 1200 Hr.				
7 1400 Hr.				
8 1600 Hr				
9 1800 Hr.				
10 2000 Hr.				
11 2200 Hr.				
12 2400 Hr				
13 2600 Hr.				
14 2800 Hr.				
15 3000 Hr				

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

DISCREPANCY RECORD

DISCREPANCY	A/C HOURS	SIGNATURE	DATE	CORRECTIVE ACTION	W.O.#	SIGNATURE AND CERTIFICATE NO.	DATE

DISCREPANCY RECORD

DISCREPANCY	A/C HOURS	SIGNATURE	DATE	CORRECTIVE ACTION	W.O. #	SIGNATURE AND CERTIFICATE NO.	DATE

SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Right:	Right:

SERVICE PUBLICATION COMPLIANCE RECORD

MANUFACTURE	PUBLI-CATION	NUMBER	COMPLI-ANCE DATE	A/C HOURS	W O NO.	SIGNATURE AND CERTIFICATE NO.

SERVICE PUBLICATION COMPLIANCE RECORD

MANUFACTURE	PUBLI-CATION	NUMBER	COMPLI-ANCE DATE	A/C HOURS	W O NO.	SIGNATURE AND CERTIFICATE NO.

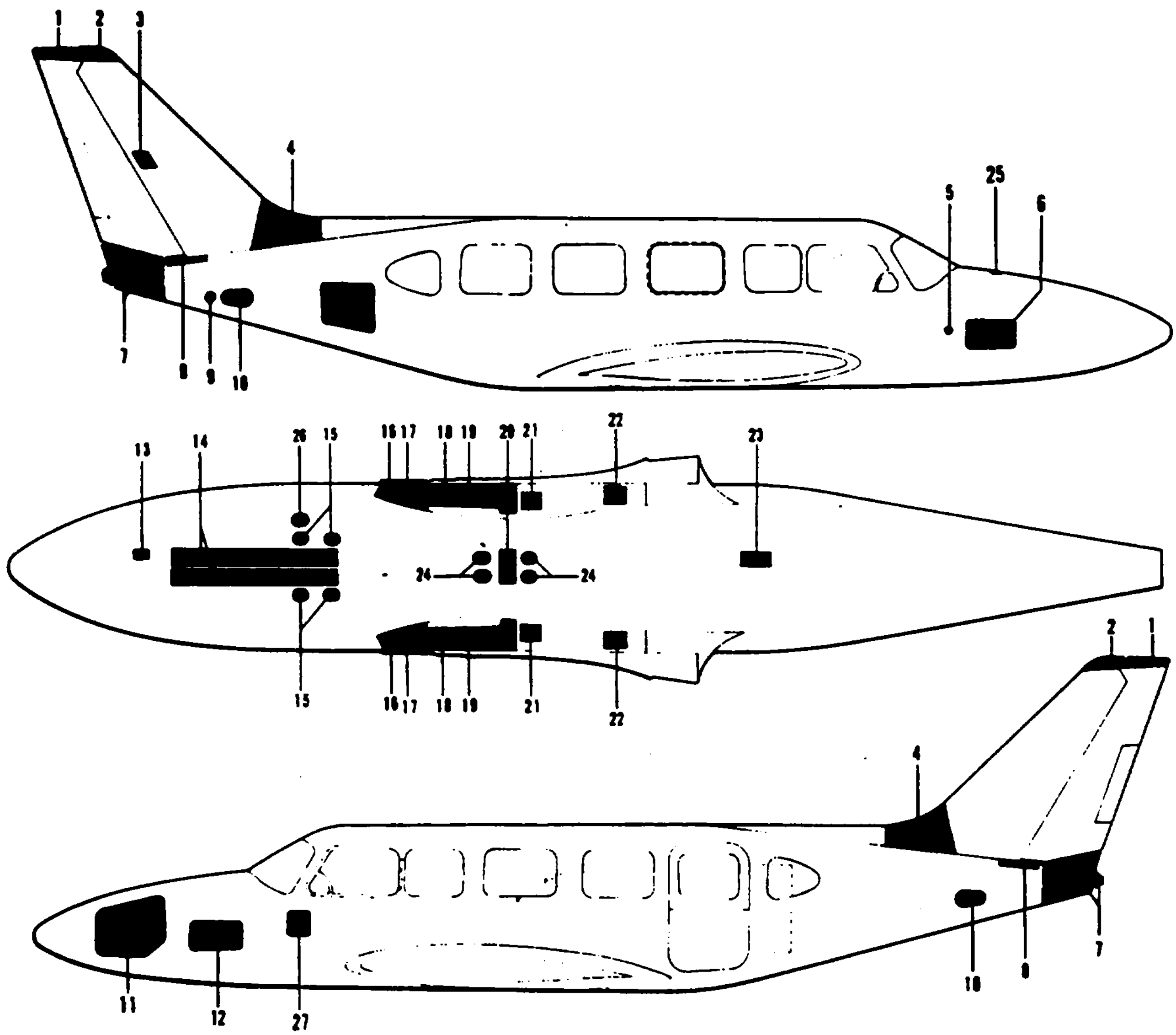
SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Rignt:	Right:

FAA AIRWORTHINESS DIRECTIVES COMPLIANCE RECORD

A.D. NUMBER	A.D. DATE	A/C HOURS	METHOD OF COMPLIANCE	ONE TIME	RECURRING	WORK ORDER NO.		SIGNATURE AND CERTIFICATE NO.

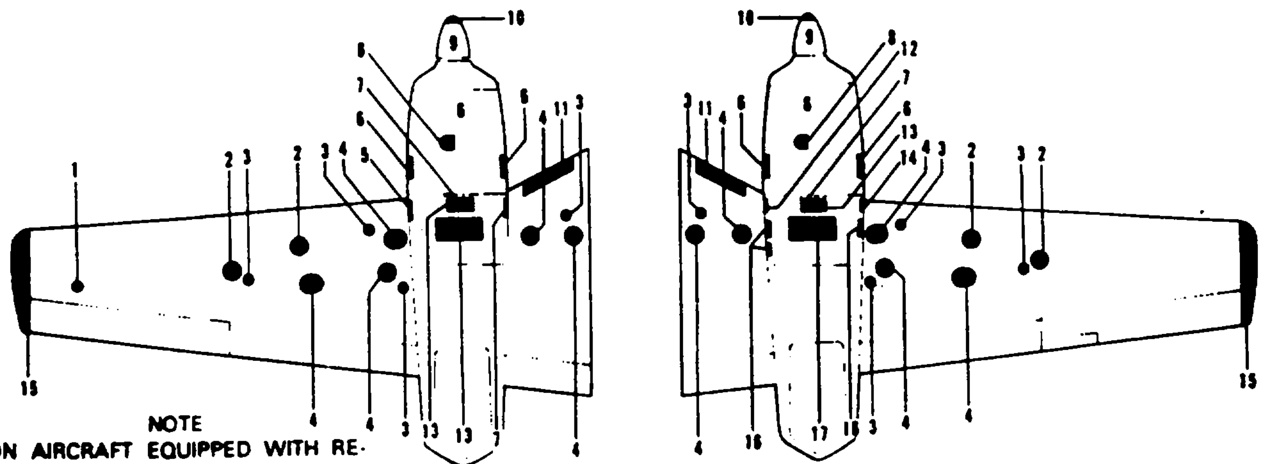
SERIAL NUMBER	REGISTRATION NUMBER	ENGINE SERIAL NO.	PROPELLER SERIAL NO.
		Left:	Left:
		Rignt:	Right:

DATE	A/C HRS.	RECOVERED PART # SERIAL #	INSTALL PART # SERIAL #	SIGNATURE AND CERTIFICATE

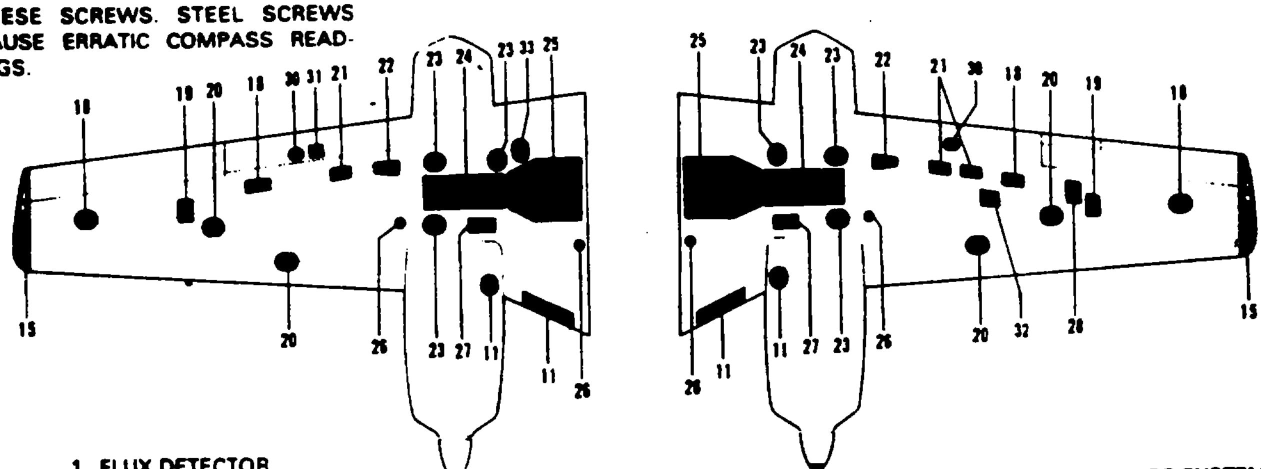


1. RUDDER TIP
2. VERTICAL STABILIZER TIP
3. RUDDER TRIM SCREW AND SENDER
4. ELT
5. RUDDER PEDAL TORQUE TUBE
6. HEATER - POWER PACK
7. ELEVATOR CONTROL ARM
8. RUDDER CONTROL HORN
9. ELEVATOR BUNGEE
10. ELEVATOR BELLCRANK
11. BATTERY - POWER PACK
12. VOLTAGE REGULATORS - FUSES - ELECTRONICS EQUIPMENT
13. EXTERNAL POWER RECEPTACLE
14. NOSE LANDING GEAR
15. HYDRAULIC LINES - ELECTRICAL LEADS
16. ELECTRICAL CONNECTORS - LINE CONNECTORS, FRONT SPAR ATTACHMENT
17. ELECTRICAL CONNECTORS - LINES
18. FUEL PUMP - FUEL FILTER - CROSSFEED VALVE - EMERGENCY SHUTOFF VALVE
19. FUEL FILTER BOWL
20. SPAR SPLICE - DEICER PRESSURE SWITCH
21. MAIN SPAR ATTACHMENT
22. REAR SPAR ATTACHMENT
23. CABIN EXHAUST
24. SPAR SPLICE
25. BRAKE RESERVOIR
26. PULLEY AND CABLE INSPECTION
27. CIRCUIT BREAKERS

Figure 5-1. Access Plates and Panels, Fuselage and Empennage

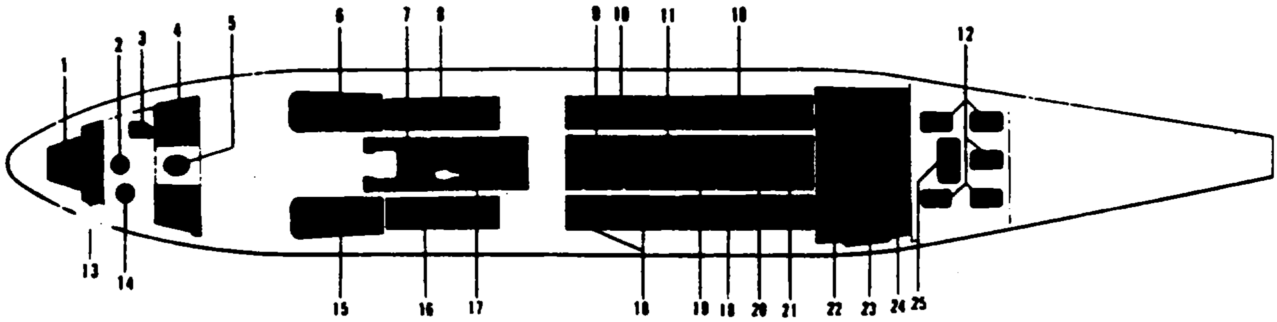


NOTE
ON AIRCRAFT EQUIPPED WITH REMOTE COMPASS SYSTEMS, ACCESS PLATE (1) MUST HAVE BRASS SCREWS ONLY WHEN REPLACING ANY OF THESE SCREWS. STEEL SCREWS CAUSE ERRATIC COMPASS READINGS.



1. FLUX DETECTOR
2. FUEL FILLER
3. FUEL SENDER UNIT
4. FUEL CELL
5. PRESSURE SYSTEM AIR FILTER - INSPECTION LIGHT - PULSE GENERATOR (IF PROP SYNCHROPHASER IS INSTALLED)
6. ENGINE
7. NACELLE INTERIOR - PRESSURE SYSTEM INLINE FILTER
8. OIL FILLER
9. PROPELLER
10. PROPELLER RECHARGE
11. LINES - WIRES - CABLES
12. NACELLE INTERIOR - CONDENSER AIR OUTLET PLATE (IF AIR CONDITIONING IS INSTALLED)
13. COWL FLAP TRANSMISSION
14. CONDENSER AIR OUTLET - PRESSURE SYSTEM AIR FILTER - STROBE SENSOR (IF PROP SYNCHROPHASER IS INSTALLED)
15. WING TIP
16. FREON CONDENSER, IF INSTALLED
17. COWL FLAP TRANSMISSION - PRESSURE SYSTEM RELIEF VALVE - PRESSURE SYSTEM INLINE FILTER - FREON CONDENSER (IF AIR CONDITIONING IS INSTALLED)
18. AILERON CABLE PULLEYS
19. AILERON BELLCRANK
20. FUEL CELL CHECK VALVE
21. AILERON CABLE FAIRLEADS
22. AILERON TRIM CABLES RIGHT WING ONLY, RUB BLOCKS AND FLAP TRANSMISSION
23. LANDING GEAR ATTACHMENTS
24. MAIN LANDING GEAR
25. GEAR DOOR ACTIVATING CYLINDER
26. FUEL CELL DRAIN
27. LANDING GEAR SIDE BRACE ATTACHMENTS
28. AILERON TRIM SCREW AND SENDER
29. ELEVATOR TRIM SCREW AND SENDER
30. FLAP POSITION SENDER
31. WING FLAP TRANSMISSION
32. AILERON TRIM CABLES AND RUB BLOCKS
33. ROLL SERVO

Figure 5-2. Access Plates and Panels, Wings



1. BATTERY DRAIN AND VENTS
2. PITOT ATTACHMENT LINES
3. CABIN AIR CONTROL
4. HEATER AIR INLET LINE
5. NOSE GEAR STEERING BELLCRANK
6. HYDRAULIC LINES
7. TRIM CONTROL CABLES AND PULLEYS
8. TRIM CABLES AND PULLEYS - ENGINE CONTROL LINES, WIRES AND CABLES
9. ROLL SERVO, IF INSTALLED
10. TRIM CABLES AND PULLEYS
11. FLAP MOTOR - AILERON BALANCE CABLE
12. CONTROL AND TRIM CABLES
13. BAGGAGE COMPARTMENT COVER PLATE
14. EXTERNAL POWER RECEPTACLE ATTACHMENTS
15. CONTROL CABLES, PULLEYS AND TURNBUCKLES
16. CONTROL CABLES, PULLEYS AND TURNBUCKLES - ENGINE CONTROL LINES, WIRES AND CABLES
17. HYDRAULIC HAND PUMP, PNEUMATIC BLOWER
18. CONTROL CABLES AND PULLEYS
19. TRIM WARNING SYSTEM, IF INSTALLED
20. AUTOPILOT UNITS: ROLL, PITCH AND PITCH TRIM SERVOS, VOLTAGE DIVIDER, AND GYRO AMPLIFIER - CONTROL CABLES - WING FLAP MOTOR
21. PITCH SERVO, IF INSTALLED
22. CABIN EXHAUST DOOR MECHANISM
23. CONTROL AND TRIM CABLES AND PULLEYS - SEAT ATTACHMENTS
24. PITCH TRIM SENSOR, IF INSTALLED
25. GROUND VENT FAN

Figure 5-3. Access Plates and Panels, Fuselage Interior

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CHAPTER

6

DIMENSIONS AND AREAS

CHAPTER 6 - DIMENSIONS AND AREAS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
6-00-00	GENERAL	1E1	
6-00-01	DIMENSIONS AND AREAS	1E1	
6-00-02	Station Reference Lines	1E5	
6-00-03	Access and Inspection Provisions	1E5	

GENERAL.

DIMENSIONS AND AREAS. (Refer to Figure 6-1.)

The principal airplane dimensions are shown in Figure 6-1 and listed in Chart 601. The serial number plate for the airplane is located near the tail skid. The MAA plate is located under the lower front corner of the entrance door. The engine number plates are located on the right side of the oil sump.

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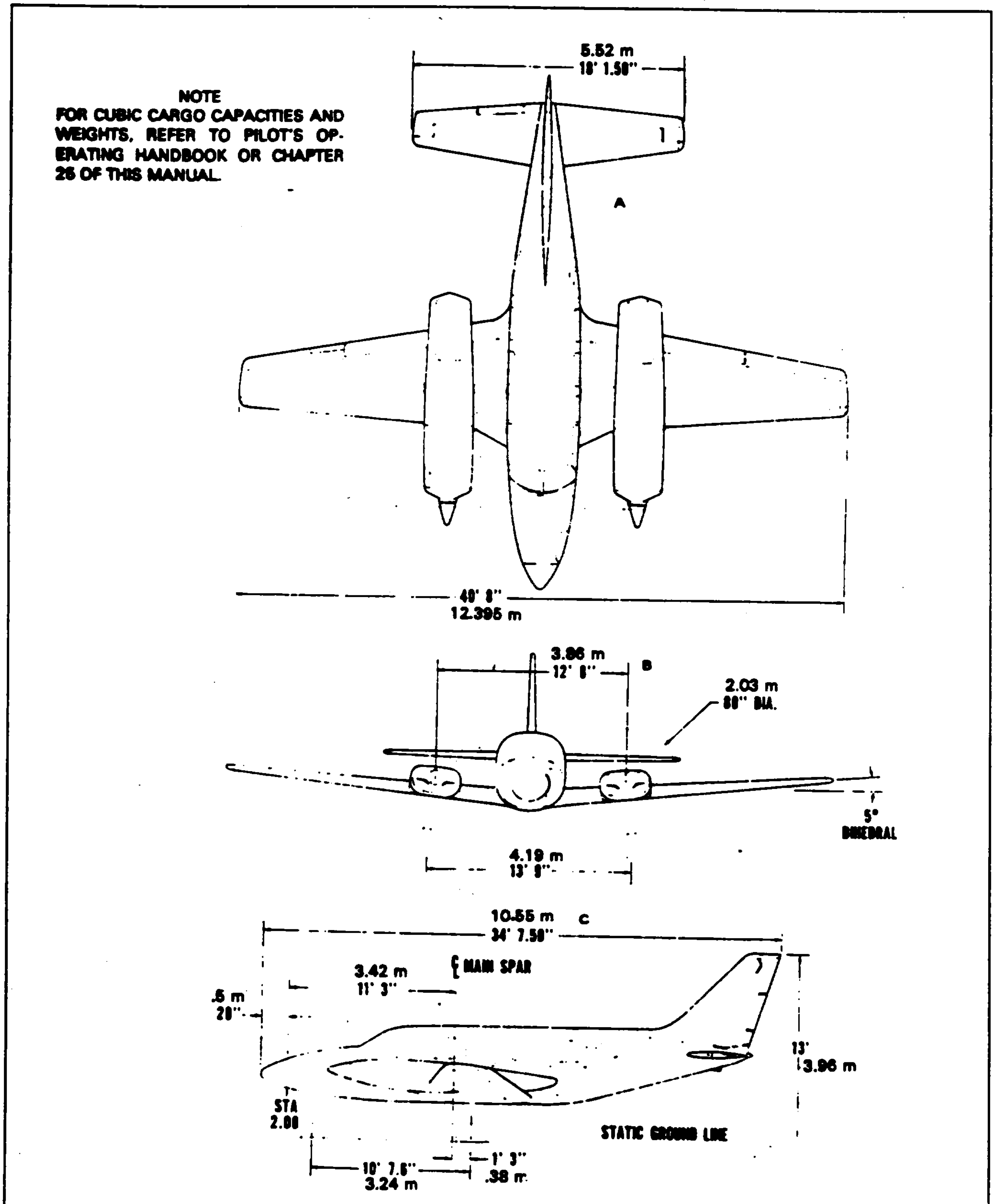


Figure 6-1. Dimensions

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	T-1020
ENGINE	
Manufacturer	Avco Lycoming
Model	T1O-540-J2B and LT1O-540-J2B
Rated Horsepower, RPM, Altitude:	350 - @ 2575 - 13,000 ft. 260 - @ 2400 - 20,000 ft. 210 - @ 2200 Refer to Pilot's Operating Manual
Oil, SAE Number	See Lubrication Chart
Oil Sump Capacity	12 qts.
Turbocharger, AiResearch	THO8A6Q
Fuel, Aviation Grade, Minimum Octane	100/ 130
Fuel Injector, Bendix	RSA-10ED1
Magnetos, Bendix	
Left Engine	S6LN 1209 and 1208
Right Engine	S6RN 1209 and 1208
Magneto Timing (Spark Advance)	20°
Magneto Point Clearance	
Main	0.016 ± 0.003
Retard and Tach	0.016 ± 0.006
Retard Angle	30°
Spark Plugs (Shielded):	
AC	HSR-87L1
Champion	RHB-36W
Spark Plug Gap Setting	Refer to latest Issue of Lycoming Service Instruction 1042
Firing Order-Left and Right Engine	1-4-5-2-3-6
Starter, Prestolite, 24 Volt	MHB-4001, MHB-4013, MHB-4014, MHB-4018
Alternator, Prestolite, 24 Volt, 70 Amp	ALU 8403 or ALU 8421, ALU 8421-LS
Voltage Regulator, Lamar	B-00286-1
Over Voltage Relay, Lamar	B-00266-1
Fuel Pump: Lear Siegler	RG9080-J4A or J7A
PROPELLER	
Manufacturer	Hartzell
Type	3 Blade, Constant Speed, Feathering
Hub	HC-E3YR-2ATF, HC-E3YR-2ALTF
Blade	FC8468-6R, FJC8468-6R
Diameter	80 in.
Governor Model	
Left	F-6-24Z or F-6-24
Right	F-6-24LZ or F-6-24L

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS (cont.)

MODEL	T-1020
FUEL CELL CAPACITIES	
Inboard (Main) Fuel Cells	Two
Capacity (each)	56 U.S. gal.
Unusable Fuel (each)	3 U.S. gal.
Outboard (Auxiliary) Fuel Cells (Optional)	Two
Capacity (each)	40 U.S. gal.
Unusable Fuel (each)	2 U.S. gal.
LANDING GEAR	
Type	Hydraulically retractable
Shock Strut Type	Combination air and oil
Fluid Required (Struts & Brakes)	MIL-H-5606
Strut Extension (Static load)	3.25 in.
Nose Wheel Travel	40° + 1° Right 40° + 1° Left
Main Wheel Toe-In	.5 degrees
Turning Radius (Min.) (Nose Wheel)	25 ft. 3 in.
Turning Radius (Min.) (Wing Tip)	49.6 ft.
Wheel, Nose	Cleveland
Wheel, Main	Cleveland
Brake Type	Cleveland
Tire, Nose	6:00 x 6 ply rating
Tire, Main	6:50 x 10, 8 ply rating
Tire Pressure, Nose	42 psi
Tire Pressure, Main	66 psi

STATION REFERENCE LINES. (Refer to Figure 6-2.)

In order to facilitate the location of various components of the airplane which require maintenance and servicing, a method utilizing fuselage station, wing station, buttock line, and waterline designations are frequently used in this manual. Fuselage stations, buttock lines (BL) and waterlines (WL) 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 AND INSPECTION PROVISIONS. (Refer to Figure 6-3.)

The access and inspection provisions for the airplane are shown in Figure 6-3. The components to be serviced or inspected through each opening is identified in the illustration by the use of an assigned index reference number. All access plates and panels are secured by either metal fasteners or screws.

—CAUTION—

Before entering the aft section of the fuselage, be sure the airplane is supported at the tail skid

The floor panels may be removed by first removing the desired seats, then removing the carpet, thus exposing the floor panel attachment screws. To enter the aft section of the fuselage, remove the rear baggage compartment upholstery panel.

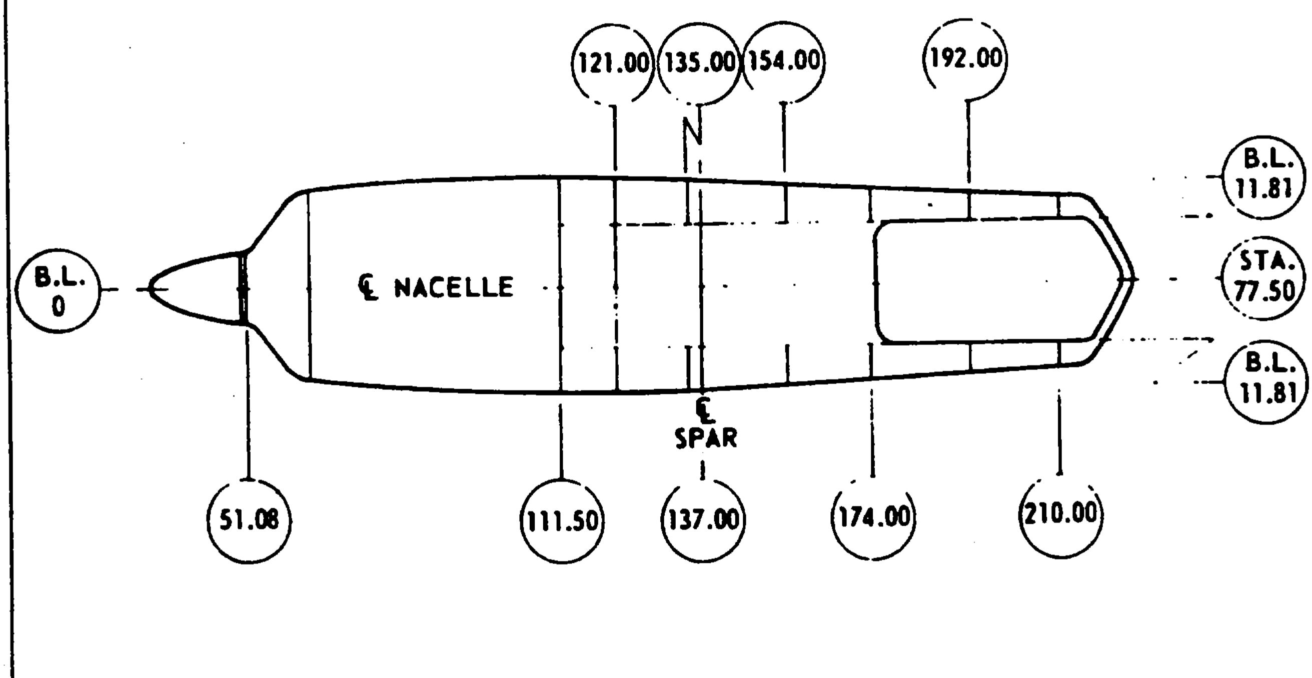


Figure 6-2. Station References

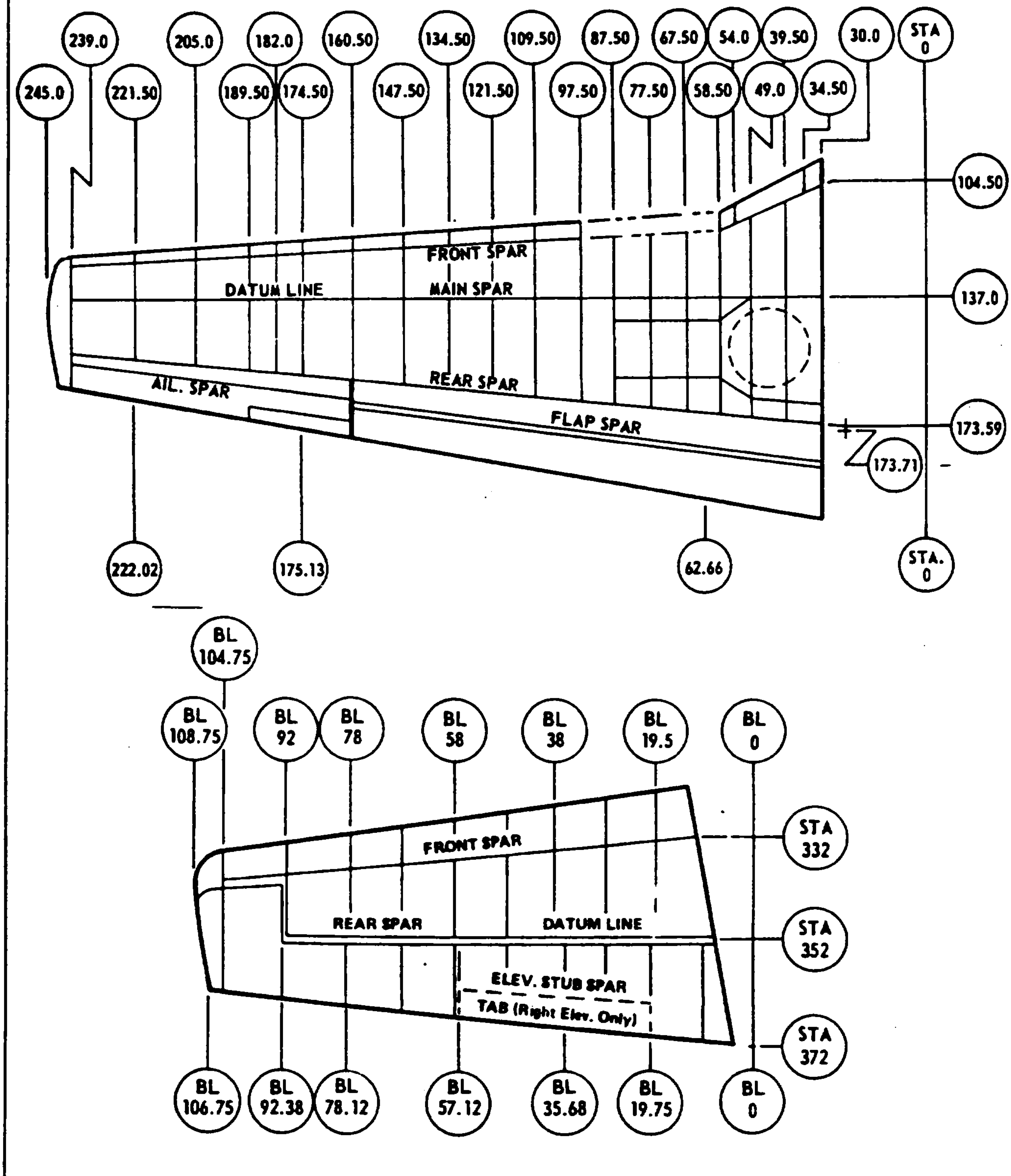


Figure 6-2. Station References (cont.)

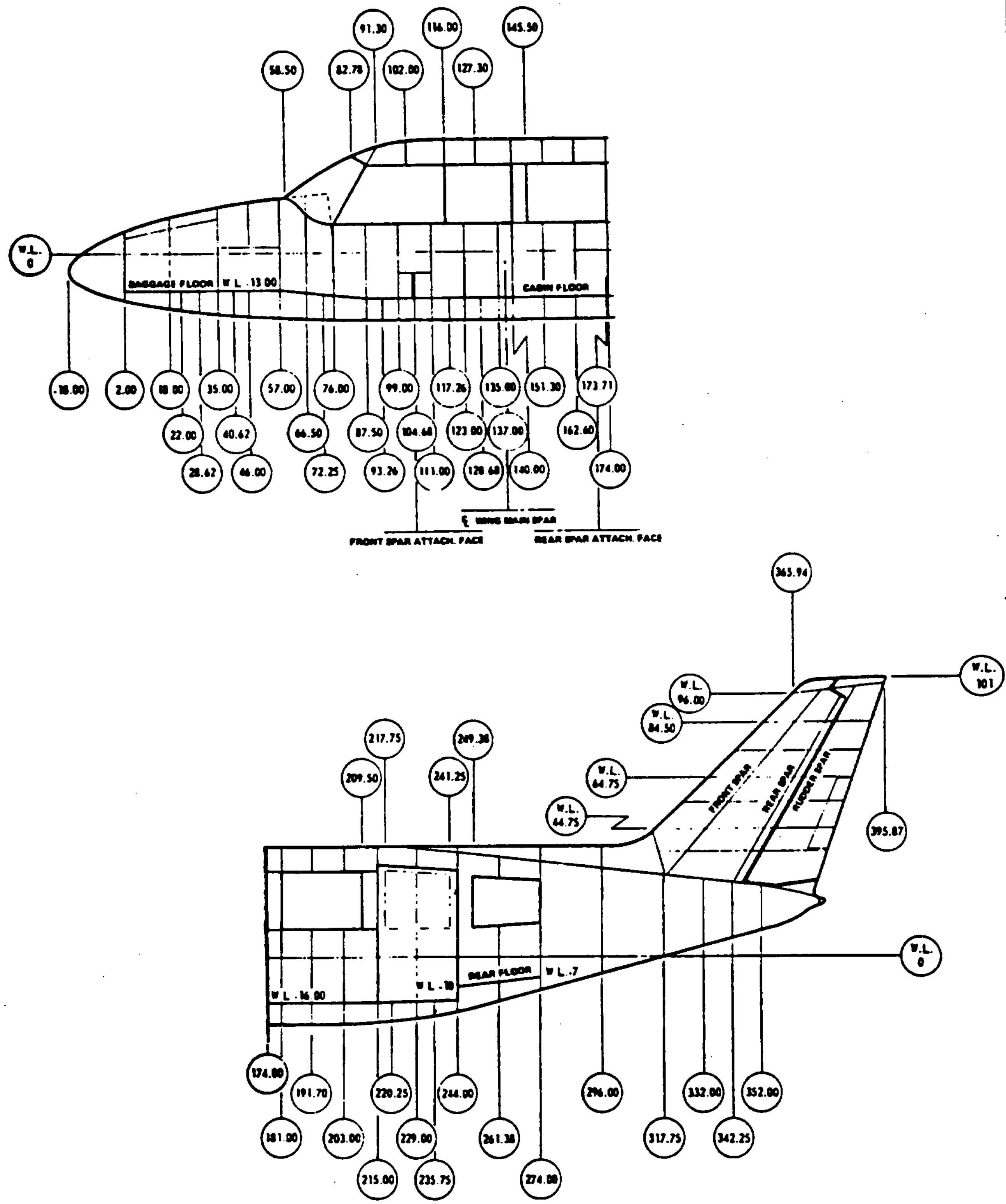
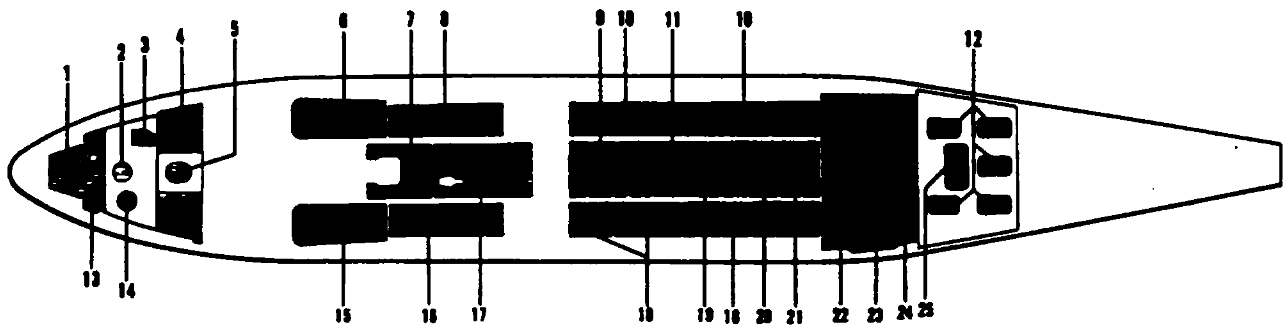
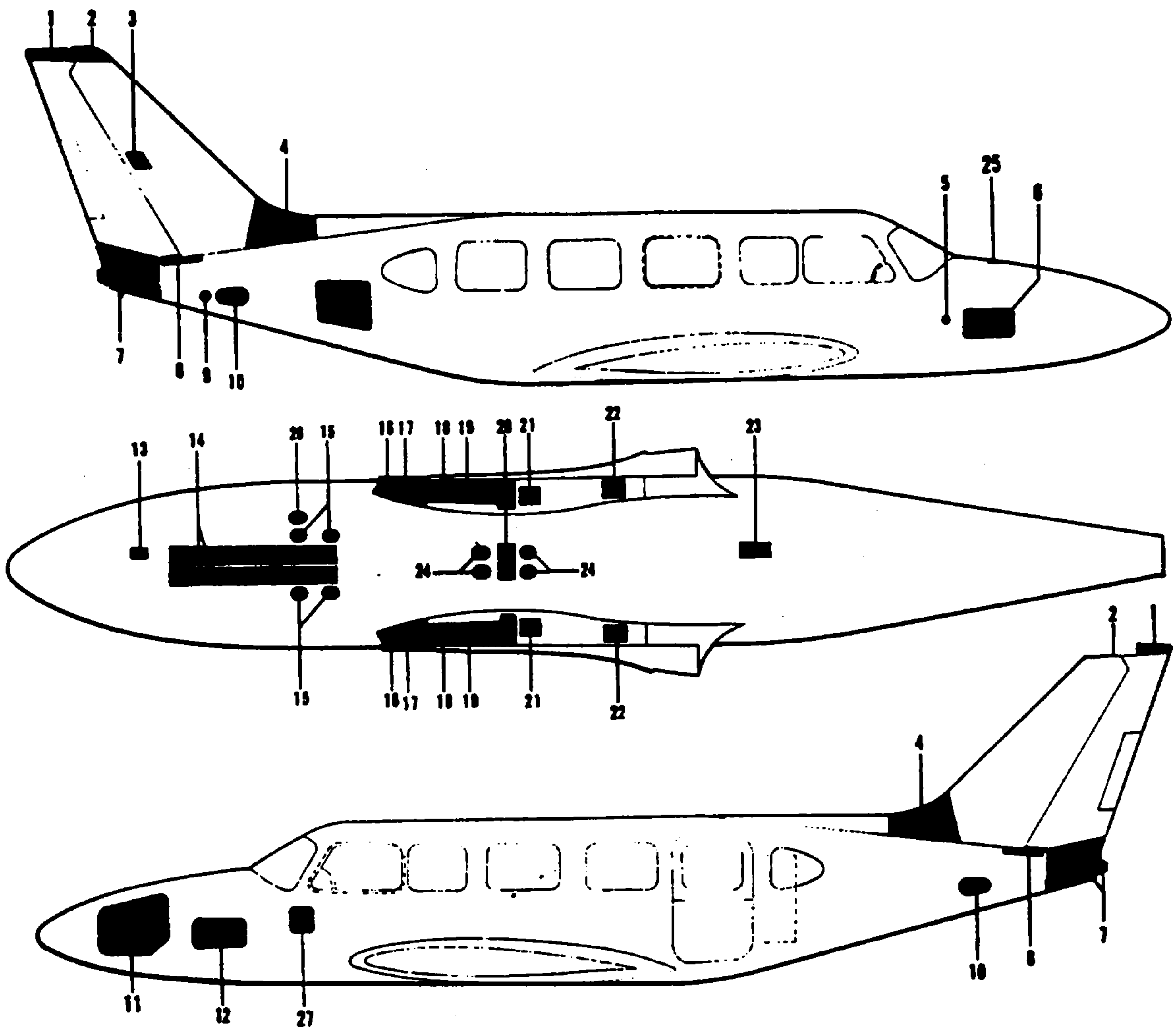


Figure 6-2. Station References (cont.)



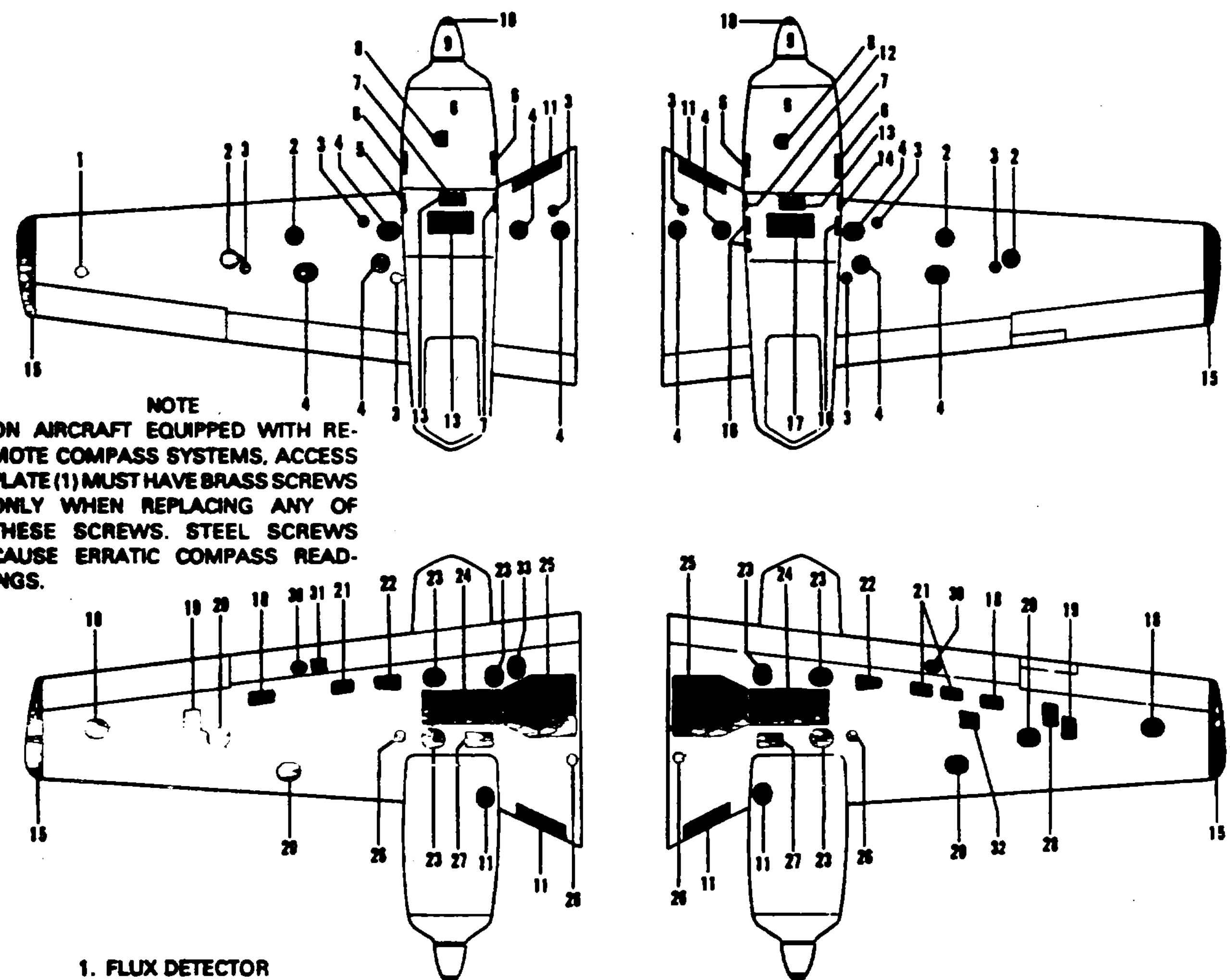
1. BATTERY DRAIN AND VENTS
2. PITOT ATTACHMENT LINES
3. CABIN AIR CONTROL
4. HEATER AIR INLET LINE
5. NOSE GEAR STEERING BELLCRANK
6. HYDRAULIC LINES
7. TRIM CONTROL CABLES AND PULLEYS
8. TRIM CABLES AND PULLEYS - ENGINE CONTROL LINES, WIRES AND CABLES
9. ROLL SERVO, IF INSTALLED
10. TRIM CABLES AND PULLEYS
11. FLAP MOTOR - AILERON BALANCE CABLE
12. CONTROL AND TRIM CABLES
13. BAGGAGE COMPARTMENT COVER PLATE
14. EXTERNAL POWER RECEPTACLE ATTACHMENTS
15. CONTROL CABLES, PULLEYS AND TURNBUCKLES
16. CONTROL CABLES, PULLEYS AND TURNBUCKLES - ENGINE CONTROL LINES, WIRES AND CABLES
17. HYDRAULIC HAND PUMP, PNEUMATIC BLOWDOWN
18. CONTROL CABLES AND PULLEYS
19. TRIM WARNING SYSTEM, IF INSTALLED
20. AUTOPILOT UNITS: ROLL, PITCH AND PITCH TRIM SERVOS, VOLTAGE DIVIDER, AND GYRO AMPLIFIER - CONTROL CABLES - WING FLAP MOTOR
21. PITCH SERVO, IF INSTALLED
22. CABIN EXHAUST DOOR MECHANISM
23. CONTROL AND TRIM CABLES AND PULLEYS - SEAT ATTACHMENTS
24. PITCH TRIM SENSOR, IF INSTALLED
25. GROUND VENT FAN

Figure 6-3. Access Plates and Panels



1. RUDDER TIP
2. VERTICAL STABILIZER TIP
3. RUDDER TRIM SCREW AND SENDER
4. ELT
5. RUDDER PEDAL TORQUE TUBE
6. HEATER - POWER PACK
7. ELEVATOR CONTROL ARM
8. RUDDER CONTROL HORN
9. ELEVATOR BUNGEE
10. ELEVATOR BELLCRANK
11. BATTERY - POWER PACK
12. VOLTAGE REGULATORS - FUSES - ELECTRONICS EQUIPMENT
13. EXTERNAL POWER RECEPTACLE
14. NOSE LANDING GEAR
15. HYDRAULIC LINES - ELECTRICAL LEADS
16. ELECTRICAL CONNECTORS - LINE CONNECTORS, FRONT SPAR ATTACHMENT
17. ELECTRICAL CONNECTORS - LINES
18. FUEL PUMP - FUEL FILTER - CROSSFEED VALVE - EMERGENCY SHUTOFF VALVE
19. FUEL FILTER BOWL
20. SPAR SPLICE - DEICER PRESSURE SWITCH
21. MAIN SPAR ATTACHMENT
22. REAR SPAR ATTACHMENT
23. CABIN EXHAUST
24. SPAR SPLICE
25. BRAKE RESERVOIR
26. PULLEY AND CABLE INSPECTION
27. CIRCUIT BREAKERS

Figure 6-3. Access Plates and Panels (cont.)



NOTE

ON AIRCRAFT EQUIPPED WITH REMOTE COMPASS SYSTEMS, ACCESS PLATE (1) MUST HAVE BRASS SCREWS ONLY WHEN REPLACING ANY OF THESE SCREWS. STEEL SCREWS CAUSE ERRATIC COMPASS READINGS.

1. FLUX DETECTOR
2. FUEL FILLER
3. FUEL SENDER UNIT
4. FUEL CELL
5. PRESSURE SYSTEM AIR FILTER - INSPECTION LIGHT - PULSE GENERATOR (IF PROP SYNCHROPHASER IS INSTALLED)
6. ENGINE
7. NACELLE INTERIOR - PRESSURE SYSTEM INLINE FILTER
8. OIL FILLER
9. PROPELLER
10. PROPELLER RECHARGE
11. LINES - WIRES - CABLES
12. NACELLE INTERIOR - CONDENSER AIR OUTLET PLATE (IF AIR CONDITIONING IS INSTALLED)
13. COWL FLAP TRANSMISSION
14. CONDENSER AIR OUTLET - PRESSURE SYSTEM AIR FILTER - STROBE SENSOR (IF PROP SYNCHROPHASER IS INSTALLED)
15. WING TIP
16. FREON CONDENSER, IF INSTALLED
17. COWL FLAP TRANSMISSION - PRESSURE SYSTEM RELIEF VALVE - PRESSURE SYSTEM INLINE FILTER - FREON CONDENSER (IF AIR CONDITIONING IS INSTALLED)
18. AILERON CABLE PULLEYS
19. AILERON BELLCRANK
20. FUEL CELL CHECK VALVE
21. AILERON CABLE FAIRLEADS
22. AILERON TRIM CABLES RIGHT WING ONLY, RUB BLOCKS AND FLAP TRANSMISSION
23. LANDING GEAR ATTACHMENTS
24. MAIN LANDING GEAR
25. GEAR DOOR ACTIVATING CYLINDER
26. FUEL CELL DRAIN
27. LANDING GEAR SIDE BRACE ATTACHMENTS
28. AILERON TRIM SCREW AND SENDER
29. ELEVATOR TRIM SCREW AND SENDER
30. FLAP POSITION SENDER
31. WING FLAP TRANSMISSION
32. AILERON TRIM CABLES AND RUB BLOCKS
33. ROLL SERVO

Figure 6-3. Access Plates and Panels (cont.)

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CHAPTER

7

LIFTING AND SHORING

CHAPTER 7- LIFTING AND SHORING

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CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
7-00-00	GENERAL	1E15	
7-10-00	JACKING	1E15	2R 11-83

GENERAL.

JACKING. (Refer to Figure 7-1.)

The airplane is provided with a jacking pad on each main spar just outboard of the engine nacelle and two support positions under the fuselage. One at the tail skid and the other between fuselage stations 1.75 and 19.35, both along the fuselage centerline. To jack the airplane, proceed as follows:

1. Place the wing jacks under the wing jack pads.
2. Position the tail support stand under the tail skid and attach the stand to the tail skid.
3. Position the nose jack and jack pad tool P /N 71973-2 under the nose section between stations 1.75 and 19.35.
4. Raise all jacks evenly until all three wheels clear the floor.

—CAUTION—

If the nose jack and jack pad tool are not used be sure to apply sufficient tail support ballast; otherwise the airplane could tip forward and fall on the nose section.

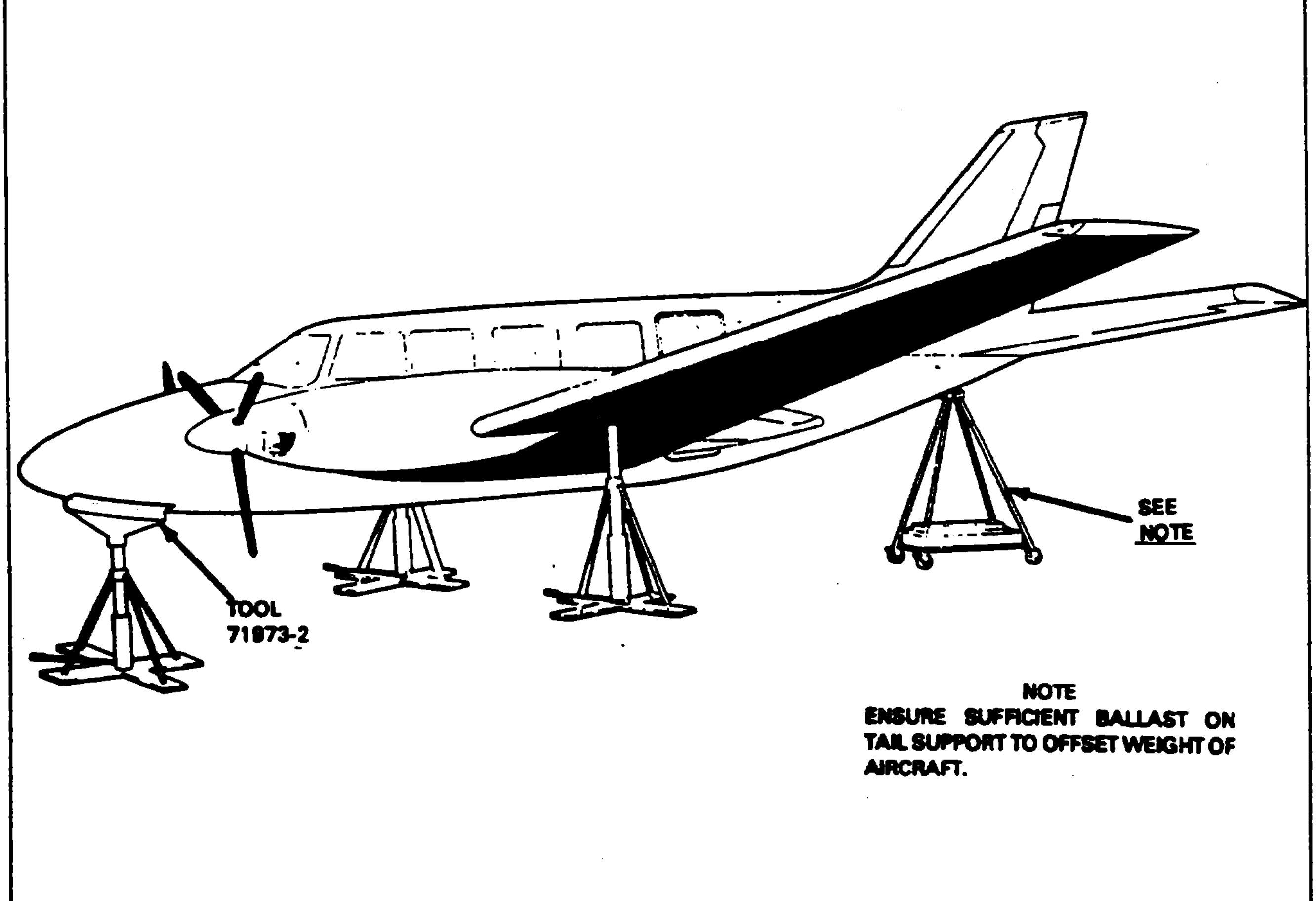

Figure 7-1. Jacking Arrangement

CHAPTER

8

LEVELING AND WEIGHING

CHAPTER 8 - LEVELING AND WEIGHING

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CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
8-00-00	GENERAL	1E18	
8-10-00	LEVELING	1E18	
8-20-00	WEIGHT AND BALANCE DATA	1E19	
8-20-01	Weighing	1E19	
8-20-02	Preparation For Weighing	1E19	
8-20-03	Weighing The Aircraft	1E20	

GENERAL.

LEVELING. (Refer to Figure 8-1.)

All configurations of the airplane are provided with a means for longitudinal and lateral leveling. The airplane 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 on the right side of the fuselage nose section at station 57.00 and 35.00. Place a spirit level on these screw heads and deflate the nose wheel tire or adjust the jacks until the bubble of the level is centered.
2. To laterally level the airplane, place a spirit level across the two center seat rails of the cabin and deflate the tire on the high side of the airplane or adjust either jack until the bubble of the level is centered.

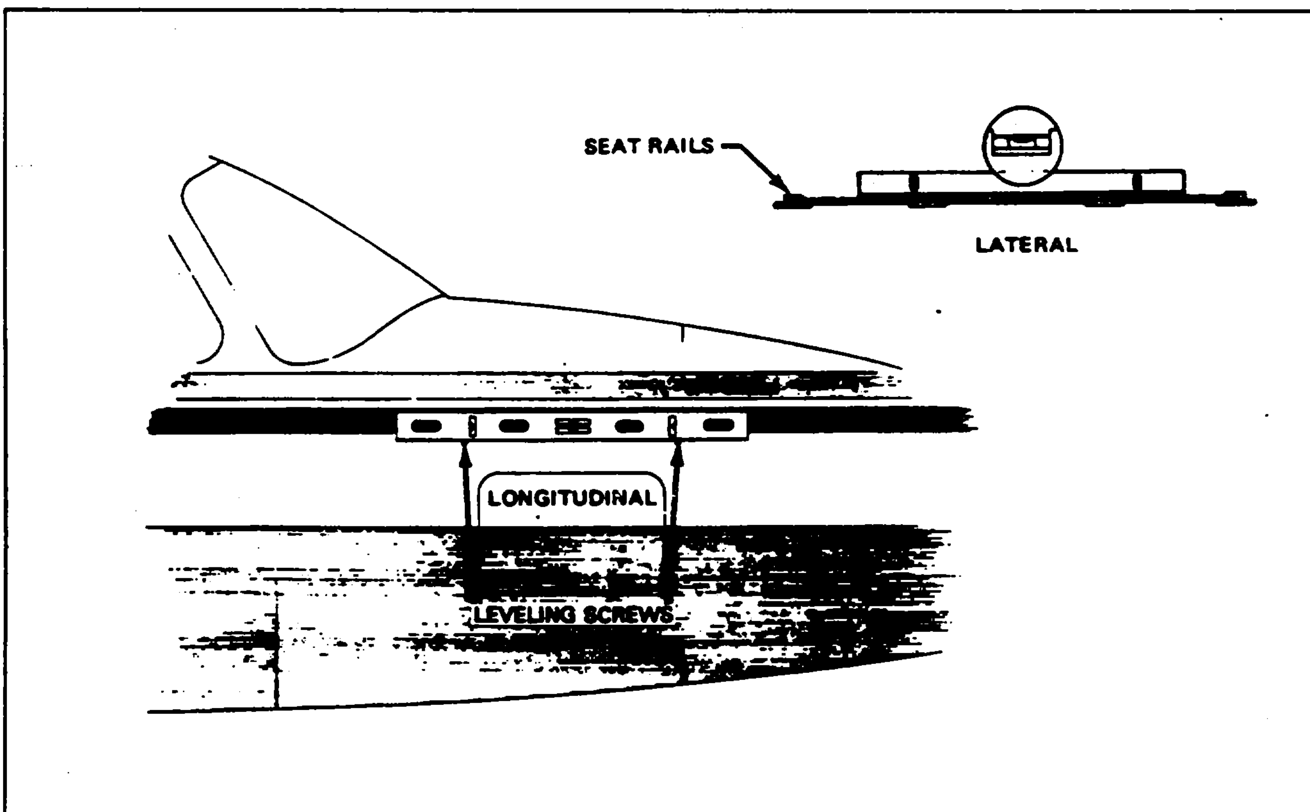

Figure 8-1. Leveling

WEIGHT AND BALANCE DATA.

When figuring various weight and balance computations the weight and empty weight center of gravity of the airplane may be found in the Weight and Balance section of the Pilot's Operating Handbook.

WEIGHING. (Refer to Figure 8-2.)

The airplane is normally weighed with undrainable fuel, full engine oil, full hydraulic fluid, flaps up and landing gear down. A scale of 3,000 lbs. minimum capacity is required under each main gear wheel, and a scale of 1,000 lbs. minimum capacity is required under the nose wheel. The airplane must be clean and all items listed on the Aircraft Installed Equipment List must be installed in the airplane.

The airplane may also be weighed with full fuel tanks, but it is not recommended, and care must be taken to verify all fuel tanks are "exactly full" and not partially under or over full (fuel topped off to bottom of filler neck with airplane in level attitude). See Chapter 12 for fuel capacities.

Temperature will have an effect when weighing the airplane (especially if fuel tanks are full) and therefore will affect the balance. The airplane and scales should be allowed approximately two hours to stabilize prior to performing the weighing operation.

PREPARATION FOR WEIGHING.

1. Clean airplane.
2. Inventory airplane to insure Equipment List accurately reflects what is installed in the airplane. All items specified must be installed.
3. Drain fuel per Chapter 12 if weighing empty.
4. Place airplane and scales in hangar on level surface and allow two hours for temperature stabilization.

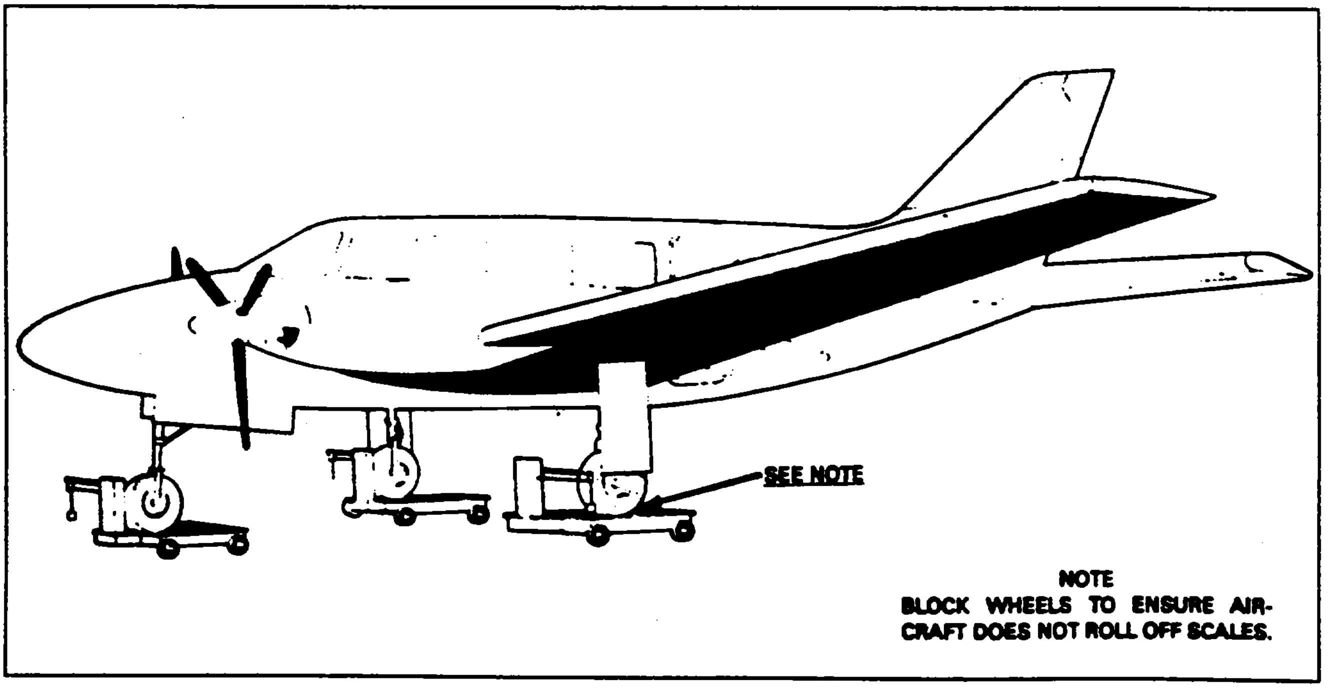

Figure 8-2. Weighing

WEIGHING THE AIRCRAFT.

1. Place a 3,000 lbs. minimum scale and a ramp in front of each main landing gear and a 1,000 lbs. minimum scale and ramp under the nose landing gear.
2. Secure the scales from rolling forward and tow the airplane up onto the scales. Remove the ramp so as not to interfere with the scales.
3. Chock forward and aft sides of all three wheels.

—WARNING—

If wheels are not blocked, the airplane could roll off scales and cause serious injury and damage.

4. Release emergency brake.
5. If the airplane is to be weighed for weight and balance computations, level the airplane per instructions given in the paragraph titled "Leveling."
6. Record weights on Weight and Balance Report. Insure "TARE" weight (weight of chocks, blocks or other weighing aids) is also entered to obtain NET weight.

—NOTE—

Refer to P. O. H. for Weight and Balance Determination for flight information.

—END—

CHAPTER

9

TOWING AND TAXIING

CHAPTER 9 - TOWING AND TAXIING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
9-00-00	GENERAL	1E23	
9-10-00	TOWING	1E24	
9-20-00	TAXIING	1E24	

GENERAL.

Before attempting to tow or taxi the airplane, ground personnel should be checked out by a qualified pilot or other responsible person on the tow turning limits of the nose gear, engine starting and shutdown procedures and any other system functions which may be required to properly and safely move the airplane. (Refer to Figure 9-1.)

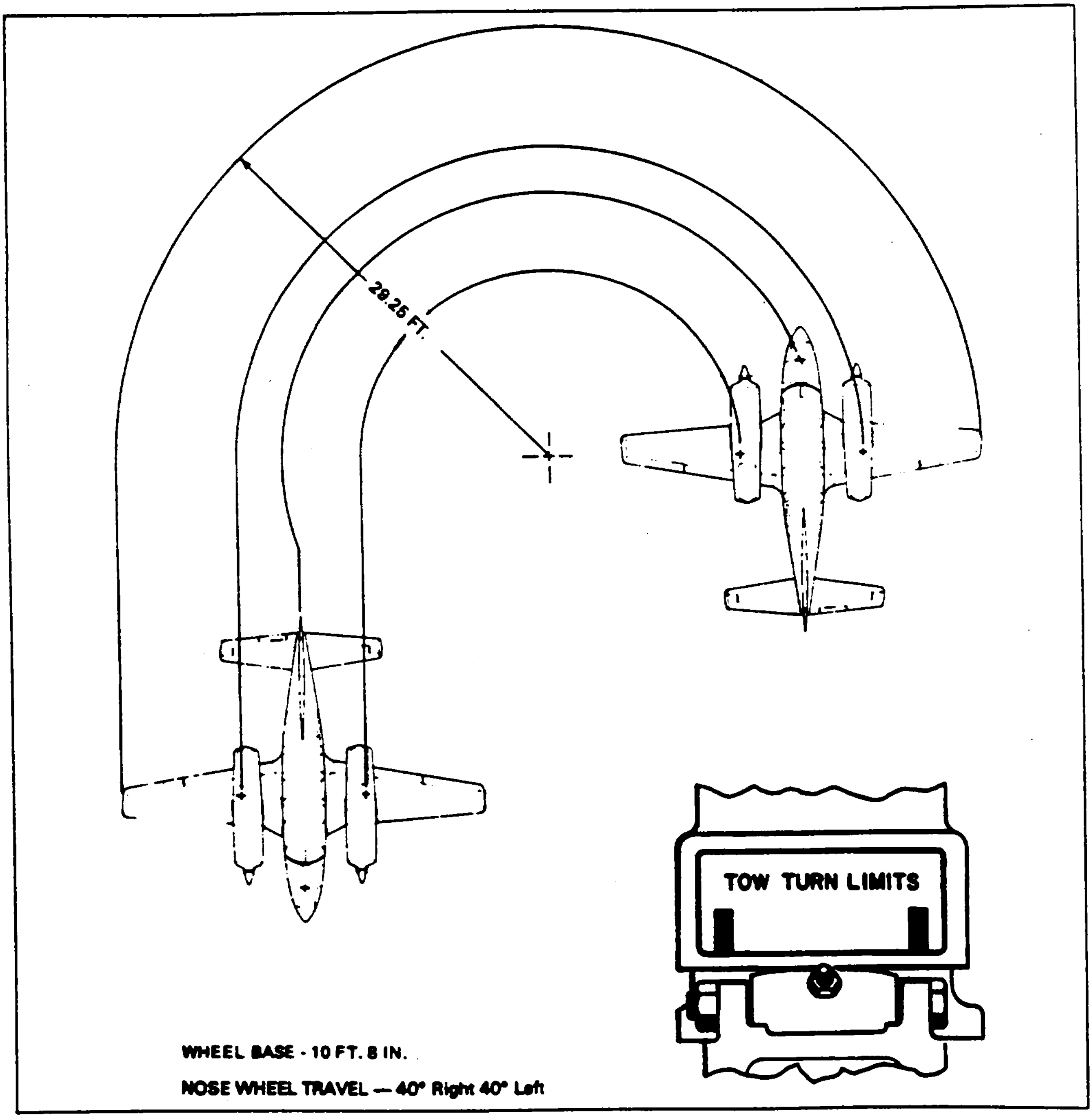

Figure 9-1. Turning Radius and Limits

TOWING.

The airplane may be moved by using the nose wheel steering bar that is stowed on the aft wall of the nose baggage compartment or power 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.

To pull the airplane on a hard level surface, it will require approximately 100 pounds pull to start its roll and approximately 60 pounds to maintain roll.

—CAUTION—

When towing, do not turn the nose gear in either direction beyond its 20 degree arc from center as this will result in damage to the nose gear and steering mechanism. A placard is installed on the nose gear strut to indicate turn limits. (Refer to Figure 9-1.) Also do not tow airplane with control locks installed.

In the event towing lines are necessary, lines (rope) will be attached to both main gear struts just below the side brace link attachments. Ascertain that cowl flap doors are closed. Lines should be long enough to clear the nose and/or tail by not less than 15 feet, and a qualified person to ride in the pilot's seat to maintain control by use of the brakes and nose wheel steering.

A collapsible towbar is located in the nose baggage compartment fastened to the rear bulkhead. The towbar is removed by pulling it from the friction retainers.

TAXIING.

When it is certain that the propeller back blast and taxi areas are clear, start the engines. Apply power slowly to start the taxi roll and perform the following checks:

1. Taxi forward a few feet and apply brakes to determine their effectiveness.
2. Taxi with propellers set in low pitch, high RPM setting.
3. While taxiing, make slight turns to determine the effectiveness of the steering.
4. Observe wing clearance when taxiing near buildings or other stationary objects. If possible, station guides at each wing tip to observe.
5. When taxiing on uneven ground avoid any holes and ruts.
6. Do not operate the engines at high RPM when running or taxiing over ground that has loose stones, gravel or any other loose material that may cause damage to the propeller blades.

—END—

CHAPTER

10

PARKING AND MOORING

CHAPTER -10 - PARKING AND MOORING

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CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
10-00-00	GENERAL	1F3	
10-10-00	PARKING	1F3	
10-20-00	MOORING	1F3	

GENERAL.

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 in accordance with sub-system section on Mooring.

1. When parking the airplane, head it into the wind if possible.
2. Set the parking brake by applying toe pressure against the top of the rudder pedals and at the same time pull out on the brake handle. To release the parking brake, apply toe pressure on the pedals and push in on the parking brake handle.

—NOTE—

Care should be taken when setting brakes that are very hot or during cold weather, when accumulated moisture may freeze the brakes. Prior to setting the brakes, if either of the above conditions exist, it is recommended that chocks be used to block the wheels rather than setting brakes.

3. Insert the internal control lock.

MOORING.

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

1. Head the airplane into the wind, if possible and close engine cowl flaps.
2. Block the wheels with wheel chocks.
3. Insert the internal control lock and/or control surface locks.
4. Secure tie-down ropes to the wing tie-down rings and the tail skid at approximately 45 degree angles to the ground. When using rope constructed of non-synthetic material, leave sufficient slack to avoid damage to the aircraft when the ropes contract due to moisture.

—CAUTION—

Use square or bowline knots. Do not use slip knots.

—NOTE—

Additional preparations for high winds include using tie-down ropes from the landing gear forks, and securing the rudder.

5. Install pitot tube cover(s) if available.

—END—

CHAPTER

11

REQUIRED PLACARDS

CHAPTER 11- REQUIRED PLACARDS

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11-20-00	PLACARDS AND MARKINGS	1F6	

PLACARDS AND MARKINGS.

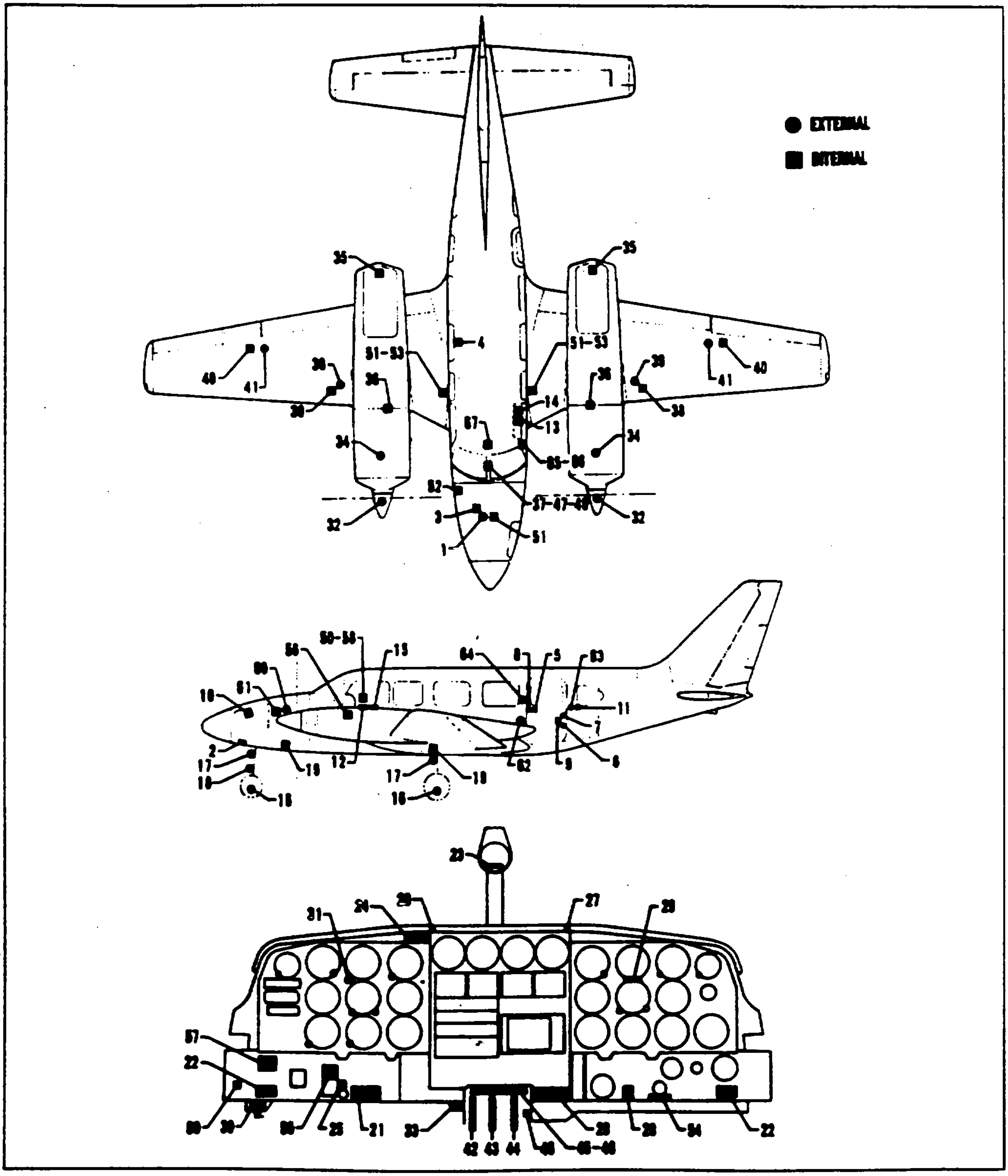

Figure 11-1. Placards and Decals

1. PLACARD - BRAKE RESERVOIR (INTERNAL)
   DECAL - BRAKE RESERVOIR (EXTERNAL)
2. PLACARD - STARTING PROCEDURE, EXTERNAL POWER
3. PLACARD - HYDRAULIC LINE ROUTING
4. PLACARD - EMERGENCY EXIT
5. DECAL - "OPEN-LOCK"
6. DECAL - "PULL HERE"
7. DECAL - "PRESS HERE"
8. DECAL - "DOOR-OPEN"
9. PLACARD - DOOR HANDLE LATCH
10. PLACARD - BAGGAGE CAPACITY
11. PLACARD - CARGO LOADING
12. PLACARD - ARMREST STOWAGE
13. PLACARD - PILOT DOOR (OPEN-CLOSED)
14. PLACARD - PILOT DOOR (THEFT LOCK)
15. PLACARD - LATCH
16. PLACARD - TIRE INFLATION, MAIN
    PLACARD - TIRE INFLATION, NOSE
17. PLACARD - OLEO SERVICE INSTRUCTIONS ,MAIN
    PLACARD - OLEO SERVICE INSTRUCTIONS, NOSE
18. PLACARD - TOW TURN LIMITS
19. DECAL - TEST PORT (EMERGENCY GEAR EXTENSION)
20. PLACARD - ALTERNATE AIR CONTROLS
21. PLACARD - PARKING BRAKE
22. PLACARD - MIKE AND PHONE JACKS
23. PLACARD - HEATED WINDSHIELD
24. PLACARD - SPEED CONTROL, KNOTS
25. PLACARD - CIGAR LIGHTER
26. PLACARD - ANNUNCIATOR TEST
27. PLACARD - ANNUNCIATOR HI/LOW
28. PLACARD - FLAP TEST
29. PLACARD - "PULL TO ERECT"
30. PLACARD - ALTERNATE STATIC SOURCE
31. PLACARD - PREFLIGHT TEST
32. DECAL - PROPELLER, PRESSURE TEMPERATURE
33. PLACARD - PROPELLER SYNCHROPHASER CONTROL
34. PLACARD - LUBRICATION
    PLACARD - OIL CAPACITY (12 QT.)
35. PLACARD - NACELLE LOCKER BAGGAGE
36. PLACARD - FUEL PRESSURE
    PLACARD - FUEL FLOW PRESSURE
    PLACARD - INSTRUMENT AIR DECK PRESSURE
    PLACARD - FUEL PRESSURE
37. PLACARD ASSEMBLY - FUEL CONTROL
38. PLACARD - FUEL VENT CHECK VALVE, LEFT
    PLACARD - FUEL VENT CHECK VALVE, RIGHT
39. DECAL - FUEL CELL QUANTITY, MAIN
40. PLACARD - FUEL VENT CHECK VALVE, AUXILIARY, LEFT
    PLACARD - FUEL VENT CHECK VALVE, AUXILIARY, RIGHT
41. DECAL - FUEL CELL CAPACITY, AUXILIARY
42. PLACARD - THROTTLE CONTROL
43. PLACARD - PROPELLER CONTROL
44. PLACARD - MIXTURE CONTROL
45. PROPELLER - THROTTLE QUADRANT
46. PLACARD - QUADRANT WARNING
47. PLACARD - COWL FLAP
    PLACARD - TRIM CONTROL, LATERAL
    PLACARD - TRIM CONTROL, LONGITUDINAL
    PLACARD - TRIM CONTROL, DIRECTIONAL
48. PLACARD - AIR CONDITIONING
49. PLACARD - YAW
    PLACARD - ROLL
50. PLACARD - "MIKE A/P OFF"
    PLACARD - "MIKE"
    PLACARD - "DOWN-UP", TRIM CONTROL
51. PLACARD - HYDRAULIC GEAR DOWN
    PLACARD - HYDRAULIC GEAR UP
    PLACARD - HYDRAULIC PRESSURE
    PLACARD - HYDRAULIC SUCTION
52. PLACARD - HYDRAULIC SYSTEM FILL PORTS
53. PLACARD - HYDRAULIC DOOR OPEN
    PLACARD - HYDRAULIC DOOR CLOSE
54. PLACARD - CABIN EXHAUST
55. PLACARD - WINDSHIELD WIPER SWITCH, KNOTS
56. PLACARD - STROBE LIGHTS
57. PLACARD - E.L.T. WARNING
58. PLACARD - CONTROL WHEEL
59. PLACARD - ACCELEROMETER TEST SWITCH
60. DECAL - ACCESS PANEL
61. PLACARD - ACCESS PANEL
62. DECAL - "PIPER AIRE"
63. PLACARD - "RADAR EQUIPPED"
64. DECAL - PIPER LOGO
65. PLACARD - EMERGENCY AVIONICS BUS
66. PLACARD - MASTER SWITCH
67. PLACARD - EMERGENCY GEAR EXTENSION ACCESS
    PLACARD - EMERGENCY GEAR EXTENSION INSTRUCTIONS

Figure 11-1. Placards and Decals (cont.)

CHAPTER

12

SERVICING

CHAPTER 12-SERVICING

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12-10-02	Filling Fuel Cells	1F11	
12-10-03	Draining Moisture From Fuel System	1F11	
12-10-04	Draining Fuel System	1F11	
12-10-05	Brake System	1F13	
12-10-06	Filling Brake System Reservoir	1F13	
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12-10-18	Propellers	1F17	
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12-20-12	Oxygen System	1G6	
12-20-13	Oxygen System Safety Precautions	1G6	
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GENERAL.

This chapter will cover all routine servicing of the airplane, scheduled and non-scheduled, such as replenishment of fuel, oil, hydraulic fluid, oxygen, tire pressure and lubrication requirements. The servicing of oleo struts with air and/or oil and many other items required to completely service the airplane. Special attention should be given to any CAUTION included with the particular items discussed.

REPLENISHING.

FUEL SYSTEM.

At intervals of 50 hours or 90 days, whichever comes first, clean the screens and bowl in each fuel filter unit located between each wing and the fuselage. Remove and clean the filters in accordance with the instructions outlined in Chapter 28. Additional service information may also be found in Chapter 28. Inspection intervals of the various fuel system components may be found in Chapter 5.

FILLING FUEL CELLS.

The fuel cells of each wing are filled through filler necks located on the forward slope of the wings, outboard of the engine nacelles.

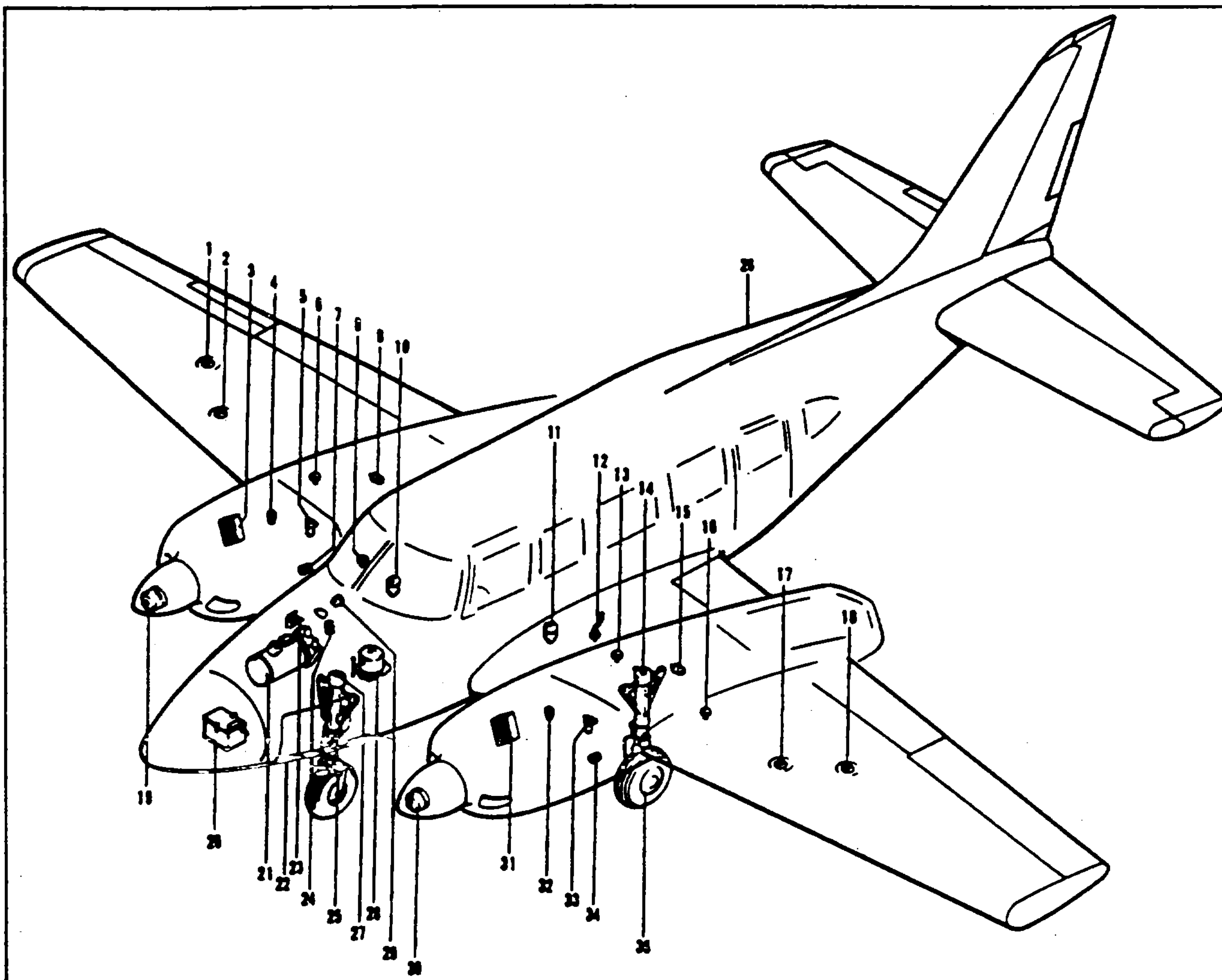
DRAINING MOISTURE FROM FUEL SYSTEM.

To facilitate draining the fuel system filter bowls, lines and fuel cells of moisture and foreign matter, drains are incorporated in the bottom of each filter bowl, in the system crossfeed line and the inboard end of each fuel cell.

1. To flush either filter bowl, open the access door located on the panel between the underside of the wing and fuselage. Push up on the arms of the drain valve for a few seconds with the fuel selector valve on one cell, then change the selector valve to the other cell and repeat the process. Allow enough fuel to flow each time to clear the fuel line as well as the fuel filter bowl. The same procedure will apply to the cells of the opposite side.
2. To flush the crossfeed line, open the crossfeed valve and push up on the arms of the drain valve for a few seconds. The drain valve is located on the left panel of the filter bowl access door.
3. To flush the fuel cells, push up on the arms of each cell drain and allow to flow for a few seconds.

DRAINING FUEL SYSTEM.

The bulk of the fuel may be drained from the system by opening the valve at the inboard end of each fuel cell. Push up on the arm of the drain valve and turn counterclockwise to hold the drain in the open position. The remaining fuel in the system may be drained through each filter bowl. Any individual cell or compartment may be drained by closing the selector and crossfeed valves and then draining the desired component.



1. FILLER, OUTBOARD FUEL CELL, RIGHT (IF INSTALLED)
2. FILLER, INBOARD FUEL CELL, RIGHT
3. FILTER, INDUCTION, RIGHT ENGINE
4. OIL FILLER, RIGHT ENGINE
5. FILTER, HYDRAULIC, RIGHT
6. FUEL DRAIN, RIGHT OUTBOARD (IF INSTALLED)
7. FILTER, PRESSURE PUMP INLET
8. FUEL DRAIN, RIGHT INBOARD
9. FILTER, PRESSURE LINE, RIGHT
10. FUEL FILTER, RIGHT
11. FUEL FILTER, LEFT
12. CROSSFEED DRAIN
13. FUEL DRAIN, LEFT INBOARD
14. FILLER, OLEO SHOCK STRUT, L AND R
15. FILTER, PRESSURE LINE, LEFT
16. FUEL DRAIN, LEFT OUTBOARD (IF INSTALLED)
17. FILLER, INBOARD FUEL CELL, LEFT
18. FILLER, OUTBOARD FUEL CELL, LEFT (IF INSTALLED)
19. AIR VALVE, RIGHT PROPELLER
20. BATTERY
21. HEATER
22. EXTERNAL POWER SUPPLY
23. POWER PACK FILL FITTINGS
24. RESERVOIR, BRAKE SYSTEM
25. TIRE, NOSE
26. FILLER, OXYGEN
27. FILLER, OLEO SHOCK STRUT, NOSE
28. RESERVOIR, POWER PACK
29. GAUGE, OXYGEN PRESSURE
30. AIR VALVE, LEFT PROPELLER
31. FILTER, INDUCTION, LEFT ENGINE
32. OIL FILLER, LEFT ENGINE
33. FILTER, HYDRAULIC, LEFT
34. FILTER, PRESSURE PUMP INLET
35. TIRE, MAIN L AND R

Figure 12-1. Service Points

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 master 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 or air is in the system. When it's found necessary to accomplish repairs to any of the brake system components or bleed the system, refer to the instructions given in Chapter 32.

FILLING BRAKE SYSTEM RESERVOIR.

The brake system reservoir should be filled to the level marked on the dipstick with MIL-H-5606 hydraulic fluid. The reservoir, located in the upper nose section above the power pack, should be checked every 100 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.

The reservoir scupper should be sealed per the following procedure:

1. Gain access to the brake reservoir scupper, open the nose baggage door, remove the tow bar and screened radio access panel.
2. Clean surface around scupper and adjacent aircraft skin with a suitable solvent to remove any foreign matter.
3. Apply a bead of sealant (3M EC 750 or equivalent) around the scupper. Particular attention should be paid to sealing the forward edge of the scupper at the hinge attaching point.
4. Install the removed items and make the appropriate logbook entry.

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 hose in a suitable container. Open the bleeder valve and slowly pump the brake pedal until fluid ceases to flow. To clean the system, flush with denatured alcohol.

SERVICING LANDING GEAR.

The operation of the landing gear oleo's is standard for the air-oil type. The piston tube has a total travel of 8.50 inches, and 3.25 inches of tube exposed under normal static load. (Normal static load is the empty weight of the airplane plus full fuel and oil.) All major attachments and actuating bearings are equipped with grease fittings for lubrication. (Refer to Lubrication Chart.)

LANDING GEAR OLEO STRUTS.

Air-oil shock struts are incorporated in each landing gear oleo assembly to absorb the shock resulting from the impact of the wheels on the runway during landing. To obtain proper oleo action, the nose and main gear oleo struts must have approximately 3.25 inches of piston tube exposed, with the airplane setting on a level surface, under normal static loads.

—NOTE—

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

If a strut has less than the required inches exposed, determine whether it needs air or oil by rocking the airplane. If the airplane settles to its normal position within one cycle after the rocking force is removed, the oleo strut requires inflating (air). If the airplane continues to oscillate after the rocking force is removed, the oleo strut requires filling (oil).

—WARNING—

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

—NOTE—

Struts may be serviced and adjusted per placard on strut.

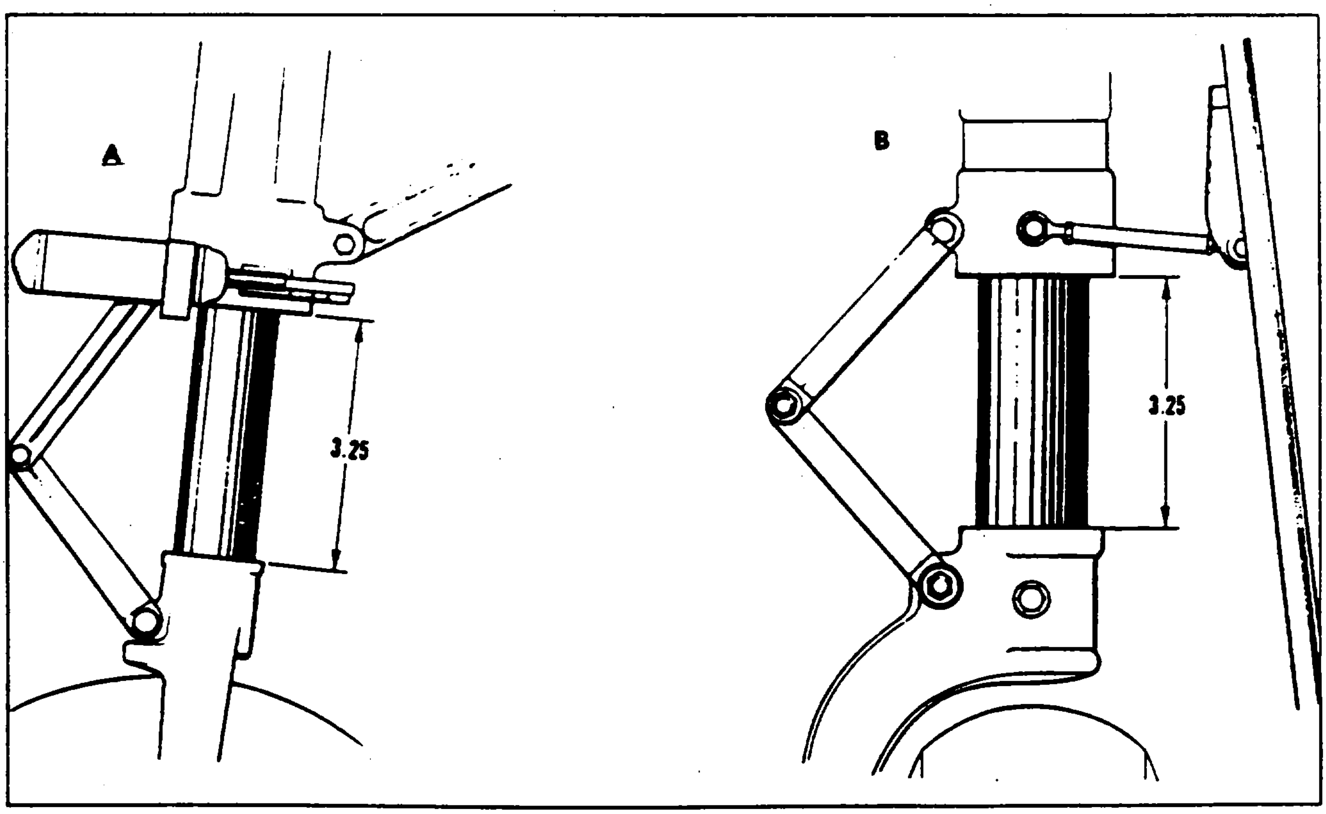


Figure 12-2. Landing Gear Strut Exposure

ADDING FLUID TO STRUTS.

To add fluid to an oleo strut which is partly full, proceed as follows:

1. Place the airplane on jacks. (Refer to Chapter 7.)
2. Place a pan under the gear to catch spillage.
3. Release the air in the oleo strut by pressing in on the air valve core pin.
4. Remove the air valve (filler plug). Allow valve core to remain in valve (filler plug).
5. Compress the strut to two inches from the fully compressed position.
6. At the two inch extended position, fill the strut through the filler opening with MIL-H-5606 fluid.
7. Slowly compress the strut to the fully compressed position allowing fluid to overflow.
8. With oleo strut in the compressed position, reinstall air valve and safety.
9. Inflate the oleo struts with air to the required pressure.
10. Remove the airplane from the jacks.

FILLING OLEO STRUTS.

To fill an oleo strut which has been completely emptied because of repair leakage, etc., proceed as follows:

1. Place the airplane on jacks. (Refer to Chapter 7.)
2. Place a pan under the gear to catch spillage.
3. Remove valve core from air valve.
4. Attach a clear plastic tube to the valve stem and place the other end of the tube in a container of hydraulic fluid as specified.

—NOTE—

An air-tight connection is necessary between the plastic tube and 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 a prolonged filling operation.

5. Extend the oleo strut by pulling down on the wheel. Fluid will be sucked into the oleo strut. Compress and extend the oleo strut until it is full of fluid, and air bubbles cease to appear in the plastic tube.
6. Compress the oleo strut to within 1/4 inch of full compression, allowing the excess fluid to overflow.
7. With the oleo strut in the near compressed position, reinstall the valve core.
8. Inflate the oleo struts in accordance with information in Figure 12-2.
9. Remove the airplane from the jacks.

INFLATING OLEO STRUTS.

With the aircraft on the ground and making certain that the oleo strut has sufficient fluid as described in Landing Gear Oleo Struts, attach a strut pump to the air valve and pump up the oleo strut. The oleo struts should be inflated until 3.25 inches of piston is exposed with normal static weight (normal static weight is the empty weight of the airplane plus full fuel and oil) on the gears. Before capping the valve, check for valve core leakage.

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.

TIRE BALANCING. (Refer to Chapter 95 for Tire Balancer Building information.)

Proper balancing is critical for the life of the 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 fabrication instructions.) 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 on 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 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.

APPLICATION OF TIRE RUBBER PROTECTIVE AGENT.

To prevent tire sidewall cracking due to rubber deterioration as the result of ozone attack and weathering it is permissible to apply Age-Master #1 Rubber Protective Agent to the tires as follows:

1. Clean all of tire surfaces of any oil or grease.
2. First apply a single heavy coat using a brush at a rate of 0.4 to 0.5 fluid ounces per sq. foot. Cover surface completely and evenly. Repeat application. Allow to dry for 5 to 10 minutes.
3. Second coat. Apply per Step 2. Allow to dry for 20 to 30 minutes before handling.
4. Remove any agent on wheel assembly with cleaning solvent.
5. It is permissible to re-apply as conditions require.

HYDRAULIC SYSTEM.

The fluid level in the hydraulic reservoir should be checked every 100 hours. Access to the reservoir is through the access panel on the right side of the nose section. If the fluid level is low, it should be filled with filtered hydraulic fluid, MIL-H-5606.

FILLING HYDRAULIC SYSTEM RESERVOIR.

A special filling and draining service valve hookup is provided on this airplane to facilitate service to the hydraulic system and power pack. It is located behind the access panel on the right side of the nose section at station 46.0. A pressure pot or hydraulic test unit can be connected to this service valve by the following procedure:

1. Remove the access panel and the protective cap on the suction, fill and drain fitting.
2. Connect the hydraulic fluid supply line from the supply source to the fitting and then raise the lever to open the valve and proceed to fill the reservoir.
3. To gravity fill the reservoir, support the supply container of hydraulic fluid higher than the fluid level in the power pack reservoir.
4. When filling is completed be sure to close the suction, fill and drain valve by placing the lever in the down position before disconnecting the supply line from the service valve fitting.
5. Reinstall the protective cap on the fitting and install the access panel.

PROPELLERS.

The blades should be checked periodically for damage. Minor nicks in the leading edge of blades should be filed out and all edges rounded. Daily inspection should include examination of blades and spinner for visible damage and grease leakage. For further information on propeller servicing, refer to Chapter 61.

ENGINE LUBRICATION.

The engine oil level should be checked before each flight and changed after each 50 hours of engine operation. During oil change, the oil screen(s) should be removed and cleaned, and the oil filter cartridge replaced. The engine manufacturer does not recommend oils by brand names. Use a quality brand Aviation Grade Oil of the proper season viscosity. For more information on recommended oils, refer to the latest revisions of Lycoming Service Instruction Letter No. 1014 and Lycoming Service Bulletin No. 318.

—CAUTION—

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

FILLING OIL SUMP.

The oil sump should normally be filled with oil to the 11 U.S. quart mark on the engine dipstick. The specified grade of oil may be found in the lubrication chart or on each engine oil filler access door. To service the engine with oil, open the quick release access door on top of the cowl and remove the oil filler cap.

—NOTE—

Oil dipsticks are marked for right and left engines. Use the correct side of stick when checking oil level

DRAINING OIL SUMP.

To drain the oil sump provide a suitable container with a minimum capacity of 12 quarts. Remove the engine cowl and open the oil drain valve located on the underside of the engine by pushing the arms of the drain up and turn counterclockwise. This will hold the drain in the open position. It is recommended the engine be warmed to operating temperature to insure complete draining of the old oil.

OIL FILTER (FULL FLOW).

1. The oil filter element should be replaced after each 50 hours of engine operation; this is accomplished by removing the lockwire from the bolt head at the end of the filter housing, loosening the bolt, and removing the filter assembly from the adapter.
2. Before discarding the filter element, remove the outer perforated paper cover, and using a sharp knife, cut through the folds of the element at both ends, close to the metal caps. Then, carefully unfold the pleated element and 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 particle 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 element has been replaced, tighten the attaching bolt within 20 to 25 foot-pounds torque. Lockwire the thermostatic bypass valve to the oil filter housing drain plug and the drain plug to the filter housing attaching bolt.

OIL SCREENS (SUCTION).

The oil suction screen, is located on the bottom aft end of the engine sump, installed horizontally. To remove, cut the safety wire and remove the hex head plug. The screen should be cleaned at each oil change to remove any accumulation of sludge and to examine for metal filings or chips. If metal particles are found in the screen, the engine should be examined for internal damage. After cleaning and inspection, place the screen inside the recess in the hex head plug, to eliminate possible damage to the screen. Insert the screen into the housing and when certain that the screen is properly seated, tighten and safety the plug with MS-20995-C41 safety wire.

RECOMMENDATIONS FOR CHANGING OIL. (Refer to the latest revisions of Lycoming Service Instruction No. 1014 and Lycoming Service Bulletin No. 318.)

1. Following break-in the only lubricants that are recommended for the TIO-540 series engines are multi-viscosity ashless dispersant oils that essentially conform with MIL-L-22851 specifications.
2. Whenever the oil is changed, remove and check the oil section screen for metal particles. Clean and reinstall. Anyone using Spectrometric oil analysis should read the latest revision of Lycoming's Service Letter No. L 171 on this subject.
3. In engines that have been operating on straight mineral oil for several hundred hours, a change to additive oil should be made with a degree of caution, since the cleaning action of some additive oils will tend to loosen sludge deposits and cause plugged oil passages. When an engine has been operating on straight mineral oil and is known to be in excessively dirty condition, the switch to additive or compounded oil should be deferred until after the engine is overhauled.
4. When changing from straight mineral oil to compounded oil, the following precautionary steps should be taken:
   A. Do not add additive oil to straight mineral oil. Drain the straight mineral oil from the engine and fill with additive oil.
   B. Do not operate the engine longer than twenty-five hours before the first oil change.
   C. Check all oil screens for evidence of sludge or plugging. Change oil every ten hours if sludge conditions are evident. Resume normal oil drain periods after sludge conditions improve.

SPECTROMETRIC OIL ANALYSIS.

The use of Spectrometric oil analysis is becoming widespread in the general aviation field. It is another useful procedure in the maintenance of modern reciprocating aircraft engines. The spectrometric method requires complete understanding of the procedures, schedules and interpretation by the maintenance personnel using this system. It must be remembered that the oil analysis technique is not a replacement for other established maintenance checks, such as differential cylinder pressure checks, boroscopic examination, and filter content inspection. The oil analysis is used to estimate wear ratio values of the particular engine or engines being monitored. For further information on Spectrometric oil analysis, refer to latest revision of Lycoming Service Letter No. L171.

SERVICING ENGINE AIR FILTER.

Visually inspect the filter to determine its condition. Accumulation of exhaust soot (fine carbon particles) collects on the filter and causes a rapid increase in restriction or short filter life, washing is effective on carbon, soot and oil laden filters. Filters should be rejected for use if the paper filter material is torn or ruptured or the housing is damaged. The filter gasket should have no tears and be securely bonded in place. The usable life of the filter should be restricted to one year or 500 hours, whichever comes first.

The method of cleaning the filter is as follows:

1. Tap the filter on a hard surface to remove any loose particles of dust, etc.
2. Wash the filter in a good non-sudsing detergent or the filter manufacturer's cleaner D-1400. Mix two ounces of D-1400 to one gallon of water.

3. Soak the filter in solution for 15 minutes, then move the filter back and forth about two minutes to free the dirt deposits from the filter.
4. Rinse the complete filter in a stream of water until rinse water is clear. (Maximum water pressure 40 psi.) A good thorough rinse is very important.
5. Dry filter thoroughly before reusing. Do not use light bulbs or extreme heat for drying.
6. After cleaning, hold filter up to a light bulb and inspect for damage or ruptures. Filters should not be oiled.

INSTALLATION OF FILTER.

1. Position filter in filter plenum with gasket up.
2. Insert filter mounting brackets out through the slots in the plenum sides and secure with screws. Tighten screws only enough to hold filter firm.
3. Install engine cowl. (Refer to Chapter 71.)

SCHEDULED SERVICING.

AIRFRAME LUBRICATION.

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 the 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 Lubrication Charts. 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 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.
3. Use extra care when greasing the Hartzell propeller hub to avoid blowing the clamp gaskets. Remove one grease fitting while applying grease to the other fitting. Uneven greasing will affect propeller balance.

APPLICATION OF OIL.

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.
3. Squeeze the magneto cam follower felts at regular inspection periods. If oil appears on fingers, do not add oil. If the felt is dry, moisten with light oil.

—CAUTION—

Be careful not to add too much oil, because the excess will be thrown off during operation and will cause pitting and burning of the magneto points.

LUBRICATION CHARTS.

The lubrication charts consist of individual illustrations for the various aircraft systems, and each component to be lubricated is indicated by a number which references the component, type of lubrication, and frequency of lubrication in hours. Special instructions are listed at the beginning of the lubrication charts and referenced on the particular chart.

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CHART 1201. SPECIAL LUBRICATION INSTRUCTIONS

SPECIAL INSTRUCTIONS

1. AIR FILTER - TO CLEAN FILTER. WASH IN WARM WATER AND MILD DETERGENT AND DRY. DO NOT USE OIL.
2. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A QUICK DRYING TYPE SOLVENT BEFORE RELUBRICATING.
3. COWL AND FLAP TRANSMISSIONS AND SCREWS. TRIM SCREWS AND WHEEL BEARINGS - DISASSEMBLE AND CLEAN WITH A QUICK DRYING TYPE SOLVENT. WHEN REASSEMBLING TRANSMISSIONS, PACK 3/4 MINIMUM FULL WITH DUKES FORMULA NO.2, P/N 2196-74-1 LUBRICANT (PIPER AIRCRAFT P/N 923 120). APPLY A THIN COATING OF MIL-G-23827 GREASE TO THE SCREW.
4. OLEO STRUTS, POWER PACK RESERVOIR AND BRAKE RESERVOIR - FILL PER INSTRUCTIONS ON UNIT OR CONTAINER, OR REFER TO SERVICE MANUAL, CHAPTER 12.
5. PROPELLER - REMOVE ONE OF THE TWO GREASE FITTINGS FOR EACH BLADE. APPLY GREASE THROUGH FITTING UNTIL FRESH GREASE APPEARS AT HOLE OF REMOVED FITTING.
6. LUBRICATION POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE RELUBRICATING .

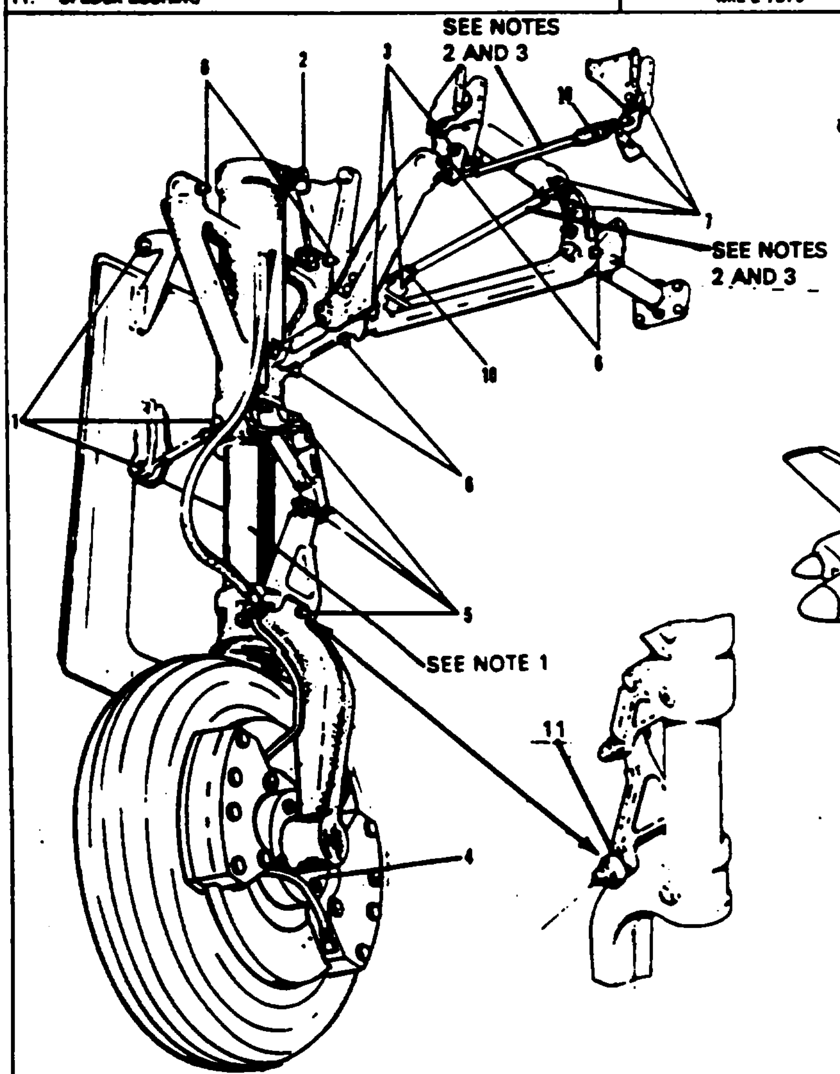
NOTES

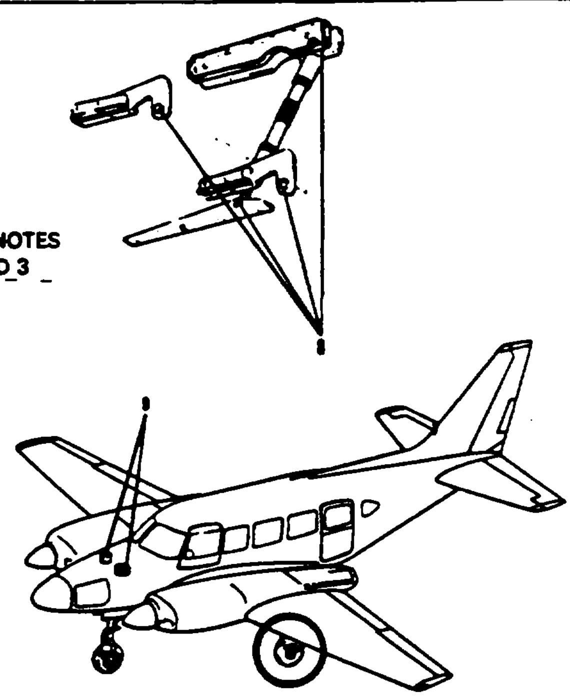
1. PILOT - LUBRICATE TRACK ROLLERS AND STOP PINS AS REQUIRED.
2. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER. PACK CLEVELAND WHEEL BEARINGS WITH MOBIL GREASE 77 OR MOBILUS EP2. PACK GOODYEAR BEARINGS WITH A GREASE THAT CONFORMS TO MIL-G-81322 SPECIFICATION.
3. SEE LATEST REVISION OF LYCOMING SERVICE INSTRUCTION NO.1014 FOR USE OF DETERGENT OIL.

CAUTIONS

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVER-LUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.

COMPONENT	LUBRICANT	FREQUENCY
1. GEAR DOOR, OUTBOARD, HINGES AND CONTROL RODS, RIGHT AND LEFT	MIL-L-7870	100 HRS
2. GEAR OLEO STRUT FILLER, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 4 AND CAUTION 1)	MIL-H-5606	AS REQUIRED
3. GEAR DOWNLOCK HOOK, CONTROL ROD AND CABLE ENDS AND BELLCRANK, RIGHT AND LEFT	MIL-L-7870	100 HRS
4. WHEEL BEARINGS, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 3 AND NOTE 2)	SEE NOTE 2	100 HRS
5. GEAR TORQUE LINK FITTINGS, RIGHT AND LEFT	MIL-G-23827	100 HRS
6. GEAR SIDE BRACE LINK BUSHING AND HOUSING BUSHING, RIGHT AND LEFT	MIL-G-23827	100 HRS
7. GEAR UPLOCK HOOK, CONTROL ROD AND CABLE ENDS, CYLINDER ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS
8. GEAR DOOR, INBOARD, HINGES AND CYLINDER ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS
9. BRAKE AND POWER PACK RESERVOIR (SEE SPECIAL INSTRUCTION 4 AND CAUTION 1)	MIL-H-5606	AS REQUIRED
10. GEAR UPLOCK ROD ASSEMBLY AND DOWNLOCK ROD ASSEMBLY (SEE NOTES 2 AND 3)	MIL-G-3545	100 HRS
11. UPLOCK BUSHING	MIL-L-7870	100 HRS





NOTES

1. WIPE EXPOSED STRUT WITH CLEAN CLOTH AND HYDRAULIC FLUID MIL-H-5606.
2. CLEAN AND LUBRICATE WHENEVER LANDING GEAR AND WHEEL AREA HAS BEEN WASHED.
3. UPLOCK ROD USED ON AIRCRAFT MODELS WITH S/N 31-8253001 TO 31-8253012 INCLUSIVE. CABLE ASSEMBLY USED ON AIRCRAFT MODELS WITH S/N 31-8353001 AND UP.

Figure 12-3. Lubrication Chart (Landing Gear, Main)

COMPONENT	LUBRICANT	FREQUENCY
1. NOSE GEAR OLEO STRUT FILLER (SEE SPECIAL INSTRUCTION 4 AND CAUTION 1)	MIL-H-5606	AS REQUIRED
2. STEERING ARM ROLLERS, BELLCRANK RETRACTION ROD ENDS, AND STEERING ROD ENDS	MIL-L-7870	100 HRS
3. NOSE GEAR DOOR ACTUATOR, RETRACTION ROD END AND CYLINDER ROD END	MIL-L-7870	100 HRS
4. UPLOCK HOOK AND UPLOCK ROD (SEE NOTES 2 AND 3)	MIL-L-7870	50 HRS
5. DOOR HINGES	MIL-L-7870	100 HRS
6. DRAG LINK ASSEMBLY AND IDLER LINK	MIL-G-23827	100 HRS
7. WHEEL BEARINGS (SEE SPECIAL INSTRUCTION 3 AND NOTE 2)	MOBILGREASE 77 OR MOBILUX EP2	100 HRS
8. UPPER AND LOWER TORQUE LINK	MIL-G-23827	100 HRS
9. UPPER AND LOWER TORQUE LINK CONNECTING BOLT AND SHIMMY DAMPENER	MIL-L-7870	100 HRS
10. GEAR HOUSING BUSHINGS	MIL-G-23827	100 HRS
11. NOSE GEAR STEERING CAM AND CAM FOLLOWER	MIL-G-3545	50 HRS
12. UPLOCK BUSHING	MIL-L-7870	100 HRS
13. NOSE GEAR UPLOCK ROD ASSEMBLY (SEE NOTES 2 AND 3)	MIL-G-3545	50 HRS

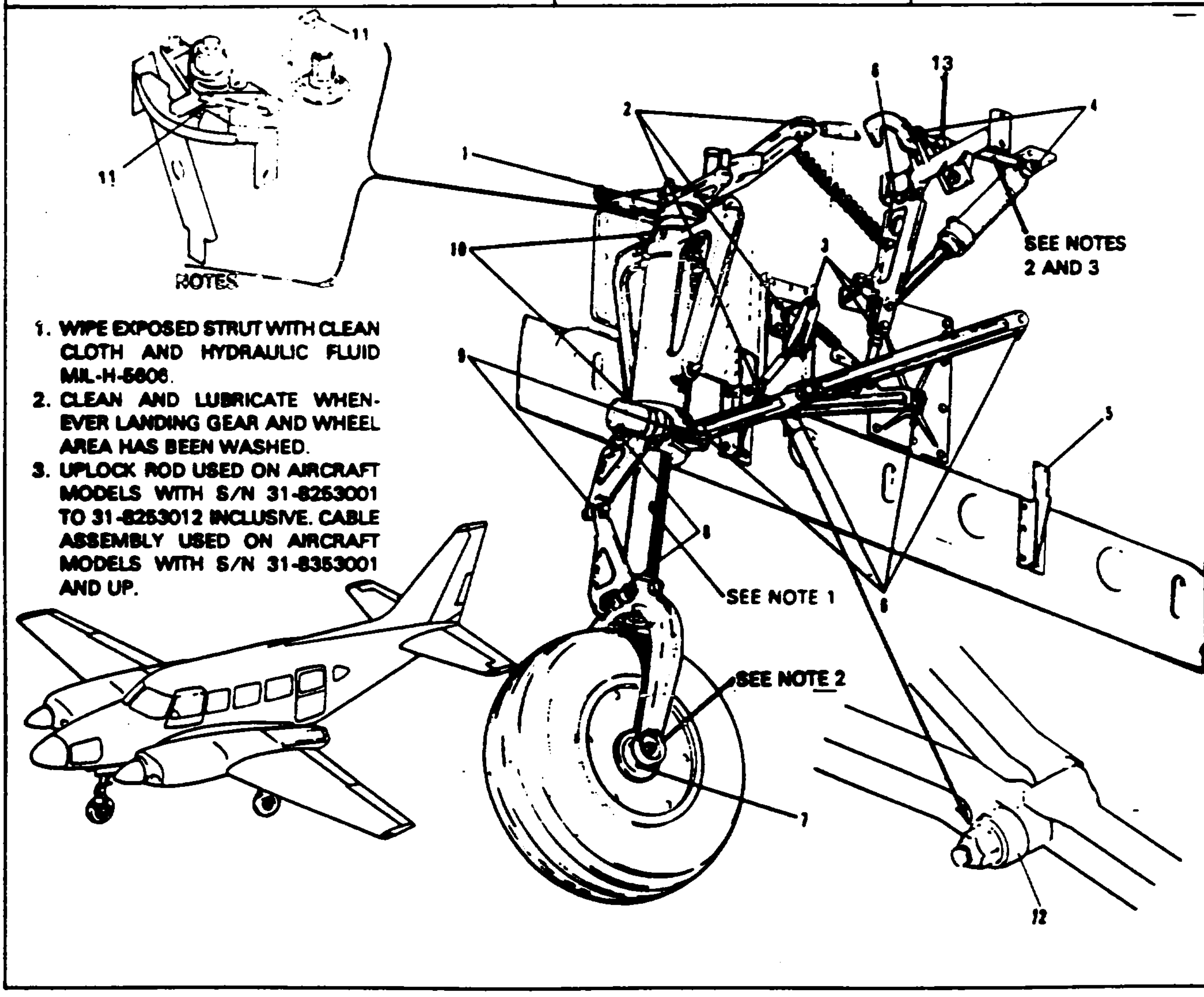


Figure 12-4. Lubrication Chart (Landing Gear, Nose)

COMPONENT	LUBRICANT	FREQUENCY
1. AILERON TRIM SCREW (SEE SPECIAL INSTRUCTION 3)	MIL-G-23827	500 HRS
2. AILERON TRIM TAB HINGES AND CONTROL ROD ENDS	MIL-L-7870	100 HRS
3. RUDDER TRIM SCREW (SEE SPECIAL INSTRUCTION 3)	MIL-G-23827	500 HRS
4. RUDDER AND RUDDER TRIM TAB HINGES AND CONTROL ROD ENDS	MIL-L-7870	100 HRS
5. ELEVATOR AND ELEVATOR TRIM TAB HINGES AND CONTROL ROD ENDS	MIL-L-7870	100 HRS
6. AILERON HINGES, RIGHT AND LEFT	MIL-L-7870	100 HRS
7. FLAP TRANSMISSION PIVOT BOLTS AND SENDER ARM	MIL-L-7870	100 HRS
8. FLAP TRANSMISSION AND SCREW, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 3)		500 HRS
9. FLAP TRACK, RIGHT AND LEFT	ALL PURPOSE SLIP SPRAY (DUPONT NO. 6611)	50 HRS
10. FLAP TRACK ROLLERS, RIGHT AND LEFT	MIL-L-7870	100 HRS
11. AILERON BELLCRANK CABLE ENDS, PIVOT BEARING AND CONTROL ROD ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS
12. TRIM SCREWS	MIL-G-23827	500 HRS

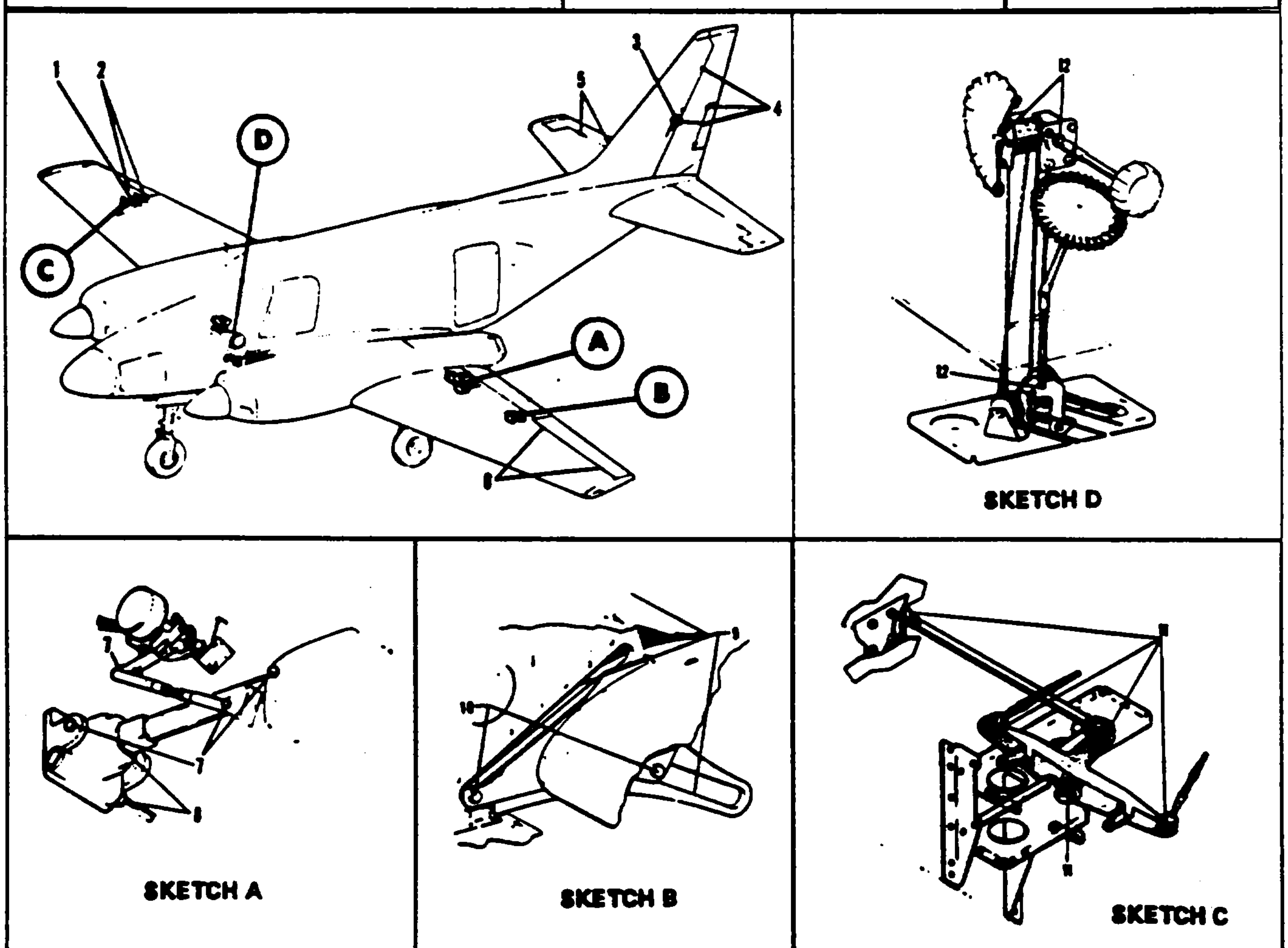
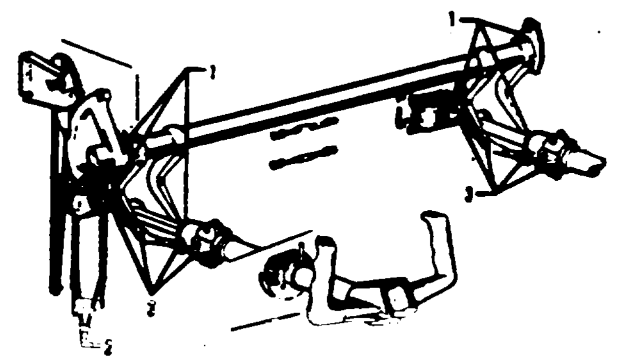


Figure 12-5. Lubrication Chart (Control System)

COMPONENT	LUBRICANT	FREQUENCY
1. CONTROL WHEEL, TORQUE TUBE BEARINGS, SPROCKET BUSHINGS AND ROLLER BEARINGS	MIL-L-7870	500 HRS
2. CONTROL WHEEL CHAIN, VERTICAL AND HORIZONTAL	MIL-L-7870	500 HRS
3. CONTROL WHEEL, ROLLERS, LINK AND FLEXIBLE JOINT	MIL-L-7870	100 HRS
4. RUDDER PEDALS, TORQUE TUBE BEARINGS AND BLOCK, CONTROL CABLE ENDS, AND BRAKE CYLINDER ENDS	MIL-L-7870	100 HRS
5. ELEVATOR BELLCRANK, PIVOT BOLTS AND CABLE ENDS	MIL-L-7870	100 HRS
6. RUDDER HORN CABLE ENDS	MIL-L-7870	100 HRS
7. ELEVATOR TRIM (SEE SPECIAL INSTRUCTIONS 3)	MIL-G-23827	500 HRS
8. ELEVATOR TRIM TAB CONTROL ROD ENDS	MIL-L-7870	100 HRS
9. ELEVATOR CONTROL ROD	MIL-L-7870	100 HRS



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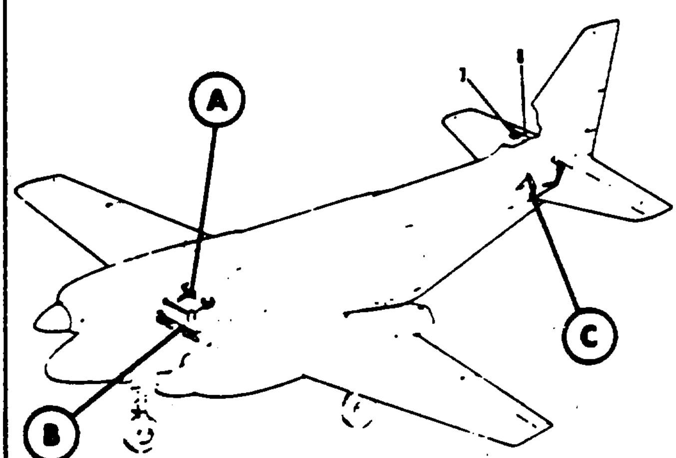
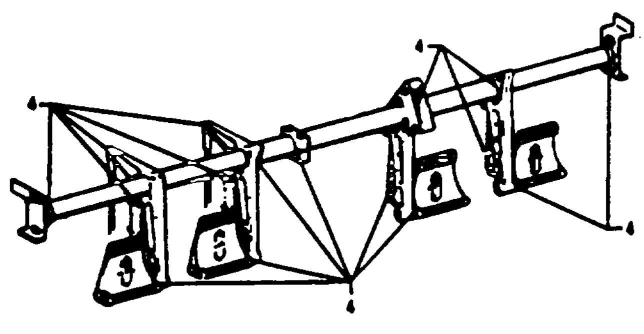
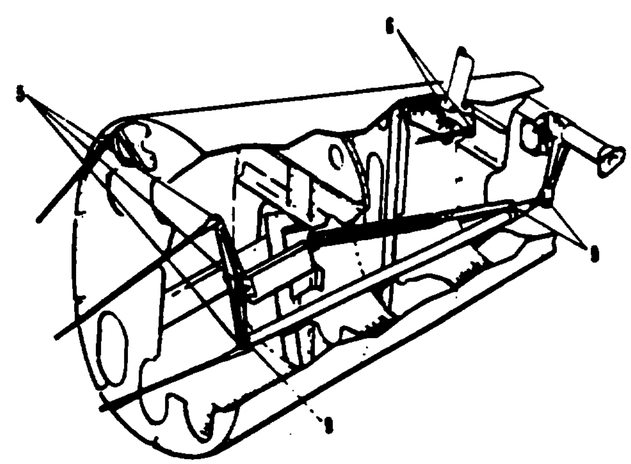




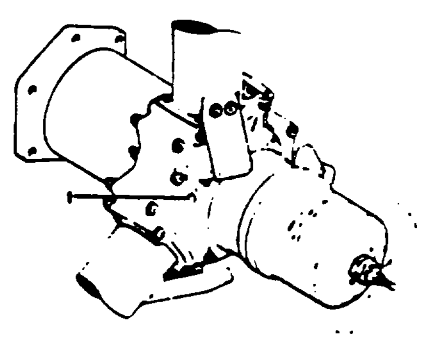
SKETCH B



SKETCH C

Figure 12-5. Lubrication Chart (Control System) (cont.)

	COMPONENT	LUBRICANT	FREQUENCY
1.	ZERK FITTINGS, BLADE HUB, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 5)	MIL-G-23827	100 HRS
2.	GOVERNOR, THROTTLE AND MIXTURE CABLE ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS
3.	AIR FILTER, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 1)		50 HRS
4.	ALTERNATE AIR MECHANISM, RIGHT AND LEFT	MIL-L-7870	100 HRS
5.	OIL FILTER CARTRIDGE, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 7)		50 HRS
6.	ENGINE OIL SUMP, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 7 AND NOTE 3)	MIL-L-6082	50 HRS
7.	FUEL PANEL AND CONTROL LEVERS (SEE CAUTION 2)	MIL-L-7870	500 HRS
8.	COWL FLAP TRANSMISSION AND SCREW, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 3)		500 HRS
9.	COWL FLAP BELLCRANK BEARINGS, RIGHT AND LEFT	MIL-L-7870	100 HRS
10.	COWL FLAP CONTROL ROD ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS
11.	COWL FLAP HINGE	MIL-L-7870	100 HRS



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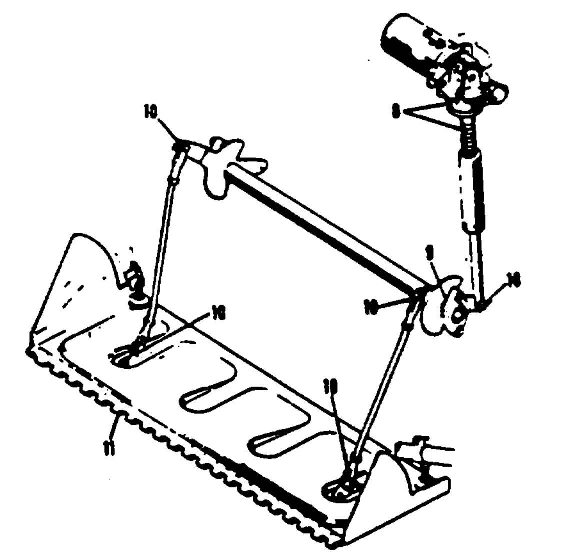

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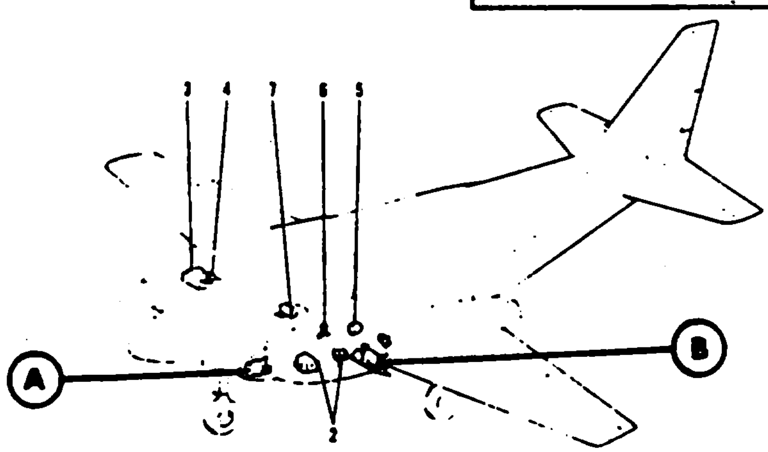

Figure 12-6. Lubrication Chart (Power Plant, Propeller and Cowl Flap)

COMPONENT	LUBRICANT	FREQUENCY
1. CABIN DOOR LATCH, HINGES AND STEP MECHANISM	MIL-L-7870	100 HRS
2. NOSE CONE AND FORWARD BAGGAGE DOOR HINGES AND LATCHES	MIL-L-7870	100 HRS
3. PILOT DOOR LATCH AND HINGES	MIL-L-7870	100 HRS.
4. NACELLE LOCKER HINGES	MIL-L-7870	100 HRS
5. SEAT TRACKS	MIL-L-7870	100 HRS
6. CARGO DOOR (OPTIONAL)	MIL-L-7870	100 HRS

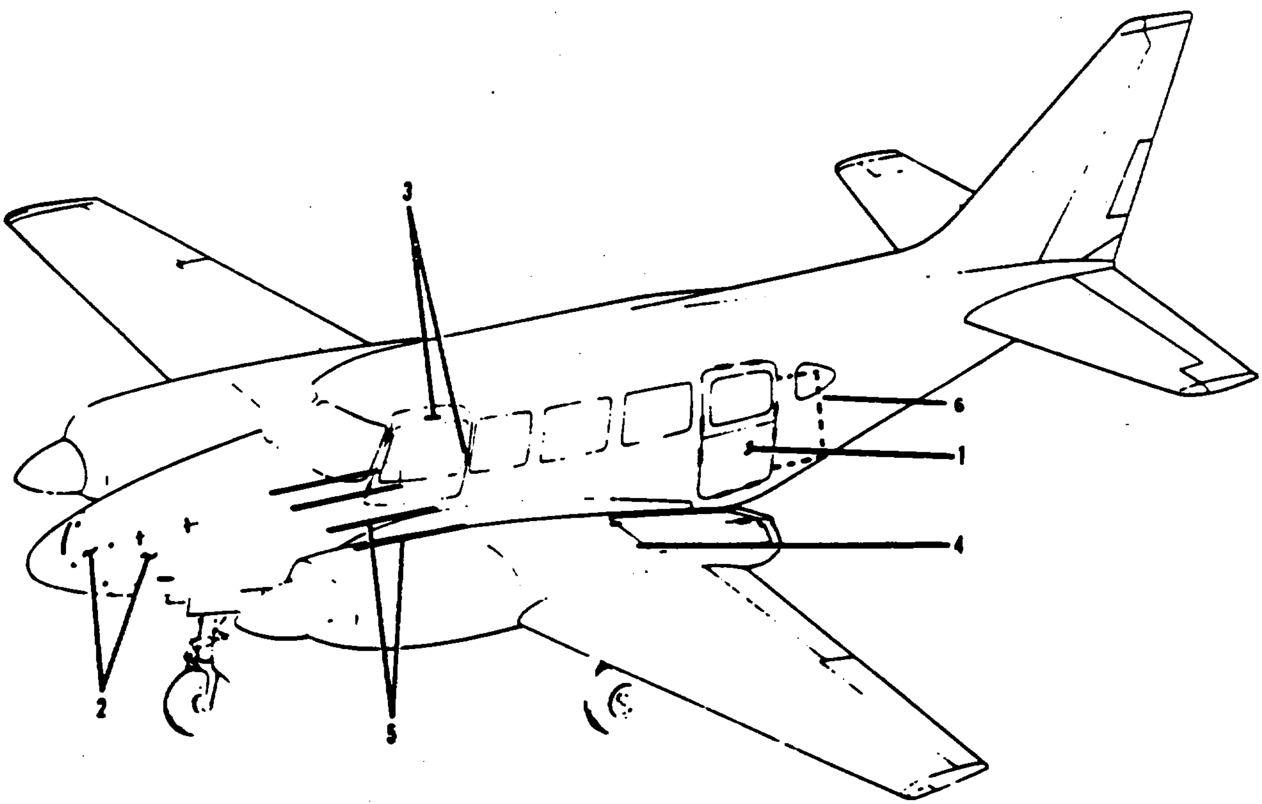

Figure 12-7. Lubrication Chart (Doors and Seats)

SERVICING AIR CONDITIONING SYSTEM.

Servicing this system consists of periodically checking the freon refrigerant level by operating the system and observing the sight gauge window in the upper end of the receiver-dryer. This is done by gaining access to the receiver-dehydrator sight gauge located in the right wheel well. The inboard gear door must be opened to get to the unit. Refer to Chapter 32 of this manual for details on opening the gear doors. Check for signs of foam or bubbles in the sight gauge. If these conditions are observed, refer to Chapter 21 for further instructions on the air conditioner. If the system must be recharged, it is advisable to check the oil in the compressor at this time before recharging the system, and replace the receiver-dryer and any O-rings in connections which were opened.

SERVICING ELECTRICAL SYSTEM.

There is little service required for the electrical system, other than making visual and operational checks of the various equipment. For more detailed information on servicing and repair of the various components, refer to Chapter 39.

OPERATION OF EXTERNAL POWER RECEPTACLE.

The external power receptacle is located on the under side of the nose section below the forward side of the baggage compartment door. To avoid any damage to the airplane's electrical system, follow the instructions on the access door of the power receptacle.

SERVICING BATTERY.

Access to the battery is through the nose baggage compartment panel. The stainless steel box has a plastic drain tube located on the bottom side near the right rear corner. 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 present in the battery. All connections must be clean and tight. If the battery is not up to normal charge, recharge in accordance with the battery manufacturer's instructions.

REMOVAL OF INDUCTION AIR FILTER.

1. Remove lower engine cowl.
2. Remove the filter attachment brackets located on the right, left and aft sides of the filter plenum by removing the screws on the outside of the plenum and then remove the brackets from the inside of the plenum.
3. Remove the filter.

INSTALLATION OF INDUCTION AIR FILTER.

1. Place filter in plenum.
2. Attach plenum with filter attachment brackets.
3. Reinstall lower engine cowl.

ALTERNATE AIR DOOR.

The alternate air door is incorporated in the induction air tube between the air filter and the turbocharger compressor inlet. The purpose of the door is to provide a source of air should there be an air stoppage through the filter. The following should be checked during inspection:

1. Door seal must fit flush with interior of duct opening.
2. Actuate the door to determine that it is not sticking or binding.
3. A minimum of a 9 pound force is required to open the door against the magnetic force. The 9 pound force is to be applied at the center of the door and perpendicular to the door surface, using a force scale. Make several checks to insure 9 pound test is consistent. If the 9 pound force test fails, check to insure both magnetic catch plates make full contact with alternate air door. Full contact can be obtained by bending the magnetic catch bracket as needed.
4. Check the cockpit control cable for free travel.
5. Check that when the control knob in the cockpit is full in, the cable is adjusted to maintain .062 to .125 inch clearance between cam and alternate air door in the fully closed and magnetically latched position.

OXYGEN SYSTEM.

The oxygen for the breathing system is furnished from a stationary cylinder located on the upper right side of the fuselage aft of the rear baggage compartment. At 1850 psi of pressure, the oxygen cylinder has a capacity of 48 cubic feet. Service and maintenance instructions for the oxygen system may be found in Chapter 35. Safety Precautions and Filling Procedures follow.

OXYGEN SYSTEM SAFETY PRECAUTIONS.

The utmost care must be exercised in servicing, handling and inspection of the oxygen system. Comply with the following precautions:

1. Keep the oxygen regulator, cylinder, gauge, valve, fittings, masks and all other components of the oxygen system free of oil, grease, gasoline and all other readily combustible substances.
2. Do not allow foreign matter to enter the oxygen lines.

—WARNING—

The presence of foreign matter in the high pressure lines can cause an explosion. When coming on contact with oxygen equipment, keep hands, tools and clothing clean - hospital clean.

3. Never attempt to repair or repaint oxygen equipment.
4. Keep fire and heat away from oxygen equipment. Do not smoke while working with or near oxygen equipment and take care not to generate sparks with carelessly handled tools when working on the oxygen system.
5. Never allow electrical equipment to come in contact with the oxygen cylinder.
6. Use only Ribbon Dope Thread Sealant (Permacel 412) on oxygen system. Apply only to the first three threads of male fittings to prevent thread seizure.

FILLING OXYGEN CYLINDER.

The filler valve or valves for the oxygen system are accessible through doors located on the right side of the fuselage tail section aft of the rear baggage compartment.

1. To fill the oxygen cylinder or cylinders, open the access door, remove the cap from the filler valve, and attach the filler hose from the oxygen recharge unit to filler valve. Ascertain that all fittings are free from oil, grease, dirt, etc.

—NOTE—

If the airplane's oxygen cylinder pressure is below 50 psi, the system should be purged as described in Chapter 35.

2. To obtain the correct filling pressure for the oxygen system at various ambient temperatures, a table is included for your convenience. The pressures given are not exact, but sufficiently accurate for practical purposes of working pressures between 1800 and 2400 psig cylinders. The cylinder should be allowed to cool to a stabilized temperature after filling before checking against the figures given in Chart 1202.
3. When using a recharge unit consisting of one supply cylinder, slowly open the valve of the supply unit and allow the oxygen to transfer.
4. When using a recharge unit consisting of two or more supply cylinders (cascade storage system), it is recommended that the following procedure be used:
   A. Before opening any valves, check the pressure remaining in the airplane's oxygen cylinder. If it is still partly charged, note the pressure indicated on the cylinder gauge. Then open and close each valve on the cascade storage system and determine which cylinder has the lowest pressure. When found if this cylinder has a pressure lower than the oxygen cylinder in the aircraft, do not attempt using it for filling; use the storage cylinder that has a pressure higher than the aircraft's cylinder but lower than the others.
   B. Open the valve on only the one storage cylinder with the lowest pressure. When the pressure indicated on the aircraft's oxygen gauge and charging gauge has become equal, close the valve of the storage cylinder; then go to the storage cylinder with the next higher pressure and repeat the procedure.
   C. If after using the last storage cylinder the aircraft's oxygen system is still not fully charged, a full storage cylinder should be put in place of a cylinder with the lowest pressure and used in the same manner.
   D. A good deal of oxygen will remain in the large cylinders used in the cascade system after filling only one of the cylinders but such remaining oxygen will be at a pressure something less than the 1850 psi which is not sufficient pressure to completely refill another aircraft cylinder, although it will refill several smaller cylinders.
   E. It is not economical even on a three or four cylinder cascade system to begin recharging with oxygen at less than 300 psi pressure in the 300 cubic foot bank of cylinders. So use 300 cubic foot cylinders down to approximately 300 psi; then return for refilling. In two cylinder systems, use to approximately 100 psi; then return for filling.
5. When the pressure gauge on the recharge unit or in the aircraft reaches 1800 to 1850 psi, close the pressure regulator valve on the recharge unit. Disconnect the filler hose from the filler valve; replace the protective cap on the filler valve and close the access cover. Check the cylinder pressure according to Chart 1202 after the cylinder temperature stabilizes.

CHART 1202. INDICATED OXYGEN PRESSURES FOR GIVEN AMBIENT TEMPERATURES

Ambient Temperature - ° F	Indicated Cylinder Pressure - Psig
110	1980
100	1935
90	1890
80	1845
70	1800
60	1755
50	1710
40	1665

—END—

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CHAPTER

20

STANDARD PRACTICES/ AIRFRAME

CHAPTER 20 - STANDARD PRACTICES - AIRFRAME

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CHAPTER 20- STANDARD PRACTICES - AIRFRAME (cont.)

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GENERAL.

This chapter contains general information pertaining to standard aircraft hardware installation and removal practices. The information included will be very helpful if it is referred to on a regular basis.
For standard repair practices of a minor nature, refer to AC43.13.

Testing and inspecting of aluminum castings and machined aluminum parts may be accomplished by the dye penetrant method.

Usually, a good visual inspection with 10X magnifying glass will show any damage or defect in a repair that is of a significant nature.

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.

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

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.

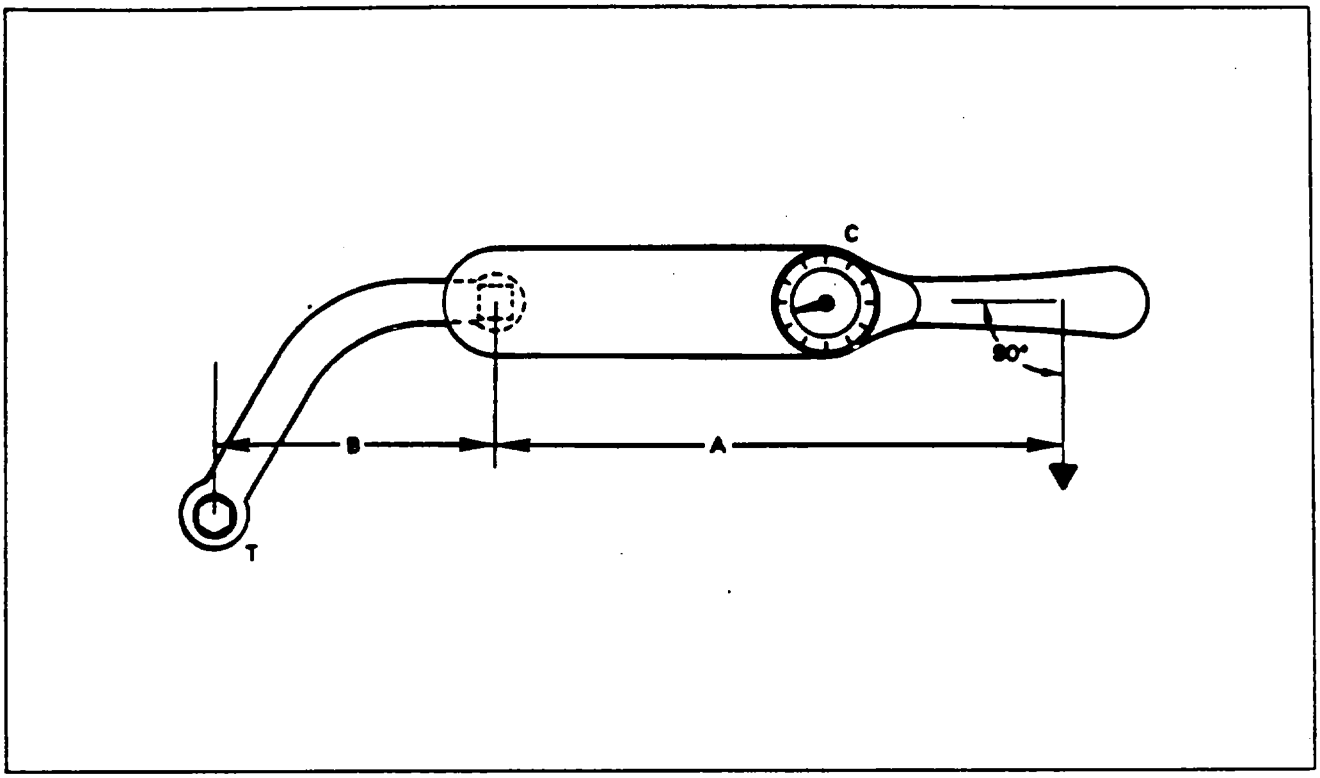


Figure 20-1. Torque Wrench Extension

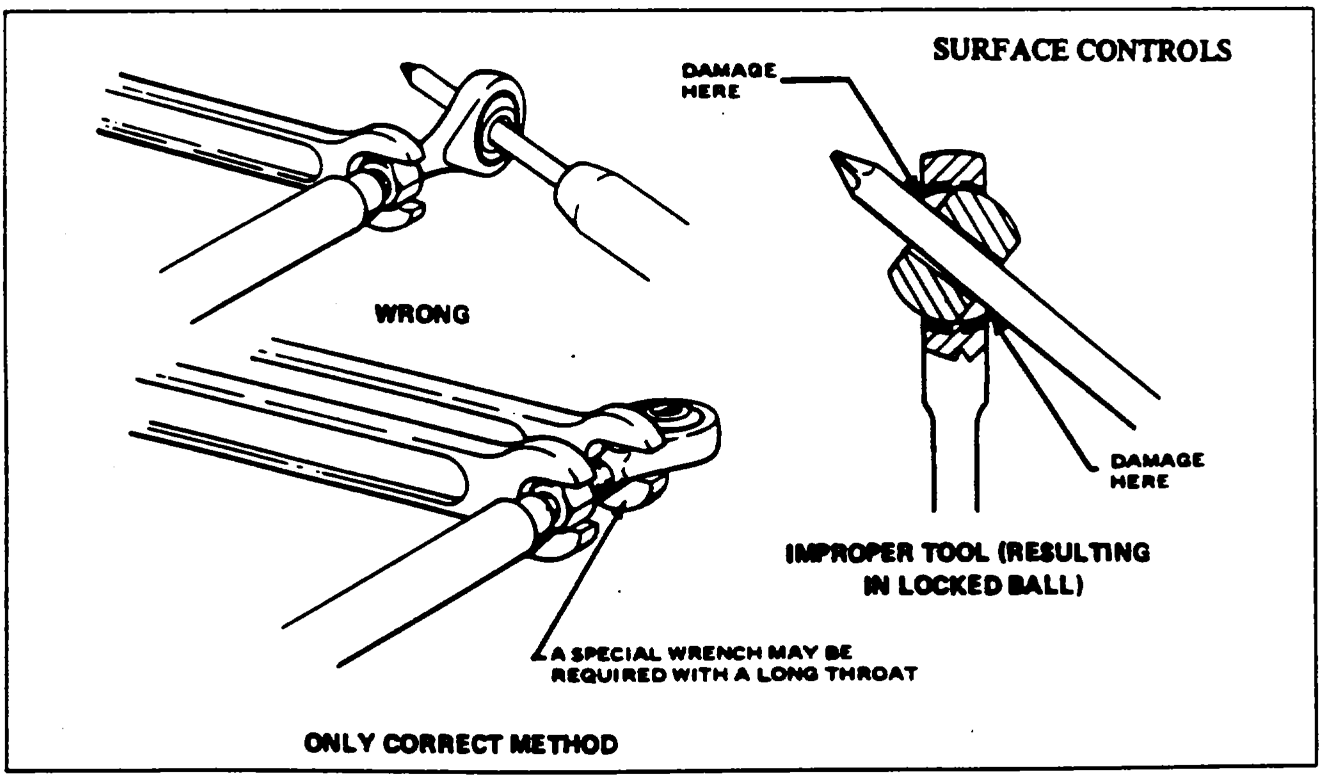


Figure 20-2. Method of Installing Rod End Bearings

CHERRYLOCK RIVETS, REMOVAL. (Refer to Figure 20-3.)

Should it be necessary to remove an installed cherrylock rivet, the following procedures are recommended.

1. 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.

2. If the rivets have been installed in thin sheets, driving out the locked stem may damage the sheets. It is recommended that a small center drill be used to provide a guide for a larger drill on top of the rivet stem, and the tapered portion of the stem be drilled away to destroy the lock (See Views 2 and 3).
3. Pry the remainder of the locking collar out of the rivet head with the drift pin (See View 3).
4. Drill nearly through the head of the rivet, using a drill the same size as the rivet shank. (See View 4).
5. Break off rivet head, using a drift pin as a pry (See View 5).
6. Drive out the remaining rivet shank with a pin having a diameter equal to the rivet shank. (See View 6).

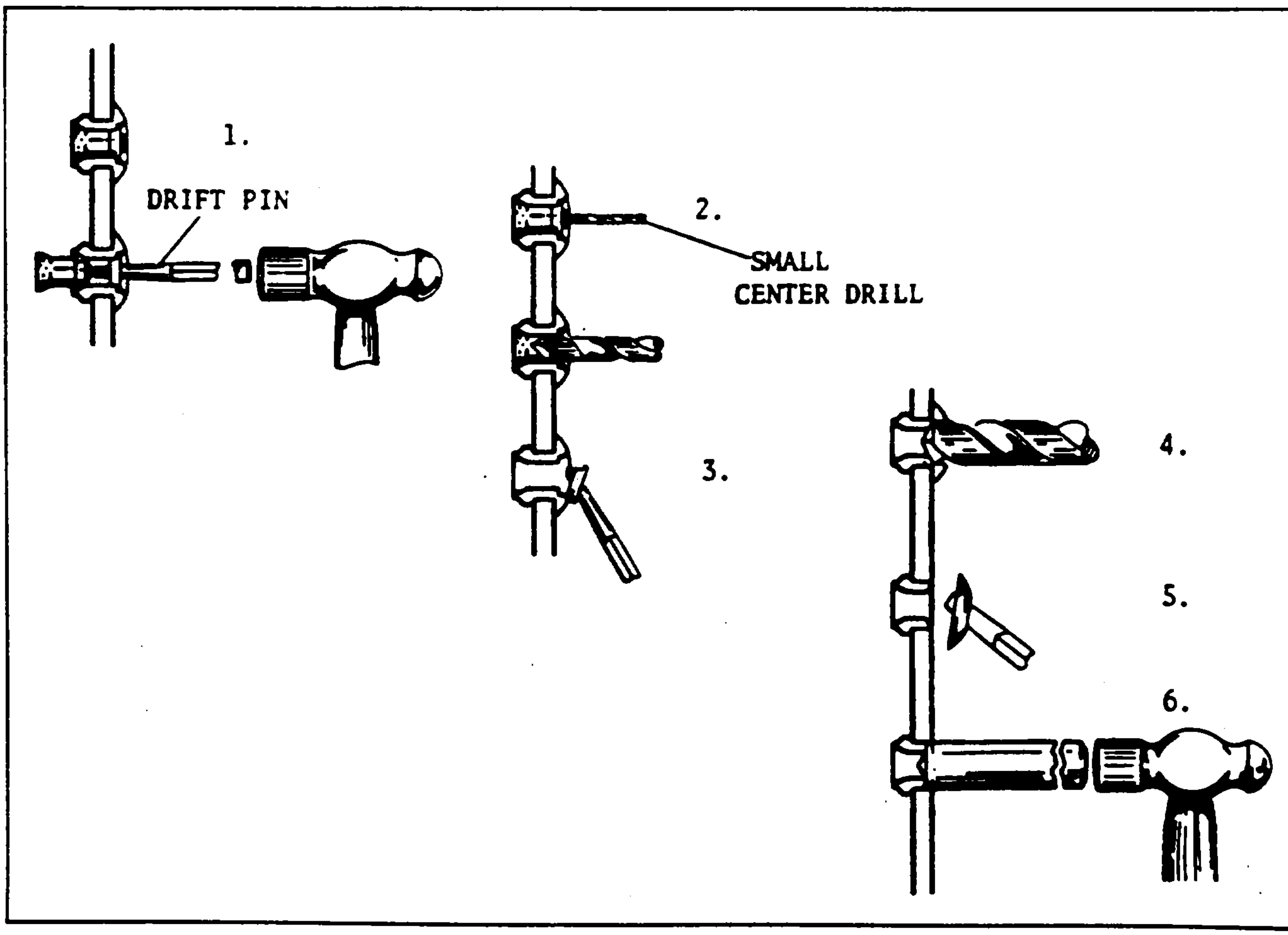


Figure 20-3. Cherrylock Rivet Removal

IDENTIFICATION OF FLUID LINES. (Refer to Figure 20-4.)

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 l-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 the original installation of identification markers, but the aviation mechanic is 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 line 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 20-5.)

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 20-5 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 of 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.

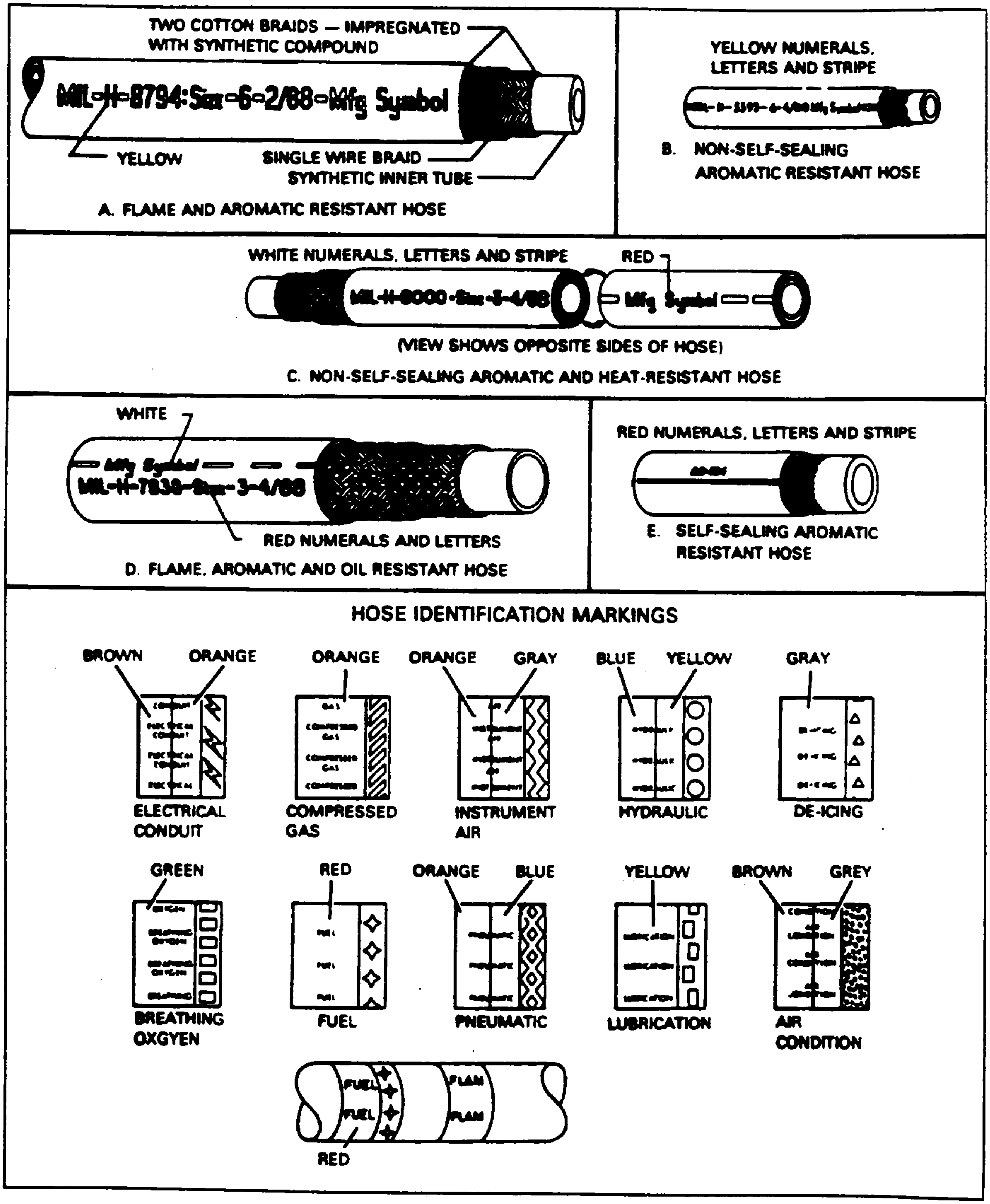
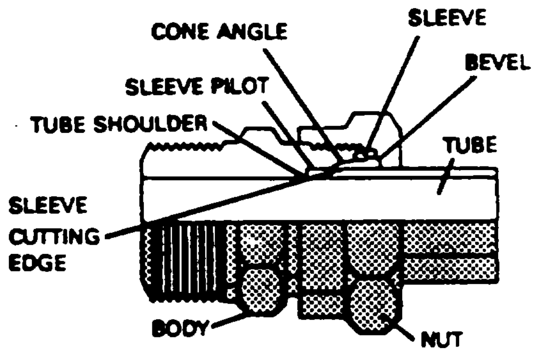


Figure 20-4. Hose/Line Markings

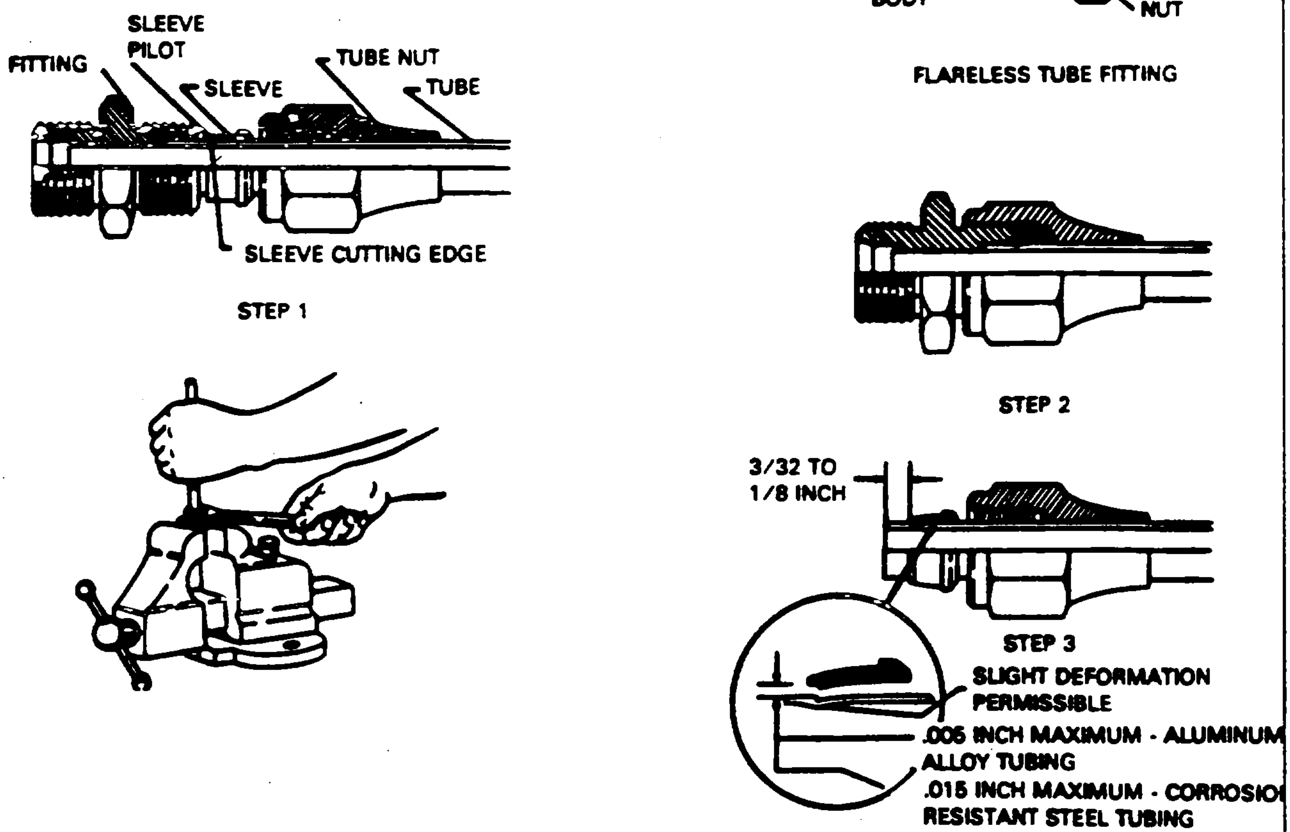
TUBING SYSTEM	LUBRICANT
HYDRAULIC	MIL-H-5606
FUEL	MIL-H-5606
OIL	SYSTEM OIL
PNEUMATIC	MIL-L-4343
OXYGEN*	MIL-T-5542

*CAUTION - DO NOT USE OIL OR GREASE

TUBING AND HOSE LUBRICANTS



FLARELESS TUBE FITTING



PRESETTING FLARELESS - TUBE ASSEMBLY

Figure 20-5. Flareless Tube Fittings

CHART 2001. THREAD LUBRICANTS

TYPE OF LINE	TYPE OF LUBRICANT
Brakes	MIL-H-5606
Deicer (Air)	TT-A-580 (JAN-A-669), Anti-Seize Compound (White Lead Base)
Freon	TT-A-580 or MIL-T-5544, Anti-Seize Compound
Fuel	MIL-T-5544, Anti-Seize, Graphite Petrolatum
Oil	MIL-G-6032, Lubricating Grease (Gasoline and Oil Resistant)
Oxygen	Ribbon Dope Thread Sealant Permacel 412
Pitot and Static	TT-A-580 (JAN-A-669), Anti-Seize Compound (White Lead Base)

—NOTE—

Lubricate engine fittings only with the 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
1	26-1/2	30

LUBRICATION OF GASKETS AND SEALS.

Gaskets and O-ring seals which require lubrication should be lubricated with the same type of fluid they are sealing.

LUBRICATION OF THREADS.

All fittings on external lines, including their points of attachment at the engine and other components, should be lubricated with the proper lubricant as specified in Chart 2001.

The following steps should be followed when applying thread lubricants:

1. Thoroughly clean threads before applying lubricant.
2. Use selected thread lubricant sparingly.
3. Apply thread lubricant to male threads only.
4. Lubricate the first three threads on straight fittings.
5. Do not lubricate the first two threads on tapered fittings. Apply the lubricant to the next three threads only.
6. Ascertain that lubricant does not enter fittings or flared areas.
7. Any fittings going to the engine should be lubricated with the type of fluid going through the lines.

AIRCRAFT FINISH CARE.

CLEANING.

The complete airplane is carefully finished inside and outside to assure maximum service life. Both sides of all parts are alodine-treated and sprayed with zinc chromate primer. The external surfaces are coated with durable acrylic lacquer.

When washing the airplane, it is advisable to use a mild soap and water solution. Loose dirt should be flushed away with clean water. Harsh abrasive or alkaline soaps or detergents could cause corrosion or make scratches in the finish.

Use naphtha and a soft cloth to remove stubborn oil and grease. Any good automotive wax can be used to preserve the painted surfaces. Soft cleaning cloth or chamois should be used to prevent scratches when cleaning or polishing. Apply a heavier coating of wax on the leading edges of the wings and tail surfaces and on the nose cone section and propeller spinners to reduce the abrasion problems in these areas.

On aircraft equipped with pneumatic deicers, refer to Chapter 30 for application of ICEX material. This is a special compound which will not harm the rubber surface of the deicer boots.

When repainting the airplane, never use aluminum foil as a paint spray mask on Aircon Nesa coated windshields. Nesa film is used on the exterior for static electricity protection and is basically tin oxide. Most metal brightners, whether alkaline or acidic, can react with the aluminum foil and release hydrogen, which may come in contact with the tin oxide. When the hydrogen and the tin oxide combine, the tin oxide film is reduced to pure tin and when wiped away will leave a permanent dark stain. If metal brightners are to be used, insure adequate protection for the windshield by using paper and pasteboard prior to painting.

CLEANING INTERIOR SURFACES

CLEANING HEADLINER, SIDE PANELS AND SEATS.

1. Clean headlines with a good quality rug and upholstery shampoo, such as the type manufactured by Bond Sanitary Products of York, Penna. Follow the manufacturer's instructions carefully. Avoid soaking or harsh rubbing.

—CAUTION—

Solvent cleaners require adequate ventilation.

2. Clean side panels and seats with a stiff bristle brush and vacuum where necessary.
3. Leather material should be cleaned with saddle soap or a mild soap and water.

WOOD SURFACES.

Wood surfaces may be cleaned with any good household liquid or spray cleaner and polish manufactured for this purpose.

CARPETS.

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

CLEANING EXTERIOR SURFACES.

The airplane should be washed with a mild soap and water. Harsh abrasive or alkaline soaps 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. A cleaning compound may be used on the stainless steel exhaust shield.
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 the surface with clean water.
2. Wash with mild soap and water or a 50/50 solution of isopropanol and water. (Do not use plastic cleaners on glass windshields.) Do not use any abrasive materials, strong acids or bases, methanol, or Methyl Ethyl Ketone. Use a soft cloth or sponge in a straight rubbing motion. Do not rub harshly.

—CAUTION—

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

3. Rinse thoroughly and dry.
4. After cleaning, plastic surfaces may be polished by applying a thin coat of hard polishing wax. Rub lightly with a soft cloth. Use a circular rubbing motion. Do not apply wax to glass windshields with surface coatings for anti-static protection.
5. A severe scratch or mar in plastic can be removed by using jeweler's rouge to rub out the scratch. Smooth both sides and apply wax.
6. To improve visibility through windshield and windows during flights 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 9101. Consumable Materials for Specifications and Manufacturer's address.)

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.

—NOTE—

If desired, the inboard gear doors may be lowered by actuating the emergency hand pump handle, with the master switch off.

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.

ENGINE COMPARTMENT.

Before cleaning the engine compartment, place a plastic cover or similar material around the pressure pump inlet filter and a strip of tape on the magneto vents to prevent any solvent from entering these units.

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

—CAUTION—

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

3. Allow the solvent to remain on the engine from five to ten minutes, then rinse the engine clean with additional solvent and allow to dry.

—CAUTION—

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

4. Remove the protective covers from the filter and magnetos.
5. Lubricate controls, bearing surfaces, etc., per Lubrication Chart.

CORROSION CONTROL.

Corrosion is the deterioration of metal by chemical or electrochemical attack. Water which is allowed to remain on the aircraft and industrial pollution are the major causes of corrosion in aircraft. The two general types of corrosion are: 1) a direct chemical attack (ex. spilled battery acid); and, 2) electrochemical attack which requires a medium (usually water). The latter is the most common and is responsible for most forms of aircraft corrosion.

Since corrosion is a constant threat, the only effective method to control it is a routine of regular inspection, cleaning, and surface refinishing.

FORM OF CORROSION.

The following are the most common forms of corrosion:

1. Surface Corrosion appears as a general roughening or pitting on the surface usually accompanied by a powdery deposit of corrosion products. It may spread under the surface and not be recognized until the paint or plating is lifted off the surface in small blisters.
2. Dissimilar Metal Corrosion may occur when two dissimilar metals are contacting each other. This type may be serious because it usually takes place out of sight. The only way to find it before structural failure is by disassembly and inspection. Insulating is necessary between two contacting dissimilar surfaces (2-3 coats of zinc chromate on each surface; plus a .003 thick piece of vinyl tape if one of the surfaces is magnesium).
3. Intergranular Corrosion is difficult to detect in its early stages. When severe, it causes the surface of the metal to "exfoliate" (flake or lift).
4. Stress Corrosion is the result of sustained tensile stresses and corrosive environment. It usually occurs in assemblies such as aluminum alloy bellcranks with pressed in bushings; landing gear shock struts with pipethread grease fittings, clevis pin joints and shrink fit parts.
5. Fretting Corrosion takes place when two parts rub together, constantly exposing fresh active metal to the corrosive effects of the atmosphere.
6. Filiform Corrosion is the appearance of numerous meandering threadlike filaments of corrosion on the surface of various types of metal.

CONDITIONS AFFECTING CORROSION.

Some conditions which affect the occurrence of corrosion are:

1. The environmental conditions affect the corrosion characteristics. A hot, humid climate increases corrosion. One of the worst conditions would be allowing the aircraft to be constantly exposed to the corrosive elements found near the ocean.
2. Different metals and their sizes affect resistance to corrosion.
3. The foreign materials which most frequently contribute to corrosion are:
   - A. Soil and atmospheric dust.
   - B. Oil, grease and exhaust residues.
   - C. Salt water & salt moisture condensation.
   - D. Spilled battery acids & caustic cleaning solution.
   - E. Welding, brazing and soldering flux residue.

A clean aircraft will resist corrosion better than a dirty one. Cleaning frequency depends on several factors (such as geographical location, type of operation, etc.). Soil should be removed as soon as possible, especially when it is on a high temperature area.

After cleaning, insure that no cleaning solution remains in any holes, crevices or joints, as it may lead to increased corrosion. Also, all exposed areas (landing gear, flap tracks, control surface, hinge parts, etc.) should be lubricated after cleaning.

INSPECTION.

Corrosion should be inspected for at every inspection. In trouble areas, the inspection frequency should be increased.

In addition to routine inspections:

1. Aircraft operating around a marine environment should be given special checks on a weekly basis.
2. Aircraft operating in semi-acid condition should be inspected monthly.
3. Inspections for corrosion should be performed by personnel familiar with corrosive problems and their remedies as follows:
   A. Daily and preflight inspections should include the engine frontal areas, all intake vents, engine compartment, gaps, seams, and faying surfaces in the exterior skins, wheel and wheel well areas, battery compartments, fuel cell and all other drains, and any bilge areas not requiring extensive removal of inspection access covers.
   B. Detailed inspection should include the above referenced areas along with areas requiring removal of screw attached inspection plates and panels to thoroughly inspect the internal cavities of the aircraft.
4. During inspection remember that paint tends to hide corrosion in its initial stages. However, the results of corrosion can sometimes be seen as blisters, flakes, chips and other irregularities in the paint.

CORROSION REMOVAL AND CONTROL.

Corrosion cannot be prevented or eliminated on aircraft; it can only be reduced to an acceptable level by proper control methods.

All corrosion products must be removed prior to refinishing. If they are not removed, corrosion will begin again, even though the affected area is refinished.

Before beginning any rework:

1. Position the airplane in a wash rack or provide some type of washing apparatus for rinsing of all surfaces.
2. Connect a static ground line to the airplane.
3. Remove the airplane battery if required.
4. Protect the pitot-static ports, engine openings airscoops, louvers, wheels, tires and other portions of the airplane from moisture and chemical brightening agents.
5. Protect the surfaces next to the rework areas from chemical paint strippers, corrosion removal agents and surface treatment materials.

An evaluation of the corrosion damage is necessary to determine the type and extent of repairs required. The following are general guidelines:

1. Light Corrosion: discoloration or pitting normally removed by light hand sanding or a small amount of chemical treatment.
2. Moderate Corrosion: similar to light corrosion except there could be some blistering or evidence of sealing and flaking; removed by extensive hand sanding or mechanical sanding.
3. Severe Corrosion: similar to moderate corrosion with severe blistering, exfoliation, sealing and/or flaking; normally removed by extensive mechanical sanding or grinding.

—CAUTION—

Removal of severe corrosion may be deemed as a major repair. The repair must be approved by the FAA upon completion.

There are several methods for removing corrosion; chemical treatment; hand sanding with abrasive paper or metal wool; and, mechanical sanding or buffing with abrasive mats or grinding wheels. The method selected depends on the type and extent of the corrosion.

Depressions resulting from rework must be faired into the surrounding surface.

The depth of materials removed should not exceed the safe limits.

Reprotecting the surface after corrosion removal is very important. It should be done as soon as the repair work is finished. The surface should be protected in the same manner as the original surface was protected unless the manufacturer recommends some other procedure or protective coating.

CHART 2003. TYPES OF METAL CORROSION

Type of Material	Type of Corrosion	Remedy**
Steel	Rust*	Complete removal of corrosion by mechanical means.
Aluminum	White to grey powdery material.	Mechanical polishing or brashing with material softer than aluminum
Magnesium (highly susceptible to corrosion).	White powdery snow-like mounds and white spots.	
Cadmium (plating)	White to brown to black motting of surface (plating is still protecting until iron appears).	Mechanical removal of corrosion should be limited to metal surfaces from which the cadmium has been depleted.
Chromium (plating)	May pit in chloride environment	Promotes rusting of steel where pits occur in the coating.

* Red rust generally shows on bolt leads, hold-down nuts and other aircraft hardware. Its presence in these areas is generally not dangerous. However, it is indicative of a need for maintenance and also of the possibility of corrosive attack in more critical areas.

Any corrosion on the surface of a highly stressed steel part is potentially dangerous. A careful removal of corrosion product using mild abrasives (rouge or fine grit aluminum oxide paper) is necessary, using care not to overheat the metal when removing the corrosion.

**For abrasion, do not use dissimilar materials (ex. steel on aluminum). Remove only the material required to clean up the affected area.

AREAS PRONE TO CORROSION.

Certain areas are more prone to corrosion than others. The following list is intended to be a general guide to areas where corrosion is frequently found.

1. Areas around steel fasteners are susceptible to corrosion. The paint on these areas cracks which allows moisture to seep in and corrode the under-lying metal. Each time the fastener is removed, it should be coated with zinc chromate before reinstallation. The paint should be wet when fasteners are installed. See Figure O.
2. Fluids tend to seep into faying surfaces, seams and joints due to capillary action. The effect of this type of intrusion is usually detectable by irregularities in the skin's surface.
3. Spot welded assemblies are particularly prone to corrosion. The only means to prevent this type of corrosion is by keeping potential moisture entry points in the spotweld filled with a sealant or preservative compound .
4. Areas which are exposed to exhaust gases may have their finish damaged by deposits. These deposits may result in an aggressive attack on the metal by corrosion. Heat from the exhaust may also blister or otherwise damage the paint. Gaps, seams, hinges and fairings are some places where exhaust gas deposits may be trapped and not reached by normal cleaning methods.
5. The wheel well and landing gear are the most exposed parts of the aircraft. Due to the complexity of its shape, maintaining a protective coverage is difficult. The especially troublesome areas are: magnesium wheels, around boltheads, lugs and wheel well areas; exposed rigid tubing, B-nuts, ferrules: under clamps and tubing identification tape; exposed position indicator switches and other electrical equipment; crevices between stiffners, ribs and lower skin surfaces.
6. Flaps, flight control slots and equipment installed in these areas may corrode unnoticed unless a careful surveillance is maintained.
7. Engine frontal areas, air inlet ducts and the leading edge of wings, because they are constantly exposed to abrasion by dirt, dust, gravel and rain, should be checked frequently for the beginning of corrosion.
8. Hinges (piano hinges especially) are extremely vulnerable to corrosion due to the wearing away of their protective coating and their being a natural trap for dirt, salt and moisture.
9. Control cables may have bare spots in their preservative coating which could lead to corrosion. Cables having external corrosion should be checked for internal corrosion. If internal corrosion is present, replace the cable. If only external corrosion is present, remove corrosion with a wire brush and recoat cable with preservative.
10. Any area where water may be trapped is a trouble spot for corrosion. Drain holes should be checked and cleaned regularly.
11. Battery compartment and vent openings are particularly prone to corrosion due to spilled electrolyte. Fumes from overheated battery electrolyte will spread to adjacent areas and cause rapid corrosion of unprotected surfaces. Frequent cleaning and neutralization of deposits will minimize corrosion from this cause .
12. Due to magnesium parts being prone to corrosion, special attention should be given to their surface treatment, proper insulation (due to dissimilar metal corrosion) and paint coatings.
13. Electrical components and connectors should be checked. Their inspection frequency should be based on their operational environment and past trouble with them.
14. Skin joints and lap-overs are two areas which may contain moisture. Corrosion in these areas may go unnoticed unless particular attention is paid to them during inspection.
15. Hoses having an internal wire braid which are located in a position where they are frequently water soaked need a protective treatment.
16. Drilled holes and the trimmed end of sandwich panels should be protected. An inhibitor solution and / or sealant application is recommended. Any gaps or cavities which allow dirt or moisture to enter should be filled with a sealant.

PAINTING.

This section contains descriptions and instructions for the various types of finishes used on Piper Aircraft. Also contained are suggestions which would aid the mechanic or painter in achieving good results when applying these finishes.

Before proceeding with any of the steps outlined in this chapter, determine the correct type of paint used on the aircraft. The paint type may be found in the aircraft's log book, Parts Catalog or the Pilot's Operating Handbook.

PAINTING SAFETY.

The overspray from certain enamels, if swept up and put in a pail of water, can catch fire by themselves. Keep all overspray residue in covered containers away from the buildings where spraying is done. Wash out thoroughly rags and sponges which have been used to apply one of the phosphoric acid conversion coatings such as Alodine before throwing them away. If the material is allowed to dry in the rag, there will be a danger of it catching fire from spontaneous combustion.

Use an air drill only when mixing dopes or lacquers. Mixing with an electric drill is a fire hazard. It is possible that the fumes may be ignited by the arcing drill motor.

If there ever is a fire in a can of paint, immediately cover the can; drop the lid back on it, use a piece of cardboard, or whatever is handy. Almost any kind of cover will either smother the fire, or at least contain it, until a fire extinguisher can be brought to the can.

Another safety factor is the importance of proper air movement in the spray area. A properly designed spray booth has an air movement system that not only keeps the air circulating but removes all of the solids and solvents. Since all the materials used in painting are heavier than air, the exhaust system for the booth should be near the floor. If spraying in an area not designed primarily as a spray booth, at least be sure there is enough air movement to leave no more than a mild odor of the finish material while spraying. A heavy concentration of fumes is dangerous. It creates a possible fire hazard and an excessive concentration of fumes will deplete the oxygen supply required by the operator.

—CAUTION—

Do not allow paint stripper to come into contact with any fiberglass reinforced parts such as radomes, radio antenna, wing parts or wing tips. Fiberglass structures may be finished with acrylic lacquer or polyurethane enamel.

SANDING.

Before sanding, first clean the surface thoroughly. When hand sanding an area, the first item to have is the proper grade of wet or dry sandpaper. A coarse sandpaper will remove paint faster, but it will also leave sandscratches which may show up on the finish coat. The paint manufacturer should have the recommended grade of sandpaper included on the can's label.

Do not use a back-and-forth motion when sanding. Use a circular motion. Circles of about 6 inches in diameter are good if there is enough room for them on the surface.

If a circular motion can't be used, do not sand in a straight line with the fingers pointing in the direction of the strokes. Tilt your fingers at an angle to the direction of the stroke. This allows the pressure areas beneath your fingers to overlap each other.

When using an air sander, keep the sanding pad as level to the surface as possible. Try different combinations of pressure and speed to find which is correct for the job. Use the entire pad for sanding, not just the edge as this will clog up or wear out the grit on the edge.

PAINT APPLICATION.

When masking the aircraft prior to the application of paint strippers, etc., ensure that the windshield is thoroughly protected. (Refer to Cleaning - General.) A large majority of paint strippers, metal brighteners and solvents will either attack the exposed sealant, the anti-static coatings on the glass, or the exposed plastic. Contact with these materials may damage the windshield to the point of replacement being necessary.

—WARNING—

Aircraft should be grounded before painting to insure that no static electricity charges could build up and discharge.

—CAUTION—

Movable control surfaces should be balanced after painting. Refer to appropriate sections in Maintenance manual.

Before force drying at elevated temperatures, insure that all fuel tank vents are unobstructed and will not result in expanded fuel spilling over the newly painted surfaces or on to the paint booth floor.

—NOTE—

Do not paint pitot tubes, gas caps, or antenna covers that were not factory painted.

Metallic paints should not be used on radar nose cones or antenna covers.

Do not allow silicone lubricants to come into contact with any surfaces which are to be painted, as the lubricant is very difficult to remove completely.

The biggest mistake when using pressure-fed equipment is getting too much finish on the surface and having it run or sag. Use low enough air pressure at the pot to get just enough material to do the job. Then all the air pressure needed at the gun is only that which is sufficient for proper atomization. To get the proper pressures, begin with 35-40 PSI on the gun and bring the fluid pressure up to match the air pressure, instead of bringing the air pressure up to match the fluid pressure. Six or eight PSI is enough pressure on the pot for most acrylic lacquers. Do not exceed 10 PSI unless there is excessive line loss in the hose. Using low pressure should prevent air impingements, runs and sags. Pressure on a pressure cap or suction cup gun may vary from 20-55 PSI.

SPRAY PATTERNS.

Be sure the paint is thinned sufficiently. Do not exceed paint manufacturer's specifications. The use of a Zahn cup and stop watch is recommended to check the viscosity.

Malfunctions. Spitting may be caused by a dried out packing around the material needle valve (lubricate with a few drops of light oil), dirt between the body of the gun and the fluid nozzle seat or a loose or defective nut attaching the gun to the suction cup. Refer to Figure 20-6.

1. Normal spray pattern. Width is determined by amount of air flowing out of wing ports. When increasing width, increase the amount of material to get a proper coverage.
2. Insufficient atomizing air pressure. To correct the condition, increase the air pressure to the gun.
3. Excessive atomizing pressure or else attempting to get too wide a pattern with this material. To correct this condition, increase the amount of material and decrease the amount of air from the wing ports.

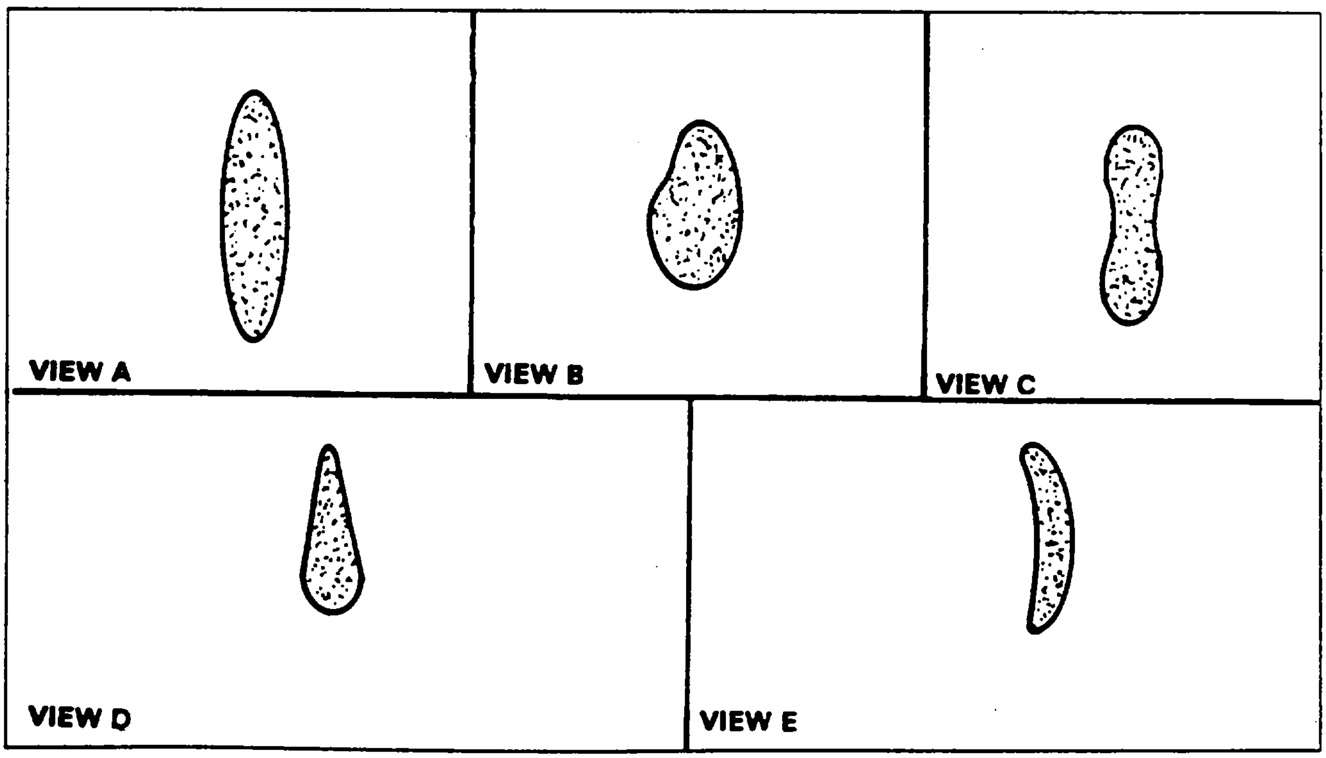


Figure 20-6. Spray Patterns

4. Indicates material build-up around one side of the fluid nozzle which cuts off the flow of atomizing air to one side of the pattern. To correct this condition, remove air nozzle and soak in thinner. A damaged or loose fitting nozzle will cause this defect.

—CAUTION—

Do not probe with wire or metal scraper, as this will scratch and damage these passages.

5. One of the wing portholes is plugged up. To correct this condition, remove the air cap and soak it in thinner and blow the passages out with compressed air.

CLEANING SPRAY GUN.

Always clean the gun after use. First empty and clean the pot (or cup) and fill with thinner. (Insure that the hose between the pot and gun have been emptied back into the pot by loosening the gun's air cap and the pressure pot lid, holding cloth over the gun's nozzles and triggering the gun, thus forcing the material back into the pot.) Spray thinner through the gun until the thinner appears clear.

—NOTE—

Remove pressure from equipment before beginning cleanup.

Then soak only the nozzle in thinner to further clean the head. Lubricate the air valve stem and all the packings with light oil. Tighten packing nuts finger tight only.

—CAUTION—

Do not allow material to remain in gun after use. However, if the passages should become plugged up with acrylic lacquer, disassemble the gun and soak the parts in acetone or MEK. If passages should become plugged up with polyurethane or epoxies, discard the hoses and clean the passages by digging the material out if possible.

SPRAY TECHNIQUES.

Select the proper gun, fluid tip, needle, proper air pressures and fluid viscosity for the material being applied.

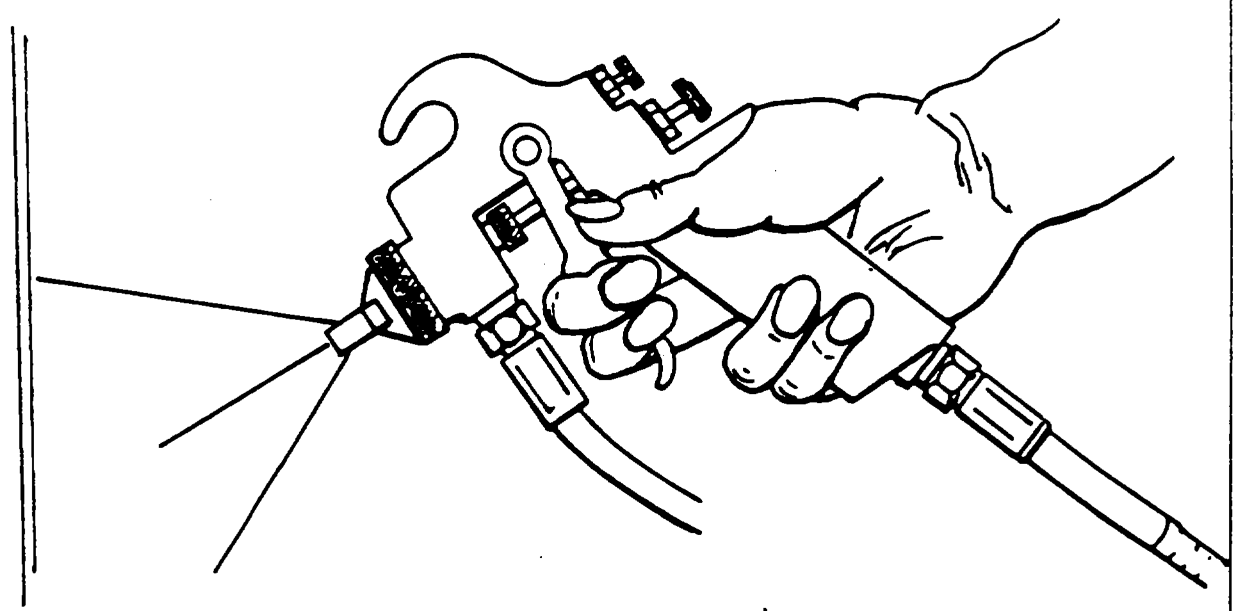
The nozzle of the gun should be held between six and ten inches from the surface, depending on the material.

The gun should be held perpendicular to the surface so the material will spray out in an even pattern. If the gun is tilted or tipped, Figure 20-7, the pattern will be heavier on the side nearest the gun, and dry and rough on the side farthest from the gun.

Move the gun parallel to the surface being sprayed. Begin the stroke, then pull the trigger. Release the trigger before completing the stroke, Figure 20-8. If the gun is arced when spraying, the surface will be uneven; heavy where the gun was nearest the surface and thin where the spray arced away.

Before starting to lay the film of paint over the flat part of the structure, cut in the edges and corners. This is done by spraying along the corner which gives the thickest coat along the edge and blends out in the flat portion, Figure 20-9.

A single layer of material laid on the surface by one pass of the gun will be typically about 10 to 12 inches wide, thicker in the middle and tapering off at each end. In order to get a good, even build-up of finish, spray on the first pass; then come back with the gun on the return pass, overlapping all but about two or three inches of this first pass. The third pass will overlap all but about two or three inches of the second. Continue this overlap and the resulting finish will be a nice even film with no runs or sags.



IF THE GUN IS NOT HELD PERPENDICULAR TO THE SURFACE, ONE SIDE OF THE SPRAY PATTERN WILL BE WET WITH A TENDENCY TO RUN, AND THE OTHER SIDE WILL BE ROUGH AND DRY.

Figure 20-7. Improper Spray Technique

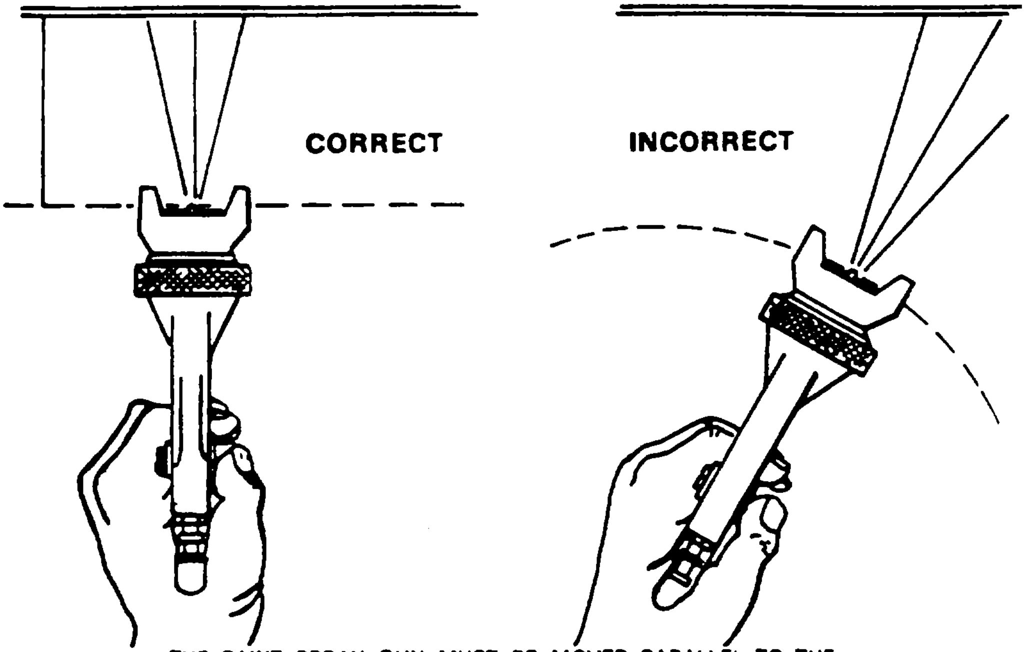


Figure 20-8. Spray Technique

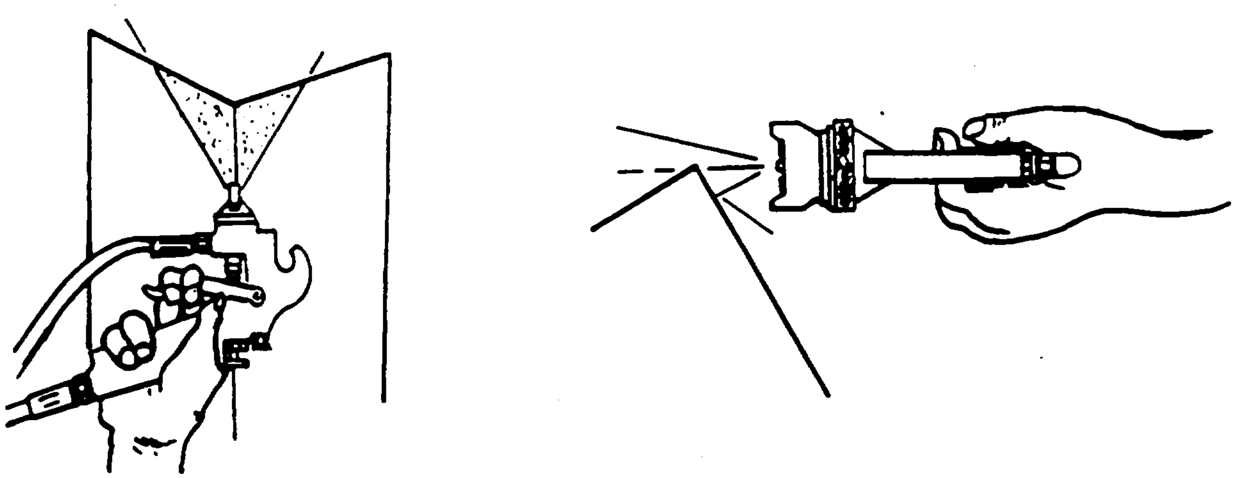


Figure 20-9. Spraying Corners

AIRCRAFT PAINTING SEQUENCE.

In painting an airplane, considerable planning should precede the actual shooting. Position the airplane in the booth in such a way that the airflow will be from the tail toward the nose so that you can paint in this direction and the overspray will be ahead of you. In a down-draft booth, center the aircraft under the air inlets so that all outlets will exhaust overspray.

If possible, have two painters work simultaneously on opposite sides of the airplane, working away from each other. In this way, the overspray problems will be minimized.

First, paint the ends and leading edges of the ailerons and flaps; then, the flap and aileron wells, the wing tip and leading and trailing edges. Paint difficult areas such as landing gear, wheel wells (etc.) first, before going on to flat surfaces.

Paint the bottom of the airplane first, using a creeper for the belly and the bottom of low wing airplanes. Prime the bottom of the horizontal tail surfaces first, starting at the root and working outward, spraying chordwise. Then work up the fuselage, allowing the spray to go up the sides. Work all the way up to the engine. Spray the bottom of the wing with each painter starting at the root and working toward the tip, spraying chordwise.

Jack up the nose of the airplane to lower the tail enough to allow the top of the fin to be reached. Both painters work together with one slightly ahead of the other so they will not spray each other. When spraying the top of the fuselage, tilt the gun so the overspray will be ahead of the area being painted and the new material will wipe out the overspray. Spray primer across the fuselage, and spanwise on the vertical and horizontal tail surfaces and the wing.

After the primer has cured for the proper time and is ready to receive the top coats, the same sequence is used to spray on the finish. Spray the tack coat on the bottom surfaces starting at the center of the fuselage and spraying across it, then out the horizontal surfaces spanwise. Spray the tack coat on the top of the aircraft lengthwise on the fuselage and chordwise on the surfaces.

Spray the final coat on, using the same sequence and direction as the prime coat. Spray the bottom of the fuselage crosswise and the wing and tail surfaces chordwise. Spray the top of the airplane across the fuselage and spanwise on the wing and tail surfaces.

It is often impossible to reach completely across the top of the wing, so spray as far as you can reach while working from the root to the tip, along the trailing edge; then walk around the tip and work back toward the fuselage. Keep the gun tilted back so the overspray will not fall on the rear half of the wing where the paint has hardened to such a point that the overspray will not blend in.

Spraying on a coat of acrylic lacquer with an excess of solvents can be used to wash out acrylic overspray. This softens the film and allows the overspray to sink into the finish. Dried overspray from any material other than polyurethane can be "burned down" or "washed out" by spraying a mixture of one part retarder and two parts thinner on the surface while the overspray and base finish are still fresh. This mixture will soften the surface enough to allow the overspray to sink in and allow the surface to gloss. Enamel overspray does not usually present the problems of lacquer or dope, since it has a much slower drying rate. The overspray can sink into the finish while it is still wet.

COLOR MATCHING.

—NOTE—

See aircraft logbooks for color codes.

—WARNING—

Use an air drill motor. Do not use an electric drill with an agitator attachment. This stirs up flammable fumes which may be ignited by the sparking brushes in an electric motor.

If there should be a fire in the container, cover the container to smother out the fire or to control it until a fire extinguisher can be brought to the can. Do not attempt to carry the burning can outside.

To get a proper color match, use the same type of paint as originally used and insure that it is thoroughly mixed. Use either a mechanical shaker for 15 minutes, or if no shaker is accessible, use the following steps:

1. Pour off half of the can of material into a CLEAN can of the same size as the one you have just opened.
2. Stir or shake the remaining material until EVERY BIT of the pigment is in suspension. This is important with any finish, but especially so with the metallics.
3. Pour all of the paint from the first can into the second can and carefully examine it to be sure all pigment has been loosened from the bottom.
4. After being certain that every bit of the pigment is in suspension, "box" the material by pouring it back and forth between the two containers until it is THOROUGHLY mixed.

If unable to get a color match using standard methods, there are three components which may be varied:

A. The spray pressure.
B. The amount of thinner.
C. The number of coats.

If metallic material is applied wet and / or heavy it will be dark and will have a tendency to be dull. If it is applied light or dry, it will be too light colored and too bright or too metallic looking. Changing the spray techniques or the air pressure will change the color.

POLYURETHANE PAINT SAFETY.

When using polyurethane paints, certain safety precautions and attention to health hazards must be observed.

1. During transit and storage observe for signs of a bulging can, emission of other than normal odor, or a change in the resin from a clear to cloudy state. This defect results in the slow buildup of carbon dioxide in the cans which could cause the can to burst. Any cans found to be defective should be removed and disposed of with caution.
2. Always insure adequate ventilation and/or wear an appropriate breathing protection facemask when painting.

3. Health Hazards. Polyurethane paints can produce irritation of the skin, eyes, and respiratory tract during mixing and application. Personnel exposed to the vapors and mists produced during spray application may have difficulty in breathing, dry cough, and shortness of breath.
4. Protection Equipment. Production type mixing and spray painting operations should be conducted in specially designed, exhaust-ventilated areas, using personal protective equipment as follows:
   A. A well-fitted respirator with fresh cartridges inserted daily.
   B. Solvent-resistant gauntlet style gloves.
   C. Safety goggles.
5. Painters should be fully clothed with collars buttoned and sleeves taped at the wrist.

DIFFICULTIES WITH POLYURETHANE.

Due to polyurethane's high content of solids, there are a few difficulties encountered in its application. A light tack coat is sprayed on first, then allowed to sit for about fifteen minutes. Then a full wet coat is sprayed on. This may not appear to cover the area and may cause the painter to spray on another coat. Since polyurethane is so slow flowing, this second coat will probably run or sag. The same will happen if the paint is applied to a cold skin when the air is warm.

The pressure pot should have a slow moving agitator to keep the pigments from settling out during spraying. A fast agitation creates tiny air bubbles which are carried to the surface being sprayed.

High temperatures cause polyurethane to cure rapidly; while low temperatures allow a longer flowing-out time. The temperature of the metal should not be much lower than 50° to 60° F when spraying.

High humidities also accelerate the cure, but if the humidity is excessive, the finish will have millions of microscopic air bubbles entrapped in it.

An excessively heavy coat of finish will cause gassing in the curing process and the surface will contain all of the tiny holes that result from this gas.

APPLICATION OF POLYURETHANE.

1. DuPont Imron Method.
   A. Remove old finish with commercial grade paint remover.

—NOTE—

Do not allow stripper to come into contact with fiberglass. Refer to step D for finish removal on fiberglass parts.

—CAUTION—

Always wear protective goggles and rubber gloves when using a paint stripper. Wash strippers off skin immediately. If stripper comes into contact with eyes, flood repeatedly with water and CALL A PHYSICIAN.

B. Rinse thoroughly with water (pay particular attention to rivets and seams).
C. Wipe with Methyl Ethyl Ketone.

If finishing fiberglass parts proceed to step D, for aluminum parts proceed to step E, for magnesium parts proceed to step F.

D. For fiberglass parts, remove old finish by sanding followed by wiping with MEK. Proceed to step G.
E. For aluminum parts, clean and condition metal with step A, 225S cleaner, follow with step B 226S conversion coating. Proceed to step G.
F. For magnesium parts, apply step B226S conversion coating (diluted with 6 parts water). Rinse and dry.
G. Prime surface to be painted with Corlar Epoxy Primer or Multi-Purpose Primer Surfacer.
H. Allow to dry at least 4 hours before topcoating.
I. Sand; then wipe with 3812S Reducer.
J. Tack wipe surface to be painted before applying topcoat.
K. Mix enamel as per manufacturer's directions.
L. To apply solid colors, use 50 PSI at the gun for siphon equipment. Spray a medium first coat, allow to tack up and follow with a full second coat.
M. To apply metallic colors, use 65 PSI. Apply a light medium tack coat. Allow to set up for 20 minutes. Repeat for a second coat. Then reduce 15% with 8485S (17-18 seconds in a #2 Zahn cup) and apply a third light medium coat. Another light medium coat of the reduced paint may be added. After drying, this may be clear coated with 500S clear.

—NOTE—

Drying time with 1895 accelerator is 2-4 hours tape-free. Without accelerator 6-10 hours tape-free. For fisheyes use 259S Imron Additive (2-4 oz. 1 gal.). Don't use FEE (Fisheye Eliminator).

N. Clean equipment promptly with DuPont lacquer thinner or 8485S Reducer. Do not leave mixed paint in equipment.

—NOTE—

Recoating may be done at any stage of drying. Striping, lettering or decals may be applied when tape-free (See "NOTE" under step "M"). If film has cured over 72 hours, scuff sand before recoating, striping, lettering or applying decals. Don't scuff sand metallic coat when clear coating with 500S.

—CAUTION—

Keep paint away from heat, sparks and open flame. Avoid prolonged or repeated breathing of vapor or spray mist and contact with eyes and skin. Keep container closed when not in use. Wash hands thoroughly after using and before eating or smoking. USE ONLY WITH ADEQUATE VENTILATION.

—WARNING—

BREATHING OF VAPOR MAY CAUSE IRRITATION. CONTAINS LEAD. DRIED FILM OF THIS PAINT MAYBE HARMFUL IF INGESTED.

—WARNING—

When mixed with 192S, the mixture will have the hazards of both components. Observe all applicable label precautions. FIRST AID: In case of skin contact, flush with plenty of water, for contact with eyes, flush with plenty of water for 15 minutes and get medical attention. If affected by inhalation of vapor, remove the victim to fresh air. If swallowed, CALL A PHYSICIAN IMMEDIATELY. Induce vomiting.

2. Ranthane Method.
   A. Clean surface and lightly etch with Rand-O-Prep.
   B. Flush with water, dry and wipe surface with MEK or acetone.
   C. Mix Ranthane Primer according to manufacturer's directions. Reduce with 1 1/2 parts Ranthane Primer Reducer and age this mixture for 20 minutes. Re-stir.
   D. Spray light even coat. Allow to dry at least 1 hour. (Primer must be topcoated within 48 hours).

—NOTE—

Use primer within 6 hours of mixing. Discard any remaining mixture.

   E. Mix Ranthane color according to manufacturer's directions and apply within 48 hours of priming. Spray one very thin mist coat. Let dry 15 minutes, then apply a full wet coat and allow to dry. May be taped after curing for 5 hours.

—NOTE—

Use mixed colors within 4 hours; Discard any remaining mixture.

   F. Trim and lettering may be applied within 48 hours. If later than 48 hours, sand, rinse and dry before application.
   G. Rework should not be attempted before 16 hours of curing. Sand area with #400 wet sandpaper, rinse and dry. Follow step E.
   H. For repainting, all previous old coatings (if they are not Ranthane coats) must be removed. Wash surface with commercial aircraft cleaning compounds, then rinse with water. Wipe with MEK or acetone. Apply Randolph Rand-O-Prep. Flush with water and dry. Wipe with MEK or Acetone. Repeat steps C, D, E and F. Allow finish to cure for one week before compounding if this is desired.

—NOTE—

Do not leave mixed material in spray equipment. Clean all equipment the same day, wash with M.E.K

—CAUTION—

Avoid prolonged skin contact use only in a well ventilated area, avoid inhalation of the overspray. Solvents are flammable.

I. To refinish areas previously covered with Ranthane, wash thoroughly area to be refinished. If stripping is necessary, (for inspection) use Rand-O-Strip B-5000. If the surface has been stripped, prime with Ranthane Primer according to step C and D.

J. If previous coat hasn't been stripped and removed, thoroughly wash and then water sand the previous coating with 380 or 400 wet sanding paper. Wash, dry and repaint according to step E.

—NOTE—

All measurements mentioned in the following instructions are by volume only.

3. Alumigrip Method.
   A. Zinc Chromate Wash Primer - Thoroughly mix one part each of zinc chromate wash primer and acid reducer. If blushing is encountered during application, add one part of retarder to the previous solution .
   B. Urethane Primer - Thoroughly mix two parts urethane primer and one part primer catalyst. Thin as required with urethane thinner. The recommended viscosity is 18 to 20 seconds using a number 2 Zahn Cup.

—NOTE—

If cratering is encountered during application, anti-crater solution may be added to the primer solution, (not to exceed one ounce per gallon of catalyzed, thinned primer solution).

Allow catalyzed primer to stand for a minimum of thirty minutes before application.

   C. Urethane Enamel - Thoroughly mix equal parts of urethane enamel and enamel catalyst. Thin as required with enamel thinner. Recommended viscosity is 18 to 22 seconds using a number 2 Zahn cup. For cratering refer to "NOTE" in previous step.

Allow catalyzed enamel to stand for thirty minutes minimum prior to application.

   D. Surface Preparation - After removing old finish, if any, clean areas to be painted with ScotchBrite pads and water. Follow this by wiping clean with water or an appropriate solvent. Prior to application of primer wipe the areas with M.E.K. and clean rags.
   E. Primer Application - Coat parts to be painted with zinc chromate wash primer solution followed by a coat of urethane primer solution. Coat fiberglass parts only with urethane primer solution.

Allow the zinc chromate wash primer to dry 30 minutes minimum before applying the urethane primer.

Allow the urethane primer to dry two to four hours before applying urethane enamel.

—NOTE—

Longer drying times may be needed as temperature and humidity vary.

F. Urethane Enamel Application - If urethane primer coat is older than 48 hours, lightly sand it prior to the application of the urethane enamel.

4. Titanine Polyurethane Method.

—NOTE—

All measurements mentioned in the following instructions are by volume only.

A. Surface Preparation - After removing old finish, clean surfaces to be painted with Scotch-Brite pads and water. Wipe clean with water or an appropriate solvent and clean rags. Clean exterior skins with an alkaline cleaner, followed by Alodine 1200. Wash out all rags used with Alodine before disposing of them. There is a danger that they may catch fire from spontaneous combustion.

—NOTE—

In all cases, it is important to apply the coating quickly after cleaning.

B. Prime - Thoroughly mix 4 parts primer, 1 part primer catalyst and 2 parts primer reducer. Allow to stand for thirty minutes and then remix before use.

C. Polyurethane Enamel - Thoroughly mix 1 part enamel catalyst, 1/2 part enamel reducer (except when using flat black; then increase enamel reducer to 2 parts), and 4 parts urethane enamel. Allow to stand for 15 minutes then remix before use.
Thin as required with enamel reducer. Recommended viscosity is 38 to 40 seconds using a number 1 Zahn Cup.

D. Refinish - Installation of pressure - sensitive decals, placards and tapes on Titanine Polyurethane finish.
Affix all pressure - sensitive decals, placards and tapes after the application of the finish coating. Install the pressure sensitive item between four and seven hours after the application of the final coating. When possible, install the pressure sensitive item during the 5th or 6th hours after the final coating.

5. Ameron Method.

A. Clean the surface to be coated before chemical conversion treatment and priming.

—NOTE—

For best results, apply the epoxy primer to wash primed or Alodined surfaces.

When wash primer is used, it must be overcoated with epoxy primer.

B. Mix zinc chromate wash primer to manufacturer's directions. The application should result in a smooth low glass continuous film. Allow to dry 30-45 minutes to 75°F.

C. Mix intermediate epoxy primer to manufacturer's directions. Thin 20-30% by volume with MX-15 thinner. Air dry 4-6 hours at 75°F or force dry 2-3 hours at 125°F before top coating with Jet-Glo.
D. Tack wipe surface before applying topcoat.
E. Mix Ameron Jet-Glo polyurethane enamel to manufacturer's directions. Reduce with 110-655 thinner to a viscosity of 17-20 seconds using a No. 2 Zahn Cup at 75°F.
F. Apply Jet-Glo to a spreading rate of approximately 300 sq. ft./gal. to attain a 2.0 mil. dry film thickness. A recommended pot pressure of 10-13 PSI and an atomizing airpressure of 50-60 PSI are suggested as a starting point. Best results are obtained with a three coat application consisting of a good tack coat, followed by a medium wet coat and a full finish coat.
G. Allow Jet-Glow to air dry 12-14 hours at 75-80° or force dry 4-6 hours at 125° F to obtain a tape free condition.

—NOTE—

Ameron Accelerator 110-975 using a level of 1/2 oz. per 1/2 gallon of color (mixed) will air dry stripes in approximately 2 hours. This will allow double-striping the same day.

DIFFICULTIES WITH ACRYLICS.

The hiding quality of acrylics is poor and the tendency is to spray it on too thick. If the lacquer is too viscous for proper spraying, excessive air pressure must be used.

If the acrylic film is sprayed on too thick, it may produce a glassy surface, but it may appear hazy if viewed from the side instead of directly. This is due to tiny air bubbles being introduced into the paint by excessive air pressure.

To prevent this, thin the acrylic lacquer at least in a ratio of four parts of color to five parts of thinner. This may seem too thin but it is necessary to keep the air pressure low enough to prevent formation of air bubbles. Multiple thin coats should be used instead of fewer coats of thick paint.

APPLICATION OF ACRYLICS.

1. Randacryl Method.
   A. For applying Randacryl to enamel finished surfaces, first strip all the enamel finish from the surface with Rand-O-Strip B-5000. Apply one thin, wet coat of Randolph Wash Primer, Epibond or Rand-OPlate Primer. Allow to dry overnight. Proceed with step B.
   B. For applying Randacryl to acrylic finished surfaces, first rub the surface with clean dry Kraft Paper (first making sure that the surface is thoroughly cleaned).
   C. Tack rag, then apply three coats of properly thinned Randacryl allowing one-half hour drying time between coats. The gloss of the final coat can be improved by adding Y-9910 Universal Retarder (in the proportion of 1/4 of the thinner used).
   D. Allow an overnight drying period before applying trim or lettering if retarder has been used. Remove tape as soon as the trim or letters have been applied.

E. To touch up a small area, first wash the area thoroughly. Remove all wax, grease and dirt. Sand area lightly and apply a coat of zinc chromate primer to bare metal.

—NOTE—

When coating over an unknown finish with Randacryl, test paint a small area before proceeding.

F. Repeat steps B, C and D.

—NOTE—

Randacryl is not intended for use on fabric or directly over enamels. Rand-O-Plate and Epibond have been used as a sealer coat overaged "air dry " enamel surfaces prior to coating with Randacryl. This procedure quite often satisfies touch-ups for small sections.

2. Enamel System for Metal - On the clean metal, spray one coat of RANDOLPH Wash Primer, Rand-O-Plate or Epibond Primer. After it is dry, spray one very light mist coat of RANDOLPH Enamel over the primed surface. Follow in 15 to 20 minutes with one normal coat of enamel. Enamel should dry at least 48 hours before masking for lettering.

TRIM AND REGISTRATION NUMBERS.

When an aircraft is being painted, apply the predominant color first over the entire surface. Apply the trim colors over the base color after it dries. When the top of the fuselage is to be painted white with a dark color adjoining it, apply the light color and feather it into the area to be painted with the dark color. When the light color has dried, place masking tape and paper along the line of separation and spray the dark color on.

Allow the paint to dry for several hours before removing the masking tape. Remove the tape by pulling slowly parallel to the surface. This will reduce the possibility of peeling off the finish with the tape.

Registration numbers may be applied by either painting or affixing self-adhering plastic figures. They must be formed of solid lines using a color that contrasts with the background. The location and size of the identification numbers vary, depending on the size of the aircraft. The location and size may be found in the Federal Aviation Regulations.

PAINT SYSTEM COMPATIBILITY.

Before painting, determine what type of finish was used previously. Refer to the Piper Parts Catalog for the correct paint number and color.

To identify paint finishes, first apply a coating of engine oil to a small area of the surface to be checked. Old nitrocellulose finishes will soften within a period of a few minutes. Acrylics, Urethanes, and epoxy finishes will show no effects.

If not identified, next wipe down a small area of the surface in question with a rag wet with methyl ethyl ketone. MEK will pick up the pigments from an acrylic finish, but not from epoxy or cured Urethane coatings. Wipe the surface, don't rub. Heavy rubbing will pick up even epoxy and Urethane pigments from coatings that aren't fully cured.

The use of several different types of paint, coupled with several proprietary coatings, makes repair of damaged and deteriorated areas particularly difficult, since paint finishes are not necessarily compatible with each other. The following general rules for constituent compatibility are included for information and are not necessarily listed in the order of importance.

1. Old type zinc chromate primer may be used directly for touchup of bare metal surfaces and for use on interior finishes. It may be overcoated with wash primers if it is in good condition. Acrylic lacquer finishes will not adhere to this material.
2. Modified zinc chromate primer will not adhere satisfactorily to bare metal. It must never be used over a dried film of acrylic nitrocellulose lacquer.
3. Nitrocellulose coatings will adhere to acrylic finishes, but the reverse is not true. Acrylic nitrocellulose lacquers may not be used over old nitrocellulose finishes.
4. Acrylic nitrocellulose lacquers will adhere poorly to both nitrocellulose and epoxy finishes and to bare metal generally. For best results the lacquers must be applied over fresh, successive coatings of wash primer and modified zinc chromate. They will also adhere to freshly applied epoxy coatings (dried less than 6 hrs).
5. Epoxy topcoats will adhere to all paint systems that are in good condition. Epoxy may be used for general touchup, including touchup of defects in baked enamel coatings.
6. Old wash primer coats may be overcoated directly with epoxy finishes. A new second coat of wash primer must be applied if an acrylic finish to be applied.
7. Old acrylic finishes may be refinished with new acrylic if the old coating is thoroughly softened using acrylic nitrocellulose thinner before paint touchup.
8. Damage to epoxy finishes can best be repaired by using more epoxy, since neither of the lacquer finishes will stick to the epoxy surface. In some instances, airdrying enamels may be used for touchup of epoxy coatings if edges of damaged areas are first roughened with abrasive paper.

COMMON PAINT TROUBLES.

1. Poor Adhesion - Paint properly applied to correctly pretreated surfaces should adhere satisfactorily, and when it is thoroughly dry, it should not be possible to remove it easily, even by firm scratching with the fingernail. Poor adhesion may result from one of the following:
   - A. Inadequate cleaning and pretreatment.
   - B. Inadequate stirring of paint or primer.
   - C. Coating at incorrect time intervals.
   - D. Application under adverse conditions.
   - E. Bad application.
2. Spray Dust - Spray dust is caused by the atomized particles becoming dry before reaching the surface being painted and thus failing to flow into a continuous film. The usual causes are incorrect air pressure or the distance the gun is held from the work.

3. Sags and Runs - Sags and runs result from too much paint being applied, causing the film of wet paint to move by gravity and present a sagging appearance. Incorrect viscosity, air pressure, and gun handling are frequent causes. However, inadequate surface preparation may also be responsible.
4. Spray Mottle - Sometimes known as "orange peel" or "pebble", spray mottle is usually caused by incorrect paint viscosity, air pressure, spray gun setting, or the distance the gun is held from the work.
5. Blushing is one of the most common troubles experienced. It appears as a "clouding" or "blooming" of the paint film. It is more common with cellulose than synthetic materials. It may be caused by moisture in the air supply line, adverse humidity, drafts, or sudden changes in temperature.

STORAGE.

Paint, enamel, and other finishing material should be stored in a dry place away from direct sunlight and heat. Each container should have a code and color number identifying the material.

The storage facilities should conform to occupational safety and health act (OSHA) requirements regarding air circulation, lighting and fire protection. It should also be locked to prevent children and unauthorized personnel from getting inside.

Pigmented materials should be inverted at every inventory so that the pigments will not have as much of an opportunity to pack at the bottom of the can. Empty containers should be disposed of properly.

Because the useful life of some finishes is limited, use the older materials first.

Temperatures in the storage area should be approximately 50°-90°. If finishes are stored in temperature extremes, allow them to come to room temperature before using.

PAINTING FACILITY.

Painting facilities should conform to applicable local, state and OSHA standards with respect to air circulation, exhaust emissions, lighting and fire protection.

When spraying, there should be a sufficient movement of air in the painting area so there is no more than a slight odor of the finishing material. The exhaust fan should be belt-driven and located near the floor. The fan's motor should be located away from the fumes.

All personnel in the spraying area should wear approved respiration for their own personnel safety. It is not advisable to breathe the fumes as they deplete the oxygen supply required by the body.

WAXING.

Wax may be applied to the exterior of the aircraft after a minimum of ten days have elapsed since the last application of paint, enamel or lacquer.

Follow the wax manufacturer's recommendation concerning preparation application and environmental limitation. Also, the air temperature in the area should be 60° F minimum.

Polish the waxed surfaces within two hours after application.

Wipe all laps, seams and window collars in the direction of the seam to avoid wax buildup.

DECALS.

To insure the proper adhesion of decals, insure that all surfaces are clean and free of wax, oil, (etc.). Porous surfaces should be sealed and rough surfaces sanded, then cleaned to remove any residue.

1. Paper Decals - Soak paper decals in water for 1-3 minutes. Place one edge of the decal on the receiving surface and slide decal off of paper backing. Blot water from around the decal with a soft absorbant cloth. Remove bubbles trapped beneath the decal by wiping carefully towards the nearest edge of the decal with a cloth.

Coat decal with clear varnish to protect it from deterioration and peeling.

Paper decals can be removed by rubbing the decal with a cloth dampened with lacquer thinner. Use lacquer thinner sparingly if the decals are applied over painted or doped surfaces.

2. Vinyl Film Decals - Separate paper backing from vinyl film. Remove any bits of paper adhering to film by either rubbing with a clean water saturated cloth or by using a piece of masking tape.

Apply cyclohexanone or equivalent, to adhesive side of film. Position decal while adhesive is still tacky and apply to surface. Work a roller across the decal until all air bubbles are removed.

To remove a vinyl decal, place a cloth saturated with cyclohexanone or methyl ethyl ketone on the decals. Scrape with a Micarta scraper. Remove remaining adhesive with a cloth dampened with dry-cleaning solvent.

3. Metal Decals.
   A. Cellophane Backed.
      (1) Immerse in water for 1-3 minutes.
      (2) Remove and dry.
      (3) Remove cellophane backing.
      (4) Position on receiving surface. (For large foil decals, position center on receiving surface and work outward from center.)
      (5) Roll with rubber roller and press all edges firmly.
   B. Paper Backed.
      (1) Peel backing from decal.
      (2) Apply light coat of cyclohexanone.
      (3) Position and smooth as in steps 4 and 5 of cellophane backed decals.
   C. Metal Decals with No Adhesive.
      (1) Apply cement MIL-A-5092 to decal and receiving surface.
      (2) Allow cement to dry until tacky.
      (3) Apply and smooth down decal.
      (4) Remove excess adhesive with aliphatic naphtha.

To remove metal decals, moisten the edge of the decal with aliphatic naphtha and peel the decal off.

—END—

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CHAPTER

21

ENVIRONMENTAL SYSTEM

CHAPTER 21- ENVIRONMENTAL SYSTEM

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GENERAL.

This section contains information for the operation, service and overhaul of the combustion heater and combustion air blower (used with the heater). The instructions are organized so that the mechanic can refer to: Description and Principles of Operation, for a basic understanding of the system; Troubleshooting, for a methodical approach in locating the difficulty; Corrective Maintenance, for the removal, repair and installation of components; and adjustments and tests, for the operation of the repaired system.

HEATING.

TROUBLESHOOTING.

Troubles peculiar to the heating and ventilating system are listed in Chart 2101 along with their probable cause and suggested remedies.

DESCRIPTION AND PRINCIPLES OF OPERATION.

A 50,000 B. T. U. Janitrol heater, installed in the right nose section, furnishes hot air for cabin heating and windshield defrosting. Fuel is supplied from the right wing fuel cells only. The air inlet for the heater is located on the lower right side of the nose section. The air passes through the heater into the distribution box and then to the heater outlets and/ or the defroster outlets. Heat outlets are provided in the cockpit and cabin areas. The cockpit outlets are located below and at the end of the armrests. The cabin outlets are located below the full length air ducts along the floor. The defroster outlets are located in the instrument panel cover.

The heater is protected from overheating by a heat limit switch. If the heater temperature reaches a predetermined setting, the limit switch opens and the heater becomes inoperative. This is indicated by the illumination of the HEATER FAIL warning light in the annunciator panel. The heat limit switch will automatically reset when sufficient time is allowed for the heater to cool. By depressing the START/ RESET switch momentarily, the heater can be restarted. Heater restart is indicated by the HEATER FAIL warning light extinguishing after the START/RESET switch is released.

An additional scoop mounted on the bottom of the airplane draws fresh air into the cabin through individual vents at each seat. Each vent is adjustable for the desired airflow. A cabin exhaust outlet is located in the raised floor panel of the aft cabin area. The exhaust scoop is located-in the lower aft section of the fuselage just aft of the main cabin door. This outlet should be open when heater is operating. To aid in cabin ventilation during ground operation an optional ground ventilation fan can be installed aft of the cabin exhaust in the raised floor panel in the aft cabin area. An ON-OFF control switch labeled GROUND VENT FAN located in the overhead switch panel.

Heater operation is controlled by two switches mounted one below the other and located in the lower right panel just to the right of the pedestal. The upper switch has three positions FAN, OFF and HEAT. The lower switch is a momentary on type and is marked START/RESET. The FAN position will operate the vent blower only and may be used for cabin ventilation on the ground or windshield defogging when heat is not desired. When heat is desired the heater switch must be turned to the HEAT position and the START/ RESET switch is momentarily depressed, the heater fuel pump turns on and ignition occurs simultaneously.

The control levers along the bottom of the instrument panel control air flow and temperature. The second lever from the right regulates air flowing to the cockpit and cabin through the heater system. The left lever is connected to an adjustable thermostat which makes it possible to select the desired temperature of heater air and the second lever from the left is the defroster control.

For the overhaul and complete disassembly of the heater and its components, refer to overhaul instructions in this manual. A wiring diagram of the heater Electrical System Installation will be found in Chapter 91 of this manual.

CHART 2101. TROUBLESHOOTING (HEATING SYSTEM)

Trouble	Cause	Remedy
Heater fails to light.	Heater switch or circuit breaker open.	Turn on heater switch or close circuit breaker.
	Low voltage supply.	Apply external power supply. Attempt to start heater.
	Fuel cut off from tank.	Turn on manual shut off valve or master solenoid.
	Restriction in fuel nozzle orifice.	Remove the nozzle and clean or replace it.
	Suction leak ahead of pump.	Secure all fittings.
	Fuel heater solenoid not operating.	Remove and check sole noid. Replace if faulty.
	Insufficient fuel pressure.	Lower no current to fuel pump. Check operation of pump.
	Fuel lines clogged or broken.	Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located.
	Ignition vibrator inoperative.	Replace vibrator. Check for defective ignition unit.
	Regulator not operating properly.	Check for low pressure or replace regulator.
	Manual reset limit (overheat) switch open.	Press reset button firmly and recheck to determine reason for switch opening

CHART 2101. TROUBLESHOOTING (HEATING SYSTEM) (cont.)

Trouble	Cause	Remedy
Heater fails to light (cont.)	Combustion air pressure switch open. (Defective switch or low combustion air blower output.)	Check for low blower output due to low voltage and correct it, if switch is defective, replace it.
	Cycling switch open.	Replace if defective.
	Duct switch open.	Operate control to see if switch will come on. Replace switch if defective.
	Bad spark plug.	Replace plug.
	Incorrect gap setting.	Reset gap setting.
Ventilating air blower fails to run.	Heater switch "OFF." Broken or loose wiring to motor.	Engergize the heater switch. Check and repair wiring.
	Circuit breaker open.	Close circuit breaker.
	Worn motor brushes.	Replace motor bushes.
	Blower wheel jammed.	Remove and check the ventilating air blower wheel and realign if necessary.
	Motor burned out.	Remove blower assembly and replace motor.
	Defective radio-noise filter.	Replace filter.
Combustion air blower fails to run.	Faulty wiring to motor.	Inspect and replace faulty wiring.
	Poor ground connection.	Tighten ground screw. Be sure dry metal preservation has been removed.
	Worn motor brushes.	Replace motor brushes.

CHART 2101. TROUBLESHOOTING (HEATING SYSTEM) (cont.)

Trouble	Cause	Remedy
Combustion air blower fails to run (cont.)	Blower wheel jammed. (Usually indicated by hot motor housing.)	Overhaul the combustion air blower.
	Defective radio-noise filter.	Replace filter.
	Faulty or burned-out motor.	Remove combustion air motor for overhaul or replacement of motor.
Heater fires but burns unsteadily.	Insufficient fuel supply.	Inspect fuel supply to heater, including shut-off valve, solenoid valve fuel pump and fuel lines. Make necessary repairs.
	Spark plug partially fouled. *—CAUTION—* ***Do not create spark gap by holding lead to heater jacket. Damage to lead and ignition unit win result and operator may receive an electrical shock.***	Replace spark plug.
	Loose primary connect-tion at ignition assembly.	Tighten the connection.
	Faulty vibrator.	Replace the vibrator.
	Combustion air blower speed fluctuates. (Can be caused by low volt-age, loose blower wheel, worn brushes or motor.	Remove and overhaul the combustion air blower assembly as required or correct low voltage condition.
	High voltage leak in lead between ignition assembly and spark plug.	Replace ignition assem-bly.

CHART 2101. TROUBLESHOOTING (HEATING SYSTEM) (cont.)

Trouble	Cause	Remedy
Heater starts then goes out. (cont.)	Inoperative ignition assembly.	If vibrator is in good condition, replace ignition assembly only.
	Restriction in fuel nozzle orifice.	Remove nozzle for cleaning or replacement.
	Nozzle loose in retainer or improper spray angle.	Tighten or replace the nozzle as required.
Heater starts then goes out.	Lack of fuel at heater.	Check fuel supply through all components from the tank to the heater. Make necessary corrections.
	Inoperative or chattering combustion air pressure switch.	Adjust or replace switch.
	Inoperative overheat switch.	Replace switch.
	Inoperative cycling switch.	Adjust or replace the switch.
	Low voltage.	Attach external power.
Heater fails to shut off.	Fuel solenoid valve in heater stuck open.	Remove and replace solenoid assembly.
	Inoperative duct and cycling switch.	Check and repair.
	Defective heater switch.	Replace the heater switch.

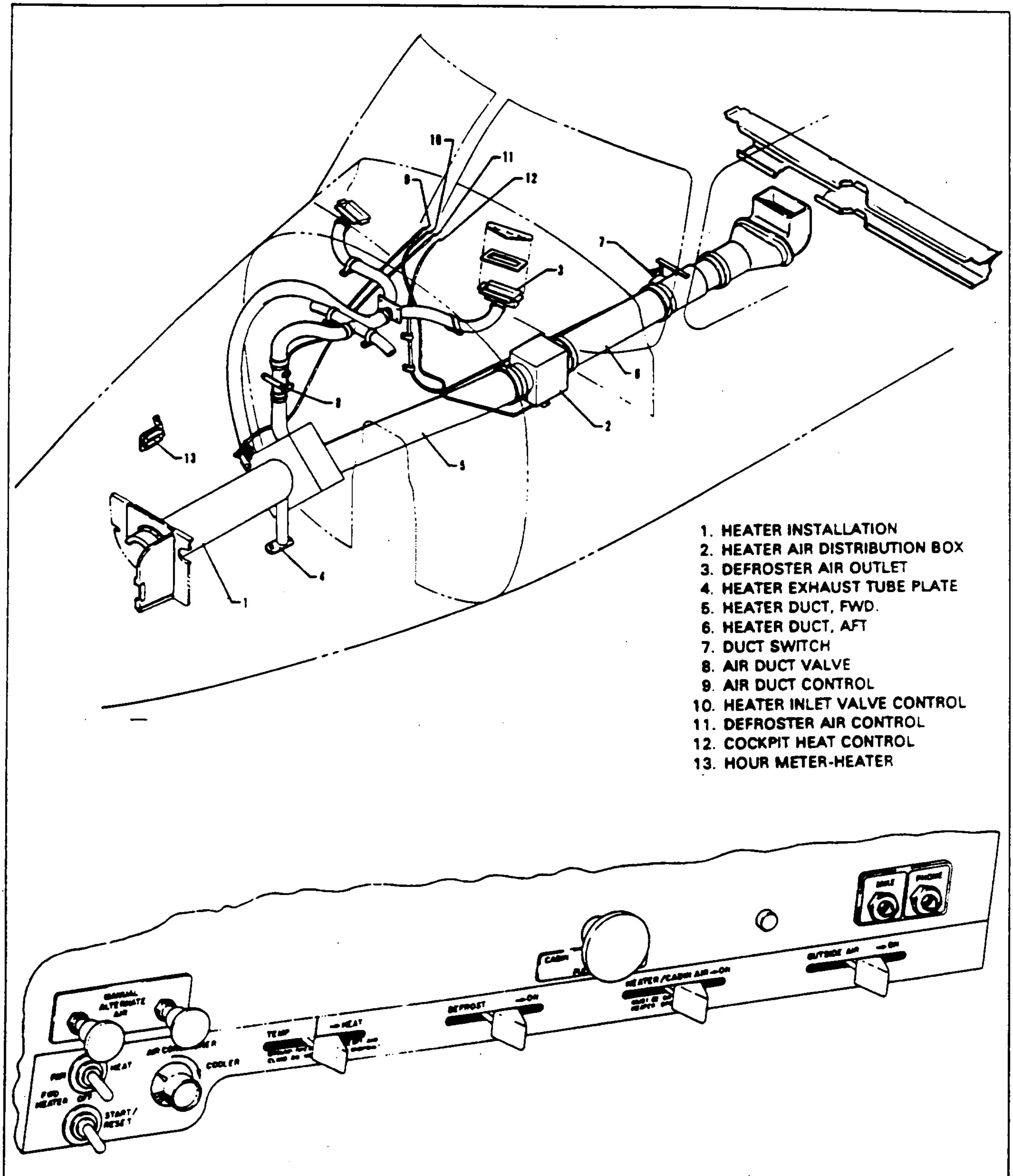
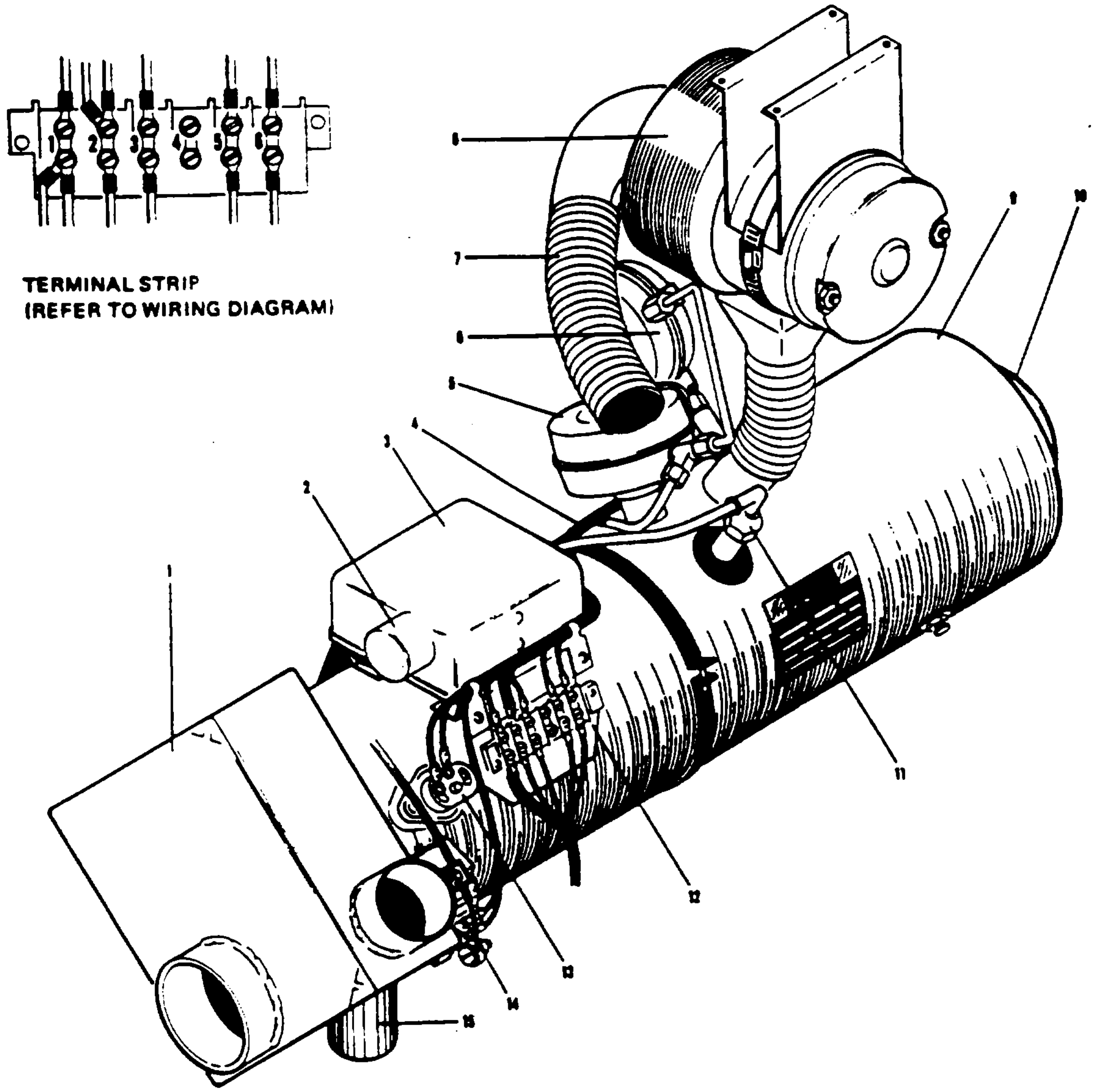


Figure 21-1. Heating and Ventilating System



1. HEAT DISTRIBUTION BOX
2. VIBRATOR ASSEMBLY
3. IGNITION ASSEMBLY
4. HARNESS ASSEMBLY
5. COMBUSTION AIR PRESSURE SWITCH
6. OMITTED
7. COMBUSTION AIR INTAKE TUBE
8. COMBUSTION AIR BLOWER
9. VENTILATING AIR BLOWER
10. VENTILATING AIR INTAKE VALVE
11. SPARK PLUG
12. TERMINAL STRIP
13. LIMIT SWITCH
14. CYCLING SWITCH
15. HEATER EXHAUST PIPE

Figure 21-2. Heater Assembly and Combination Air Blower

OPERATING CONTROLS.

—*NOTE*—

The schematic diagram (Figure 21-3) shows the heater circuit including the electrical wiring in the airplane.

1. The HEATER SWITCH is connected in the line that supplies electrical power to all heater equipment and controls. When this switch is in the OFF position, the entire heater system is inoperative. This switch has a FAN position which permits use of the ventilating air blower to circulate cool air through the system for summer ground operation. With the switch in FAN position, the heater is inoperative and only the ventilating air blower is energized.
2. The HEATER SWITCH is a normally open switch that supplies power to (lock-in) the safety relay through which power is supplied to the ignition and fuel circuits of the heater.

OPERATING PROCEDURE. (Refer to Figure 21-3.)

1. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air and combustion air blowers should operate.
2. Momentarily depress the START/RESET switch, the heater will ignite and continue to operate.
3. The DUCT SWITCH can be set to regulate the cabin temperature for desired comfort level. If this switch is set for ground operating comfort, it may be necessary to reposition it after being airborne, since ram air will increase the ventilating air flow and the heater output. An override micro switch is incorporated on the duct switch to override the duct stat at the very last movement of the duct stat arm toward the high position.
4. To stop heater operation, turn off the HEATER SWITCH.
5. It is desirable to operate the fan several minutes to cool the heater after operation. To stop fan operation, turn OFF the HEATER SWITCH.

INSPECTION.

INSPECTION OF HEATER AND HEATER COMPONENTS.

1. Inspect all fuel lines and fittings for fuel stains, indicating leakage, and replace lines or tighten fittings as necessary.
2. Check heater for loose bolts, screws, and wiring.
3. Inspect all electrical connections for corrosion. If corrosion is evident, clean affected components, and wipe with a lightly oiled cloth.

PREFLIGHT AND/OR DAILY INSPECTION.

1. Inspect the ventilating air inlet scoop, combustion air inlet scoop, exhaust outlet and fuel drain for possible obstructions. Make sure that all of these openings are clear of any restrictions and that no damage has occurred to air scoop protrusions.

2. Perform an operational check as follows:
   A. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air blower | and combustion air blower should operate. Operate both combustion air and ventilating air blower and check each for unusual current draw, noise or vibrations.

—*NOTE*—

To proceed with the operational check, follow paragraph entitled Operating Procedures, steps 1 through 5. This procedure should be repeated one or more times.

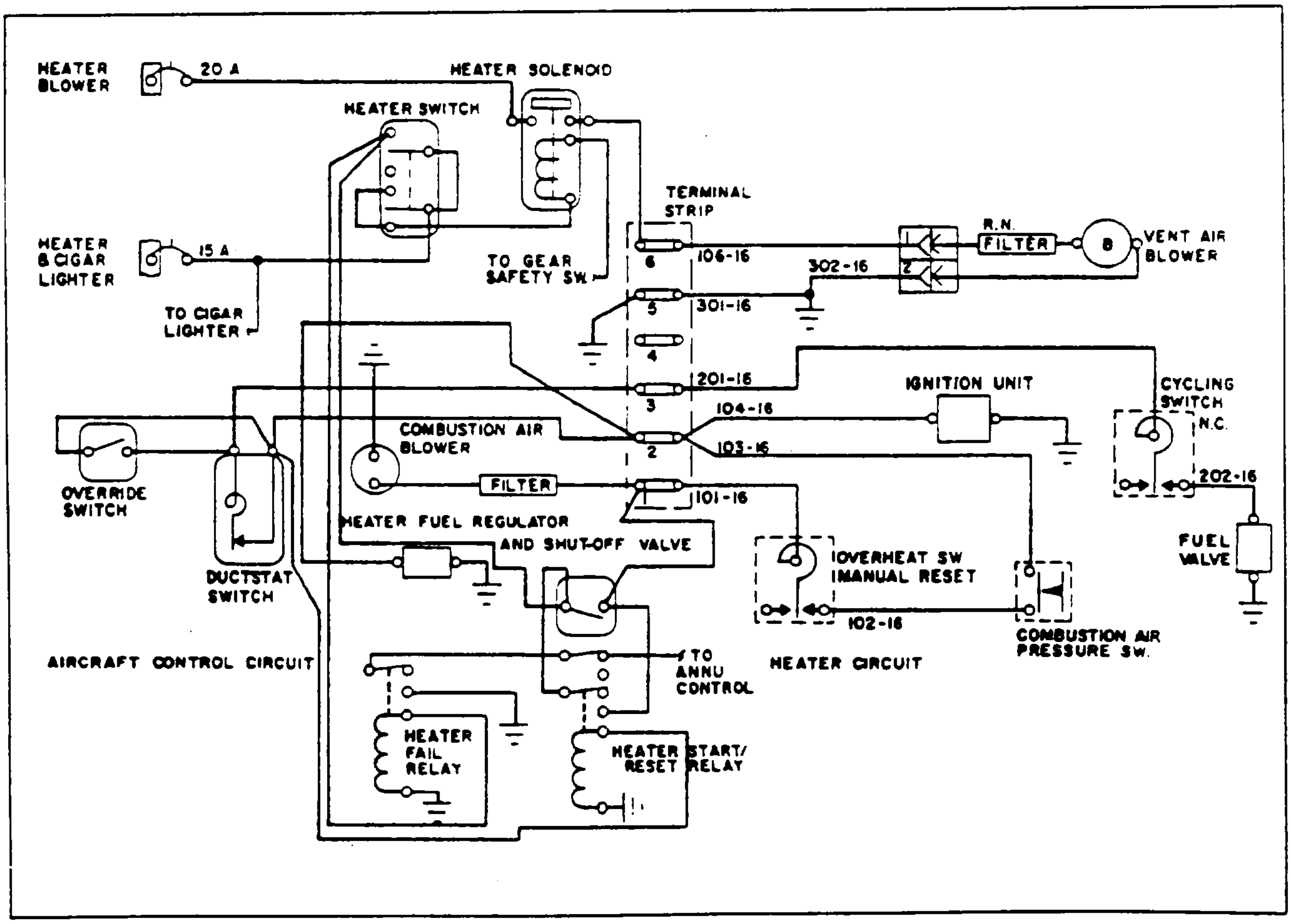


Figure 21-3. Wiring Schematic

100-HOUR INSPECTION.

The mandatory 100-Hour Inspection shall be conducted on new heaters or overhauled heaters with a new combustion tube assembly upon accumulation of 500-heater operating hours or twenty-four months, whichever occurs first, and thereafter at intervals not to exceed 100-heater operating hours or twenty-four months, whichever occurs first. If an hour-meter is used or the heater assembly, it should be connected across terminals number 2 and 5 or the heater terminal strip. If an hourmeter is not used, count one heater operating hour for each two flight hours for normal aircraft operation. Consideration should be given for any excessive ground operation of the heating system.

—NOTE—

The 100 Hour Inspection consists of the functional checks and inspections listed below and the Pressure Decay Test.

1. Inspect ventilating air and combustion air inlets and exhaust outlet for restrictions and security at the airplane skin line.
2. Inspect the drain line to make sure it is free of obstructions. Run a wire through it if necessary to clear an obstruction.
3. Cheek all fuel lines for security at joints and shrouds, making sure that no evidence of leaks exists. Also check for security of attachment of fuel lines at the various points in the airplane.
4. Inspect electrical wiring at the heater terminal block and components for loose connections, possible chafing of insulation, and security of attachment points.
5. Inspect the high-voltage cable connection at the spark plug to make sure it is tight. Also, examine the cable sheath for any possible indications of arcing, which would be evidenced by burning or discoloration of the sheath.
6. Inspect the combustion air blower assembly for security of mounting and security of connecting tubing and wiring. Tighten any loose electrical terminals and air tube connections.
7. Operate both the combustion and ventilating air blowers and check for unusual noise or vibrations.
8. It is recommended that the condition of the spark plug be checked for operation as described in paragraph titled "Spark Plug".
9. Evaluate the condition of the combustion chamber by performing a "Pressure Decay Test" as described in the latest revision of Janitrol Maintenance and Overhaul Manual P/N 24E25-1.
10. Following the 100 hour inspection, perform the "Preflight and/or Daily Inspection".

—NOTE—

Janitrol Maintenance and Overhaul Manual P/N 24E25-1 can be obtained from the Midland-Ross Corp., Janitrol Aero Division, 4200 Surface Road, Columbus, Ohio 43228. (Phone: 614-276-3561)

OVERHAUL INSTRUCTIONS.

The heater assembly shall be overhauled after 1000 hours or whenever the pressure decay test requirement cannot be met. The heater should be removed from the aircraft, disassembled, all parts thoroughly inspected and necessary repairs and/ or replacements made prior to reassembly. Detailed step-by-step instructions are included for a complete heater overhaul. In some instances, however. inspections may reveal that it is unnecessary to remove certain parts. If so, those portions of the overhaul procedures may be eliminated.

INSPECTION OF REMAINING COMPONENTS. (Refer to Figure 21-8.)

1. Discard all rubber parts such as grommets, gaskets, etc. These items should always be replaced at overhaul. Also discard the rope gasket.
2. Inspect all wires and wiring harnesses for damage to insulation, damaged terminals, chafed or cracked insulation and broken plastic bands. Individual wires can be replaced by making up new wires from No. 16 AWG stock and cut to correct length. It is advisable to use an acceptable crimping tool for installing terminals, rather than solder for all heater wiring connections. If wiring harness damage is visible, the entire harness assembly should be replaced. If only one or more wires are damaged, cut the cable ties, make up new wires, install them in the harness, and restore all cable ties and clamps. If heater controls were operating properly at the time of removal, reinstall them.
3. Inspect all hard parts, consisting of bolts, screws, nuts, washers and lockwashers. Replace damaged parts.
4. The combustion air pressure switch installed on the system must respond to delicate pressure changes and should always be checked and/ or replaced at overhaul. (Refer to Step 3 testing and Figure 21-5.)
5. Replace the vibrator in the ignition unit at each overhaul.
6. Inspect the ignition assembly (Figure 21-8) for dented case, loose or damaged primary terminal insulator and broken or obviously damaged high-voltage lead. Give particular attention to the condition of the spring connector at the end of the lead. If the spring is burned off, visibly eroded, or carbon tracked, the ignition assembly should be replaced.

—NOTE—

Do not attempt a field repair of the ignition unit, as it is a sealed assembly.

7. Inspect the terminal strip for distortion and cracks and replace it if either condition exists.
8. Inspect radio-noise filters for short circuits by checking from either terminal to ground with an ohmmeter. An open-circuit reading should be obtained.
9. Inspect the spray nozzle with a magnifying glass for any obstructions in the nozzle orifice and any sign of damage to the slight conical protrusion at the nozzle tip. Use compressed air to remove obstructions and re-examine the orifice to make sure it is open. Exercise care when handling the nozzle to avoid pressing or rapping on the tip face. Do not burr or scrape off deposits on the tip face. After cleaning, it is advisable to store the nozzle in a polyethylene bag until ready for reassembly.
10. Replace the nozzle at overhaul.

—NOTE—

The nozzle can be spray tested by installing it in the holder and connecting the fuel tube to a 7 psi fuel pressure source. The conical angle spray pattern should be even and dispersed the same in all directions. Exercise caution to keep atomized fuel away from fire

11. Inspect the nozzle holder for damaged threads at the fuel-tube fitting and for crimped or cracked fuel line or distorted housing. Check the solenoid for continuity by connecting across each wire lead with an ohmmeter. A reading between 82-87 ohms at 24 volts, 57-65 ohms at 28.5 volts should be obtained at room temperature. If not within these limits, it should be replaced.
12. Remove the brushes, one at a time, from the ventilating air blower motor by removing the brush cap and carefully withdrawing the brush from its guide. Remove foreign material from the brush guide and commutator with a stream of filtered compressed air. Check for brush wear. Inspect the commutator for grooved brush track, pitting or burning. The commutator surface should be smooth and medium brown in color. Replace the motor if the commutator or other parts show damage.
13. Inspect the combustion air blower motor as described in the preceding step.
14. Inspect the blower fan for broken or bent blades and replace it for either condition.

TESTING.

The following tests should be performed as outlined in the succeeding paragraphs.

1. Check ventilating air and combustion air motors for correct RPM and current draw.
   A. Connect motor to 28-volt DC power supply. Rotation should be counterclockwise when viewed from the shaft end.
   B. Both the ventilating and combustion air motors manufactured by (Universal Electric) should rotate at approximately 7500 RPM at rated voltage with a current draw approximately three amperes. The ventilation blower motor manufactured by (Howard Industries) should turn 9800 RPM and draw approximately 15-16 amperes in a no lead condition.
   C. If current draw is excessive, or if speed is too low, replace the brushes. Recheck both current draw and RPM after brushes are properly run-in.
   D. If, after replacing brushes, operation is still unsatisfactory, replace the motor.

—NOTE—

The motor checks described above should be made without the blower housing attached, for both the ventilating air and combustion air motors.

2. Test the combustion tube assembly for leaks as follows:
   A. Fashion a sealing plate from approximately .125 inch thick flat stock to seal the combustion head opening in the combustion tube assembly. (Refer to Figure 21-4.) Use a rubber gasket under the plate and attach the plate with two screws.
   B. Make up seals for all remaining openings, except the one used to connect the air pressure source. (Refer to Figure 21-4.) Use rubber stoppers as shown. The combustion air inlet tube can be sealed best with a drilled stopper and clamp. Other openings should be sealed with expansion plugs. The seal used in the exhaust tube should be formed so that it will not deform the air pressure switch tube which protrudes into the exhaust.
   C. Install plugs and caps in all openings except the one to which the combustion air pressure switch is attached. (Any opening can be used to connect the air pressure source; however, the combustion air pressure switch opening is usually the most convenient. The drain opening would normally be considered a second choice.)
   D. Connect a regulated air supply to the opening that has not been plugged and apply a pressure of between three and five psi to the combustion tube assembly.

E. Submerge the combustion tube assembly in water for several minutes while watching for bubbles which would indicate leaks. No air leakage is permitted from the combustion tube assembly. No weld or braze repairs are permitted on a combustion tube assembly.

3. Test the combustion air pressure switch as follows. (Refer to Figure 21-5.)
   A. Connect an adjustable air pressure line that can be controlled in a range of zero to 5.0 inches of water to the switch opening with a water manometer and needle valve in the line ahead of switch. Switch must be tested in position or as installed in the airplane.
   B. Connect an ohmmeter across the switch terminals to determine the exact instant of switch closing.
   C. Apply air pressure allowing it to build up very slowly from zero. The switch contacts should close at 0.5 ± 0.1 inches of water which will be indicated on the manometer.

—NOTE—

The switch cover has a differential pressure tap and this opening must be left open to atmosphere during the test.

   D. Make several trials to insure switch reliability. Be sure to increase and decrease the air pressure slowly in order to produce accurate indications.
   E. If an adjustment is required, rotate the adjusting screw clockwise to increase settings and counterclockwise to decrease settings.

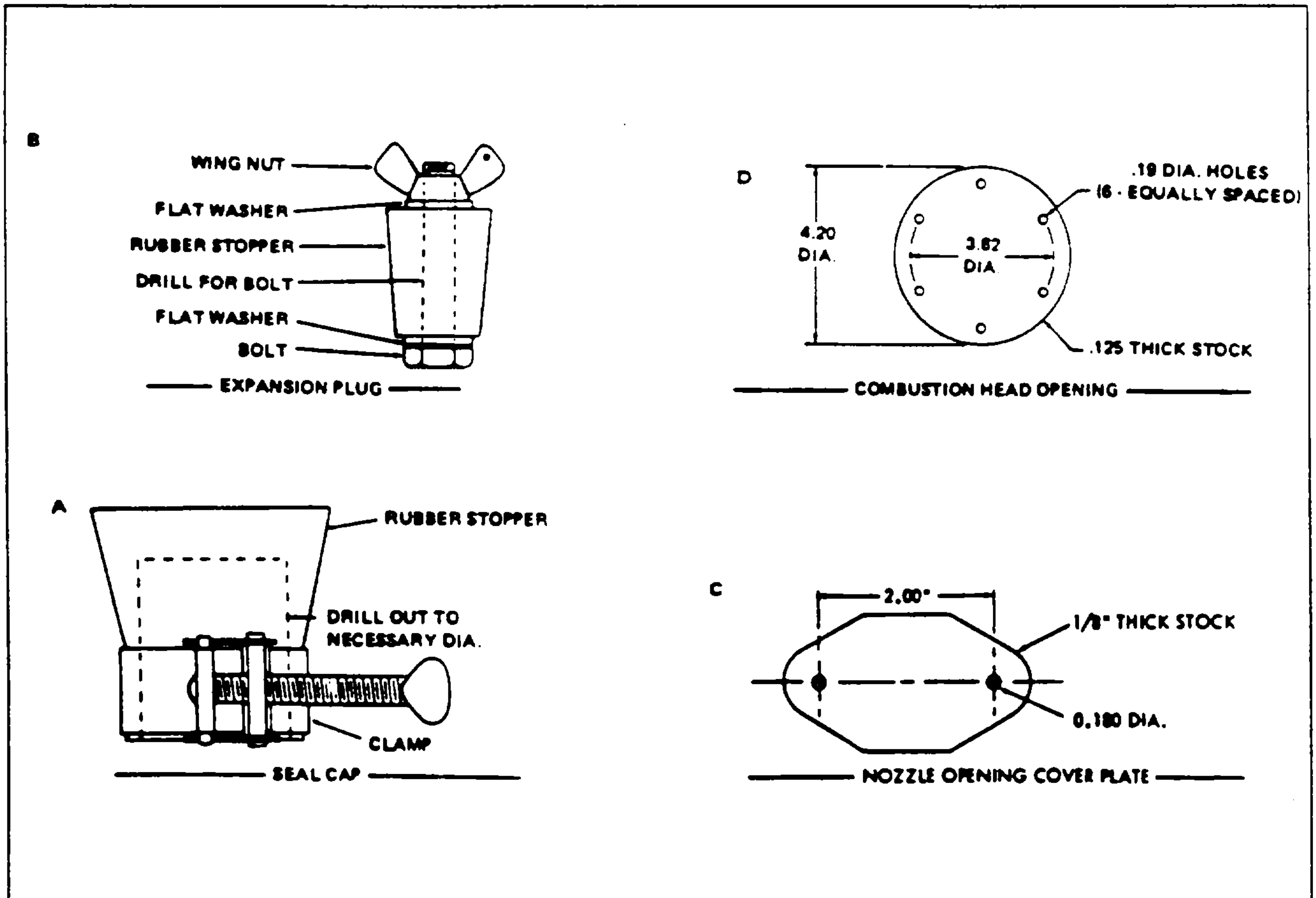


Figure 21-4. Suggested Design for Seal Plate, Plugs and Caps for Combustion Tube Leakage Test

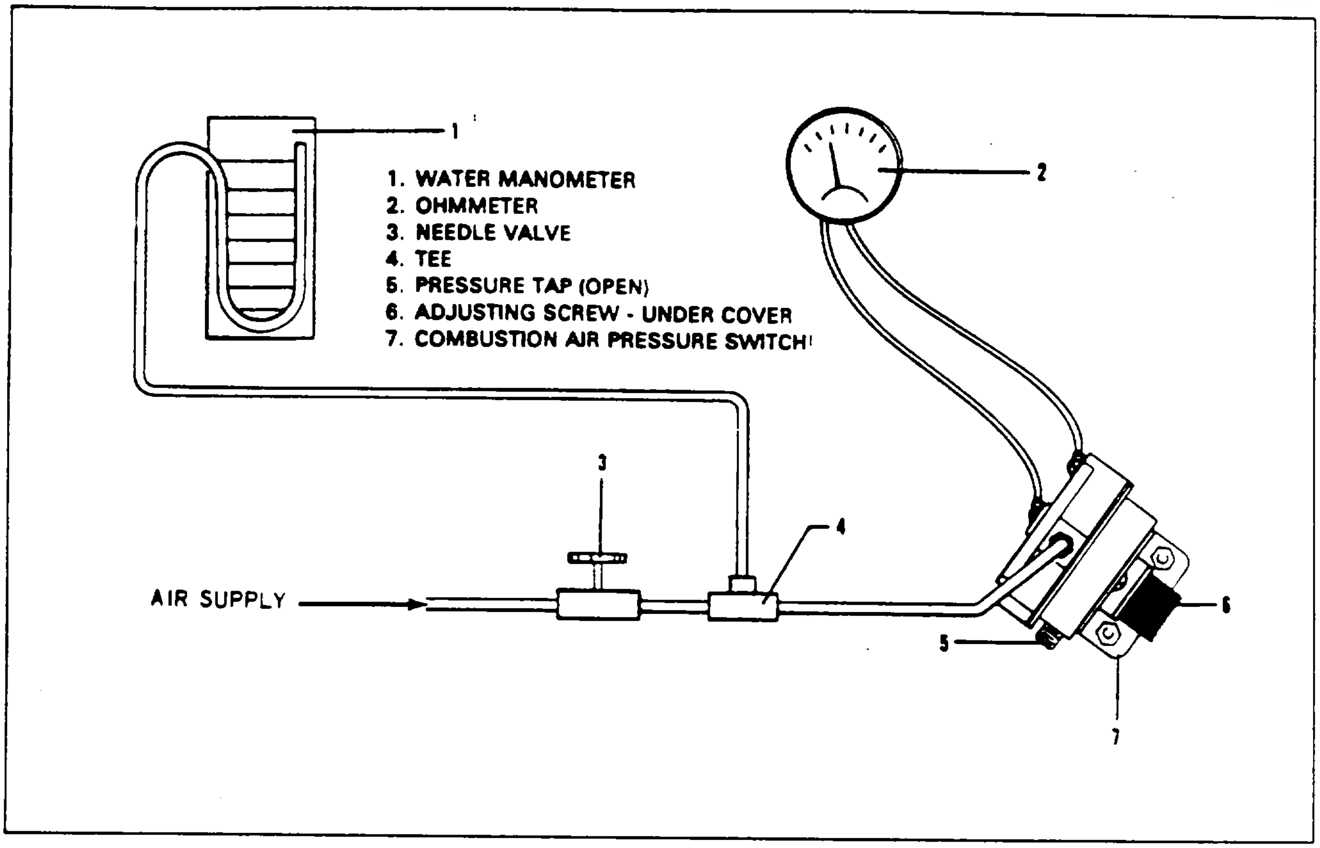


Figure 21-5. Test Set-up - Combustion Air Pressure Switch

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4. Test the fuel feed and nozzle holder assembly for leaks as follows: This test can be simplified if the following routine is used to test both the fuel line and fuel line shroud tube.
   A. Using filtered compressed air, apply 20 psi to the shroud drain port located on the surface near the threaded nozzle cavity.
   B. Immerse the fuel feed and nozzle holder assembly in clean water with the fuel inlet and nozzle cavity left open.
   C. Observe for bubbles which would indicate leakage. If bubbles appear at either fuel fitting, there is a leak in the fuel tube. If bubbles appear externally on the shroud tube, or at either end of the shroud tube juncture, the shroud tube is leaking.
   D. In either of the above cases, the complete fuel feed and nozzle holder assembly must be replaced.
5. Spray test the nozzle (Figure 21-8) as follows:
   A. Install the nozzle in the fuel feed and nozzle holder assembly. Connect the fuel tube to the fuel solenoid. Connect solenoid to a 7 psi fuel pressure source.
   B. Connect the solenoid leads to a 24-volt battery. Connect a switch in the line to open and close the solenoid when desired.
   C. With the switch closed (solenoid valve energized) and the fuel line connected, observe the fuel spray pattern. It should be conical in shape with even dispersion in all directions.

—WARNING—

Be sure to keep the atomized spray away from fire.

   D. Energize and de-energize the solenoid several times. The spray should shut off permanently each time the solenoid is de-energized. There should be no sign of dribbling at the nozzle tip in excess of one or two drops.
   E. If the spray pattern is distorted, check for an obstruction and clean the nozzle. If this fails to provide a normal spray pattern, replace the nozzle.
   F. If the nozzle continues to dribble, the solenoid valve is not closing properly and the solenoid valve must be replaced.

HEATER ELECTRICAL SYSTEM CHECKS.

ELECTRICAL CONTINUITY CHECK.

These tests are listed as an aid in isolating open circuited or inoperative electrical components should the heater fail to light with the HEATER switch energized.

—NOTE—

The schematic wiring diagrams (Refer to Figures 21-3, 21-6 and 21-7) show, in addition to the heater circuitry, a suggested aircraft control circuit. For the purposes of this manual, the circuitry shown in these illustrations win be utilized to describe electrical continuity checks.

It must be assumed that power, which is furnished through the heater circuit breaker, is present at the HEATER SWITCH at all times. Always check the circuit breaker before performing electrical continuity checks.

HEATER POWER CIRCUIT CHECK.

1. With the HEATER SWITCH in the HEAT position, electrical continuity should be present at the following locations. (Refer to Figure 21-7.)

—NOTE—

Power for the ventilating air blower is the same as described in Vent Blower Power Circuit Check, except that power is now supplied through the HEAT side of the HEATER SWITCH.

A. Terminal No. 1 of the heater terminal strip, to overheat switch, to combustion air pressure switch and also through filter to combustion air blower.
B. From terminal No. 1 of the heater terminal strip through the combustion air pressure switch to radio noise filter and onto the combustion air motor also to terminal No. 1 of the overheat switch.
C. From terminal No. 3 of the overheat switch through the combustion air pressure switch to terminal No. 2 of the heater terminal strip.
D. From terminal No. 2 of the heater terminal strip to the ignition unit; to the heater fuel pump; and through adjustable duct stat switch to terminal No. 3 of the heater terminal strip.
E. From terminal No. 3 of the heater terminal strip through the cycling switch to the fuel solenoid valve.

In the event that electrical continuity is not present at one or more of the above listed points, the wiring must be traced back to the power source. If components are still inoperative after the wiring inspection, check the individual inoperative components for continuity and, if necessary, replace them.

VENT BLOWER POWER CIRCUIT CHECK.

1. With the HEATER SWITCH in the FAN position, electrical continuity (28 volts nominal) should be present at the following locations. (Refer to Figure 21-6.)
   A. Terminal No. 6 on the heater terminal strip.
   B. From terminal No. 6 of the heater terminal strip through the radio noise filter to the ventilating air motor.
   C. The ground circuit for the ventilating air motor is provided by utilizing the common ground of terminal No. 5 of the heater terminal strip when the landing gear is down. The ventilating air motor is inoperative when the landing gear is up.

MAINTENANCE.

JANITROL HEATER.

The heater is a fuel operated 24 VDC electrically controlled unit installed in the nose section just forward of bulkhead Sta. 57.00.

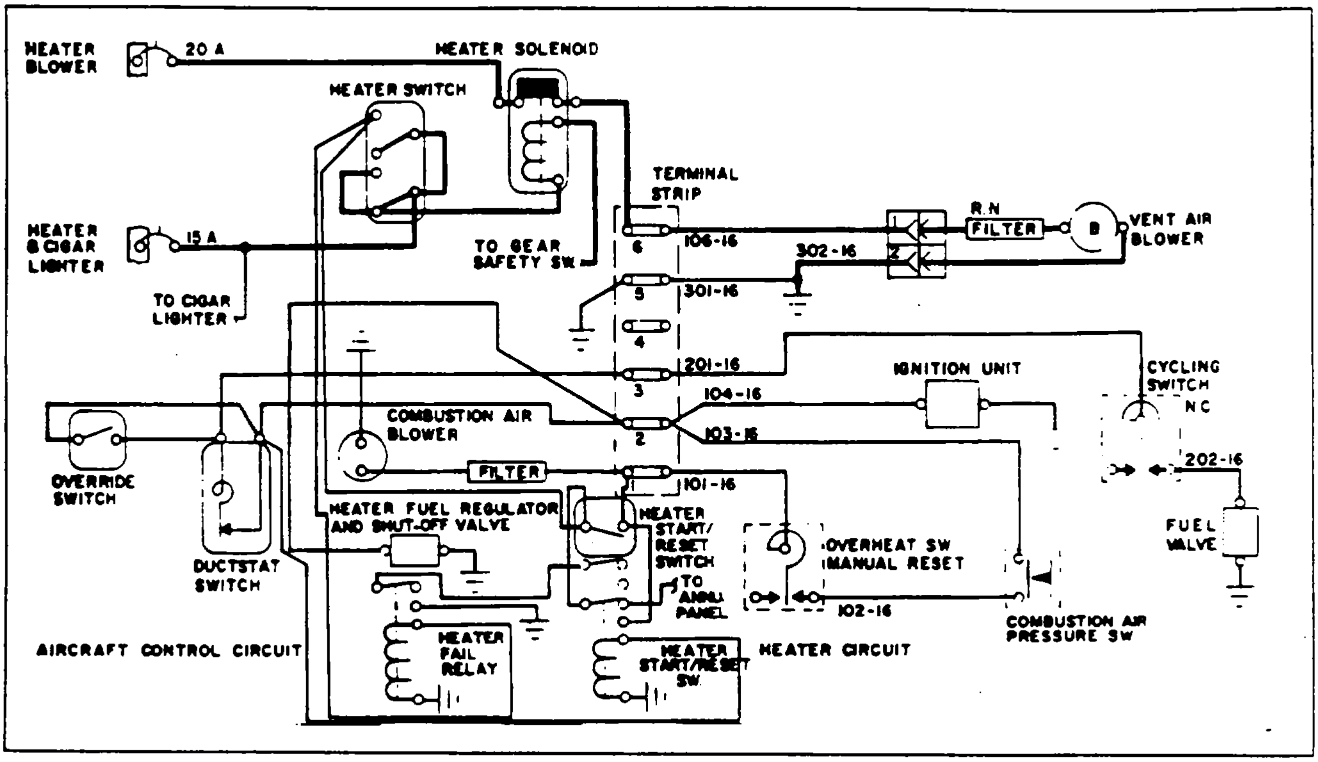


Figure 21-6. Vent Blower Power Circuit

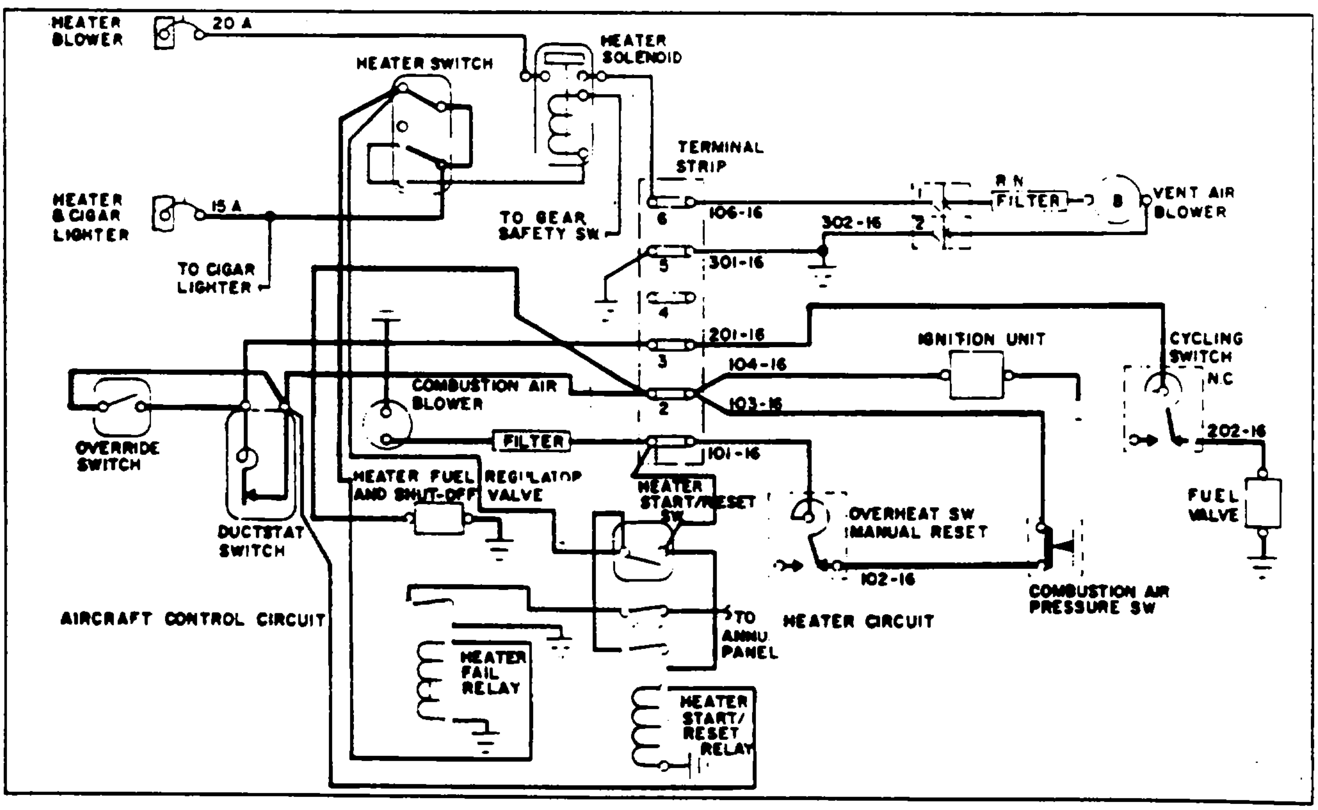


Figure 21-7. Heater Power Circuit

REMOVAL OF HEATER.

1. Turn the heater control switch off.
2. Remove the access panel located on the right side of the nose section.
3. Open the forward baggage door and remove the access panel located on the right rear side of the baggage compartment door.
4. Loosen the shroud cover of the fuel inlet line fitting located on the forward upper left side of the heater. Disconnect the fuel line from the heater.
5. Remove the screws that secure the forward end of the heater to the fuselage bulkhead plate assembly.
6. Disconnect the air inlet valve cable attached to the forward end of the heater.
7. Disconnect the electrical leads from the heater. (Identify the lead connections to facilitate reinstallation.)
8. Disconnect the combustion air blower inlet tube from the blower and the tube between the blower and heater.
9. Disconnect the fuel drain and allow it to drop down.
10. Disconnect the duct switch and cabin heat control cables.
11. Disconnect the defroster and heat ducts from the air-heat distributor box.
12. Loosen the clamp that secures the heater to its mounting bracket and remove the heater from the airplane.

INSTALLATION OF HEATER.

1. Position the heater on its mounting bracket and secure with clamp.
2. Attach the forward end of the heater to the fuselage bulkhead.
3. Connect the air inlet valve cable to the forward end of the heater.
4. Connect the fuel line to the heater and install shroud cover.
5. Connect the fuel drain to the underside of the heater.
6. Position the combustion air blower, connect tubes and secure the unit to its mounting bracket.
7. Connect the defroster and heat ducts to the air-heat distribution box.
8. Connect the heat control cable to the control arm located on the air-heat distribution box. Adjust the cable so that when the door is completely closed, approximately .062 to .125 inch springback exists between the control lever and lever stop.
9. Connect the duct switch control cable to the switch on the right side of the air-heat distribution box. Adjust the cable so that when the control lever is full against its stop the control arm aligns with the vertical line of the switch. (Do not loosen the allen set screw that secures the arm to the switch shaft.) Move the lever to the extreme right to ascertain that the control arm on the duct switch will have a $105° \pm 1$ travel to high heat position.
10. Connect the electrical leads to the heater.
11. Operate the heater long enough to determine that the unit is operating properly.
12. Install the access panels in the baggage compartment and at the side of the fuselage.

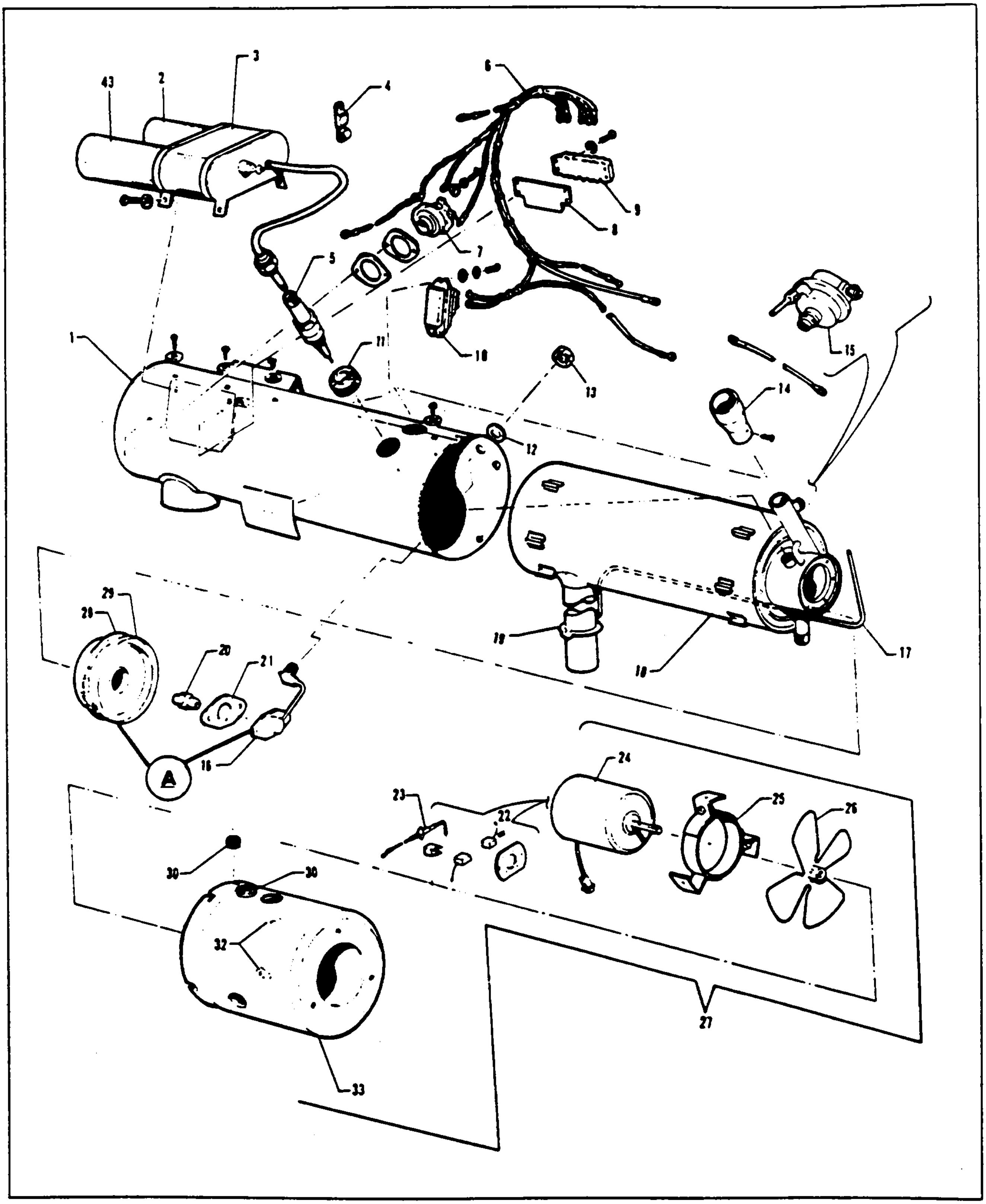
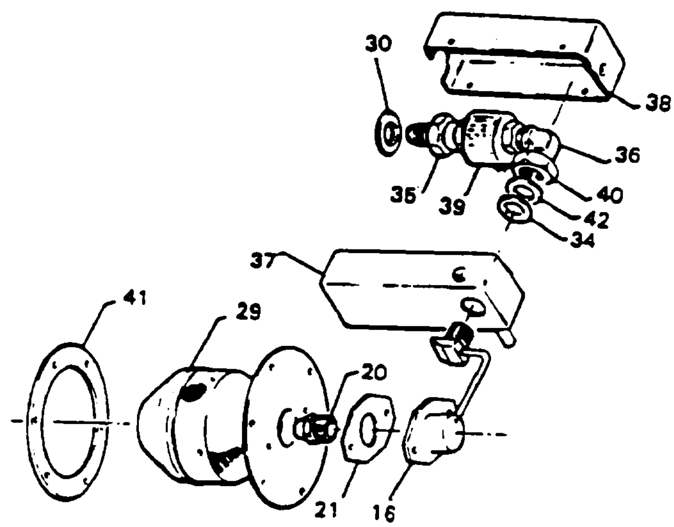


Figure 21-8. Exploded View of Heater Assembly

VIEW A



1. JACKET ASSEMBLY
2. VIBRATOR
3. IGNITION ASSEMBLY
4. STRAP, CABLE
5. SPARK PLUG
6. HARNESS ASSEMBLY
7. LIMIT SWITCH
8. INSULATOR, TERMINAL STRIP
9. TERMINAL STRIP
10. CYCLING SWITCH
11. GROMMET
12. GASKET
13. NUT
14. ADAPTER
15. COMBUSTION AIR PRESSURE SWITCH
16. FUEL FEED AND NOZZLE HOLDER
17. COMBUSTION AIR SWITCH TUBE
18. COMBUSTION TUBE
19. GASKET
20. FUEL SPRAY NOZZLE
21. VALVE ASSEMBLY GASKET
22. BRUSH PLATE ASSEMBLY
23. CAPACITOR
24. MOTOR ASSEMBLY, VENT AIR BLOWER
25. BRACKET ASSEMBLY, MOTOR
26. FAN, VENT AIR BLOWER
27. BLOWER ASSEMBLY
28. GASKET COMBUSTION HEAD
29. COMBUSTION HEAD ASSEMBLY
30. GROMMET
31. SCREW
32. FASTENER WASHERS
33. BLOWER HOUSING
34. FUEL SHROUD GASKET
35. NIPPLE
36. ELBOW
37. FUEL SHROUD BOX, LOWER
38. FUEL SHROUD BOX, UPPER
39. FUEL SOLENOID
40. NUT
41. GASKET
42. WASHER
43. COIL

Figure 21-8. Exploded View of Heater Assembly (cont.)

DISASSEMBLY OF HEATER. (Refer to Figure 21-8.)

1. Remove the screw and slide the elbow adapter off the combustion air inlet tube.
2. Disconnect and remove electrical wiring and individual wires from the various components on the heater. If wires appear to be in good condition, it may be desirable to remove wire harness assembly intact. First, disconnect wires at terminal strip and components.

—NOTE—

It is advisable to label all wires, prior to removal, to insure correct connections during reassembly. Cable straps and clips must be replaced if removed, as they cannot be re-used.

3. Carefully disconnect the high voltage ignition lead at the spark plug. Handle the spring connector on the end of this lead with care to prevent fouling or damage.
4. Remove the four screws and cable straps to free the ignition assembly from the heater jacket and remove the ignition assembly. The vibrator may be removed by exerting a firm pull straightaway from the ignition assembly case.
5. Remove the grommet from the jacket and remove the spark plug with a 7/8 inch deep socket. Make sure the spark plug gasket is removed.
6. Remove the two screws and lift out the overheat (limit) switch and spacer gaskets.
7. Remove the two screws and lift out the cycling switch.
8. Remove the four screws to release the terminal strip and insulator from the jacket.
9. Disconnect the fitting at the combustion air pressure switch. Unscrew and remove the combustion air pressure switch from the combustion air inlet tube.
10. Loosen the four fasteners and rotate the blower and motor housing to disengage the notched end from the four screws in the end of the heater jacket. Separate the electrical quick-disconnect on motor lead wires. Remove blower assembly. Remove grommet from fuel shroud and carefully pull fuel solenoid wires through hole in shroud. With open wrench, remove fuel solenoid.
11. Reach inside the inlet end of the jacket assembly with a 3/4 inch open wrench to hold the fuel tube fitting at the jacket; then remove the elbow fitting, nut, washer, gasket and fuel shroud.
12. Remove the two screws and carefully withdraw the nozzle holder assembly from the combustion tube assembly. Remove the gasket.
13. Remove the screws and remaining cable straps if not previously removed from the seam of the jacket assembly. Note positions of cable straps as they are removed. Spread the jacket at the seam and remove it from the combustion tube assembly; this will free the rope gasket, which can be removed from the particular port on which it remains attached.
14. Carefully unscrew and remove the spray nozzle from the nozzle holder and solenoid valve assembly.

—CAUTION—

Handle the nozzle with care to avoid damage to the tip. The material around the orifice is very thin and any sharp blow on the face of the nozzle can distort the spray pattern and cause malignition or improper combustion.

15. Loosen and remove the three screws and rubber grommet from the blower housing.
16. Slide the ventilating air blower motor out of the blower housing with the motor bracket assembly and blower fan attached. Loosen the set screw on the blower fan and slide it off the end of the motor shaft; then remove the motor bracket assembly. If these parts are in good condition, they need not be disassembled further.

REASSEMBLY OF HEATER. (Refer to Figure 21-8.)

1. Insert the ventilating air motor into the motor bracket assembly; slide the blower fan on the end of motor shaft and rotate it until the set screw is aligned with the flat side of the motor shaft. Tighten the set screw just tight enough to hold it at this time.
2. Attach the capacitor and leads assembly to the motor bracket with the screw and lock washer. Make sure a good electrical ground connection is made at this point. Install ground bracket and three new fasteners.
3. Insert this assembly into the blower housing.
4. Make sure all wires are routed and grommeted as they were prior to disassembly and then secure the assembly in housing with three screws.
5. The motor should be positioned in the bracket to locate the blower fan properly in the blower housing. The blower fan should be positioned so it will rotate freely and just clear the contoured spill plate in the blower housing. Tighten the Allen-head set screw and spin the blower fan by hand for a clearance check; then apply appropriate voltage to run the motor as a final clearance check.
6. Place a new rope gasket in position on the exhaust outlet. Spring the jacket assembly open at the seam and insert the combustion tube assembly carefully into the jacket. Exercise care to clear the pressure switch tube in the exhaust outlet and see that the rope gasket is properly located. Close the gap on the jacket assembly and install screws to secure it at the seam. (Solenoid lead wire is grounded under one of these screws. See notations made during disassembly.) Make sure the seam is in good condition and a tight fit is effected.
7. Install cable straps at locations noted during disassembly.
8. If new spray nozzle is not being installed, remove the original nozzle from the polyethylene bag. Screw the nozzle into nozzle holder and tighten to 75-100 inch-pounds. It is very important to torque the nozzle to this value, as in correct tightening could cause improper heater operation and "drool."

—CAUTION—

The spray nozzle has a slight protrusion on the nozzle face. If this area has been struck by any object which would make a dent or destroy the original contour, the nozzle must be replaced.

9. Install a new head gasket and the head assembly to the combustion tube assembly with six screws.

—NOTE—

When installing combustion head, do not tighten six mounting screws until spark plug is installed. This will insure the proper alignment of spark plug with combustion head. Tighten six screws after plug is installed.

10. Insert the fitting on end of nozzle fuel tube through the opening in jacket and attach the nozzle holder to the combustion head assembly with the two screws. It may be necessary to place a slight bend in the shrouded fuel tube to permit alignment of screw holes. Be sure to use a new gasket.
11. Using a new spark plug gasket, install the spark plug and tighten to a torque of 28 foot-pounds. Install the grommet in the jacket around the spark plug.
12. Install the ignition assembly on the jacket assembly with the four screws. Connect the high voltage lead to the spark plug and tighten it to 20 foot-pounds.
13. Attach the overhead limit switch and two spacer gaskets to the jacket assembly with two screws. Tighten the screws securely.

14. Attach the cycling switch to the jacket assembly with the two screws.
15. Place the terminal strip insulation in position on the jacket followed by the terminal strip. Secure both parts by installing the two screws.
16. Center the fuel fitting in jacket opening. Place the fuel fitting shroud gasket, washer and shroud on the fuel fitting, and install the nut finger tight. Insert a 3/4 inch open-end wrench inside the jacket and hold the fuel-tube fitting while tightening the nut with a 3/4 inch deep socket. Install the elbow fitting and solenoid. Carefully pull solenoid lead wires through hole in shroud and install grommet.
17. Rotate the combustion air pressure switch onto the threaded fitting on the combustion air tube and tighten it firmly.
18. Slide the grommet over the combustion air tube and connect the tube to the fitting on the combustion air pressure switch.
19. Install the wiring harness and connect all wire leads to their respective terminals. (Refer to the wiring diagram, Figure 21-3.) Place the grommet (Figure 21-8) in position in the jacket; locate the ventilating air blower at the end of the jacket. Thread the quick-disconnect on the motor leads through the grommet and connect it to the mating connector on the wiring harness.
20. Place the blower housing in position on the jacket assembly and secure it by installing the four screws, if removed at disassembly. This operation is easier if the screws are started into their threads and the blower housing rotated into place, allowing the screws to enter the notched openings in edge of blower housing. Tighten all screws securely.
21. Install the adapter with the screw.

SPARK PLUG.

The spark plug is installed in the heater at the air/fuel mixture area to provide spark during heater operation .

REMOVAL OF SPARK PLUG.

1. Remove the necessary access panels to expose the spark plug area of the heater assembly.

—NOTE—

Insure that the heater electrical circuits are de-energized.

2. Unscrew and remove the high voltage lead connector at the spark plug. Exercise care to avoid fouling or damaging the connector.
3. Remove the grommet from the heater jacket opening.
4. Using a 7/8 inch deep hex socket, unscrew and remove the spark plug. Make sure the spark plug gasket is removed with the spark plug. It will normally stick on the spark plug threads, but if gasket should drop into the ventilating air passages of the heater, remove it with a wire hook.

INSTALLATION OF SPARK PLUG.

1. If a new spark plug is being installed, be sure to adjust the spark gap as outlined in the following paragraph. Do not bend the electrode on the spark plug.

2. Place a new spark plug gasket on the threads. If the gasket does not hold on the threads and would be likely to fall off during installation, place a small drop of Aviation Permatex or similar material on the gasket to stick it temporarily to the plug shell.
3. Screw the spark plug into the heater with a deep socket wrench. Tighten to a torque of 28 foot-pounds.
4. Install the grommet (Figure 21-8) in the heater jacket opening.
5. Carefully insert the spring connector on the high voltage lead into the spark plug shell; press down gently and start the nut on the threads. Tighten the nut to 20 foot-pounds.
6. Operate the heater to check dependability and close all access openings.

SPARK PLUG GAP CHECK AND ADJUSTMENT. (Refer to Figure 21-12.)

A spark gap of 0.156 to 0.188 inches must be maintained on the P/N 39D18 spark plug. This gap should be checked any time a plug is replaced or at the time of heater overhaul. A spark gap greater than that specified can shorten the life of the ignition assembly. There are several ways to check spark gap on this heater. Method I is recommended when the heater is being overhauled and before the installation of the fuel nozzle. Method II is suitable for checking the gap through the spark plug well when the heater is not disassembled.

Method I:

1. Using a 5/32 inch drill (0.156) or a piece of 5/32 inch rod, reach through the opening in the combustion head (fuel nozzle location) and find the ground electrode. (It is welded inside the head.)
2. Move the drill along the side of the electrode on the spark plug side. (Movement should be from the outer edge towards the center.) The drill or rod should just pass through the spark plug gap opening. Should the drill fail to pass through this opening, the gap is too narrow. If it passes through too freely, the gap is too wide. In either case, it will be necessary to bend the ground electrode in the direction required. This may be done by removing the spark plug and reaching through the opening.
3. Recheck the gap after repositioning of the ground electrode.

Method II:

1. Measure the distance between the seating surface of the spark plug with a new gasket installed to the end of the plug electrode.
2. Using a depth gauge, measure the distance between the ground electrode in the heater to the spark plug seating surface in the heater jacket and check this measurement against the measurement obtained in Step 1. The difference should be between 0.156 to 0.188 of an inch.
3. The ground electrode can be bent to obtain the required gap.

INSPECTION AND SERVICING SPARK PLUG.

1. If the spark plug appears to be in good condition, except for a mild coating of oxide on the porcelain and electrodes, it may be cleaned and reused. Cleaning is accomplished on a conventional airplane type spark plug cleaner, except that it will be necessary to use two or more adapters in order to raise the long extension of the plug far enough out of the cleaner nozzle opening to perform an effective job. Plug the ceramic insert cavity at the terminal end of the plug with a piece of paper or cloth to keep out any of the cleaning sand. Wipe the cavity out thoroughly with a cloth wet with carbon tetrachloride. If after cleaning the spark plug porcelain is white and the electrodes are not eroded, proceed to check the ground electrode in the heater and adjust the spark gap in accordance with instructions found in this chapter.

—NOTE—

If the spark plug fails to clean up properly and/or the electrodes are badly eroded, it should be replaced.

—NOTE—

The ground electrode can be replaced if it is eroded to approximately half of its original 1/8 inch diameter. This can be done as follows: (Refer to Figure 21-12.)

1. Grind off the head of the rivet where it projects through the combustion head and remove the electrode.
2. Install a new CRES rivet AN125452 which is 1.500 inches in length.
3. Heliarc tack weld the rivet head to hold it in place against the combustion head.
4. Check spark gap as noted in Methods I or II.

SPARK-SPRAY IGNITION. (Refer to Figure 21-14.)

The controlled atomized spray from a specially designed spray nozzle, coupled with high-voltage spark plug ignition, insures instant firing and continuous burning under all flight conditions.

Heat is produced by burning a fuel-air mixture in the combustion chamber of the heater. Aviation gasoline is injected into the combustion chamber through the spray nozzle. The resulting cone-shaped fuel spray mixes with combustion air and is ignited by a spark from the spark plug. Electric current for ignition is supplied by an ignition unit which converts 28 volts to high-voltage, oscillating current to provide a continuous spark across the spark plug gap. A shielded, high voltage lead connects the ignition assembly to the spark plug. Combustion air enters the combustion chamber tangent to its surface and imparts a whirling or spinning action to the air. This produces a whirling flame that is stable and sustains combustion under the most adverse conditions because it is whirled around itself many times. Therefore, ignition is continuous and the combustion process is self-piloting. The burning gases travel the length of the combustion tube, flow around the outside of the inner tube, pass through crossover passages into an outer radiating area, then travel the length of this surface and out the exhaust.

Ventilating air passes through the heater between the jacket and combustion tube assembly outer surface and through an inner passage in the assembly. Consequently, ventilating air comes into contact with two or more heated, cylindrical surfaces.

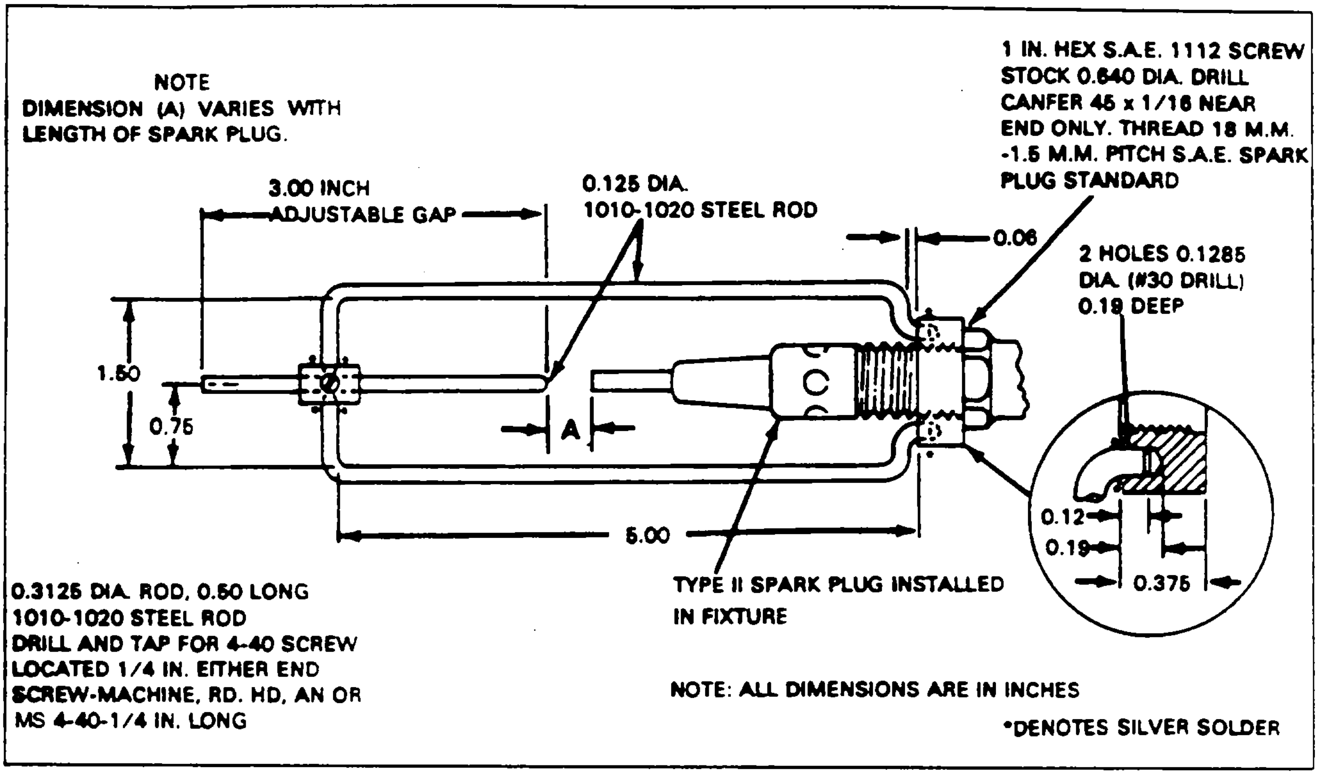


Figure 21-9. Spark Plug Fixture

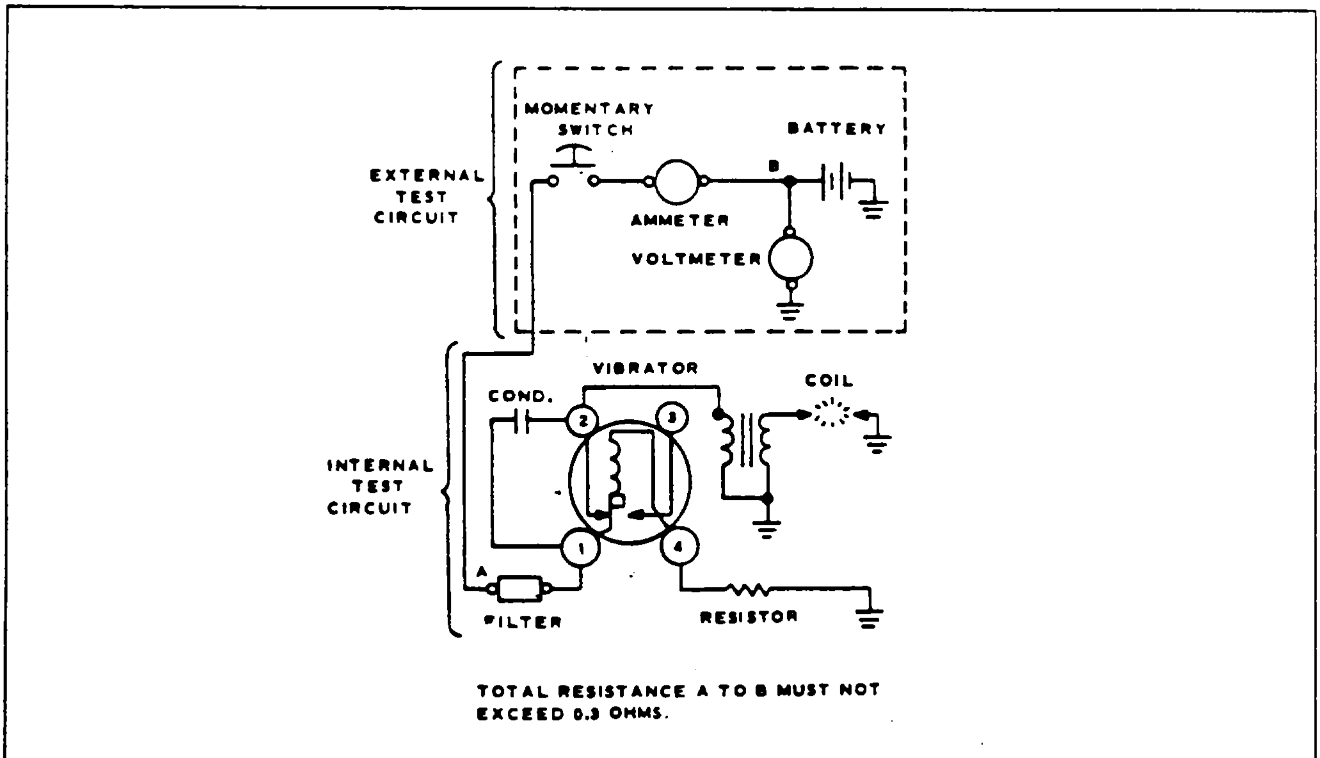


Figure 21-10. Wiring - Test Setup

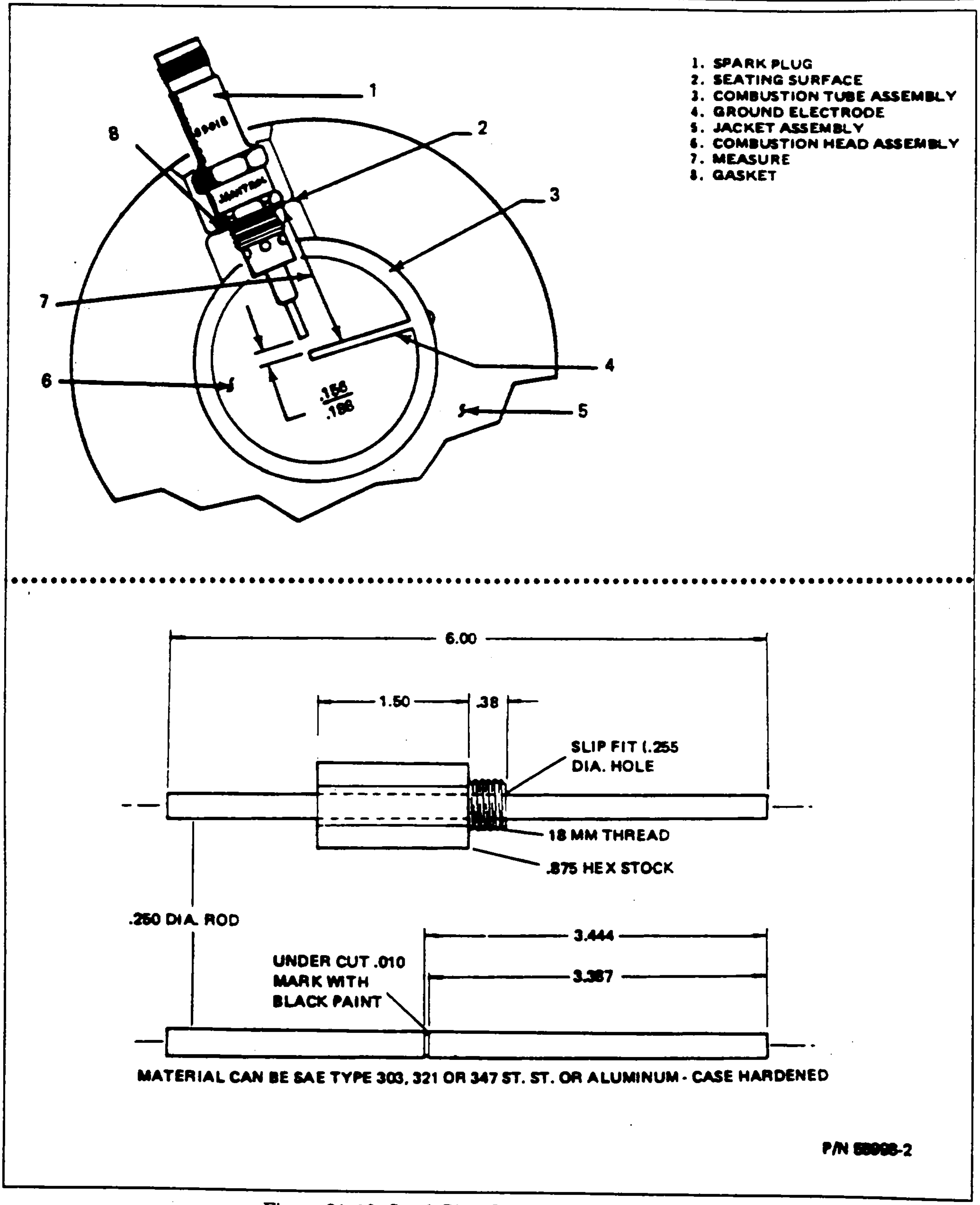


Figure 21-12. Spark Plug Gap Adjustment and Tool

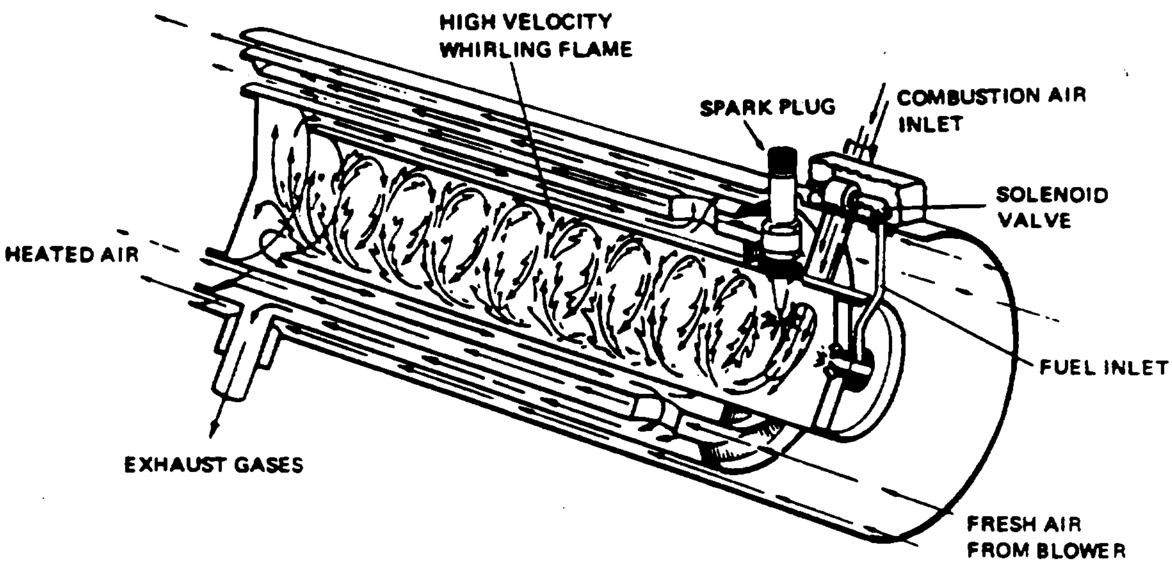


Figure 21-14. Diagramatic Cutaway of Heater to Show Whirling Flame Action

HIS SPACE INTENTIONALLY LEFT BLANK

IGNITION ASSEMBLY.

This unit converts 28-volt DC to high voltage, oscillating current capable of producing a continuous spark in the combustion chamber of the heater. This unit remains energized and produces a continuous spark during heater operation. It contains a condenser, resistor, radio noise filter and vibrator socket. It also has an externally mounted vibrator ignition coil

REMOVAL OF IGNITION ASSEMBLY. (Refer to Figure 21-8.)

—NOTE—

Make sure the heater electrical circuits are de-energized.

1. Disconnect the primary wire from the primary terminal of the ignition assembly.
2. Carefully unscrew and disconnect the high-voltage ignition cable at the spark plug. Exercise care to avoid fouling or damaging the connector.
3. Remove the four attaching screws and lift the ignition assembly off the heater jacket.

INSTALLATION OF IGNITION ASSEMBLY. (Refer to Figure 21-8.)

1. Place the ignition assembly in position on the heater jacket, with the high-voltage cable facing the spark plug end of the heater.
2. Install the four screws and tighten the screws securely.
3. Carefully connect the high-voltage lead to the spark plug.
4. Connect the primary lead to the primary terminal on the ignition assembly and tighten the nut securely.
5. Check for proper heater operation.

TESTING IGNITION UNIT.

The ignition unit does not require complete overhaul. The following test will indicate whether or not the unit is operational and whether the vibrator should be replaced before reinstallation in the aircraft. The following equipment is required to test the components:

1. A battery that will supply power at approximately 24-volts DC.
2. A voltmeter with a range of 0-30 volts.
3. A lead from the battery to the test fixture in which is included an ammeter with a range of 0-3 amperes and a normally open, momentary-closed switch. The total resistance of the lead including the ammeter and switch must not exceed 0.3 ohms.
4. A spark gap of 0.187 inch ± 0. A convenient means of arranging the correct spark gap is to install a spark plug, P/N 39D18, in a test fixture arranged to provide a ground electrode and a .187 inch spark gap. (Refer to Figure 21-9 for information on fabricating this fixture.)

—NOTE—

Any one of several spark plugs may be used with the spark plug fixture detailed in Figure 21-9. However, the "A "dimension in that sketch must be varied with the length of spark plug electrode to provide a gap of .187 inch for all spark plugs.

—*NOTE*—

When testing an ignition unit, do not use a screwdriver as a substitute for a spark plug and spark plug fixture.

5. The high tension shielded ignition lead between the ignition unit and the spark plug is a part of the cover assembly.
6. Arrange the test equipment as shown in Figure 21-10.

OPERATIONAL TEST OF IGNITION UNIT.

1. Close the momentary switch and read the voltmeter and ammeter. Release the momentary switch immediately.
2. The amperage reading at 28 volts D.C. must be 1.25 ± 0.25 amperes.

VIBRATOR.

The vibrators should be replaced after 250 hours of operation. This schedule applies equally to vibrators installed in new units as well as new vibrators installed in ignition units that have been in service.

REMOVAL OF VIBRATOR.

1. Remove the hose type clamp from the housing brackets that secure the vibrator.
2. Remove the vibrator from the ignition unit; it may require a slight back-and-forth movement to remove it from the unit. A piece of masking or friction tape around the exposed portion of the vibrator will help to grip the vibrator for removal.

INSTALLATION OF VIBRATOR.

1. Install the new vibrator with the index marks aligned. The connector pins on the vibrator can be felt entering the pin sockets in the vibrator socket; then press the vibrator fully and firmly into position.
2. Replace the clamp.

VENTILATING AIR BLOWER.

This blower is attached to the inlet end of the heater assembly and provides a source of ventilating air through the heater. Ram air from the ventilating air intake scoop is used during flight.

COMBUSTION AIR BLOWER.

This centrifugal-type blower supplies air to the combustion chamber of the heater. Performance of the combustion air blower is assisted by the use of ram air during flight.

REMOVAL OF COMBUSTION AIR BLOWER. (Refer to Figure 21-15.)

1. Disconnect wire at quick-disconnect terminal.
2. Disconnect the inlet tubing from the inlet air adapter.
3. Loosen the clamps that hold the combustion air blower assembly in the support bracket and slide the motor out of the bracket.

REPLACING MOTOR BRUSHES. (Refer to Figure 21-15.)

1. Remove the brush cap at one of the brush locations. Note position of brush inside the guide and carefully lift the brush and brush spring out of the guide. Be sure to hold the brush so that it can be reinstalled in precisely the same position if no brush replacement is required.
2. Inspect the brush for wear. A new brush is .531 inch long. If brushes are worn to a length of .187 inch, they must be replaced.
3. Looking through the brush guide, inspect the commutator, which should be smooth and medium brown to dark brown in color. Remove all dust from commutator with compressed air. If the commutator is grooved in the brush track, gouged, scored or shows signs of having burned spots, replace the complete motor assembly. If the commutator is in good condition, install new motor brushes, and tighten brush caps into place. Make sure each brush is oriented so that the curved end fits the curvature of the commutator.
4. After installing new brushes, it is advisable to run-in the brushes as follows: Connect the motor to a controlled voltage supply (rheostat in a 28 volt line). Operate the motor at approximately 1/2 its normal speed for the first hour, then gradually increase the speed until it is rotating at approximately normal speed. Continue the run-in operation for at least two hours to properly seat the brushes before installing the blower in the airplane.

INSTALLATION OF COMBUSTION AIR Blower. (Refer to Figure 21-15.)

1. Prior to installing the combustion air blower, inspect all parts of the assembly for loose screws, loose nuts and poor ground connection on the blower housing. Make sure the blower wheel is tight on the shaft and properly located in the housing. It should have just enough clearance to rotate at full speed without binding against the outer housing. Blower performance is based upon this close-tolerance clearance. It is recommended that correct voltage be applied for this clearance check.
2. Install the blower inlet adapter in the same orientation as before removal.
3. Place the combustion air blower assembly in position in the attaching clamp so the air tubing can be connected, and slide the tubing into position at the point where it was disconnected during removal. Tighten the motor in the attaching strap.
4. Secure the air tubing by tightening the clamp or installing the sheet metal attaching screws.
5. Connect the wire lead to No. 1 terminal on terminal strip.
6. Check motor operation. By disconnecting the wire at the No. 3 terminal on heater terminal strip, blower can be operated without fuel flow to the heater.

DISASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 21-15.)

1. Remove the combustion air blower inlet adapter by removing three screws, lock washers, cover plate and gasket.
2. Remove the housing outer half by removing the four screws.

3. Loosen the set screw in the blower wheel and slide it off the motor shaft.
4. Remove the two hex nuts, lock washers and flat washers, and slide the housing inner half off the motor through bolts. The spacer will drop off.
5. Install new motor brushes. If the motor commutator is badly worn or if the motor is defective in any respect, it must be replaced.

CLEANING. (Refer to Figure 21-8.)

1. Clean individual metal parts (except those parts containing switches and electrical wiring) and the combustion tube assembly, by immersing them in dry-cleaning solvent, such as Stoddard solvent (Federal Specification P-D-680). A bristle brush should be used to assist the cleaning process if foreign accumulations are stubborn to remove.

—CAUTION—

Do not attempt to burr or scrape off any deposits on face of spray nozzle. The face of the nozzle is very susceptible to damage from mishandling. Carefully repeat cleaning process using only a bristle brush and repeated applications of solvent to loosen any stubborn deposits.

2. Use compressed air or lintless cloth to dry the parts, unless sufficient time is available for them to air dry.
3. Wipe electrical components with a clean, dry cloth. If foreign material is difficult to remove moisten the cloth in carbon tetrachloride or electrical contact cleaner and clean all exterior surfaces thoroughly.

CLEANING AND INSPECTING THE COMBUSTION TUBE ASSEMBLY. (Refer to Figure 21-8.)

1. Slight scaling and discoloration of the combustion tube assembly is a normal condition for units that have been in service up to 500 airplane hours. The slight scaling condition will appear to be mottled and a small accumulation of blue-gray powder may be present on the surface in certain areas. This condition does not require replacement of combustion tube assembly, unless severe overheating has produced soft spots in the metal.

—NOTE—

This assembly should be inspected prior to cleaning in order to prevent the removal of visible evidences of damage.

2. Look inside the exhaust outlet to determine if the combustion tube appears to be heavily scaled or mottled. Deformation is more difficult to detect visually but can usually be observed by looking straight through the combustion tube assembly and sighting along the outer surface of the inner combustion tube. An assembly that has been obviously deformed should be replaced. Slight deformation will not affect heater operation unless it is extensive and localized enough to reduce the flow of ventilating air through the heater more than 10 percent. Inspect the sensing tube for clogging. If it is clogged, it must be cleaned. Disconnect at switch and clean tube by blowing air through it. If combustion by product residue has collected in the exhaust end of the tube, it may be necessary to clean the tube with a wire.

3. The combustion tube assembly may be cleaned by either of two methods:
   A. One method is to soak the combustion tube assembly overnight in a solution of Kelite No. L235 cleaning solution (1 to 12 parts by volume). The solution should be maintained at temperature of between 190° F and 210° F. After overnight soaking, rinse the combustion tube assembly thoroughly in water to remove all traces of the Oakite solution. In order to reach all areas of the combustion tube assembly, it is advisable to let it stand in the rinsing water for as long as 1/2 hour, while occasionally agitating it to circulate the water. All openings should be left open during this operation. Be sure to dry the combustion tube assembly thoroughly after cleaning by blowing with air.
   B. A second method of cleaning is what is commonly known as hand "tumbling." Insert shot or other metallic particles through the exhaust outlet opening, then close all openings and shake the combustion tube assembly vigorously, while rotating it and changing from end-to-end frequently. Be sure to pour out all of the particles and loosened material, then with all openings uncovered, direct a stream of compressed air into the combustion tube assembly from first one opening, then the other. Make sure all loose material is removed.

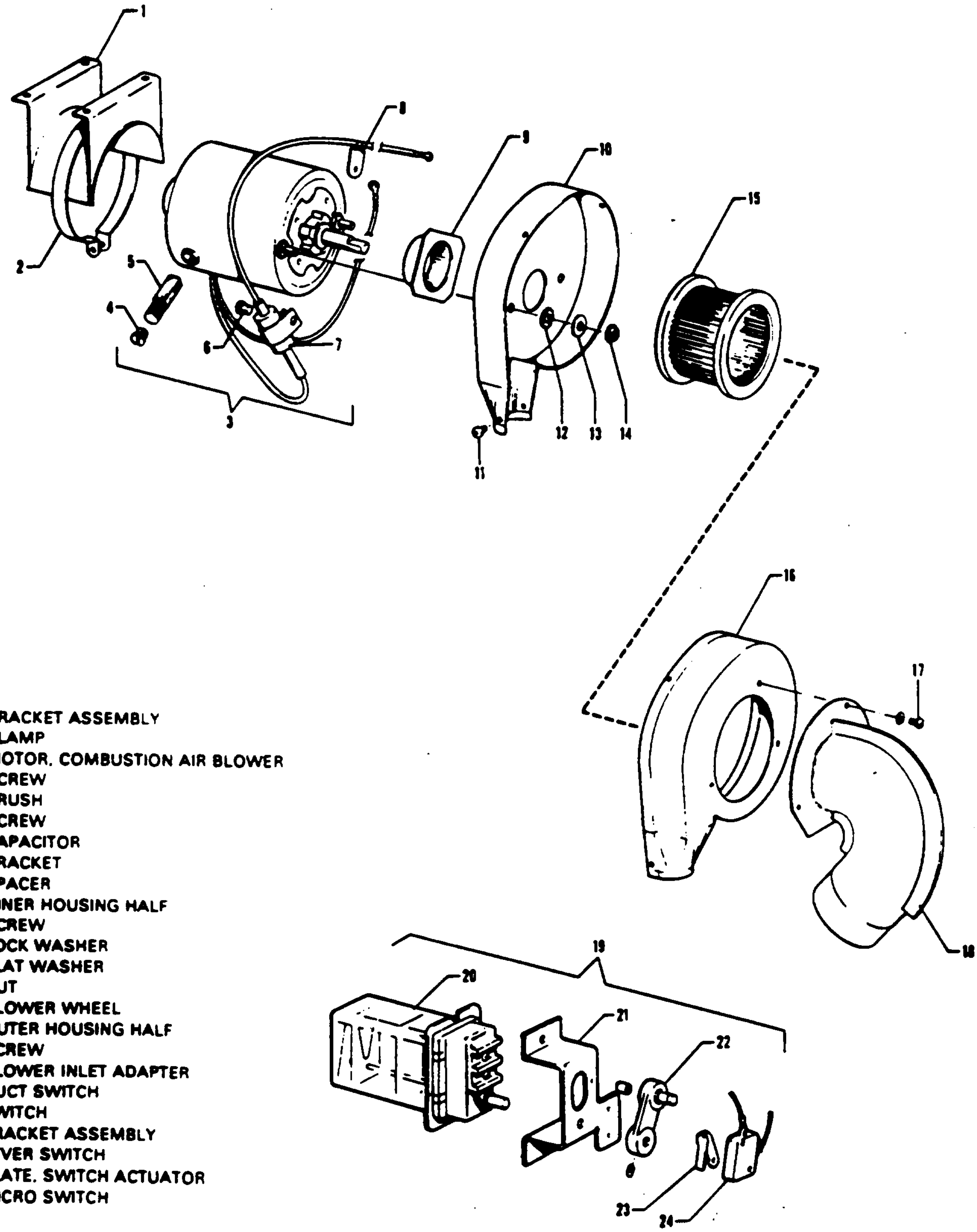
REPAIR OF COMBUSTION TUBE ASSEMBLY.

—NOTE—

No weld or braze repairs are authorized.

REASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 21-15.)

1. Place the spacer over the end of the motor shaft and attach the motor assembly to the inner housing half with the two self-locking nuts, flat washers and lock washers.
2. Slide the blower wheel on the motor shaft and tighten the set screw lightly against the flat portion of the motor shaft.
3. Place the outer half blower housing in position on the inner housing half and install screws.
4. Attach the capacitor at the point shown with screws. The motor ground lead terminal can be grounded to the motor support bracket.
5. Loosen the Allen set screw in the blower wheel and shift the wheel on the motor shaft until it is near the inlet in the blower housing. Tighten the set screw securely. The blower wheel should just clear the inlet flange when rotated at full RPM. Spin the blower wheel by hand for clearance check; then apply proper voltage to run motor and recheck for proper clearance.
6. Attach the blower inlet adapter to blower housing with three screws and lock washers.



1. BRACKET ASSEMBLY
2. CLAMP
3. MOTOR, COMBUSTION AIR BLOWER
4. SCREW
5. BRUSH
6. SCREW
7. CAPACITOR
8. BRACKET
9. SPACER
10. INNER HOUSING HALF
11. SCREW
12. LOCK WASHER
13. FLAT WASHER
14. NUT
15. BLOWER WHEEL
16. OUTER HOUSING HALF
17. SCREW
18. BLOWER INLET ADAPTER
19. DUCT SWITCH
20. SWITCH
21. BRACKET ASSEMBLY
22. LEVER SWITCH
23. PLATE, SWITCH ACTUATOR
24. MICRO SWITCH

Figure 21-15. Exploded View of Combustion Air Blower and Motor Assembly

COMBUSTION AIR PRESSURE SWITCH.

This differential pressure switch cuts off the heater operation whenever the fuel-air mixture is not appropriate for efficient heater operation. This switch is set to activate at 0.5 inches of water ± .03 inches.

REMOVAL OF COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 21-8.)

1. Disconnect the electrical leads from the terminals of the combustion air pressure switch item. (Identify leads to facilitate reinstallation.)
2. Disconnect the tube assemblies from the switch. (Identify tube connections to facilitate reinstallation.)

—CAUTION—

Exercise caution not to exert excessive bending of the tubes during removal and installation procedure.

3. Unscrew and remove the combustion air pressure switch from the fitting on the combustion air inlet tube.

INSTALLATION OF COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 21-8.)

1. Install the combustion air pressure switch by rotating it on the threaded fitting of the combustion air inlet tube and tighten it securely. Exercise caution not to overtorque the switch as this could change the setting.
2. Connect the tube assemblies to the switch using a suitable thread lubricant.
3. Connect the electrical leads to the appropriate switch terminals. If in doubt regarding proper connections, refer to the wiring diagram, Figure 21-3.
4. Check for proper heater operation.

HEATER SAFETY LIMIT SWITCH.

Located in the heater is a heat limit switch which acts as a safety device to render the heater system inoperative if a malfunction should occur causing excessively high temperatures. This control is located in the downstream end of the vent jack, with the reset button on the heater shroud. It is reached only through the access hole in the right side of the nose section to insure that the malfunction causing the overheat condition is corrected prior to future heater operation.

REMOVAL OF CYCLING SWITCH AND LIMIT (OVERHEAT) SWITCH.

1. If the limit switch is damaged or defective, disconnect the two electrical leads from the switch terminals. Be sure to mark the leads for proper reassembly. (The switch terminals are identified by numbers "1" and "2.")
2. Remove the two attaching screws and lift the limit switch and spacers (gaskets) from the jacket opening.

3. If the cycling switch is damaged or defective, disconnect the electrical leads, being sure to mark them for proper reassembly.
4. Remove the two screws and lift the cycling switch from the jacket opening.

—NOTE—

No attempt should be made to repair either of these switches. If they do not operate properly, they should be replaced.

INSTALLATION OF CYCLING SWITCH AND LIMIT (OVERHEAT) SWITCH.

1. Install the limit switch and two spacers (gaskets) by placing them in position in the heaterjacket opening and installing two screws.
2. Tighten screws securely; then reconnect the electrical leads in accordance with markings made during disassembly. (If in doubt about electrical connections, refer to the wiring diagram, Figure 21-3.)
3. Install the cycling switch by placing it in position in the heater jacket opening and securing it with the two screws. Tighten screws securely; then reconnect the electrical leads to their respective terminals as marked during disassembly. (If in doubt about connections, refer to wiring diagram, Figure 21-3.)

—NOTE—

The cycling switch shuts off the heater at 250° F. It win then reset itself when the temperature falls below this point. The overheat switch operates at 300-400° F.

DUCT SWITCH. (Refer to Figure 21-16.)

This switch is installed in the ventilating air duct downstream from the heater to sense the ventilating air outlet temperature. To select the desired cabin temperature, the switch may be adjusted manually from a high of 250° F ± 10° downward through a range of 146° F. The switch has differential of 15° F ± 5° at any given setting.

REMOVAL OF DUCT SWITCH. (Refer to Figure 21-15.)

1. Place the control lever arm at the "H" position and loosen the screws holding the through control wire and slide the control wire out of the lever arm.
2. Disconnect the two electrical leads from the terminals on the exposed face of the switch.
3. Remove the two wires from the duct switch to the micro switch (Identify wires to facilitate reinstallation.)
4. Remove the two attaching screws and washers from the duct.
5. Carefully lift out the switch and gasket (if gasket is used.)

CLEANING AND INSPECTION OF DUCT SWITCH.

1. Brush off any dust or lint from the switch operating mechanism (exposed inside the duct) and wipe external surfaces with a clean cloth.

INSTALLATION OF DUCT SWITCH. (Refer to Figure 21-15.)

1. Insert the switch carefully, with gasket (if used), into the ventilating duct opening and install the two attaching screws and washers.
2. Connect the two electrical leads to their respective terminals, as marked during removal. Connect the two wires from the micro switch to the duct switch terminals.
3. Set the temperature selector shaft at the high stop, then carefully place the temperature control in the aircraft cabin to high heat position. Reinstall control wire into control lever arm and tighten screws.
4. Set the micro switch to activate at the very last movement of the control lever arm in the high heat position.
5. Operate the heater with the duct switch set above ambient temperature to check operation.

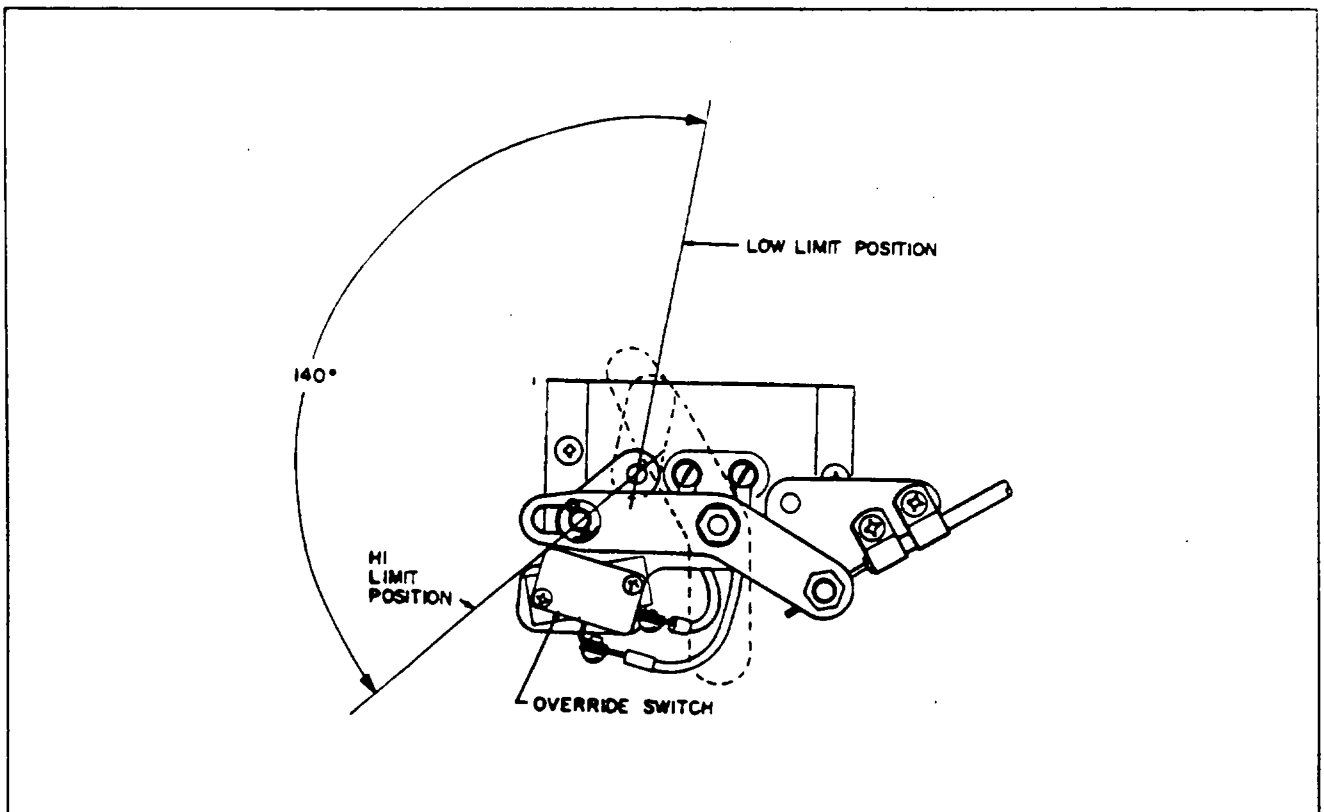


Figure 21-16. Left Side View - Duct Switch

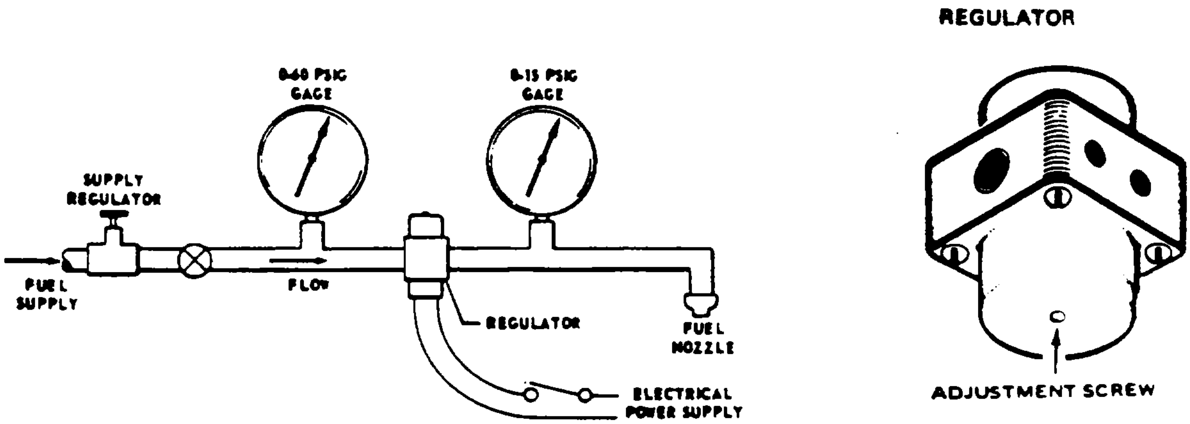


Figure 21-17. Test Setup for Fuel Regulator and Shutoff Valve

FUEL REGULATOR AND SHUTOFF VALVE.

This unit provides preset, regulated fuel pressure as well as remote shutoff to the heater. It is set for 7.5 psi. The shutoff valve is operated by a solenoid.

REMOVAL OF FUEL REGULATOR AND SHUTOFF VALVE.

1. Disconnect the electrical leads from the valve.
2. Disconnect the fuel lines from the inlet and outlet openings. Take note of these connections for correct installation.
3. Remove the screws attaching the unit to its mounting bracket.

ADJUSTMENT OF FUEL REGULATOR AND SHUTOFF VALVE.

The fuel regulator and shutoff valve used in this system are adjustable but not repairable. The following steps cover the proper adjustment of this unit:

1. Install the regulator in a test stand similar to that shown in Figure 21-17.
2. Install a 2.5 gph nozzle (Janitrol Part No. D08D09). Gasoline or Stoddard solvent can be used for testing.
3. Apply a fluid pressure of 20 to 50 psi and energize the solenoid.
4. Using a screwdriver, break the adjustment seal and adjust the regulated outlet pressure as close to 7.5 psi as possible. (Turn clockwise to increase pressure; counterclockwise to decrease pressure.)

5. Slowly vary the inlet pressure from 10 to 50 psi. The outlet pressure should remain between 7.0 and 8.0 psi.
6. With the inlet pressure of 50 ± 3 psi, de-energize and energize the solenoid at least twice. The outlet pressure should be 7.0 to 8.0 psi with the solenoid energized. When the solenoid is de-energized, the pressure should drop to zero and the fuel flow from the nozzle should stop.
7. With the solenoid energized, slowly reduce the inlet pressure from 50 to 10 psi. Outlet pressure should remain between 7.0 and 8.0 psi.
8. During the above test, observe for signs of external leakage. Any leakage is cause for rejection of the regulator. After satisfactory adjustment has been made, apply Glyptol around the threads of the adjustment screw and in the slot.

INSTALLATION OF FUEL REGULATOR AND SHUTOFF VALVE.

1. Install the fuel regulator and shutoff valve on its mounting with the attaching screws.
2. Connect the fuel lines to the inlet and outlet openings and secure.
3. Connect the electrical lead. Be sure to slide an insulating sleeve (or tape) over the connection to avoid a short circuit and tie the sleeve in place.

TEST PROCEDURE.

GENERAL.

A test of all components should have been made after overhaul to insure proper operation. Some shops may not have complete testing facilities for measuring air flows, pressure drops, and other factors which would be accomplished in a laboratory-type test. If such a test cannot be made, install the heater and check operation on the ground and in the air to determine if operation is normal. In shops where complete test equipment is available and a complete functional test can be performed, the test routine described in subsequent paragraphs should be made.

EQUIPMENT REQUIRED. (Refer to Figure 21-18.)

1. An improvised stand to hold the heater during test. The heater should be located far enough away from any combustible material or atmosphere to avoid hazard. A location should be chosen where exhaust can be dispelled. Do not add an excessive extension to the heater exhaust.
2. A source of fuel capable of being regulated at 7.5 ± .5 psi.
3. The combustion air blower to be used with the heater should be used for the test.
4. A 28 volt current supply, which may be a DC generator with a rheostat, ammeter and voltmeter in the line to control and indicate the current draw and voltage output.
5. Two water manometers (zero to 5.0 inch water column) for measuring the pressure in the ventilating air duct and in the combustion air stream.
6. A piece of duct to be attached to the downstream end of the heater. It should have a minimum length of 24 inches and the same diameter as the heater being tested. A 2.25 inch diameter orifice should be centrally located at the outlet end. An aperture should be provided for the thermometer and duct switch and a static tap should be attached as shown in Figure 21-18.

7. A thermometer with 500° F scale.
8. A fuel-pressure gauge.
9. A controlled source of compressed air for final leakage test.

OPERATIONAL TEST. (Refer to Figures 21-18 or 21-19.)

1. Connect the heater to the test setup as shown in Figure 21-18. Make sure the combustion air blower is mounted securely and that the heater is clamped to its supporting stand.
2. Insert the duct switch in the sheet metal extension tube at the location shown in Figure 21-18.
3. Connect components and heater as outlined in the wiring connection diagram, Figure 21-19. The power supply switch should be open.
4. Connect the power source to the heater.
5. Disconnect wire lead from terminal "3" on the heater side of heater terminal strip to prevent the heater from lighting and close the power source switch to check operation of blowers. The combustion air blower and ventilating air blower should operate at full speed with no blower wheel interference. If either blower fails to run, locate and correct the trouble before proceeding with the test.
6. Connect a voltmeter across the two combustion air pressure switch terminals to determine if the switch is closed, which would be indicated by a zero reading on the meter. If a full voltage reading is obtained, the combustion air supply is either inadequate or the switch is defective or improperly adjusted. Make necessary corrections.
7. Observe the manometer connected to the ventilating air pressure tap, which should show a reading of 1.1 inches of water (minimum) at rated voltage.
8. Observe the manometer connected to the combustion air tube tap, which should show a reading of 1.5 inches of water (minimum) at rated voltage.
9. Open the power supply switch and reconnect the terminal lead disconnected in preceding step 5.
10. Close the power supply switch and turn on the fuel supply. The heater should light within five seconds (may require slightly longer for air to be purged from fuel lines on the first trial).
11. Observe operation of duct switch, which should control heater operation according to the switch setting.
12. If the duct switch fails to control the temperature according to the setting, place the control lever in High "H" position and notice the control variation. A high reading of 250° F ± 10° should be obtained (reading will vary in different applications).
13. Connect a jumper across the terminals of the duct switch to make it inoperative and observe action of the cycling switch. The cycling switch should cycle to control the outlet air temperature at approximately 250° F (nominal). This is a function of ambient temperature and air flow conditions. If operation is within a range of 190° F to 290° F, the switch is operating normally. If the switch is out of range it can be reset in the same manner as described for the duct switch, except that no control lever or indicator stop are used. If adjustment fails to restore proper temperature range, replace the switch.
14. With duct switch still jumped, place a jumper across the cycling switch terminals to check operation of the overheat switch. Block the ventilating air outlet and notice if the overheat switch shuts off the heater. It should open at between 300° F and 400° F. (This is also a function of ambient temperature and air flow.) After the switch shuts off, remove ventilating air restriction and switch reset button until it clicks. The heater should light and operate.
15. Shut down the heater and check all components visually to make sure no damage has occurred to any of them.
16. Remove heater and other components from the test setup and install it in the airplane.

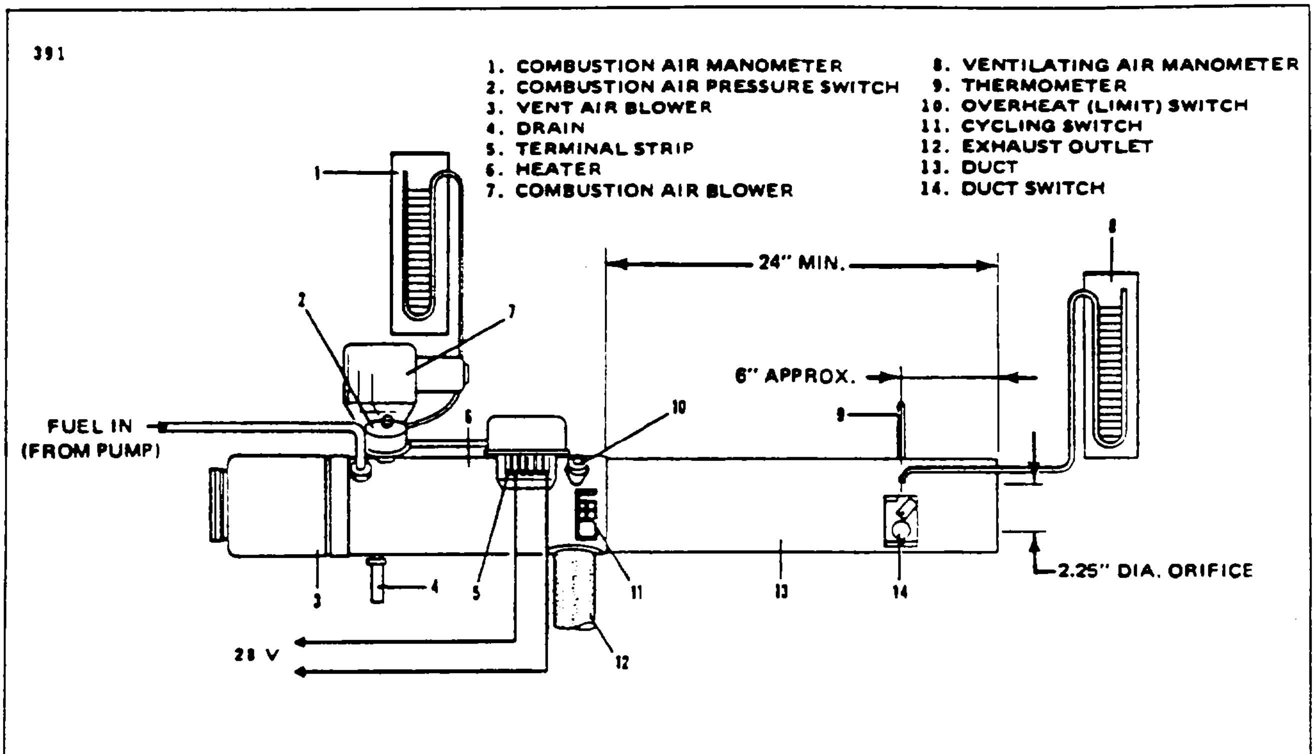


Figure 21-18. Suggested Setup for Heater Operation Test

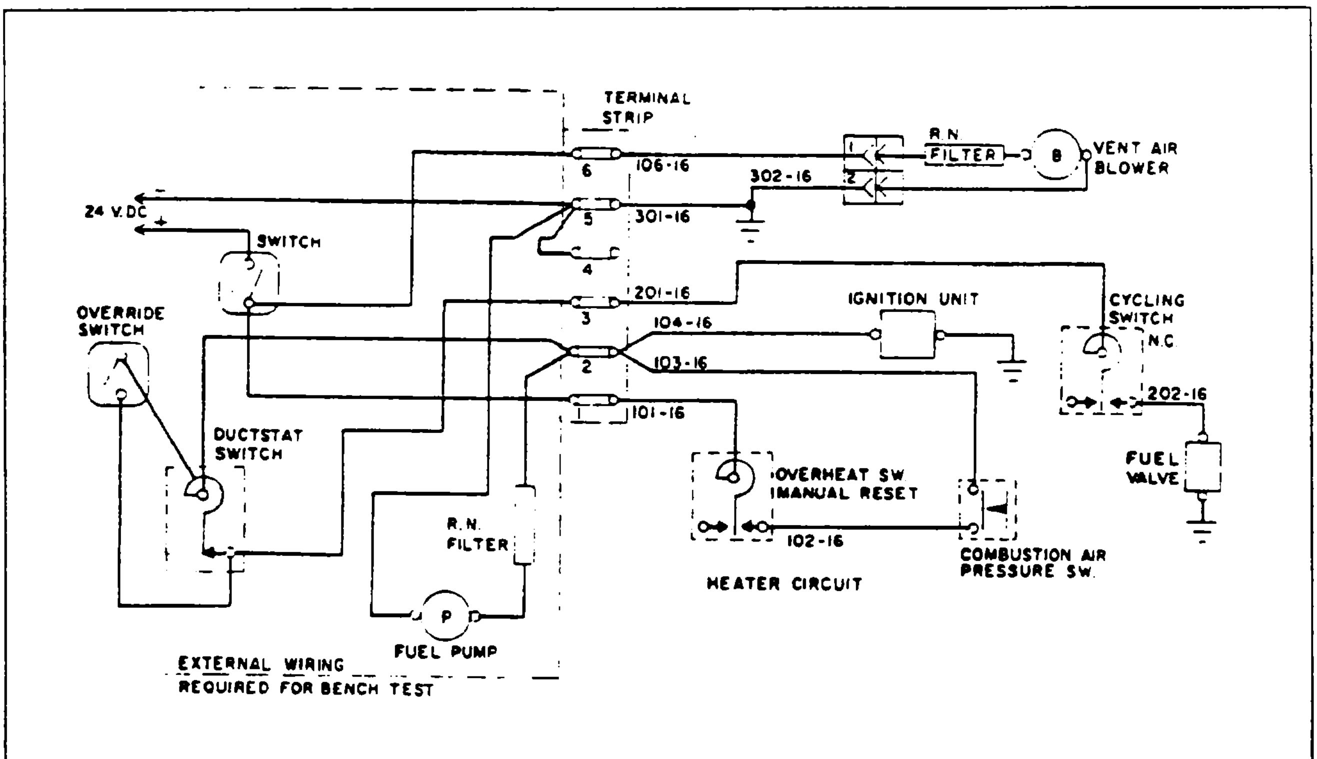


Figure 21-19. Wiring Connections for Heater Operation Test

COOLING.

DESCRIPTION AND PRINCIPLES OF OPERATION.

The vapor cycle air conditioning system consists of a variety of parts which make up the complete system. The compressor is an engine mounted, belt driven, two cylinder, reciprocating compressor. It is driven from the starter drive gear pulley of the right engine through an electric clutch mounted to the compressor. This clutch is used to engage the compressor. The condenser is a fin and tube heat exchanger mounted behind the right engine fire wall. The condenser is cooled by air taken from the propeller slipstream, through an adjustable air scoop on top of the right nacelle. This scoop is normally retracted in flight and also on the ground when the air conditioner is not operating. It will open on the ground by means of a safety switch located on the right main landing gear, which completes the circuit to open the scoop when the master switch is on and the cabin temperature control switch calls for air cooling. The condenser provides the heat sink to condense the high pressure freon vapor. The receiver-dehydrator acts as a reservoir to ensure that only liquid refrigerant is supplied to the expansion valve. It also functions as a trap for any air or moisture that was left in the system during the initial charging of the system. The system has two evaporator modules mounted in the cabin on the forward side of the main spar. The evaporator is a fin and tube heat exchanger which cools and dehumidifies the air. Each evaporator is equipped with an expansion valve. These valves control the flow of freon into the evaporator cores. A capillary coil mounted to the suction lines at the evaporators regulates the operation of the valves. The refrigerant is carried to and from the air conditioning module from the compressor through flexible hoses and aluminum tubing routed from the compressor at the right front of the right engine, down under and across the engine to a point on the left side of the fire wall. From there through the condenser to the main spar, into the wheel well, into the cabin module evaporators. The pressure and suction line running approximately parallel. The suction line being the larger of the two.

The air conditioner is an independent unit which dehumidifies, cools, and recirculates the cabin air. The temperature is selected by the temperature control mounted in the instrument panel. Under all normal operations, the temperature control switch will control the operation of the air conditioner. The system uses R-12 refrigerant which is drawn into the compressor and pumped to the condenser under high pressure. The freon vapor is heated as a result of the compression process. As it flows through the condenser, the vapor is cooled by ram air which causes the vapor to condense into a liquid state. This liquid refrigerant then passes from the condenser to the receiver-dehydrator assembly, which acts as a reservoir and also functions as a filter to remove any trapped air or moisture that was in the system during the initial charging. High pressure liquid freon is supplied from the receiver, to an expansion valve. This valve meters the refrigerant into the evaporator core at a rate which allows the liquid refrigerant to evaporate. Heat from the evaporator core surface is lost to the boiling and vaporizing refrigerant, which is cooler than the core, thereby cooling the core and the air passing through it. As this process is taking place, moisture in the air condenses on the outside surface of the evaporator core and is drained off as water. By the time the refrigerant leaves the evaporator, it has completely vaporized. The refrigerant vapor then returns to the compressor where the cycle is repeated.

TROUBLESHOOTING.

Troubles peculiar to the air conditioning system are listed in Chart 2102, along with their probable cause and suggested remedies.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER)

Gauge Indication	Probable Causes	Remedy
High discharge refrigerant.	Overcharge of frigerant.	Purge excess repressure.
	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. Straigten 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 leaks.
	Damaged compressor valves or dirt under valves.	Isolate compressor. Remove valve plate. Clean valves or replace valve plate. Replace gaskets.
	Blown gasket.	Replace gasket.
	Damaged compressor. Worn or broken piston or piston rings.	Isolate compressor. Repair or replace compressor.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Gauge Indication	Probable Causes	Remedy
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.
Low suction pressure. (evaporator not cold enough) suction gauge may read a vacuum in- evaporator lacks refrigerant.	Undercharge of refrigerant. Moisture freezing in expansion valve. Valve will show frost.	Add Freon. Install new dryer. Evacuate and re charge system.
	Expansion valve inlet screen clogged.	Remove screen. Clean with sol dicating vent and replace.
	Inoperative expansion valve. Valve stuck closed or capillary bulb has lost its charge.	Warm capillary by holding in hand. If suction pressure does not charge, replace expansion valve.
	Restriction anywhere in liquid line. Restric tion 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.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Gauge Indication	Probable Causes	Remedy
High suction pressure (cont.)	Compressor drive belt slipping.	Adjust belt tension.
	Magnetic clutch slipping.	Check electrical circuit for correct voltage to clutch coil. Clean clutch surfaces of oil.
	Strainer at suction service valve clogged.	Clean with solvent and replace.
	Leaking or broken compressor valves.	Replace valves with valve kit.
System produces no cooling.	Electrical	
	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 disconnected.
	Clutch coil or solenoid burned out or disconnected.	Check current flow to clutch or solenoid-replace if inoperative.
	Thermostat sensing element defective.	If system works in manual mode, check thermostat and cabin comfort control panel.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
System produces no cooling. (cont.)	Electrical	
	Circulating fan 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 re-placement.
	Expansion valve stuck in open position.	Replace expansion valve.
	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 shaft seal.
	Clogged screen or screens in receiver dehydra-tor or expansion valve; plugged hose or coil.	Repair as necessary.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
—NOTE— *After completing repairs of any above causes, the system must have the dehydrator replaced. Then the complete system must be purged, evacuated, and recharged to remove excess moisture.*		
System will not produce sufficient cooling.	Electrical	
	Circulating fan motor sluggish in operation.	Remove fan 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 clogged.	Clean with compressed air. Use cleaning solvent to remove cigarette tars.
	Insufficient air circulation over condenser coils; fins clogged with din or bugs.	Clean condenser. coils.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
System will not produce sufficient cooling. (cont.)	Refrigeration	
	Insufficient refrigerant in system.	Recharge system until bubbles disappear in receiver 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.	Purge system; replace receiver.
	Excessive moisture in system.	Purge system; replace receiver.
	Air in system.	Purge, evacuate, and charge system. (Replace receiver.)

—NOTE—

When a unit must be removed from the system for service or replacement, the system must have the dehydrator replaced also, and the system must be purged, evacuated, and recharged to remove excess moisture.

Trouble	Cause	Remedy
Excessively noisy system.	Electrical	
	Defective winding or improper connection in compressor clutch coil or solenoid.	Replace or repair as necessary.
	Mechanical	
	Loose or excessively worn drive belts.	Tighten or replace as required.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
Excessively noisy system. (cont.)	Electrical	
	Noisy clutch.	Remove clutch for service or replacement as necessary.
	Compressor noisy.	Check mountings and repair; remove compressor for service or replacement.
	Compressor oil level low.	Fill with correct specified oil.
	Circulating fan noisy; excessive wear in blower motor.	Remove blower motor for service or replacement as necessary.
	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.

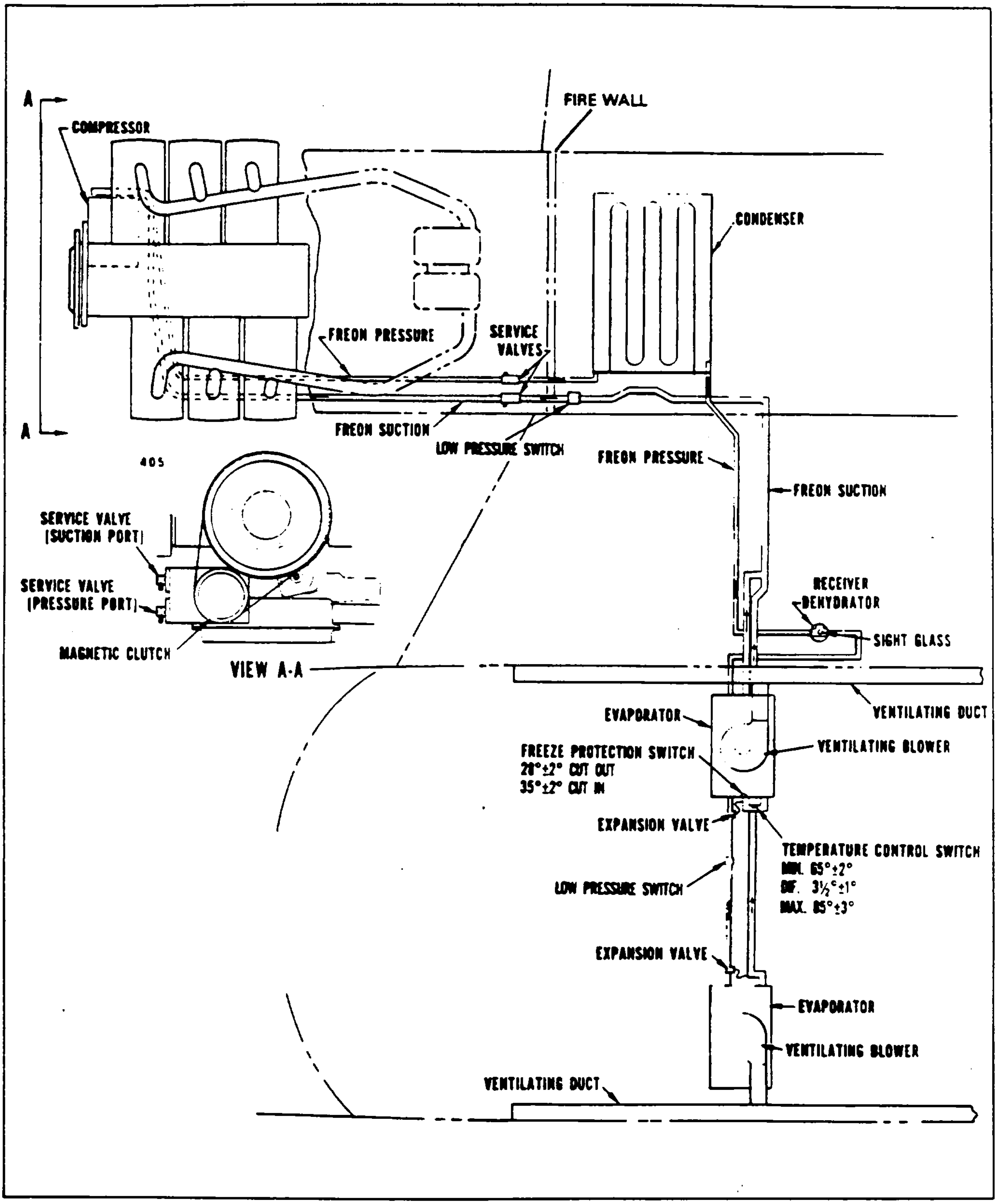
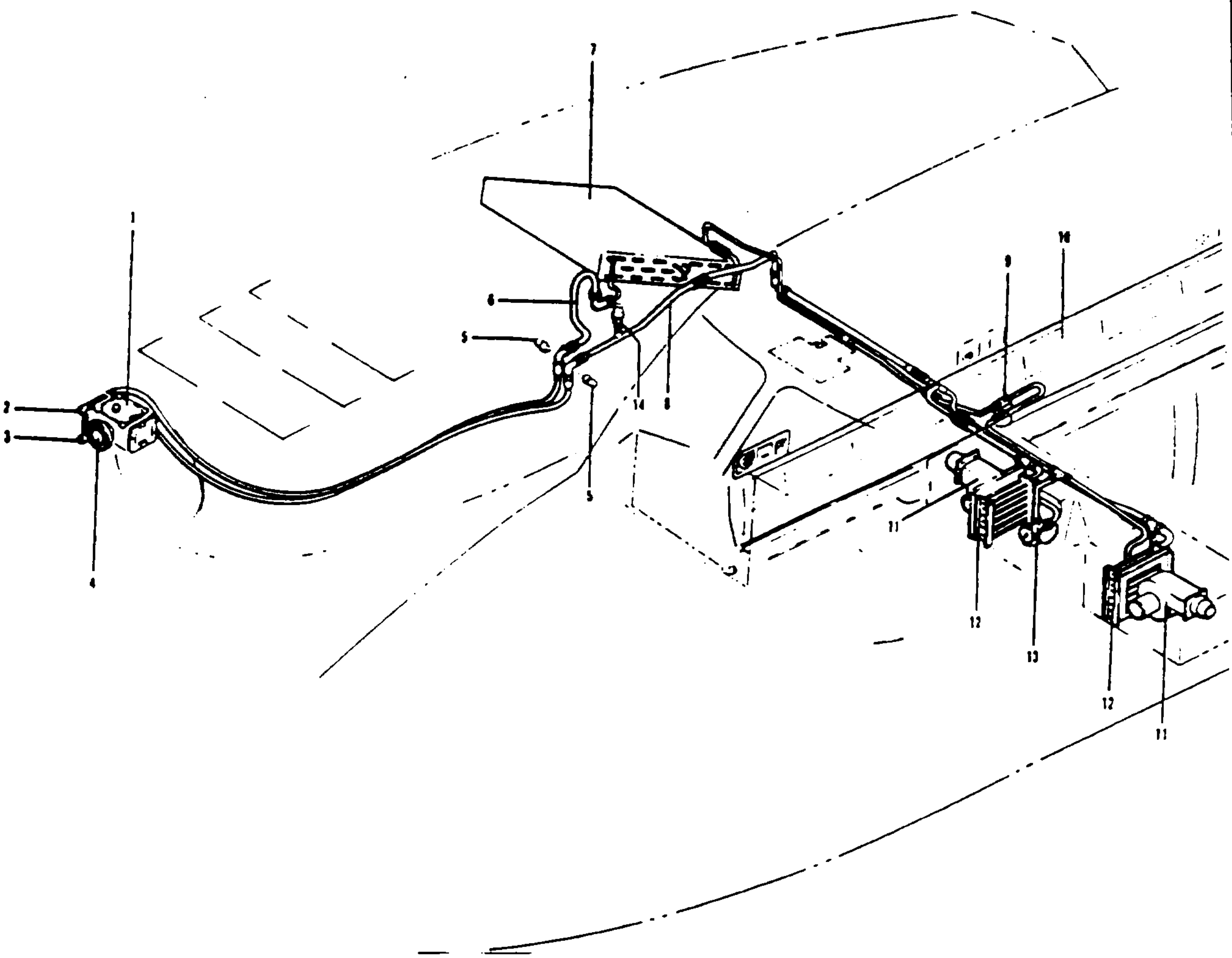


Figure 21-20. Air Conditioning Schematic Diagram



1. COMPRESSOR
2. SUCTION PORT VALVE
3. PRESSURE PORT VALVE
4. MAGNETIC CLUTCH
5. SERVICE VALVES
6. FREON PRESSURE LINE
7. CONDENSER
8. FREON SUCTION LINE
9. RECEIVER-DEHYDRATOR AND SIGHT GLASS
10. VENTILATING DUCT
11. VENTILATING BLOWER
12. EVAPORATOR
13. EXPANSION VALVE
14. LOW PRESSURE SWITCH

Figure 21-21. Air Conditioning System Installation

CHART 2103. TEMPERATURE PRESSURE CHART

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

MALFUNCTION DETECTION.

The detection of system malfunction largely depends on the mechanic's ability to relate the gauge pressure readings to 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 check up 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 work has been done and before the aircraft is released to the customer. The serviceman performing this test carefully will ensure that the repairs have been properly performed and that the system will operate satisfactorily.

The Performance Test when properly carried out 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 the operating 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.

PERFORMANCE TEST.

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 work has 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 the operating 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.

PERFORMANCE TEST IN COLD CLIMATES.

To run a performance test on the T-1020 air conditioning in cold climate, below 70° F, the following procedures will have to be used:

1. Obtain an air blower with the following requirements:
   A. 300 cfm at 3.00" H20 static pressure with standard air density of .0765 lbs/cu ft., or a Piper recirculating air blower Piper Part No. 460 003.
2. Take the air blower and connect the exhaust side to an appropriate hose.
3. Insert the hose into the T-1020 nose inlet opening. Using the T-1020 heater with the air blower, the necessary cabin heat load will be supplied.

—CAUTION—

Since the nose inlet opening on the T-1020 is on the lower right-hand side of the nose, and the air conditioning unit operates off the right engine, be sure the air blower and hose are secure and all personnel clear.

4. Start the air conditioning for the performance test.
5. With the heater and air blower operating, the air conditioner should be allowed to operate until the freeze protection shuts it down.
6. With the freeze protection checked, remove the spar splice access plate.
7. Place a jumper wire (No. 18 or larger) across the freeze protection pressure switch, wires H115EE and H95EF.
8. This will allow further operation to check the thermostat operation and the freon level.

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.

—WARNING—

The air conditioner MUST NOT be operated with the right engine uncowled. Dangerously high compressor discharge pressures result from the low condenser cooling airflow, caused by the disturbed air flow over the uncowled engine. If the air conditioner is accidentally operated with the right engine uncowled for more than about three minutes, then the fusible plug in the right wheel-well area must be checked for possible extrusion or blowout.

If the air conditioner is to be operated for ground testing, then the gauge lines can be run up through the engine cowlflap area to the Schrader valves on the fire wall, being careful to miss the engine exhaust.

1. The most accurate way to check the condition of the system is by attaching gauges to the system as shown in Figure 21-25.
2. Always wear safety goggles when handling refrigerant.

—WARNING—

One of the most important precautions is protection of the eyes when handling refrigerant. Any liquid refrigerant which may accidentally escape is approximately 21.7 F below zero. Serious injury could result if refrigerant comes in contact with the eyes. If refrigerant comes in contact with the eyes:

1. DO NOT rub the eyes. Rinse the eyes with cool water to gradually raise temperature
2. Apply a protective film of antiseptic oil over the eyeball to reduce the possibility of infection.
3. Consult a physician immediately. Should refrigerant come in contact with skin, it should be treated as though the skin had been frostbitten or frozen.

3. Large quantities of R-12 refrigerant should not be discharged into a closed room. It may displace the oxygen in the air.
4. Large quantities of Refrigerant 12 which come in contact with live flame will produce poisonous phosgene gas.
5. Keep lines capped to prevent foreign material and moisture from entering the system.
6. This is a high pressure system and the pressure should be released slowly before disconnecting any lines.

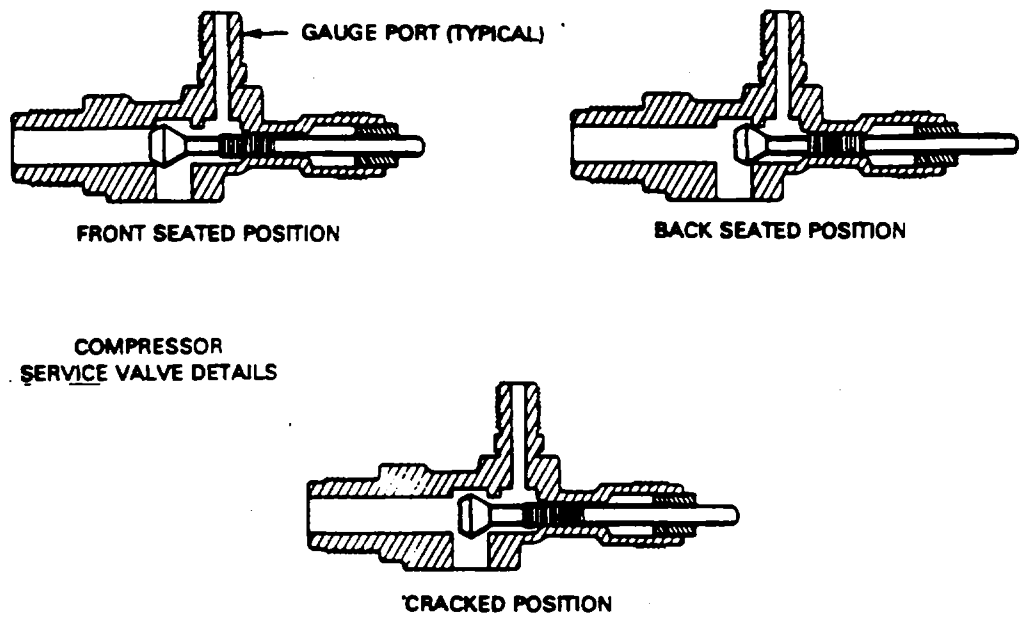


Figure 21-22. Service Valves

7. Use clean, dry refrigerant oil which should be contained in a capped container to reduce the possibility of the oil absorbing moisture and dirt.
8. Replace O-rings when a connection has been broken. Dip new O-rings in refrigeration oil before using. Do not over torque connections. Refer to Chart 2104.
9. To insure a consistent seal on all flared and pipe fittings used on the air conditioning system, seal the fittings with Loctite refrigerant sealant. Sealant should be applied only to the flare surfaces of the flare fittings.
10. Torque all flare fittings in accordance with 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. (Refer to Figure 21-22.)

Discharge and suction valves are three-position valves mounted on each side of the compressor cylinder head. The suction side of the compressor is identified by the "S" or word "SUCTION" cast in the cylinder head. The discharge side is identified by the letter "D" or word "DISCHARGE."

The purpose of the three-position valves is to facilitate servicing of the system. By closing the valves (front seated) the compressor is isolated from the rest of the system and oil can be checked on the compressor without discharging the system.

When the stem is turned in, the valve is "FRONT SEATED" (the gauge port is open and the system is closed) when the stem is turned out, the valve is "BACK SEATED," (the system is open). When the stem is turned to the halfway position commonly know as being "CRACKED" (the gauge port is open to the system). The "BACK SEATED" position is the normal valve position when the air conditioning system is in service.

There are Schrader valves in the discharge and suction lines located on the left forward side of the right nacelle. These valves are placed in this position to allow the necessary checks and services to be safely made with the engine operating.

TEST GAUGE AND MANIFOLD SET.

The proper testing and diagnosis of the air conditioning system require that a manifold gauge set be attached to 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 controlling the flow of refrigerant through the manifold.

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

Both the high and low side of the manifold have hand shutoff 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 21-23, 21-25 and 21-26.)

CHECKING THE 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.

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 -23.)
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. (Refer to Figure 21-25.)

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 nacelle.
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 Chart 2106 and Compressor Oil Level Check) then repeat steps 1 thru 5.
9. If no further leads 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 protective cap on the Schrader valve fitting on the suction line valve (on left side of fire wall), and connect a charging hose with a shutoff valve arrangement to the fitting. The charging hose must have Schrader fitting or adapter to fit the valve.
2. 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.
3. 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.
5. Using an electronic leak detector, check all joints and repair any leaks.
6. After completion of repair of any leaks, proceed to check the system in accordance with one of the methods outlined for any other leaks.
7. If no further repair is required on the system, it is now ready to evacuate in accordance with the following paragraph.

EVACUATING THE SYSTEM.

If the system has been operated in a discharged condition or any time 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 receiver-dehydrator must be changed at least once every two years. The following table demonstrates the effectiveness of moisture removal under a given vacuum.

CHART 2105. SYSTEM VACUUM CHART

	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 the cowling from the right engine. (Refer to Chapter 71.)

—CAUTION—

Ascertain that all system pressure is released before attempting the evacuation. (Refer to Malfunction Detection.)

2. Connect the manifold gauge set to the Schrader valves on the fire wall. (Refer to Figure 21-26.)
3. The high and low manifold hand valves should be in the closed position. (Refer to Figure 21-23.)
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. Operate 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.

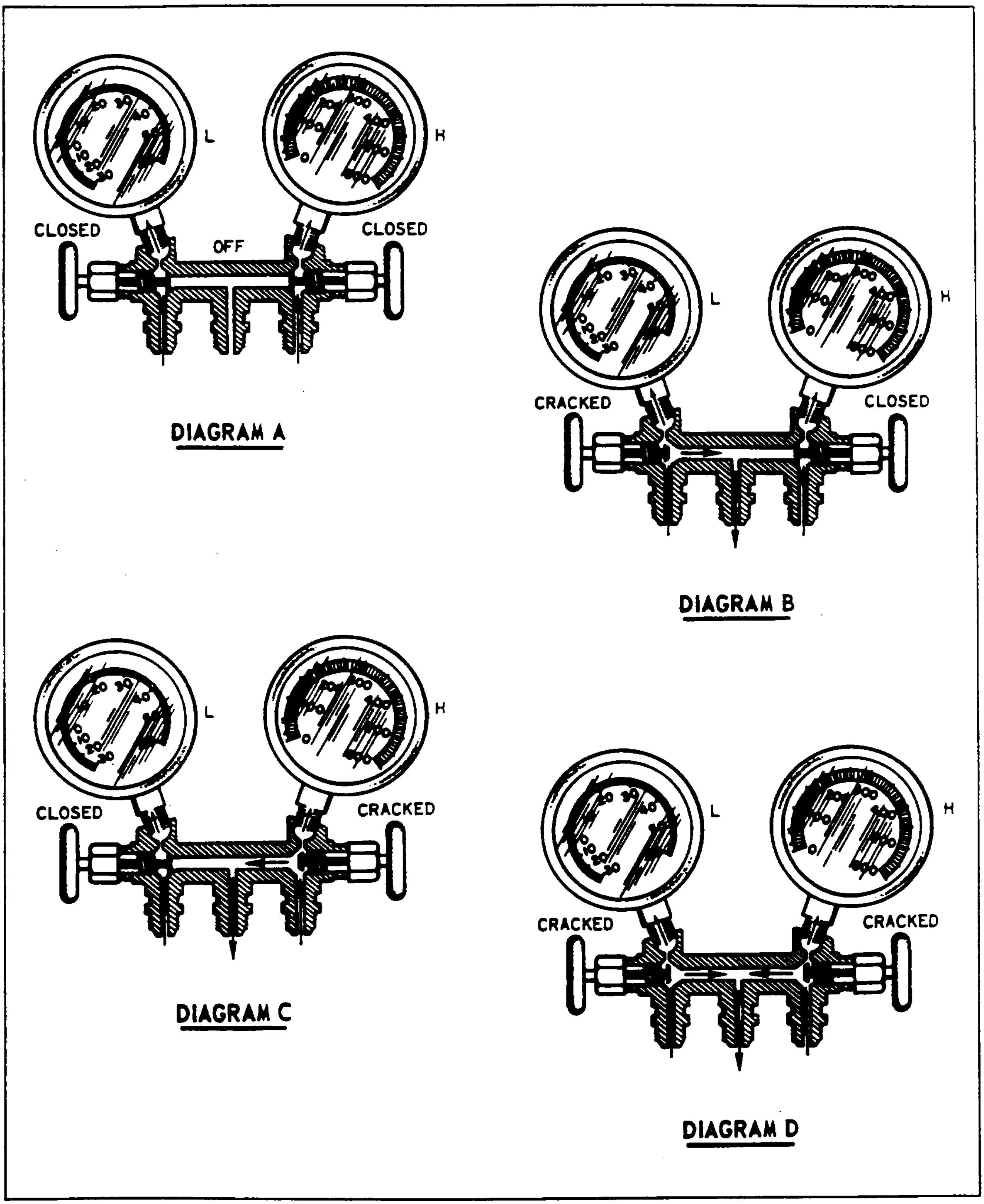


Figure 21-23. Manifold Set Operation

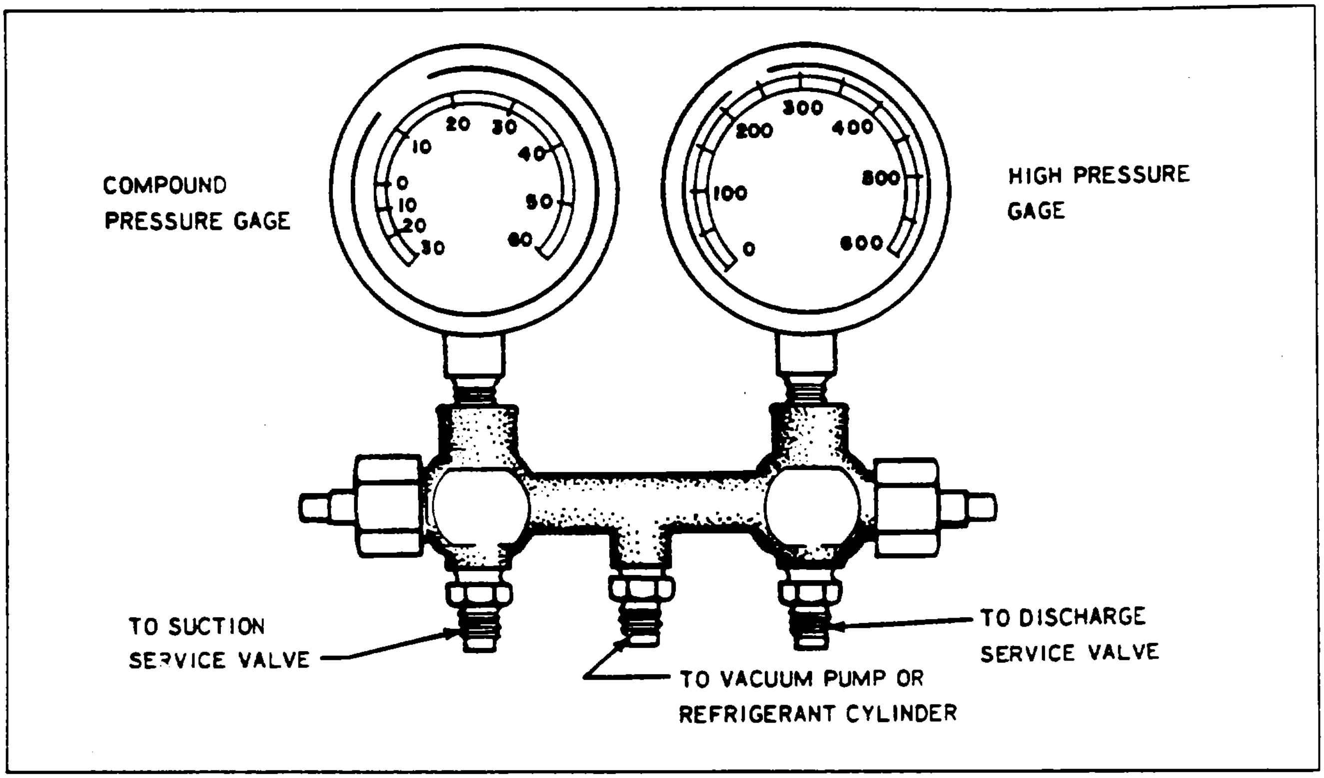


Figure 21-24. Test Gauge and Manifold Set

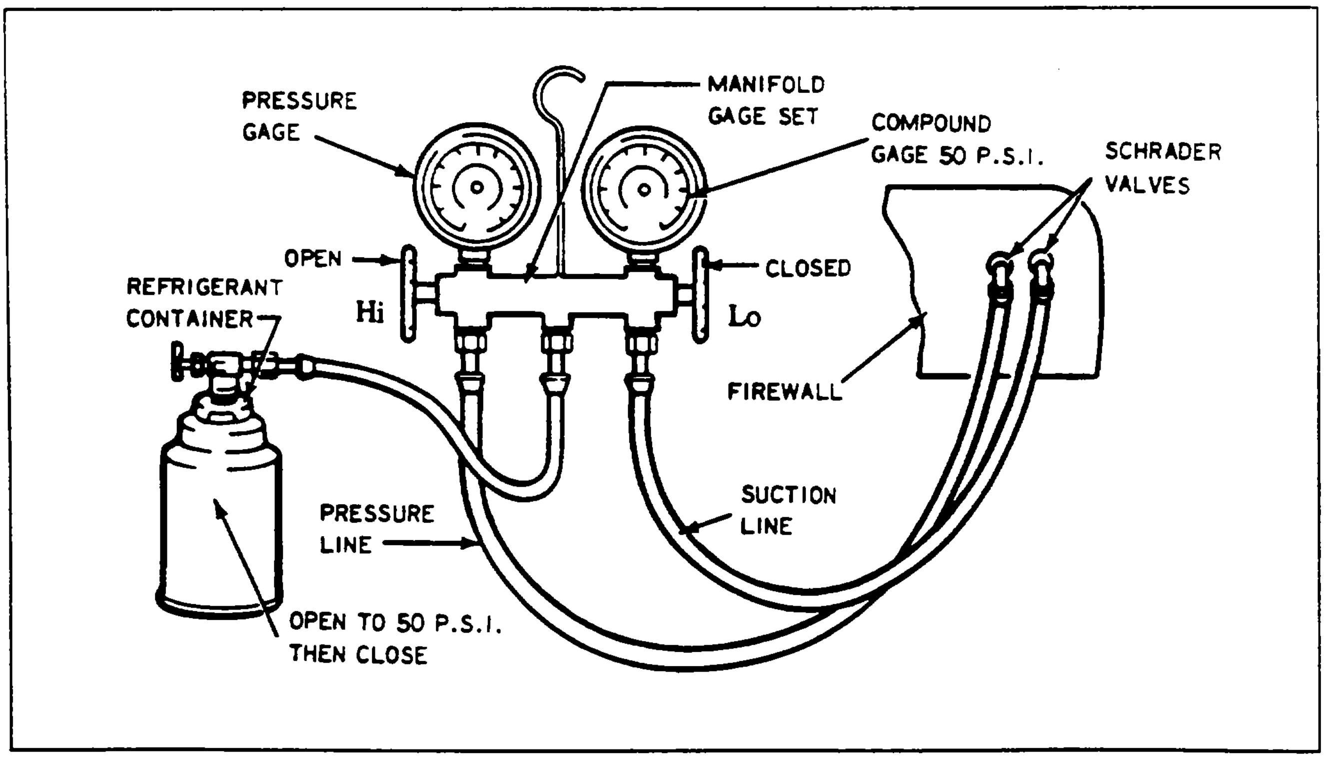


Figure 21-25. Leak Test Hookup

CHARGING THE SYSTEM.

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

CHARGING STATION METHOD.

—NOTE—

Applies to Kent Moor J8393-02 or similar charging station. Use Refrigerant 12. (Refer to Figure 21-28.)

1. DEPRESSURIZING (required only if system contains refrigerant).
   A. Close all valves on charging station.
   B. Connect red high-pressure charging line to high pressure Schrader valve at the fire wall fitting of the right nacelle. (Refer to Figures 21-27 and 21-29.)
   C. Open valve 2 (high pressure control) on charging station one turn.
   D. Hold end of blue low pressure charging line in a shop rag and slowly open valve 1 (low pressure control) on charging station allowing refrigerant to exhaust from system into shop rag.

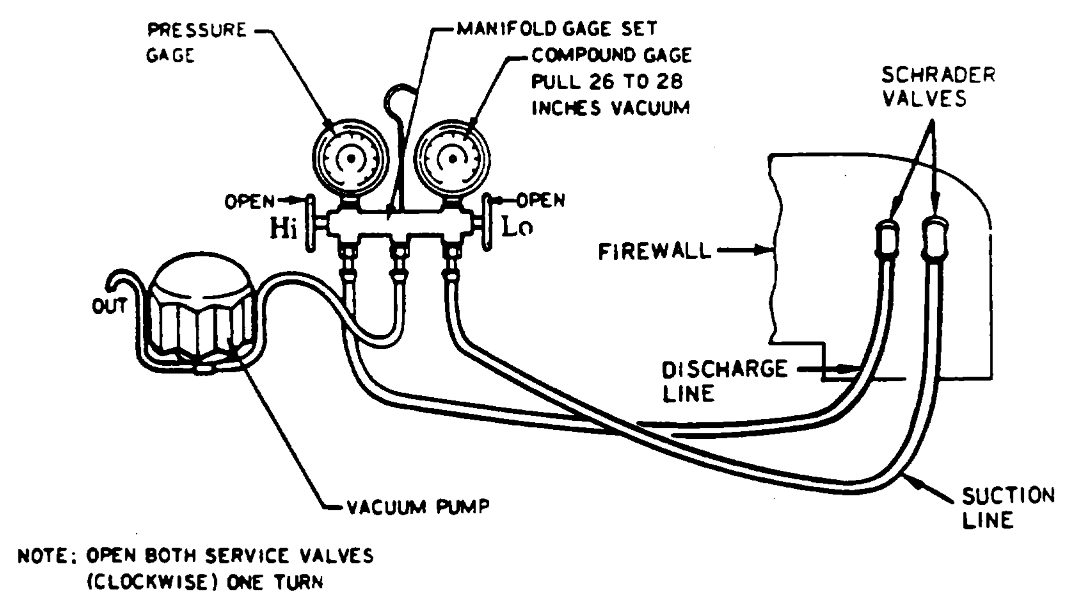


Figure 21-26. Evacuation Hookup

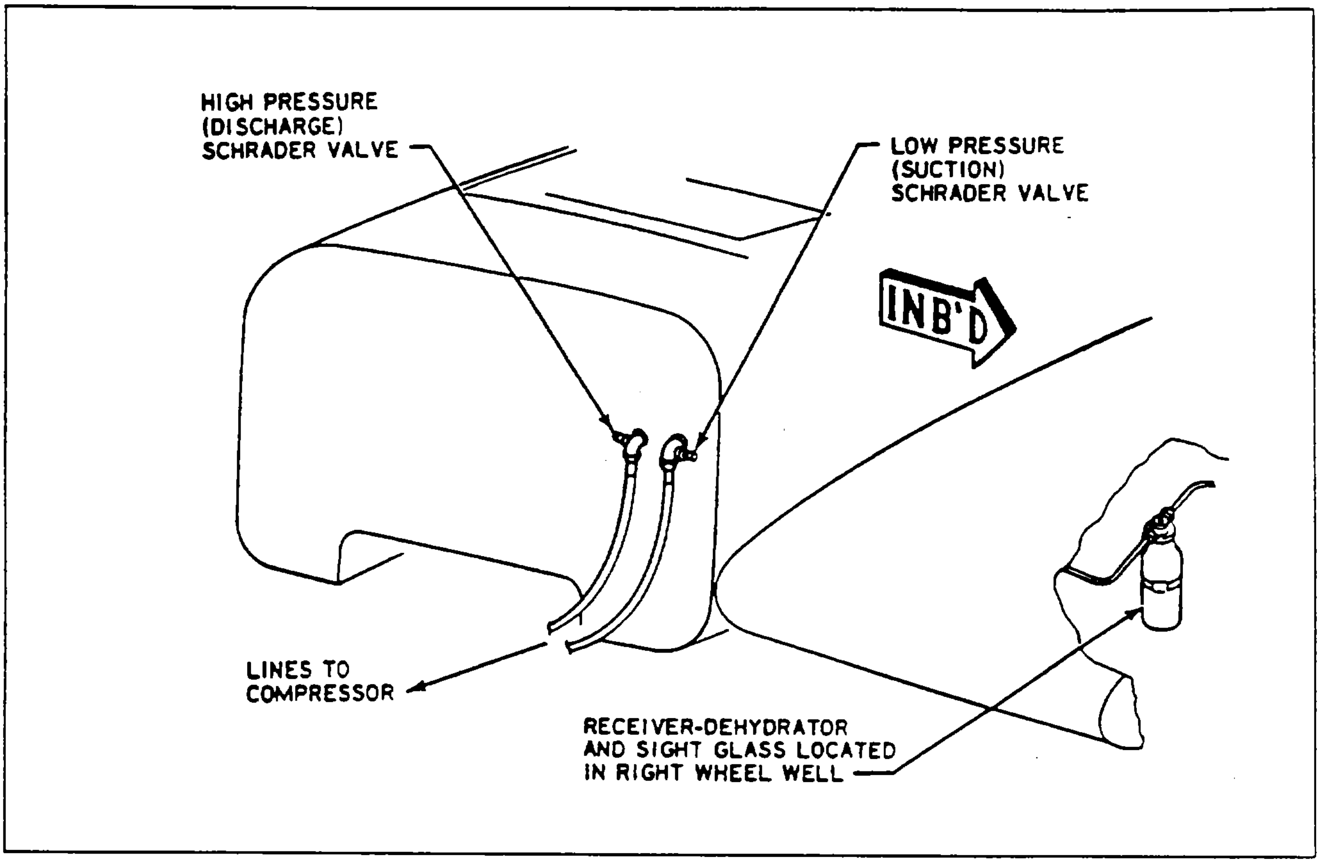


Figure 21-27. Service Points (Air Conditioning System)

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—CAUTION—

REFRIGERANT CAN CAUSE FREEZING OF SKIN. BE PARTICULARLY CAREFUL NOT TO ALLOW CONTACT WITH EYES. Do not allow refrigerant to escape too rapidly as excessive oil may be carried out of system. When hissing stops, pressure should read zero indicating the system is empty and service valves should be closed if no further work is planned.

E. Open refrigerant drum valve and valve at base of charging cylinder and allow approximately 1/2 pound of refrigerant to enter cylinder.
F. Open valve 4 on charging station (refrigerant control) and flush out high and low pressure lines by opening valves 1 and 2 momentarily until a white stream of refrigerant is observed. Close all valves.

2. EVACUATING SYSTEM.

—NOTE—

Be certain system has been depressurized before attempting to evacuate.

A. Connect red high pressure hose to the fire wall fitting high pressure Schrader valve and the blue low pressure hose to the fire wall fitting low pressure Schrader valve. (Refer to Figures 21-27 and 21-29.)
B. Connect vacuum pump power cord to 110 volt outlet.
C. Remove exhaust port cap and open valve on pump. Turn on pump and open the low and high pressure and vacuum control valves on the charging station. (Refer to Figure 21-28.)
D. Operate pump until 26 to 28 inches vacuum is attained. Continue to operate pump for 25 minutes after 26 to 28 inches vacuum is reached.

—NOTE—

Reduce vacuum reading one inch for each 1000 feet altitude above sea level.

E. While system is evacuating fill charging cylinder as outlined in step 3.
F. If 28 inches of vacuum cannot be attained, close valve 3 (vacuum control), stop pump and check system for leaks per step 4.
G. After evacuation, close valve 3 (vacuum control) stop pump. Check system for leaks per step 4.
H. When no leaks are evident proceed with charging per step 5.

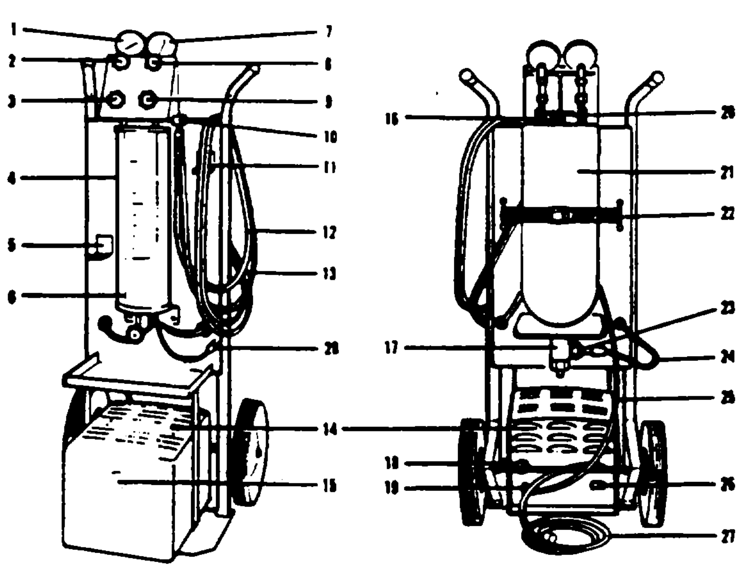
3. FILLING THE CHARGING CYLINDER.

A. Be sure refrigerant drum valve is open.
B. Open valve at base of charging cylinder and fill cylinder with required amount of refrigerant to charge system (4.0 lbs. for full charge). Liquid refrigerant can be seen rising in sight glass.
C. As refrigerant stops filling the cylinder, open valve at top of cylinder behind control panel intermittently to relieve pressure and allow refrigerant to continue filling cylinder.
D. When refrigerant reaches desired level in the sight glass, close both the valve at the base of the charging cylinder and the valve at the refrigerant tank. Be certain that the top cylinder valve is fully closed.

—NOTE—

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

4. CHECKING SYSTEM FOR LEAKS.
   A. Open valve at bottom of charging cylinder and allow two pounds of refrigerant to enter cylinder.
   B. With system evacuated per step 2, close all charging station valves. Open valve 4 (refrigerant control) and valve 2 (high pressure control) and allow one pound of refrigerant to enter system.
   C. Using the Bacharach Leakator or equivalent electronic leak detector, check all joints and repair any leaks.
   D. Evacuate again for 15 minutes and add another one pound of refrigerant to system.
   E. Release the one pound of refrigerant from the system and re-evacuate for 5 minutes to be certain as much contamination is removed from the system as possible. The system is now ready for charging per step 5.
5. CHARGING SYSTEM - FULL CHARGE.
   A. With 4 pounds of refrigerant in the cylinder per step 3, valve 2 (high pressure control) fully open, and valve 1 (low pressure control) closed, open valve 4 (refrigerant control) and allow as much liquid refrigerant to enter the high side of the system as possible. It will be necessary to slightly warm the base of the charging cylinder. (If charging station does not have a cylinder heater use heat from a 75 to 100 watt bulb and watch that system pressure does not exceed 150 psig) in order to drive the last portion of charge into the system. Do not use open flame or other high heat source for warming cylinder.
   B. After completion of charging, close all valves on charging station. Close refrigerant drum valve and recap the compressor exhaust. Remove charging lines from compressor using care due to the small amount of refrigerant remaining in the lines. (Cover Schrader fittings with a shop rag during removal of lines to catch escaping refrigerant.) Replace lines on holder and open valve on top of charging cylinder to release remaining pressure.



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

Figure 21-28. Charging Stand

6. ADDITION OF PARTIAL CHARGE.

—NOTE—

Ambient air temperature should be 70° F or higher during this operation.

A. Open the main gear doors to gain access to the receiver-dehydrator and sight glass located in the right wheel well.
B. Connect a charging hose from the low pressure fire wall fitting Schrader valve to the refrigerant container valve. Place the container upright (valve on top) under the right wing in a position which will make the container accessible while viewing the sight glass.
C. Operate the right engine at 900 - 1000 rpm with the air conditioner ON.
D. Observe the receiver-dehydrator sight glass for bubbles. (Plastic plug will have to be removed and should be replaced to keep the sight glass clean following charging.) A mirror will be needed to see into the sight glass properly. Bubbles or foam indicate the system needs refrigerant.
E. With the right engine and air conditioner operating, open the valve on the refrigerant container keeping the valve up to add only gaseous refrigerant.

—CAUTION—

Tipping the container and allowing liquid refrigerant to enter the system can damage the compressor. Continue to add refrigerant until the sight glass clears of all bubbles. Close the container valve after the sight glass clears.

F. If means are available to weigh the container, an additional 1/2 pound of refrigerant can be added to increase the time between system charges.
G. Turn off the air conditioner and stop the engine after charging. Remove the charging hose from the Schrader valve using a cloth to direct the escaping refrigerant. Recap Schrader valve.

REFRIGERANT DRUM METHOD.

1. DISCHARGING THE SYSTEM.
   A. Close both valves on a standard gauge set. Connect the red high pressure hose from the gauge set to the high pressure Schrader valve on the fire wall fitting. Connect the blue low pressure hose from the gauge set to the low pressure Schrader valve on the fire wall fitting. (Refer to Figures 21-27 and 21-29.)
   B. Crack both valves on the gauge set and allow the system to slowly discharge. Regulate flow to prevent oil loss from the compressor during discharging.
   C. Close valves on gauge set after system is discharged.
2. EVACUATING THE SYSTEM USING EXTERNAL VACUUM PUMP.
   A. With gauge set connected per step 1 and gauge valves open, connect the suction line of the vacuum pump to the center outlet of the gauge set.
   B. Start vacuum pump and pull a vacuum of 26 to 28 inches mercury. Continue to operate pump for 25 minutes.
   C. If 26 to 28 inches vacuum cannot be attained, check system for leaks per step 3.

—NOTE—

Reduce vacuum reading one inch for each 1000 feet altitude above sea level.

D. After evacuating, check for leaks per step 4.
E. When no leaks are evident close service valves on compressor, remove gauge set and proceed with charging per step 4.

3. EVACUATING SYSTEM USING SYSTEM COMPRESSOR.

—NOTE—

This method is the least desirable due to the requirement of working near the running engine.

A. Using lines long enough to extend from the rear of the wing, connect the gauge set to the fire wall fitting Schrader valves. Connect the low pressure gauge to the suction side and the high pressure gauge to the discharge side. (Refer to Figures 21-27 and 21-29.) Secure the gauge set to prevent movement and aircraft damage from prop blast.
B. Open the high pressure gauge valve fully. Close the low pressure gauge valve.
C. Start the right engine and run at 900-1000 prop rpm. Turn air conditioner on in manual mode.
D. Evacuate to 26 to 28 inches vacuum. Continue to evacuate system for approximately 10 minutes. Close the high pressure gauge valve. Turn off the air conditioner and stop the right engine. Check the system for leaks per step 4.
E. If you cannot pull 26 to 28 inches (at sea level) vacuum on the system, turn off air conditioner and engine. Check for leaks per step 4.

—NOTE—

Decrease vacuum reading one inch for each 1000 feet of elevation above sea level.

F. When no leaks are evident charge per step 5.

4. CHECKING SYSTEM FOR LEAKS.
A. With the gauge set hoses connected per step 1 and system evacuated, connect a charging hose between the gauge set manifold and a refrigerant container.
B. The refrigerant container should be placed in a container of warm (150° F max.) water. The container should be in the upright position with the valve on top.
C. Open the refrigerant container valve with the gauge set high pressure valve open and allow refrigerant gas to enter the system until the system pressure stops rising. Close the container valve.
D. Using the Bacharack Leakator or equivalent electronic leak detector, check all joints and repair any leaks.
E. Release the refrigerant, evacuate the system again for approximately 15 minutes and then add another refrigerant gas charge per step c above.
F. Release the refrigerant and again evacuate the system for 5 minutes to be sure all contamination is removed. The system is now ready for charging.

5. CHARGING THE SYSTEM - FULL CHARGE.
A. Determine the weight of the refrigerant container and its heating water and container on a suitable scale. The refrigerant container and scale should be located at the rear of the wing or on the left side of the fuselage well clear of the right prop.
B. Loosely connect a suitable charging line to the gauge set which should be connected to the evacuated system. Connect the other end of the charging line to the refrigerant container valve and purge the line by opening the valve and allowing refrigerant gas to flow through the hoses. Tighten the hose at the gauge set, open the low pressure gauge valve.

C. With the right engine operating at 900-1000 rpm and the air conditioner ON, allow 4 pounds of refrigerant gas to flow into the system by opening the container valve. Close the container valve when the proper charge is reached and stop.
D. Carefully remove the gauge set hoses from the fire wall fitting Schrader valves. Use a cloth to divert any escaping refrigerant. Recap the Schrader valves.

6. ADDITION OF PARTIAL CHARGE. (See step 6 under Charging Station Method.)

COMPRESSOR SERVICE.

Maintenance to this unit and related components is limited to the replacement of the drive belt and magnetic clutch.

COMPRESSOR REMOVAL. (Refer to Figures 21-29 and 21-30.)

To remove and install the compressor from the air conditioning system without discharging the refrigerant in the system, the following procedures should be used:

1. Ensure that the circuit protector is off for the air conditioning system.
2. Remove the cowling from the right engine.
3. Disconnect the electrical leads to the magnetic clutch on the compressor.
4. Fully close both service valves (clockwise) on the compressor.
5. Remove both service valves from the compressor with the related pressure and suction lines attached.

—CAUTION—

Compressor pressure will bleed off at the flanges of these valves, when the bolts are loosened.

6. Loosen the compressor adjustment bolts, release the belt tension and remove the drive belt.
7. Support the compressor and remove the four bolts holding the compressor mounting bracket to the engine.

COMPRESSOR INSTALLATION.

When installing the compressor into the air conditioning system, it should be purged of air before the service valves are opened (counterclockwise).

1. Attach the compressor to the mounting bracket (4 bolt), do not tighten at this time.
2. Attach the compressor and mounting bracket assembly to the engine (shimming may be required to attain pulley alignment) and secure.
3. Install drive belt over compressor clutch pulley. (See Replacement of Compressor Drive Belt.)
4. Check pulley alignment by one of the following methods:
   A. Visually check the alignment of the compressor pulley with the crankshaft pulley, there must not be any misalignment.
   B. A half inch rod about 18 inches long can also be used to check pulley alignment before installing the drive belt, by laying the rod in the pulley grooves and making sure the rod falls squarely in the two pulley grooves.

—NOTE—

Assure that the drive belt is properly aligned. Misalignment produces rapid belt wear.

5. Check the oil level in the compressor in accordance with instructions given in Compressor Oil Level Check.
6. With the service valves still (closed), connect them to the compressor.
7. Close all valves (counterclockwise) on the charging stand, and remove the gauge port cap from the low pressure service valve.
8. Connect the blue, low pressure, charging line to the low pressure gauge port. (Refer to Figure 21-29.
9. Operate the vacuum pump and open both the low pressure control valve and the vacuum control valve on the charging stand. Continue to operate pump for 5 minutes after 26 to 28 inches of vacuum is reached.
10. After evacuation, close both the low pressure control valve and vacuum control valve. Wait 5 minutes and observe the vacuum gauge, no more than a 2 inch drop in vacuum is allowed. If the 26 inch vacuum cannot be attained or if the rise in pressure exceeds 2 inches, check the compressor for leaks. Turn off the vacuum pump.
11. Open both service valves fully (counterclockwise) on the compressor.

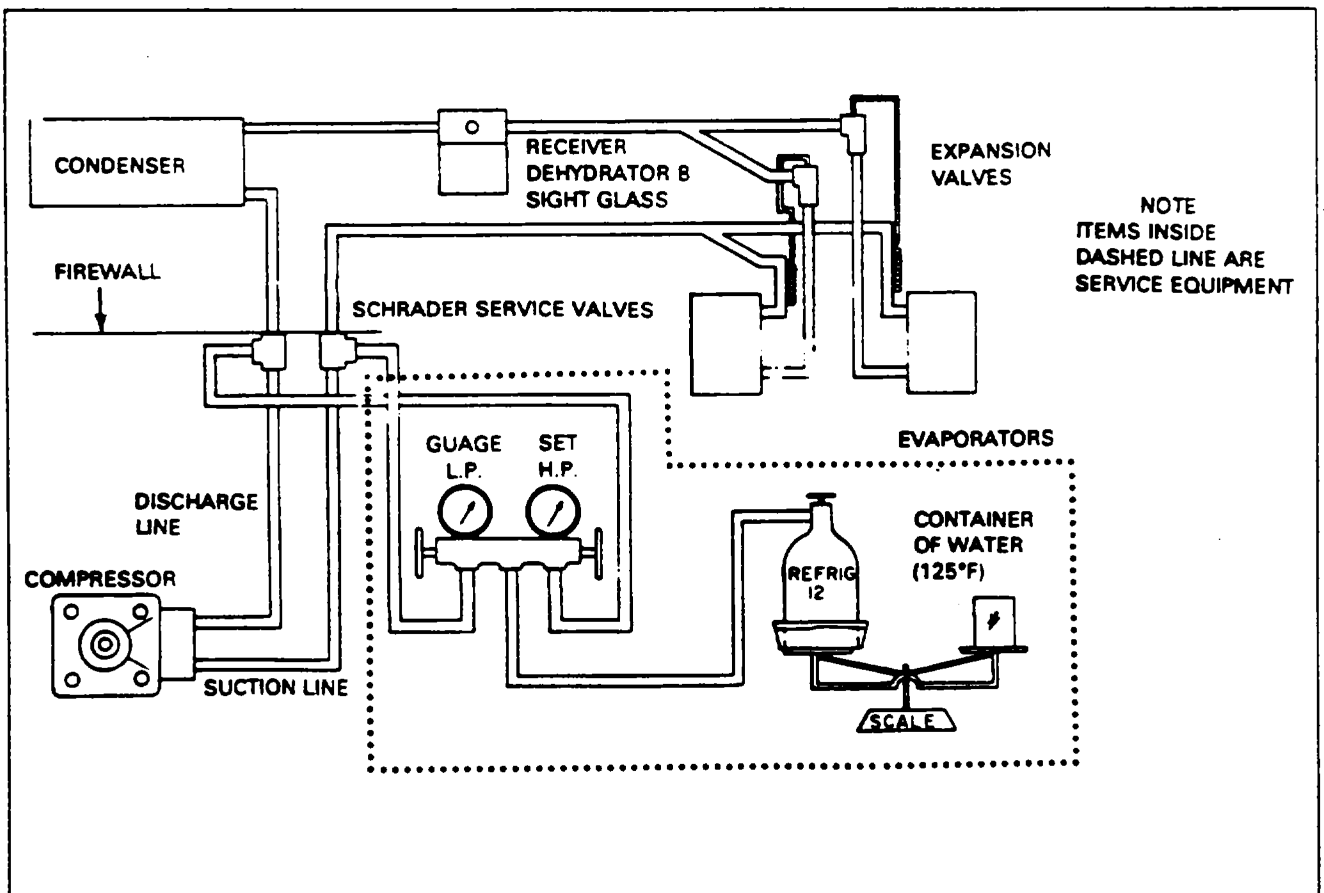


Figure 21-29. Charging Hookup

12. Carefully remove the blue line from the low pressure valve. This line will contain a small amount of refrigerant.

—CAUTION—

It is advisable to cover hands before removing the line from the gauge fitting to prevent skin from coming in contact with cold refrigerant.

13. Replace gauge port cap on the low pressure valve and both valve stem caps.

COMPRESSOR OIL LEVEL CHECK. (Refer to Figure 21-30.)

Anytime the air conditioning system is discharged, the oil level in the compressor should be checked. The dipstick required for this check is shown in Figure 21-30.

The following dipstick calibration applies with the compressor installed on the aircraft:

Before inserting the dipstick the shaft key should be located in the up position. The front face of the compressor clutch is marked with a metal stamped "K" indicating the key position.

The compressor should never be operated with less than 6 ounces of oil. When oil is added the level should not go above 10 ounces. Suniso No. 5 or Texaco Capella E grade, 500 viscosity oil or equivalent must be used. BE SURE THIS OIL IS CLEAN AND MOISTURE FREE.

The 16 ounce oil level is required in compressors installed on new systems. Approximately 6 ounces is distributed in the system during operation. Replacement compressors should be charged with 10 ounces of oil unless the system has been flushed clean of all oil. When a compressor is changed the system should be run and stabilized in temperature prior to rechecking the oil level. The level should be topped off to 10 ounces if necessary.

CHART 2106. COMPRESSOR OIL CHARGE

Oil Charge Ounces	6	8	10	16
Dipstick Reading Inches	11/16	15/16	1-1/4	1-7/8

REPLACEMENT OF COMPRESSOR DRIVE BELT.

1. Loosen the adjustment bolts on the mounting bracket.
2. Push the compressor toward the engine to relieve the belt tension.
3. Loosen alternator belt tension.
4. Remove propeller and starter fly wheel. (Refer to Chapter 61.)
5. Remove alternator and compressor belts.
6. Put the new belt in position on the engine. Reinstall the alternator belt.
7. Install starter fly wheel, putting the compressor and alternator belts in their respective grooves and slide fly wheel on the crankshaft. (Do not adjust belt tensions at this time.)
8. Install propeller. (Refer to Chapter 61.)
9. Install the alternator belt.
10. Install the compressor belt on the compressor pulley. Adjust belt tension. (Refer to the following paragraph.)

ADJUSTMENT OF DRIVE BELT TENSION.

The adjustment of the compressor drive belt is very important to obtain long belt life and proper compressor operation. See Chart 2107 for alternator and refrigerant compressor belt tensions for the engine. Recheck new belt tension after 10 hours of operation.

CHART 2107. BELT TENSIONS
(WITH FREON COMPRESSOR INSTALLED)

BELT	BELT CONDITION	GATES #150 TENSIOMETER	ACTUAL MEASUREMENT LOAD VS. DEFLECTION
Alternator	New *Service	99 lbs. 66 lbs.	6.31 lbs. - .16 in. 4.25 lbs. - .16 in.
Refrigerant Compressor	New *Service	104 lbs. 69 lbs.	6.75 lbs. - .14 in. 4.50 lbs. - .14 in.

*Pertains to a belt that has been in use for longer than one hour

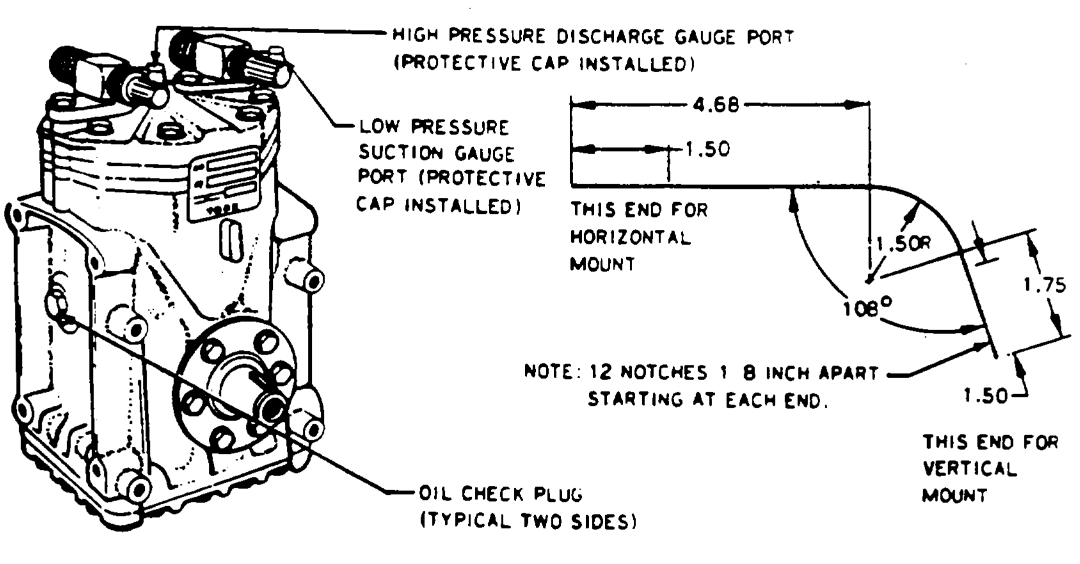


Figure 21-30. Compressor and Fabricated Oil Dipstick

MAGNETIC CLUTCH REMOVAL.

1. Remove the self-locking capscrew and washer from the compressor shaft.
2. Insert a 5/8-11 UNC-2B capscrew in the threaded portion of the hub and tighten. The pressure exerted by the capscrew on the end of the compressor shaft will force off the rotor pulley assembly without damage to the clutch or compressor.

—*CAUTION*—

Do not use a wheel puller on the outer diameter of the pulley. This can damage the pulley grooves or clutch bearing.

3. Cut the lockwire on the four bolts securing the field assembly against the compressor bosses and remove the bolts, washer and field assembly.

MAGNETIC CLUTCH INSTALLATION. (Refer to Figure 21-25.)

1. Position the field assembly against the compressor bosses with the electrical leads at the top.
2. Secure the field assembly to the compressor with four bolts and torque to 85 to 120 inch-lbs. Safety wire all four bolts.

—*NOTE*—

The compressor shaft must be clean and free from burrs.

3. Slide the pulley assembly onto the tapered shaft and secure with washer and self-locking capscrew. Torque the capscrew to 180 to 240 inch-lbs.

—*NOTE*—

If the clutch is not engaged while tightening the capscrew, insert a spanner wrench into the holes provided in the armature face.

4. Spin the pulley by hand to check for any interference between the field and rotor-pulley assemblies. A rubbing noise can be heard as the pulley rotates if there is interference. The rotor-pulley assembly must be removed and the mounting of the field assembly adjusted until the interference is eliminated.

CONDENSER REMOVAL.

The condenser is located in the right nacelle aft of the fire wall, between stations 121.00 and 136.75.

1. Remove the access panels on both sides and in front of air scoop.
2. Disconnect the activating rods from the air scoop and remove air scoop assembly panel.
3. With the system completely discharged, disconnect the two lines on the inboard side of the condenser.

—*NOTE*—

Cap the open lines to prevent moisture and dust from contaminating the system.

4. Remove the screws which hold the condenser to the mounting brackets. (Let the condenser lay in the nacelle.)
5. Remove the mounting brackets from the longitudinal bulkheads.
6. Remove the condenser from the nacelle, being careful not to bend the fins of the core or damage the connecting tubes. Cap the lines till reinstalled.

—NOTE—

Protect the condenser core fins during handling. Insure that the fins are not bent or crumpled. This would cause a low efficiency of the condenser. If fins are bent, comb the fins with an air conditioning comb. These can be purchased locally at any air conditioning dealer.

CONDENSER INSTALLATION.

1. Place condenser in the right nacelle with the line connections on the inboard side.
2. Install the mounting brackets to the longitudinal bulkhead with the flanged side up.
3. Attach the condenser to the mounting brackets.

—NOTE—

It is advisable to change the receiver-dehydrator whenever the system has been open to the atmosphere.

4. Complete the hookup of the lines to the condenser. Apply a small amount of Loctite refrigerant sealant to the flare only to insure leak free connections. (Torque the fittings.)
5. With the condenser secured, proceed to evaluate and recharge.
6. When the system is completely charged, check it for any leaks. (Refer to Checking the System for Leaks.)
7. Replace air scoop and access panels.

ADJUSTMENT OF CONDENSER AIR SCOOP AND SAFETY SWITCH.

1. Condenser air scoop adjustment is as follows:
   A. Disconnect the pin joint between the scoop actuating arms.
   B. Place the air conditioner rocker switch in the "OFF" position.
   C. When aircraft or external power is applied with the air conditioner breaker(s) closed, the actuator motor should drive the mechanism clockwise (looking inboard) to the down position.

—CAUTION—

If the motor turns in the opposite direction turn off power and check the wiring.

   D. With the system in the full down (clockwise) position the length of the actuator arms can be adjusted to hold the scoop firmly closed.
   E. Insert the pins to connect the arms to the scoop and lock the locknuts on the lower clevis of each arm.

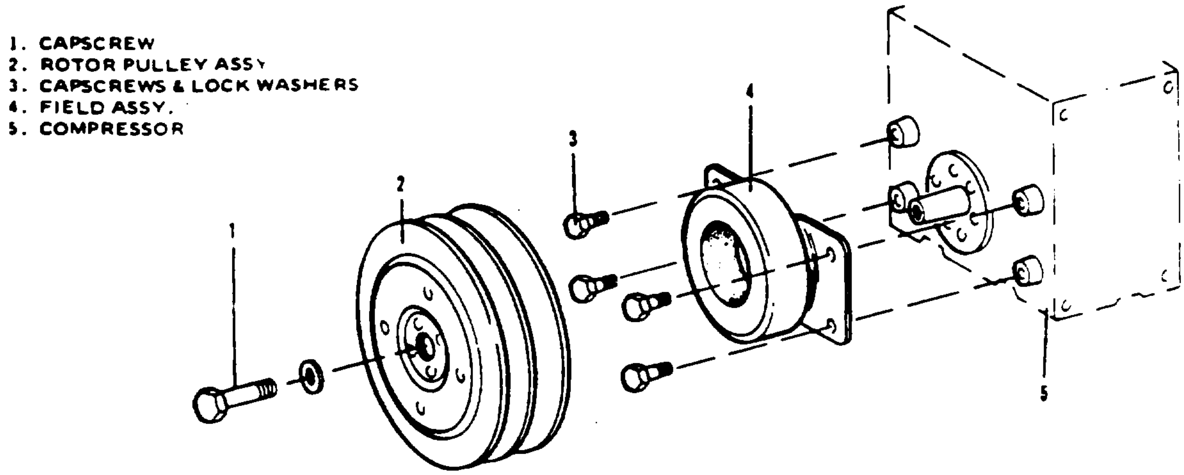


Figure 21-31. Magnetic Clutch Installation

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F. The scoop can now be opened by closing the right landing gear scissors switch, placing the air conditioner rocker switch in air condition position and turning the thermostat control fully clockwise.

—NOTE—

Temperature in the cabin must be 70° F or warmer to actuate the thermostat. If the temperature is colder than this, the thermostat terminals will have to be shorted to activate the system.

G. The open position should be adjusted to 2.90 ±.10 from the top of the bulkhead at station 121.0 to the underside of the lip on the air scoop, by adjusting the actuating screw at the upper limit switch. Lock the jam nut after adjustment is set.

H. Cycle the scoop by turning the air conditioner rocker switch on and off to insure proper operation.

2. The landing gear safety switch used to activate the condenser air scoop is located on the right main gear upper torque link, is adjusted so that the switch is actuated in the last .250 ± .125 inch of oleo extension.

   A. Place airplane on jacks. (Refer to Jacking, Chapter 7.)
   B. Compress the strut until nine inches is obtained between the top of the gear fork and the bottom of the gear housing. Hold the gear at this measurement.
   C. Adjust the switch down until it actuates at this point. Secure the switch.
   D. Extend and then compress the strut to ascertain that the switch will actuate in the last .250 ± .125 inch of oleo extension.
   E. Remove airplane from jacks.
   F. Refer to Chapter 32 for left gear safety switch information.

RECEIVER-DEHYDRATOR REMOVAL.

This unit is mounted on the inboard bulkhead in the right main gear wheel well.

1. Discharge the system of all refrigerant.
2. Disconnect the refrigerant lines at the receiver-dehydrator. Cap the end of the lines to prevent contamination of the system.
3. Loosen the clamps and remove the receiver-dehydrator from its mounting bracket.

—NOTE—

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

RECEIVER-DEHYDRATOR INSTALLATION.

1. Mount the new receiver in the mounting bracket with the sight glass up. Position the clamps so that the wormgear housings are in line with the aft fitting of the receiver.
2. Install new O-rings on the line fittings and lubricate the O-rings with refrigerant oil.
3. Connect the refrigerant lines to the dehydrator.

—CAUTION—

Torque the fittings. (Refer to Chart 2104.)

4. Evacuate and recharge the system per instruction in this Chapter.

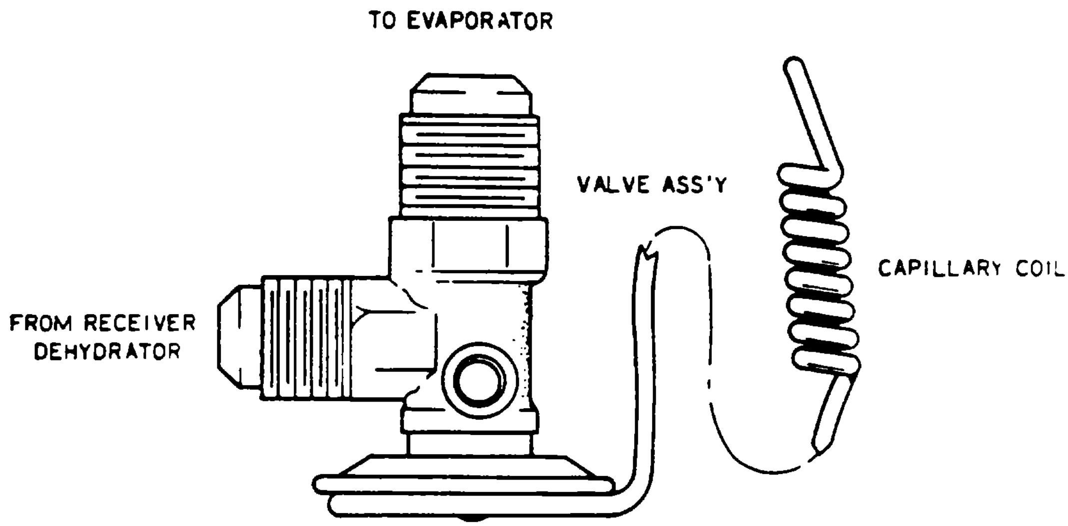

Figure 21-32. Expansion Valve (Typical)

EXPANSION VALVE REMOVAL. (Refer to Figure 21-32.)

This air conditioning system is equipped with two evaporator units; each unit has an expansion valve mounted on the inboard side of the module. The evaporator units are located in the cabin area aft of the divider panel beneath the second and third seats.

1. Remove the seat(s) from the airplane.
2. Remove the appropriate cabin divider panel.
3. Remove the seat tracks and carpet from the floorboard panel.
4. Remove the screws securing the floorboard panel over the unit and remove the panel.
5. Discharge the system prior to loosening any fittings.
6. Remove the tape covering the pressure line, capillary tube and clamp. Remove the clamp. (Do not kink the capillary tube.)
7. Loosen and separate related tube fittings (heat fittings to approximately 400 degrees to loosen). Cap all tube ends to prevent contamination of the system.

—NOTE—

This part is not serviceable.

EXPANSION VALVE INSTALLATION. (Refer to Figure 21-32.)

1. Install the expansion valve to the evaporator core, seal all tube connections with Loctite refrigerant sealant (applied to tube flanges only). Couple the fitting and torque in accordance with Chart 2104.
2. Secure the capillary tube to the evaporator outlet line (with the clamp provided). Cover capillary tube, clamp and outlet line with Presstite insulating tape (or equivalent).
3. Evacuate and charge the system. Check system for leaks.
4. Install floorboards, carpet, seat tracks, cabin divider panels and seats previously removed and secure.

EVAPORATOR REMOVAL. (Refer to Figure 21-29.)

The evaporators are located in the lower sections of the air conditioning modules. To remove the evaporator core, it is necessary to remove the module as an assembly which is located in the cabin area aft of the divider panel beneath the second and third seats.

1. Remove the seat(s) from the airplane.
2. Remove the appropriate cabin divider panel.
3. Remove the seat tracks and carpet from the floorboard panel.
4. Remove the screws securing the floorboard panel over the unit and remove the panel.
5. The air conditioning system must be completely discharged before disassembly.
6. Remove the inboard end panels of the modules, (three screws each panel).
7. Remove divider panels (six screws each panel) on right panel disconnect the related electrical connections .
8. Loosen and separate tube fittings (the tube flanges are sealed and may require heat to separate).

—NOTE—

When Loctite refrigerant sealant has been used on a joint it must be heated to 400° F prior to disassembly.

9. Remove the (4) AN-3 bolts (2 each end) and 2 sheet metal screws attaching the evaporator mounting bracket to the spar cover. Lift assembly away. (Cap tubing ends.)
10. Remove expansion valve. (Refer to Expansion Valve Removal.)
11. Remove the (8) AN-3 bolts attaching the evaporator core to the mounting flanges. (On the right evaporator remove the temperature control switch capillary tube, which is attached to the top forward side of the evaporator core with retainer clips.)

—NOTE—

Protect the evaporator core fins during assembly and disassembly. (A piece of cardboard taped to each side.) Insure that the fins are not bent or crumpled. This would cause a low efficiency in the cooling action. If fins are bent, comb the fins with an air conditioning comb. These can be purchased locally at any air conditioning dealer.

EVAPORATOR INSTALLATION.

1. With the module shroud removed, place the evaporator core in the respective mounting brackets, with the tube fittings on the inboard side and the drain tubes aft. Secure with (8) AN3-3A bolts. (In the right module attach the temperature control switch capillary tube to the second tube from the forward side of the evaporator core, with the special clips, placed approximately 6 inches apart (P/N 44843.)
2. Install the evaporator assembly on the spar cover and mating air duct and secure to this spar cover.
3. Apply Loctite refrigerant sealant to all tube flanges. Couple the fittings and torque in accordance with Chart 2104.
4. Secure the expansion valve capillary. (Refer to Expansion Valve Installation.)
5. Evacuate and charge the system and check for leaks.
6. Install divided panels and inboard end panels (on right panel connect electrical connections).
7. Install floorboards, carpet, seat tracks, cabin divider panels and seats previously removed and secure.

BLOWER AND MOTOR ASSEMBLY.

Each module is equipped with a blower assembly (they differ in that the left one rotates counterclockwise and the right one clockwise). Located in the upper part of the unit module.

BLOWER MOTOR ASSEMBLY REMOVAL.

1. Remove the divider panel.
2. Disconnect the related electrical wires.
3. Remove the two screws attaching the air duct bracket to end panel and disengage the locking lip.
4. Remove the clamp attaching the blower motor to the mounting bracket and remove assembly.

—NOTE—

The blower motor assembly is not a serviceable unit, it should be replaced with a new assembly.

—NOTE—

Protect the evaporator fins.

BLOWER AND MOTOR ASSEMBLY INSTALLATION.

1. Place the blower motor assembly in the mounting bracket and tighten the clamp enough to hold the unit. Engage the locking lip on the duct bracket and the forward edge of the duct opening in the end panel of the module. Secure with attaching screws.
2. Realign blower motor assembly with air duct and secure clamp.
3. Make related electrical connections. (Left blower rotates counterclockwise and the right clockwise.)
4. Check electrical circuits, install divider panel and secure.

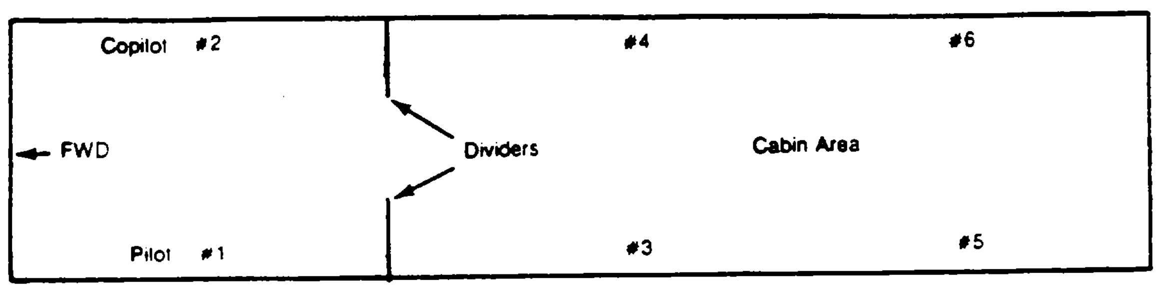

Figure 21-33. Air Conditioning Outlets

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CHART 2108. AIR VELOCITY CHART

OUTLET NO. (Refer to Fig. 21-33)	FEET PER (MIN.)
1.	2800
2.	2800
3.	2500
4.	2800
5.	1700
6.	1000

AIR CONDITIONING MODULE REMOVAL. (Refer to Evaporator Removal.)

Discharge system before any disassembly.

AIR CONDITIONING MODULE INSTALLATION. (Refer to Evaporator Installation.)

AIR CONDITIONING SYSTEM-AIR FLOW CHECKS.

The following information is intended to point out areas in the air flow portion of the system that may cause air flow inefficiencies. Air flows should be measured with a flow meter No. 460, purchased from:

Dwyer Instruments, Inc.
P. O. Box 373-T, Michigan City, Ind. 46360
Phone No. 219-872-9141

1. The air flows at the individual outlets should fall at or above the velocities shown in Chart 2108. For purposes of identification, the outlets are numbered left to right, forward to aft, starting with the pilots outlet (No. 1) as shown in Figure 21-33.
2. Chart 2108 shows the air velocities for the corresponding outlet number. Air flows should be measured with the rear outlets, main cabin and pilots doors closed, and remaining outlets open. A simple way to check the outlet is to record the outlet number on a sheet of paper, and record the air flows at each outlet, working from the cockpit and moving aft. Check your recorded flows against Chart 2108.
3. When checking air flows, hold the probe from the flow meter perpendicular to and in the center of the outlet. Refer to Figure 21-34.
4. Should the air flow at the various outlets be less than the limits given in Chart 2108, the plenum chambers at the evaporator boxes and individual air outlet boxes must be checked for air leaks. Air should enter the air ducts only through the air grille at the bottom of the evaporators, and not through the holes in the ducting and evaporators. Also, air should not be re-circulated within the evaporator boxes.
5. Seal all holes up to .187 of an inch in diameter, and any relief corners of the detail parts with General Electric RTV 106 (Piper Code 911 041) sealant. Seal all other holes, voids and joints of the ducts with 3M Pressure Sensitive Tape No. 69EGS (Piper Code 189 741).

—NOTE—

Insure that pressure sensitive tape is installed on the forward and back sides of the duct seams. (Refer to Figure 21-35.)

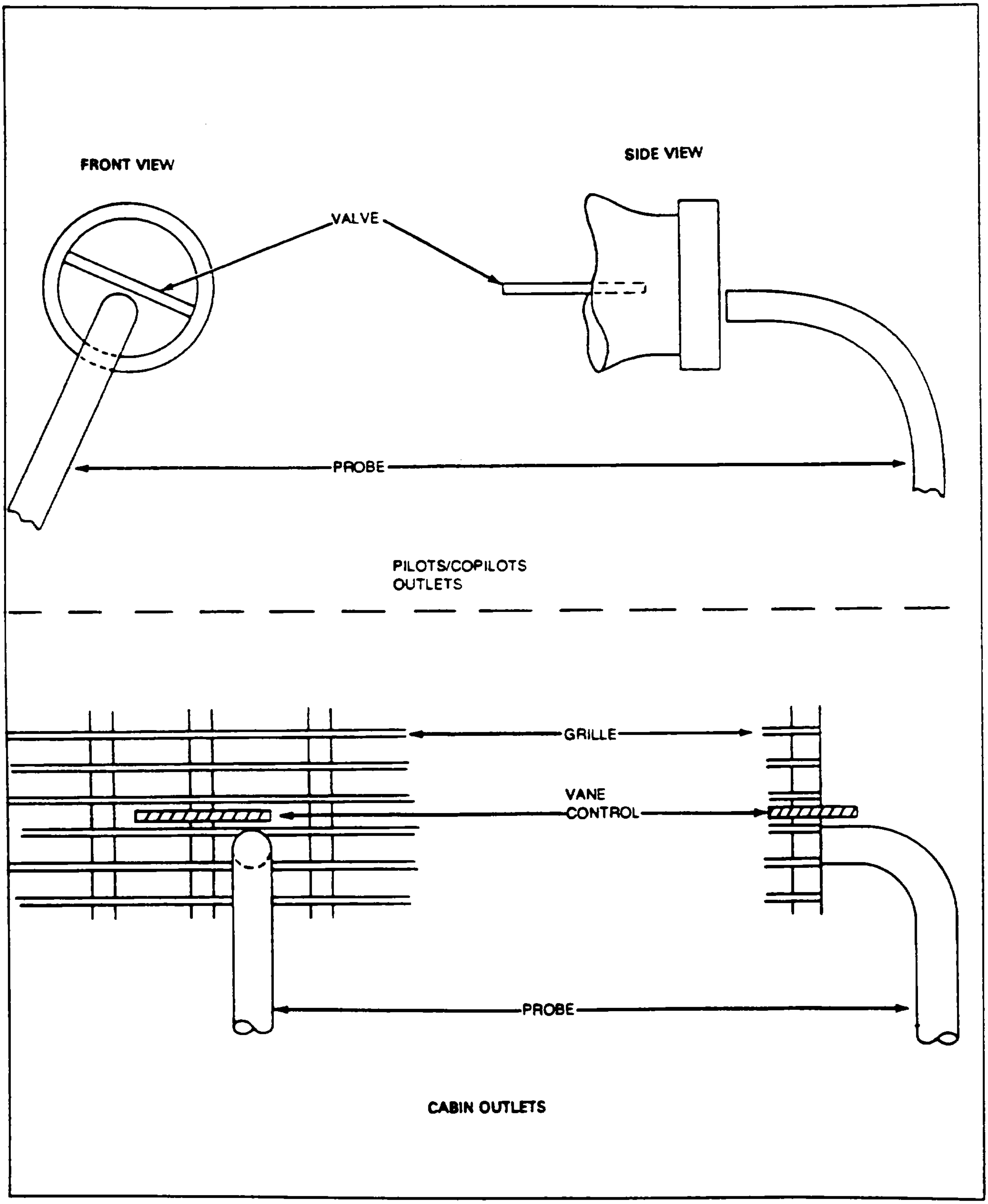


Figure 21-34. Positioning of Airflow Probe to Outlets

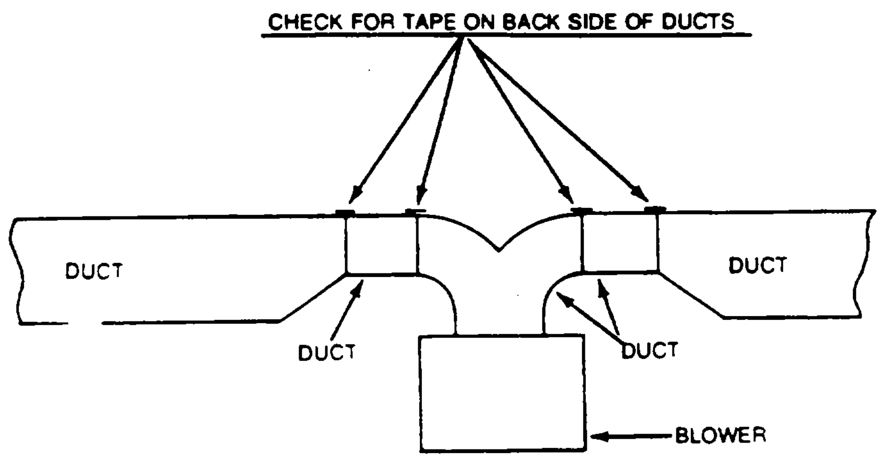
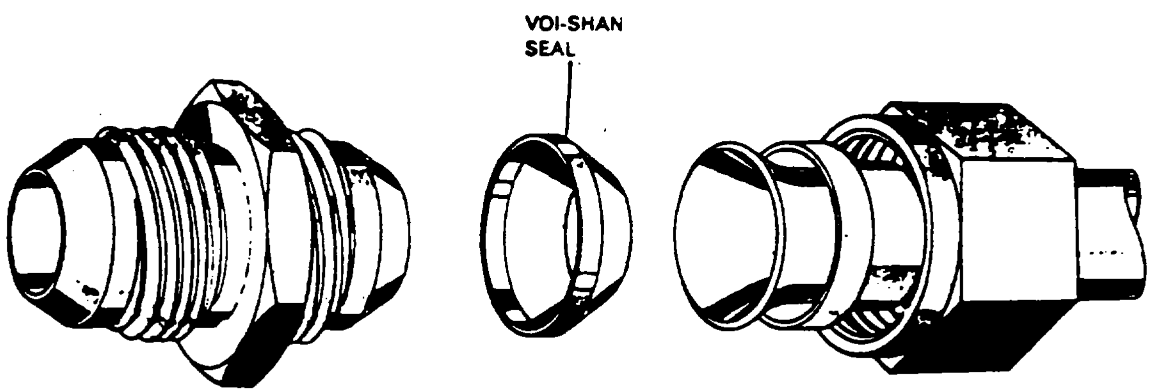


Figure 21-35. Sealing of Ducts



NOTE:
Use Voi-Shan seals number VSF1015A6BX (Piper Code 486 476) for ⅜" diameter tube, VSF1015A8BX (Piper Code 486 479) for ½" diameter tubes. VSF1015A12BX (Piper Code 486 478) for ¾" diameter tubes.

Figure 21-36. Installation of VOI-SHAN Seals

—*CAUTION*—

Be careful not to seal the water drain outlets in the evaporator boxes.

6. Inspect the evaporator boxes to insure that the foam rubber gaskets are installed. These gaskets are located at the junctures of the parts to prevent re-circulation of the cool air. If any air is recirculated, it reduces the amount being transmitted to the outlets.
7. Inspect side panel air ducts to insure they are not crushed. The panels are usually crushed by leaning against the side panels when upholstered panels are not in place.

FREON SYSTEM CHECKS.

Freon, because of its chemistry, is difficult to confine with rubber hoses and seals. For this reason an acceptable leak rate has been established, and due to temperature and system operation the leak rate will vary. Following are some areas of the system which should be inspected to prevent freon leaks:

1. Improper tightening of "B" nuts is a source of freon leaks. An alternate method of tightening "B,, nuts in lieu of torque valves is as follows:
   A. Hand tighten "B" nut; move the tube from side to side while tightening the nut to aid seating the nut and flare to the nipple.
   B. With the proper wrench, tighten the nut 1/4 turn.
   C. Loosen the "B" nut and repeat steps A and B.
2. Flared fittings are sometimes difficult to seal. On the hard-to-get-at fittings, it may be necessary to install Voi-Shan seals. (Refer to Figure 21-36.) To install the seal, place seal over the nipple end and place tube flare over seal and nipple. Tighten per the procedure given in paragraph 1 except tighten only once.

—*CAUTION*—

When installing Voi-Shan seals check for cracks and scored flared ends and nipple ends. Replace parts as necessary.

3. Leaks are most frequently found in the nacelle area or around the evaporators.
   A. In the nacelle, the fittings at the condenser and at the aft side of the firewall and the fittings in the immediate area.
   B. In the evaporator area the fittings at and around the expansion valve.
   C. Although the above areas seem to be most susceptible to leaks, all fittings are subject to leaks and should be checked.
   D. Because of the planned leaks at the compressor shaft seal and the freon loss of the rubber hoses, Piper Aircraft Corporation has discontinued the use of Freon 12 with Dytel. The red dye also shows up the planned leaks as well as other leaks.

CABIN TEMPERATURE.

Air temperature should be measured at the six individual outlets and recorded to check efficiency of the system. A temperature differential should range from 24° F to 29° F between the outlet temperature and outside temperature.

If the temperatures don't fall within these figures the system should be checked for leaks. Refer to Chart 2108 for possible causes.

—*END*—

T1000

AIRLINE DIVISION

T1020

MAINTENANCE MANUAL

CARD 2 OF 5

PA-31-350 T1020

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 768)

INTRODUCTION.

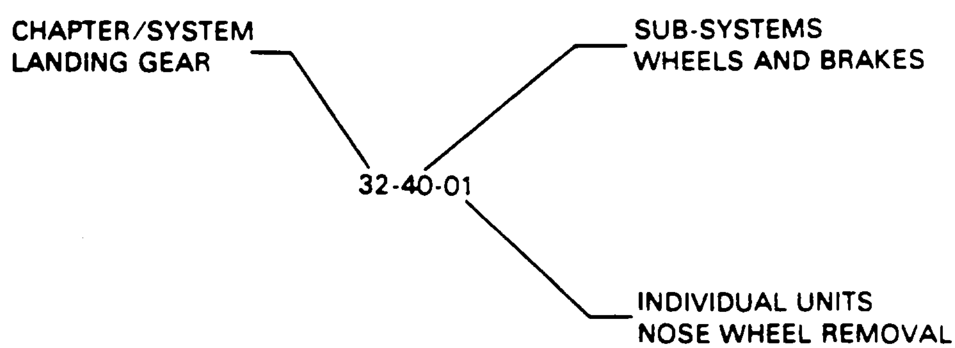
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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 Maintenance Manual is provided to support and maintain the Piper Model PA-31-350 T-1020 aircraft manufactured by the Piper Aircraft Corporation of Lakeland, Florida.

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 T-1020 Parts Catalog P/N 761 775, 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. 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 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, or 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 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:

SAMPLE EFFECTIVITY CODES

First Revision:	Month and Year (11-80)
Second Revision:	Revision Indication, Month and Year(2R 12-80)
Third Revision:	Revision Indication, Month and Year (3R 1-81)
Fourth Revision:	Revision Indication, Month and Year (4R 2-81)
Added Subject:	Identification, Month and Year (A 3-80)

Revisions to this Maintenance Manual 761 768 issued September 2, 1981 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
PR820223	February 23, 1982	1, 2, 3, 4 and 5
PR821015	October 15, 1982	1, 2, 3, 4 and 5
PR831117	November 17, 1983	1, 2, 3, 4 and 5
PR840703	July 3, 1984	1, 2, 3, 4 and 5
IR860430	April 30,1986	1
IR860920	September 20, 1986	1
IR871009	June 15, 1988	3
IR900313	March 13, 1990	2

INTERIM REVISION

Revisions appear in chapter 27 of card 2. Please dispose of your current card 2 and replace with the revised one.
DO NOT DISPOSE OF CARDS 1, 3, 4, or 5.

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VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual =	AVCO LYCOMING = OVERHAUL MANUAL DIRECT DRIVE ENGINE - P/N 60294-7 Avco Lycoming Division Williamsport, PA 17701
Parts Catalog =	AVCO LYCOMING - P/N PC-315 Avco Lycoming Division Williamsport, PA 17701
Operators Handbooks =	AVCO LYCOMING TIO-540 and LTIO-540 SERIES AIRCRAFT ENGINES - P/N 60297-23 Avco Lycoming Division Williamsport, PA 17701

PROPELLER:

Overhaul Instructions =	HARTZELL CONSTANT SPEED AND FEATHERING PROPELLER - P/N 117D Hartzell Propeller Inc. P.O. Box 1458, 1800 Covington Avenue, Piqua, Ohio 45356

MAGNETOS:

Installation, Operation and Maintenance Instructions =	S-1200 SERIES MAGNETO IGNITION SYSTEM - P/N-L-609-3 Bendix Electrical Components Division Sidney, New York 13838

WHEELS AND BRAKES:

PARTS CATALOGS and Maintenance Instructions =	CLEVELAND WHEEL AND BRAKE Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011

VENDOR-SUPPLIER INFORMATION.

Refer to the following list of manufactures, to obtain Service Manual and field service data:

Autoflite	BENDIX AVIONICS DIVISION 2100 N.W. 62nd Street Fort Lauderdale, Fla. 33310 (305) 776-4100 TWX 510-995-8884

VENDOR-SUPPLIER INFORMATION (cont.)

Autoflite (cont.)

EDO-CORPORATION
AVIONICS DIVISION
Box 610
Municipal Airport
Mineral Wells, Texas 76067
(817) 325-2517

SPERRY FLIGHT SYSTEMS
AVIONICS DIVISION
7500 Balboa Blvrd.
P.O. Box 9028 Van Nuys, Ca. 91409
(213) 894-8111 Telex: 65-1367

COLLINS GENERAL AVIATION
DIVISION
Rockwell International
Cedar Rapids, Iowa, 52406
(319) 395-3625 Telex: 46-4421

KING RADIO CORPORATION
400 N. Rodgers Rd.
Olathe, Kansas, 66061
(813) 782-0400 Telex: 4-2299
Kingrad

GLOBAL NAVIGATION
2144 Michelson Drive
Irvine, Ca. 92715
(714) 851-0119

PIPER PUBLICATIONS.

PA-31-350 T-1020
Parts Catalog = 761 775
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, FL 32960

CONTINUOUS
INSPECTION = 761 770
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, FL 32960

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CHAPTER

22

AUTO FLIGHT

CHAPTER 22 - AUTOFLIGHT

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GENERAL.

Due to the wide variety 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 Lauderdale, Fla. 33310
(305) 776-4100/TWX 5109559884

Collins General Aviation Division
Rockwell International
Cedar Rapids, Iowa, 52406
(319) 395-3625 Telex: 464-421

Edo Corporation - Avionics Division
Box 610
Municipal Airport
Mineral Wells, Texas, 76067
(817) 325-2517 Telex: 76067

King Radio Corporation
400 North Rodgers Road
Olathe, Kansas, 66061
(913) 782-0400 Telex: 4-2299-Kingrad

Sperry Flight Systems/Avionics Div.
8500 Balboa Blvrd.
P.O. Box 9028
VanNuys, CA. 91409
(213) 894-8111 Telex: 65-1367

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

CHAPTER 23

COMMUNICATIONS

CHAPTER 23 - COMMUNICATIONS

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GENERAL.

This chapter of the manual contains information necessary to perform operational checks of the Emergency Locator Transmitter (ELT), with a pilot's remote switch. Included are appropriate removal and installation instructions to facilitate battery replacement.

EMERGENCY LOCATOR TRANSMITTER.

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 under the dorsal fin. (Refer to Figures 23-2 and 23-3.)

1. Remove the access panel on the dorsal fin.
2. Set the ON/OFF/ARM switch on the transmitter to OFF.
3. Disconnect antenna coaxial cable from ELT.
4. Remove ELT from its mounting bracket by releasing the latch on the strap and sliding the ELT off the bracket.
5. Extend the portable antenna. (See Figure 23-2.)
6. Unscrew the four screws that hold the control head to the battery casing and slide apart.
7. Disconnect the battery terminals from the bottom of the circuit board.
8. Discard old battery pack. (DO NOT EXPOSE TO FLAME.)

— CAUTION —

The battery pack is shipped with a sealant on the inside lip so that a water tight seal will be retained. DO NOT REMOVE THIS SEALANT.

9. Connect new battery pack terminals to the bottom of the circuit board.
10. Reinsert the control head section into the battery pack being careful not to pinch any wires, and replace the four screws. If the four holes do not line up, rotate the battery pack 180° and reinsert.
11. Slide the portable antenna back into the stowed position.
12. Place transmitter into its mounting bracket and fasten the strap latch.
13. Connect the antenna coaxial cable to the ELT and ensure that the contact separator is inserted between the antenna contact finger and the portable antenna. (Ref. Fig. 23-3.)
14. Press RESET button and set ON/OFF/ARM switch to ARM.
15. Make an entry in the aircraft logbook, including the new battery expiration date.
16. A unit operational check may now be performed on the ELT. (Refer to Testing Emergency Locator Transmitter.)

— *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.

DESCRIPTION, OPERATION AND TESTING OF PILOT'S REMOTE SWITCH.

A pilot's remote switch, located on the lower left instrument panel allows the transmitter to be controlled from inside the cabin. The pilot's remote switch is placarded ON, ARM. The ARM position should be selected for all normal flight operations. If activation occurs with the remote switch in the ARM position, the transmitter must be reset. A button labeled RESET is located above the selector switch. To rearm the unit after it has been turned off or after it has been activated, the RESET button should be pressed in after the selector switch has been placed in the ARM position. This will end transmission and rearm the unit.

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 including 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 the above caution.

1. Remove the access panel or cover to gain access to the transmitter.
2. Turn the aircrft master switch ON.
3. Turn the aircraft communications 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.

4. 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 or ARM if there is no OFF. 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 slight delay before transmission occurs.

5. A transmitter which is functioning properly should emit a characteristic downward swept tone.
6. When the test is completed, ascertain the transmitter ON/ARM/OFF switch is in the ARM position.

— *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, if there is one, before reverting to the ARM position again.

— *CAUTION* —

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

7. Replace the access panel and secure with the appropriate screws.

— *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.

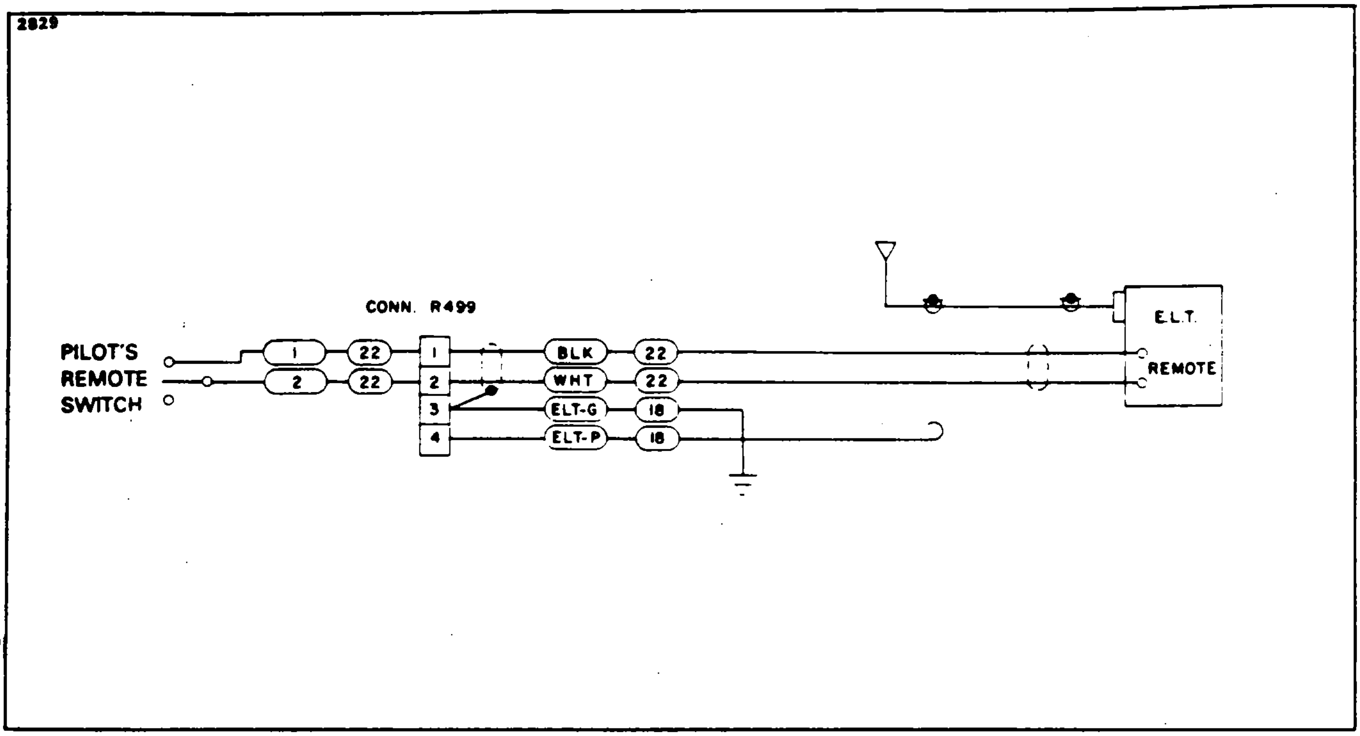

Figure 23-1. Emergency Locator Transmitter Schematic (Narco)

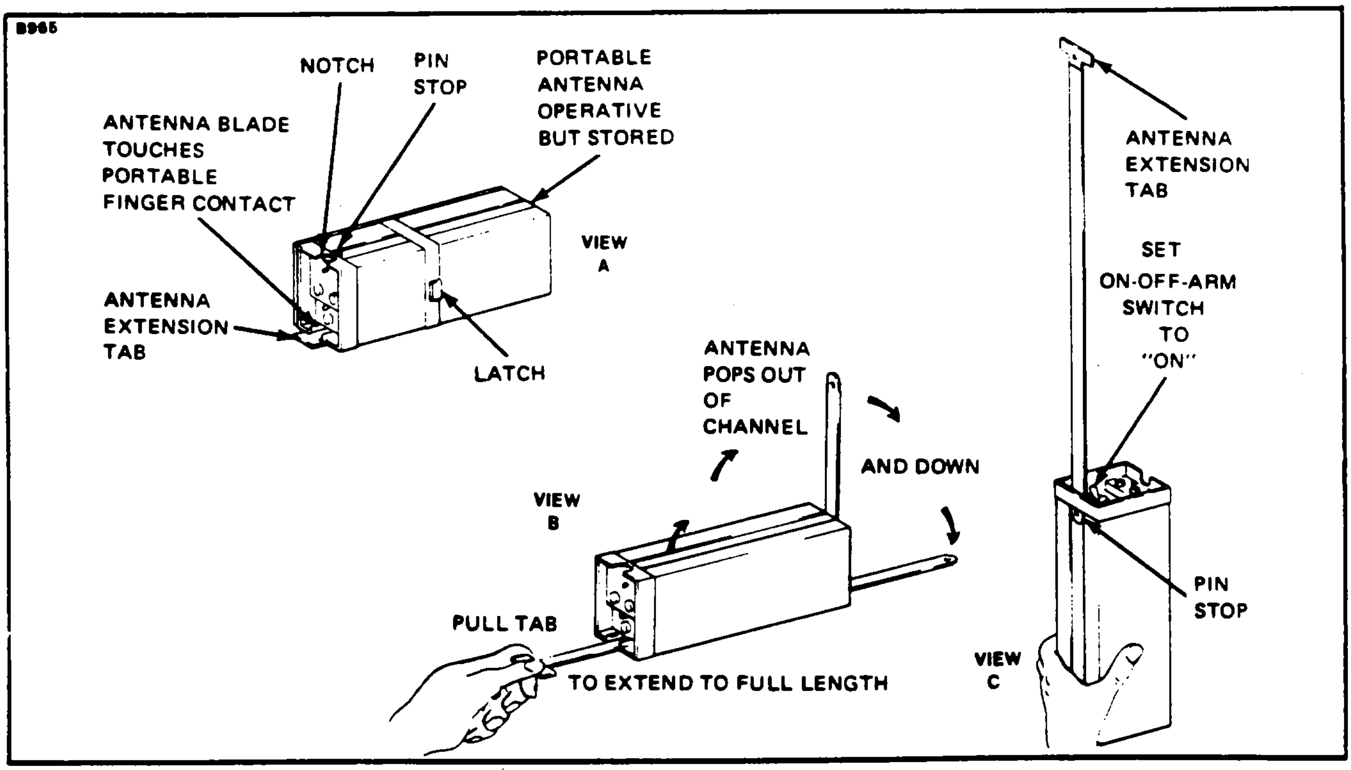

Figure 23-2. Portable Folding Antenna (Narco)

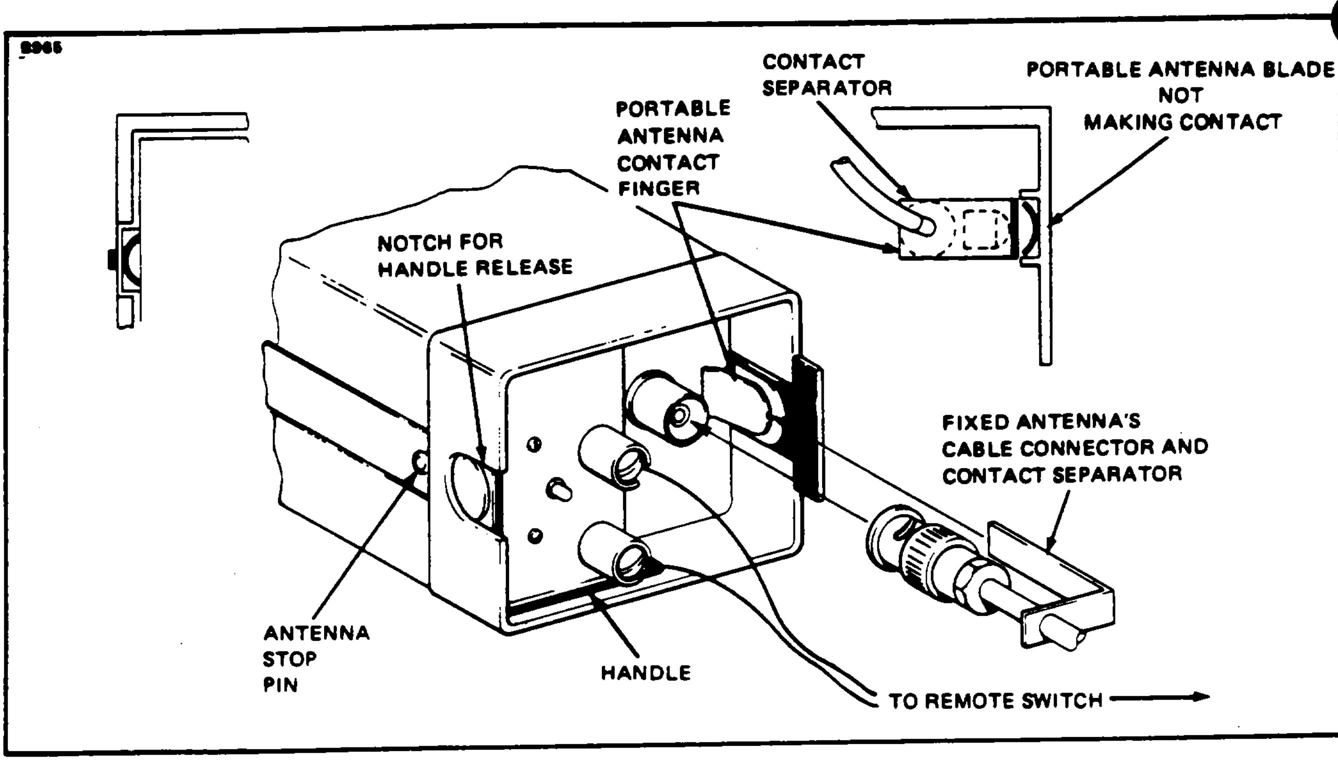

Figure 23-3. ELT Using Fixed Aircraft Antenna (Narco)

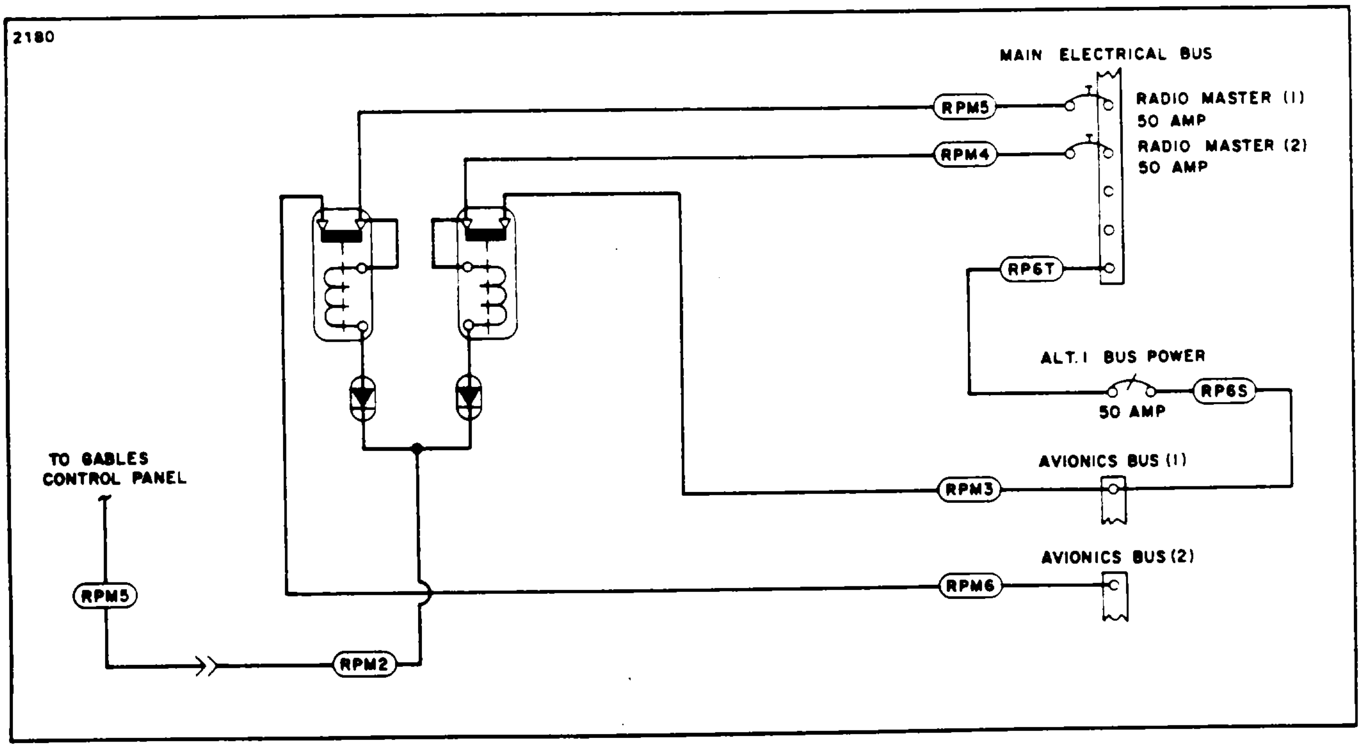

Figure 23-4. Avionics Master and Emergency Switch Circuit

AVIONICS MASTER AND EMERGENCY SWITCH CIRCUIT. (Refer to Figure 23-4.)

DESCRIPTION AND OPERATION.

Electrical power for the various avionics components is controlled by the Avionics Master Switch located in the Gables Control Panel. This switch operates a solenoid which, when engaged, provides power from the main Electrical Bus to the *1 and *2 Avionics Busses. This circuit is protected by two 50 amp circuit breakers (Radio Master *1 and Radio Master *2) on the Main Electrical Bus.

In the event of a malfunction in the Avionics Master Switch circuit, a 50 amp Emergency Switch (circuit breaker) is provided between the Main Electrical Bus and the *1 Avionics Bus. With this circuit breaker engaged, power is supplied directly to the *1 Avionics Bus, allowing the avionics components operating off of this bus to be used. The Emergency Switch does not supply electrical power to the *2 Avionics Bus and all components utilizing this bus will be inoperative.

— END —

CHAPTER

24

ELECTRICAL POWER

CHAPTER 24 - ELECTRICAL POWER

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24-33-03	Overvoltage Relay Operational Check	2C21	
24-34-00	AMMETER	2C21	
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GENERAL.

This section contains instructions for correcting difficulties which may arise in the operation of the electrical system throughout the airplane. It includes a general description and function of each part of the system along with test and adjustments of the various components. This does not include any electronics installation such as AutoPilot or radios. For electronics information, refer to Chapter 23 of this manual.

DESCRIPTION.

Electrical power is supplied by a 28-volt direct current, single wire, negative ground electrical system. The system incorporates one 24-volt battery to furnish power for starting and as a reserve power source in case of alternator failure. An external power receptacle is also provided in the nose of the airplane for the use of external power during cold weather operation and when operating equipment for test purposes.

The electrical generating system consists of the alternator paralleling system. This system incorporates two engine driven alternators, however, the field voltage of each unit is controlled independently by its own voltage regulator. These regulators are interconnected electronically so as to provide paralleled outputs from their associated alternators under normal operating engine RPM ranges. The system incorporates separate overvoltage relays. The overvoltage relay will open and remove field voltage to the unregulated alternator in the event of a failure of the voltage regulator.

Electrical switches are located in a panel on the left side of the cockpit next to the pilot's knee, in an overhead panel just above the windshield and in a panel along the lower section of the instrument panel. A fuse block is located on the forward left side of bulkhead 57.00 for the alternator circuits.

TROUBLESHOOTING.

Troubles peculiar to the electrical system are listed in Chart 2401 along with their probable causes and suggested remedies. The wiring diagrams included in the manual will give a physical breakdown of the different electrical circuits used in the airplane. (Refer to Chapter 91 for Electrical System Schematics.)

After the trouble has been corrected, check entire electrical system for security and operation of its components.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM)

Trouble	Cause	Remedy
	ALTERNATOR	
No output from alternator.	Malfunction of alternator, alternator output circuit or field circuit.	Check alternator output and field circuits. Check alternator.
Reduced output alternator.	Open diode.	Check alternator.
	STARTER	
Motor fails to operate.	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to wiring diagram and check all wiring.
	Defective starter solenoid or control switch.	Replace faulty unit.
	Binding, worn, or improperly seated brush, or brushes with excessive side play.	Brushes should be a free fit in the brush boxes without excessive side play. Binding brushes and brush boxes should be wiped clean with a gasoline (undoped) moistened cloth. A new brush should be run in until at least 50% seated; however, if facilities are not available for running in brushes, then the brush should be properly seated by inserting a strip of No. 0000 sandpaper between the brush and commutator with the sanded side next to the brush. (Continued on next page)

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
Motor fails to operate. (cont.)	Binding, worn, or improperly seated brush, or brushes with excessive side play. (cont.)	Pull sandpaper in the direction of rotation, being careful to keep it in the same contour as the commutator. — *CAUTION* — ***Do not use coarse sandpaper or emery cloth.*** After seating, clean thoroughly to remove all sand and metal particles to prevent excessive wear. Keep motor bearing free from sand or metal particles.
	Dirty commutator.	If commutator is rough or dirty, smooth and polish with No. 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 and then replace with new part.
Motor operates at proper speed but fails to crank engine.	Faulty Bendix drive.	Remove Bendix drive assembly. Clean and check, replace.
Low motor and cranking speed.	Worn, rough, or improperly lubricated motor or starter.	Disassemble, clean, inspect and relubricate, replacing ball bearings if worn.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
Low motor and cranking speed. (cont.)	Same electrical causes 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, rough, pitted or scored commutator.	Clean as outlined above.
	Grounded or open field circuit.	Test and replace defective parts.
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.
	BATTERY 24 V	
Battery will not hold charge.	Battery worn out.	Replace battery.
	Charging rate not set right.	Reset.
	Discharge too great to replace.	Reduce use of starter on the ground; use external power wherever possible.
	Standing too long.	Remove and recharge battery if left in unused airplane one week or more.
	Equipment left "ON" accidentally.	Remove and recharge.
	Impurities in electrolyte.	Replace battery.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
Battery will not hold charge. (cont.)	Short circuit (ground) in wiring.	Check wiring.
	Broken cell partitions.	Replace battery.
Battery life is short.	Overcharge due to level of electrolyte being below tops of plates.	Maintain electrolyte level.
	Heavy discharge.	Replace.
	Sulfation due to disuse.	Replace.
	Impurities in electrolyte.	Replace battery.
Cracked cell.	Hold down loose.	Replace battery and tighten.
	Frozen battery.	Replace.
Compound on top of battery melts.	Charging rate too high.	Reduce.
Electrolyte runs out of vent plugs.	Too much water added to battery.	Drain and keep at proper level.
Excessive corrosion inside container.	Spillage from over-fillings.	Use care in adding water.
	Vent lines leaking or clogged.	Repair or clean.
Battery freezes.	Discharged battery.	Replace.
	Water added and battery not charged immediately.	Always recharge battery at least 1/2 hour when adding water in freezing weather.
	Leaking jar.	Replace.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
Battery polarity reversed.	Connected backwards on airplane or charger.	Battery should be slowly discharged 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.
	BATTERY-DISCONNECT SOLENOID	
Does not operate.	Open circuit.	Repair wiring.
	Dirty contacts on connector plug.	Clean contacts.
	Open-circuited solenoid coil.	Replace unit.
	Plunger binding.	Remove and wash plunger and housing thoroughly with carbon tetrachloride. Change spring compression only as a last resort.
Intermittent operation.	Short-circuited coil. Loose electrical connection.	Replace coil. Clean and tighten electrical connections.
	Plunger binding.	See remedy pertaining to "Plungerbinding" under "Does not operate."
	Badly burned points.	If points cannot be dressed down, replace the unit.

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 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 rectifers, 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.

HOW TO FIND BAD ELECTRICAL CONNECTIONS AND POOR GROUND BONDING.

When an electrical system (like a starter system) just doesn't perform quite right, even after all the obvious things (like rebuilding the starter) have been done, consider the wires and connections of just that system. Hard starting, or generators and alternators that won't stay parallel, or other mysterious cases of electrical grief, are often caused by bad electrical connections. These look good, when checked with a volt/ohm meter, but show up bad, when measured in thousandths of an ohm, or milliohms. Therefore, the mechanic needs two things:

1. Equipment to measure resistance in milliohms, within +/- 20% accuracy.
2. An ability to judge how many milliohms is too many, to identify trouble.

The average shop already has (or can get) a digital volt meter that will read a 12 volt battery in four significant figures (like "12.62" volts). The only other thing needed, and not already there, is a set of special twin strand test leaks (40' of Piper P/N 153 419 wire), and a table of wire resistance values. A picture of the test equipment hook up and a table of resistance values follow. See Figure 24-1a and Chart 2401a.

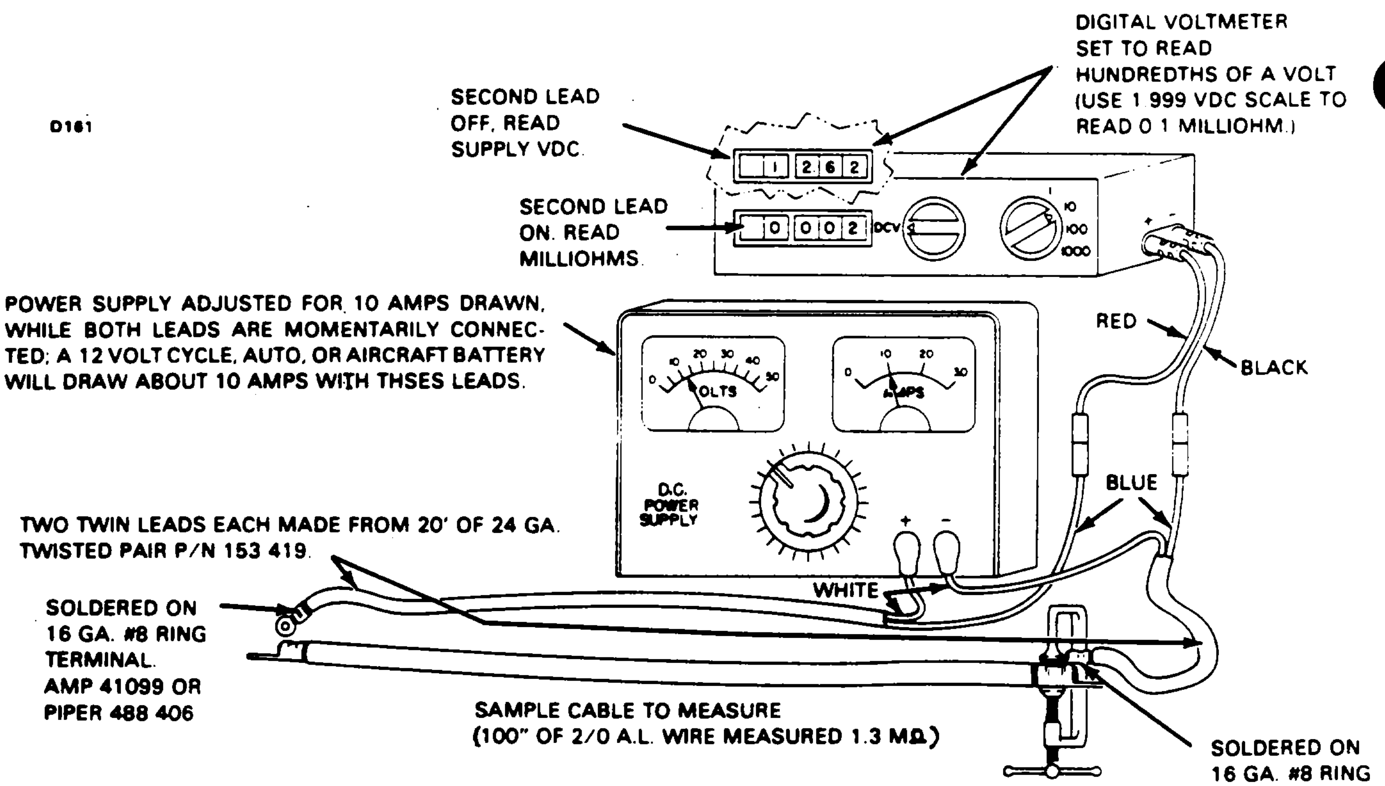
How to judge:

1. Each connection will usually measure 1 mΩ or less (certainly not more than 3 mΩ): that includes the connection between wire strands and a terminal crimped on to those strands, or between a connection stud and a terminal fastened on to it with washers and nuts.
2. Measure between aircraft battery minus terminal, and engine case or alternator or starter ground, and expect about 3 mΩ or less.
3. 3 mΩ is typical for each length of heavy gauge (bigger around than a pencil) starter or alternator power wire.
4. The whole fuselage will probably measure 3mΩ or less, from end to end.
5. Don't measure mΩ through a small fuse...the 10 amp test current would blow smaller fuses. (It is practical to turn down the test current to 5 amp and then double the measured voltage, to safely measure a 10 amp fused circuit.)
6. Nearly every normal resistance over 3 mΩ will be due to the resistance of wire, as shown on the chart. Determine the wire gauge (usually shown on Piper electrical schematics) and estimate the length of each wire to be measured. Then, use the resistance table to estimate within 20%, how many milliohms each wire should measure.

CHART 2401a. WIRE RESISTANCE TABLE

Diameter Sol. Wire	ft. per 100 mΩ	Gauge No.	Resistance in Milliohms per Foot (mΩ/ft.) 68°F/20°C	32°F/0°C	122°F/50°C	167°F/75°C
Copper Wire						
.020"	3.9'	24	25.67 mΩ	23.65	28.70	31.22
.025"	6.2'	22	16.14	14.87	18.05	19.63
.032"	10'	20	10			
.040"	16'	18	6.4			
.051"	25'	16	4.0			
.064"	37'	14	2.5			
.080"	63'	12	1.6			
.102"	100'	10	1.0			
.129"	159'	8	.63			
.162"	253'	6	.40			
.204"	403'	4	.25			
.258"	640'	2	.16			
.289"	807'	1	.12			
.325"	1018'	0	.098			
.365"	1283'	00	.078			
Aluminum Wire						
.289"	492'	1	.20			
.365"	782'	00	.13 mΩ			

Times Wire and Cable Co. brand RG-58A/U Coax value:
Center conductor = 12.6 milliohm/foot
Shield = 4.11 milliohm/foot



BASIC PRINCIPLE: $R = \frac{E}{I}$ SO $\frac{0.02V}{10\ AMP}$ = .002 OHM (2 MILLIOHM)

Figure 24-1a. Kelvin Resistance Bridge

Write down a list of wires and connections to be measured, followed by how many m are measured . . . look at this whole list to see which measurement looks far (50% or more) above what was estimated or expected, and fix something. There will usually be a loose nut, or dirty washer, or loose or dirty crimp where a terminal was crimped on a wire, or a set of bad switch contacts. A wire could be frayed in the middle, but the trouble is usually right at one end of a wire. Terminals crimped on the ends of a heavy aluminum cable may be really good at one end, and really bad, at the other end . . . measure a bad wire from exposed wire strands to the terminal crimped to them. Clean, recrimp, replace, tighten, and rework suspected connections until you can account for at least 2/3 of all the milliohms in each measurement. Then if trouble persists, it is elsewhere.

ALTERNATOR.

DESCRIPTION.

The positive output terminal of each alternator is connected to the aircraft electrical bus through separate 90 ampere circuit breaker switches. Each alternator has a shunt installed between aircraft electrical bus and its positive output terminal in order to monitor output current on an ammeter.

The field circuit for each alternator is wired through a section of a Dual Master Switch (L or R as appropriate), an auxiliary switch which is ganged to the circuit breaker switch, an overvoltage relay and a voltage regulator. Field voltage can be manually disconnected from either alternator by turning off the appropriate section (L or R) of the Dual Master Switch. Turning both sections of the master switch off completely disconnects all electric power from the aircraft bus bar. Field voltage will be automatically removed from an alternator whenever its overvoltage relay actuates or its circuit breaker switch trips.

The system has one ammeter installed to measure system currents. The output current of either alternator may be checked by pressing the appropriate button "LEFT" or "RIGHT" located above the ammeter on the overhead switch panel. A shunt is installed between aircraft electrical bus and the positive terminal of the battery to allow measuring of the battery charge and discharge current with its ammeter.

An alternator inoperative "INOP" warning light is provided for each alternator. The appropriate light will illuminate whenever its respective alternator fails to provide output voltage.

The 90 ampere circuit breaker switches should not be turned off when their associated alternator is operating normally. Turning "OFF" one of these switches while it is carrying current could cause a high voltage transient to occur on the electrical bus with possible subsequent damage to the semi-conductor equipment attached to it.

DESCRIPTION OF ALTERNATOR. (Refer to Figure 24-1.)

The principal components of the alternator are the brush holder assembly, the slip ring end head, the rectifiers, the stator, the rotor, and the drive end head.

1. The brush and holder assembly contains two brushes, two brush springs, a brush holder and insulators. Each brush is connected to a separate terminal stud and is insulated from ground. The brush 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 a 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. Each pair of rectifiers is connected to a stator lead with high temperature solder. The stator leads are anchored to the rectifier mounting plate with epoxy cement for vibration protection.

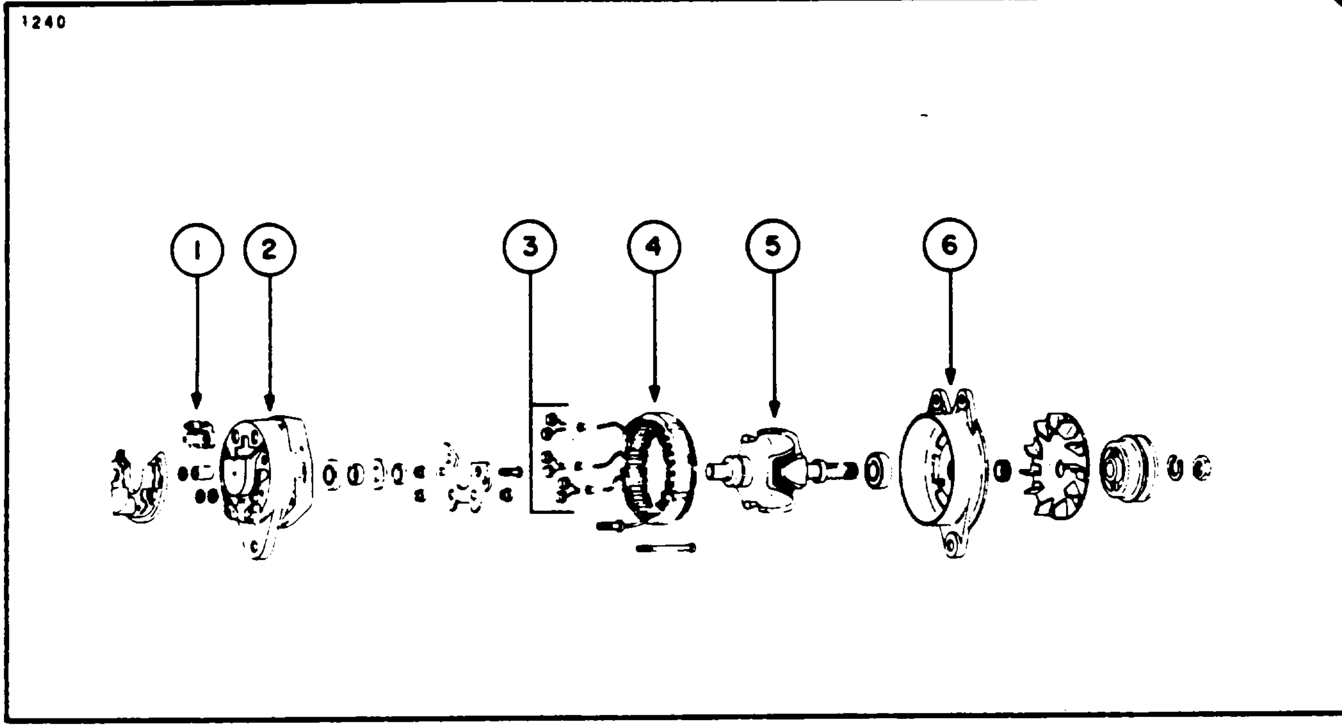


Figure 24-1. Exploded View of Alternator

4. The stator contains a special lead which is connected to the center of the three phase windings and is used to activate low voltage warning systems or relays. The stator has been treated with a special epoxy varnish for high temperature resistance.

5. The rotor contains the slip ring end bearing inner race and spacer on the slip ring end of the shaft. The rotor winding and winding leads have been specially treated with a high temperature epoxy cement to provide vibration and temperature resistance characteristics. High temperature solder is used to secure the winding leads to the slip rings.

6. The drive end head supports a sealed, prelubricated ball bearing in which the drive end of the rotor shaft rotates.

CHECKING ALTERNATOR PARALLELING SYSTEM.

The alternator paralleling system incorporates an ammeter which provides for an independent check of each alternator, as well as the charge/discharge current of the battery. In the event either ALTERNATOR INOPERATIVE light begins to glow or the ammeter check for either alternator fails to indicate an output, check the appropriate alternator circuit breaker switch, also the voltage regulator circuit breaker. If the circuit breakers are in their normal operating position, a further check of the alternator system should be accomplished. (Refer to Figure 24-2.)

1. Verify that the ammeters are operating properly.
2. Disconnect the output (+) lead at the alternator.

3. Disconnect the field F-2 lead at the alternator.

— CAUTION —

DO NOT ALLOW THE FIELD LEAD TO COME IN CONTACT WITH AIRFRAME GROUND WHEN THE MASTER SWITCH IS ON AS THE VOLTAGE REGULATOR WILL BE DAMAGED.

4. Verify that all electrical units are off and the battery is fully charged.
5. Turn on the appropriate section of the master switch for the alternator being tested (L or R).
6. To check the alternator output circuit, connect a voltmeter or 24-volt test light to the previously disconnected output (+) lead. Check that the circuit breaker switch for the alternator under test is turned on. If a reading of approximately 24-volts is obtained on the voltmeter, or the test light glows, the output circuit is operational.
7. Should there be no indication of voltage, trace back through the output circuit until voltage is indicated. (Refer to Figure 24-2.) A component that does not indicate voltage at both its input and output terminals should be replaced.
8. Check the field circuit by connecting a voltmeter to the previously disconnected field (F-2) lead. If a reading of approximately 1 to 3-volts is obtained the field circuit is operative.
9. If voltage is present at both the output and field leads, the alternator should be checked for a possible malfunction.

ADJUSTMENTS.

The only adjustment necessary to maintain the alternator system is the adjustment of the voltage control on the voltage regulator. A voltage of 28.5-volts is maintained. All other control adjustments are made at time of installation and need not be reset.

— IMPORTANT —

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

1. ***When installing a battery, always make absolutely 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 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.***

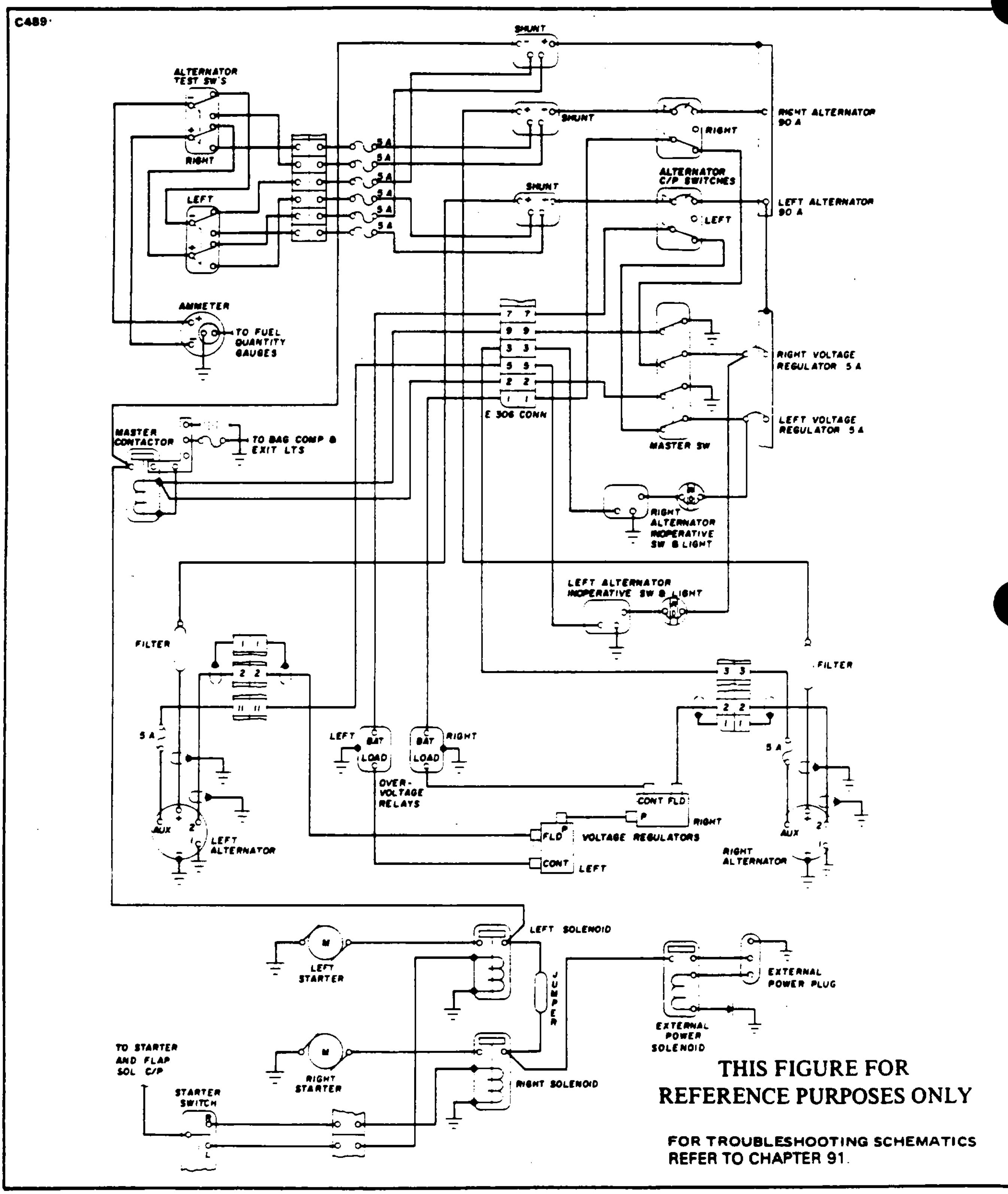


Figure 24-2. Alternator Paralleling System

OVERHAUL OF ALTERNATOR.

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 ALTERNATOR.

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 24-3, support the end head and press out the three negative 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 24-4. 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 24-5. 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 24-6.)

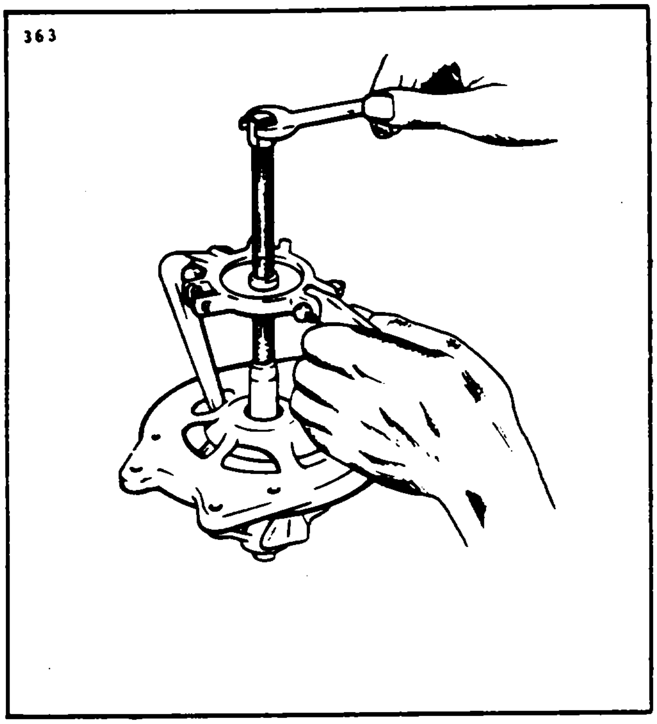


Figure 24-3. Removal of Drive End Head

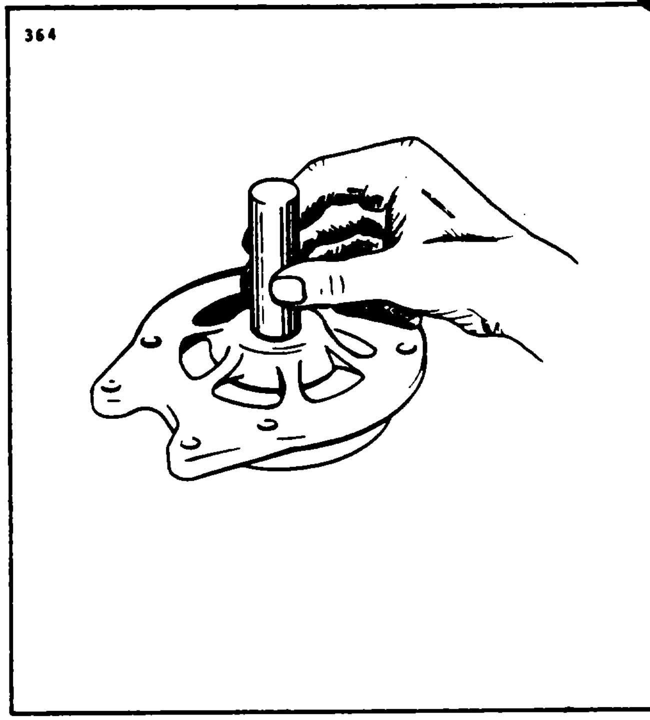


Figure 24-4. Removal of End Head Bearing

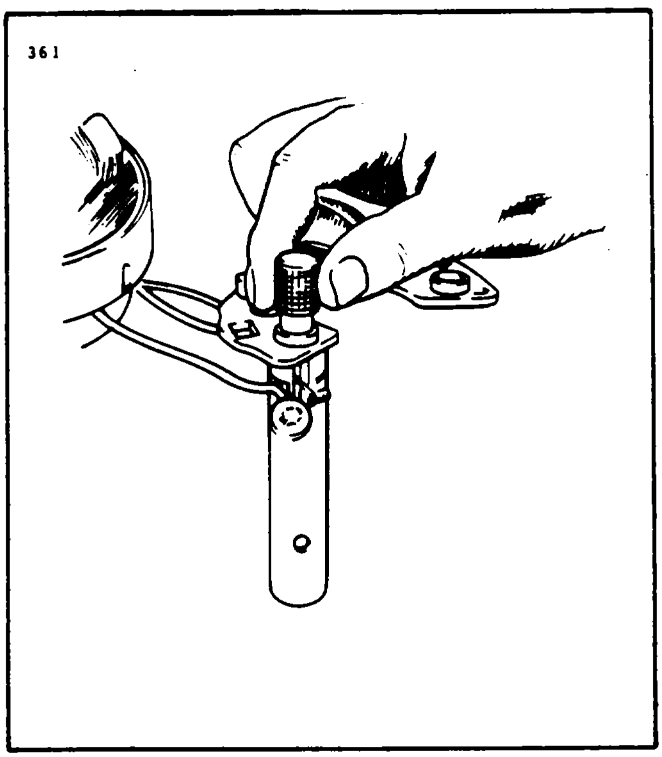


Figure 24-5. Removal of Rectifier

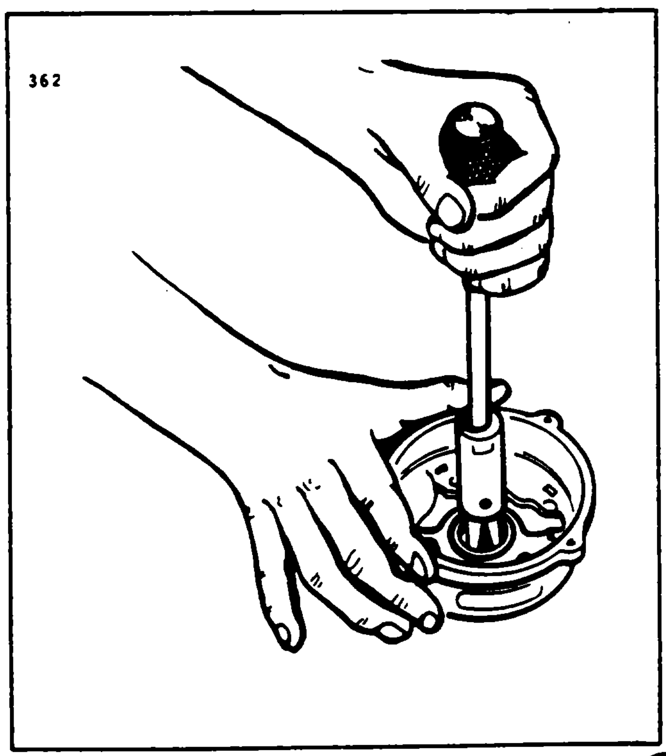


Figure 24-6. Removal of Slip Ring End Bearing

INSPECTION AND TESTING OF COMPONENTS.

Upon completion of the 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 24-7.) 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 24-8, or use an ohmmeter. Rotor current draw and resistance are listed in the Alternator Service Test Specifications paragraph. 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 a 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 that 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.

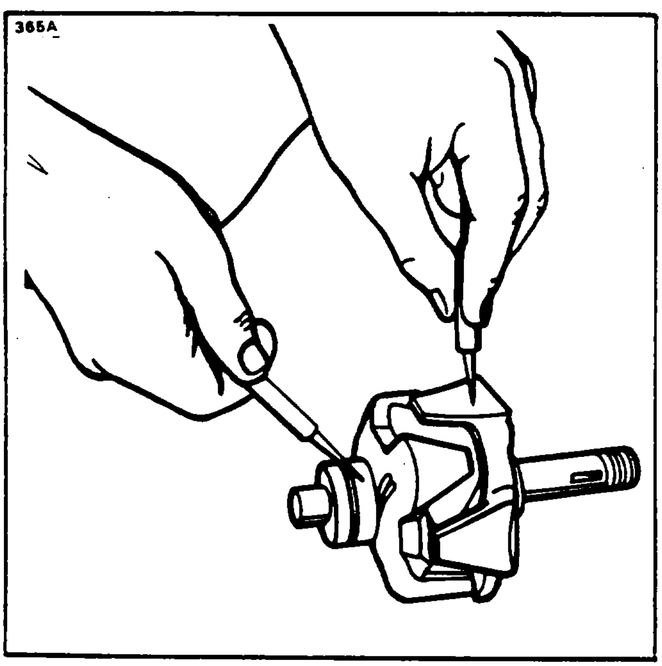


Figure 24-7. Testing Rotor for Ground

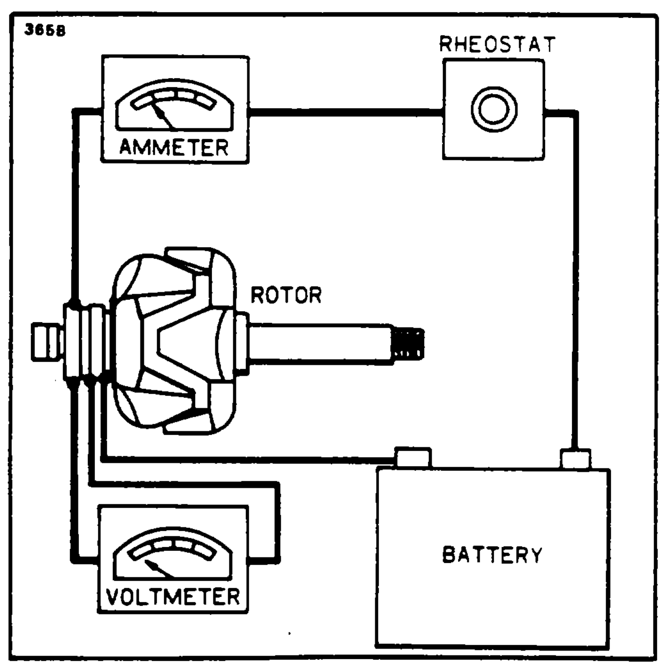


Figure 24-8. Testing Rotor for Shorts

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 stator lead, and the other test bulb or ohmmeter probe to the stator frame. If the test bulb lights, or the 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.

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 24-9.)

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 24-10.

— CAUTION —

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

3. Reassemble the rectifier mounting plate studs and insulators, making sure they are in the correct order. (Refer to Figure 24-11.)

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. Correct assembly of bearing, seal, inner race and spacer is shown in Figure 24-12. Stake the seal in place.

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 35 foot-pounds, using a strap wrench to hold the pulley. Do not install the blast tube assembly until after the unit has been bench tested.

7. Install the brush and holder assembly and retaining screws. Spin the rotor and check for interference between the brush holder and rotor. Check across the field terminals with an ohmmeter. The ohmmeter must indicate the amount of rotor resistance listed in the Alternator Service Test Specification paragraph.

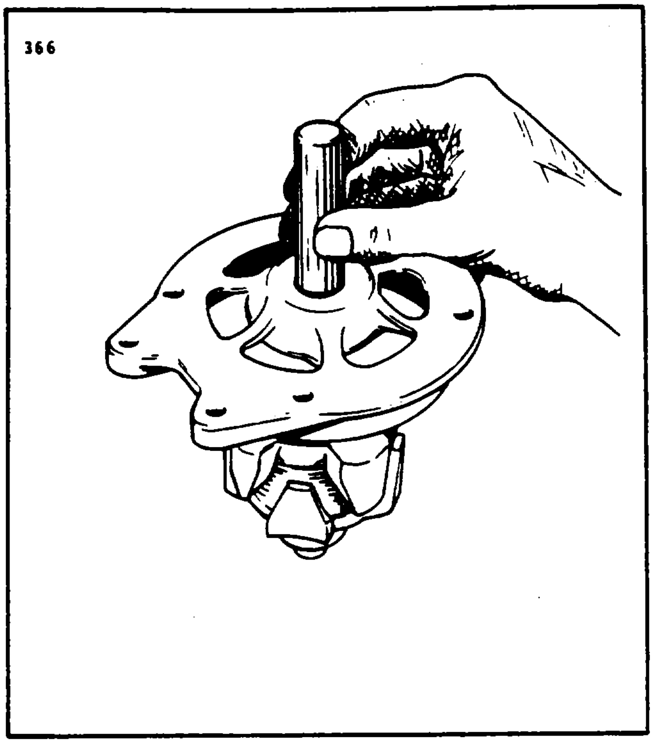


Figure 24-9. Installation of Bearing

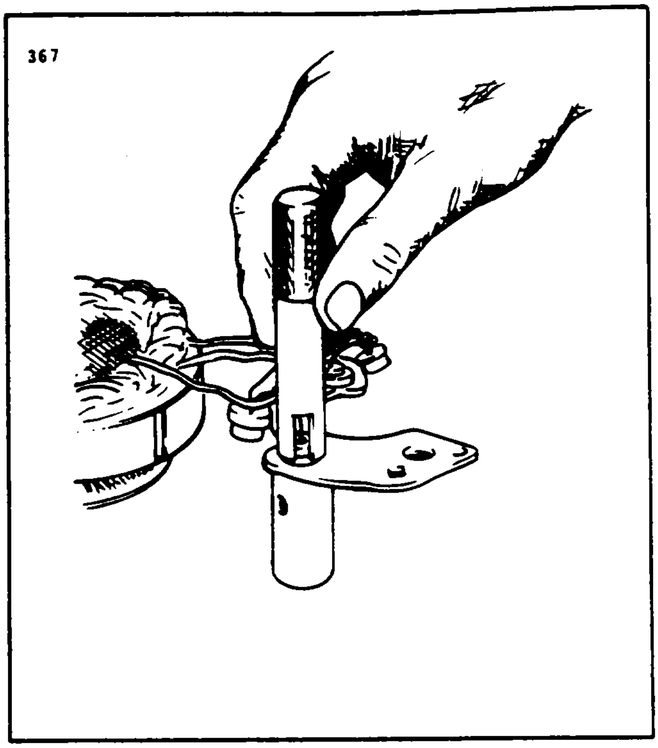


Figure 24-10. Installation of Rectifier

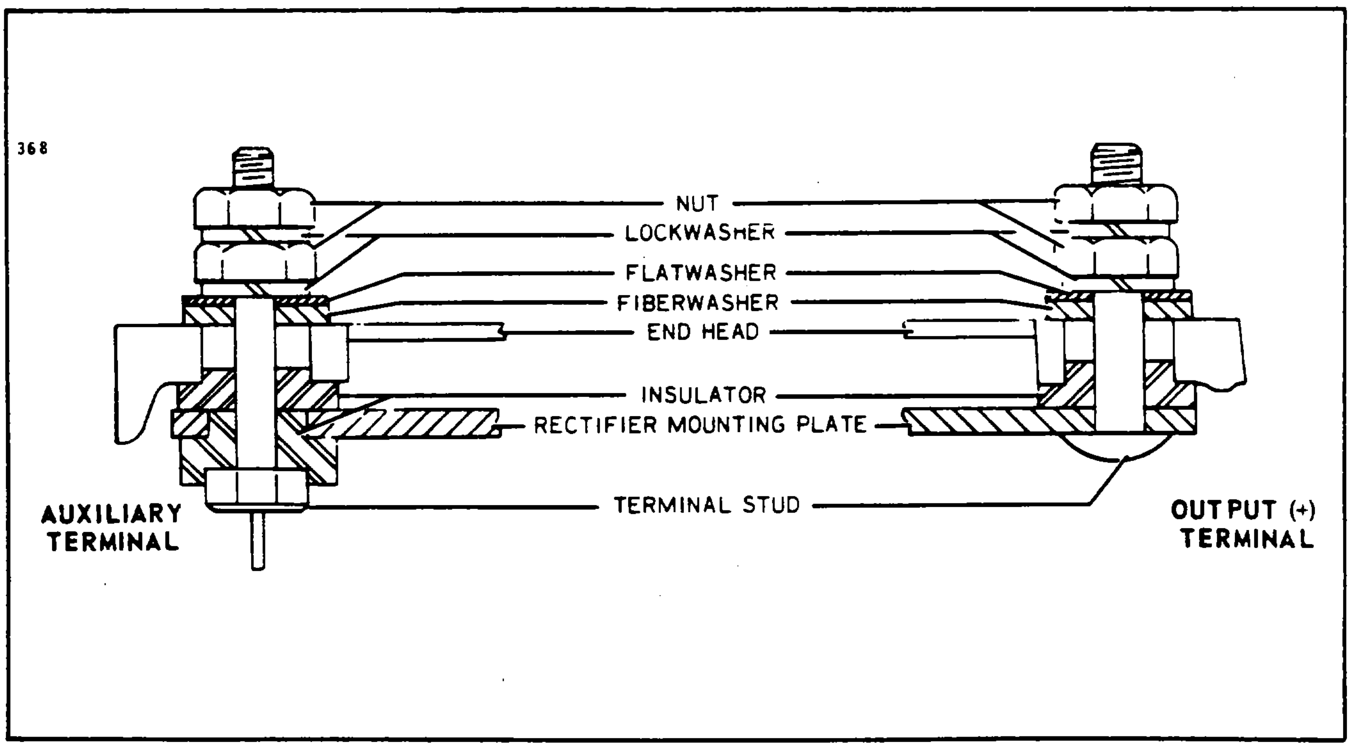


Figure 24-11. Terminal Assembly

TESTING OF ALTERNATOR.

1. Wiring connections for bench testing the alternator are shown in Figure 24-13. Refer to the individual specification pages for output test figures. Adjust the carbon pile, if necessary, to obtain the specified voltage.

— *NOTE* —

Always refer to the electrical schematic when installing the alternator or testing the alternator.

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 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. Most aircraft are 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.

ALTERNATOR NOMENCLATURE.

1. Bearings: These units have 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 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.
5. Ventilation: These units use a slip ring end cover that has a hose type connection for air pressure ventilation. Remove this cover when bench testing the alternator.

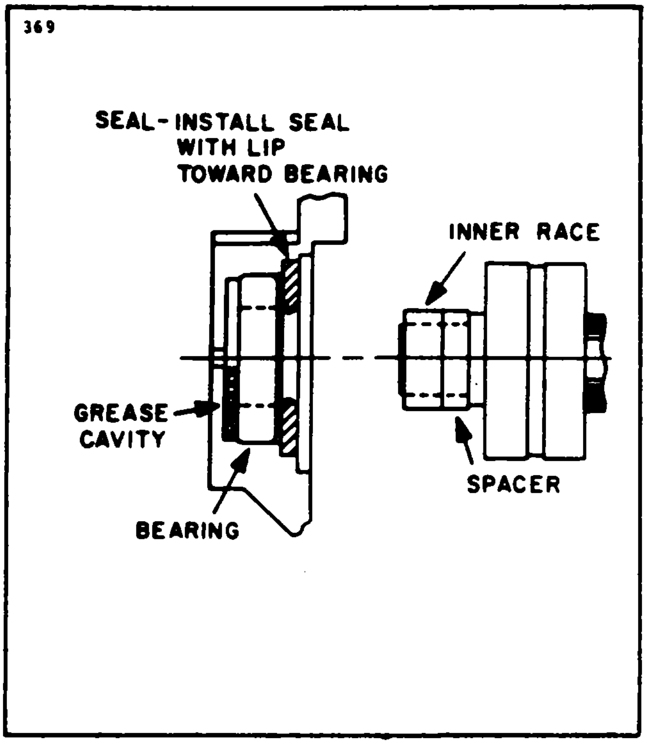


Figure 24-12. Slip Ring End Bearing Assembly

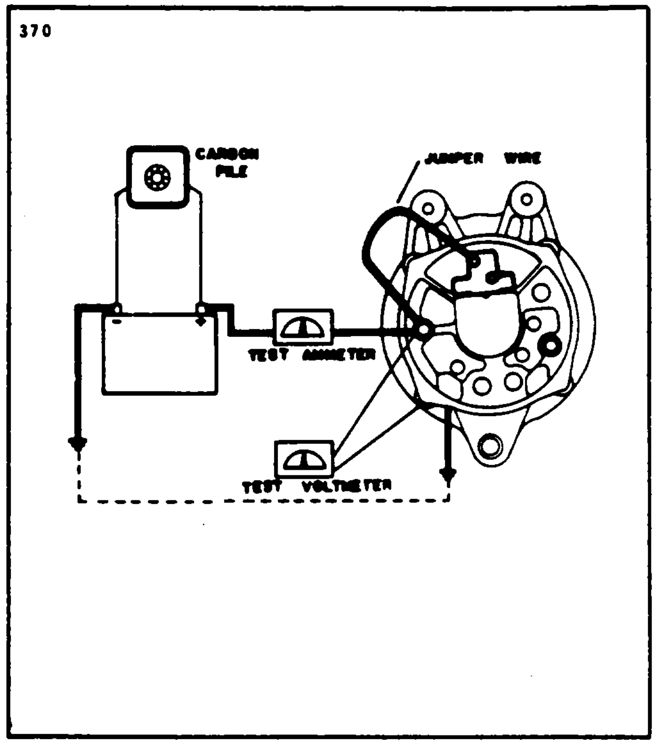


Figure 24-13. Testing Alternator

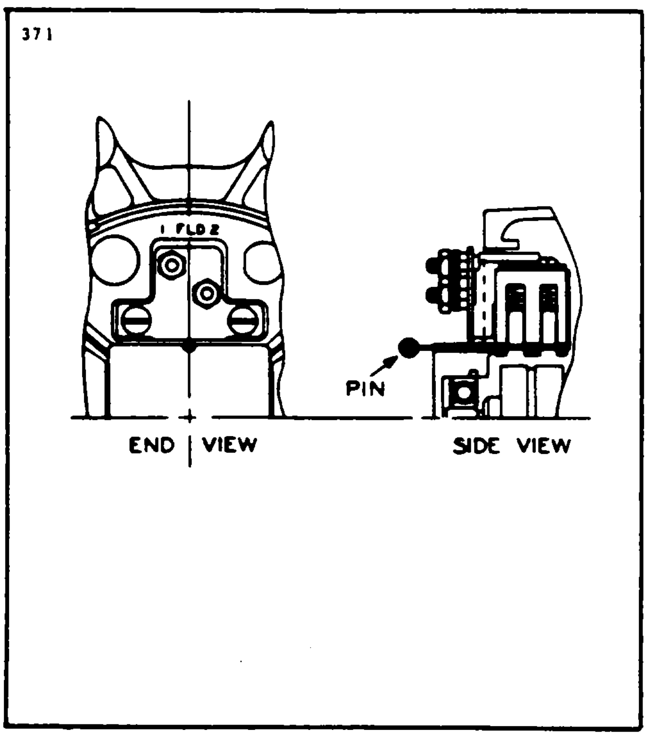


Figure 24-14. Brush Installation

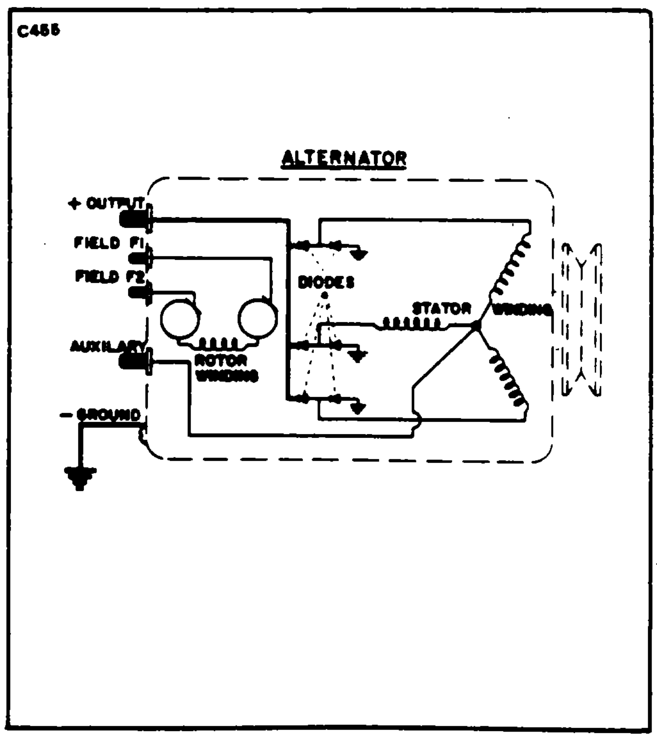


Figure 24-15. Internal Wiring Diagram

ALTERNATOR SERVICE TEST SPECIFICATIONS.

Prestolite specifications for the 28-volt alternators installed as standard equipment on the T-1020 series airplanes are as follows:

CHART 2402. ALTERNATOR TEST SPECIFICATIONS

Alternator Model	ALU 8403 or ALU 8421	
Voltage	24-volts	
Rated Output	70 amperes	
Ground Polarity	Negative	
Rotation	Bi-Directional	
Rotor:		
Current Draw (70°-80° F)	1.9 to 2.3 amps @24.0-volts	
Resistance (70°-80° F)	10.5 to 12.5 ohms	
Output Test (70°-80° F):		
Volts	28.0	28.0
Amperes Output	23.0	61.0
Field Amperes	2.05	2.05
Alternator RPM	4000 min.	8000 min.

METHODS OF CHECKING ALTERNATOR BELT TENSION.

1. If properly installed, tensioned and checked periodically, the alternator drive belt will give very satisfactory service. However, an improperly tensioned belt will wear rapidly and may slip and reduce alternator output. Consequently, a belt should be checked for proper tension at the time it is installed, again after 25 hours operation and each 100 hours thereafter, or whenever any work is performed that would affect belt tension.

— NOTE —

A minimum of .030 of an inch clearance is required between the back face of the ring gear and the edge of the belt at both locations of passage.

2. There are two satisfactory methods of checking belt tension; however, the first method described will be found preferable by most maintenance personnel because it is technically simple and requires little time for accomplishment.

A. Torque Method: This method of checking belt tension consists of measuring the torque required to slip the belt at the small pulley and is accomplished as follows:

(1) Apply a torque indicating wrench to the nut that attaches the pulley to the alternator and turn it in a clockwise direction. Observe the torque shown on the wrench at the instant the pulley slips.

(2) Check the torque indicated in Step (1) with torque specified in the following chart. Adjust belt tension accordingly.

— NOTE —

The higher tension specified for a new belt is to compensate for the initial stretch that takes place as soon as it is operated. These higher tension values should not be applied to belts which previously have been used.

B. Deflection Method: Belt tension may be checked by measuring the amount of deflection caused by a predetermined amount of tension; this is accomplished in the following manner:

(1) Attach the hook of a small spring-scale to the belt at the approximate mid-point between the ring gear support and the alternator.
(2) Pull on the scale until a reading of 14 pounds is obtained (10 pounds for used belts).
(3) Measure the distance the belt has moved with the 10 to 14 pound load applied. The distance (deflection) should be 5/16 inch. If less than 5/16 inch, the belt is too tight.

C. Note that the belt tension of the belt is adjusted by means of an idler pulley.

— NOTE —

The alternator pulley and starter ring gear support pulley must be aligned for maximum belt life. Alternator pulley tilt may be checked by placing a bubble protractor on the pulleys' faces.

CHART 2403. ALTERNATOR BELT TENSION

Width of Belt	Condition	Torque Indicated at Alternator Pulley
3/8 inch	New	11 to 13 ft.-lbs.
3/8 inch	Used	7 to 9 ft.-lbs.
1/2 inch	New	13 to 15 ft.-lbs.
1/2 inch	Used	9 to 11 ft.-lbs.
NOTE: SEE CHAPTER 21 FOR ALTERNATE BELT TENSION WITH FREON COMPRESSOR INSTALLED.		

BATTERY.

REMOVAL OF BATTERY.

1. Remove the forward panel of the nose baggage compartment.
2. Reach to the forward base of the battery box and remove the cap bolts securing the box to its mounting platform.
3. Disconnect the vent line from each side of the box.
4. Remove the battery box cover.
5. Disconnect the battery cables.

— NOTE —

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

6. Tip the box aft enough to remove the battery.

INSTALLATION OF BATTERY.

Installation of the battery is in reverse order of removal.

CHARGING BATTERY.

When recharging the battery, it should be removed from the airplane.

1. Remove cell caps and check fluid level.
2. Begin charging rate of 2 amperes and finishing with 1 ampere.
3. Should the battery boil over, clean per Battery Box Corrosion Prevention.
4. When battery is completely charged, reinstall in the airplane.

BATTERY BOX CORROSION PREVENTION.

The following checks against corrosion within the battery box should be performed at least every 30 days:

1. Check terminals and connections for corrosion. Corrosion effects may be neutralized by applying a solution of baking soda and water mixed to the consistency of thin cream.

— CAUTION —

Do not allow soda solution to enter battery.

Repeat application until all bubbling action has ceased.

2. Wash battery and box with clean water and dry.
3. Close battery box drain tube clamp.
4. As necessary, paint the battery box with an acid resistant paint.

STARTING THROUGH EXTERNAL POWER RECEPTACLE WITH AIRPLANE'S BATTERY NEARLY DEPLETED.

— *NOTE* —

Should the hydrometer reading indicate less than 1190, the battery should be removed and recharged or replaced prior to flight.

1. When using a 24-volt battery for external power starting and the airplane's battery is nearly depleted, the following procedure should be used:
   A. Disconnect the airplane's battery at the negative terminal to prevent excessive loading of the external starting battery.
   B. Check that all of the airplane's electrical equipment and master switch are turned off.
   C. Connect the external battery to the external power receptacle and start RIGHT ENGINE ONLY using normal starting procedures.
   D. Remove external battery and then reconnect airplane's battery at the negative terminal.
   E. Turn master switch on and check ammeter for battery charging current.
2. When starting with a power cart and the airplane's battery is nearly depleted, the procedure in Step (1) need not be followed. The capacity of a power cart is sufficient to start an aircraft with a low battery. If a six-volt battery is available, it can be connected in series with the 24-volt external battery to supply 30-volts for starting. In this case, use the same starting procedure as used with a power cart.

— *CAUTION* —

In the event it becomes necessary to start the engine through the external power receptacle, due to a low battery condition, ascertain that aircraft battery is on the charging line by monitoring the battery ammeter (charging current will be high). Do not take off until charging current falls below 20 amps.

Never use a 12 or 24-volt battery in place of a six-volt battery since electrical damage may result.

HYDROMETER READING AND BATTERY CHARGE PERCENT.

CHART 2404. HYDROMETER PERCENTAGE GUIDE

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

REGULATOR.

REGULATOR COMPONENTS.

Alternator output voltage can, within the limits of the design capability of the alternator, be controlled by properly varying the average level of current flow in the rotor winding. The LAMAR solid state electronic regulator is well suited for this purpose. The alternator, due to its design, has self-limiting current characteristics and therefore needs no current-limiting element in the regulator.

1. Transistor: The transistor (Symbol "Q") is an electronic device which can control the flow of current in an electrical circuit. It has no mechanical or moving parts to wear out.
2. Rectifier Diode: The rectifier diode (Symbol "D") will pass current in only one direction (forward direction); and in this respect it may be compared to a check valve.
3. Zener Diode: The zener diode (Symbol "Z") in addition to passing current in the forward direction, will also pass current in the reverse direction when a particular value of reverse voltage is applied. This property makes it useful as a voltage reference device in the regulator.
4. Capacitor: The capacitor (Symbol "C") is a device which will store electrical energy for short periods of time. This property makes it useful as a filter element to smooth variations of voltage.
5. Resistor: The resistor (Symbol "R") is a device which is used to limit current flow.

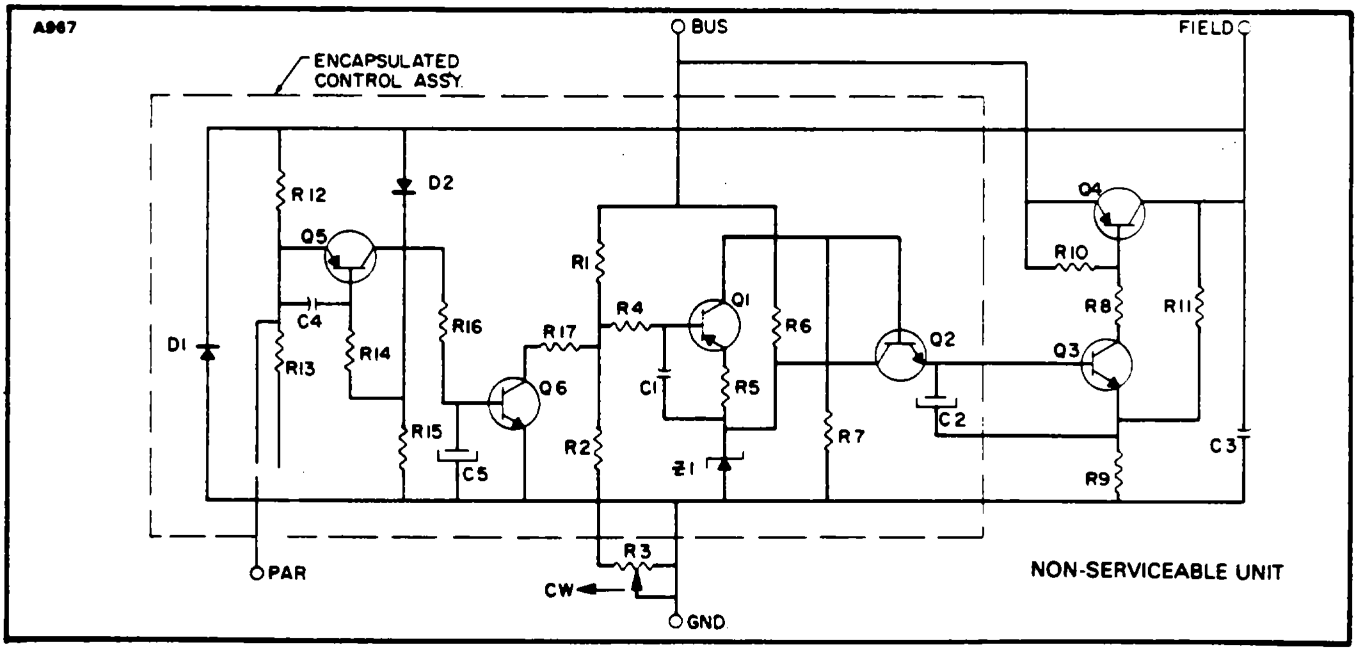


Figure 24-16. Regulator Diagram (Lamar)

OPERATION OF REGULATOR. (Refer to Figure 24-16.)

1. When the alternator is turned on, battery voltage is applied to the "BUS" terminal of the regulator and via Q4 through the "FIELD" terminal of the regulator to the alternator field terminal F2. The amount of voltage applied to the field of the alternator is controlled automatically by action of the regulator in response to alternator output as described below.
2. Current flow through R6 and Z1 establishes a reference voltage across Z1.
3. Resistors R1 and R2/R3 comprise a voltage divider which is adjustable by means of the variable portion R3. Voltage at the junction of R1 and R2 and the reference voltage across Z1 are applied to comparison transistor Q1. R3 is adjusted so that these voltages are balanced with the desired alternator output voltage present on the "BUS" terminal of the regulator.
4. Thereafter, whenever alternator output voltage (as applied to the "BUS" terminal) falls below the desired regulation value, the comparison transistor Q1 will supply increased current to driver transistors Q2/Q3, which in turn will drive power transistor Q4 to a higher value of field current. This will result in alternator output voltage increasing to a value which will restore balance between the two voltages applied to Q1.
5. Conversely, if alternator output voltage (as applied to the "BUS" terminal) increases due to a greater engine speed or reduced loading of the electrical system, the comparison transistor Q1 will act to reduce current flow to the driver transistors Q2/Q3, and thus reduce the driver to power transistor Q4. This will result in a reduction of alternator field current and automatically restore balance between the two voltages applied to comparison transistor Q1.
6. Capacitors C1 and C2 function, together with their related transistors, in a way to smooth alternator output ripple and voltage spikes so that the alternator field current is controlled at a steady value.
7. The LAMAR solid state regulator controls alternator field current to a steady value as required by the electrical load conditions and engine speed. It does not continuously switch field current between high and low values as do mechanical regulators and the switching type of electronic regulators.
8. The design of this unit is such as to provide an alternator output voltage that does not vary with ambient temperature.

BALANCING CIRCUIT OPERATION. (Considering two identical alternators and regulators having the "PAR" terminals of the regulators connected.)

1. Balancing circuit operation is initiated within one regulator whenever individual field voltages delivered by the regulator units to their related alternators are not equal.
2. When a difference in individual field voltages occurs, one-half the difference is impressed across R12 within each regulator and is thus applied to the input of Q5.
3. In that regulator which is delivering the lower field voltage, the polarity of R12 voltage drop causes Q5 collector current flow.
4. Q5 collector current flow results in conduction occuring in the collector circuit of Q6.
5. Q6 collector current flows from regulator divider R1/R2 + R3 through limiting resistor R17 to ground.
6. Conduction through R17 effectively alters the ratio of the regulator divider R1/R2 + R3 in the direction to increase Q1 collector current flow.
7. As described above under OPERATION OF REGULATOR, increased Q1 current results in increased output from the regulator to the field of its related alternator.
8. Feedback action results in Q6 collector current stabilizing at a value that results in nearly equal field voltage being delivered by the two regulators to their respective alternator fields.

9. The balancing circuit will thus automatically maintain, at a low value, the difference voltage applied to the alternator fields. In a parallel system having identical alternators operating at the same RPM, the output currents of the alternators will thus be maintained nearly equal.

10. In whichever regulator of a pair is set to deliver the highest voltage, the balancing circuits are inactive. Thus system voltage is determined by the regulator of a pair which is set to higher voltage. The lower set regulator will adjust itself automatically, as described above, to deliver the same field voltage as the one which is set higher, within the limits of its design capability.

11. The balancing regulator system as described provides for automatic load balancing of parallel operated alternators having independent field excitation circuits. The pilot can, while in flight, remove either alternator system completely from the aircraft system and maintain operation of the other system.

PREPARATION FOR TESTING. (Regulators may be tested using the aircraft's alternator or an alternator test stand.)

— CAUTION —

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

1. The aircraft technician or other electrical systems specialist, must disconnect the battery ground cable at the battery before connecting or disconnecting a test ammeter or other test equipment or before making wiring changes in the electrical system.
2. Voltmeters with test probes or clips are not recommended. Fully insulated bolted terminal connections are best, and these should be attached when all power is removed as previously described.
3. When installing a battery in an aircraft, be sure that the battery negative terminal is in a position so that this terminal can be connected to the battery ground cable for negative ground systems.
4. The regulator under test is to be mounted on a grounded metallic surface using three No. 8 screws pulled up tight. For extended test periods the heat transfer from regulator to the mounting surface is significant.
5. A ground wire between the regulator "GND" terminal and the aircraft or test stand structure is essential for proper operation. The alternator frame must also be solidly bonded to the system ground.
6. The LAMAR regulator is intended for use with alternator systems having one field terminal grounded at the alternator. The other field terminal F2 of the alternator is connected to the "FIELD" terminal of the regulator. NEVER UNDER ANY CIRCUMSTANCE PERMIT A GROUND TO CONTACT THIS CIRCUIT EVEN FOR AN INSTANT WHILE POWER IS APPLIED TO THE SYSTEM. Due to this precaution, the mechanic should not use tools near these circuits while power is applied.
7. The alternator should be in good condition and capable of producing full output, and the alternator drive belt must be adjusted tight enough to prevent slippage.
8. The battery must be in good condition and should be fully charged.
9. The voltmeter and ammeter should be of the best quality and should be accurate.
10. A carbon-pile connected across the battery may be used to load the charging circuit while testing the regulator.

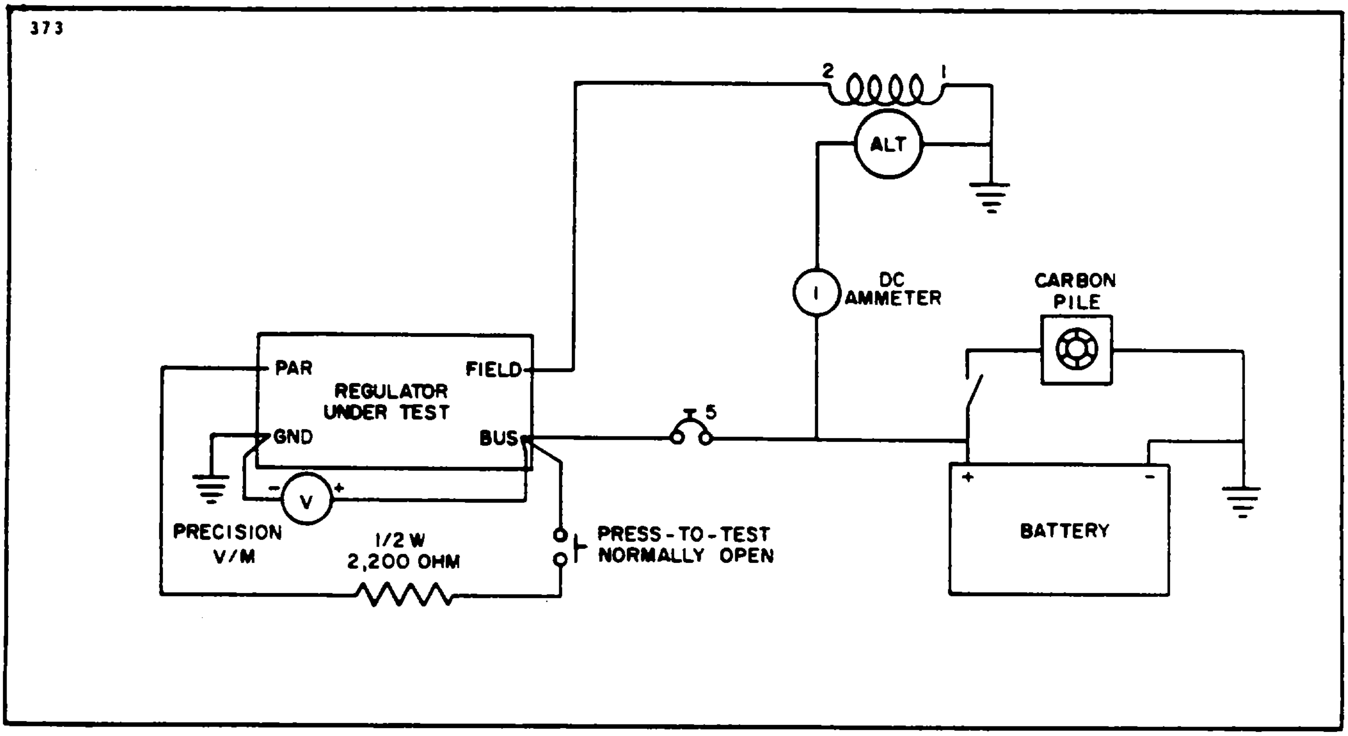


Figure 24-17. Testing Regulator (Lamar)

TESTING REGULATOR.

1. The procedure for testing the regulator, whether on the airplane or on the test bench, remains the same. Connect the test meters and regulator wiring as shown in Figure 24-17.
2. All circuit connections should be clean and tight. This includes the test instrument connections which must not come loose or open the charging circuit at any time while the system is operating.
3. The voltmeter will not indicate the true regulator setting until the regulator has been operating in the charging system or on the test bench for at least five minutes, at a charge rate of from 10 to 15 amperes.
4. With the connections made as shown in Figure 24-17, start the engine and adjust its speed to obtain an RPM of 1500. Adjust the carbon pile or accessory load to establish the 10 to 15 ampere load value. Note that the battery charge current is indicated by the ammeter. Therefore, the current value may change downward at the beginning of a test run. This will be especially true if the battery was used for engine starting.
5. After five minutes operating time, check the regulator operating voltage as indicated by the voltmeter. Refer to Chart 2402. Alternator Test Specifications, for correct operating voltage. The operating voltage is shown for ambient temperature in which the regulator is operating.

6. If the voltmeter reading indicates that the operating voltage is not within limits, carefully insert a small screwdriver (Phillips #O) in the voltage adjustment access hole on top of the regulator and adjust voltage adjustment slowly to obtain desired value. Before condemning the regulator, recheck the alternator and the battery; making sure that they are in good condition. Recheck all circuit connections and all wiring for unwanted resistance (voltage drop test). Recheck the voltmeter for accuracy and repeat the entire operating test.

7. Balance circuit operation is confirmed by closing the press-to-test switch momentarily and observing that the alternator output current increases abruptly to a higher level. Upon release of this switch, the alternator output will be restored to its previous level, except that minor differences may be noted which are due to battery charge conditions.

ADJUSTING REGULATOR.

1. These regulators are normally used in parallel alternator systems of multi-engine aircraft. Their final adjustment should be made in actual operation in the aircraft system with test equipment connected as shown in Figure 24-18. The balance adjustment is made while operating only one engine, either left or right. The engine to be operated must be selected so as to permit the technician a completely safe access to both of the regulators, so that they may be adjusted while the engine is operating without danger. We shall designate the engine selected to be operated as "RIGHT" and the inoperative engine as "LEFT" for purposes of discussion.
2. Lift the wire from the "PAR" terminal of either regulator and insulate the free end so it will not contact other circuits or ground during the adjustment procedure. Breaking the circuit disables the balancing circuit in both regulators.
3. Turn off the "LEFT" alternator field switch. All the "RIGHT" alternator switches are to be on.
4. Operate the "RIGHT" engine and alternator system with a load of 15 to 30 amperes, and an engine RPM of 1500 for at least five minutes. If required, carefully set the "RIGHT" regulator voltage adjustment to the correct voltage value as measured with the precision voltmeter connected to the regulator terminals. Replace the snap plug in the "RIGHT" regulator adjustment access hole.

— CAUTION —

Do not make any further adjustment of the "RIGHT" regulator.

— NOTE —

Several operations of connecting and disconnecting the "PAR" circuit wire are required by the following steps. For convenience, a switch or a dependable clip connection may be used to accomplish this. No danger of damage exists if this circuit touches any other circuit or ground, however, erroneous results will be obtained if such occurs.

5. Shutdown the system, including the master electrical switch. Connect a portable voltmeter (non-precision) such as Simpson No. 260 or equivalent between the "FIELD" terminals of the left and right regulators in addition to the aircraft system wires already on these terminals. The positive terminal of the meter is to be on the right regulator terminal. Use a 30-volt or 50-volt meter range initially.
6. Restore operation of the right engine and alternator system using load and RPM as in Step 4, and turn on the left alternator system switching. (HOWEVER, THE LEFT ENGINE IS NOT OPERATING.)

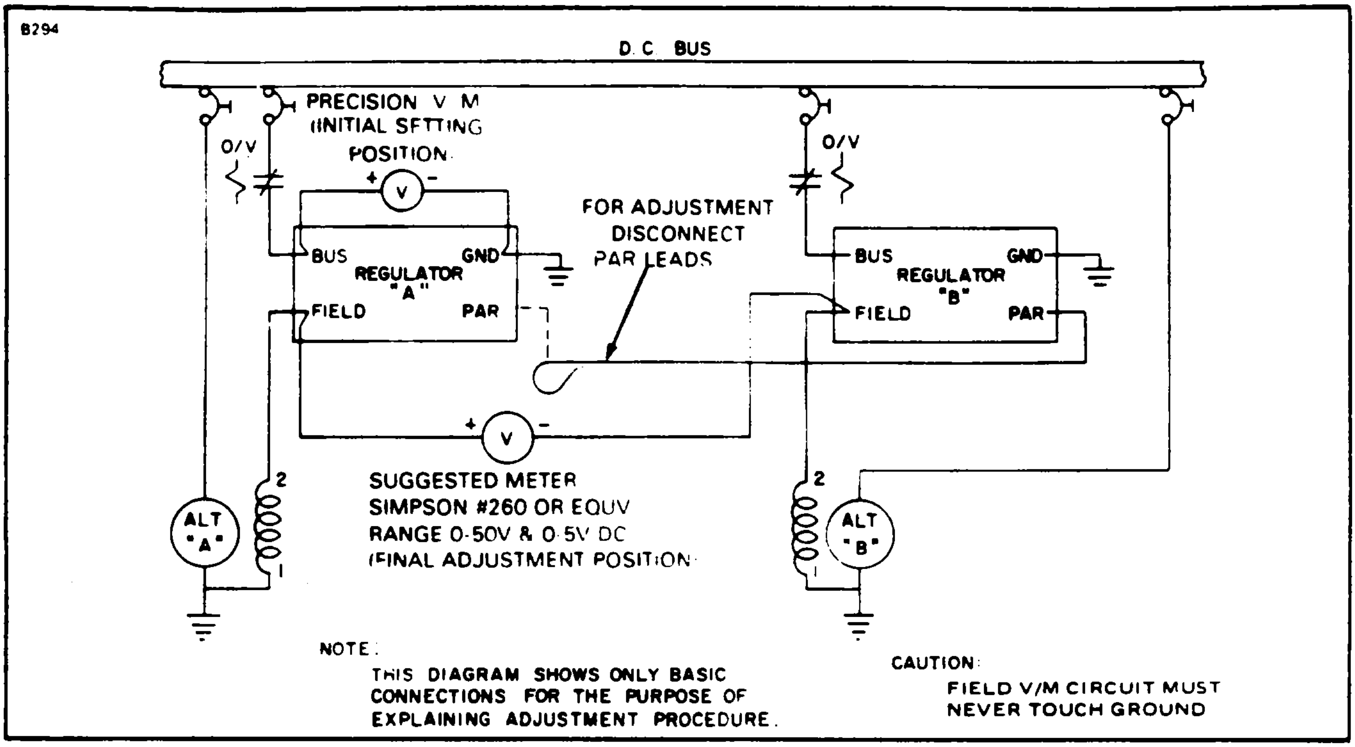


Figure 24-18. Adjusting Regulator (Lamar)

7. Now slowly rotate the left regulator voltage adjustment while observing the voltmeter connected between the field terminals. If a reverse (downscale) reading is obtained with meter polarity as specified, turning the "LEFT" regulator adjustment counterclockwise will bring the meter up scale. Then slowly set the "LEFT" adjustment to a point where the voltmeter will read a low value. Any reading from zero to 8.0-volts is acceptable. A stable reading should not be expected. A lower meter range such as 10-volts may be used for this adjustment. Now reconnect the wire to join the "PAR" terminals of the two regulators and observe that the voltmeter drops to a very low value (0.2 to 0.5-volt) and it will be stable. Continue operations in this manner for 5 to 10 minutes to establish initial warmup of the "LEFT" regulator and alternator system. After the warmup period make a final adjustment of the balance. This is done by again briefly opening the "PAR" circuit between regulators and touching up the "LEFT" adjustment for a low reading of the voltmeter between field terminals. Again any value from zero to 8.0-volts is acceptable; and again it will not be stable while the "PAR" circuit is open. Remove the adjustment screwdriver and replace the snap plug in the "LEFT" regulator adjustment hole.

8. Shutdown the "RIGHT" engine and master switch. Remove all voltmeter leads. Reconnect the "PAR" circuit wire removed in Step 2 and check all terminal screws for security.

OVERVOLTAGE CONTROL.

PURPOSE AND OPERATION.

1. The overvoltage control is used to protect electrical circuits and electronic equipment from excessive voltage in the event of a charging circuit malfunction.
2. The overvoltage control consists of a mechanical relay and a solid state triggering device. The solid state triggering device activates the mechanical relay, when the voltage reaches a preset value, thereby opening the relay contacts and disconnecting the field circuit of the alternator.
3. The relay contacts will remain open until the alternator switch is turned off. Figure 24-19 illustrates the overvoltage control connected in a typical Prestolite insulated field alternator.

TEST PROCEDURE.

Connect the relay as shown in Figure 24-20. Use a 100 ohm potentiometer of 15 watt rating, or more, to adjust the voltage. The voltmeter is used to read the voltage until the relay opens, at which time the voltmeter reading will drop to zero. See tabulation for voltage reading. Test figures are at 75 degrees Fahrenheit. Relay contacts open between 31.50 and 32.50-volts. Use 36-volts to test.

— *NOTE* —

These units are not adjustable. Replace the overvoltage control if it does not test to specifications.

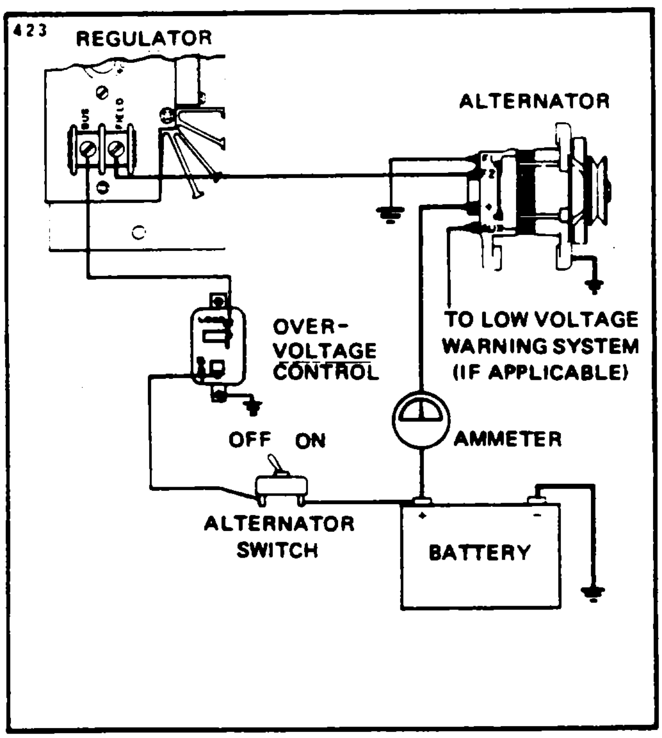


Figure 24-19. Application of Overvoltage Control

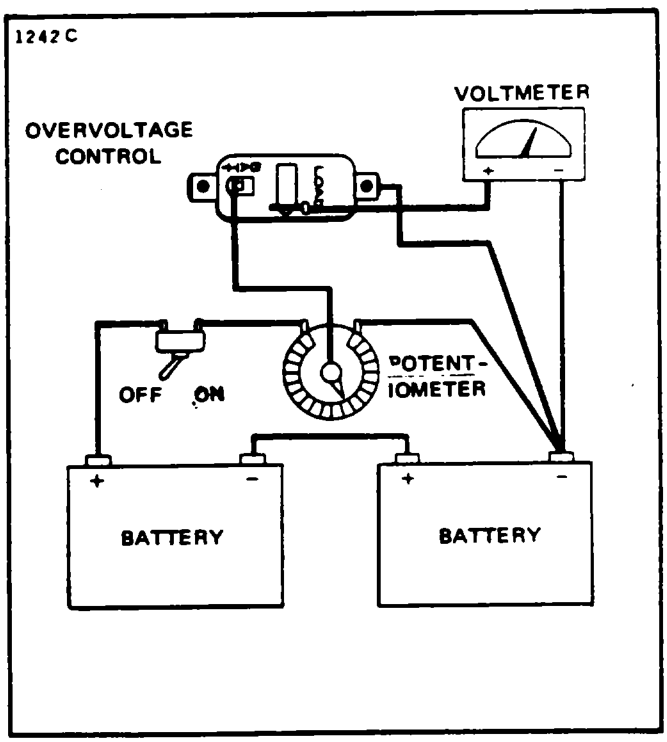


Figure 24-20. Testing Overvoltage Control

OVERVOLTAGE RELAY OPERATIONAL CHECK (PARALLELING SYSTEM).

This check should be accomplished at each 500 hour inspection, per the following instructions:

1. Pull all circuit breakers to the out (OFF) position except the left and right voltage regulator (5 amp) circuit breakers.
2. Obtain a variable D.C. voltage power supply and set it to zero output.
3. Connect the power supply to the aircraft through the external power receptacle.
4. Turn ON the left alternator section of the Dual Master Switch.
5. Obtain a volt/ohmmeter and set it to 60-volts D.C. Connect the positive lead of the VOM to the output (LOAD) terminal of the LEFT overvoltage relay. Connect the negative lead of the VOM to airframe ground.
6. Increase the output voltage of the variable D.C. power supply until the LEFT overvoltage relay trips out. (An audible click will be heard when the relay operates and the VOM needle must drop to zero-volts.) Record the power supply voltmeter reading which was indicated just prior to the overvoltage relay operating. Voltage limits are: Min. 31.50-volts - Max. 32.50-volts.
7. Reduce the power supply to zero. Turn OFF the left alternator section of the Dual Master Switch. Another click will be heard when the overvoltage relay resets itself for normal operation.
8. Turn ON the right alternator section of the Dual Master Switch. Reconnect the volt/ohmmeter to the right overvoltage relay and repeat Steps 6 and 7.

AMMETER.

GENERAL.

The ammeters are mounted in the overhead instrument panel. This instrument measures the current going into the entire electrical system including the battery charging demand.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

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CHAPTER

25

EQUIPMENT / FURNISHINGS

CHAPTER 25 - EQUIPMENT/FURNISHINGS

TABLE OF CONTENTS/EFFECTIVITY

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25-21-00	Divider Curtain and Curtain Track	2D3	A 2-82
25-21-01	Removal	2D3	1R 2-82
25-21-02	Installation	2D3	1R 2-82
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25-22-02	Installation	2D3	1R 2-82
25-23-00	FIRE EXTINGUISHER, HAND HELD	2D5	A 10-82
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25-50-01	Loading Limitations	2D6	A 2-82
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GENERAL.

The T-1020 flight and passenger compartments are equipped with the following standard and optional equipment and/or furnishings. The flight compartment is equipped with two crew seats, a fire extinguisher is mounted beneath the pilot's seat. A divider between the crew and passenger compartments is made up of a curtain. The passenger compartment is equipped with nine seats. (Refer to the Parts Catalog for part no.) This chapter provides instructions for removal and installation of the equipment listed above.

FLIGHT AND PASSENGER COMPARTMENT

DIVIDER CURTAIN AND CURTAIN TRACK

REMOVAL.

1. Remove one of the two stop screws located at either end of the forward or aft curtain tracks and slide the curtains off the curtain tracks.
2. The forward and aft divider curtain tracks can be removed by releasing the remaining three and five attachment screws respectively.

INSTALLATION.

1. Install the curtain tracks by means of attachment screws.
2. Slide the curtain on the tracks and secure with the stop screws on the end of the track.

PASSENGER SEATS.

REMOVAL.

1. Lift up on the seat latch and slide the seat all the way aft to the end of the track and remove the seat from the cabin.

INSTALLATION.

1. Install seat on seat track; lift up on latch release and slide forward to desired position and lock latch.

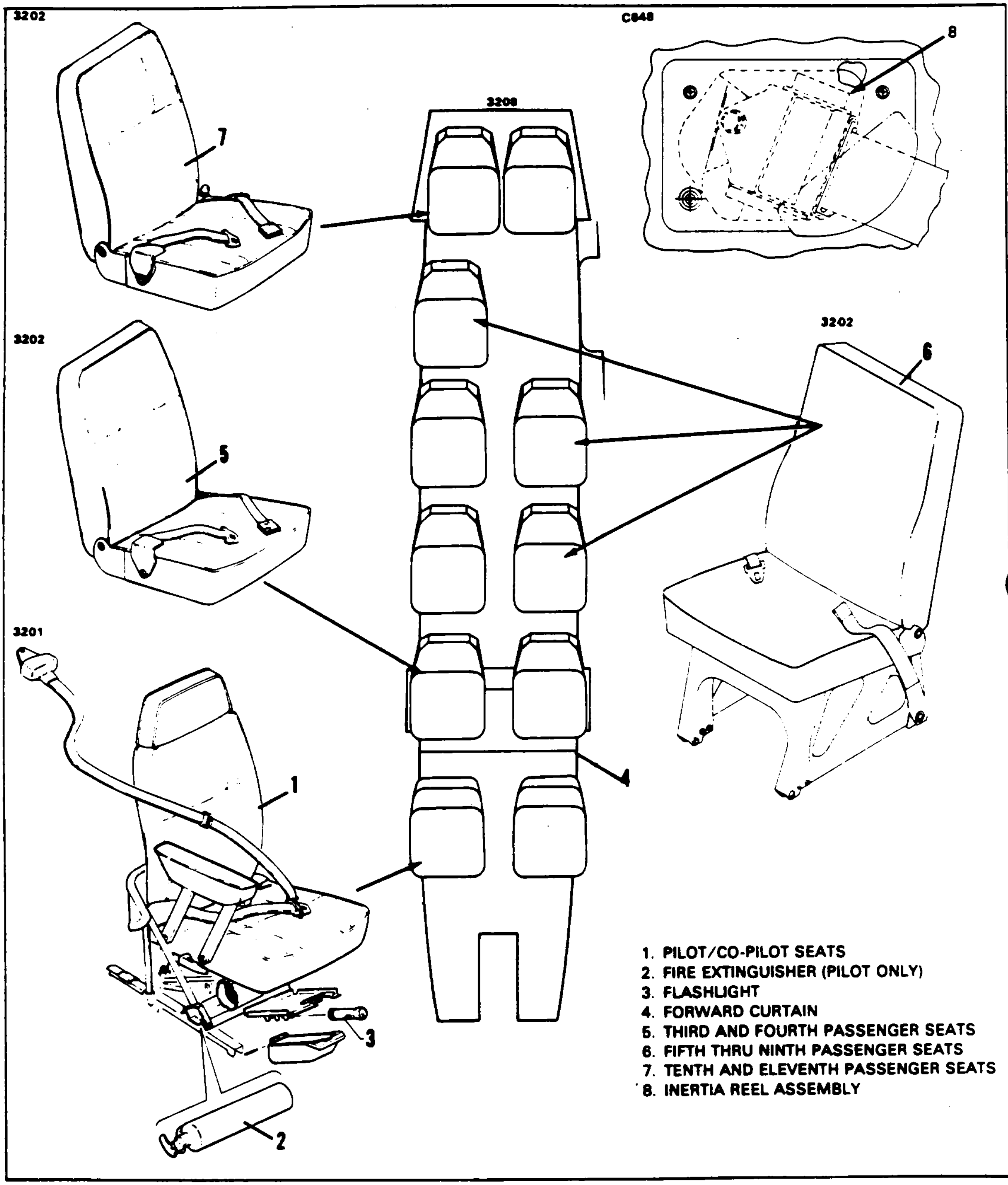

Figure 25-1. Interior Arrangement

FIRE EXTINGUISHER, HAND HELD.

A portable fire extinguisher is mounted to the seat frame beneath the pilot's seat. The extinguisher is suitable for use on liquid or electrical fires. It is operated by aiming the nozzle at the base of the fire and squeezing the trigger grip. Releasing the trigger automatically stops further discharge of the extinguishing agent. Read the instructions on the nameplate and become familiar with the unit before an emergency situation. The Halon 1211 extinguisher is fully discharged in 15 to 20 seconds.

— *WARNING* —

The concentrated agent from extinguishers using Halon 1211 or the by product when applied to a fire are toxic when inhaled. Ventilate the cabin as soon as possible after fire is extinguished to remove smoke or fumes.

PORTABLE FIRE EXTINGUISHER, INSPECTION AND MAINTENANCE.

1. It is recommended that the fire extinguisher be inspected monthly or in accordance with the manufacturer's instructions on the label attached to the fire extinguisher.
2. When inspecting the fire extinguisher, check the following items:
   A. Check that the inspection tag is present and has been updated.
   B. Check that the locking ring is firmly in place and has not been tampered with.
   C. Check for cleanliness, dents, scratches, damage and corrosion. If found, take extinguisher to a qualified dealer or distributor for testing and/or repair.
   D. Check the discharge nozzle for cleanliness and clogging.
   E. Check for a full charge. Check the charge weight noted on the nameplate with an appropriate scale.
   F. Check that the gauge indicator is in the green service pressure section.

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 the 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 orientate properly, snap in place. Extend harness a few times to make sure action is correct.

— NOTE —

When passenger (optional) shoulder harnesses are installed the lap belt assemblies are included. The lap belt assemblies installed on the seats must be removed.

CARGO.

The cargo configuration consist of special cargo barriers, consisting of four tubular structures, two aft of the pilot's seat and two aft of the copilot's seat. These structures are fabricated to plug into holes in the seat tracks and the top fuselage structure. A cargo net and tie down straps anchored to the barriers and tie down rings positioned on the seat tracks facilitate securing cargo of varying bulks for appropriate weight distribution.

A blanket is secured to an extrusion above the windows to protect the interior during cargo operation. There are roller assemblies available which fit on the seat tracks to make handling of bulky items easy. The use of the barriers and protective devices can be altered in such a manner that the aircraft could serve a dual purpose by converting for mixed cargo and passenger use in certain configurations. The pilot's door and cargo door also contribute to the complete utilization of the aircraft during cargo operation.

LOADING LIMITATIONS.

There are specific limitations which must be observed when loading the aircraft. A cargo loading placard is mounted on the aft bulkhead as an aid in the loading of the aircraft. (Refer to Figure 25-2.)

INSTALLATION OF CARGO FURNISHINGS. (Refer to Figure 25-3.)

1. To accommodate cargo remove the cabin dividers and all seats except pilot and copilot.
2. Install cargo barriers.
   A. The outboard barriers are installed in the seat track at the bottom and secured at the top with bolt through hole in ceiling where cargo barrier trim cover is installed.
   B. Install the inboard barriers by placing a pin through hole in cargo barrier trim cover and attach bottom to seat tracks.
3. Secure the equipment containers to the barriers behind the seats.

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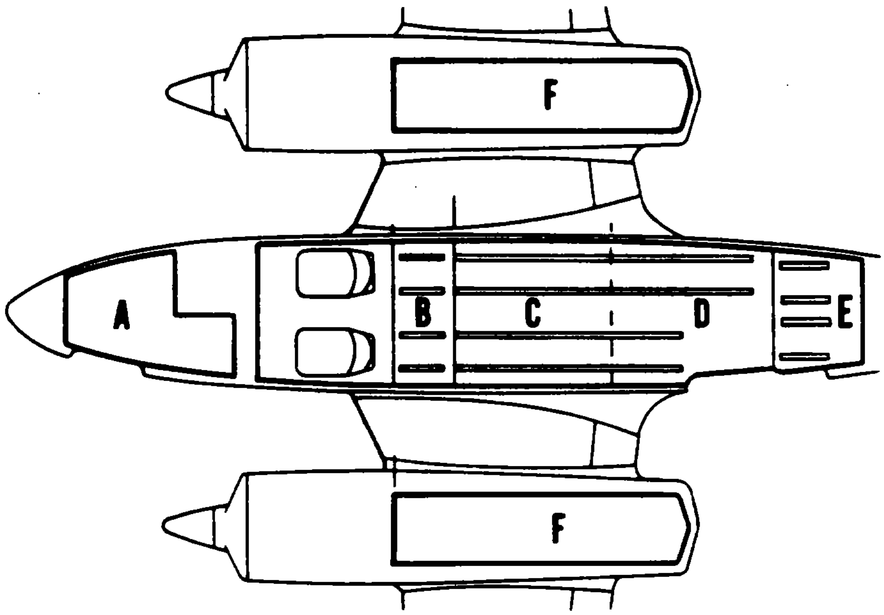


MAXIMUM CAPACITY

<table>
<tr><th>AREA</th><th>FLOOR LOAD
LBS/SQ FT</th><th colspan="2">ALLOWABLE
LBS</th></tr>
<tr><td>A</td><td>100</td><td colspan="2">200</td></tr>
<tr><td>B</td><td>200</td><td>400</td><td rowspan="4">2000

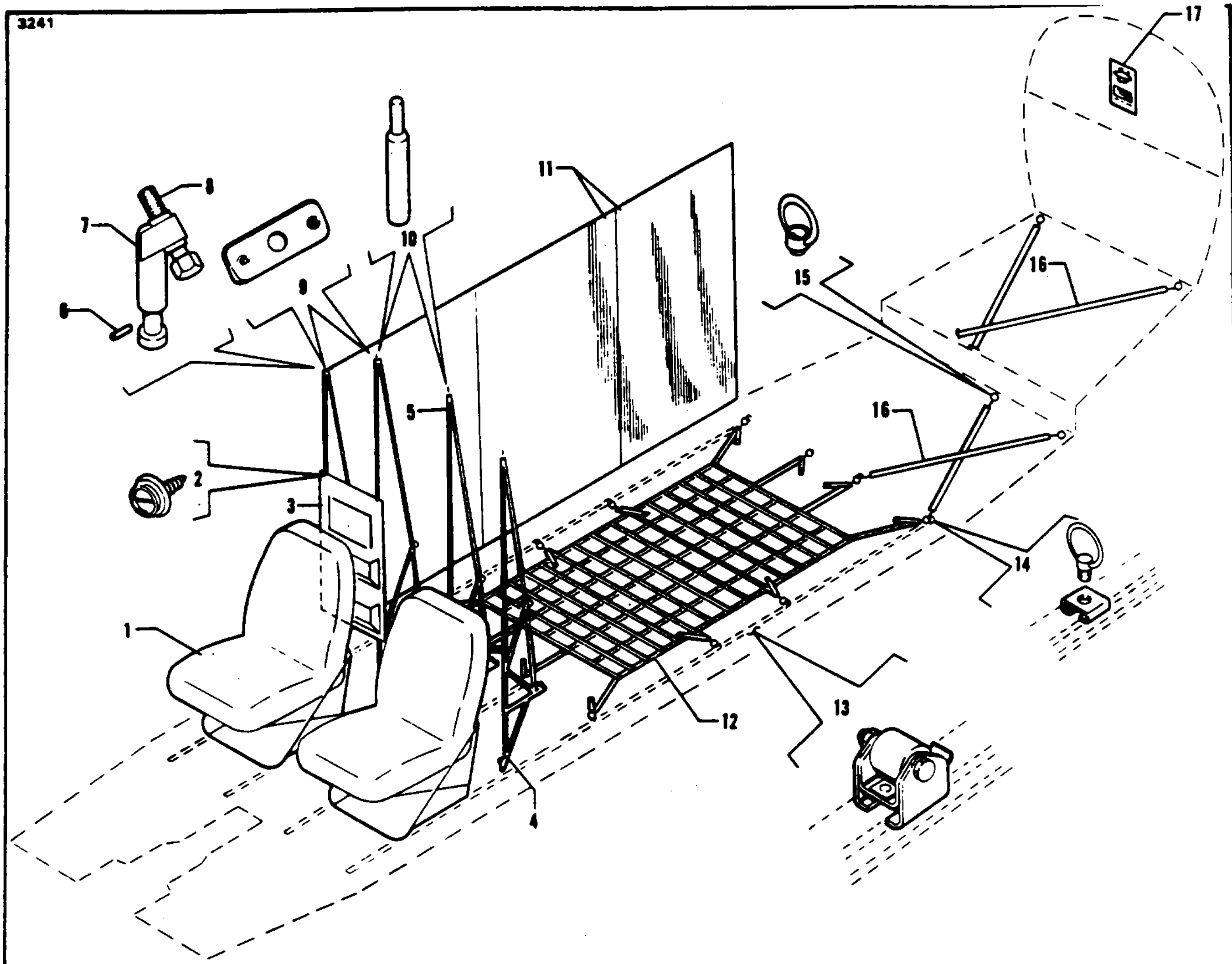
TOTAL</td></tr>
<tr><td>C</td><td>200</td><td>1800</td></tr>
<tr><td>D</td><td>200</td><td>900</td></tr>
<tr><td>E</td><td>100</td><td>200</td></tr>
<tr><td>F</td><td>10</td><td colspan="2">150 EACH</td></tr>
</table>

MAXIMUM TIEDOWN CAPACITY

PER FOOT OF TRACK	200 LBS
PER TRACK	900 LBS
PER TIE DOWN RING	200 LBS

CARGO MUST BE LOADED WITHIN THE WEIGHT
AND BALANCE LIMITS OF THIS AIRCRAFT

Figure 25-2. Cargo Loading Placard



1. PILOT'S AND COPILOT'S SEAT
2. SCREW
3. EQUIPMENT CONTAINER
4. OUTBOARD BARRIER
5. INBOARD BARRIER
6. ROLL PIN
7. CARGO BARRIER ATTACHMENT FITTING
8. BOLT
9. CARGO BARRIER TRIM COVER
10. P/N
11. CARGO BLANKETS
12. CARGO NET
13. CARGO ROLLER ASSEMBLY
14. TIE DOWN RING ASSEMBLY
15. TIE DOWN RING ASSEMBLY
16. CARGO STRAP
17. PLACARD
18. BUSHING
19. HEADLINER

Figure 25-3. Cargo Furnishing Installation

4. Install the cargo blankets.
5. Install tie down rings in desired position and lock in place by turning the threaded ring into the seat track lock holes.
6. Install tie down rings in wedjit holes, if required.
7. Install cargo rollers in desired positions.
8. Install cargo loading placard.
9. When cargo is loaded, secure cargo with cargo net and tie down straps.

— WARNING —

When loading cargo, check cargo loading placard, Figure 25-2.

— END —

CHAPTER

27

FLIGHT CONTROLS

CHAPTER 27 - FLIGHT CONTROLS

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GENERAL.

This chapter covers the removal, installation, and rigging and adjustment procedures for the various control surfaces of the airplane. The different control surfaces do not have to be removed in order of paragraphs in this chapter, since individual paragraphs describe the removal, installation, and rigging of each control surface or system.

DESCRIPTION.

The primary flight controls are of the conventional type, operated by dual control wheels and rudder pedals. The rudder pedals also control the action of the brakes and nose wheel steering. For coordinated action of the rudder and ailerons, their control cables are interconnected through a cable-spring system.

Aileron, elevator, and rudder trim are operated by trim control wheels which in turn move cable wrapped drums located in the control pedestal and mating drums in the particular control surface. As the trim control wheels are rotated, they in turn rotate the mating drums at the control surfaces, to actuate the particular trim tab. A sender unit is installed at each trim tab and will transmit a signal to the indicator at the control pedestal indicating the position of the trim tab.

The wing flap system consists of a flap selector switch located on the instrument panel, a reversible electric motor (with braking provided) mounted under the cabin floor panel, a flap transmission in the trailing edge of each wing and interconnecting flexible shafts. Sender units located in the wings and attached to the flaps will transmit a signal to an indicator located on the instrument panel above the flap selector switch indicating the position of the flap.

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

TROUBLESHOOTING.

Troubles peculiar to the control system 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.
	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.
	Control column horizontal chain improperly adjusted.	Adjust chain tension.
	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 control column.
Control wheels not horizontal when ailerons are neutral.	Incorrect rigging of aileron system.	Rig aileron system.

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

Trouble	Cause	Remedy
AILERON CONTROL SYSTEM (cont.)		
Incorrect aileron travel.	Aileron control rods not adjusted properly.	Adjust aileron control rods.
	Aileron bellcrank stops not adjusted properly.	Adjust stops.
Correct aileron travel cannot be obtained by adjusting bellcrank stops.	Incorrect rigging of aileron cables, control wheel and control rod.	Rig aileron cables, control wheel and control rod.
Control wheel stops before control surfaces reach full travel.	Incorrect rigging between control wheel and control cables.	Rig control wheel and control cables.
AILERON TRIM CONTROL SYSTEM		
Lost motion between trim control wheel and trim tab.	Cable tension too low.	Adjust cable tension.
	Cables not in place on pulleys.	Install cables.
	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 cable tension.
	Pulleys binding or rubbing.	Replace binding pulleys. Provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables.
	Trim tab hinge binding.	Lubricate hinge. If necessary, replace.
	Cables crossed or routed incorrectly.	Check routing of control cables.

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

Trouble	Cause	Remedy
AILERON TRIM CONTROL SYSTEM (cont.)		
Trim tab fails to reach full travel.	System incorrectly rigged.	Check and/or adjust rigging.
	Either or both trim drums incorrectly wrapped.	Check and/or adjust rigging.
Trim indicator fails to indicate correct trim position.	Trim sender unit not adjusted properly.	Adjust sender unit.
	Low voltage in system.	Check power supply.
Trim indicator fails to indicate any movement.	Circuit breaker open.	Reset circuit breaker.
	Master switch not on.	Turn on master switch.
	Trim indicator ground open.	Check ground wire.
	Trim sender unit defective.	Replace sender unit.
	Trim indicator unit defective.	Replace indicator unit.
	Defective wiring in system.	Check wiring.
Trim indicator pointer moves to extreme right position.	Trim sender unit ground open.	Check sender unit ground.
ELEVATOR CONTROL SYSTEM		
Lost motion between control wheel and elevator.	Cable tension too low.	Adjust cable tension.
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Cables not in place on pulleys.	Install cables correctly.

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

Trouble	Cause	Remedy
ELEVATOR CONTROL SYSTEM (cont.)		
Resistance to elevator control movement.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension.
	Binding control column.	Adjust and lubricate.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly.
	Bent elevator or hinge.	Repair or replace elevator or hinge.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Incorrect elevator travel.	Elevator arm stops incorrectly adjusted.	Adjust stop screws.
	Elevator control rod incorrectly adjusted.	Adjust control rod.
Correct elevator travel cannot be obtained by adjusting elevator arm stops.	Elevator cables incorrectly rigged.	Rig cables.
ELEVATOR TRIM CONTROL SYSTEM		
Lost motion between trim control wheel and trim tab.	Cable tension too low.	Adjust cables.
	Cables not in place on pulleys.	Install cables.
	Broken pulley.	Replace pulley.
	Linkage loose or worn.	Check linkage and tighten or replace.

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

Trouble	Cause	Remedy
ELEVATOR TRIM CONTROL SYSTEM (cont.)		
Trim control wheel moves with excessive resistance.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cables.
	Pulleys binding or rubbing.	Replace binding pulleys. Provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables.
	Trim tab hinge binding.	Lubricate hinge. If necessary, replace.
	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.
	Either or both trim drums incorrectly wrapped.	Check and/or adjust rigging.
Trim indicator fails to indicate correct trim position.	Trim sender unit not adjusted properly.	Adjust unit.
	Low voltage in system.	Check power supply.
Trim indicator fails to indicate any movement.	Circuit breaker open.	Reset circuit breaker.
	Master switch not on.	Turn on master switch.
	Trim indicator defective.	Replace indicator unit.
	Trim indicator ground open.	Check ground wire.
	Trim sender unit defective.	Replace sender unit.
	Defective wiring in system.	Check wiring.

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

Trouble	Cause	Remedy
ELEVATOR TRIM CONTROL SYSTEM (cont.)		
Trim indicator pointer moves to extreme nose down position.	Trim sender unit ground open.	Check sender unit ground.
RUDDER CONTROL SYSTEM		
Lost motion between rudder pedals and rudder.	Cable tension too low.	Adjust cable tension.
	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.
	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.
	Cables crossed or routed incorrectly.	Check routing of control cables.

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

Trouble	Cause	Remedy
RUDDER CONTROL SYSTEM (cont.)		
Rudder pedals not neutral when rudder is stream-lined.	Rudder cables incorrectly rigged.	Rig rudder cables.
Incorrect rudder travel.	Rudder bellcrank stop incorrectly adjusted.	Rig rudder bellcrank stop.
	Nose wheel contacts stops before rudder.	Rig wheel contacts stops.
RUDDER TRIM CONTROL SYSTEM		
Lost motion between trim control wheel and trim tab.	Cable tension too low.	Adjust cable tension.
	Cables not in place on pulleys.	Install cables.
	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.
	Pulleys binding or rubbing.	Replace binding pulleys. Provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables.
	Trim tab hinge binding.	Lubricate hinge. Re-place if necessary.
	Cables crossed or routed incorrectly.	Check routing of control cables.

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

Trouble	Cause	Remedy
RUDDER TRIM CONTROL SYSTEM (cont.)		
Trim tab fails to reach full travel.	System incorrectly rigged.	Check and/or adjust rigging.
	Either or both trim drums incorrectly wrapped.	Check and/or adjust rigging.
Trim indicator fails to indicate correct trim position.	Trim sender unit not adjusted properly.	Adjust sender unit.
	Low voltage in system.	Check power supply.
Trim indicator fails to indicate any movement.	Circuit breaker open.	Reset circuit breaker.
	Master switch not on.	Turn on master switch.
	Trim indicator ground open.	Check ground wire.
	Trim sender unit defective.	Replace sender unit.
	Trim indicator defective.	Replace indicator unit.
	Defective wiring in system.	Check wiring.
Trim indicator pointer moves to extreme right position.	Trim sender unit ground open.	Check sender unit ground.

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

Trouble	Cause	Remedy
FLAP CONTROL SYSTEM		
Flaps fail to extend or retract though flap solenoid actuates. (Motor circuit)	Battery switch off.	Turn switch on.
	Flap motor circuit breaker open.	Reset circuit breaker.
	Defective flap selector switch.	Replace selector switch.
	Defective flap motor circuit relay.	Replace relay.
	Ground open from flap motor circuit relay.	Check ground connection.
	Ground open from flap selector switch.	Check ground connection.
	Defective flap motor.	Replace motor.
	Defective circuit wiring.	Isolate cause and repair.
Flaps fail to extend on retract. Flap solenoid does not actuate. (Solenoid circuit)	Battery switch off.	Turn switch on.
	Flap solenoid circuit breaker open.	Reset circuit breaker.
	Defective flap selector switch.	Replace selector switch.
	Defective up or down limit switch.	Replace defective switch.
	Defective flap solenoid.	Replace flap solenoid.
	Ground open from flap solenoid.	Check ground connection.
	Defective circuit wiring.	Isolate cause and repair.
Flaps fail to retract completely.	Up limit switch incorrectly adjusted.	Adjust flap.

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

Trouble	Cause	Remedy
FLAP CONTROL SYSTEM (cont.)		
Flaps do not extend completely.	Down limit switch incorrectly adjusted.	Adjust limit switch.
Flaps not synchronized or fail to fit evenly when retracted.	Incorrect adjustment of the transmission tube.	Rig.
Flaps have erratic operation during extension and retraction.	Binding between flexible shaft and motor.	Isolate cause and lubricate cable if required.
	Binding between track and rollers.	Refer to Rigging and Adjustment.
	Slipping or stripped transmission.	Replace transmission.
	Loose electrical connection.	Check and repair electrical connections.
	Transmission needs lubrication.	Lubricate transmission.
Flap on one side fails to operate.	Broken flexible actuator shaft.	Replace flexible shaft.
	Defective transmission.	Determine cause and replace or repair.
	Faulty time delay switch.	Check operation.
No indication of flap position on indicator.	Defective indicator unit.	Replace indicator unit.
	Defective sender unit.	Replace sender unit.
	Sender unit not adjusted properly.	Adjust sender unit.

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

Trouble	Cause	Remedy
FLAP CONTROL SYSTEM (cont.)		
No indication of flap position on indicator. (cont.)	Defective wiring.	Check and repair wiring.
	Battery switch off.	Turn switch on.
	Circuit breaker open.	Reset circuit breaker.
	Sender unit ground open.	Check ground connection.
Annunciator light ON, flaps operate.	Amplifier component failure.	Replace the amplifier.
Annunciator light ON, flaps inoperative.	Flap motor circuit breaker off.	Reset flap motor circuit breaker.
	Flaps symmetrical.	Check and rerig flaps.
	Potentiometer failure.	Replace potentiometer.
	Motor and/or relay failure.	Replace component.
Flaps inoperative and annunciator light off; flap indicator pointing OFF.	Power lost to amplifier.	Reset flap control circuit breaker.
Flaps inoperative and annunciator light off; flap indicator showing flap position.	Annunciator failure.	Test annunciator.
	Flap asymmetric condition.	Check and rerig flaps.
	Flap motor circuit breaker off.	Reset flap motor circuit breaker.

STANDARD PROCEDURES.

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

1. It is recommended, though not always necessary to level and place the airplane on jacks during rigging and adjustment of controls.
2. Remove turnbuckle barrels from cable ends before withdrawing the cables through the structures.
3. Tie a cord to the cable end before withdrawing it through the structure. This will facilitate reinstallation of the cable.
4. Turnbuckle stations are given at neutral position.
5. When referring to marking cable end, etc., before disconnecting, a felt marker may be used.
6. When turnbuckles have been set to correct cable tension, no more than three threads should be exposed from either end of the turnbuckle barrel.
7. Cable tension should be taken with the appropriate surface control in its neutral position and tension specified corrected to ambient temperature in the area where tension is being checked. (Refer to Chart 2702.)

— NOTE —

Whenever the elevator control system is serviced, a friction check of the system must be accomplished in accordance with instructions given in Elevator Control System Friction Measurement.

8. Ascertain that all cable guard pins are installed in their proper location, and are not interfering with control cable travel.
9. When installing rod end jam nuts, refer to Figure 27-1 for proper installation method.

CHART 2702. CONTROL CABLE RIGGING TENSION VS. TEMPERATURE

AMBIENT TEMPERATURE DEGREES FAHRENHEIT	CABLE TENSION IN POUNDS		
	AILERON	RUDDER	ELEVATOR
30°	21	18	14
40°	23	19	15
50°	25	20	16
60°	28	21	17
70°	32	23	18
80°	35	25	20
90°	39	27	22
100°	45	32	26

NOTES:
1. TOLERANCE ± 2 LBS.
2. AIRCRAFT SHOULD BE ALLOWED TO STABILIZE IN A CONSTANT TEMPERATURE FOR A MINIMUM OF TWO HOURS PRIOR TO CHECKING AND ADJUSTING TENSIONS.

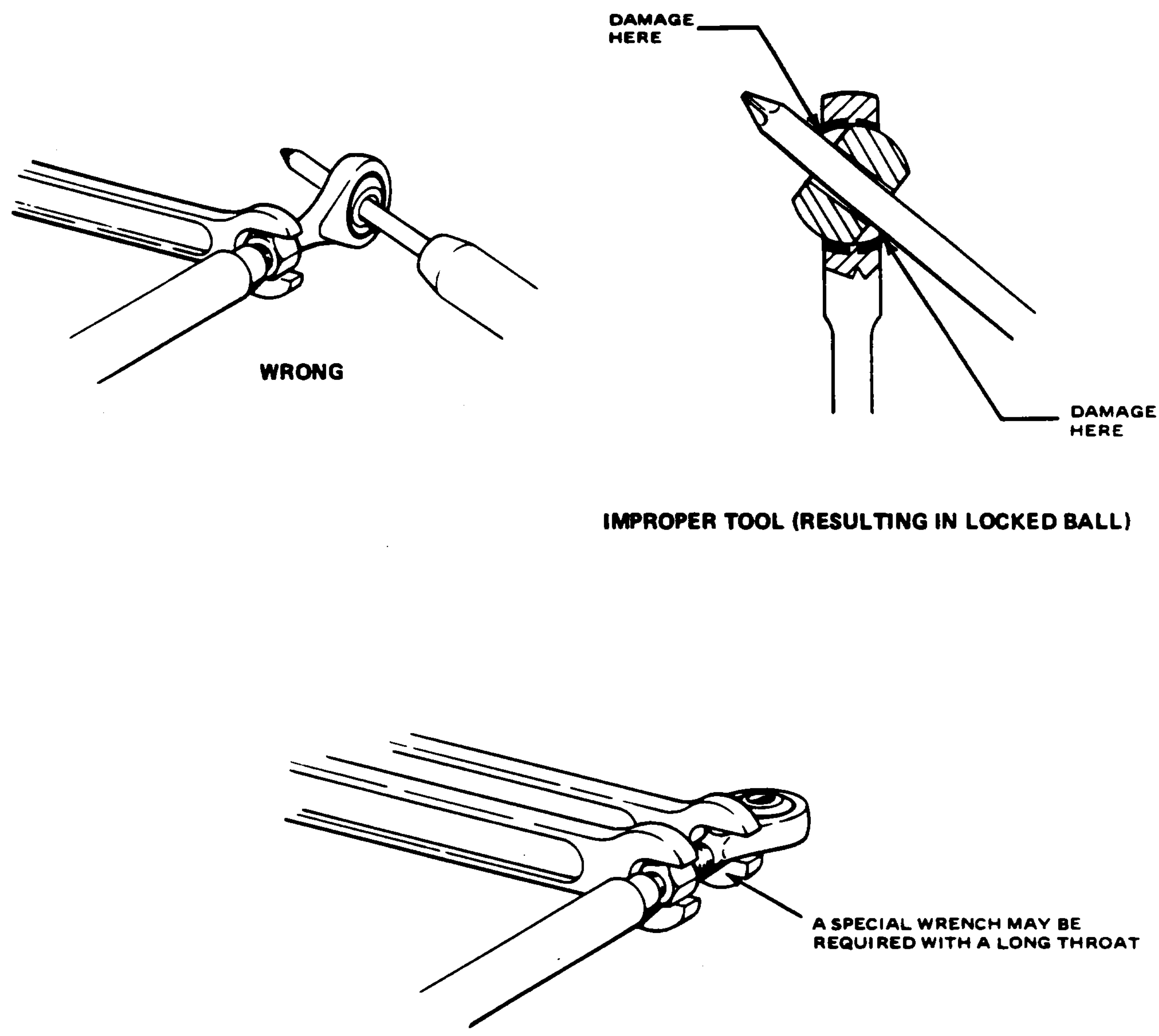

Figure 27-1. Correct Method of Installing Rod End Bearings

WRAPPING TRIM DRUMS. (Refer to Figure 27-2.)

All trim drums are wrapped basically by the same procedure and must be removed from the airplane.

1. Mark the end of the drum toward the base of the housing bracket for a reference when later installing and wrapping the cable on the drum.
2. With the drum housing bracket firmly held, remove one of the cable guard bolts from the housing bracket.
3. Remove the drum screw or the drum shaft from the trim screw assembly. The screw is removed by removing the stop located on the end of the screw, opposite the base of the housing bracket. Turn the screw from the drum. The shaft is removed by driving the roll pin from the center of the drum. Press the shaft from the drum.
4. Remove the drum from the housing.
5. Unwrap the trim cable and remove the cable and lock pin from the drum. (If one end of the cable has been marked to facilitate hook-up of the cable ends, note this location in relation to the drum when installing a new cable on the drum.)
6. Check the condition of the bushings in the housing bracket for excess wear.
7. To install and wrap the trim cable, locate the center of the cable, measuring from end to end.
8. Insert the center of the cable into the cable slot in the drum and install the lock pin.
9. Hold the drum with the previously marked or base end of the drum down.
10. Looking down on the drum, wrap up the cable that leads from the base end nine and one-quarter turns in a counterclockwise direction. The cable from the upper end, wrap down in a clockwise direction, nine and one-quarter turns.
11. Insert the drum in the housing bracket, position the drum and route the cables from the assembly as shown in Figure 27-14.

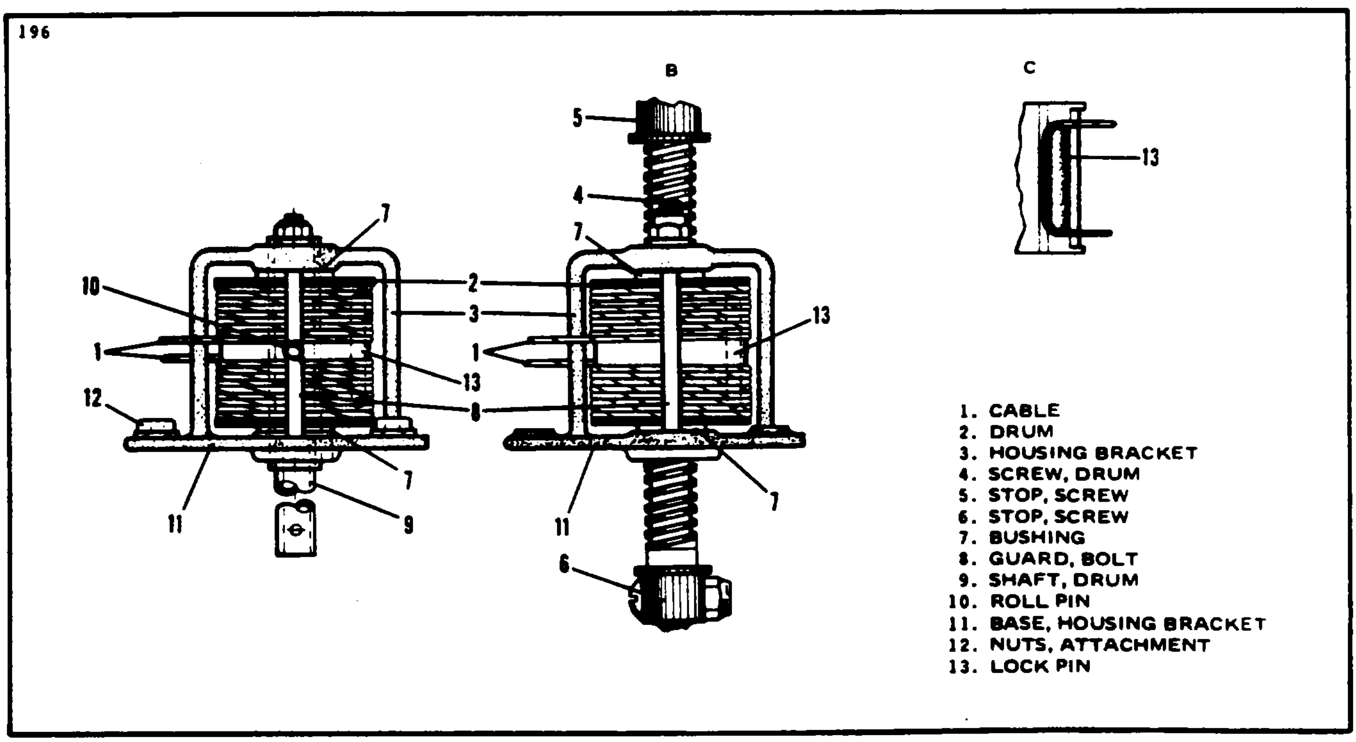

Figure 27-2. Trim Screw Assembly

12. Install the screw and screw stop or the drum shaft and secure with the roll pin.
13. Block the trim cables in center position to keep them tight and from unwrapping, by the method shown in Figure 27-5.
14. Center the drum between the stops on the screw by rotating the screw. On rudder trim, set drum to obtain .875 from base of housing to screw stop.

CONTROL COLUMN ASSEMBLY.

REMOVAL OF CONTROL COLUMN ASSEMBLY. (Refer to Figure 27-3.)

1. To remove either control wheel with tube, proceed as follows:
   A. Mark the control tube, ring, and collar in relation to location around the roller fitting. Note the installed position of link assemblies for reinstallation. If link assemblies are not installed in the same position control friction may increase.
   B. Cut safety wire from the cap bolts which secure the control tube and ring to the roller fitting. Remove bolts from the fitting.
   C. Slide the control tube from the roller fitting and ring, and draw the tube from the instrument panel. Do not allow the square tube assembly to fall.
2. The square tube assembly may be removed and disassembled by the following procedure:
   A. Remove the cotter pins and bolt assemblies that join the links with the control arm.
   B. Remove the bolt assembly that joins the forward end of the square tube with the flexible joint of the sprocket assembly. Remove the square tube assembly from behind the instrument panel.
   C. The square tube assembly may be disassembled by first removing the collar from the tube. Draw the tube from the roller fitting.
   D. Cut the wire that safeties the cap bolts that secure the collar to the roller fitting. Remove the bearing housing from the fitting.
   E. Disassemble the rollers from the fitting. Note the number and location of the spacer washers.
3. The sprocket assembly may be removed from the bulkhead and disassembled by the following procedure:
   A. Disconnect one of the two turnbuckles that connect the horizontal roller chains. Remove the outboard chain guard from the inside of the sprocket housing that is to be removed. Unwrap the chain from the sprocket that is to be removed.
   B. If the left sprocket assembly is to be removed, first remove the floor panel located between the control pedestal and left side of the fuselage. Loosen one of the aileron cable turnbuckles at fuselage station 76.00 to relieve tension from the vertical roller chain. Disconnect one end of the chain where it attaches to the control cable and unwrap the chain from the sprocket.
   C. Remove the cap bolts that attach the sprocket housing to the bulkhead and remove the housing.
   D. To disassemble the sprocket assembly, remove the bolt that secures the sprocket to the sprocket stud. Use a Kaynar wrench (P/N W10-3) to remove the hex nut.

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      800 S. State College Blvd.
      Fullerton, California

   E. Remove nut and slide stud from sprocket housing.

4. To remove the torque tube assembly, use the following procedure:
   A. With the floor panel removed from between the control pedestal and the left fuselage side panel and the links disconnected from between the control tube housing and the torque tube arms, loosen one of the elevator control cable turnbuckles at fuselage station 86.50 enough to relieve cable tension.
   B. Remove the bolt and roll pins.
   C. Disconnect bolt and roll pins and remove elevator control sector by pushing extensions assembly in torque tube.
   D. Push the right extension tube inside torque tube and remove the torque tube.
   E. The bearings may be removed if desired.
5. The control tube guide located on the instrument panel may be removed by removing the assembly cover and the screws that secure the housing.

INSTALLATION OF CONTROL COLUMN ASSEMBLY. (Refer to Figure 27-3.)

1. Installation of the control column torque assembly may be accomplished by the following procedure:
   A. Position but do not attach control arms on uninstalled torque tube assembly.
   B. Lubricate bearings and attach bearings to their mounting locations.
   C. Slide the tube extensions inside torque tube and install the torque tube. Pull the tube extensions through the bearings.
   D. Install the control sector, with the cables attached, on the end of extension tube. With the sector, tube extensions and arms in position, install roll pins and bolts. Tighten bolts to a standard torque.
   E. Reconnect elevator cable turnbuckle at station 86.50 and set cable tension per specifications given in Figure 27-17.
2. The aileron chain sprocket assembly may be assembled and installed by the following procedure:
   A. Press the sprocket shaft bushings in the sprocket housing.
   B. Position the sprocket in the housing, spacer bushing (right only) and slide the stud (in place). Insert bolt through the sprocket and stud, install nut and tighten to a standard torque. Use Kaynar wrench, P/N W10-3.

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      Fullerton, California

   C. Install the stud washers and nut, and tighten enough to allow the sprocket to rotate free with no end play.

— NOTE —

The left sprocket must be placed in its housing to allow the sprocket to rotate 180° from stop to stop.

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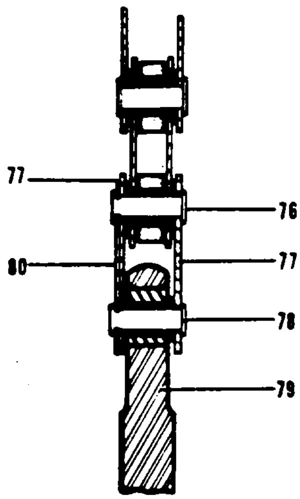

SKETCH A

1. PIN, CABLE GUARD
2. BOLT ASSEMBLY
3. BRACKET, MOUNTING
4. BUSHING
5. PULLEY
6. PIN, CABLE GUARD
7. PLATE, CABLE ATTACH
8. SECTOR, CONTROL
9. BOLT ASSEMBLY
10. BOLT ASSY. AND ROLL PIN
11. ARM, CONTROL, L.O.
12. BOLT ASSY. AND ROLL PIN
13. ARM, CONTROL, L.I.
14. TUBE, TORQUE
15. BEARING, BLOCK
16. ARM, CONTROL, R.I.
17. BOLT ASSY. AND ROLL PIN
18. ARM, CONTROL, R.O.
19. BEARING, BLOCK
20. BOLT ASSEMBLY
21. COLLAR, CONTROL SHAFT
22. HOUSING, BEARING
23. FITTING, ROLLER
24. SAFETY WIRE
25. CAP BOLT
26. RING, CONTROL TUBE
27. CONTROL TUBE, RIGHT
28. BOLT
29. SAFETY WIRE
30. LINK ASSEMBLY
31. SQUARE TUBE
32. BOLT ASSEMBLY
33. COTTER PIN
34. COLLAR, STOP
35. BOLT ASSEMBLY
36. FLEXIBLE JOINT
37. HOUSING, SPROCKET
38. SCREW
39. CAP BOLT
40. CHAIN, RIGHT
41. TURNBUCKLE
42. CHAIN, LEFT
43. CONTROL WHEEL
44. CONTROL TUBE, LEFT
45. SCREW, ADJUSTMENT
46. BLOCK
47. HOUSING, GUIDE ASSEMBLY
48. SCREW, ADJUSTMENT
49. COVER
50. SPROCKET
51. LINK ASSEMBLY
52. CONTROL CABLE, ELEVATOR
53. CONTROL CABLE, AILERON
54. CHAIN, AILERON
55. PLATE, CABLE ATTACH
56. GUARD, CHAIN
57. BUSHING
58. NUT
59. WASHER
60. PIN, STOP
61. HOUSING, SPROCKET
62. GUARD, CHAIN
63. BOLT ASSEMBLY
64. STUD
65. NUT, KAYNAR
66. SPACER
67. BOLT CAP
68. WASHER
69. ROLLER
70. WASHER, SPACER
71. BOLT ASSEMBLY
72. ANGLE
73. BUSHING, ECCENTRIC
74. BEARING
75. BLOCK
76. PIN, LINK
77. PLATE, LINK
78. PIN, LINK
79. CABLE END
80. LOCK
81. CONTROLS LOCKED
82. BOLT ASSEMBLY AND ROLL PIN

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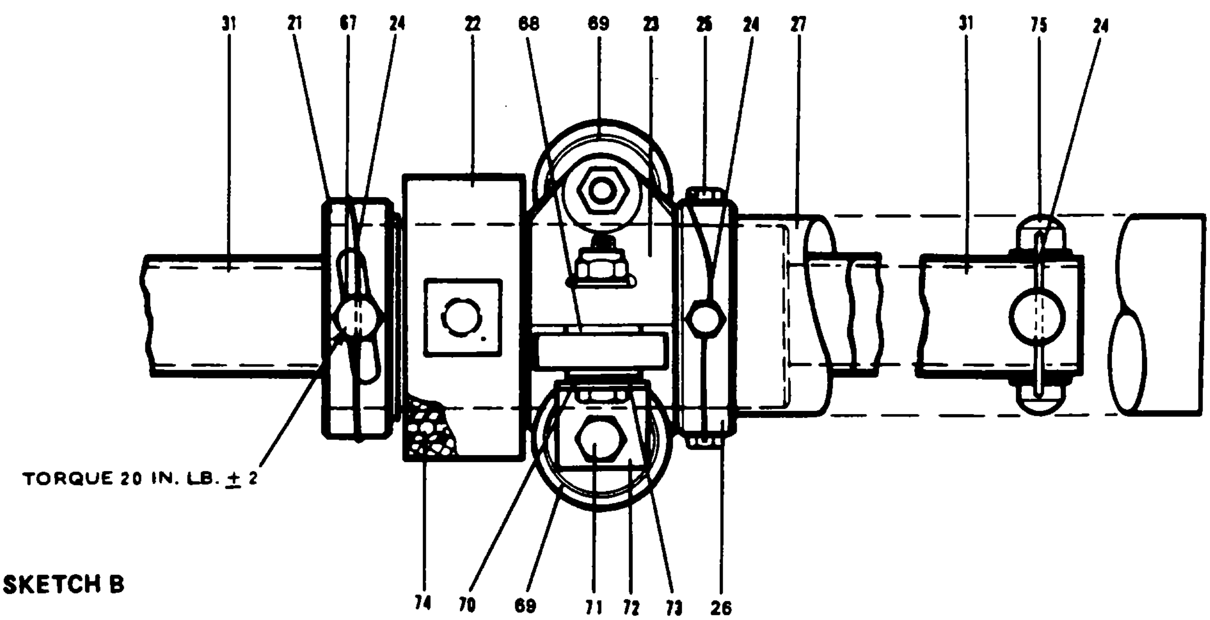
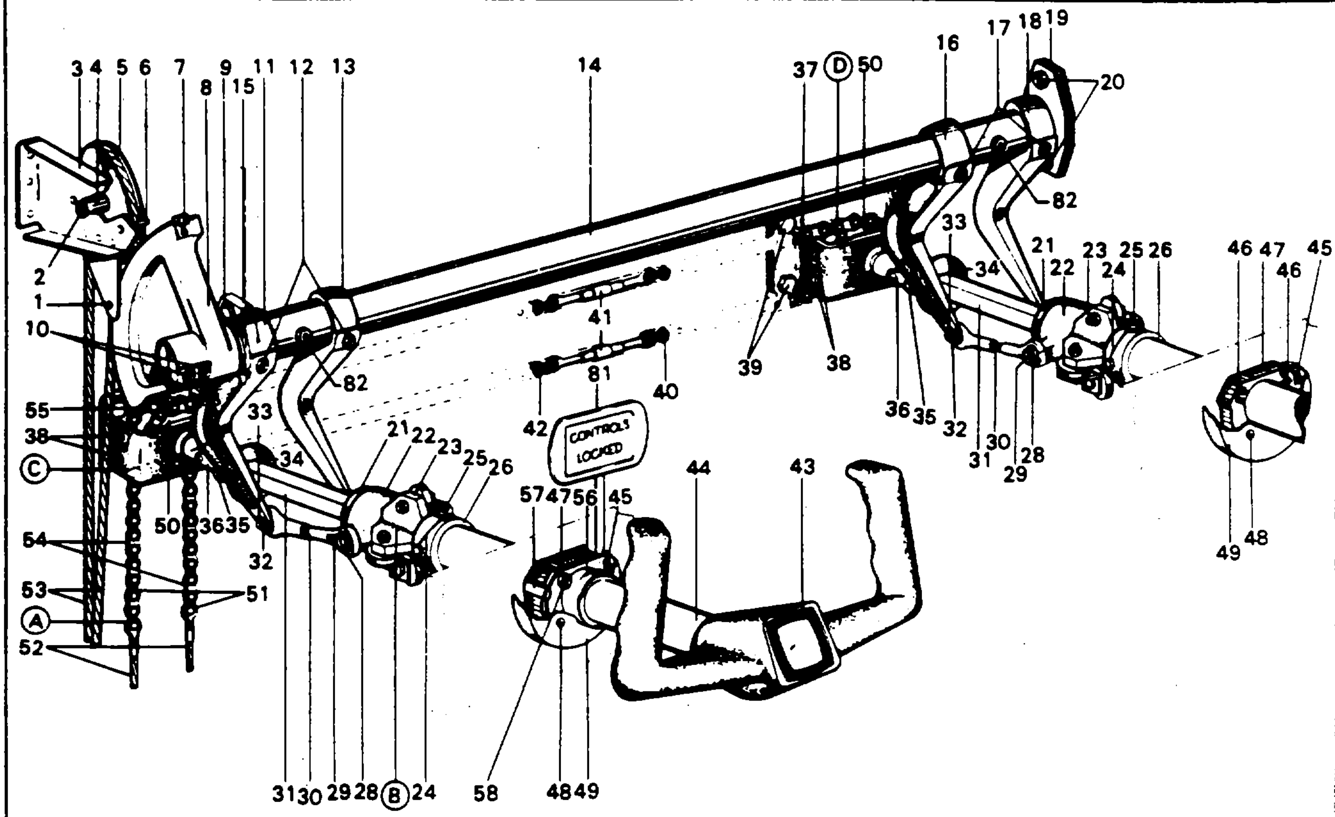


SKETCH B

Figure 27-3. Control Column Installation



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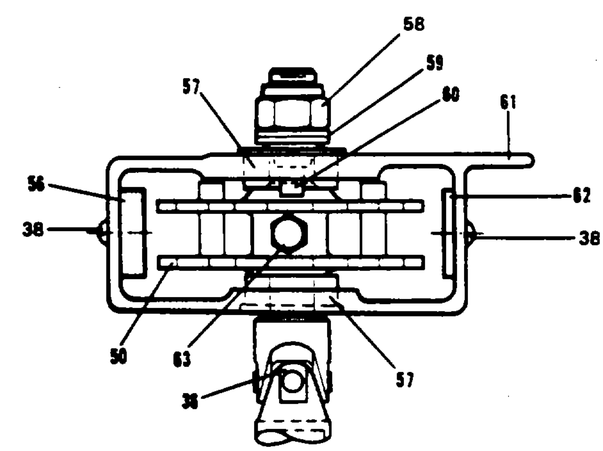

SKETCH C

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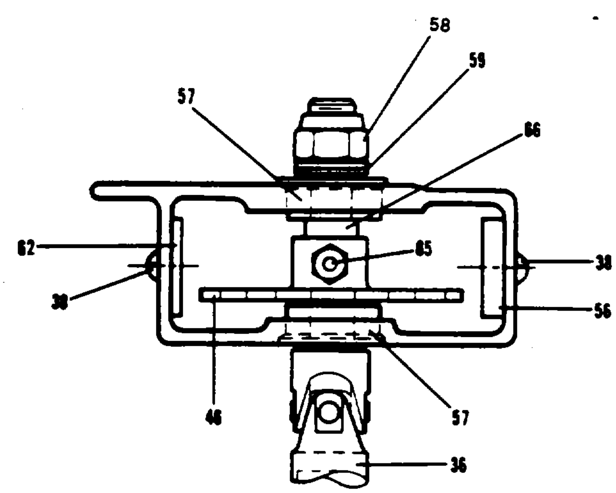


SKETCH D

Figure 27-3. Control Column Installation (cont.)

D. Attach the sprocket assembly to the bulkhead and torque.

E. Position the horizontal roller chain around the right and left sprocket and temporarily connect turnbuckles. Check chain tension and correct position after both control wheels are installed.

F. If the left sprocket assembly was removed, wrap the vertical chain around the sprocket and connect the chain to the control cable end. Ascertain that when the sprocket is centered between stops the roller chain is centered. Set aileron cable tension per specifications given in Figure 27-9 and safety turnbuckle.

3. The square tube assembly may be assembled and installed by the following procedure:

A. Slide the square tube in the roller housing.

B. Install the rollers and washers on the roller housing and adjust with the use of the eccentric bushings in each roller to allow .003 of an inch between the square tube and rollers. Finish by installing angles shimmed with spacer washers as required, and tighten bolt assemblies to a standard torque. Recheck clearance between rollers and square tube and lubricate the rollers.

C. Install the bearing housing with bearings on the roller housing. Install collar and cap bolts. Rotate the collar tight against the bearing housing, tighten cap bolts and safety.

D. Ascertain that the four nylon guides are installed and safetied.

E. Slide the collar on the forward end of the square tube.

F. Place the square tube assembly in position and connect it to the flexible joint of the sprocket assembly. Install bolt assembly and secure.

G. Connect link assembly to control arm and bearing housing.

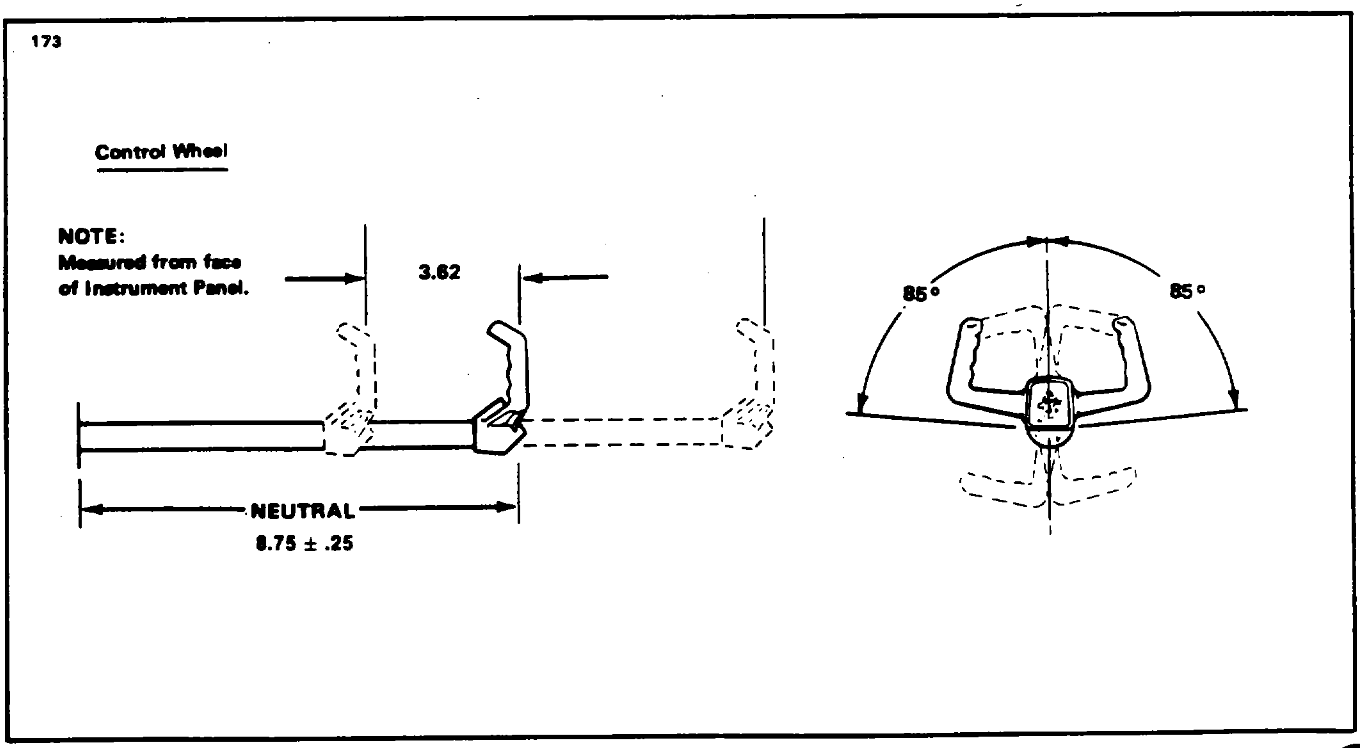


Figure 27-4. Control Wheel Travel

4. Attach the control tube guide block to the front side of the instrument panel. Tighten the two top attachment screws and leave the two bottom screws loose until the final adjustment is made.
5. To install the control wheel, the following procedure may be used:
    A. Slide the tube guide cover on the control tube and insert the tube through the instrument panel.
    B. Place the ring over the end of the control tube and slide the end of the tube over the end of the roller fitting. Install cap bolt, torque and safety.
    C. Check that when the left sprocket is centered between its stops, the control wheel will also be centered. If the control wheel does not center, it may be necessary to remove the cap bolts and rotate the control tube on the roller housing or remove the bolt that joins the square tube and flexible joint, and rotate the tube 180°. Reinstall bolts, torque and safety.
6. Adjust the control wheel tube slides at the instrument panel by tightening the adjustment screw to remove any play in the tube without restricting normal tube movement.
7. Adjust the horizontal roller chain so that when the left control wheel is held solid, in center position, the right wheel will also be centered with no play. Safety turnbuckles and install chain guards in the sprocket housing.
8. Check control operation and install access panels removed.

AILERON AND TAB.

REMOVAL OF AILERON CONTROL CABLES. (Refer to Figure 27-6.)

1. Remove the two left floor panels located between the forward bulkhead of the fuselage and the main spar. Remove the left floor panel behind the main spar.
2. If the right or left balance cable is to be removed, remove the center floor panel aft of the main spar.
3. Remove the access plates located under the wing, along the trailing edge, at stations 151.50 and 178.00 and aft plate located on the fillet fairing between the fuselage and wing.
4. To remove the right or left primary control cables, the following procedure may be used:
    A. Mark one set of cable ends to facilitate installation, and separate the aileron control cables at the turnbuckle within the fuselage at station 76.00.
    B. Loosen the turnbuckle, separating the ends at the forward end of the aileron bellcrank.
    C. Remove the cable guard pins at wing stations 29.00 and 150.00 and within the fuselage at station 164.50.
    D. Draw the cable back through the fuselage, through the wing and out through the access hole at the aileron bellcrank.
5. Removal of the right balance cable may be accomplished by the following procedure:
    A. Loosen the turnbuckle, separating the turnbuckle ends at the aft end of the aileron bellcrank.
    B. Separate the right and left balance cables at the cable ends at station 171.00.
    C. If not previously accomplished, remove the cable guard pins at wing stations 28.00 and 150.00 and fuselage station 171.00.
    D. Draw the cable through the wing into the fuselage.

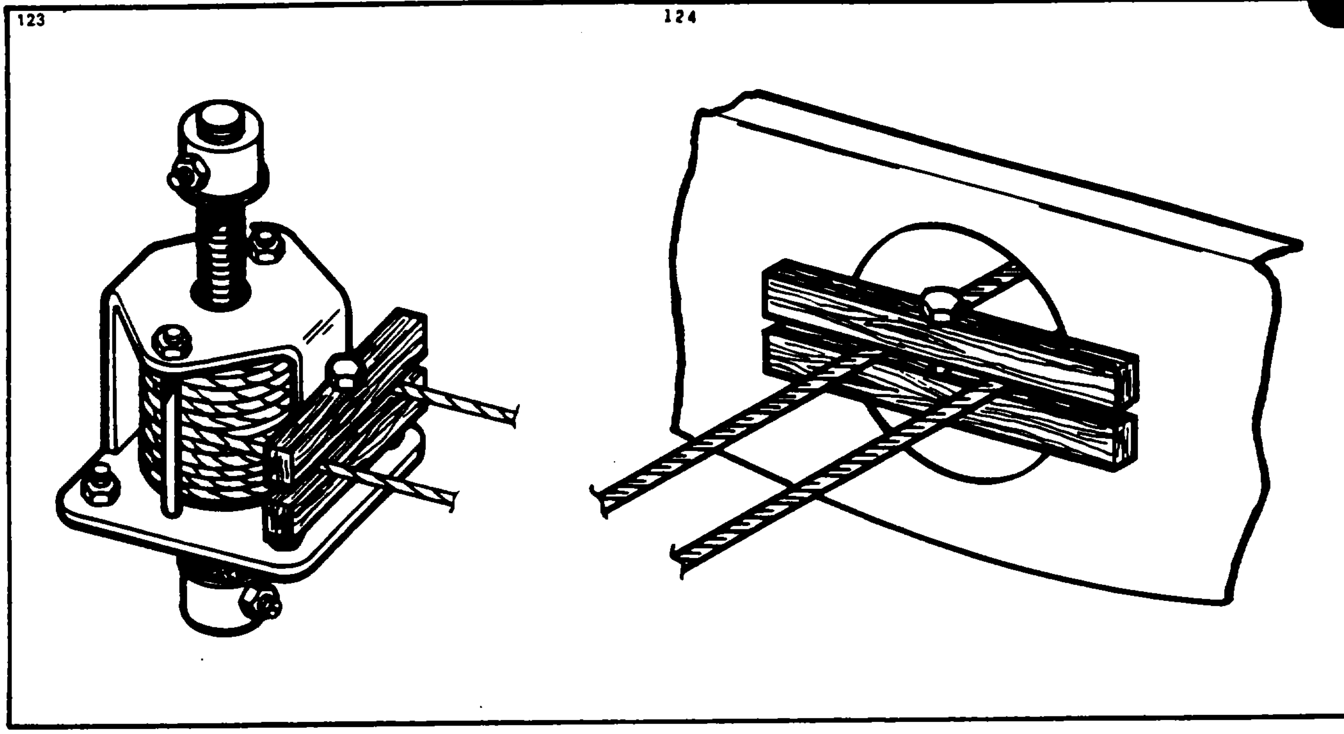
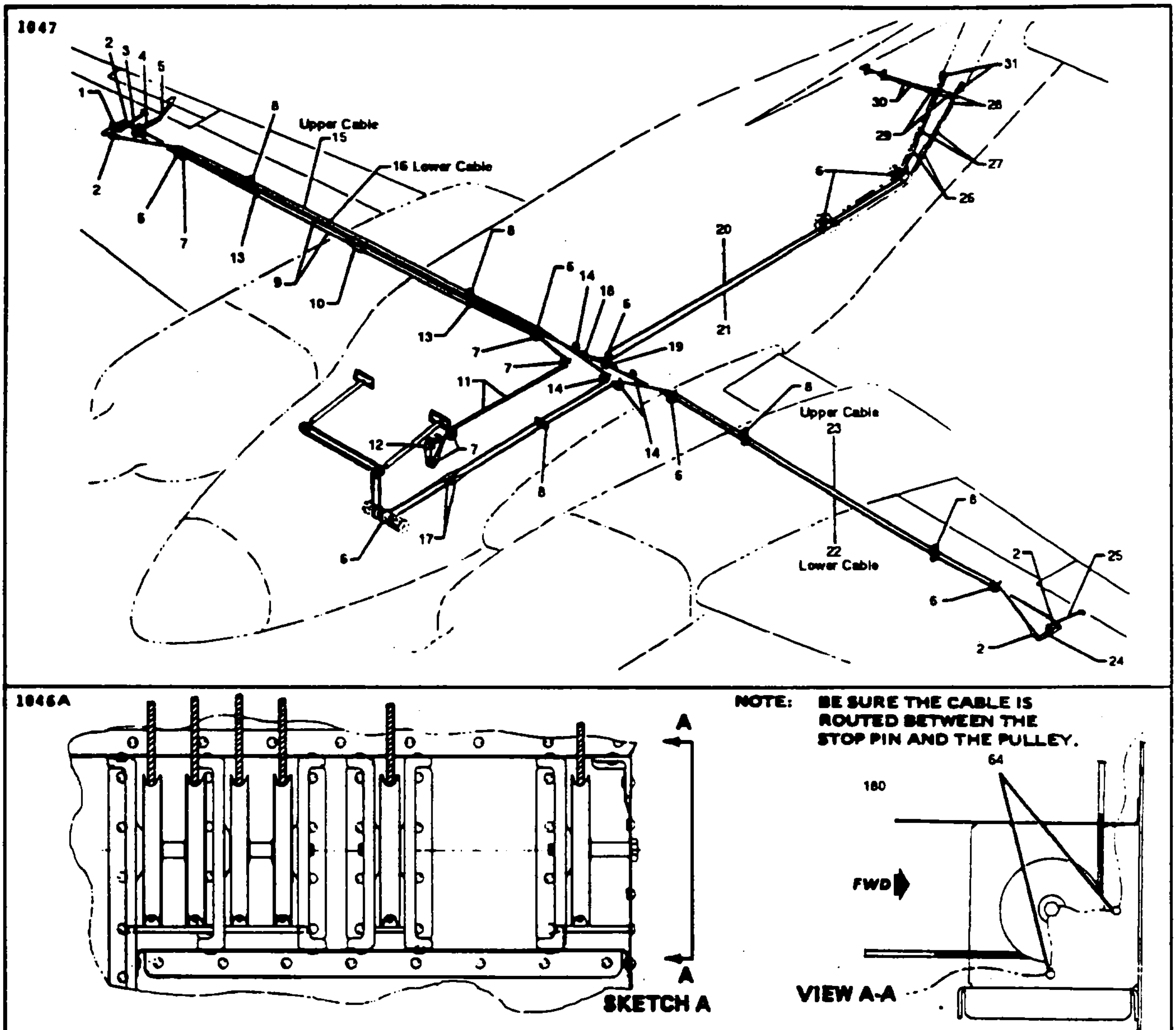


Figure 27-5. Methods of Blocking Trim Cables

6. The left balance cable may be removed by the following procedure:
   A. Loosen the turnbuckle, separating the turnbuckle ends at the aft end of the aileron bellcrank.
   B. Remove the interior panel to the aft section of the fuselage and disconnect the interconnecting cables that lead to the rudder cables at the turnbuckles at station 288.00.
   C. If not previously accomplished, remove the cable guard pins at wing stations 29.00 and 150.00 and fuselage station 171.00.
   D. Remove the fairlead at fuselage station 171.25, between where the interconnecting cables attach to the balance cable.
   E. Draw the cable from the wing into the fuselage.
   F. Remove the cable guard pins at fuselage stations 244.00 and 274.00.
   G. Draw the interconnecting cables forward through the fuselage.

INSTALLATION OF AILERON CONTROL CABLES. (Refer to Figure 27-6.)

1. The right or left primary control cables may be installed by the following procedure:
   A. From the access hole at the aileron bellcrank, draw the control cable through the wing into the fuselage and then forward through the fuselage.
   B. Connect the control cable turnbuckle ends at the forward end of the aileron bellcrank.
   C. Connect the cable to the forward control cable at the turnbuckle within the fuselage at station 76.00.
   D. If balance cable is installed, install the cable guard pins at wing stations 29.00 and 150.00 and fuselage stations 164.50.



1. BELLCRANK, RIGHT
2. TURNBUCKLE
3. ROD, AILERON CONTROL
4. TRIM SCREW ASSY.
5. ROD, TRIM CONTROL
6. PULLEY CLUSTER
7. PULLEY CLUSTER
8. FAIRLEAD
9. TRIM CABLE
10. TURNBUCKLES
11. TRIM CABLE
12. TRIM SCREW ASSY.
13. RUB BLOCK
14. PULLEY
15. CABLE, CONTROL (R)
16. CABLE, BALANCE (R)
17. TURNBUCKLE
18. CABLE ENDS
19. RUB BLOCK
20. INTERCONNECTING CABLE (R)
21. INTERCONNECTING CABLE (L)
22. CABLE, BALANCE (L)
23. CABLE, CONTROL (L)
24. BELLCRANK, LEFT
25. ROD, CONTROL
26. TURNBUCKLE
27. SPRING
28. SPRING
29. SPRING
30. CABLE
31. CONNECTOR
32. BOLT ASSEMBLY
33. SHAFT
34. LOCKNUT
35. ROD, CONNECTOR
36. ARM
37. SENDER
38. BRACKET
39. BOLT, GUARD
40. DRUM
41. HOUSING
42. BOLT, CAP
43. STOP, SCREW
44. SCREW
45. BOLT ASSY.
46. NUT, JAM
47. CLEVIS
48. BOLT ASSY.
49. BRACKET
50. BRACKET
51. ROD END
52. NUT, JAM
53. BOLT ASSY.
54. END, TURNBUCKLE
55. END, TURNBUCKLE
56. BOLT ASSY.
57. ROD END
58. NUT, JAM
59. STOP BOLT
60. NUT, JAM
61. STOP BLOCK
62. BOLT, PIVOT
63. BOLTS ASSY.
64. ROD, CABLE GUARD

Figure 27-6. Aileron and Aileron Trim Controls

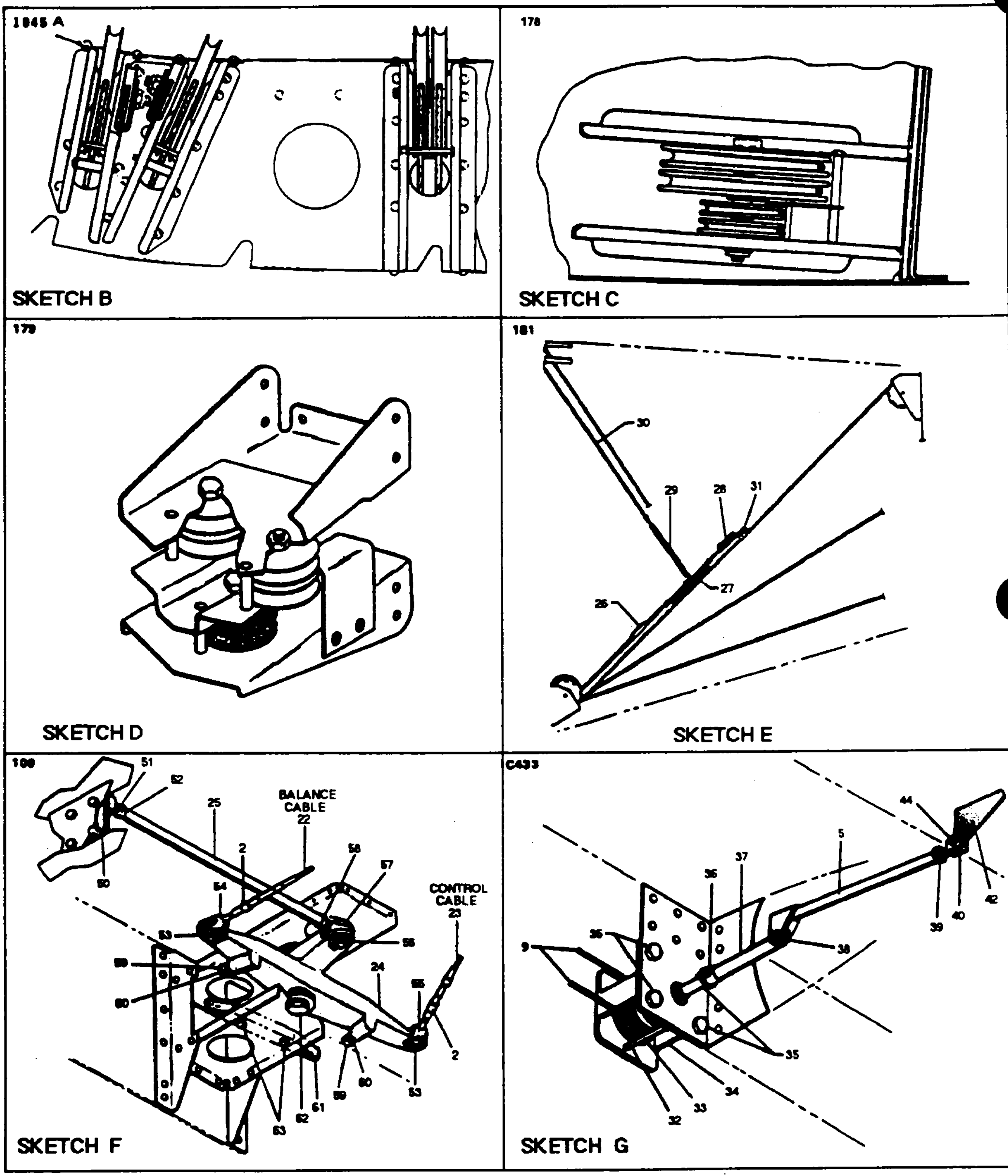


Figure 27-6. Aileron and Aileron Trim Controls (cont.)

2. The right balance cable may be installed by the following procedure:
   A. Ascertain that the right and left balance cables are connected, if the left cable is installed.
   B. Draw the cable from the fuselage into the wing and attach the turnbuckle at the aft end of the aileron bellcrank.
   C. With the aileron primary cable installed, install the cable guard pins at wing stations 29.00 and 150.00 and fuselage station 171.00.
3. The left balance cable may be installed by the following procedure:
   A. Connect the right and left balance cables at the cable ends at fuselage station 171.25.
   B. Draw the interconnecting cables to the rudder back through the fuselage and connect the cable ends to the rudder take off cable ends at the turnbuckles at station 285.00.
   C. Install cable guard pins at fuselage stations 244.00 and 274.00.
   D. Draw the balance cable from the fuselage through the wing and attach the turnbuckle at aft end of the aileron bellcrank.
   E. Install the fairlead at fuselage station 171.25, between where the interconnecting cable attaches to the balance cable.
   F. Install cable guard pins at fuselage station 171.00 and wing stations 29.00 and 150.00.
4. Set cable tension per Figure 27-9 and check control cable rigging and adjustment. Also check cable clearance.
5. Install access plates and panels.

REMOVAL OF AILERON BELLCRANK ASSEMBLY. (Refer to Figure 27-6.)

1. Remove the access plate to the bellcrank assembly.
2. Relieve cable tension from the control system by rotating one of the turnbuckles attached to the bellcrank.
3. Disconnect the turnbuckle ends from the forward and aft ends of the bellcrank.
4. Disconnect the aileron control rod at the bellcrank.
5. Remove the pivot bolt securing the bellcrank and remove bellcrank from wing.
6. The stop block may be removed by unbolting and removing from the wing.

INSTALLATION OF AILERON BELLCRANK ASSEMBLY. (Refer to Figure 27-6.)

1. Place the bellcrank in its mounting bracket with the adjustable stops toward the outboard end of the wing.
2. Install the pivot bolt and torque.
3. Install the aileron control rod, secure bolt assembly and safety.
4. Connect the turnbuckle ends to the bellcrank, secure and safety.

— NOTE —

The aft end of the bellcrank and balance cable end is painted red to help facilitate proper hook-up. Do not tighten turnbuckle fork ends on bellcrank so tight that the ends cannot rotate.

5. Install stop block and torque bolts.
6. Check aileron controls rigging and adjustment per the following paragraph.
7. Install access plate and secure.

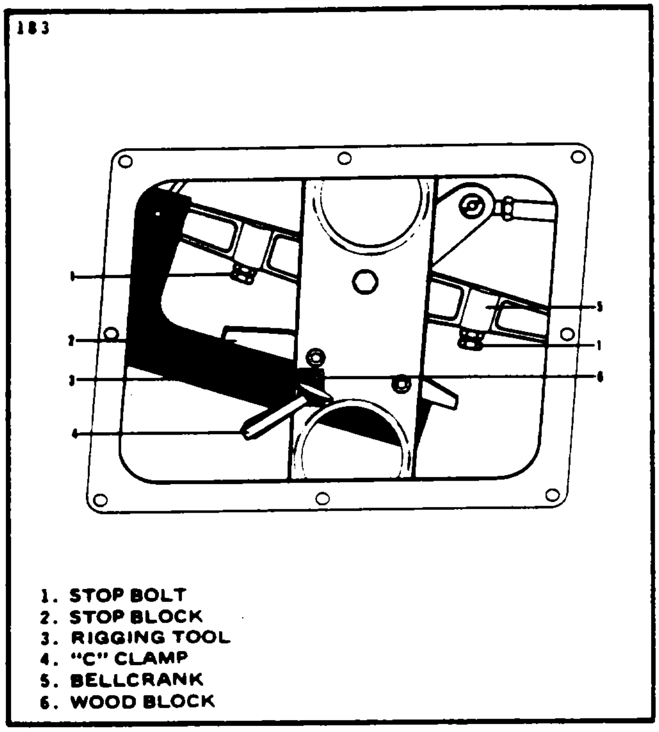


Figure 27-7. Installation of Bellcrank Rigging Tool

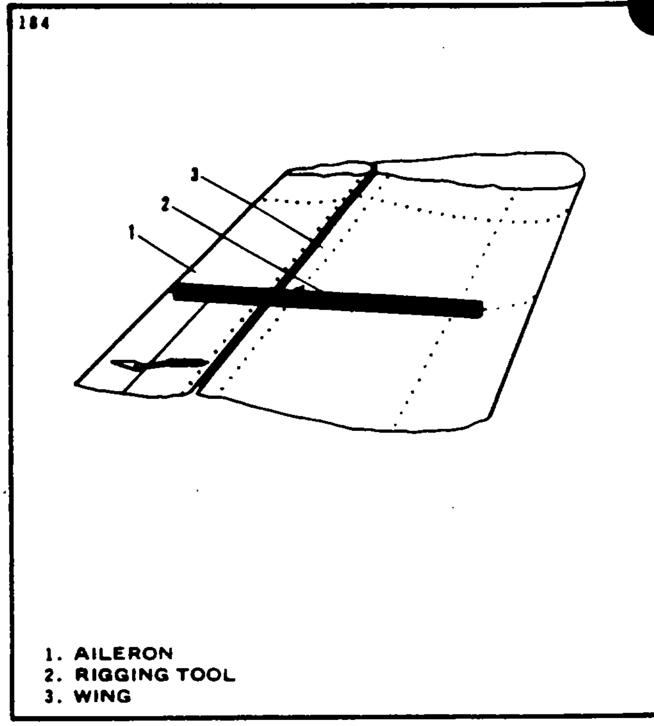


Figure 27-8. Installation of Aileron Rigging Tool

RIGGING AND ADJUSTMENT OF AILERON CONTROLS. (Refer to Figure 27-6.)

1. To rig the aileron controls, set the right and left aileron bellcranks in neutral position by attaching an aligning tool within both wings as shown in Figure 27-7. (This tool may be fabricated from dimensions given in Chapter 95.) The tool is used by the following procedure:

A. Remove the access plates to the aileron bellcranks at wing station 178.00.

B. Remove the cotter pin and nut that secures the forward turnbuckle fork end to the bellcrank. The bolt should not be removed.

C. Insert the tool between the bellcrank mounting brackets and over the end of the bolt from which the nut was removed. (It may be necessary to loosen one of the primary control cables or the balance cable.)

D. Position the tool so that it fits tight against the outboard side of the bellcrank stop block.

E. Clamp the tool to the lower support bracket with a small "C" clamp. Place a small block of wood or similar material between the clamp and lower bracket so as not to damage the bracket or bend the turned edge that is around the bracket lighting hole.

2. Check or adjust the aileron for neutral position by the following procedure:

A. Place a modified straightedge, as shown in Figure 27-8 against the underside of the wing, next to and outboard of the row of rivets at station 189.00 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.) Do not place tool over rivets.

B. With the bellcrank in neutral and the forward edge of tool and spacer contacting the wing, the trailing edge of the aileron should make contact with the aft end of the tool.

C. Should the three points not contact, loosen the jam nuts of the control rod ends and rotate the rod until the three contact points touch the skin surfaces. Tighten the rod end locknuts.

3. With the bellcrank in neutral position, adjust cable tension as given in Figure 27-9 to maintain neutral-center alignment of control wheels. Remove the floor panel to the left of the control pedestal. Alternately adjust the primary and balance cable turnbuckles at the bellcranks with the turnbuckles within the fuselage at station 76.00. Cable tension should be taken at the non-ridged primary control cable and tension corrected to ambient temperature per Chart 2702. Safety turnbuckles.

4. To adjust the interconnecting cables between the aileron and rudder cables, first ascertain that cable tension has been set for both the aileron and rudder cables. Ascertain that the aileron and rudder controls. and surfaces are neutral, then remove the access panel to the aft interior section of the fuselage and adjust the interconnecting cable turnbuckles at station 285.00 so that the springs will extend .060 of an inch.

5. Place a bubble protractor on the inboard section of the aileron and establish neutral or zero on the protractor. Remove the tools holding the aileron bellcranks in neutral, replace nuts and safety. Adjust the bellcrank stop bolts to the specific aileron travel from neutral as given in Figure 27-9. Stops of both bellcranks should contact their stop blocks at the same time and before the control wheel contacts its stop.

6. Simulate flight load by dropping both aileron-trailing edges down to a maximum of 1/4" from neutral. This adjustment is accomplished by adjusting the control rod connecting the bellcrank to the aileron.

— NOTE —

If provisions are provided for safety wiring the nut and screw on the aileron bellcrank assembly, safety wire with MS20995C as shown in Figure 27-10.

7. Check control operation, bolts and turnbuckles for safety and installation of cable guard pins.
8. Install access plates and panels.

REMOVAL OF AILERON TRIM ASSEMBLY (CONTROL PEDESTAL). (Refer to Figure 27-6.)

1. Remove the right and left pilot's seat and the right row of seats within the cabin if installed.
2. Remove the access plate attached to the right side of the control pedestal.
3. Remove the aileron trim control knob by removing the roll pin that secures the knob to screw assembly shaft and remove knob. Remove the covers from the face of the control pedestal.
4. Remove the floor panel aft of the control pedestal, and the right panels fore and aft of the main spar.
5. Relieve cable tension from the aileron cables by loosening one of the turnbuckles in the fuselage at station 76.00.
6. Remove the aft access plate on the right fillet fairing located between the fuselage and wing. Remove the aileron and aileron trim pulleys in the wing at station 29.00.
7. Remove the outboard access plate located on the aft side of the wheel well. Remove one screw from each set of rub blocks at wing station 54.00 and open the blocks enough to allow the cable ends to pass through.
8. Remove the access plate on the underside of the wing at the trailing edge at station 92.50.

Cable Tensions

Aileron	35 lbs. ± 2 lbs.
Aileron Trim Tab	14 lbs. ± 2 lbs.

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.

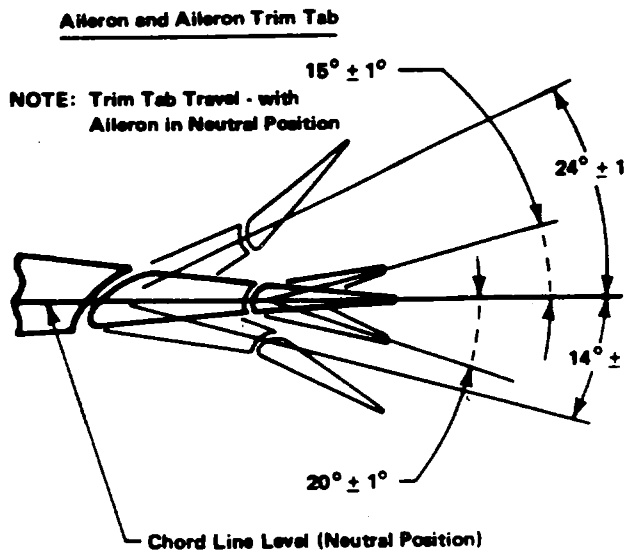
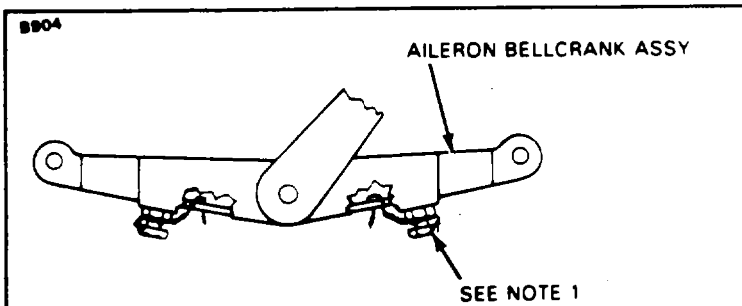
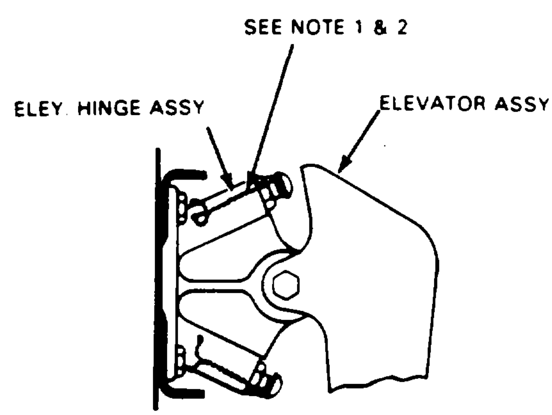
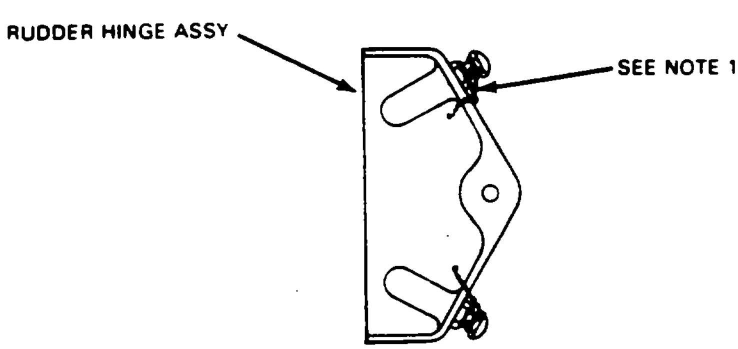


Figure 27-9. Aileron Control Travels and Cable Tension







NOTES

1 AFTER STARTING WIRE THRU HEAD OF SCREW. MAKE ONE COMPLETE WRAP AROUND SHANK OF SCREW NEXT TO JAM NUT FINISH WIRING THRU HOLES PROVIDED IN FORGING. INSTALL SAFETY WIRE THRU HEAD OF SCREW WITH WET ZINC CHROMATE.

2 THE LOCK WIRE SHOULD ALWAYS BE INSTALLED AND TWISTED SO THAT THE LOOP AROUND THE HEAD STAYS DOWN AND DOES NOT TEND TO COME UP OVER THE BOLT HEAD AND LEAVE A SLACK LOOP

Figure 27-10. Safety Wiring Control Surface Stops

9. Block the trim cables at the screw assembly within the control pedestal and within the wing at station 96.50 to prevent the cables from unwrapping from their drums by one of the methods shown in Figure 27-5. (If the trim assembly within the wing is also to be removed, then remove the access plates at wing station 171.00 and block the cables at the trim screw assembly.)

10. Mark one set of cable ends within the wing at station 90.00 to facilitate installation and disconnect the cables at the turnbuckles.

11. Remove the pulleys within the fuselage at station 102.00 and the cable guard pins at stations 99.00 and 163.00.

12. Unbolt the screw assembly from its mounting bracket. Remove the screw assembly, drawing the cables through the control pedestal from the wing and fuselage.

INSTALLATION OF AILERON TRIM ASSEMBLY (CONTROL PEDESTAL). (Refer to Figure 27-6.)

1. Ascertain that the cable is evenly wrapped on the trim drum (centered) and blocked to prevent unwrapping. (Refer to Wrapping Trim Drum.)
2. Lubricate the screw assembly shaft bearing on the face of the control pedestal.
3. Position the screw assembly in the pedestal on its mounting bracket and secure.
4. Draw the cables from the pedestal through the fuselage and into the wing.
5. Install the cable pulleys in the fuselage at station 102.00 and secure.
6. Install the aileron and aileron trim pulleys in the wing at station 29.00.
7. Set the aileron cable tension per Figure 27-9 and check rigging and adjustment.
8. If the trim cables from the screw assembly within the wing are installed, connect the cable ends at the turnbuckles at wing station 90.00. (If the trim assembly within the wing is not installed, pull the cables tight and block them, reaching through the access opening in the wing at station 92.50.)
9. With the cables connected, install the cable guard pin in the fuselage at station 99.00 and 162.60.
10. Close the rub blocks within the wing at station 54.00 and secure.
11. Remove the cable blocks.
12. Install the cover on the face of the control pedestal and the control knob on its shaft and secure with roll pin.
13. Set cable tension with the turnbuckles in the wing at station 90.00 per Figure 27-9 and check rigging and adjustment.
14. Install access plates and panels in the fuselage, on the underside of the wing and in the wheel well. Install seats if required.

REMOVAL OF AILERON TRIM ASSEMBLY (WING). (Refer to Figure 27-6.)

1. Remove the access plates located under the wing along the trailing edge at wing stations 92.50, 117.50, 151.50 and 171.00.
2. Disconnect the trim control rod located between the trim screw and tab, at the screw.
3. Block the trim cables to prevent them from unwrapping from their drums at the screw assembly and within the wing at station 87.50 by one of the methods shown in Figure 27-5. (If the trim assembly within the fuselage is to be removed, block the cables at the screw assembly within the control pedestal.)
4. Mark one set of cable ends at wing station 90.00 to facilitate installation and disconnect the cables at the turnbuckles.

5. Reach through the access opening at wing station 117.50, remove one screw from each set of rub blocks and open the blocks enough to allow the cable ends to pass through.
6. Remove the cable guard pin within the wing at station 150.00.
7. Disconnect the electrical leads to the trim indicator sender.
8. Remove the cap bolts that attach the screw assembly to the spar and remove the assembly from the wing.

INSTALLATION OF AILERON TRIM ASSEMBLY (WING). (Refer to Figure 27-6.)

1. Ascertain that the trim cable assembly is evenly wrapped (centered) on the drum, the drum centered between the stops on the trim screw and the cables blocked to prevent them from unwrapping.
2. Position the screw assembly in the wing, install the attachment cap bolts and torque.
3. Draw the cables through the wing and connect them at the turnbuckles at wing station 90.00. (If the cables from the fuselage are not installed, block the cables at the rib at wing station 87.50 by reaching through the access opening at wing station 92.50.)
4. Remove the cable blocks next to the trim screw assembly and trim cables leading from the fuselage.
5. Connect the control rod to the trim screw.
6. Connect the electrical leads to the trim indicator sender.
7. Install the cable guard pin at wing station 150.00.
8. Close the rub blocks at wing station 117.50 and secure.
9. If the complete cable system is installed, set cable tension with the turnbuckles at wing station 90.00 per Figure 27-9 and check rigging and adjustment.
10. Install access plates.

REMOVAL OF AILERON TRIM SENDER ASSEMBLY. (Refer to Figure 27-6.)

1. Remove the two access plates located on the underside of the wing at station 171.00.
2. Disconnect the electrical leads to the sender.
3. Disconnect the sender arm from the sender shaft and turn the arm to allow it to separate from the connector rod.
4. Remove the sender from its mounting bracket.

INSTALLATION OF AILERON TRIM SENDER ASSEMBLY. (Refer to Figure 27-6.)

1. Install the sender unit on its mounting bracket by placing the index tab on the sender into the index slot in the bracket. Secure the sender.
2. Insert the end of the connector rod on the sender arm, install the arm on the shaft of the sender and leave arm free to rotate until sender is rigged to the trim indicator.
3. Connect the electrical leads to the sender.
4. Rig sender unit.
5. Install access plates.

RIGGING AND ADJUSTMENT OF AILERON TRIM. (Refer to Figure 27-6.)

1. To adjust the aileron trim, it must be ascertained that the following has been accomplished either during installation or as a preadjustment check.
   A. Trim cables are evenly wrapped (centered) on their drums, both in the control pedestal and in the wing and both cable turnbuckles are located approximately at wing station 90.00.
   B. The trim drum in the wing is centered between the stops of the trim screw.
   C. Cable tension set per specifications given in Figure 27-9.
2. Remove the access plates on the underside of the right wing at stations 92.50 and 171.00.
3. With the trim screw held from rotating, turn the trim drum until .560 of an inch exists between the forward screw stop and the drum housing, as measured along the screw. Do not measure from sender mounting bracket. (Neutral position of the screw is at this measurement.)
4. With the trim screw in neutral position, the trailing edges of the tab and aileron should align. Should they not, remove the bolt from the aft end of the trim control rod and adjust the rod end until the trailing edges align. Reinstall bolt and tighten it so that bushing will not rotate and secure.
5. Turn the trim in each direction to screw stops to check tab angle as given in Figure 27-9 and also check the minimum number of cable wraps left on the drum. (Minimum allowable is one and one-quarter turns.)
6. Check rigging and adjustment of trim sender and indicator per the following paragraph.

RIGGING AND ADJUSTMENT OF AILERON TRIM SENDER AND INDICATOR. (Refer to Figure 27-6.)

1. Remove the access plates on the underside of the right wing at station 171.00.
2. Ascertain that the aileron trim is properly adjusted per the preceding paragraph.
3. With the arm on the sender shaft free to rotate, set the aileron and aileron trim tab in neutral position.
4. Calibrate the trim indicator located in the control pedestal by first rotating the sender shaft, as viewed from the shaft end, in a clockwise direction to its stop position.
5. Turn on the master switch. A minimum of 24-volts must be supplied to the electrical system when making this adjustment.
6. Rotate the sender shaft slowly counterclockwise, when viewed from the shaft end, until the trim indicator on the pedestal reads neutral. Tighten the arm on the sender shaft.
7. Turn trim to both extremes and observe trim indicator reading. Indicator pointer should travel to both extreme positions on the indicator dial.
8. Install the access plates.

RUDDER AND TAB CONTROLS.

REMOVAL OF RUDDER CONTROL CABLES. (Refer to Figure 27-11.)

1. Remove the left pilot's seat and left row of passenger seats.
2. Remove the left row of floor panels and the floor panel lateral to the entrance door.
3. Remove the interior access panel to the aft section of the fuselage.
4. Remove the tail cone and the access plate under the rudder on the top aft section of the fuselage.

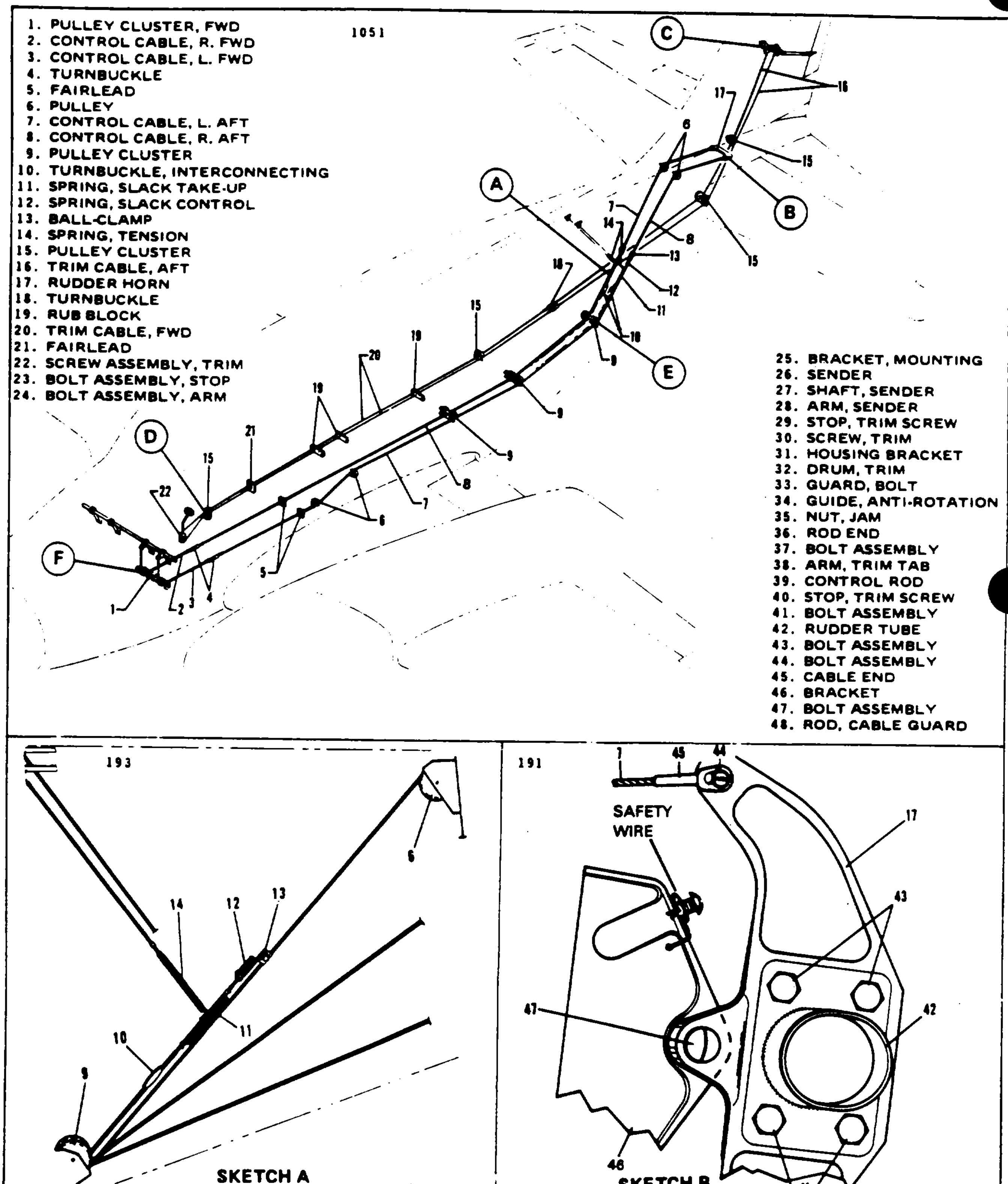


Figure 27-11. Rudder and Rudder Trim Controls

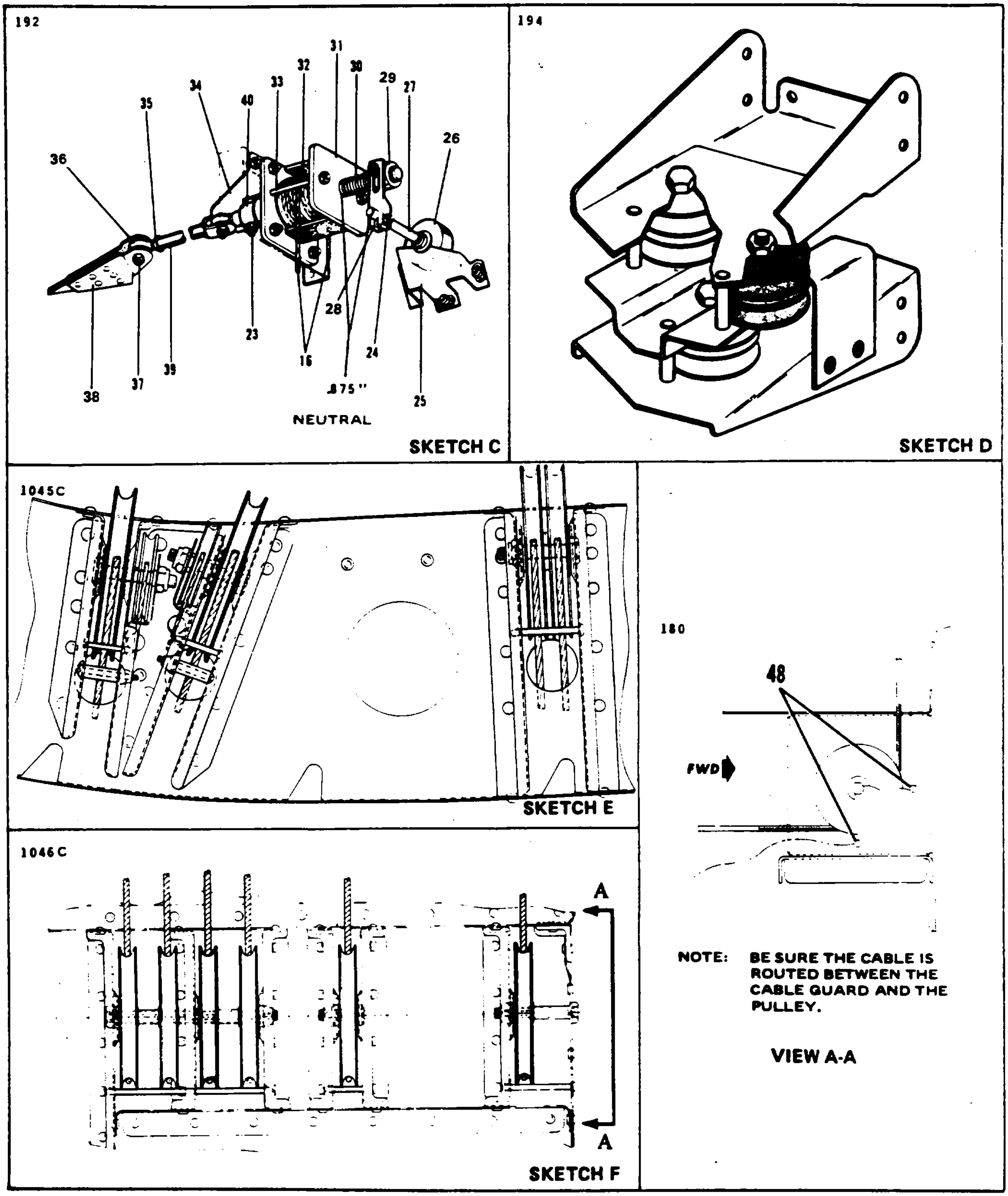


Figure 27-11. Rudder and Rudder Trim Controls (cont.)

5. Loosen the aileron and rudder interconnecting cables at the turnbuckles at station 275.00, in the aft section of the fuselage, enough to allow the large connecting spring at station 298.00 to be disconnected from the rudder cable.
6. Mark one set of cable ends to facilitate installation and disconnect the cables at the turnbuckles at station 76.00.
7. Mark and disconnect the cables from the rudder horn.
8. Remove the cable guard pins at fuselage stations 215.00, 244.00, 274.00 and 317.75. In addition, when removing the left cable, remove pins at stations 140.00 and 162.60.
9. Draw the cables aft through the fuselage and remove.

INSTALLATION OF RUDDER CONTROL CABLES. (Refer to Figure 27-11.)

1. Connect the cables to the rudder horn.
2. Draw the cables forward through the fuselage and connect to the forward cables at the turnbuckles at station 76.00.
3. Install the cable guard pins at stations 215.00, 244.00, 274.00 and 317.75. If the left cable was removed, install pins at stations 140.00 and 162.60.
4. Connect the aileron and rudder interconnecting cables to the rudder cables.
5. Set cable tension per Figure 27-12 and rigging and adjustment.
6. Install access plates, panels and seats.

REMOVAL OF RUDDER HORN. (Refer to Figure 27-11.)

1. Remove the left pilot's seat and floor panel to the left of the control pedestal.
2. Remove the access plate, under the rudder, on the top aft section of the fuselage.
3. Relieve cable tension from the rudder control by loosening one of the turnbuckles at fuselage station 76.00.
4. Mark one end of the rudder horn and cable end to facilitate installation and disconnect the cables from the rudder horn.
5. Unbolt the rudder horn from the rudder torque tube plate and the hinge fitting. Remove the horn.

INSTALLATION OF RUDDER HORN. (Refer to Figure 27-11.)

1. Position the rudder horn under the rudder torque plate and on the hinge fitting. Install bolts and torque.
2. Connect the rudder cables to the horn and secure. Allow the cable ends to rotate freely.
3. Set cable tension per Figure 27-12 and rigging and adjustment.
4. Install access plate, panel and seat.

RIGGING AND ADJUSTMENT OF RUDDER CONTROLS. (Refer to Figure 27-11.)

1. Ascertain that the left pilot's seat, the floor panel to the left of the control pedestal and tail cone are removed.

2. To adjust the rudder and rudder pedal for neutral, it first should be ascertained that the nose gear steering has been aligned with the rudder pedals according to Alignment of Nose Landing Gear, Chapter 32. Adjustment of the rudder and rudder pedals may be accomplished as follows:

   A. Clamp the rudder pedals to align in a lateral position as shown in Figure 27-13.

   B. Adjust the turnbuckles at fuselage station 76.00 to obtain proper cable tension, per Figure 27-12, and to align the rudder at neutral position. Neutral position of the rudder may be established by aligning vertically the forward overhang at the upper portion of the rudder with the vertical fin or with the use of the fabricated rudder rigging jig. (A rigging jig and pointer may be fabricated from specifications given in Chapter 95.)

3. Rudder travel adjustment with the use of the fabricated rudder rigging tool (refer to Figure 27-14) may be accomplished as follows:

   A. Level the airplane longitudinally and laterally. (Longitudinal leveling is not mandatory if a propeller protractor is used for this adjustment.)

   B. Allow the elevator to remain in its down position.

   C. Position the jig on the elevator torque tube and slide it to the left until the centerline on the jig plate aligns with the centerline of the airplane.

   D. Set a bubble protractor to 29° 28' and position it on the centerline of the jig plate. (This angle assures rudder travel measurement perpendicular to the rudder hinge centerline.)

   E. With protractor still set to 29° 28', center the bubble by adjusting the screws at the aft end of the jig plate. (Keep jig legs tight to elevator torque tube.)

   F. Slide the pointer into the trailing edge of the rudder with the point approximately .125 inch from plate.

   G. Set rudder with stops to the degree of travel as given in Figure 27-12 and lock stops.

— NOTE —

If provisions are provided for safety wiring the nut and screw on the rudder hinge assembly, safety wire with MS20995C as shown in Figure 27-10.

4. To adjust the interconnecting cables between the aileron and rudder cables, first ascertain that cable tension has been set for both the aileron and rudder cables. Ascertain that the aileron and rudder controls and surfaces are neutral and adjust the interconnecting cable turnbuckles at station 275.00 so that the spring will extend .060 of an inch.

5. Safety turnbuckles and install access plates, panels and seats.

Cable Tensions

Rudder	25 lbs. ± 2 lbs.
Rudder Trim Tab	14 lbs. ± 2 lbs.

Rudder Pedal 21° 15' each way.
Neutral to Fwd 3.87 in.
Neutral to Aft 3.63 in.
7.50 Total

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.

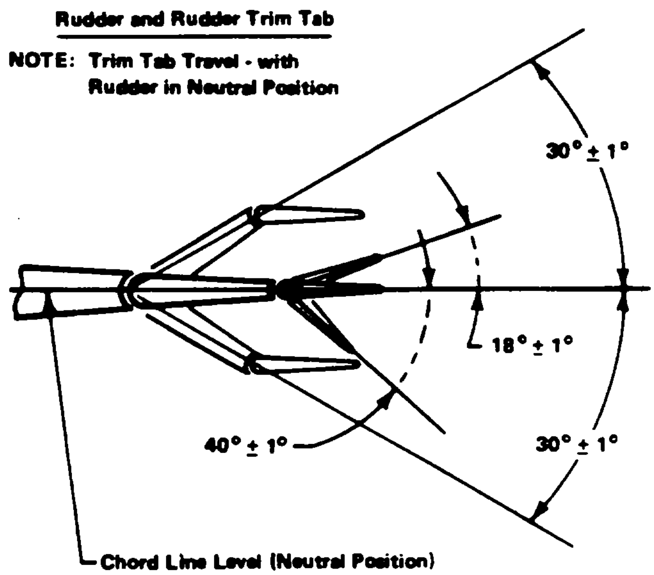


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Figure 27-12. Rudder and Trim Tab Control Travels and Cable Tensions

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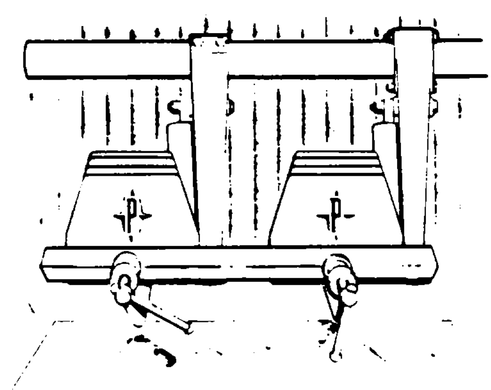
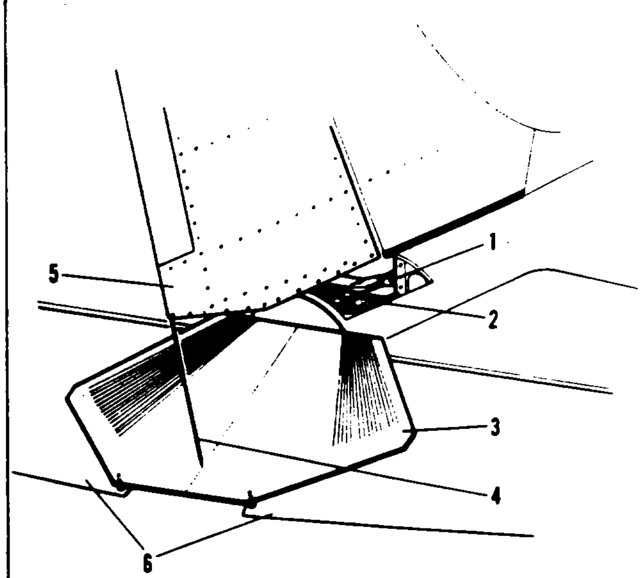


Figure 27-13. Clamping Rudder Pedals in Neutral Position

195



1. STOP BOLT
2. RUDDER HORN
3. RIGGING TOOL
4. POINTER
5. RUDDER
6. ELEVATOR

Figure 27-14. Installation of Rudder Rigging Tool

REMOVAL OF RUDDER TRIM ASSEMBLY (CONTROL PEDESTAL). (Refer to Figure 27-11.)

1. Remove the right pilot's seat and right row of passenger seats.
2. Remove the lower cover from the face of the control pedestal.
3. Remove the floor panel located aft of the control pedestal, the right panel forward of the main spar, the first and second panels aft of the main spar and the panel lateral to the entrance door.
4. Remove the interior access panel to the aft section of the fuselage.
5. Block the forward trim cables at the trim screw assembly within the lower section of the control pedestal and the aft cables at bulkhead 317.75, to prevent the cables from unwrapping from their drums, by one of the methods shown in Figure 27-5. (If the aft screw assembly is also to be removed, then remove the access plate attached to the right side of the vertical fin and block the cables at the screw assembly instead of in the fuselage.)
6. Mark one set of cable ends at station 287.50 to facilitate installation and disconnect the cables at the turnbuckles.
7. Remove the cable guard pin at fuselage stations 99.00 and 244.00.
8. Remove one screw from each set of rub blocks at stations 162.50, 174.00 and 215.00 and open them far enough to allow the cable ends to pass through.
9. Cut safety wire and remove the roll pin that secures the flexible joint to the control shaft of the trim screw assembly.
10. Remove the bolts that attach the screw assembly to its mounting bracket. Draw the assembly with cables from the control pedestal.

INSTALLATION OF RUDDER TRIM ASSEMBLY (CONTROL PEDESTAL). (Refer to Figure 27-11.)

1. Ascertain that the cable is evenly wrapped on the trim drum (centered) and blocked to prevent unwrapping. (Refer to Wrapping Trim Drum.)
2. Insert the trim screw shaft in the end of the swivel joint, install roll pin to secure swivel joint to screw shaft and secure with MS20995-C41 safety wire, then position the assembly on its mounting bracket. Install attachments bolts and secure.
3. Draw the cables from the pedestal through the fuselage to the aft section of the fuselage.
4. If the trim cables from the rudder are installed, connect the cable ends. (If the cables from the rudder are not installed, pull the cables tight and block them in the fuselage at bulkhead 244.00.)
5. With the cable installed and connected, install the cable guard pin at stations 99.00 and 244.00 and close and secure the rub blocks at stations 162.50, 174.00 and 215.00.
6. Remove the cable blocks.
7. Set cable tension with the turnbuckles at station 287.50 per Figure 27-12 and check rigging and adjustment.
8. Install cover on face of control pedestal, access plates and panels and seats.

REMOVAL OF RUDDER TRIM ASSEMBLY (RUDDER). (Refer to Figure 27-11.)

1. Remove the interior access panel to the aft section of the fuselage.
2. Remove the access plates located on the right side of the fuselage under the horizontal stabilizer and on the right side of the vertical fin.

3. Block the trim cables to prevent them from unwrapping at the screw assembly within the vertical fin and within the fuselage at the bulkhead at station 244.00 by one of the methods shown in Figure 27-5. (If the trim assembly within the fuselage is also to be removed, then block the cables at the trim screw assembly in the control pedestal.)
4. Mark one set of cable ends within the fuselage at station 287.50 to facilitate installation and disconnect the cables at the turnbuckles.
5. Remove the cable guard pin at fuselage stations 332.00 and 342.00.
6. Disconnect the trim control rod from the trim screw.
7. Remove the anti-rotation guide bushing and bolt assembly from the aft end of the screw.
8. Remove the trim sender arm from the trim screw.
9. Remove the cap bolts that attach the screw assembly to the spar.
10. Remove the screw assembly through the access hole and draw the trim cables from the fuselage and fin.

INSTALLATION OF RUDDER TRIM ASSEMBLY (RUDDER). (Refer to Figure 27-11.)

1. Ascertain that the trim cable assembly is evenly wrapped (centered) on the drum, the drum centered between stops on the trim screw and the cables blocked to prevent them from unwrapping.
2. Position the screw assembly in the vertical fin, install the attachment bolts and secure.
3. Draw the cables through the fin into fuselage and connect them at the turnbuckles at station 287.50. (If the cables from the control pedestal are not installed, draw the cables tight and block them at the bulkhead at station 317.75. Install the trim screw assembly in the control pedestal.)
4. Remove the cable blocks from next to the trim screw assembly and from the cables leading from the control pedestal.
5. Install the anti-rotation guide bushing and bolt assembly at the aft end of the screw.
6. Connect the control rod to the trim screw and secure.
7. Connect the trim sender arm to the trim screw. Allow the sender arm to rotate freely on the sender shaft until trim rigging and adjustment is made.
8. Install the cable guard pin at fuselage stations 332.50 and 342.00.
9. With the complete trim control system installed, set cable tension with the turnbuckles at station 287.50 per Figure 27-12 and check rigging and adjustment.
10. Install access plates and panel.

REMOVAL OF RUDDER TRIM SENDER ASSEMBLY. (Refer to Figure 27-11.)

1. Remove the access plate located on the right side of the vertical fin.
2. Disconnect the electrical leads to the sender.
3. Disconnect the trim sender arm from the trim screw.
4. Remove the sender with mounting bracket by removing the mounting bracket attachment screws from the left surface of the vertical fin.
5. Remove the sender through the access opening.
6. Remove the arm from sender shaft.
7. Remove sender from mounting bracket.

INSTALLATION OF RUDDER TRIM SENDER ASSEMBLY. (Refer to Figure 27-11.)

1. Install the sender unit on its mounting bracket by placing the index tab on the sender into the index slot in the bracket. Secure the sender.
2. Position the sender arm on the shaft of the sender and allow the arm to rotate freely until adjustment is made.
3. Position the sender mounting bracket in fin, install attachment screws and secure.
4. Attach the sender arm on the trim screw.
5. Connect the electrical leads.
6. Rig sender unit.
7. Install access plate.

RIGGING AND ADJUSTMENT OF RUDDER TRIM. (Refer to Figure 27-11.)

1. To adjust the rudder trim, it must be ascertained that the following has been accomplished either during installation or as a preadjustment check:
   A. Trim cables are evenly wrapped (centered) on their drums, both in the control pedestal and in the fin, and both cable turnbuckles are located approximately at fuselage station 287.50.
   B. The trim drum in the fin is centered between the stops of the trim screw.
   C. Cable tension is set as given in Figure 27-12.
2. Remove the access plate on the right side of the vertical fin.
3. With the trim screw connected to the control rod and not allowed to rotate, turn the trim drum until 1.21 of an inch exists between the forward screw stop and the drum housing, as measured along the screw. (Neutral position of the screw is at this measurement.)
4. With the trim screw in neutral position, the trailing edges of the tab and rudder should align. Should they not, remove the attachment bolt and loosen the jam nut on the rod end at the aft end of the tab control rod. Turn the rod end until the trailing edges align. Secure attachment bolt and rod end jam nut.
5. Turn the trim in each direction to screw stops to check tab angle or measured distance from the centerline of the rudder as given in Figure 27-12 and also check minimum number of wraps left on trim drum. (Minimum allowable is one and one-quarter turns.)
6. Check rigging and adjustment of trim sender and indicator.

RIGGING AND ADJUSTMENT OF RUDDER TRIM SENDER AND INDICATOR. (Refer to Figure 27-11.)

1. Remove the access plate on the right side of the vertical fin.
2. Ascertain that the rudder trim is properly adjusted.
3. With the arm on the sender shaft free to rotate, set the rudder and rudder tab in neutral position.
4. Calibrate the trim indicator located in the control pedestal by first rotating the sender shaft, as viewed from the shaft end, in a clockwise direction to its stop position.
5. Turn on the master switch. A minimum of 24-volts must be supplied to the electrical system when making this adjustment.
6. Rotate the sender shaft slowly counterclockwise when viewed from the shaft end, until the trim indicator on the pedestal reads neutral. Tighten the arm on the sender shaft.
7. Turn trim to both extremes and observe trim reading. Indicator pointer should travel to both extreme positions on the indicator dial.

8. Should the indicator pointer not reach either extreme position on the dial, return the tab to neutral, loosen the sender in its bracket and slide it closer to the trim screw. Tighten the sender and check neutral indication. If neutral indication has changed, repeat Steps 6 and 7.
9. Install the access plate.

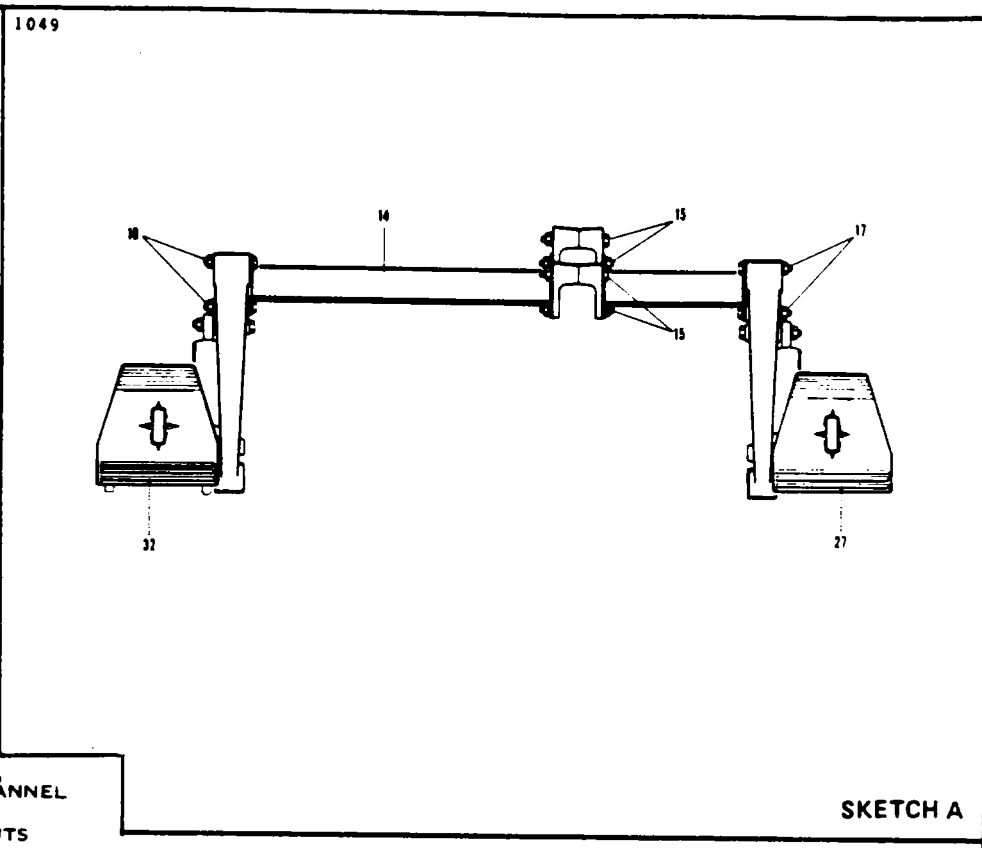
REMOVAL OF PEDAL ASSEMBLY. (Refer to Figure 27-15.)

1. Remove the left pilot's seat and the floor panel to the left of the control pedestal.
2. Relieve tension from the rudder control cables by loosening one of the cable turnbuckles at fuselage station 76.00.
3. Disconnect the rudder control cables from the pedal assembly.
4. Disconnect the brake master cylinder from the pedal assembly.
5. Disconnect the steering control rods from the two inboard pedals.
6. Remove the rudder torque tube guards, if installed, by removing the machine screws, nuts, and clamps positioning the guards to the torque tube and remove the attaching hardware securing each guard to the brake line support channel.
7. Remove the small round access plate located on the right side of the fuselage at station 63.25.
8. Remove the bolts that secure the retainer collars and left pedals on the torque tube.
9. Slide the torque tube out through the right side of the fuselage. (Note the number of spacer washers between each set of collars and bearings.)
10. The left pedals are free to be removed.
11. To remove the outer torque tube assembly with right pedals, unbolt and separate the tube's bearing blocks located on top of the wheel housing. (Note number of spacer washers between the bearing blocks.)
12. Remove the outer tube assembly and disassemble.
13. The torque tube bearings may be removed by removing the cap bolts that secure the bearings to their mounting brackets.

INSTALLATION OF PEDAL ASSEMBLY. (Refer to Figure 27-15.)

1. Install and secure the torque tube bearings to their mounting brackets with cap bolts.
2. Assemble the outer torque tube assembly, including both right pedals.
3. Position the outer torque tube assembly over the wheel housing and install bearing blocks. Spacers are installed between the blocks so that when the blocks are bolted the tube will be free to rotate with minimum up and down play. (Spacers are available in thickness of .012, P/N 81102-35; .020, P/N 81102-36 and .032, P/N 81102-37.
4. Lubricate and slide the torque tube through the side of the fuselage and right bearing far enough to slide the right retainer collar on the tube.
5. Slide the tube through the outer torque tube assembly installing the left pedals and left retainer collar.
6. Insert the bolts through bolt retainer collars and tube (do not install nut) and determine number of spacer washers required to allow minimum side play. The tube may be slid to either side when the collar bolts are removed to allow the spacer washers to be divided and installed evenly between each set of retainers and bearings.

1. NUT, ANCHOR
2. BRACKET, MOUNTING
3. BLOCK, BEARING
4. BOLT ASSEMBLY
5. RETAINER
6. TORQUE TUBE
7. BOLT ASSEMBLY
8. ROLL PIN - BOLT
9. CABLE END
10. BOLT ASSEMBLY
11. BOLT ASSEMBLY
12. BLOCK, BEARING
13. SPACER
14. TORQUE TUBE, OUTER
15. BOLT ASSEMBLY
16. ROLL PIN - BOLT
17. BOLT ASSEMBLY
18. RETAINER
19. BOLT ASSEMBLY
20. BOLT, CAP
21. BLOCK, BEARING
22. BRACKET, MOUNTING
23. PLATE
24. ROD
25. CONTROL CABLE
26. BRAKE CYLINDER
27. PEDAL, RIGHT OUTER
28. PEDAL, RIGHT INNER
29. ROD, STEERING
30. NUT, JAM
31. BOLT ASSEMBLY
32. PEDAL, LEFT INNER
33. PEDAL, LEFT OUTER
34. BRAKE LINE SUPPORT CHANNEL
35. TORQUE TUBE GUARD
36. MACHINE SCREWS AND NUTS
37. SCREWS, NUTS AND CLAMPS



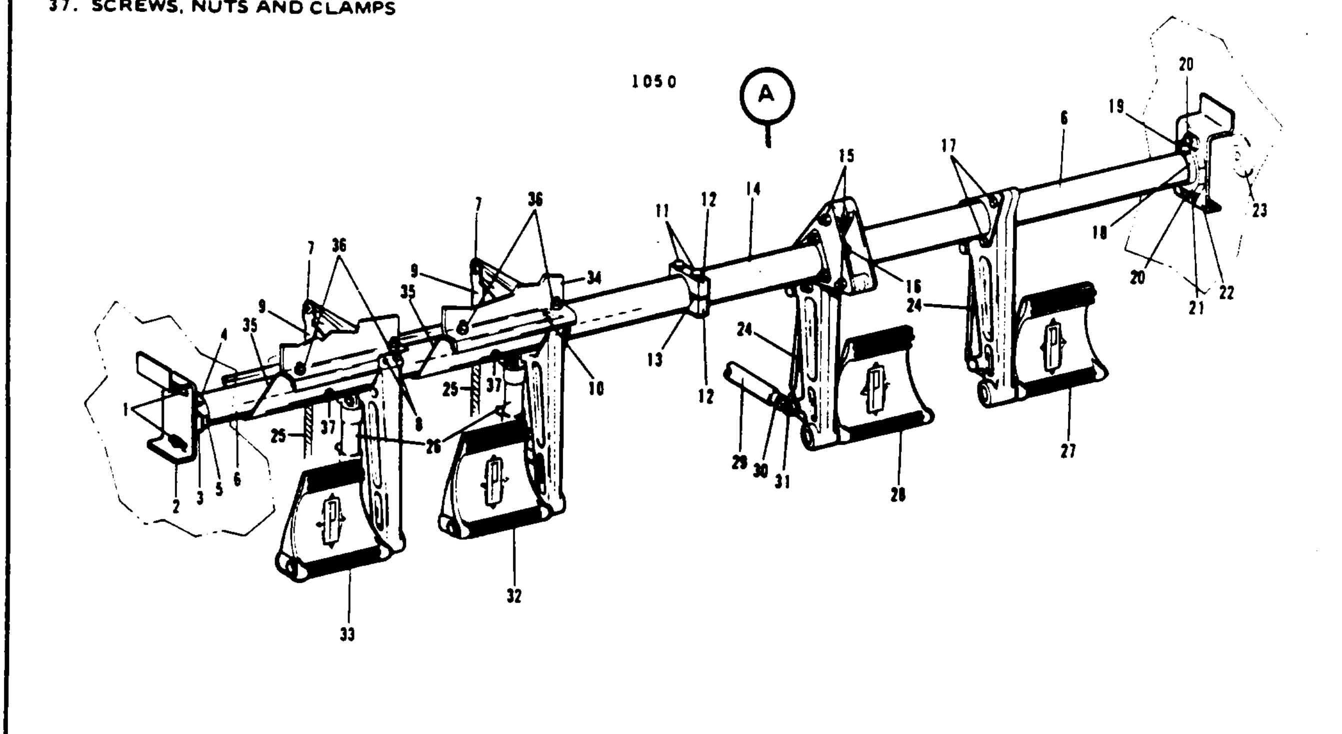


Figure 27-15. Rudder Pedal Installation

7. With the spacer washers installed, install the bolts through the retainers and both left rudder pedals. Install nuts with washers and secure.
8. Wipe off excess lubricant from torque tube.
9. Install the rudder torque tube guards by positioning each guard in front of the torque tube and securing it in place with the two machine screws and nuts at the brake line support channel. Install the clamps around the torque tube and fasten to the guards with machine screws and nuts.
10. Connect the steering control rods at the pedals. Pedal and nose wheel alignment may be checked by referring to Chapter 32.
11. Set cable tension per Figure 27-12 and check rigging and adjustment.
12. Install access plates, panels and seats.

ELEVATOR AND TAB.

REMOVAL OF ELEVATOR CONTROL CABLES. (Refer to Figure 27-8.)

1. To remove the control cables that connect between the elevator control sector and the aft control cables, beginning at fuselage station 86.50, the following procedure may be used:
   A. Remove the left pilot's seat and the floor panel located on the left of the control pedestal.
   B. Mark one set of cable ends to facilitate installation and disconnect the cables at the turnbuckles at station 86.50.
   C. Remove the cable guard pins at the forward pulley cluster at station 57.00.
   D. The inboard (right) cable may be removed by removing the three cable guard pins at the control section and pulley, disconnecting it from the lower end of the sector and drawing it aft, around the pulleys.
   E. The outboard (left) cable may be removed by removing the cable guard pin at the control sector (if not previously removed, when removing the inboard cable), disconnecting it from the upper end of the sector and drawing it aft, around the pulley.
2. To remove the control cables that route aft, beginning from fuselage station 86.50 to the elevator bellcrank, the following procedure may be used:
   A. Remove the right and left pilot's seat and the right row of seats in the fuselage, if installed.
   B. Remove the floor panel to the left of the control pedestal, the left panels fore and aft of the main spar, the center panel aft of the main spar and the floor panel laterally to the entrance door.
   C. Remove the interior access panel to the aft section of the fuselage.
   D. Remove the left or right access plate located on the side of the fuselage.
   E. Mark one set of cable ends to facilitate installation and disconnect the cables at the turnbuckles at station 86.50.
   F. Mark and disconnect the cables from the elevator bellcrank.
   G. To remove the cable that leads to the upper end of the elevator bellcrank (right cable), remove the cable guard pins at stations 111.00, 151.00, 191.70, 244.00 and 274.00.
   H. To remove cable that leads to the lower end of the elevator bellcrank (left cable), remove the cable guard pins at stations 111.00, 162.60, 203.00, 244.00 and 274.00.
   I. Draw the cable aft through the fuselage.

INSTALLATION OF ELEVATOR CONTROL CABLES. (Refer to Figure 27-16.)

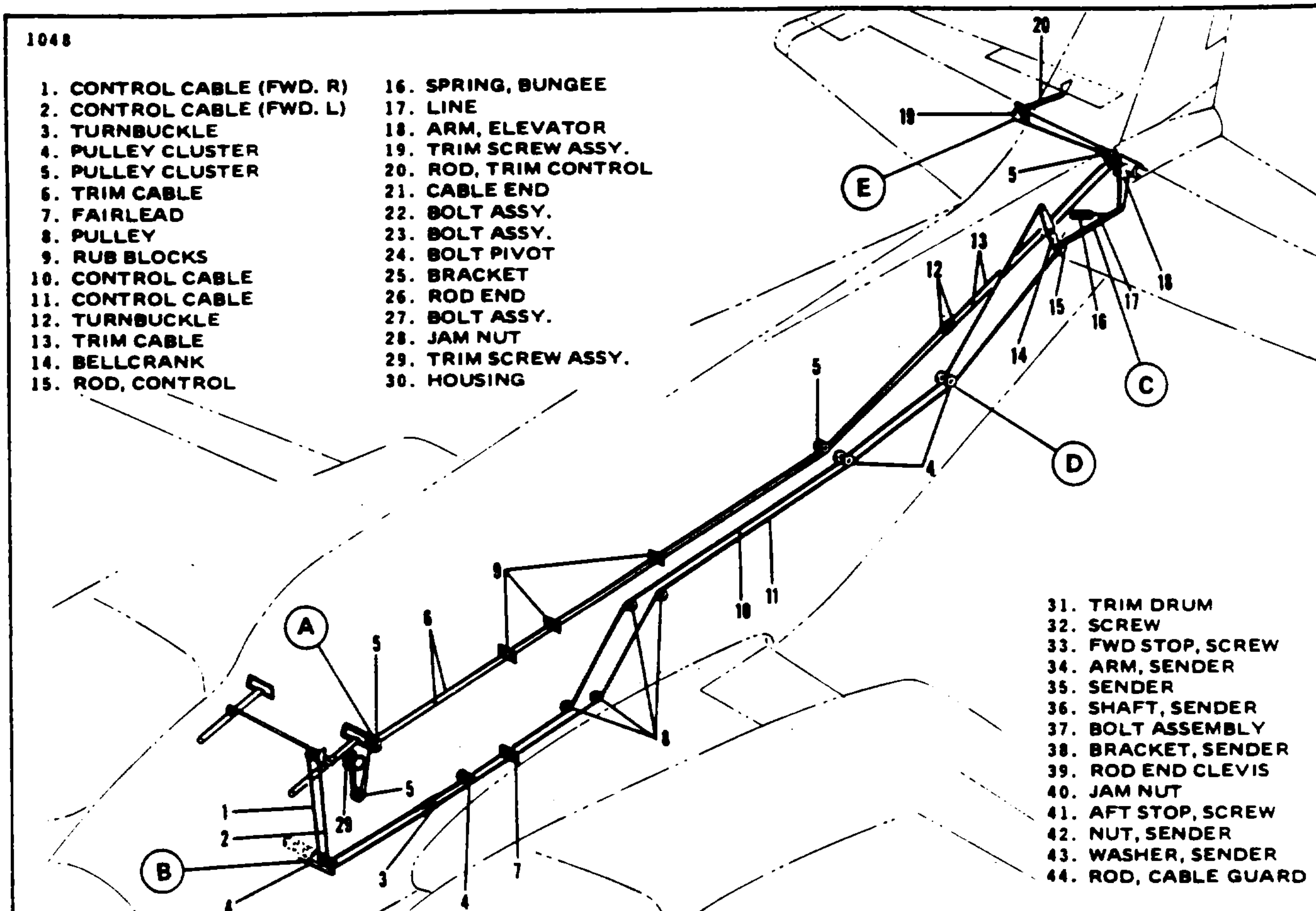
1. The control cables that connect between the elevator control sector and the aft control cables may be installed by the following procedure:
   A. The outboard (left) cable may be installed by drawing the cable forward from fuselage station 86.50, around the forward pulley cluster, upward and attach it to the upper end of the control sector.
   B. The inboard (right) cable may be installed by drawing the cable forward from fuselage station 86.50, around the forward pulley cluster, over the upper pulley and attach it to the lower end of the control sector.
   C. If aft control cables are installed, connect the cables at station 86.50.
   D. Install cable guard pins.
2. The control cables that route aft, beginning at fuselage station 86.50 to the elevator bellcrank, may be installed by the following procedure:
   A. Connect the cables to the elevator bellcrank and draw the cables forward through the fuselage.
   B. Connect the cables to the forward cables at station 86.50.
   C. Install the cable guard pins for the cable that connects to the upper end of the elevator bellcrank (right cable) at stations 111.00, 151.00, 191.70, 244.00 and 274.00.
   D. Install the cable guard pins for the cable that connects to the lower end of the elevator bellcrank (left cable) at stations 111.00, 162.00, 203.00, 244.00 and 274.00.
3. Set cable tension per Figure 27-17 and rigging and adjustment.
4. Install access plates, panels and seats.

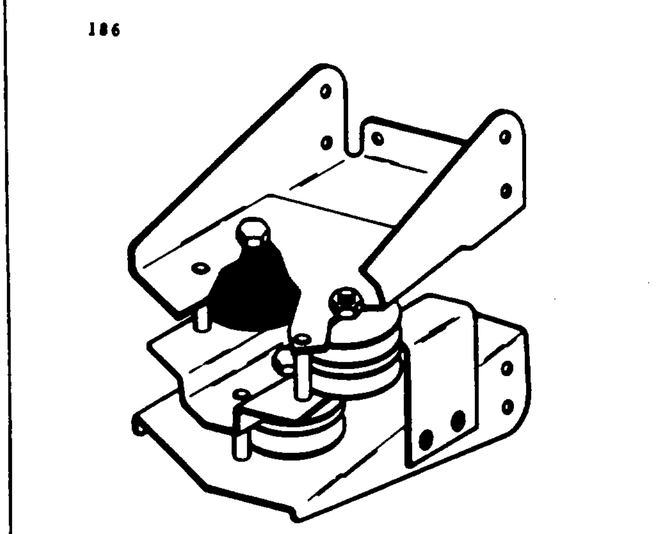
REMOVAL OF ELEVATOR BELLCRANK ASSEMBLY. (Refer to Figure 27-16.)

1. Remove the left pilot's seat and the floor panel located to the left of the control pedestal.
2. Relieve cable tension from the control system by loosening one of the cable turnbuckles at station 86.50.
3. Remove the access plate on the side of the fuselage under the horizontal stabilizer and the tail cone.
4. At the bellcrank, disconnect the elevator control cables.
5. Disconnect the elevator bungee spring from between the attachment bracket at the fuselage bulkhead and elevator control rod.
6. Disconnect the elevator control rod from between the bellcrank and elevator horn.
7. Remove the bellcrank from its mounting bracket.

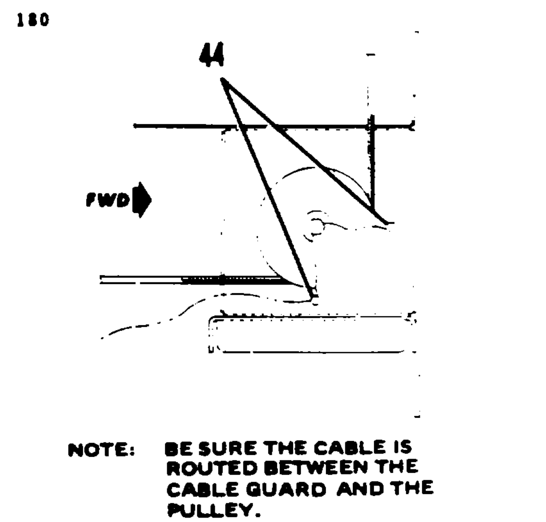
INSTALLATION OF ELEVATOR BELLCRANK ASSEMBLY. (Refer to Figure 27-16.)

1. Position the bellcrank, install pivot bolt and torque to 60-85 inch-pounds.
2. Attach the forward end of the control rod to the bellcrank and secure.
3. The aft end of the control rod and balance spring are to be connected during rigging and adjustment.
4. Connect the control cables to the bellcrank. Tighten bolts so that the cable ends may turn freely on the bellcrank and safety.
5. Check cable tension per Figure 27-17 and rigging and adjustment.
6. Install access plates, tail cone and seat.





SKETCH A



VIEW A-A

Figure 27-16. Elevator and Elevator Trim Controls

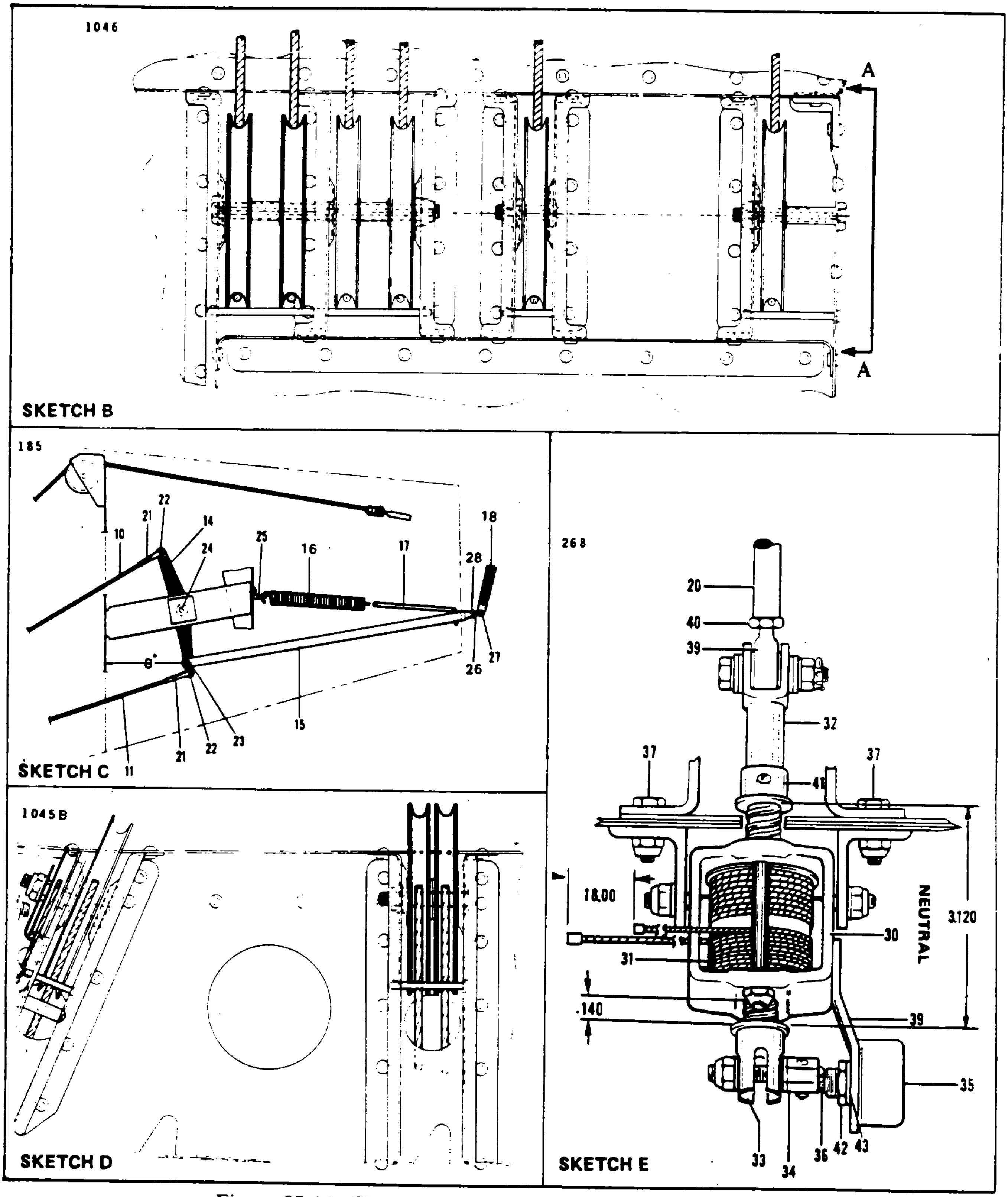


Figure 27-16. Elevator and Elevator Trim Controls (cont.)

RIGGING AND ADJUSTMENT OF ELEVATOR CONTROLS. (Refer to Figure 27-16.)

1. Ascertain that the left pilot's seat, the floor panel to the left of the control pedestal, an access plate on the side of the fuselage under the horizontal stabilizer and tail cone are all removed.
2. Put the elevator in neutral position by placing a modified straightedge, as shown in Figure 27-18, against the underside of the horizontal stabilizer, next to and inboard of the row of rivets at station 19.00 with the aft end of the tool even with the trailing edge of the elevator. (This tool may be fabricated from dimensions given in Chapter 95.)
3. With the elevator in neutral position, check or adjust the elevator bellcrank for neutral. The bellcrank is neutral when the center of the forward attachment bolt of the elevator control rod is at eight inches as measured perpendicular back from the bulkhead at station 317.75. Obtain this setting by turning the control rod end to the desired length and secure with jam nut.
4. With the elevator bellcrank neutral, adjust the turnbuckles at fuselage station 110.50 to obtain cable tension as given in Figure 27-17 and correct tension to ambient temperature per Chart 2702. Allow the control wheel to neutralize fore and aft. The neutral position of the control wheel is 8.75 ± .25 inches as measured from the instrument panel along the underside of the control column to the wheel.
5. To set the proper tension of the elevator balance spring, connect a spring scale to the aft end of the spring and pull rearward until 37 lbs. ± 1 lb. tension is obtained with the elevator in the neutral position. At this point observe which hole in the link is in line with the hood at the end of the spring and connect the spring into this hole in the link. If 37 lbs. ± 1 lb. cannot be reached with existing link holes, refer to latest revision of Piper Service Bulletin No. 549 and No. 626.

— *NOTE* —

If provisions are provided for safety wiring the nut and screw on the elevator hinge assembly, safety wire with MS20995C as shown in Figure 27-10. The lock wire should always be installed and twisted so that the loop around the head stays down and does not tend to come up over the bolt head and leave a slack loop.

6. With the elevator neutral, place a bubble protractor on the inboard section of the elevator and establish neutral or zero on the protractor. Move the elevator up until the control arm contacts its stop. (Refer to Figure 27-19.) Check the up travel as given in Figure 27-17. Adjust the stop screw in or out to obtain proper adjustment. Move the elevator down and check and adjust by the same method. Tighten adjustment screw locknuts and torque to 20-25 inch-pounds. The elevator control arm should contact its stops before the control wheel contacts its stops.
7. Check control operation and direction of travel, bolts and turnbuckles for safety and installation of cable guards.
8. Check the complete elevator control system (including autopilot, if installed) to determine the friction in the system.
9. Install access plates and panels, tail cone and seats.

Cable Tensions

Elevator	20 lbs. ± 2 lbs.
Elevator Trim Tab	14 lbs. ± 2 lbs.

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.

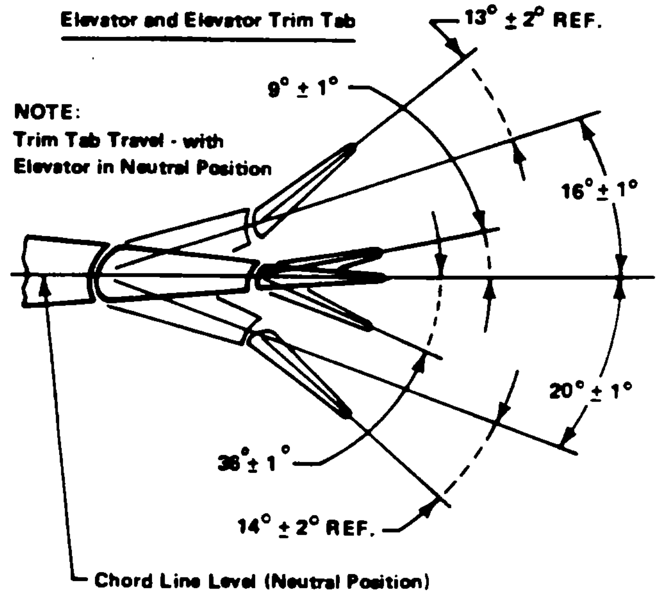


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Figure 27-17. Elevator and Elevator Trim - Travels and Cable Tensions

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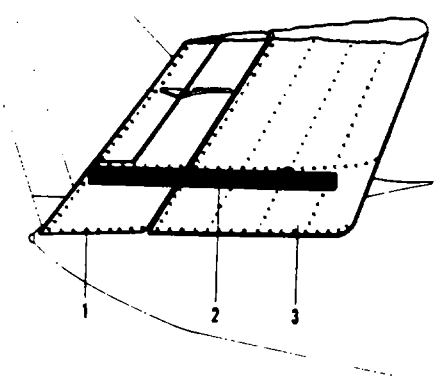

1. ELEVATOR
2. RIGGING TOOL
3. STABILIZER

Figure 27-18. Installation of Elevator Rigging Tool

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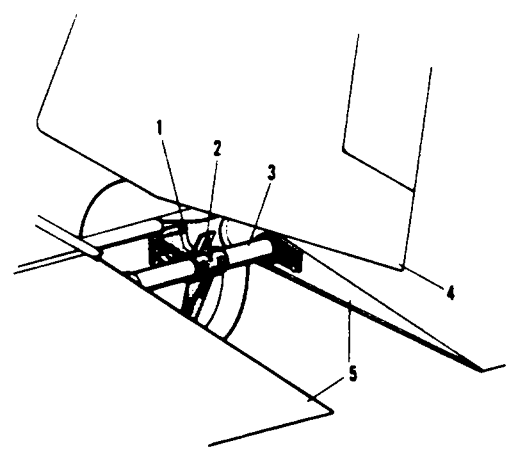


1. STOP BOLT & SAFETY WIRE
2. STOP PLATE
3. TORQUE TUBE
4. RUDDER
5. ELEVATOR

Figure 27-19. Elevator Travel Stops

REMOVAL OF ELEVATOR TRIM ASSEMBLY (CONTROL PEDESTAL). (Refer to Figure 27-16.)

1. Remove the access plates attached to the sides of the control pedestal.
2. Remove the aileron trim control knob by removing the roll pin that secures the knob to the screw assembly shaft and remove knob. Remove the covers from the face of the control pedestal.
3. Remove the right pilot's seat and the right row of passenger seats.
4. Remove the floor panel located aft of the control pedestal, the right panel forward of the main spar, the right first and second panels aft of the main spar and the panel lateral to the entrance door.
5. Remove the interior access panel to the aft section of the fuselage.
6. Block the forward trim cables at the trim screw assembly within the control pedestal and the aft cables at bulkhead 317.75, to prevent the cables from unwrapping from their drums, by one of the methods shown in Figure 27-5. (If the aft screw assembly is also to be removed, then remove the access plate attached to the underside of the horizontal stabilizer and block the cables at the screw assembly instead of in the fuselage.)
7. Mark one set of cable ends at station 291.00 to facilitate installation and disconnect the cables at the turnbuckles.
8. Remove the cable guard pins atfuselage stations 78.00, 99.00 and 244.00.
9. Remove one screw from each set of rub blocks at stations 162.50, 174.00 and 215.00 and open them far enough to allow the cable ends to pass through.
10. Remove the screw that secures the elevator trim control wheel on the spline shaft and remove wheel.
11. Remove the screws that attach the screw assembly to the control pedestal.

INSTALLATION OF ELEVATOR TRIM ASSEMBLY (CONTROL PEDESTAL). (Refer to Figure 27-16.)

1. Ascertain that the cable is evenly wrapped on the trim drum (centered) and blocked to prevent unwrapping. (Refer to Wrapping the Trim Drum.)
2. Position the trim screw assembly in the control pedestal and secure.
3. Draw the cables from the pedestal through the fuselage to the aft section of the fuselage.
4. If the trim cables from the elevator are installed, connect the cable ends. (If the cables from the elevator are not installed, pull the cables tight and block them in the fuselage at bulkhead 244.00.)
5. With the cables installed and connected, install the cable guard pins at stations 78.00, 99.00 and 244.00, and close and secure the rub blocks at stations 162.50, 174.00 and 215.00.
6. Remove the cable blocks.
7. Install the trim control wheel on the trim screw shaft at the side of the pedestal and secure with screw.
8. Set cable tension with the turnbuckles at station 291.00 per Figure 27-17 and check rigging and adjustment.
9. Install the cover on the face of the control pedestal and the aileron control knob and secure knob with roll pin.
10. Install access plates, panels and seats.

REMOVAL OF ELEVATOR TRIM ASSEMBLY (ELEVATOR). (Refer to Figure 27-16.)

1. Remove the interior access panel to the aft section of the fuselage.
2. Remove the access plates located on each side of the fuselage under the horizontal stabilizer; the plate, under the rudder, on the top aft section of the fuselage; and the plate on the underside of the right horizontal stabilizer.
3. Block the trim cables to prevent them from unwrapping at the screw assembly within the horizontal stabilizer and within the fuselage at the bulkhead at station 244.00 by one of the methods shown in Figure 27-5. (If the trim assembly within the fuselage is also to be removed, then block the cables at the trim screw assembly in the control pedestal.)
4. Mark one set of cable ends within the fuselage at station 291.00 to facilitate installation and disconnect the cables at the turnbuckles.
5. Remove the cable guard pin at station 352.00 through the access opening at the top aft section of the fuselage.
6. Disconnect the electrical leads from the sender unit.
7. Disconnect the trim control rod from the trim screw.
8. Remove the cap bolts that attach the screw assembly to the stabilizer spar.
9. Remove the screw assembly and draw the trim cables from the fuselage and elevator.

INSTALLATION OF ELEVATOR TRIM ASSEMBLY (ELEVATOR). (Refer to Figure 27-16.)

1. Ascertain that the trim cable assembly is evenly wrapped (centered) on the drum and the cables are blocked to prevent them from unwrapping.
2. Allow the sender arm to rotate freely on the sender shaft until trim rigging and adjustment is made.
3. Position the screw assembly with sender unit attached in the horizontal stabilizer; install the attachment cap bolts and secure. (Do not connect the fork of the trim screw to the control rod and arm assembly until trim rigging and adjustment is made.)
4. Draw the trim cables through the stabilizer into the fuselage and connect them at the turnbuckles at station 291.00. (If the cables from the control pedestal are not installed, draw the cables tight and block them at the bulkhead at fuselage station 317.75. Install the trim screw assembly in the control pedestal.)
5. Remove the cable blocks from next to the trim screw assembly and from the cables leading from the control pedestal.
6. Connect the electrical leads to the sender unit.
7. Install the cable guard pin at fuselage station 352.00.
8. With the complete trim control system installed, set cable tension with turnbuckles at station 291.00 per Figure 27-17 and check rigging and adjustment.
9. Install access plates and panels.

REMOVAL OF ELEVATOR TRIM SENDER ASSEMBLY. (Refer to Figure 27-16.)

1. Remove access plate located on underside of right horizontal stabilizer.
2. Disconnect the electrical leads to the sender.
3. Loosen the bolt that secures the sender arm on the sender shaft.
4. Loosen and turn off nut that attaches sender unit to mounting bracket.
5. Slide the sender from the mounting bracket and the sender arm.
6. Remove the sender through the access opening.
7. The sender arm may be removed from the trim screw, if desired.

INSTALLATION OF ELEVATOR TRIM SENDER ASSEMBLY. (Refer to Figure 27-16.)

1. If removed, install the sender arm on the trim screw.
2. Insert the shaft of sender unit through mounting bracket, lockwasher, locknut and sender arm.
3. Position sender unit on its mounting bracket by placing the index tab on the sender into the index slot in the bracket. Secure sender on the mounting bracket. (Allow the arm to rotate freely on the sender shaft until adjustment is made.)
4. Connect the electrical leads to the sender.
5. Rig the sender unit.
6. Install access plate.

RIGGING AND ADJUSTMENT OF ELEVATOR TRIM. (Refer to Figure 27-16.)

1. To adjust the elevator trim, it must be ascertained that the following has been accomplished either during installation or as a preadjustment check:
   A. Trim cables are evenly wrapped (centered) on the drum in the control pedestal, and both turnbuckles are located approximately at fuselage station 291.00.
   B. Cable tension is set as given in Figure 27-17.
2. Remove the access plate on the underside of the right horizontal stabilizer.
3. Rotate the trim drum until 8-1/2 wraps exist on the drum at the aft (base end) series of cable wraps. (The drum is in neutral at this position.)
4. Check that there is .14 of an inch between the forward screw stop and the drum housing measured along the screw. If this measurement is not correct, disconnect the fork of the trim screw from the trim control rod, if not previously disconnected, and turn the trim screw until .14 of an inch is obtained. Hold the trim drum neutral while turning the screw. (The trim screw neutral position is at this measurement.) Reconnect with screw stop nuts down.
5. With the trim screw, trim drum and elevator in neutral position, the trailing edges of the tab and elevator should align. Should they not, loosen the jam nuts on each end of the control rod and rotate the rod until the trailing edges align. Tighten jam nuts.
6. Turn the trim each direction to the screw stops to check tab angle as given in Figure 27-17, and also check minimum number of cable wraps left on the drum. (Minimum allowable is one and one-quarter turns.)
7. Check rigging and adjustment of trim sender and indicator.

RIGGING AND ADJUSTMENT OF ELEVATOR TRIM SENDER AND INDICATOR. (Refer to Figure 27-16.)

1. Remove the access plate on the underside of the right horizontal stabilizer.
2. Ascertain that the elevator trim is properly adjusted.
3. With the arm on the sender shaft free to rotate, set the elevator and elevator tab in neutral position.
4. Calibrate the trim indicator located in the control pedestal by first rotating the sender shaft, as viewed from the shaft end, in a clockwise direction to its stop position.
5. Turn on the master switch. A minimum of 24-volts must be supplied to the electrical system when making this adjustment.

6. Rotate the sender shaft slowly counterclockwise, when viewed from the shaft end, until the trim indicator on the pedestal reads neutral. Tighten the arm on the sender.
7. Turn trim to both extremes and observe trim reading. Indicator pointer should travel to both extreme positions on the indicator dial.
8. Should the indicator pointer not reach either extreme position on the dial, return the tab to neutral, loosen the sender in its bracket and slide it closer to the trim screw. Tighten the sender and check neutral indication. If neutral indication has changed, repeat Steps 6 and 7.
9. Install the access plate.

ELEVATOR CONTROL SYSTEM FRICTION MEASUREMENT.

PPS50022-1

The complete control system including Autopilot, if installed, must be checked to determine the total friction. The system must be rigged to its proper travels and cable tensions prior to determining the total friction.

The total friction must not be in excess of six pounds with the bungee spring adjusted to 37 ± 1 pounds. The following procedure will let you determine the actual frictional value of the system:

1. Attach a spring scale to the inboard trailing edge of the elevator.
2. With the spring scale attached, position the elevator trailing edge down approximately 2 inches from the neutral position.
3. Record the force (see Note 2) required to raise the elevator through the neutral position until the trailing edge is approximately 2 inches above neutral.
4. Record the restraining force lowering the elevator from the 2 inch up position through the neutral position to the original 2 inch down position.
5. Repeat above raising and lowering processes until average forces are obtained.
6. The "Total Friction" is obtained by subtracting the two forces.

— NOTES —

1. ***Do not exceed 60 pound force for any measurement.***
2. ***The elevator shall be rotated with a steady movement and the force reading taken when the elevator is passing through the neutral position. Do not stop rotation when taking the reading.***

FLAPS.

This section contains removal, installation, service, disassembly and assembly, rigging and adjustment and functional test procedures for the flap system and its components.

DESCRIPTION AND OPERATION. (Refer to Figures 27-21 and 27-22.)

PPS50015-1

The wing flap control system provides continuous control and monitoring of flap position and condition over its full range. In addition to the limiting of both up and down overtravel, the system will shut the driving mechanism off in the event of a 5° or more differential between right and left flap position and it will self-monitor and automatically react appropriately in the event of critical component failure in the control circuitry.

Preselection of any desired flap position from full up (0°) to full down (40°) is possible thru the positioning of the selector control which has an 80° stroke analog lever. (That is, 2° of lever movement represents 1° of wing flap movement.) The selector incorporates a friction type drag brake to hold the lever at any desired intermediate position as well as ball lock detents at 0°, 15°, and 40° of flap extension. Flaps are deployed mechanically by a single motor driven thru two flexible shafts connected to individual ball screw actuators.

Selection of the desired flap position moves the control rheostat wiper relative to the left wing flap rheostat wiper with a resultant amplifier output which will operate the flap motor through contactors K1 and K2 to move the left and right flaps to the desired position. If at any time the amplifier sees a differential voltage in excess of 0.55 VDC between the left wing flap rheostat wiper and the right wing flap rheostat wiper, the amplifier will shut the system off. This condition corresponds to a maximum differential of 5° of flap position.

A flap fault test switch is provided to check the control circuitry for asymmetrical flap protection as well as the operation of the fault lamp switching transistor. The activation of this switch while flaps are in motion will give a false signal to the right side follower potentiometer, simulating an out-of-sync condition causing the amplifier to shut the system off and illuminate the fault light. Release of the switch will clear the simulated fault and allow the system to respond normally to selector position command.

All adjustments are made with the motor circuit breaker pulled (OFF) and the flaps in the down position. Adjustment procedures will require some special equipment such as a digital voltmeter and flap transmission tools.

FLAP ACTUATOR MOTOR.

REMOVAL OF FLAP ACTUATOR MOTOR. (Refer to Figure 27-23.)

1. Remove the center floor panel located in the main cabin area. The flap actuator motor is located on the forward side of the fuselage bulkhead at station 174.
2. Disconnect the electrical leads from the motor.
3. Cut the safety wire and disconnect the flexible drive shaft ends from the motor.
4. Remove the clamp that holds the motor on its mounting bracket. Remove the motor.
5. If desired to replace the shock grommets in the bulkhead, the motor with its mounting bracket may be removed together by removing the bracket mounting bolts at the bulkhead.

DISASSEMBLY OF FLAP ACTUATOR MOTOR. (Refer to Figure 27-22.)

1. Remove nuts, lockwashers, and screws from motor.
2. Remove rear end bell from sleeve and magnet assembly.
3. Remove front end bell from sleeve and magnet assembly.
4. Remove armature assembly from sleeve and magnet assembly.

— CAUTION —

Strong magnet pull will be encountered when removing the armature from the sleeve and magnet assembly.

5. Remove spring washer and ball bearing from armature shaft.
6. Remove brushes and brush springs from brush holders.
7. Remove four screws and insulator assembly from front end bell.
8. Remove nuts, lockwashers, contact studs and nylon shoulder washers from front end bell.

SERVICE OF FLAP ACTUATOR MOTOR.

1. Wash all disassembled parts except brushes, bearings and armature with a suitable dry cleaning solvent.
2. Examine all parts for cracks, burrs and corrosion.
3. Visually inspect the armature for the following:
   A. Commutator for pitting, scoring or burning.
   B. Loose windings.
   C. Damaged or worn splines.
   D. Worn shaft caused by bearing seizure.
4. Except for repairs to commutator, all parts found to be defective or worn must be replaced with new parts. Do not attempt to repair defective parts. Ball bearings must be replaced at overhaul.
5. Commutator may be turned down to a minimum diameter of 1.093 inch. Polish with fine grade sandpaper.
6. Measure length of brushes. If less than .437 inch they must be replaced.
7. Electrically test the armature as follows:
   A. Bar to bar continuity. Resistance readings should be the same when measuring two adjacent bars as measurement is stepped around commutator.
   B. Insulation resistance between commutator and shaft should be 10 megohm minimum at 85v.

ASSEMBLY OF FLAP ACTUATOR MOTOR. (Refer to Figure 27-22.)

1. Assemble shoulder washers, contact studs, lockwashers and nuts to front end bell. Position flat on contact studs parallel to the side of the brush holder. Torque outer nut to 30-35 inch-pounds.
2. Install insulator assembly on front end bell and secure with 4 screws.
3. Install brush springs and brushes into brush holders. Position brush leads through slot towards center of end bell and connect to contact studs.
4. Attach ball bearings to each end of the armature shaft.

— *NOTE* —

A light press fit on the bearings may be required on the shaft.

5. Install front end bell assembly onto commutator end of armature.
6. Insert armature assembly into sleeve and magnet assembly with commutator end of armature towards larger recess in motor sleeve.

— *CAUTION* —

A strong magnet pull will be encountered when inserting armature assembly into sleeve and magnet assembly.

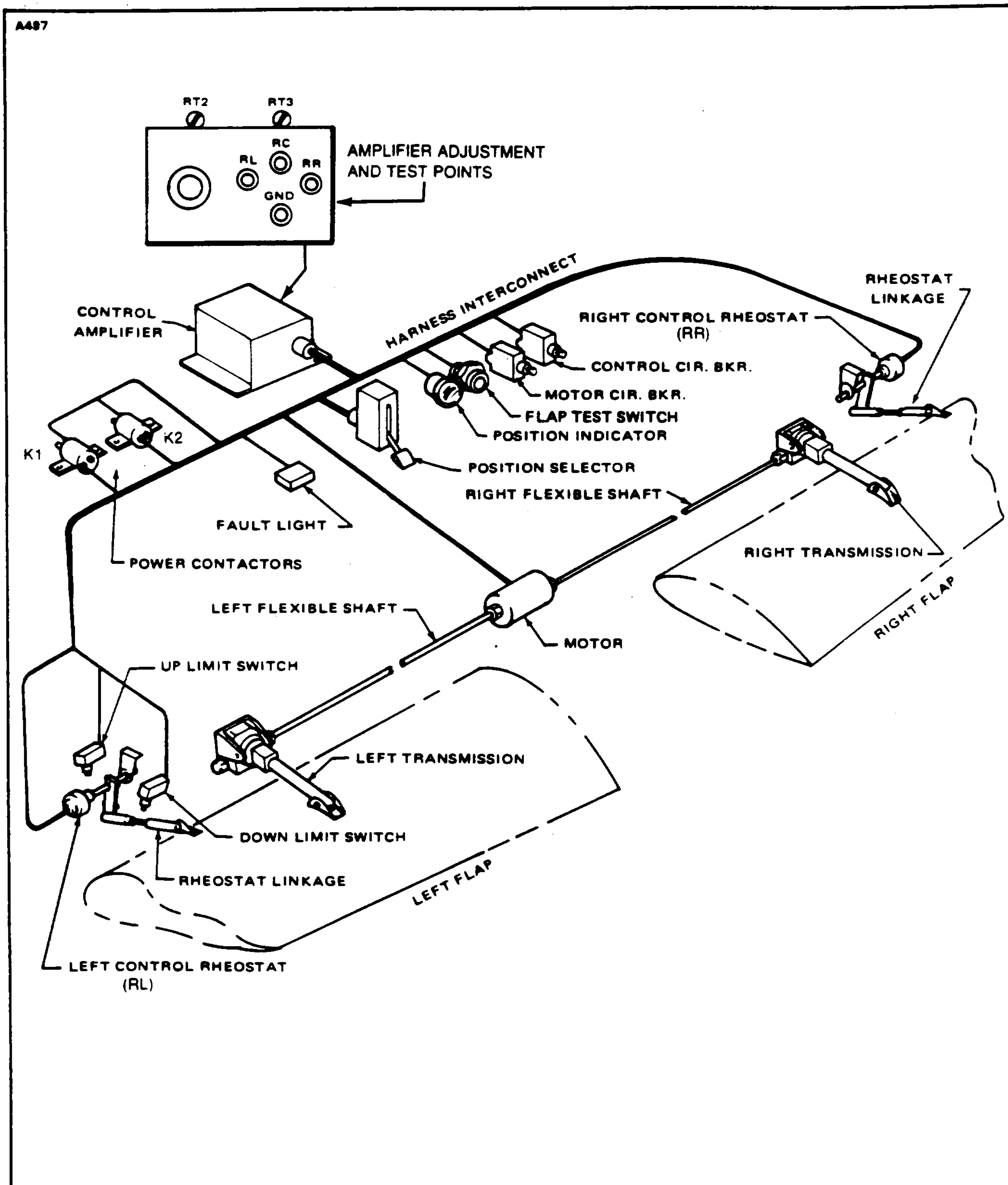


Figure 27-21. Flap System Diagram

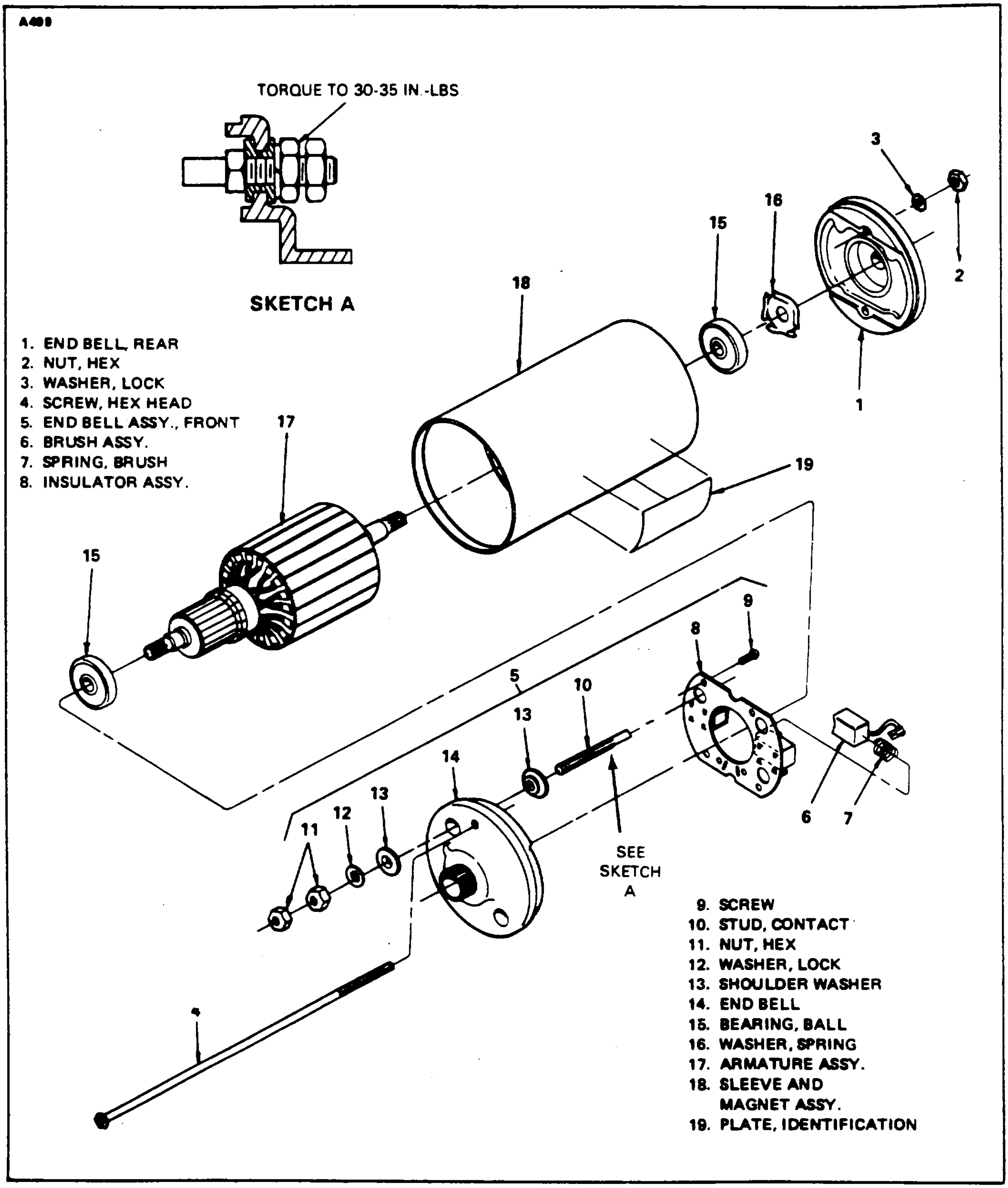


Figure 27-22. Motor Assembly, Exploded View

7. Position front end bell on sleeve so that mounting holes are in line with pin in sleeve and lockwire hole is to the right of the pin.
8. Insert spring washer into bearing bore of rear end bell with tangs on washer pointing up.
9. Install rear end bell on sleeve with mounting holes lined up with pin in sleeve and lockwire hole to the left of the pin.
10. Insert screws through front end bell and rear end bell. Secure with lockwashers and hex nuts. Torque nuts 30-40 inch-pounds.

INSTALLATION OF FLAP ACTUATOR MOTOR. (Refer to Figure 27-23.)

1. Install the shock grommets in the bulkhead at station 174.
2. Install the flap actuator motor and bracket on the forward side of the bulkhead. Ascertain that the anti-rotation pin on the motor fits in the pinhole in the mounting bracket. Secure the holding clamp.
3. Connect the flexible drive shaft ends to the motor and attach nut fingertight, secure with MS20995-C41 safety wire.
4. Connect the electrical leads.
5. Check flap rigging and adjustments per instructions given in this section.
6. Install access plates and panels.

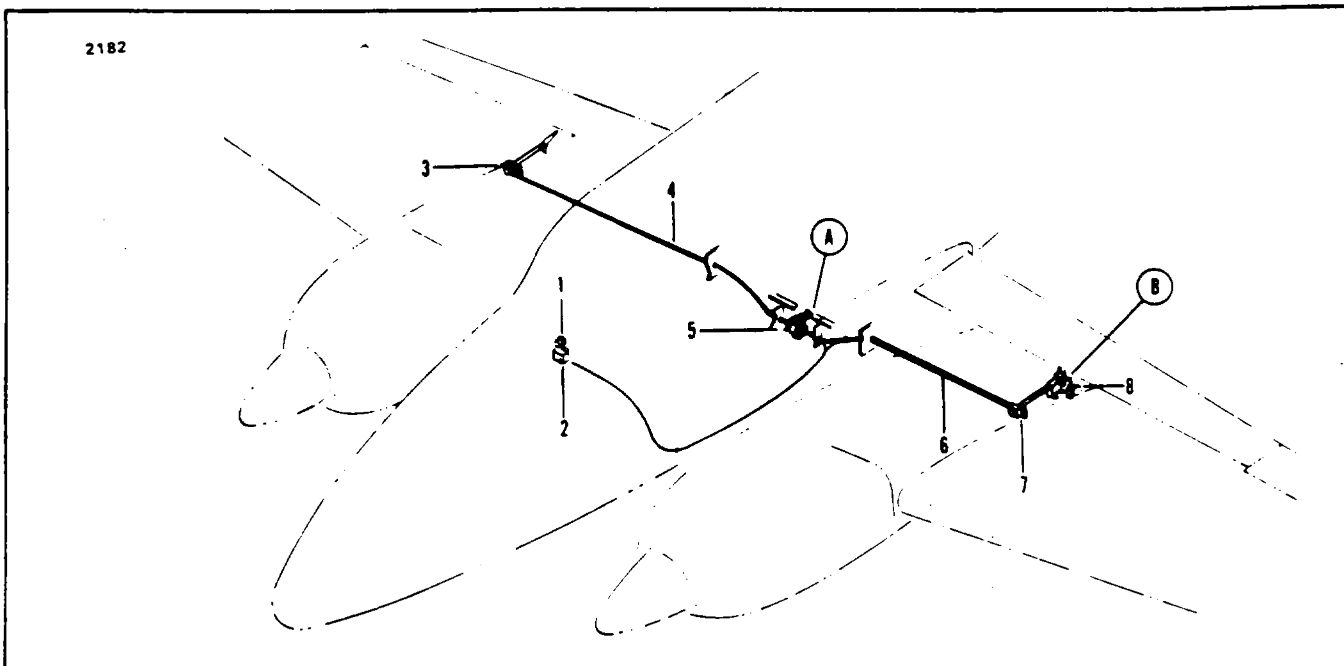
FLEXIBLE ACTUATOR SHAFT. (Refer to Figure 27-23.)

REMOVAL OF FLEXIBLE ACTUATOR SHAFT. (Refer to Figure 27-23.)

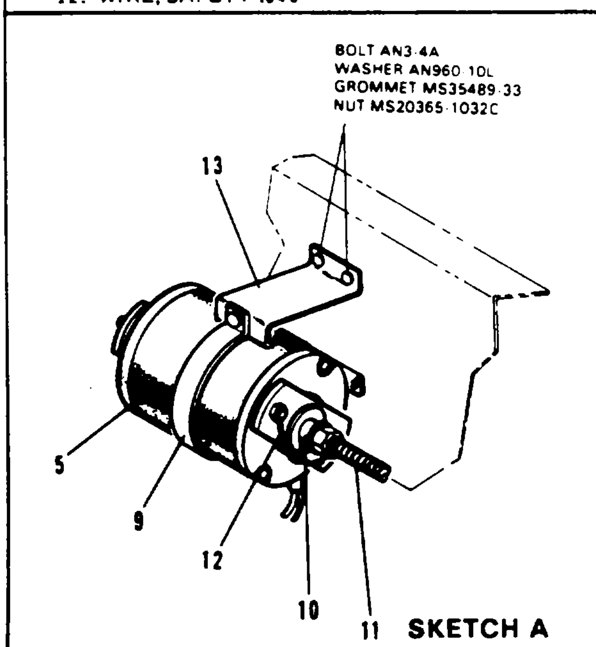
1. Remove the center floor panel located in the main cabin area.
2. Remove the right and/or left row of seats and floor panels aft of the main spar.
3. Remove the aft access plate on the fairing located on the underside between the fuselage and wing.
4. Remove the access plates at the aft side of the wheel well at stations 34.50, 44.50 and 54, and on the underside of the wing at stations 65, 82.75 and 92.50.
5. Cut the safety wire and disconnect the shaft from the actuator motor and flap transmission.
6. Remove the support clamp on the fuselage bulkhead and the support grommets within the wing and fuselage.
7. Remove the actuator shaft.

INSTALLATION OF FLEXIBLE ACTUATOR SHAFT. (Refer to Figure 27-23.)

1. Draw the shaft through the wing into the fuselage.
2. Connect the flexible drive shafts to the transmissions. Be sure that the splines are properly engaged and run the shaft attaching nut on fingertight. Safety the nut with MS20995-C41 safety wire.
3. Check the flap rigging and adjustments per instructions given in this section.
4. Install the access plates, panels, clamps, grommets and seats.



1. INDICATOR, FLAP POSITION
2. SELECTOR SWITCH
3. TRANSMISSION ASSY, RIGHT
4. SHAFT ASSEMBLY, RIGHT
5. MOTOR
6. SHAFT ASSEMBLY, LEFT
7. TRANSMISSION ASSY, LEFT
8. FLAP POSITION SENDER ASSY
9. STRAP, MOTOR SUPPORT
10. NUT
11. SHAFT ASSEMBLY
12. WIRE, SAFETY .040
13. MOUNTING BRACKET, MOTOR
14. ROD, LINKAGE
15. BUSHING AND SCREW ASSY
16. FLAP HORN
17. BOLT ASSEMBLY
18. TUBE, TRANSMISSION
19. SWITCH, DOWN LIMIT
20. SHAFT, SENDER
21. ARM, SENDER
22. SENDER; FLAP POSITION
23. SWITCH , UP LIMIT
24. ADJUSMENT BOLT, UP LIMIT
25. ADJUSTMENT BOLT, DOWN LIMIT
26. ATTACHMENT BOLT ASSY
27. GROMMET
28. BOLT ASSY, SENDER ARM



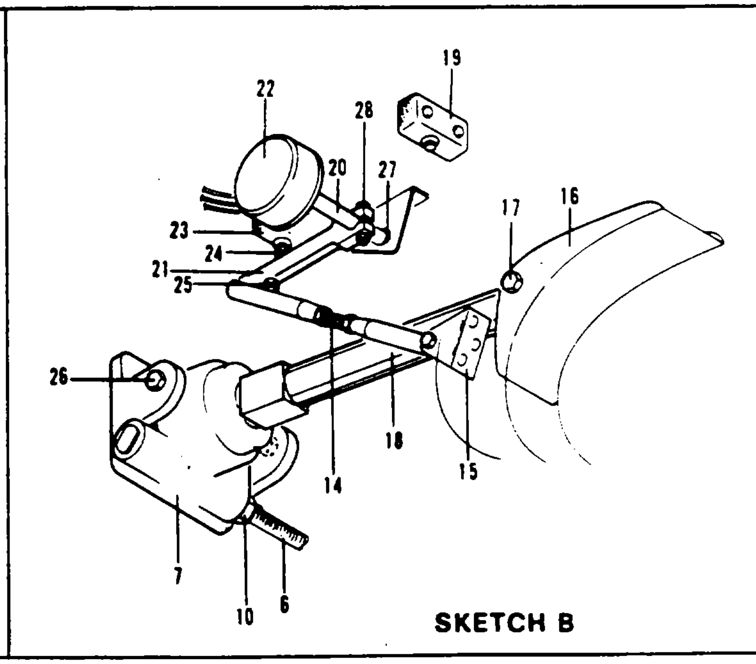


Figure 27-23. Flap Controls

FLAP TRANSMISSION.

REMOVAL OF FLAP TRANSMISSION. (Refer to Figure 27-23.)

1. Lower the flap and remove the access plate on the aft underside of the wing and at the false spar area, both of which are at station 92.50.
2. Disconnect the transmission tube from the flap horn bracket.
3. Remove the safety wire and disconnect the flexible actuator shaft.
4. Remove the spreader bushing and washers from between the transmission attachment brackets.
5. Remove the transmission from its mounting brackets and draw the unit through the access opening in the wing false spar.

INSPECTION OF WING FLAP TRANSMISSION. (Refer to Figure 27-24.)

The flap transmissions are inspected at the first 500 hour inspection cycle of the aircraft and at each 100 hours thereafter. This is accomplished without removal of the transmission, by the following procedures:

1. Position the flaps in the extended position (Down).
2. Remove the access covers on the lower wing surface to gain access to the flap transmissions.
3. With the use of vise grip pliers and exerting light pressure, grasp the exposed portion of the screw close to the transmission as shown. (Refer to Views A and B.)
4. With the pliers secured to the screw, a light pressure will move the pliers and screw as free play in the transmission gear set is taken up in either direction. Do not force the pliers.
5. Place a six inch ruler along the skin surface as shown in View B, and measure the overall distance the pliers move.
6. Should the dimension exceed .300 of an inch, replace the transmission assembly.
7. Reinstall the access panels and make appropriate logbook entry.
8. Continue inspection at 100 hour intervals.

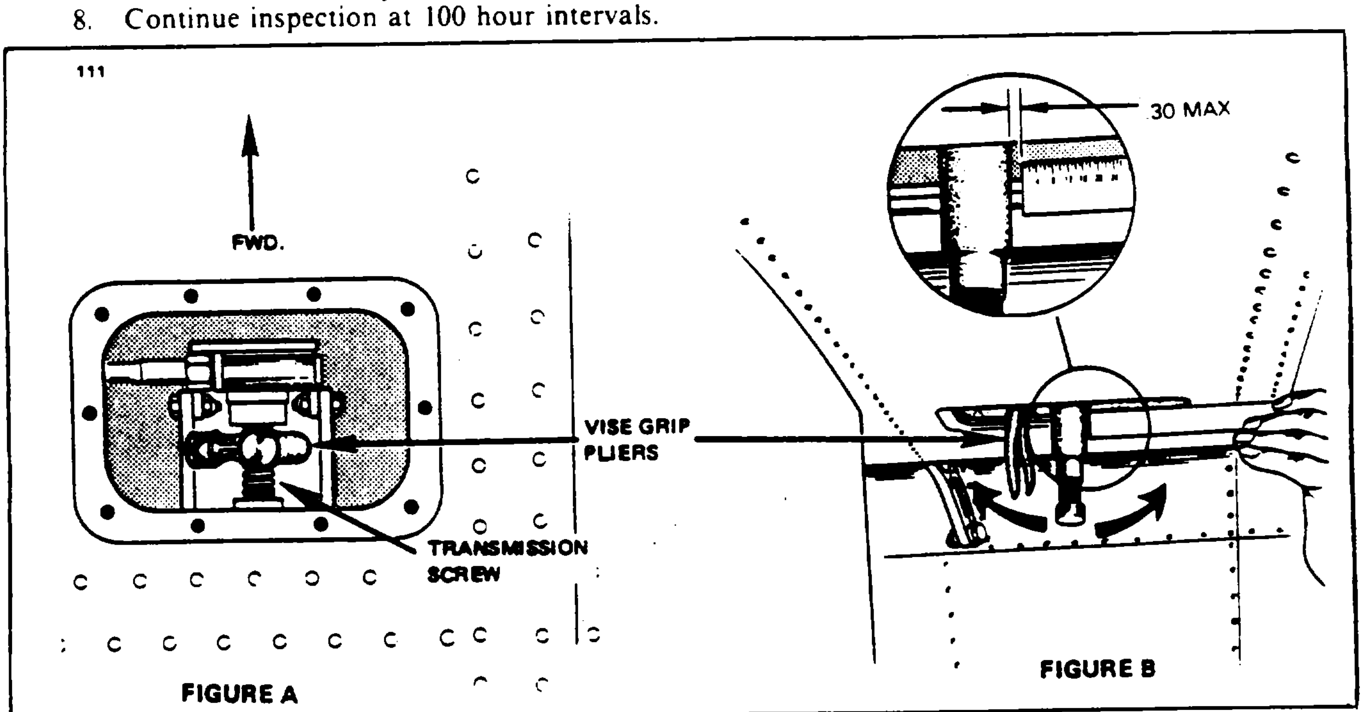


Figure 27-24. Wing Flap Transmission Inspection

INSTALLATION OF FLAP TRANSMISSION. (Refer to Figure 27-23.)

Ascertain that the correct flap transmission assemblies are being installed by checking the part numbers on the assemblies with information in the latest T-1020 Parts Catalog.

1. Lubricate the flap transmission assembly in accordance with lubrication chart.
2. Insert the transmission through the access opening in the wing false spar and attach to its mounting brackets. To allow the transmission to rotate, tighten the attachment bolts only finger tight and safety.
3. Install the spreader bushing with one washer between each mounting bracket and bushing. Install the through bolt and secure.
4. If working with the left transmission, connect the flexible actuator shaft and safety with MS20995-C41 safety wire. Attach the right flexible shaft during rigging and adjustment.
5. Check the flap rigging and adjustment per instructions given in this section.
6. Install access plates.

RIGGING AND ADJUSTMENT OF FLAP SYSTEM. PPS50035-1

Following are definitions of terms used in the description and service information presented in the following paragraphs:

RC — Control Rheostat Wiper
RL — Left Wing Flap Rheostat Wiper
RR — Right Wing Flap Rheostat Wiper
VC — Voltage at RC (Control)
VL — Voltage at RL (Left Flap)
VR — Voltage at RR (Right Flap)
ΔVCL — Voltage difference between VC & VL at flap-up position
ΔVCR — Voltage difference between VC & VR at flap-up position
ΔVRL — Voltage difference between RL & RR
RT2 — Amplifier Trimmer Adjustment - Left
RT3 — Amplifier Trimmer Adjustment - Right
VC_{l} - VC+ (.10 +.10/-.05)

The Control rheostat operated by the Flap Selector will be referred to throughout this rigging procedure as RC (rheostat control). The wing flap rheostats will be designated as RL (rheostat left) and RR (rheostat right). The voltages present or read at the center taps will be referred to as VC, VL and VR respectively.

1. Proper operation requires that the rheostat (RL) on the left flap respond to any changes in the flap position selector rheostat (RC) in the form of VL and VC. It follows that the amount of stroke travel, as well as how it is centered with respect to the ends, will be determined by how RL is adjusted relative to RC. Since VC is fixed and cannot be changed, a trimmer pot RT2 is provided in the control amplifier to allow adjustment of VL to agree with VC.
2. Throughout all of the adjustment procedures it is important that, whatever changes are made to RL and RT2, must also be made to RR and RT3. It is the function of RR to track RL over the entire stroke range and shut the system OFF if the outputs in the form of VL and VR deviate by more than 0.55 volts. This voltage differential (ΔV) corresponds to a five degree asymmetrical flap condition. An additional function of RR is to provide a voltage input to the control amplifier in order to provide an output to the flap position indicator.

— NOTE —

In general, the adjustments of RL, RR, RT2 and RT3 are always made with the flaps in the DOWN position and the magnitude of these adjustments will be based on the values of VC, VL and VR measured with flaps in the UP position.

— WARNING —

All adjustments must be made with the motor power off.

— CAUTION —

Ascertain that all electrical power to the flap control system is OFF. (Pull flap control and motor circuit breakers, set battery master switch OFF and have no external power applied to the aircraft.)

A. Remove access plates on the false spar at wing stations 92.50 and 101.0 for both right and left wings.

B. Remove access plates on the bottom of the wings at wing stations 82.75 and 92.50.

C. Ascertain that the flap position sender arm is free to rotate on the rheostat shaft and that the linkage rod is set at the proper length. (See Figure 27-29, Sketch A.)

D. With the transmission assemblies disconnected from the flap horns and the sleeves turned in all the way to the ball nut seat, ascertain that the flaps are free to roll full travel on the flap tracks.

E. Attach the flap rigging tools on the left and right wings upper surface, at station 147.50, by using existing rivnuts.

— NOTE —

When measuring the flap deflection angles lift the trailing edge of the flap to eliminate play between rollers and track slots.

F. Adjust the UP limit actuating bolt so that the UP limit switch is actuated when the flap is moved (manually) to the 0 degree position as indicated by the rigging tool.

G. Repeat the procedure of Step F, preceding to adjust the DOWN limit switch (40 degrees).

— NOTE —

The following rigging limits:
UP 0° +1°/-0° (0° to 1° down)
APPROACH 15° +1°
DOWN 40° +1°

H. Support the left flap in the full DOWN position as indicated by the rigging tool. Turn the transmission sleeve for the left flap out from its forward stop (recording the number of turns) until the attachment hole in the sleeve aligns with the corresponding hole in the flap horn. Temporarily install the attachment bolt.

I. Repeat the procedure of Step H, preceding for the right flap. If the number of turns (plus or minus one half turn) does not provide alignment of the attachment hole in the sleeves with the corresponding hole in the flap horns (attachment bolt cannot be installed), loosen the bolts attaching the horn to the flap sufficiently to permit movement of the horn by tapping to achieve proper alignment. Temporarily install the attaching bolt. Retorque the horn attaching bolts. Remove any supporting means from the flaps which should now be held in place by the sleeve attaching bolts.

J. Install castellated nuts on the sleeve attaching bolts and tighten the nuts so as to allow .03 of an inch thrust play for the bolts. Safety with cotter pins.

K. Connect the flexible drive shafts to the transmissions. Be sure that the splines are properly engaged and run the shaft attaching nut on finger tight. Safety with MS20995C41 wire.

L. Remove the covers from RT2 and RT3 on the flap control amplifier and ascertain that both trimmers are in their full clockwise position (maximum resistance).

M. Insert a 30 amp fuse (for test purposes only) in the flap motor electrical power connection.

N. Apply external power to the aircraft and establish bus voltage at 28 + .5 volts.

O. Place the flap selector in the DOWN position.

P. Engage flap control circuit breaker - DO NOT engage flap motor circuit breaker at this time. Allow five minutes warm-up time.

Q. Measure voltage at VC and adjust voltages of RL and RR by rotating the shafts at the wing pots as follows:

(1) VL shall be .10 +.10/-.05 below VC in the DOWN position and .10 +.10/-.05 above VC in the UP position.

(2) VR may be adjusted to within .01 volt of VC to allow the indicator to read correctly. (Suggest using a difference between VR and VC of .1 volt for initial adjustment.)

R. Lock actuator arms on rheostat shafts. Remeasure VC, VL and VR to be sure they are still the same values. Readjust if necessary. Record voltages on work sheet.

S. Move flap selector to the UP position. Listen for audible click of the motor solenoid. If solenoid does not actuate check wiring for proper interconnect.

T. Move flap selector back to full DOWN position.

U. Engage the flap motor circuit breaker and move selector to full UP position. When the flaps stop moving (actuating arm may not engage the UP limit switch) record system voltages on a work sheet as follows:

	VC	VL	VR
DOWN Position	X.XX	X.XX	X.XX
UP Position	X.XX	X.XX	X.XX

V. The values at the DOWN position have already been established for VC, VL and VR in Step Q preceding. At this time enter the reading for VC, VL and VR at the UP position. The work sheet might now resemble the following example (voltage values used in this example are for illustrative purposes only. They are NOT system requirements):

	VC	VL	VR
DOWN	9.15	8.95	8.95
UP	4.06	4.38 (See Steps 3 & 4)	4.36 (See Steps 3 & 4)

— CAUTION —

No adjustments are to be made at the wing rheostats (RL and RR) until the flap motor circuit breaker is pulled.

3. If VL and VR differ by more than .50 volts, an out of sync. shutdown has occurred due to an actuator arm being loose on the rheostat shaft. If this has happened, place a jumper wire between RL and RR at the amplifier and select flaps full DOWN. Pull flap motor circuit breaker and readjust voltages at RR and RL as per Step Q and begin again.

4. If VL is within .04 volts of VC the system has shutdown because the amplifier sees that the position selected (VC) and the position sensor (VL) have been satisfied. If this has happened, reselect flaps to full DOWN, readjust voltages at RL and RR per Step Q with greater spread between VL, VR and VC, than the initial adjustment.

5. If the system has completed a full stroke (up limit switch has been engaged) and the flap position indicator reads correctly, no further adjustment is necessary. (It is considered acceptable if the indicator pointer center line is tangent to the upper or lower edge of the indicator graduation mark.) This is provided that VL and VR are within the limits of Step Q. Proceed to Step 8. If position and / or indicator criteria are not satisfied, proceed as follows: Calculate VC_1 by the formula: $VC_1 = VC + (10 +.10/-.05)$.

A. Calculate the voltage difference between VC_1 and VL, VC_1 and VR as measured in the UP position. Multiply the voltage difference by 2 as shown in the following example:

					Voltage Difference between VC_1 and VL		Voltage Difference between VC_1 and VR	
Flap	VC	VC_1	VL	VR	Higher	Lower	Higher	Lower
UP	4.06	4.16	4.38	4.36	ΔVCL = .22V x 2 Adj. = .44		ΔVCR = .20V x 2 Adj. = .40	
DOWN	9.15	N A	8.95	8.95				

— *CAUTION* —

Make no adjustments until the flap motor circuit breaker is pulled OFF.

B. With the flaps extended, adjust VL at the rheostat shaft so that the voltage is 2 x ΔVCL (.44V in the example) below the original VL reading in the DOWN position. Tighten the actuator arm. Now adjust RT2 so that VL reads .10 +.10/-.05 below VC in the DOWN position.

C. With the flaps extended, adjust VR at the rheostat shaft so that the voltage is 2 x ΔVCR (.40V in the example) below the original VR reading in the DOWN position. Tighten the actuator arm. Now adjust RT3 so that VR reads .10 +.10/-.05 below VC in the DOWN position.

6. Reinstate the flap motor circuit breaker and select flaps full UP. Record voltages as per Step U, and repeat the procedures if required. No more than two repeats should be necessary. Ascertain the VL and VR are within limits of VC as specified in Step Q.

7. Check the position indicator readings against the flap selector and flap deflection, using the following procedure:

A. When measuring flap deflection angles, lift the trailing edge of the flap to eliminate play between the rollers and the track slots. If the indicator does not correspond to the flap position, place the flaps in the APPROACH position.

B. Adjust the flap indicator "Trimmer," located on the inboard end of the amplifier box (opposite the connector end), so that the flap indicator needle falls in the center of the APPROACH graduation.

C. Check the location of the flap indicator needle in the UP and DOWN positions. Adjust the "Trimmer" so that the needle centerline falls within or tangent to the upper or lower edge of the graduation in the UP, APPROACH, and DOWN positions.

— *NOTE* —

If the "Trimmer" is rotated to raise the needle, the needle will raise about the same in all three positions.

D. If unable to adjust the indicator needle to provide proper indication (as in example below), proceed with the following steps:

EXAMPLE

Flap Position	Needle Indicator
UP APPROACH DOWN	Center of graduation Center of graduation Below down graduation

(1) Adjust indicator "Trimmer" so that the flap indicator needle is at the upper tangent of the graduation at UP and APPROACH positions.
(2) Now adjust RT3 so that the needle falls within the DOWN graduation.
(3) Recheck indicator at UP, APPROACH and DOWN positions readjusting the "Trimmer" as required.
(4) Check that VL and VR are still within the limits of VC as specified in Step Q, and that the position indicator agrees with the flaps position in the UP, APPROACH and DOWN positions.

8. After the system is properly rigged for stroke and position indication, place the positive probe of the digital voltmeter in RR at the amplifier and the negative probe in the RL. Select the flaps full DOWN and monitor the voltage throughout the extension. Voltage is not to exceed .15 volts at any time.

— *NOTE* —

The System should be allowed to warm up for approximately five minutes before making any electrical adjustments.

9. Run the flaps through three complete UP, DOWN cycles to ensure proper operation of flaps.
10. Check flap deflection angles with rigging tools installed at DOWN, APPROACH and UP settings, observing Note below.

— *NOTE* —

When measuring flap deflection angles, lift the trailing edge of the flap to eliminate play between rollers and track slots.

If out of limits, repeat the rigging procedure, beginning with Step Q. If satisfactory, remove rigging tools and install screws in rivnuts on upper wing surface.

11. Locate the flap system test switch on the aircraft instrument panel. Move the flap selector handle to the full DOWN position and activate the test switch at approximately 15 degrees of flap travel. Observe that the wing flap light (amber) located in the annunciator panel is illuminated and the flap extension has stopped. Release flap system test switch. Observe that annunciator light is extinguished and flaps continue to extend to the full DOWN position.
12. Remove the 30 amp fuse installed in Step M, and install all access plates removed.

FLAP CONTROL BOX.

REMOVAL OF FLAP CONTROL BOX.

1. Remove the knob from the control box.
2. Remove the electrical connector from the rear side of the control box.
3. Remove the two screws that secure the control box to the instrument panel.
4. Remove the control box from the instrument panel.

— NOTE —

It is recommended that the flap control box (selector) be sent back to manufacturer for servicing. Environ Division of Calco Mfg. Co., 506 Highway 27 North, Haines City, Florida 33844.

INSTALLATION OF FLAP CONTROL BOX.

1. Install the flap control box in the instrument panel.
2. Install the two screws that secure the control box.
3. Connect the electrical leads.
4. Install the knob.

FLAP CONTROL AMPLIFIER.

REMOVAL OF FLAP CONTROL AMPLIFIER.

1. Open access door in nose of airplane to gain access to amplifier at station 35.00.
2. Disconnect the electrical plug from the amplifier.
3. Remove the attaching screws and remove the amplifier from the airplane.

INSTALLATION OF FLAP CONTROL AMPLIFIER.

1. Install control amplifier in airplane and secure with attaching screws.
2. Connect the electrical plug to the amplifier.
3. Check rigging and adjustment of flaps per instructions given in this section.
4. Close and secure access door.

ELECTRICAL SYSTEM FUNCTIONAL TEST PROCEDURE.

— NOTE —

The serviceman should refer to Figure 27-28 for amplifier schematic and Chapter 91 for the schematic diagram of the system when accomplishing this test procedure. To gain access to the system components refer to the appropriate Removal and Installation Instructions in this section of the manual.

1. Pull all circuit breakers to the OUT position.
2. Actuate the flap motor and flap control circuit breakers.
3. Turn ON battery master switch or connect external power to aircraft.
4. Operate the flap selector handle in the control box and observe UP and DOWN operation of wing flaps.
5. If the wing flaps fail to operate, check fault light. If fault light is ON, proceed to Step 14. If fault light is OFF proceed to Step 6.
6. Check for 27.5-volts at motor contactor and pin 1 of connector J1 to verify circuit breakers and wiring are not defective.
7. Check for 27.5-volts across power terminals of both K1 and K2 relays.
8. Disconnect the flex shaft(s) from the motor assembly.
9. If the drive motor fails to operate, check the UP and DOWN limit switches in the 27.5-volt leg of the coils of relays K1 and K2. Do this by checking for 27.5-volts at the N.C. contacts on the limit switches.
10. To check the drive motor and relay operation, disconnect the electrical harness plug connector E368. Ground relay K1 at pin 6 or relay K2 at pin 4 of the connector, then fabricate a jumper lead to extend from pin 1 (A+) of the connector to either wire lead F4E of relay K1 or wire lead F4D of relay K2 to actuate either the up or down relay and run the motor.
11. Check the 27.5-volt power at the drive motors while another person is energizing relays K1 and K2. If 27.5-volts are not present at the drive motor, the contacts of relays K1 and/or K2 are defective. Replace defective relay(s). If the drive motor operates by energizing relays K1 and/or K2 locally, the trouble is in the control box, the left wing potentiometer RL, the right wing potentiometer RR, or in the flap control amplifier.
12. Reconnect the flex shaft(s) to the motor assembly and connect the electrical harness plug to connector J1.
13. Pull the flap motor circuit breaker to prevent the flap motor from running for the remainder of the test procedure.
14. Using a precision voltmeter (10-volt range) connect the negative lead to the GND test jack of the amplifier and the positive lead to the RC test jack. Slowly operate the flap selector handle in the control box over its entire range. The voltage readings should be approximately +9-volts in the down position and approximately +4-volts in the up position.
15. If the RC voltage readings are too high or too low, the problem is either in the harness wiring or the control box. Test the harness wiring, if defective repair or replace the harness wiring. If the harness wiring is good replace the control box.
16. Connect the voltmeter between test jacks RR and RL on the amplifier. Use long enough meter leads so the person adjusting potentiometers can also read the voltmeter. If this voltage exceeds 0.5-volts the shut down is due to flap asymmetry. Correct cause of asymmetry and rerig flap system.

17. Connect the voltmeter between test jacks RR and GND on the amplifier. Voltage should equal RC voltage within 0.3-volts.

18. Connect the voltmeter between test RL and GND on the amplifier. Voltage should equal RC voltage within 0-3-volts.

19. If voltage readings in either Steps 17 or 18 exceeds 0.3-volts shut down is due to flap asymmetry. Correct cause of asymmetry and rerig flap system.

20. If the problem is not located at this point, the amplifier is defective and must be replaced.

21. Turn battery master switch OFF or remove external power from the aircraft.

22. Connect flex shaft(s) to motor assembly. Flex shaft(s) nut(s) must be lockwired to motor assembly.

STALL WARNING.

DESCRIPTION.

The stall warning system consists of a lift detector which is electronically connected to a stall warning horn and light. As stalling conditions are approached, the lift detector will activate the stall warning horn and light.

The lift detector is located on the leading edge of the left wing. A tab will extend beyond the leading edge at the point where the lift detector is mounted. With the master switch in the ON position, gently lift tab, stall warning horn and/or light should activate.

On airplanes with a stall warning time delay, the delay unit is mounted to the channel above the access panel at station 64.5. This time delay unit assures a horn sound when the lift detector closes and for four seconds after the detector switches opens.

A heated lift detector is available with the de-ice group. This provides heat for both the vane and plate to assure proper operation during icing conditions. A safety switch is located on the right landing gear.

REMOVAL OF LIFT DETECTOR.

— NOTE —

The master switch must be off prior to performing any work on the lift detector, warning horn or light. Place reference marks on holding plate and wing skin for use when reinstalling wing.

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.

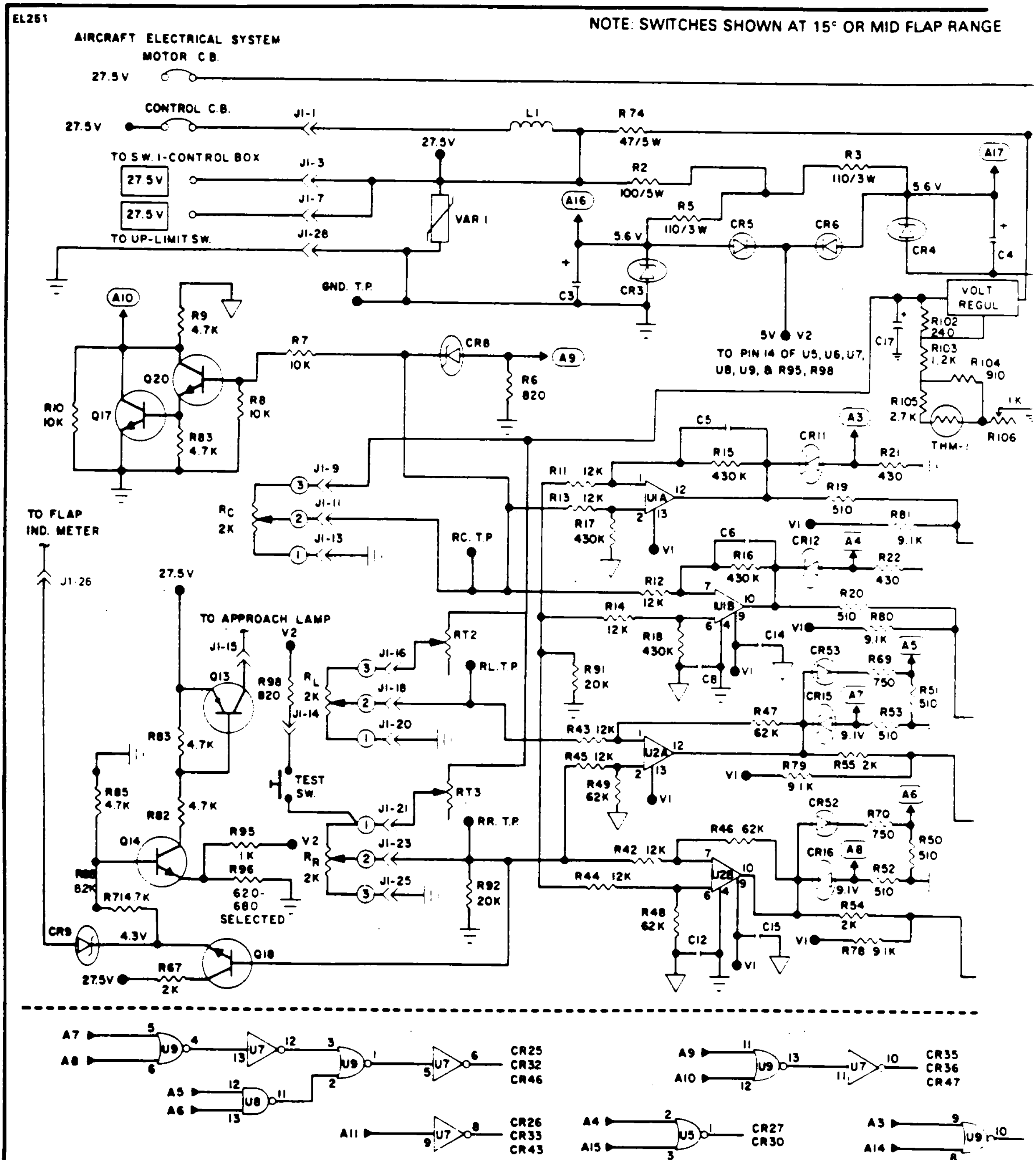


Figure 27-25. Amplifier - Electrical Schematic (Calco) P/N 8502M1

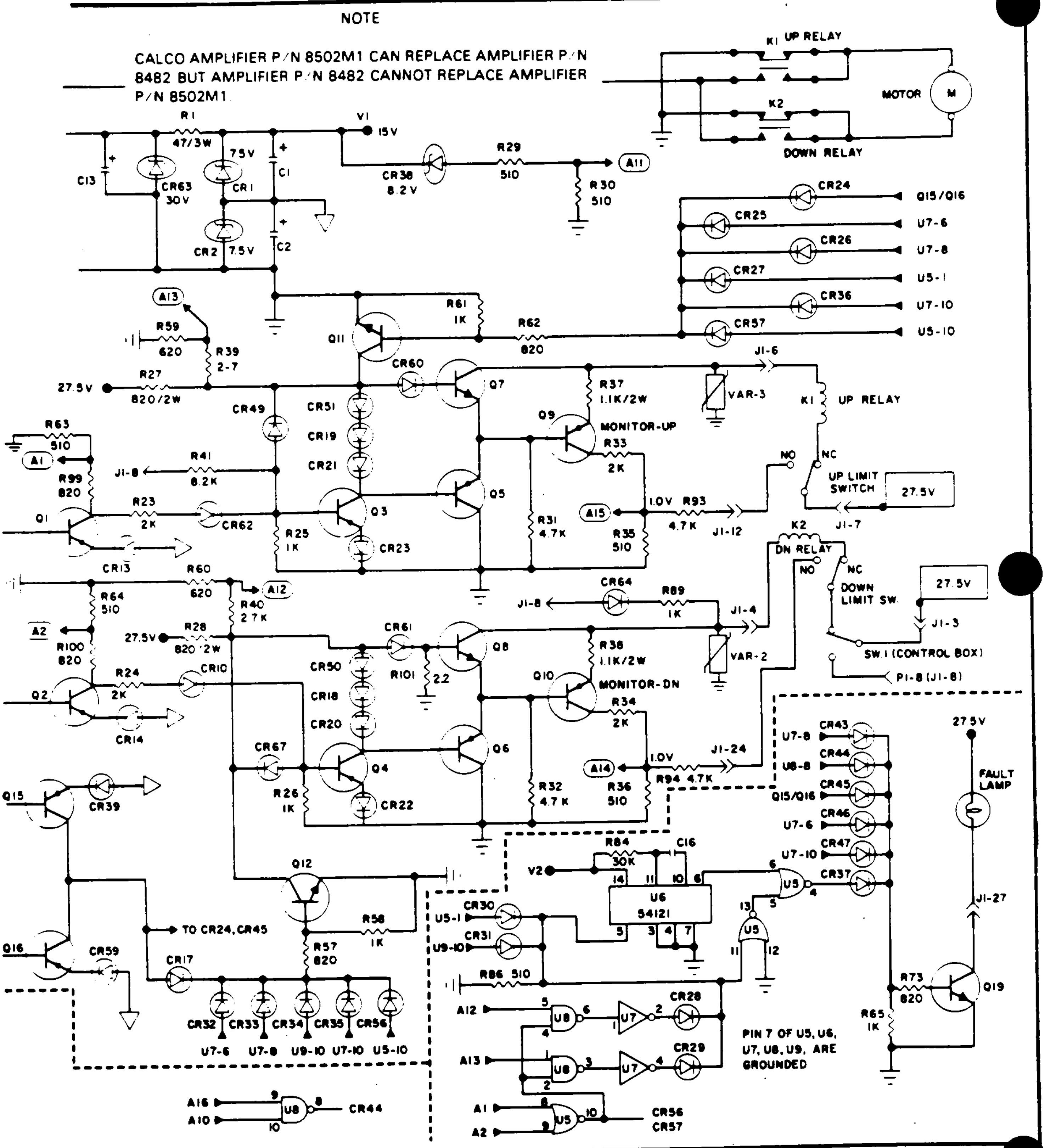


Figure 27-25. Amplifier - Electrical Schematic (Calco) P/N 8502M1 (cont.)

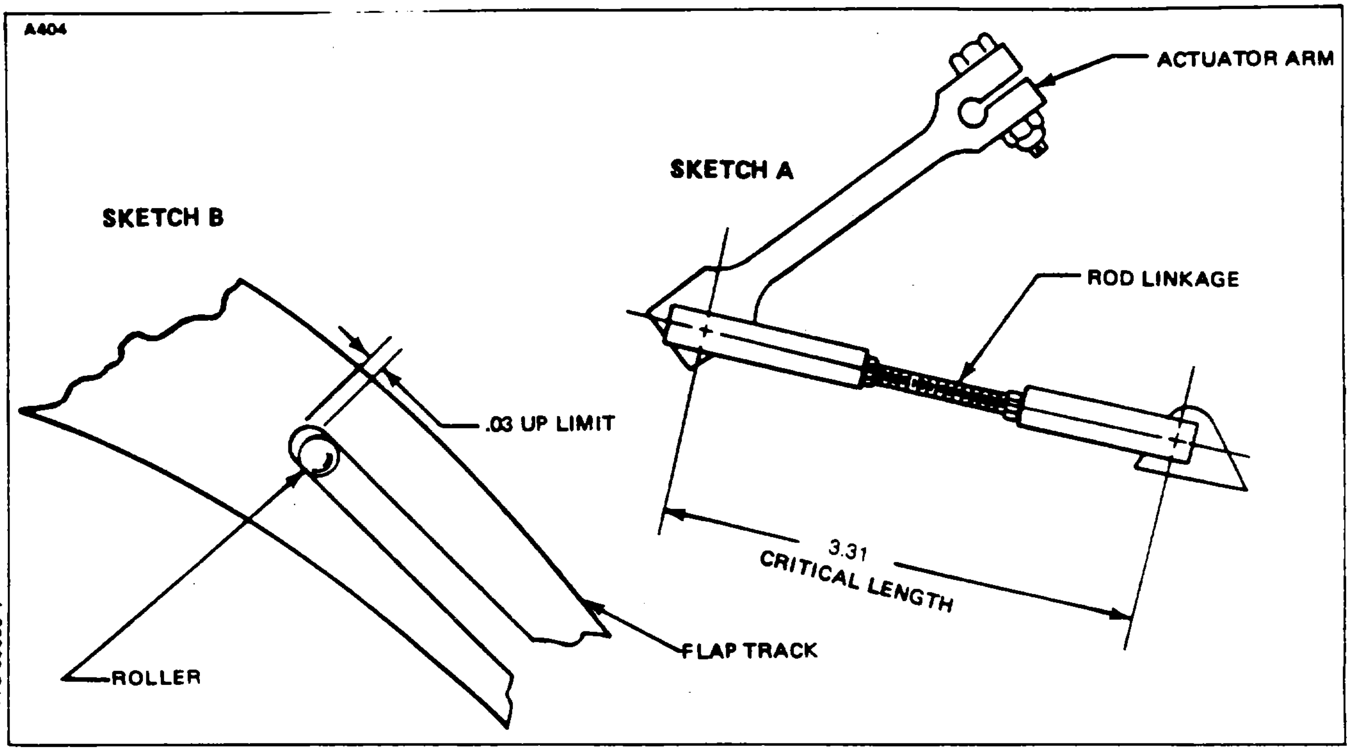


Figure 27-26. Flap Rigging Adjustments

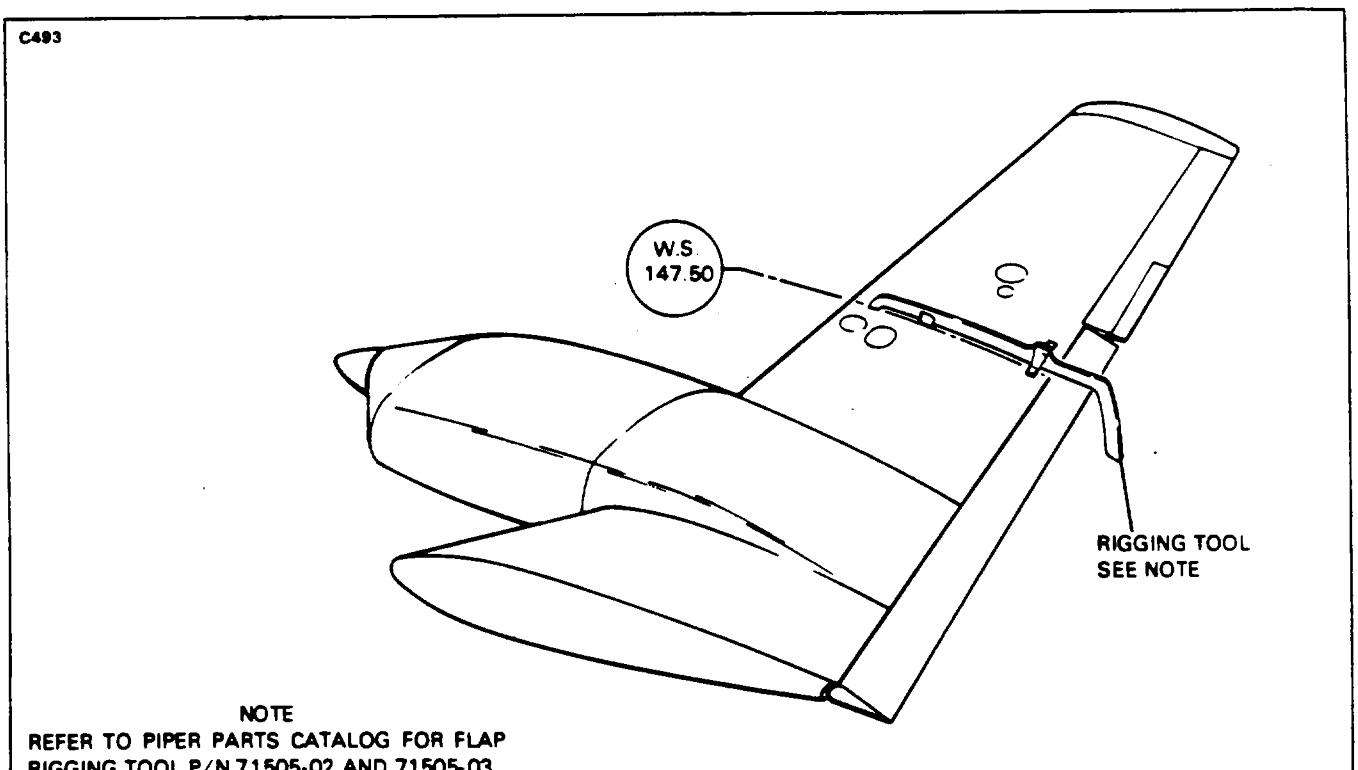


Figure 27-27. Use of Flap Rigging Tool

INSTALLATION OF LIFT DETECTOR.

1. Attach electrical wires to their correct terminals on the lift detector.
2. Position the lift detector with its mounting plate on the wing, determing that the sensor blade drops down freely; 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 Phillips 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 and landing gear 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.

— *END* —

GRIDS 2G13 THRU 2G18
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CHAPTER

28

FUEL

CHAPTER 28 - FUEL

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CHAPTER 28 - FUEL (cont.)

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GENERAL.

The fuel system components covered in this chapter consist of fuel cells, fuel selector valves, filters and electric fuel pumps.

This chapter provides instructions for removal, cleaning, inspection and repair, reassembly, testing and adjustment of the various fuel system components. A troubleshooting chart to assist in isolating and correcting troubles which may occur is also included.

DESCRIPTION.

The fuel system is contained in two independent units that allow each engine to have its own fuel supply. The systems are connected only by a crossfeed that will allow fuel to be drawn from one set of fuel cells to the engine of the opposite side, in the event of an emergency.

The fuel cells are of the bladder type. The inboard cells and the (optional) outboard cells are installed in cavities in the wings, with each inboard (main) cell holding a capacity of 56 U.S. gallons. The outboard (optional) cells hold a capacity of 40 U.S. gallons each. This gives a total fuel load of 192 U.S. gallons when (optional) fuel cells are installed. Optional lockable filler caps are available.

Fuel is taken from each cell through a screen located in the cell outlet fitting and then onto the shutoff selector valve. From the selector valve, fuel is drawn in a series configuration through the fuel boost pump, electric fuel pump, emergency shutoff valve and on to the engine-driven pump. These units, except for the engine-driven pump, are accessible through a panel located between the underside of each wing and the fuselage. The fuel filter and electric and engine pumps incorporate a bypass that will open in the event of fuel stoppage through their normal avenue of flow. As mentioned above, two extra fuel boost pumps have been placed in the fuel system. Each pump is an electric, continuous duty, inline type pump located between the fuel filter and the electric fuel pump. These pumps are provided to maintain fuel under pressure to the other fuel pumps, improving the altitude performance of the fuel system. Each pump is controlled by a separate circuit breaker located in the circuit breaker control panel. These pumps are activated when the master switch is turned on, and continue to operate until the master switch is turned off or the circuit breakers are pulled (off). Red fuel boost pump warning lights in the annunciator provide a visual of an inoperative pump. Each warning light is controlled by a sensor switch located above the fire wall shutoff valve, forward of the crossfeed fuel line, and is connected to the fuel boost pump. This pressure switch will activate when the pressure produced by the fuel boost pump falls to a pressure of 2-4 psi. Refer to the electrical schematic for the fuel boost pumps and the fuel flow warning circuit.

Left and right fuel flow warning lights are mounted in the annunciator and will illuminate to warn the pilot of an impending fuel flow interruption. Each light is controlled by a sensing probe mounted near each board fuel tank outlet. In the event the fuel level near the tank outlet drops to a point where a fuel flow interruption and power loss could occur, the sensing probe will activate and energize the gated relay. This relay, located aft of bulkhead station 81.00 and bolted to the windshield channel bracket, delays the illumination of the warning light for 2 seconds. If after the 2 second delay the sensing probe is still activated, the relay will then lose the circuit to the warning light for a minimum of 10 seconds and will remain closed if the cause is not corrected. The lights are provided with a "press-to-test" feature through the annunciator test button. The lights should illuminate and remain on for 10 seconds. During this test, the fuel boost pump inoperative lights should illuminate when the button is depressed (no hold required on this circuit) and go out when the button is released.

Drains are provided for each fuel cell, filter bowl and the crossfeed line. The cell drains are visible on the underside of each wing at the inboard end of the cells. The filter bowl drains are accessible through an access door on the panel that is located between the underside of each wing and the fuselage. The crossfeed is located on the left panel, aft of the filter bowl access door.

The fuel valves are operated through controls located in a panel at the base of the pedestal. A warning light has been incorporated on the fuel control panel to indicate when either shutoff valve is closed. A lock on the fire wall fuel shutoff lever has been designed as a safety feature to prevent an inadvertent fuel shutoff. Fuel gauges will indicate the quantity of fuel in each cell that fuel is being drawn from.

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.

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CHART 2801. TROUBLESHOOTING (FUEL SYSTEM)

Trouble	Cause	Remedy
Fuel gauge fails to indicate proper tank level. NOTE: With current off, gauges will indicate fuel level as existed when current was shut off or failed.	Circuit breaker out.	Reset and check.
	Broken wire.	Check and repair.
	Gauge inoperative.	Replace.
	Tank selector switch inoperative.	Repair or replace.
	Incomplete ground.	Check ground connections at fuel transmitters in wings and at gauge.
	Float and arm assembly of fuel transmitter(s) in wing sticking.	Check fuel transmitters in wings and repair or replace.
Fuel gauge indicating approximately 1/2 tank when tank is full but will function normally on other tank.	Inboard fuel transmitter assembly grounded.	Check inboard fuel transmitter installation and repair.
	Float and arm assembly of fuel transmitter(s) in wing sticking.	Check fuel transmitters in wings and repair or replace.
No fuel pressure indication.	Emergency shutoff valve off.	Turn on.
	Fuel valve stuck.	Check valve.
	No fuel in tanks.	Check fuel, fill.
	Filters dirty.	Clean filters.
	Defective fuel pumps.	Check pumps for pressure build up. Check diaphragm and relief valves in engine pump. Check for obstruction in electric pump. Check bypass valve. Air leak in intake lines.
	Defective gauge.	Replace gauge.

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

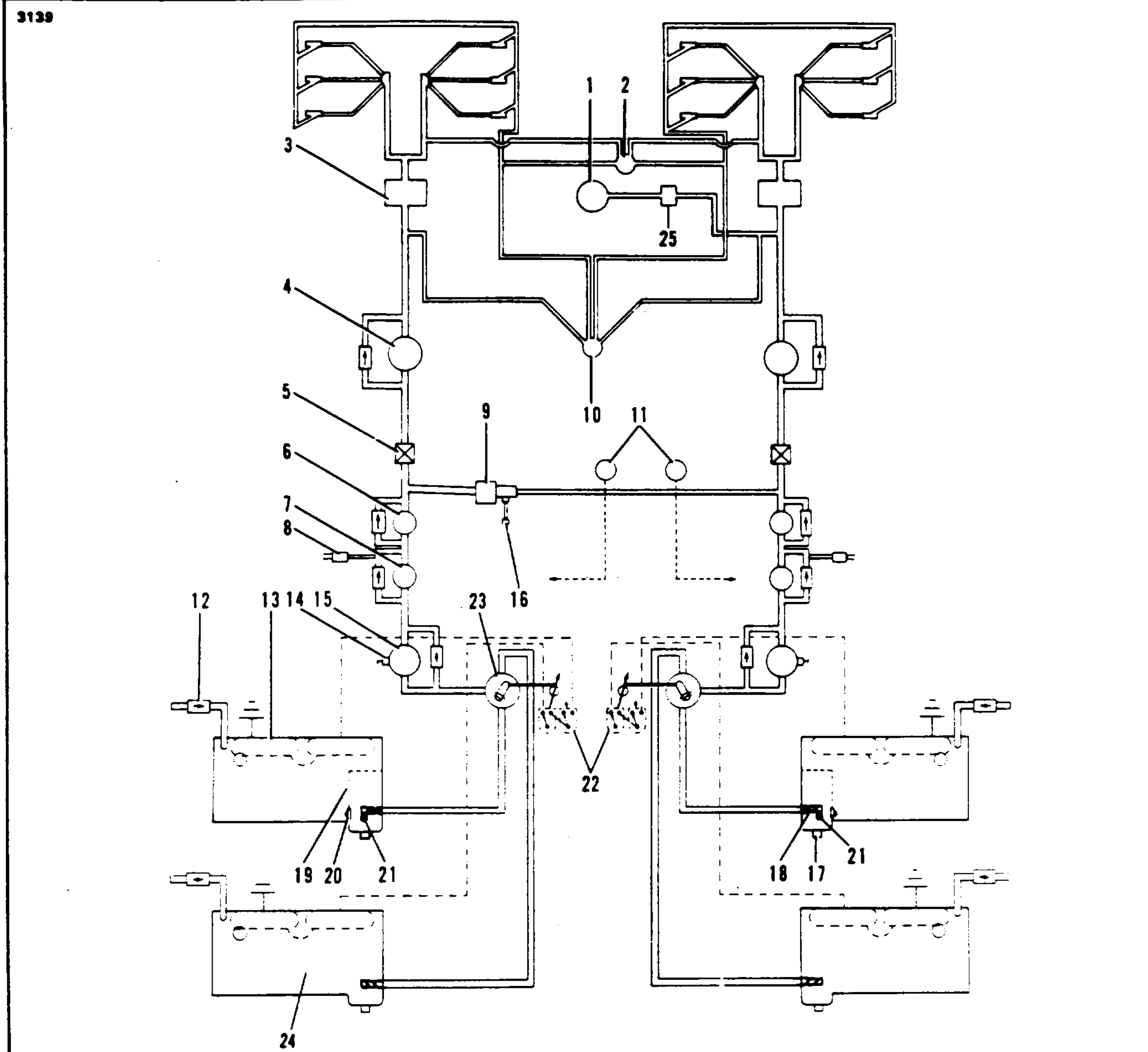
Trouble	Cause	Remedy
Fuel quantity increases in flight.	Suction on tank.	Tighten fuel filler cap nut.
Pressure low or pressure surges	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty pump.	Replace.
Unidentified leak.	Fuel lines damaged or improperly installed.	Locate and repair or tighten.
	O-rings improperly installed.	Locate and repair or tighten.
Fuel valve leaks.	Worn O-rings.	Replace O-rings or valve.
FUEL WARNING SYSTEM		
Fuel flow warning light fails to illuminate.	Bulb(s) burned out.	Replace.
	No power from bus.	Check and reset the gear, oil temperature, and fuel quantity indicator circuit breaker.
		Trace through system for an open circuit or faulty component.
	Fuel flow sensor probe malfunction.	Check free movement of probe tip; replace if defective.
	Gated delay relay malfunction.	Replace relay after the cause for the white wire to ground has been isolated and corrected.
Fuel flow warning light fails to extinguish.	Low fuel level in fuel cell.	Fill.

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

Trouble	Cause	Remedy
FUEL WARNING SYSTEM (cont.)		
Fuel flow warning light fails to extinguish. (cont.)	Fuel flow sensor probe malfunction.	Check free movement of probe tip; replace if defective.
	Ground in circuit.	Trace through system for ground.
	Pressure switch malfunction.	Replace.
Fuel flow warning lights illuminate momentarily when voltage is initially applied to the circuit.	Normal operation of the gated delay relay.	
Fuel boost pump warning light fails to illuminate.	Bulb(s) burned out.	Replace.
	No power from bus.	Check and reset the gear, oil temperature, and fuel quantity indicator circuit breaker. (If the breaker is popped, the fuel flow warning lights have failed also.)
		Trace through system for an open circuit or faulty component.
	Pressure switch malfunction.	Replace.
Fuel boost pump warning light fails to extinguish.	Fuel boost pump circuit breaker popped.	Check and reset.
	Fuel boost pump malfunction.	Check operation and output pressure.
	Pressure switch malfunction.	Replace.

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

Trouble	Cause	Remedy
FUEL WARNING SYSTEM (cont.)		
Fuel boost pump warning light fails to extinguish. (cont.)	Ground in circuit.	Check circuit for ground.
Test switch fails to illuminate all warning lights.	No power from bus.	Check and reset the gear, oil temperature, and fuel quantity indicator circuit breaker. Trace through system for an open circuit or faulty component.
	Test switch malfunction.	Check connections and replace if necessary.
All the warning lights fail to extinguish.	Test switch grounded.	Correct or replace if necessary.



1. COMBUSTION HEATER
2. FUEL FLOW GAUGE
3. FUEL INJECTOR
4. ENGINE DRIVEN FUEL PUMP
5. FIRE WALL FUEL SHUTOFF
6. EMERGENCY FUEL PUMP
7. FUEL BOOST PUMP
8. PRESSURE SWITCH
9. EMERGENCY CROSSFEED VALVE
10. FUEL PRESSURE GAUGE
11. FUEL QUANTITY GAUGE
12. FUEL TANK VENT CHECK VALVE
13. INBOARD FUEL TANK
14. FUEL FILTER QUICK DRAIN
15. FUEL FILTER
16. CROSSFEED QUICK DRAIN VALVE
17. FUEL TANK QUICK DRAIN
18. FUEL TANK STRAINER
19. SURGE TANK
20. FLAPPER VALVE
21. LOW FUEL WARNING PROBE
22. FUEL SENDER SELECTOR SWITCHES (OPTIONAL)
23. FUEL TANK SELECTOR VALVE (OPTIONAL)
24. OUTBOARD FUEL TANK (OPTIONAL)
25. FUEL REGULATOR SHUTOFF VALVE

Figure 28-1. Fuel System Schematic

STORAGE.

REMOVAL OF WING FUEL CELLS. (Refer to Figure 28-2 or 28-3.)

1. Turn the fuel selector to the off position and drain the fuel cell. (Refer to Draining Fuel System, Chapter 12.)
2. From the underside of the wing, remove the access plates to the fuel cell outlet and vent.
3. Loosen the clamp and disconnect the nipple fittings at the fuel outlet at the inboard end of the cell and vent line at the outboard end of the cell. Remove flapper valve from inboard tanks prior to removing fuel cells.
4. Remove the screws that secure the drain fitting plate, draw the drain down enough to disconnect the fitting clamp and remove the drain.
5. On top of the wing, remove the access plates to the fuel cell and senders.
6. Disconnect the wires from the sender units, remove the screws that secure the sender and carefully draw the sender with gasket from the cell. Note the installed position of the senders.
7. Reach through the access hole and untie the nylon cord that secures the cell.
8. Remove the filler cap and machine screws that secure the cap adapter and gaskets.
9. Remove the cap bolts that secure the adapter bracket to the fuel cell and draw the adapter bracket out through the elongated access hole, being careful not to damage the cell.
10. Place tape or another protective material around the cell access opening to prevent damage to the cell when removing.
11. Push the cell down and work the nylon cord back through the cell hangers and rib bushing to the outboard ends of the cell compartment.
12. Fold the cell neatly within the wing and remove it gently through the opening in the top of the wing.

CLEANING AND INSPECTION OF FUEL CELLS.

1. Fuel cells may be cleaned by the following procedure:

   A. New Cells: It should not be necessary to clean new cells upon removing them from their containers, if they are installed in the airframe cavities promptly. If for any reason the cells are not installed immediately, and become dirty, they should be cleaned with soap and warm water to remove foreign material prior to installation in a clean cavity.

   B. Used Cells: Prior to removal, the cells are to be drained of fuel, purged with fresh air and swabbed out to remove all traces of fuel. Following removal, the cells are to be cleaned inside and out with soap and warm water.

— WARNING —

Use a vapor-proof light for inspection.

— *NOTE* —

To determine if fuel cell is repairable, reach through the fuel cell access plate and take a section of cell between thumb and forefinger. Wipe the ridge created by this action with MEK. If fine cracks are evident, the fuel cell is not repairable.

2. Fuel cells may be inspected by the following procedure:
   A. New Cells: Inspect the cell surface inside and outside for cuts, abraded (scuffed) areas and accessory damage. Also, inspect the fitting seals for nicks, scratches and foreign material.
   B. Used Cells: Cells removed from the airframe cavity for inspection and repair or cells being returned to service from storage, should be inspected as outlined above. Cells installed in the airframe cavity may be inspected for possible repairs by reaching through the fuel cell access plate and taking a section of cell between the thumb and forefinger. Wipe the ridge created by this action with MEK. If fine cracks are evident, the fuel cell is not repairable.
   C. Baffled Fuel Cells: Inspect every 2 years by conducting the following inspection:
      (1) Defuel both main cells. (Refer to Chapter 12.)
      (2) Remove the access plates located inboard of the nacelle. Remove both wing and fuel cell access plates.
      (3) Inspect fuel cell fittings for deterioration of the rubber used, using the fingernail to attempt to scrape the rubber off the metal or nipple fitting. If the rubber has not deteriorated, the fingernail will glide across the rubber. If a degraded condition exists the fingernail will dig into the rubber. Usually the deteriorated rubber will have changed from a light yellowish-tan to a dark reddish brown.
      (4) Check the tension and knots of the two nylon support cords.
      (5) Inspect the interior of the cell for security of baffle and the free operation of the flapper valve. Inspect both sides of the baffle.
      (6) Inspect the exterior of the cells to insure the Velcro tape has not parted from the cell surface or liner surfaces.
      (7) Install all access plates on fuel cells and wings. Fill cells and check for leaks.
   D. Fuel Cell Filler Cap: Inspect large o-ring with a 10x magnifying glass for cuts or cracks. Replace o-ring if any damage is found. If o-ring is sound, adjust cap per steps (1) thru (4).
      (1) Unlock and remove cap from adapter plate.
      (2) Tighten ¼-28 self locking nut at base of cap ½ turn. (If castle nut is used in lieu of self locking nut remove chain assembly, adjust nut ½ turn and replace chain assembly).
      (3) Lock cap into adapter plate in top of fuel cell.
      (4) If cap continues to leak replace cap and return defective cap to manufacturer for repair.

FUEL CELL COMPARTMENT.

1. Thoroughly clear the cell compartment of all fittings, trimmings, loose washers, bolts, or nuts.
2. Round off all sharp edges of the fuel cell compartment.
3. Inspect the fuel cell compartment just prior to fuel cell installation.
4. Tape over all sharp edges and all rough rivets.

MOLDED NIPPLE FITTINGS.

The molded nipple fitting is a lightweight fitting developed for ease in installation in certain locations in the airplane. In order to get the best service from this type fitting, it is necessary to exercise certain precautions at the time of installation. The specific precautions other than the general care in handling are as follows:

1. Insert the outlet tube finger strainer into the fitting as shown in Sketch "B", Figures 28-2, and 28-4.
2. Insert the vent tube into the fitting until the end is flush with the inside edge of the nipple.
3. The hose clamp must be clear of the end of the fitting by .250 inch where possible.
4. Locate the hose clamp on the fabric-reinforced area of the nipple.
5. Torque the hose clamps as follows:
   - A. Outlet hoses = 15-20 inch pounds.
   - B. Drain hoses = 12-16 inch pounds.
   - C. Vent hoses = 12-16 inch pounds.

Do this once. Do not re-tighten unless the hose clamp is loosened completely and allowed to set for 15 minutes before retightening.

6. Do not use sealing paste or gasket compound.
7. Apply a thin film of Simonize Wax to metal flow tubes to facilitate installation and removal.

INSTALLATION OF WING FUEL CELL. (Refer to Figures 28-2 and 28-3.)

1. Inspect the cell compartment.

2. Install two 4 inch strips (side by side) of Ludlow two sided adhesive transfer tape No. 7322, Piper part number 189 704, to the fuel liner at a point directly beneath the location of the fuel indicator sender unit float in "empty" position. Leave the backing on the tape to prevent adherence to the cell until the cell is properly positioned.

3. Should the cell be in its shipping container, do not remove until ready for installation.

4. Check to be sure that the cell is warm enough to flex. Do not use sharp tools such as screwdrivers, files, etc., for installation purposes.

5. Place tape or another protective material over the edges of the elongated access opening to prevent damage to the cell.

6. Remove the flapper valve from the fuel cell (if installed) to prevent breakage.

7. Roll the cell into the shape and size which can be inserted through the access opening of the cell compartment.

8. Unroll the cell and establish correct relationship of the cell to the compartment. Insure bottom of fuel cell is smoothed out and free of wrinkles.

9. Remove the backing from the tape installed in Step 2. Press the cell to the exposed tape on the cell.

10. Lay out the nylon cord (furnished with fuel cell) on the wing to determine the length of cord for each tie. The cords are routed as shown in Figures 28-2 or 28-3. Allow enough extra cord to work with.

11. Double tie a washer (AN960-416) securely to the ends of each cord. Reach through the access openings and start the cord through the spar bushing at each end of the cell compartment.

12. From each end of the cell, feed the cord through the cell hangers and rib bushings until the cords can be joined at the access opening. Do not tie cords yet.

13. Connect the fuel drain valve plate by inserting the threaded end of bolt or rod, not under three inches long, up through the plate and nipple fitting of the fuel cell. (Refer to Figure 28-5.) Reach through the fuel cell opening and install a two or two and one-half inch diameter washer on the bolt or rod and secure with a nut. Pull the nipple down through the opening in the wing panel enough to clamp the nipple fitting to the plate. Remove the bolt or rod, secure plate to wing panel and install drain valve.

14. Connect the fuel outlet with finger strainer and vent tube to the molded nipple fittings and secure. Press outward firmly to engage the cell with the velcro tape fasteners.

— NOTE —

The nylon cord used to hold the fuel cells is .125 diameter with a minimum breaking strenth of 550 pounds and conforming to MIL-C-5040C type III specifications. Obtain through Goodyear.

— NOTE —

Install the vent line check valve with the "B" identification mark on the valve bottom.

15. Wipe the inside of the cell clean of all dirt and foreign material with a clean, soft, lint-free tack cloth and inspect for cleanliness. Install flapper valve.

16. Install the fuel cap adapter bracket by wrapping the bracket with a protective cover so as not to damage the cell, insert it through the elongated access opening and slide it in position. Install the gasket between the bracket and cell and start the cap bolts that attach the bracket to the cell. Align the holes in the adapter with the holes in the skin bracket and torque cap bolts to 35 ± 5 inch-pounds.

17. Position the cap adapter and gaskets: one gasket on each side of the wing skin bracket, with the attachment holes in the skin bracket and adapter bracket. Install machine screws and secure.

18. Install fuel senders, gaskets; one on each side of bracket and screws. Tighten nylon screws to 5 + 2, -0 inch-pounds. Install low fuel warning probe and seal.

19. Connect sender wires and ascertain that insulator sleeve is insulating to point where wire attaches sender. Install sender access plates.

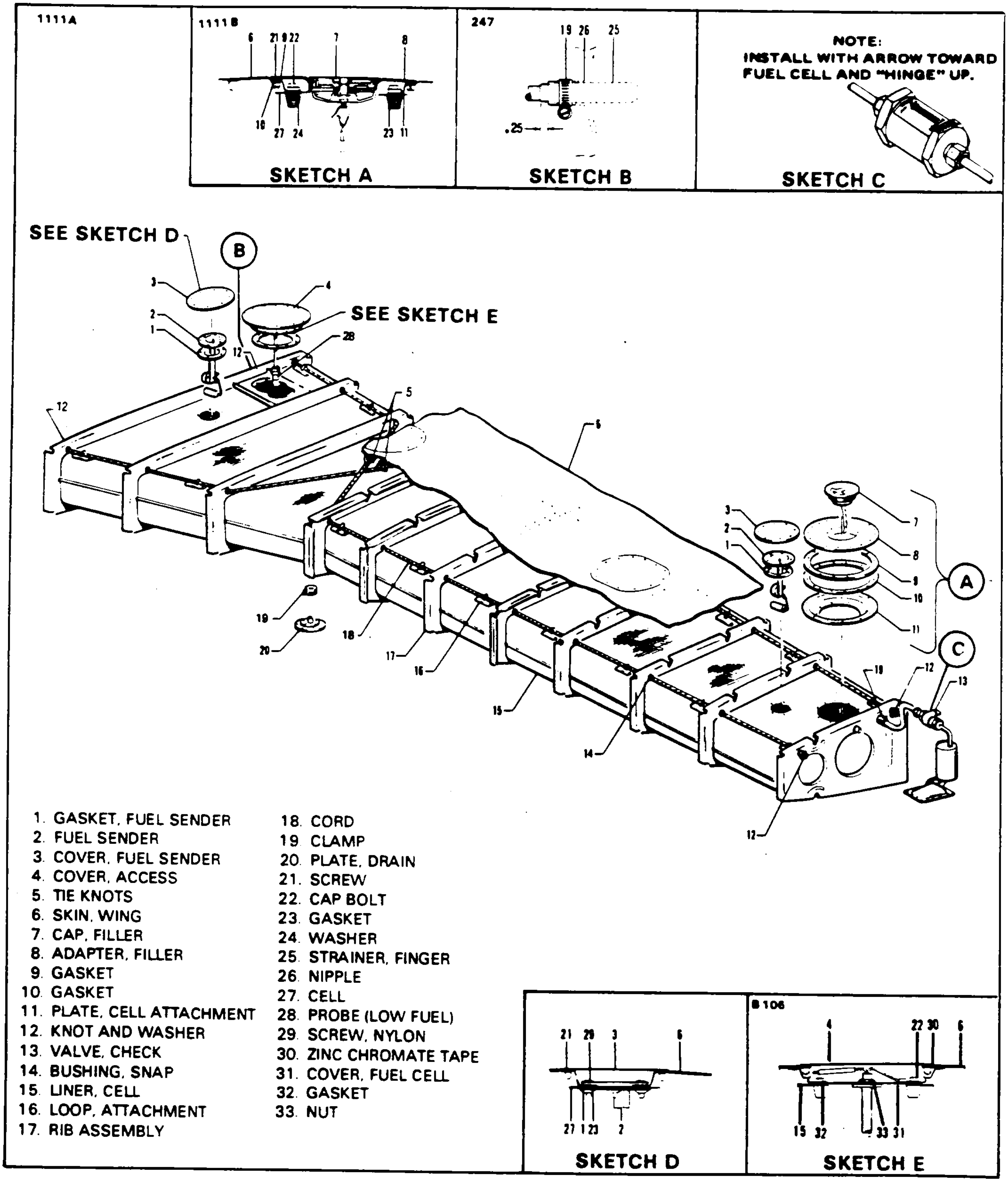
20. Draw the nylon tie cords tight and hold. Ascertain the cell is in correct position in the cell compartment. Again draw the cord tight, hold with clamp or pliers and tie. A recommended tie is shown in Figure 28-4.

21. Install the cell cover remaining access plates on top of the wing. Torque cell cover cap bolts to 35 ± 5 inch-pounds.

22. Put enough fuel in cell to check for fitting leaks.

23. Install remaining access plates.

24. Check that the fuel sender unit is calibrated with the fuel quantity.



1. GASKET, FUEL SENDER
2. FUEL SENDER
3. COVER, FUEL SENDER
4. COVER, ACCESS
5. TIE KNOTS
6. SKIN, WING
7. CAP, FILLER
8. ADAPTER, FILLER
9. GASKET
10. GASKET
11. PLATE, CELL ATTACHMENT
12. KNOT AND WASHER
13. VALVE, CHECK
14. BUSHING, SNAP
15. LINER, CELL
16. LOOP, ATTACHMENT
17. RIB ASSEMBLY
18. CORD
19. CLAMP
20. PLATE, DRAIN
21. SCREW
22. CAP BOLT
23. GASKET
24. WASHER
25. STRAINER, FINGER
26. NIPPLE
27. CELL
28. PROBE (LOW FUEL)
29. SCREW, NYLON
30. ZINC CHROMATE TAPE
31. COVER, FUEL CELL
32. GASKET
33. NUT

Figure 28-2. Fuel Cell Installation (Main/Inboard)

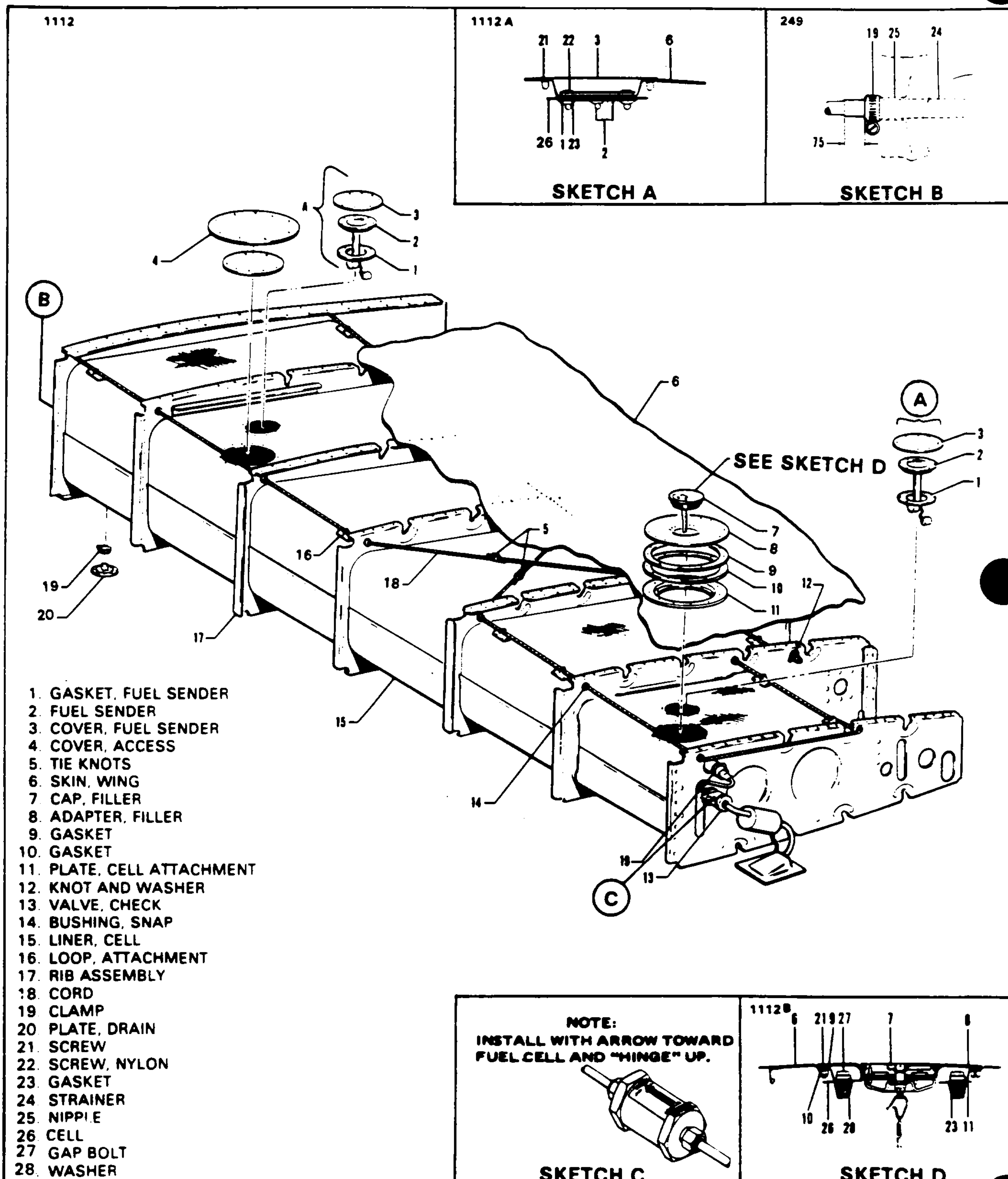


Figure 28-3. Fuel Cell Installation (Optional/Outboard)

HANDLING AND STORAGE OF FUEL CELLS.

1. Prevent needless damage by exercising common sense care in all handling of the cells. Folding or collapsing of cells is necessary to place them in containers for storage, install in airframe cavities and carrying from place to place. Protect fitting seal surface from contact with cavities during removal or installation. Use protective covers over fitting seal when practical. Protect cell from tools, hot lights, etc., when working around them. Avoid stepping on folds or creases in cells. Do not carry cells by fittings. Maintain original cell contours or folds when refolding for boxing, rolling to insert in airframe cavities or handling in the repair area. The cells to be repaired should be placed on a well-lighted table. Maintain natural contours, if possible, while repairing. Prevent contact with sharp edges, corners, dirty floors or other surfaces. Repair area must be well-ventilated. Do not stack cells. Inspect cavities and insure cleanliness prior to installing any cell.

— WARNING —

Do not permit smoking or open flame near repair area or cells.

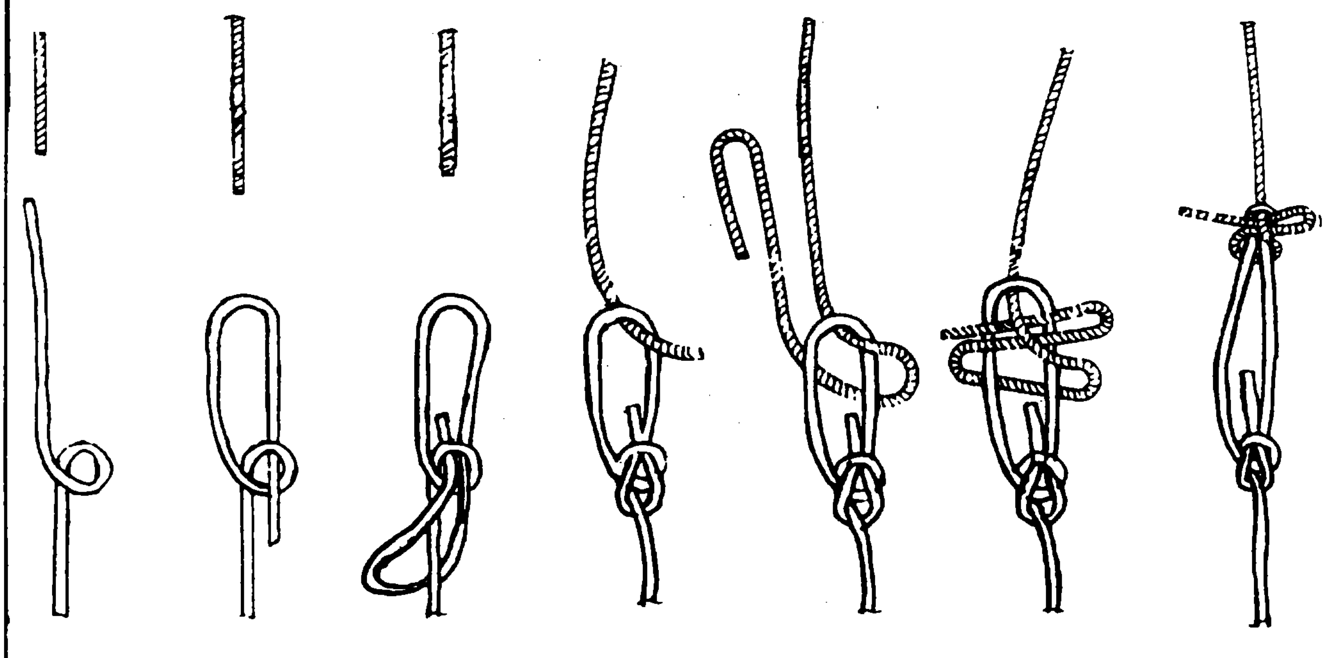


Figure 28-4. Fuel Cell Tie Detail

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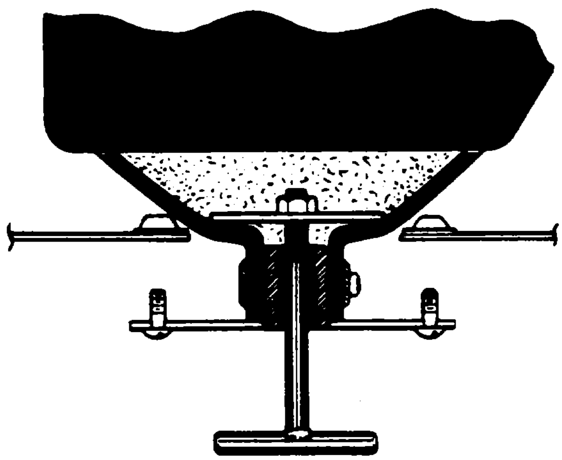

Figure 28-5. Installation of Fuel Valve Drain Plate

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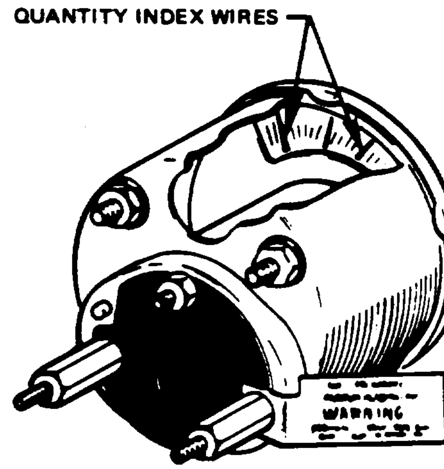


Figure 28-6. Fuel Gauge Adjustment Wires

2. When storing cells, observe the following rules:
   A. Fold cells smoothly and lightly as possible with a minimum number of folds. Place protective wadding between folds.
   B. Wrap cell in moisture-proof paper and place it in a suitable container. Do not crowd cell in container, use wadding to prevent movement.
   C. Stack-boxed cells to allow access to oldest cells first. Do not allow stacks to crush bottom boxes. Leave cells in boxes until used.
   D. Storage area must be dry, 70° F. and free of exposure to sunlight, dirt and damage.
   E. Used cells must be cleaned with soap and warm water prior to storage. Dry and box as outlined above.

REPAIR OF FUEL CELLS.

GENERAL.

The following is the repair procedure recommended for field repair of fuel cells constructed of Goodyear BTC85 material only. There are two methods by which these repairs may be accomplished. One method is by heat cure, the other is air cure. The end result of either repair is a neat repair. The heat repair allows the cell to be cured and ready for reinstallation in two hours while the air cure method requires that the cell not be moved for 72 hours during the air cure period.

— NOTE —

Air cure repairs to be made at room temperature of approximately 75° F. For each 10° drop in temperature add 20 hours to cure time. For instance, if room temperature reads 65° F, air cure for 92 hours instead of 72 hours.

— NOTE —

The repair of Goodyear Vithane fuel cells is restricted to authorized personnel. Authorized personnel are those who have been certified and trained by Goodyear representatives, or those who have received their training from persons who have been certified and trained by Goodyear representatives.

— NOTE —

To determine if fuel cell is repairable, reach through the fuel cell access plate and take a section of cell between thumb and forefinger. Wipe the ridge created by this action with MEK. If fine cracks are evident, the fuel cell is not repairable.

HANDLING OF REPAIR MATERIALS.

1. All materials are to be protected from dirt contamination, sunlight, and excessive heat or cold while in storage. Containers are to be tightly capped and stored at a temperature of 70° F.
2. The repair cement code 80C27 referred to in this text is prepared immediately prior to use by mixing repair cement 80C27 (pint can with 320 gms.) with cross-linker 80C28 (4 oz. bottle with 81 cc).

— CAUTION —

80C27 repair cement requires thorough mixing to obtain full adhesive values.

3. Repair cement has a pot life of 20 minutes after mixing. The unmixed 80C27 and 80C28 have a shelf life of six months from date of packaging.

— CAUTION —

All containers for cements and solvents should be properly identified.

REPAIR LIMITATIONS OF FUEL CELLS.

Repair limitations are as follows:

1. FT-192 repair fabric is for repair of simple contours only. Patches referred to in this text are of this material.
2. Inside patches are to lap defect edges a minimum of 1.0 inch in each direction.
3. Outside patches are to lap defect edges .25 to .50 inches larger than inside patches.
4. Outside patches are to be applied and cured prior to applying an inside patch.
5. Blisters between inner liner and fabric, larger than .25 of an inch in diameter require an outside and an inside patch.
6. Separations between layers or plies larger than .50 inch in diameter require an outside and inside patch. Holes and punctures require an outside and inside patch.
7. Slits or tears up to 6.3 inches maximum length require an outside and inside patch.
8. External abraded or scuffed areas without fabric damage require an outside patch only.
9. A loose edge may be trimmed provided that a .50 inch minimum lap or seam is maintained.
10. Air cure repair patches are to remain clamped and undisturbed for 72 hours at room temperature of approximately 75° F.

— CAUTION —

For each 10° drop in temperature from 75° F, add 20 hours cure time. For example, at 65° F, cure for 92 hours.

11. All heat cured patches are ready for use when cool.
12. Fitting repairs are confined to loose flange edges, seal surface rework and coat stock.
13. The maximum number of heat cure repairs in the same area is four.

— NOTE —

Any damage not covered by the above should be returned to The Goodyear Tire & Rubber Company, Rockmart, Georgia, for repair.

REPAIR PATCH (HEAT CURE METHOD).

1. Prepare exterior cell wall and exterior patch first. Cut Repair patch from FT-192 material to size required to insure proper lap over injury in all directions. (See Limitations.) Hold shears at an angle to produce a beveled edge (feather) on patch. Round corners of patch. Dull side or gum contact face of repair patch should be the largest surface after beveling.
2. Wash one square foot of cell wall surrounding injury and repair patch contact side with a clean cloth soaked with Methyl Ethyl Ketone solvent.
3. Abrade Cell wall surface about injury and contact side of patch with fine emery cloth to remove shine.

4. Repeat Methyl Ethyl Ketone washings two more times. A total of three washings each surface.
5. Tape an 8"x 8" piece of cellophane inside cell over injury.
6. When all the above preparatory work has been done and cell has been positioned for patch application on repair table, mix the 80C27 cement (320 gms) with the cross-linker 80C28 (81 cc), and stir mixture thoroughly for five minutes.

— *NOTE* —

Cement must be at a minimum of 70° F before mixing. Keep away from water and excessive heat.

7. Brush one even coat of mixed repair cement on the cell wall around injury and on the contact side of repair patch. Allow to dry for twenty minutes.
8. Repeat a second mixing of repair cement and brush a second coat.

— *CAUTION* —

Do not use first can of mixed cement for this coat.

9. Allow cement to dry approximately five minutes and then center patch over injury. Lay repair patch by rolling down on surface from center to edge without trapping air. Hold the unrolled portion of repair patch off the cemented surface until roller contact insures an air-free union. At this time repair patch may be moved by hand on wet surface to improve lap. Do not lift repair patch, slide it.

— *CAUTION* —

Make sure cellophane inside cell over injury remains in place as any cement will stick cell walls together without it as a separator.

10. Cover one smooth surface each of two aluminum plates (plates must be larger than patch), with fabric-backed airfoam fabric side out. Tape airfoam in place. Foam must cover edges of plate for protection. Use a cellophane separator to prevent the cement from sticking in the wrong place.
11. Fold cell adjacent to patch and place prepared plates one over repair patch and one on opposite side.
12. Center a repair iron 2F1-3-2572-1 on the plate over the repair patch. Secure the assembly with "C" clamp. Tighten by hand. Check cement flow to determine pressure.

— *CAUTION* —

Make sure that cell fold is not clamped between plates. This would cause a hard permanent crease. Also make sure that patch does not move when clamp is tightened.

CHART 2802. FUEL CELL REPAIR EQUIPMENT LISTS

Repair Kit, Goodyear Drawing No. 2F1-3-37813

Group I Materials

80C27 Repair Cement	8	pint cans, 320 gms in each
80C28 Cross-Linker	8	4 oz. bottles, 81 cc in each
Methyl Ethyl Ketone	2	1 pint cans
FT-192 Repair Fabric	2	Sheet 12" x 12"
AP368 Manual	1	

Group II Materials

The following equipment is necessary to perform the repair.

Group II equipment will be furnished at additional cost, if ordered by customer.

Foam Rubber Cloth Back Sheet, 1/4" x 12" x 12"	2
Paint Brush, 1 inch wide	2
Aluminum plates, 1/4" x 6" x 6"	4
Measuring cup (250 ml)	1
Cellophane (Sheet 12" x 24")	2

NOTES

Accessories - order per individual cell requirements.

Phenol plates, phenol plate assemblies and phenol test equipment can be ordered as required from cell manufacturer.

Cure Iron (Set 240° F) Optional.

13. Connect repair iron into 110 volt electrical outlet and cure repair for two hours. After two hours cure, unplug electric and allow repair iron to cool to touch. Then remove "C" clamp. Wet cellophane to remove from repair.

14. Inside patch is applied same as above procedure except for size of repair patch (see limitations) after outside patch has been cured.

— CAUTION —

Success of applying both an outside and inside repair patch simultaneously is doubtful and not recommended.

REPAIR PATCH (AIR CURE METHOD).

Follow procedure for heat cure method, except omit repair iron and cure each patch per air cure limitations (minimum 72 hours), undisturbed at 75° F.

METAL FITTING - SEALING SURFACES.

1. Rub off roughness of affected area with a fine file or fine emery cloth. Treat reworked area.
2. Clean metal surface using a clean cloth dipped in Methyl Ethyl Ketone. Moisten cleaned surface with clean cloth dipped in water. Apply alodine 1200 solution, undiluted, to the affected area with a small nylon brush. Allow solution to dry until a light golden color appears. When coating has been formed, remove excess solution by wiping with a clean water-moistened cloth. Allow coating to dry.

— WARNING —

Do not allow solution to come in contact with hands, eyes or clothing.

LOW FUEL WARNING SENDER SEALING. (Refer to Figure 28-7.)

The following instructions and illustration explain the recommended procedures for sealing the low fuel warning probe to prevent any possible fuel leakage.

1. Defuel the aircraft to obtain a fuel level which is below the warning probe, and remove the access cover plates on both wings above the probes. Disconnect the electrical splice at the probe.
2. Remove hardware securing the probe assembly mounting plate to the fuel cells and lift the assembly from the cells.
3. Remove the cotter pin, castle nut and washer securing the probe to the mounting plate and remove old sealant.
4. Apply MIL-S-8802-B½ sealant (or equivalent) between the mounting plate and mounting surface of the probe.
5. Assemble the probe to the plate as shown in Figure 28-7. It is acceptable to use a combination of light and regular washers to obtain alignment between the cotter pin hole and nut castellation. Torque the nut to 40 ± 5 in.-lbs.
6. Replace the special gasket P/N 2F1-2-14523 at the fuel cell opening and install the probe assembly using the original hardware. Place the electrical ground wire terminal under one bolt head. Torque all bolts to 35 ± 5 in.-lbs., and check installation for leaks.
7. Connect electrical knife splice. Apply zinc chromate tape or equivalent to the cover plate mounting flange and install access plates. Remove any excess zinc chromate tape from edges of access plates.

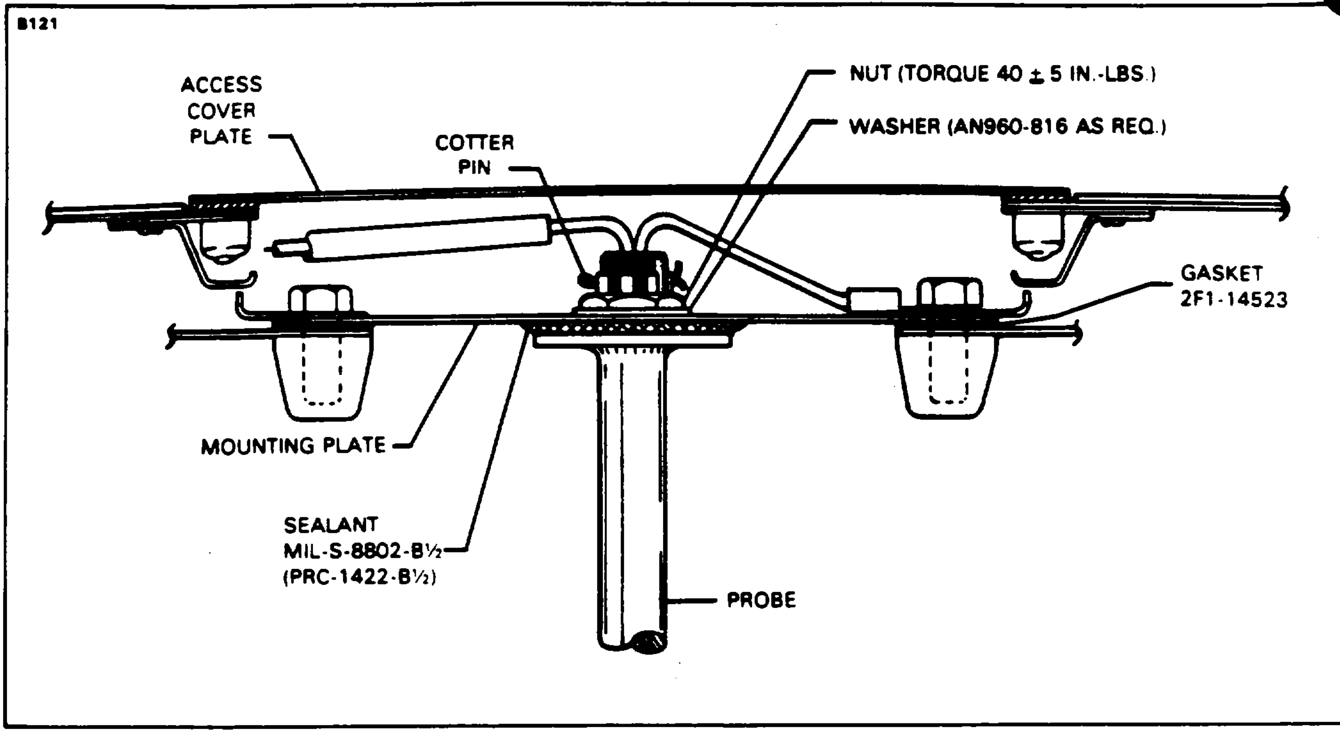


Figure 28-7. Low Fuel Warning Sender Sealing

ACCESSORY REPLACEMENT.

1. Obtain cured repair accessory from cell manufacturer.
2. Mark location of old accessory and preserve markings for guide lines to locate new part.
3. Remove old accessory by gradually loosening an edge with a blunt probe-like instrument.
4. When a loose edge is created, grasp accessory by loose edge with pliers and gently pull accessory off cell wall. Be careful not to pull cell lap open while peeling accessory off. Pull from blind side of a cell lap toward the exposed edge.
5. Buff the cell surface under accessory with emery cloth to smooth roughness and prepare for cement.

— *NOTE* —

Removal of old accessory will probably leave an uneven cavity and surface.

6. Prepare replacement accessory by buffing and washing contact surface. Also wash cell surface (see repair patch).
7. Apply mixed 80C27 repair cement to both surfaces being sure to level cavity left by removal of old accessory.
8. Roll new accessory into place as with a repair patch and place suitable padded plates in position to insure adequate pressure when clamped. Use cellophane separator to prevent cement sticking in the wrong place.
9. Cure as with repair patch either cure method.

DEFECT REPAIRS OF FUEL CELL.

1. Blisters: Remove loose material by trimming. Apply an outside and inside repair patch.
2. Holes, Punctures, Cuts, Tears and Deep Abraded Areas: Trim away any ragged material and apply an outside and inside repair patch.
3. Loose Seams: Buff loose edge and contact surface with emery cloth. Wash three times with Methyl Ethyl Ketone. Apply 80C27 mixed cement two coats as with repair patch. Clamp and cure. Either method may be used. See repair patch. Loose seams may be trimmed if minimum lap remains.
4. Loose Fitting Flange - Inside: Buff edge of flange and contact surface under flange. Apply 80C27 mixed repair cement, cellophane, padded plates and clamp. Follow procedure as outlined for repair patch, except for patch itself.
5. Looseness Against Metal: Prepare metal as per metal fitting - sealing surfaces. Apply 80C27 mixed cement and cure.

TESTING FUEL CELLS.

Either of the following test procedures may be used to detect leaks in the bladder cells.

1. Soap Suds Test.
   A. Attach test plates to all fittings.
   B. Inflate the cell with air to a pressure of 1/4 psi maximum.
   C. Apply a soap and water solution to all repaired areas and any areas suspected of leakage. Bubbles will appear at any point where leakage occurs.
   D. After test, remove all plates and wipe soap residue from the exterior of the cell.
2. Chemical Test.
   A. Attach test plates to all fitting openings except one.
   B. Make up a phenolphthalein solution as follows: Add 40 grams phenolphthalein crystals in 1/2 gallon or Ethyl Alcohol, mix, then add 1/2 gallon of water.
   C. Pour ammonia on an absorbant cloth in the ratio of 3 ml per cubic foot of cell capacity. Place the saturated cloth inside the cell and install remaining test plate.
   D. Inflate the cell with air to a pressure of 1/4 psi maximum, cap and maintain pressure for fifteen minutes.
   E. Soak a large white cloth in the phenolphthalein solution, wring out thoroughly, and spread it smoothly on the outer surface of the cell. Press the cloth down to insure detection of minute leaks.
   F. Check the cloth for red spots which will indicate a leak. Mark any leaks found and move the cloth to a new location. Repeat this procedure until the entire exterior surface of the cell has been covered. If red spots appear on the cloth, they may be removed by resoaking the cloth in the solution.
   G. The solution and test cloth are satisfactory only as long as they remain clean. Indicator solution that is not in immediate use should be stored in a closed rust proof container to prevent evaporation and deterioration.

After the test, remove all plates and test equipment. Allow the cell to air out.

In conducting either test outlined above, the cell need not be confined by a cage or jig, providing the 1/4 psi pressure is not exceeded.

— *NOTE* —

The chemical test is the more sensitive and preferred test.

DISTRIBUTION.

FUEL VALVES.

REMOVAL OF FUEL VALVES.

The crossfeed valve and emergency shutoff valve are located between the wing and fuselage and are removed by the following procedure.

1. Remove the access plate located forward of the main spar on the underside of the wing, between the wing and fuselage.
2. If the crossfeed valve or emergency shutoff valve is to be removed, ascertain that the fuel tank shutoff valve is off.
3. Disconnect the control cable from the valve handle.
4. Disconnect the lines from the valve and cover the ends to prevent contamination.
5. Remove the valve from its attachment fitting.

— *NOTE* —

Repair to the crossfeed valve is limited to replacing O-ring packings.

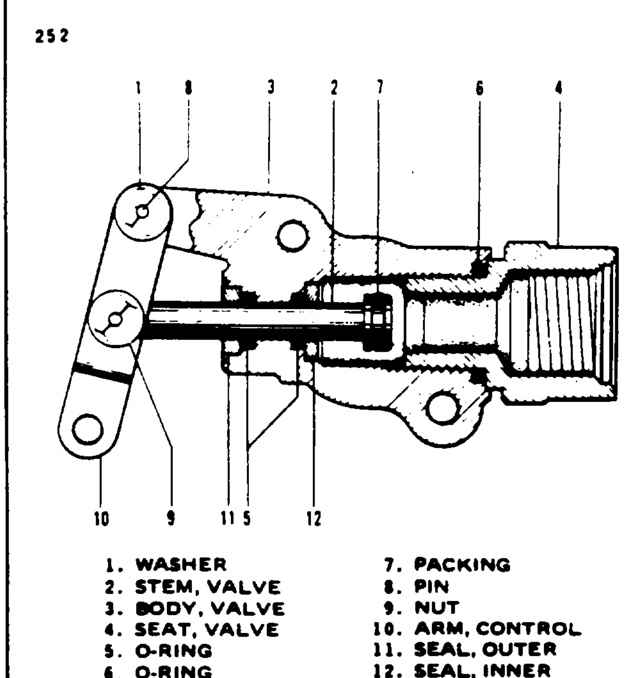


Figure 28-8. Crossfeed Valve

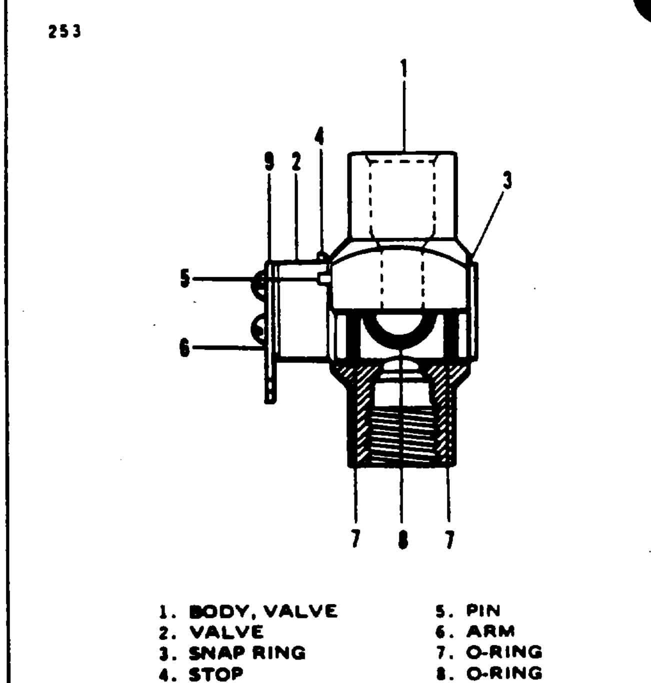


Figure 28-9. Fire Wall Shutoff Valve

CROSSFEED VALVE.

DISASSEMBLY OF CROSSFEED VALVE. (Refer to Figure 28-8.)

1. Disconnect the control arm from the valve step by removing nut from the pin.
2. Push the stem out of the valve body.
3. Remove seal(s) requiring replacement.
4. If seat valve is removed, replace O-ring packing.

CLEANING, INSPECTION AND REPAIR OF CROSSFEED VALVE.

1. Clean the valve components in a suitable cleaning solvent.
2. Inspect the valve for the following:
   A. Check that the friction surfaces of the valve body and stem are free from nicks, dents and burrs.
   B. Check that the inner and outer seals are not worn so much as to allow the valve stem to misalign in the valve seat. (For replacement of inner and outer seal, return to Scott.)
   C. Check that the threaded surfaces of the seat fitting are not stripped or cross-threaded.
3. Repair to the valve is limited to reconditioning of parts, such as smoothing out minor nicks and scratches, and the replacing of O-ring packings.

— NOTE —

Fitting in valve is special. Do not use AN fittings.

ASSEMBLY OF CROSSFEED VALVE. (Refer to Figure 28-8.)

1. If seat valve was removed, install the O-ring packing and assemble the seat fitting on the valve body.
2. Lubricate the O-ring packings with a thin coat of stop-lock grease and install.
3. Push the stem into the valve.
4. Connect the control arm with the stem and secure with pin and nut.
5. Check valve operation.

LEAK TEST OF CROSSFEED VALVE.

1. Connect one port of the valve to a 50 psig air source.
2. Close valve, apply pressure to 50 psig and submerge in kerosene or a similar petroleum base fluid for two minutes.
3. Depressurize and connect the air source to the other port of the valve.
4. Repeat step 2.
5. There shall be no evidence of leaking through the valve seat or around the valve stem.
6. Disconnect and wipe fluid from exterior.

FIREWALL SHUTOFF VALVE.

DISASSEMBLY OF FIREWALL SHUTOFF VALVE. (Refer to Figure 28-9.)

1. Remove the snap ring on the bottom of the valve.
2. Push the valve from the valve body.
3. Remove and discard the O-rings.

CLEANING, INSPECTION AND REPAIR OF FIREWALL SHUTOFF VALVE.

1. Clean the valve components in a suitable cleaning solvent.
2. Inspect the valve for the following:
   A. Check that the valve and valve body stop pins are not bent, broken or missing.
   B. Check that the handle is not loose on the valve.
   C. Check that the valve and inside of the valve body is free of scratches, burrs, etc., that may damage the O-rings.
3. Repair to the valve is limited to reconditioning of parts, such as smoothing out minor nicks and scratches, and replacing of O-rings.

ASSEMBLY OF FIREWALL SHUTOFF VALVE. (Refer to Figure 28-9.)

1. Ascertain that the snap ring is installed on the upper portion of the valve.
2. Place new O-rings on the valve.
3. Lubricate the O-rings with DC-55 (MIL-G-4343) and insert the valve in the valve body. Place the valve so that the valve is allowed only 90° travel between stops.
4. Lock the valve in the valve body by installing the snap ring on the valve.

LEAK TEST OF FIREWALL SHUTOFF VALVE.

1. Connect the inlet port of the valve to a 50 psig air source.
2. Close valve, apply pressure to 50 psig and submerge in kerosene or similar petroleum base fluid for two minutes.
3. There should be no evidence of leakage through the valve port or around seat.
4. Disconnect and wipe fluid from exterior.

INSTALLATION OF FUEL VALVES. (Refer to Figure 28-10.)

1. Place the valve in position and secure.
2. Connect the lines to the valve.
3. Connect the control cable to the valve and check for proper adjustment.
4. Allow fuel to flow to valve and check for leaks.
5. Install access plates.

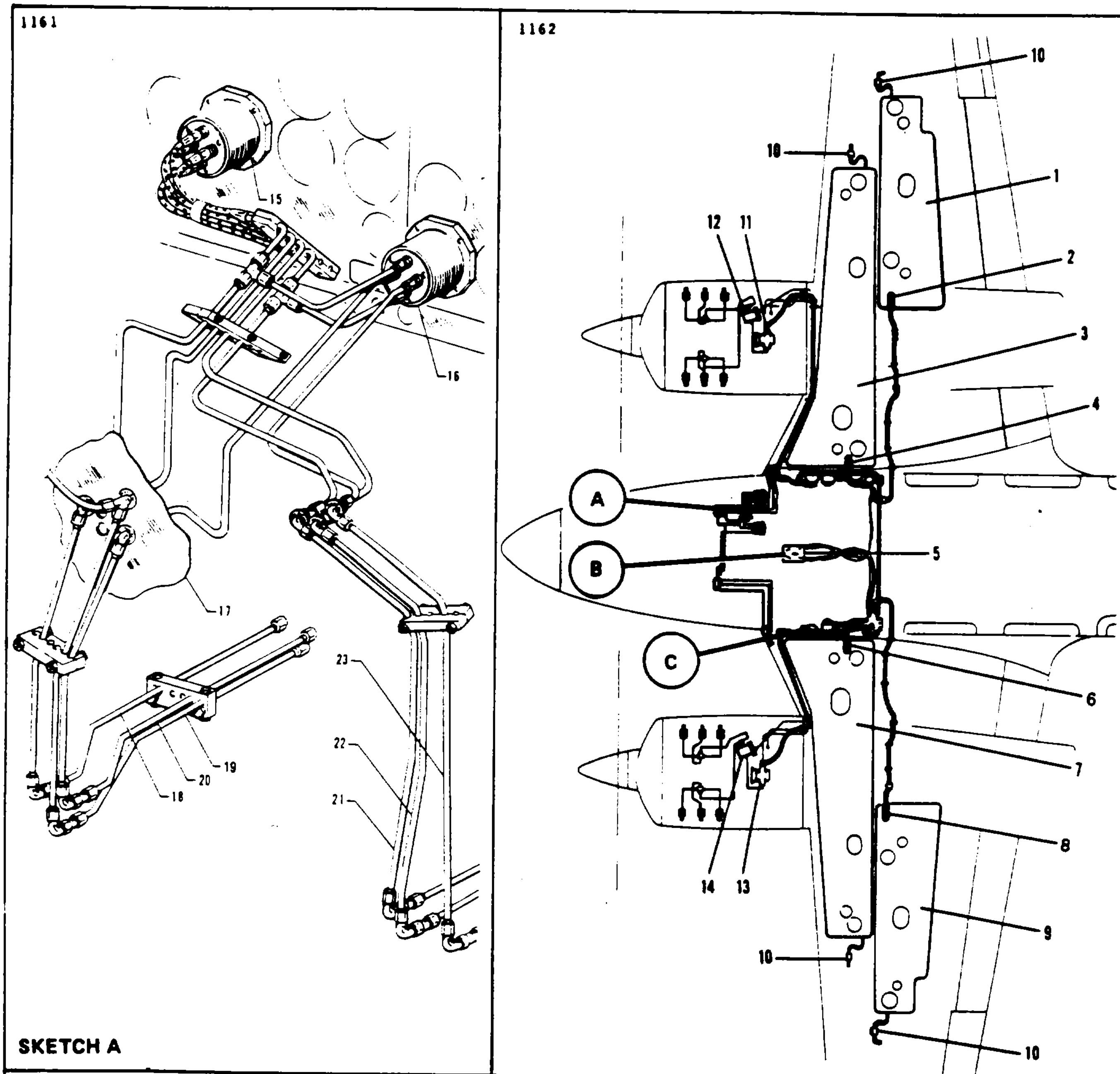
ADJUSTMENT OF FUEL VALVES.

ADJUSTMENT OF CROSSFEED VALVE.

1. Remove the fuel control panel cover in the cockpit and the access panel to the control valve located below the fuselage and the underside of the left wing.
2. Ascertain that the control cable clevis end is connected to the crossfeed valve. The clevis on the valve handle should be free to rotate.
3. Place the crossfeed handle in the cockpit in the OFF position.
4. Assemble the control cable clevis on the arm of the crossfeed handle. Adjust the clevis end of the control cable to obtain a maximum of seven-sixteenths of an inch between the center of the pin that goes through the valve and valve body. (Refer to Figure 28-11.)
5. Move the crossfeed handle to the ON position and ascertain that there is a minimum of one inch between the center of the shaft pin and the valve body.
6. Install safety wire through roll pin and around crossfeed control shaft.
7. Reinstall the access and selector panels.

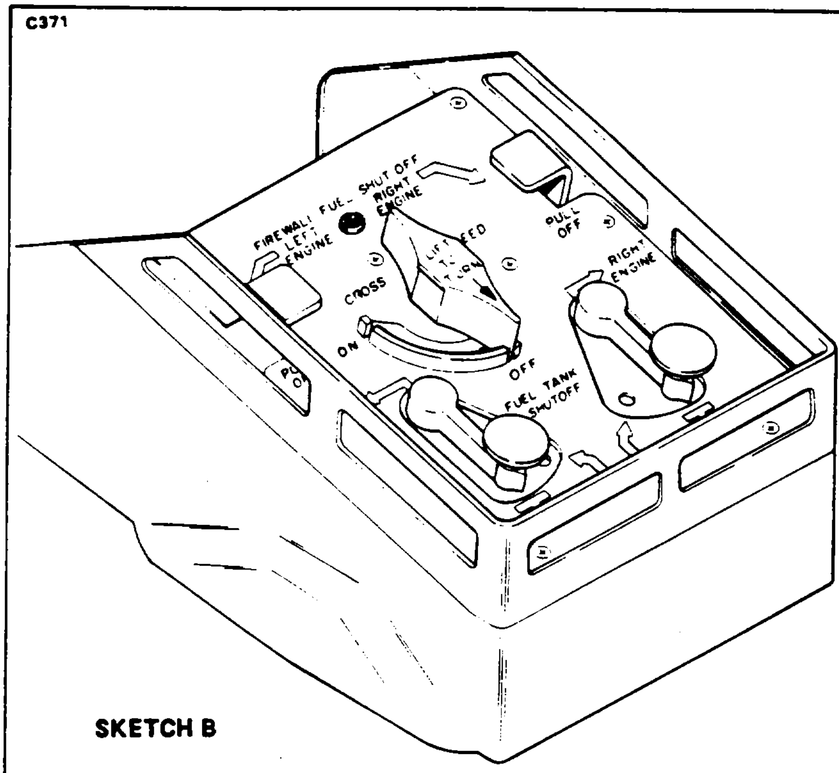
ADJUSTMENT OF FIREWALL SHUTOFF VALVE.

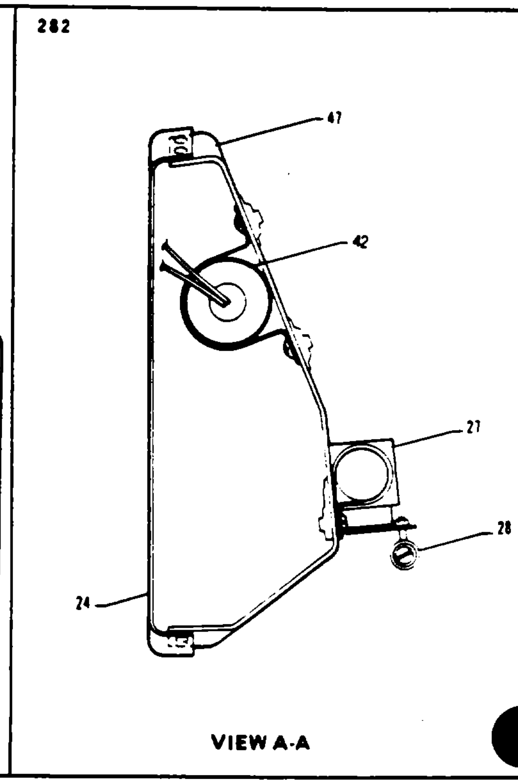
1. Remove the fuel control panel cover in the cockpit and the access panel to the control valve located just ahead of the main spar between the fuselage and the underside of the wing.
2. Ascertain that the control cable clevis ends are connected to the arm of the shutoff lever in the cockpit and the arm of the shutoff valve. Allow the jam nuts of the clevises to remain loose.
3. Rotate the control cable from under the wing so that the valve will contact its stops before the lever in the cockpit contacts its stops.
4. Adjust the limit switches so that when either shutoff lever is moved to the OFF position the fuel shutoff light illuminates.
5. Reinstall the access and fuel control panels.



1. CELL, RIGHT OUTBOARD (OPTIONAL)	12. INJECTOR, RIGHT	23. LINE, LT. FUEL FLOW PRESSURE
2. STRAINER, RIGHT OUTBOARD (OPTIONAL)	13. FUEL PUMP, LEFT	24. RIB ASSEMBLY
3. CELL, RIGHT INBOARD	14. INJECTOR, LEFT	25. BRACKET, MOUNTING
4. STRAINER, RIGHT INBOARD	15. GAUGE, FUEL PRESSURE	26. LINE TO LT. ENGINE
5. PANEL, FUEL CONTROL	16. GAUGE, FUEL FLOW	27. VALVE, EMERGENCY SHUTOFF
6. STRAINER, LEFT INBOARD	17. BULKHEAD	28. CONTROL, EMERGENCY SHUTOFF
7. CELL, LEFT INBOARD	18. LINE, RT. DECK PRESSURE	29. BRACKET, MOUNTING
8. STRAINER, LEFT OUTBOARD (OPTIONAL)	19. LINE, RT. FUEL PRESSURE	30. FUEL PUMP, ELECTRIC
9. CELL, LEFT OUTBOARD (OPTIONAL)	20. LINE, RT. FUEL FLOW PRESSURE	31. VENT, FUEL PUMP
10. VALVE, CHECK	21. LINE, LT. DECK PRESSURE	32. FILTER
11. FUEL PUMP, RIGHT	22. LINE, LT. FUEL PRESSURE	33. DRAIN, FILTER

Figure 28-10. Fuel System Installation





34. STRAINER, FINGER
35. DRAIN, CROSSFEED
36. LINE FROM LT. OUTER CELL
37. DELETED
38. DELETED
39. VALVE, CROSSFEED
40. LINE, CROSSFEED
41. L. PRESSURE SWITCH
42. R. PRESSURE SWITCH
43. FUEL BOOST PUMP
44. LOCKWIRE (MS20995C41)
45. LINE TO L. PRESSURE SWITCH
46. BRACKET, LEFT
47. BRACKET, RIGHT
48. BUSHING
49. CROSSFEED CONTROL CABLE

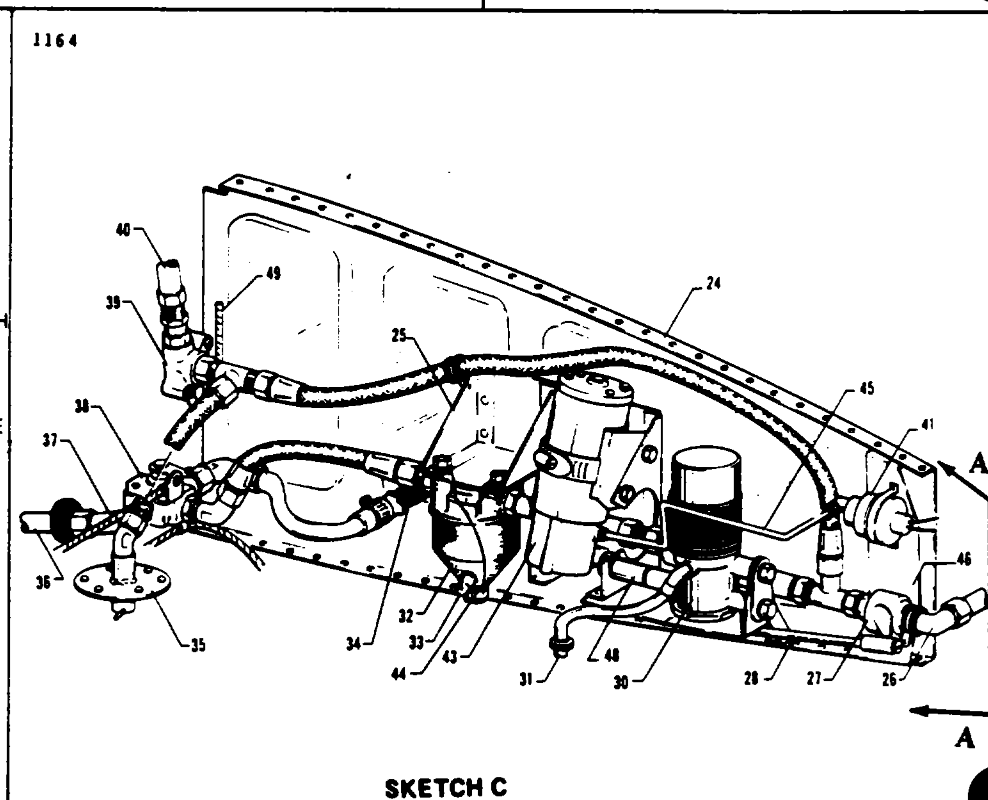


Figure 28-10. Fuel System Installation (cont.)

FUEL FILTER.

REMOVAL OF FUEL FILTER. (Refer to Figure 28-10.)

The instructions given are for the removal of the complete filter from the airplane. For cleaning and servicing purposes only, steps 1 and 2 of this paragraph are necessary.

1. Turn the fuel tank valve to the OFF position.
2. Remove the access panel forward of the main spar, between the underside of the wing and the 4200fuselage.
3. Disconnect the electrical leads to the fuel pumps.
4. Disconnect the fuel lines to the filter and fuel pumps. Cover the line ends to prevent contamination.
5. Remove the bolts that secure the filter and pumps to their mounting brackets.
6. Separate the filter from the fuel pump.

DISASSEMBLY OF FUEL FILTER. (Refer to Figure 28-12.)

1. Cut safety wire and remove cap nut from the bottom of the filter bowl.
2. Remove the bowl from the filter body.
3. The O-ring seal may be removed from the body.
4. Loosen and remove both the check nut and nut from the stud that holds the filter cartridge subassembly.
5. Slide the filter cartridge from the stud. The filter discs and washers need not be separated from the element outer tube for normal cleaning.
6. If necessary to disassemble the filter cartridge, remove the retainer cup from the outer tube and slide discs and washers from the outer tube. Do not use a screwdriver or sharp tool that may damage the discs.
7. The filter bypass assembly may be removed by using the proper size screwdriver and turning out the relief seat. Remove relief ball and spring.

CLEANING, INSPECTION AND REPAIR OF FUEL FILTER. (Refer to Figure 28-12.)

1. Wash the element in oil solvent such as mineral spirits. (It is not necessary to remove discs from element outlet tube for normal cleaning.) Plug open ends of element outlet tube while washing to keep out dirt.
2. Inspect filter discs for damage and broken screens.
3. Check condition of bowl gasket and washer.
4. Check condition of bowl drain and drain O-ring.
5. Check for corrosion of filter parts.
6. Check movement of bypass valve.
7. Check condition of filter rubber shock mounts.
8. Normal repairs necessary for the filter are replacement of bowl gaskets and damaged filter discs.

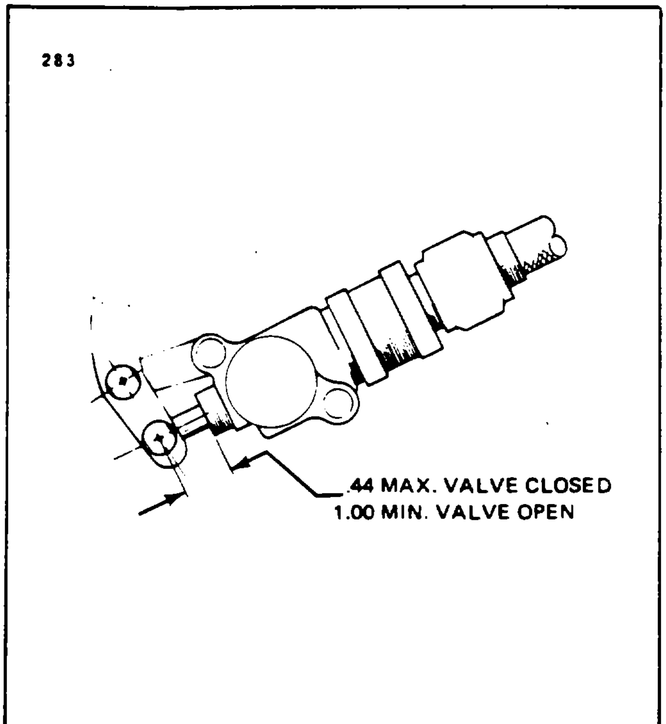


Figure 28-11. Adjustment of Crossfeed Valve

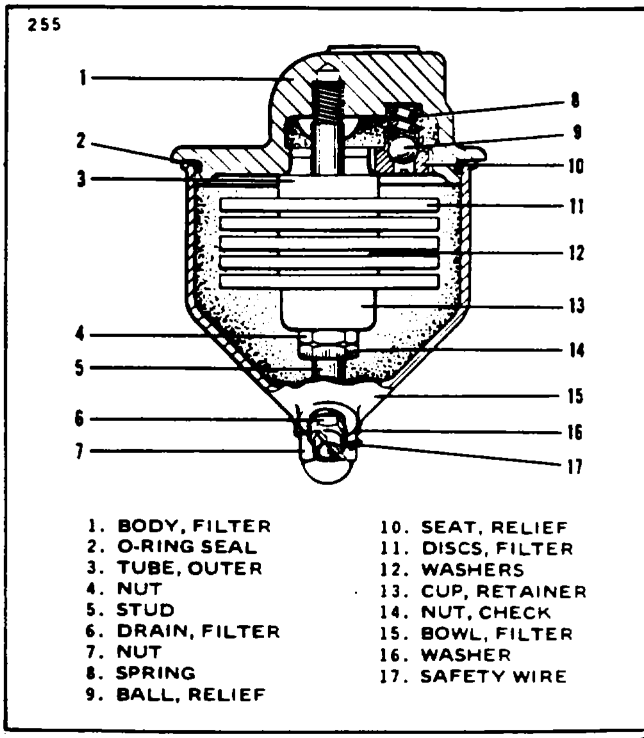


Figure 28-12. Fuel Filter

ASSEMBLY OF FUEL FILTER. (Refer to Figure 28-12.)

1. If removed, install bypass valve spring, relief ball and seat.
2. Place the filter cartridge (assembled) on the housing stud. Ascertain that the end of the outlet tube has positioned itself in the filter body.
3. Secure the filter cartridge with nut. Torque nut 10 to 15 inch-pounds. Torque check nut against nut 40 to 60 inch-pounds.
4. Place bowl gasket on housing and install bowl, gasket and cap nut. Torque cap nut 60 to 80 inch-pounds and safety.
5. Install the filter.

INSTALLATION OF FUEL FILTER. (Refer to Figure 28-10.)

1. Connect the filter and electric fuel pump. Tighten the jam nut on the fitting between the pump and filter to allow the O-ring to seat on the non-threaded portion of the fitting.
2. Position the filter and pump on the mounting brackets and secure.
3. Connect the lines to the filter and pump tee.
4. Connect the electrical leads to the fuel pump.
5. Turn on the fuel valve and check for fuel leaks.
6. Install the access plate.

CLEANING FUEL SYSTEM.

1. To flush fuel tanks disconnect 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 that there is no dirt and foreign matter in the fuel valves, lines or tank. During this operation. agitation of the fuel within the tank will help pick up and remove any dirt. Repeat this procedure for each tank.
3. When all tanks are flushed, clean the filter assembly.

ELECTRIC FUEL PUMP.

REMOVAL OF ELECTRIC FUEL PUMP. (Refer to Figure 28-10.)

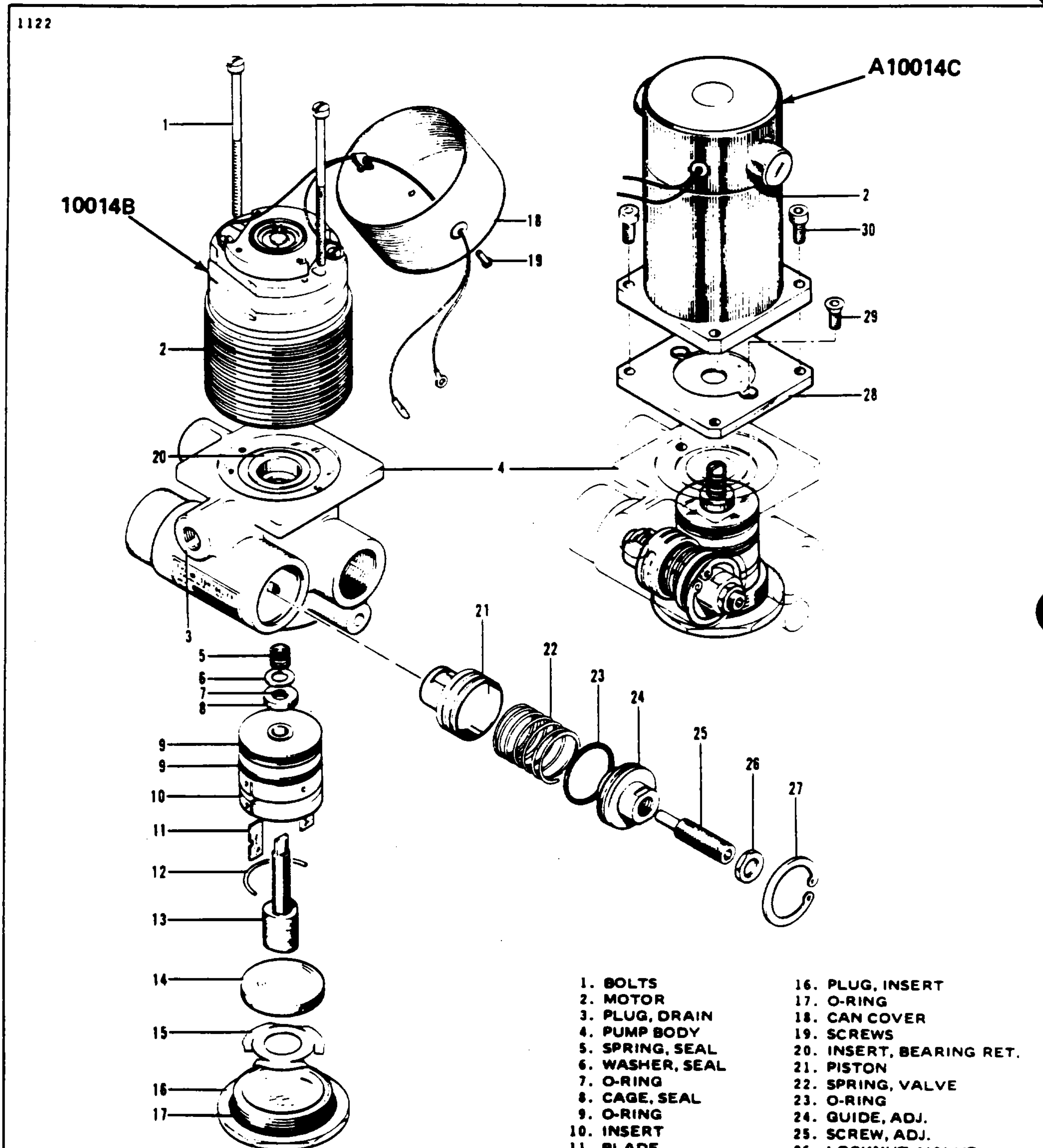
Instructions given are for the removal of the electric fuel pumps from the airplane for the purpose of cleaning, inspection, replacement or repair and adjustment.

1. Turn the fuel tank valve to the OFF position.
2. Remove the access panel forward of the main spar, between the underside of the wing and the fuselage.
3. Disconnect the electrical leads to the fuel pumps.
4. Disconnect the fuel lines from the fuel pumps and filter assembly. Cover the line ends to prevent contamination.
5. Remove the bolts that secure the pumps and filter to their mounting brackets and remove from the airplane.
6. Separate the fuel pump from the filter.

DISASSEMBLY OF ELECTRIC FUEL PUMP. (Refer to Figure 28-13.)

The motor of the pump assembly may be separated from the pump by removing the two motor thru bolts located inside the cover at the commutator end of the motor. The motor of the pump assembly may be separated from the pump by removing the four motor attachment screws. Care should be taken when separating the pump from the motor to insure that the shaft end bearing, which is a press fit on the armature shaft, slips out of the pump body housing. After separation of the pump and motor, disassembly of the pump can proceed as follows:

1. Remove seal spring, seal washer and seal cage containing seal O-ring from pump shaft. Long thin nose pliers may be used to facilitate removal of seal cage.
2. Unscrew the insert plug with O-ring seal from the pump body. Remove the wear plate spring and wear plate (used with newer pumps).
3. Insert number 5-40 screws into tapped hole or face of insert and pull insert assembly from pump body. If necessary, pry the insert loose from the pump body using a lever arm between the pump body and screw head.
4. Remove rotor from insert by pushing on the end of rotor shaft. Remove blade retaining spring and blades. Also O-ring seals.
5. Using a light arbor press, apply pressure to valve adjusting screw to release tension against the Tru-Arc retaining spring and remove the spring with Tru-Arc pliers. Pull out adjustment guide containing O-ring seal, adjusting screw and locknut.
6. Remove the valve spring and piston assembly.
7. Remove the bearing retainer insert from pump body, when required, by means of an arbor press.



1. BOLTS	16. PLUG, INSERT
2. MOTOR	17. O-RING
3. PLUG, DRAIN	18. CAN COVER
4. PUMP BODY	19. SCREWS
5. SPRING, SEAL	20. INSERT, BEARING RET.
6. WASHER, SEAL	21. PISTON
7. O-RING	22. SPRING, VALVE
8. CAGE, SEAL	23. O-RING
9. O-RING	24. GUIDE, ADJ.
10. INSERT	25. SCREW, ADJ.
11. BLADE	26. LOCKNUT, VALVE
12. RING, BLADE RET.	27. RING, RET. (TRU-ARC)
13. ROTOR	28. ADAPTER
14. WEAR PLATE	29. SCREWS
15. WEAR PLATE SPRING	30. SCREWS

Figure 28-13. Electric Fuel Pump

CLEANING, INSPECTION AND REPAIR OF ELECTRIC FUEL PUMP.

1. Clean all parts in oil solvent such as mineral spirits.
2. Inspect all parts for wear, with special attention to the insert, rotor and blades. (Check wear limits per Chart 2803.)
3. Repair is limited to replacing parts that are defective or worn.

ASSEMBLY OF ELECTRIC FUEL PUMP. (Refer to Figure 28-13.)

1. Replace the bearing insert retainer and press flush with body housing.
2. Lubricate O-ring seals with Parker O-Lube or equivalent to facilitate reassembly.
3. Replace the valve spring and piston assembly. Check for free movement of plunger.
4. With the piston assembly, valve spring, adjustment guide and adjustment screw in place, secure with Tru-Arc retaining spring.
5. Install the rotor into the insert and the rotor blades into the slots with the notches toward the outer edge of the insert. Secure the blades with the blade retaining spring. Clearance across the top of the rotor and blades should measure a nominal .0005 after reassembly.
6. Replace the two O-ring seals on the insert.
7. Install the insert and rotor assembly into the pump body.
8. Install the O-ring seal on the insert plug and install plug into pump body. Newer pumps with wear plate in plug, be sure the wear plate spring is between the wear plate and the plug, before installing plug into pump body.
9. Replace the seal cage, seal washer and seal spring on the rotor shaft before installing the motor to the pump body.
10. Replace the motor on the pump body being sure the female end of the motor shaft fits over the male end of the rotor shaft. Secure the motor with attachment hardware.
11. Replace the cover on the end of the motor housing and secure with two screws.
12. Adjust pump.

ADJUSTMENT OF ELECTRIC FUEL PUMP (BENCH TEST).

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 28-volt DC power source. (The black lead is the negative lead.)
3. Using a suitable container with the proper octane fuel, connect a fuel line from the 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.

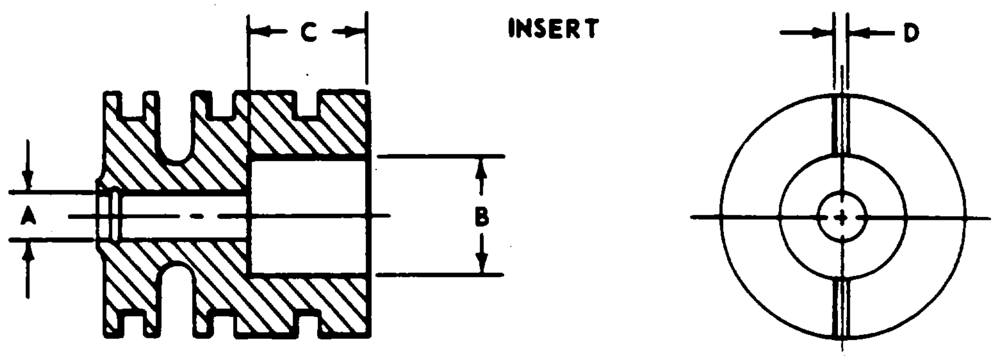
— NOTE —

It is advisable to have a full 28-volt DC current when running the pump in order to obtain the correct pressure of 47 ± 1 psi if boost pump is not installed or 40 ± 1 psi if boost pump is installed, maximum no flow.

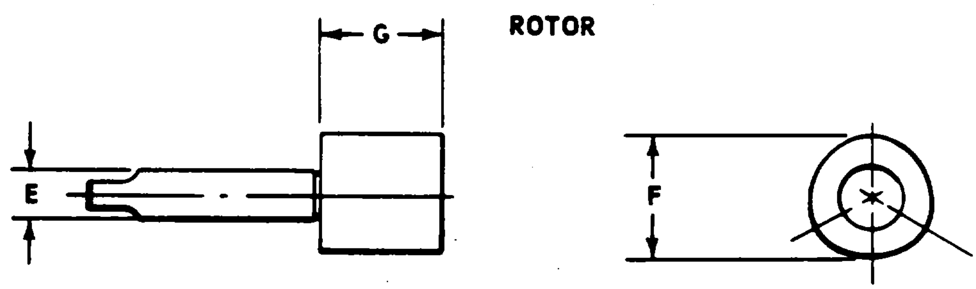
CHART 2803. WEAR LIMITS FOR ELECTRIC FUEL PUMP

DIM.	WORN PART LIMIT	DIM.	WORN PART LIMIT
A	.2502 MAX.	F	.6245 MIN.
B	.6252 MAX.	G	.6244 MIN.
C	.6252 MAX.	H	.6246 MIN.
D	.0455 MAX.	J	.298 MIN.
E	.2493 MIN.	K	.0448 MIN.

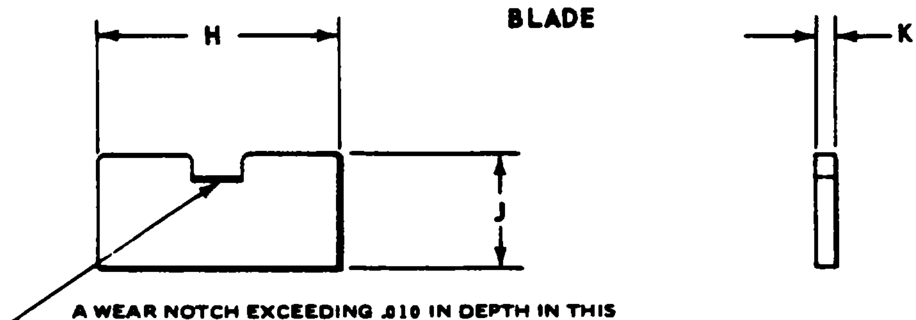
INSERT



ROTOR



BLADE



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 the proper reading of 47 ± 1 psi if boost pump is not installed or 40 ± 1 psi if boost pump is installed, maximum no flow. If boost pump is installed and operated in conjunction with electric fuel pump pressure reading should be 47 to 54 psi, maximum 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 adjustment screw until the gauge reading agrees with the above noted pressure. Repeat Steps 5 and 6 until the proper pressure is obtained. Lock the adjustment screw with the locknut.
7. Disconnect the power source from the pump and remove the fuel lines from the pump.

ADJUSTMENT OF ELECTRIC FUEL PUMP (IN THE AIRPLANE).

1. With the access panels removed and the tank shutoff 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 tank shutoff ON; open the bypass valve on the test line and start the pump.

— NOTE —

It is advisable to operate the opposite engine in order to supply the full 28-volt DC current to the pump. Observe all safety precautions when engine is running.

5. When a steady flow of fuel is obtained, close the bypass valve and check the reading on the pressure gauge. It should read 47 ± 1 psi if boost pump is not installed or 40 ± 1 psi if boost pump is installed, maximum no flow. If boost pump is installed and operated in conjunction with electric fuel pump pressure reading should be 47 to 54 psi, maximum no flow. Do not keep the bypass valve closed for more than one minute during pump operation and adjustment.
6. Loosen locknut on adjustment screw and turn the screw to obtain the proper pressure noted above. Repeat Steps 4 and 5 until adjustment is complete. Lock the adjustment screw with the locknut.
7. Turn off fuel pump and close fuel selector. Shut down opposite engine if it was used to supply full 28-volts DC current. Remove the test line from the pump.
8. Reconnect the original fuel line to the pump. Open the fuel selector and run the pump to check for any fuel leaks.
9. Shut off the pump; close the fuel tank shutoff valve and replace and secure the access panels.

INSTALLATION OF ELECTRIC FUEL PUMP.

1. Connect the fuel pump and fuel filter. Tighten the jam nut on the fitting between the pump and filter to allow the O-ring to seat on the non-threaded portion of the fitting.
2. Position the fuel pump and filter on the mounting brackets and secure with bolts.
3. Connect the fuel lines to the pump and filter.
4. Connect the electrical wires to the pump motor. (Black wire is ground wire.)
5. Turn on the fuel valve and check for fuel leaks.
6. Install the access plate and secure it.

ELECTRIC FUEL BOOST PUMP.

ADJUSTMENT OF FUEL BOOST PUMP.

The fuel boost pump has been adjusted by the manufacturer at 9-12 PSIG, no flow. Should a pressure test indicate a value lower, do not attempt to disassemble or repair fuel pump. If fuel pump proves to be defective it should be replaced.

INDICATING.

FUEL BOOST PUMP.

FUEL BOOST PUMP WARNING SENSOR OPERATIONAL TEST.

Use the press-to-test button to check the bulb. Ascertain that the system is fueled. Place mixture control in idle cut off, fuel tank shutoff valves and fire wall shutoff valves on and crossfeed off, boost pumps circuit breakers off, lights should come on. Push breakers on, one at a time, and observe that the proper light goes out. Turn boost pumps off, lights should come on. If lights do not come on, open throttle and mixture control to relieve pressure and then close, the lights should come on and stay on.

— NOTE —

Do not run pumps at no flow for more than one minute.

Troubleshoot the electrical wiring and refer to the paragraphs on adjustment of fuel boost pumps and warning sensors, if the operational test does not check out.

REMOVAL AND INSTALLATION OF FUEL BOOST PUMP WARNING SENSOR.

1. Remove the lower wing fillet access plate.
2. Disconnect the electric connections.
3. Remove the retaining clip.
4. Unscrew pressure switch from the elbow fitting and remove, catch spillage.
5. Installation of the switch is the reverse of steps 1 through 3.

ADJUSTMENT OF FUEL BOOST PUMP WARNING SENSOR.

The pressure switch has been adjusted to 2-4 PSIG by the manufacturer. Replace the switch if it is found to be defective.

FUEL FLOW.

REMOVAL AND INSTALLATION OF FUEL FLOW WARNING CIRCUIT GATED DELAY RELAY.

1. Remove the instument access plate.
2. Unplug the electrical connector.
3. Unbolt the relay from the bracket and remove.
4. Installation is the reverse order of steps 1 through 3.
5. There is no adjustment for this unit; replace if defective.

— *NOTE* —

Extreme care should be exercised when handling the relay to insure that the white wire does not become grounded which will ruin the solid state unit.

REMOVAL AND INSTALLATION OF THE FUEL FLOW SENSOR PROBE.

1. Remove the cover plate aft of the fuel quantity sender.
2. Disconnect the electric wires and remove bolts.
3. Remove sensor probe from cell.
4. Installation is the reverse order of steps 1 through 3.
5. There is no adjustment of the switch; replace if defective.

WARNING INDICATOR.

REMOVAL AND INSTALLATION OF WARNING INDICATOR LAMPS.

Each individual warning indicator has a spring-loaded mechanism which allows easy access to the lamps. A small release located on the inboard side of the indiator, when pushed, allows the indicator to pop out and to swing outboard, exposing the lamps. The lamps can then be pulled out of the back of the indicator and new ones inserted. To close, push indicator back into original position until it latches.

REMOVAL AND INSTALLATION OF WARNING INDICATOR HOUSING.

1. Remove the two screws on each side of the housing.
2. Pull housing out far enough to disconnect connector E322 and remove.
3. Installation is the reverse order of steps 1 and 2.

FUEL QUANTITY.

CHECKING FUEL QUANTITY GAUGES.

1. Completely drain the inboard and outboard (if installed) fuel cells that relate to the gauge that is to be checked. (Refer to Draining Fuel Cells, Chapter 12.)
2. Level the airplane longitudinally and laterally.
3. Ascertain that the crossfeed and emergency shutoff valves are closed.

— NOTE —

The electrical system must supply 28 volts to the gauge to make this check.

4. Turn the master switch ON and observe the fuel quantity gauge. It should read empty with the respective fuel tank shutoff valve at the ON position.
5. Add fuel to each cell in the amount of 10.0 U.S. gallons to the outboard cell and 14.0 U.S. gallons to the inboard cell, to bring each cell to one-quarter its full capacity.
6. Again move either fuel tank shutoff valve to the ON position and observe the gauge. At either position the quantity pointer should align with any part of the one-quarter gauge index wire.
7. Continue to add fuel in increments of 10.0 and 14.0 U.S. gallons to the outboard and inboard cells respectively for each quarter capacity of the cells. At each quarter increment, until full, check that the quantity pointer aligns with any part of the index wire, with either fuel tank shutoff valve in the ON position.
8. Should the gauge and the amount of fuel in the cell not correspond, the gauge may be calibrated.

CHECKING FUEL QUANTITY SENDERS.

1. Disconnect the sender unit and check for the ohm readings notes in Chart 2804.

CHART 2804. FUEL QUANTITY SENDER RESISTANCE LIMITS

Unit Location	Float Position	Ohm Reading
Main & Auxiliary Inboard	Empty Full	0 to 0.5 48 to 52
Main & Optional Outboard	Empty Full	0 to 0.5 38 to 42

2. The sender unit must be replaced if the above tolerances are not maintained.

ADJUSTMENT OF FUEL GAUGES.

The fuel gauges have been calibrated at time of installation at the factory and normally need not be recalibrated unless a gauge or cell sender unit has been replaced. Should it become necessary to calibrate a gauge, the following procedure may be used.

— *CAUTION* —

Adjust the quantity gauge; do not try to change adjustments of the sender units.

1. Accomplish the preparatory procedure as given in steps 1 thru 3 and read note.
2. Lower the overhead panel that houses the fuel gauges. Do not disconnect the electrical wires.
3. Remove the light receptacle from the back of the fuel gauge. Note the quantity index wires in the gauge. (Refer to Figure 28-6.)
4. Add fuel to each cell in the amount of 10.0 U.S. gallons to the outboard cell and 14.0 U.S. gallons to the inboard cell. to bring each cell to one-quarter its full capacity.
5. With a small insulated screwdriver. reach through the light receptacle hole and move the index wire to align with the quantity pointer. Should the position of the pointer vary slightly when the fuel selector lever is moved from one cell to another. the wire may be adjusted to compensate for this difference by setting the wire at an average distance between the two selected positions of the needle. The wire should then align with part of the needle when the needle is in either position.
6. Continue to add fuel in increments of 10.0 and 14.0 U.S. gallons to the outboard and inboard cell respectively for each quarter capacity of the cells. At each quarter increment. until full. adjust the wire with the pointer in the same manner.

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FUEL QUANITY INDICATOR.

GENERAL.

The two fuel quantity gauges are mounted in the overhead panel. Two transmitter units are installed in each fuel tank. Each unit contains a resistance strip and a movable control arm. The position of this arm is controlled by a float and this position is transmitted electrically to the indicator gauge to show the amount of fuel in the tank. The two transmitters in each tank are connected in series, the outboard sender must be insulated from airframe ground.

TROUBLESHOOTING.

CHART 2805. FUEL QUANTITY INDICATORS

Trouble	Cause	Remedy
Fuel gauge fails to indicate.	Broken wiring.	Check and repair.
	Circuit breaker out.	Check for possible short circuit: then reset breaker.
	Gauge not operating.	Replace.
Fuel gauge indicates empty when tanks are full.	Loss of ground.	Check ground connections at outboard transmitter in wings.
	Float arm stuck.	Replace fuel transmitter.
	Short to ground.	Check wiring.
Fuel gauge indicates empty or approximately half full when tanks are full.	Short to ground.	Check wiring.

— *END* —

GRIDS 2I15 THRU 2I24
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CHAPTER 29

HYDRAULIC POWER

CHAPTER 29 - HYDRAULIC POWER

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GENERAL.

The hydraulic system components covered in this chapter consist of landing gear actuating cylinders, hydraulic lines, filters, hand pump and power pack. The brake system, although hydraulically operated, is not included in this section as it has its own hydraulic system independent of the power pack. The brake system along with landing gear is covered in Chapter 32 of this manual.

This chapter also provides instructions for remedying difficulties which may arise in the operation of the hydraulic system.

DESCRIPTION AND OPERATION.

The purpose of the hydraulic Power Pack is to provide the hydraulic power required for operation of the landing gear. The Power Pack is operated through a flexible shaft by a selector lever fashioned like a wheel which is mounted on the instrument panel, left of the engine control quadrant. The Power Pack contains the system reservoir and assorted valves which control the system operation. The Power Pack works in conjunction with the engine driven pumps, solenoid valves and hydraulic cylinders to perform the desired sequence of operation as selected by the control lever in the cockpit.

— CAUTION —

To insure not having the landing gear moving to the up (retracted) position while the aircraft is on the ground, the following check should be performed prior to applying hydraulic pressure to the system. Try to move the selector lever to the up position, if the lever can be moved to the up position it indicates an improperly adjusted selector mechanism or the anti-retraction system is inoperative. Select gear down prior to applying system pressure or engine starting.

In case of an electrical failure, the door solenoid valve within the Power Pack will move (spring pressure) to the door open position and remain in that position. The doors will not open until the selector lever is moved to the gear down position and the gear extension cycle is started.

— CAUTION —

Prior to starting any investigation of the hydraulic system, place the airplane on jacks in accordance with instructions given in Chapter 7 of this manual.

TROUBLESHOOTING.

Chart 2901 lists the possible troubles which may be encountered and their probable causes and suggested remedies. When trouble arises place the airplane on jacks (Per Chapter 7) and perform a system operational check to determine the trouble.

— *NOTE* —

If it is found that the Power Pack is at fault and requires disassembly, it is recommended that it be replaced on an exchange basis or overhauled by a recommended overhaul shop. If however, this cannot be achieved, the Power Pack may be repaired in accordance with instructions given within this Chapter.

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM)

Trouble	Cause	Remedy
Landing gear system fails to operate.	Selector lever disconnected.	Connect lever.
	Selector lever out of adjustment.	Adjust lever.
	Selector lever jammed. (Note: Selector lever cannot be moved to gear up while left main gear strut is compressed or when power is off.)	Adjust lever.
	Hydraulic fluid in reservoir below operating level.	Fill the power pack with hydraulic fluid.
	Leak or obstruction in hydraulic lines.	Check the system with hydraulic test unit or hand pump.
	Internal leakage in main relief valve.	Check system operation.
	Internal leakage in hand pump relief valve.	Check system operation.

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont.)

Trouble	Cause	Remedy
Gear operates abnormally slow or partially.	Low fluid level.	Fill power pack with hydraulic fluid.
	Leaking or kinked line.	Replace line.
	Internal leak in cylinder.	Repair or replace cylinder.
	Priority valve out of adjustment or leaking.	Check valve operation.
	Slow leak in main relief valve. (Engine pump.)	Check system operation.
	Slow leak in hand pump relief valve.	Check system operation.
	External leakage at selector valve.	Replace damaged O-rings.
	One engine pump inoperative.	Replace pump.
Selector handle returns to neutral before cycle is complete.	Cable, line or other obstruction restricting the travel required to fully select gear up or down.	Check and remove obstruction.
	Selector lever and /or push-pull rods out of adjustment.	Adjust control.
	If gear completes cycle (red light out) but doors do not close battery output may be low.	Check voltage.

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont.)

Trouble	Cause	Remedy
Selector handle returns to neutral before cycle is complete. (cont.)	Time delay valve and/or piston release lock out of adjustment.	Check operation.
	Time delay valve air locked.	Bleed air out by holding selector down for 30 seconds, then make three or four rapid movements to neutral and back to down.
Gear retracts or extends before doors open.	Priority valve leaks in power pack.	Check valve cracking pressure.
	Solenoid valve stuck in closed position.	Turn off power and hand pump doors open. (Note: With power off solenoid valve shuttles to door open and the doors may be opened without selecting gear up or down.)
	Micro switch on power pack out of adjustment.	Check for loose wire or mounting, or bent bracket.
Doors come open in flight. NOTE Refer to Landing Gear Troubleshooting Chart 3201.	Improper rigging of door actuator.	Check for proper rigging.
	Malfunction of actuator lock mechanism.	Check actuator operation.
Doors fail to close.	Faulty limit switch.	Check all indicator lights.
	Low electric power supply.	Check battery.
	Cannon plug on power pack loose.	Tighten.

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont.)

Trouble	Cause	Remedy
Doors fail to close. (cont.)	Solenoid valve stuck in door open position.	Check wiring to solenoid valve.
	Circuit breaker out.	Check breaker. (Note: Without electric power, the gear doors will open but not close.)

CHART 2902. LEADING PARTICULARS, HYDRAULIC POWER PACK

NOMENCLATURE	WTC 2135-1
	(See Note Below)
Operating Pressure	1900 P.S.I.
Main Relief Valve Pressure (Primary)	1900 - 1950 P.S.I.
Hand Pump Relief Valve Pressure (Secondary)	2025 - 2100 P.S.I.
Hand Pump Relief Valve Reseat Pressure	1900 - 1950 P.S.I.
Low Pressure Thermal Relief Vent Valve "Open"	0 to 100 P.S.I.
Low Pressure Thermal Relief Vent Valve "Closed"	150 P.S.I. Max.
Priority Valve Cracking Pressure	600 - 650 P.S.I.
Hand Pump Check Valve Cracking Pressure	1 to 3 P.S.I.
Landing Gear Position Release	1220 - 1250 P.S.I.
Time Delay Valve	5 to 9 seconds
Hydraulic Fluid Required	MIL-H-5606
Weight Dry - Power Pack	10.00 pounds
Hydraulic Fluid Flow Rate (Both Pumps Operating)	1.6 G.P.M.
Reservoir Operating Fluid Level (Engine Pump) (Minimum - Maximum)	1.82 - 2.13 pints
Reservoir Fluid Level (Emergency) (Stand Pipe Level)	1.22 pints

— NOTE —

Should the values in the text differ from the chart values, the chart values take precedence.

MAIN HYDRAULIC SYSTEM.

HYDRAULIC SYSTEM FAILURE.

The emergency use of the hand pump to extend the gears indicates the engine driven pumps were operating without sufficient fluid. This condition causes additional wear on the engine driven pumps. Therefore, the filter elements must be removed and checked even if pump failure is not apparent and/or the primary cause of the problem.

1. Remove the filter elements and check for metal particles.
2. If no metal particles are evident proceed with the following:
   A. Replace filter element.
   B. Replenish fluid as noted in Chapter 12.
3. If metal particles are evident in either filter proceed with the following:
   A. Inspect, replace or repair both hydraulic pumps.
   B. Prime pumps. Do not connect the pumps to the rest of the hydraulic system until the system has been flushed.
   C. Proceed to flush the system.

FLUSHING HYDRAULIC SYSTEM.

When contamination of the hydraulic system is suspected, the complete system should be drained and flushed to remove the contaminated fluid. The cause and type of contamination should be determined and corrected. Use the following steps to perform this operation:

1. Remove the engine cowlings as explained in Chapter 71.
2. Disconnect the hydraulic lines at the engine driven pumps.
3. Drain the hydraulic fluid from the Power Pack reservoir by using the suction, fill, and drain fitting on the bracket located at the lower aft corner of the nose access panel opening behind the hydraulics components cover.
4. Disconnect the hydraulic lines at the actuating cylinders and drain the fluid from all the hydraulic lines.
5. Remove and replace the filter elements located on the engine firewall, and flush out the filter bowls.
6. Flush the hydraulic system with clean hydraulic fluid (MIL-H-5606). Examine several seals and cylinder bores for damage.
7. When the hydraulic system is completely flushed and there is no more indication of contamination, reconnect the previously disconnected fittings and replenish the system with clean hydraulic fluid.
8. Bleed the hydraulic system as described in the section on Bleeding the Hydraulic System and check for leaks.
9. Replace the engine cowlings as explained in Chapter 71.

TESTING SYSTEM.

HYDRAULIC SYSTEM OPERATIONAL CHECKS USING PIPER TEST UNIT.

This test unit (Part No. 753 080) would offer invaluable assistance in checking hydraulic systems, hydraulic Power Pack and related components in the airplane. Examples are: landing gear cycling operation, Power Pack operating pressure checks and adjustments etc., all being performed without operating the engines.

This unit consists of an electric motor driven hydraulic pump, bypass valve, fluid reservoir, filter, pressure gauge, hoses and adapter fittings housed in a metal cabinet mounted on casters for ease of movement.

HYDRAULIC TEST UNIT (OPTIONAL).

Multi-purpose hydraulic test units can be used to provide the same functions as the Piper unit; however, the test unit must be capable of duplicating and monitoring the operating pressures and the flow rate given in Chart 2902.

— *NOTE* —

The following procedures are written with a Piper, or optional hydraulic test unit in mind; however, the operating manual for the specific unit being used should be studied for the appropriate application described.

CONNECTING TEST UNIT.

1. Remove the access panel on the right side of the nose section and open access in hydraulics components cover.
2. If the system requires filling only, remove the protective cap from the suction, fill and drain valve mounted on the bracket located at the lower aft corner of the nose access panel opening and connect the pressure hose from the test unit. Open the valve on the suction port and by placing the control lever in the up position, proceed to fill the system per instructions with test unit. Observe the fill lines to determine when the reservoir is full.
3. If the system must be operated during various ground checks, overhaul, or inspection of its components, remove the protective caps from both the suction and pressure ports and connect the test unit pressure hose to the pressure port and the test unit suction hose to the suction port. Open the valve on the suction port and proceed to operate the test unit according to instructions furnished with it.

TESTS.

CYCLING LANDING GEAR.

1. Connect the hydraulic test unit, described in "Connecting Test Unit," and jack the airplane as outlined in Chapter 7.
2. Set hydraulic test unit bypass valve open.
3. Start test unit pump motor.

4. Place gear selector handle in the up or down position and slowly close the bypass valve till system pressure has reached that specified in Chart 2902.
5. Using the landing gear control handle in airplane, operate gear as desired.

— NOTE —

Should a retraction malfunction be expected due to air in the system, follow the procedure in "Checking Landing Gear Cycle Time". Gear cycling time can be prolonged by slowly opening the test unit bypass valve part way. This will bleed off part of the pump flow.

6. After completion of cycling, ascertain that the landing gear selector handle is in the down neutral position, and that the landing gear is down and locked.
7. Disconnect hydraulic test unit.
8. Remove the airplane from jacks. (Refer to Chapter 7.)

CHECKING LANDING GEAR CYCLE TIME.

When the hydraulic system on the airplane is suspected of malfunction because gear cycle time is slow, it could be caused by low fluid in airplane reservoir causing system to be full of air. The following procedure will purge air from the system and fill the reservoir:

1. Place the airplane on jacks in accordance with Jacking, Chapter 7.
2. Cycle the landing gear through two complete cycles.
3. Excessive foam in the reservoir indicates there may be a leak in the suction plumbing in which air is being drawn into the system. Check all ground service suction connections for leaks.
4. With landing gear extended, place gear handle in full up position and record time required for gear to retract and doors to close. Time should not exceed 9 seconds ± .5 seconds plus the time required for the time delay valve to operate.
5. With landing gear retracted, place gear handle in full down position and record time required for gear to extend and doors to close. Time should not exceed 8 seconds ± .5 seconds plus the time required for the time delay valve to operate.

— NOTE —

These times are taken using a single test unit and can be reduced considerably with the use of two test units, one hooked to each firewall fitting. If time is within limit when operated by test unit, but exceeds limit when operated by engine driven pump there may be internal leakage in the pump or a suction air leak through the suction plumbing system to either of the engine driven pumps. Refer to procedure for checking for suction air leakage. When tests indicate a defective pump, repair or replace the defective pump. If time exceeds the limit when operated either by the test unit or engine driven pump, internal leakage is in the hydraulic system. Check actuators for internal leakage. Repair or replace actuators as required. If actuators are not defective, Power Pack internal leakage is indicated. Repair or replace Power Pack.

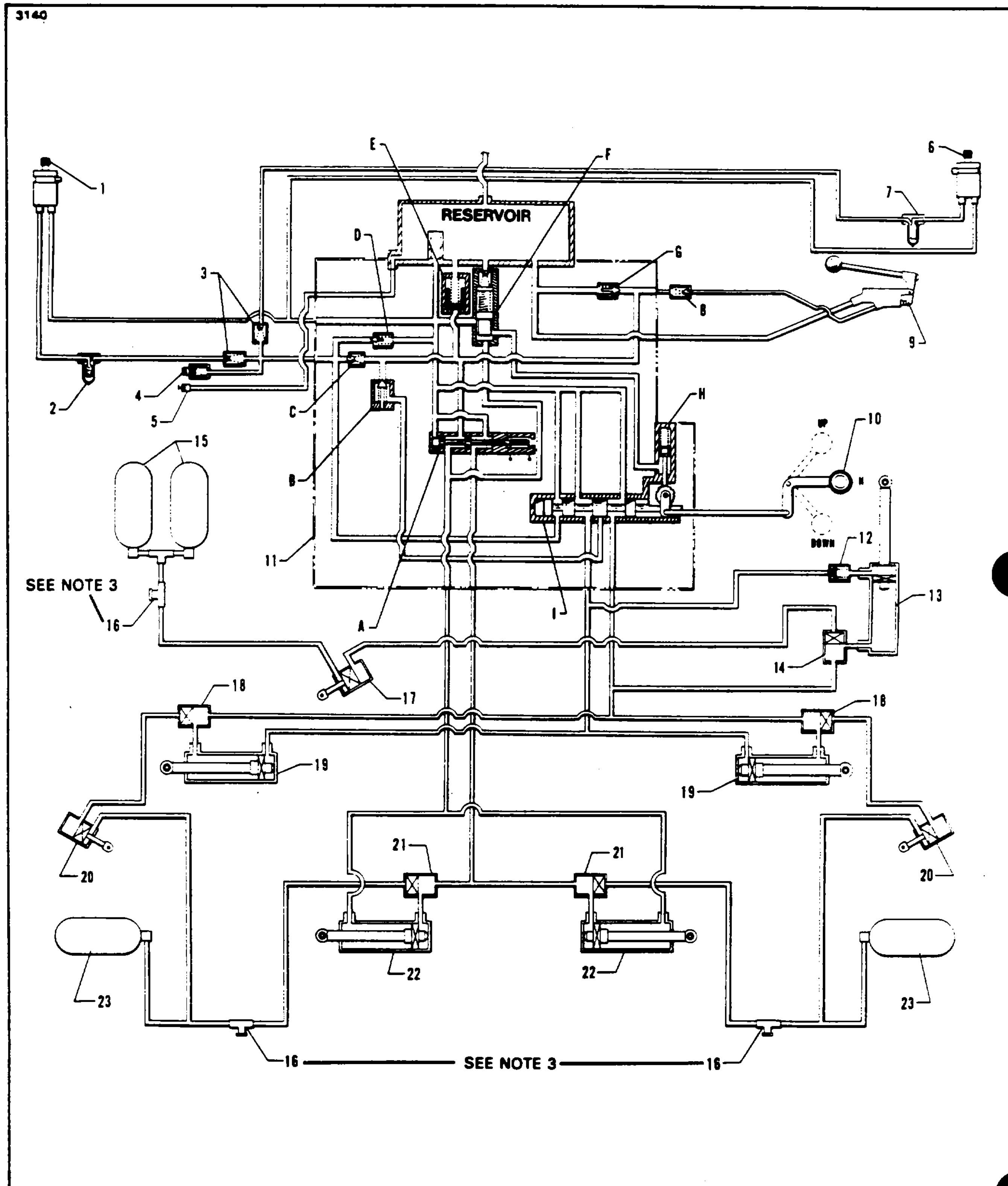

Figure 29-1. Schematic Diagram of Hydraulic System

1. HYDRAULIC PUMP LEFT ENGINE
2. HYDRAULIC FILTER LEFT ENGINE
3. CHECK VALVE FOR RIGHT AND LEFT ENGINE
4. PRESSURE PORT
5. SUCTION — FILL
6. HYDRAULIC PUMP RIGHT ENGINE
7. HYDRAULIC FILTER RIGHT ENGINE
8. HAND PUMP CHECK VALVE
9. HAND PUMP
10. GEAR SELECTOR (REMOTE)
11. POWER PACK
    A. DOOR SOLENOID VALVE
    B. PRIORITY VALVE
    C. ENGINE PUMP CHECK VALVE
    D. MAIN RELIEF VALVE
    E. LOW PRESSURE THERMAL RELIEF VALVE
    F. TIME DELAY VALVE

11. POWER PACK (cont)
    G. HAND PUMP RELIEF VALVE
    H. PISTON RELEASE (LOCK)
    I. LANDING GEAR SELECTOR VALVE
12. RESTRICTOR VALVE
13. NOSE GEAR ACTUATOR
14. EMERGENCY SHUTTLE VALVE (NOSE GEAR)
15. EMERGENCY NITROGEN CYLINDER (NOSE GEAR)
16. EMERGENCY SERVICE PORTS
17. EMERGENCY UNLOCK ACTUATOR (NOSE GEAR)
18. EMERGENCY SHUTTLE VALVE (MAIN GEAR)
19. EMERGENCY MAIN GEAR ACTUATOR
20. EMERGENCY UNLOCK ACTUATOR (MAIN GEAR)
21. EMERGENCY SHUTTLE VALVE (MAIN GEAR)
22. EMERGENCY MAIN GEAR DOOR ACTUATOR
23. EMERGENCY NITROGEN CYLINDER (MAIN GEAR)

NOTES:
1. GEAR IS SHOWN DOWN AND LOCKED, DOORS CLOSED AND SELECTOR HANDLE IN NEUTRAL, POWER ON.
2. REFER TO FIGURE 29-2 FOR SCHEMATIC OF POWER PACK ELECTRICAL SYSTEM.
3. SERVICE PORTS (ITEM 16) FOR REMOVING PRESSURE FROM LINES AFTER ACTIVATION OF EMERGENCY EXTENSION SYSTEM.

Figure 29-1. Schematic Diagram of Hydraulic System (cont.)

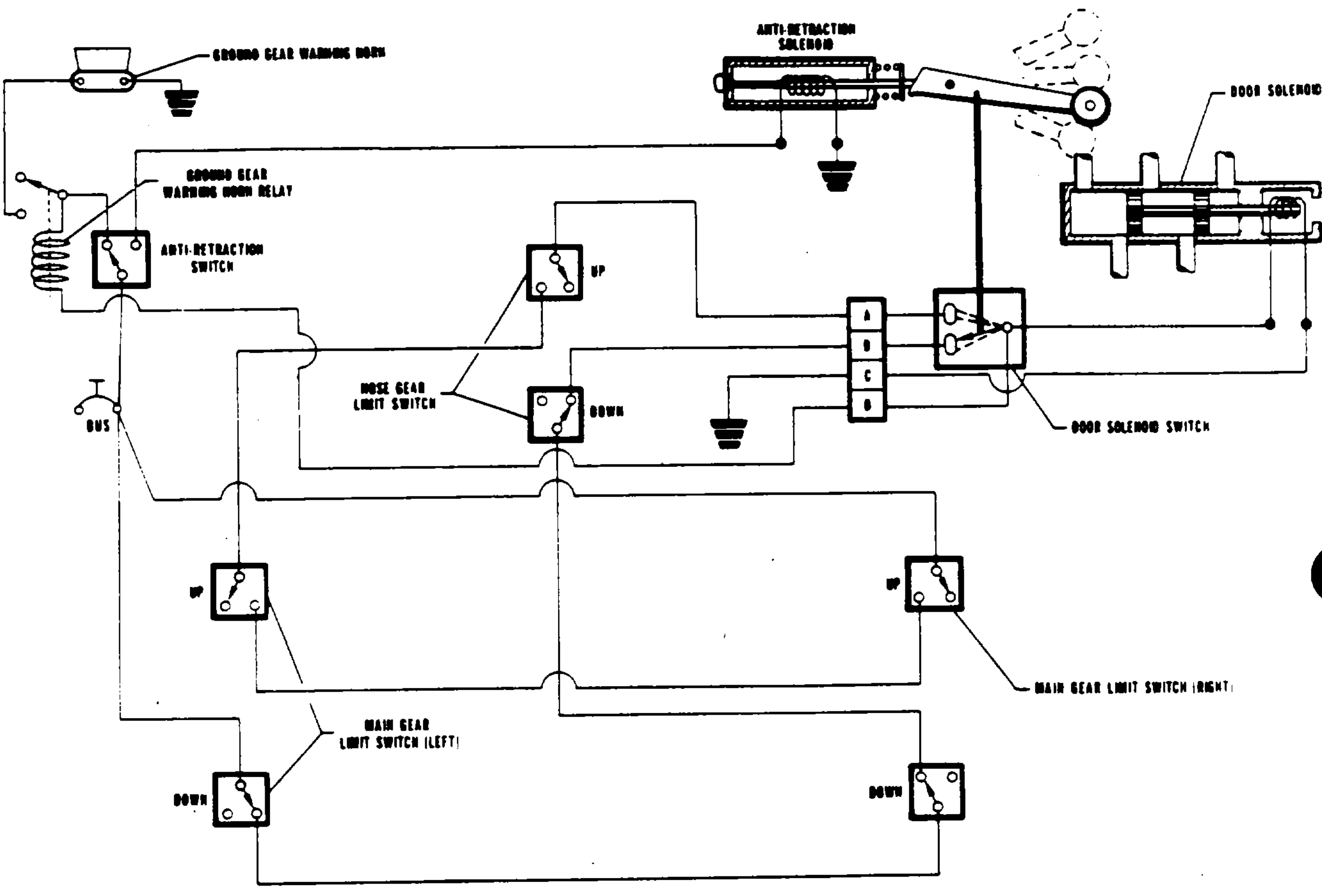

Figure 29-2. Schematic of Power Pack Electrical System

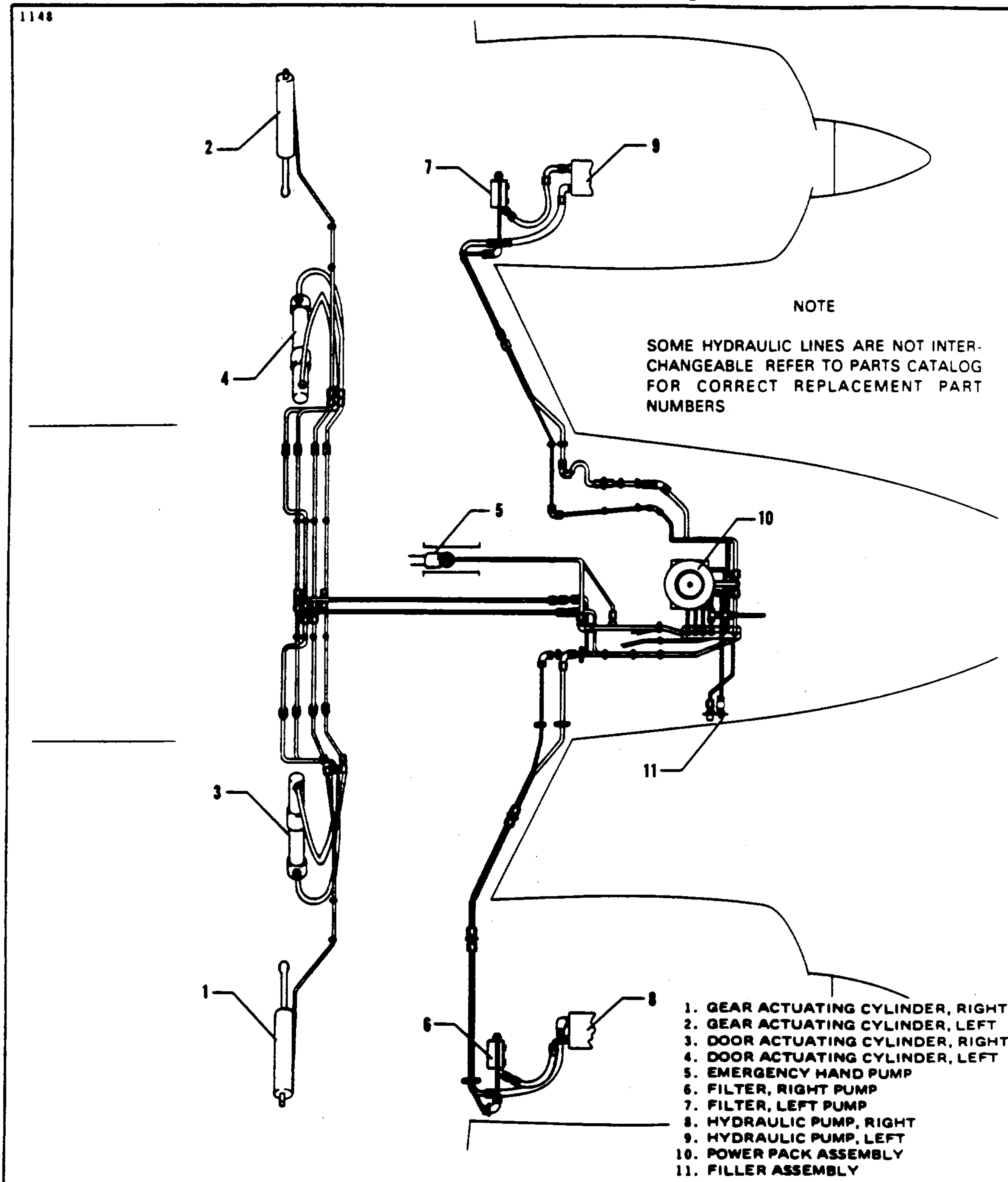

Figure 29-3. Hydraulic System Installation

CHECKING TIME DELAY VALVE.

1. Connect the hydraulic test unit as described in "Connecting Test Unit."
2. With test unit operating and airplane master switch ON, move the landing gear selector handle to the down position. Note the delay of the handle returning to the neutral position.

— *NOTE* —

The time delay between moving the selector handle to the down position (master switch must be ON) and the automatic releasing of the selector handle to neutral should be 3 to 9 seconds at room temperature. Colder temperature will cause a longer delay.

3. If the time delay fails specification given in "Note" ascertain that valve is not air locked. Bleed air out by holding selector down for 30 seconds, then make three or four rapid movements to neutral and back to down.
4. There is no adjustment of the time delay valve. If it is defective, replace it.
5. Disconnect hydraulic test unit.

CHECKING HANDLE RELEASE TO NEUTRAL.

1. Place airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Connect hydraulic test unit as described in the paragraph "Connecting Test Unit."
3. Cycle the landing gear through two complete cycles, ending with gear down and locked, and the doors closed.
4. Set the hydraulic test unit bypass valve full open.
5. Place the landing gear selector handle in the full down position.
6. Very slowly close the bypass valve until the handle trips back to neutral. Read the gauge at the point of the handle trip. The pressure should be as indicated in Chart 2902. Be sure to allow time for the time delay valve to open.

— *NOTE* —

One release valve serves to release the handle from both the gear down and gear up positions. If the handle return springs are adjusted correctly, the release valve should release the handle from both positions at the same pressure. The preceding procedure checks the release pressure from the gear down position, and the following procedure checks the release pressure from the gear up position. This is performed only to assure satisfactory operation of other equipment relative to handle release operations.

7. Set hydraulic test unit bypass valve full open.
8. Place landing gear selector handle in the full up position.
9. Very slowly close the bypass valve until the handle trips back to neutral. Read the gauge at the point of handle trip. The pressure should be as indicated in Chart 2902. Be sure to allow time for the time delay valve to open.
10. Refer to handle release adjustment, should it be required.
11. Ascertain that the landing gear selector handle is in the down neutral position, and that the landing gear is down and locked.
12. Disconnect test unit, and remove airplane from jacks.

CHECKING PRIORITY VALVE.

1. Connect hydraulic test unit, and place airplane on jacks in accordance with Jacking, Chapter 7.
2. Cycle landing gear through two complete cycles.
3. With gear down and locked and test unit operating, turn the master switch off, move the gear handle to the down position. This will cause the doors to open and the handle will return to neutral position. Leave the switch off to permit the doors to remain open, thereby making it easier and faster to complete this check.
4. Open hydraulic test unit bypass valve.
5. Place landing gear selector handle full up. Very slowly close bypass valve, observing pressure gauge of the test unit and noting pressure at which priority valve opens. Priority valve should open at 600-650 psi as indicated in Chart 2902.

— NOTE —

As the priority valve opens, the nose gear downlock starts to release. Read the pressure gauge at this point.

6. Make any priority valve adjustments as required.
7. Ascertain that the landing gear selector handle is in the down neutral position, and that the landing gear is down and locked.
8. Disconnect the test unit, and remove the airplane from jacks.

CHECKING MAIN RELIEF VALVE.

1. Connect test unit.
2. Open test unit bypass valve.
3. Hold the landing gear selector handle in the full down position.
4. Slowly close bypass valve, observing pressure build-up and point at which pressure stabilizes on test unit gauge. Stabilization indicates relief valve setting. The relief valve pressure and flow rate are 1900 to 1950 psi and 1.6 gallons per minute, respectively, as listed in Chart 2902.
5. The Power Pack main relief valve adjustment can be accomplished with the Power Pack installed in the airplane. Remove the top cover and drain fluid to gain access to adjusting screw.
6. Disconnect the hydraulic test unit.

CHECKING HAND PUMP RELIEF VALVE.

1. Place landing gear selector handle in the full down position. With master switch off, extend the handle located to the right of the pilot's seat under the floor, and operate emergency hand pump to open landing gear doors.
2. Disconnect door open line (upper fitting) from main gear door cylinder and connect hydraulic test unit pressure hose to door open line. Cap actuator fitting.
3. Close bypass valve on hydraulic test unit.
4. Operate emergency hand pump in airplane, observing hydraulic test unit pressure gauge for pressure at which hand pump relief valve opens. This pressure should be from 2025 to 2100 psi as indicated in Chart 2902.
5. The Power Pack hand pump relief valve adjustment can be accomplished with the Power Pack installed in the airplane. Remove the cover and drain fluid to gain access to adjusting screw.
6. Open bypass valve on test unit to release the pressure, disconnect the test unit pressure hose from door open line. Remove cap from actuator fitting and reconnect door open line to main gear door actuator.
7. Replenish hydraulic reservoir fluid as required.

CHECKING FOR SUCTION AIR LEAKAGE.

1. Remove engine cowling for access.
2. Disconnect hydraulic pump suction (larger) hose from the pump and connect test unit suction hose to airplane suction hose, using a suitable fitting.
3. Disconnect hydraulic pump pressure (smaller) hose from pump and connect test unit pressure hose to airplane pressure hose, using a suitable fitting.
4. Connect test unit electrical cable to appropriate electrical power source.
5. Jack the airplane and cycle the landing gear through five complete cycles.
6. Observe the test unit reservoir for any air bubbles which would indicate leakage in suction line, hose, or fittings. Replace defective parts.

— NOTE —

If replacement of parts stops any visible air in test unit reservoir, but air still enters hydraulic system, engine driven pump may have a suction leak.

7. Ascertain that the landing gear selector handle is in the down neutral position, and that the landing gear is down and locked.
8. Remove the airplane from jacks and disconnect test unit.

DISCONNECTING TEST UNIT.

1. Ascertain that the landing gear selector is in the down neutral position, and the landing gear is down and locked.
2. Shutdown the test unit per instruction supplied with the unit.
3. Close the suction-fill-drain valve in the airplane by placing the control lever in the down positon and disconnecting the test unit hose from the fitting. Install the protective cap over the fitting. Disconnect and remove the test unit pressure hose from the pressure fitting in the airplane if previously connected. Install the protective cap on the fitting.
4. Check the fluid level in the Power Pack Reservoir and check the system for leaks.
5. Close access in the hydraulic components cover and install the access panel on the right side of the nose section.

HYDRAULIC POWER PACK.

REMOVAL OF POWER PACK. (Refer to Figure 29-4.)

1. Remove the right access panel at the nose section of the airplane between stations 25.60 and 57.00 and remove hydraulic components cover completely by removing retaining strips from the outer edges of the cover.
2. Drain the Power Pack by removing the drain cap from the end of the suction, fill and drain plug installed just inside the access opening behind the hydraulic components cover and connecting a fluid line from the fitting to a suitable container, then reaise the lever to open the valve and proceed to drain the reservoir.

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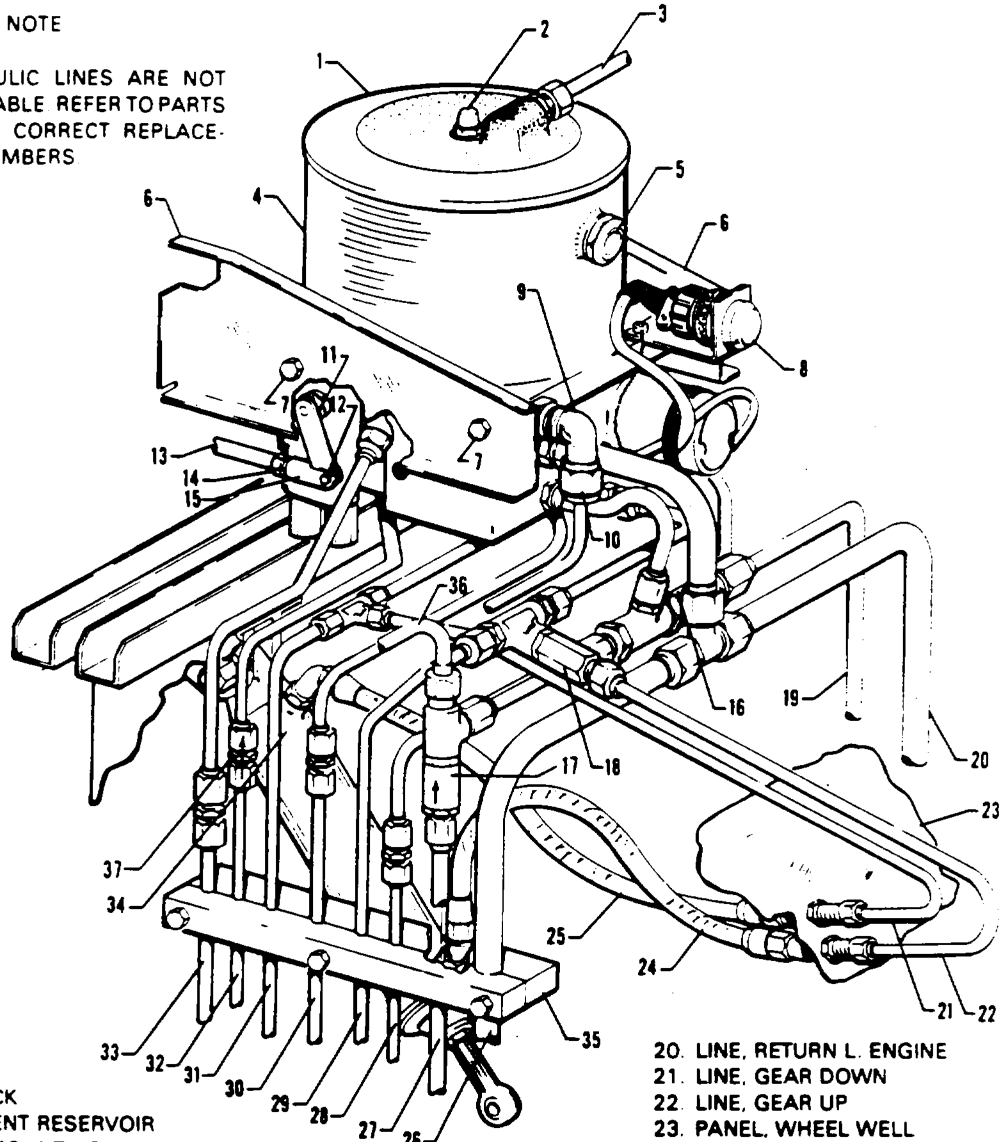
NOTE

SOME HYDRAULIC LINES ARE NOT INTERCHANGEABLE REFER TO PARTS CATALOG FOR CORRECT REPLACEMENT PART NUMBERS



1. CAP
2. NUT, CAP
3. LINE, VENT
4. POWER PACK
5. TRANSPARENT RESERVOIR
6. BRACKET, MOUNTING
7. BOLT
8. CONNECTOR, ELECTRICAL
9. FITTING, ELBOW
10. SUCTION, FILL, DRAIN
11. ARM, CONTROL
12. PIN
13. ROD, CONTROL
14. NUT, JAM
15. CLEVIS
16. CHECK VALVE, L. ENGINE
17. CHECK VALVE, R. ENGINE
18. VALVE
19. LINE, PRESSURE L. ENGINE
20. LINE, RETURN L. ENGINE
21. LINE, GEAR DOWN
22. LINE, GEAR UP
23. PANEL, WHEEL WELL
24. HOSE, GEAR UP
25. HOSE, GEAR DOWN
26. LINE, RETURN R. ENGINE
27. LINE, PRESSURE R. ENGINE
28. LINE, DOOR CLOSE
29. LINE, GEAR UP
30. LINE, DOOR OPEN
31. LINE, GEAR DOWN
32. LINE, HAND PUMP PRESSURE
33. LINE, HAND PUMP SUCTION
34. CYLINDER, NOSE GEAR
35. BLOCK
36. HYDRAULIC PRESSURE
37. CHECK VALVE, HAND PUMP PRESSURE

Figure 29-4. Power Pack Installation

3. Disconnect the electrical connector located at the forward end of the Power Pack.
4. Disconnect the vent line from the Power Pack.
5. Disconnect the gear selector control cable from the Power Pack control arm on the outboard side of the Power Pack.
6. Disconnect the various hydraulic lines from the Power Pack. Cap the open lines to prevent contamination.
7. Cut the safety wire and remove the attachment bolts which secure the Power Pack to the mounting brackets.
8. Move the Power Pack forward and then out the access opening.

INSTALLATION OF POWER PACK. (Refer to 29-4.)

1. Position the Power Pack within the mounting brackets. Insure that the Power Pack control arm is facing outboard. Secure the Power Pack and the bracket supports to the mounting brackets with bolts and safety.
2. Uncap and connect the various hydraulic lines to the Power Pack.
3. Connect the electrical connector to the forward end of the Power Pack and the landing gear selector cable to the selector arm.
4. Fill the Power Pack in accordance with instructions given in Chapter 12.
5. Bleed the hydraulic system per instructions given in this chapter.
6. Perform a system operational check and inspection.
7. Close the hydraulic components cover and replace the access panel on the side of the airplane nose section.

— NOTE —

If cable was removed from support, the gear selector will require readjustment. Refer to Adjustment of Gear Selector Handle Mechanism.

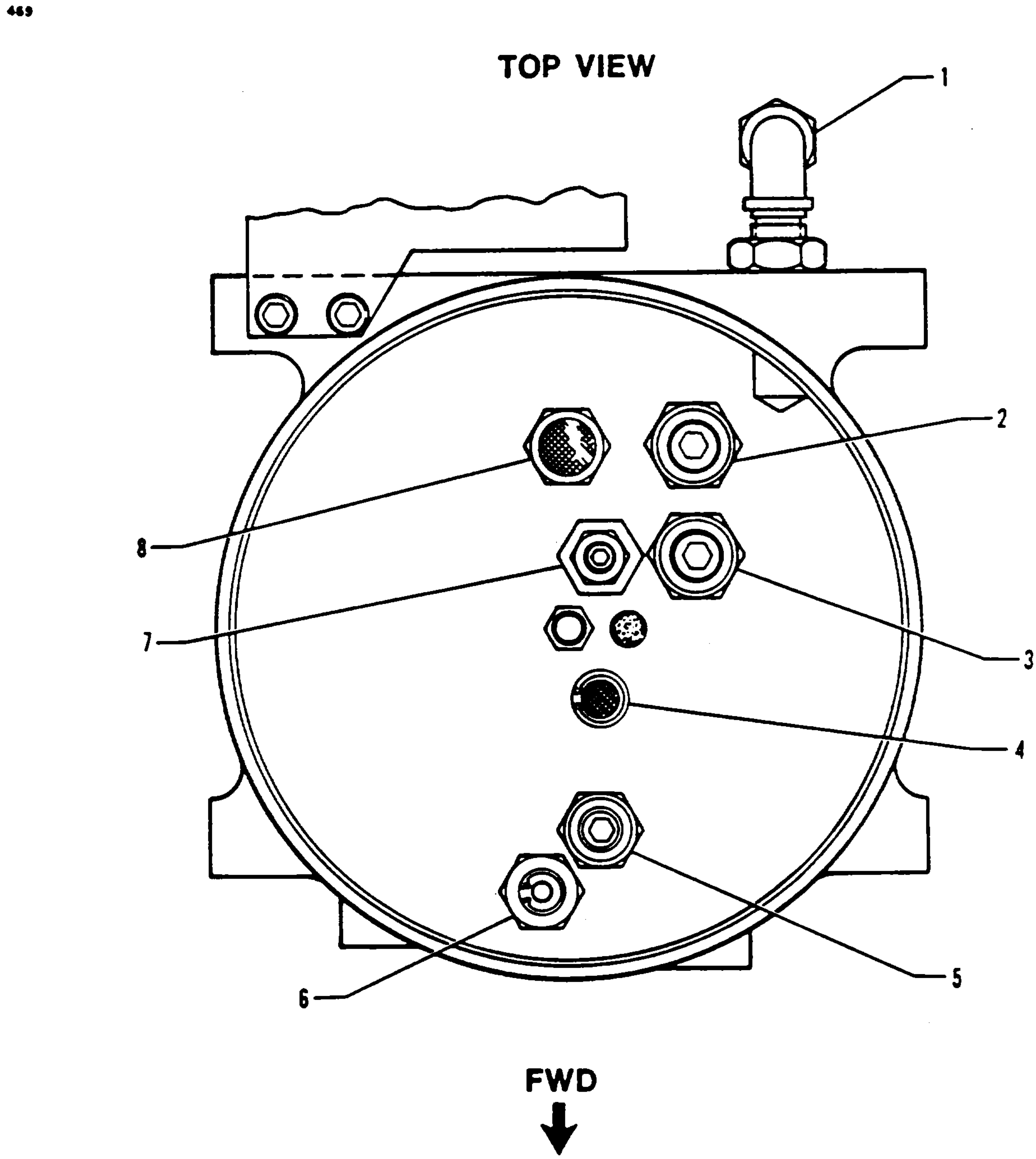
DISASSEMBLY OF POWER PACK. (Refer to Figure 29-6.)

After the Power Pack has been removed from the airplane and all ports are capped or plugged, spray with cleaning solvent (Federal Specifications P-S-661, or equivalent) to remove all accumulated dust or dirt. Dry with filtered compressed air. To disassemble the unit, proceed as follows:

1. Remove wire, nut, reservoir cover and O-ring. Cover is a snug fit on reservoir. Use a soft mallet and tap cover lightly to remove.
2. Remove deflector plate and snap ring from center stud and remove baffle plate from reservoir. Drain remaining hydraulic fluid from reservoir.
3. Remove the reservoir and O-ring. Reservoir is a snug fit in Body and requires a hard pull to disengage from Body.
4. Remove center stud and O-ring.

— NOTE —

All electrical wires are color coded. Disregard color of wire terminals. If colored wires are matched when wires are re-installed, the wires will be connected correctly.



1. DRAIN FITTING
2. MAIN RELIEF VALVE
3. PRIORITY VALVE
4. FILTER, HAND PUMP SUCTION
5. HAND PUMP RELIEF VALVE
6. TIME DELAY CHECK VALVE
7. DOOR VENT VALVE
8. STANDPIPE, FILTER

Figure 29-5. Location of Power Pack Components

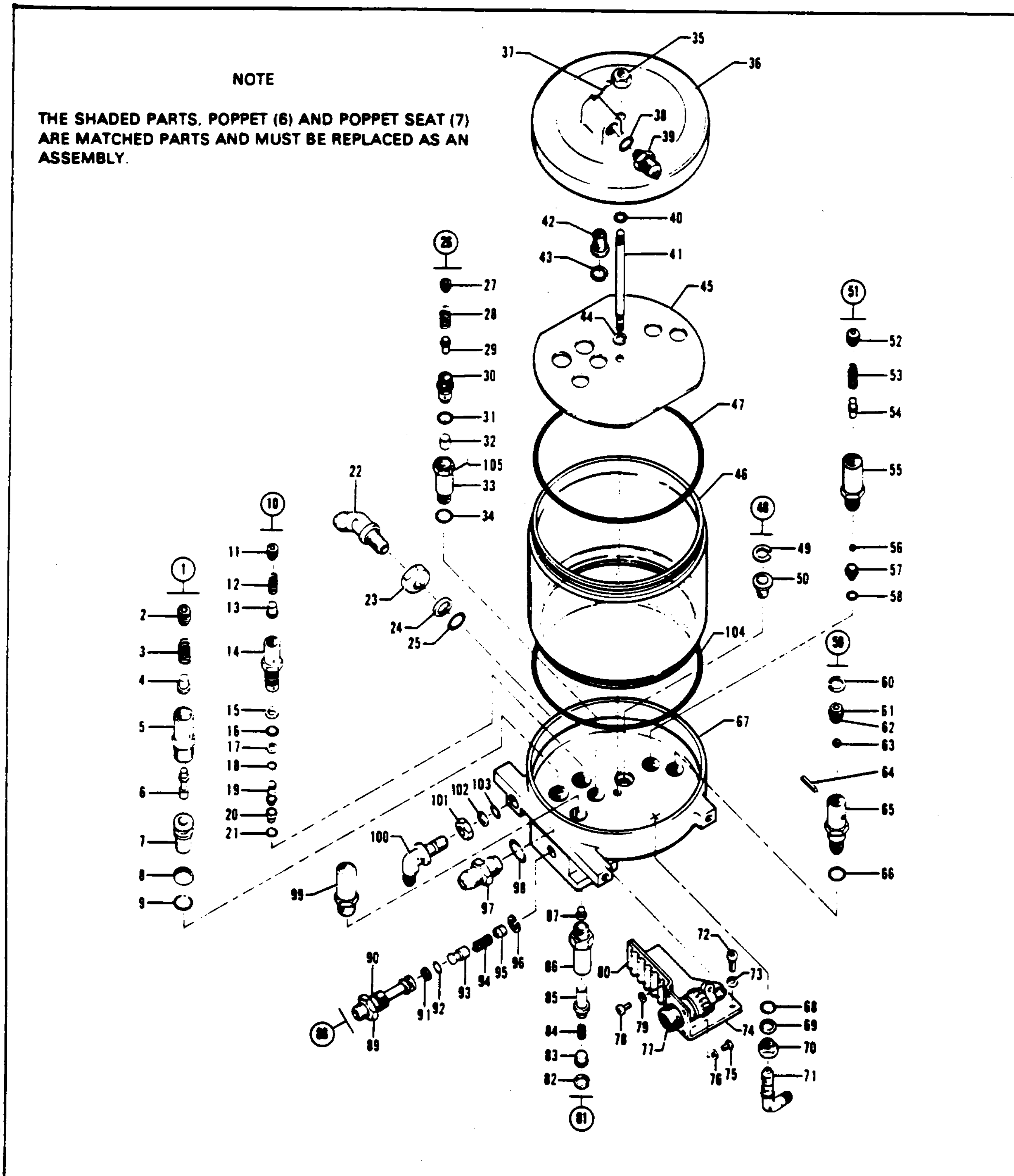


Figure 29-6. Hydraulic Power Pack

1. MAIN RELIEF VALVE
2. ADJUSTING SCREW
3. SPRING
4. BUTTON
5. BODY, RELIEF VALVE
6. POPPET
7. POPPET SEAT
8. BACK UP
9. "O" RING
10. PRIORITY VALVE
11. ADJUSTING SCREW
12. SPRING
13. BUTTON
14. BODY, PRIORITY VALVE
15. BACK UP
16. "O" RING
17. BACK UP
18. "O" RING
19. POPPET
20. POPPET SEAT
21. "O" RING
22. FITTING
23. NUT
24. BACK UP
25. "O" RING
26. DOOR VENT VALVE
27. ADJUSTING SCREW
28. SPRING
29. STEM
30. RETAINER
31. "O" RING
32. PISTON
33. BODY, VENT VALVE
34. "O" RING
35. NUT
36. COVER, RESERVOIR
37. WIRE, SAFETY
38. "O" RING
39. FITTING
40. "O" RING
41. CENTER STUD
42. FILTER, VENT
43. SNAP RING
44. SNAP RING
45. BAFFLE PLATE
46. RESERVOIR
47. "O" RING
48. FILTER, HAND PUMP SUCTION
49. SNAP RING
50. FILTER, HAND PUMP
51. HAND PUMP RELIEF VALVE
52. ADJUSTING SCREW
53. SPRING
54. STEM
55. BODY, SECONDARY RELIEF VALVE
56. BALL
57. SEAT
58. "O" RING
59. CHECK VALVE, TIME DELAY
60. SNAP RING
61. "O" RING
62. SEAT
63. BALL
64. PIN
65. BODY, CHECK VALVE
66. "O" RING
67. BODY
68. "O" RING
69. BACK UP
70. NUT
71. FITTING
72. BOLT
73. WASHER
74. BRACKET
75. BOLT
76. WASHER
77. PLUG, ELECTRICAL
78. SCREW
79. WASHER
80. TERMINAL BLOCK
81. SPRING CARTRIDGE
82. SNAP RING
83. BUTTON
84. SPRING
85. PLUNGER
86. BODY, HANDLE RELEASE
87. SCREW, STOP
88. HAND PUMP CHECK VALVE
89. FITTING
90. "O" RING
91. BACK UP
92. "O" RING
93. POPPET
94. SPRING
95. GUIDE
96. SNAP RING
97. FITTING
98. "O" RING
99. STANDPIPE-FILTER
100. FITTING
101. NUT
102. BACK UP
103. "O" RING
104. "O" RING
105. WIRE SAFETY
106. BRACKET ASSEMBLY
107. DEFLECTOR PLATE

Figure 29-6. Hydraulic Power Pack (cont.)

5. Remove screws, washers, switch assembly and insulating plate. Switch will remain hanging from the electrical wires. (Refer to Figure 29-7.)
6. Remove plastic strap attaching the electrical wires to the door solenoid valve and remove the safety wire from the door solenoid valve. (Refer to Figure 29-7.)
7. Disconnect electrical wires of switch and door solenoid from terminal block.
8. Remove four bolts attaching the manifold assembly. Work the manifold assembly from the Power Pack, taking care to prevent the loss of the transfer sleeves between the manifold and the Power Pack. (Refer to Figure 29-7.)
9. Remove the five transfer sleeves from the manifold. (Refer to Figure 29-7.)

— NOTE —

As the manifold is separated from the Power Pack body, the teeth on the landing gear selector spool become disengaged from the gear. This will permit the selector spool to move. DO NOT remove the selector spool from its position. Never move it to a position that is more than flush with the manifold body at the end opposite the selector spool teeth. If moved beyond this position, an O-ring will become caught and the selector spool will then be difficult to remove.

CLEANING, INSPECTION AND REPAIR OF POWER PACK.

1. Discard all old O-rings and gaskets.
2. Remove the line fitting caps and wash all parts in dry cleaning solvent (Federal Specification P-S-661, or equivalent) and dry with filtered compressed air.

— NOTE —

During inspection and until the Power Pack is to be reassembled, be careful to keep the parts as clean as possible. After cleaning the parts, keep them on a clean surface, and covered with a clean cloth.

3. Inspect all parts for scratches, scores, chips, cracks and indications of excess wear.
4. Repairs are limited to replacement of parts, O-rings and gaskets.
5. The parts catalog should be used to obtain the proper parts for the Power Pack being serviced.

ASSEMBLY OF POWER PACK.

1. Use new O-rings and gaskets during assembly.
2. Lubricate all O-rings with petrolatum per VV-P-236 or equivalent during assembly.
3. Lubricate all threaded surfaces on the various valves in the Power Pack with MIL-G-7711 grease or equivalent before installing.

— NOTE —

When positioning reservoir cover make sure that the vent fitting points to the right when Power Pack is installed in the airplane. Also when installing reservoir cover, make certain the large O-ring is not being pinched.

4. Install the reservoir cover on the reservoir and secure with nut. Torque nut to 35 inch-pounds. Safety the nut to the reservoir cover using safety wire.

RESERVOIR.

ASSEMBLY OF RESERVOIR. (Refer to Figure 29-6.)

1. Install the center stud into body. Torque to 45-inch pounds.
2. Lubricate two reservoir O-rings and install.
3. Push reservoir into body.
4. Drop baffle plate into reservoir and secure by placing snap ring onto center stud.
5. Slide deflector plate over center stud.
6. Lubricate O-ring and install onto center stud.

TESTING RESERVOIR FOR LEAKAGE. (Refer to Figure 29-6.)

1. Remove the drain fitting as applicable, and attach a test hand pump with 200 psi gauge to the drain port.
2. Remove the cap from the reservoir vent fitting at the top of the reservoir and operate the hand pump until the reservoir is completely full, as indicated by fluid coming out of vent fitting.
3. Cap the reservoir vent fitting.
4. Operate the test hand pump to raise the pressure in the reservoir until the pressure gauge indicates 50 psi maximum.
5. Check for leaks, there should be no external leakage.
6. Crack the vent fitting to release the pressure, remove the test equipment, drain the reservoir and cap the fittings.
7. The hydraulic Power Pack is now ready to be installed in the airplane.

MANIFOLD.

DISASSEMBLY OF MANIFOLD. (Refer to Figure 29-7.)

1. Remove the door solenoid by unscrewing it from the manifold. Use the proper wrench. Remove the plunger return spring.
2. Remove the pin, and then remove the plunger from the spool by carefully pulling it from the manifold.
3. Using a hook formed from a brass welding rod, withdraw the transfer valve sleeve from the manifold, by inserting the hook into one of the oil holes in the transfer valve sleeve.

— *NOTE* —

Be sure that the end of the hook is not over .06 inches long and use the hook with care to prevent scratching the bore in the manifold. The sleeve will be hard to withdraw due to O-ring friction.

4. Remove screw, spring and the time delay plunger using a small wooden dowel inserted in the center of the plunger. The plunger should slide out very easily.
5. Remove the landing gear selector spool by grasping the rack (teeth) end of the spool and pulling it from the manifold.

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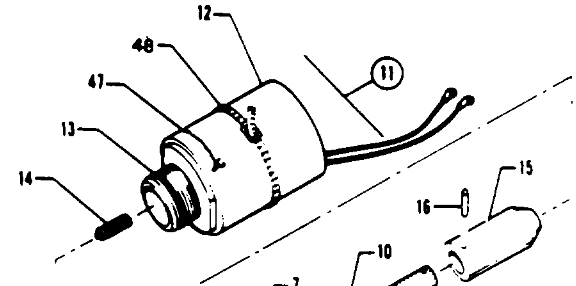
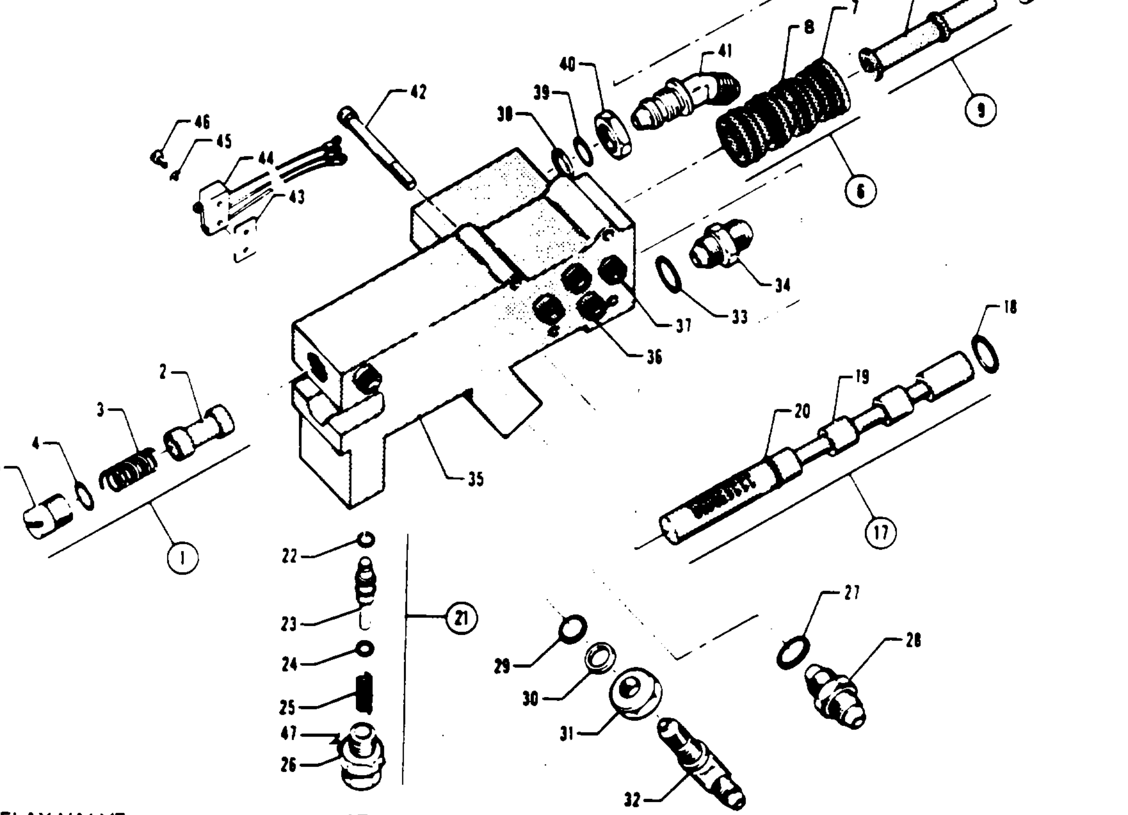
NOTE

NOTE

THE SHADED PARTS, TIME DELAY PLUNGER (2), LANDING GEAR SELECTOR SPOOL (19) AND MANIFOLD (35) ARE MATCHED, LAPPED PARTS. IF IT IS NECESSARY TO REPLACE ANY OF THESE PARTS, REPLACE THEM WITH A MATCHED ASSEMBLY CONTAINING (2), (19) AND (35). SHADED PARTS, TRANSFER VALVE SLEEVE (7), AND SPOOL (10) ARE ALSO MATCHED AND LAPPED PARTS AND MUST BE REPLACED BY A MATCHED ASSEMBLY CONTAINING (7) AND (10).





1. TIME DELAY VALVE
2. PLUNGER, TIME DELAY
3. SPRING
4. "O" RING
5. SCREW
6. TRANSFER VALVE
7. SLEEVE, TRANSFER VALVE
8. "O" RING, SLEEVE
9. DOOR SELECTOR SPOOL
10. SPOOL, DOOR SELECTOR
11. DOOR SOLENOID VALVE ASSEMBLY
12. SOLENOID, DOOR
13. "O" RING SOLENOID
14. SPRING, PLUNGER RETURN
15. PLUNGER
16. PIN
17. LANDING GEAR SELECTOR SPOOL
18. "O" RING
19. SPOOL, LANDING GEAR SELECTOR
20. "O" RING
21. HANDLE DETENT ASSEMBLY
22. "O" RING
23. PLUNGER
24. "O" RING
25. SPRING
26. RETAINER
27. "O" RING
28. FITTING
29. "O" RING
30. BACKUP
31. NUT
32. FITTING
33. "O" RING
34. FITTING
35. MANIFOLD ASSEMBLY
36. SLEEVE, TRANSFER
37. "O" RING
38. "O" RING
39. BACKUP
40. NUT
41. FITTING
42. BOLT
43. INSULATING PLATE
44. SWITCH ASSEMBLY
45. WASHER
46. SCREW
47. WIRE, SAFETY
48. STRAP, PLASTIC

Figure 29-7. Power Pack Manifold

— NOTE —

DO NOT bend the selector spool, pull straight out. The landing gear selector spool, time delay plunger and the manifold are matched, lapped parts. If it is necessary to replace any of these three parts, replace them as an assembly only.

6. Remove the landing gear handle-release retainer, spring and plunger from the manifold. The end of the plunger has a ball which should remain in the plunger. If it does not, remove the ball from the manifold.
7. Remove the caps and the fittings and wash the manifold in cleaning solvent (Federal Specification PS-661 or equivalent) and dry with filtered, compressed air. Be sure internal passages are clean. Reinstall caps on fittings.

ASSEMBLY OF MANIFOLD. (Refer to Figure 29-7.)

1. Lubricate and install the O-ring on the landing gear selector spool, and the O-ring into the manifold at the opposite end.

— NOTE —

The landing gear selector spool, time delay valve plunger and manifold are matched, lapped parts. If necessary to replace as an assembly only.

2. Insert the selector spool into the manifold from the landing gear handle end of the manifold. Insert only until the taper of the selector spool is protruding out the manifold end, approximately .06 inches.

— NOTE —

If the selector spool is not protruding .06 inches out of the manifold opposite the rack when installing into the body (see Figure 29-10), the gear will not be engaged in its proper position. Also, do not move the selector spool more than .12 inches out of the manifold opposite the rack. The O-ring could be caught and damaged, and would have to be replaced by an O-ring.

3. Check that the landing gear selector spool slides freely.
4. Inspect the door solenoid spool for freedom of movement within the transfer valve sleeve.

— NOTE —

The spool and the transfer valve sleeve are matched, lapped parts. If necessary to replace, replace as an assembly only.

5. Lubricate the four O-rings and install on transfer valve sleeve.
6. Install transfer valve sleeve into manifold.
7. Attach the plunger to the door selector spool with a pin and install into the transfer valve sleeve.
8. Lubricate O-ring and install on the solenoid.

9. Lubricate the door solenoid threads, insert the plunger return spring into the plunger cavity and screw assembly into the manifold. Torque to 70 inch-pounds.
10. Install time delay plunger and spring into manifold.
11. Lubricate O-ring and install onto screw and screw the time delay assembly into the manifold. Screw should be flush with the outside of the manifold.

INSTALLATION OF MANIFOLD. (Refer to Figure 29-7.)

1. Lubricate the O-rings and install on the five transfer sleeves.
2. Insert the transfer sleeves into the manifold.
3. Mate the manifold to the Power Pack body, using care to prevent damage to the O-rings on the transfer sleeves.

— NOTE —

When mating the manifold with Power Pack body, index the landing gear selector spool rack with the input shaft gear as shown in Figure 29-10. With landing gear selector spool protruding .06 inches from face "A" of manifold and input shaft return cam in the horizontal position, tooth of input shaft gear will match with toothspace in the landing gear selector spool rack.

4. Install the four manifold attaching bolts and torque to 35-inch pounds. Do not over torque bolts as this will cause binding of the landing gear selector spool.
5. Lubricate an MS28775-010 O-ring and an MS28775-008 O-ring and install on the bottom and top of the plunger respectively.
6. Install plunger and lubricated spring into manifold.
7. Lubricate threads of retainer, install into manifold, torque to 25 inch-pounds and safety wire retainer to manifold.

POWER PACK HANDLE RELEASE MECHANISM.

DISASSEMBLY OF POWER PACK HANDLE RELEASE MECHANISM. (Refer to Figure 29-8.)

1. Remove the lockwire retaining the roll pin in the input shaft and arm.
2. Using a punch, drive the roll pin out of the arm and shaft, and remove arm.
3. Using a punch, drive the roll pin out of the return cam and remove the return cam.
4. Pull the input shaft assembly from the Power Pack.

ASSEMBLY OF POWER PACK HANDLE RELEASE MECHANISM. (Refer to Figure 29-8.)

1. If the switch cam, the gear and the detent cam were removed from the input shaft, then the parts must be assembled and indexed as shown in Figure 29-8, View "A."
2. Lubricate the input shaft, slide detent cam and gear into place and secure gear with roll pin.
3. Slide switch cam onto input shaft and secure with roll pin. Install assembly into Power Pack body.

4. Install the return cam and secure with roll pin. Check the landing gear shaft for freedom of movement in the Power Pack Body. Check for slight end play between the input shaft and the Power Pack Body. If shaft binds, remove return cam, lap the face of the return cam boss and reinstall the return cam.

5. Install the Power Pack control arm on the end of the shaft with the arm pointing down. Align the holes between the shaft and the arm assembly and install the roll pin. Install .041 safety wire through the roll pin and around half of the arm. Pull the twisted end of the safety wire around the other half of the arm assembly. (Refer to Figures 29-9 and 29-10.)

ADJUSTMENT OF POWER PACK HANDLE-RELEASE MECHANISM. (Refer to Figure 29-11.)

The following procedure outlines the adjustments to set the handle release cartridges and stops in the correct position before installing the Power Pack into the airplane.

1. Rotate the input shaft into the "gear up" detent position and adjust the left stop screw to allow a slight overtravel past the detent position.
2. Rotate the input shaft into the "gear down" detent position and adjust the right stop screw to allow a slight overtravel past the detent position.
3. Rotate the input shaft to the neutral position, which will bring the input shaft return cam to the horizontal position.

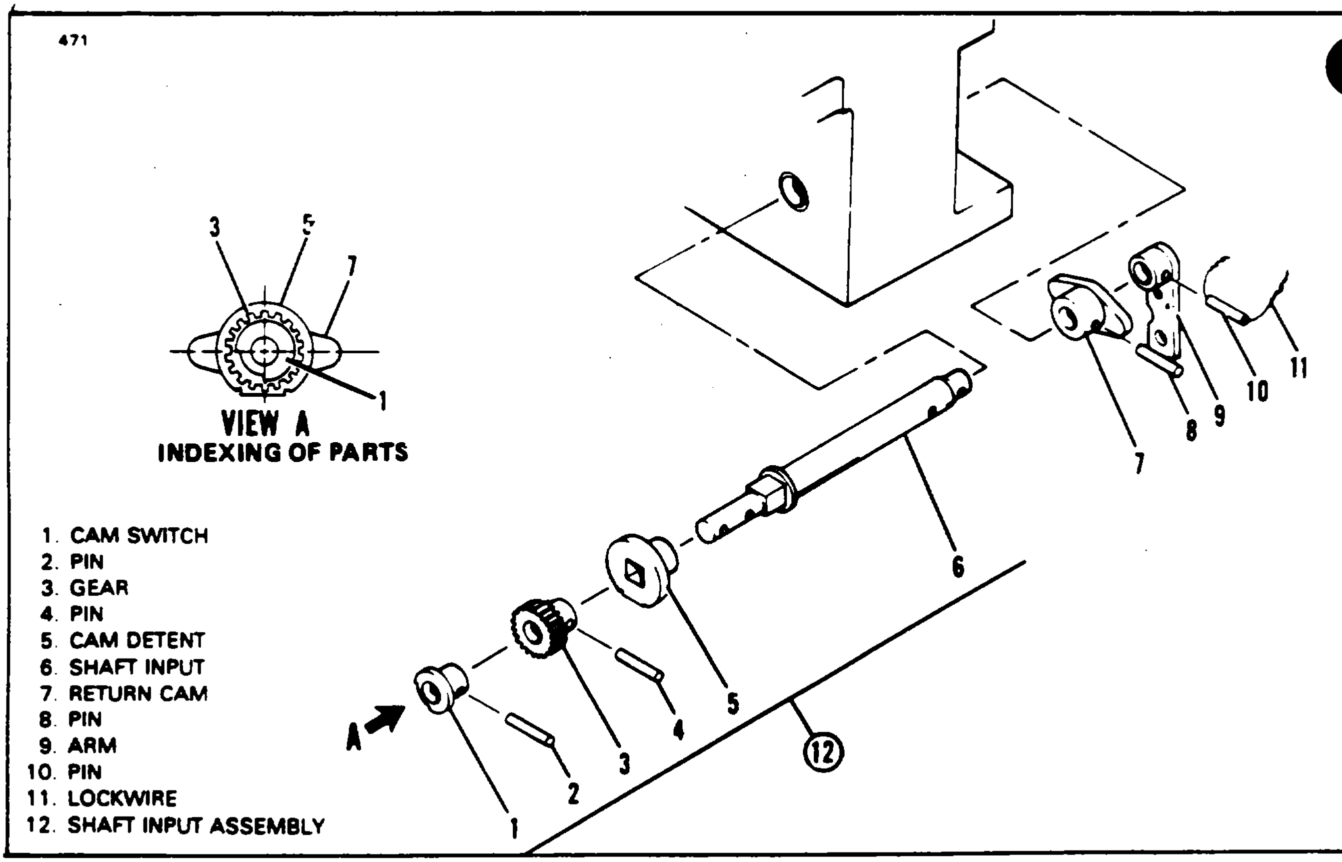


Figure 29-8. Power Pack Handle - Release Mechanism

4. Hold the input shaft return cam in the horizontal (neutral) position by inserting a .125 dia. drill or punch through hole in the arm and into rigging hole in body. Rigging hole is noted as hole "A" in Figure 29-11. Adjust handle return cartridges in such a manner that their return plunger balls touch the surface of the input shaft return cam slightly.

— *CAUTION* —

REMOVE DRILL OR PUNCH FROM RIGGING HOLE "A."

5. The detent must hold in both detent positions and must return with a positive snap when manually released from either detent position.

GEAR SELECTOR HANDLE MECHANISM.

OPERATION OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 29-12.)

Operation of the gear selector handle must give the feel of having made a positive engagement with a detent. With the selector handle in the up or down position and in a detent, a force of 3-1/2 to 6 pounds applied perpendicular to the centerline of the handle at the centerline of the centerline of the knob will be required to move the handle from the detent and return it to the neutral position. To check the operation of the gear selector mechanism, place the airplane on jacks (refer to Jacking, Chapter 7) and operate the gear selector handle through its entire travel, both up and down.

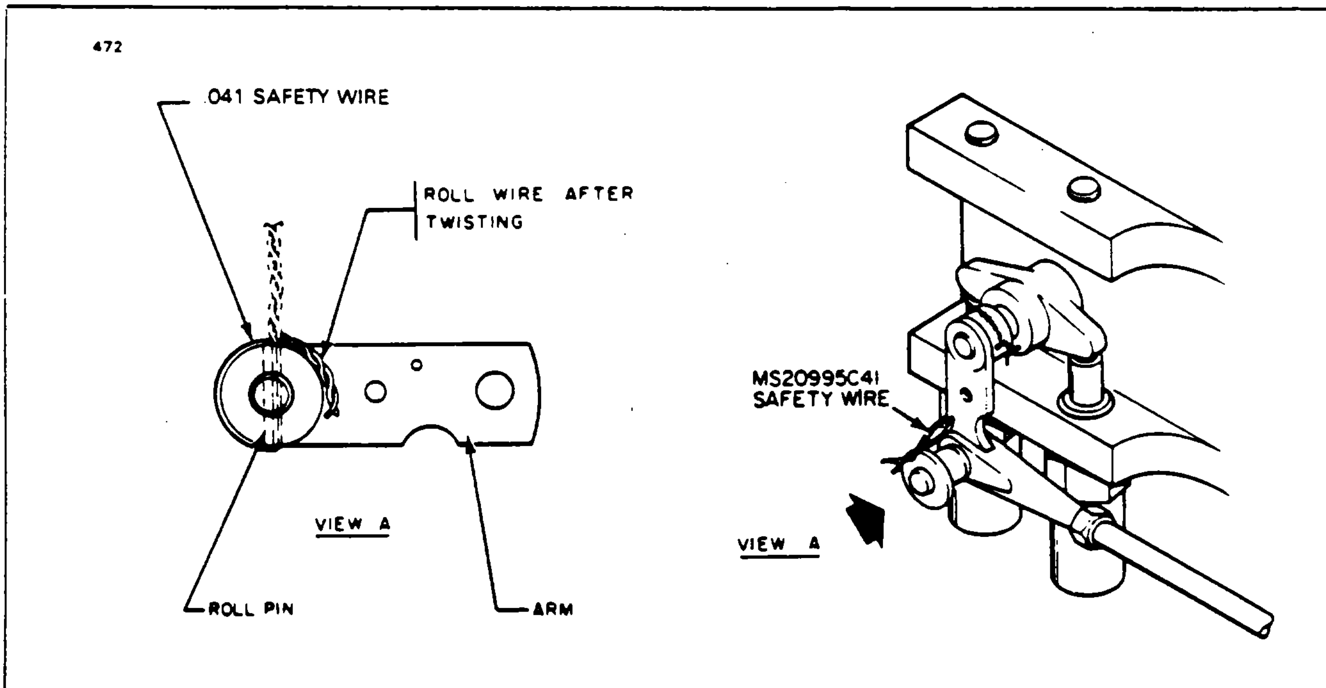


Figure 29-9. Safetying Control Arms

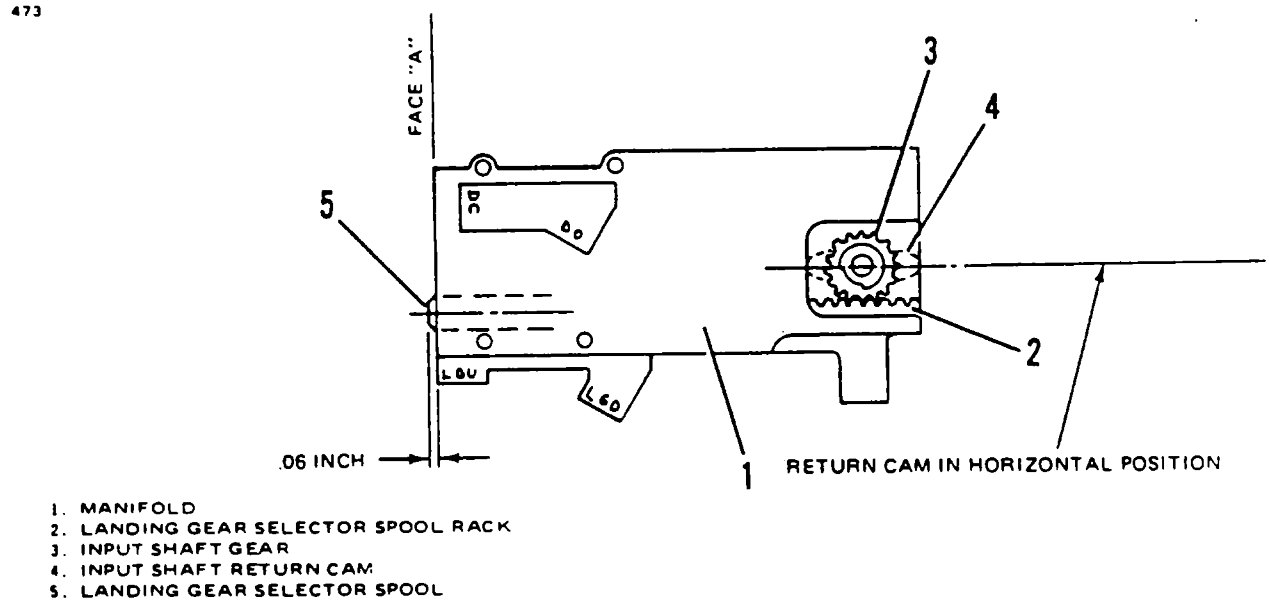


Figure 29-10. Indexing of Selector Spool

INSPECTION OF GEAR SELECTOR HANDLE MECHANISM.

1. Ascertain that the handle does not contact the ends of the slot in the instrument panel when actuated to the extremes of its travel.
2. Inspect and be certain there is adequate clearance between the selector gear mechanism and wiring harness which runs laterally across the aircraft.
3. Determine that lock nuts are securely tightened and that all grommets have been properly installed.
4. Check security of control cable connections to the actuator arms, both the power pack and selector handle.

ADJUSTMENT OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 29-11.)

1. Disconnect the landing gear selector control cable from the selector handle on one end and the Power Pack control arm on the other end.
2. Connect a spring scale to the control arm and pull both fore and aft, perpendicular to the centerline of the arm to determine that it will leave the detent at a force of 9 ± 1 or 2 pounds. If it does not release at the required force, adjust the mechanism.
3. Depress the button on the solenoid lock to allow the selector handle to travel freely. With the selector handle in the up or down position and in a detent, a force of 3-1/2 to 6 pounds applied perpendicular to the centerline of the handle at the centerline of the knob will be required to move the handle from the detent.

4. Position the control arm on the Power Pack in neutral by inserting a .125 diameter drill into the rigging hole (Hole "A") in the control arm and Power Pack body.
5. Place the selector handle in the neutral position and hold.
6. Position the control cable to allow equal travel at both ends.
7. Adjust the terminal ends of the control cable to obtain the neutral position on both the control arm and the selector handle.
8. Connect the terminal ends of the control cable to the Power Pack control arm and the selector handle.
9. Remove the drill from the rigging hole in the Power Pack.

— *CAUTION* —

REMOVE DRILL FROM RIGGING HOLE (Hole "A," Figure 29-11.)

— *NOTE* —

Whenever the cable assembly is removed from the airplane and then reinstalled, be sure to seat the cable where it passes through the pressure bulkhead at station 57.0. Refer to Chapter 53 for sealing.

10. Safety Power Pack control arm attachment pin as shown in Figure 29-9.

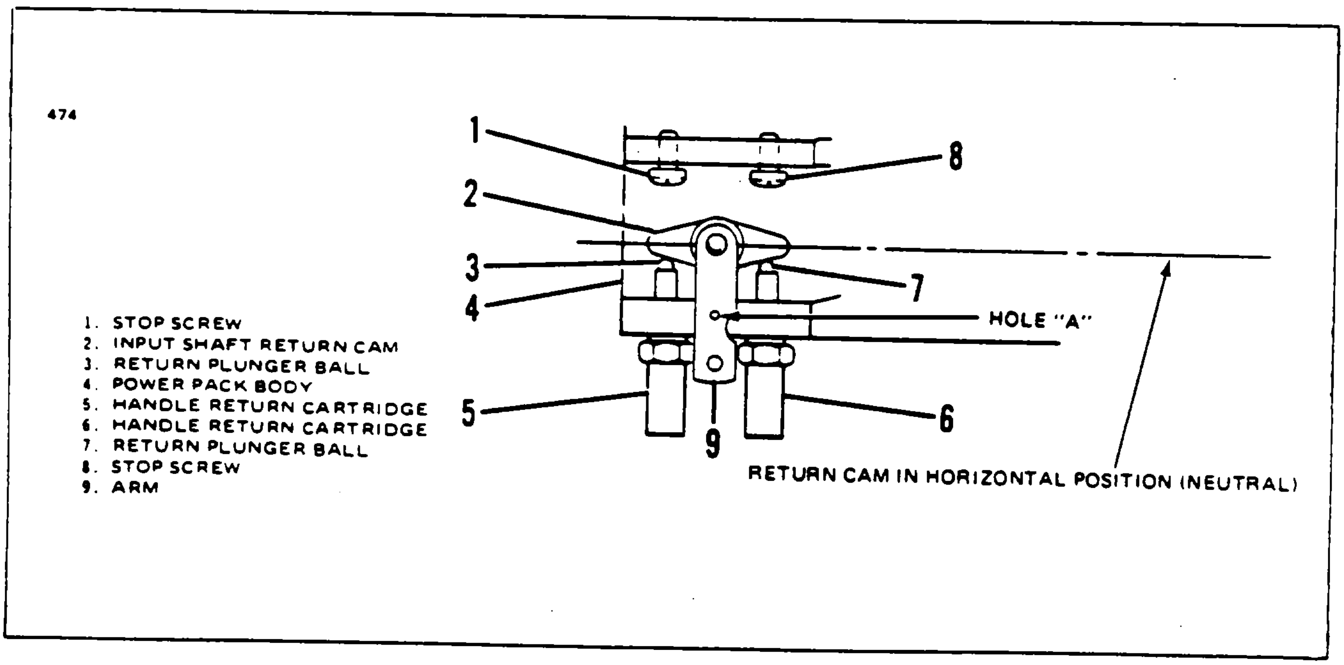


Figure 29-11. Handle Release Adjustment

11. Check operation of the gear selector handle mechanism.
    A. Place airplane on jacks.
    B. Connect hydraulic test unit per Connecting Test Unit.
    C. Operate the gear selector handle through its entire travel and cycle the gear both up and down.

DISASSEMBLY OF SPRING CARTRIDGE ASSEMBLY. (Refer to Figure 29-6, item 81.)

1. Remove the two handle release bodies from the Power Pack body.
2. Remove the snap rings, buttons, springs and plungers.

— CAUTION —

Take care when removing the snap rings as the cartridges are spring loaded.

MAIN RELIEF VALVE.

DISASSEMBLY OF MAIN RELIEF VALVE. (Refer to Figure 29-6, item 1.)

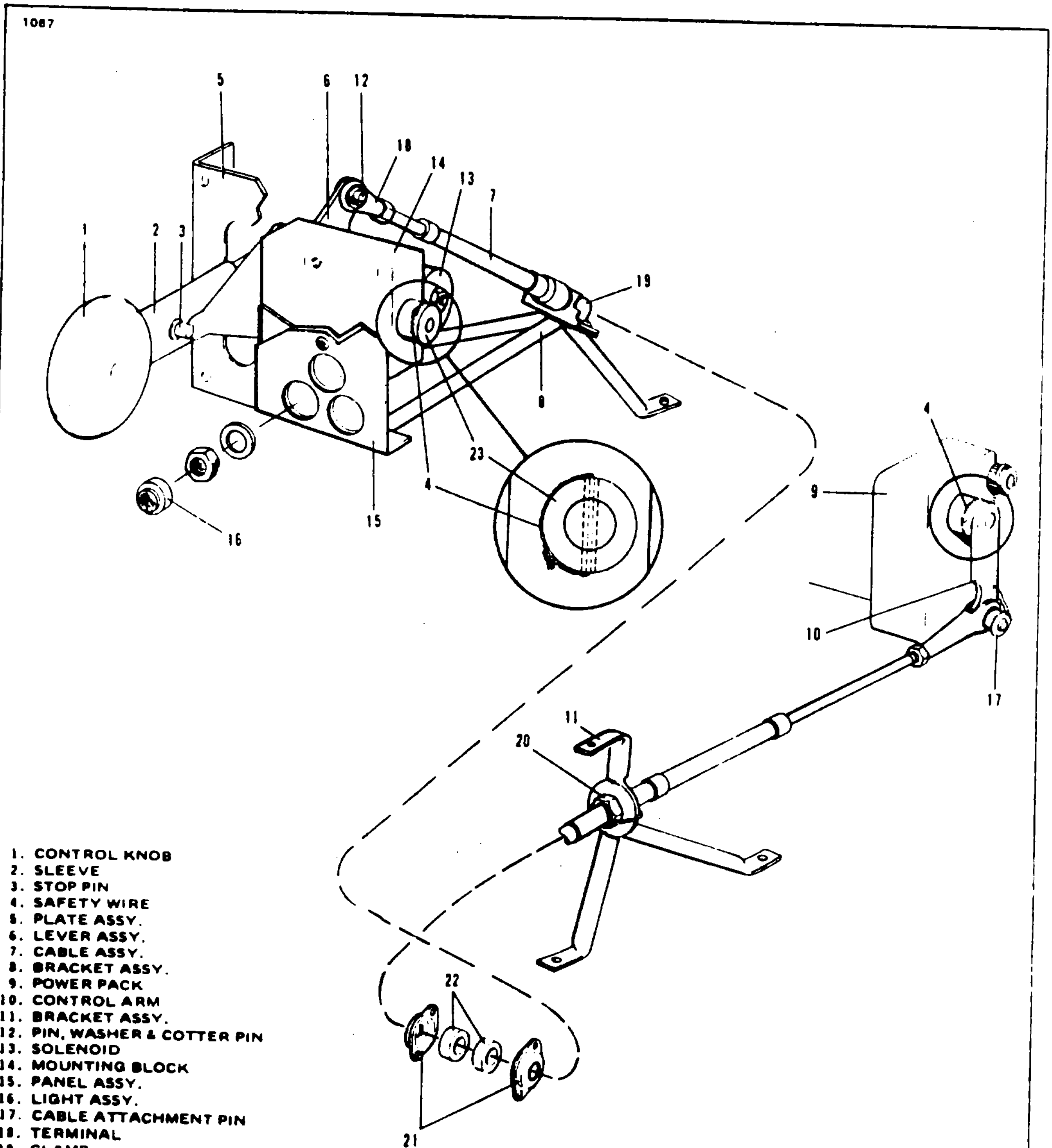
1. Carefully remove the adjusting screw at the top of the main relief valve.
2. Remove relief valve body which contains the spring and button.
3. Remove the poppet from the poppet seat.
4. Use a brass hook, not over .125 inches long, and pull the poppet seat up and out of the Power Pack body. Hook through the holes inside of the seat and use care not to damage the bore in the body.
5. Reassemble poppet into poppet seat. The poppet and poppet seat are matched parts.

ASSEMBLY OF MAIN RELIEF VALVE. (Refer to Figure 29-6, item 1.)

1. Inspect the poppet and the poppet seat from pitting or score marks. The two parts are matched parts. If either or both are damaged, replace as an assembly only.
2. Lubricate and install the O-ring and back up ring on the poppet seat; insert the poppet into the seat and install the assembly onto the body.
3. Lubricate threads and install relief valve body into the Power Pack body. Torque to 70 inch-pounds.
4. Install button and spring into the relief valve body and secure with adjusting screw. The adjusting screw provides adjustment of the main relief valve. Install flush at this time.

ADJUSTMENT OF MAIN RELIEF VALVE. (Refer to Figure 29-6, item 1.)

1. With the input shaft in the "gear up" or "gear down" position, apply pressure until fluid flows from the main relief valve.
2. Adjust the adjusting screw at the top of the main relief valve until the valve cracks at 1900-1950 psi as given in Chart 2902. Bleed pressure after each adjustment by cracking the cap on the "door open" fitting.



1. CONTROL KNOB
2. SLEEVE
3. STOP PIN
4. SAFETY WIRE
5. PLATE ASSY.
6. LEVER ASSY.
7. CABLE ASSY.
8. BRACKET ASSY.
9. POWER PACK
10. CONTROL ARM
11. BRACKET ASSY.
12. PIN, WASHER & COTTER PIN
13. SOLENOID
14. MOUNTING BLOCK
15. PANEL ASSY.
16. LIGHT ASSY.
17. CABLE ATTACHMENT PIN
18. TERMINAL
19. CLAMP
20. LOCKNUT
21. FIREWALL PLATE
22. GROMMET
23. BUSHING

Figure 29-12. Landing Gear Selector Mechanism Installation

PRIORITY VALVE.

DISASSEMBLY OF PRIORITY VALVE. (Refer to Figure 29-6, item 10.)

1. Remove the adjusting screw at the top of the priority valve.
2. Remove priority valve body containing the spring, button and poppet.
3. Use a brass hook and remove the poppet seat from the body. Be careful not to score the bore.
4. Carefully remove the O-ring from the bottom of the cavity.

ASSEMBLY OF PRIORITY VALVE. (Refer to Figure 29-6, item 10.)

1. Lubricate and install the O-ring and the back up on the poppet and insert the poppet into the priority valve body.
2. Lubricate O-ring and install into the Power Pack body.
3. Inspect the poppet seat for a sharp seating edge. Lap as required to obtain a good sharp seating edge. Push the poppet seat into the valve body and after installing the assembly into the Power Pack body, torque to 70 inch-pounds.
4. Install the button and spring and secure them with the adjusting screw. The adjusting screw provides adjustment for the priority valve. Install flush at this time.

ADJUSTMENT OF PRIORITY VALVE. (Refer to Figure 29-6.)

1. Place the input shaft in the "gear up" position and remove cap from the "gear up" fitting.
2. Apply pressure and note the priority valve cracking pressure by observing the pressure gauge when fluid first starts to flow from the "gear up" port.
3. Adjust the screw until the priority valve cracks at 600-650 psi as given in Chart 2902. Bleed pressure after each adjustment by cracking cap on "door open" fitting.
4. Disconnect the test unit and cap all open fittings.

TIME DELAY CHECK VALVE.

DISASSEMBLY OF TIME DELAY CHECK VALVE. (Refer to Figure 29-6, item 59.)

1. Remove check valve body from the Power Pack body.
2. Remove the snap ring.
3. Using a brass hook, pull out the ball seat.
4. Remove the ball.

— *NOTE* —

A pin is pressed into the body - DO NOT remove. If it is necessary to replace any of these parts, replace as an assembly only.

ASSEMBLY OF TIME DELAY CHECK VALVE. (Refer to Figure 29-6, item 59.)

1. Install ball into the check valve body.
2. Lubricate and install the O-ring in the seat.
3. Install seat into check valve body and secure with the snap ring.
4. Lubricate threads, install the O-ring on the valve body, and install the assembly into the Power Pack body. Torque to 45 inch-pounds.

DOOR VENT VALVE.

DISASSEMBLY OF DOOR VENT VALVE. (Refer to Figure 29-6, item 26.)

1. Remove adjusting screw from top of retainer.
2. Remove vent valve body from the Power Pack body.
3. Remove the spring and stem.
4. Cut the wire and remove retainer from vent valve body.
5. Remove the O-ring and piston.

ASSEMBLY OF DOOR VENT VALVE. (Refer to Figure 29-6, item 26.)

1. Install the piston into the vent valve body.
2. Lubricate and install the O-ring on the retainer and screw the retainer into the valve body, tighten and secure with .032 safety wire.
3. Install the stem, spring and adjusting screw into the retaininer with the adjusting screw flush.
4. Lubricate threads, install O-ring on the valve body and install assembly into Power Pack body. Torque to 55 inch-pounds.

ADJUSTMENT OF DOOR VENT VALVE. (Refer to Figure 29-6, item 26.)

1. Remove the cap from the "door open" fitting on the Power Pack and attach the pressure hose from the hand pump with the 200 psi pressure gauge to the "door open" fitting.
2. Slowly apply pressure to see that fluid seeps from the door vent valve.
3. Adjust the adjusting screw so that fluid flows from the vent valve from 0 to 100 psi (see Chart 2902.)
4. Increase pressure to 150 psi max, and check to see that the door vent valve is shut off. If pressure falls below 100 psi, fluid must resume flowing from door vent valve (see Chart 2902.)
5. Relieve pressure by cracking the hose fitting from the hand pump.
6. Disconnect the test unit and cap all open fittings.

VENT FILTER.

DISASSEMBLY OF VENT FILTER. (Refer to Figure 29-6.)

1. Remove snap ring and pull out filter.

ASSEMBLY OF VENT FILTER. (Refer to Figure 29-6.)

1. Install vent filter into reservoir cover and secure with snap ring.

STANDPIPE-FILTER.

DISASSEMBLY OF STANDPIPE-FILTER. (Refer to Figure 29-6.)

1. Remove the standpipe-filter from the Power Pack body.

ASSEMBLY OF STANDPIPE-FILTER. (Refer to Figure 29-6.)

1. Install standpipe-filter into the Power Pack body. (Torque to 55-inch pounds.)

HAND PUMP CHECK VALVE.

DISASSEMBLY OF HAND PUMP CHECK VALVE. (Refer to Figure 29-6, item 88.)

1. Remove the fitting from the Power Pack body.
2. Remove the snap ring from the fitting.
3. Remove the guide, spring and poppet.

ASSEMBLY OF HAND PUMP CHECK VALVE. (Refer to Figure 29-6, item 88.)

1. Install poppet, spring and guide into fitting and secure with snap ring.
2. Lubricate the threads on the fitting valve and install the required O-ring closest to the flanged end.
3. Install the back up ring and O-ring on the fitting.
4. Install the valve assembly in the body using a torque of 55-inch pounds.

HAND PUMP RELIEF VALVE.

DISASSEMBLY OF HAND PUMP RELIEF VALVE. (Refer to Figure 29-6, item 51.)

1. Remove the adjusting screw at the top of the hand pump relief valve..
2. Remove the hand pump relief valve body by unscrewing it from the Power Pack body.
3. Remove the spring and the stem from the valve body.
4. Remove ball.
5. Use a brass hook and carefully remove the seat from the body. Be careful not to score the bore.
6. Remove the O-ring from the bottom of the cavity.

ASSEMBLY OF HAND PUMP RELIEF VALVE. (Refer to Figure 29-6, item 51.)

1. Lubricate and install the O-ring into the Power Pack body.
2. Inspect the seating surface of the seat. Seating edge has to be sharp, lap if necessary to obtain a clean, sharp edge.
3. Drop the ball into the cavity of the hand pump relief valve body and install the ball seat into the body, trapping the ball between the two parts.
4. Lubricate threads and install the assembly into the Power Pack body. Torque to 70 inch-pounds.
5. Insert the stem and the spring into the valve body and install the adjusting screw. The adjusting screw provides adjustment for the hand pump relief valve. Install flush at this time.

ADJUSTMENT OF HAND PUMP RELIEF VALVE. (Refer to Figure 29-6, item 51.)

1. With the input shaft in either the "gear up" or "gear down" position, apply hand pump pressure very slowly until fluid flows from the hand pump relief valve.

— CAUTION —

It is important that the hand pump be operated slowly as pressure is being increased to bleed the hand pump relief valve.

2. Bleed air from the Power Pack by cracking the cap on the "door open" fitting.
3. Adjust the adjusting screw at the top of the valve until the valve cracks at 2025-2100 psi as given in Chart 2902, pumping slowly. Bleed pressure by cracking the cap on the "door open" fitting after each adjustment.

HAND PUMP SUCTION SCREEN.

DISASSEMBLY OF HAND PUMP SUCTION SCREEN. (Refer to Figure 29-6, item 48.)

1. Remove the suction screen by removing the snap ring.

ASSEMBLY OF HAND PUMP SUCTION SCREEN. (Refer to Figure 29-6, item 48.)

1. Install the filter into the Power Pack body and secure with snap ring.

ADJUSTMENT OF DOOR SOLENOID VALVE. (Refer to Figure 29-7, item 11.)

1. Remove the caps from the "door open" and "door closed" fittings on Power Pack.
2. Connect a test harness to the electrical plug of the Power Pack and to power source. (Test harness may be fabricated as shown in Figure 29-13.)
3. With the test harness switch in the "OFF" position and the input shaft in either the "up neutral" or "down neutral" position, apply pressure and note that fluid flows from the "door open" fitting.
4. With the test harness switch in either the "gear up" or "gear down" position, the input shaft in either the "up neutral" or "down neutral" position, apply pressure and note that fluid flows from the "door closed" fitting.
5. Disconnect the test equipment and cap all open fittings.

INSTALLATION AND ADJUSTMENT OF INBOARD GEAR DOOR SWITCH. (Refer to Figure 29-7.)

1. Install switch assembly with the insulating plate between the switch and manifold, and secure with washers and screws. Tighten screws lightly.
2. Move the selector spool to the gear up and down position a couple of times to insure proper actuating of switch from "on" to "off." Torque switch screws to 20-inch pounds.
3. Safety wire solenoid to bracket (see Figure 29-7) using .032 safety wire.
4. Connect the electrical wires from the switch to the terminal block (see Figure 29-6) and secure to solenoid using plastic strap.

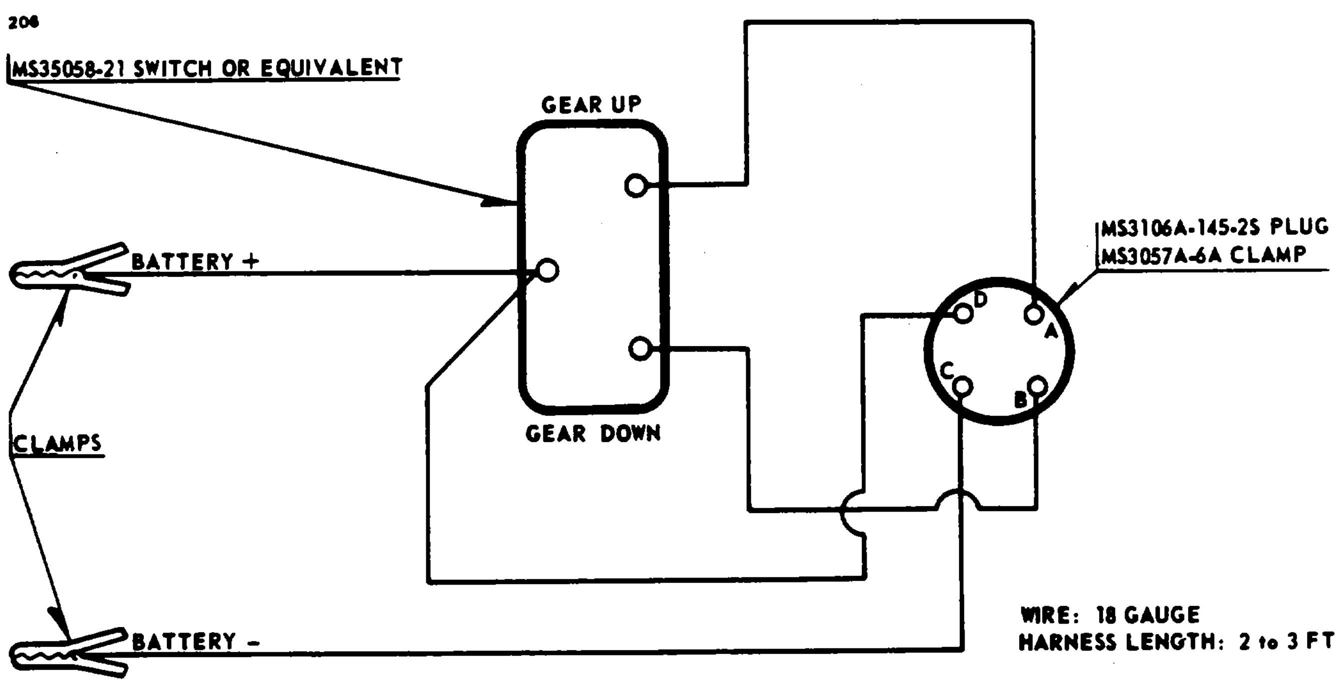


Figure 29-13. Power Pack Test Harness Schematic

— *NOTE* —

Electrical wires are color coded. Disregard the color of the wire terminals. If the colors are matched when installing the wires, the wires will be connected correctly.

5. (Refer to Figure 29-6.) Install plungers, springs and button into the handle release bodies and retain with snap rings.
6. (Refer to Figure 29-6.) Install the handle release assemblies in the body. Install assemblies loose, they will be adjusted later.

POWER PACK BENCH TEST AND ADJUSTMENT.

After completion of the overhaul, the Power Pack may be bench tested prior to installation in the airplane using a hydraulic test unit or similar test equipment. This procedure requires a minimum of test equipment for testing the Power Pack.

1. Use only clean hydraulic fluid per MIL-H-5606.
2. Minimum equipment needed as follows:
   - A. Test unit pump and hand pump with a 2500 psi capacity.
   - B. One hydraulic pressure gauge of 2500 psi capacity.
   - C. One hydraulic pressure gauge of 200 psi capacity.
3. Connect the test pressure hose to the pressure inlet port of the Power Pack. The 2500 psi gauge is to operate off the pressure line.
4. Connect the suction hose to the suction port of the Power Pack.
5. If a vent hose is part of the test unit, connect it to the vent port at the port at the top of the reservoir cover. Do not plug vent port.
6. Cap all other fittings with high pressure caps.

— *NOTE* —

For the control of the door valve solenoid, it will necessary to fabricate an electric harness as shown in Figure 29-13. This harness, when connected to a 24 volt battery will allow control of the electrical current to the door valve solenoid, permitting operation of the hydraulic door circuits.

BLEEDING THE HYDRAULIC SYSTEM.

1. Jack the airplane as described in Chapter 7.
2. Ascertain that the reservoir is full.
3. Connect a hydraulic test unit to the airplane.
4. Cycle the landing gear system through several cycles.
5. Check that hydraulic reservoir is full.
6. Disconnect the hydraulic test unit.
7. Ascertain that the landing gear selector handle is in the down neutral position, and that the landing gear is down and locked.
8. Remove the airplane from jacks.

REMOVAL AND INSTALLATION OF HYDRAULIC LINES.

Remove a damaged hydraulic line by disconnecting the fittings at each end and by disconnecting where secured by brackets. Refer to Figure 29-3 as an aid in the location of attaching brackets and bends in the lines. Provide a small container for draining the line. Install a new or repaired line in reverse order and refill the Power Pack with hydraulic fluid.

— *NOTE* —

Where straight thread type fittings are used, the locknuts are to be tightened so that the O-ring seals are on the non-threaded portion of the fitting.

— *NOTE* —

Some hydraulic lines are not interchangeable. Refer to Parts Catalog for correct replacement part numbers.

REMOVAL AND INSTALLATION OF HYDRAULIC FILTERS.

The hydraulic filters located on the lower right forward side of each engine firewall, are removed by the following procedure:

1. Remove the turtle back skin aft of the cowlings to gain access to both the forward and aft sides of the firewall.

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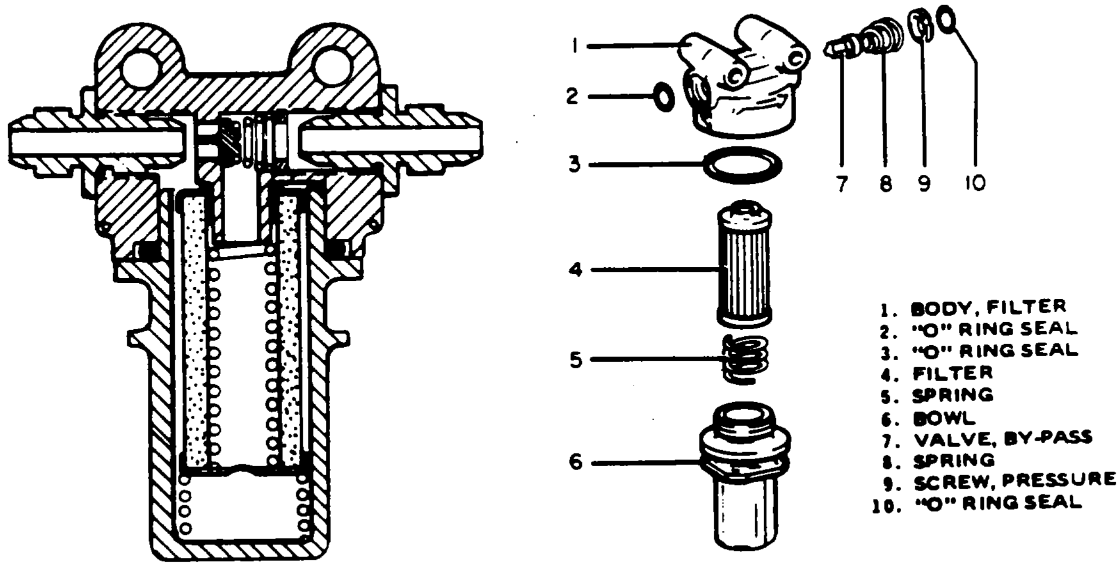


Figure 29-14. Hydraulic Filter

2. Disconnect the filter inlet hose and the outlet line from the filter.
3. Remove the filter from the firewall by holding the bolts at the aft side of the firewall and turning off the nut at the filter.
4. The filter may be installed in the reverse procedure.
5. After engine has been operated, check for leaks.

REPLACEMENT OF FILTER ELEMENTS. (Refer to Figure 29-14.)

1. Remove the turtle back skin aft of the cowlings to gain access to both forward and aft sides of the firewall.
2. Cut safety wire, unscrew bowl and remove filter element.
3. Clean filter bowl with a suitable cleaning solvent and dry.
4. Replace filter element and O-ring on bowl.
5. Half fill filter bowl to minimize trapped air in the hydraulic system and replace bowl.
6. Safety filter bowl wiht MS20995C20 safety wire and replace cowl.
7. After engine has been operated, check for leaks.

HYDRAULIC PUMP.

HYDRAULIC PUMP OPERATIONAL CHECK.

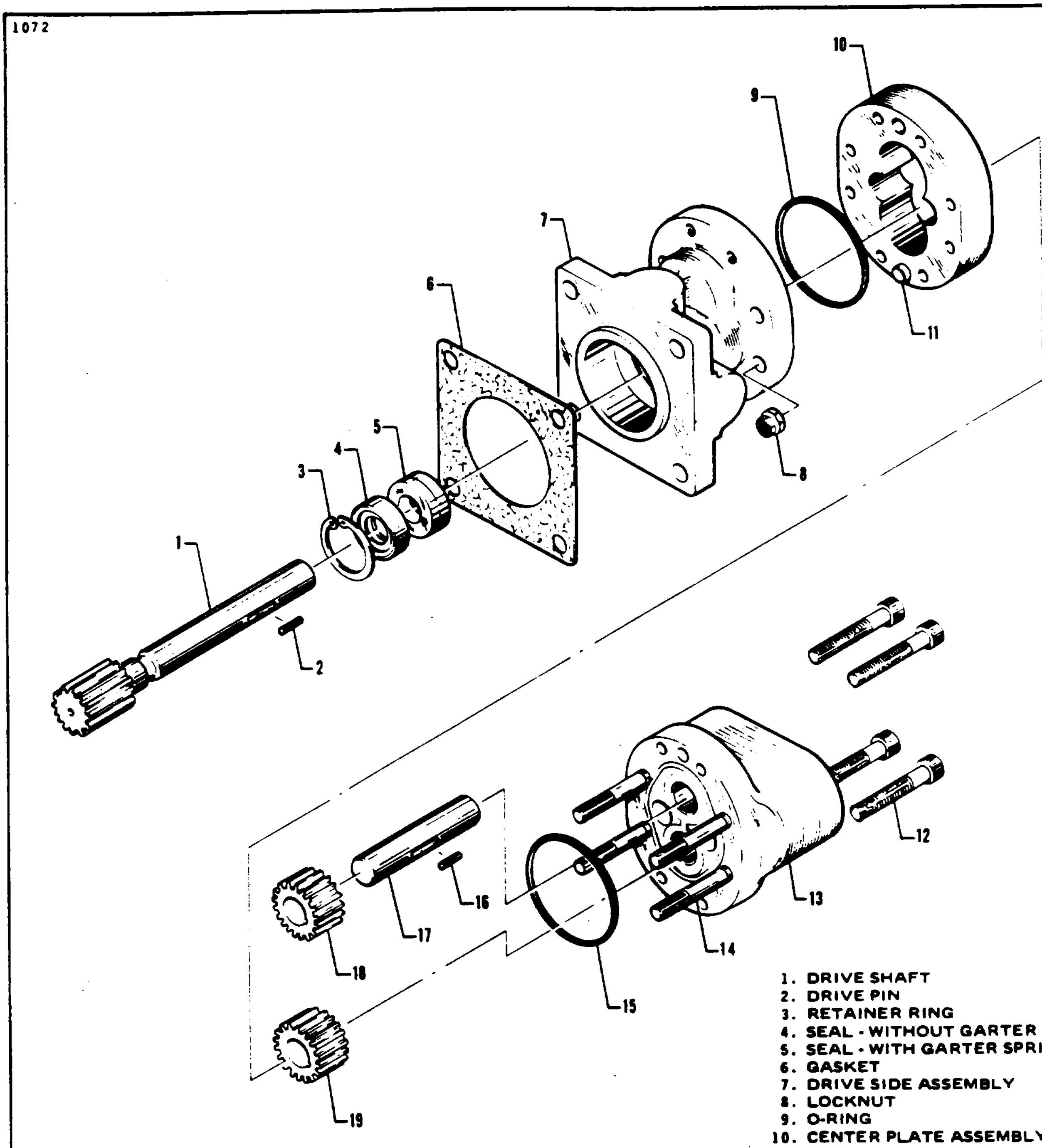
To determine the operable condition of each hydraulic pump, the following check may be conducted:
1. Start one engine and allow it to stabilize at idle.
2. With the engine operating at approximately 1000 rpm, move the gear selector handle to the gear down position. The one pump should build up pressure within the hydraulic system, and return the selector handle to neutral position within three to nine seconds. Again select the down position and check the handle return time.
3. Shut down the engine and repeat the preceding steps for the other engine.
4. Should it be found that the selector handle will not return to neutral during the operational check for one pump, but will return within the required time with the check of the other, then it can be assumed that the pump is at fault and it should be removed to determine the cause of malfunction.

PROCEDURE AFTER HYDRAULIC PUMP FAILURE.

Should a pump breakage occur, there may be metal particles in the hydraulic system. To rectify this condition the hydraulic system should be flushed. Proceed with the following steps:
1. Replace the defective engine-driven hydraulic pump and prime it. Do not connect the pump to the rest of the hydraulic system until the system has been flushed.
2. Proceed to flush the system.
3. Remove the filter elements and check for metal particles. If metal particles are evident in the filter, clean the filter bowl with dry cleaning solvent and dry with compressed air. Install new filter elements.

REMOVAL OF HYDRAULIC PUMP.

1. Remove upper and lower engine cowls, as required, by releasing skin fasteners and separating the two halves.



1. DRIVE SHAFT
2. DRIVE PIN
3. RETAINER RING
4. SEAL - WITHOUT GARTER SPRING
5. SEAL - WITH GARTER SPRING
6. GASKET
7. DRIVE SIDE ASSEMBLY
8. LOCKNUT
9. O-RING
10. CENTER PLATE ASSEMBLY
11. DOWELS (4)
12. SCREW, SQC. HD. CAP.
13. REAR SIDE ASSEMBLY
14. STUD
15. O-RING
16. DRIVE PIN
17. SECONDARY SHAFT
18. SECONDARY GEAR
19. DRIVE GEAR

Figure 29-15. Hydraulic Pump

2. Place a drip pan under the engine to catch spillage.
3. Disconnect the two hydraulic hoses from the end of the pump and cap them to prevent contamination.
4. Disconnect the drain hose from bottom of the pump.
5. Remove the four nuts, lockwashers, and flat washers from the base of the pump.
6. Remove the pump from the engine housing.
7. Upon removal of the pump from its drive gear, remove and destroy or discard the gasket from the pump mounting face. The gasket and all seal rings should be replaced with new parts upon reassembly. Never reinstall an old gasket or seal ring.

DISASSEMBLY OF HYDRAULIC PUMP. (Refer to Figure 29-15.)

1. Clean outside of pump thoroughly.
2. Mark a line from the rear side, across the centerplate to the drive side with blue Dykem or some equivalent removable substance. This will assure proper reassembly.

— *CAUTION* —

During disassembly do not use a screw driver or sharp tool to separate the parts.

3. Remove the four socket head cap screws, securing the rear side, centerplate and drive side together. These screws are threaded into the drive side.
4. Remove the four locknuts from the studs extending out of the drive side flange that mates with the centerplate.
5. Remove the rear side by rocking it from side to side and sliding it from the four dowels. In case of sticking, tap gently with a plastic or rubber hammer.
6. Remove the four studs from the rear side. Remove and discard the large O-ring seal from the rear side. Pull the drive and secondary shafts until drive pins clear gears. Remove drive pins.
7. Remove drive gear, secondary gear, and secondary shaft by pulling from centerplate.
8. Remove drive shaft by pushing out of drive side. Remove centerplate, with dowels, by rocking it from side to side.
9. Remove large O-ring seal from drive side and discard.
10. Remove retainer either ring securing seal in drive side seal bore. Note proper position of the seal upon disassembly. Seal must not be reversed at reassembly. Remove and discard the two part seal.

CLEANING, INSPECTION AND REPAIR OF HYDRAULIC PUMP.

1. Immerse and wash all metallic parts in trichlorethylene (Military Specification MIL-T-7003) or some equivalent commercial cleaning solvent. Clean all openings and passages with a fine fiber brush, or equivalent, dipped in solvent. Do not scrub any surface with a tool that will scratch surface.

— ***WARNING*** —

Wear goggles, rubber gloves and provide adequate ventilation when using trichlorethylene or cleaning solvents. Repeated contact of solvent with skin may produce irritation. If vapors are inhaled, serious damage may result.

2. Dry all parts thoroughly with a clean, lint-free cloth or with dry, filtered compressed air at 20 psi maximum. Blow out all parts, bores, and passages with compressed air.

3. Under strong light and preferabley under magnification, inspect all parts for scoring, nicks, scratches, pitting, corrosion, cracks and excessive wear. Inspect all threaded surfaces for chipping and crossed or stripped threads. Inspect parts for conformance to information given in Chart 2903. The Chart gives the items which should be inspected and the corrective action necessary when the pump parts do not pass this inspection.

— NOTE —

Although the pump may still operate under conditons where some of the parts exceed the wear limits, it will probably be found that the pump is not producing its rated capacity and therefore, the system may not be doing an adequate job. Therefore, it is necessary to repair or replace any parts that are not within the stated limits.

ASSEMBLY OF HYDRAULIC PUMP. (Refer to Figure 29-15.)

The seal and seal rings should be soaked in Hydraulic (MIL-H-5606) fluid for two hours minimum time before installation.

1. Replace drive shaft seal into drive side seal bore. Be sure to install drive shaft seal, "back to back", as noted during disassembly.
2. Replace retainer ring into drive side seal bore.
3. Install new O-ring seal on drive side.
4. Mate centerplate assembly with drive side assembly and align dowel pins.
5. Install drive shaft from engine side of drive side assembly.
6. Install secondary shaft into centerplate. Install drive and secondary gears onto drive and secondary shafts. Be sure the drive pin counter bore on the drive gear faces the pump rear side. Install drive pins.
7. Install the four studs and new O-ring seal on the rear side assembly.
8. Lightly oil gear teeth with hydraulic fluid before completing assembly.
9. Mate the rear side assembly with the centerplate, using caution to align the drive and secondary shafts with the respective holes in the rear side assembly.
10. Replace the four locknuts on the studs extending out of the drive side flange that mates with the centerplate.
11. Replace the four socket head cap screws that secure the rear side, centerplate and drive side assemblies together. Torque the socket head cap screws and locknut to 60 inch-pounds.
12. When the pump is assembled, turn drive shaft by hand to make sure the pump turns freely. If there is any sticking or binding at all, disassemble pump and determine the trouble. Do not apply power to the pump until it turns freely by hand.

— NOTE —

If possible run pump at rated speed while gradually increasing the pressure up to rated pressure by the end of a thirty minute period.

CHART 2903. INSPECTION AND REPAIR, HYDRAULIC PUMP

ITEM (Refer to Figure 29-15.)	INSPECTION	REPAIR
Rear Side	Visually inspect the lapped face for scratches or signs of scoring.	Lap the surface to remove any scratches.
Centerplate	Visually inspect the two lapped faces for scratches or scoring. Inspect the gear pockets for deep scratches.	Lightly stone any burrs around the gear pockets. Lap the faces, but do not remove more than than 0.0001" total of metal from both sides.
Drive Side	Visually inspect the lapped surface for scratches or signs of scoring.	Lap the surface to remove any scratches. If deep scratches are present replace part.
Secondary Shaft	Inspect the shaft for deep scratches in the bearing area.	If deep scratches are present, replace secondary shaft.
Gears	Visually inspect gears for evidence of chipped teeth or cracks around the bore. Measure the gear O.D., which should be 1.1646" .1.1644".	If gears are not within tolerance or if there are any cracked teeth, replace the pump.
Bearings	Visually inspect the bearing bores for scratches and/or scoring.	If badly scored, replace pump.

NOTE

The T-1020 Parts Catalog should be used to obtain repair kits to service this pump.

INSTALLATION OF HYDRAULIC PUMP.

1. Place a new gasket on the base of the housing.
2. Lubricate the pump shaft splines with Molybdenum Disulfide, Type "G", paste from lubricant.
3. Install the pump on the housing.

— *NOTE* —

When installing the pump, keep the drain fitting facing to the lower right in the downward position.

4. Line up the shaft splines with the gear inside the engine housing.
5. Install flat washers, and nuts on the base of the pump and tighten.
6. Install the two hydraulic hoses and prime the pump before completing the hookup to the firewall fittings.
7. Check to be sure that the system reservoir contains the required amount of clean hydraulic fluid.
8. Change system fluid filters.

PRIMING HYDRAULIC PUMP.

The following instructions for priming the hydraulic pump assures that the pump will not be operated in a dry condition and shall be followed whenever a pump is serviced or replaced.

1. Remove the hydraulic suction and pressure lines from the firewall fittings.
2. Install caps on suction and pressure fitting at the firewall to prevent the loss of fluid prior to the hookup of the hydraulic lines.
3. Holding both lines at a level higher than the pump, pour hydraulic fluid, MIL-H-5606, into the lines.
4. Remove one cap at a time from the firewall fittings and connect the appropriate line to the fitting, trying not to spill any of the hydraulic fluid previously put into the lines.
5. After the engine has been operated, check the hookup for leaks.

AUXILIARY.

HAND PUMP (EMERGENCY).

REMOVAL OF HAND PUMP.

1. Remove the pump access panel located aft of the control pedestal.
2. Disconnect the hydraulic pressure and suction lines from the forward end of the pump.
3. Remove the pump from its mounting bracket by removing attachment bolts.
4. Remove the pump from the airplane.
5. Cover the pressure and suction lines to prevent contamination.

DISASSEMBLY OF HAND PUMP. (Refer to Figure 29-16.)

1. To remove the plunger and component parts, remove quick click pin and the four screws allowing the bracket to separate from the pump body.

— *NOTE* —

To remove the quick click pins, use a hollow steel rod having an outside diameter of .186 - .184 inches and an inside diameter (bore) of .166 inches. The inside diameter should have a minimum of .125 inches.

2. Pull the plunger assembly from the pump body.
3. Slide the scraper and the gland from the plunger.
4. To remove the check valve assembly from the plunger, remove the snap ring from the plunger cavity and with a low charge of air injected into the hole in the side of the plunger, remove the seat, ball and spring.
5. To remove the check valve assembly located in the suction port of the pump body, remove the snap ring. Inject a low charge of air into the plunger bore in the pump body to remove the seat, the ball and spring.

CLEANING, INSPECTION AND REPAIR OF HAND PUMP.

1. Clean the pump parts with a suitable solvent and dry thoroughly.
2. Inspect the pump etc., that could damage O-rings, and check threaded areas for damage.
3. Inspect the plunger for enlarged pinholes, surface area for scratches, burrs, etc., that could damage O-rings.
4. Inspect check balls and seats for damaged seating areas and corrosion.
5. Check general condition of remaining parts.
6. Repairs to the pump are limited to polishing out small scratches, burrs, etc., replacing O-rings and worn or damaged parts.

ASSEMBLY OF HAND PUMP. (Refer to Figure 29-16.)

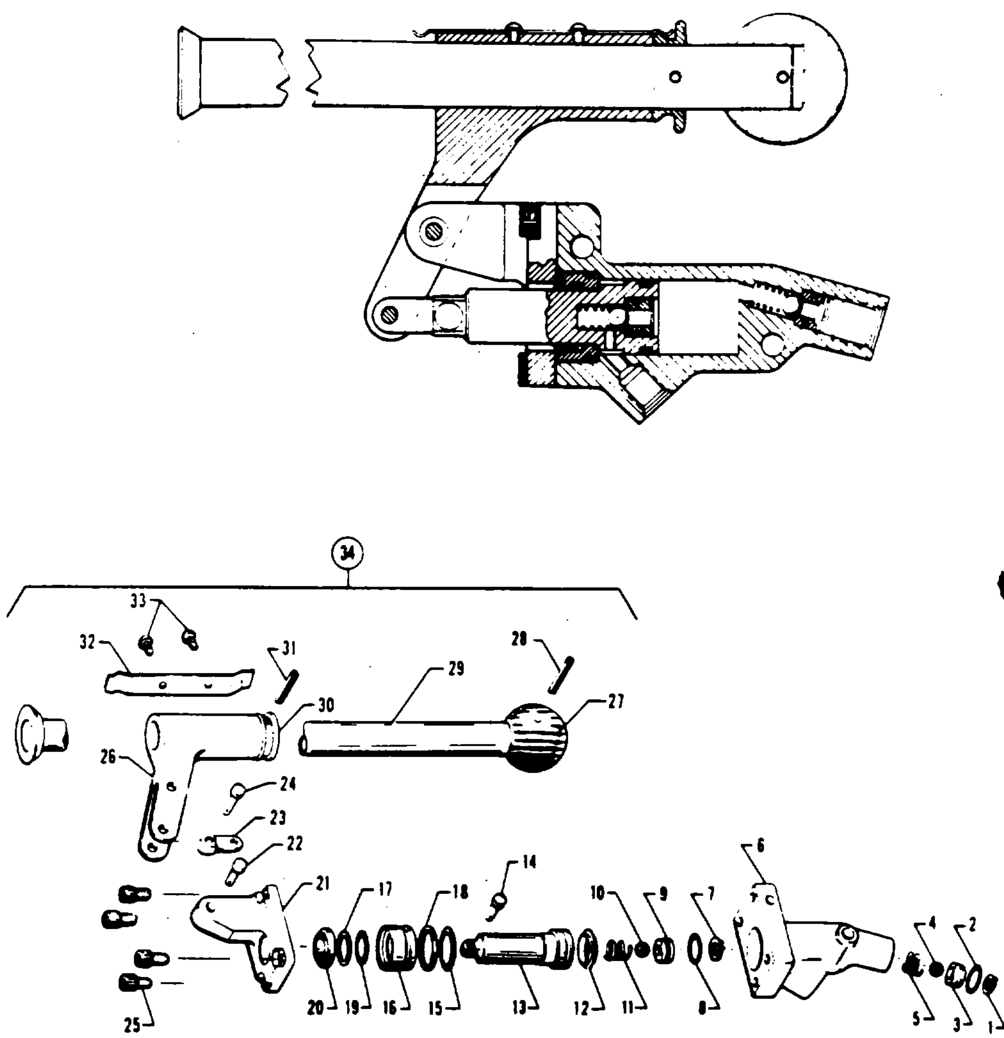
Lubricate all parts with oil per MIL-H-5606 prior to assembly.

1. Lubricate O-ring and install on seat.
2. Install the spring, ball and lubricated seat into the plunger and retain with snap ring.
3. Install GT-ring on the plunger.
4. Install O-ring and back up into inside groove of gland.
5. Install O-ring and back up onto outside groove of gland.
6. Lubricate the complete gland and slide it onto the plunger with the recessed end on the outside.
7. Lubricate the bore of the pump body and slide the plunger with the gland into the pump body.
8. Install the scraper onto the recess of the gland by sliding the scraper over the plunger. Tapered lip of scraper to face outward.
9. Attach the bracket to the pump body with the four screws. Torque to 70 inch-pounds.
10. Position link and install quick click pin.
11. Lubricate O-ring and install on seat.
12. Install spring, ball and lubricated seat into the suction port of the pump body and secure with snap ring.

INSTALLATION OF HAND PUMP.

1. Position the hand pump on its mounting bracket and secure with bolts.
2. Connect the hydraulic pressure and suction lines to the forward end of the pump.
3. Bleed the hand pump, and test the hand pump operation.

1328



1. SNAP RING
2. "O" RING
3. SEAT
4. BALL
5. SPRING
6. BODY, PUMP
7. SNAP RING
8. "O" RING
9. SEAT
10. BALL
11. SPRING
12. GT-RING
13. PLUNGER
14. QUICK CLICK PIN
15. "O" RING
16. GLAND
17. BACK UP
18. BACK UP
19. "O" RING
20. SCRAPER
21. BRACKET
22. QUICK CLICK PIN
23. LINK
24. QUICK CLICK PIN
25. SCREW
26. LEVER
27. GRIP
28. ROLL PIN
29. HANDLE
30. STOP
31. ROLL PIN
32. SPRING
33. DRIVE SCREW
34. HANDLE ASSEMBLY

Figure 29-16. Hand Pump

4. Install access panel.
5. Ascertain that the reservoir is filled with hydraulic fluid.

BLEEDING HAND PUMP.

The hand pump may be purged by operating the pump until all air has been expelled from the pump. This will usually require approximately 15 cycles of the pump.

HAND PUMP TEST.

1. Ascertain that the reservoir is filled with hydraulic fluid.
2. Remove cap from door-open port and operate emergency hand pump until fluid flows from port with no evidence of air in the system. Replenish reservoir with clean hydraulic fluid as necessary to maintain fluid level.
3. After pump is primed and bled of all air, install 3000 psi pressure gauge at door-open port.
4. Operate emergency hand pump very slowly until pressure on gauge stops increasing, indicating that the hand pump relief valve has opened.

— CAUTION —

It is very important that the hand pump be operated very slowly as pressure is being increased to bleed the hand pump relief valve. If the hand pump is operated rapidly, damage to the valve can occur as air permits parts to "slam" against each other.

Maximum indication of the gauge should be as indicated in Chart 2902. During the pumping operation, the emergency hand pump should not feel spongy in either the up or down stroke.

5. Crack door-open fitting to release gauge pressure. Remove gauge, cap door open fitting and drain fluid from reservoir.

— NOTE —

At the completion of the test, the line should be reinstalled and the fluid level in the reservoir checked.

REMOVAL OF SHUTTLE VALVES.

Shuttle valves are located on the gear actuator cylinders and main gear door actuator cylinders and may be removed as follows.

1. Place airplane on jacks. (Refer to Jacking, Chapter 7)
2. Disconnect hydraulic lines and cover open line ends to prevent contamination.
3. Remove valve from cylinder and cover opening on cylinder to prevent contamination.

DISASSEMBLY OF SHUTTLE VALVES.

1. Remove end plug.
2. Remove piston and seal.

CLEANING INSPECTION AND REPAIR OF SHUTTLE VALVES.

1. Clean valve ports with a suitable solvent and dry thoroughly.
2. Inspect end plug, piston, body for cracks, chips, scratches, scoring and wear which may effect proper function of shuttle valve.
5. Repair of shuttle valves is limited replacing defective parts and minor scratches and scores may be removed by polishing with "fine abrasive" crocus cloth providing their removal does not affect the operation of the shuttle valve.

ASSEMBLY OF SHUTTLE VALVES.

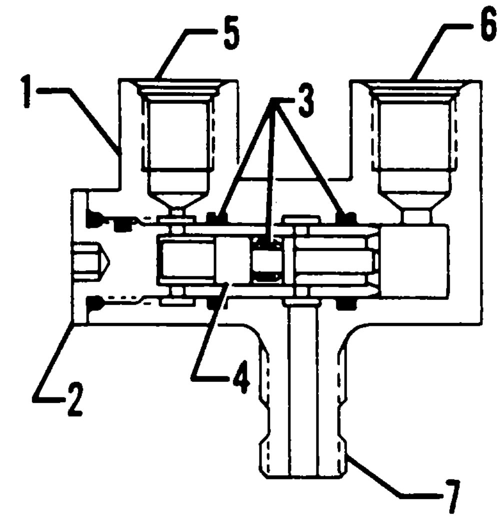
Lubricate all parts with hydraulic fluid per MIL-H-5606 prior to assembly.

1. Install O-rings.
2. Install piston being careful not to damage O-rings.

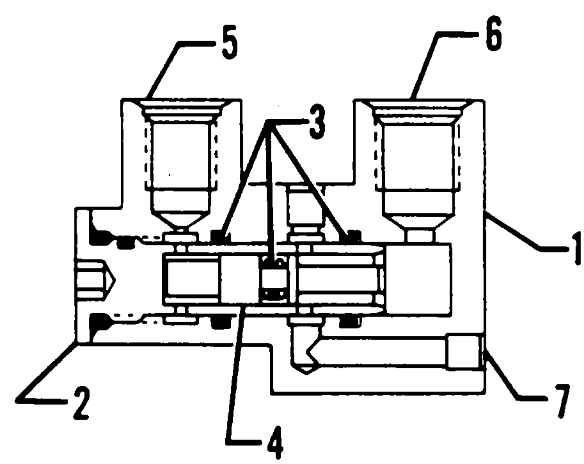
INSTALLATION OF SHUTTLE VALVES.

1. Position shuttle valve on cylinder and secure it.
2. Connect hydraulic line.
3. Check operation of the installation.
4. Remove airplane from jacks.

C650



WTC 2216



1. VALVE ASSEMBLY
2. PLUG ASSEMBLY
3. O-RING
4. SEAL, DOUBLE, DELTA, PISTON
5. AIR
6. PORT
7. FITTING

WTC 2217

Figure 29-17. Shuttle Valves. (WTC 2216, WTC 2217)

GRIDS 2L8 THRU 2L24
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T1000

AIRLINE DIVISION

T1020

MAINTENANCE MANUAL

CARD 3 OF 5

PA-31-350 T1020

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 768)

INTRODUCTION.

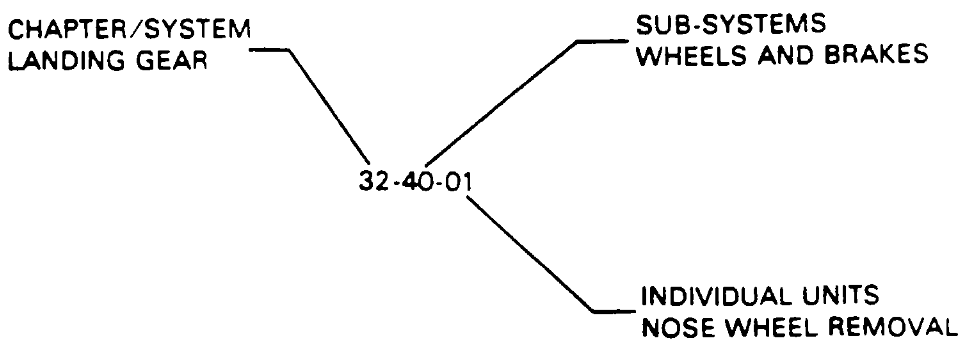
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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 Maintenance Manual is provided to support and maintain the Piper Model PA-31-350 T-1020 aircraft manufactured by the Piper Aircraft Corporation of Lakeland, Florida.

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 T-1020 Parts Catalog P/N 761 775, 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. 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 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, or 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 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:

SAMPLE EFFECTIVITY CODES

First Revision:	Month and Year (11-80)
Second Revision:	Revision Indication, Month and Year(2R 12-80)
Third Revision:	Revision Indication, Month and Year (3R 1-81)
Fourth Revision:	Revision Indication, Month and Year (4R 2-81)
Added Subject:	Identification, Month and Year (A 3-80)

Revisions to this Maintenance Manual 761 768 issued September 2, 1981 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
PR820223	February 23, 1982	1, 2, 3, 4 and 5
PR821015	October 15, 1982	1, 2, 3, 4 and 5
PR831117	November 17, 1983	1, 2, 3, 4 and 5
PR840703	July 3, 1984	1, 2, 3, 4 and 5
IR860430	April 30,1986	1
IR860920	September 20, 1986	1
IR871009	June 15, 1988	3
IR900313	March 13, 1990	2

INTERIM REVISION

Revisions appear in chapter 27 of card 2. Please dispose of your current card 2 and replace with the revised one.
DO NOT DISPOSE OF CARDS 1, 3, 4, or 5.

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VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual =	AVCO LYCOMING = OVERHAUL MANUAL DIRECT DRIVE ENGINE - P/N 60294-7 Avco Lycoming Division Williamsport, PA 17701
Parts Catalog =	AVCO LYCOMING - P/N PC-315 Avco Lycoming Division Williamsport, PA 17701
Operators Handbooks =	AVCO LYCOMING TIO-540 and LTIO-540 SERIES AIRCRAFT ENGINES - P/N 60297-23 Avco Lycoming Division Williamsport, PA 17701

PROPELLER:

Overhaul Instructions =	HARTZELL CONSTANT SPEED AND FEATHERING PROPELLER - P/N 117D Hartzell Propeller Inc. P.O. Box 1458, 1800 Covington Avenue, Piqua, Ohio 45356

MAGNETOS:

Installation. Operation and Maintenance Instructions =	S-1200 SERIES MAGNETO IGNITION SYSTEM - P/N-L-609-3 Bendix Electrical Components Division Sidney, New York 13838

WHEELS AND BRAKES:

PARTS CATALOGS and Maintenance Instructions =	CLEVELAND WHEEL AND BRAKE Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011

VENDOR-SUPPLIER INFORMATION.

Refer to the following list of manufactures, to obtain Service Manual and field service data:

Autoflite	BENDIX AVIONICS DIVISION 2100 N.W. 62nd Street Fort Lauderdale, Fla. 33310 (305) 776-4100 TWX 510-995-8884

VENDOR-SUPPLIER INFORMATION (cont.)

Autoflite (cont.)	EDO-CORPORATION AVIONICS DIVISION Box 610 Municipal Airport Mineral Wells, Texas 76067 (817) 325-2517
	SPERRY FLIGHT SYSTEMS AVIONICS DIVISION 7500 Balboa Blvrd. P.O. Box 9028 Van Nuys, Ca. 91409 (213) 894-8111 Telex: 65-1367
	COLLINS GENERAL AVIATION DIVISION Rockwell International Cedar Rapids, Iowa, 52406 (319) 395-3625 Telex: 46-4421
	KING RADIO CORPORATION 400 N. Rodgers Rd. Olathe, Kansas, 66061 (813) 782-0400 Telex: 4-2299 Kingrad
	GLOBAL NAVIGATION 2144 Michelson Drive Irvine, Ca. 92715 (714) 851-0119

PIPER PUBLICATIONS.

PA-31-350 T-1020 Parts Catalog =	761 775 Piper Aircraft Corporation 2926 Piper Drive Vero Beach, FL 32960
CONTINUOUS INSPECTION =	761 770 Piper Aircraft Corporation 2926 Piper Drive Vero Beach, FL 32960

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CHAPTER

30

ICE AND RAIN PROTECTION

CHAPTER 30 - ICE AND RAIN PROTECTION

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GENERAL.

DESCRIPTION.

The material contained herein provides information for general maintenance characteristic of the ice and rain protection systems. These systems consist of wing deice boots, windshield wipers, propeller deice boots and their related controls. If further information is necessary contact the product manufacturer or Piper Service Representative.

AIRFOIL.

DESCRIPTION AND PRINCIPLES OF OPERATION.

The deicer is essentially a fabric reinforced rubber sheet containing built-in inflation tubes. The type used in this installation have spanwise inflation tubes. Deicers are attached by means of a cement to the leading edges of the surfaces being protected. There are either aluminum or flexible rubber air connections on the backside of the deicer boots called "air connection stems." Each stem projects from the underside of the boot into the leading edge, through a round hole provided in the metal skin, for connection to the airplane's pneumatic air supply system.

The deicing system is controlled by a "momentary on" type control switch. When this WING DEICE switch is actuated, the boots perform one complete inflation cycle. The switch must be actuated for each additional inflation cycle. This allows the pilot to manually select boot inflation in any desired time interval that icing conditions require. After each inflation cycle, the timer automatically resets to allow the inflation cycle to begin when the switch is actuated.

Actuation of the momentary switch triggers a system cycle timer, which in turn shifts the two stage regulators to high pressure (18 psi), opens the 'A' system solenoid valve to send air to the wing boots, and cuts off air to the copilot's gyros (when installed). After six seconds, the 'A' system solenoid is closed and the 'B' system solenoid is opened to send air to the tail boots for six seconds. At the completion of the tail cycle, the 'B' system solenoid closes, the two stage regulators return to low pressure (gyro pres.) and the copilot's air supply resumes.

When the inflation cycle is complete, the deicer solenoid valves permit overboard exhaustion of the pressurized boots. Suction is then reapplied to the deicer boots to hold them close to the airfoil surface.

Two blue indicator lights with press-to-test and dimming features, illuminate when each surface deicer boot system inflates to a predetermined pressure. Illumination of the indicator light is controlled by a pressure sensitive switch connected to the deicer pressure lines (one in the 'A' system, and one in the 'B' system).

A ply of conductive neoprene is provided on the surface to dissipate static electric charges. These charges, if allowed to accumulate, would eventually discharge through the boot to the metal skin beneath, causing static interference with the radio equipment and possible punctures in the rubber. Also, such static charges would constitute a temporary fire hazard after each flight.

TROUBLESHOOTING.

In the utilization of the troubleshooting charts, it must be assumed that the engine driven pneumatic pumps and the airplane electrical system are operational. It is further assumed that the deicer system installation was made in an approved manner.

CHART 3001. TROUBLESHOOTING (PNEUMATIC DEICER SYSTEM)

Trouble	Cause	Remedy
DEICER BOOTS INSTALLED		
Deicers do not inflate. Both engines operating at minimum cruise RPM or either engine at 2200 RPM.	Open circuit breaker.	Push circuit breaker to reset.
	System connection loose or wire broken.	Tighten or repair as required.
	Timer not functioning.	Test or replace as required.
	Control valves not functioning.	Make electrical test. Replace as required.
	Piping lines blocked or not connected.	Blow out lines and inspect connections. Make air leakage test.
Deicers inflate slowly. (Inflation time - 6 seconds.)	Piping lines partially blocked or not connected securely.	Blow out lines and inspect connections. Make air leakage test.
	Deicer pump valve not functioning.	Check fitting in deicer port for proper installation.
	Low air pump capacity.	Check performance to manufacturers specifications.
	Deicer puncture.	Repair per specification or replace.
Deicers inflate, indicator light does not function. (Ascertain that deicer boot switch is "ON.")	Indicator lamp burned out.	Replace lamp.
	System pressure not being reached.	Check "deicers inflate slowly" above.
	Pressure switch not functioning.	Make electrical test and replace if required.
	Wires loose or broken. Poor grounding of pressure switch.	Make electrical test. Repair or replace broken wires. Check for proper ground.
Deicers deflate slowly.	Pressure control valve set too slow.	Readjust pressure control valve.

CHART 3001. TROUBLESHOOTING (PNEUMATIC DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
DEICER BOOTS INSTALLED (cont.)		
	Piping or lines partially blocked.	Inspect and blow out lines.
	Control valve partially blocked.	Inspect and clean.

OPERATIONAL CHECK.

The pneumatic deicing system should be checked at least every 100 hours. This check can be done on the ground. A visual inspection should be performed to determine the condition of the deicer boots, and any areas in need of repair should be taken care of before continuing with the operational check of the system.

With one engine operating, activate the deicing system switch. The pressure will flucuate as the tubes inflate and deflate. Check the pneumatic pressure gauge. If pressure is satisfactory, observe the operation of the deicers carefully for evidence of malfunctioning. Look for tubes which leak or fail to inflate and deflate properly. Repeat the procedure for the other engine.

ELECTRICAL TEST.

With engines off, turn airplane battery switch to ON position.

1. Timer: Activate the deicer system switch. The timer should begin to operate immediately and complete one full cycle of the system. If the timer does not function:
   - A. Reset circuit breaker and recheck.
   - B. Check circuit from power source, through circuit breaker, to switch, to timer, to ground.
   - C. Replace timer.
2. Solenoid Valves: Check solenoid valves. Activate system switch to ON position. Solenoid valve should be actuated immediately for 6 seconds, as evidenced by an audible "click" that can be felt if hand is placed on a solenoid.

PRESSURE LEAKAGE TEST.

1. This test can be performed in either the left or right nacelles.
2. Disconnect the hose from the filter to the control valve at the control valve end. Connect a source of clean air to the filter hose. It is necessary to have a pressure of 18 psig to perform this test. Observe the system pressure on the airplane's pneumatic pressure gauge.
3. Apply 18 psig pressure to the system by means of a hand operated valve; trap the pressure in the deicer system. Observe the system for leakage. The leakage rate should not exceed a pressure drop of 3.0 sig per minute.
4. Remove test equipment and replace all system components.

PNEUMATIC SYSTEM ADJUSTMENT.

The pneumatic system is adjusted to provide adequate pressure for the airplane instruments and any other equipment. Refer to Chapter 36 of this Service Manual for the proper procedure.

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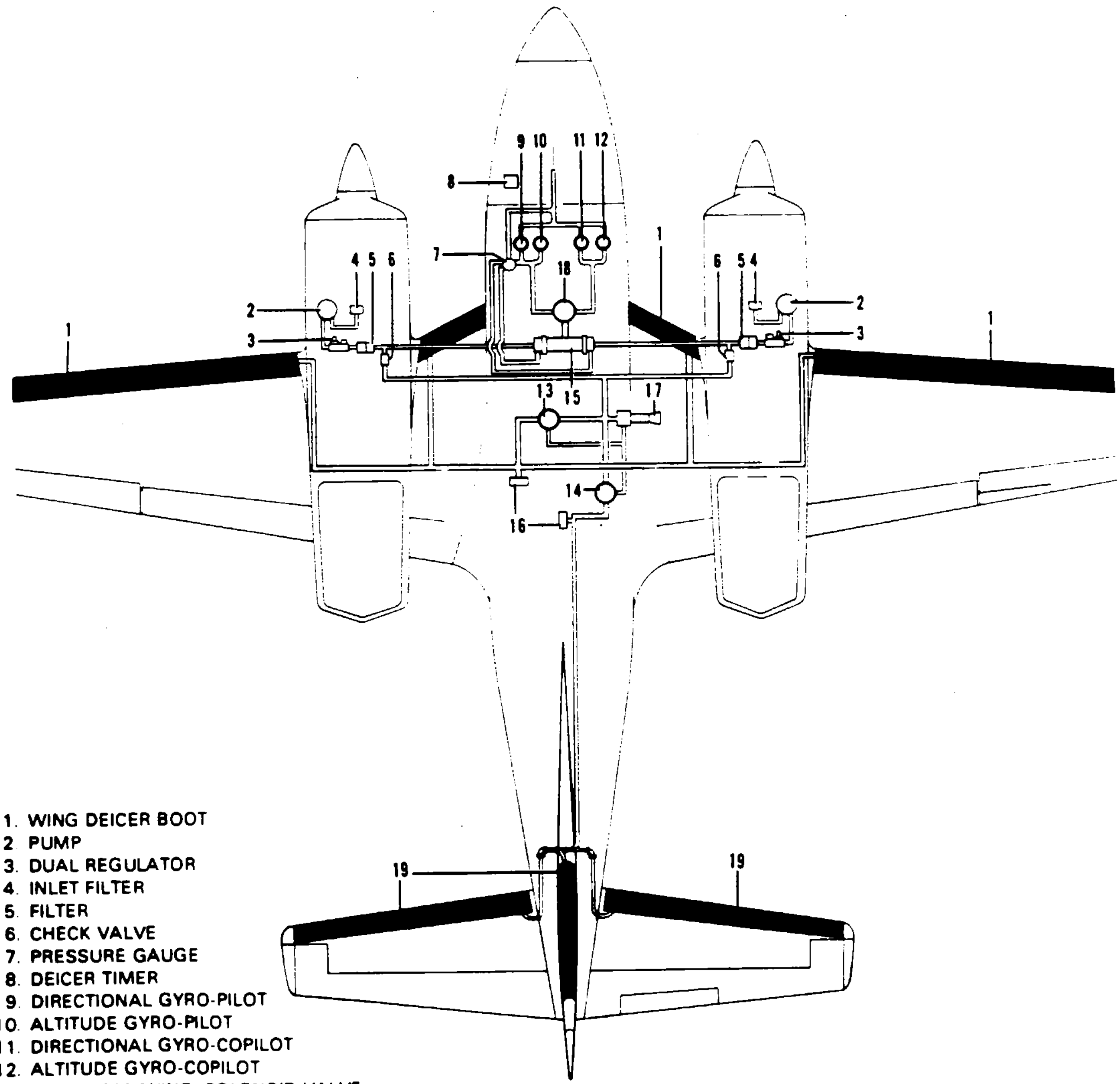

1. WING DEICER BOOT
2. PUMP
3. DUAL REGULATOR
4. INLET FILTER
5. FILTER
6. CHECK VALVE
7. PRESSURE GAUGE
8. DEICER TIMER
9. DIRECTIONAL GYRO-PILOT
10. ALTITUDE GYRO-PILOT
11. DIRECTIONAL GYRO-COPILOT
12. ALTITUDE GYRO-COPILOT
13. A. SYSTEM (WING) SOLENOID VALVE
14. B. SYSTEM (TAIL) SOLENOID VALVE
15. MANIFOLD CHECK VALVE
16. PRESSURE SWITCH
17. EJECTOR
18. RELAY VALVE
19. EMPANNAGE DEICING BOOT

Figure 30-1. Pneumatic Deicer System Installation (Typical)

COMPONENT MAINTENANCE AND REPLACEMENT.

FILTER REPLACEMENT.

There are four air line filters installed in the pneumatic system of this airplane. Two inline filters (#1J4-6) and two air filters (#1J1-3). The following instructions will cover the removal and installation of these filters.

1. Removal of Inline Filter (#1J4-6) located aft of the fire wall in both the left and right engine nacelle.
   A. Remove the appropriate access panel on the upper section of the engine nacelle. (Refer to Chapter 6.)
   B. Disconnect the hose clamps and remove the appropriate filter from the line connections.

— NOTE —

These filters are the disposable type and must be replaced by a new one every 500 hours. Refer to T-1020 Parts Catalog for correct part number.

2. Installation of Inline Filter (#1J4-6). The filter has an arrow on the case indicating direction of air flow, and should be installed in the exact position of the old filter.
   A. Place the new filter in the engine nacelle aft of the fire wall and connect the air lines to the filter and secure with hose clamps.
   B. Install and secure access panel previously removed.
3. Removal of Air Filter (#1J1-3) located in lower left and right engine nacelle aft of the firewall above the air inlet opening.
   A. Remove the appropriate access panel on the outboard sides of the engine nacelle aft of the fire wall. (Refer to Chapter 6.)
   B. Disconnect the hose clamp and remove the hose from the filter.
   C. Remove the locking nut from the filter line and remove the filter.

— NOTE —

The filter should be cleaned or replaced as required at each 100 hour inspection. Refer to T-1020 Parts Catalog for correct part number.

4. Installation of Air Filter (#1J1-3).
   A. Place the filter in the same position as it was prior to removal and secure with the locking nut.
   B. Connect the hose to the filter and secure with hose clamp.
   C. Install and secure access panel previously removed.

CONTROL VALVES.

No service is recommended for these valves except for their replacement in the event of failure.

TIMER MAINTENANCE.

No field maintenance is recommended. Refer to Parts Catalog for replacement timer.

INSPECTIONS.

A ground check of the entire deicer system should be made at least every 100 hours. To permit ground checking the system without engine operation, a test plug is designed into all systems, usually between the pressure check valve and the combination unit.

Before checking the system, all deicers should be inspected for damaged areas and repaired according to the procedure in this section outlining the cold patch or vulcanized repairs. In order to check the system, refer to Chart 3002 for operating pressures.

CHART 3002. OPERATING PRESSURES

Recommended Operating Pressure PSIG	Test Pressure in PSIG	
	MIN.	MAX.
15	13	17
18	16	20

GROUND TEST PROCEDURE.

After the test pressure range is established, connect an external source of air providing this pressure to the test plug. When the air supply is turned on, the check valves in the lines from the pneumatic pumps close automatically. The deicer system should be within one psig of the recommended operating pressure with each inflation cycle.

If deicers do not reach the operating pressure, check the inflation time to ascertain that the solenoid valves are open the specified length of time, (six seconds). If this is not the cause of trouble or if the boots deflate slowly, the lines or valves may be plugged. Then the lines should be disconnected and blown clear.

Check the timing of the system through several complete cycles. If cycle time is off the specified time, determine and correct the difficulty. Wing and tail boots are inflated simultaneously for six seconds.

Inflation must be rapid to provide efficient deicing. Deflation should be completed before the next inflation cycle of the boots.

100 HOUR INSPECTION.

At each 100 hour inspection of the airplane, inspect and operate the deicer boots. Make checks as follows:

1. Carefully inspect the deicers for evidence of damage or deterioration and repair or replace damaged boots.
2. Resurface boots which show signs of considerable wear or deterioration.

3. Inspect all hose connections which form a part of the pneumatic deicing system. Replace deteriorated sections of non-kink hose.
4. Check the operation of the boots and the operating pressure of the system.
5. If new or replacement boots have been installed, check the tube inflation to make sure that the air connection stems have been properly connected.
6. Disconnect all drain lines in the system and check for proper drainage.
7. Check the on-off control switch for freedom of action. Check associated electric wiring.
8. Clean or replace the air filters.

— NOTE —

This operation may be omitted if the boots were installed on the airplane subsequent to the last previous 100 hour check.

BOOTS.

REMOVAL OF BOOTS.

The removal of deicer boots should be done in a well ventilated area to avoid difficulty from the fumes of the solvents. Materials required to remove the boots are: Turco 388 or Kelite 21 to remove dried cement, and MEK (Menthylethylketone) in squirt can.

— NOTE —

Disconnect line fittings from boot fittings.

1. Starting at one corner of the upper trailing edge of the deicer, apply a minimum amount of solvent to the seam line while tension is applied to peel back the corner of the deicer.
2. Using a pressure handle squirt can filled with solvent, separate the deicer boot from the surface for a distance of 4 inches all the way along the upper trailing edge.
3. The area between the deicer and the wing which has now been separated will act as a reservoir for the solvent, therefore, the deicer can be pulled down towards the leading edge with a uniform tension.
4. From the centerline of the leading edge to the lower trailing edge of the deicer, use the pressure handle squirt can to soften the bond between the deicer and the wing skin.
5. Use Kelite 21 or Turco 388 to clean the dry cement off the exposed wing area, and clean the area thoroughly with MEK (Methyl Ethyl Ketone).

REPAIR OF BOOTS.

Deicer repairs are classified as cold, when made on the boot installed on the airplane, and vulcanized , when made on the demounted boot in the shop.

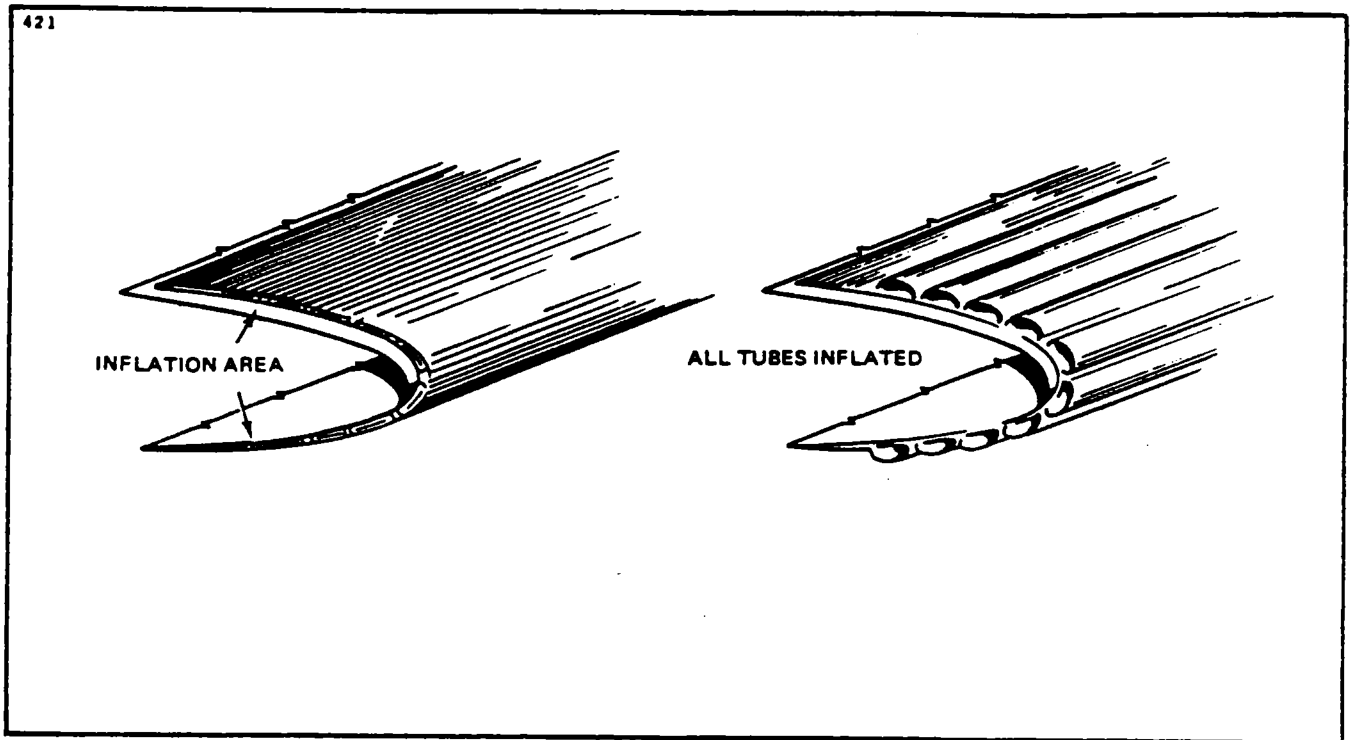

Figure 30-2. Pneumatic Deicer Boots Operation

COLD REPAIR.

The materials and supplies for making cold repairs are listed in Chart 3003.

1. SCUFF DAMAGE. This type of damage will be most commonly encountered and, fortunately, it is not necessary in most cases to make a repair. On those rare occasions when the scuff is severe and has caused the removal of the entire thickness of surface ply in spots (the brown natural rubber underneath is exposed), repair the damage using Part No. 74-451-16 and proceed as follows:

A. Clean the area around the damage with a cloth dampened slightly with solvent. Buff the area around the damage with 74-451-75 emery buffing stick so that it is moderately but completely roughened. Wipe the buffed area with a clean cloth slightly dampened with solvent to remove all loose particles.

B. Select a patch of ample size to cover the area. Apply one even thorough coat of cement, Part No. 74-451-20, to the patch and the corresponding damaged area. Allow cement to set a couple of minutes until tacky.

C. Apply the patch to the deicer with an edge, or the center, adhering first. Work down the remainder of the patch carefully to avoid trapping air pockets. Thoroughly roll the patch with stitcher-roller, Part No. 74-451-73, and allow to set for ten to fifteen minutes.

D. Wipe the patch and surrounding area from the center outward with a cloth slightly dampened with solvent. Apply one light coat of A-56-B conductive cement, Part No. 74-451-11, to the patched area.

E. Satisfactory adhesion of patch to deicer will be reached in four hours. Deicer may be inflated for checking repair in a minimum of 20 minutes.

2. TUBE AREA DAMAGE. Repair cuts, tears or ruptures to the tube area with fabric reinforced patches, Part No. 74-451-16, 17, -18 or -19 depending on size of damaged area.

A. Select a patch of ample size to cover the damage and to extend to at least 5/8 inch beyond the ends and edges of the cut or tear. If none of the patches is of proper size, cut one to the size desired from one of the larger patches. If this is done, bevel the edges by cutting with the shears at an angle.

— NOTE —

These patches are manufactured so that they will stretch in one direction only. Be sure to cut and apply the patch selected so that stretch is in the widthwise direction of the inflatable tubes.

B. Buff the area around the damage with buffing stick, Part No. 74-451-75, so that the surface is thoroughly roughened.

C. Apply the patch to the deicer with the stretch in the widthwise direction of the inflatable tubes, sticking edge of patch in place, working remainder down with slight pulling action so the injury is closed. Do not trap air between patch and deicer surface.

3. LOOSE SURFACE PLY IN DEAD AREA (NON-INFLATABLE AREA). Peel and trim the loose surface ply to the point where the adhesion of surface ply to the deicer is good.

A. Scrub (roughen) area in which surface ply is removed with steel wool. Scrubbing motion must be parallel to cut edge of surface ply to prevent loosening it. Buff the edges of the adjoining surface ply 1/2 inch with 74-451-75 buffing sticks, taper down to the tan rubber ply. Remove loose particles with solvent and rag.

B. Cut a piece of surface ply material, Part No. 74-451-23, to cover the damaged area and extend at least one inch beyond in all directions.

C. Mask off the damaged boot area 1/2 inch larger in length and width than the size of surface ply patch. Apply one coat of cement, Part No. 74-451-11, to damaged area and one coat to patch. Allow cement to set until tacky. Roll the surface ply to the deicer with 2 inch rubber roller, Part No. 74-451-74. Roll edges with stitcher-roller, Part No. 74-451-73. Apply just enough tension on the surface ply when rolling to prevent wrinkling, and be careful to prevent trapping air. If air blisters appear after surface ply is applied, remove them with a hypodermic needle.

D. Clean excess cement from deicer with solvent.

4. LOOSE SURFACE PLY IN TUBE AREA. Loose surface ply in tube area is usually an indication of the deicer starting to flex fail. This type of failure is more easily detected in the form of a blister under the surface ply when deicer is pressurized. If this type of damage (or void) is detected while still a small blister (about 1/4 or 3/8 inch diameter) and patched immediately, the service life of the deicer will be appreciably extended. Apply repair patch as outlined in paragraph 1.

5. DAMAGE TO FABRIC BACK PLY OF DEICER DURING REMOVAL. If cement has pulled loose from the wing skin and adhered to the back surface of the deicer, remove it with clean rags and MEK. In those spots where the coating has pulled off the fabric, leaving bare fabric exposed, apply at least two additional coats of cement, Part No. 74-451-24. Allow each coat to dry thoroughly.

VULCANIZED REPAIR.

Due to the variety of boot damage possible, it is recommended that the B. F. Goodrich Company be contacted so they can determine the extent of damage and whether it is repairable by the vulcanized method, or not. The overall condition of the deicer boot must be given careful consideration before deciding on any repairs. Damages can vary from minor punctures which may be easily repaired, to extensive ripping of the tube or stretch areas which may make repairs exceedingly difficult or actually impossible. The determination of just where this division between repairable and unrepairable damage exists will depend upon the careful judgment of the inspector. For this reason, we recommend contacting the B. F. Goodrich Company, at Akron, Ohio

CHART 3003. MATERIAL AND SUPPLIES FOR COLD REPAIR

Part No.	Quantity	Description
74-451-C (FSN1650-856-7939)	1	Cold Patch Repair Kit (B.F. Goodrich Co.)
74-451-11	1/2 pt. can	A-56-B Conductive cement
74-451-16	30 pcs.	Small oval patch 1-1/4 x 2-1/2 in.
74-451-17	30 pcs.	Medium oval patch 2-1/2 x 5 inch
74-451-18	10 pcs.	Large oval patch 5 x 10 in.
74-451-19	3 pcs.	Patch 5 x 19 inch.
74-451-20	(2) 1/2 pt.	*No. 4 cement (patching only)
74-451-70	2	Cement brush 1/2 in.
74-451-73	1	1/8 in. Steel stitcher
74-451-75	6	Emery Buffing sticks
74-451-87	1	Buffing Shield

*This cement will give best results with the patches in this kit.

The following items may be procured from the B.F. Goodrich Co., Akron, Ohio, or other manufacturer, as required:

74-451-21	6 ft. roll x 6 in. wide	Type 21 or 22 fillet
74-451-22	15 ft. roll x 2 in. wide	Neoprene coated splicing tape
74-451-23	4 ft. long x 8 in. wide	Neoprene surface ply
74-451-24 (FSN8040-628-4199 and/ or FSN8040-514-1880)	1 quart	—EC-1403 cement and/or EC-1300 L
74-451-74	1	2 in. dia. x 2-1/2 in. rubber roller
74-451-100	1	—EC 801 Filler Compound

—Minnesota Mining and Manufacturing Company, Adhesives Division, 411 Piquette Ave., Detroit, Michigan.

CHART 3003. MATERIAL AND SUPPLIES FOR COLD REPAIR (cont.)

Part No.	Quantity	Description
The following materials may be obtained from local supply:		
		Toluol
	As required	Clean, lint-free cloths (preferably cheese cloth)
	Rolls	1 in. masking tape
	1	Sharp knife
	6 ft. long	Steel measuring tape
	1	Fine sharpening stone
	As required	320 grit emery cloth
	As required	Hypodermic needles (22 gauge or smaller)
Methylethylketone (MEK) can be used instead of Toluol, howerver MEK causes very rapid drying and provides only 10 seconds working time compared with 40 seconds for Toluol.		

INSTALLATION

The following procedure for installing deicers assumes that the airplane has provisions for air connections, etc.

PREPARATION OF LEADING EDGES.

If the leading edges are painted, remove all paint including zinc chromate primer.

1. With one inch (1) masking tape, mask off leading edge boot area, following 1/2 inch margin for non-recessed boots. Take care to mask accurately, thus eliminating the need for cleaning off excess cement later.
2. Clean the metal surfaces thoroughly, at least twice, with MEK or acetone. For final cleaning, wipe the solvent film off quickly with a clean dry cloth before it has time to dry.

— *NOTE* —

It is permissible to install deicers on alodined or anodized surfaces.

3. Fill gaps of skin splices that lead under deicers with sealing compound EC-801.
4. Remove the summper plugs from the air connection grommets. In some cases, it will be necessary to remove sections of doped fabric used to cover the air connection holes. Draw out the ends of the non-kink hose section so that they protrude through the connection holes in the leading edge. If hose is cracked or deteriorated, replace with new hose.

PREPARATION OF DEICER.

Moisten a clean cloth with MEK or acetone and carefully clean the rough, back surface of the boot at least twice. Change cloths frequently to avoid recontamination of the cleaned areas.

MOUNTING DEICER ON LEADING EDGE.

Thoroughly mix EC-1300L cement before using. Apply one even brush coat to the cleaned back surface of the boot and to the cleaned metal surface. Allow the cement to air dry for a minimum of one hour. Apply a second coat to both surfaces and allow to air dry a minimum of one hour. Ambient temperature for installation should be held between 40° and 110° F. However, longer drying time of the cement coats may be required as the humidity approaches 99%. Deicer and leading edge may be cemented for a maximum of 48 hours before actual installation, if cemented parts are covered and kept clean.

Snap a chalk line along the leading edge of the airfoil section. Intensify chalk line on leading edge and the white reference line on the boot with a ball point pen. Most boots are made with an excess of material at the inboard and outboard edges for final trimming after installation and some recessed boots trim on the upper and lower edges.

Securely attach hose to deicer connections using clamps or safety wire.

1. Holding the backside of the boot close to the leading edge, fasten the end of each non-kink hose to the corresponding air connection stem. Tinnerman or other suitable non-kink hose clamps should be used for this purpose. Tighten each clamp with a pair of slip joint pliers but do not squeeze the clamp so tight that the hose is damaged.

— NOTE —

If non-kink hose clamps are not available, wrap each hose connection with several turns of friction tape. Over the tape wrap two separate bindings of safety wire, about 1/2 inch apart. Each of these bindings should consist of several turns of wire. Twist together the ends of each binding to tighten. Press the twisted ends down against the hose. Finally, wrap the wire with several additional turns of friction tape.

2. Push the hose connections into the leading edge grommets or seals, as the case may be. Obtain sufficient personnel to hold boot steady during installation. (Limit handling cemented side of boot with fingers.) Continue installation by reactivating the cement along the centerline leading edge surface and boot in spanwise strips approximately 6 inches wide. Rubber roll the deicer firmly against the wing leading edge. being careful not to trap any air under the deicer. Always roll parallel to the inflatable tubes. Position the deicer centerline to coincide with leading edge centerline. Hold boot in this position while reactivating about 3 inches around connections and around corresponding holes in leading edge, using a clean, lint free cloth moistened with Toluol. Insert connections in leading edge holes when cement has dried to a tacky state, and rubber boot to leading edge in tackified area.
3. If the deicer should attch "off course," use MEK to remove and reposition properly. Avoid twisting or sharp bending of the deicer.
4. Rubber roll, apply pressure over entire surface of the deicer. All rolling should be done parallel to the inflatable tubes. Roll trailing edges with a narrow stitcher roller.

— CAUTION —

Avoid excessive soaking or rubbing of the cement which could remove the cement from the surface.

Remove all masking tapes, and clean surfaces carefully with Toluol so that no solvent will run under deicer edges.

5. Apply masking tape to deicer edges where exposed trimmed ends or gaps between sections are to be filled with MMM EC-801 sealing compound.

Apply masking tape to deicer approximately 1/4 inch in from trailing edges, and tape wing skin approximately 1/4 inch from trailing edges, both forming a neat, straight line.

6. Apply a brush coat of A-56-B cement to surfaces between tapes and to EC-801 seams, being sure that the conductive coating (A-56-B) is continuous from the deicer surface to the wing painted surface.

7. Remove tapes immediately after applying A-56-B cement (before cement dries).

— NOTE —

Application of A-56-B conductive cement is not necessary on deicers that have "CONDUCTIVE" noted on labels.

— CAUTION —

The cements and solvents used for installation are flammable and their fumes slightly toxic. Therefore, all work should be done in a well-ventilated area away from any sparks or flames. (Use of solvent resistant type gloves is recommended.)

In the event it becomes necessary to remove or loosen installed boots, use MEK to soften the "adhesion" line. A minimum of this solvent should be applied to the seam line while tension is applied to peel back the boot. This removal should be slow enough to allow the solvent to undercut the cement, thus preventing injury to the part. Excessive quantities of solvent must be avoided.

ADHESION TEST.

Using excess boot material trimmed from the ends of any wing and empennage deicers, prepare one test specimen for each deicer installed. This specimen should be a 1 x 8 inch full thickness strip of boot material cemented to the wing skin adjacent to installed boot following the identical procedure used for installation. Leave one inch of the strip uncemented to attach a clamp. Four hours or more after the installation, attach a spring scale to the un-cemented end of each strip and measure the force required to remove strip at the rate of one inch per minute. The pull should be applied 180° to the surface. (Strip doubled back on itself.)

A minimum of five pounds tension (pull) shall be required to remove the test strip. If less than five pounds is required, then acceptability of the boot adhesion shall be based on the following tests:

1. Carefully lift one corner of boot in question sufficiently to attach a spring clamp.
2. Attach a spring scale to this clamp and pull with force 180° to the surface and in such a direction that the boot tends to be removed on the diagonal.
3. If a force of five pounds per inch of width can be exerted under these conditions, the installation shall be considered satisfactory. Remember, the width increases as the corner peels back.
4. Re-cement corner following previous procedure.
5. Failure to meet this requirement shall result in reinstallation of the boot.

— *NOTE* —

Possible reasons for failure are: dirty surfaces, cement not reactivated properly, cement not mixed thoroughly. Corrosion of the metal skin may occur if good adhesion is not attained, especially around rivet heads and metal skin splices.

If these adhesion requirements are met, the airplane may be flown immediately. Do not inflate deicers within 12 hours of installation or until adhesion strength of 8 to 10 pounds is obtained.

DEICER BOOTS PRESSURE TEST.

1. Use a source of clean air, which can be regulated between 18 and 20 psi, along with a testing rig consisting of:
   A. Adjustable regulator.
   B. Pressure regulator.
   C. Shutoff valve.

— *NOTE* —

The shutoff valve must be connected so as to trap air in the deicer system.

2. Disconnect the line to the pressure regulator. Attach the test rig on the line to the pressure regulator. Bypass the one ejector valve and install temporary test line. Apply 19 psi of air to the system, and using the shutoff valve, trap this air pressure in this portion of the system. A soap solution may be used to check for leakage, which should not exceed 3 psi per minute.
3. Check the pressure switch operation with the deicer system under pressure, while the battery switch is in the ON position; the indicator light will glow.
4. With the master switch ON and the deicer control switch in the OFF position, press the indicator light to check the circuit and light bulb. If the indicator light does not function, check and reset the circuit breakers; a short may exist.
5. Remove the test rig, lubricate the threads, replace and tighten items dismantled.
6. With boots pressure test completed, recheck system pressure.

MAINTENANCE.

Clean deicers when the airplane is washed with a mild soap and water solution. In cold weather, wash the boots with the airplane inside a warm hangar if possible. If the cleaning is to be done outdoors, heat the soap and water solution before taking it out to the airplane. If difficulty is encountered with the water freezing on the boots, direct a blast of warm air along the region being cleaned, using a portable type ground heater.

As alternates, use Benzol or non-leaded gasoline. Moisten the cleaning cloth in solvent, scrub lightly, and then, with a clean, dry cloth, wipe dry so that the cleaner does not have time to soak into the rubber. Petroleum products such as these are injurious to rubber and, therefore, should be used sparingly.

ICEX APPLICATION.

B. F. Goodrich Icex is silicone base material specifically compounded to lower the strength of adhesion between ice and rubber surfaces of airplane deicers. Icex will not harm rubber, and offers added ozone protection.

Properly applied and renewed at recommended intervals, Icex provides a smooth polished film that evens out the microscopic irregularities on the surface of rubber parts. Ice formations have less chance to cling. Ice is removed faster and cleaner when deicers are operated.

It should be emphasized that Icex is not a cure-all for icing problems. Icex will not prevent or remove ice formations. Its only function is to keep ice from initially getting a strong foothold, thus making removal easier.

One 16 ounce pressurized can of Icex will cover deicer surfaces of the average light twin-engine plane approximately three times. It is also available in quart cans (unpressurized).

Before applying Icex, thoroughly clean deicer or other rubber surfaces with a rag dampened with non-leaded gasoline. Follow by a scrub wash of mild soap and water. Allow time for surfaces to dry.

Shake the Icex can well. Hold the nozzle approximately 12 inches from the surface and spray. Apply sparingly. If the application is too heavy, it results in a sticky surface which is very undesirable because it will pick up runway dust and prevent best ice removing efficiency.

Due to the natural abrasive effects on leading edges of deicers, during flight, reapply Icex every 150 flight hours on wings and empennage deicers.

RESURFACING CONDUCTIVE CEMENT.

The following materials are required to remove and replace the old, damaged coating:

1. Fine grit sandpaper.
2. Two inch paint brush.
3. One inch masking tape.
4. Conductive neoprene cement, No. A-56-B, B. F. Goodrich Company.
5. Isopropyl Acetate, Federal Specification TT-I-721, as cleaning or thinning solvent.
6. Alternate solvent - (Toluol or Toluene may be used as an alternate for isopropyl acetate).

— CAUTION —

Cements and solvents used for resurfacing are flammable and their fumes slightly toxic. Therefore, all work should be done in a well ventilated area away from any sparks or flames.

During cold weather, place the airplane in a warm hangar and locate so that the boots are inline with one or more blast heaters. Do resurfacing before any other work on the airplane to allow as much time as possible for the new coat to cure.

— NOTE —

If, for some reason the resurfacing cannot be done indoors, it may be deferred at the discretion of the inspector, until a warm, clear day permits the work to be satisfactorily accomplished outdoors. However, if the deicers are in such condition that immediate resurfacing is required, remove them from the airplane and resurface in a shop.

Clean deicer thoroughly with isopropyl acetate.

1. Roughen entire surface of boot, using a fine grit sandpaper.
2. Clean surface again with clean, lint-free cloth moistened with cleaning solvent.
3. Apply masking tape beyond upper and lower trailing edges, leaving a 1/4 inch gap of bare metal.
4. Mask off any legible deicer brands.
5. Apply one brush coat of A-56-B cement to deicer and allow to dry at least one hour. Then apply second coat and allow to dry at least four hours before operating deicers. Plane may be flown as soon as cement is dry. Check flow strips for security. If not satisfactory, re-cement per instructions in Kit 760 322.

— NOTE —

If A-56-B cement has aged 3 months or over, it may be necessary to dilute the cement with isopropyl acetate to obtain proper brushing consistency. Mix thoroughly, approximately 5 parts cement to one part isopropyl acetate.

WINDOWS AND WINDSHIELDS

WINDSHIELD WIPER MECHANISM.

REMOVAL OF WIPER MECHANISM. (Refer to Figure 30-3.)

1. Remove the access panel on the left side of the nose section.
2. Gain access to the wiper motor by removing the upper panel of the baggage compartment.
3. Cut the lockwire at the bolt which secures the arm to the serrated converter shaft and remove the bolt.
4. Loosen the adjustment nut and lift the wiper arm off the converter shaft. Refer to wiper blade replacement and adjustment.
5. Remove two screws from seal cover around converter shaft and remove cover and old sealant from shaft.
6. Disconnect the electrical connection to the wiper motor.
7. Remove the remaining screws holding the motor and converter to the airplane, and remove the complete assembly.
8. If necessary, the converter and motor can be separated by unscrewing the motor from the converter.

— CAUTION —

When separating the motor from the converter, do not lose the coupling between the motor shaft and converter drive shaft.

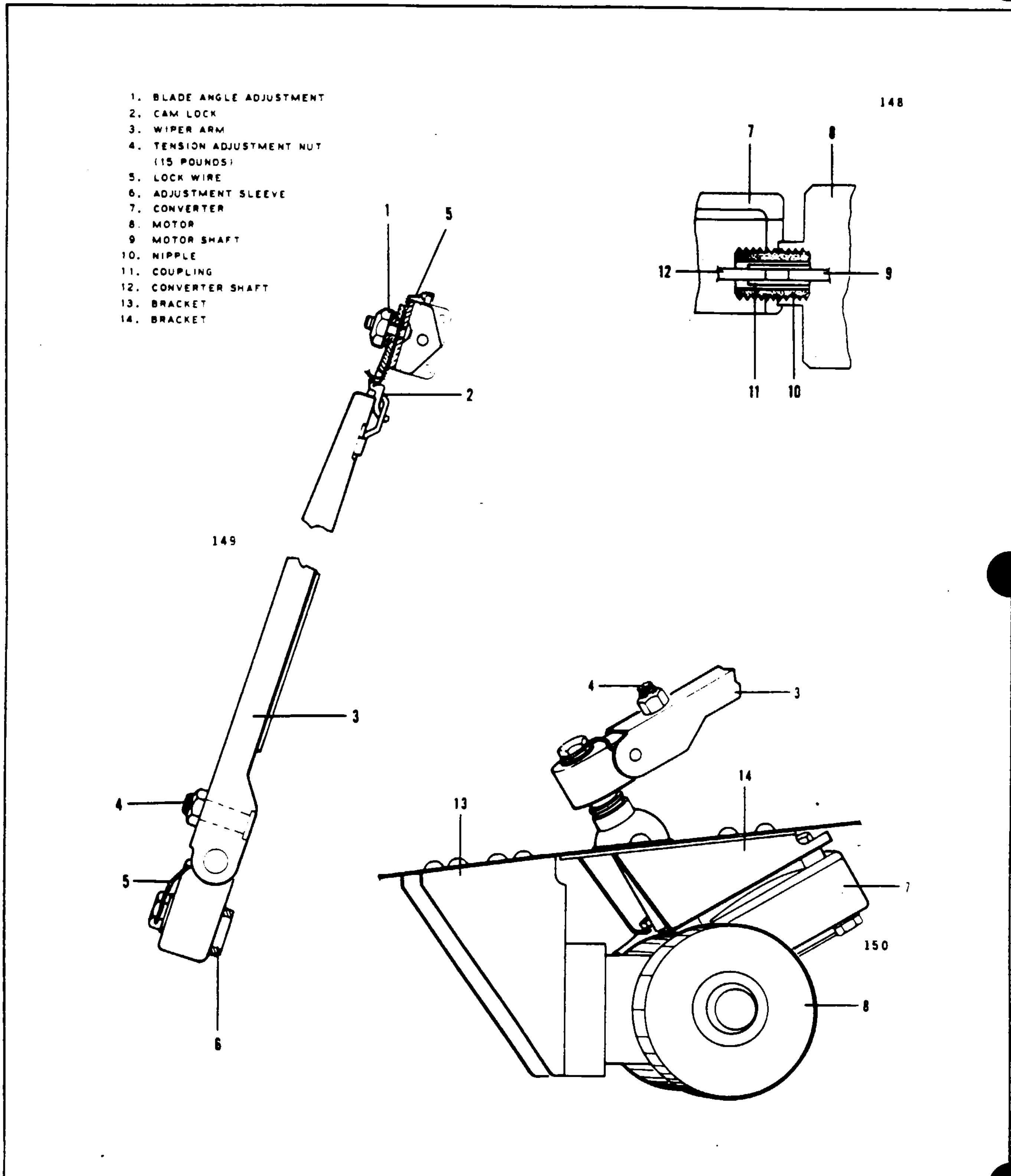

Figure 30-3. Windshield Wiper

INSTALLATION OF WIPER MECHANISM. (Refer to Figure 30-3.)

1. The wiper motor and the converter must be timed before connecting the two units together and installing them in the airplane. The timing can be accomplished as follows:
   A. Rotate the drive shaft in the converter until the end of travel, corresponding to the park position, is obtained at the serrated converter shaft.
   B. Temporarily connect the electrical connector to the wiper motor and operate the motor, ending with the switch in the PARK position. Disconnect the electrical connector.
2. Assemble the wiper motor and converter by screwing the two units together.

— *NOTE* —

Ascertain that the coupling is installed when connecting the motor and converter.

3. Assemble the units slowly until the coupler engages the converter drive shaft. The alignment should be automatic, but if severe binding occurs, back off and reassemble.
4. Screw units together until the nipple bottoms in the converter and then back off for alignment of mounting brackets.
5. Install the assembled units into the airplane and secure with four screws. Do not install the seal cover at this time.
6. Apply a bead of sealer around the converter shaft where it extends through the fuselage and position and secure the seal cover in place with two remaining screws.
7. Connect the electrical connector to the wiper motor and replace the access panels removed.
8. Install and secure the nose baggage compartment upper panel into position.
9. Refer to wiper blade and arm installation and adjustment.

WIPER BLADE AND ARM REMOVAL.

1. Cut the lockwire at the bolt which secures the arm to the serrated converter shaft and remove the bolt.
2. Loosen the adjustment nut to relieve the arm tension and remove the wiper arm from the converter shaft.
3. Cut lockwire and pull the lock on the wiper blade out to remove the blade from the arm assembly.

WIPER BLADE AND ARM INSTALLATION. (Refer to Figure 30-3.)

1. Install the wiper blade to the arm assembly and ascertain that the blade is locked to the arm and safety with MS20995-C20 lockwire.
2. Turn the wiper switch on momentarily to the PARK position, then position the arm assembly and adjustment sleeve on the serrated converter shaft so the wiper blade is clearing the windshield centerpost by approximately 1.75 to 2.00 inches during operation.

3. If the arm is not in the proper position, remove the arm and sleeve and rotate it in the direction required to get the proper setting.

— *NOTE* —

The outside teeth on the adjustment sleeve will not locate the arm in the desired position.

4. Install the bolt through the wiper arm into the converter shaft. Tighten and safety with MS20995-C41 lockwire.

WIPER BLADE AND ARM ADJUSTMENT. (Refer to Figure 30-3.)

1. Adjust the wiper blade height on the windshield by unlocking the blade height adjustment cam.
2. Adjust the blade height on the windshield so the bottom of the blade clears the windshield collar by three inches. Lock the adjustment cam.
3. To adjust the wiper blade angle, loosen the nut on the wiper blade attachment stud and rotate the blade until it is parallel with the windshield centerpost, then tighten the nut on the stud.
4. Adjust the wiper arm tension to obtain five pounds tension at the blade pivot point by adjustment of the nut on the wiper arm adjustment stud.

— *NOTE* —

Ascertain that the base of the adjustment stud is in the recess provided in the wiper arm.

PROPELLERS.

DESCRIPTION AND PRINCIPLES OF OPERATION. (Refer to Figure 30-4.)

The Propeller Deicing System consists of an electrically-heated deicer bonded to each propeller blade, a slip ring assembly with a brush block assembly to transfer electrical power to the rotating deicers, a timer, an ammeter, a control switch-circuit breaker, shunt, together with wiring harnesses to complete the circuit. Power is drawn from the aircraft electrical system.

To conserve electrical power, current is cycled to the deicer heaters at timed intervals rather than continuously. Each deicer has two separate heaters; one for the outer half and one for the inner half. By heating all outer or inner heaters on only one propeller at a time, rotational balance is held during deicing.

Current is drawn from the airplane electrical system through the switch, ammeter and timer. The timer successively delivers current via the slip ring and brush block arrangement to (phase 1) the outer heaters on the right propeller, (phase 2) the inner heaters on the same propeller, (phase 3) the outer heaters of the left propeller and (phase 4) the inner heaters on the left propeller. The timer energizes each of these four phases in turn for about 30 seconds and then repeats the cycle as long as the control switch is on. The cycling sequence given is vital so that ouboard heaters on each propeller operate before the inboard heaters. See cycle sequence. (Refer to Figures 30-5 thru 30-8.) The system may be used continuously in flight if needed.

— *NOTE* —

Heating may begin at any phase in the cycle depending on the timer position when the switch was turned off from previous use.

1. Deicers: The deicers contain special heater wires protected by fabric plies and by oil and abrasion-resistant rubber. The side of the deicer cemented to the propeller has a dull finish whereas the air side finish is "glossy." Each deicer has a separate lead for the inboard and outboard heater and a third lead which is a common ground. These leads are so marked. An unmarked ground can be identified by using an ohmmeter across the three possible pairs of leads. One pair will show twice the resistance of the other pairs. The later are the "hot" leads and the lead excluded from the pair that shows twice the resistance of the other pairs is the ground lead. All deicers used on this airplane must be of the new design, which includes a grey plastic patch where deicer and strap join.

2. Slip Rings, Brushes and Brush Blocks: To transfer electrical power to the rotating deicers, a brush block assembly is mounted to the engine or similar stationary member and has brushes which are spring-loaded to press against the revolving slip rings. The slip ring assembly is provided as a slip ring gear assembly which replaces the original starter ring gear of the engine.

3. Timer: The timer is a sealed unit. If found inoperative, it must be replaced as an assembly - no field repairs are authorized. For timer function, refer to information given in this chapter.

4. Ammeter: This ammeter is designed for each particular system and it is therefore important that the correct replacement part number be used if replacement should be required. In the event of low aircraft battery voltage (very possible in ground checks), the ammeter readings will be lower than at full voltage. Provided the ammeter needle reads in the shaded range on the scale, (full aircraft voltage) current flow is considered as normal.

5. Switch: The switch-circuit breaker is mounted in the switch and circuit breaker control panel.

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CHART 3004. TROUBLESHOOTING
(PROPELLER DEICER SYSTEM)

Trouble	Cause	Remedy
Ammeter shows zero current. (All 4 phases of the 2 minute cycle.)	Tripped circuit breaker switch.	Locate and correct short before setting circuit breaker.
	No power from airplane.	If no voltage into switch, locate and correct open.
	Circuit breaker switch faulty.	If no voltage at switch output with voltage at switch input, replace the switch. If voltage is satisfactory at switch output, go to next step.
	Ammeter faulty. (If some or all deicers heat with ammeter at zero, replace the ammeter.)	Test for voltage up to and out of ammeter. If low or zero output and input satisfactory, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter.
	Open ammeter to timer.	Disconnect harness at timer and check voltage at Pin B (of harness) to ground. If none, locate and correct open.
Ammeter shows normal current part of cycle, zero current rest of cycle.	Open in wiring between timer and brush block assembly.	Use heat test to find deicers not heating and test for voltage on that contact of wire harness. plug. (At brush block assembly.) If zero over 2 minutes, locate and fix open in wiring from timer to wire harness plug.

CHART 3004. TROUBLESHOOTING
(PROPELLER DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Ammeter shows normal current part of cycle, zero current rest of cycle. (cont.)	Open between brush block assembly and deicer lead straps.	If there is voltage to brush block wire harness plug, try voltage at junction of deicer lead and slip ring lead. If no voltage, find and correct open in wiring within brush block or no contact of brush to slip ring.
	No ground circuit, one engine.	If voltage is found at deicer leads, locate and fix open from deicer to ground.
Ammeter shows normal current part of cycle, low current rest of cycle.	Inner and outer deicers heating same phase.	Locate and repair incorrect connections.
	Open in deicer or slip ring leads.	Disconnect deicer straps to check heater resistance. If satisfactory, locate and fix open in slip ring leads.
	High resistance in circuit with low current.	If not in contact of brush to slip ring (including ground brush), trace wiring to deicer and to timer to fix partially broken wire, loose or corroded connection.
Ammeter shows low current over entire cycle.	Aircraft voltage low.	Check voltage into switch.

CHART 3004. TROUBLESHOOTING
(PROPELLER DICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Ammeter shows low current over entire cycle. (cont.)	Ammeter faulty.	Test for voltage up to and out of ammeter. If low or zero output and input satisfactory, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter.
	High resistance up to timer.	Check for partially broken wire, loose or corroded connection in wiring from aircraft supply to timer input.
Ammeter shows excess current over entire cycle.	Ammeter faulty.	Test for voltage up to and out of ammeter. If low or zero output and input satisfactory, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter.
	Ground between ammeter and timer.	Disconnect harness at timer and with ohmmeter check from Pin B (of harness) to ground. If ground is indicated, locate and correct.
Ammeter shows normal current part of cycle, excess current rest of cycle.	Ground between timer and brush block.	Disconnect leads at brush block and, with ohmmeter, check from power leads to ground. If ground is indicated, locate and correct.
	Ground between brush block and deicers. (Excluding ground brush circuit.)	If no short exists at brush-slip ring contact, check for ground from slip ring lead to propeller assembly while flexing slip ring and deicer leads. If a ground is indicated, locate and correct.

CHART 3004. TROUBLESHOOTING
(PROPELLER DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Ammeter shows normal current part of cycle, excess current rest of cycle. (cont.)	Short between two adjacent circuits.	Check for cuts or low resistance between circuits. If any, locate and correct.
	Timer faulty.	Test timer.
Ammeter does not "flick" approximately every 30 seconds.	Timer ground open.	Disconnect harness at timer and check with ohmmeter from Pin G (of harness) to ground. If no circuit, fix open per schematic diagram.
	Timer contacts are welded (caused by short circuit in system.)	Test timer. If timer does not cycle with voltage at Pin B, replace timer but be sure short causing original failure has been located and corrected.
Ammeter flicks between 30 second phase periods.	Loose connection between aircraft power supply and timer input.	If trouble occurs over entire cycle, trace wiring from power source to timer input to locate and tighten loose connection.
	Loose or poor connection timer to deicers.	If trouble occurs in part of cycle, find which deicers are affected and check for rough or dirty slip rings causing brush to "skip". If not this, trace circuits to locate and fix loose or poor connection. (If all deicers on one propeller are affected, check the ground circuit.) Flex deicer straps for break in deicer straps.
	Timer cycles erratically.	Test timer.

CHART 3004. TROUBLESHOOTING
(PROPELLER DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Radio noise or interference with deicers on.	Brushes "arcing".	Check brush alignment. Look for rough or dirty slip rings. If this is the cause, clean machine or replace slip ring assembly as required. Check slip ring alignment.
	Loose connection.	Refer to "Ammeter flicks between 30 second phase periods.
	Switch faulty.	Try jumper wire across switch - if radio noise disappears, replace the switch.
	Wiring located within 8 inches of radio equipment wiring.	Relocate at least 8 inches away from input wiring to radio equipment.
Cycling sequence not correct.	Crossed connections.	Check system wiring circuit diagram for improper connections.
Rapid brush wear or frequent breakage.	Brush block out of alignment.	Check brush alignment.
	Slip ring wobbles.	Check slip ring alignment with dial indicator.

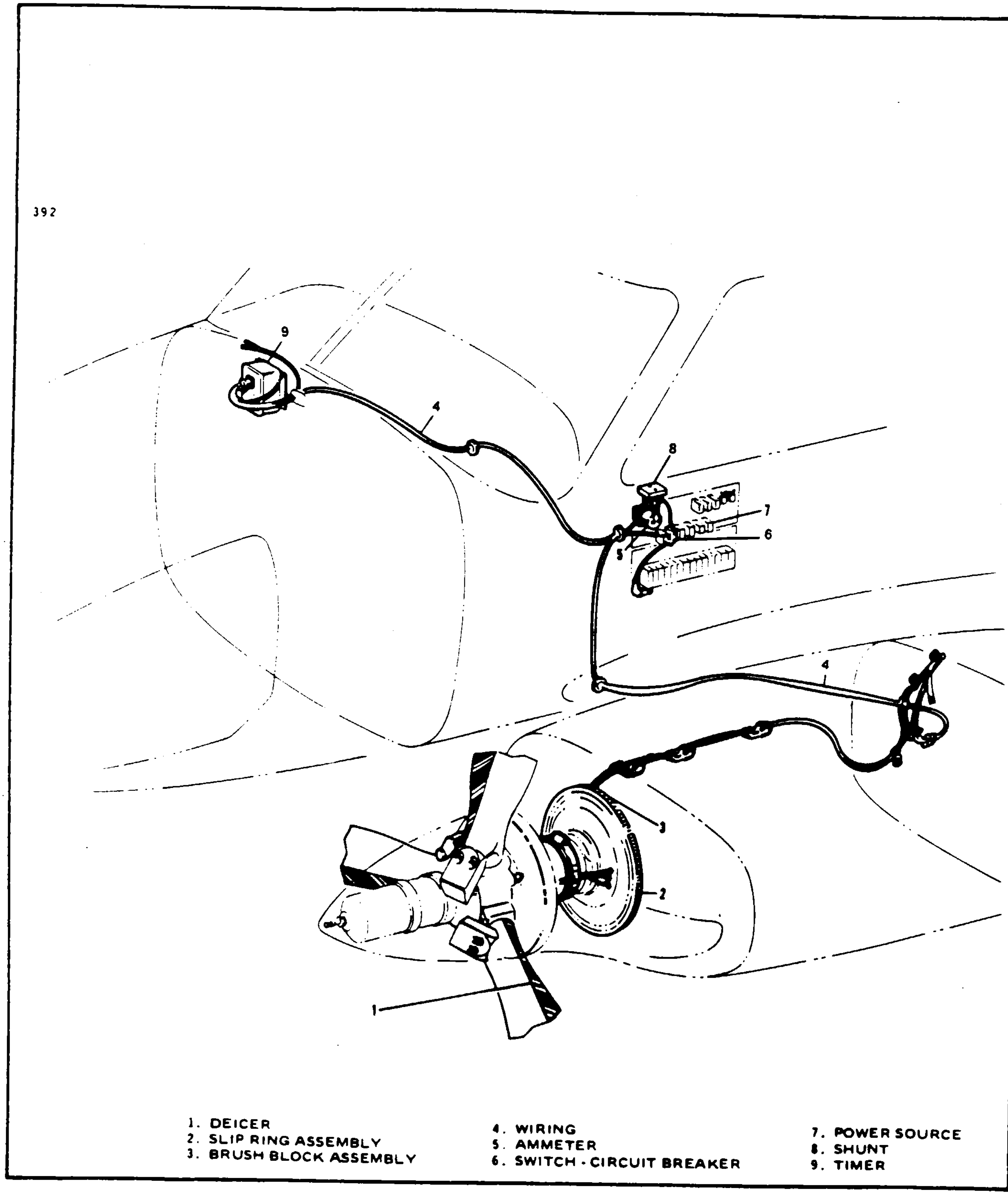

Figure 30-4. Electric Propeller Deicer Installation

MAINTENANCE PRACTICES.

DEICER SYSTEM OPERATIONAL CHECK.

1. Lock the brakes and operate the engine at near take-off power.
2. Turn deicer system switch ON and observe deicer ammeter for at least two minutes.
3. The ammeter needle must "flicker" approximately every 30 seconds as the step switch of the timer operates.
4. With engines stopped, turn deicer switch ON and feel deicers on propellers for proper sequence of heater operation.
5. The starting point is not important but the sequence is vital and must be: Right Outboard, Right Inboard, Left Outboard, Left Inboard Heaters, in that order.
6. Temperature rise should be noticeable and each heater should warm for about 30 seconds.
7. Local hot spots indicate surface damage requiring replacement of De-Icer.

USING THE AMMETER.

Whether in flight or during ground testing, the ammeter can be used to indicate the general nature of most electrical problems. The troubleshooting chart is primarily based on this use of the ammeter and assumes that the user does understand all normal operating modes of the system as given in Principles of Operation.

— NOTE —

When troubleshooting, first use the "ammeter test" and "heat test" to determine which circuits are involved. Use circuit diagram for assistance to check voltages or continuity.

HELPFUL TIPS.

1. If the ammeter reading drops to one third normal current, this indicates that one heater circuit is open or possible improper connections are allowing both inboard and outboard units to heat at the same time.
2. Excess current reading on the ammeter always indicates a power lead is shorted to ground. Thus, when trouble of this nature is found it is vital that the grounded power lead be located and corrected.
3. A considerable number of timers that have been returned for repair proved to be fully workable when tested. Accomplish the test described in "Timer Test" before concluding that the timer is defective.

50 HOUR INSPECTION.

1. Lock brakes and operate engines at near take-off power. Turn deicer system switch ON and observe deicer ammeter for at least two minutes. Ammeter needle must rest within the shaded band except for a "flicker", approximately every 30 seconds, as the step switch of the timer operates. If not, refer to the appropriate entry of the troubleshooting chart.

2. With engines stopped, turn deicer switch ON and feel deicers on propellers for proper sequence of heater operation. The starting point is not important but sequence is vital and must be: Right Outboard, Right Inboard, Left Outboard and Left Inboard Heaters, in that order. Temperature rise should be noticeable and each heater should warm for about 30 seconds. Local hot spots indicate surface damage requiring replacement of De-Icer.

3. Remove spinner dome and open access doors as required. With assistant observing deicer ammeter and with deicer switch ON, flex all accessible wiring - particularly the deicer lead straps, leads from slip ring assembly and the fire wall electrical connectors and their wiring. Any movement of the ammeter needle other than the "30 second flicker" of cycling - indicates a short or open that must be located and corrected.

100 HOUR INSPECTION.

1. Remove cowling in accordance with Removal of Engine Cowling, Chapter 71.
2. Conduct 50 hour inspection.
3. Check for radio noise or radio compass interference by operating the engine at near take-off power and with radio gear ON while turning deicer switch ON and OFF. If noise or interference occurs with deicer switch ON, and disappears when switch is OFF, see troubleshooting chart.
4. Ascertain that all clamps, clips, mountings and electrical connections are tight. Check for loose, broken or missing safety wire.
5. Deicers: Closely check deicers for wrinkled, loose or torn areas, particularly around the outboard end and where strap passes under the strap retainer. Look for abrasion or cuts, especially along the leading edge and the flat or thrust face. If heater wires are exposed in damaged areas or if rubber is found to be tacky, swollen or deteriorated (as from oil or solvent contact), replace the damaged deicer.

— NOTE —

Check that strap restrainers are correctly located and secure. Look for cracks or other damage. Operate propeller from "full pitch" to "feathering" and check that deicer lead straps do not come under tension, or are pinched by propeller blade.

6. Slip Rings: Check slip rings for gouges, roughened surface, cracks, burned or discolored areas and for deposits of oil, grease or dirt.
   A. Clean greasy or contaminated slip rings with CRC 2-26 solvent. (This solvent is available from CRC Chemical Division Webb Inc., CJ10 Limekiln Pike, Dresher, PA. 19025.)
   B. If uneven wear is found or if wobble is noticed, set up dial indicator as shown in Figure 30-9 to check alignment of slip rings to propeller shaft.
7. Brush Block - Brushes: Examine mounting brackets and housing for cracks, deformation or other physical damage.
   A. Test that each brush rides fully on its slip ring over 360°. Figure 30-10 shows wear pattern if this condition is not corrected. If alignment is off, shim where brush block bracket attaches to engine back bone or pivot at support arm which is attached to generator idler pulley bracket.
   B. Check for proper clearance of brush block to slip rings as shown in Figure 30-13. If not correct, loosen mounting screws and move in elongated holes to correct block position before tightening securely.
   C. Visually check brush block for approximately 2° angle of attack. (Refer to Figure 30-13.) If not, loosen mounting screws and twist block, but be sure to hold clearance limits shown when tightening.

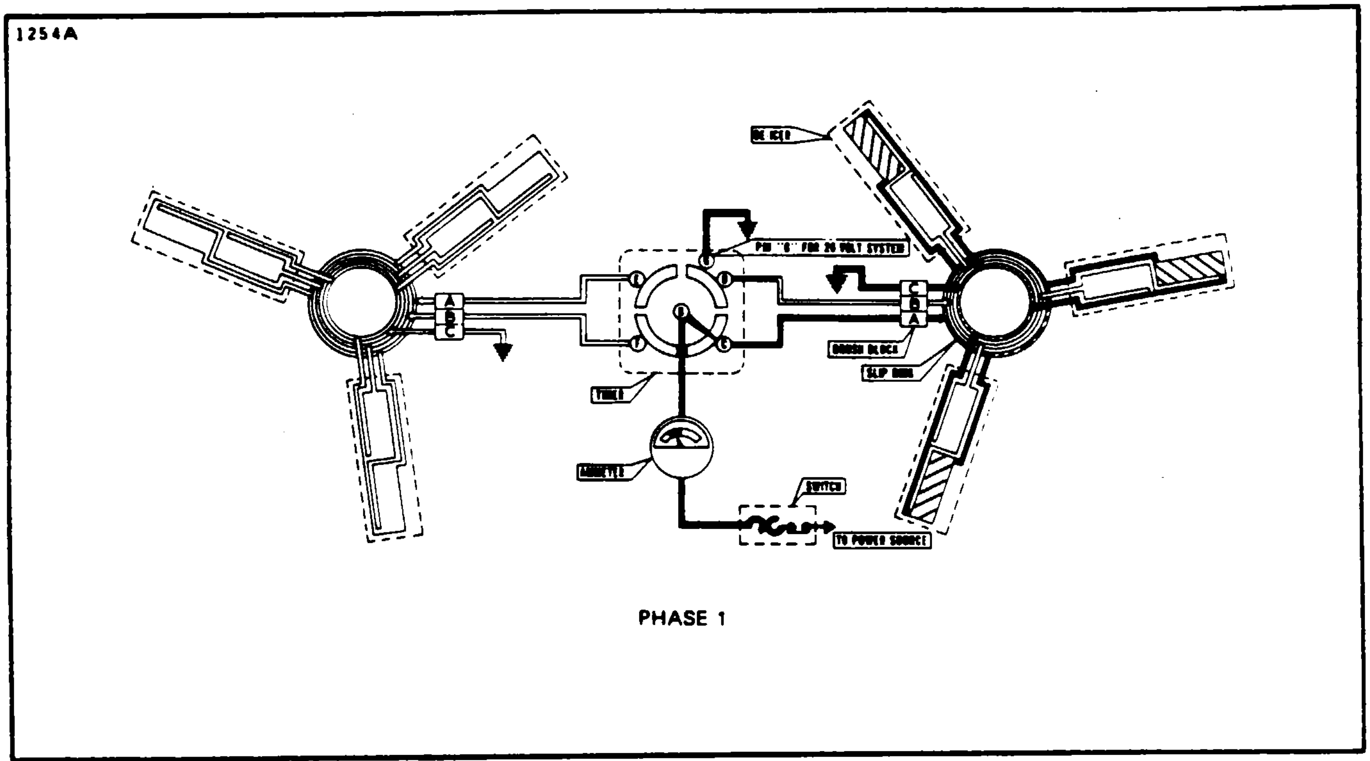

Figure 30-5. Electrical Diagram Showing Cycle Sequence - Phase I

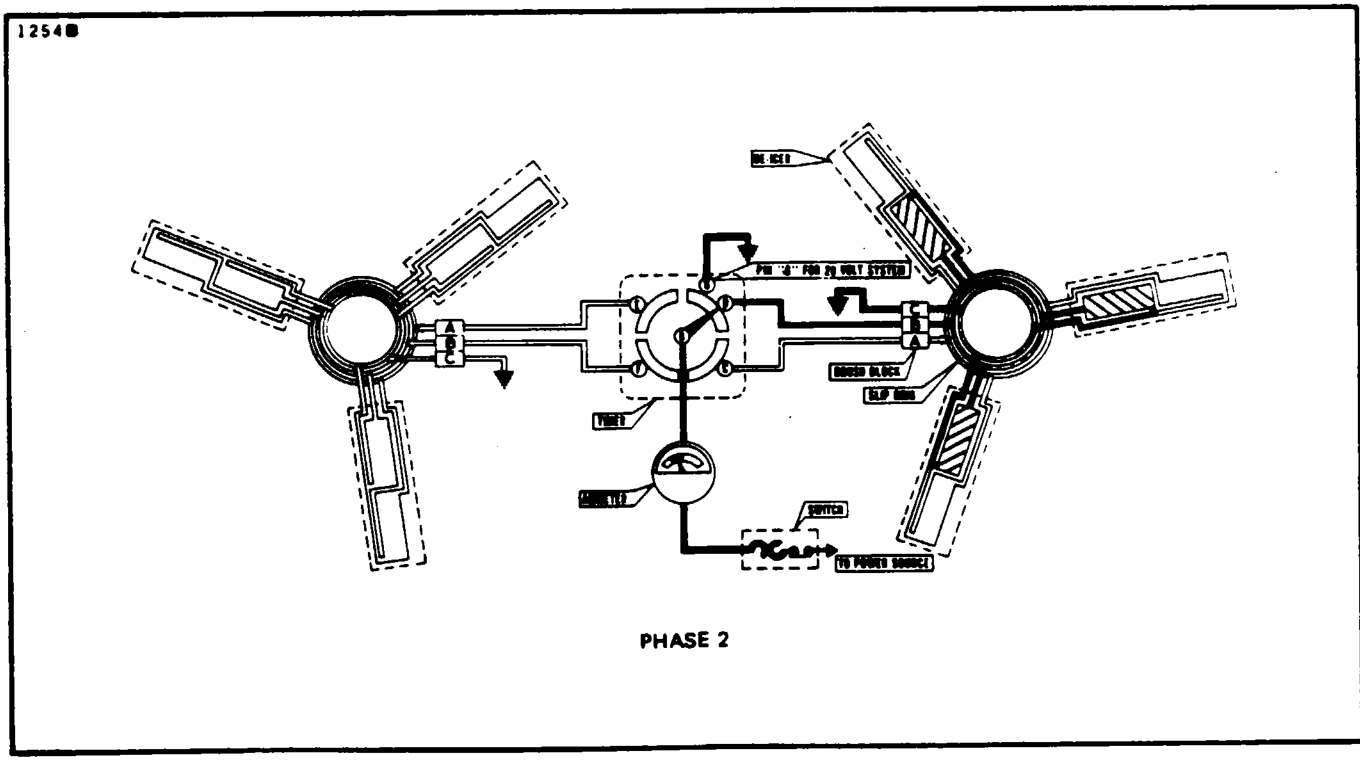

Figure 30-6. Electrical Diagram Showing Cycle Sequence - Phase II

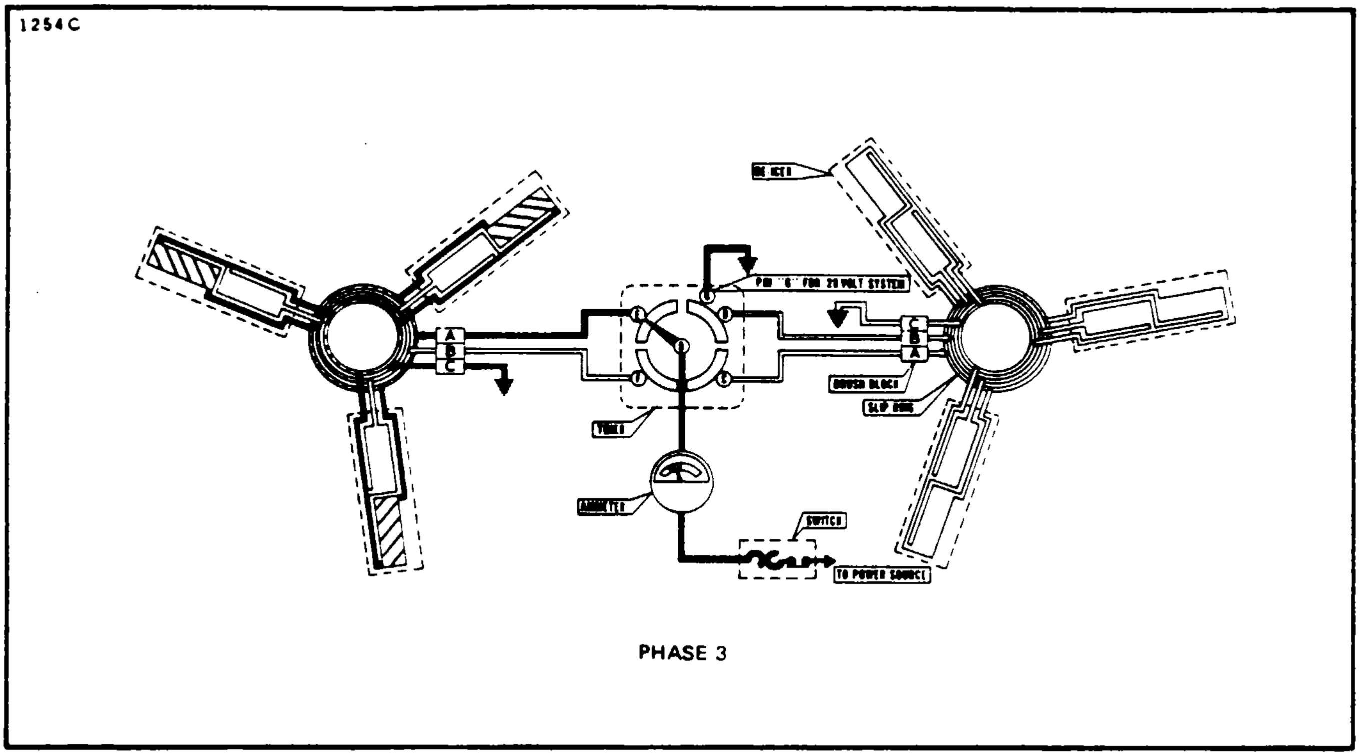

Figure 30-7. Electrical Diagram Showing Cycle Sequence - Phase III

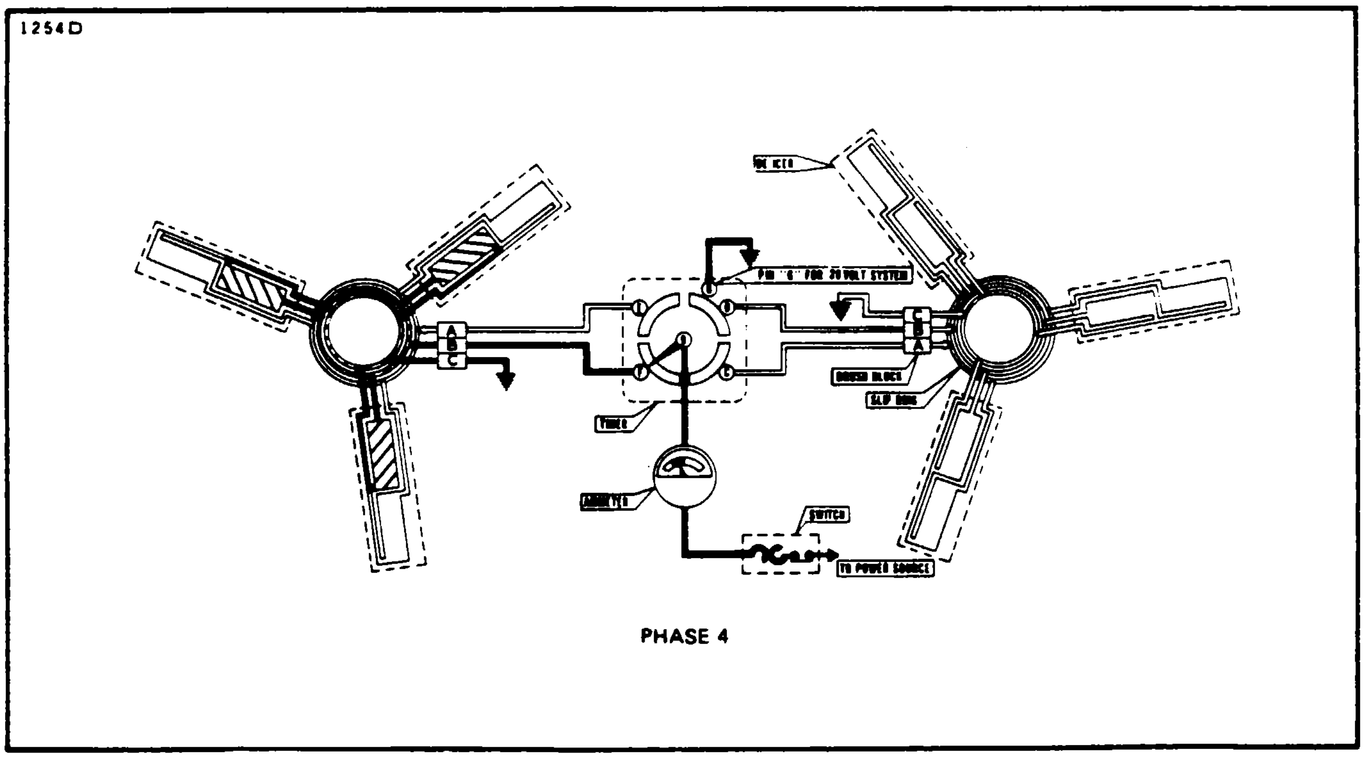

Figure 30-8. Electrical diagram Showing Cycle Sequence - Phase IV

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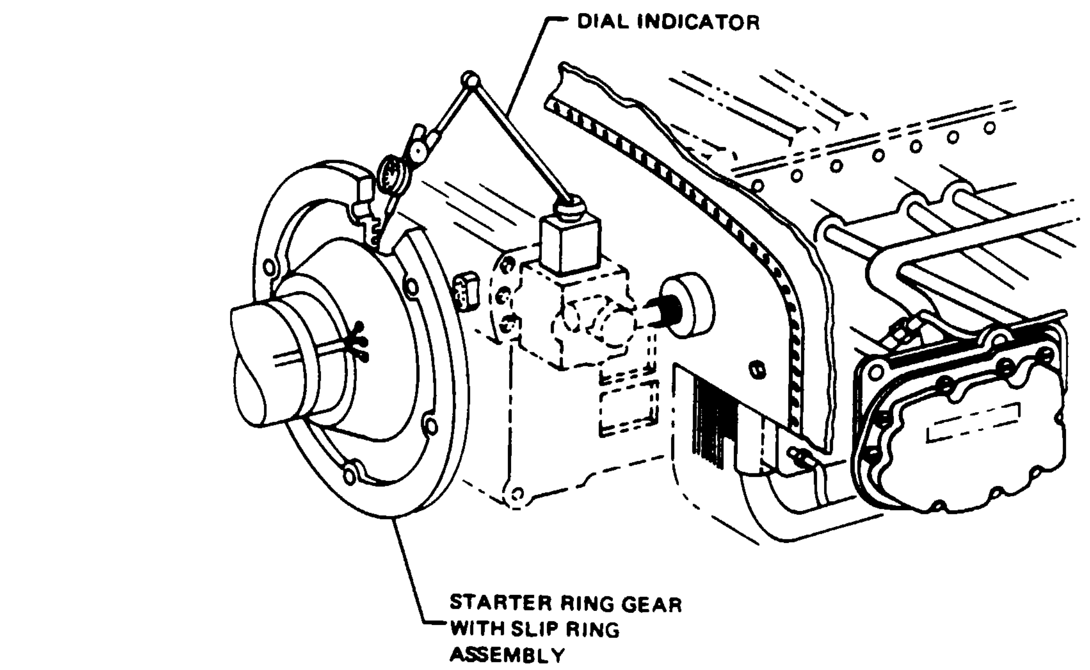

Figure 30-9. Typical Use of Dial Indicator

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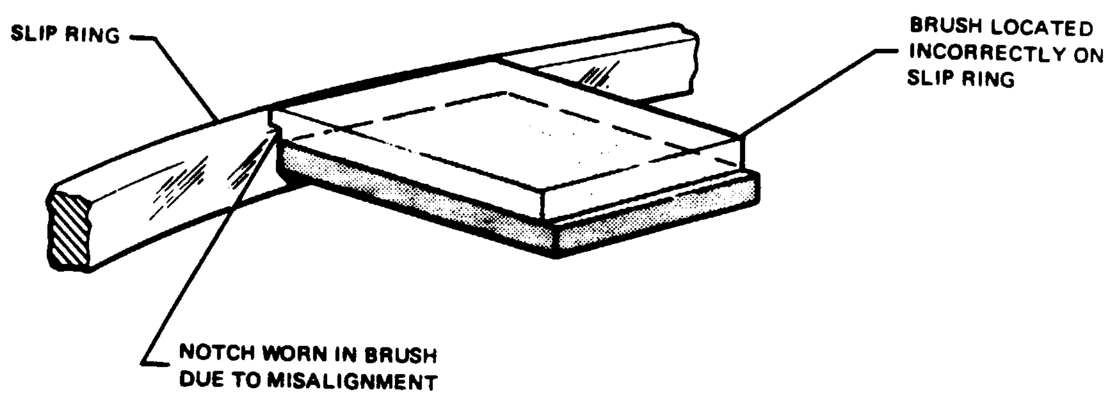

Figure 30-10. Centering of Brushes on Slip Rings

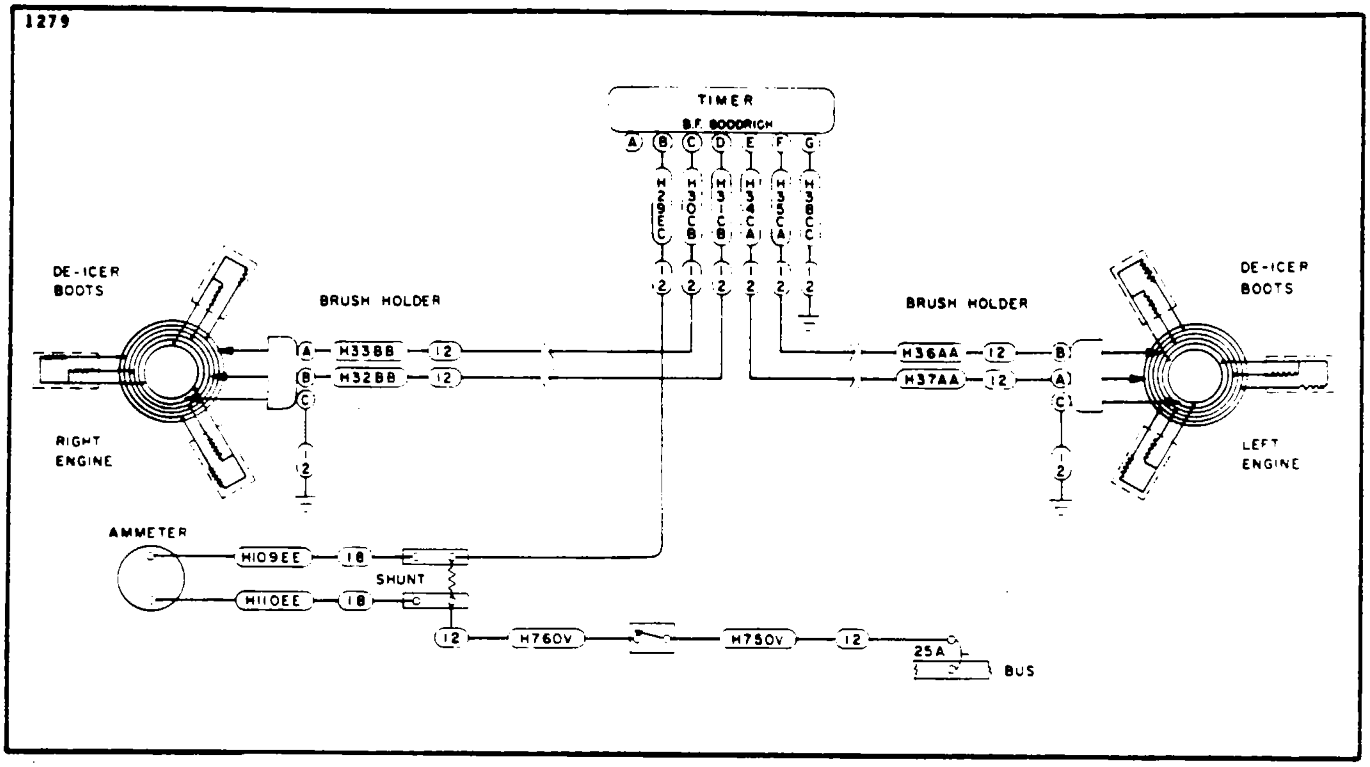

Figure 30-11. Wiring Schematic, Electric Propeller Deicing System

8. System Wiring: With deicer system operating, have assistant observe ammeter while visually inspecting and physically flexing wiring from brush blocks through fire wall, to timer, to ammeter, to switch and to aircraft power supply. The ammeter will flicker as the timer switches approximately every 30 seconds in the cycle. Jumps or flickers at other times indicates loose or broken wiring in the area under examination at that moment. In such case, check continuity through affected harness, while flexing and prodding each wire in the area that gave initial indication of trouble. Use the wiring diagram in Figure 30-11 to trace circuitry.

BRUSHES/BRUSH BLOCK.

CHECKING FOR BRUSH WEAR.

Insert small diameter wire through hole in rear of brush retainer assembly. (Refer to Figure 30-12.) Replace brushes if the length of the inserted portion of wire measures more than 1.562 inches.

REPLACEMENT OF BRUSHES.

1. Disconnect leads from terminals on brush retainer assembly.
2. Remove brush retainer assembly from mounting bracket by removing attaching screws.

3. Separate brush retainer assembly by the following procedure: (Refer to Figure 30-12.)
   A. Remove terminal block by removing the four attaching screws.
   B. Move the guide block laterally to disengage the dowel pins from retainer block.
   C. Heat terminal stud to melt solder in order to remove brush leads from stud.
4. Reassemble brush retainer assembly by the following procedure:
   A. Install insulation on "A" & "B" brush leads.
   B. Solder brush leads to terminal stud.

— NOTE —

New springs should always be used when replacing brushes.

C. Position brushes and spring into guide block and engage the guide block onto the dowel pins on the retainer block.
D. Position terminal block on brush retainer, assembly with four attaching screws.

5. Position brush retainer assembly on mounting bracket and secure with attaching screws.

— CAUTION —

Side loads on brushes should be avoided to prevent brush damage.

6. Attach electrical lead to terminal studs making certain the lead is connected to proper stud.
7. Check for free movement of brushes by pushing the brushes back into the block and allowing the spring pressure to return them. DO NOT SNAP. If free movement is impaired, correct the restriction and recheck.
8. Reinstall the brush block to the mounting bracket utilizing the hardware removed.

— NOTE —

New deicer brushes must be run in a minimum of two hours of engine operation prior to energizing the deicer boots. Brushes should be checked for proper seating and alignment after the run in period.

ALIGNMENT OF NEW BRUSHES.

Any time the brush block is dismounted, the alignment of reinstallation must be checked.

— NOTE —

New deicer brushes must be run in a minimum of two hours of engine operation prior to energizing the deicer boots. Brushes should be checked for proper seating and alignment after the run in period.

REPLACEMENT OF BRUSH BLOCK MODULAR BRUSH ASSEMBLIES.

Modular brush block assembly, P/N 3E2044-1, is a direct replacement for brush block assembly, P/N 4E1311-2. Instructions concerning replacement of brush block assemblies with modular brush assemblies are given in B.F. Goodrich Service Bulletin E-77-54.

BRUSH MODULE REPLACEMENT.

Brush modules must be replaced when .265 inch of brush material remains. Measure the brushes as shown in Figure 30-12. Replace brush modules as follows:

— NOTE —

Brushes are not offered individually as replacements. When a brush wears out, the module containing it should be replaced.

1. Remove the modular brush assembly from the aircraft by removing the attachment hardware and disconnecting the engine wire harness.
2. Remove assembly screws and separate modules and spacers.

— NOTE —

The part number of each module is etched into the surface of the plastic housing. Replace with the same part number module.

3. Restack modules and spacers as shown in Figure 30-16. If there is interference between adjacent ring terminals, reorient center module as shown in Figure 30-15.

— NOTE —

Ascertain that flat washer is positioned between star washer and housing.

4. Reconnect aircraft wire harness and ensure adjacent ring terminals are not touching.
5. Install assembly on the aircraft and check adjustments.

SLIP RINGS.

MACHINING OF SLIP RINGS.

Slip rings with roughened or damaged surfaces can be machined to restore to serviceability. Remove the starter ring gear assembly from the aircraft to mount it in a lathe, located concentrically in the lathe and with not over 0.002 wobble or run-out over 360° rotation with respect to mounting surface of starter gear/slip ring assembly. Take light cut for smooth finish and cut no deeper than required to remove surface damage. Contact surfaces of the three slip rings must be parallel within 0.005 inch and flat within 0.005 inch overall - deviation from flat not to exceed 0.002 inch over a 4 inch arc. If necessary, undercut insulation between slip rings to a depth of .030 inch below the contact surface of the slip rings. In this operation, width of slip ring must not be reduced more than .005 inch. Contact surface of slip rings must have a finish of 29-35 micro inches. De-burr slip ring edges and reinstall on airplane.

— NOTE —

If in machining, the solder or braze connection on the underside of the slip ring is exposed, replacement of the ring gear assembly will be necessary.

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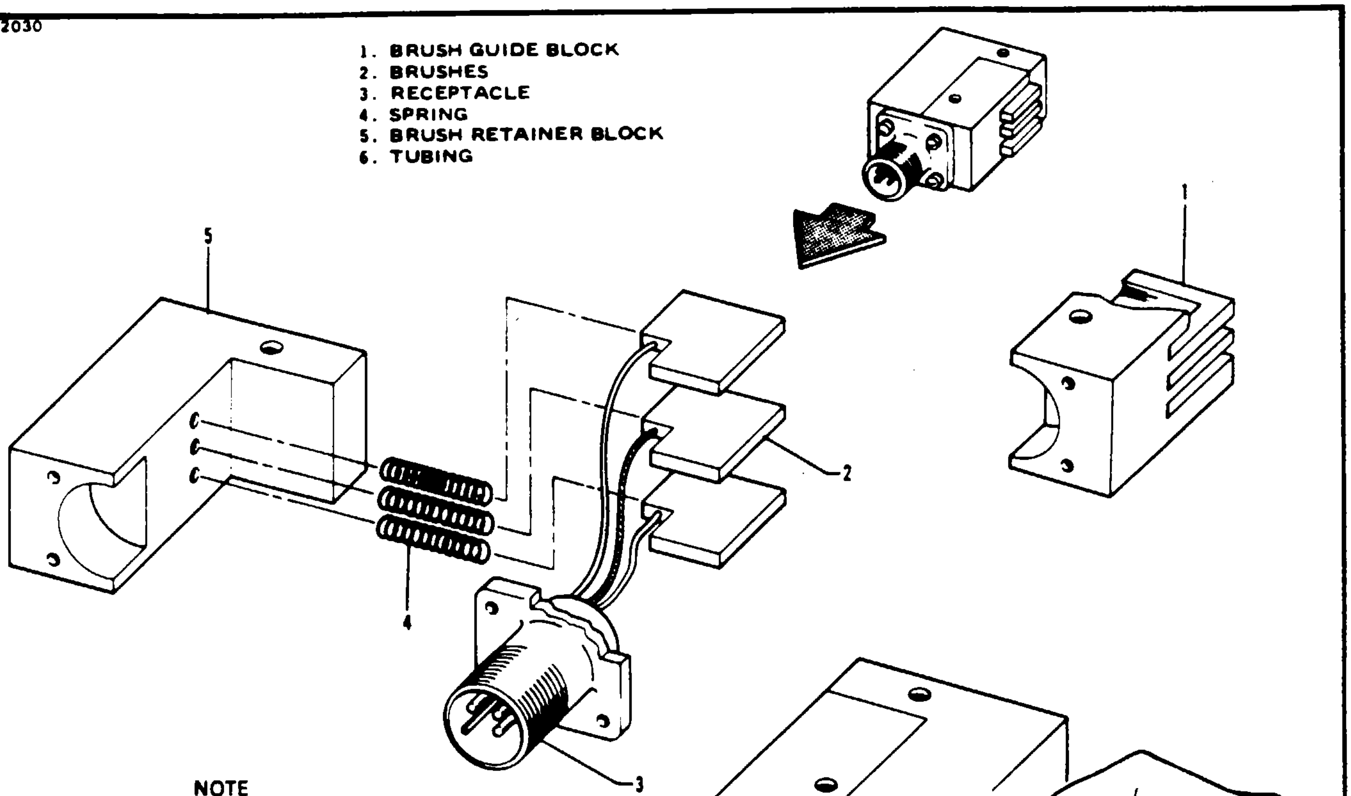
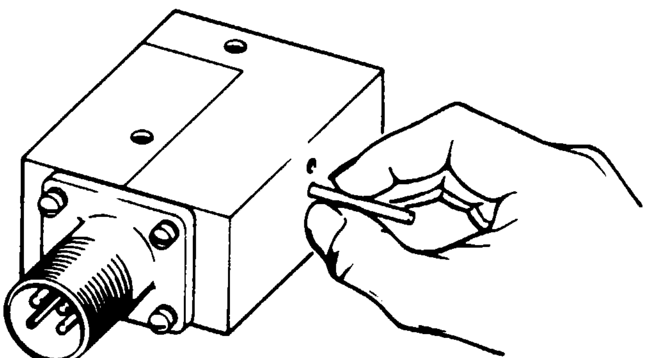
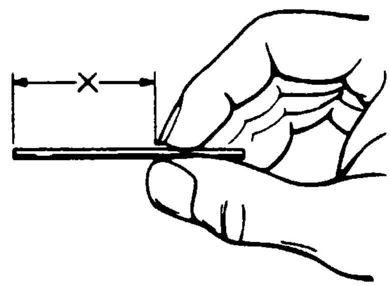
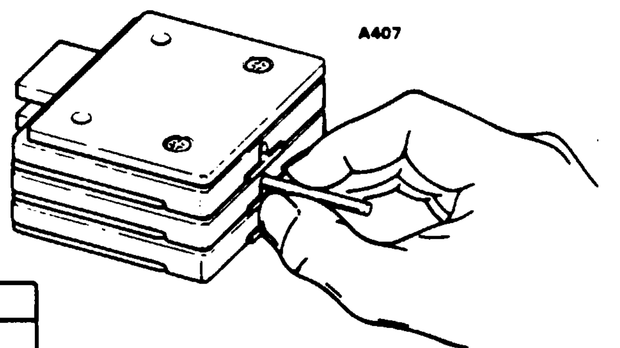




MEASURING BRUSH WEAR

NOTE
MEASURE BRUSH WEAR AS SHOWN, X-DIMENSION (INCHES) GIVEN INDICATES WHEN BRUSHES MUST BE REPLACED. DURING MEASUREMENT ONLY 1/16 INCH OF BRUSH SHOULD BE ALLOWED TO PROTRUDE FROM BRUSH BLOCK. THIS IS THE NORMAL POSITION OF THE BRUSH WHEN INSTALLED ON THE AIRCRAFT.





BRUSH BLOCK ASSEMBLY	X DIMENSION (INCHES) MUST REPLACE
4E1311-2	1 9/16
3E2044-1	
BRUSHES WITH RODS	17/64
BRUSHES WITHOUT RODS	1 7/64

Figure 30-12. Brush Block Assmelby and Brush Wear Check

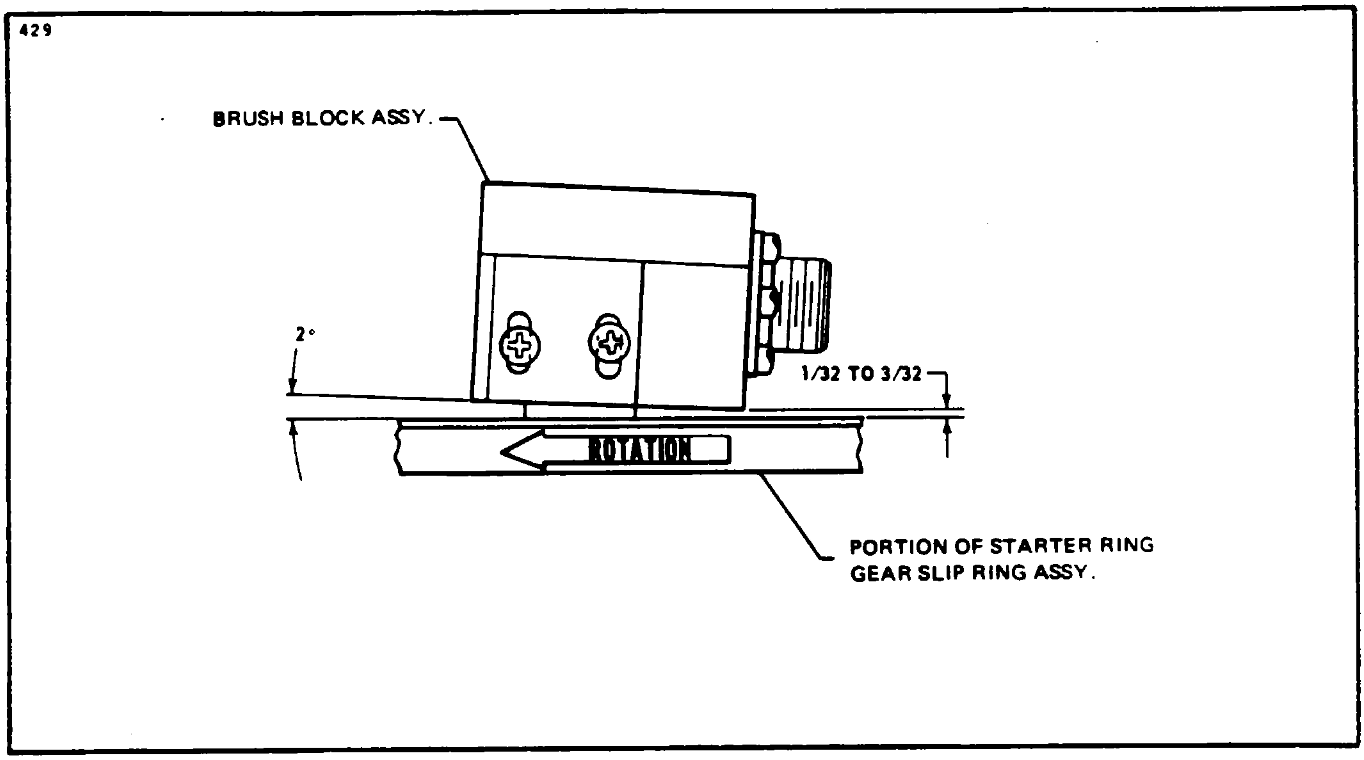


Figure 30-13. Angle of Contact Brushes to Slip Rings

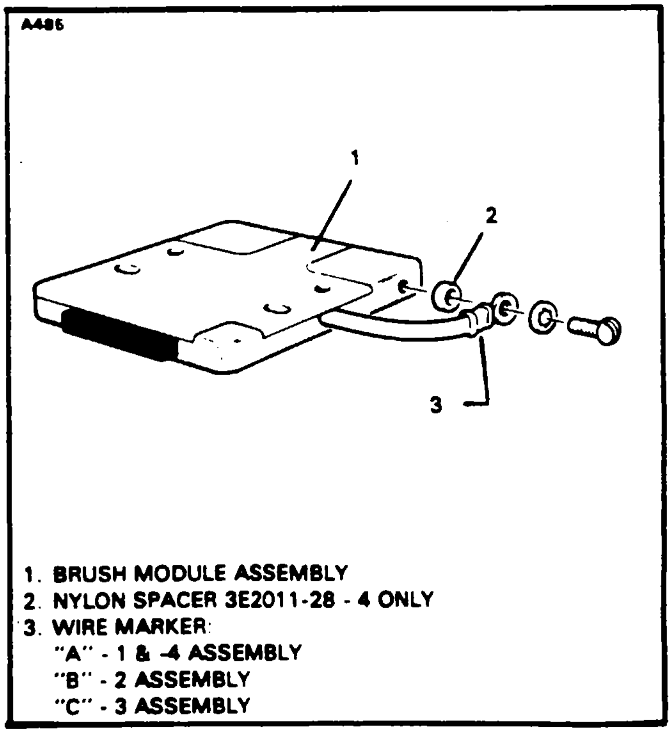


Figure 30-14. Brush Module Assembly (3E2011)

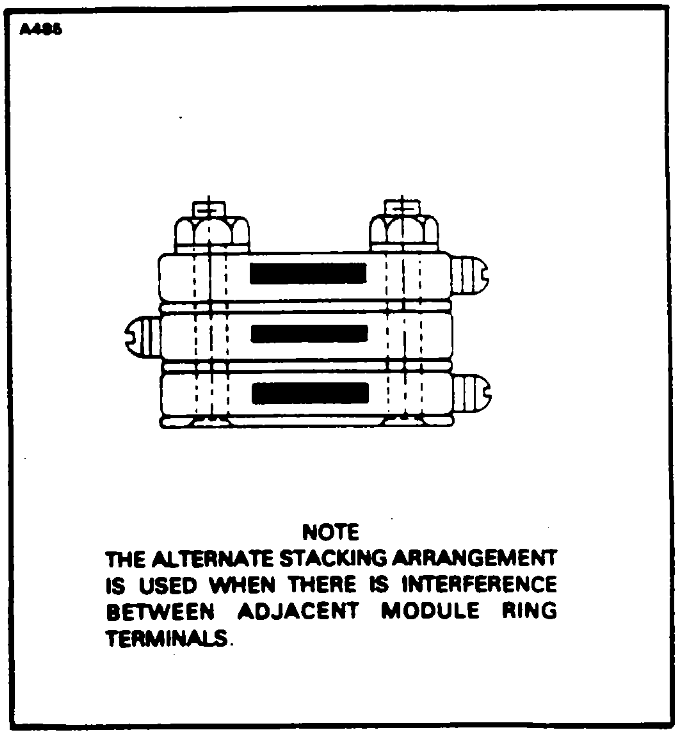


Figure 30-15. Alternate Module Stacking Arrangement

1. BRUSH MODULE ASSEMBLY 3E2011-1
2. BRUSH MODULE ASSEMBLY 3E2011-2
3. BRUSH MODULE ASSEMBLY 3E2011-3
4. SPACER
5. SCREW
6. WASHER
7. LOCK WASHER
8. NUT

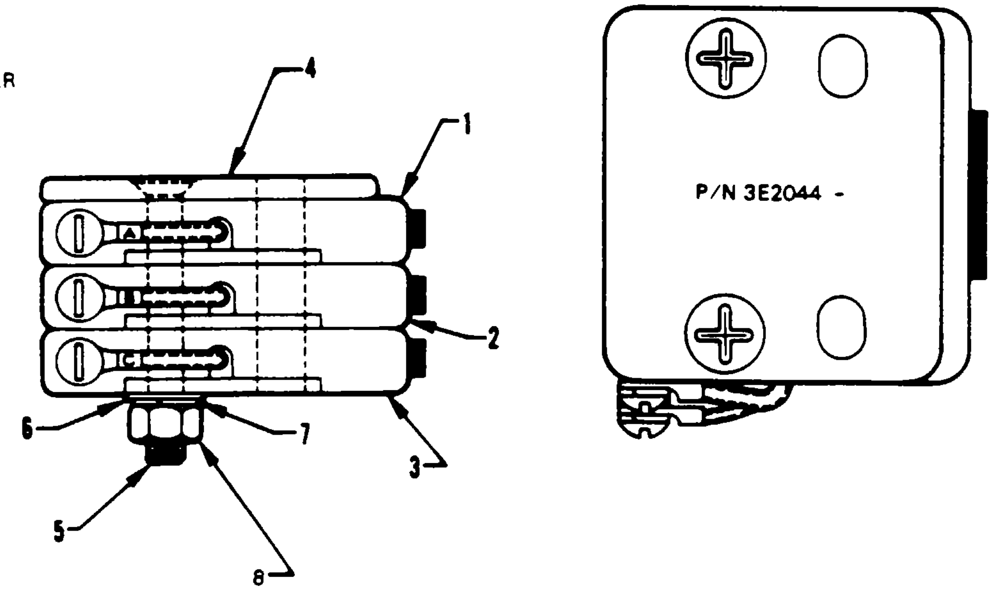


Figure 30-16. Modular Brush Assembly (3E2044-1)

REPLACEMENT OF SLIP RINGS.

Starter ring assemblies that are open or shorted electrically, cracked or damaged structurally, or which have damaged surfaces beyond the scope of minor repair to clean up, should be replaced with a new starter ring assembly.

DEICER BOOTS.

RESISTANCE CHECK OF DEICER BOOTS.

To determine incorrect resistance, short or open at the brush-to-slip ring contact, disconnect harness at the timer and use low-range ohmmeter to read resistance from each deicer circuit lead (pins C, D, E and F of harness plug) to ground; it should read 1.55 to 1.78. If this reading is not obtained, disconnect the deicer lead straps to measure heater resistances individually. Individual heater should be 4.58 to 5.26. If first check is off limits but second check is satisfactory, trouble is probably in the brush-to-slip ring area; if the second check is off limits, the deicer is damaged and must be replaced.

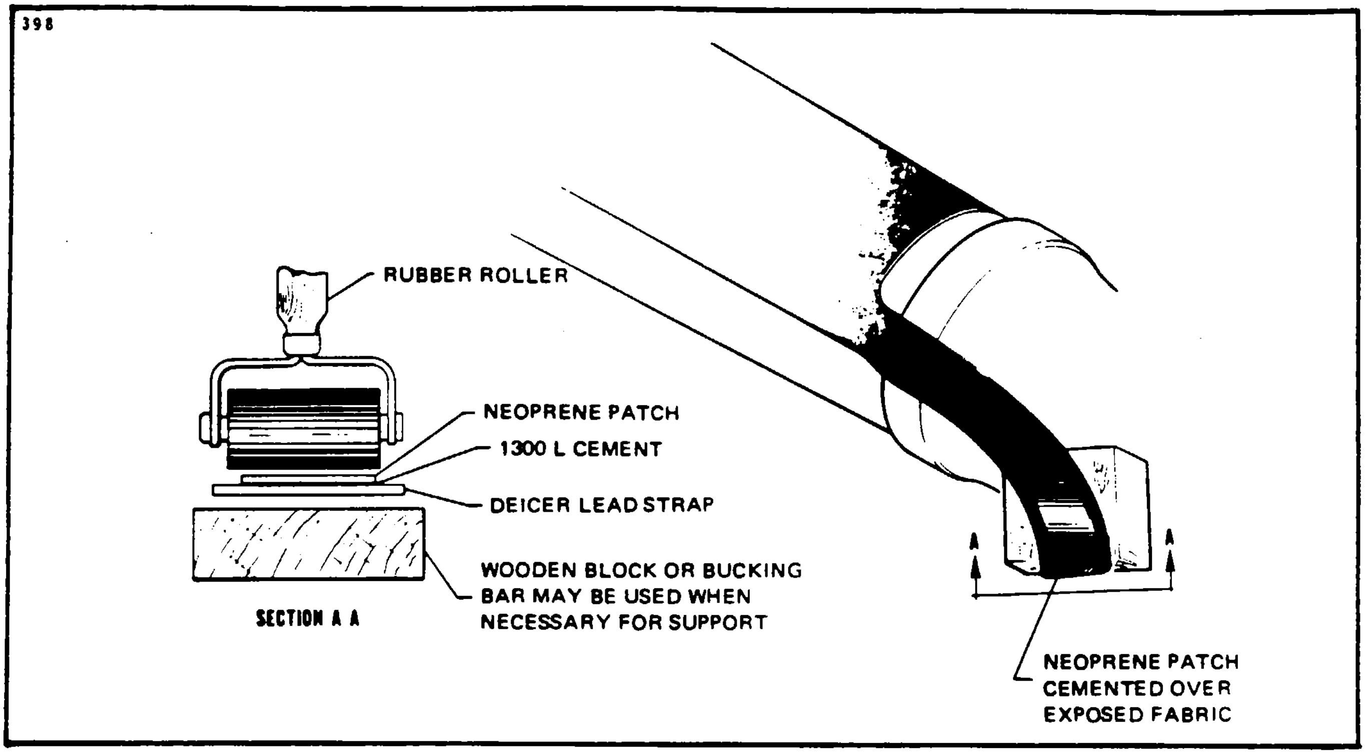


Figure 30-17. Repair of Lead Strap

REPLACEMENT OF DEICER BOOTS.

If tests show the blade deicer to have an open circuit, to be the wrong resistance or to be visibly damaged beyond repair, replace the deicer boot.

REPAIR OF PROPELLER DEICER LEAD STRAP. (Refer to Figure 30-17.)

Use B.F. Goodrich Field Repair Kit No. 77-802 which contains rubber patch material sufficient for several repair jobs. Cements and solvents specified in these directions are not included in this kit. (The abbreviation "MEK" in further steps stands for Methylethylketone.) The following steps apply wherever "cementing" is specified in the text.:

1. Clean the area to be bonded or patched with MEK or acetone to remove all grease and dirt. It is vital that surface be clean for good cementing job. After last wipe with cleaner, quickly wipe surface with a clean dry lint-free cloth to remove solvent film.
2. Apply one even coat of 1300L cement (Minnesota Mining and Mfg. Co.) to area to be bonded or patched and allow to dry (approximately one hour above 40° F). Apply second even coat of 1300L cement and allow to dry.
3. Cut the patch (.020 thick rubber to about 1/4 inch large on all sides of the damaged area). The protective paper is on the side to be cemented. Apply masking tape on the open side to prevent the patch from curling as cement dries than strip off protective paper and apply 1300L cement in a smooth even coat. Allow to air dry. After one hour, apply second coat and allow to air dry.

4. With cemented surfaces either dry or with just a trace of "tackiness," apply light coat of MEK or Toluol over these surfaces to "re-tackify" and quickly complete the cementing job as directed. Allow one hour to air dry before peeling off the masking tape or mylar coating on the air side. Rub edges and center of patch to see that it is holding before releasing for flight. (Approximately 24 hours.)

— NOTE —

Do not touch cemented surface with dirty or oily fingers.

REMOVAL OF DEICER.

1. Disconnect terminals of propeller deicer from studs on the spinner bulkhead.
2. Use MEK or Toluol to soften the adhesion line between the deicer and the propeller blade.
3. Starting at one corner of the deicer, loosen enough of the deicer to grasp in the jaws of a vise grip pliers or similar tool.
4. Apply a steady pull on the deicer to pull it off the propeller surface. Continue using MEK or Toluol to soften the adhesion lines. Unless the deicer being removed is damaged and is to be scrapped, cushion the jaws of any pulling tool used to prevent damage to the deicer suface. Remove very slowly and carefully. If deicer has failed and is to be returned under request for warranty, extreme care should be exercised so that no additional damage is incurred to the deicer during and after removal.
5. Remove residual cement from blade. Use Turco No. 3 or equivalent to help with dried cements.

PREPARATION OF SURFACE PRIOR TO INSTALLATION OF DEICER.

1. Mark and cut from masking tape a pattern the size of the propeller deicer including the first inch of the lead strap. (Refer to Figure 30-18.)
2. Place a mark at the hub end of the blade in line with the blade leading edge. The location for this mark can be determined by sighting along the leading edge. Starting at the hub (see NOTE below), center the pattern on this mark and stick the pattern to the leading edge. Mark the position of the deicer lead strap where it crosses the hub.

— NOTE —

All deicers on a single propeller must be located the same distance from the hub for rotational balance.

3. Remove the pattern and remove any paint in the marked off area. Clean down to bare metal. Next, clean the area thoroughly with MEK or acetone. For final cleaning, wipe the solvent off quickly with a clean dry lint-free cloth to avoid leaving a film.

— CAUTION —

Cleanliness of metal and rubber parts cannot be too highly stressed. Only perfectly clean surfaces will assure maximum adhesion.

4. Using a pencil or pen, mark a centerline at the hub of the propeller blade and on the tape at the outboard edge of the masked area.

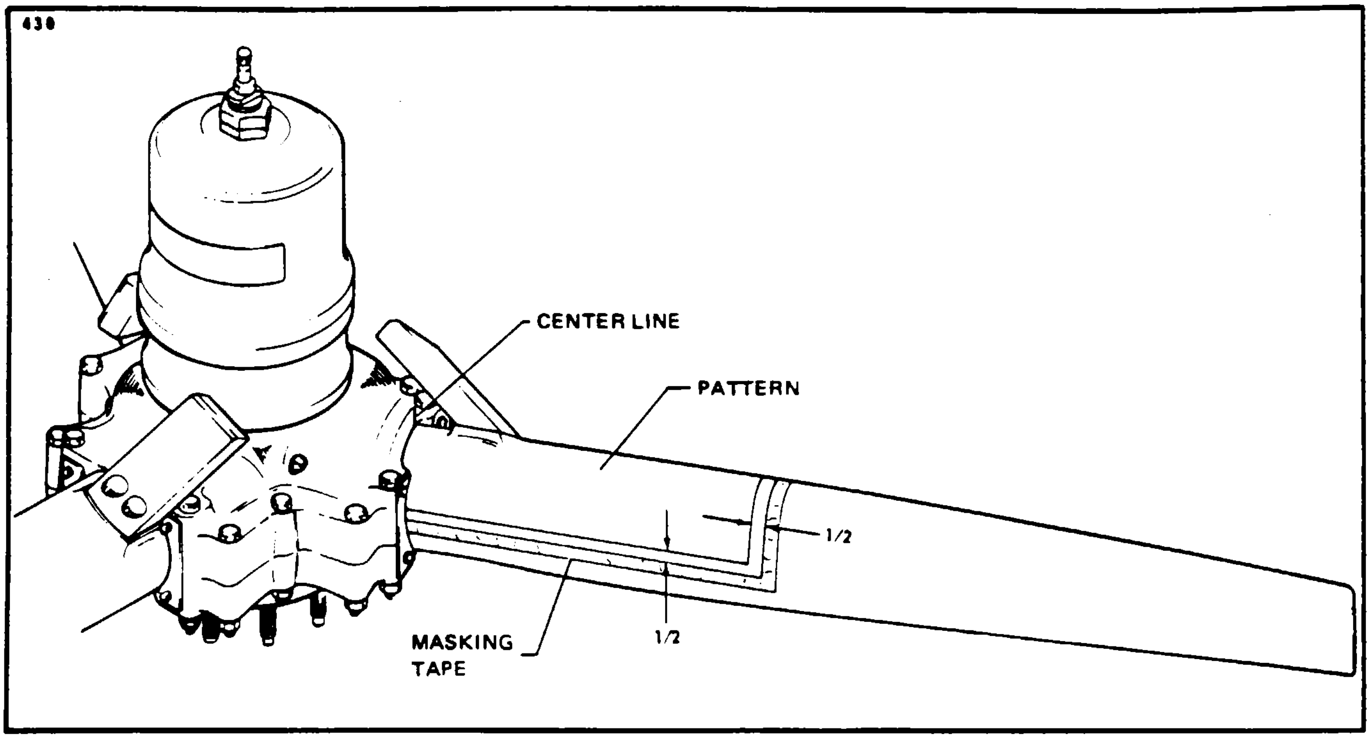


Figure 30-18. Installation of Deicer Boots.

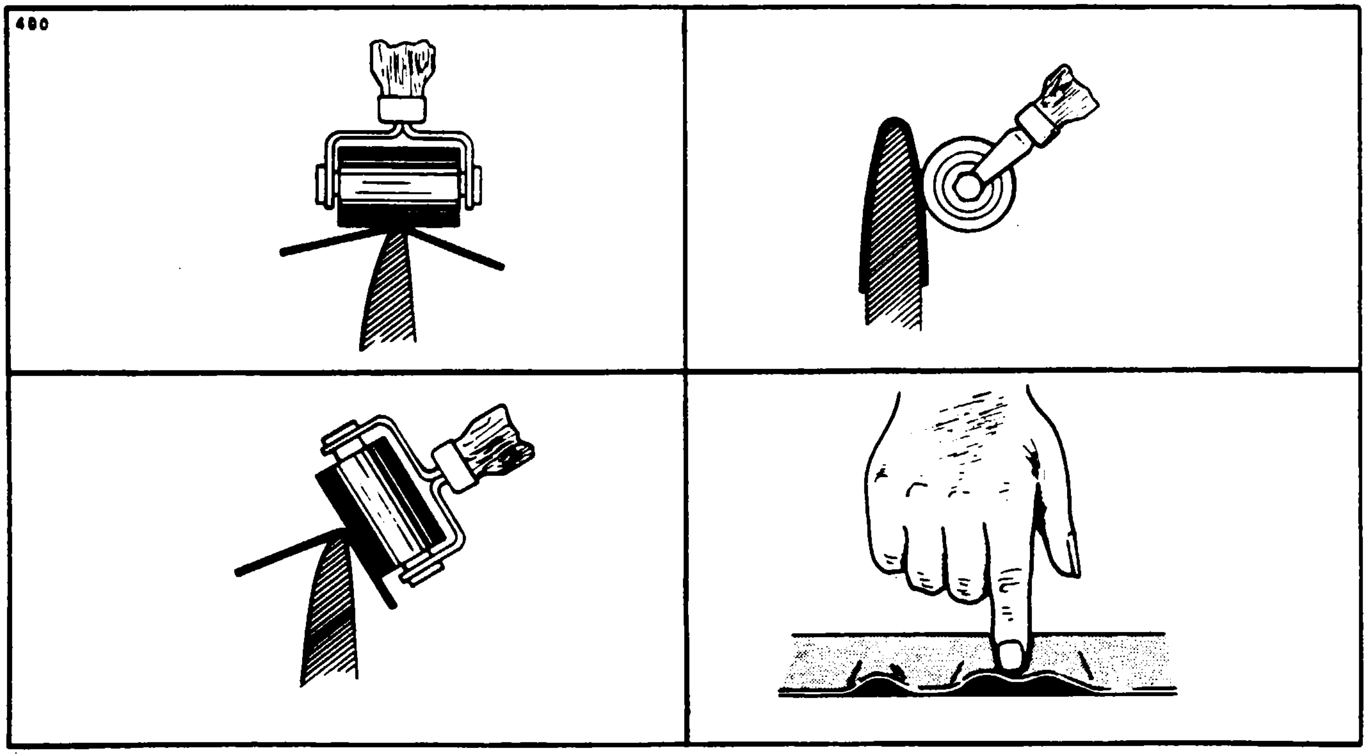


Figure 30-19. Wrinkled Deicers

APPLICATION OF CEMENT.

1. Using a silver pencil, mark a centerline on the glossy side of the deicer.
2. Moisten a clean cloth with MEK or acetone and clean the unglazed surface of the deicer, changing cloth frequently to avoid contamination of the clean area.
3. Thoroughly mix the 1300 L cement. Apply one even brush coat of cement to the unglazed back surface of the deicer. Cement one inch of the deicer lead strap. Allow to air dry for a minimum of one hour at 40° F or above, when the relative humidity is less than 75%. If the humidity is 75% to 90%, allow two hours drying time. Do not apply cement if the relative humidity is higher than 90%. After allowing the proper amount of drying time, apply a second even brush coat of 1300L cement.

— *NOTE* —

If curling of the deicer edges is a problem, apply masking tape to the edges of the glazed side before apply cement to the unglazed side. Remove the tape before starting to install the deicer.

4. Apply an even brush coat of 1300L cement on the cleaned surface of the propeller blade, immediately after the second coat of cement has been applied to the deicer. This timing is important for the cement on both surfaces to reach the tack stage at the same time.

INSTALLATION OF DEICERS AND REQUIRED MATERIALS.

It is imperative that the following instructions be followed exactly to insure maximum adhesion to the propeller blades.

1. When the cement coats are tacky dry on both propeller surface and deicer surface, proceed as follows:

   A. Position in the deicer on the propeller leading edge, using centerlines starting from the hub. (Refer to Figure 30-18.) Make sure that the strap will fall in the position previously marked. Working towards the tip, tack the deicer centerline to the leading edge of the propeller blade. Use tackifying solvent as necessary. If the deicer is allowed to get off course, pull up with a quick motion and remove deicer. Recement if necessary before proceeding. Roll firmly along the centerline with a rubber roller, as shown in Figure 30-18.

   B. Roll the tapered edges, especially the inboard edge, of the deicer with a narrow steel stitcher roller.

— *CAUTION* —

To avoid damage to resistance wires, do not use metal stitcher on body of deicer.

   C. Apply one even brush coat of sealer around the edges of the installed deicer.

   D. Remove the masking tape from the blade immediately after applying the sealer.

   E. Allow 12 hours cement curing time before turning up propeller. Allow 24 hours curing time before operating the deicers. Handle the propeller carefully to prevent damage to the deicers.

2. Propeller deicers, one for each propeller blade, are supplied in B. F. Goodrich propeller deicing system kits. Replacement deicers may be ordered from the B. F. Goodrich Company.

CHART 3005. REQUIRED MATERIALS FOR REPAIR OF PROPELLER DEICER

The materials and tools listed below are commercially available and are not supplied by B. F. Goodrich in kit form:

Item	Amount
Cement 1300L (Minnesota Mining & Mfg. Co.)	1 pt. per six blades
Sealer A56B (B. F. Goodrich)	1/2 pt. per six blades
Cleaning Solvent MEK (Methyl Ethyl Ketone) or Acetone	
Cleaning Cloth - any clean, lint-free cloth	
1 in. Paint Brush	
2 in. Rubber Hand Roller	
1/4 in. Metal Hand Stitcher	
Scissors	
Turco #3 (Turco Products Co.)	1 pt. per six blades
Masking Tape	

NOTE

MEK can be used instead of Toluol to tackify cement: however, tests show that MEK causes rapid drying and provides only 10 seconds working time for deicer application compared with 40 seconds for Toluol.

PREPARATION AND APPLICATION OF SEALER.

Deicers loosened due to destruction of adhesive bond by lubricants do not respond well to recementing. Therefore, removal, cleaning and reinstallation of the deicers are recommended.

1. Clean an area .500 inch wide around the circumference of the deicer down to the bare metal. Use MEK or Acetone and clean thoroughly.
2. Clean outer .500 inch of all deicer edges and back under deicer about .250 inch on all sides past loosened areas with MEK or Acetone. For final cleaning, quickly wipe off solvent with a clean, dry, lint-free cloth to avoid leaving a film.
3. Recement loosened areas of deicers.
4. Mix the filler, sealer or paint thoroughly and in the proper proportions by weight, as given in the following steps:
   A. 82-075A/B - one part A/one part B.
   B. 82-076-1/2 - Twelve parts - 1/one part - 2.
   C. EC-1031/EC-801 - Twelve parts 1031/one hundred part 801.
   D. C-19861/C-21871/C-16176 - one part 19861/seven parts 21871/two and two thirds parts 16176.
5. Locate masking tape approximately - .125 inch beyond cemented area around deicer to allow application of filler directly to metal. Apply one even brush coat of 82-075A/B filler (or EC-801 sealer) over .125 inch of bare metal, cemented area and about .125 of an inch of deicer. (See Figure 30-20.)
6. Insure that a fillet of filler completely covers the area between deicer strap and blade. (See Figure 30-21.) Immediately remove masking tape and allow filler to dry for six hours.
7. Apply new masking tape approximately .125 of an inch beyond filler to allow application of sealer directly to metal. Apply one even brush coat of 82-076-1/2 sealer (or C19861/C-16176 paint) over .125 of an inch of bare metal, filled area and .250 of an inch of deicer. (See Figure 30-20.)
8. Insure that sealer completely covers area between deicer strap and blade. (See Figure 30-21.) Immediately remove masking tape and allow sealer to dry for 24 hours before starting engine.

WRINKLED DEICERS. (Refer to Figure 30-19.)

If edge of deicer is found wrinkled or loose, try recementing. Use MEK or Toluol to loosen the bond for an additional 1/4 inch beyond the loose or wrinkled area. Apply one coat of 1300L cement to the deicer and propeller bonding surfaces and allow to air dry for one hour. Then apply a second coat of 1300L cement to both the deicer and bonding surface. Allow to dry. Retackify with MEK or Acetone and press with fingers to work out wrinkles or to secure loose edges. If material has stretched and will not cement flat, replace the deicer.

ELECTRICAL CHECK.

1. Check the electrical resistance of each of the two elements within the deicer. Refer to Schematic, Figure 30-11, and Resistance Readings. Refer to Chart 3006.
2. Check for intermittent open circuits by tensioning the deicer strap slightly while measuring the resistance. Also, press lightly on the deicer surface in the area adjacent to the strap retainer. Resistance must not vary.

3. Identification of the circuits within the element may be confirmed by referring to the resistance values and schematic diagram, Figure 30-11. Proper identification is necessary in order to make the system cycle properly and to obtain amperage values during system operation. Minimum and maximum ohms between common ground and either of the other terminals is 4.58 to 5.26.

— NOTE —

These resistances apply only to deicers that are not connected to terminal studs.

FINAL ELECTRICAL CHECK OF PROPELLER DEICERS.

1. Make certain that all terminals are tight. Do not over-torque.
2. Check the electrical resistance between the deicer terminals or between the slip rings. The reading should be:

CHART 3006. ELECTRICAL RESISTANCE

Resistance Check	Max.	Min.
1 Blade each Element	5.26	4.58
2 Blades in Parallel	1.78	1.55

3. If the propeller is installed on an airplane, the deicer circuits on the propeller must be electrically isolated from the rest of the airplane wiring when making the above resistance check. The isolating can be done by any one of the following methods:
   A. Remove the brush block.
   B. Retract the brushes and slip a sheet of paper between the brushes and the slip rings. If this method is used, make certain that the brushes are not misaligned or damaged by insertion of the paper shim.
   C. Disconnect the timer and engine wire harness at any convenient place.
4. Reconnect any circuits that may have been disconnected, or remove paper shims that might have been used for making the final electrical check.

INSTALLATION OF DEICER STRAPS AND WIRE HARNESS.

1. The deicer lead strap is fastened to the bulkhead in the same positions from which they were removed.
2. The deicer strap is to be attached to the studs on the spinner bulkhead.

— CAUTION —

Never use Type "B" star washer (teeth on outer diameter) adjacent to tongue of deicer terminals.

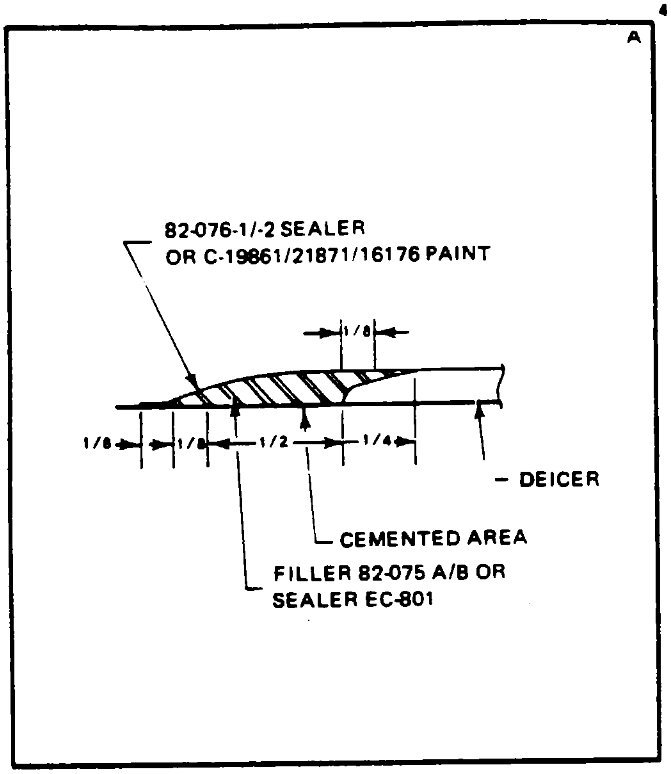


Figure 30-20. Sealer Application (Boot)

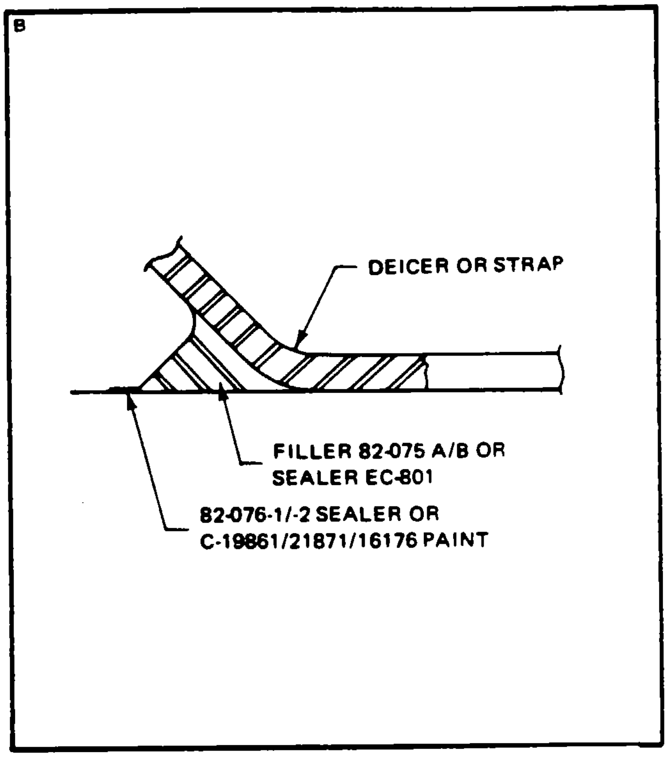


Figure 30-21. Sealer Application (Lead Strap)

3. Make certain that there is no slack in the deicer lead strap between the terminals and the clip. This is important because it assures enough slack between the clip and the strap restrainer to allow for proper feathering. A test should be conducted on each propeller deicing system to insure that deicer lead straps are installed in such a manner that the propeller can be moved from full low pitch through the feathering position without placing the straps in tension.

— NOTE —

Deicers should have a piece of gray plastic bonded to the air side (shiny side) of the deicer strap as shown in Figure 30-22. The strap restrainers should be positioned as shown in Figure 30-23 when the propeller blades are in the full feather position.

4. If damage occurs to slip ring wire harness, rubber spacers or hose clamps, replaced damaged parts.

BALANCING.

To assure balance of the propeller assembly, the original balancing weights or their equivalents must be reinstalled. The weights must be left in their original position on the propeller hub. The restrainer and weights should not interfere with any part of the propeller assembly under any condition. If for any reason balance weights were removed, reinstall safety wire on screws.

TIMER TEST.

Field experience indicates that too often the timer is considered at fault when the true trouble lies elsewhere. Before removing a timer as defective, perform this test:

1. Disconnect wire harness at timer and with deicer switch ON, check voltage from Pin B of harness plug to ground. If system voltage is not present, the fault is not in the timer. If system voltage is present at Pin B, check ground circuit using ohmmeter from Pin G to ground. If no circuit is shown, the fault is in ground lead, not in timer. If ground connection is open, the timer step switch will not change position.
2. When power and ground circuits have been checked, connect a jumper wire from Pin B of harness to B contact of timer socket to power timer. Connect a jumper wire from Pin G of harness to G contact of timer socket to complete the power circuit. Now use voltmeter from ground to the timer socket and check that timer is cycling to deliver system voltage to C, D, E, and F contacts in that order. (The starting point is not important but sequence must be as given.) Each of these four contacts must deliver voltage for approximately 30 seconds, in turn, and there must be zero voltage on the three contacts not energized.
3. If the timer meets these requirments, it is not the cause of the trouble. If it fails to perform as indicated, the trouble does lie in the timer and it should be replaced.

OTHER COMPONENTS.

Do not attempt internal repairs of the timer, ammeter, or switch. If inoperative, these components must be replaced with one of the correct part numbers. For any other repair or maintenance problems not covered in this manual, inquire at Aerospace and Defense Products Division of the B. F. Goodrich Company, Akron, Ohio 44318.

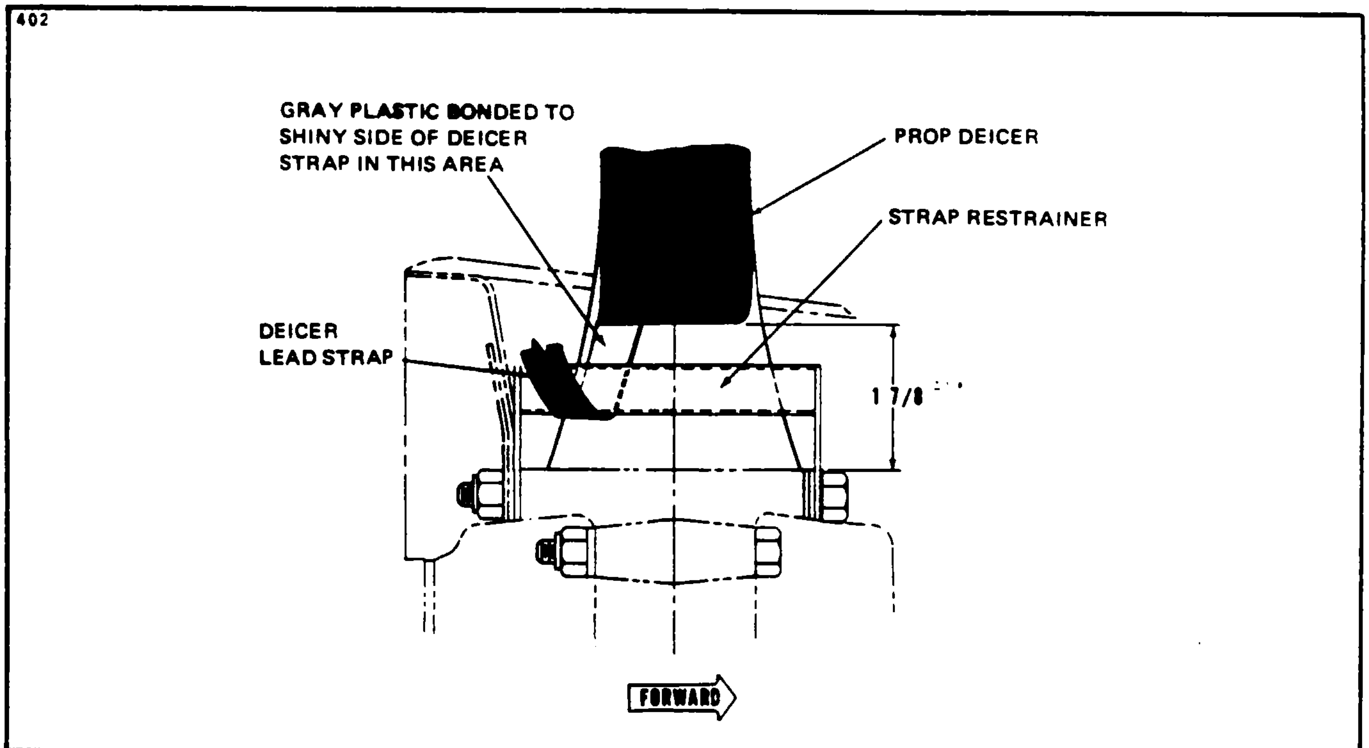


Figure 30-22. Propeller Blade Low Pitch Position

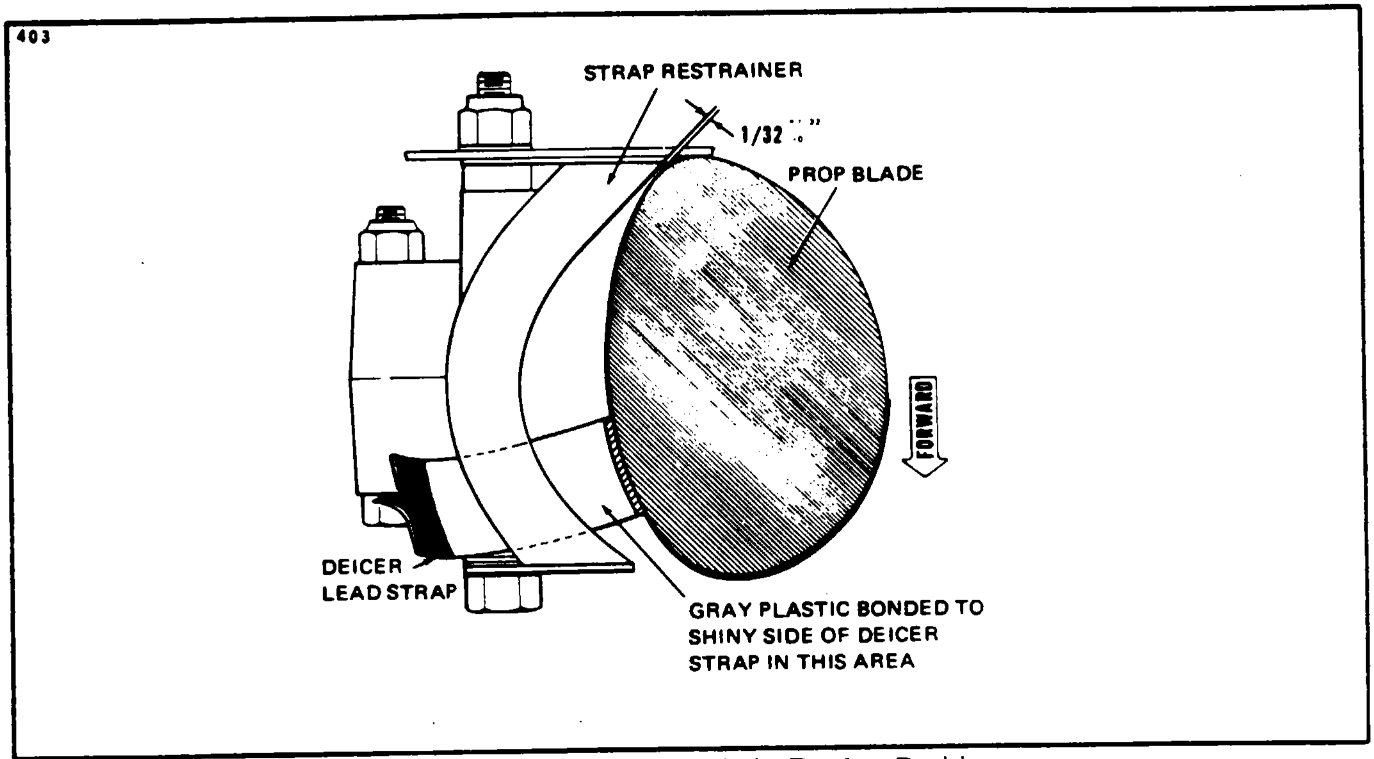


Figure 30-23. Propeller Blade in Feather Position

— END —

GRIDS 3D5 THRU 3D8
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CHAPTER

32

LANDING GEAR

CHAPTER 32 - LANDING GEAR

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32-90-02	Main Gear	3G14	A 10-82

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GENERAL.

This chapter provides instructions for remedying difficulties which may arise in the operation of the landing gear and brake systems. The instructions are organized so that the mechanic can refer to Descriptions and Principles of Operation for a basic understanding of the systems; Troubleshooting for a methodical approach in locating the difficulty; Corrective Maintenance for the removal, repair and installation of components; and Adjustment and Test for the operation of the repaired systems.

DESCRIPTION AND PRINCIPLES OF OPERATION.

The tricycle landing gear system incorporates air-oil oleo type struts that are hydraulically operated and fully retractable with the nose gear retracting aft into the nose section and the main gear retracting inboard into the wing. Doors completely cover the gear when retracted. The nose and outboard main gear doors operate by mechanical linkage and remain open when the gear is extended. The main gear inboard doors operate hydraulically and are controlled by the limit switches opening during gear extension and closing again when the gear has fully extended. To prevent the gear from retracting while the airplane is on the ground, an anti-retraction safety switch is located on the left gear upper torque link, which will not allow the gear actuator lever to move to the gear up position until weight is off the landing gear allowing the strut to extend to within one-quarter of an inch of full extension.

The nose gear is steerable through a 40 degree arc by the use of the rudder pedals. As the gear retracts, the steering linkage becomes separated from the gear and is centered, so that the rudder pedal action with the gear retracted is not impeded by the nose gear operation.

Located on the instrument panel, to the right of the gear selector control, are one red and three green indicator lights. The red light will show an indication when the gear is not locked in either the up or down position and the green lights will show when each individual gear is down and locked. There is no indication light when the gear is up and locked. The red light will also show an indication whenever the inboard gear doors are not completely closed. A warning horn in the cockpit will sound whenever power from one or both engines is reduced below 10 to 12 inches of manifold pressure when the gear is not in the down locked position. This horn will also sound whenever the landing gear selector handle is in the gear up position while the airplane is on the ground and the master switch is on. If the gear selector handle can be moved to the up position with the airplane on the ground, it is an indication of an improperly adjusted selector mechanism or the anti-retraction system is inoperative.

Two means of emergency extension are available. The emergency blowdown system and the hand pump located in the cockpit between the pilot seats, under the floor access panel. The emergency blowdown system employs a logic circuit which senses the gear(s) not extended such that when the system is activated by pulling the control ring located between the pilot's and copilot's seats the remaining gear(s) is (are) extended and locked in place. Besides the emergency blowdown system the gear can also be pumped down. A hand pump under a floor access panel between the pilot's and copilot's seat can be used to extend the gear should the hydraulic pump system fail. If a problem does develop however, and time permits, it is suggested that the hand pump be tried first, because once the emergency blowdown system is activated, the affected mechanism and hydraulic system must be purged and serviced.

The brakes are hydraulically actuated by individual master cylinders mounted on the left (optional on right) set of rudder pedals. A reservoir, accessible through the access door on the upper right portion of the nose section, supplies fluid to each master cylinder. From these cylinders, hydraulic fluid is routed through lines and hoses to a parking brake valve located on the left aft side of the forward cabin bulkhead, through the cabin and wings, to the brake assemblies on each main landing gear. To operate the brakes, apply toe pressure against the top of the rudder pedal. The parking brake may be actuated by applying toe pressure and at the same time pulling out on the brake handle. To relieve parking brake pressure, apply toe pressure on the pedals and at the same time push in on the parking brake handle.

Servicing of the hydraulic and brake system is found in Chapter 12.

TROUBLESHOOTING.

Mechanical and electrical switch troubles peculiar to the landing gear system are listed in the Troubleshooting Chart. When troubleshooting, first eliminate hydraulic malfunctions as listed in Chapter 29. Then proceed to switch malfunctions and last to the mechanical operation of the gear itself, both of which are listed in this section. Always place the airplane on jacks before attempting any troubleshooting of the gear.

CHART 3201. TROUBLESHOOTING (LANDING GEAR SYSTEM)

Trouble	Cause	Remedy
Landing gear selector handle fails to operate to gear up position.	Selector lever cannot be moved to the gear up position while the LEFT main gear strut is compressed or with the power off.	Ascertain that the LEFT main gear strut is extended and that the power is on.
	Faulty safety switch on left main gear.	Adjust or replace safety switch.
Gear retracts or extends before the doors open.	Priority valve leaks in power pack.	Check priority valve cracking pressure.
	Solenoid valve stuck in closed position.	Turn off power and hand pump doors open.
	Micro switch on power pack out of adjustment.	Check for bent bracket or loose mounting or wire and adjust.
— NOTE — *With power off, solenoid valve shuttles to door open and the doors may be opened without selecting gear up or down.*		
Doors come open in flight.	Doors are rigged too tight.	Adjust rigging of doors.
	Micro switch on power pack out of adjustment.	Adjust micro switch.

CHART 3201. TROUBLESHOOTING (LANDING GEAR SYSTEM) (cont.)

Trouble	Cause	Remedy
Doors fail to close.	Circuit breaker out.	Check circuit breaker.
	Limit switch out of adjustment.	Adjust limit switch.
	Gear not fully retracted.	Check adjustment.
	Cannon plug on power pack loose.	Tighten plug.
	Solenoid valve stuck in door open position.	Check wiring to solenoid valve.
	Powerpak microswitch out of adjustment or faulty.	Adjust or replace switch.
Nose gear fails to lock up when handle returns to neutral.	Not enough actuator stroke.	Increase the actuator stroke.
	Gear doors pinching.	Relieve door pinch by lengthening door operating rods.
Main gear fails to lock up.	Uplock rod out of adjustment.	Adjust rod.
	Actuator out of adjustment.	Adjust actuator.
No red light on panel when gear are in transit.	Circuit breaker out.	Check circuit breaker.
	Indicator light burned out.	Replace indicator light.
	Circuit wire broken.	Check wiring.
No green light on panel when gear are down.	Circuit breaker out.	Check circuit breaker.
	Indicator light burned out.	Replace indicator light.
	Lock switch defective or out of adjustment.	Replace and/or adjust lock switch.
	Gear not locked in down position.	Adjust the gear.

CHART 3201. TROUBLESHOOTING (LANDING GEAR SYSTEM) (cont.)

Trouble	Cause	Remedy
Flashing red indicator light or warning horn sounding when power from one or both engines is above 15 inches of manifold pressure.	Throttle switches are faulty.	Replace switches.
	Throttle switches out of adjustment.	Adjust throttle switches.
Red indicator light stays on with gear up and locked.	Doors could be open.	Adjust doors.
	Switch defective.	Replace defective switch.
Flashing red light and warning horn fail to operate when power from both engines is reduced below 14 or 15 inches manifold pressure.	Throttle switches out of adjustment.	Adjust throttle switches.
	Throttle switches are defective.	Replace switch.
	Horn or light defective.	Replace defective part.
	Defective wiring.	Check wiring.
Nose gear shimmies during fast taxi, take-off and landing.	Internal wear in shimmy dampener.	Replace shimmy dampener.
	Shimmy dampener 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.
Main landing gear shimmies during fast taxi, take-off and 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 SYSTEM) (cont.)

Trouble	Cause	Remedy
Strut bottoms on normal landing or when taxiing over rough ground.	Insufficient air and/or fluid in strut.	Service strut with air and/or fluid.
	Defective internal parts in strut.	Replace defective parts.
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.
Nose gear fails to steer properly.	Oleo cylinder binding in strut housing.	Lubricate strut housing.
	One brake dragging.	Determine cause and correct.
	Steering arm roller sheared at top of strut.	Replace defective roller.

REPLACEMENT OF WIPER STRIP ON LANDING GEAR STRUTS.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Jack the airplane only high enough to take weight off the gear.
3. Release the air pressure from the strut by depressing the valve core pin until the pressure has diminished.
4. Using snap ring pliers, disengage the snap ring from the annular slot in the oleo housing and allow it to lay at the lower end of the piston tube along with the wiper strip retainer washer.
5. Remove the old wiper strip from the housing, and clean and inspect the housing to determine that no pieces remain in it.
6. Wipe the piston tube and check it for any abrasions which may damage the new wiper. Polish the tube to remove any abrasions found.
7. A new wiper strip should be cut with a 30 degree bevel, a little longer than needed, to circle the piston tube.
8. Insert the new wiper strip up into the oleo housing with the tapered edge down. Slide the retainer washer and snap ring up the piston tube and insert them into the oleo housing. Using snap ring pliers to compress the snap ring, install it into the annular slot in the oleo housing.
9. Inflate the oleo strut in accordance with instructions given in Oleo Struts, Chapter 12, and remove the airplane from the jack.

MAIN GEAR AND DOORS.

MAIN GEAR OLEO STRUT.

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

The main gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed on the airplane.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Place a drip pan under the main gear to catch spillage.
3. Remove the air and fluid from the oleo. (Refer to Oleo Struts, Chapter 12.)
4. To remove the piston tube assembly from the oleo housing, remove the upper and lower torque link connecting bolt assembly and separate the links. Note the number and thickness of spacer washers between the two links.
5. Compress the piston tube, reach up along the tube and release the retainer ring from the annular slot at the bottom of the oleo housing.
6. Pull the piston tube with component parts from the (housing) cylinder.

— NOTE —

Prior to disassembling the upper bearing with retaining pins from the piston tube place a reference mark with a grease pencil from the upper bearing to the piston tube. This will insure proper indexing of parts upon reassembly.

1. BOLT, ORIFICE TUBE
2. WASHER
3. O-RING, PACKING
4. TUBE, ORIFICE
5. PLATE, ORIFICE
6. RING, RETAINER
7. PIN, RETAINER
8. BEARING, UPPER
9. SPACER
10. O-RING, GASKET
11. BEARING, LOWER
12. O-RING, PACKING
13. WIPER STRIP
14. WASHER
15. RING, RETAINER
16. O-RING, PACKING
17. PLUG
18. GREASE FITTING
19. VALVE, AIR
20. PLUG, FILLER
21. HOUSING, OLEO
22. TUBE, PISTON
23. BOLT ASSEMBLY
24. FORK
25. PIN, COTTER
26. NUT, AXLE
27. BOLT ASSEMBLY
28. PIN, COTTER
29. BOLT ASSEMBLY
30. BEARING, UPLOCK
31. TORQUE LINK, LOWER
32. BOLT ASSEMBLY
33. TORQUE LINK, UPPER
34. BOLT ASSEMBLY
35. WASHER, SPACER
36. CONTACT, SAFETY SWITCH
37. BUSHING
38. PLACARD, SERVICE
39. SAFETY WIRE
40. SCREW
41. AXLE
42. POLY-PAK SEAL

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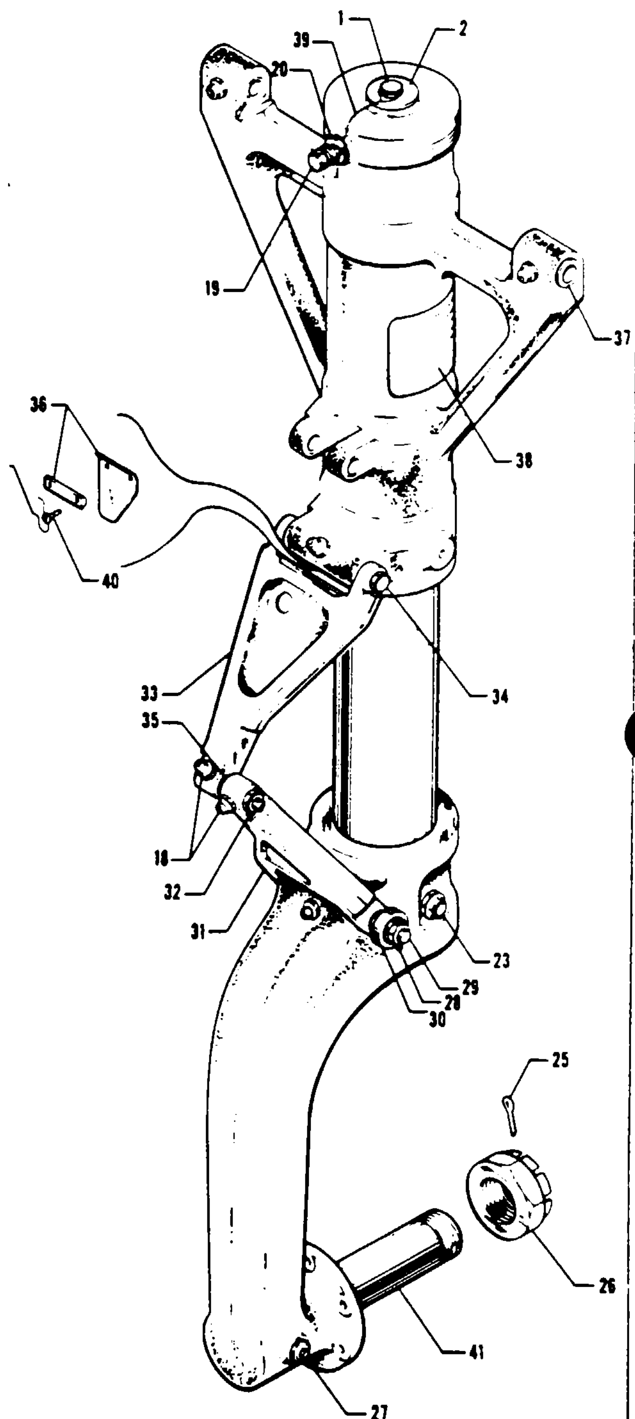
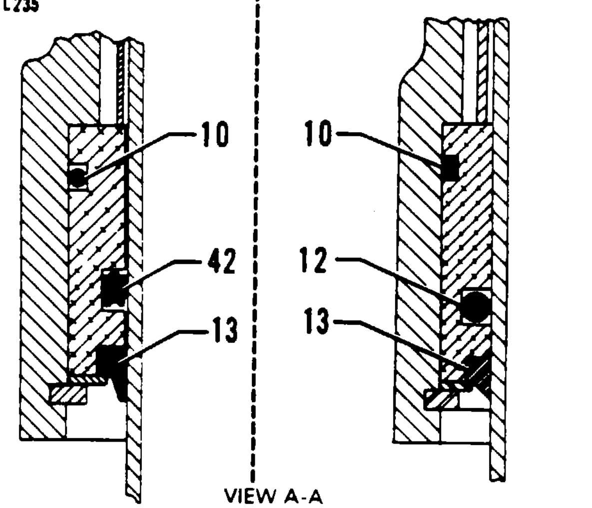


STRUT USED WITH CLEVELAND WHEEL AND BRAKES | STRUT USED WITH GOODYEAR WHEEL AND BRAKES

C235



VIEW A-A
(Refer to following page)

Figure 32-1. Main Gear Oleo Strut Assembly

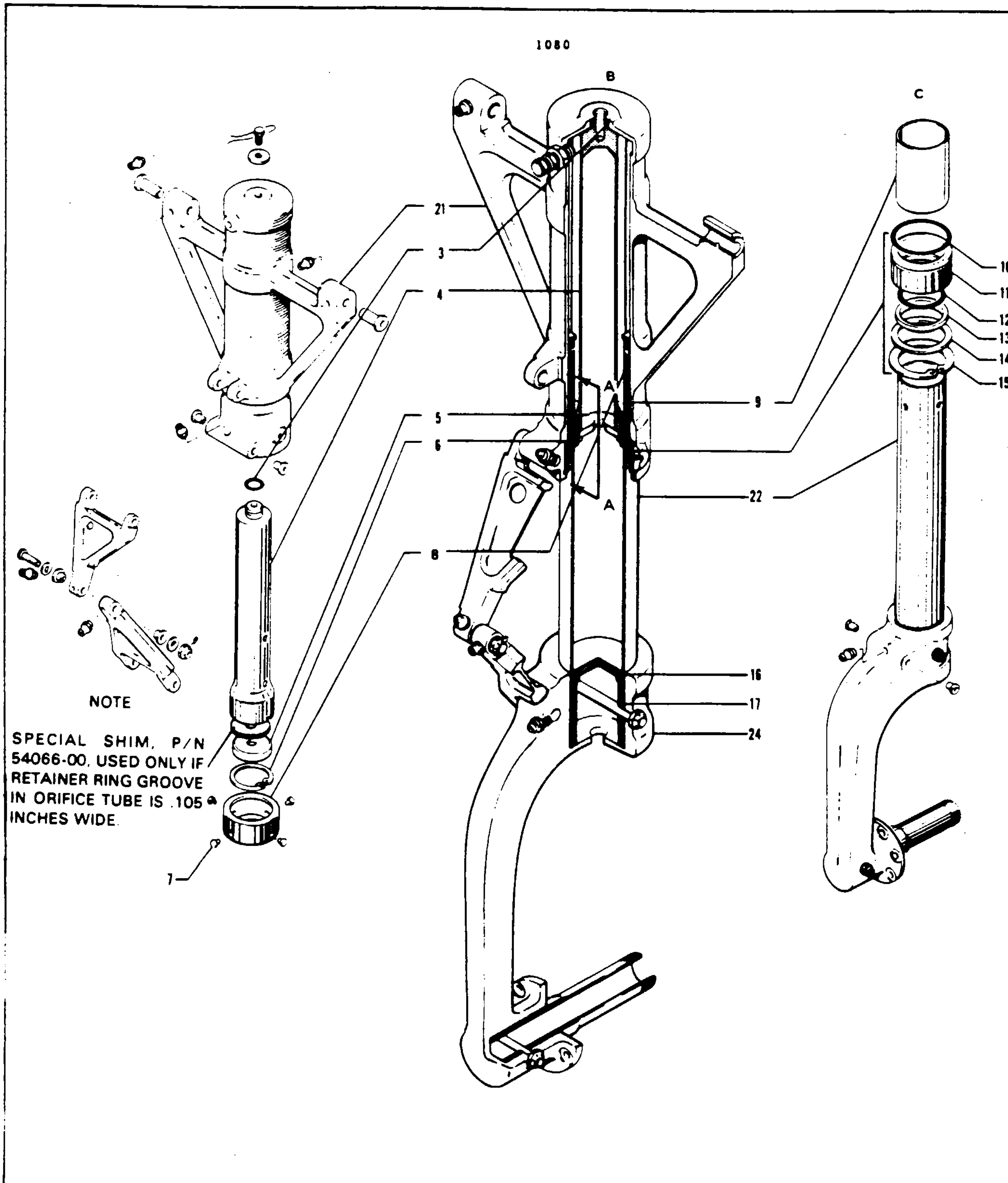


Figure 32-1. Main Gear Oleo Strut Assembly (cont.)

7. The fork tube components may be removed by reaching in the tube and pushing out the upper bearing retaining pins. Slide off the upper bearing, spacer, lower bearing with O-rings, wiper, washer and retainer ring.
8. To remove the orifice tube from the oleo housing, cut safety wire and remove cap bolt and washer from top of the housing.
9. The orifice plate is removed from the orifice tube by releasing the retainer ring that holds the plate in position.

— NOTE —

Do not remove piston plug from piston tube, or piston tube from fork.

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR OLEO.

The instructions for cleaning, inspection and repair of the main gear oleo are the same as those given for the nose gear oleo.

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

1. Ascertain that all parts are cleaned and inspected.
2. To assemble and install 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 retainer ring. Lubricate and install the O-ring on the upper end of the tube. Insert the tube up through the bottom oleo housing. With the tube exposed through the top of the housing, install washer and tighten cap bolt finger tight.
3. The piston tube assembly may be assembled to the oleo housing by first installing the tube components on the tube. In order slide onto the tube the retainer ring, washer, lower bearing with inner and outer O-rings, spacer and upper bearing. Align reference marks on the upper bearing and piston tube to insure proper indexing of the lock pin holes of the upper bearing and tube and install retainer pins.
4. Carefully insert the piston tube assembly into the oleo housing, guiding the orifice tube into the piston tube until the retainer ring can be installed in the annular slot at the lower end of the housing. Install wiper strip, slide washer into position and secure assembly with retainer ring. At the top of the housing, tighten the cap bolt.
5. Install the upper and lower torque links. (Use same thickness spacer washers between the two links as those removed to maintain correct wheel alignment.)
6. Lubricate the gear assembly. (Refer to Lubrication Chart, Chapter 12.)
7. Service the oleo strut with fluid and air (refer to Oleo Struts, Chapter 12) and safety with MS20995-C40 wire between the filler plug and cap bolt.
8. Check the gear alignment and gear operation.

MAIN LANDING GEAR.

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

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Remove the two access plates forward and two access plates aft of the outboard wheel door.

3. With the hand pump, retract the main gear slightly to relieve the gear from its downlocked position and to lower the inboard gear door out of the way.
4. Disconnect brake line.
5. To remove side brace link assembly, the following procedure may be used:
A. Disconnect the actuating cylinder and downlock rod or cable from the upper side brace link arm by removing clevis bolt. Disconnect the other end of the downlock rod or cable at the downlock hook.
B. Remove downlock hook and spring by removing pivot bolt.
C. Remove the downlock switch bracket with switch by removing the four screws that attach the bracket between the forward and aft side brace links. Remove the clamps that secure the electrical wiring to the side brace link.
D. Disconnect the lower side brace link from the gear oleo housing and let the link assembly swing down.
E. Remove the bolt that connects the upper and lower side brace links.
F. Disconnect the aft link from its attachment plate.
G. To remove the forward link, remove the nut with washers that is holding the link on its pivot shaft. Slide the link from the pivot shaft.
H. The pivot shaft may be removed by reaching through the pivot shaft bracket access hole, removing the bolt securing the shaft to the shaft fitting. Slide the tube through the attachment bracket. The shaft fitting is attached with cap bolts, washers and anchor nuts.
6. Disconnect the outboard gear door retraction rods at the gear housing. With the lower side brace link disconnected from the housing, the gear may be removed by removing the attachment bolt assemblies at the attachment plates on each side of the gear housing. Note, if any, the number and location of spacer washers between the gear housing and attachment plates.
7. The uplock hook and spring may be removed by disconnecting the uplock rod or cable from the hook and then the hook pivot bolt. Disconnect the emergency actuator rod from the uplock hook.
8. The uplock rod or cable may be removed by disconnecting the rod or cable end at the lock crank.
9. The landing gear and upper drag link attachment plates may be removed by reaching through the access holes to the nuts that secure the plates. While holding the nuts, wrench the attachment bolts.

CLEANING, INSPECTION AND REPAIR OF MAIN LANDING GEAR.

1. Clean all parts with a suitable cleaning solvent.
2. Inspect bolts, bearings, bushings and ball joints for excess wear, corrosion and damage.

— *WARNING* —

Refer to latest revision of Piper Service Bulletin 845 of specific inspection/replacement instructions for the Main Landing Gear Forward Side Braces. Piper considers compliance with service bulletins as mandatory.

3. Inspect the gear housing, side brace links, idler links, rods and attachment plates for cracks, bends or misalignment.
4. Inspect lock hook for wear and oversized bearing surfaces.
5. Inspect the lock hook springs for the following:
A. Excess wear or corrosion, especially around the hook portion of the springs. A spring should be rejected if wear or corrosion exceeds one-quarter the diameter of the spring. Clean away all corrosion and repaint the springs.
B. Check the lock hook springs for load tensions below the minimum allowable tolerances. The minimum tension for the uplock hook spring is 4 pounds, and the minimum tension for the downlock hook spring is 7 pounds. These checks are performed by fastening a fish type scale to the particular hook and spring and pulling against the hook and spring to get a reading on the scale.
6. Inspect the uplock roller for freedom of movement and minimum wobble.
7. Inspect lock rod or cable end bearings for corrosion, damage and freedom of movement. Also, inspect the sliding surfaces of the uplock rod.

8. General condition of limit switches and wiring for fraying, poor connections or conditions that may lead to failures.

9. Attach the upper and lower drag links and check that when stop surfaces of the two links contact, linkage is .063 to .156 inch through center. (Refer to Figure 32-2.) Should this distance exceed the required through center travel and all bolts and bushings are tight, replace one or both side brace links.

10. Repair of the landing gear is limited to reconditioning of parts such as replacing bearings and bushings, smoothing out minor nicks and scratches, repainting of areas where paint has chipped or peeled and replacement of parts.

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

— NOTE —

When assembling any units, lubricate bearings and friction surfaces with proper lubricant as described in Chapter 12.

1. Position the attachment plates of the landing gear housing and upper drag links and bolt in place.
2. The uplock hook may be installed by the following procedure:
   A. Place the "U" end of the uplock spring over the back of the hook with the loops also toward the back.
   B. Spread the spring and fit the loops over the bushing that extends through the hook.
   C. Slide the hook inboard through the bracket until the bracket hole aligns with the bolt hole in the hook.
   D. Install the pivot bolt and tighten so the hook will rotate freely, yet without side play.
3. Attach the uplock cable or rod with the proper end attached to the hook and the other end to the crank fitting. Attach the emergency actuator rod to the hook also.
4. To install the main gear housing assembly, position the gear so that the attachment points on the housing align with the attachment plates. If needed, install spacer washers between attachments to allow a minimum amount of end play. Tighten nut on each pivot bolt to a snug fit, allowing the gear to swing free, and safety.
5. The upper and lower side brace link assembly may be installed by the following procedure:
   A. Install the forward upper link pivot tube attachment fitting to the spar and secure with cap bolts.
   B. Slide the pivot shaft through the attachment plate and into the attachment fitting. Secure the pivot shaft to the attachment fitting.
   C. Ascertain that the forward upper arm is installed on the link. Install the link on the pivot shaft and secure with washers and nut.
   D. The aft upper drag link may be installed by sliding the link on the aft attachment plate pivot bolt. Tighten the nut to allow the link to swing free with no side play and safety.
   E. Position the lower link between the upper drag link ends, install bolt assembly and tighten to allow the link to turn free with no side play.
   F. Attach the lower drag link to the landing gear housing, secure and safety. Move the gear in and out of the downlock position several times to determine that there is no binding.
6. Position the downlock switch bracket between the forward and aft upper drag links and bolt in place.
7. The downlock hook may be installed on the drag link assembly by the following procedure:
   A. Place the "U" end of the downlock spring over the back of the hook with the loops also toward the back.
   B. Spread the spring and fit the loops over the bushing that goes through the hook.
   C. Insert the ends of the spring into holes located in the downlock switch bracket on each side of the drag link assembly. Push the hook down between the two upper drag links until the bolt holes in the links align with the bushing hole of the hook.
   D. Insert the pivot bolt and on each side of the bushing install spacer washers to maintain a minimum amount of side play. Secure bolt and safety.

8. The downlock cable or rod may be installed by bolting the sliding end of the rod or cable to the downlock hook and the other end to the upper drag link arm, at the same time attaching the landing gear actuating cylinder.

— NOTE —

If downlock cable is used, insure the anti-rotation clip is installed at the upper drag link arm as shown in Sketch B of Figure 32-2.

9. Lubricate the landing gear assembly. (Refer to Lubrication, Chapter 12.)
10. Check the main gear adjustment, operation and alignment.

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

1. With the airplane on jacks and the gear extended, disconnect the inboard and outboard gear door operating rods and keep the doors in the open position.
2. Disconnect emergency actuator cylinder and inboard release cable. Locate them clear of the primary gear extension components.
3. Disconnect the downlock operating rod or cable from the downlock hook.
4. The through center adjustment of the side brace links is accomplished as follows:
   A. Maintain the gear in the downlocked position with both stop surfaces of the side brace links touching.
   B. Ascertain that the linkage is 0.063 to 0.156 of an inch through center.
   C. If one side of the stop surfaces does not touch, it can be filed to obtain the desired through travel.
   D. If filing brings the through travel beyond the 0.156 inch tolerance then a link or links must be replaced.

— NOTE —

A fabricated tool may be constructed to check through center travel of the side brace link assembly while the links are installed. (Refer to Chapter 95.)

5. Use the fabricated tool in the following procedure:
   A. The gear is down and locked with no hydraulic pressure on the system.

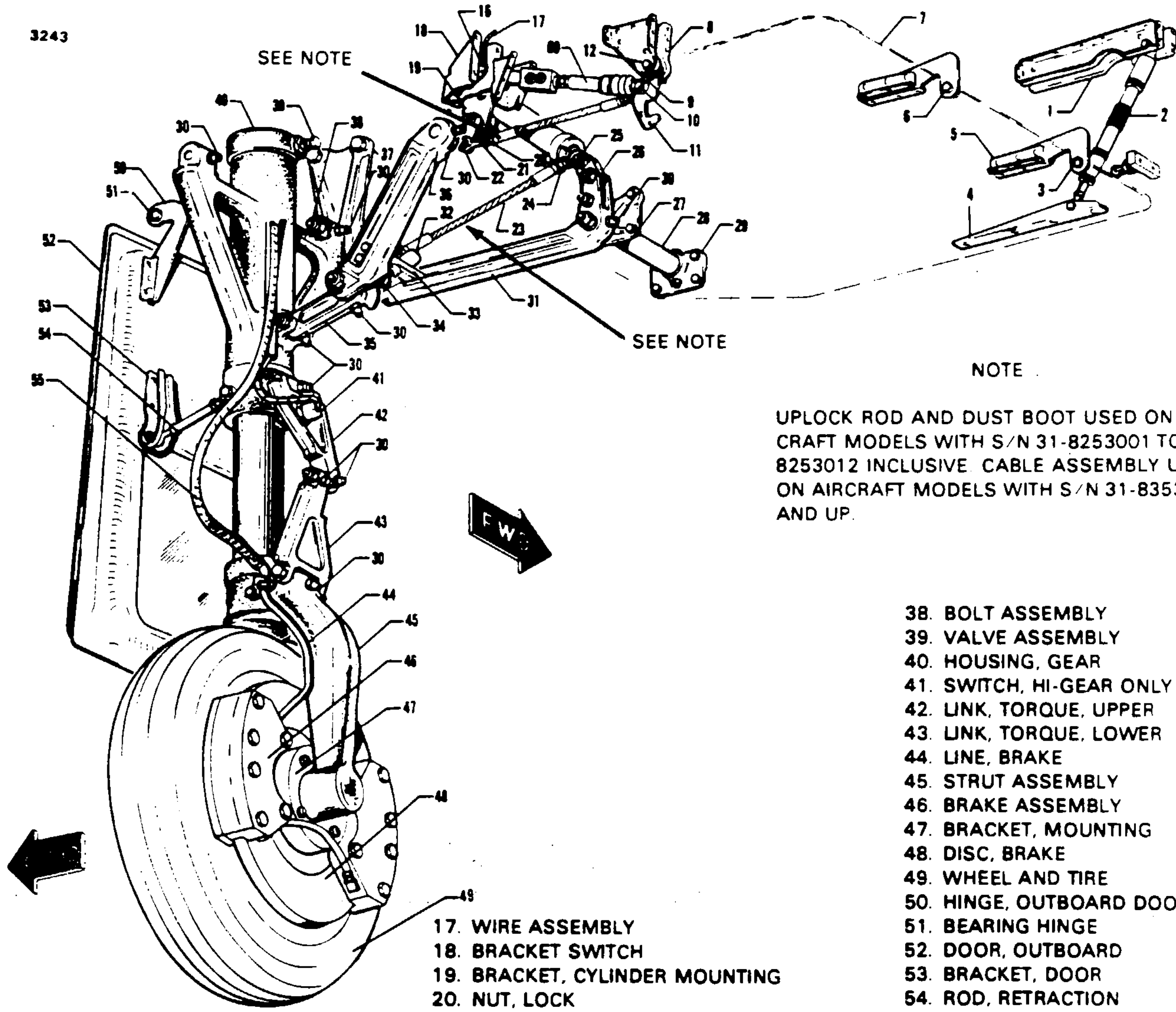
— NOTE —

The airplane may be either on or off jacks.

   B. Remove the cotter pins that safety the nuts that secure both upper side brace links to their attachment plates.

— NOTE —

On the right gear only, remove the pin at the nut that secures the lower link to the gear housing. Do not remove the nuts.



NOTE

UPLOCK ROD AND DUST BOOT USED ON AIRCRAFT MODELS WITH S/N 31-8253001 TO 31-8253012 INCLUSIVE. CABLE ASSEMBLY USED ON AIRCRAFT MODELS WITH S/N 31-8353001 AND UP.

1. BRACKET, LOCK CYLINDER
2. LOCK CYLINDER
3. BEARING, HINGE
4. BRACKET, INBOARD DOOR
5. HINGE, INBOARD DOOR
6. BEARING, HINGE
7. DOOR, INBOARD
8. BRACKET, UPLOCK HOOK
9. SPRING, UPLOCK
10. BOLT ASSY AND BUSHING
11. HOOK, UPLOCK
12. BOLT ASSY AND BUSHING
13. NUT, LOCK
14. ROD, UPLOCK (OR CABLE) SEE NOTE
15. CYLINDER
16. SWITCH, UPLOCK
17. WIRE ASSEMBLY
18. BRACKET SWITCH
19. BRACKET, CYLINDER MOUNTING
20. NUT, LOCK
21. CRANK ASSEMBLY
22. ROD END
23. ROD, GEAR LOCK (OR CABLE) SEE NOTE
24. NUT, LOCK
25. ROD END
26. ARM, GEAR RETRACTION
27. PLATE, ATTACHMENT
28. SHAFT
29. FITTING, SHAFT
30. FITTING, GREASE
31. SIDE BRACE, UPPER FWD.
32. SWITCH, DOWNLOCK
33. BRACKET, SWITCH
34. HOOK, DOWNLOCK
35. SIDE BRACE, LOWER
36. SIDE BRACE, UPPER AFT
37. PLATE, MOUNTING
38. BOLT ASSEMBLY
39. VALVE ASSEMBLY
40. HOUSING, GEAR
41. SWITCH, HI-GEAR ONLY
42. LINK, TORQUE, UPPER
43. LINK, TORQUE, LOWER
44. LINE, BRAKE
45. STRUT ASSEMBLY
46. BRAKE ASSEMBLY
47. BRACKET, MOUNTING
48. DISC, BRAKE
49. WHEEL AND TIRE
50. HINGE, OUTBOARD DOOR
51. BEARING HINGE
52. DOOR, OUTBOARD
53. BRACKET, DOOR
54. ROD, RETRACTION
55. HOSE, BRAKE
56. NUT, LOCK
57. WASHER
58. ROD END
59. CYLINDER STOP
60. NUT, LOCK
61. NUT, LOCK
62. PIN, DOWNLOCK
63. CLEVIS BOLT
64. BUSHING
65. WASHER
66. BOLT, HOOK PIVOT
67. BOLT AN178-33
68. SPRING, DOWNLOCK
69. ACTUATOR ROD EMERGENCY GEAR EXTENSION
70. ANTI-ROTATION CLIP

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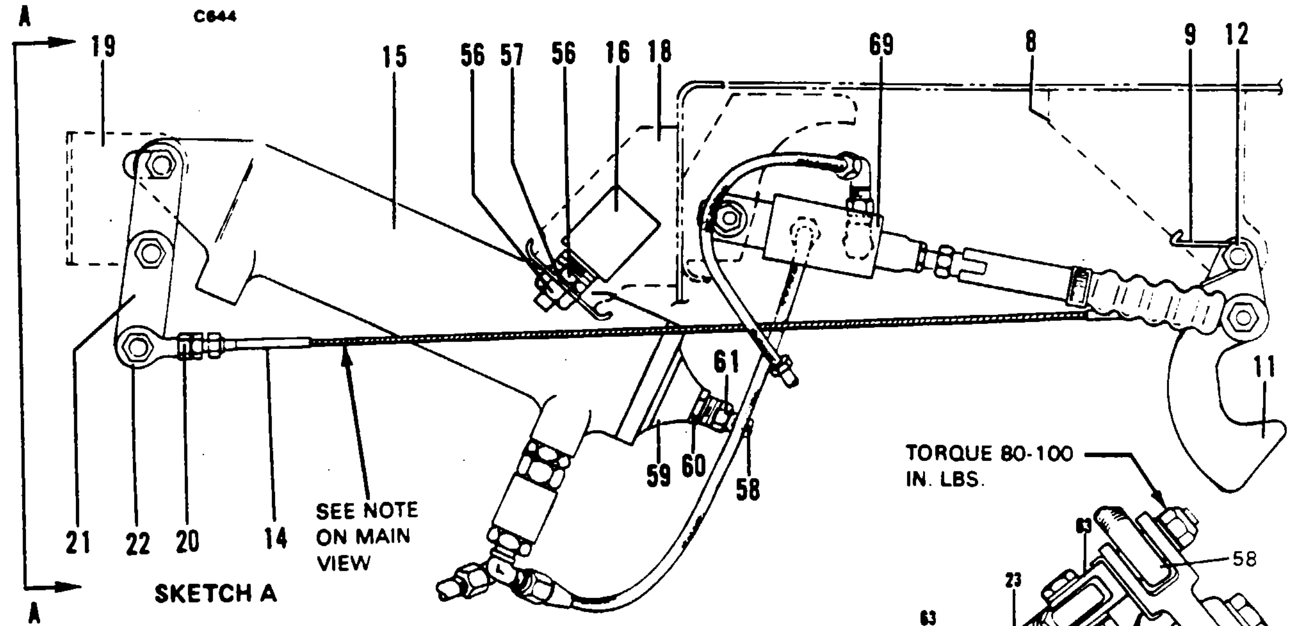
Figure 32-2. Main Landing Gear Installation (Left)



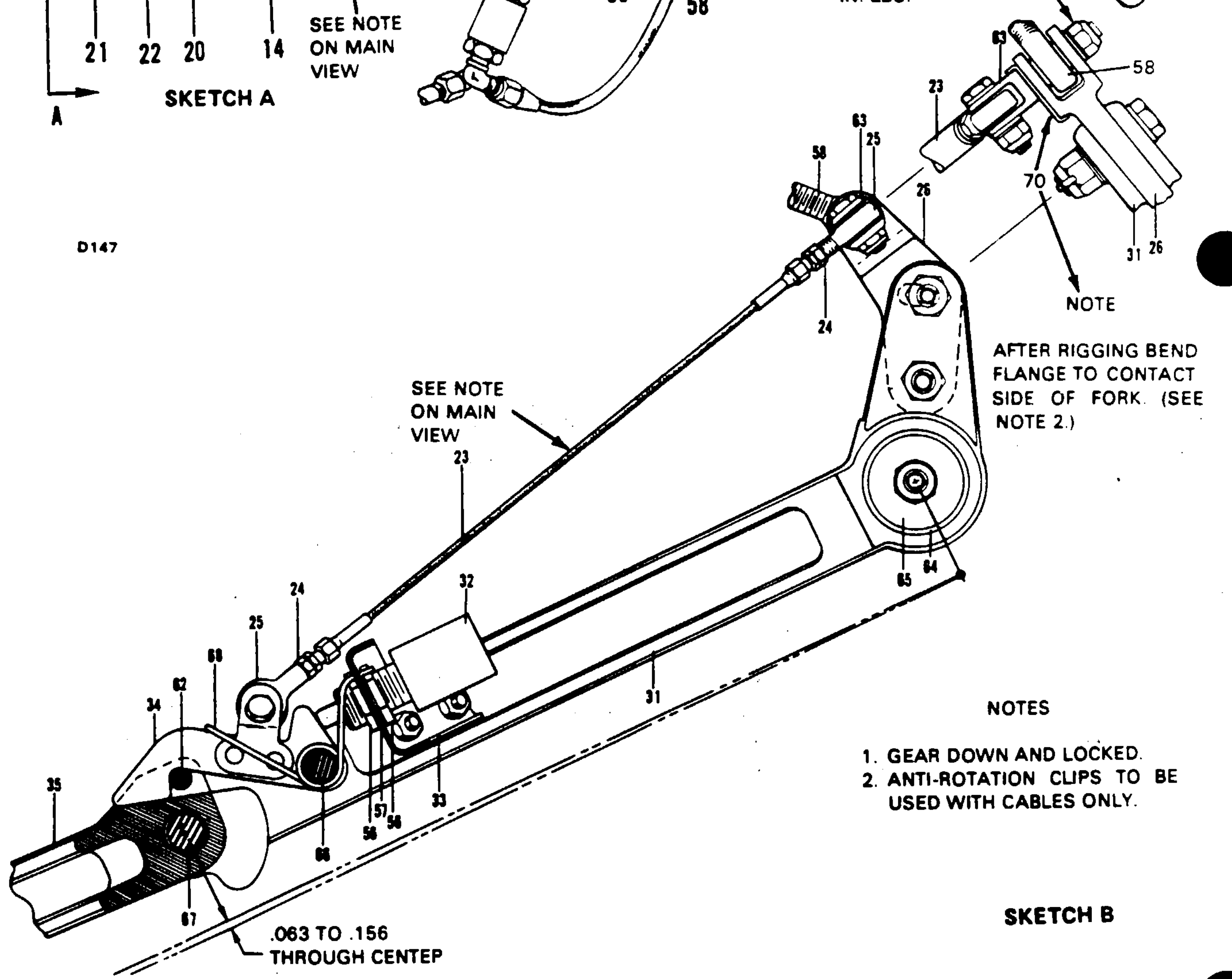


Figure 32-2. Main Landing Gear Installation (Left) (cont.)

C. Place the tool tube through the elongated hole in the tool plate and place the tube over and between the upper link attachment nuts.

D. Swing the plate up and against the head of the bolt that connects the upper and lower links. The plate sleeve slides over the nut or the head of the bolt that connects the lower link to the gear housing.

E. Look through the sight hole in the plate to ascertain that the center of the bolt is 0.063 to 0.156 of an inch below the centerline on the plate.

F. Remove the tool and reinstall the cotter pins.

6. Operate the downlock hook by hand to determine that it engages freely and then open and close the joint several times to assure that the hook is operating properly.

7. If the hook operates properly, determine proper clearance between the hook and pin by engaging the hook and pushing up on the side brace link assembly, where the upper and lower links hinge, until the hook is tight against the pin. This will allow the link stops to separate. Clearance between the stops should not exceed 0.020 of an inch. If clearance exceeds 0.020 of an inch and pin is not worn and the link through travel is within limits; then hook must be replaced.

8. If hook will not clear pin, file inside surface of hook until minimum clearance is reached between the link stops as indicated in Step 6. Be careful to maintain the new surface parallel with the original surface. Replace pin if worn.

— CAUTION —

Do not file pin.

9. To replace pin, cut the pin, file off any burrs left by the cut and drive the pin out from either side. Do not try to drill the pin out as this may damage the link. Install new pin and flange.

10. With the downlock hook engaged, pull the retraction arm located at the top of the forward side brace towards the downlock hook to the limits of its travel. Also pull the downlock operating rod or cable out to its full length and adjust the end until the hook bolt can be freely inserted through the hook lugs.

11. Remove the bolt and extend the end one full turn, tighten the locknut and install the attaching bolt.

12. To adjust the uplock hook, use the following procedure, and put the airplane on jacks.

A. Disconnect the uplock operating rod or cable from the hook.

B. Retract the gear, being careful to keep the rod or cable clear of moving parts.

C. As the uplock roller approaches the hook, operate the hook by hand until the roller is engaged.

D. Determine that the actuator cylinder and crank attaching bolt are outboard in the slots of the attachment bracket.

— NOTE —

This may also be obtained with the actuator attached to the retraction arm and pressure maintained on the actuator.

E. Pull the uplock rod or cable out to its full length and adjust the rod end or cable until the attaching bolt can be freely inserted. Remove the bolt and turn the end out one full turn and install bolt and spacer bushing. Tighten the locknut on the ends.

F. If applicable reinstall the dust boot after the uplock rod is completely adjusted.

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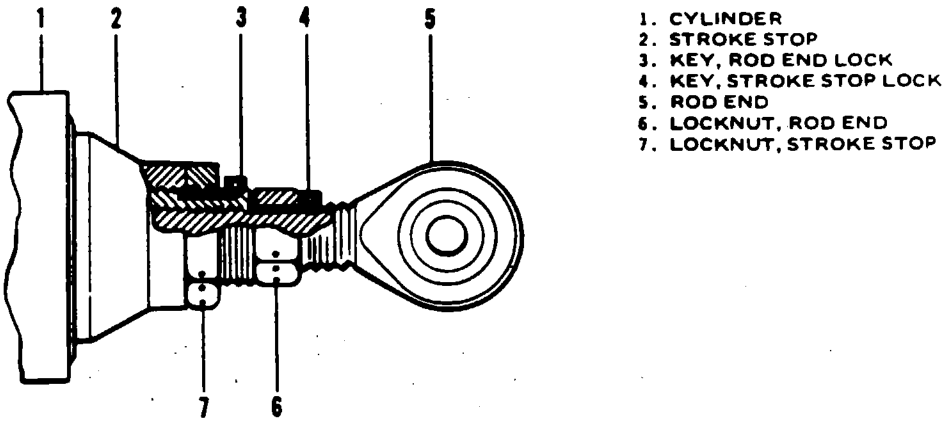

Figure 32-3. Actuator Cylinder

13. Adjust the gear actuator rod end until the uplock roller clears inner hook surface when the piston is bottomed.

— *NOTE* —

Bottom the piston with hydraulic pressure. It may require several adjustments because of deflection in the linkage.

— *CAUTION* —

When installing the fork bolt in the actuator rod end be sure that the forked end is properly aligned with the downlock operating rod or cable.

14. Extend gear and as side braces approach the locked position, apply a side force to the wheel so that the hydraulic actuator must force the linkage into the locked position.

15. Adjust the stroke control stop on the lower end of the actuator to stop the piston travel at this point. Repeat several times to determine that the stroke control is properly adjusted.

16. Back off the stroke stop one-half turn and tighten locknut on stop. Place the key locks between the locknut and the keyway in the rod. Screw the locknut on the rod and keep the key lock centered in the keyway while tightening the locknut. With the locknut torqued, install the lock wire from the key lock to the locknut. Refer to Figure 32-3 which shows the proper installation of the locks and locknuts on the piston rod end.

— CAUTION —

Be sure that all rod ends have sufficient gripping thread by determining that a wire will not go through the check hole in the rod.

ALIGNMENT OF MAIN LANDING GEAR.

1. Place a straightedge no less than fifteen feet long across the front of both main landing gear wheels. Butt the straightedge against the tires at the hub level of the landing gear. Ascertain that the straightedge is the same distance from the forward side of the axle hubs. Devise a support to hold the straightedge in position.
2. Place a spacer block against the wheel rim at the hub line, with the wide end toward the front of the wheel to check and/or adjust the landing gear for proper toe-in of .5 degree. (Refer to Figure 32-4.) Set a square against the straightedge and spacer block and check to see if its outstanding leg bears against the spacer block.

— NOTE —

A carpenter's square, because of its especially long legs, is recommended for checking main landing gear wheel alignment.

3. If a gap appears at the rear, between the block and square, the wheel is toed-out and must be realigned. If a gap appears at the forward end between the block and square, the wheel has too much toe-in and must be realigned to get .5 degree toe-in.
4. To rectify toe-in or toe-out condition, remove bolt connecting upper and lower torque links and remove or add spacer washers to move the wheel in desired direction.
5. Recheck the wheel alignment. If the wheel alignment is correct, safety the castellated nut with a cotter pin. If the misalignment still exists, separate the torque links and add or remove a spacer washer. Limit the number of spacers installed to allow for installation of the cotter pin in the bolt.

MAIN GEAR DOOR ASSEMBLY.

REMOVAL OF MAIN GEAR DOOR ASSEMBLY.

1. To remove the outboard gear door, disconnect the retraction rods from the door and remove the hinge bolts.
2. To remove the inboard gear door, place the airplane on jacks and retract the gear enough to allow the door to open. Disconnect the actuating cylinder rod and remove hinge bolts.

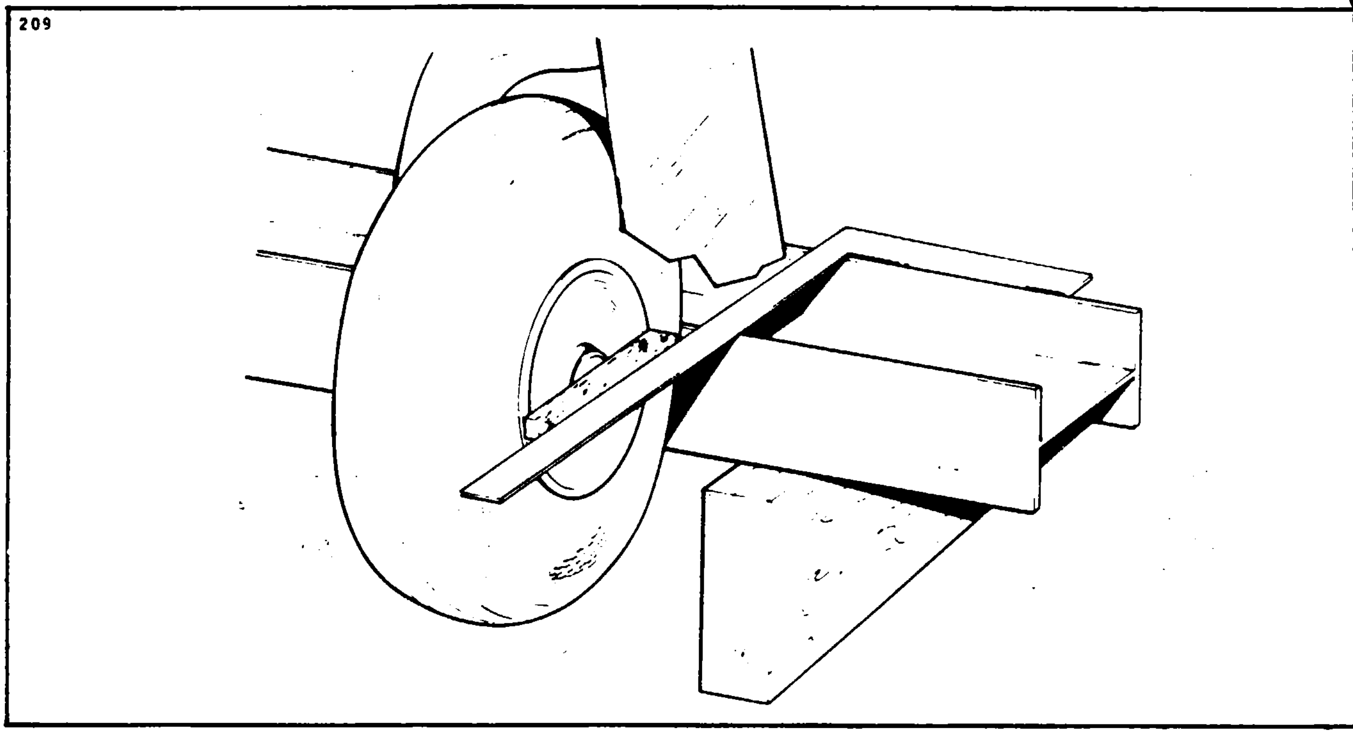

Figure 32-4. Aligning Main Gear

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR DOOR ASSEMBLY.

1. Clean all parts with a suitable cleaning solvent.
2. Inspect the outboard or inboard doors for cracks or bent skin. Loose hinge brackets and worn or corroded bearings.
3. Repair to the door assemblies is limited to replacing hinge bearing, brackets or rivets, minor skin repairs and painting.

INSTALLATION OF MAIN GEAR DOOR ASSEMBLY.

1. The inboard gear door is installed by aligning the hinge bracket holes with the bearings, installing bolt assembly and securing. Install the actuating cylinder rod to the door.
2. The outboard gear door is installed by aligning the hinge bracket holes with the bearings, installing bolt assemblies and securing. Attach the actuating rods between the door and landing gear housing.

ADJUSTMENT OF MAIN GEAR DOORS.

1. Ascertain that the main landing gear has been properly adjusted.
2. Adjust outboard door rods to their maximum length and bolt to the bosses on the gear housing. Retract gear and observe the amount of gap. Shorten rods by several turns of the rod ends and retract gear again. Repeat until door closes properly.

— *CAUTION* —

Damage to the door may result if rods are too short.

3. Adjust inboard door using same procedure as used for outboard door.

— *NOTE* —

Should it be necessary to fit new doors or refit the present doors, maintain a gap of approximately .062 of an inch, except at the hinge side, between the door and the skin surface of the wing. A gap of approximately .093 of an inch should be maintained at the hinge side of the door.

NOSE GEAR AND DOORS.

NOSE GEAR OLEO STRUT.

DISASSEMBLY OF NOSE GEAR OLEO. (Refer to Figures 32-5 and 32-6.)

The nose gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed on the airplane.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Place a drip pan under the nose gear to catch spillage.
3. Remove air and fluid from the oleo. (Refer to Oleo Struts, Chapter 12.)
4. To remove the complete cylinder and fork assembly from the oleo housing as shown in Figure 32-6, cut safety wire, and remove bolt, washer, nut, washer, spring, sleeve and special washers that secure the steering arm to the plate assembly, cut safety wire and remove cap bolt that attach the plate assembly and aligner guide to the top of the oleo cylinder.
5. Disconnect the shimmy dampener by removing the bolt assembly that connects the dampener to the cylinder.
6. Release and remove the retainer ring at the top of the housing and pull the complete cylinder assembly from the bottom of the housing. The upper and lower housing bushings should remain pressed in the housing.
7. To remove the piston tube assembly from the cylinder, separate upper and lower torque links by removing the connecting bolt with washer, nut and cotter pin. Note spacer washer between the two links.

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1. PIN, RETAINER
2. BEARING, UPPER
3. SPACER
4. O-RING, OUTER GASKET
5. BEARING, LOWER
6. O-RING, INNER PACKING
7. WIPER STRIP
8. WASHER
9. RING, RETAINER
10. RING, RETAINER
11. BUSHING, HOUSING TOP
12. CYLINDER, OLEO
13. BUSHING, HOUSING BOTTOM
14. O-RING PACKING
15. TUBE, ORIFICE
16. PLATE, ORIFICE
17. RING, RETAINER
18. GREASE FITTING
19. FORK
20. BOLT ASSEMBLY
21. BOLT ASSEMBLY
22. TORQUE LINK, LOWER
23. WASHER, SPACER
24. BOLT ASSEMBLY
25. TORQUE LINK, UPPER
26. TUBE, PISTON
27. SHIMMY DAMPENER
28. BOLT ASSEMBLY
29. BOLT ASSEMBLY
30. BOLTS AND SAFETY WIRE
31. BRACKET
32. BUSHING
33. STUD, DOOR UPLOCK
34. PLACARD, SERVICE
35. HOUSING, OLEO
36. BUSHING
37. STEERING ARM STOP ASSEMBLY
38. BRACKET ASSEMBLY
39. PLUG, FILLER
40. NOSE GEAR STEERING PLATE
41. VALVE, AIR
42. ARM, STEERING
43. PIN, COTTER
44. SAFETY WIRE
45. DELETED
46. CAM FOLLOWER
47. O-RING, PACKING
48. PLUG, PISTON TUBE
49. DELETED
50. BUSHING
51. STEERING ARM
52. BEARING
53. SPRING
54. WASHER
55. NUT (MS20365-1216C)
56. WASHER
57. BOLT (AN6H-40A)

41860

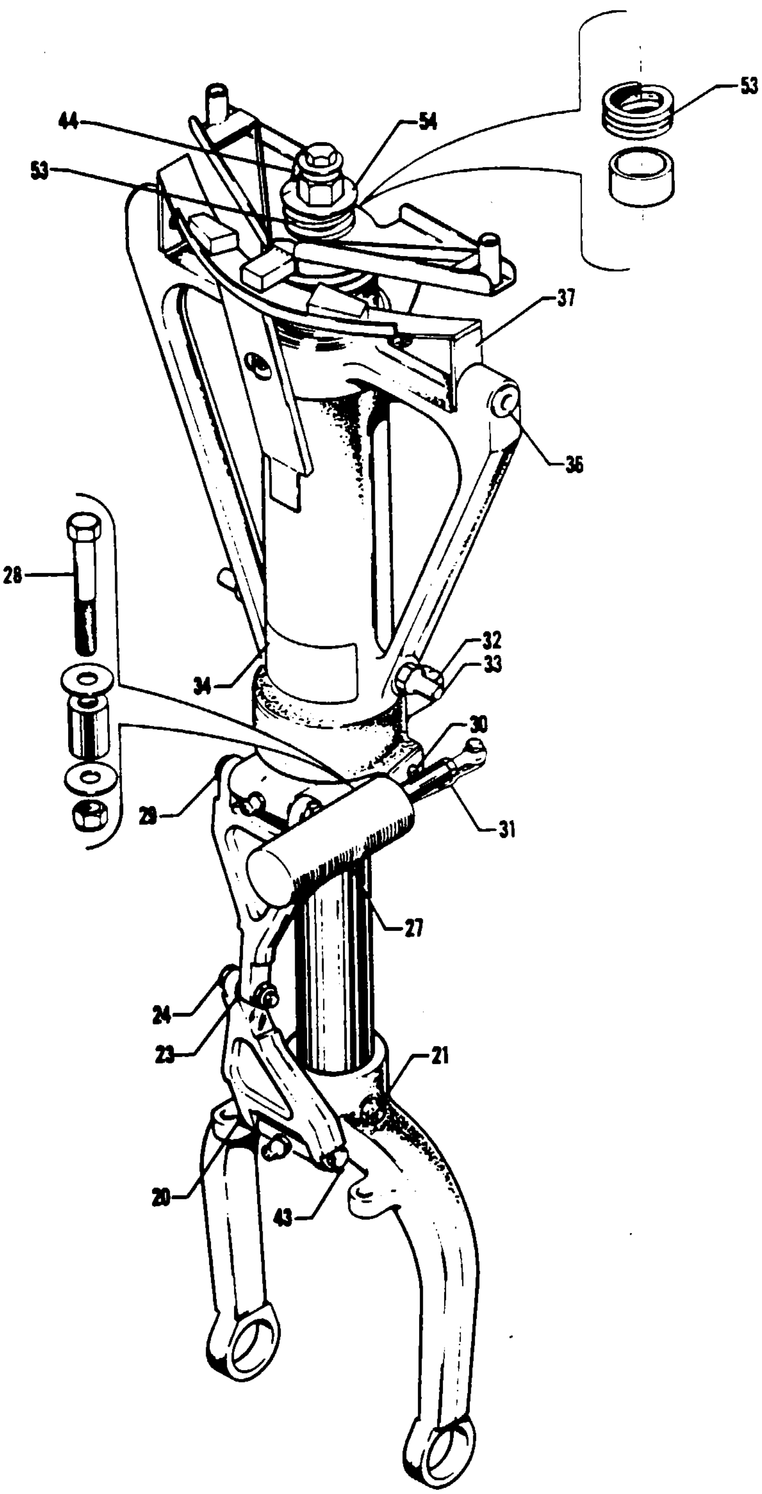

Figure 32-5. Nose Gear Oleo Strut Assembly

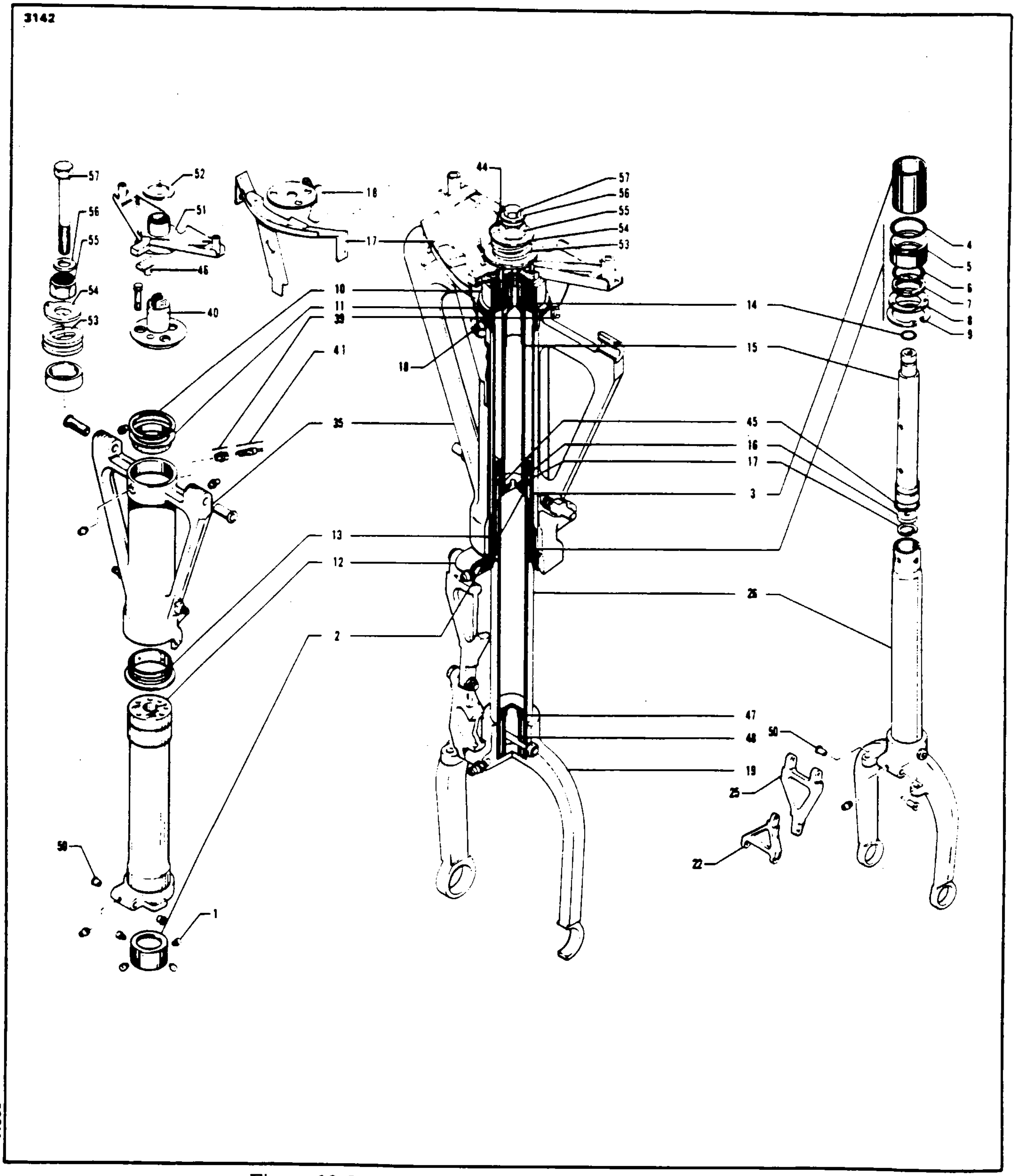

Figure 32-5. Nose Gear Oleo Strut Assembly (cont.)

8. Compress the piston tube, reach up along the tube and release the snap ring from annular slot at the bottom of the oleo housing.
9. Pull the piston tube with component parts from the cylinder.
10. The piston tube components may be removed by reaching in the tube and pushing out the upper bearing retaining pins. Slide off the tube, the upper bearing, spacer, lower bearing with outer and inner O-rings, wiper strip, washer and retainer ring.
11. To remove the orifice tube, remove bolt and washer of the orifice tube from the top of the cylinder. Pull the tube from the cylinder.
12. The orifice plate is removed from the bottom of the orifice tube by releasing the retainer ring that holds the plate in position.

— *NOTE* —

Do not remove piston tube plug from piston tube or piston tube from fork.

CLEANING, INSPECTION AND REPAIR OF NOSE GEAR OLEO.

1. Clean all parts with a 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. Orifice plate for hole restriction.
   F. Fork tube for corrosion, scratches, nicks, dents and misalignment.
   G. Air valve general condition.
3. Repair of the oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.
4. Individual replacement of wiper strips may be achieved.

ASSEMBLY OF NOSE GEAR OLEO. (Refer to Figures 32-5 and 32-6.)

1. Ascertain that parts are clean and inspected.
2. To assemble 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 retainer ring. Lubricate and install the O-ring on the upper end of the tube.
3. Insert the tube up through the bottom of the cylinder. Orifice tube is fully installed in cylinder housing when the upper end of the orifice tube is approximately .062 lower than flush with the upper end of cylinder assembly.
4. The fork tube assembly may be assembled by installing the tube components on the tube. In order, slide onto tube: retainer ring, washer, lower bearing with outer and inner O-rings, spacer and upper bearing. Align lock pin holes of the upper bearing and orifice tube and install pins.

1. SAFETY WIRE
2. BOLT, TORQUE 45-70 IN.-LBS.
3. WASHER
4. NUT, TORQUE 550-560 IN.-LBS.
5. WASHER
6. SPRING
7. SPECIAL WASHERS 2 REQ.
8. ARM STEERING
9. STOP ASSY. STEERING ARM
10. SAFETY WIRE
11. BOLT CAP (AN4H-5A TORQUE 50-55 IN.-LBS.)
12. PLATE ASSEMBLY
13. BRACKET GUIDE
14. RING, RETAINER
15. CLAMP, HOSE - LIGHTS
16. VALVE, AIR
17. HOUSING, OLEO
18. SLEEVE

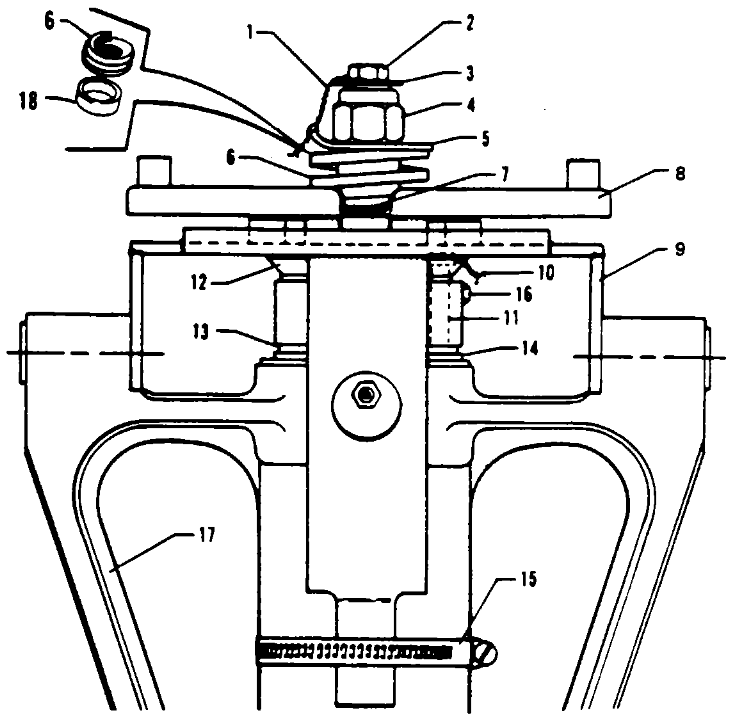

Figure 32-6. Nose Gear Oleo Strut Assembly

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5. Lubricate the inner wall of the cylinder. Carefully insert the piston tube assembly into the bottom of the cylinder, allowing the orifice tube to guide itself into the piston tube, until the retainer ring can be installed in the annular slot at the end of the cylinder. Install wiper strip, slide washer into position and secure assembly with retainer ring.
6. At the top of the cylinder tighten the orifice tube bolt.
7. Install the upper and lower torque links.
8. Ascertain that the upper and lower oleo housing bushings are installed. Install the cylinder into the oleo housing and secure with retainer ring.
9. At the top of the oleo housing, install on the cylinder the aligner guide bracket and steering arm. Torque cap bolts, 30-35 in.-lbs. and safety with MS20995C40 wire.
10. At the top of the oleo housing, as shown in Figure 32-6, install on the cylinder the aligner guide bracket and the plate assembly. Torque cap bolts, 30-35 in.-lbs. and safety with MS20995C51 wire. Install steering arm, special washers, sleeve, spring, washer, nut with torque of 550-560 in.-lbs., washer, bolt with torque of 45-70 in.-lbs., and safety with MS20995C51 wire.
11. Install the shimmy dampener.
12. Lubricate the gear assembly. (Refer to Lubrication Chart, Chapter 12.)
13. Service oleo strut with fluid and air. (Refer to Oleo Struts, Chapter 12.)
14. Check the nose gear for alignment for operation.

NOSE LANDING GEAR.

REMOVAL OF NOSE LANDING GEAR. (Refer to Figures 32-6 and 32-7.)

1. Remove the right and left access panels (sta. 70.0) to the aft interior portion of the nose section. Remove the access plates located on the nose baggage compartment floor panel to gain access to the landing gear attachment bolts. (Refer to Access Plates and Panels, Chapter 6.)
2. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
3. With the hand pump, retract the nose gear slightly to relieve the gear from its downlocked position.
4. To remove the drag link assembly, the following procedure may be used:
   A. Disconnect gear retraction rod from the upper right drag link.
   B. Disconnect the lower drag link from the gear oleo housing.
   C. The upper and lower link assemblies may be removed as one unit by removing the upper drag links attachment bolts at their attachment plates.
5. With the lower drag link disconnected from the gear housing, the gear may be removed by removing the attachment bolt assemblies at the attachment plates on each side of the gear housing. Note, if any, the number and location of spacer washers between the gear housing and attachment plates.
6. The idler link may be removed after the gear operating rod has been disconnected, by the following procedure:
   A. Remove the downlock spring and the eye bolt which is attached to the idler link.
   B. Disconnect the gear actuating cylinder rod from the link.
   C. Remove the link pivot bolt by sliding the bolt out of the link, allowing the head to enter the hole in the side of the limit switch bracket. With the head through the bracket hole, the threaded end of the bolt can continue out of the link.
   D. Remove the idler link.

7. The uplock rod or cable may be removed by removing the nut from the actuating cylinder support bolt and sliding the rod or cable off the bolt. Retain the bolt in place to support the cylinder.

8. The uplock hook may be removed after the removal of the uplock rod or uplock cable and blowdown actuating rod and the hook pivot bolts. Remove the hook with the uplock spring.

— NOTE —

The idler link, uplock rod or cable and uplock hook may also be removed with support tube as one unit.

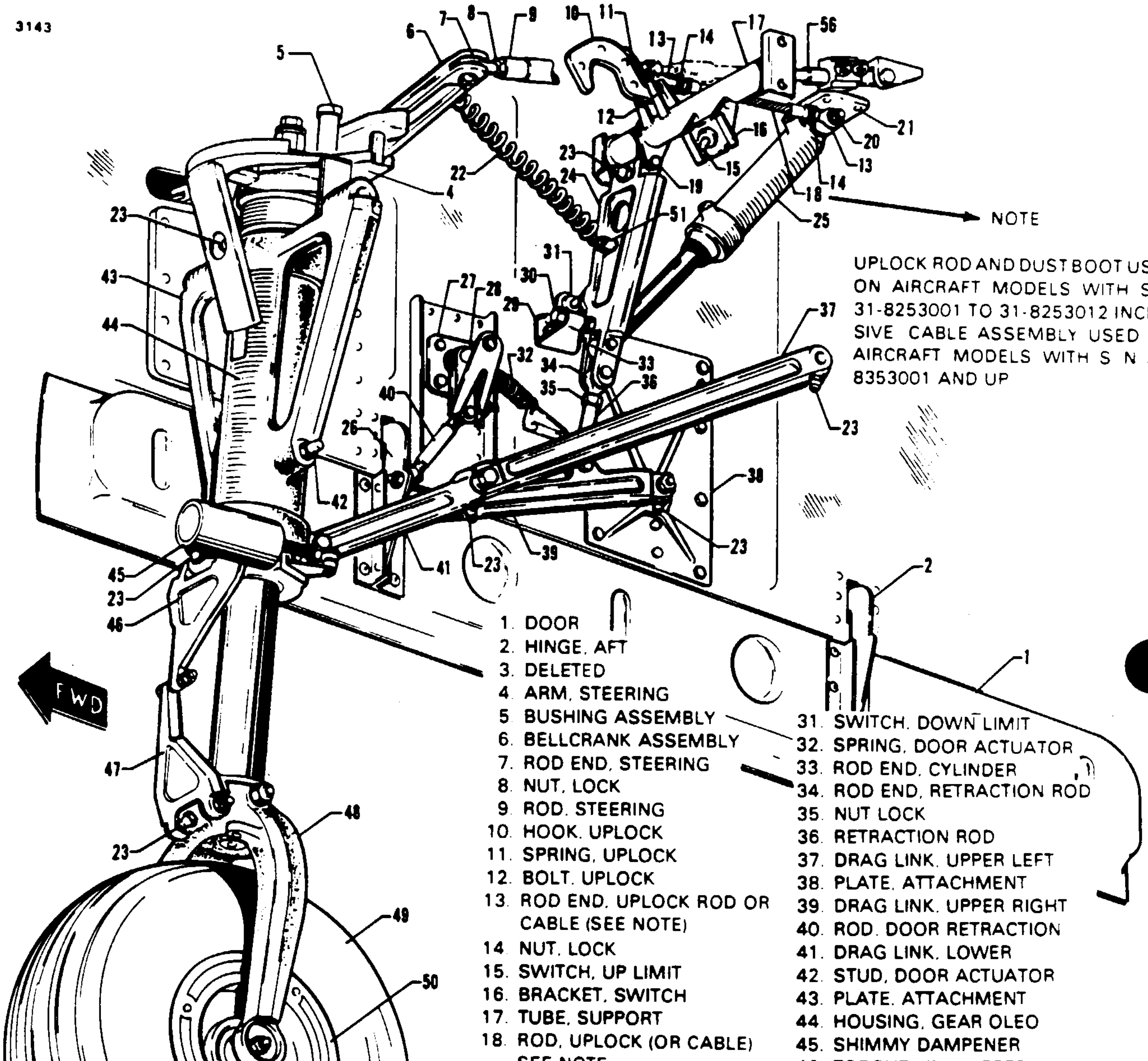
9. To remove the support tube first remove the up limit switch and wire support clamps. Hold the support nuts within the nose section, loosen the support bolts and remove tube.

10. The gear housing attachment plates may be removed by grinding the rivet heads flush with the plate and removing the rivets.

11. The upper drag links attachment plates may be removed by holding the attachment nuts within the nose section and loosening the support bolts.

CLEANING, INSPECTION AND REPAIR OF NOSE LANDING GEAR.

1. Clean all parts with a suitable cleaning solvent.
2. Inspect the landing gear assembly components for the following unfavorable conditions:
   A. Bolts, bearings, bushings and ball joints for excessive wear, corrosion and damage.
   B. Gear housing, drag links, idler link, rods and attachment plates for cracks, bends or misalignment.
   C. Downlock spring for wear, corrosion and not returning to complete compression.
   D. Uplock hook for wear and oversized bearing surfaces.
   E. Uplock roller for freedom of movement and minimum wobble.
   F. Both uplock rods sliding surfaces for corrosion, freedom of movement and lubrication.
   G. Uplock rod or cable and end bearings for corrosion and freedom of movement. Also inspect the sliding surfaces of the uplock rod.
   H. General condition of limit switches.
   I. Wiring for fraying, poor connections or conditions that may lead to failures.
3. Attach the upper and lower drag links and check that when stop surfaces touch, linkage is .063 to .156 inch through center. Should this distance exceed the required through center travel and bolt and bushings are tight, replace one or all drag links.
4. The shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, the dampener should be replaced rather than repaired.
5. Repair to the landing gear is limited to reconditioning of parts such as replacing bearings and bushings, smoothing out minor nicks and scratches, repainting of areas where paint has chipped or peeled and replacement of parts.



UPLOCK ROD AND DUST BOOT USED ON AIRCRAFT MODELS WITH S N 31-8253001 TO 31-8253012 INCLUSIVE CABLE ASSEMBLY USED ON AIRCRAFT MODELS WITH S N 31-8353001 AND UP

1. DOOR
2. HINGE, AFT
3. DELETED
4. ARM, STEERING
5. BUSHING ASSEMBLY
6. BELLCRANK ASSEMBLY
7. ROD END, STEERING
8. NUT, LOCK
9. ROD, STEERING
10. HOOK, UPLOCK
11. SPRING, UPLOCK
12. BOLT, UPLOCK
13. ROD END, UPLOCK ROD OR CABLE (SEE NOTE)
14. NUT, LOCK
15. SWITCH, UP LIMIT
16. BRACKET, SWITCH
17. TUBE, SUPPORT
18. ROD, UPLOCK (OR CABLE) SEE NOTE
19. BOLT ASSEMBLY
20. BOLT ASSEMBLY
21. BRACKET
22. SPRING, DOWNLOCK
23. FITTING, GREASE
24. LINK, IDLER
25. CYLINDER, ACTUATING
26. HINGE, FWD
27. PLATE, DOOR ACTUATOR
28. DOOR ACTUATOR
29. BRACKET
30. STOP BOLT, LINK
31. SWITCH, DOWN LIMIT
32. SPRING, DOOR ACTUATOR
33. ROD END, CYLINDER
34. ROD END, RETRACTION ROD
35. NUT LOCK
36. RETRACTION ROD
37. DRAG LINK, UPPER LEFT
38. PLATE, ATTACHMENT
39. DRAG LINK, UPPER RIGHT
40. ROD, DOOR RETRACTION
41. DRAG LINK, LOWER
42. STUD, DOOR ACTUATOR
43. PLATE, ATTACHMENT
44. HOUSING, GEAR OLEO
45. SHIMMY DAMPENER
46. TORQUE LINK, UPPER
47. TORQUE LINK, LOWER
48. FORK ASSEMBLY
49. TIRE
50. WHEEL
51. BOLT, EYE
52. STOP, STROKE
53. NUT, LOCK AND SAFETY WIRE
54. BEARING, UPLOCK
55. BOLT ASSEMBLY
56. ACTUATOR ROD EMERGENCY GEAR EXTENSION

Figure 32-7. Nose Landing Gear Installation

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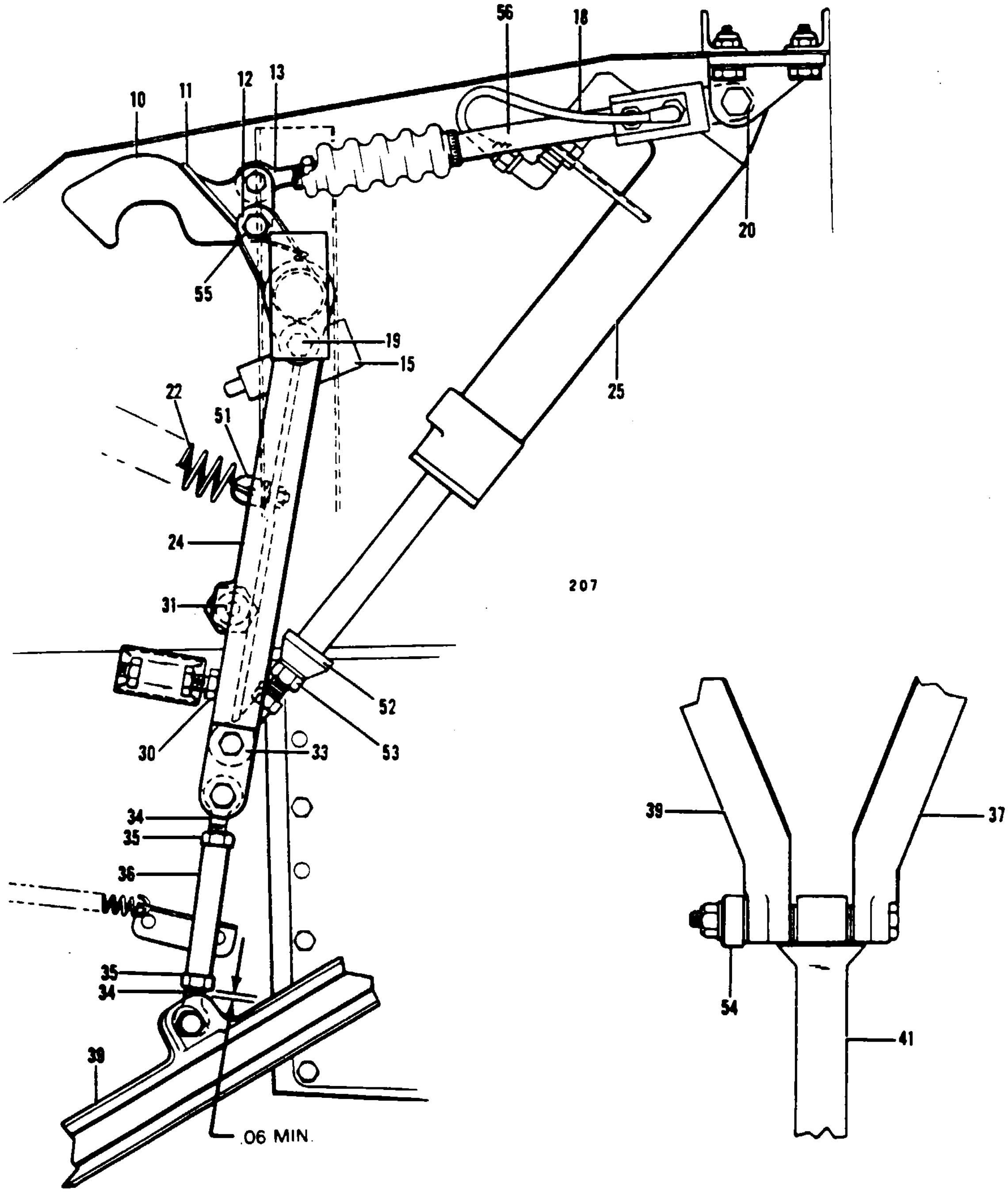

SKETCH A

SKETCH B

Figure 32-7. Nose Landing Gear Installation (cont.)

INSTALLATION OF NOSE LANDING GEAR. (Refer to Figure 32-7.)

— NOTE —

When assembling any units of the landing gear, lubricate bearings and friction surfaces with proper lubricant as described in Chapter 12.

1. Position the right and left upper drag link plates and bolt in place.
2. Position the right and left gear housing attachment plates and rivet in place.
3. Install the support tube and secure. Connect the up limit switch and secure electrical wiring to the tube.

— NOTE —

The uplock hook, uplock rod or cable idler link and retraction rod may be assembled on the support tube as a unit and then installed on the airplane, or each component installed individually after the support tube has been installed.

4. The uplock hook with uplock spring may be installed as follows:
   A. Place the "U" end of the uplock spring over the back of the hook with the loops toward the back.
   B. Spread the spring and snap the loops over the bushing that extends through the hook.
   C. Hook the ears of the spring over the aft side of the hook bracket and push the hook forward until the bolt holes in the bracket align with the holes in the hook.
   D. Bolt the hook in position and ascertain that it rotates freely with no side play, then safety it.
5. Install the uplock rod or cable and blowdown actuating rod by attaching and securing the proper ends to the uplock hook and the other end on the gear actuating cylinder support bolt and the other end of the blowdown actuating rod to its support bracket.
6. The idler link may be installed by the following procedure:
   A. Align the bolt hole in the link with the lug holes of the support tube and with the down limit switch contact boss to the right.
   B. Insert the head of the pivot bolt in to the hole in the side of the up limit switch bracket far enough to allow the threaded end of the bolt to be inserted into the tube lug and link. Tighten the nut on the bolt allowing the link to turn free with no side play.
   C. Attach retraction rod and actuating cylinder rod end to the link. Do not connect retraction rod to link until gear adjustment has been completed.
   D. The downlock spring may be attached after gear check and adjustment has been completed.
7. To install the gear housing assembly, position the gear so that the attachment points on the housing align with the attachment plates. If needed, install spacer washers between attachments to allow a minimum amount of side play. Tighten the pivot bolt nuts to a snug fit, allowing the gear to swing free, then safety pivot bolt nuts.

8. The drag links may be installed as follows:
   A. Align upper and lower drag link bolt holes. Install bolt, uplock bearing and secure.
   B. Ascertain that the linkage through center travel is within tolerance.
   C. Attach the upper drag links to the attachment plates, tighten nuts to a snug fit, allowing the links to swing free, and safety.
   D. Attach the lower drag link to the landing gear housing and temporarily install bolt. Secure and safety bolt after gear has been adjusted.
   E. Manually retract and extend the landing gear several times to ascertain smoothness of operation.
   F. Attach the retraction rod to the upper drag link and adjust the rod to obtain approximately .06 of an inch clearance between the lower locknut and link.

— CAUTION —

Ascertain that the locknuts are tightened against the retraction rod.

9. Grasp the gear fork and rotate to determine that there are no gaps existing between the steering arm travel bushings and steering bellcrank which could cause the nose wheel to shimmy. Bushings are available in several different diameters to establish the proper clearance.
10. Lubricate the landing gear assembly. (Refer to Lubrication Chart, Chapter 12.)
11. Check the nose gear for alignment and operation.

ADJUSTMENT OF NOSE LANDING GEAR. (Refer to Figure 32-7.)

1. With the airplane on jacks and gear extended, disconnect both gear door retraction rods and secure the doors in the open position.
2. To facilitate adjustment of the uplock, disconnect the lower drag link from the landing gear oleo housing.
3. Disconnect the actuating cylinder rod end from the idler link.
4. Ascertain that one end of the downlock spring is disconnected.
5. Rotate the drag link assembly up by hand until the uplock hook engages the uplock bearing.
6. Disconnect the emergency acutator, emergency idler link rod and emergency idler link; locate them clear of the primary gear extension components.
7. Pull the actuating cylinder barrel down and forward until the actuator attaching bolt is at the bottom of the slots in the attachment fitting.

— NOTE —

Actuator cylinder attaching bolt must remain in the bottom of the attachment fitting slots during this adjustment.

8. With both uplock rods or cable fully extended and the hook resting fully on the uplock roller, adjust the ends (uplock rod or cable and blowdown actuating rod) until the attaching bolt on the hook can be freely inserted. Remove the bolt and extend the rod ends one full turn and lock rod ends. Reinstall bolt and secure.

9. Attach the lower drag link to the landing gear housing, secure and safety unless checking link through travel as in Step 10.

10. With the gear in the down position and the stop surfaces of the drag links touching, ascertain that the linkage is .063 to .156 inch through center.

— *NOTE* —

A fabricated tool may be constructed to check through center travel of the drag link assembly while the links are installed on the airplane. (Refer to Chapter 95.)

A. To use the fabricated tool to check through travel of the drag link assembly, ascertain that the gear is in the downlocked position with no hydraulic pressure on the system.

B. Remove the cotter pins that safety the nuts and secure both upper drag links to their attachment plates and the lower link to the gear housing.

C. Place the tool tube through the elongated hole in the tool plate and place the tube over and between the upper link attachment nuts.

D. Swing the plate up and against the head of the bolt that connects the upper and lower links. The plate sleeve slides over the nut of the bolt that connects the lower link to the gear housing.

E. Look through the sight hole in the plate to ascertain that the center of the bolt is .063 to .156 inch below the centerline on the plate.

F. Remove the tool and reinstall the cotter pins.

11. Adjust the retraction rod to provide a distinct snap-through action as the idler linkage passes through center.

12. Adjust the idler link stop bolt on the right side of the wheel well so that the link is .220 to .280 of an inch through center. A straightedge laid from the attachment bolt heads of the idler link and retraction rod will give the through travel measurements.

13. Connect the downlock spring.

14. Extend the actuator cylinder with hydraulic pressure from the hand pump and adjust the rod end until the attachment bolt can be freely inserted. Release pressure and extend the rod end one full turn.

— *NOTE* —

Actuator cylindeer attachment bolt must remain at the top of the attachment fitting slot during adjustment.

15. Reinstall attachment bolt and secure. Tighten rod end locknut. Figure 32-1 shows the piston rod end with installation of locknut and lock.

— *NOTE* —

It may be necessary to partially retract gear to tighten locknut.

16. Retract gear and adjust stroke control stop actuator until the uplock bearing clears the inside of the uplock hook surface by .030 to .060 of an inch. Tighten locknut on stroke control stop. (Refer to Figure 32-3.)
17. Connect landing gear doors and ascertain doors are properly adjusted.

— *CAUTION* —

Ascertain that all rod ends have sufficient thread engagement by inserting a wire in the check hole of the rod.

ALIGNMENT OF NOSE LANDING GEAR.

1. With no load on the nose wheel, make sure no gap exists at the points where the steering arm bushings contact the steering bellcrank, but will allow the bushings to rotate with a slight drag. Install bushings (.438 dia., P/N 14976-12; .625 dia., P/N 14976-23; .687 dia., P/N 14976-21; .812 dia., P/N 14976-102; .750 dia., P/N 14976-13; 1.00 dia., P/N 14175-113) to obtain proper adjustment.
2. Two methods of aligning the nose landing gear are as follows:

CHALK METHOD:

A. Place the airplane on a smooth level floor that will accommodate the striking of a chalk line.
B. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
C. Level the airplane laterally and longitudinally. (Refer to Leveling, Chapter 8.)
D. From the center of the tail skid, extend a plumb bob and mark the contact point on the floor.
E. Extend and attach a plumb from a point that is approximately 24 inches forward along the bottom-center row of rivets as measured from the wheel well opening. Mark the point of contact on the floor.
F. Using the two plumb bob marks as a guide, snap a chalk line, extending several feet beyond each mark.
G. Clamp rudder pedals to align in a lateral position. (Refer to Figure 32-8.)
H. Adjust the rod end bearings of each steering rod to align the nose wheel with the chalk line and to bring the rudder pedals into neutral angle forward and aft. To align the nose wheel straight forward, stand in front of the nose gear and align the center rib of the tire with the chalk line or lay a straightedge along the side of the tire and parallel the straightedge with the chalk line. The neutral angle of the rudder pedals is at station 65.75 and center of the rudder pedal tube. (Refer to Figure 32-9.) One end of each rod must be disconnected and jam nuts loosened to make this adjustment, but do not attempt to make the adjustment by means of one bearing, but divide the adjustment between the bearings at each end of each rod. Check that rod ends have sufficient thread engagement, reinstall rods and secure jam nuts.
I. To check nose gear steering for its 40 degree right and left travel, mark on each side of the nose wheel a 40 degree angle line from centerline and wheel pivot point. Turn wheel to maximum travel in both directions to check for allowable travel. Should travel be exceeded in one direction and not enough in the other direction, check for possible damage to the gear fork or torque links.

JIG METHOD: Fabricate a jig tool conforming to specifications given in Chapter 95.

A. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
B. Level the airplane laterally and longitudinally.
C. Attach the (fabricated) nose wheel jig to the front of the nose wheel at the axle and extend and attach a plumb bob from a point that is approximately 20 inches forward along the bottom-center row of rivets as measured from the wheel well opening. (Refer to Figure 32-10.)

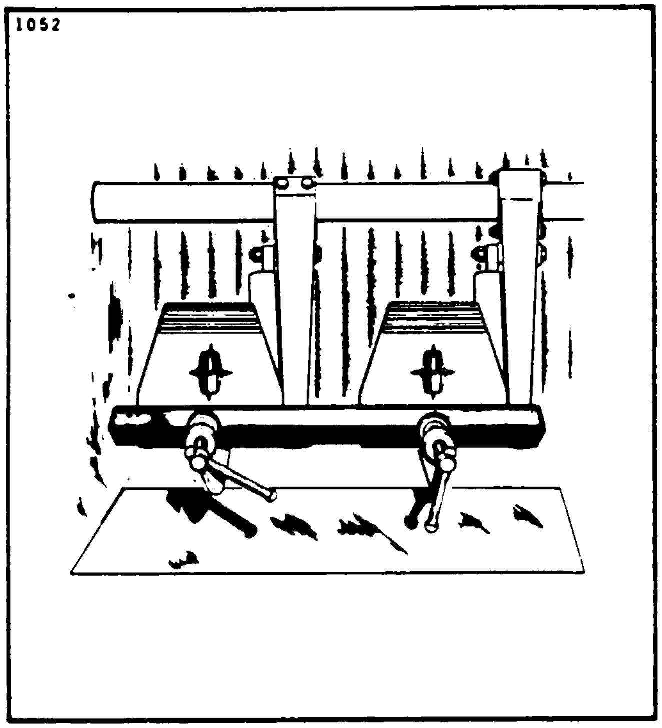

Figure 32-8. Clamping Rudder Pedals in Neutral Position

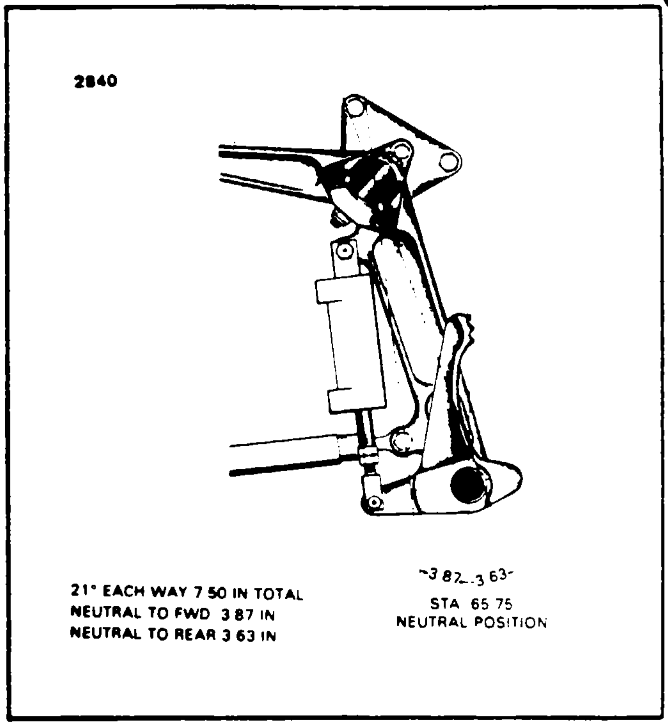

Figure 32-9. Rudder Pedals Neutral Angle

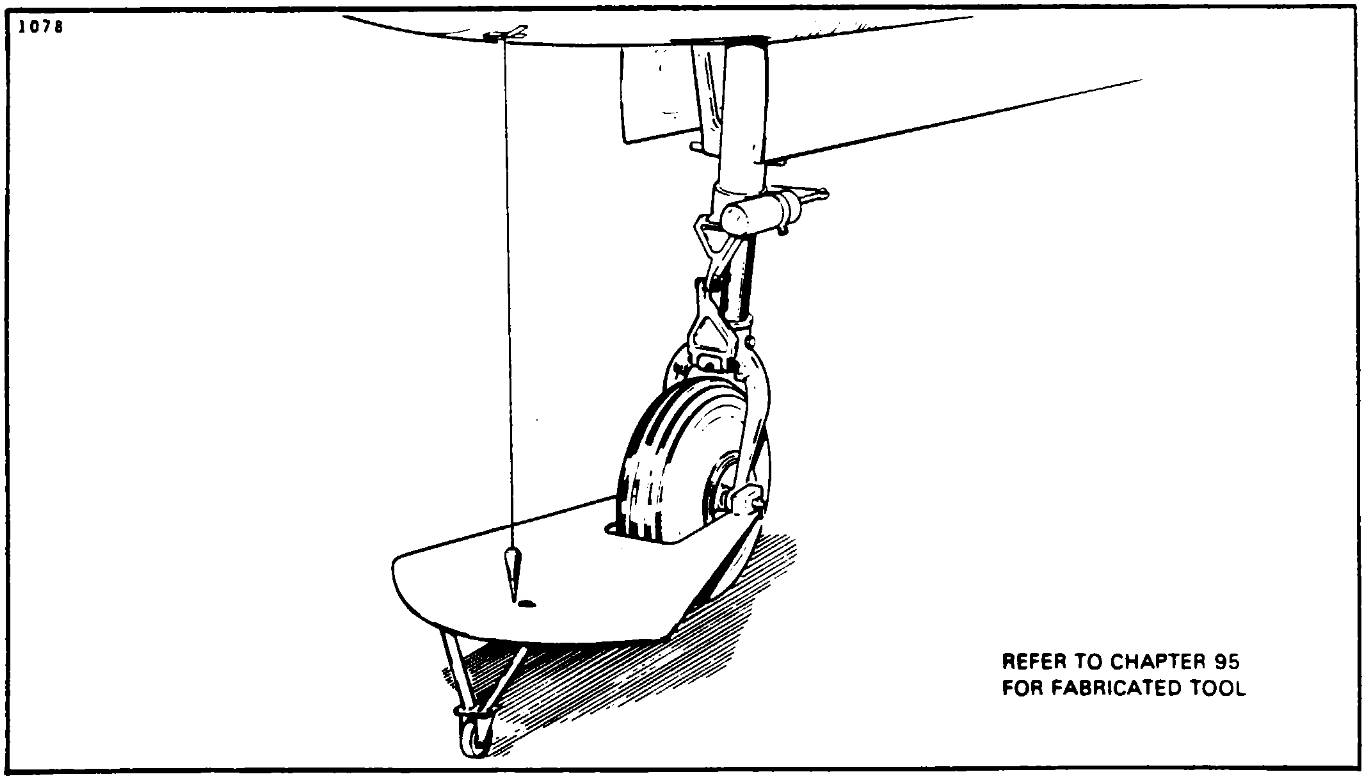

Figure 32-10. Aligning Nose Gear

D. Clamp the rudder pedals to align in a lateral position. (Refer to Figure 32-8.) Adjust the rod end bearings of each steering control rod to align the plumb bob with the centerline marked on the jig end to bring the pedals in neutral angle forward and aft. The neutral angle is at station 65.75 and center of the rudder pedal horizontal tube. (Refer to Figure 32-9.) Do not attempt to make the adjustment by means of one bearing, but divide the adjustment between the bearings at each end of the steering rods. Check that rod ends have sufficient gripping thread by ascertaining that a wire will not go through the check hole in the rod, and then tighten locknut.

E. To check nose gear steering for its 40 degree right and left travel, turn the nose wheel with jig attached in each direction to determine that the plumb bob aligns with the 40 degree marks on the jig.

NOSE GEAR DOOR ASSEMBLY.

REMOVAL OF NOSE GEAR DOOR ASSEMBLY.

1. To remove the gear door, disconnect the retraction rod at the door and remove the hinge bolts at each side of the wheel well.
2. To remove the door retraction mechanism, ascertain that the retraction rod is disconnected, disconnect the downlock spring and remove the snap ring that holds the retraction mechanism on its support shaft. Pull the retraction mechanism from the shaft.

CLEANING, INSPECTION AND REPAIR OF NOSE GEAR DOOR ASSEMBLY.

1. Clean all parts with a suitable cleaning solvent.
2. Inspect the door for cracks or bent skin, loose hinge brackets and worn or corroded bearings.
3. Check the retraction mechanism for worn downlock spring and worn or damaged surfaces.
4. Repair to the door assembly is limited to replacing hinge bearings or rivets and mechanism parts, minor skin repairs and repainting.

INSTALLATION OF NOSE GEAR DOOR ASSEMBLY.

1. To install the door retraction mechanism, position and bolt the unit in place and connect the downlock spring.
2. The gear door is installed by aligning the bracket bolt hole with the hinge, installing bolt assembly and securing. Attach and secure retraction rod.

ADJUSTMENT OF NOSE GEAR DOOR.

1. Ascertain that the nose landing gear has been properly adjusted.
2. With gear up and locked, close one door at a time and adjust door operating rods until bolts can be freely inserted. Shorten rods one full turn of rod end bearings. Do not install bolts.

3. Extend gear and install door operating rod bolts. Adjust "door open" stop bolts to allow door linkage to pass .06 to .12 inches through center.
4. Retract gear slowly and observe that all parts are operating satisfactorily.
5. If gear fails to remain retracted after cockpit handle returns to neutral, it will be necessary to readjust either or both of the following items until gear will lock up.
   A. Increase actuator stroke by turning out stroke control stop.
   B. Relieve door "pinch" by lengthening door operating rods.

EXTENSION AND RETRACTION.

EMERGENCY EXTENSION SYSTEM.

A mechanically actuated pneumatic emergency extension system is incorporated into the landing gear system of the T-1020.

Pressure for emergency extension of the gears is provided by four sealed, disposable gas storage cylinders (one for each main gear and two for the nose gear). These cylinders are located beneath an access cover on the cabin floor between the pilot's and copilot's seats.

GAS STORAGE BOTTLES.

REMOVAL OF GAS STORAGE BOTTLES.

1. To remove the gas storage bottles, gain access to the extender installation cover plate (beneath the access plate between the pilot's and copilot's seats).
2. Unscrew bottles from inflator.
3. Remove gas storage bottle.

TESTING/INSPECTION OF GAS STORAGE BOTTLE.

The bottles should be weighed every 1000 hours to determine if they have developed any leakage. The satisfactory weight of each bottle is stamped on the side of the bottles. If the bottle should fall below the minimum acceptable weight, it should be replaced.

INSTALLATION OF GAS STORAGE BOTTLE.

— NOTE —

If the nose gear emergency extension system has been utilized, both nose gear gas storage bottles must be replaced.

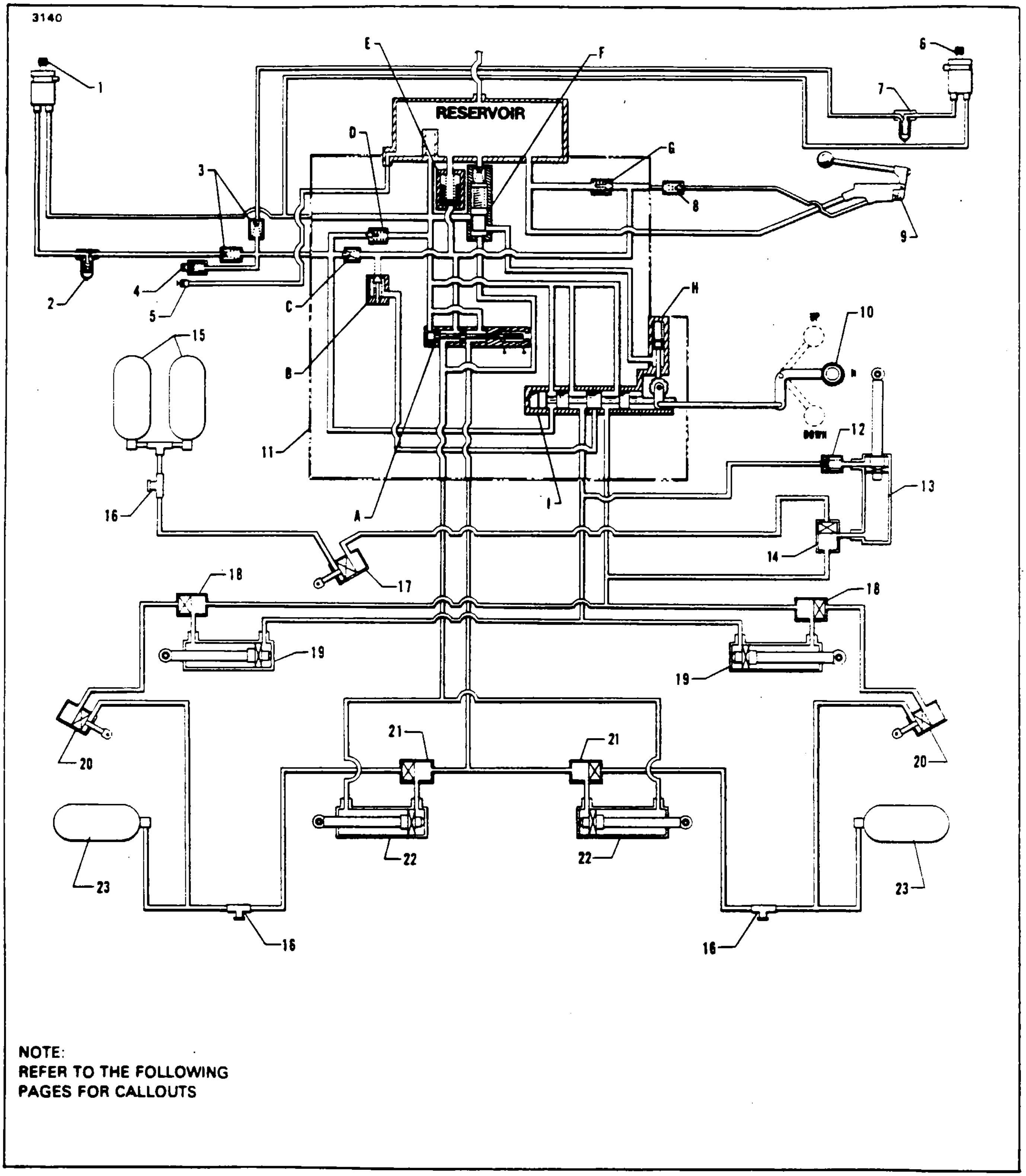

Figure 32-11. Emergency Extension System Installation

1. HYDRAULIC PUMP LEFT ENGINE
2. HYDRAULIC FILTER LEFT ENGINE
3. CHECK VALVE FOR RIGHT AND LEFT ENGINE
4. PRESSURE PORT
5. SUCTION-FILL
6. HYDRAULIC PUMP RIGHT ENGINE
7. HYDRAULIC FILTER RIGHT ENGINE
8. HAND PUMP CHECK VALVE
9. HAND PUMP
10. GEAR SELECTOR (REMOTE)
11. POWER PACK
    A. DOOR SOLENOID VALVE
    B. PRIORITY VALVE
    C. ENGINE PUMP CHECK VALVE
    D. MAIN RELIEF VALVE
    E. LOW PRESSURE THERMAL RELIEF VALVE
    F. TIME DELAY VALVE
11. POWER PACK (CONT.)
    G. HAND PUMP RELIEF VALVE
    H. PISTON RELEASE (LOCK)
    I. LANDING GEAR SELECTOR VALVE
12. RESTRICTOR VALVE
13. NOSE GEAR ACTUATOR
14. SHUTTLE VALVE (NOSE GEAR)
15. NITROGEN CYLINDER (NOSE GEAR)
16. TEST PORTS
17. UNLOCK ACTUATOR (NOSE GEAR)
18. SHUTTLE VALVE (MAIN GEAR)
19. MAIN GEAR ACTUATOR
20. UNLOCK ACTUATOR (MAIN GEAR)
21. SHUTTLE VALVE (MAIN GEAR)
22. MAIN GEAR DOOR ACTUATOR
23. NITROGEN CYLINDER (MAIN GEAR)

Figure 32-11. Emergency Extension System Installation (cont.)

l. Screw gas storage bottles in gear extender installation.

— *CAUTION* —

Exercise care not to accidentally fire bottles when installing them.

REMOVING PRESSURE FROM LINES AFTER ACTIVATION OF SYSTEM.

After activation of one of the gear emergency extension systems, pressure must be removed from the line. This may be accomplished by following the instructions given in "Rigging Emergency Extension System".

RIGGING EMERGENCY EXTENSION SYSTEM.

Rigging of the emergency extension system must be performed following any use of the emergency extension system, pneumatic pressure from the system must be released and the hydraulic system purged per the following procedure.

1. To release the pressure from the affected system, loosen the cap at the tee fitting service port for that gears system till the pressure recedes and leave the cap loose on the fitting.
2. Once the damage has been corrected on the hydraulic system, connect the hydraulic test cart to the hydraulic test ports.
3. Utilizing the test cart, cycle the gear to the down position and then at least six times more to insure the shuttle valve and system is in the hydraulic mode. It may be necessary, depending on the type of damage that may have occurred to the hydraulic system, to actuate the gear more than six times to remove any air in the hydraulic system.
4. Retighten the cap on the service fitting.
5. Remove the access cover plate between the pilot's and copilot's seats.
6. Slowly unscrew the expended gas storage bottle from the actuator assembly being careful to release any residual pressure in the affected system.
7. Reset actuator assembly to the cocked position and insure cable assembly is free to operate.
8. Install replacement bottle and replace access cover plate.
9. Perform function test of affected system.

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TESTING EMERGENCY GEAR EXTENSION SYSTEM FOR OPERATION AND LEAKS.

This test procedure should be used whenever the system has been opened for any service and at each 1000 hour inspection, to insure system operation and integrity. To perform this test a special fitting must be fabricated and installed in place of the gas storage bottles. (Refer to Chapter 95 for details.) Also needed is a source of nitrogen gas such as an industrial 3000 psig. cylinder along with regulator, pressure gauge, control valves and lines. (Refer to Figure 32-11a for suggested hookup and equipment.)

1. Place the airplane on jacks. (Refer to Chapter 7.)
2. Remove one of the nose gear emergency extension gas storage bottles.
3. Remove both of the main gear emergency extension gas storage bottles.
4. Install the fabricated test fitting into one of the open discharger assemblies. Insure that the test valves shown in figure 32-11a are closed.
5. Cycle the landing gear up hydraulically and insure the landing gear selector handle is in the up neutral position.
6. With the 3000 psig nitrogen cylinder attached to the test fitting, adjust the cylinder regulator to 1000 psig.
7. Open the dischage valve on the test rig and insure that the particular landing gear extends properly and that there is no mechanical interference during the extension cycle.

— NOTE —

The main gear will contact the inboard gear doors during the extension cycle, however these doors should not significantly impede the main gear extension. The main gear must not "hang-up" on the main gear doors. Should interference be evident, the inboard gear door unlocking mechanism is improperly rigged. (Refer to Chapter 32 for rigging instructions.)

8. Close the discharge valve on the test rig and note the pressure on the test gauge.
9. After two minutes the pressure trapped in the system must not decrease by more than 50 psig (950 psig min.). Should pressure below this limit check entire system for leaks. Make repairs and retest.
10. Perform steps 4 thru 9 on the other two remaining landing gear emergency extension system.
11. Upon successful completion of this test, open the vent valve then remove all test equipment and reinstall the gas storage bottles and secure in place.

— CAUTION —

Exercise care not to accidentally fire the bottles when installing them.

12. Ascertain that the landing gear is down and locked and the selector handle is in the down neutral position prior to removing the airplane from jacks. (Refer to Chapter 7.)

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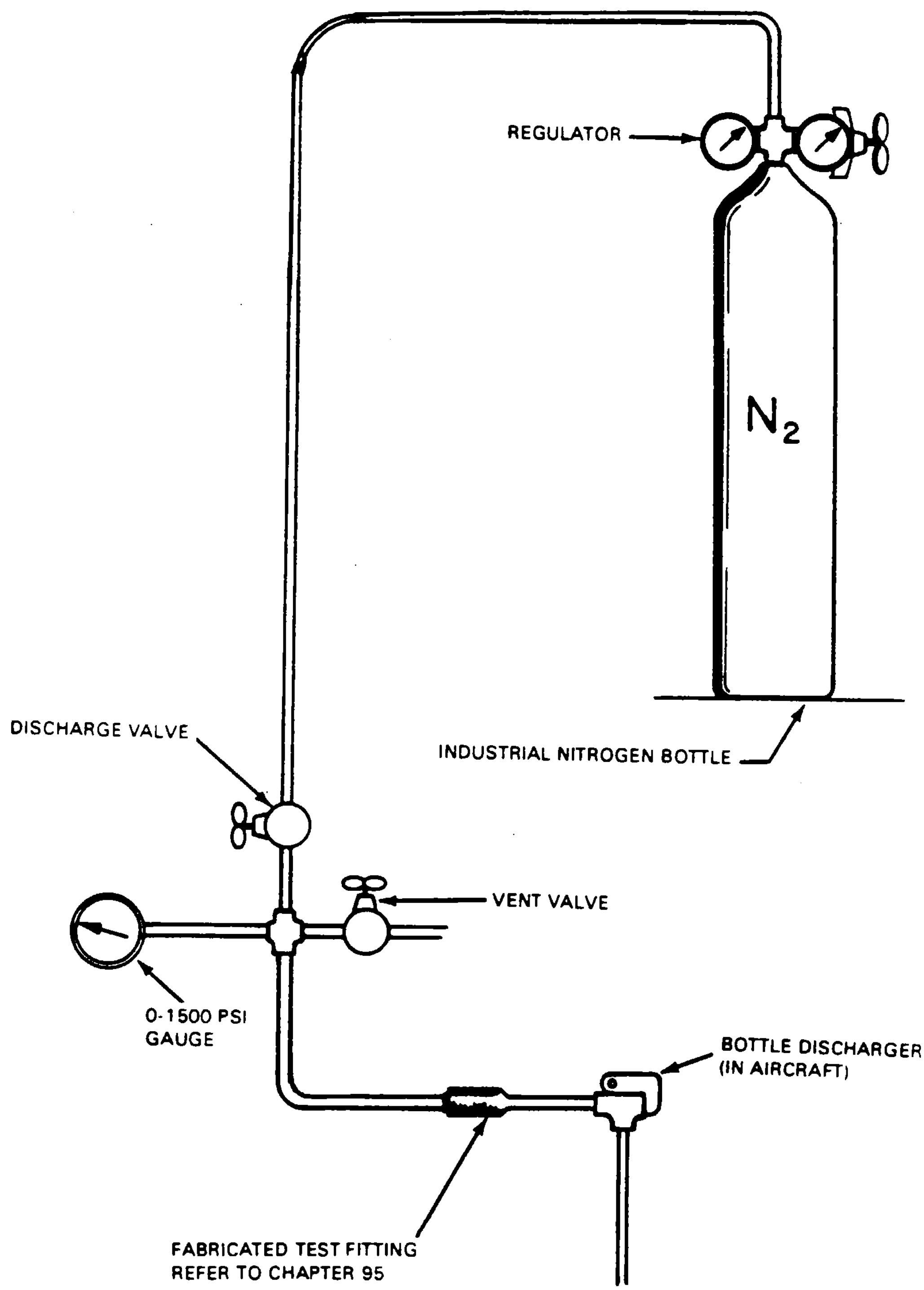


Figure 32-11a. Test Equipment Installation, Emergency Gear Extension System

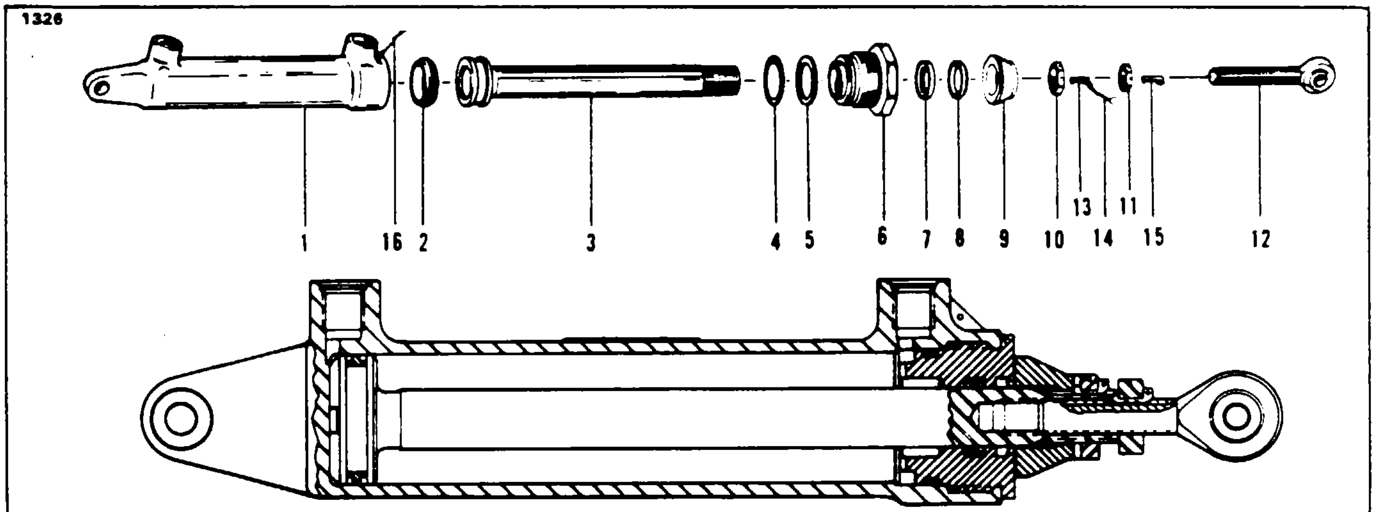
GEAR ACTUATING CYLINDERS.

REMOVAL OF GEAR ACTUATING CYLINDER.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Disconnect the hydraulic lines and shuttle valves from the actuating cylinder and cover the open line ends to prevent contamination.
3. Disconnect the cylinder operating rod end from the link assembly.
4. Disconnect the attachment end of the cylinder by removing the bolt that secures the cylinder and nose gear uplock rod or the main gear uplock crank assembly.
5. Remove the cylinder from the wheel well.

DISASSEMBLY OF GEAR ACTUATING CYLINDER. (Refer to Figure 32-12.)

1. Before disassembly, establish rod end engagement distance to aid in preliminary assembly of the actuating cylinder.
2. Loosen nut to disengage key and remove rod end.
3. Cut safety wire and remove. Remove nut, key and stop from piston.
4. Remove safety wire and end cap from the cylinder body by unthreading end cap and pulling out the piston.
5. Slide end cap from the piston.



1. CYLINDER BODY
2. GT-RING
3. PISTON
4. "O" RING
5. BACK UP
6. END CAP
7. GT-RING
8. SCRAPER
9. STOP
10. NUT
11. NUT, SELF LOCKING
12. ROD END
13. KEY
14. WIRE, SAFETY
15. KEY
16. WIRE, SAFETY

Figure 32-12. Gear Actuating Cylinder (Wiebel Tool WTC 2115-1)

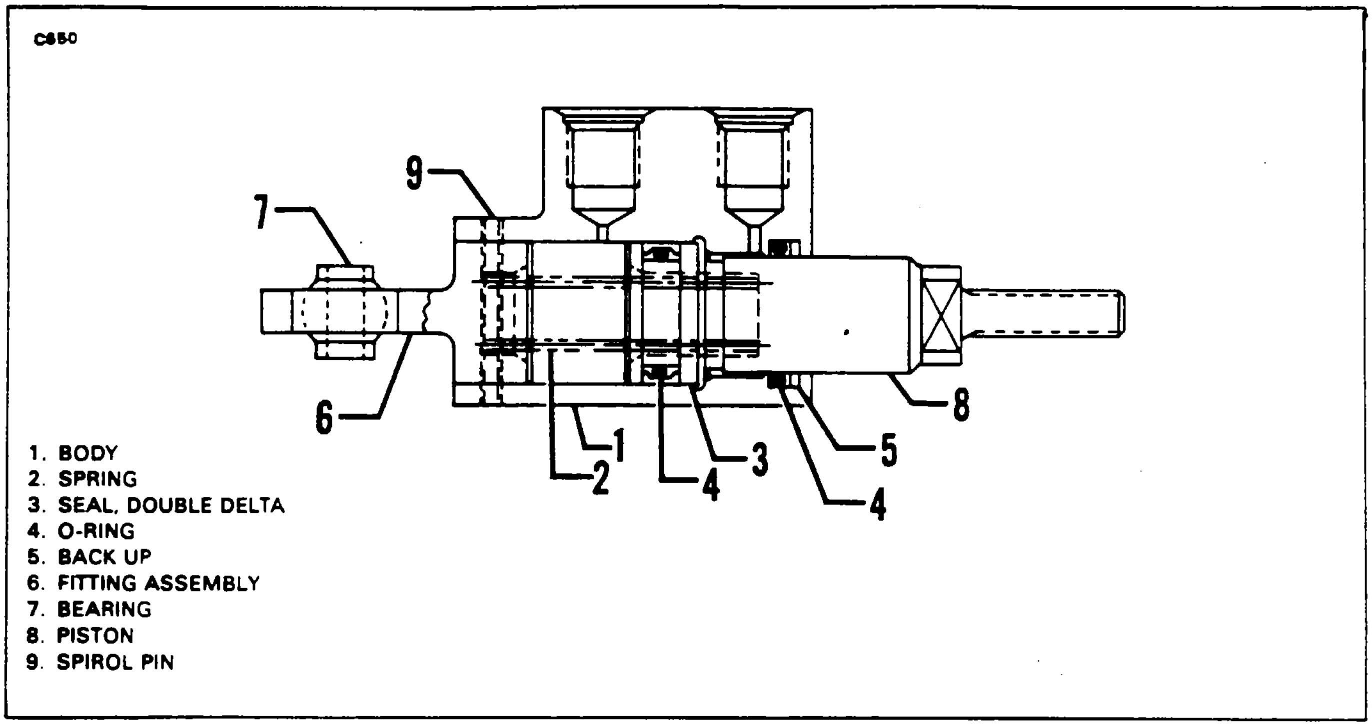


Figure 32-13. Unlock Actuator (Wiebel Tool WTC 2215)

CLEANING, INSPECTION AND REPAIR OF GEAR ACTUATING CYLINDER.

1. Clean the cylinder parts with a suitable solvent and dry thoroughly.
2. Inspect the cylinder interior walls and piston exterior surfaces for scratches, burrs, corrosion, etc.
3. Inspect threaded areas for damage.
4. Inspect the rod end fitting for wear and corrosion.
5. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc., and replacing parts.

ASSEMBLY OF GEAR ACTUATING CYLINDER. (Refer to Figure 32-12.)

Lubricate all parts with hydraulic fluid per MIL-H-5606 prior to assembly.

1. Install GT-ring on the head of the piston.
2. Install back up and O-ring into outside groove of end cap.
3. Install GT-ring and scraper into inside grooves of end cap. Tapered lip of scraper to face outward.
4. Lubricate the piston assembly, the end cap assembly and the bore of the cylinder body.
5. Slide the end cap assembly onto the piston assembly.
6. Slide the piston with the end cap into the cylinder, tighten the end cap by torquing to 65 inch-pounds and secure to the cylinder body using safety wire.
7. Install the stop and the nut with key on the piston.
8. Install the rod end with nut and key into the piston.
9. Adjust stop for proper piston stroke, tighten nut by torquing to 65 inch-pounds and secure by wiring nut to key using safety wire.
10. Adjust rod end to preliminary length obtained before disassembly. (Refer to Adjustment of Landing Gear for final adjustments.) Engage key and tighten nut to a torque of 85 inch-pounds.

INSTALLATION OF GEAR ACTUATING CYLINDER.

1. Position the attachment end of the cylinder and the uplock rod end of the nose gear or the uplock crank assembly of the main gear on their mounting bracket. Install attachment bolt and secure.
2. Connect the operating rod end of the cylinder to the gear link assembly.
3. Connect the hydraulic lines and shuttle valves to the cylinder.
4. Check operation of the installation and landing gear rigging.
5. Remove the airplane from jacks.

EMERGENCY UPLOCK ACTUATOR.

REMOVAL OF ACTUATOR.

1. Place the aircraft on jacks. (Refer to Jacking, Chapter 7.)
2. Disconnect the pneumatic lines and cover the open line ends to prevent contamination.
3. Remove the bolts, the uplock rod ends and remove actuating assembly.

DISASSEMBLY OF ACTUATOR.

1. Remove two spiral pins and remove end cap and spring from actuator body.
2. Remove the piston.

CLEANING, INSPECTION OF ACTUATOR.

1. Clean the actuator parts with a suitable solvent and dry thoroughly.
2. Inspect the actuator interior walls and piston exterior surfaces for scratches, burrs, corrosion, etc.
3. Inspect threaded area for damage.
4. Inspect rod end fitting for wear and corrosion.
5. Repairs to the actuator are limited to polishing out small scratches, burrs, etc., and replacing parts.

ASSEMBLY OF ACTUATOR.

Lubricate all parts with hydraulic fluid per MIL-H-5606 prior to assembly.

1. Install back up and O-ring into actuator. (Refer to Figure 32-13.)
2. Install O-ring on piston.
3. Install piston, spring, end cap in actuator body and secure with spirol pins.

INSTALLATION OF ACTUATOR.

1. Position the attachment ends of the actuator on their mounting brackets and secure with mounting bolts.
2. Connect the pneumatic lines to actuator.
3. Check operation of installation.

GEAR DOOR ACTUATING CYLINDERS.

REMOVAL OF GEAR DOOR ACTUATING CYLINDER.

1. With master switch off, actuate the hand pump handle to bring the gear door down.
2. Disconnect the hydraulic lines from the actuating cylinder and cover the open line ends to prevent contamination.
3. Disconnect the cylinder from the door and its mounting bracket.
4. Remove the cylinder from the wheel well.

DISASSEMBLY OF GEAR DOOR ACTUATING CYLINDER. (Refer to Figure 32-14.)

1. Unlock the cylinder by applying hydraulic pressure to the clevis end port. Extend piston all the way.
2. Loosen locknut and remove rod end from piston. Remove locknut from piston.
3. Remove safety wire from nuts. Loosen both nuts.
4. Remove end cap from barrel but leave end cap on piston.
5. Remove clevis end from barrel. Pull piston with end cap from barrel. Use care when pulling piston out of barrel to prevent the loss of the six balls which are nested in the head end of the piston.
6. Remove end cap from piston.
7. Pull race, plunger and spring out of the clevis end.
8. Remove GT-ring from end cap.
9. Remove O-rings and the back up rings from the barrel.
10. Remove GT-ring from piston.
11. Remove O-ring and back up ring from plunger.

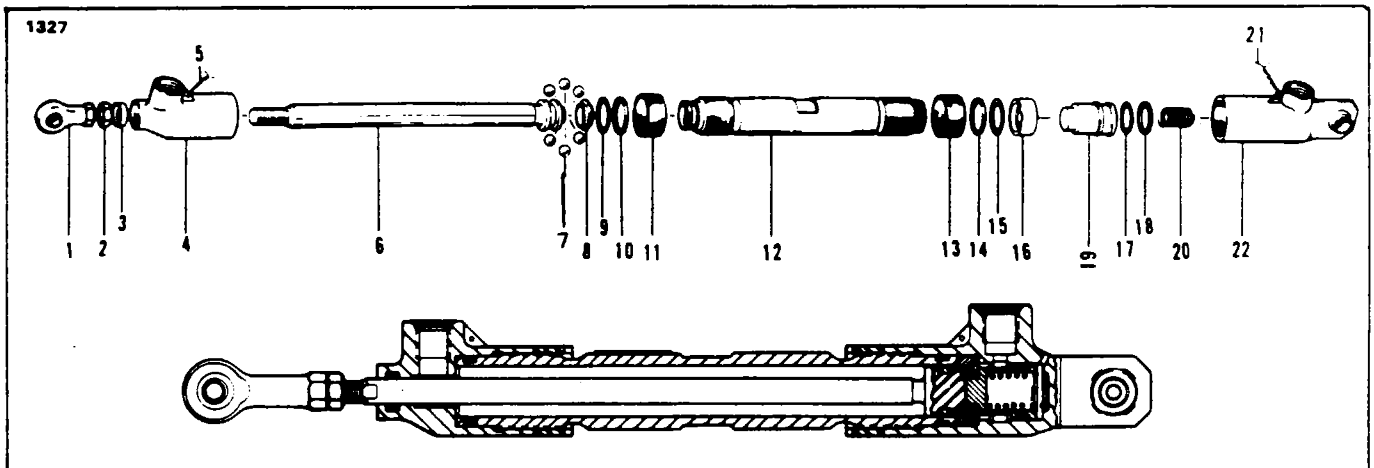
CLEANING, INSPECTION AND REPAIR OF GEAR DOOR ACTUATING CYLINDER. (Refer to Figure 32-14.)

1. Clean the cylinder parts with a suitable solvent and dry thoroughly.
2. Inspect all threaded surfaces for cleanliness and for freedom of cracks and excessive wear.
3. Inspect the plunger spring for evidence of breaks and distortion. Compress the spring to a length of .750 inches and measure load. Load should be 30 ± 2 pounds.
4. Inspect the end cap, piston, barrel, race, plunger and clevis end for cracks, chips, scratches, scoring, wear and surface irregularities which may affect proper function of the door actuator cylinder.
5. Repair of most parts of the landing gear door actuator assembly is impractical. Replace defective parts with new parts. Minor scratches and scores may be removed by polishing with "fine abrasive" crocus cloth (Federal Specifications P-C-458) providing their removal does not affect the operation of the actuator assembly. Replace all O-rings, back up rings and GT-rings with new ones during the reassembly of the actuator.

ASSEMBLY OF GEAR DOOR ACTUATING CYLINDER. (Refer to Figure 32-12.)

Lubricate all parts with hydraulic fluid per MIL-H-5606 prior to assembly.

1. Install O-ring and back up ring into groove of plunger.
2. Install nut and nut on barrel.
3. Install back up rings and O-rings into grooves of barrel.
4. Install spring, plunger and race into clevis end and secure by screwing barrel into clevis end. Tighten barrel down against the race, and torque to 120 to 140 inch-pounds. Then tighten nut against the clevis end and torque to 120 to 140 inch-pounds.
5. Install GT-ring into groove of piston.
6. Install GT-ring into groove inside the end cap.
7. Slide piston into the end cap, install six balls into holes in piston head and insert assembly into bore of barrel. Screw end cap onto barrel and align port in end cap with port in clevis end. Tighten nut against end cap and torque to 120 to 140 inch-pounds.
8. Secure nut to end cap using safety wire.
9. Secure nut to clevis end using safety wire.
10. Install locknut and rod end on piston.
11. Adjust rod end to achieve proper length of actuator assembly and lock with locknut.



1. ROD END
2. LOCK NUT
3. GT-RING
4. END CAP
5. SAFETY WIRE
6. PISTON
7. BALL
8. GT-RING
9. "O" RING
10. BACK UP
11. NUT
12. BARREL
13. NUT
14. BACK UP
15. "O" RING
16. RACE
17. "O" RING
18. BACK UP
19. PLUNGER
20. SPRING
21. SAFETY WIRE
22. CLEVIS END

Figure 32-14. Gear Door Actuating Cylinder (Wiebel WTC 2114-1)

INSTALLATION OF GEAR DOOR ACTUATING CYLINDER.

1. Position the cylinder on its mounting bracket and secure with attachment bolt.
2. Extend the cylinder control rod enough to attach the rod end to the door and secure with attachment bolt.
3. Connect the hydraulic lines to the cylinder.
4. To bring the gear door back to the closed position, turn the master switch ON, place the gear selector switch in the down position and actuate the hand pump until the door closes.

HIGH ALTITUDE GEAR OPERATION.

Should it be necessary to operate the landing gear above 15,000 feet, the landing gear selector may return to its neutral position before the gear door closing cycle is complete. If this occurs, manual override of the time delay cycle must be used to close the gear doors.

During gear extension, if the selector returns to neutral at the same time the gears are locked down, and before the gear doors have had time to close, again select the gear down position and hold the handle down for an additional 3 to 4 seconds. This allows completion of the door closing cycle.

During gear retraction, if the selector returns to neutral and the gear unsafe light remains lit, again select the gear up position and hold the handle up for 4 seconds after the gear unsafe light extinguishes. Be sure that the light has extinguished before exceeding the maximum gear extended speed.

WHEELS AND BRAKES.

MAIN WHEEL ASSEMBLY.

REMOVAL AND DISASSEMBLY OF MAIN WHEEL. (Refer to Figure 32-15.)

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. To remove the main wheels, remove the bolts that join brake cylinder and lining back plate assemblies.
3. Remove the brake assembly.
4. Remove the snap ring that secures the axle hub cap. Remove the cotter pin and axle nut. Slide the wheel off the axle.
5. The wheel may be disassembled by removing the valve core and completely deflating the tire. Break tire bead from wheel by using a mallet. Remove the wheel through bolts. Separate the wheel halves from the tire by removing the wheel half opposite the valve stem first and then the other half.

— *CAUTION* —

Do not pry between the wheel flange and tire bead with sharp tools, as this could damage the wheel and tire.

6. Remove the bearing cone by removing snap ring securing the grease seal and seal retainers. The bearing cup should be removed only for replacement.

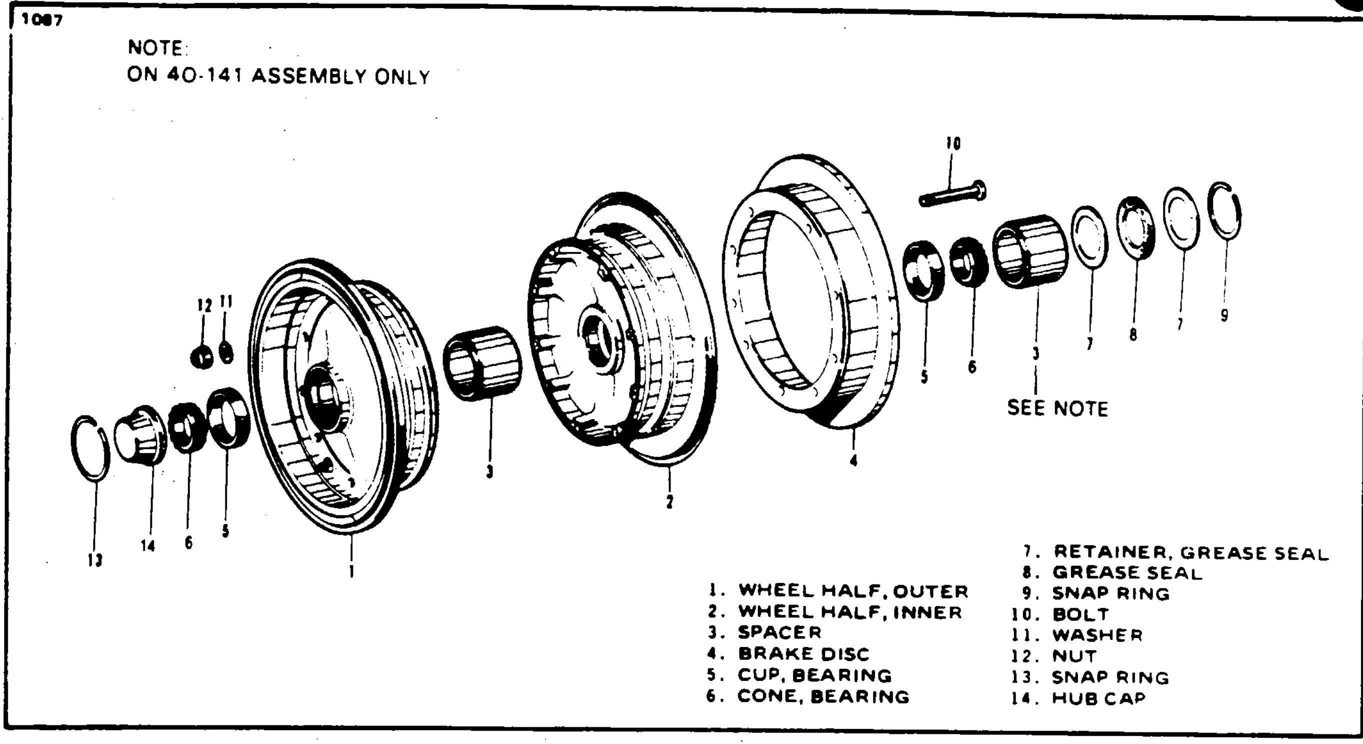


Figure 32-15. Main Wheel Assembly (Cleveland)

INSPECTION OF MAIN WHEEL ASSEMBLY.

Inspect brake disc for cracks, excessive wear or scoring, rust, corrosion and warpage. Remove rust and blend out nicks, using fine 400 grit sandpaper. Replace disc if cracked or when disc is worn below minimum thickness. (Refer to Figure 32-16.) Ascertain that the latest revision of Piper Service Letter 766 is complied with if applicable. In addition also perform the same inspection given for nose wheel.

REPAIR OF MAIN WHEEL ASSEMBLY.

Repairs are limited to blending out small nicks, scratches, gouges and areas of slight corrosion, plus the replacement of parts which are cracked or badly corroded.

— NOTE —

Remove rust and blend out small nicks, using fine 400 grit sandpaper.

Wheels may also be repainted if the parts have been repaired and thoroughly cleaned. Paint exposed areas with one coat zinc chromate primer and one coat of aluminum lacquer.

— NOTE —

Never paint working surfaces of the bearing cups.

1. Bearing Cup Replacement:
   A. Removal:
      (1) Insert wheel half into boiling water for 15 minutes or place in an oven not exceeding 250°F (121°C) for 15 minutes.
      (2) Remove from source of heat and invert wheel half. If the cup does not drop out, tap the cup evenly from the axle bore with a fiber drift pin or suitable arbor press.
   B. Installation:
      (1) To replace a new cup apply one coat of zinc chromate primer to wheel half bearing bore.
      (2) Insert wheel half into boiling water for 15 minutes or place in an oven not exceeding 250°F (121°C) for 15 minutes. Chill new bearing cup in dry ice for a minimum of 15 minutes.
      (3) Remove wheel half from source of heat and bearing cup from the dry ice. Install the chilled bearing cup into the gearing bore of the heated wheel half. Tap gently to seat evenly in place, using a fiber drift pin or suitable arbor press.

ASSEMBLY AND INSTALLATION OF MAIN WHEEL. (Refer to Figure 32-15.)

1. Ascertain that the bearing cup in each wheel half is fully seated in the wheel housing. Lubricate the bearing cones per lubrication chart in Chapter 12. Install cone, grease seal retainer, grease seal felt, and snap ring into the proper wheel halves.
2. Inflate the tube sufficiently to round it out. Install tube into tire so that balance mark (yellow or white band) is radially aligned with the tire balance mark (red dot).
3. Place outer wheel half into tire and pull tube valve stem through valve hole. Turn tire and outer wheel half over and place the spacer (refer to Figure 32-15) and inner wheel half into position and align the bolt holes with the outer wheel half and the brake disc. Install bolts through the brake disc and inner wheel half and washers and nuts on the outer wheel half. Torque wheel nuts per recommended torque value on name plate of wheel.
4. Inflate tire to recommended operating pressure per Chapter 12.
5. Place the wheel on the axle and install axle nut. Tighten to allow the wheel to turn free yet not fit loose on the axle. Safety nut and install the hub cap, securing with snap ring.
6. Install the brake assembly by installing the brake cylinder on the torque plate, positioning the spacer, lining back plate, and installing the bolts securing assembly. If the brake line was disconnected, reconnect and bleed brakes.

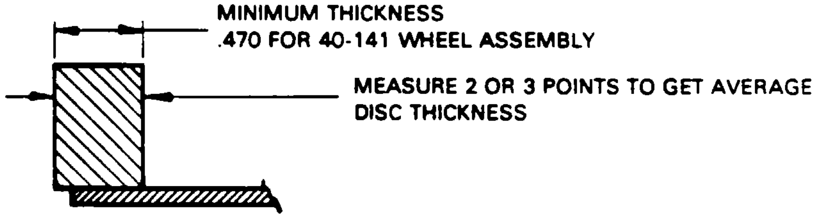


Figure 32-16. Brake Disc Minimum Thickness

NOSE WHEEL ASSEMBLY.

REMOVAL AND DISASSEMBLY OF NOSE WHEEL. (Refer to Figure 32-17.)

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. To remove the nose wheel, remove the axle tie rod nut, tie rod and axle plugs. Insert a 1-7/16 inch diameter tube into the fork and tap out the axle from the wheel assembly.
3. Flex the fork enough to remove the wheel spacers and to allow the wheel to clear the fork assembly.
4. The wheel halves may be separated by removing the valve core and completely deflating the tire. Break tire bead from wheel by using a mallet. 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 other half.

— *CAUTION* —

Do not pry between the wheel flange and tire bead with sharp tools, as this could damage the wheel and tire.

5. The wheel bearing assemblies may be removed from each wheel half by first removing the snap rings that secure the grease seal retainers, and then the retainers, grease seals and bearing cones. The bearing cups should be removed only for replacement.

INSPECTION OF NOSE WHEEL ASSEMBLY.

1. Degrease all parts and dry thoroughly.
2. Visually check all parts for cracks, distortion, defects and excess wear.
3. Check tie bolts for looseness or failure.
4. Check internal diameter of felt grease seals for distortion or wear. Replace the felt grease seal if surface is hard or gritty. Lightly coat felt grease seals with SAE 10 oil. (Do not soak felts in oil.)
5. Check tire for cuts, internal bruises and deterioration.
6. Check bearing cones and cups for wear and pitting and relubricate per lubrication chart.
7. Replace any wheel casting having visible cracks.

REPAIR AND REPLACEMENT OF NOSE WHEEL ASSEMBLY.

The instructions for repair and replacement of the nose gear wheel assembly are the same as those given for the main gear wheel.

ASSEMBLY AND INSTALLATION OF NOSE WHEEL. (Refer to Figure 32-17.)

1. Ascertain that the bearing cup in each wheel half is properly installed. Lubricate the bearing cones per lubrication chart in Chapter 12. Reassemble the cones, grease seal retainers, grease seal felts and snap rings into the proper wheel halves.
2. Inflate the tube sufficiently to round it out. Install tube into tire so that balance mark (yellow or white band) is radially aligned with the tire balance mark (red dot).
3. Place outer wheel half into tire and pull tube valve stem through valve hole. Turn tire and outer wheel half over and place inner wheel half into the tire and align the bolt holes with the outer wheel half. Install bolts through the inner wheel half and washers and nuts on the outer wheel half. Torque wheel nuts per recommended torque value on name plate of wheel.
4. Inflate tire to recommended operating pressure per Chapter 12.
5. Flex the fork enough to allow for the installation of the wheel and spacer tubes. Insert the axle tube, fork caps and tie bolt. Adjust the tie bolt nut to allow the wheel to turn free, yet not fit loose on the axle.

BRAKE ASSEMBLY.

REMOVAL AND DISASSEMBLY OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-18.)

1. To remove the brake assembly, first disconnect the brake line from the brake cylinder housing. Cap brake line to prevent contamination.
2. Remove the self-locking cap bolts that secure the backing plates and shim to the brake cylinder housing.
3. Slide the brake cylinder housing from the torque plate.
4. Remove the pressure plate by sliding off the anchor bolts of the housing.
5. The pistons may be removed by injecting low air pressure in the cylinder fluid inlet and forcing the pistons from the housing.
6. The following procedure should be used when removing anchor bolts:
   A. Position cylinder assembly on a holding fixture. (Refer to Figure 32-19. Step A.)
   B. Use a suitable arbor press and remove the anchor bolt from the cylinder body.

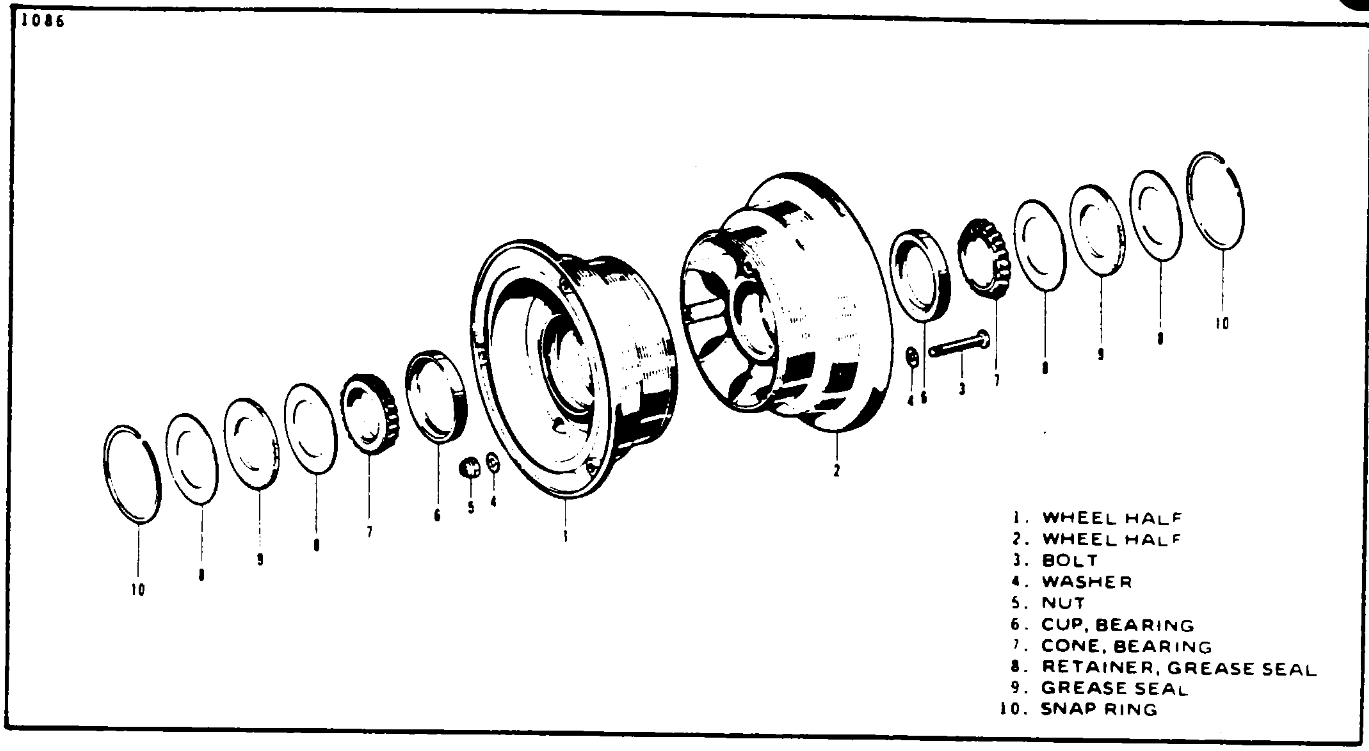


Figure 32-17. Nose Wheel Assembly

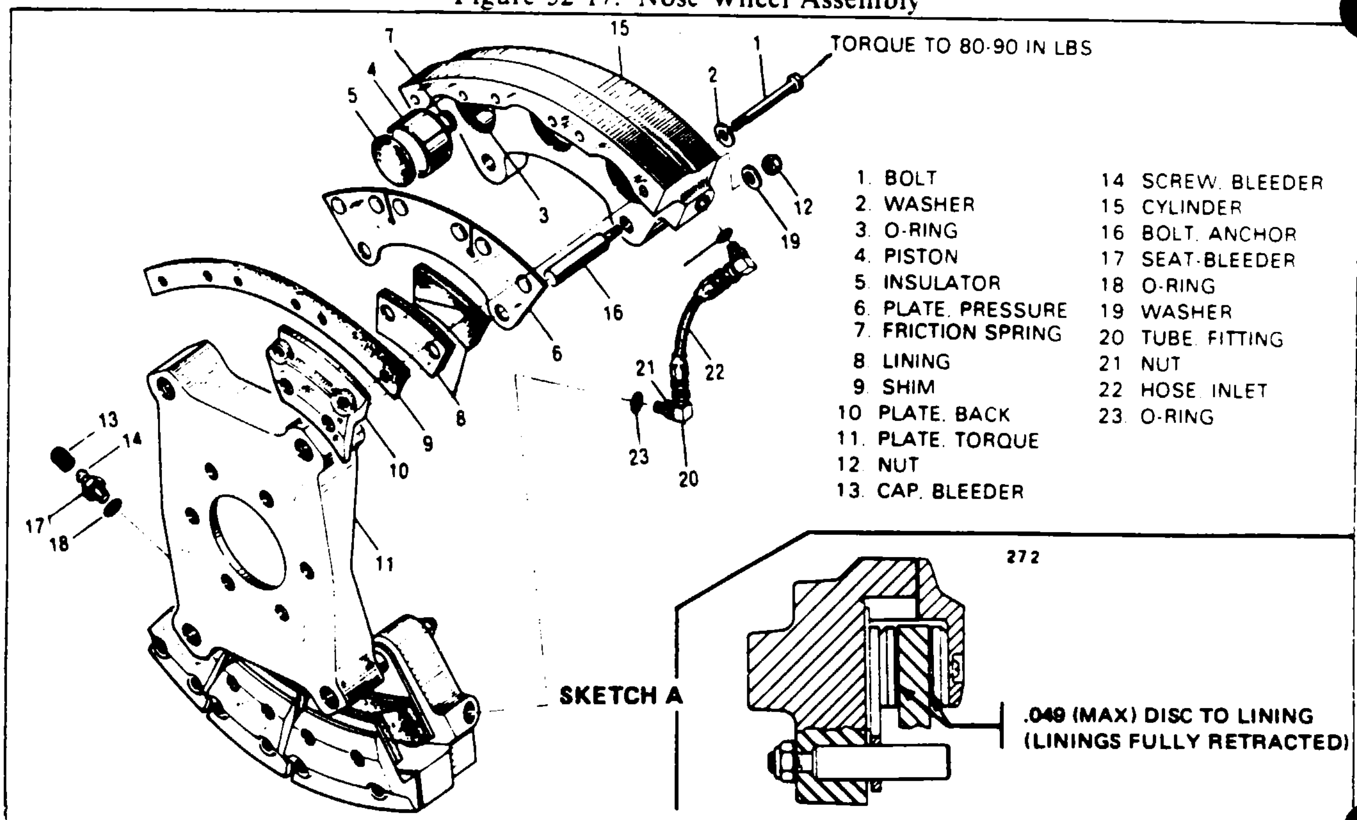


Figure 32-18. Wheel Brake Assembly (Cleveland 30-123)

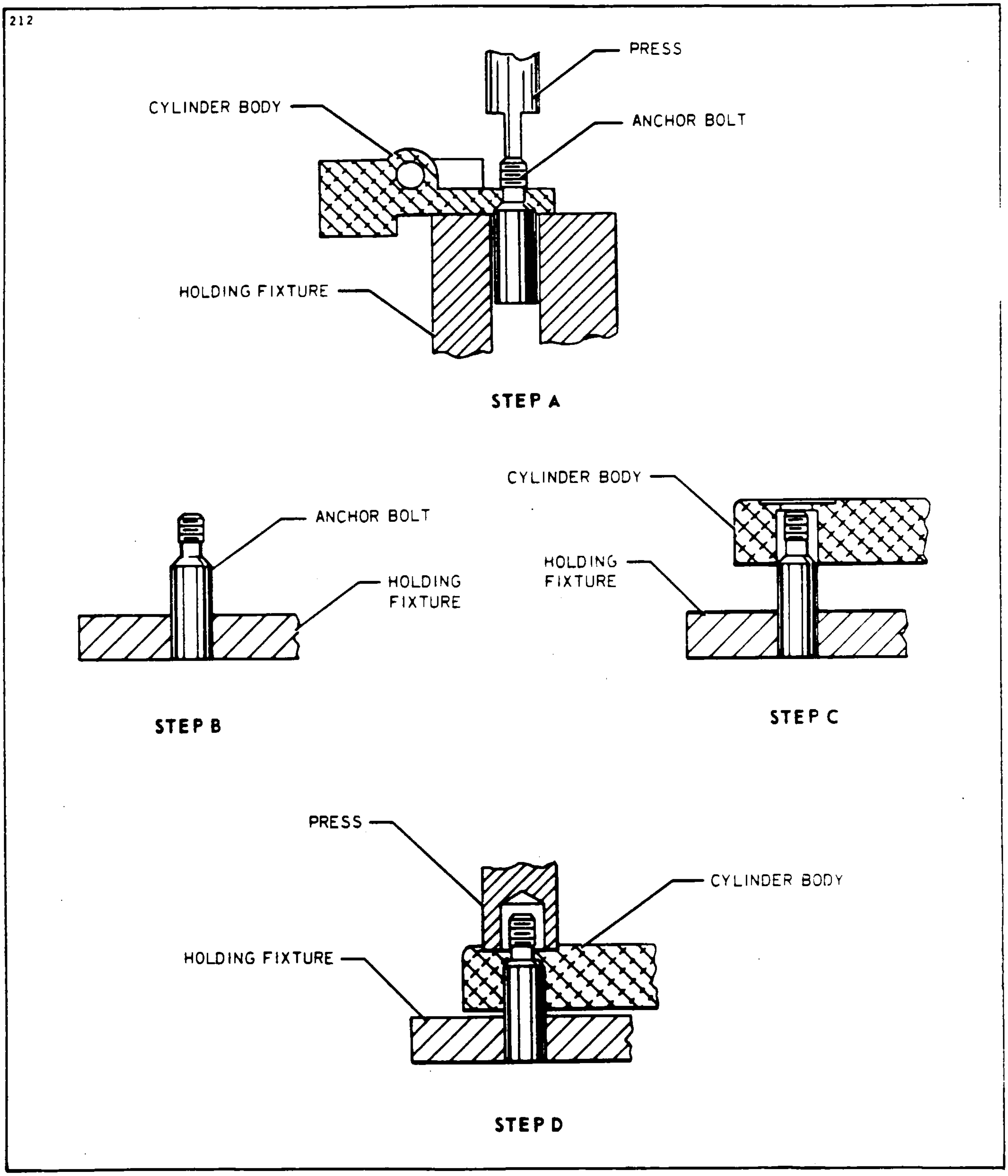


Figure 32-19. Removal and Installation of Anchor Bolts

CLEANING, INSPECTION AND REPAIR OF WHEEL BRAKE ASSEMBLY.

1. Clean the assembly with denatured alcohol and dry thoroughly.
2. Check the walls of the cylinder housing and pistons for scratches, burrs, corrosion, etc., that may damage O-rings.
3. Check the general condition of the bleeder screw and lines.
4. Check anchor bolts for wear.
5. Lining may be removed from a backing plate by inserting a sharp tool between the lining and plate. Press new lining on the backing plate.

— NOTE —

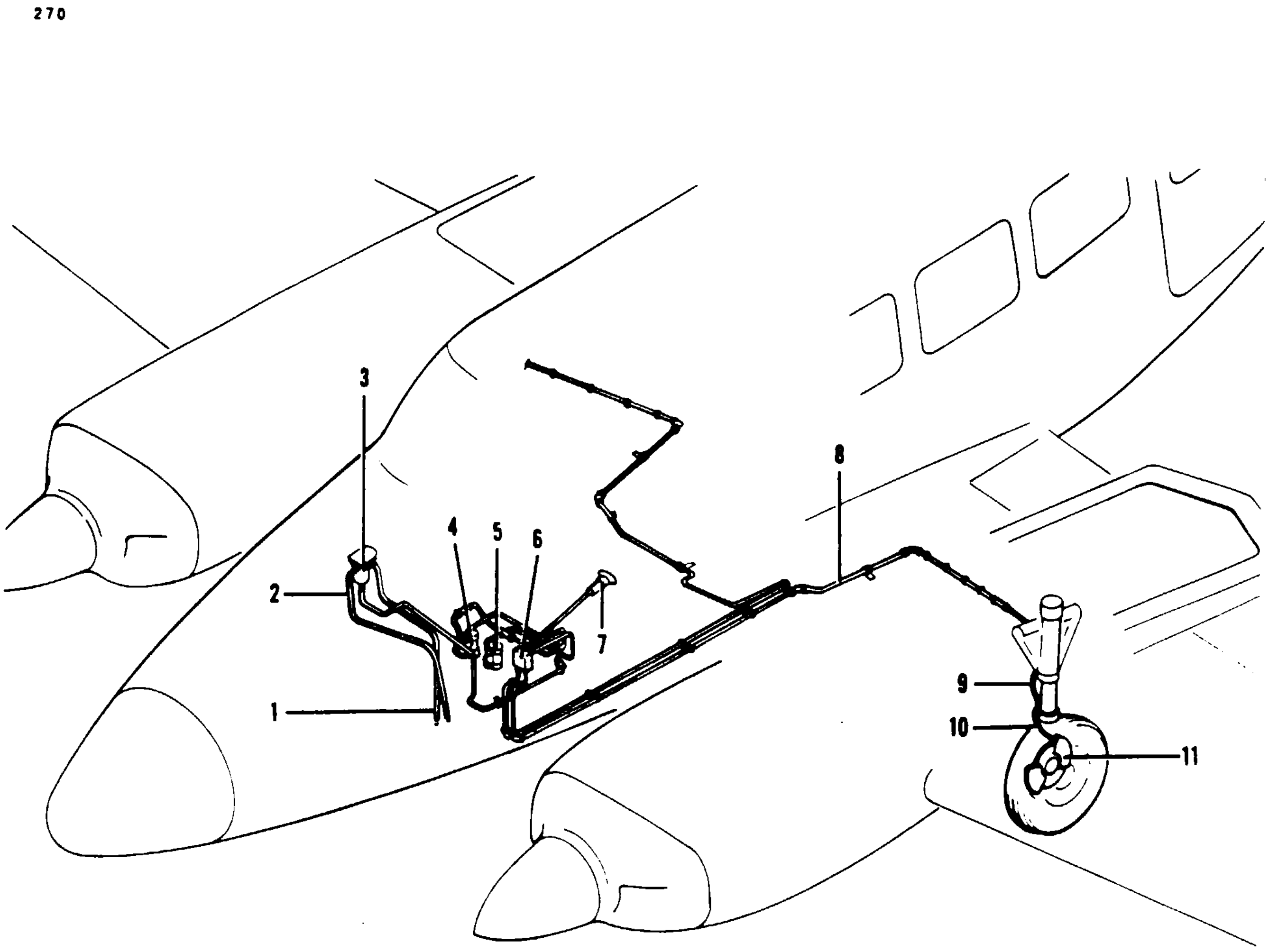
Replacement brake linings should be conditioned by performing three consecutive hard braking applications from 45 to 50 mph. Do not allow the brake discs to cool substantially between stops. This conditioning procedure will wear off high spots and generate sufficient heat to glaze the linings. Once the linings are glazed, the braking system will provide many hours of maintenance free service.

BRAKE ADJUSTMENT AND LINING TOLERANCES.

No adjustment of the brake 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 bonded type and need not be replaced until the thickness of any one segment becomes worn to .100 of an inch or unevenly worn.

ASSEMBLY AND INSTALLATION OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-18.)

1. If anchor bolts have been removed, they should be reinstalled as follows:
   A. Support anchor bolt in a holding fixture. (Refer to Figure 32-19, Step B.)
   B. Align cylinder body over anchor bolt. (Refer to Figure 32-19, Step C.)
   C. Using a suitable arbor press, apply pressure on the spot face directly over the anchor bolt. (Refer to Figure 32-19, Step D.)
   D. Install washer and nut; torque nut to 60 inch-pounds.
2. Lubricate O-rings with fluid MIL-H-5606 and install. Slide the pistons in cylinder housing until flush with surface of the housing. For pistons with friction rings (see Figure 32-18) check pilot bores and chamfers for burrs and nicks, remove before installing piston. Place piston in bore, rotate to seat friction ring and lightly tap into place. If piston does not seat, alternately tap and rotate. If considerable effort is required, remove piston and inspect pilot bore and piston tail for damage. Rework, if necessary and repeat above procedure.
3. Apply a small amount of thread lube to the threaded area of the inlet and outlet fittings and install in cylinder.
4. Slide the pressure lining plate onto the anchor bolts of the housing.



1. TUBE, DRAIN
2. TUBE, VENT
3. RESERVOIR ASSEMBLY
4. MASTER CYLINDER, RIGHT
5. MASTER CYLINDER, LEFT
6. VALVE, PARKING BRAKE
7. HANDLE, PARKING BRAKE
8. LINK, FUSELAGE
9. HOSE, FLEXIBLE
10. LINK, GEAR
11. BRAKE ASSEMBLY

Figure 32-20. Brake Installation (Typical)

5. Slide the housing assembly on the torque plate of the gear.
6. Install the backing plates and secure with self-locking cap bolts; torque to 60 inch-pounds.
7. With brake line disconnected, push the linings as far apart as possible. In this position there should not be excessive drag or the tolerance between the disc and lining should not be greater than noted on Sketch A of Figure 32-18. Assemblies falling outside the limits noted should be removed and rechecked for lining and brake disc minimum thickness. The wheel should rotate freely, if binding occurs, check axle nut to insure proper seating. If rubbing occurs, check back plate assembly and pressure plate assembly linings to be sure that linings are fully seated.
8. Connect the brake line to the housing and bleed brakes.

BRAKE MASTER CYLINDER.

REMOVAL OF BRAKE MASTER CYLINDER.

1. Disconnect the brake lines from the cylinder and place a protective cover over the line openings to prevent contamination of the system.
2. Remove the cylinder from the pedal assembly by removing the clevis pin at the piston rod and the bolt at the top of the cylinder body.

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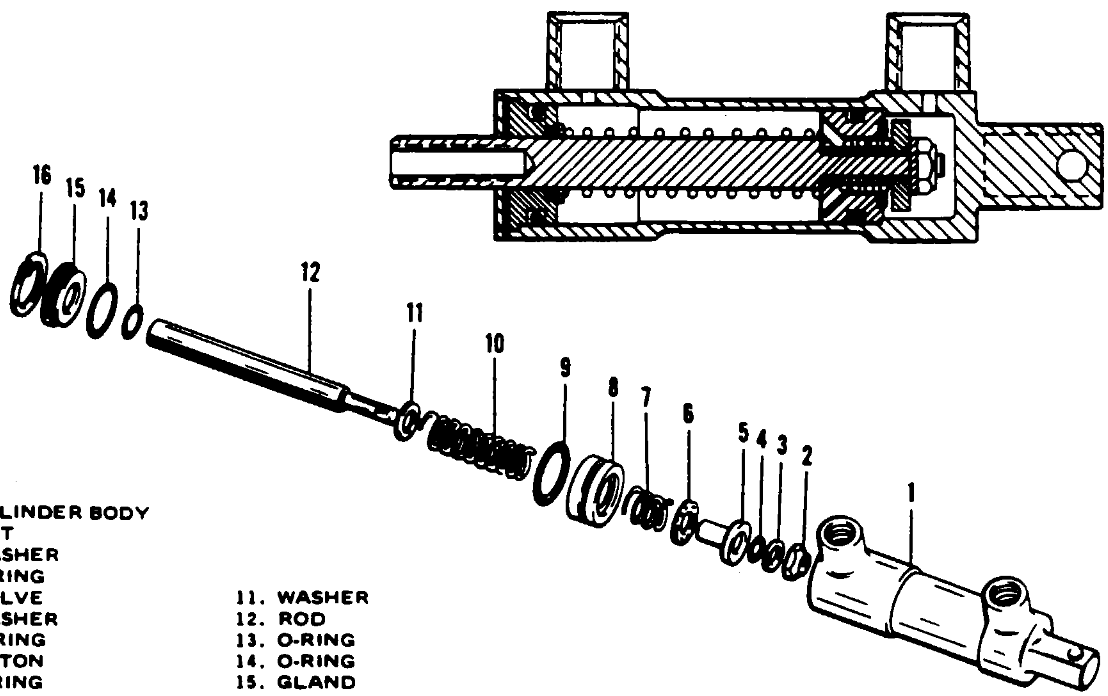

1. CYLINDER BODY
2. NUT
3. WASHER
4. O-RING
5. VALVE
6. WASHER
7. SPRING
8. PISTON
9. O-RING
10. SPRING
11. WASHER
12. ROD
13. O-RING
14. O-RING
15. GLAND
16. SNAP RING

Figure 32-21. Brake Master Cylinder Assembly

ASSEMBLY OF PARKING BRAKE VALVE. (Refer to Figure 32-22.)

1. Install O-rings on valve cam.
2. Lubricate O-rings with fluid (MIL-H-5606), insert cam into valve body and secure with spring, bushing, washer and self-locking nut.
3. Install O-ring on valve, insert valve in hole of out port, install valve spring and secure with outlet fitting.

INSTALLATION OF PARKING BRAKE VALVE.

1. Attach the valve to the bulkhead mounting bracket with screws.
2. Connect the fluid lines to the valve.
3. Connect the control cable to valve lever and determine that when valve lever fits in the closed detent, parking brake handle is .062 to .125 inch of being full in against stop.

BLEEDING PROCEDURE.

If the brake line has been disconnected for any reason, it will be necessary to bleed the brake system as described below:

1. Place a suitable container at the brake reservoir to collect fluid overflow.
2. Remove the rubber bleeder fitting cap located on the bottom of the brake unit housing on the landing gear.
3. Slide a hose over the bleeder fitting, loosen the fitting one turn and pressure fill the brake system with MIL-H-5606 fluid. (Refer to Figure 32-23.)

— NOTE —

By watching the fluid pass through the plastic hose at the top of the brake reservoir, it can be determined whether any air remains in the system. If air bubbles are evident, filling of the system shall be continued until all of the air is out of the system and a steady flow of fluid is obtained.

4. Tighten bleeder fitting and remove the hose. Check brakes for proper pedal pressure.
5. Repeat this procedure on the other gear.
6. Drain excess fluid from reservoir to fluid level line with a syringe.

DISASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 32-21.)

1. The internal parts of the brake master cylinder may be removed by removing the snap ring from the annular slot at the lower end of the cylinder. Pull the complete piston assembly from the cylinder.
2. Slide the packing gland, O-ring, washer and spring from the piston rod.
3. The piston valve assembly may be removed by first removing the self-locking nut from the piston rod. This will allow the piston with component parts to be removed.

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 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.

ASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 32-21.)

1. Install O-ring on the cylinder piston. Assemble onto the piston rod, the piston, spring, washer seal and valve. Allow the valve to extend into the base of the piston. Slide the O-ring and washer in place and secure with self-locking nut.
2. Install O-ring seal on the packing gland. Slide spring, washer, O-ring and packing gland onto the piston rod.
3. Dip the piston assembly in fluid (MIL-H-5606) and install the assembly into the cylinder. Push the packing gland into the cylinder until the snap ring can be installed into the annular slot at the bottom of the cylinder.

INSTALLATION OF BRAKE MASTER CYLINDER.

1. Compress the piston within the cylinder and adjust the clevis end of the piston rod to obtain 6.69 inches between attachment holes of the cylinder body and the piston rod clevis. Lock clevis in position with locknuts.
2. Attach the cylinder to the rudder pedal by securing at the cylinder body with bolt assembly and at the clevis with clevis pin.
3. Connect the fluid lines to the cylinder.

PARKING BRAKE VALVE.

REMOVAL OF PARKING BRAKE VALVE.

1. Disconnect the parking brake cable from the valve actuating arm.
2. Disconnect the fluid lines from the valve.
3. Remove the screws that attach the valve to its mounting bracket.
4. Place a protective material over the line openings to prevent contamination of the system.

DISASSEMBLY OF PARKING BRAKE VALVE. (Refer to Figure 32-22.)

1. Remove the two fittings from the outside of the valve body. A valve spring is held in place by the fittings. Use caution not to loosen these when removing the fittings.
2. From the valve body, remove the valve spring and valve.
3. To remove the valve cam, remove the nut, washer, bushing and spring and pull the cam from the valve body.

CLEANING, INSPECTION AND REPAIR OF PARKING BRAKE VALVE.

1. Clean the valve parts with a suitable solvent and dry thoroughly.
2. Inspect valve and seat surfaces of valve body for excessive wear and corrosion.
3. Inspect the cam assembly for burrs, scratches, excess wear, loose operating lever, etc.
4. Check general condition of valves and springs.
5. Repair to the valve is largely limited to smoothing burred or scratched surfaces and replacing O-rings.

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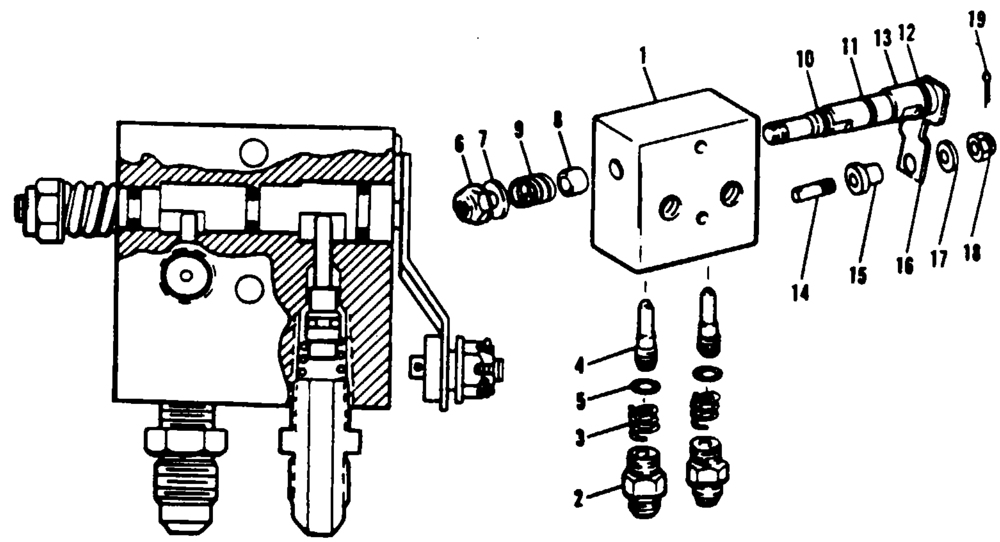

1. VALVE BODY
2. FITTING
3. SPRING
4. VALVE
5. O-RING
6. NUT
7. WASHER
8. BUSHING
9. SPRING
10. O-RING
11. O-RING
12. O-RING
13. CAM
14. STUD
15. SWIVEL
16. LEVER
17. WASHER
18. NUT
19. COTTER PIN

Figure 32-22. Parking Brake Valve Assembly

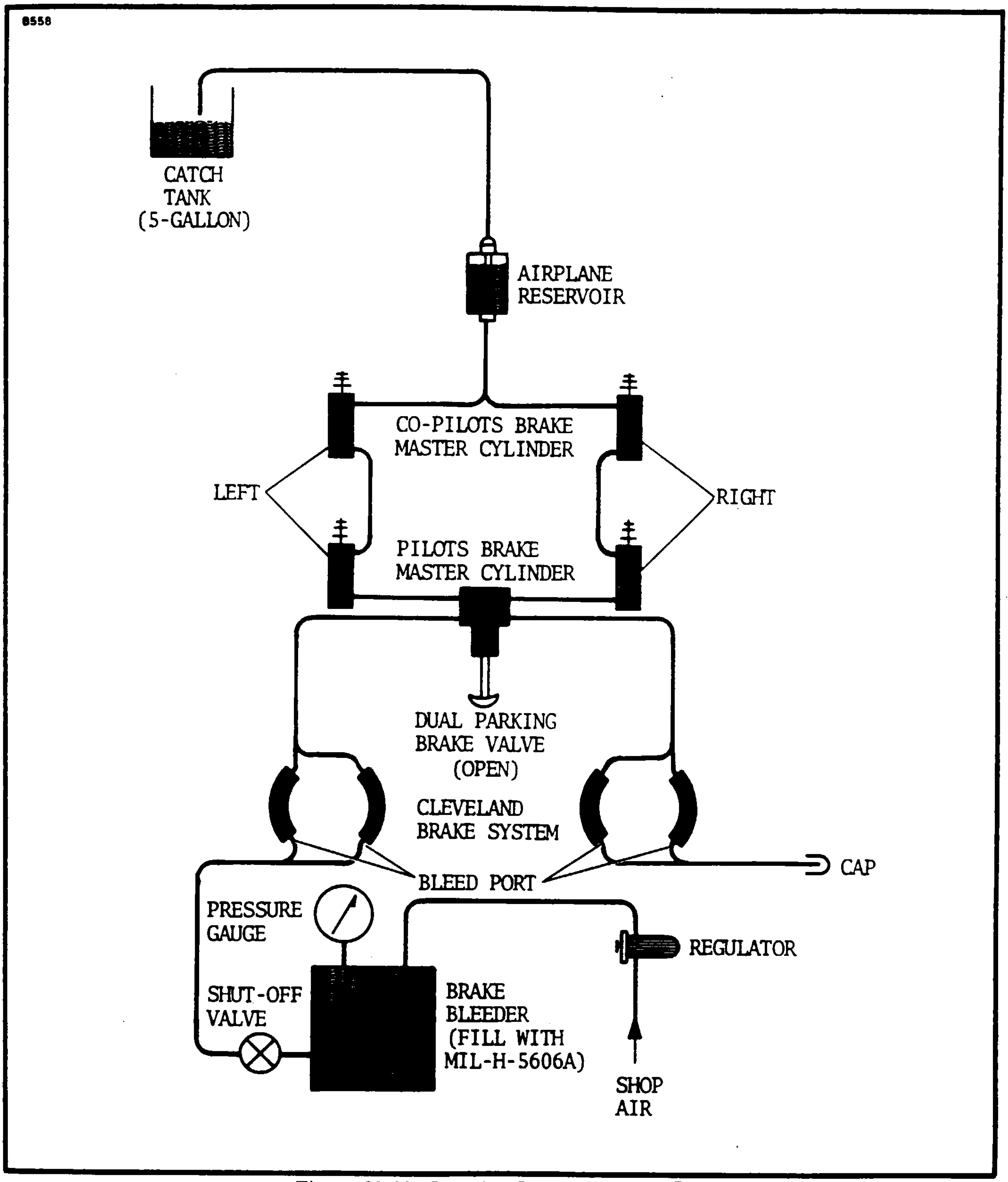

Figure 32-23. Bleeding Brake (Pressure Pot)

GEAR SELECTOR HANDLE MECHANISM.

REMOVAL OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 32-24.)

Removal of the gear selector mechanism can be divided into three individual assemblies. The Solenoid Assembly; The Selector Handle Assembly; and The Flexible Cable Assembly.

1. Removal of Solenoid Assembly.
   A. Disconnect the two wires leading from the solenoid.
   B. Remove two locknuts securing the solenoid to the mounting block and remove the solenoid.
2. Removal of Selector Handle Assembly.
   A. Remove stop pin and pull the control knob and sleeve from the lever assembly.
   B. Disconnect the wires leading from the panel assembly. Remove four light assemblies securing the panel assembly to the plate assembly.
   C. Remove pin, washer and cotter pin securing the terminal to the lever assembly.
   D. Remove the selector assembly from the instrument panel.
3. Removal of Flexible Cable Assembly.
   A. Remove screws and clamp securing cable assembly to bracket assembly.
   B. Push cable assembly through grommet adjacent to the bracket assembly.
   C. Remove pin securing the terminal to the control arm of the power pack. Remove the lock nut and terminal from the end of the cable assembly.
   D. Cut safety wire and remove lock nut nearest the end of the cable assembly. Carefully pull the cable assembly through the hole in bracket assembly.
   E. Disassemble the firewall plates and grommets and pull cable assembly through the hole in the bulkhead at station 57.0.

INSTALLATION OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 32-24.)

1. Installation of Flexible Cable Assembly.
   A. Insert the end of the cable assembly with lock nuts through the hole in the bulkhead at station 57.0.
   B. Insert the cable assembly through bracket assembly. An equal number of threads should appear on each side of the plate in the bracket assembly. Tighten and safety wire the two lock nuts.
   C. Install lock nut and terminal on the end of the cable assembly. Position the control arm in the terminal and insert pin and safety.
   D. Position the free end of the cable assembly into the slot in bracket assembly and secure in position with clamp.
   E. Assemble firewall plates and grommets.
2. Installation of Selector Handle Assembly.
   A. Install the selector assembly on the instrument panel.
   B. Position the terminal on lever assembly and secure in position with pin, washer and cotter pin.

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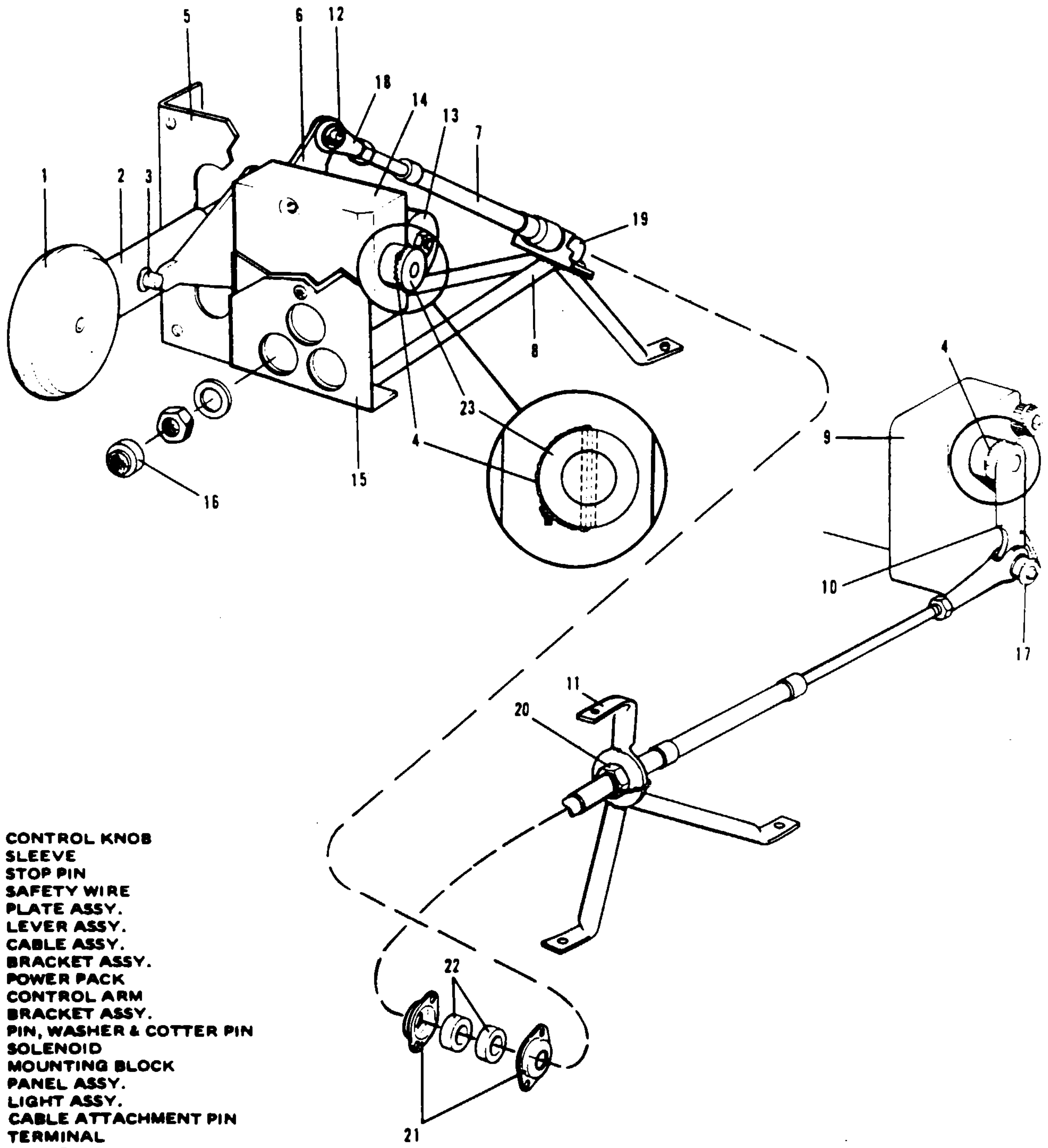


1. CONTROL KNOB
2. SLEEVE
3. STOP PIN
4. SAFETY WIRE
5. PLATE ASSY.
6. LEVER ASSY.
7. CABLE ASSY.
8. BRACKET ASSY.
9. POWER PACK
10. CONTROL ARM
11. BRACKET ASSY.
12. PIN, WASHER & COTTER PIN
13. SOLENOID
14. MOUNTING BLOCK
15. PANEL ASSY.
16. LIGHT ASSY.
17. CABLE ATTACHMENT PIN
18. TERMINAL
19. CLAMP
20. LOCKNUT
21. FIREWALL PLATE
22. GROMMET
23. BUSHING

Figure 32-24. Landing Gear Selector Mechanism

C. Carefully thread the wires from the panel assembly through the hole provided in the plate assembly. Position the panel assembly on the plate assembly. Insert the base assemblies of the lights through the plate and panel assemblies and install nylomatic washer and locknut, and light cap. Connect wires to their appropriate terminals.

D. Insert the sleeve on the lever and install the control knob and stop pin.

3. Installation of Solenoid Assembly.
   A. Position the solenoid on mounting block and secure in position with two locknuts.
   B. Connect the solenoid wires to their appropriate terminals.

STEERING.

RUDDER AND STEERING PEDAL ASSEMBLY.

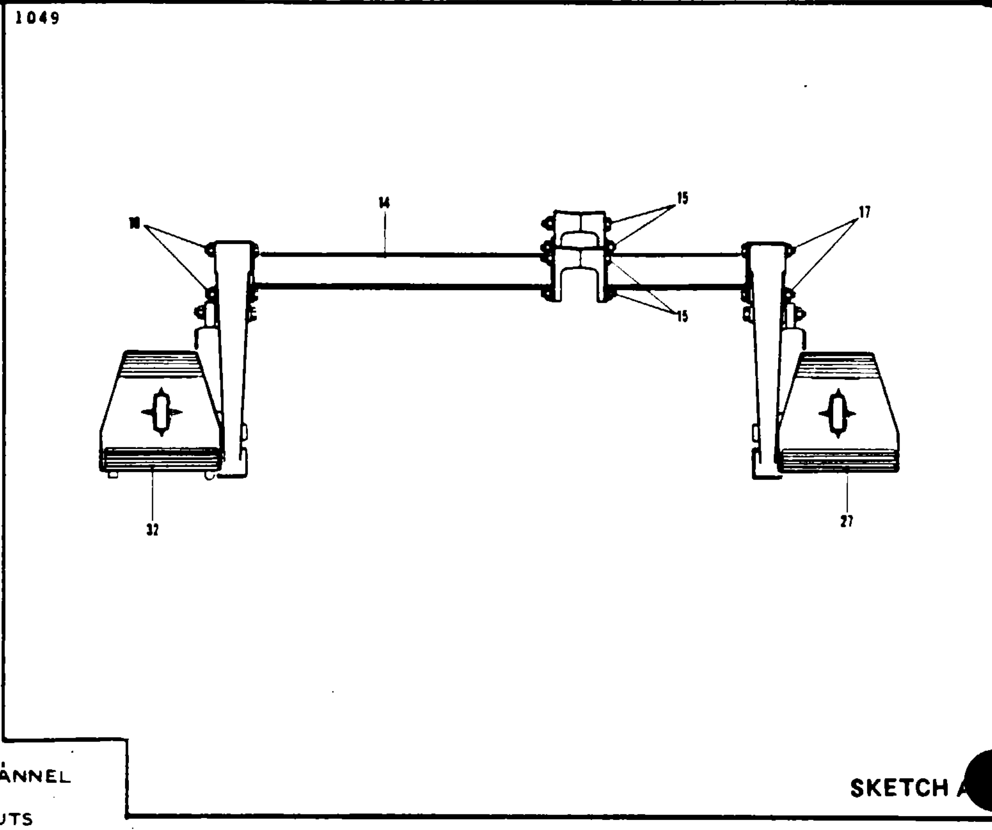
REMOVAL OF PEDAL ASSEMBLY. (Refer to Figure 32-25.)

1. Remove the left pilot's seat and the floor panel to the left of the control pedestal.
2. Relieve tension from the rudder control cables by loosening one of the cable turnbuckles at fuselage station 76.00.
3. Disconnect the rudder control cables from the pedal assembly.
4. Disconnect the brake master cylinder from the pedal assembly.
5. Disconnect the steering control rods from the two inboard pedals.
6. Remove the rudder torque tube guards, if installed, by removing the machine screws, nuts, and clamps positioning the guards to the torque tube and remove the attaching hardware securing each guard to the brake line support channel.
7. Remove the small round access plate located on the right side of the fuselage at station 63.25.
8. Remove the bolts that secure the retainer collars and left pedals on the torque tube.
9. Slide the torque tube out through the right side of the fuselage. (Note the number of spacer washers between each set of collars and bearings.)
10. The left pedals are free to be removed.
11. To remove the outer torque tube assembly with right pedals, unbolt and separate the tube's bearing blocks located on top of the wheel housing. (Note number of spacer washers between the bearing blocks.)
12. Remove the outer tube assembly and disassemble.
13. The torque tube bearings may be removed by removing the cap bolts that secure the bearings to their mounting brackets.

INSTALLATION OF PEDAL ASSEMBLY. (Refer to Figure 32-25.)

1. Install and secure the torque tube bearings to their mounting brackets with cap bolts.
2. Assemble the outer torque tube assembly, including both right pedals.
3. Position the outer torque tube assembly over the wheel housing and install bearing blocks. Spacers are installed between the blocks so that when the blocks are bolted the tube will be free to rotate with minimum up and down play. (Spacers are available in thickness of .012, P/N 81102-35; .020, P/N 81102-36 and .032, P/N 81102-37.)

1. NUT, ANCHOR
2. BRACKET, MOUNTING
3. BLOCK, BEARING
4. BOLT ASSEMBLY
5. RETAINER
6. TORQUE TUBE
7. BOLT ASSEMBLY
8. ROLL PIN - BOLT
9. CABLE END
10. BOLT ASSEMBLY
11. BOLT ASSEMBLY
12. BLOCK, BEARING
13. SPACER
14. TORQUE TUBE, OUTER
15. BOLT ASSEMBLY
16. ROLL PIN - BOLT
17. BOLT ASSEMBLY
18. RETAINER
19. BOLT ASSEMBLY
20. BOLT, CAP
21. BLOCK, BEARING
22. BRACKET, MOUNTING
23. PLATE
24. ROD
25. CONTROL CABLE
26. BRAKE CYLINDER
27. PEDAL, RIGHT OUTER
28. PEDAL, RIGHT INNER
29. ROD, STEERING
30. NUT, JAM
31. BOLT ASSEMBLY
32. PEDAL, LEFT INNER
33. PEDAL, LEFT OUTER
34. BRAKE LINE SUPPORT CHANNEL
35. TORQUE TUBE GUARD
36. MACHINE SCREWS AND NUTS
37. SCREWS, NUTS AND CLAMPS



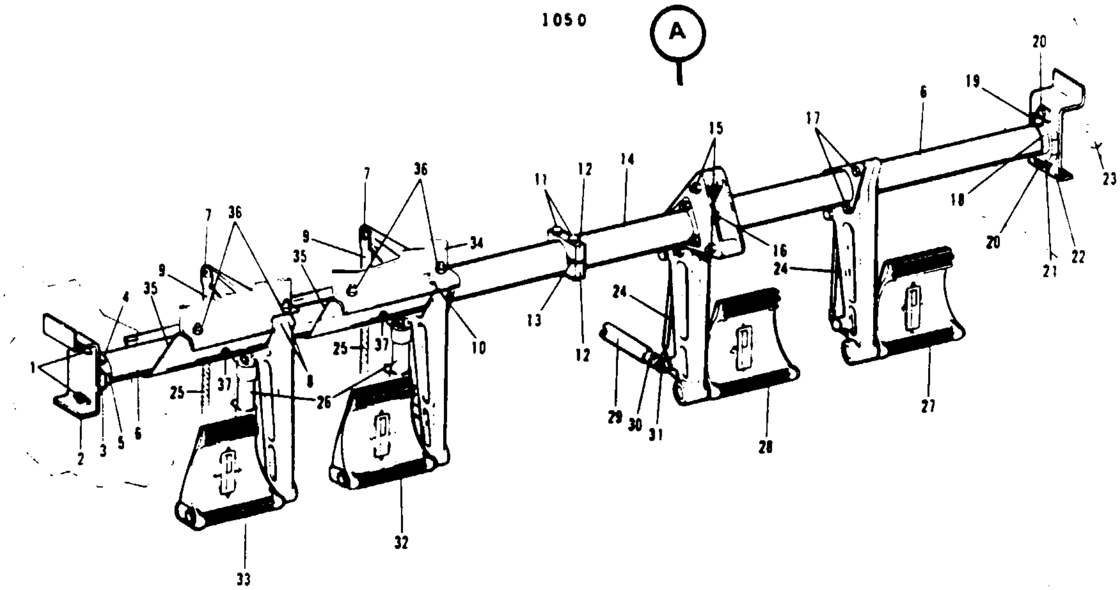


Figure 32-25. Rudder Pedal Installation

4. Lubricate and slide the torque tube through the side of the fuselage and right bearing far enough to slide the right retainer collar on the tube.
5. Slide the tube through the outer torque tube assembly installing the left pedals and left retainer collar.
6. Insert the bolts through bolt retainer collars and tube (do not install nut) and determine number of spacer washers required to allow minimum side play. The tube may be slid to either side when the collar bolts are removed to allow the spacer washers to be divided and installed evenly between each set of retainers and bearings.
7. With the spacer washers installed, install the bolts through the retainers and both left rudder pedals. Install nuts with washers and secure.
8. Wipe off excess lubricant from torque tube.
9. Install the rudder torque tube guards by positioning each guard in front of the torque tube and securing it in place with the two machine screws and nuts at the brake line support channel. Install the clamps around the torque tube and fasten to the guards with machine screws and nuts.
10. Connect the steering control rods at the pedals. Pedal and nose wheel alignment may be checked by referring to the appropriate paragraphs in this section.
11. Set cable tension per Chart 2702 and check rigging and adjustment.
12. Install access plates, panels and seats.

POSITION AND WARNING.

ADJUSTMENT OF NOSE GEAR UP LIGHT SWITCH.

1. Ascertain that the nose landing gear uplock is properly adjusted.
2. Retract gear fully and ascertain that the uplock roller is engaged and resting against the uplock hook. (No pressure on hydraulic system.)
3. Adjust the gear uplock switch toward the hook until it actuates. The red indicator light in cockpit should go out.

— NOTE —

Main gear up switches must be actuated also to extinguish red light.

4. Extend and retract to ascertain proper adjustment.

ADJUSTMENT OF NOSE GEAR DOWN LIGHT SWITCH.

1. Ascertain gear is properly adjusted for downlock position.
2. With gear down and locked, adjust gear down switch toward the link until it actuates. The green indicator light in cockpit should come on.
3. Check switch operation by partially retracting and extending gear several times.

ADJUSTMENT OF MAIN GEAR UP LIGHT SWITCH.

1. Ascertain that the main landing gear uplock is properly adjusted.
2. Retract gear fully and ascertain that the uplock roller is engaged and resting on the uplock hook. (No pressure on hydraulic system.)
3. Adjust the gear uplock switch toward the link until it actuates. The amber indicator light in cockpit should go out.

— NOTE —

Opposite main gear switch and nose gear switch must be actuated also to extinguish amber light.

4. Extend and retract gear to ascertain proper adjustment.

ADJUSTMENT OF MAIN GEAR DOWN LIGHT SWITCH. (Refer to Figure 32-26.)

1. Ascertain that the main landing gear downlock is properly adjusted.
2. With the gear down and locked, the green indicator light in the cockpit should come on when the downlock hook is lowered to within .030 to .070 of an inch of bottoming in the hook slot of the lower side brace link. The following check and adjustment may be accomplished:
   A. By hand, raise the downlock hook until the downlock switch is heard to actuate (click).
   B. With hook raised, place a .070 of an inch wire feeler gauge between the hook and bottom surface of the slot in the side brace link. (Refer to Figure 32-26.)
   C. Lower the hook, allowing it to rest on the feeler gauge. (The end of the gauge should be even with the lock pin.) The switch should not be heard to actuate.
   D. Again raise the hook, allowing the switch to actuate, and place a .030 gauge in the slot of the side brace link.
   E. Lower the hook. The switch should actuate allowing the green indicator light in the cockpit to come on.
   F. When lowering hook, if the switch actuates too soon, adjust the switch toward the hook. If it actuates too late, adjust the switch away from the hook.

ADJUSTMENT OF MAIN INBOARD GEAR DOOR AJAR SWITCHES.

1. Ascertain that main inboard gear doors are adjusted properly.
2. With the master switch off, actuate the hand pump to bring the gear doors down.
3. Disconnect the actuator cylinder rod from the doors so they hang free.

4. Locate the switch by adjusting the retainer nuts so that when the door is closed by hand. a click can be heard approximately one inch before the door is completely closed.

— *CAUTION* —

Avoid extreme outward adjustment that would cause the switch mounting tab to bend back when the door is closed, resulting in damage to the switch unit.

— *NOTE* —

An ohmmeter or continuity tester can be used to indicate switch actuation.

5. Install the actuator cylinder rod to the door.
6. Turn the master switch ON and with the gear selector in down position, actuate the hand pump until the door closes.

ADJUSTMENT OF LANDING GEAR SAFETY SWITCH.

The landing gear safety switch, used to activate the selector solenoid is located on the left main upper torque link, is adjusted so that the switch is actuated in the last .250 ± .125 inch of oleo extension.

1. Place airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Compress the strut until nine inches is obtained between the top of the gear fork and the bottom of the gear housing. Hold the gear at this measurement.
3. Adjust the switch down until it actuates at this point. Secure the switch.
4. Extend and then compress the strut to ascertain that the switch will actuate in the last .250 ± .125 inch of oleo extension.
5. Remove airplane from jacks.

GEAR WARNING SWITCHES.

REMOVAL OF GEAR WARNING SWITCHES. (Refer to Figure 32-27.)

The gear warning switches are located within the control pedestal, directly under the throttle controls. Each switch will actuate the warning horn.

1. The switches may be removed from their mounting brackets by the following procedure:
   A. Remove the top cover plates of the pedestal, one of which is forward of the control levers, the other surrounds the levers, by removing their attachment screws.
   B. Remove the switch from its mounting bracket by removing the two screws that secure either switch and spacer block. First remove the nut from each screw, and allow the bracket of the other switch and spacer block to swing full forward by turning the adjustment screw counterclockwise. Pull aft on the switch bracket to be removed and push out the attachment screws.
   C. Disconnect the necessary electrical leads.

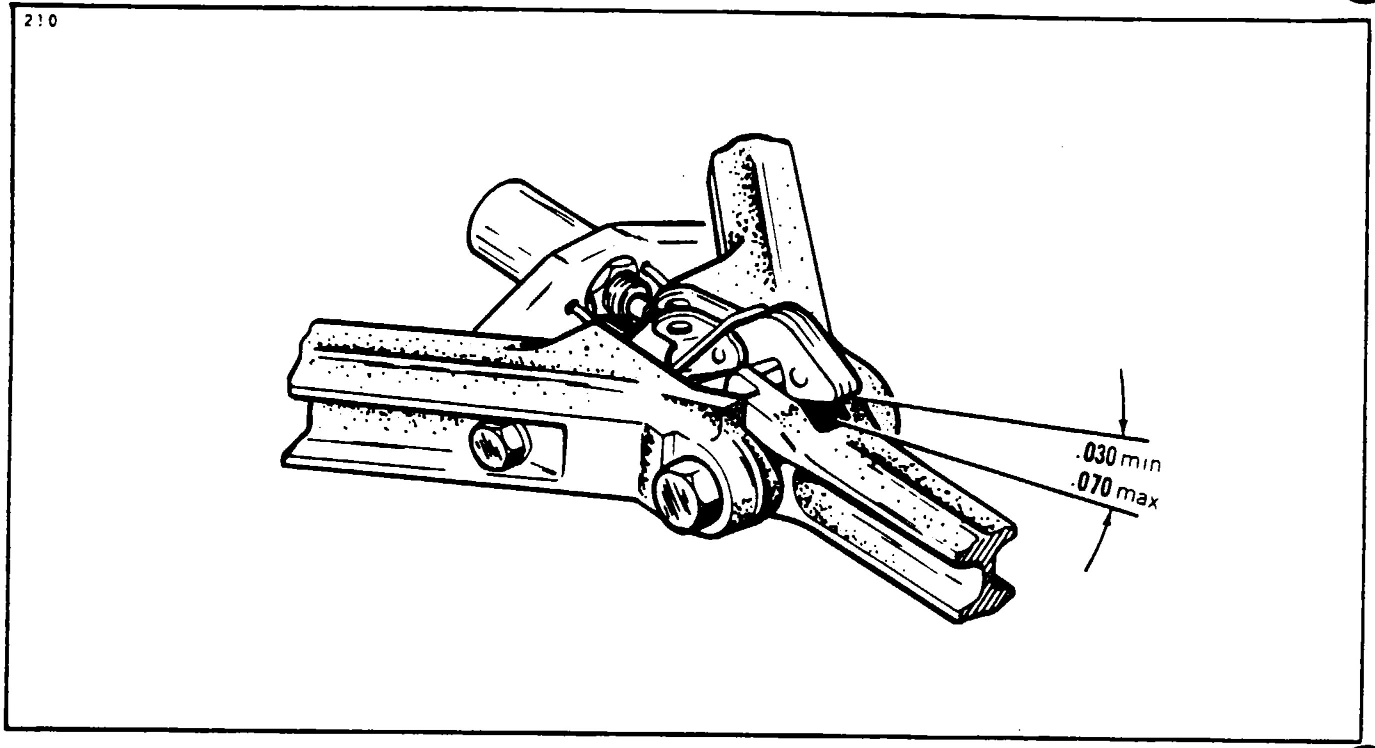


Figure 32-26. Adjusting Main Gear Down Light Switch

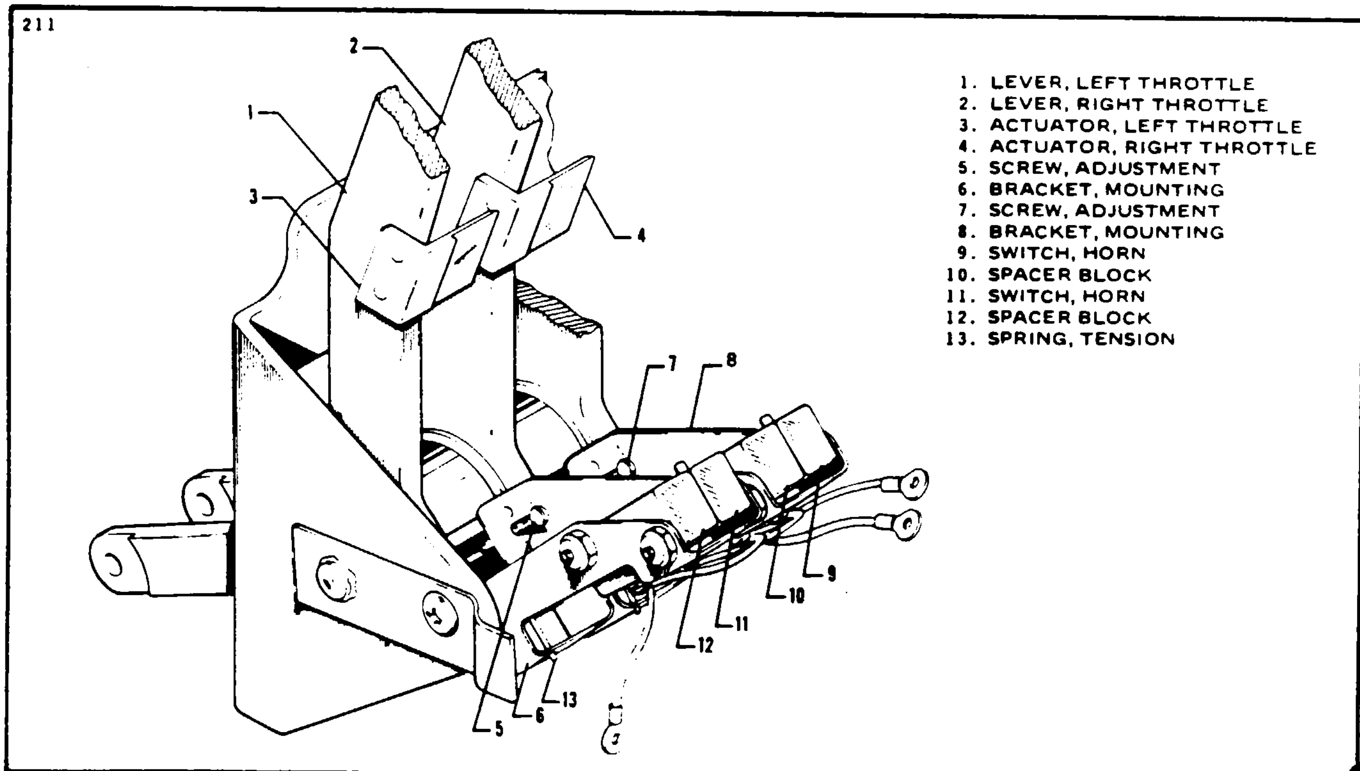


Figure 32-27. Gear Warning Switches Installation

2. The switch mounting brackets may be removed by removing the control lever assembly as follows:
   A. Disconnect the engine control cables from the control levers by removing the connecting clevis pins.
   B. Remove the flush head screw at each side of the pedestal housing.
   C. Remove the friction knob with washer from the right side of the pedestal.
   D. Remove the cap bolts that secure the frame.
   E. Pull the assembly from the pedestal housing.
   F. Remove the control keeper tube that holds the switch brackets in the control frame by removing the tube attachment screws from each side of the frame.

INSTALLATION OF GEAR WARNING SWITCHES. (Refer to Figure 32-27.)

1. The switch mounting brackets, as part of the control lever assembly, may be installed as follows:
   A. Assemble the mounting brackets (switches and spacer blocks may be installed with mounting brackets), tension springs and spacer washers in the control frame and secure with keeper tube. Secure keeper tube in frame.
   B. Install control lever assembly in the pedestal housing and secure with cap bolts and screws.
   C. Install the friction knob with washer on the end of the lever shaft at the right side of the pedestal.
   D. Connect the engine control cables to their respective levers using clevis pins. Place washer on ends of clevis pins and secure cotter pins.
2. The switches may be installed on their mounting brackets by the following procedure:
   A. Connect the electrical leads to their respective switch terminals. (Refer to Electrical System Schematic, Chapter 91, for wire installation.)
   B. Place the switch and spacer block in its mounting bracket and install attachment screws. It will be necessary to swing the bracket of the other switch and spacer block forward to install the attachment screws. Install nuts on the screws and secure.
   C. Position the pedestal cover plates on the pedestal, install screws and secure.
   D. Adjust the switches.

ADJUSTMENT OF GEAR WARNING SWITCHES.

The gear warning horn switches are installed in the control pedestal, with each controlled by a throttle lever. Each switch actuates the warning horn when either or both throttles are reduced below 10 to 12 inches of manifold pressure. The following is a procedure for the adjustment of the gear warning switches:

1. Ground Adjustment:
   A. Start and run the engines with the propeller set for full increase RPM.
   B. To set the throttle switches to actuate at a desired throttle setting, retard the throttles until approximately five inches of manifold pressure is indicated above the desired in-flight pressure. Mark the throttle cover in some manner in relation to the throttle levers for the adjustment of the gear up warning horn switches.
   C. Shut down the engines.
   D. Set the throttle at the locations marked. With the adjustment screw on the switch bracket, adjust each switch separately toward the actuator angle until the switch is heard to actuate. (On airplanes with an inactive switch, substituting for spacer block, adjust until the active switch is heard to actuate.) The adjustment screw may be reached by inserting a long screwdriver through the travel slot of the throttle lever in the pedestal cover.

2. Horn Operational Check:

A. To check the horn operation, jack the airplane and retract the landing gear. With the master switch on, retard either throttle until the gear up indicator horn sounds. Check the location of the throttle to the adjusting mark. The warning horn will operate when either or both throttles are retarded.

B. With the warning horn operating, lower the gear to insure that the horn ceases to operate when the gear is down and locked.

C. Remove the airplane from the jacks.

3. Flight Adjustment:

A. Flight test the airplane to insure operation of the warning system when the gear is up and power is reduced to the desired manifold pressure.

B. If the horn fails to operate at the desired settings, mark the throttles at the proper manifold pressure and repeat the preceding adjustment procedure as described in Step 1. The switches may be adjusted with the airplane in flight using caution not to let the presence of the screwdriver interfere with the operation of the controls.

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WEAR LIMITS

NOSE GEAR.

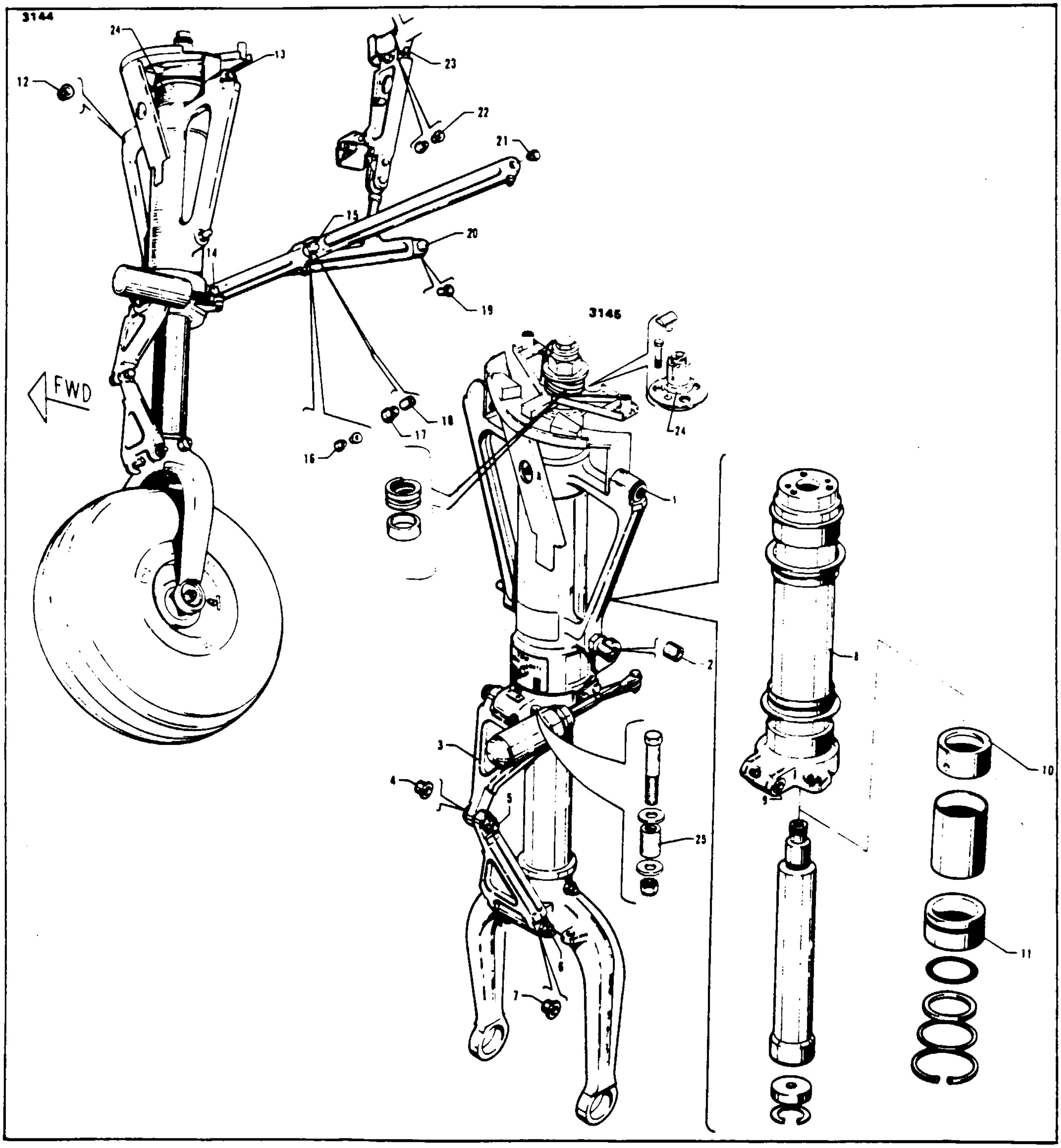

Figure 32-28. Nose Gear Wear Limits

Index No.	Part No.	Item	Mfg. Dimension	Min. Service Limit	Max. Service Limit
1	31766-2	Trunnion Bushing	.5625 +.0015 -.0000	.5625	.5650
13	AN9-32	Trunnion Bolt - AN179 may be used to reduce play.	.5620 +.0000 -.0040	.5570	.5620
12	NAS77-9-36	Trunnion Plate Bushing	.5625 +.0015 -.0000	.5625	.5645
2	NAS75-7-016	Drag Link Lug Bushing	.4375 +.0015 -.0000	.4375	.4410
14	AN177-25	Drag Link Lug Bolt	.4367 +.0000 -.0005	.4350	.4367
16	NAS77-7-38	Lower Drag Link - Applies to both ends of link.	.4375 +.0015 -.0000	.4375	.4410
15	AN177-37	Bolt - Drag Link Joint	.4367 +.0000 -.0005	.4355	.4367
18 17 21	NAS75-7-014 NAS77-7-68 NAS77-7-38	Bushing - Upper Drag Link - L & R - Both ends	.4375 +.0015 -.0000	.4375	.4410
20	AN177-23	Bolt - Drag Link - Top L & R	.4367 +.0000 -.0005	.4350	.4367
19	NAS77-7-40	Bushing - Drag Link Plate - L & R	.4375 +.0015 -.0000	.4375	.4410
22	NAS77-4-50	Bushing - Nose Gear Idler - Top	.2500 +.0015 -.0000	.2500	.2520

Figure 32-28. Nose Gear Wear Limits (cont.)

Index No.	Part No.	Item	Mfg. Dimension	Min. Service Limit	Max. Service Limit
23	AN4-33	Bolt - Nose Gear Idler - Top - AN174 may be used to reduce play.	.2490 +.0000 -.0030	.2455	.2490
4	NAS77-4-42	Bushing - Torque Link	.3745 +.0010 -.0000		
5	AN174-14	Bolt - Torque Link Joint	.2492 +.0000 -.0005	.2475	.2492
3	45318-00	Link - Torque			
6	AN175-32	Bolt - Torque Link Attachment	.3117 +.0000 -.0005	.3105	.3117
7	31785-00	Bushing - Fork - Torque Link Attachment	.3130 +.0020 -.0000	.3130	.3160
9	NAS77-5-42 or 43256-06	Bushing - Cylinder - Torque Link Attachment (Unnotched) Bushing (Notched)	.3125 +.0015 -.0000	.3125	.3160
11	45328-00	Bearing - Oleo Strut - Lower	2.002 +.001 -.000		
10	31779-00	Bearing - Oleo Strut - Upper	2.3730 +.0000 -.0020	Chrome Plate Worn Thru	2.3730
8	45314-05	Cylinder Assembly (Cylinder Bore)			
24	TRA 2031	Nose Gear Steering Bearing (As Required)			
25	M34-14	Shimmy Dampener Bearing			

Figure 32-28. Nose Gear Wear Limits (cont.)

MAIN GEAR WEAR LIMITS.

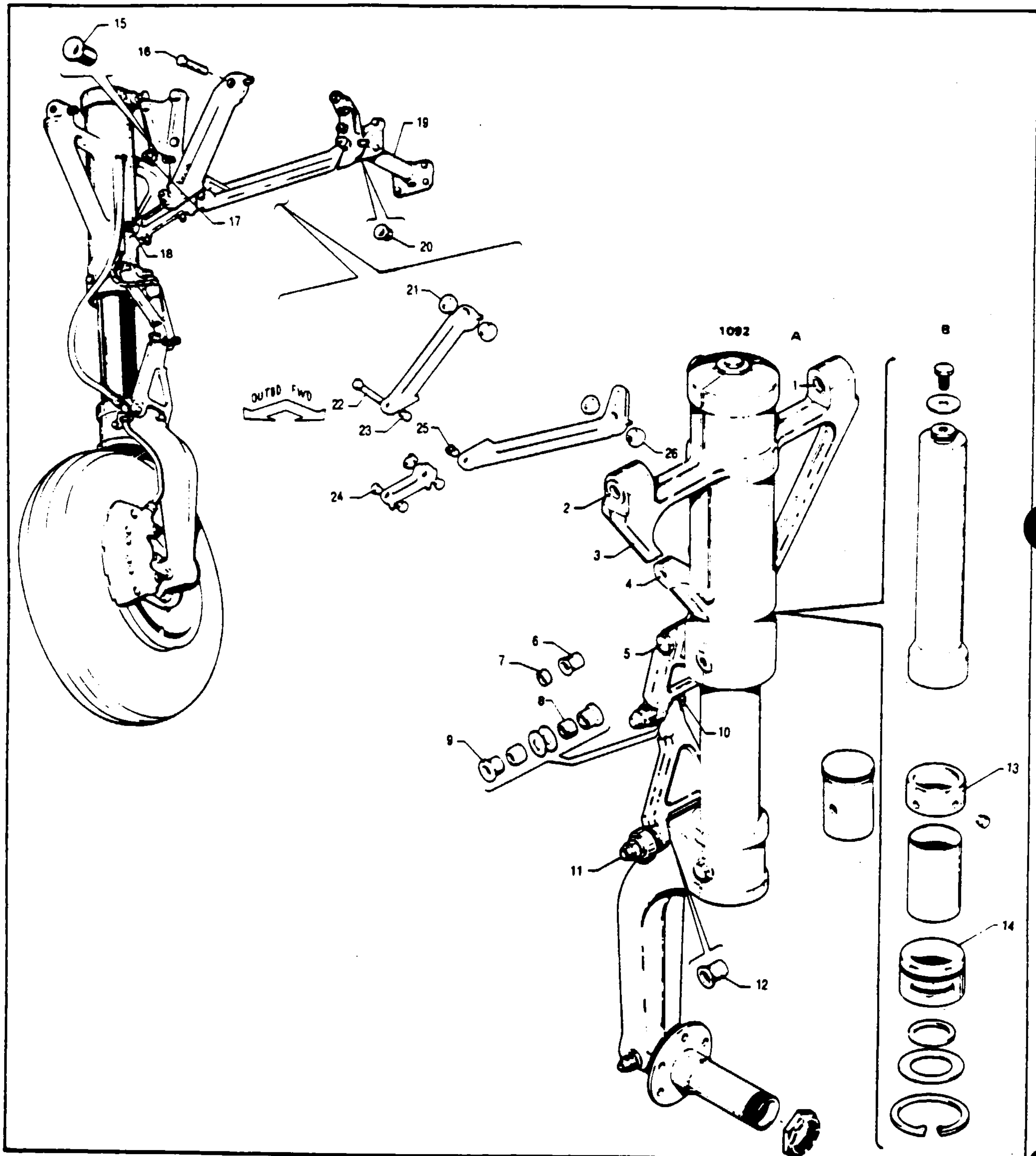

Figure 32-29. Main Gear Wear Limits

Index No.	Part No.	Item	Mfg. Dimension	Min. Service Limit	Max. Service Limit
2 1	20737-23 43256-4 61402-99 43256-5	Bushing - Trunnion	.6245 +.0015 -.0000	.6245	.6270
17	AN10-36	Bolt - Trunnion - AN180 may be used to reduce play.	.6240 +.0000 -.0040	.6190	.6240
15	NAS77-10-94	Bushing - Trunnion Plate	.6250 +.0015 -.0000	.6250	.6270
4	61402-98 43256-3	Bushing - Side Brace Lug	.4990 +.0010 -.0000	.4990	.5025
18	AN178-26	Bolt - Side Brace Lug	.4991 +.0000 -.0005	.4981	.4991
24	NAS77-8-44	Bushing - Side Brace - Lower Link - Applies to both ends of link.	.5000 +.0015 -.0000	.5000	.5020
22	AN178-34	Bolt - Side Brace Joint	.4991 +.0000 -.0005	.4981	.4991
23,25	NAS77-8-72	Bushing - L & R Side - Brace Link - Lower End	.5000 +.0015 -.0000	.5000	.5020
21	NAS77-8-38	Bushing - Aft Side Brace - Upper End	.5000 +.0015 -.0000	.5000	.5025
16	AN8-30	Bolt - Aft Side Brace - Upper End - AN178 may be used to reduce play.	.4990 +.0000 -.0040	.4940	.4990

Figure 32-27. Main Gear Wear Limits (cont.)

Index No.	Part No.	Item	Mfg. Dimension	Min. Service Limit	Max. Service Limit
20	NAS77-8-84	Bushing - Aft Side - Brace Fitting	.5000 +.0015 -.0000	.5000	.5025
26	NAS77-18-50	Bushing - Forward Side - Brace - Upper End	1.1250 +.0015 -.0000	1.1250	1.1280
19	42058-00	Shaft - Forward Side - Brace Pivot	1.1245 +.0000 -.0010	1.1225	1.1245
6	20737-40 43256-2	Bushing - Housing - Torque Link Attachment	.3740 +.0020 -.0000	.3745* *Ream at install. if req.	.3775
5	AN176-42	Bolt - Torque Link to Housing	.3742 +.0000 -.0005	.3732	.3742
7	NAS75-6-011	Bushing - Torque Link	.3750 +.0015 -.0000	.3750	.3775
8 9	NAS75-7-011 NAS77-7-35	Bushing - Torque Link - Center	.4375 +.0015 -.0000	.4375	.4400
10	AN7-22	Bolt - Torque Link - Center - AN177 may be used to reduce play.	.4370 +.0000 -.0040	.4330	.4370
12	20737-40 43256-2	Bushing - Fork - Torque Link Attachment	.3740 +.0020 -.0000	.3745* *Ream at install. if req.	.3775

Figure 32-27. Main Gear Wear Limits (cont.)

Index No.	Part No.	Item	Mfg. Dimension	Min. Service Limit	Max. Service Limit
11	AN176-51	Bolt - Torque Link to Fork	.3742 +.0000 -.0005	.3732	.3742
14	40246-00	Bearing - Oleo Strut - Bottom	2.7500 +.0020 -.0000	2.7500	2.7530
13	40247-00 or 40247-02	Bearing - Oleo Strut - Top (Unnotched) Bearing (Notched)	3.2480 +.0000 -.0020	Chrome Plate Worn Thru	3.2480
3	40327-00	Housing Assembly (Cylinder Bore)	3.2500 +.0030 -.0000	3.2500	3.2545

Figure 32-29. Main Gear Wear Limits (cont.)

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CHAPTER

33

LIGHTS

CHAPTER 33 - LIGHTS

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— NOTE —

Refer to Chapter 91 for electrical schematics

GENERAL.

This Chapter provides instructions relating to maintenance of the lighting equipment used on the T-1020.

FLIGHT COMPARTMENT.

COCKPIT LIGHTING.

The lighting in the cockpit area of the T-1020 is controlled by several types of electrical power connections. The overhead map lights are controlled by on/off switches located on the forward part of the overhead panel. In the center of the overhead panel is the potentiometer for the pilot's flight panel (all instruments, placards and dials necessary for the pilot's flight operation). Another potentiometer, controlling the light intensity for the overhead gauges and switches, is located on the left forward side of the overhead panel. Two optional dimmers, one for the co-pilot's lights and one for the radio panel lights, complete the switching arrangement for cockpit lighting. All cockpit lighting, except for radio lights, is protected by a single circuit breaker. The radio lights are protected by the radio accessories circuit breaker.

SOLID STATE DIMMER ASSEMBLY.

DESCRIPTION OF OPERATION.

The potentiometer controlling the pilot's flight panel lighting is connected to a Solid State Dimmer assembly. This potentiometer controls the electrical flow through the dimmer to the pilot's panel lights. The voltage is switched on and off simultaneously with the low voltage control circuit. A switch inside the potentiometer controls this on/off function. When the potentiometer's control knob is turned on, the lighting intensity is very dim. Lighting intensity increases with a clockwise rotation of the potentiometer's control knob until it reaches its brightest intensity. At this point the knob will no longer turn clockwise. Reversal of the knob movement will allow the lighting intensity to be adjusted to a suitable level. When the lighting intensity is turned to a lower setting, the solid state dimmer serves as a release for excess heat. Wiring leading to a terminal block and various panel lights completes the circuit for the solid state dimmer.

TROUBLESHOOTING.

When troubleshooting the solid state dimmer assembly, it must first be determined if the trouble is a defective dimmer assembly, or a shorted or open connection in the wiring for the unit. Verify that the proper voltage exists at the circuit breaker by turning on the map light. If the map light is working, there should be voltage at the connector to the dimmer assembly. To check voltage at dimmer assembly connector E304 gain access to dimmer assembly as described in removal of solid state dimmer and measure voltage at connector. If voltage is present, the solid state dimmer assembly may be defective. Prior to replacing the solid state dimmer assembly with another unit, check the rest of the wiring system for a possible short. If the wiring is not shorted or opened, replace the solid state dimmer assembly.

CHART 3301. LAMP REPLACEMENT GUIDE

Location	Piper Part No.	Lamp No.
Alternator Inoperative	472 861	106S-R-F38
Alternator Warning	472 028	327
Altimeter	472 047	335
Ammeter	472 078	1450
Bolt Lights, Instrument	472 028	327
Compass	472 047	335
Cowl Flap	453 791	356
Deicer	472 028	327
Dome Light	758 151	MS15584-15
Door Ajar	472 028	327
Door Step Lights	472 027	1495
Flap Indicator	472 028	327
Forward Baggage	472 755	L30-32
Fuel Control	472 028	327
Fuel Gauge	453 792	1828
Fuel Selector Panel	753 476	313
Fuel Shutoff Warning	472 028	327
Gear Down	472 028	327
Gear Down Warning	472 028	327
Gear Unlocked	472 028	327
Ground Recognition Beacon	758 418	RP-11SC-1047
Landing Light	472 769	4596
Map Light	472 052	304
No Smoking-Fasten Seat Belt	758 472	A-9906-7
Panel Lamp	472 052	304
Pneumatic Malfunction	472 058	387
Reading Light	453 886	1309
Recognition Light (Inflight)	761 214	LP1982SP
Stall Warning	472 028	327
Starter Energized	472 876	1065-A-FB59
Taillight		A-508
Tail Strobe		A-506
Tell-Tail Lights	472 184	DA-27
Trim Indicator	472 047	335
Voltmeter	453 792	1828
Wing Inspection	472 049	4593
Wing Tip Position		W1290-28
Wing Tip Strobe		A-610
NOTE: REFER TO PARTS CATALOG FOR CURRENT PART NUMBERS		

CHART 3302. COMPONENT VALUES TO OBTAIN BALANCED LIGHT OUTPUT INTENSITY

NOTE

Balancing of light output intensity is only needed when green light and blue light panels are mixed in the same aircraft. Use the following procedure on the green light panels only. Insert in series with the black lead the components listed below for that particular panel.

PANEL	COMPONENT	VALUE
Air Control	Resistor	47K
Landing Gear Strip	Resistor	47K
Light Switch	Resistor	47K
Panel Light Switch	Resistor	47K
Windshield & Pitot Heat	Resistor	47K

REMOVAL OF SOLID STATE DIMMER.

In the standard aircraft, there is only one solid state dimmer assembly. The dimmer assembly is located on the forward side of the bulkhead at Sta. 57.00 and W.L 775 on the right side of the aircraft.

The following procedures apply to the panel lights dimmer only.

1. Access to the dimmer is through the forward baggage compartment.
2. Locate dimmer assembly on upper forward bulkhead at Sta. 57.00 and disconnect electrical connector E304.
3. Remove the screws securing the dimmer assembly to the bulkhead.
4. Remove the dimmer assembly from the airplane.

INSTALLATION OF SOLID STATE DIMMER.

1. Position the solid state dimmer in place on bulkhead at Sta. 57.00 and secure with appropriate screws.
2. Connect plug connector E304 to dimmer assembly.

SPEAKER PANEL DOME LIGHTS.

REMOVAL OF DOME LIGHTS IN SPEAKER PANEL ASSEMBLIES.

The lamp is located in the forward section of the overhead speaker panel. It is necessary to remove the complete panel assembly from the headliner before the lamp can be changed.

1. Remove the attachment screws and lower the speaker panel assembly from the headliner. Two control knobs must also be removed if the forward speaker panel is being removed.
2. Remove the screws holding the light assembly to the panel and remove light assembly.
3. The lamp can now be replaced using proper lamp number.

INSTALLATION OF DOME LIGHTS IN SPEAKER PANEL ASSEMBLIES.

1. Replace the light assembly and secure to panel with screws.
2. Install the speaker panel assembly into the headliner.
3. Secure the speaker panel assembly to the headliner with attachment screws. Replace the two control knobs if previously removed from the forward speaker panel assembly.

OVERHEAD READING LIGHT.

REMOVAL OF LAMP IN OVERHEAD READING LIGHTS.

The lamp is located above each passenger window.

1. Remove the lens cover from the light assembly.
2. Remove the lamp from the light assembly.

INSTALLATION OF LAMP IN OVERHEAD READING LIGHTS.

1. Replace the lamp using the proper number.
2. Reinstall the lens cover.

REPLACEMENT OF COWL FLAP INDICATOR LIGHTS.

The cowl flap indicator lights are located between the left and right cowl flap indicator. The light bulbs may be replaced by removing the bottom trim panel from the face of the pedestal by removing panel attachment screws. Each bulb is rotated from its socket. The cowl flap switches are attached to the panel trim.

REPLACEMENT OF TRIM INDICATOR LIGHTS.

The trim indicator lights are located in the control pedestal, between the indicator units. The light bulbs may be replaced by first removing the aileron trim control knob by pushing out the roll pin that secures the knob. Then remove the trim panel from the face of the pedestal by removing panel attachment screws. Each bulb is rotated from its socket. Replace bulbs and attachments in reverse order of removal.

OVERHEAD ENTRANCE LIGHT.

REMOVAL OF LAMP IN OVERHEAD ENTRANCE LIGHT.

The removal of the headliner panel is necessary to replace the lamp.

1. Remove the machine screws holding the circular trim plate around light assembly, and remove the trim panel.
2. Using a flat tool, carefully pry out the headliner panel from the trim extrusions.
3. Remove the screws holding light assembly in place and remove assembly.
4. Remove the snap cover over the lamp on the assembly and replace the lamp.

INSTALLATION OF LAMP IN OVERHEAD ENTRANCE LIGHT.

1. Replace the snap cover over the lamp on the light assembly.
2. Replace light assembly and secure with screws.
3. Carefully replace the headliner panel into the trim extrusions.
4. Replace circular trim plate and secure with screws.

DOOR STEP LIGHTS.

REMOVAL OF LAMP IN DOOR STEP LIGHTS.

1. Remove the screws holding the door step light assembly to the door trim panel.
2. Slide off the rubber boot on the rear of the light assembly.
3. Remove the snap bracket, from the rear of the light assembly and remove the lamp.

INSTALLATION OF LAMP IN DOOR STEP LIGHTS.

1. Replace the lamp using the proper number.
2. Reinstall the snap bracket and rubber boot.
3. Reinstall the light assembly and secure it to the panel with screws.

EXTERIOR.

LANDING LIGHT.

REMOVAL OF LANDING LIGHT. (Refer to Figure 33-1.)

1. To remove either lamp from the landing light mounting plate, remove the screws from the front of the lamp attachment plate and then remove the attachment plate from the lamp mounting plate. When removing the attachment plate, use caution not to drop the lamps. Disconnect the electrical leads from the desired lamps.
2. To remove the lamp light assembly from the gear strut, disconnect the electrical leads from the lamps and release the clamps that secure the assembly to the strut housing.

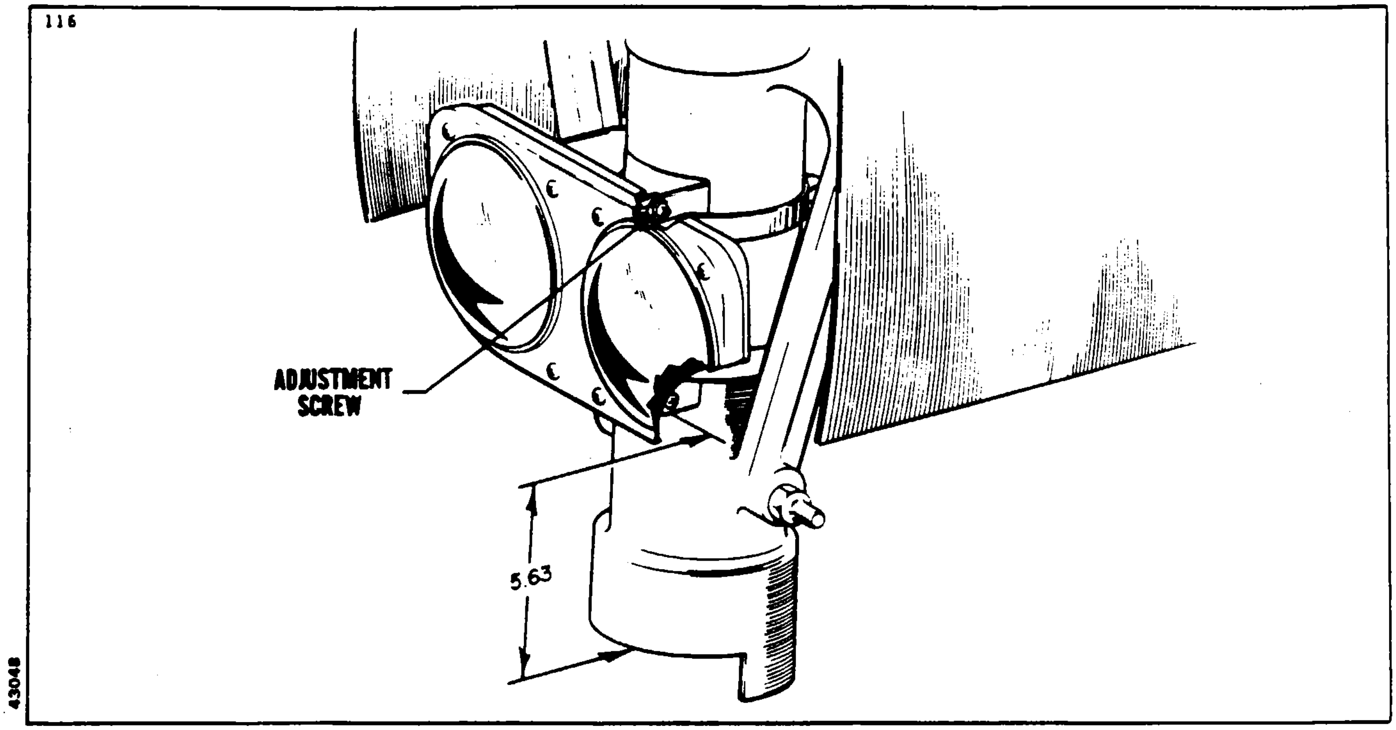

Figure 33-1. Landing Light Installation

INSTALLATION OF LANDING LIGHT.

1. To install the landing light lamps, attach the electrical leads to the lamp(s) and place against the mounting pad. Position the attachment plate and secure with screws only tight enough to allow the lamps to fit snug in the mount.
2. To install the landing light assembly, position the assembly against the strut housing with the bottom of the mounting bracket 5.63 inches up from the bottom of the housing. (Refer to Figure 33-1.) Align the bracket longitudinally and secure with clamps. The light beam angle may be adjusted by the adjustment screws at the side of the bracket and tilting as desired.

POSITION LIGHTS.

REMOVAL OF WING NAVIGATION LIGHT.

1. To remove bulb, remove the screws securing the clear window.
2. Remove screws securing the lens retainer.
3. Remove lens and bulb.

— NOTE —

To remove the complete lamp assembly, the wing tip must be removed.

INSTALLATION OF WING NAVIGATION LIGHT.

1. Install bulb, lens gasket and secure retainer.
2. Put light window in position and secure.

REMOVAL OF WING TIP POSITION LIGHT.

The wing tip position lights are located on each wing tip, inside a plexiglass cover.

1. Remove the screws securing the plexiglass cover to the wing tip.
2. Remove the screw securing the lens retainer to the light assembly.
3. Remove the lens retainer and lens.

— NOTE —

To remove the complete light assembly, the wing tip must be removed.

INSTALLATION OF WING TIP POSITION LIGHT.

1. Install the bulb and lens.
2. Secure lens retainer with appropriate screw.
3. Place plexiglass cover in position on wing tip and secure with appropriate screws.

REMOVAL OF TAIL POSITION LIGHT.

The tail position light is located on the tip of the tail.

1. Remove the screws securing the lens retainer to the light assembly, and remove lens retainer and lens.
2. Remove bulb.

— NOTE —

To remove the complete taillight assembly, disconnect retaining nut on the electrical connection at the back of the taillight. The assembly is now free.

INSTALLATION OF TAIL POSITION LIGHT.

1. Install the bulb.
2. Install lens retainer and secure with the appropriate screws.

REMOVAL OF WING TIP STROBE LIGHTS.

The wing tip strobe lights are located on each wing tip, inside a plexiglass cover.

1. Remove the screws securing the plexiglass cover to the wing tip and remove the cover.
2. Remove the screw securing the lens retainer and remove lens and retainer.
3. Remove the three screws securing the light bracket assembly.
4. Cut the three wires to the strobe lamp at the bottom of the bracket assembly.
5. Pull cut wires from wing tip and disconnect at three pin connector; discard connector.

— NOTE —

Secure wing harness connector outside of wing.

INSTALLATION OF WING TIP STROBE LIGHTS.

1. Route wires from new lamp down through hole in the light bracket assembly.
2. Insert the wire terminals into the plastic plug supplied with the new lamp. Wire plug as follows: White wire to pin 3; Black wire to pin 2; Red wire to pin 1.
3. Connect the three pin connector to the wing harness.
4. Position the light bracket assembly on the wing tip and secure with the appropriate screws.
5. Install lens and lens retainer and secure with the appropriate screw.
6. Install plexiglass cover on wing tip and secure with appropriate screws.

REMOVAL OF WING TIP STROBE POWER SUPPLY.

For each wing tip strobe light, there is one strobe power supply mounted outboard on the outboard wing rib (L or R).

1. Remove screws from wing tip (L or R), and move just enough to gain access inside the wing tip.
2. Disconnect the three electrical connectors inside the wing tip.
3. Remove the wing tip.
4. Remove mounting screw on strobe power supply containing the ground wires.
5. Remove the other three screws mounting power to wing rib. Remove power supply from aircraft.

INSTALLATION OF WING TIP STROBE POWER SUPPLY.

1. Position power supply on wing rib (L or R), and secure with the three screws previously removed.
2. Insert other screw through the ground wire terminals; install and secure to strobe power supply.
3. Put wing tip in position on the wing leaving enough room to gain access to the inside of the wing tip.
4. Connect the three electrical connectors inside the wing tip.
5. Position wing tip on wing and secure with the appropriate screws.

REMOVAL OF TAIL STROBE LIGHT.

The tail strobe light is mounted on the tip of the tail.

1. Remove the screws securing the lens retainer and remove retainer and lens.
2. Remove the tail navigation light and keep.
3. Remove screws securing the bottom fairing, and lower it just enough to gain access to the two plugs connecting the strobe power supply to the rest of the system.
4. Disconnect the two plugs and remove the bottom fairing with the strobe power supply still attached.
5. Disconnect the two pin connector from behind the light assembly.
6. Pull the light assembly out from the tail and discard.

— NOTE —

If the strobe light is defective, the complete assembly must be discarded as it is not a repairable item.

INSTALLATION OF TAIL STROBE LIGHT.

1. Put the new strobe light assembly into place on the tail.
2. Connect the two pin connector (with two blue wires attached).
3. Position bottom fairing into place leaving enough room to gain access to the two plugs connecting the strobe power supply to the system, and connect the two plugs.
4. Secure the bottom fairing into place with the appropriate screws.
5. Install navigation light previously removed.
6. Replace lens and lens retainer and secure with the appropriate screws.

REMOVAL OF TAIL STROBE POWER SUPPLY.

The tail strobe power supply is mounted on the inside of the bottom tail fairing.

1. Remove screws securing the bottom tail fairing, and lower the fairing just enough to gain access to the two plugs connecting the strobe power supply to the rest of the system.
2. Remove strobe power supply mounting screw containing the ground wire.
3. Disconnect the two plugs and remove bottom tail fairing with the strobe power supply still attached.
4. Remove the screws securing the power supply to the bottom tail fairing. Remove power supply.

INSTALLATION OF TAIL STROBE POWER SUPPLY.

1. Position the power supply in place on the bottom tail fairing and secure with the three screws that did not contain the ground wire.
2. Position the bottom tail fairing into place, leaving enough room to gain access to the two plugs and ground wire.
3. Connect the two plugs to the aircraft harness connections and insert screw through ground wire terminal and secure.
4. Secure the bottom fairing into place with the appropriate screws.

TROUBLESHOOTING.

The strobe light assembly functions as a condenser discharge system. A condenser in the power supply is charged to approximately 450-volts DC; then 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 designed 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 whether the trouble is in the flash tube or the power supply. Replacement of the flash tube will confirm whether tube is defective. A normal 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 electrical schematic in this manual.

1. Ascertain the input voltage at the power supply is 28-volts.

— CAUTION —

When disconnecting and connecting power supply input connections, do not get the connection 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.

— CAUTION —

When disconnecting the power supply, allow five minutes of bleed down time before handling the unit.

2. Check for malfunction in interconnecting cables.
   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 fault 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. Avoid any connection between pins 1 and 3 of interconnecting cable as this will discharge the condenser in the power supply and destroy the trigger circuit.

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 1 to 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 and 2 and 3 of the interconnecting cable. If continuity exists between any of these connections, the cable is shorted and should be replaced.

4. Check tube socket assembly for shorts and opens.
   A. Disconnect the tube socket assembly of the strobe light from the interconnecting cable.
   B. The following continuity checks can be made with an ohmmeter.
   C. Check for continuity between pin 1 of AMP connector to pin 1 of tube socket, pin 2 of AMP connector to pin 6 and 7 of tube socket and pin 3 of AMP connector to pin 4 of tube socket. When making these tests, if no continuity exists the tube socket assembly is broken and should be replaced.
   D. Check for continuity between pin 1 of AMP connector to pins 4, 6 and 7 of the tube socket and pin 2 of AMP connector to pins 1 and 4 of tube socket. If continuity exists the tube socket assembly is shorted and should be replaced.

RECOGNITION LIGHTS.

REMOVAL OF INFLIGHT RECOGNITION LIGHTS.

The recognition lights are located in the left and right wing tips, inside a plexiglass cover.

1. Ascertain the circuit breaker for the recognition lights is pulled before attempting to remove the light.
2. Remove the screws securing the plexiglass cover to the wing tip.
3. Remove the two screws securing the light assembly to the bracket.
4. Pull light assembly partially out of bracket and disconnect electrical connection.
5. Remove light assembly.

— NOTE —

Bulb replacement can be accomplished by removing screw on retainer ring and removing retainer and lens.

INSTALLATION OF INFLIGHT RECOGNITION LIGHTS.

1. Reconnect the electrical connector to the light assembly.
2. Secure light assembly with two screws previously removed.
3. Place plexiglass cover in position on wing tip and secure with appropriate screws.

GROUND RECOGNITION BEACON.

REMOVAL OF GROUND RECOGNITION BEACON.

The ground recognition beacon is mounted on the fin tip.

1. Remove screws securing fin tip to the fin.
2. Lift fin tip and disconnect electrical connector and remove ground wire from light assembly.
3. Remove screws securing socket assembly to fin tip.
4. Remove socket assembly.

— NOTE —

To remove bulb only, remove the screws securing the lens retainer to the light assembly and remove lens retainer and lens. Remove bulb.

INSTALLATION OF GROUND RECOGNITION BEACON.

1. Install socket assembly on fin tip and secure with appropriate screws, placing ground wire on the forward screw and securing.
2. Reconnect the electrical connector to the light assembly.
3. Install fin tip on fin and secure with appropriate screws.

REMOVAL OF GROUND RECOGNITION BEACON FLASHER.

The flasher unit is located on the aft side of the bulkhead at Sta. 296 on the left side of the aircraft.

1. To gain access to the flasher, remove the screws securing the access panel to the rear baggage compartment and remove panel.
2. Locate flasher and disconnect the electrical connector (BLINK) from the unit.
3. Remove the two screws securing the flasher unit to the bulkhead.
4. Remove the flasher unit.

INSTALLATION OF GROUND RECOGNITION BEACON FLASHER.

1. Secure flasher unit to bulkhead with two screws previously removed.
2. Reconnect the electrical connector.
3. Install aft panel in rear baggage compartment and secure with appropriate screws.

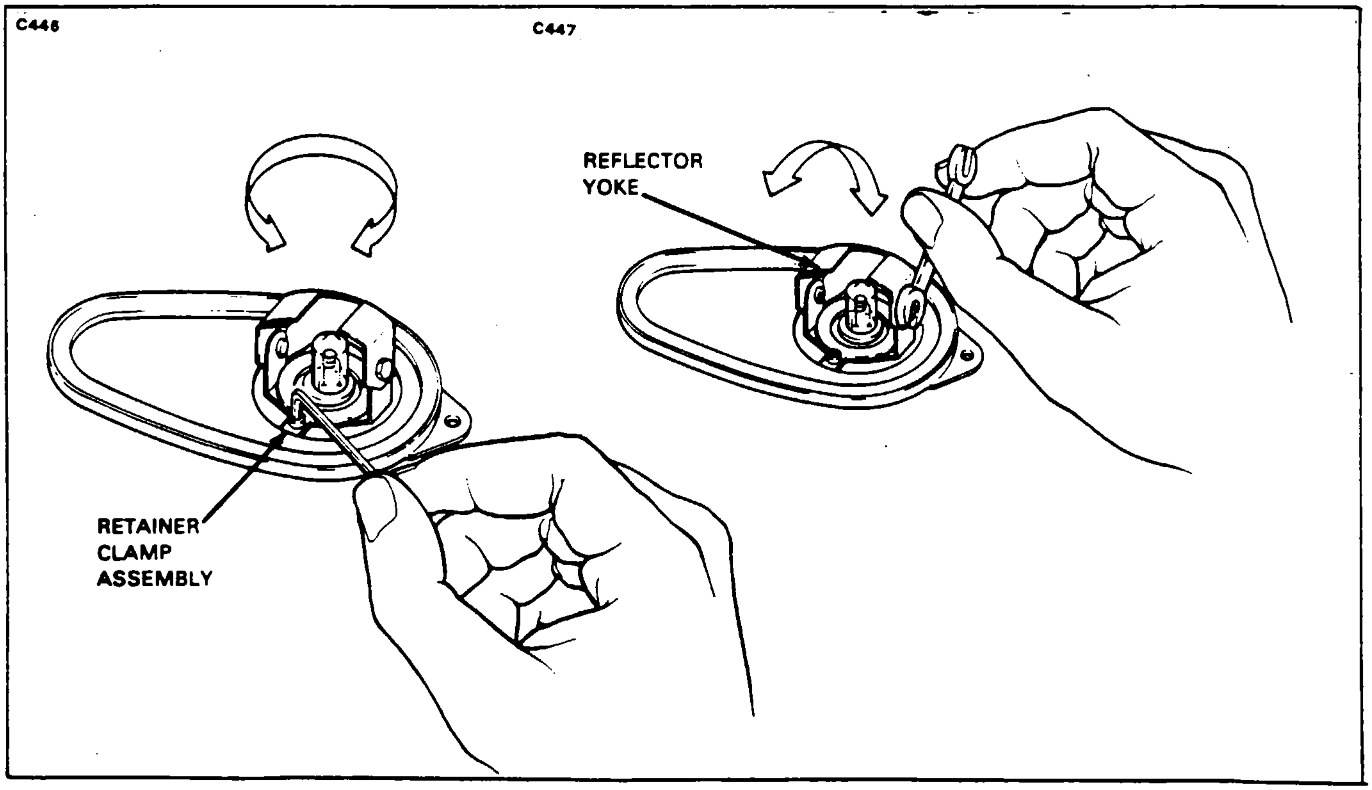

Figure 33-2. Logo Light Assembly Adjustments

LOGO LIGHTS.

The logo lights are located on the upper surface of the left and right stabilizer for vertical tail illumination. The circuit consist of two 75 watt light assemblies, protected by a 7½ amp circuit breaker and controlled by a switch mounted on the overhead switch panel.

— NOTES —

1. Handling lamp with bare finger will deposit skin oil on lamp. Remove before illumination of lamp, by cleaning lamp with a grease-free solvent such as acetone.
2. Prior to checking lamp, place lens cover over light assembly for eye protection.
3. When adjusting light assembly turn lamp switch off, allow time for cooling, reflector and lamp become extremely hot.

LOGO LAMP REPLACEMENT.

1. Remove lens screw and lens cover.
2. Remove bulb.
3. Install new bulb, place lens cover over light assembly, apply electrical power and turn on logo light switch and check for proper illumination of lamp.
4. Place logo light switch in off position, secure electrical power to aircraft, and secure lens cover with appropriate screw.

LOGO LIGHTS ADJUSTMENT. (Refer to Figure 33-2.)

The logo lights are adjustable horizontally and vertically to illuminate the vertical tail section of aircraft.
1. Remove cover lens screw and lens.
2. Loosen locking clamp retainer screws to rotate reflector forward or aft as required.
3. Loosen the reflector screws on yoke assembly to adjust up and down as required.
4. Place lens cover over light assembly, apply power to aircraft and turn on logo light switch. Proper adjustment is even light coverage of vertical tail section.
5. Place logo light switch in off, prior to securing light assembly, or readjusting light assembly.
6. Remove lens cover and tighten base locking clamp retainer screws and tighten yoke assembly reflector screws. Reinstall lens cover and secure with appropriate screw.

— END —

CHAPTER

34

NAVIGATION AND PITOT/ STATIC

CHAPTER 34 - NAVIGATION AND PITOT/STATIC

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GENERAL.

This Chapter provides maintenance information concerning the Pitot / Static Pressure System and related instrumentation of the T-1020.

DESCRIPTION.

The instrument air system consists of a pitot air system and a static air system. Refer to Figure 34-1 for system layout.

Pitot air system consists of a pitot mast located on the bottom side of the nose section, with its' related plumbing. Impact air pressure entering the pitot head is transmitted through the pitot plumbing to the airspeed indicator on the instrument panel.

Static air system consists of two static ports, one on each side of the fuselage, located just aft of bulkhead station 296.0. These ports are interconnected as shown in Figure 34-1 and the tubing is then routed forward along the top of the fuselage and down the windshield center post to the back of the instrument panel, where it is connected to the airspeed indicator, altimeter and rate of climb indicator. An alternate static air source is located below the instrument panel in front of the pilot. This alternate static source is part of the standard system and has a shutoff valve which closes the port when it is not needed.

TROUBLESHOOTING.

For troubleshooting of the various instruments, refer to the Chart with each particular instrument.

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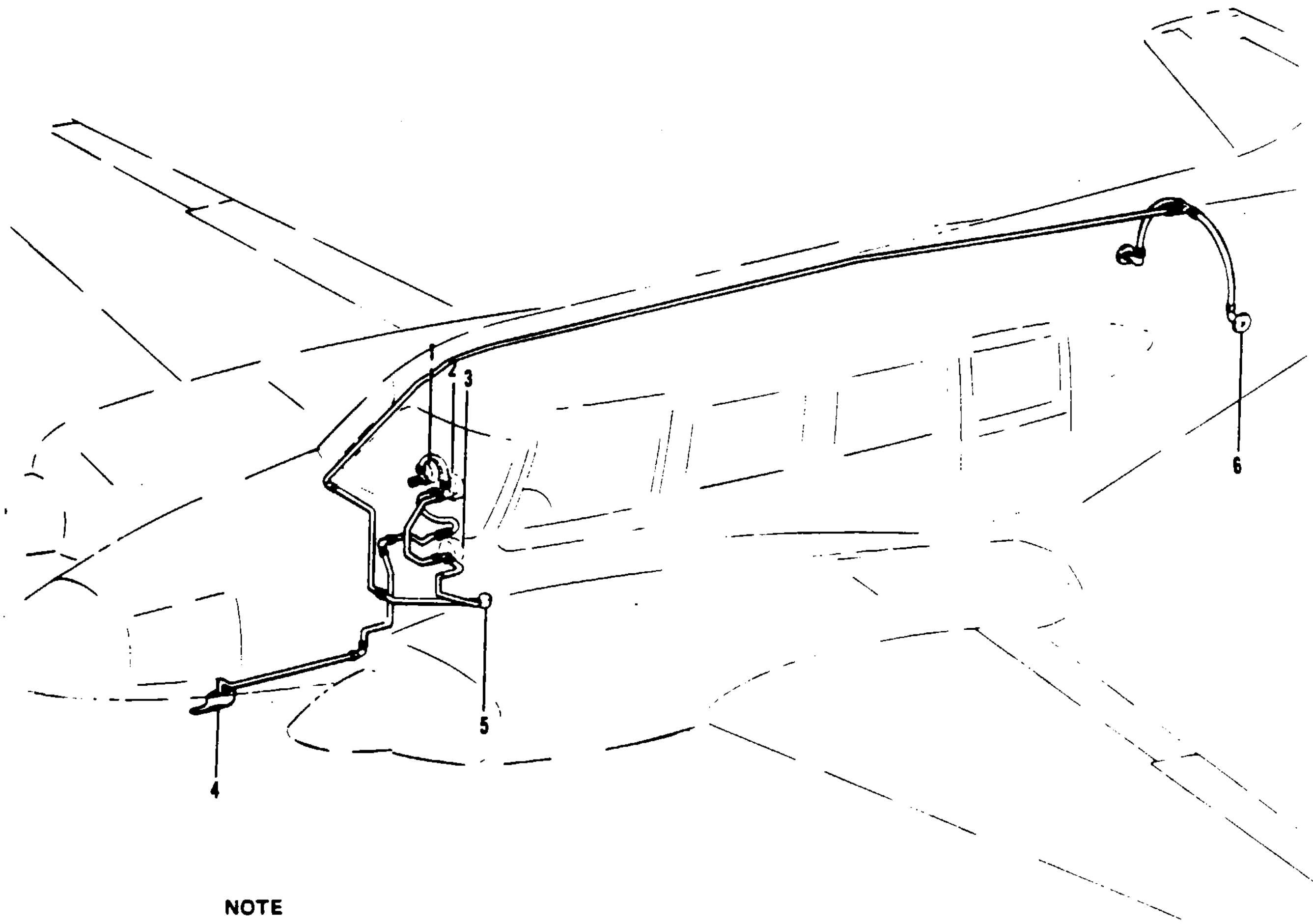

NOTE

ADVISORY CIRCULAR AC 43-203A DESCRIBES AN ACCEPTABLE MEANS OF COMPLYING WITH STATIC SYSTEM TEST REQUIRED BY FAR PART 91, SECTION 91.170 FOR AIRCRAFT OPERATED UNDER IFR CONDITIONS. FOR STATIC SYSTEM TEST FOR AIRCRAFT NOT OPERATED IN CONTROLLED AIRSPACE UNDER IFR CONDITIONS SEE ADVISORY CIRCULAR AC 43.13-1A, SECTION 4 OF CHAPTER 16. REFER TO PARTS CATALOG FOR TYPICAL SYSTEM ROUTING.

1. PITOT HEAD
2. ALTERNATE STATIC SOURCE
3. ALTIMETER
4. AIRSPEED INDICATOR
5. RATE OF CLIMB INDICATOR
6. SUCTION GAUGE
7. STATIC SOURCE FOR PILOT'S AND OPTIONAL COPILOT'S STATIC INSTRUMENTS.

44281, 44288

Figure 34-1. Instrument Air System Installation (Typical)

INSPECTION AND CHECKS OF INSTRUMENTS AND SYSTEM.

During the regular inspection of the airplane or whenever an instrument or instruments is changed or serviced, the following inspection and checks should be made to the complete system:

1. Inspect the pitot - static system for cleanliness, condition, security and operation per Advisory Circular No. AC43.203A for aircraft operated in controlled airspace under IFR conditions. Aircraft not operated in controlled airspace should be tested per Advisory Circular AC43.13-1A, Section 4 of Chapter 16.
2. Inspect the instruments for poor condition, mounting, markings, broken or loose and/or missing knob, bent or missing pointers, and improper operation (where applicable).
3. Check power-off indications of instrument pointers and warning flags for proper indication.
4. Apply power and check for excessive mechanical noise, erratic or intermittent operation, failure to indicate, sluggishness or indication of excessive friction. Note if the erection or warm-up time is excessive, caging functions are normal, and warning flags and indicating lights and test circuits are operable.
5. Note operation of instruments during engine runup. Check for intermittent or improper operation of any instrument.
6. Inspect the complete system for general condition, apparent and obvious defects, insecurity of attachments, tubing connections and pneumatic tubing for security, leaks, corrosion, cracks, bends and pinching and any evidence of chafing.
7. Check electrical connections and circuit breakers for proper size, security and condition. Check instrument lighting system for range of illumination, burned out bulbs and defective controls. Check wiring for chafing, excessive tension, improper support or broken lacing and ties.
8. Check instruments for evidence of overheating or contamination of equipment by foreign matter or water. Dust, dirt and lint contribute to overheating of equipment, poor ventilation and malfunctioning. Special attention should be given that ventilation openings in equipment housings are open and free from obstructing lint and dust.

REMOVAL OF INSTRUMENTS.

1. The non-shock mounted instruments located in the center and along the bottom of the instrument panel may be removed by the following procedure:
   A. At the back of the panel, unscrew the electrical connector from the post light(s).
   B. Disconnect the plumbing and/or electrical connector from the back of the instrument. Where two or more lines connect to an instrument, identify each line to facilitate reinstallation. Attach a dust cap or plug to each fitting.
   C. Remove the post light(s) by turning off nut.
   D. Remove the screws that secure the instrument in the panel cutout.
   E. Remove the instrument from the panel.
2. The shock-mounted instruments may be removed by the following procedure:
   A. Unsnap the forward side of the instrument panel cover and slide forward enough to allow it to move from its attachment slot. Remove the cover from over the panel.
   B. Pull the control wheel that is at the opposite side of the instrument panel from where the shock-mounted panel is to be removed, to its aftmost position and secure with a cord tied between the wheel and around the seat back.
   C. Pad the control wheel tube with foam rubber or similar material.
   D. Remove the four self-locking nuts that secure the floating panel to its shock mounts. There is one nut located on the panel at each side of the control wheel tube and one nut located at each side of the panel, near the top. With an open end wrench held next to the back side of the panel, hold the rubber mounts to eliminate twisting as the nuts are being removed.

E. Pull the panel back and allow it to rest on the padded control wheel tube.
F. Unscrew the electrical connector from the post light(s).
G. Disconnect the plumbing and/or electrical connector from the back of the instrument and identify each line to facilitate reinstallation. Attach a dust cap or plug to each fitting.
H. Remove the post light(s) by turning off nut.
I. Remove the screws that secure the instrument in the panel cutout.
J. Remove the instrument from the panel and secure the panel from rolling off the control tube.
K. Check the general condition of the rubber shock mounts and replace if necessary.

INSTALLATION OF INSTRUMENTS.

1. The non-shock-mounted instruments may be installed by the following procedure:
   A. Place the instrument in its proper panel cutout and secure with screws.
   B. Install the post light(s) and secure. Do not over tighten nut.
   C. Connect the plumbing and/or electrical connector to back of instrument.
   D. Connect the electrical connector of the post light(s). Tighten connector finger tight.
   E. Check instrument and post light(s) operation.
2. The shock-mounted instruments may be installed by the following procedure:
   A. Place the instrument in its proper panel cutout and secure with screws.
   B. Install the post light(s) and secure. Do not overtighten nut.
   C. Connect the plumbing and/or electrical connector to back of instrument.
   D. Connect the electrical connector of the post light(s). Tighten connector finger tight.
   E. Ascertain that one end of the ground straps is placed over the panel side of the shock-mount stud.
   F. Place the floating panel in position and allow the shock-mount attachment studs to protude through the panel. Install and tighten attachment nuts.
   G. Remove the padding and release the control wheel.
   H. Check the instrument and post light operation.

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.

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	Clear Pitot head.
	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.

SENSITIVE 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, per AC 43.13-1.

CHART 3402. TROUBLESHOOTING (ALTIMETER) (cont.)

Trouble	Cause	Remedy
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.
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.

CHART 3403. TROUBLESHOOTING (AIRSPEED TUBES AND INDICATOR) (cont.)

Trouble	Cause	Remedy
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.
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.
Tube does not heat or clear itself of ice with switch "ON."	Circuit breaker popped.	Reset.
	Open circuit.	Repair.
	Excessive voltage drop between battery and pitot head.	Check voltage at pitot head.
	Heating element burned out.	Replace pitot head.

NOTE

When any connections in static system are opened for checking, system must be checked per FAR 23.1325.

ATTITUDE AND DIRECTION.

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.

CHART 3404. TROUBLESHOOTING (MAGNETIC COMPASS)

Trouble	Cause	Remedy
Excessive card error.	Compass not properly compensated.	Compensate instrument.
	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Improper mounting on instrument panel.	Align instrument.
	Insufficient liquid.	Replace or repair instrument.
Card sluggish.	Weak card magnet.	Replace or repair instrument.
	Instrument too heavily compensated.	Remove excess compensation.
	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 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.

CHART 3405. TROUBLESHOOTING (DIRECTIONAL GYRO INDICATOR)

Trouble	Cause	Remedy
Excess drift in either direction.	Excessive vibration.	Check shock mounts. Replace if necessary.
	Defective instrument.	Replace instrument.
	Insufficient pressure. If pressure below 5.5 ± .5 psig, check for the following:	
	a. Relief valve improperly adjusted.	a. Adjust.
	b. Incorrect gauge reading.	b. Replace gauge.
	c. Pump failure.	c. Repair or replace.
	d. Pressure line kinked or leaking.	d. Check and repair. Check for collapsed inner wall of hose.
Dial spins during turn.	Limits (55° bank) of gimbal exceeded.	Reset gyro in level flight.
Dial spins continuously.	Defective 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.

CHART 3406. TROUBLESHOOTING (GYRO HORIZON INDICATOR)

Trouble	Cause	Remedy
Bar fails to respond.	Insufficient pressure.	Check pump and tubing.
	Filter dirty.	Clean or replace filter.
Bar does not settle.	Insufficient pressure.	Check line and pump. Adjust valve.
	Excessive vibration.	Check shock mounts. Replace if necessary.
	Incorrect instrument.	Check part number.
	Defective instrument.	Replace.
Bar oscillates or shimmies continuously.	Instrument loose in panel.	Tighten mounting screws.
	Excessive vibration.	Check shock mounts. Replace if necessary.
	Pressure 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.	

CHART 3406. TROUBLESHOOTING (GYRO HORIZON INDICATOR) (cont.)

Trouble	Cause	Remedy
Instrument tumbles in flight.	Low pressure.	Reset regulator.
	Dirty filter.	Clean or replace filter.
	Line to filter restricted.	Replace line.
	Plug missing or loose in instrument.	Replace or tighten plug.
	Bank or Pitch Limits exceeded.	

GYRO INSTALLATION INSPECTION.

The following inspections should be made before removing a suspected gyro instrument from the the airplane.

Visual Examination:

1. Has the instrument been modified?
2. Has the instrument been damaged?
3. Does the instrument show any signs of abuse?

Installation Inspection:

1. Are all pressure and static lines free from bends, restrictions or leaks?
2. Has the central air filter been replaced?
3. Is the instrument properly mounted in the panel?
4. Does the instrument physically touch other instruments, tubing or airframe members when the engines are started or stopped?
5. Are unused ports correctly sealed against air leaks?
6. Is the system pressure correct, and does the pressure gauge give an accurate reading?
7. Is the pressure regulator adjusted correctly and functioning properly?

GYRO HANDLING AND SHIPPING.

The following information applies to all three inch directional gyros and attitude horizon instruments installed by the factory or a Piper field service facility.

Gyro instruments being returned to the factory are to be placed in approved containers with all ports properly sealed immediately after removal from the aircraft instrument panel. The instrument must also be accompanied by factory copies of the warranty and credit claim forms. Thses forms and the special containers should be available at any Piper Dealer and/or Distributor. Should any gryo instrument be received by the factory in an unapproved container or if the ports are not sealed, the warranty will be immediately voided and the instrument returned to the sender. The instrument must be returned immediately after removal from the aircraft (not to exceed 15 days following discovery of defect).

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) (ELECTRICAL)

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.	Misadjustment of sensitivity spring.	Adjust by means of sensitivity spring screw. If this pulls the pointer from zero, replace instrument.
Pointer does not set on zero.	Gimbal and rotor assembly out of balance.	Replace instrument.
	Pointer incorrectly set on its staff.	Replace instrument.
	Sensitivity adjustment pulls pointer off zero.	Replace instrument.
Incorrect turn rate.	Instrument out of calibration.	Replace instrument.
Vibrating pointer.	Gimbal and rotor assembly out of balance.	Replace instrument.
	Pitted or worn pivots or bearings.	Replace instrument.

CHART 3407. TROUBLESHOOTING (TURN AND BANK INDICATOR) (ELECTRICAL) (cont.)

Trouble	Cause	Remedy
In low temperature, pointer fails to respond or does so sluggishly and with insufficient deflection.	Oil has become too thick. Insufficient bearing clearance.	Replace instrument. Replace instrument.
Pointer sluggish in returning to zero and does not set on zero when stationary.	Oil or dirt between damping pistons and cylinder. Excessive clearance between rotor and rotor pivots.	Replace instrument. Replace instrument.
Ball sticky.	Flat spot on ball.	Replace instrument.
Ball not in center when aircraft is correctly trimmed.	Instrument not level in panel.	Level instrument.

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CHAPTER

35

OXYGEN SYSTEM

CHAPTER 35 - OXYGEN SYSTEM

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GENERAL.

This chapter provides supplemental information for servicing 'oxygen system of the T-1020.

DESCRIPTION AND OPERATION.

The oxygen system consists of a storage cylinder, filler valve, dump outlet, regulator assembly, mask outlet ports and masks, distribution lines, pressure gauge and an ON/OFF control.

The storage cylinder is filled through the filler valve and supplies high pressure oxygen to the regulator assembly. The cylinder contains a valve assembly with a safety outlet which will vent the oxygen overboard through the dump outlet in the event of system over-pressurization.

High pressure oxygen is routed from the regulator to the pressure gauge while low pressure oxygen is routed from the regulator to the outlets and masks whenever the control knob is pulled to the ON position. Each outlet has a spring loaded valve which prevents the flow of oxygen until a mask hose is engaged in the outlet.

— CAUTION —

Only specially dried, Aviator's Breathing Oxygen conforming to MIL-O-27210, Type 1 is authorized for use in the oxygen system.

TROUBLESHOOTING.

Chart 3501 lists the troubles which may be encountered along with their probable cause and suggeste[d] remedy.

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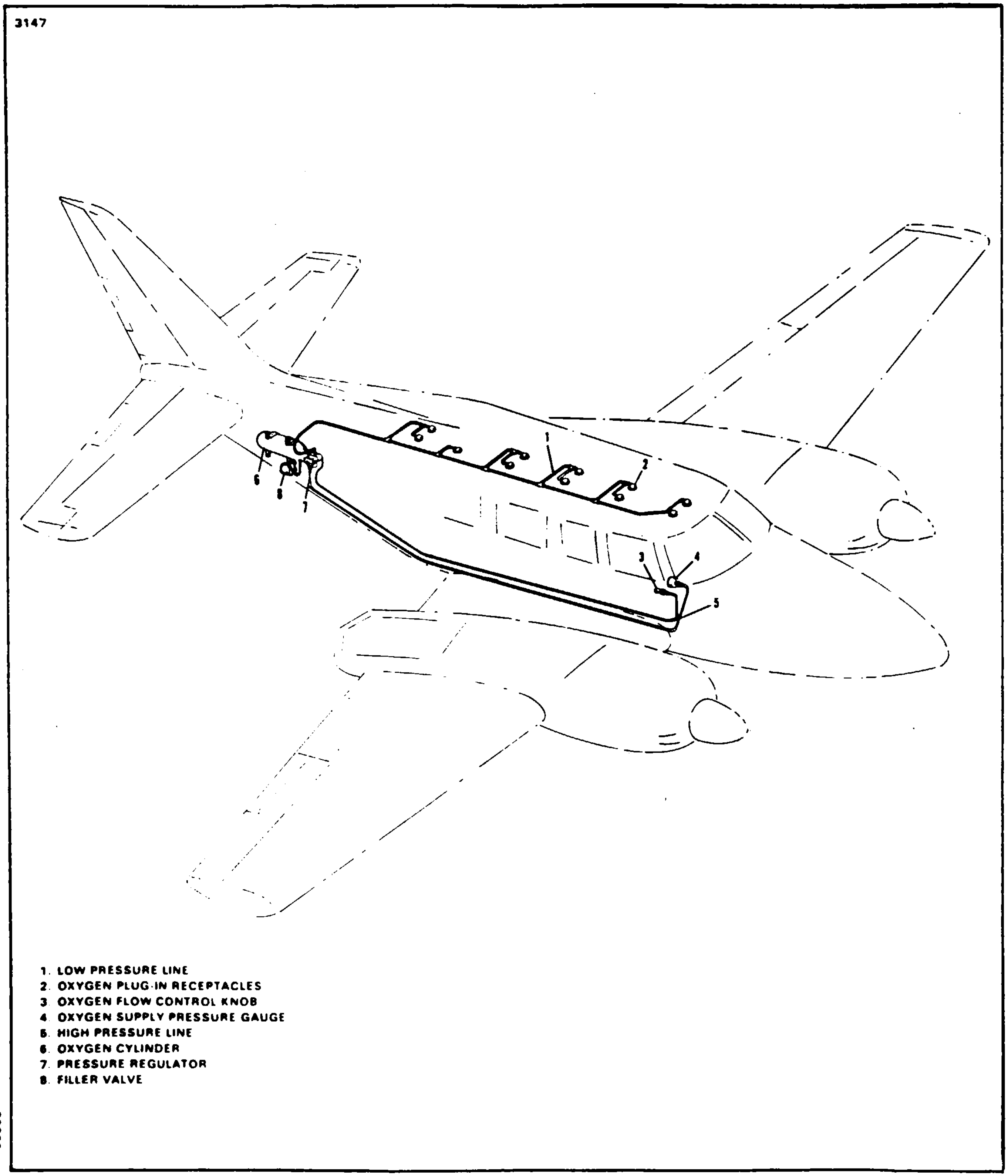

Figure 35-1. Oxygen System Installation

CHART 3501. TROUBLESHOOTING (OXYGEN SYSTEM)

Trouble	Cause	Remedy
Pressure indication normal but no oxygen flowing.	Oxygen cylinder regulator assembly defective.	Replace regulator assembly.
	Line obstruction.	Clean and purge lines.
No indication of pressure on pressure gauge.		
	Pressure gauge defective.	Replace gauge.
	Safety disc ruptured, cylinder empty.	Replace cylinder and visual indicating disc.
Oxygen cylinder will not retain pressure.	Leak in system.	Locate and repair leak.
Offensive odors in oxygen.	Cylinder pressure below 50 psi. Foreign matter has entered the system during previous servicing.	Purge the oxygen system.

PRECAUTIONS.

Before any maintenance is performed on the oxygen system, or any other system requiring removal of an oxygen system component, personnel should read and understand these instructions. Careful adherence will aid in maintaining a trouble free and safe system.

— *WARNING* —

Do not permit smoking or open flame near the airplane while maintenance is being performed on the oxygen system. Ensure all electrical power is disconnected and the airplane is properly grounded. Keep all oils, grease, soap, and solvents away from the oxygen system. Hydrocarbons constitute a fire hazard and may burn or explode when contacted by oxygen under pressure.

1. Use extreme caution to ensure all openings to the system are kept clean and free of water, oil, grease, and solvent contamination.
2. Cap all openings immediately upon removal of any component. Do not use tape or caps which will induce moisture.
3. Lubricants shall not be used anywhere in the system except those specifically approved for use with oxygen systems. (Teflon tape and Krytox 240AC).
4. All oxygen system components must be handled with care to avoid damage.
5. Prior to working on the oxygen system, personnel must clean hands and tools. Cleanliness is essential.
6. When removing regulator, retain all adjustment washers which fit around the adjustment shaft. These washers are safety stops for maximum regulated pressure and must be used with reinstallation.
7. Avoid bending tubing or damaging flareless fittings.
8. All shut-off valves must be opened slowly. An explosion could result from rapid flowing oxygen generating heat against metal.
9. Use only oxygen line leak detector fluid conforming to MIL-L-25567, Type 1. After leak test, thoroughly wipe off all test solution to prevent corrosion/contamination.
10. Clean fittings and adjacent areas prior to opening system to prevent contamination when disconnecting components.
11. Do not attempt to tighten fittings when system is pressurized.
12. Every two (2) years, oxygen system components (except tubing) should be removed, serviced, cleaned/replaced.
13. Never allow electrical equipment to come in contact with the oxygen cylinder.

TESTING FOR LEAKS.

Apply leak detector fluid conforming to MIL-L-25567, Type 1. 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 that all lines have sufficient clearance between all adjacent structures and are secured in place. Also 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 approved facility before recharging.
4. Any lines that are defective should be replaced with factory replacements.
5. Clean all lines and fittings.
6. Use Ribbon Dope Thread Sealant (Permacel 412) on male ends of fittings only. Wrap thread in direction of thread spiral, beginning with the second thread on the fitting with a ¼ in. or more overlap. Avoid getting any sealant into the lines. After joint is made remove excess material.
7. Refer to FAA Manual AC43.13-1A for more details.

— *WARNING* —

Do not permit smoking or open flame near the airplane while oxygen is being used. Keep all oils, grease, soap and solvent away from the oxygen system. Hydrocarbons constitute a fire hazard and may burn or explode when contacted by oxygen under pressure.

CHART 3502. OXYGEN SYSTEM COMPONENT LIMITS

PARTS	INSPECTION	OVERHAUL
Regulator	300 Flight Hrs.	6 Yrs.
Pressure Gauge	300 Flight Hrs.	Replace on Condition
High Pressure Lines	300 Flight Hrs.	
Low Pressure Lines	300 Flight Hrs.	
Outlets (Cabin)	300 Flight Hrs.	Replace Every 6 Yrs.
External Recharge Valve	Each Use	Replace Every 6 Yrs.
Masks	Each Use	Replace as Necessary

CLEANING OXYGEN SYSTEM/COMPONENTS.

Clean metal oxygen system components using one of the following methods.

— *WARNING* —

Use cleaning solvent only in a well-ventilated area, away from open flame or high temperatures. Avoid prolonged or repeated skin contact and inhalation of toxic vapors. Do not smoke in presence of solvent fumes.

— *CAUTION* —

Most air compressors are oil lubricated and a minimum amount of oil may be carried by the air stream. A water lubricated compressor should be used to blow tubing clean only when nitrogen is not available. The air must be clean, dry and filtered.

1. Vapor degrease using Trichloroethylene conforming to MIL-T-27602 and blow unit clean and dry with stream of dry nitrogen.
2. Flush thoroughly with clean, unused Freon TMC. Purge for two minutes minimum with 125° F. (minimum) dry nitrogen.
3. Flush clean with hot (125° F to 210° F) inhibited alkaline cleaner until free of oil and grease. Rinse thoroughly with fresh water and purge dry with dry nitrogen.
4. Flush with Naphtha: blow unit clean and dry with dry nitrogen. Flush again using anti-icing fluid or anhydrous ethyl alcohol. Rinse thoroughly with fresh water and purge dry with dry nitrogen.

OUTLETS.

REMOVAL OF OUTLETS.

1. Using a suitable spanner wrench, remove the outer half of the outlet.
2. Remove the screws holding the trim panel and remove the panel.
3. 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. Connect the outlet to the low pressure line.
3. Position the trim panel and secure with screws.
4. Position the outer half outlet and secure with a suitable spanner wrench.
5. Torque the fittings into the outlets approximately 30 inch-pounds. Do not over torque as this could damage the outlet.

PURGING OXYGEN SYSTEM.

The oxygen system is purged to remove condensed moisture and offensive odors using dry nitrogen. The system must also be purged if system pressure falls below 50 psi. or if any lines are left open for any length of time.

1. Close cylinder fill valve. (If cylinder is not installed, cap "T" fitting.
2. Inspect charging (nitrogen) connector for cleanness. Remove filler valve protective cover and connect nitrogen hose to filler valve.
3. Install oxygen mask connectors into all outlet ports.
4. Turn regulator to full open (clockwise).
5. Turn on nitrogen supply to 50 psi and purge system for 15 minutes.

6. Check for presence of contamination, condensed moisture or odor. If any unsatisfactory condition still exists, continue purging for another 15 minutes.

— NOTE —

If system is not connected to oxygen cylinder, leave 50 psi of nitrogen in system to prevent moisture from forming.

7. Shut off nitrogen supply and disconnect hose from filler valve. Install filler valve cover.
8. Close regulator (counterclockwise) to allow oxygen to purge out any nitrogen remaining in lines then close regulator.
9. Open oxygen cylinder shutoff valve.
10. Remove oxygen mask connectors from outlet ports.

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.

COMPONENTS.

OXYGEN CYLINDER.

REMOVAL OF OXYGEN CYLINDER AND REGULATOR.

The cylinder is located on the upper right side of the fusealage aft of the rear baggage compartment. Remove the screws securing the rear panel in the aft baggage compartment and remove panel to gain access to the regulator and oxygen cylinder.

— CAUTION —

Verify the cylinder valve is closed prior to disconnecting any lines from the regulator.

1. Disconnect the control cable from the regulator.
2. Disconnect the lines from the regulator.

3. Loosen and separate the mounting bracket assembly clamps that hold the cylinder in place.
4. The cylinder can be removed by first sliding it back to remove the retaining cable.
5. Remove the cylinder from the airplane using caution not to bump the neck of the cylinder and regulator.

— *CAUTION* —

The cylinder must be completely discharged of all pressure prior to removing the regulator.

INSTALLATION OF OXYGEN CYLINDER AND REGULATOR.

1. With the regulator attached to the cylinder, place the cylinder in the mounting brackets with the regulator forward. Be careful not to bump the regulator and cylinder during installation.
2. Install the retaining cable around cylinder neck and position cylinder so the control on the regulator aligns with the control cable.
3. Secure the cylinder in place by connecting and tightening the mounting bracket assembly clamps.
4. Connect the pressure lines and control cable to the regulator.
5. Install aft panel rear baggage compartment and secure with appropriate screws.

CHARGING VALVE.

REMOVAL OF OXYGEN SYSTEM CHARGING VALVE.

1. Remove the screws securing the rear panel in the aft baggage compartment and remove the panel.
2. Disconnect the tee fitting from the charging valve.
3. Remove the three nuts and bolts holding the charging valve in place and remove the valve through the access door on the outside of the fuselage.

INSTALLATION OF OXYGEN SYSTEM CHARGING VALVE.

1. Place the valve into position through the access door and replace the three bolts and nuts.
2. Tighten the three bolts and reconnect the tee fitting.
3. Install aft panel in rear baggage compartment and secure with appropriate screws.

PRESSURE GAUGE.

REMOVAL OF PRESSURE GAUGE.

Ascertain that the control valve is closed and there is no pressure in the system.

1. Disconnect charging valve line from the regulator.
2. Disconnect the connector from the back of the pressure gauge.
3. Loosen and remove the retainer nut and clamp holding the gauge in place.
4. Pull the gauge out from the front of the panel.

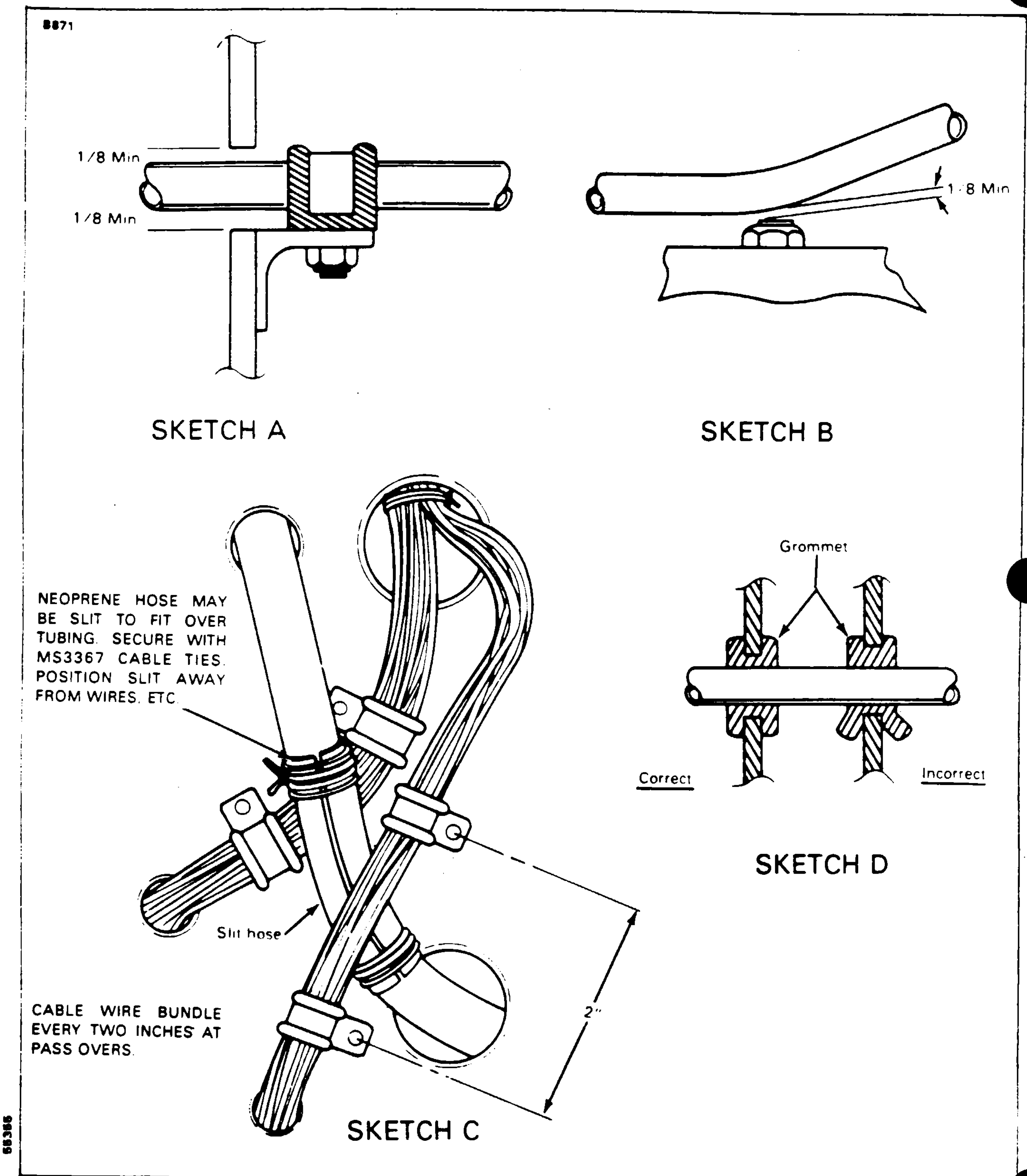

Figure 35-2. Oxygen Tubing Installations

INSTALLATION OF PRESSURE GAUGE.

1. Place the gauge into the panel from the front and replace the clamp and retainer nut on the back of the gauge. Be sure the gauge is positioned properly before tightening the clamp.
2. Reconnect the connector at the rear of the gauge.
3. Reconnect the charging valve line to the regulator.

INSPECTION AND OVERHAUL TIME LIMITS.

It is recommended that inspection and overhaul be conducted by an FAA Approved Station or the manufacturer, Scott Aviation. The following checks give recommended inspection and overhaul time for the various parts of the oxygen system.

1. The oxygen cylinder can be identified by the ICC or DOT identification stamped on the cylinder. The standard weight cylinder (ICC or DOT 3AA 1800) must be hydrostatic tested every 5 years. The light-weight cylinder (ICC or DOT 3HT 1850) must be hydrostatic tested every 3 years and must be retired from service after 15 years or 4380 pressurizations, whichever occurs first. The month and year of the last test is stamped on the cylinder beneath the ICC identification.
2. The outlets should be checked for leakage both in the non-use condition, and for leakage around an inserted connector.
3. The high pressure gauge may be checked for accuracy by comparing its indicated pressure with that of a gauge of known accuracy.
4. Inspection of the regulator may be effected by introducing into an outlet a mask connector to which is attached a 100 psi gauge. With one other outlet flowing through a plugged in mask, the indicated regulator output pressure shall be not less than 45 psig at sea level with 200 psig supply cylinder pressure. It should be noted that the permissible leakage through the 1/6 diamater vent hole in the side of the upper regulator housing is 10 cc/min. maximum, when the regulator is turned on. There shall be no external leakage anywhere on the regulator when it is turned off. All fittings shall be leak free.

CHARGING THE OXYGEN CYLINDER. (Refer to Chapter 12 for charging instructions.)

— END —

CHAPTER

36

PNEUMATIC SYSTEM

CHAPTER 36 - PNEUMATIC SYSTEM

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GENERAL.

This chapter contains maintenance information on the pneumatic system components.

DESCRIPTION.

The T-1020 uses a dry pneumatic pump system consisting of two engine driven pneumatic pumps, pressure control valves, inline filters, pressure switches, check valves, pneumatic relay and necessary tubing, hoses and connections. The system operates at preset pressures, depending on the particular system and equipment installed in the airplane. Gyro pressure is read on a gauge located in the right side of the instrument panel. Should one of the pressure pumps fail this would be indicated at the pneumatic source malfunction lights below the pressure gauge.

DISTRIBUTION.

PNEUMATIC SYSTEM FILTER REPLACEMENT.

There are four pneumatic system filters located throughout the pneumatic system. Two inlet filters located on the inlet side of the pneumatic pumps and two inline filters located along the outlet side of the pneumatic pumps. The following instructions will cover the removal and installation of these filters along with recommended cleaning and replacement times as required:

1. Removal of inlet air filters located in the outboard sides of the left and right engine nacelles aft of the fire wall, above the air inlet opening.
   A. Remove the appropriate access panel on the engine nacelle. The left nacelle access panel may have the ice detection light while the right access panel is a grill type panel.
   B. Disconnect the hose clamp and remove the hose from the filter.
   C. Remove the locking nut from the filter line and remove the filter.

— NOTE —

The filter should be cleaned or replaced at each 100 hour inspection. Refer to the Parts Catalog for correct part number.

2. Installation of inlet air filter.
   A. Place the filter in the same position as it was prior to removal and secure with the locking nut.
   B. Connect the hose to the filter and secure with a hose clamp.
   C. Install and secure access panels previously removed.
3. Removal of inline filter located aft of the fire wall in both the left and right engine nacelle.
   A. Remove the appropriate access panel on the upper section of the engine nacelle.
   B. Disconnect the hose clamps and remove the appropriate filter from the line connection.

— NOTE —

The filters are the disposable type and must be replaced by new ones every 500 hours. Refer to the Parts Catalog for correct part number.

4. Installation of inline filter. The filter has an arrow on the case indicating the direction of air flow, and should be installed in the exact position of the old filter.

A. Place the new filter in the ening nacelle aft of the fire wall and connect the air lines to the filter. Secure with hose clamps.

B. Install and secure the access panel previously removed.

DRY PNEUMATIC PUMP.

REMOVAL OF DRY PNEUMATIC PUMP.

1. Remove engine cowling and locate the pneumatic pump at the top center aft of the engine.
2. Remove hose clamps on inlet and outlet sides of pump.
3. Disconnect hoses from both sides of the pump.
4. Disconnect the four nuts securing the pump and remove the pump.

— NOTE —

Before installation of fittings on pump, check for external damage. A pump that has been damaged or dropped should not be installed. When a vise is used to secure pump while installing fittings, suitable 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 pump firmly. DO NOT apply vise pressure to outside diameter or overall length. The ports of the AIRBORNE dry air pump have been treated with a dry film lubricant and the AIRBORNE fittings are cadmium plated thus eliminating any need for thread lubricants. If a thread lubricant is required, use a powdered moly sulfide or graphite in dry form or in an evaporating vehicle; or employ a silicone spray. Apply sparingly to external threads of fittings only. DO NOT use pipe tape, thread dope, hydrocarbon oil or grease, as these can contaminate pump and cause malfunction. With pump properly secured in vise, insert fittings in ports and hand tighten firmly. Next, using a wrench, tighten each fitting from one-half to two turns additional.

INSTALLATION OF DRY PNEUMATIC PUMP.

1. Place the pump gasket in proper place and attach the pump to its mounting point and secure the pump with the four nuts. Torque the four mounting nuts to 40-50 inch-pounds.

— CAUTION —

The only dry air pump mounting gasket authorized and approved for use on the Airborne dry air pump is the Airborne gasket B3-1-2, Piper part number 751 859. Use of any other gasket may result in oil seepage or leakage at the mounting surface.

2. Connect the inlet and outlet hoses to the pump and secure the hoses to the ports with the hose clamps.
3. Replace engine cowling.

PRESSURE RELIEF VALVE.

REMOVAL OF PRESSURE RELIEF VALVE.

1. Remove access panel on top of nacelle.
2. Disconnect hose clamps and remove hoses from valve.
3. Remove hardware attaching valve to bracket and remove valve from nacelle.

INSTALLATION OF PRESSURE RELIEF VALVE.

1. Secure valve to bracket.
2. Connect hoses to valve.
3. Secure hoses to valve with hose clamps.
4. Reinstall access panel.

PNEUMATIC SYSTEM SETUP PROCEDURE.

The pneumatic system setup procedures given in these instructions cover four combinations of instrument and accessory installations. These are as follows: Pilot's and Copilot's Gyro Installation with Deicer Boots, Pilot's Gyros and Deicer Boots, Pilot's Gyros and Copilot's Gyros, and Pilot's Gyros only. Before attempting any adjustments, ascertain that all line connections are tight.

— CAUTION —

Do not use air sources other than engine driven system pumps.

— NOTE —

Insure engines are up to operating temperature prior to checking or adjusting the pneumatic system.

— WARNING —

Do not make adjustments of the pressure control valves that are within the engine nacelles while engines are running.

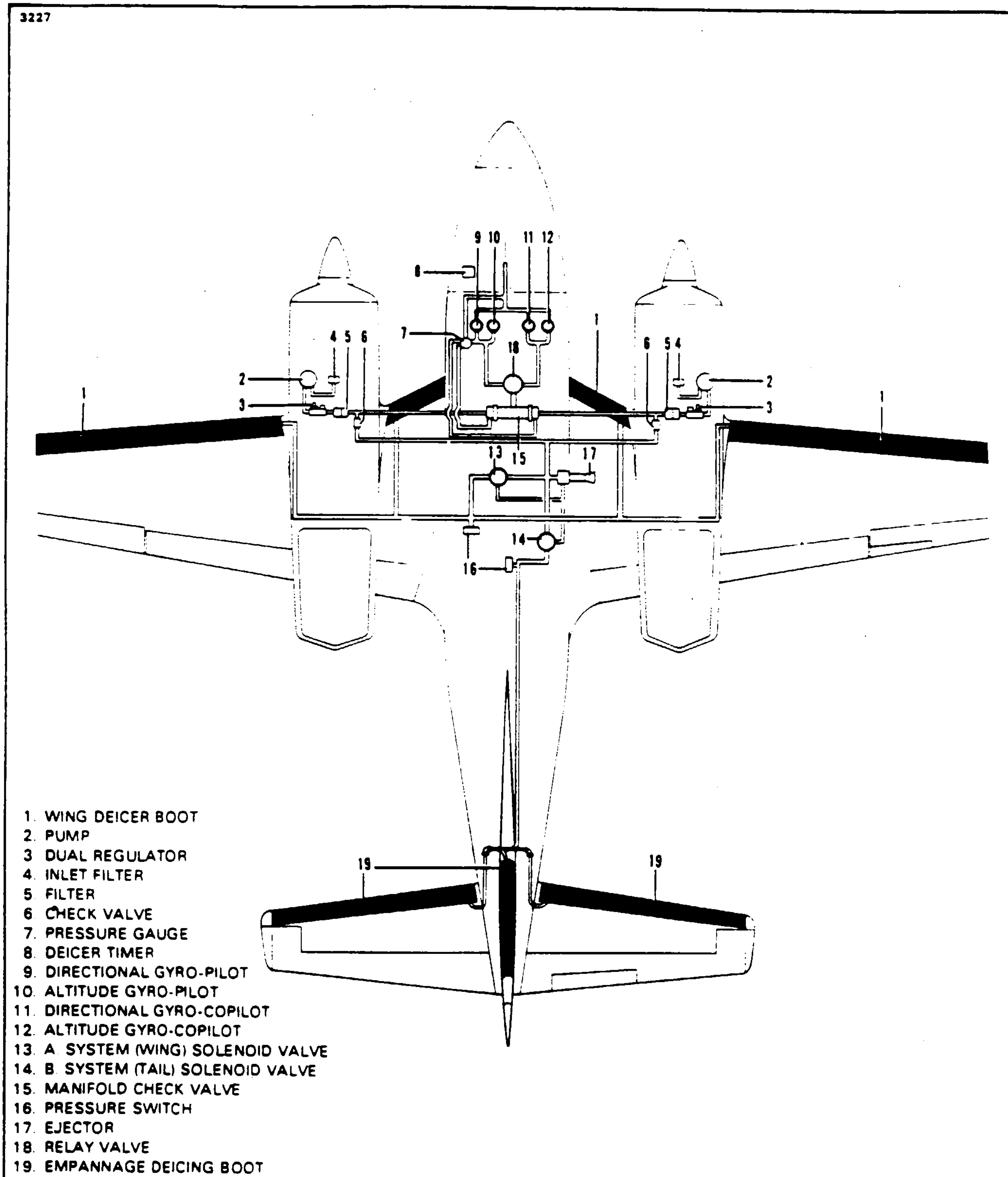

Figure 36-1. Pilot's and Copilot's Gyro Installation With Deicer

PILOT'S AND COPILOT'S GYRO INSTALLATION WITH DEICER BOOTS.

1. Install a test pressure gauge to the pneumatic system test gauge tap point by removing the left aft plate at the top of the right engine nacelle.
2. At the test gauge tap point remove the cap from the tap fitting and install the test pressure gauge.

— NOTE —

An accurate gauge with a range from 0 to 20 psi with a hose long enough to allow the face of the gauge to be easily observed is desired. The tap fitting is three-sixteenth straight thread flared.

3. Operate left engine at 2200 RPM (right engine OFF) and check if the test pressure gauge reads 6.0 psi on the test gauge. Should the reading not be as specified, shut-down the engine and remove the forward access plate at the top of the nacelle. Adjust the normal pressure regulator of the dual regulator. The normal pressure regulator incorporates the electrical solenoid. Loosen the adjustment screw jam nut of the normal pressure regulator of the dual regulators in the right side of the nacelle and turn the screw clockwise to increase pressure and counterclockwise to decrease pressure. Tighten adjustment screw jam nut.
4. Repeat Step 3 for the right engine (left engine OFF).
5. To check the deicer system operation pressure, operate left engine at 2500 RPM (right engine OFF). Actuate the deicer system. The test gauge should read 18.0 ± .5 psi (37 ± 1 in Hg).

— NOTE —

The pressure should be read just prior to completion of the cycle.

— NOTE —

Should the test gauge reading not be within tolerance, first ascertain that the deicer boots have been pressure tested.

6. To adjust the deicer system operating pressure, loosen the locknut on the nacelle mounted dual regulator. The deicer system pressure regulator is the regulator without the electric solenoid.
7. Repeat Steps 5 and 6 for the right engine (left engine OFF).
8. To adjust the gyro pressure setting, install a test gauge in the copilot's gyro pressure line. A hypo needle inserted in the hose from the right side of the gyro control located under the copilot's instrument panel and connected to a suitable pressure gauge is satisfactory.
9. Operate both engines at 2200 RPM. The test gauge pressure should read 5.5 ± .2 in Hg (2.7 ± .1 psi). To set the pressure, adjust the copilot's side of the pneumatic relay shutoff valve assembly by loosening the locknut on the right side of the control and, with an Allen wrench, turn the set screw counterclockwise (OUT) or clockwise (IN) until the desired pressure setting is obtained. Tighten the locknut.
10. With both engines operating at 2200 RPM, the pressure gauge for the pilot's gyros, located on copilot's instrument panel, should read 5.5 ± .2 in Hg (2.7 ± .1 psi). To adjust the pressure, loosen the locknut on the bottom of the pneumatic relay shutoff valve assembly and, with an Allen wrench, turn the set screw clockwise (IN) or counterclockwise (OUT) until the desired pressure setting is obtained. Tighten the locknut.
11. With both engines operating at 2200 RPM, and with the deicers activated, insure that the pressure gauge for the pilot's gyros reads 5.5 ± .4 in. Hg (2.7 ± .2 psi).

— *NOTE* —

There will be a momentary fluctation of pressure at the beginning of boot inflation. Therefore, the pilot's gyro pressure should be read just prior to completion of the boot inflation cycle. The air to the copilot's gyros is shut off when the deicer system is activated. If this condition cannot be met, the pneumatic relay valve may be defective.

12. Tighten all adjustment locknuts and install any access panels or covers removed.

PILOT'S GYROS AND DEICER BOOTS.

The adjustment of gyro pressure is as follows:

1. With both engines operating at 2200 RPM, the pressure gauge for the pilot's gyros, located on the copilot's instrument panel, should read 5.5 ± .2 in. Hg (2.7 ± .1 psi).
2. To set the pressure, adjust the regulator located under the copilot's instrument panel. Loosen the locknut on the bottom of the pneumatic relay shutoff valve assembly and, with an Allen wrench, turn the set screw clockwise (IN) or counterclockwise (OUT) until the desired pressure setting is obtained. Tighten the locknut.
3. With both engines operating at 2200 RPM, and with the deicer system activated, insure that the pressure gauge for the pilot's gyros reads 5.5 ± .4 in. Hg (2.7 ± .2 psi).

— *NOTE* —

There will be a momentary fluctuation of pressure at the beginning of boot inflation. Therefore, the pilot's gyro pressure should be read just prior to completion of the boot inflation cycle. The air to the co-pilot's gyros is shut off during boot inflation. If this condition cannot be met, the pneumatic relay valve may be defective.

PILOT'S GYROS AND COPILOT'S GYROS. (Refer to Figure 36-2.)

1. Close the center regulator located under the instrument panel by loosening the locknut and turning the knurled adjustment screw clockwise (IN) as far as possible.
2. Operate the right engine at 2200 RPM (left engine OFF). The pressure gauge mounted in the instrument panel should read 6.0 ± .3 in. Hg (2.9 ± .15 psi).
3. To adjust the pressure, loosen the locknut on the regulator mounted in the nacelle and rotate the knurled screw clockwise (IN) or counterclockwise (OUT) to obtain the desired pressure setting. Tighten the locknut.
4. Repeat Steps 1 thru 3 with the left engine operating and right engine shutdown.
5. With both engines operating at 2200 RPM, adjust the center regulator (under the instrument panel) until the instrument panel pressure gauge reads 5.5 ± .2 in. Hg (2.7 ± .1 psi). Adjustment procedure for the regulator is the same as Step 3 above.

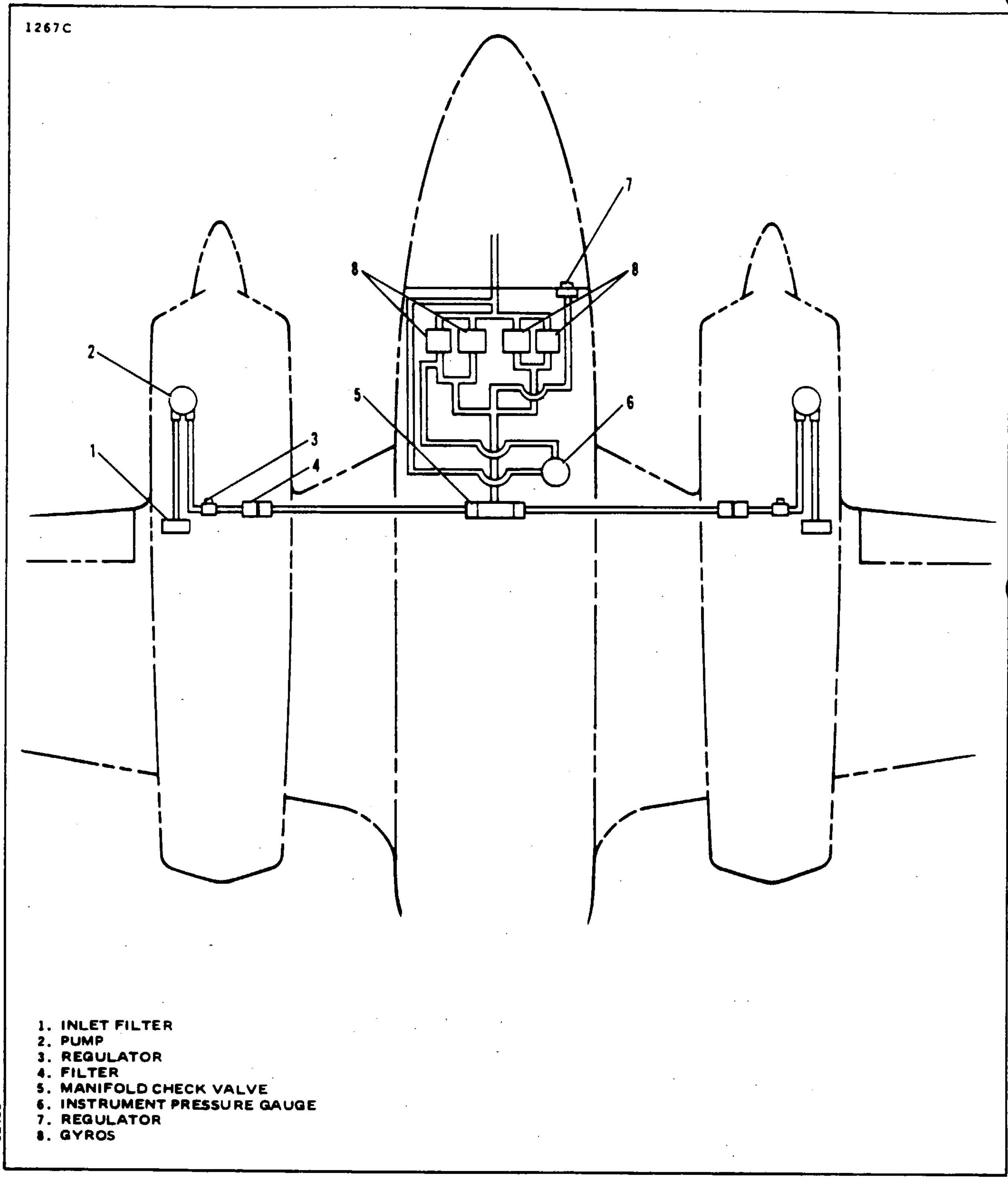

Figure 36-2. Pilot's and Copilot's Gyro Installation

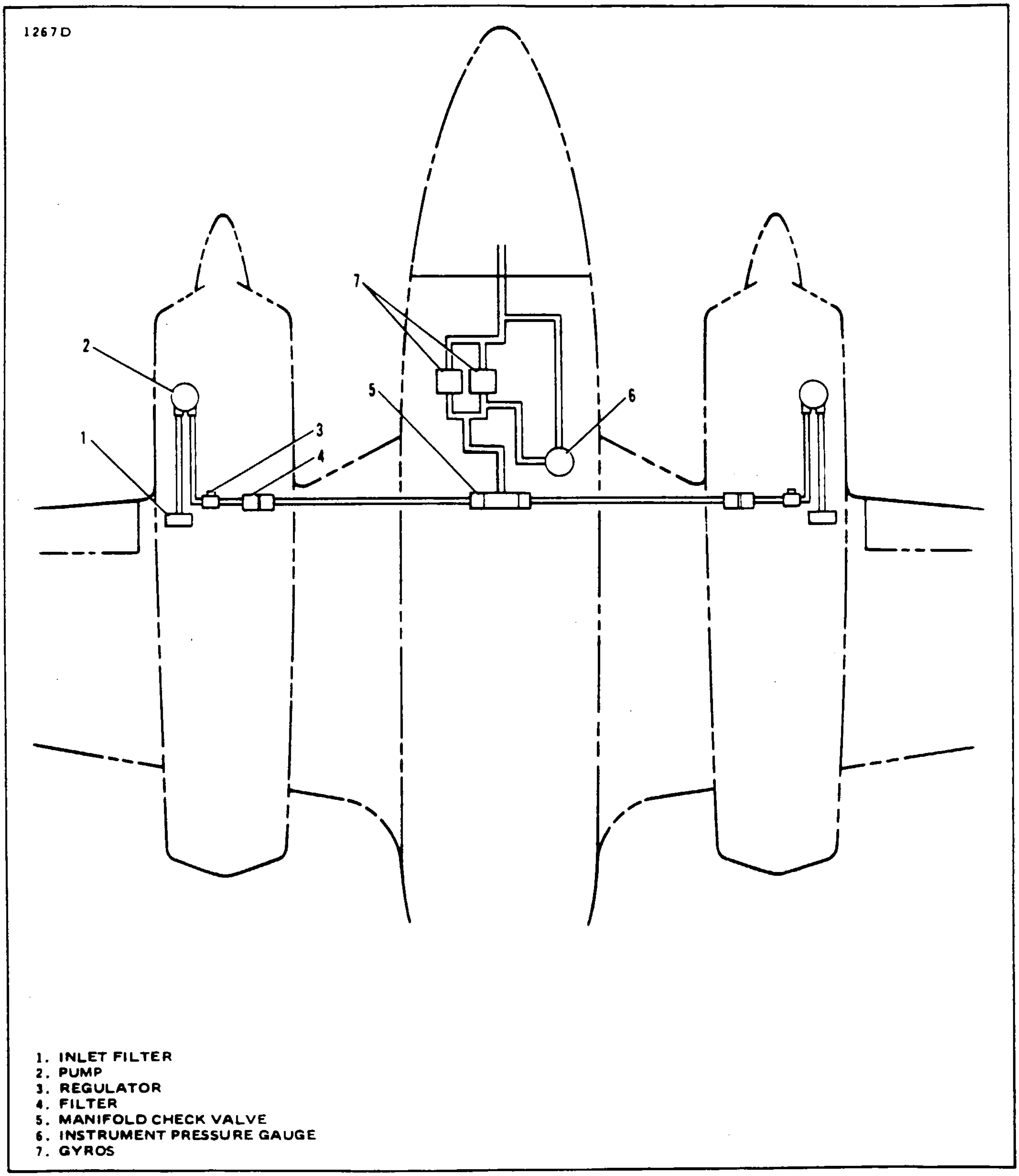

Figure 36-3. Pilot's Gyro Installation

PILOT'S GYROS. (Refer to Figure 36-3.)

1. Operate the right engine at 2200 RPM with the left engine shutdown. The instrument panel pressure gauge should read 5.5 ± .2 in. Hg (2.7 ± .1 psi).
2. To adjust the pressure, loosen the locknut on the regulator in the nacelle and rotate the knurled screw clockwise (IN) or counterclockwise (OUT) until the desired pressure setting is obtained. Tighten the locknut.
3. Repeat Steps 1 and 2 with the left engine operating and the right engine shutdown.
4. With both engines operating at 2200 RPM, insure that the pressure gauge reads 5.5 ± .4 in. Hg (2.7 ± .2 psi).

DEICER BOOTS PRESSURE TEST.

1. Use a source of clean air, which can be regulated between 18 and 20 psi, along with a testing rig consisting of:
   A. Adjustable regulator.
   B. Pressure regulator.
   C. Shutoff valve.

— NOTE —

The shutoff valve must be connected so as to trap air in the deicer system.

2. Disconnect the line to the pressure regulator. Attach the test rig on the line to the pressure regulator. Bypass the one ejector valve and install temporary test line. Apply 19 psi of air to the system, and using the shutoff valve, trap this air pressure in this portion of the system. A soap solution may be used to check for leakage, which should not exceed 3 psi per minute.
3. Check the pressure switch operation with the deicer system under pressure, while the battery switch is in the ON position; the indicator light will glow.
4. With the master switch ON and the deicer control switch in the OFF position, press the indicator light to check the circuit and light bulb. If the indicator light does not function, check and reset the circuit breakers; a short may exist.
5. Remove the test rig, lubricate the threads, replace and tighten items dismantled.
6. With boots pressure test completed, recheck system pressure.

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CHAPTER

37

VACUUM SYSTEM

— *NOTE* —

The pneumatic and vacuum systems have been combined to form Chapter 36, Pneumatic System.

CHAPTER

39

ELECTRIC/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS

CHAPTER 39 - ELECTRIC/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS

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GENERAL.

The instrumentation of the T-1020 provides for all conditions of flight. The instruments are designed to give a quick and actual indication of attitude, performance, and condition of the airplane. Some of the instruments are components of indicating systems that indicate conditions at remote parts of the airplane. A few of the instruments, however, are self-contained and merely have to be correctly installed to give an indication. Warning lights are installed to indicate unsatisfactory or dangerous conditions in some systems. Instruments requiring power from the electrical system are provided with circuit breakers to isolate the individual systems in the event of trouble. For night operation, each instrument is either individually lighted by shielded post lights or a light incorporated as part of the instrument.

INSTRUMENT AND CONTROL PANELS.

INSTRUMENT PANEL. (Refer to Figure 39-1.)

The panel has been arranged to accommodate flight instruments in the left side, in front of the pilot, electronic equipment and some engine instruments in the center, and the remaining engine and miscellaneous instruments to the right. A second set of flight instruments may be installed in the right side of the panel for use by the copilot. Additional instruments are mounted in a sub-panel located over the windshield. Most of the instruments have been shock-mounted to minimize vibration that is transmitted to the instrument panel.

INSTRUMENTS.

The instruments have been classified into two types, non-electrical and electrical. Maintenance, other than that which is described in this section should be accomplished by the instrument manufacturer or an authorized repair station.

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.
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.

— *CAUTION* —

DO NOT use thread lube on fittings or in ports of gyros. The use of thread lube can cause contamination which shortens the life expectancy of the gyro and cause premature failure. Any evidence of thread lube will create a WARRANTY VOID CONDITION. Make sure that all air lines are clean and free of oil, grease, pipe compound, or any foreign particles/or residue before connecting lines to gyro.

3. The use of teflon tape on gyro fitting threads is recommended and should be installed in the following manner:

A. Carefully lay teflon tape on the 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 fitting is installed.

B. Apply sufficient tension while winding, to assure that the tape forms into thread's grooves. One full wrap plus 1/2" overlap is sufficient.

C. After wrap is complete, maintain tension and tear tape by pulling in direction of wrap. The ragged end is the key to the tape staying in place. (If sheared or cut, tape may loosen.)

D. Press tape well into threads.

E. Screw fitting into port being careful not to exceed torque requirements as noted on decal located on cover of gyro.

4. Installation of 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.

ELECTRICAL SWITCHES AND CIRCUIT BREAKERS.

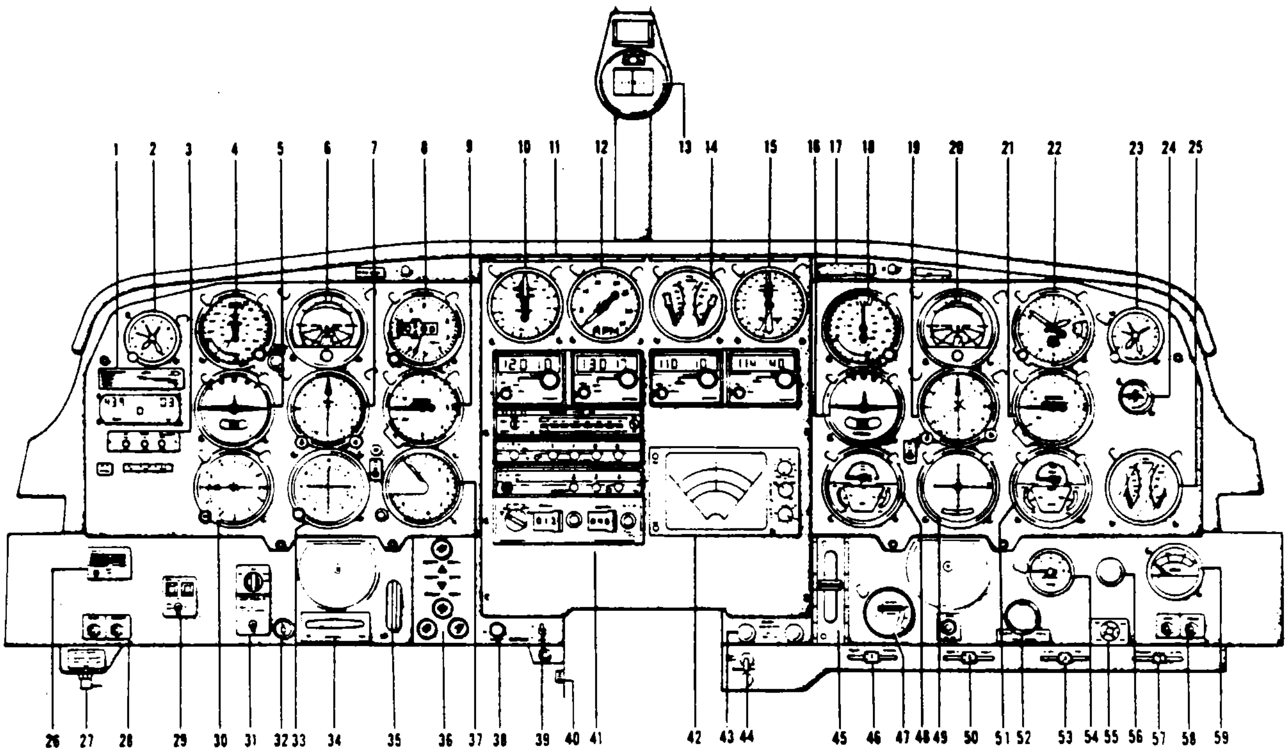
Electrical switches and circuit breakers are located in a panel on the left side of the cockpit next to the pilot's knee. Switches are also located in the overhead panel just above the windshield and in a panel along the lower section of the instrument panel.

REMOVAL AND INSTALLATION OF SWITCH AND CIRCUIT BREAKER PANEL.

Removal of the trim panel is necessary to service the switches and circuit breakers on the panel assembly. With the trim panel removed, it is now possible to remove or install new switches or circuit breakers by removing the panel assembly that they are mounted on. Use caution when working on these panels that other parts and wiring are not damaged.

REMOVAL AND INSTALLATION OF OVERHEAD SWITCH PANEL.

Removal of the overhead switches does not require the removal of the trim panel. The switches are held in place with clips and can be removed by pulling them out and replaced by pushing them back into the clips located in the panel assembly.



1. AIRSPEED PLACARD
2. CLOCK
3. DME
4. AIRSPEED INDICATOR
5. TURN AND BANK INDICATOR
6. ATTITUDE GYRO
7. DIRECTIONAL GYRO
8. ALTIMETER
9. RATE OF CLIMB INDICATOR
10. DUAL MANIFOLD PRESSURE GAUGE
11. ANNUNCIATOR PANEL
12. DUAL TACHOMETER
13. COMPASS
14. DUAL EGT GAUGE
15. DUAL FUEL FLOW GAUGE
16. TURN AND BANK INDICATOR - COPILOT
17. CATEGORY PLACARD
18. ARISPEED INDICATOR - COPILOT
19. DIRECTIONAL GYRO - COPILOT
20. ATTITUDE GYRO - COPILOT
21. RATE OF CLIMB INDICATOR - COPILOT
22. ALTIMETER - COPILOT
23. CLOCK
24. GYRO PRESSURE GAUGE
25. DUAL FUEL PRESSURE GAUGE
26. EMERGENCY LOCATOR TRANSMITTER
27. ALTERNATE STATIC SOURCE VALVE
28. MIKE AND EARPHONE JACKS - PILOT
29. AUTOPILOT CONTROLS
30. ADF
31. WINDSHIELD WIPER CONTROL/ EMERGENCY BATTERY PACK
32. CIGAR LIGHTER
33. NAV 2
34. PARKING BRAKE
35. GEAR SELECTOR
36. GEAR INDICATOR LIGHTS
37. RADAR ALTIMETER
38. RADIO LIGHT SWITCH
39. AVIONICS MASTER SWITCH
40. PA VOLUME CONTROL/ON-OFF KNOB
41. AVIONICS
42. RADAR
43. MANUAL ALTERNATE AIR CONTROLS
44. HEATER CONTROL SWITCH
45. WING FLAP SELECTOR SWITCH
46. CABIN TEMP. CONTROL
47. WING FLAP POSITION INDICATOR
48. OIL PRESS., CYL. HEAD TEMP., AND OIL TEMP. - LEFT ENGINE
49. NAV 2 - COPILOT
50. DEFROSTER CONTROL
51. OIL PRESS., CYL. HEAD TEMP., AND OIL TEMP. - RIGHT ENGINE
52. CABIN EXHAUST CONTROL KNOB
53. CABIN AIR CONTROL LEVER
54. OXYGEN SUPPLY PRESSURE GAUGE
55. PANEL LIGHTS SWITCH
56. OXYGEN CONTROL KNOB
57. COCKPIT AIR CONTROL LEVER
58. MIKE AND EARPHONE JACKS - COPILOT
59. VOLTIMETER

Figure 39-1. Instrument Panel (Typical)

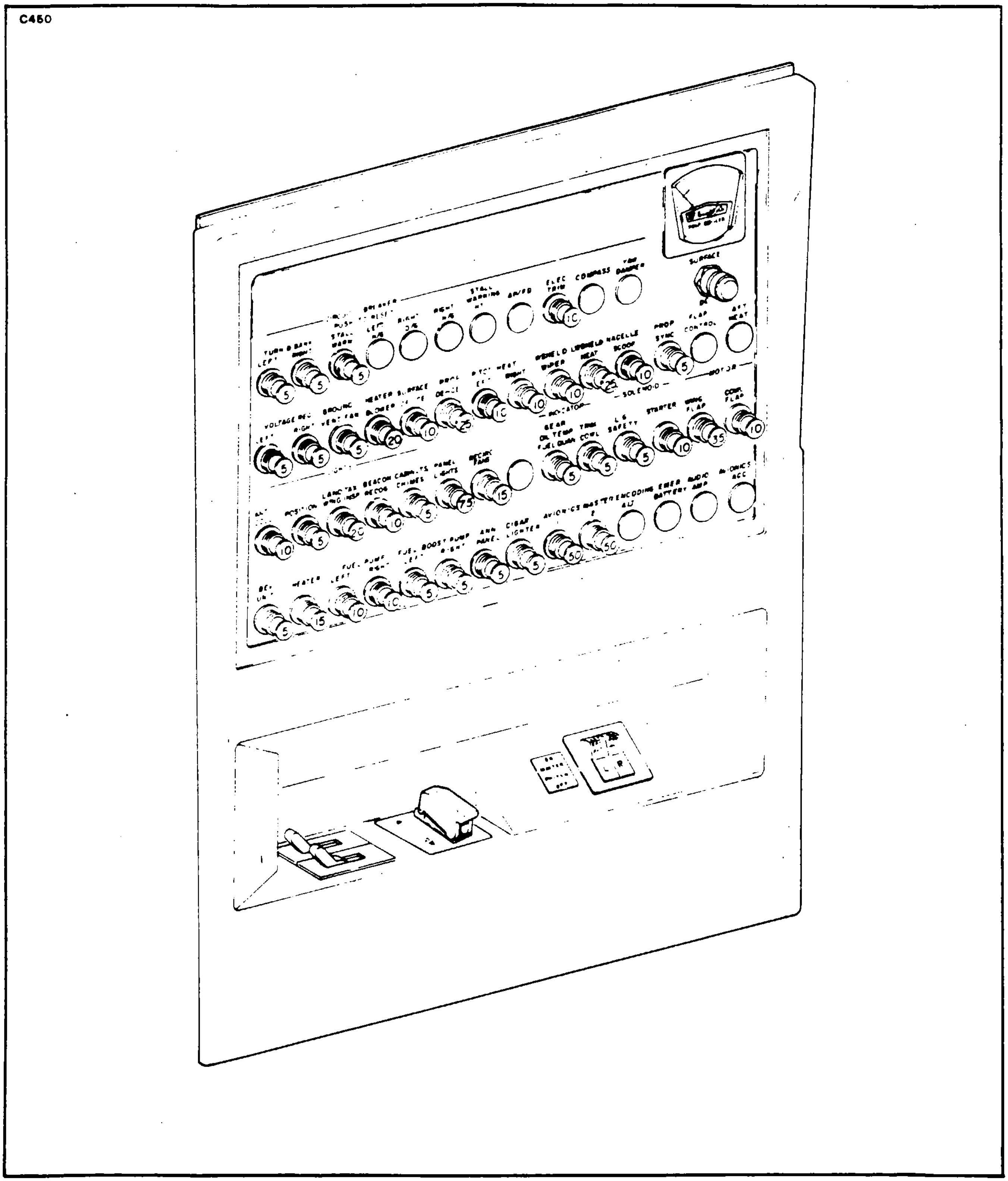
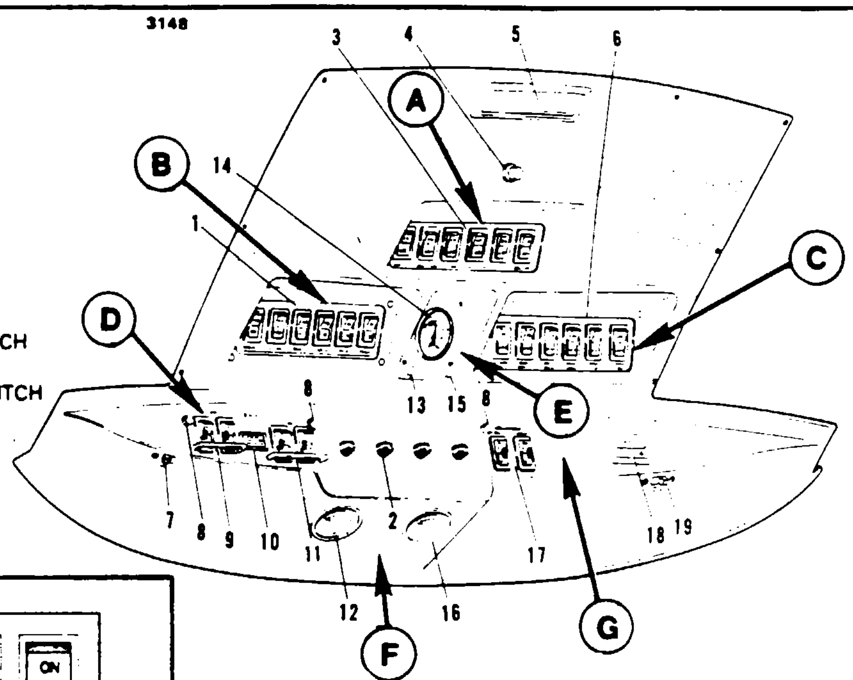


Figure 39-2. Switch and Circuit Breaker Control Panel

1. LIGHT SWITCH PANEL
2. RHEOSTAT SWITCHES
3. ELECTRICAL SWITCHES
4. DOME LIGHT SWITCH
5. DOME LIGHT
6. VARIOUS DEICING SYSTEM SWITCHES
7. LEFT MAP LIGHT SWITCH
8. POST LIGHTS
9. LEFT ENGINE MAGNETO SWITCHES
10. STARTER SWITCH
11. RIGHT ENGINE MAGNETO SWITCHES
12. LEFT FUEL GAUGE
13. LEFT ALTERNATOR PRESS-TO-TEST SWITCH
14. AMMETER
15. RIGHT ALTERNATOR PRESS-TO-TEST SWITCH
16. RIGHT FUEL GAUGE
17. FUEL PUMP SWITCHES
18. ENGINE HOUR METER
19. RIGHT MAP LIGHT SWITCH
20. DIAL LIGHT



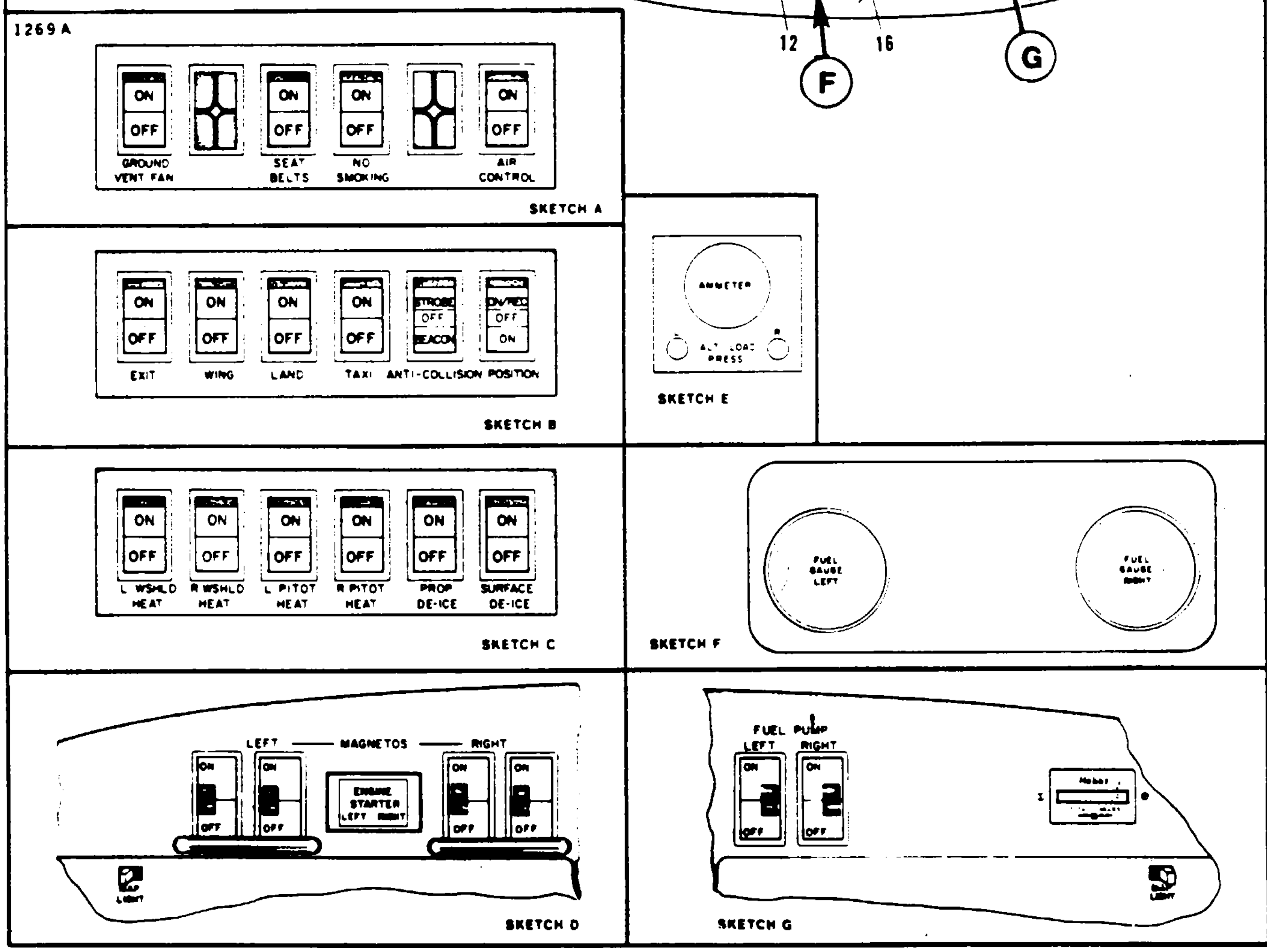


Figure 39-3. Overhead Switch Panel

ANNUNCIATOR PANEL.

The annunciator panel monitors various functions of the electrical system and contains warning lights grouped together and extending across the upper center of the instrument panel below the glare shield. The annunciator controller is secured to the instrument panel support bracket directly behind the center panel of the instrument panel.

REMOVAL OF ANNUNCIATOR PANEL.

— NOTE —

Replacement of a bulb does not require removal of the annunciator panel. To replace a defective bulb, push in on appropriate light cover assembly until it clicks, then remove the light cover assembly. Remove old bulb and replace with new bulb. Place the light cover assembly in proper cut out and push in until it clicks. This will lock the light cover assembly in place.

1. Remove screws securing cover to glare shield assembly and remove cover.
2. Remove screws securing center panel of instrument panel, pull back on panel to gain access to annunciator control box and disconnect annunciator panel connectors.
3. Remove screws securing annunciator panel to glare shield and remove annunciator panel.

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INSTALLATION OF ANNUNCIATOR PANEL.

1. Place annunciator panel into position on glare shield and secure with screws.
2. Attach annunciator panel connectors to annunciator controller and reinstall center panel of instrument panel.
3. Position cover on glare shield and secure with screws.

REMOVAL OF ANNUNCIATOR CONTROLLER.

The annunciator controller is located on the radio support shelf.

1. Gain access by removing the access panel aft of the forward baggage compartment between Sta. 35.00 and Sta. 57.00 on the left side of the airplane.
2. Disconnect electrical connector E430 from rear of the unit.
3. Remove the four screws securing the annunciator controller and mounting bracket to the radio support shelf.
4. Remove the unit, with mounting bracket attached, from the airplane.

INSTALLATION OF ANNUNCIATOR CONTROLLER.

1. Position the annunciator controller, with mounting bracket attached, in its proper location on the radio support shelf with the electrical connection facing aft.
2. Secure the unit by installing appropriate screws through the mounting bracket.
3. Connect the electrical connection to the unit.
4. Install the access panel between Sta. 35.00 and Sta. 57.00 and secure with appropriate screws.

ELECTROLUMINESCENT PANEL POWER SUPPLY.

The inverter that acts as a power supply for the electroluminescent panels is located behind the left side of the instrument panel on a support channel. A terminal block is mounted to the channel with one screw connecting the top of both inverter and terminal block to the channel.

REMOVAL OF ELECTROLUMINESCENT POWER SUPPLY.

1. Remove screws securing the inverter to the channel.
2. Disconnect black wire, red wire, wire L105EE and ground wire at disconnect points or terminal block. Make note of wire placement.
3. Remove inverter.

INSTALLATION OF ELECTROLUMINESCENT POWER SUPPLY.

1. Position inverter in place behind the instrument panel.
2. Connect black wire, red wire, wire L105EE and wire from inverter to ground to previously marked connections.
3. Install inverter in proper position and secure with appropriate screws.

CHIMES ASSEMBLY.

REMOVAL OF CHIMES ASSEMBLY.

The chimes assembly is located beneath the upper radio shelf, accessible through an access panel on left side of nose between Sta. 36.00 and Sta. 51.00.

1. Remove electrical power by pulling out the push-pull circuit breaker.
2. Remove access panel.
3. Disconnect electrical connector.
4. Remove securing screws from chimes assembly and remove.

INSTALLATION OF CHIMES ASSEMBLY.

1. Position chimes assembly on shelf mount and secure with appropriate screws.
2. Reconnect electrical connector.
3. Replace access panel (and secure with appropriate screws).
4. Place power on circuit by pushing in circuit breaker and run an operational check of system.

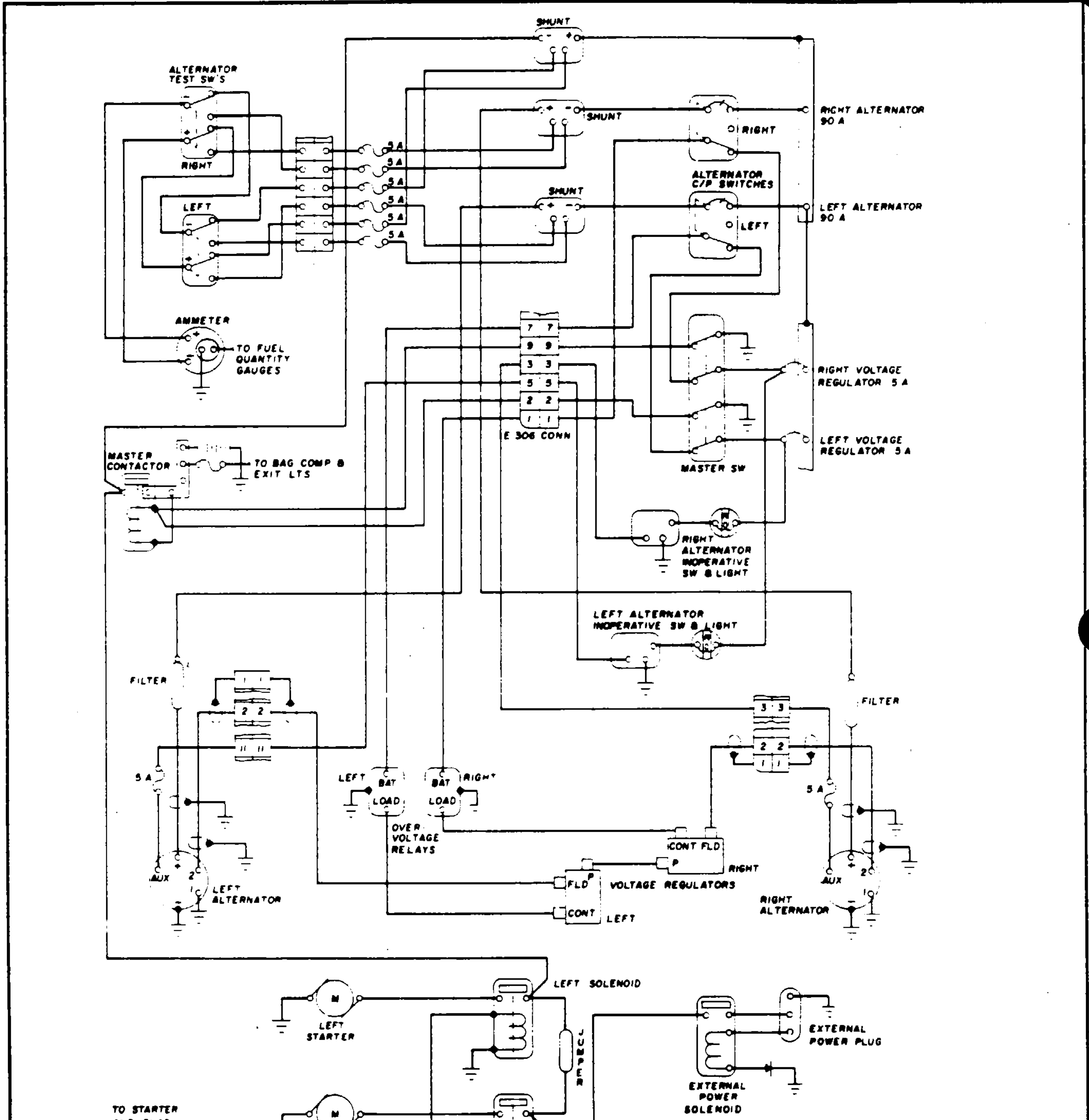
FUEL FLOW WARNING SYSTEM.

Left and right fuel flow warning lights in the annunciator will illuminate to warn the pilot of an impending fuel flow interruption. Each light is controlled by a sensing probe mounted near each inboard fuel tank outlet. In the event the fuel level near the tank outlet drops to a point where a fuel flow interruption and power loss could occur, the sensing probe will activate and energize the gated relay. This relay, located aft of bulkhead Sta. 81.00 and bolted to the windshield channel bracket, delays the illumination of the warning light for 2 seconds. If after the 2 second delay the sensing probe is still activated, the relay will then close the circuit to the warning light for a minimum of 10 seconds and will remain closed if the cause is not corrected. The lights are provided with a "press-to-test" feature. To test, depress the annunciator test button for 3 seconds; the lights should illuminate and remain on for 10 seconds. During this test, the fuel boost pump inoperative lights mounted below the fuel flow warning lights should illuminate when the button is depressed (no hold required on this circuit) and go out when the button is released.

Illumination of the lights when fuel is sufficient may indicate a bad sensing probe, a bad gated relay or a wiring problem. Steady burning of both lights can usually be traced to an open in the ground to the gated relay.

ALTERNATOR WARNING SYSTEM.

An alternator inoperative "INOP" warning light is provided in the annunciator for each alternator. The appropriate light will illuminate whenever its respective alternator fails to provide output voltage. Whenever a light illuminates the ammeter for the appropriate alternator should be checked for output. If the ammeter indicates normal alternator output while the light remains on, the trouble probably is in the indicating system instead of the alternator. The most probable cause of such an indication is a blown fuse (5 amp). This fuse is located in a fuse holder directly below each alternator. If the problem is not with the fuse the alternator switch located in the circuit breaker panel just forward of the master switch should be checked.



THIS FIGURE FOR REFERENCE PURPOSES ONLY

FOR TROUBLESHOOTING SCHEMATICS REFER TO CHAPTER 91.

Figure 39-4. Alternator Paralleling System

CHART 3901. TROUBLESHOOTING (FUEL FLOW WARNING SYSTEM)

Trouble	Cause	Remedy
Fuel flow warning light fails to illuminate.	Bulb(s) burned out.	Replace.
	No power from bus.	Check and reset the gear, oil temperature, and fuel quantity indicator circuit breaker.
		Trace through system for an open circuit or faulty component.
	Fuel flow sensor probe malfunction.	Check free movement of probe tip; replace if defective.
	Gated delay relay malfunction.	Replace relay after the cause for the white wire to ground has been isolated and corrected.
Fuel flow warning light fails to extinguish.	Low fuel level in fuel cell.	Fill.
	Fuel flow sensor probe malfunction.	Check free movement of probe tip; replace if defective.
	Ground-in circuit.	Trace through system for ground.
	Pressure switch malfunction.	Replace.
If both lights remain on.	Ground to time delay switches open.	Reconnect ground.

COCKPIT LIGHTING SYSTEM.

Instrument panel lighting is accomplished through the use of lights located in various positions adjacent to individual instruments in the panel and overhead. These lights are dimmed by the use of four rheostats which are located in the overhead panel. These include the pilot's and copilot's (optional) lights dimmer and the overhead panel lights dimmer. A single circuit breaker protects these circuits. Each rheostat is connected to a transistor (2N6282) in the dimmer control assembly which is located forward of bulkhead 81.00 on the right side. Each transistor is protected by a 5 amp fuse. Outage of any group of lights could be caused by a blown fuse or a bad transistor.

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CHAPTER

51

STRUCTURES

CHAPTER 51 - STRUCTURES

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GENERAL.

DESCRIPTION.

The T-1020 is an all metal semi-monocoque structure. The fuselage is constructed of bulkheads, stringers, and stiffeners, to which the outer skin attaches. The cabin entrance and cargo doors are located on the left side of the aircraft. An emergency exit is incorporated on the right side of the aircraft. The wings and empennage are also of a full cantilever semi-monocoque type construction.

REPAIRS.

Structural repair methods used may 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 the various skin material used. Never make a skin replacement or patch plate from material other than the type and thickness of the original skin. The repair must be as strong as the original skin. However, flexibility must be retained so that the surrounding areas will not receive extra stress.

Major alterations or repairs require the approval of the Federal Aviation Administration and can only be accomplished with the approval of the administrator by personnel qualified in accordance with the regulations. If it becomes necessary to make modifications or structural repairs, it is recommended that a properly qualified repair facility be contacted.

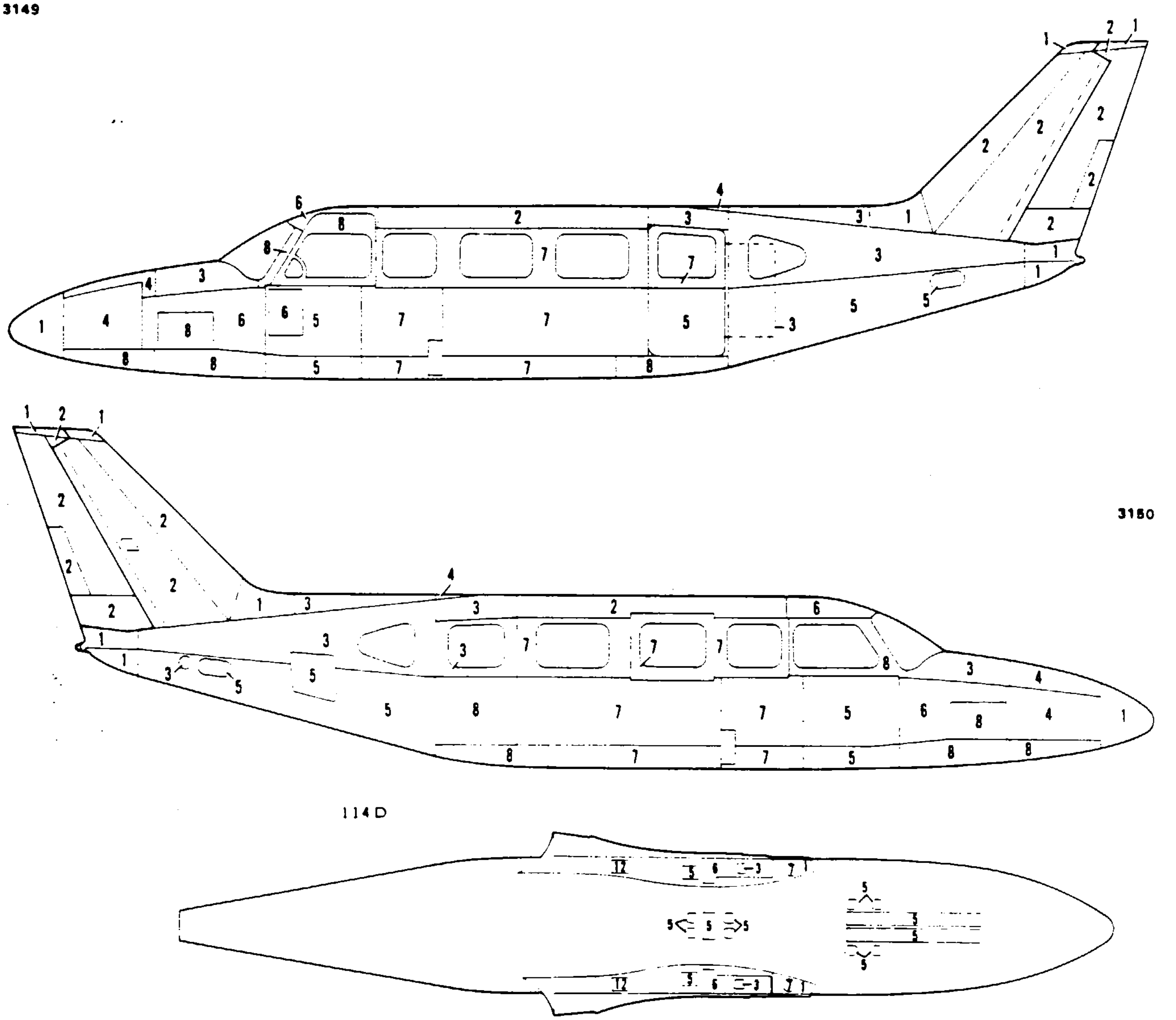
— WARNING —

No access holes are permitted in any control surfaces. The use of patch plates for repairs of all movable tail 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 tail surfaces.

— NOTE —

Any time service is accomplished on the elevator control system, a friction check must be made to insure that the system friction is within limits.

It may be necessary to cut access holes to make skin repairs in some areas of the aircraft. (Refer to Figure 51-2 for typical access holes.)



NUMBER	MATERIAL	THICKNESS	NUMBER	MATERIAL	THICKNESS
1	Fiberglass		7	2024-T3	.040
2	2024-T3	.020	8	2024-0*	.040
3	2024-T3	.025	9	2024-T3	.051
4	2024-0*	.025	10	2024-T3	.064
5	2024-T3	.032	11	321 ST STL	.015
6	2024-0*	.032	12	5052-434	.032

NOTE: LEFT WING SHOWN, RIGHT OPPOSITE AND NOTED MATERIAL OUTLINED IN DOTS USED ON RIGHT WING ONLY.
*HEAT TREAT TO 2024-T4 AFTER FORMING

Figure 51-1. Skin Thickness and Material

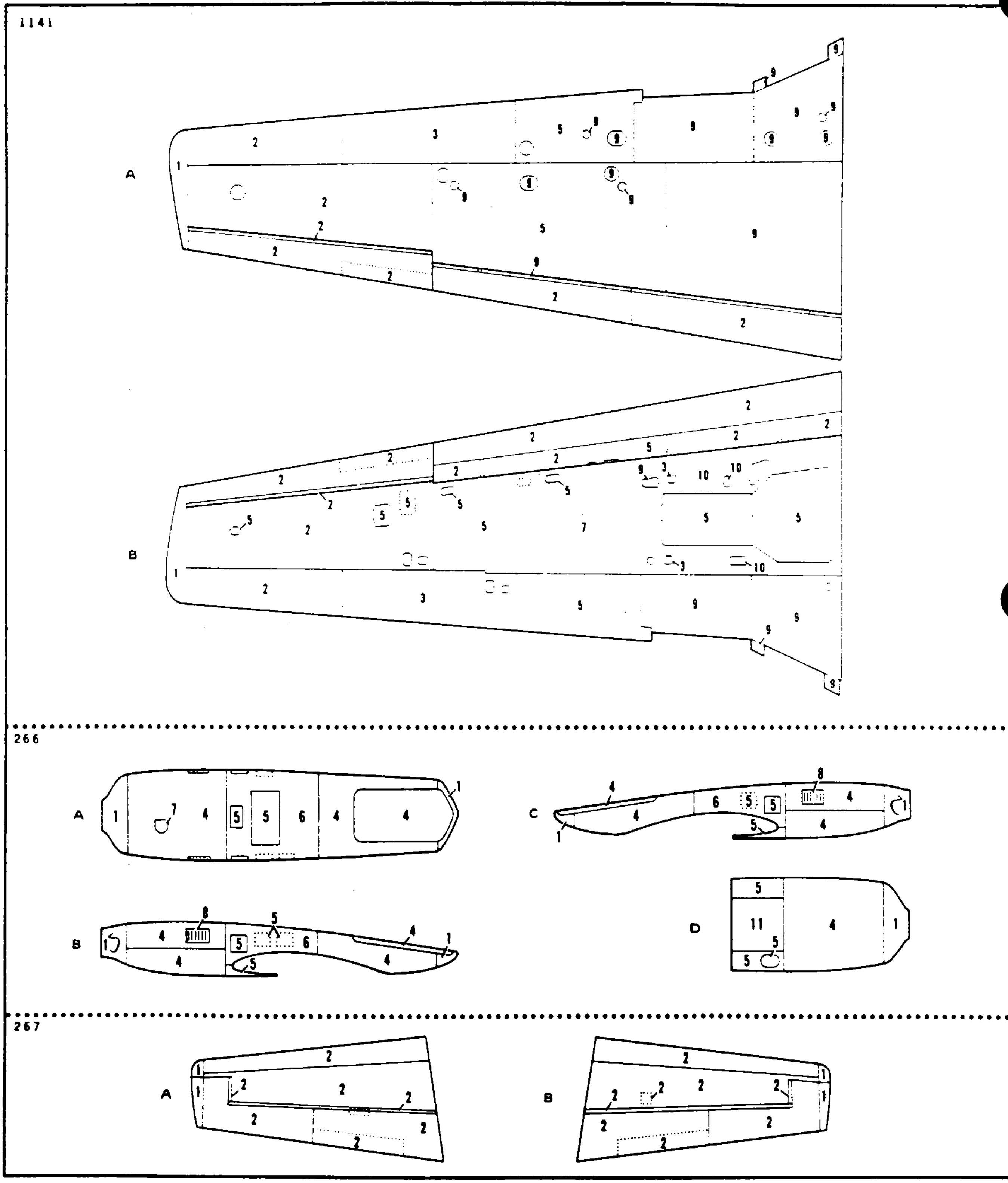


Figure 51-1. Skin Thickness and Material (cont.)

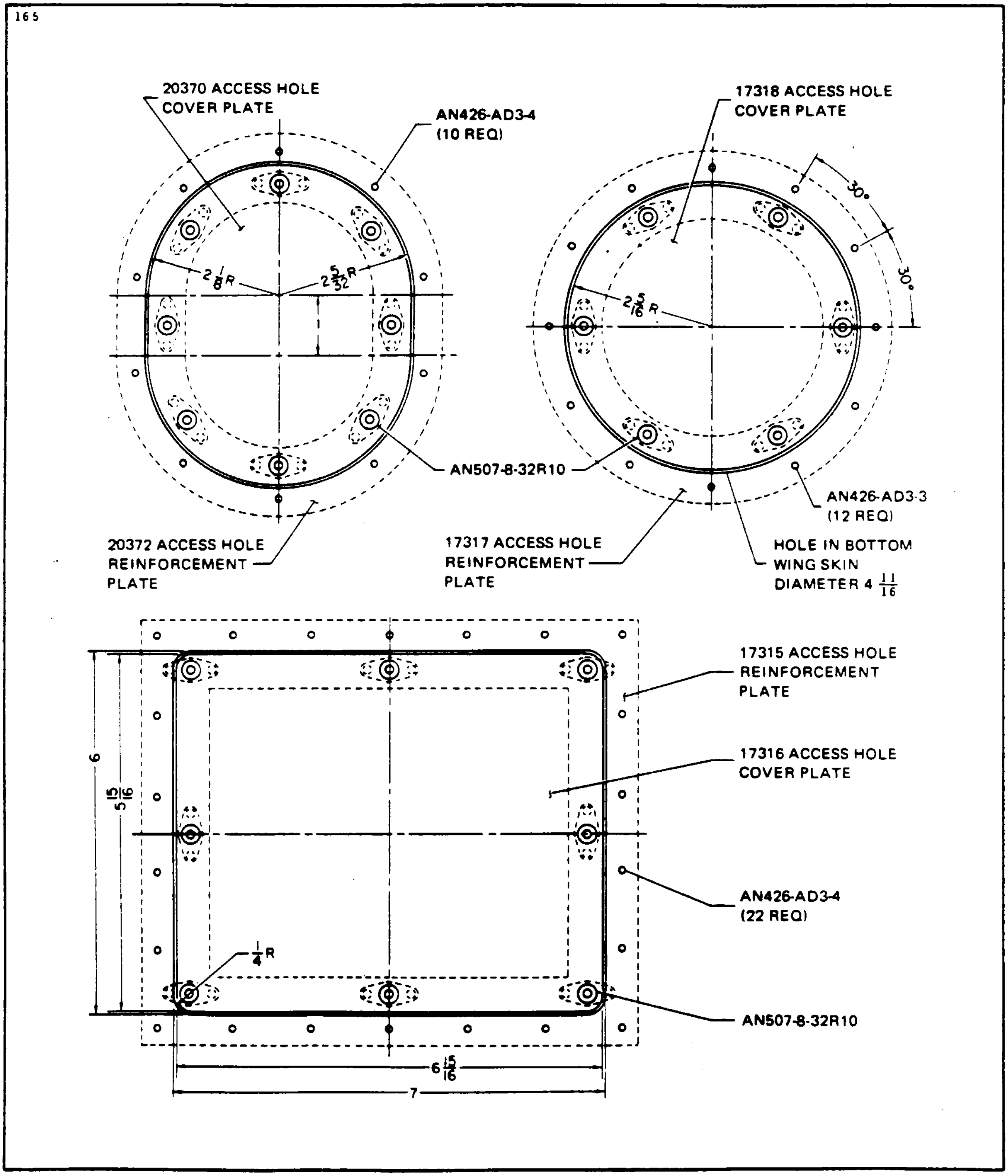


Figure 51-2. Typical Access Plates and Panels

FIBERGLASS REPAIRS.

The repair procedure in this manual will describe the methods for the repair of fiberglass reinforced structures. This section describes Touch-up and Surface Repairs such as blisters, open seams, delaminations, cavities, small holes and minor damages that have not harmed the fiberglass cloth material. Also covered are 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, that will furnish the necessary material for such repairs is available through Piper Aircraft Distributors.

— NOTE —

Very carefully follow resin and catalyst mixing instructions furnished with repair kit.

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 .062 of an 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 .062 of an 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 one 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 to two hours or overnight, for complete cure.
12. After repair has cured for 24 hours, sand 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 the 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 on 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 REPAIRS)

ITEMS	DESCRIPTIONS	SUPPLIERS
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 #1	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	Methylethyl Ketone 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 Naphtha will generally insure a good bond between epoxy compounds and thermoplastic.

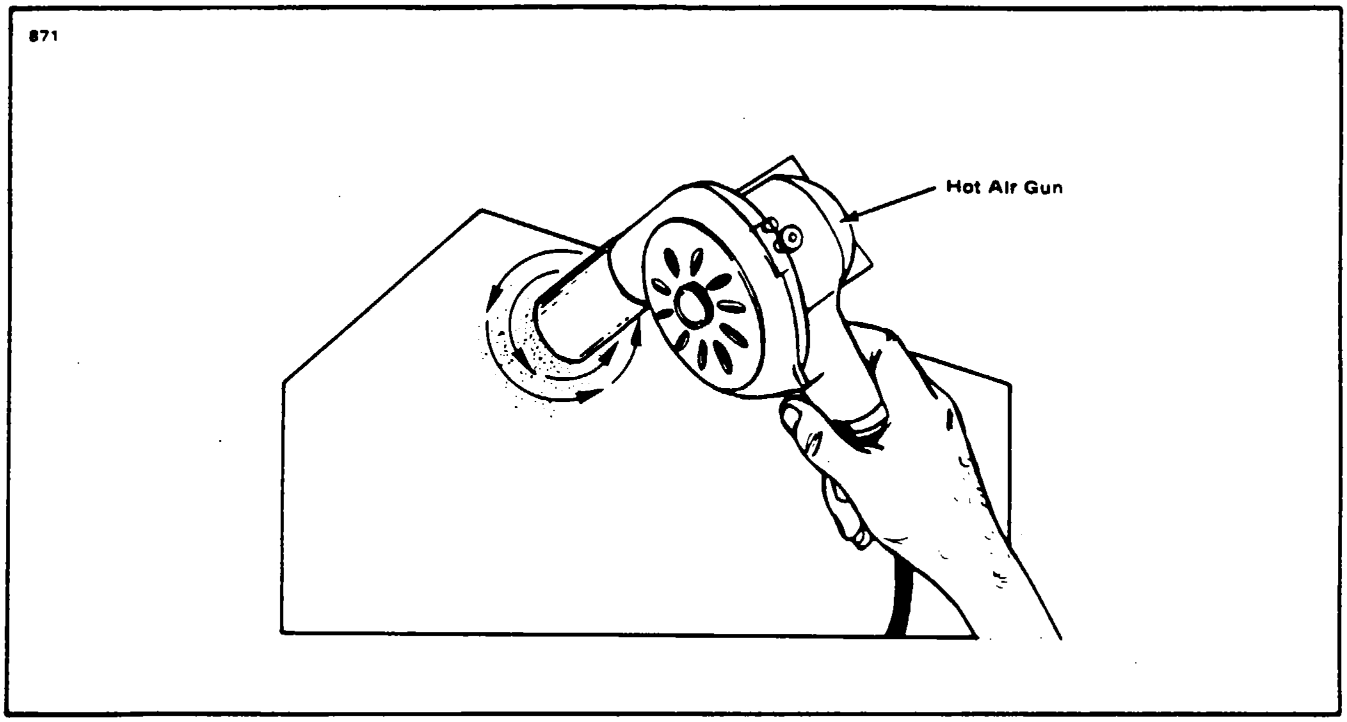


Figure 51-3. Surface Scratches. Abrasions or Ground-in-Dirt

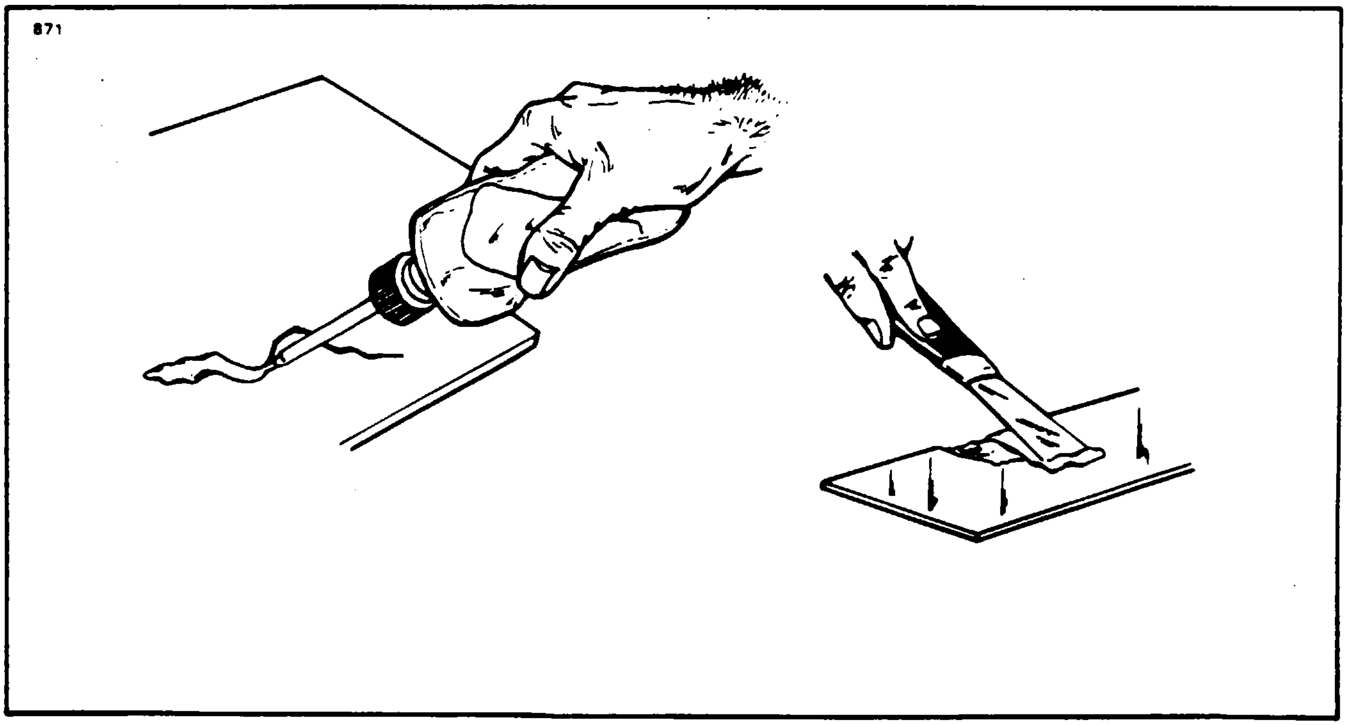


Figure 51-4. Deep Scratches. Shallow Nicks and Small Holes

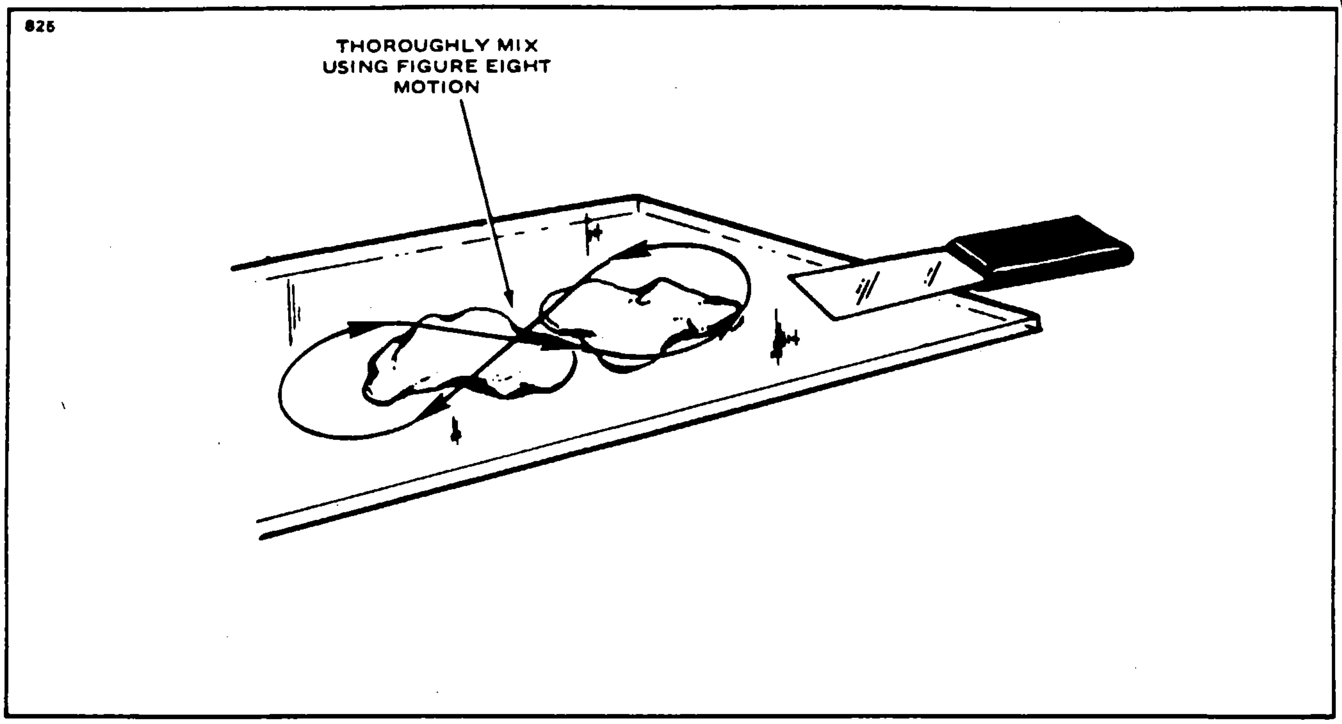


Figure 51-5. Mixing of Epoxy Patching Compound

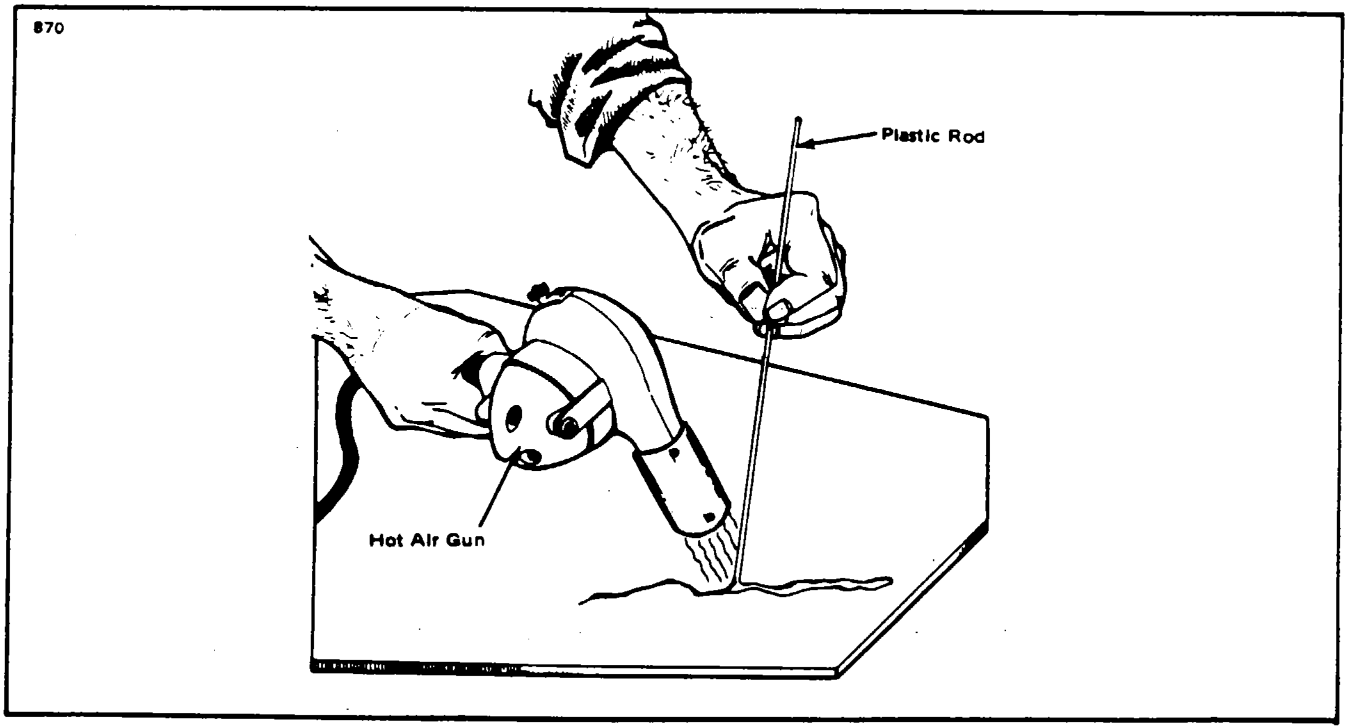


Figure 51-6. Welding Repair Method

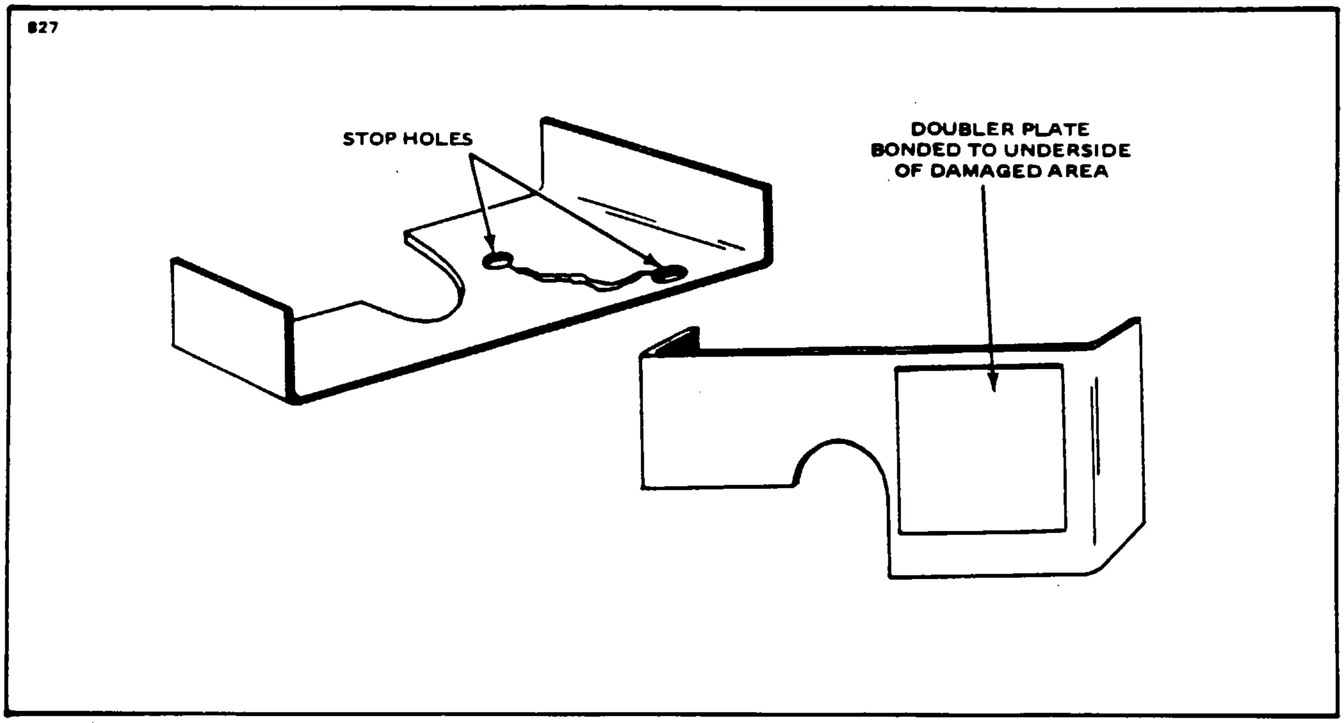


Figure 51-7. Repairing of Cracks

2. Surface Scratches, Abrasion or Ground-in-Dirt: (Refer to Figure 51-3.)

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 ¼ 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 51-4.)

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, or thin walled parts or for patching holes greater than ¼ inch in diameter.

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 51-5.)

G. A mechanical sander can be used after the compound is cured, providing the sander is kept in constant motion to prevent heat buildup.

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 51-6.)

K. After the repair is completed, sanding is allowed to obtain a surface finish of acceptable appearance.

4. Cracks: (Refer to Figure 51-7.)

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 hot 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 51-8.)

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 ½ inch in 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 51-9.)

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 51-10.)

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.

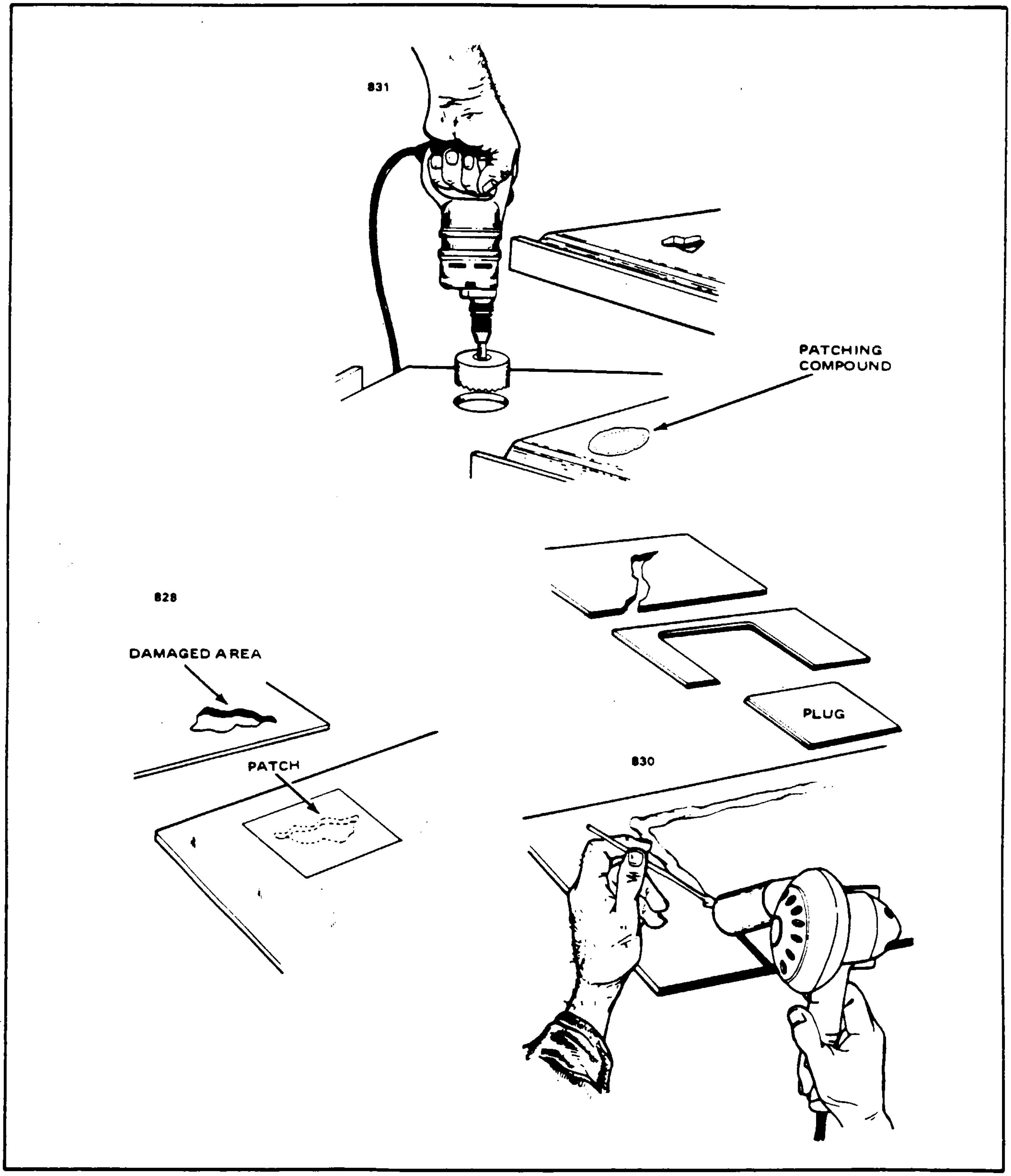


Figure 51-8. Various Repairs

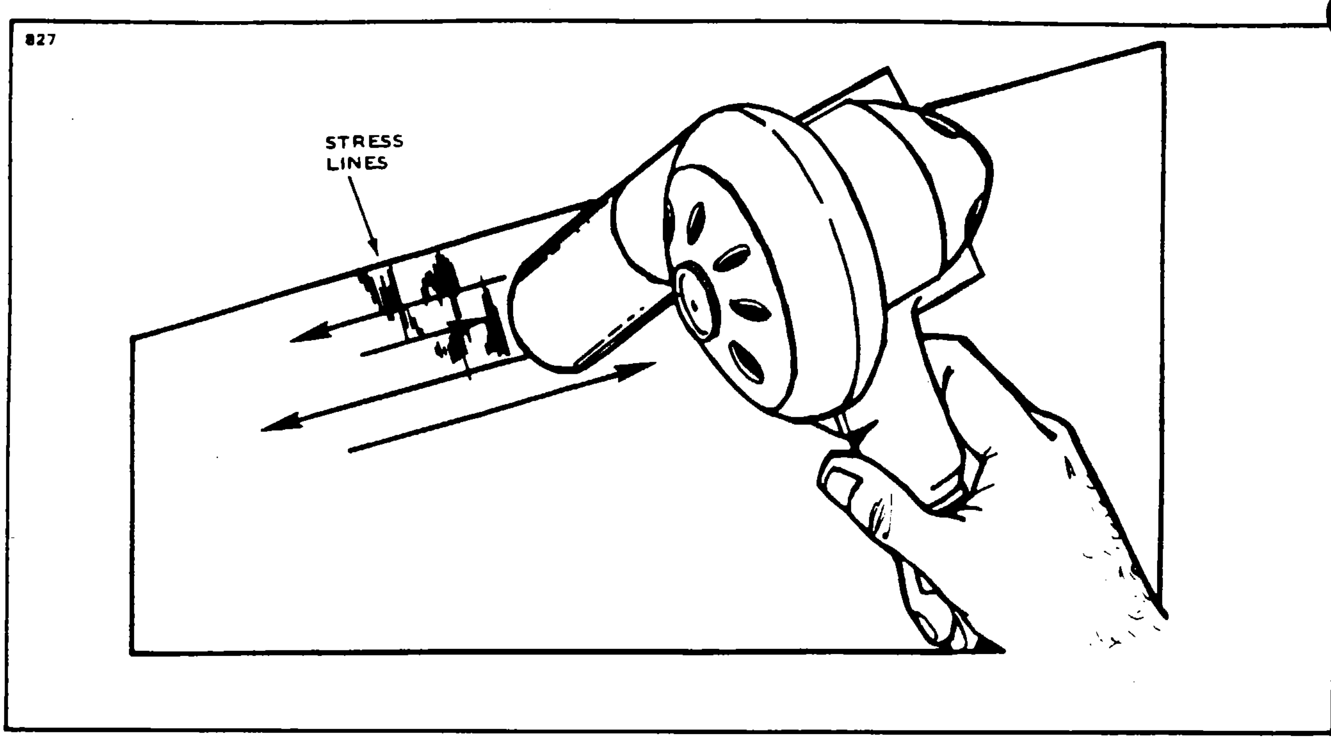


Figure 51-9. Repair of Stress Lines

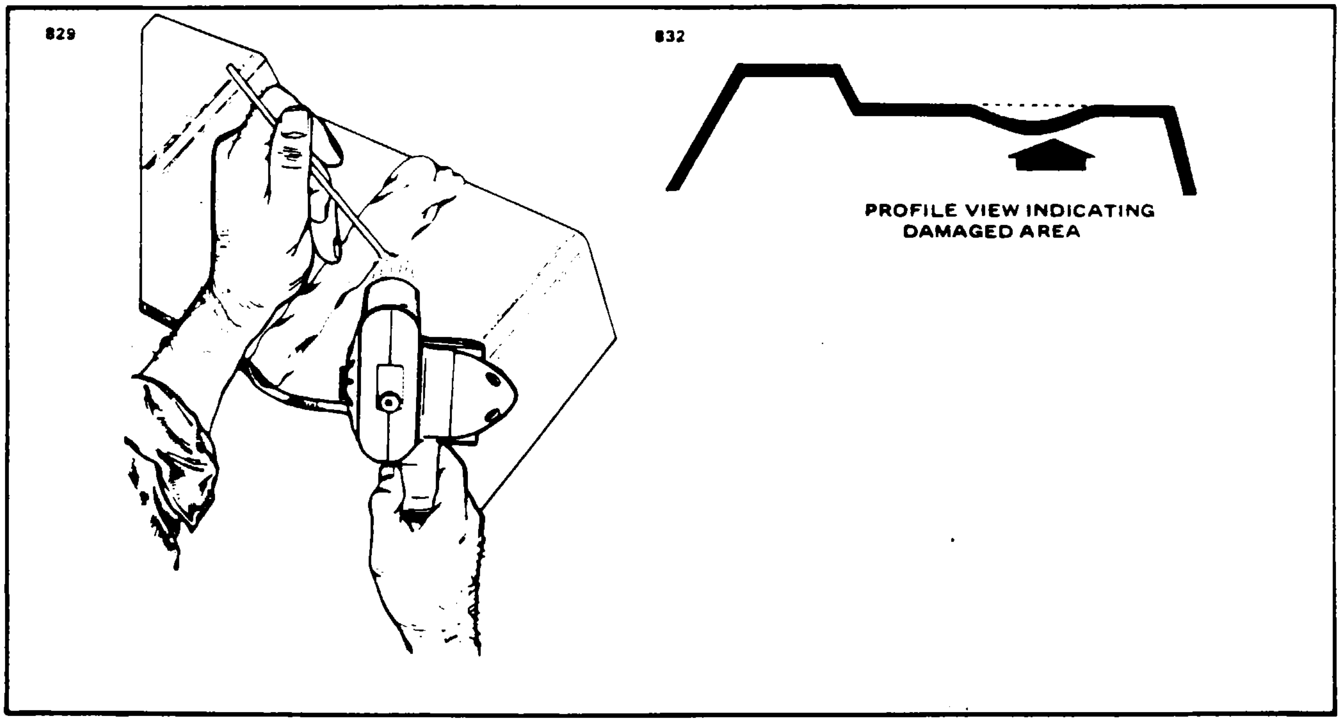


Figure 51-10. Repair of Impacted Damage

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 of 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.

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 FOR LIQUID SAFETY WALK COMPOUND.

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.

RADOME BOOT.

LIST OF MATERIALS.

1. Radome Boot - 3M No. SJ-8665-FP-1.
2. Marking pen.
3. Sponge or spray bottle.
4. Isopropyl alcohol.
5. Wetting solution: 25% isopropyl, 75% water, plus 1 teaspoon of liquid detergent (Ivory, Joy) per gallon of solution.
6. 3M PA-1 plastic squeeze or equivalent.
7. Masking tape - ½" wide.
8. Industrial razor blade knife.

PREPARATION AND INSTALLATION OF RADOME BOOT.

1. Thoroughly wash repair, primed radome with isopropyl alcohol and wipe dry.
2. Use a marking pen to place an orientation mark (+) on the top center of radome surface.
3. Position boot, with protective liner still in place, over radome:
   A. Rotate to determine optimum fit.
   B. On the top center of the boot surface, use a marking pen to trace over the orientation mark (+).
   C. Add a vertical orientation mark overlapping the bottom of the boot onto the side of the radome.
4. Turn boot inside out and place over radome (disregard orientation marks).
   A. Carefully remove transparency protective liner. Saturate the exposed adhesive surface with wetting solution as the liner is being removed to prevent adhesive to adhesive contact. (A sponge or spray bottle can be used.)
   B. After the liner has been removed, make sure that the entire adhesive surface has been saturated with wetting solution.
   C. Remove boot.
   D. Now, completely saturate the radome surface with wetting solution.

5. Place the boot over the radome (adhesive side to radome) carefully aligning the orientation marks. During this step, the boot will be right side in.
6. After proper alignment has been made, squeeze out wetting solution, starting at the top center and working out and down. Care should be taken to avoid blisters under the boot.
7. If after application of the boot, there appears to be blisters beneath the surface, piercing them with an ordinary safety pin will relieve the entrapped air or wetting solution so that the blister can be worked out with the squeegee.
8. Wrap the outside circumference of the boot with ½" wide masking tape at the desired location. Trim boot with an industrial razor blade knife being careful not to cut into the radome skin surface.
9. Wash boot with isopropyl alcohol, wipe dry and paint with a suitable polyurethane paint.

INSPECTION OF RADOME BOOT.

1. Inspect for cuts, blisters, perforations, edge lifting, etc., every 100 hours.
2. The boot should be replaced at the first sign of damage.

RADOME EROSION SHIELD.

LIST OF MATERIALS.

1. Cement - Minnesota Mining and Manufacturing Co. EC-1403 or 1300 L. (Approximate coverage 80 sq. ft. per quart mixed.)
2. Scissors - 2" blades with pointed tips.
3. Solvents - Toluol for tackifying (See Note). Methylethylketone (MEK) cement thinner and cleaning solvent.
4. Cloth - Clean and lint-free.
5. Paint brushes - One 1½" or 2" and one ½".
6. Sponge roller - 2".
7. Oil can - 3 or 4 oz. dirt and oil free.
8. Masking tape - ½" and 1" widths.
9. Flexible straightedge.
10. Hypodermic needle - 22 ga.
11. Steel stitcher roller - ⅛".
12. "V" knife.

— NOTE —

MEK (Methylethylketone) can be used instead of Toluol to activate cement. However, MEK causes very rapid drying and provides only 10 seconds working time for application compared with 40 seconds for Toluol.

PRE-INSTALLATION INSTRUCTIONS FOR RADOME EROSION SHIELD.

1. Ambient temperature for installation should be between 40° F and 110° F. Humidity must be below 99% during installation. Longer drying time of cement coats may be required as humidity approaches 99%.
2. EC 1403 cement is normally used as received. However, erosion shields with a tapered trailing edge or shields with a gauge of less than .060 should be installed with cement diluted with one part MEK to two parts cement for smoother, neater installation.
3. Use only clean, lint-free cloths for cleaning and activating cement coats.
4. Apply cement coats evenly and uniformly.
5. Cement has reached "proper tack" when it looses "webbiness" and, when touched with back of a finger knuckle, feels sticky but will not pull loose.

PREPARATION AND INSTALLATION OF RADOME EROSION SHIELD.

1. All paint must be removed by using appropriate paint remover or by sanding. (Epoxy-based paint need only be roughened.) Any holes or dents in the structure must be filled with the appropriate repair material and sanded. Clean the area to be covered, using MEK or equivalent.
2. Dry fit the erosion shield to the cleaned structure. Position identified "top" surface of erosion shield on top surface of structure. Then adjust each side to provide equal distance from structure attachment line. Smooth out any wrinkles. Apply ½" wide masking tape to the structure, next to the shield's trailing edge. (Refer to Figure 51-11, View 1.)
3. Establish a reference line at the top and draw a pencil mark on the masking tape to correspond with the center line mark on the inside of the erosion shield. Repeat at bottom and remove erosion shield from structure. (Refer to Figure 51-11, View 2.)
4. To establish a trim line apply 1" wide masking tape to butt against forward edge of the ½" wide tape previously applied. Leading edge of 1" tape will now provide the final trim line. (Refer to Figure 51-11, View 3.)

— *NOTE* —

Smaller erosion shields with a distance of less than 10" from the center to the trailing edge may be installed by applying the ½" masking tape approximately ¼" beyond the shield trailing edge and need not be final trimmed.

5. Clean the marked off area thoroughly with MEK or equivalent. For final cleaning, wipe the solvent film off quickly with a clean cloth before it dries. Wash the back (rough surface) of erosion shield with a clean cloth moistened with MEK. (The shield is dusted to prevent sticking.) Change cloths frequently to avoid recontamination.

— *NOTE* —

Do both complete cleaning operations at least twice.

6. Thoroughly mix EC 1403 (or equivalent) cement before using. Apply one even brush coat to both the back surface of erosion shield and the mating structure, up to the masking tape. Allow first coat to air dry a minimum of 30 minutes. If temperature is below 50° F, allow cement to dry at least one hour. Apply a second cement coat to both surfaces allowing to dry thoroughly for at least one-half hour, one hour preferred. Apply cement evenly to assure smooth installation. Parts may be cemented up to a maximum of 48 hours before actual installation, if cemented parts are covered and kept clean.

7. Using a straightedge, draw a line on the structure to connect the upper and lower marks previously put on the masking tape. (Cement will now be dry and tack free.) Position the shoe on the structure (dry cemented surfaces against each other) so reference lines coincide. Hold the shoe at its central area. Do not move or change its referenced position as you prepare to activate the cement.

8. Fold back the trailing edge and use a clean, lint-free cloth moistened (not dripping) with Toluol, to activate the cement on the nose or leading edge of the shield. Activate mating areas, not to exceed one square foot at a time. Avoid excessive rubbing which could remove cement from surfaces. (Refer to Figure 51-11, View 4.)

9. After cement reaches "proper state of tack" roll activated part of shield against structure with 2" sponge roller. Match reference lines as shield is rolled down. Use care to prevent trapping air between shield and structure. Avoid stretching the shield; otherwise, difficulty will be encountered around the lower periphery.

— NOTE —

When cementing, activating and rolling erosion shields on radomes start at the center and work in concentric circles outward.

— CAUTION —

Avoid twisting or sharp creasing of shield. Otherwise cement may be pulled loose from structure or shield. Should it be necessary to remove or loosen an installed shield, squirt a little Toluol from clean oil can to soften the "adhesion" line. Apply only minimum amount of solvent while slight tension is applied to the shield. Allow solvent to do most of the work of separating cemented coats because if cement pulls loose from either the structure or shield, the area must be recemented.

10. Activate another section adjacent to the bonded areas. Be certain to activate cement immediately adjacent to the bond line, thus assuring complete adhesion throughout installation. When cement has reached "proper state of tack," roll down thoroughly and continue until shield is completely attached.

11. Using a 2" sponge roller, go over entire surface, applying pressure and rolling from the center line or leading edge outward to trailing edge of shield. With steel stitcher roller, roll thoroughly at trailing edge line where shield meets the 1" masking tape. (Refer to Figure 51-11, View 5.)

12. To trim the erosion shield make initial cut into material overlapping the tape, using scissors held at an angle. Using a "V" knife, or pair of scissors with blades opened to form a "V," neatly trim off excess shield material overlapping edge of 1" masking tape, applying light, uniform tension to trim material. (Refer to Figure 51-11, View 6.)

13. If an air pocket or blister is formed, release air by inserting a hypodermic needle at 45° angle or less, pointed toward center or leading edge. Apply finger pressure on blister to remove air and reroll using steel stitcher. Remove all masking tape and clean excess cement from structure using MEK, wiping away from the trailing edge. Prevent solvent from running under and loosening edges of erosion shield. Restitch shoe at its trailing edge, using ¼" steel stitcher. Inspect complete trailing edge to see that it is firmly bonded. (Refer to Figure 51-11, View 7.)

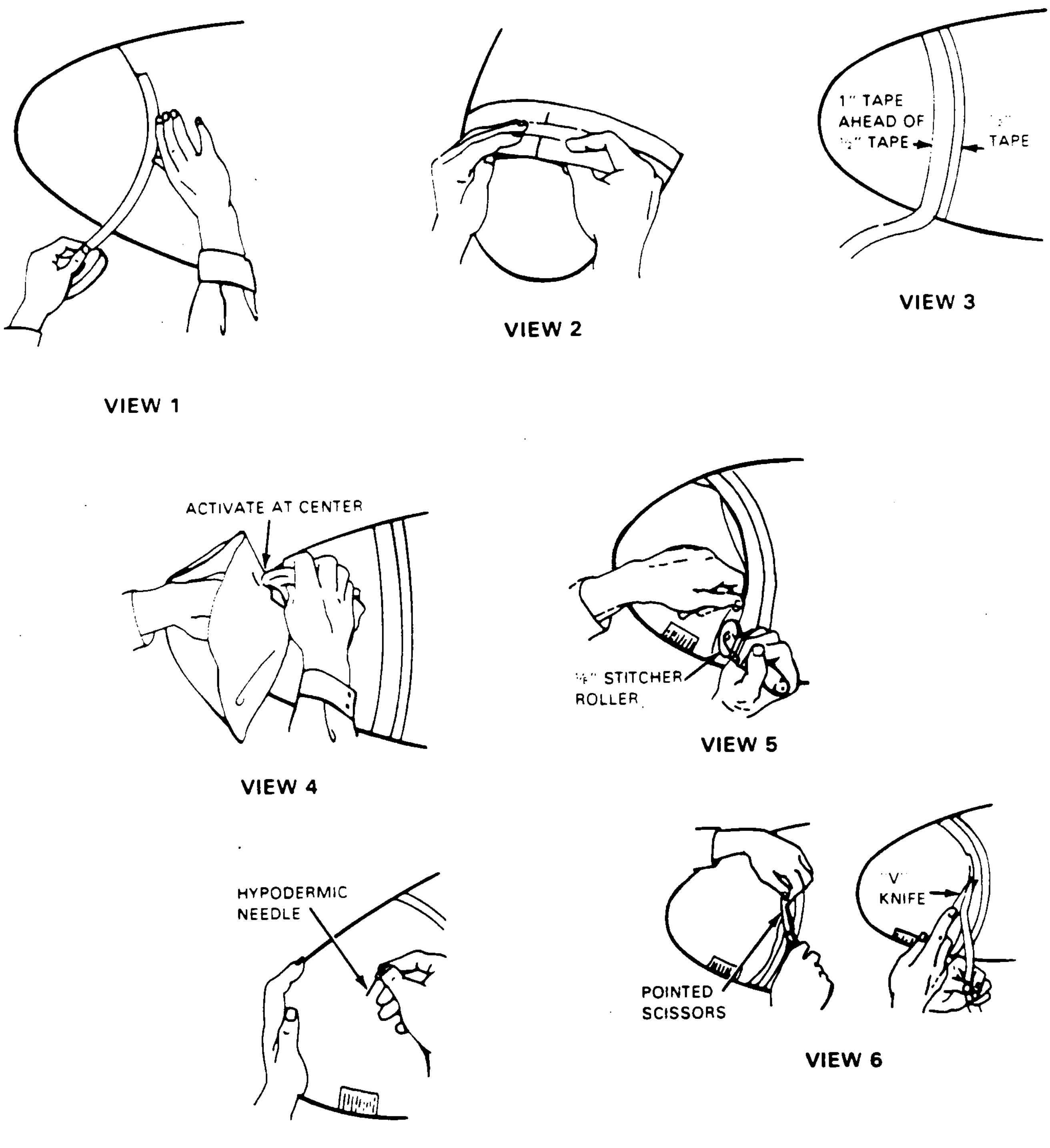


Figure 51-11. Installation of Radome Erosion Shield

CORROSION CONTROL.

Metal corrosion is the deterioration of the metal by chemical or electrochemical attack and can take place internally as well as on the surface. Water or water vapor containing salt combined with oxygen in the atmosphere produces the main source of corrosion in aircraft. There are two general types of corrosion which cover most specific forms. One is direct chemical attack such as spilled battery acid or fumes from batteries, entrapped caustic solutions and residual flux deposits from inadequately cleaned, welded, brazed or soldered joints. The other is electrochemical attack which is like the electrolytic reaction which takes place in electroplating, anodizing, or in a dry cell battery. This reaction requires a medium, usually water, which is capable of conducting a tiny current of electricity. Different areas of the same metal surface have varing levels of electrical potential and if connected by a conductor, such as salt water, will set up a series of corrosion cells and corrosion will commense. The electrochemical type is most common and responsible for most forms of corrosion on aircraft structures and component parts. The most effective method of corrosion control is regular cleaning and surface refinishing to remove the medium and minute electrical corrosive cells; this is the basis for effective corrosion control.

FORMS OF CORROSION.

There are various forms of corrosion depending on the metal involved, its size, shape and specific function along with atmospheric conditions and whatever corrosion producing agents are present.

The following will list the most common forms found on airframe structures:

1. Surface Corrosion:

   This type appears as a general roughening, etching, pitting of the surface of the metal, usually accompanied by a powdery deposit of corrosion products. Surface corrosion is caused by either direct chemical or electrochemical attack. At times this corrosion may spread under the surface coating and not be recognized until the paint or plating is lifted off the surface in small blisters which result from the pressure of the underlying accumulation of corrosion products.

2. Dissimilar Metal Corrosion:

   This type of corrosion is also known as galvanic corrosion because of the electrochemical principle involved. This electrochemical attack can be very serious because the action is usually taking place out of sight and the only way to detect it prior to structural failure is by disassembly and inspection.

3. Intergranular Corrosion:

   This type of corrosion is an attack of the metal along the grain boundaries of an alloy and results from the lack of uniformity in the alloy structure. This lack of uniformity is caused by changes that occur in the alloy during heating and cooling. Intergranular corrosion may exist without visible surface evidence. This type of corrosion is difficult to detect in its original state. Very severe corrosion of this type may cause the surface of the metal to "exfoliate." This is the flaking or lifting of the metal at the surface due to delamination of the grain boundaries caused by the pressure of corrosive residual product buildup.

4. Stress Corrosion:

   This type of corrosion is the result of combined effects of sustained tensile stresses and corrosive environments. It usually occurs in assemblies such as aluminum alloy bellcranks with pressed-in bushings, landing gear shock struts with pipe-thread type grease fittings, clevis pin joint, and shrink fit parts.

5. Fretting Corrosion:

   This type of corrosion develops when relative motion of small amplitude takes place between close fitting components. The rubbing contact destroys the protective film that was present on the surfaces and eventually removed small particles of virgin metal from the surfaces. These particles than act as an abrasive, thus preventing the formation of any protective oxide film and exposes fresh active metal to the atmosphere.

CONDITIONS AFFECTING CORROSION.

Many things affect the type, cause, speed, and seriousness of metal corrosion. Some of these conditions can be controlled and some cannot.

1. Climate:

The environmental conditions where an aircraft is maintained and operated will greatly affect the corrosion characteristics. If the location is in an area of hot, moist climate the corrosion attack is increased considerably more than an area of dry climate. One of the worst conditions would be in an area near sea water and salt air.

2. Metal Size and Type:

Variation in size and shape of metal can indirectly affect its corrosion resistance because of greater chemical composition variations and cooling-rate difference between the surfaces and centers of the materials.

3. Foreign Materials:

Among the list of foreign materials which contribute to corrosion, the following are the most frequent offenders:

A. Soil and atmospheric dust.
B. Oil, grease, and engine exhaust residues.
C. Salt water and salt moisture condensation.
D. Spilled battery acids and caustic cleaning solutions.
E. Welding, brazing and soldering flux residues. It is very important that the aircraft be kept clean. The frequency of cleaning will depend on several factors, such as geographical location, aircraft model and type of operation.

INSPECTION.

1. Inspection for corrosion should be done on a daily basis due to the fact that corrosion is a continuing problem. Except for special requirements in trouble areas, inspection for corrosion should be a part of routine inspections such as daily and preflight.
2. In addition to the routine inspections the following special requirements should be observed:

A. Aircraft which are operated in and around a marine atmosphere should be given special checks on a weekly basis.

B. Aircraft which are operated in semi-arid conditions should be given monthly inspection checks.

C. Checks and inspection for corrosion should be performed by personnel familiar with corrosion problems and how to treat them.

(1) Daily and preflight inspections should include the engine frontal areas, including all intake vents, engine compartment gaps, seams and faying surfaces in the exterior skins, wheel and wheel well areas, battery compartment, fuel cell drains and any other drains on the aircraft and if possible any bilge areas not requiring extensive removal of inspection access covers.

(2) Detailed inspection should include the above referenced areas along with areas requiring removal of screw attached inspection plates and panels to thoroughly inspect the internal cavities of the aircraft.

CORROSION REMOVAL AND CONTROL.

1. Corrosion is a natural phenomenon and cannot be completely eliminated. In most cases the rate of corrosive attack can be reduced to an acceptable level by proper methods.

2. All corrosion products must be completely removed whenever any rework is started. The corroding process will continue even though the affected area is refinished. The following steps should be carried out prior to starting any rework.

A. Position the airplane in a wash rack or provide some type of washing apparatus for rapid rinsing of all surfaces.

B. A static ground line should be connected to the airplane.

C. Remove the airplane battery if required.

D. Protect the pitot-static ports, engine openings airscoops, louvers, wheels, tires and any other portions of the airplane from moisture and chemical brightening agents.

E. Protect the surfaces next to the rework areas from chemical paint strippers, corrosion removal agents and surface treatment materials.

3. Evaluation of the corrosion damage is required after the initial inspection and cleaning to determine the nature and extent of repairs required. To help in evaluating the extent of corrosion the following guide lines have been established:

A. Light Corrosion:

This will appear as discoloration or pitting to a depth of approximately 0.001 of an inch maximum and is normally removed by light hand sanding or small amount of chemical treatment.

B. Moderate Corrosion:

This will appear similar to light corrosion except there could become blistering or evidence of scaling and flaking. Pitting depths may be as deep as 0.010 of an inch. This type of corrosion damage is normally removed by extensive hand sanding or mechanical sanding.

C. Severe Corrosion:

The general appearance may be similar to moderate corrosion with severe blistering, exfoliation, scaling and/or flaking. Pitting depths will be deeper than 0.010 of an inch, and is normally removed by extensive mechanical sanding or grinding.

4. Corrosion Removal: There are several standard methods for corrosion removal. The method used depends upon the metal and the extent of corrosion. The methods normally used are chemical treatments, hand sanding with abrasive paper or metal wool, and mechanical sanding or buffing with abrasive mats, or grinding wheels.

In some special cases a particular method may be required depending upon type and extent of corrosion. For example, corrosion in a hole may require removal by enlarging the hole, or abrasive blasting may be required to remove corrosion from steel fasteners, or irregular shaped parts or surfaces.

All depressions resulting from corrosion rework must be faired or blended with the surrounding surface. This is accomplished by first removing any rough edges and corrosion from the damaged area, and then blending the edges of the reworked area in an elliptical shape with the major axis in the longitudinal direction. In areas which have multiple pits closely spaced the intervening material should be removed to minimize surface irregularity or waviness.

5. Reprotecting of the repaired area is very important and should be accomplished as soon as the repair work is completed to insure the control of corrosion reappearing at the same area. The surface should be protected in the same manner as was originally manufactured unless the manufacturer recommends some other procedure or protective sanding.

— END —

GRIDS 3K23 THRU 3L24
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T1000

AIRLINE DIVISION

T1020

MAINTENANCE MANUAL

CARD 4 OF 5

PA-31-350 T1020

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 768)

INTRODUCTION.

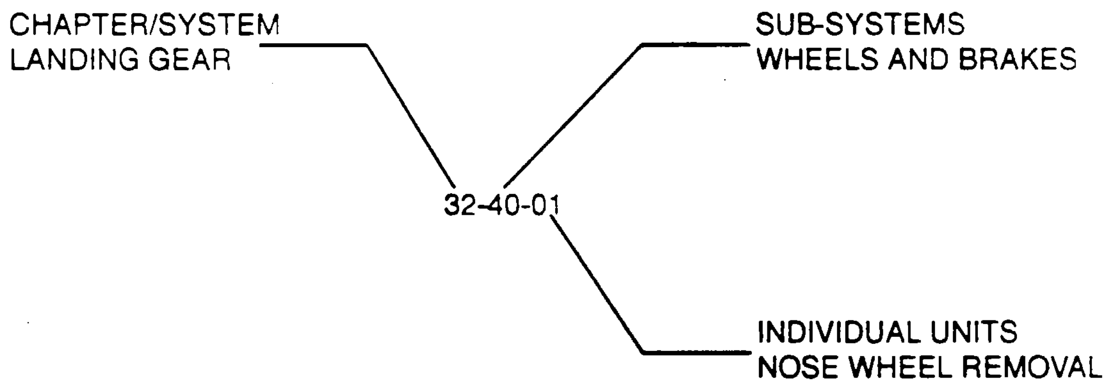
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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 Maintenance Manual is provided to support and maintain the Piper Model PA-31-350 T-1020 aircraft manufactured by the Piper Aircraft Corporation of Lakeland, Florida.

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 T-1020 Parts Catalog P/N 761 775, 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. 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 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, or 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 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:

SAMPLE EFFECTIVITY CODES

First Revision:	Month and Year (11-80)
Second Revision:	Revision Indication, Month and Year (2R 12-80)
Third Revision:	Revision Indication, Month and Year (3R 1-81)
Fourth Revision:	Revision Indication, Month and Year (4R 2-81)
Added Subject:	Identification, Month and Year (A 3-80)

Revisions to this Maintenance Manual 761 768 issued September 2, 1981 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
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PR831117	November 17, 1983	1, 2, 3, 4 and 5
PR840703	July 3, 1984	1, 2, 3, 4 and 5
IR860430	April 30, 1986	1
IR860920	September 20, 1986	1
IR871009	June 15, 1988	3
IR900313	March 13, 1990	2
IR941007	October 7, 1994	1 and 4

INTERIM REVISION

Revisions appear in chapter 5 of card 1 and chapters 61 and 71 of card 4. Please dispose of your current cards 1 and 4, and replace with the revised one. DO NOT DISPOSE OF CARDS 2, 3, or 5.

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VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual =	AVCO LYCOMING = OVERHAUL MANUAL DIRECT DRIVE ENGINE - P/N 60294-7 Avco Lycoming Division Williamsport, PA 17701
Parts Catalog =	AVCO LYCOMING - P/N PC-315 Avco Lycoming Division Williamsport, PA 17701
Operators Handbooks =	AVCO LYCOMING TIO-540 and LTIO-540 SERIES AIRCRAFT ENGINES - P/N 60297-23 Avco Lycoming Division Williamsport, PA 17701

PROPELLER:

Overhaul Instructions =	HARTZELL CONSTANT SPEED AND FEATHERING PROPELLER- P/N 117D Hartzell Propeller Inc. P.O. Box 1458, 1800 Covington Avenue, Piqua, Ohio 45356

MAGNETOS:

Installation, Operation and Maintenance Instructions =	S-1200 SERIES MAGNETO IGNITION SYSTEM - P/N-L-609-3 Bendix Electrical Components Division Sidney, New York 13838

WHEELS AND BRAKES:

PARTS CATALOGS and Maintenance Instructions =	CLEVELAND WHEEL AND BRAKE Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011

VENDOR-SUPPLIER INFORMATION.

Refer to the following list of manufactures, to obtain Service Manual and field service data:

Autoflite	BENDIX AVIONICS DIVISION 2100 N. W. 62nd Street Fort Lauderdale, Fla. 33310 (305) 776-4100 TWX 510-995-8884

VENDOR-SUPPLIER INFORMATION (cont.)

Autoflite (cont.)

EDO-CORPORATION
AVIONICS DIVISION
Box 610
Municipal Airport
Mineral Wells, Texas 76067
(817) 325-2517

SPERRY FLIGHT SYSTEMS
AVIONICS DIVISION
7500 Balboa Blvrd.
P.O. Box 9028 Van Nuys, Ca. 91409
(213) 894-8111 Telex: 65-1367

COLLINS GENERAL AVIATION
DIVISION
Rockwell International
Cedar Rapids, Iowa, 52406
(319) 395-3625 Telex: 46-4421

KING RADIO CORPORATION
400 N. Rodgers Rd.
Olathe, Kansas, 66061
(813) 782-0400 Telex: 4-2299
Kingrad

GLOBAL NAVIGATION
2144 Michelson Drive
Irvine, Ca. 92715
(714) 851-0119

PIPER PUBLICATIONS.

PA-31-350 T-1020
Parts Catalog -

761 775
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, FL 32960

CONTINUOUS
INSPECTION -

761 770
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, FL 32960

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CHAPTER

52

DOORS

CHAPTER 52 - DOORS

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GENERAL.

Contained in this chapter are removal and installation procedures for the various doors and their accompanying latch assemblies.

PASSENGER/CREW.

CABIN ENTRANCE DOOR.

REMOVAL OF CABIN ENTRANCE DOOR (UPPER).

1. Remove the door trim panel and disconnect electrical wire.
2. While holding door, remove support retaining clip, remove support.
3. Remove hinge pins from both hinges and lower door to remove.

INSTALLATION OF CABIN ENTRANCE DOOR (UPPER).

1. While holding door in place, align the hinges and insert new hinge pins. Bend the excess length of pin into slot in hinge.
2. Install support and secure with retaining clip.
3. Connect electrical wire and install the door trim panel.

REMOVAL OF CABIN ENTRANCE DOOR (LOWER).

1. Remove the snubber by removing the bolt and nut.
2. Remove scuff plate and rubber cover from cabin floor.
3. While supporting the door, remove door support cable at each side of door.
4. Remove door panel and disconnect electrical wire.
5. Remove locking roll pins from hinges, remove hinge pins and lift door out of place.

INSTALLATION OF CABIN ENTRANCE DOOR (LOWER).

1. Position door and align hinges, then insert hinge pins and secure hinge pins with locking roll pins.
2. Connect electrical wire and install door panel.
3. Install support cable at each side of door.
4. Install scuff plate and rubber cover on cabin floor.
5. Install snubber and secure with bolt and nut.

ADJUSTMENT OF CABIN DOOR.

1. Use the least amount of shims under one lower door hinge only to obtain the proper fit between the door, door frame and upper door.
2. Trim the outer skin of the door to fit the upper and lower doors together and around the door and fuselage.

REPLACEMENT OF LAMP IN CABIN DOOR STEP LIGHT.

The lower half of the cabin entrance door has two light assemblies installed on the left-hand side to provide illumination of the steps when required.

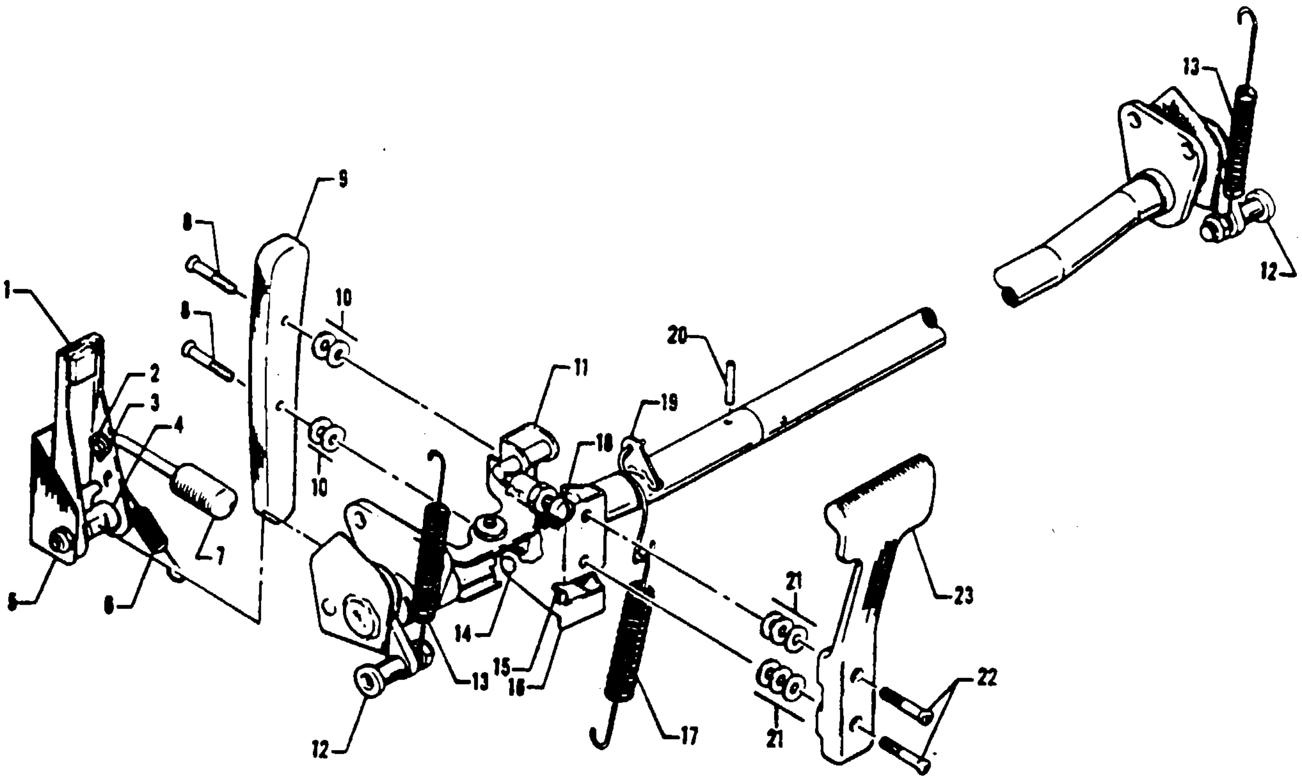
1. Remove the screws which secure the lens retainer.
2. Remove the lens retainer and lens.
3. Replace the defective lamp with a new one and test to ensure lamp lights.
4. Install lens and lens cover and secure with screws.

CABIN ENTRANCE DOOR LATCH ASSEMBLY.

REMOVAL OF DOOR LATCH ASSEMBLY. (Refer to Figure 52-1.)

1. Remove the door trim panel assemblies and the protector panel from behind the steps.
2. Remove the safety latch mechanism from the door assembly by removing the latch spring, attached between latch stop bracket, and door assembly by removing the bolt, washer and eccentric bushing.
3. The safety latch actuator rod can be removed from the safety latch stop bracket by removing the cotter pin and washer.
4. Remove one roll pin from the tube assembly and bushing, located to the rear of the steps.
5. Remove two bolts and shim washers holding the inner handle to the actuator assembly. Note the amount and thickness of shim washers for reference when reinstalling handle.
6. Remove the two door latch covers and the latch springs. Also remove the spring between the door assembly and hook on the tube assembly. Then remove hook.
7. Remove four bolts, washers and locknuts holding the latch mechanisms in place (two on each side).
8. The outer handle can be removed by disconnecting the spring between both halves of the actuator assembly and removing the cotter pin and pin. The handle and half of the actuator can now be removed and further disassembled by removing two screws, shim washers and plate from actuator. Note the amount and thickness of the shim washers removed.
9. Each latch mechanism can be removed by pulling it out of its own side of door assembly.
10. The key lock assembly is removed by removing the retainer nut, washer and weather seal.

1. LATCH STOP BRACKET
2. COTTER PIN
3. WASHER
4. ECCENTRIC BUSHING
5. DOOR ASSEMBLY
6. SAFETY LATCH SPRING
7. ACTUATOR ROD
8. SCREWS
9. HANDLE - OUTER
10. SHIM WASHERS
11. ACTUATOR



12. LATCH MECHANISM
13. LATCH SPRINGS
14. PIN
15. ACTUATOR SPRING
16. ACTUATOR ASSEMBLY
17. SPRING
18. ADJUSTING SCREW
19. HOOK, SPRING ATTACHMENT
20. ROLL PIN
21. SHIM WASHERS
22. BOLTS
23. HANDLE - INNER

Figure 52-1. Cabin Entrance Door Latch Assembly

INSTALLATION OF DOOR LATCH ASSEMBLY. (Refer to Figure 52-1.)

1. Install key lock assembly into hole in door and secure with weather seal, washer and retainer nut.
2. The latch mechanisms should be installed next, being careful to place each half into its proper place. The latch mechanism with the lock assembly going in the right side of door and aligning the tube assemblies and bushing.
3. Secure latch mechanisms with the four bolts, washers and locknuts, two for each side of door.
4. Assemble outer handle with plate and shim washers and secure to the actuator with two screws. (Use shims to align the handle flush with outer door surface.) Place handle assembly into door and connect to the other half of actuator assembly with pin and cotter pin. Connect the spring between both halves of actuator assembly.
5. Install hook on tube assembly and connect spring between hook and door assembly. Also connect springs on both ends of latch assemblies and lubricate lightly. The door latch mechanism covers can now be installed with five screws for each side.
6. Install inner handle with screws and shim washers. Use only enough shims to keep the handle from rubbing against the trim panel.
7. Align the holes in the tube assemblies and bushing, and insert the roll pin.
8. The safety latch actuator rod assembly should be connected to the safety latch stop bracket assembly with washer and cotter pin before installing in door assembly.
9. Install safety latch mechanism into door assembly and adjust the eccentric bushing in latch to position the safety latch with the cam on the tube assembly. Install the spring between the safety latch and door assembly and check for proper engagement of safety latch with the cam. Tighten bolt holding mechanism.
10. Adjust the screw on the door mechanism to remove any excess travel in the outer handle and secure with locknut.
11. Install the protector panel behind the stems, and the door trim panel assemblies with the proper screws.

ADJUSTMENT OF DOOR LATCH ASSEMBLY. (Refer to Figure 52-1.)

1. Remove aft inner door panel.
2. The safety latch mechanism can be adjusted by loosening the pivot bolt and rotating the eccentric bushing to position the safety latch into its proper position with the cam on the tube assembly, which is for the pawl to drop into the cam notch just as the outside door handle becomes flush with the outside skin. Retighten the pivot bolt to lock bushing in correct adjustment.
3. The outside door handle safety lock unlatching mechanism is adjusted by loosening the locknut on the adjusting screw, located next to the inner handle, and turning the screw as required to completely disengage the safety lock before the torque tube starts to rotate as the outside handle is actuated. Secure the locknut after adjustment is complete.
4. Close the lower door without closing the upper door. Completely close the latch, checking to assure safety latch has engaged (inside handle will not open without pushing release button). Check the latch plate spacing on both sides of the door by looking between the door and frame. Ascertain that there is at least 1/16" clearance between the shoulder on the latch pawl and the latch plate and that the pawl is completely engaged to the top of the latch plate notch. The latch plate clearance can be changed by changing the number of washers between the latch plate and the door frame. The pawl engagement can be adjusted by loosening the latch plate screws and sliding the plate vertically. The adjustment of the door "pull in" should be made simultaneously with the engagement adjustment. This can be done by sliding the latch plate horizontally until the door pulls in so that the door skin is flush with the fuselage skin. Retighten latch plate screws securely to hold adjustments. After the last latch adjustment is made, close the door and recheck latch operation and pawl engagement.

5. The door safety pin to pin receptacle clearance should be 1/16". This is checked by closing the bottom door until the latch pawls snap into the latch plates. Do not rotate handle to "lock" position. Look between rear of door and door frame to see distance between the tip of the safety pin and the pin receptacle. If this distance is not correct, adjust the pin actuator rod, inside the door, to obtain the correct setting. Rotate the door handle to full closed position to check safety pin operation.
6. The door ajar warning switches should be adjusted to turn out the warning light just as the latch pawls contact the end of the slots in the latch plates. To accomplish this, turn the adjustment screws (located under both latch plates) counterclockwise until the light goes out when the door is closed; then fine trim each switch individually. Turn one switch adjustment screw clockwise one turn at a time until the light will not go out as the latch is closed; then turn this screw one turn counterclockwise and check that light goes out. Fine trim the other switch in the same manner. Open and close the door several times watching the operation and indicator to ascertain that all latch and indicator parts operate properly.

PILOT DOOR.

REMOVAL OF PILOT DOOR. (Refer to Figure 52-2.)

1. Remove the bolt securing the support assembly to the bottom of the door.
2. Remove hinge pins from upper and lower hinges and carefully pull door away from the fuselage.

—NOTE—

Do not remove the serrated bushings from the door hinge brackets unless in need of replacement. These bushings are either concentric or eccentric in construction and must be replaced with the same type. (Refer to Parts Catalog for appropriate part numbers.)

INSTALLATION OF PILOT DOOR. (Refer to Figure 52-2.)

1. Carefully position the hinges onto the door hinge brackets and insert the hinge pins.
2. Prior to connecting the door support assembly, operate the door latching mechanism to determine if there is a flush fit between the outer skin of the pilot door and the fuselage.

—NOTE—

If the fit is not flush, it will be necessary to remove the door and rotate the serrated door hinge bushing or bushings to obtain hinge center line location that will provide proper door fit.

3. Attach the support assembly to the door.

WEATHERSTRIP INSTALLATION AND SEALING INSTRUCTIONS OF PILOT DOOR.

To obtain an acceptable seal on the pilot door, the seal must apply equal pressure all the way around the striker. This is accomplished in the following manner:

1. Apply EC 1300L cement to seal and mitered joints.
2. Install one piece of seal 87.00 in. from the forward corner up around to the aft lower corner of the door and a piece 38.5 in. along the lower surface of the door.
3. If necessary, use shims (neoprene PMS G0020-1-22) behind the seal to obtain equal pressure and adequate sealing. Neoprene 0.125 thick, Piper P/N 187-361.
4. The striker and water path must be free of any sealant and foreign matter.
5. Install two pieces of clear plastic tubing 1/8 in. OD., 5 in. long covered with a film of seal glyde or Dow Corning lubricant.
6. Insert tube approximately 3 in. into the sealing bead of the striker prior to the sealing operation.
7. Remove all sharp edges from striker joints.
8. Fill in all irregular surfaces contacting the door seal with sealant.
9. Check to see that the latch plate on aft side of door frame extends only to center line of striker bead and all edges are smooth to prevent tearing of seal.
10. Fill the empty space behind the forward and aft lower corner fillets of the door frame with sealant to prevent water passing behind these plates to the aircraft interior.
11. Seal the area between the scuff plate, bulkheads, outer skin and bulkheads with PRC 1221B-2 or MIL-S-7505C and smooth with a non-metallic tool.
12. Remove the two pieces of tubing prior to checking for leaks.
13. To check for open water path, funnel small amounts of water into the gap between the pilot door and aircraft skin.

—NOTE—

The water should flow freely from the water path at forward and aft corners of door.

14. Gradually increase the volume of water until water flows from the gap it is being funneled into.
15. A person inside the aircraft can ascertain the sealing of the door.

—NOTE—

It is not a recommended check to place large volumes of water over the aircraft exterior when specifically checking for door seal leaks, as a window leak could appear as if the door seal was leaking.

—CAUTION—

The pilot door should not be opened from outside after performing the leak check, as water standing on the scuff plate may have fallen from the overhead seal. However, when opened from inside it can be determined if the door is sealing satisfactorily.

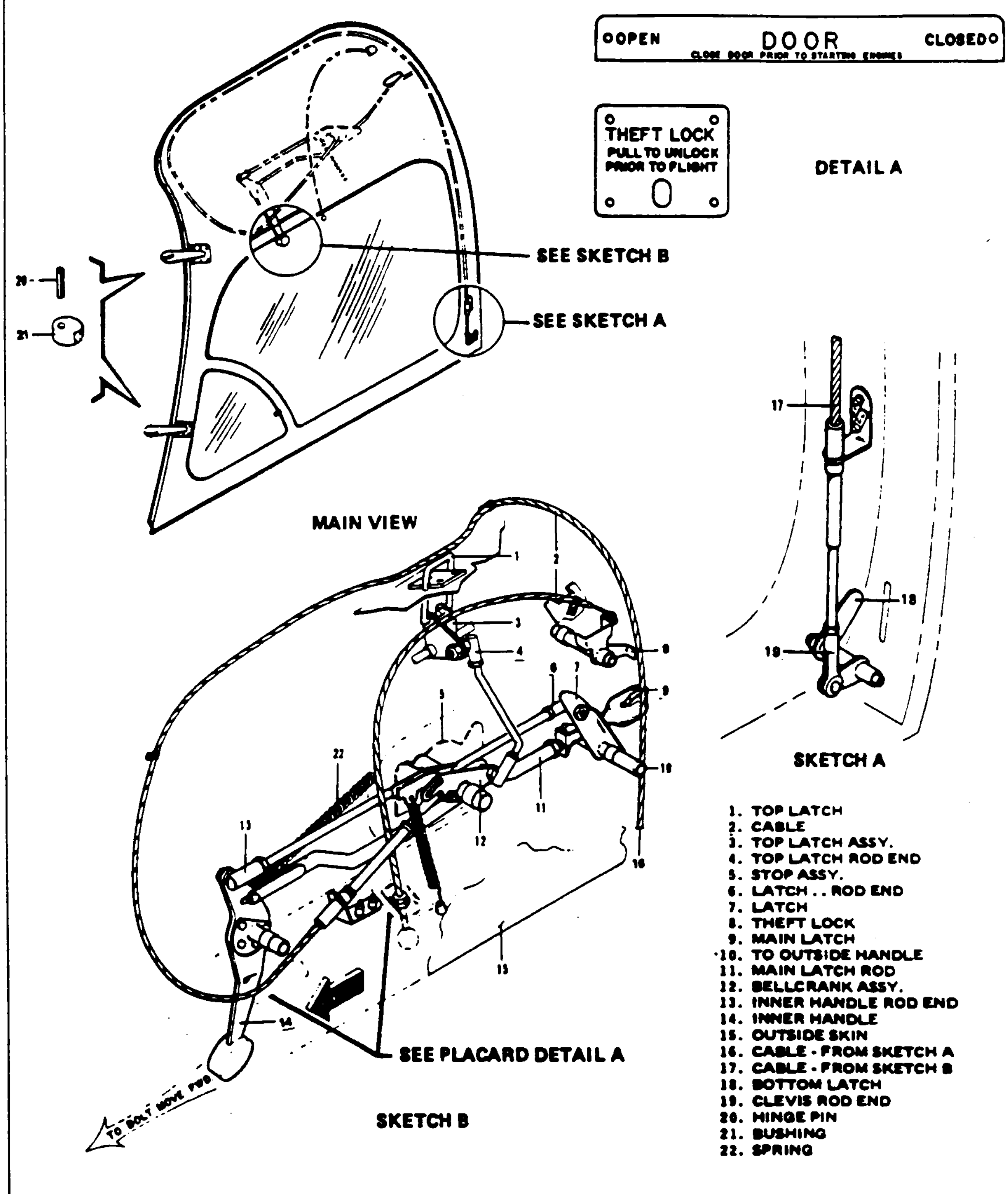


Figure 52-2. Pilot's Door Latch Assembly

16. The following may be used as an alternate to PRC 1221-2B Product Research Co. (GE RTV-102 silicone weather ban 101) and alternate for EC 847 is (EC 750 Carbolene Neoprene #F1) (1300L per PMSC 10022-4).
17. Door seal (Piper P/N 486 089) is used in all aircraft which have a pilot's door installed.

—NOTE—

Seal P/N 486 089 may be stretched to reduce size to assist door sealing, provided complete all-around seal is maintained.

ADJUSTMENT OF PILOT DOOR. (Refer to Figure 52-2.)

1. Remove trim panel from pilot's door to gain access to the latching mechanism. Open the door and engage the support assembly.
2. The outside door handle must be parallel with the airplane axis when the handle is in the fully bolted position. The following steps will accomplish this.
   A. Disconnect the rod end connected to the latch.
   B. Loosen the locknut on the latch rod end and rotate the rod end to adjust the outside handle to its proper position.
   C. Connect the rod end to the latch and tighten the locknut.
3. With the handle in the fully bolted position, adjust the bottom latch to obtain the maximum possible travel by adjusting the clevis rod end.
4. The top latch should be adjusted to obtain the best fit between the top of the door and the fuselage skin when the door is closed and bolted. This is accomplished by adjusting the top latch rod end.
5. Install the interior trim panels.

EMERGENCY EXIT.

EMERGENCY EXIT WINDOW.

Removal and installation of the emergency exit window glass is the same as that given for side windows.

EMERGENCY EXIT WINDOW MECHANISM ADJUSTMENT.

Adjustment is made by adjusting two turnbuckles which are located on either side of the emergency exit window frame.

1. Remove the trim panel from between the first and second windows by removing the screws at the panel as well as along the aft side of the first window molding.
2. Remove the trim panel from between the second and third windows by removing the screws that secure the release handle molding and then the screws that secure the trim panel. Pull the panel from the wall.

3. Adjust the turnbuckles of the cables to allow all four latches to position themselves at the same angle to the window channel. Tighten turnbuckles as required to snug up the cables. Move the handle through its full travel to ascertain that the latches move below the surface of the window channel and will also move to the other direction past 90 degrees to the channel. Safety turnbuckles.
4. If removed, reinstall the window frame to the fuselage frame.
5. Check that the window latches are engaged in the window frame by removing the two small plugs in the top and bottom of the molding and ascertaining that the latches are visible at approximately 90 degrees to the frame.
6. Install the trim panels on each side of the emergency exit and secure with screws. Install release handle molding and cover.

CARGO.

CARGO DOOR.

REMOVAL OF CARGO DOOR. (Refer to Figure 52-3.)

—NOTE—

Both upper and lower cabin doors must be open prior to removing the cargo door. Disconnect door support.

1. Remove the lock pin holding the upper and lower cable assemblies together on the right side of the cabin entrance door. Position the clevis of the lower cable assembly onto the eye bolt located directly below the cargo door and insert the lock pin.
2. Disconnect the door support from the door.
3. Pull the door latch full out. Cut and remove hinge pin and pull the door away from the fuselage.

INSTALLATION OF CARGO DOOR. (Refer to Figure 52-3.)

1. Position door and align hinges. Insert new hinge pin and bend both ends.
2. Attach door support assembly to door.
3. Operate the door latch to determine the latch pins engage properly.
4. Remove the clevis securing the lower cable to the eye bolt. Connect the upper and lower cable assemblies together by means of the lock pin attached to the lower cable assembly.

CARGO DOOR LATCH ASSEMBLY.

REMOVAL OF CARGO DOOR LATCH ASSEMBLY. (Refer to Figure 52-3.)

1. Remove bottom trim panel of cargo door.
2. Using access holes in cargo door, locate and remove spring retainer plate and spring.
3. Remove cotter pin and clevis pin securing rod assembly and link to the door latch.
4. Remove bolt, bushing and washer securing the door latch and remove it from its recess.
5. The rod assembly and link with latch pins attached may now be removed from the door.

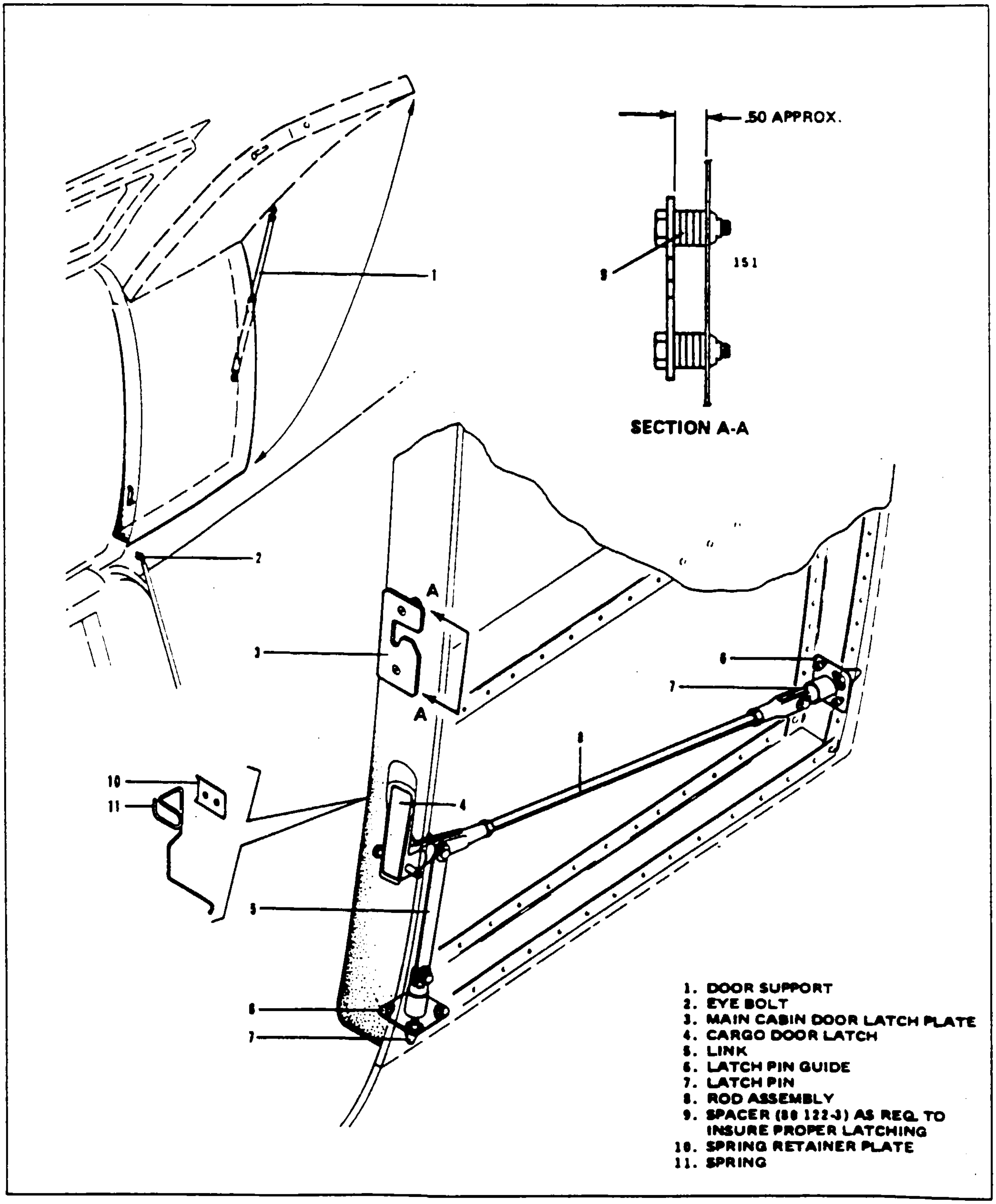


Figure 52-3. Cargo Door Latch Assembly

INSTALLATION AND ADJUSTMENT OF CARGO DOOR LATCH ASSEMBLY. (Refer to Figure 52-3.)

1. Adjustment of the latch assembly is limited to determining that the distance between the center line of the hole in the clevis at end of the rod assembly is 13.88 inches. Securely tighten the locknuts to maintain this dimension.
2. Position the door latch in its recess in the door frame and secure with bolt, bushing and washer.
3. Insert the latch pins on rod assembly and link through their respective guides in the side and bottom door frame.
4. Place the free end of the rod assembly over the end of the handle. Place the free end of the link adjacent to the clevis on the side toward the outer skin. Align the holes and insert the clevis pin, washer and cotter pin.
5. Place the hook end of spring between the clevis and the washer. Secure the other end of the spring in position with retainer plate.
6. With installation complete, operate the door latch to determine the latch pins move in and out of the pin guides smoothly.

WING LOCKER DOORS. (Refer to Figure 52-4.)

The only service required is maintaining a tight fit between the door and door frame. This is accomplished by adjusting the catch assembly. Loosen the attaching screws and move the catch to obtain the desired fit, then retighten the screws.

FORWARD BAGGAGE DOOR.

REMOVAL OF FORWARD BAGGAGE DOOR.

1. With door open and hinges exposed, loosen door support, and then remove the cotter pins and washers from the hinge pins.
2. While supporting door, remove the hinge pins and lower the door for removal.

—NOTE—

When removing the forward baggage door disconnect the baggage door light switch from the electrical system to prevent draining of the battery.

INSTALLATION OF FORWARD BAGGAGE DOOR.

1. While supporting door, align the hinges in the hinge bracket assemblies and insert the hinge pins.
2. Replace the washers and insert the cotter pins into the ends of the hinge pins.

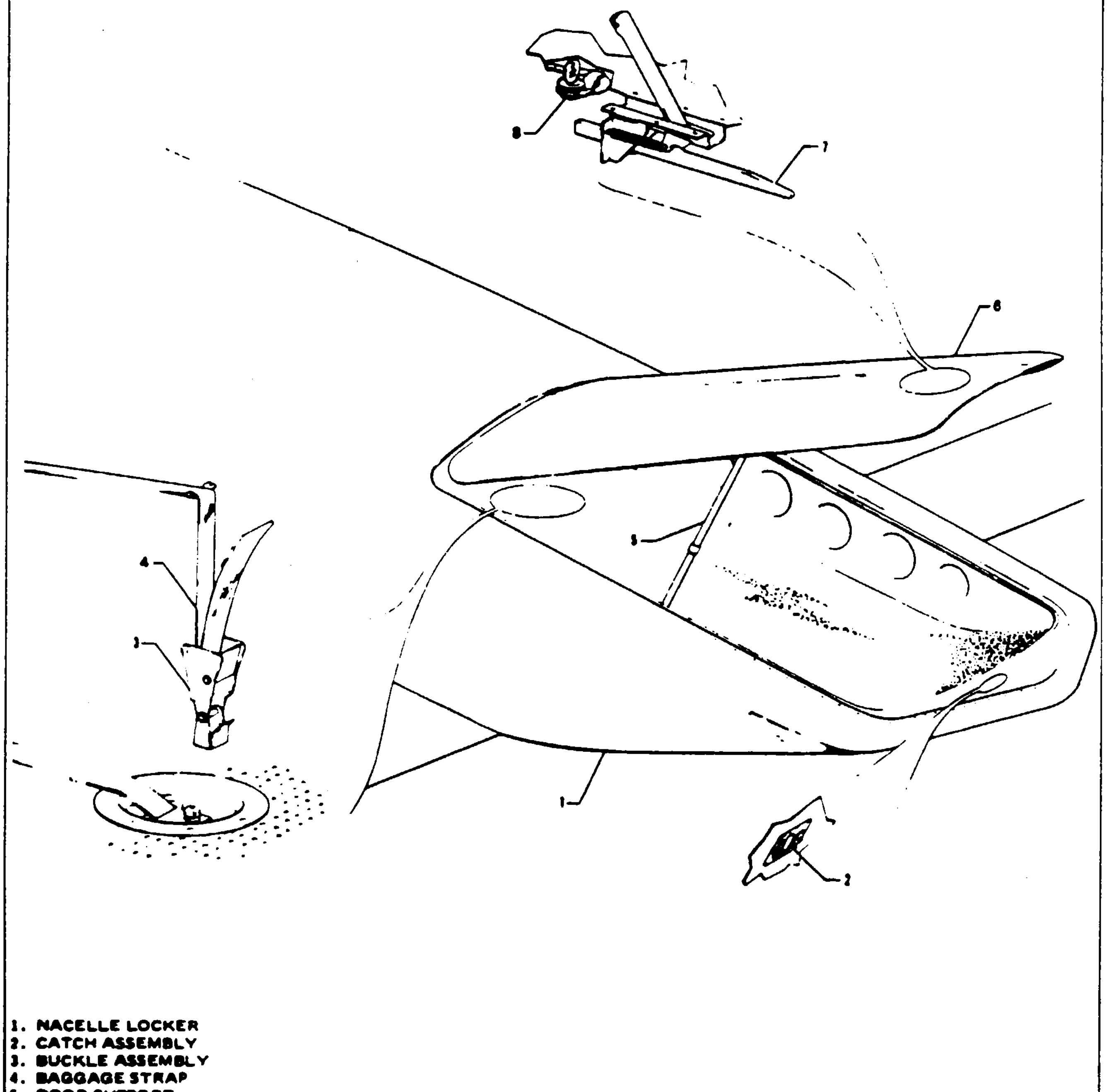
FORWARD BAGGAGE DOOR LATCH ASSEMBLY.

REMOVAL OF FORWARD BAGGAGE DOOR LATCH ASSEMBLY.

1. Removal procedure for forward baggage door tube and arm assemblies is as follows:
   A. With the door open, remove the six machine screws holding the inside cover and remove the cover from door assembly.
   B. Disconnect the spring between the link and tube assembly. Also remove two other springs located on either side of the tube assembly to the baggage door assembly.
   C. Remove the roll pin, located between the tube assembly and door handle. Also remove the spring link at this time.
   D. Remove six machine screws (three on each end) holding the arm assemblies to the door assembly and remove the tube with both arm assemblies from door.
   E. The arm assemblies can be removed from the clevis end of the tube by removing the cotter pins, washers and pins.
2. Removal procedure for forward baggage door handle assembly is as follows:
   A. Disconnect roll pin located between the tube assembly and the handle if not previously done.
   B. Remove six locknuts and machine screws holding the handle and bracket and remove from door assembly.
   C. The handle can be removed from the bracket by removing the cotter pin, washers and pin.
3. Removal procedure for forward baggage door key lock assembly is as follows:
   A. Remove two screws from the outside of the door to disconnect the lock guide plate assembly located on the inside of door.
   B. The key lock assembly can now be removed by removing the retaining nut and washer from the back of the key lock assembly.

INSTALLATION OF FORWARD BAGGAGE DOOR LATCH ASSEMBLY.

1. Procedure for installing the key lock assembly is as follows:
   A. Insert the key lock assembly from the back side of door with the latching arm towards the handle cut out on door.
   B. Replace the washer and retaining nut to back of lock and secure.
   C. Install lock guide plate and secure with two screws from outside of door.
2. Procedure for installing baggage door handle assembly is as follows:
   A. The handle and bracket can be assembled if previously taken apart by placing handle into bracket with two washers between handle and bracket and inserting the roll pin.
   B. Replace the handle and bracket assembly into the back of the door with the handle to the outer skin of door. Secure assembly with six machine screws and locknuts.
   C. If tube assembly was not removed, replace the roll pin between the tube assembly and handle and also replace the spring link. Secure with roll pin.



1. NACELLE LOCKER
2. CATCH ASSEMBLY
3. BUCKLE ASSEMBLY
4. BAGGAGE STRAP
5. DOOR SUPPORT
6. LOCKER DOOR
7. DOOR LATCH
8. LOCK ASSEMBLY

Figure 52-4. Nacelle Wing Locker Latch Assembly

3. Installation procedure for baggage door tube and arm assemblies is as follows:
   A. Secure the arm assemblies to the clevis ends on the tube assembly with pins, washers and cotter pins. Be certain that the proper arm assembly is on each end of tube.
   B. The complete tube and arm assembly can now be placed onto the rear of the door, making certain that the projection on the tube aligns with the projection on the handle. Replace the six machine screws (three on each end) to hold the arm assemblies to the door.
   C. With all holes in both projection and the spring link aligned, insert the roll pin.
   D. Connect the three springs at this time. One between the spring link and the tube, and two between the tube assembly and the door assembly.
   E. Adjustment should be made at this time before replacing cover. Use the six machine screws to secure the cover on the door assembly.

ADJUSTMENT OF FORWARD BAGGAGE DOOR LATCH.

Adjustment is done through the removal of the cover and adjustment of two clevis fittings located at the ends of the tube assembly.

1. Remove the cotter pin, washer and pin from the clevis and arm assemblies and loosen the locknuts between clevis and tube.
2. With handle in the closed position, turn the clevis in or out to get the arms of the arm assemblies to extend out at a 90 degree angle to the edge of the door assembly.
3. When the adjustment is completed, tighten the locknuts and reconnect the clevis and arm assemblies with the pins, washers and cotter pins. Replace the cover and secure with six machine screws.

DOOR WARNING.

DOOR AJAR SWITCHES.

REMOVAL OF DOOR AJAR SWITCH (CABIN DOOR).

The switch is located in the upper half of the cabin entrance door.

1. Remove the screws that hold the trim molding and safety catch to the upper door molding. Remove the molding.
2. Disconnect the two wires connected to the switch and mark them for positive identification when switch is reinstalled.
3. Remove the two locknuts, washers and bolts that secure the switch to the bracket on the door. The switch can now be removed.

INSTALLATION OF DOOR AJAR SWITCH (CABIN DOOR).

1. Install the switch in door and secure to bracket with two bolts, washers and locknuts.
2. Connect the two wires to the switch, in their proper place.
3. Replace the trim molding and safety catch. Secure with proper screws.

ADJUSTMENT OF DOOR AJAR SWITCH (CABIN DOOR).

There is a spring striker plate located on the lower half of the entrance door that can be adjusted to obtain the proper indication of the door condition.

1. Close both the upper and lower halves of the cabin entrance door and lock.
2. Apply pressure from inside the door and press the safety latch button. Pull the inner handle to unlock the door. The ajar switch should activate before the doors are completely unlatched. Make certain that the switch activates before the handle has reached a 90 degree position to the door.
3. Remove the trim cover over the end of the strap handle on lower door and loosen the screw holding the spring striker plate. Slide the plate to get the proper indication of ajar switch.
4. When adjustment is satisfactory, tighten the screw holding the striker and replace the trim cover over the end of the strap handle.

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CHAPTER

53

FUSELAGE

CHAPTER 53- FUSELAGE

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53-00-00	GENERAL	4B23	
53-00-01	Description	4B23	

GENERAL.

This chapter contains information pertinent to the fuselage structure. The fuselage assembly contains compartments to house the nose landing gear, forward baggage, avionics, crew and passengers. Attachment points are provided for the wings, cabin door, cargo door and empennage.

DESCRIPTION.

The fuselage is an all metal semi-monocoque structure with a maximum cross sectional dimension of 63.0 inches in height and 46.0 inches in width. The overall length of the fuselage, including tail cone, is 380.75 inches. The fuselage is constructed of bulkheads, stringers, stiffeners and longitudinal beams, all of which the outer skin is riveted to. Windows include a two piece windshield and six windows along each side. The four forward windows are double pane while the aft or triangular shaped window is a single pane. A storm window is located in the forward lower section of the pilot's side window and when the latch at the lower side is released, the window will swing in and forward. A 23 by 30 inch emergency exit is an integral part of the second right window and is jettisonable when the release just aft of the exit is pulled. The cabin entrance door is located on the left side of the fuselage just aft of the wing. The door separates at the middle with the upper half swinging upward and the lower half swinging down to provide cabin entrance steps.

Optional features include a pilot's door and cargo door.

The pilot's door is located adjacent to the pilot's seat and permits rapid entrance to or exit from the cockpit without the necessity of going the full length of the cabin.

The cargo door is located immediately aft of the cabin entrance door. This door swings up but only after the cabin entrance door has been opened. This door permits rapid loading and storage of cargo and also facilitates loading items normally too bulky to pass through the cabin entrance door.

All components are completely zinc chromate primed and exterior surfaces are coated with polyurethane enamel.

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CHAPTER

55

STABILIZERS

CHAPTER 55 - STABILIZERS

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GENERAL.

The stabilizers consist of the vertical stabilizer (fin), rudder with trim tab, horizontal stabilizer, and elevator with trim tab. The control surfaces are cable controlled, and are statically balanced.

CONTROL SURFACE BALANCING.

CHECKING CONTROL SURFACE BALANCE.

The movable control surfaces have been balanced at the time of installation at the factory and normally need not be rebalanced unless the surfaces have been repainted, repaired or replaced. Each control surface must be complete including paint, trim tab where required, balance weights, static wicks, etc. Tabs must be held in neutral position with a small piece of tape. Tab actuating rods must be in place and connected to the tab. The forward end of the actuating rods must be disconnected from the attachment points. Disconnected actuating rod (forward ends) must be positioned to correspond to the neutral tab position.

BALANCING EQUIPMENT.

Balancing must be done using test weights (if required) called for in the text for each surface. Any control surface being balanced must be removed from the aircraft and placed in a test fixture (jig) as shown in Figures 55-2 and 55-4. The balancing must be accomplished in a draft free area and in a manner which allows unrestricted movement of the control surface.

BALANCING DEFINITIONS.

The following is a list of balancing definitions as used in this maintenance manual:

1. Master Test Weight: A fabricated tool temporarily attached to the control surface to determine when the surface is at its lower static balance limits.
2. Balance Weight: Weight attached permanently to a control surface to produce a static hinge moment within the required range (such as 30 inch-pounds ± 10 inch-pounds trailing edge heavy).
3. Trailing Edge Heavy: Positive static hinge moment; trailing edge of the surface moves downward when released from a neutral position.
4. Leading Edge Heavy: Negative static hinge moment; leading edge of the surface moves downward when released from a neutral position.
5. Master Test Weight Arm: Perpendicular distance between the control surface hinge line and the point of application of the master test weight.
6. 0.1 Pound Test Weight: Small weight added to the master test weight during balancing procedure when the surface is trailing edge heavy with the basic master test weight installed.
7. Trim Weight: Small weight or weights added to the surface balance weight to bring the surface within tolerances. (Sometimes required depending on variations in surface construction.)

HORIZONTAL STABILIZER.

REMOVAL OF HORIZONTAL STABILIZER. (Refer to Figure 55-1.)

1. Remove the left and/or right elevator assemblies per Chapter 55.
2. Remove the access plates located on each side of the fuselage under the horizontal stabilizers and the panel located on top of the fuselage aft of the vertical fin.
3. Remove the access panel to the aft inside section of the fuselage.
4. To remove the right stabilizer, locate the elevator trim cable turnbuckles in the aft section of the fuselage, mark the ends of one turnbuckle to facilitate reinstallation, and block the cables at one of the fuselage bulkheads and in the stabilizer to prevent the trim cables from unwinding.
5. Disconnect the trim cables.
6. Through the top access hole, remove the two elevator trim cable pulleys, spacer and bolt. Draw the cables through the fuselage to this point.
7. Disconnect the elevator trim sender wires and deicer lines.
8. Remove the mounting bolts that attach the front spar to the fuselage bulkhead.
9. Remove the mounting bolts that attach the elevator torque tube hinge bracket and rear spar.
10. Pull the stabilizer directly away from the fuselage.

INSTALLATION OF HORIZONTAL STABILIZER. (Refer to Figure 55-1.)

1. Trial fit to ascertain gap between stabilizer and fuselage skin surface is .187 of an inch. Trim to obtain this gap.
2. Ascertain that the sealer extrusion is attached to the inboard side of the elevator.
3. Put the stabilizer in position and align the front and rear spar mounting holes. If installing a right stabilizer, guide the elevator trim cables and sender wires into the fuselage.
4. Position the elevator torque tube hinge bracket and temporarily install the rear spar mounting bolts.
5. Install the front spar mounting bolts, washers and nuts. Do not torque at this time.
6. Check to determine if a gap exists between the web area of the rear spar and the aft bulkhead of the fuselage. Should a gap exist, it may be necessary to use a shim plate to fill this gap. To obtain proper shim thickness, insert a feeler gauge between the spars of both stabilizers and the bulkhead. (Flat shims are available in thicknesses of .032, P/N 43709-02; .064, P/N 43709-03; .091, P/N 43709-04. Also, tapered shims are available in .064, P/N 43713-02 and .091, P/N 43713-03.)
7. With the correct shim determined (only one shim plate is allowed and cannot exceed .091 thickness), loosen the forward spar attaching bolts and remove the rear mounting bolts. Slide the shim between the spar and rear bulkhead and reinsert bolts.
8. Tighten all mounting bolts.
9. If the right stabilizer was removed, enter through the top access hole and route the trim tab control cables forward and install cable pulleys.
10. Connect the trim sender wires.
11. Connect the trim cable ends and set cable tension. (Refer to Chapter 27.)
12. Install the elevator(s) assemblies per Chapter 55.
13. Check elevator trim and elevator operation. (Refer to Chapter 27 for the rigging and adjustment of elevator and elevator trim controls.)
14. Install all access plates and panels.

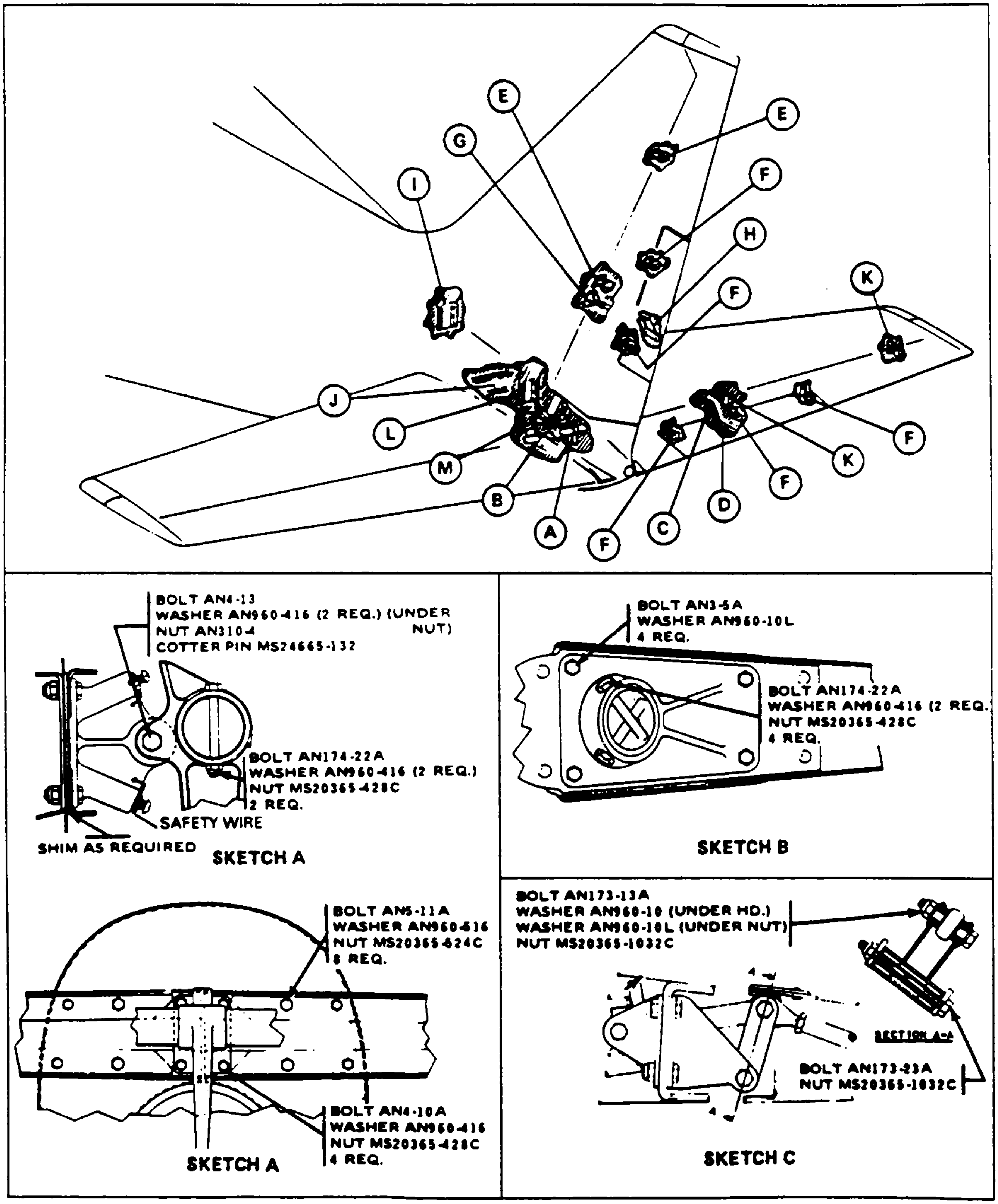

Figure 55-1. Empennage Installation

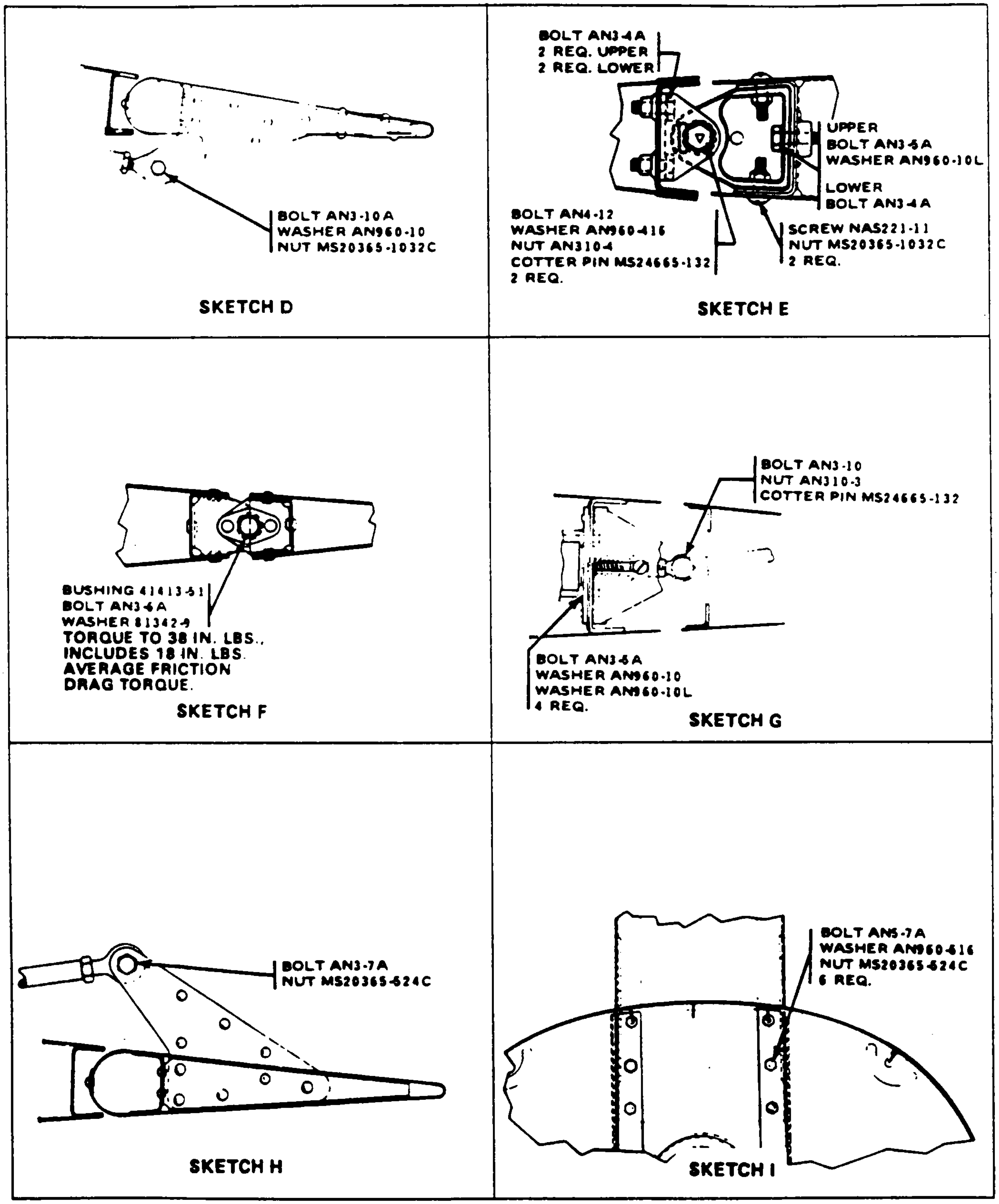

Figure 55-1. Empennage Installation (cont.)

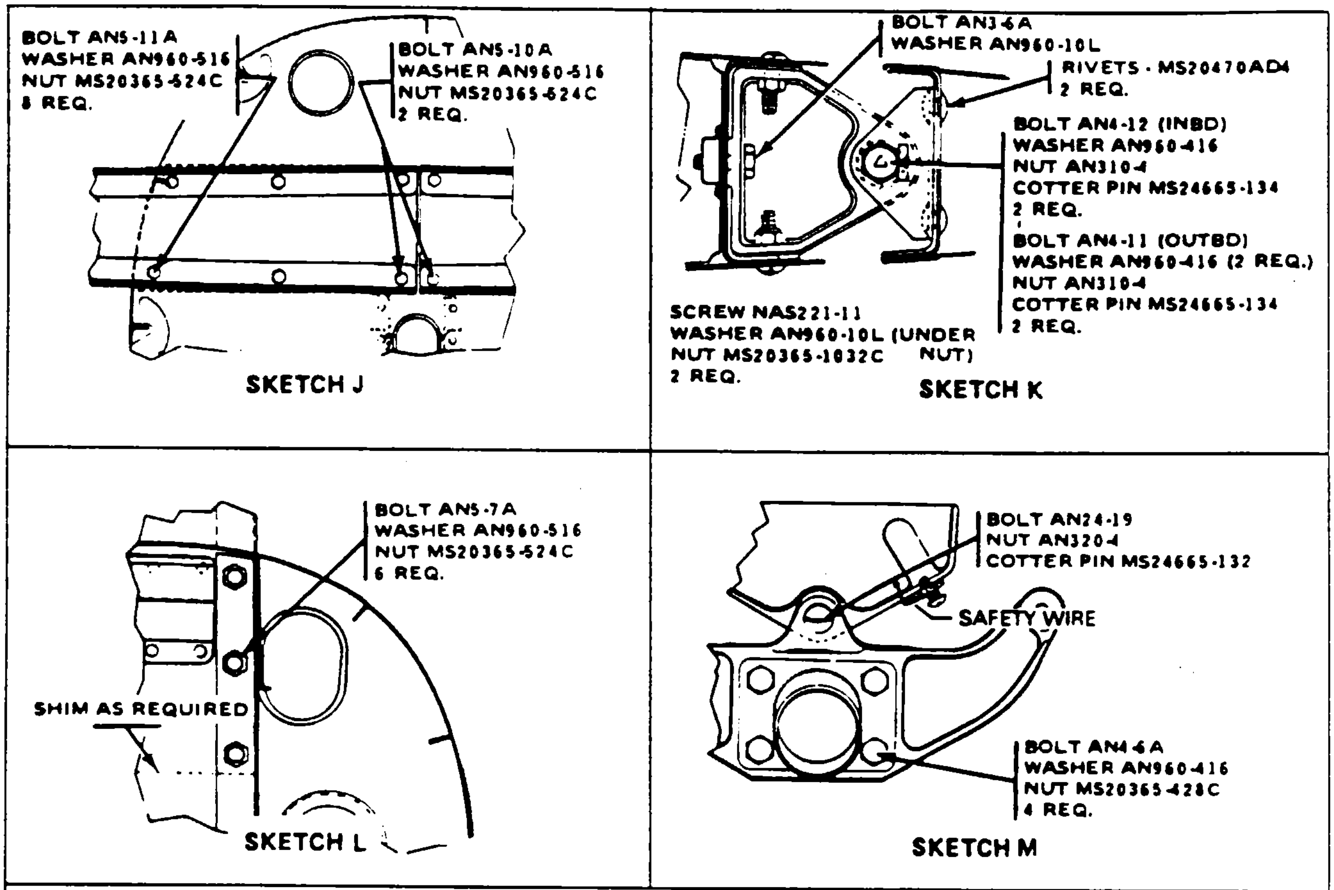

Figure 55-1. Empennage Installation (cont.)

ELEVATOR.

REMOVAL OF ELEVATOR. (Refer to Figure 55-1.)

1. Remove the screws that attach the fuselage tail cone, pull the cone back far enough to disconnect the navigation light wires and then remove the tail cone.
2. At the right elevator, disconnect the trim tab control rod.
3. Remove the bolts that attach the elevator torque tube bracket to the elevator.
4. Remove hinge bolts and move elevator aft. Disconnect the ground wires.
5. To remove the elevator torque tube assembly, after the elevators have been removed, disconnect the elevator push-pull rod at the control arm.
6. Remove the hinge bolt and separate the torque tube assembly from its mating hinge bracket.

INSTALLATION OF ELEVATOR. (Refer to Figure 55-1.)

1. Place the elevator torque tube assembly in position with its mating hinge bracket.
2. Install hinge bolt assembly, torque and safety.
3. The elevator push-pull rod may be connected to the arm of the torque tube assembly.
4. Place the elevator in position, install bolt assembly and torque.
5. Install bolts attaching the torque tube bracket and elevator. Ascertain that the elevator halves align and tighten bolts (use a protractor to check the angle between elevators).
6. Insert the elevator trim tab control rod through the right elevator and secure in position. Torque bolt.
7. Check elevator and tab for proper operation and travel. (Refer to Chapter 27 for rigging.)
8. Connect the navigation light wires and place the tail cone assembly in position. Start all screws with washers and then tighten.

REMOVAL OF ELEVATOR TRIM TAB. (Refer to Figure 55-1.)

1. Disconnect the control rod at the tab.
2. Remove the hinge bolts securing the tab.

INSTALLATION OF ELEVATOR TRIM TAB. (Refer to Figure 55-1.)

1. Place the trim tab in position, install bolts and torque.
2. Position the tab control rod, install bolt and torque.
3. For rigging and adjustment refer to Chapter 27.

CHART 5501. ELEVATOR BALANCE WEIGHT

	Elevator Part No. 54232-35
Master Test Weight Lbs.	9.70
Master Test Weight Arm in Inches	8.28
Maximum No. of 0.1 Lb. Test Weights Allowed	11
Trim Weight Part No.	43332
Maximum No. of Trim Weights Allowed Per Surface	2 per Anchor Nut
Allowable Balance Weights plus Trim Weight	1.60
Balance Limits Inch-Pounds	90 +0 -10

ELEVATOR BALANCING PROCEDURE. (Refer to Figure 55-2.)

1. Remove the complete (both halves) elevator assembly from the airplane. The complete assembly including trim tab and actuating rod must be assembled and placed on a balancing jig.
2. Fabricate a test weight in accordance with specifications in Chart 5501.
3. With the elevators assembled and mounted in the jig, establish a horizontal reference mark which aligns with the trailing edge of the elevator when held in a level position (chord line level). Ascertain that the assembly rotates freely with no binding at knife edges.
4. Hang the fabricated master test weight in the tool hole of the elevator counterbalance rib assembly part number 43745. Check the master test weight arm location as shown on Figure 55-2 and specified in Chart 5501.
5. If the elevator is balanced (trailing edge aligns with reference mark) with just the master test weight, the surface is at the minimum static limit per Chart 5501 and is satisfactory.
6. If the elevator is leading edge heavy, balance weight material must be removed to produce a balanced condition with the master test weight in place. Remove trim weights part number 43332 first, if installed; then remove material from the main balance weight. Remove material or trim weights evenly from both sides.
7. If the elevator is trailing edge heavy with just the specified master test weight installed, then it must be determined that elevator does not exceed the maximum static limits per Chart 5501.

8. Add individual 0.1 pound test weights to master test weight until the elevator balances. If the number of 0.1 pound test weights does not exceed the maximum allowed per Chart 5501, the elevator is within the static balance limits.
9. If the number of 0.1 pound test weights added to the master test weight exceeds the maximum allowable, the elevator balance exceeds the maximum and trim weights must be added to the surface balance weights, equally to each side, to produce a balanced condition. Ascertain that the number of trim weights added does not exceed the maximum amount as stated in Chart 5501.

ELEVATOR CONTROL SYSTEM FRICTION MEASUREMENT.

The complete control system including Autopilot, if installed, must be checked to determine the total friction. The system must be rigged to its proper travels and cable tensions prior to determining the total friction.

The total friction must not be in excess of six pounds with the bungee spring adjusted to 37 ± 1 pounds. The following procedure will let you determine the actual frictional value of the system:

1. Attach a spring scale to the inboard trailing edge of the elevator as shown in Figure 55-3.
2. With the spring scale attached, position the elevator trailing edge down approximately 2 inches from the neutral position.
3. Record the force (see Note 2) required to raise the elevator through the neutral position until the trailing edge is approximately 2 inches above neutral.
4. Record the restraining force lowering the elevator from the 2 inch up position through the neutral position to the original 2 inch down position.
5. Repeat above raising and lowering processes until average forces are obtained.
6. The "Total Friction" is obtained by subtracting the two forces.

—NOTES—

1. Do not exceed 60 pound force for any measurement.

2. The elevator shall be rotated with a steady movement and the force reading taken when the elevator is passing through the neutral position. Do not stop rotation when taking the reading.

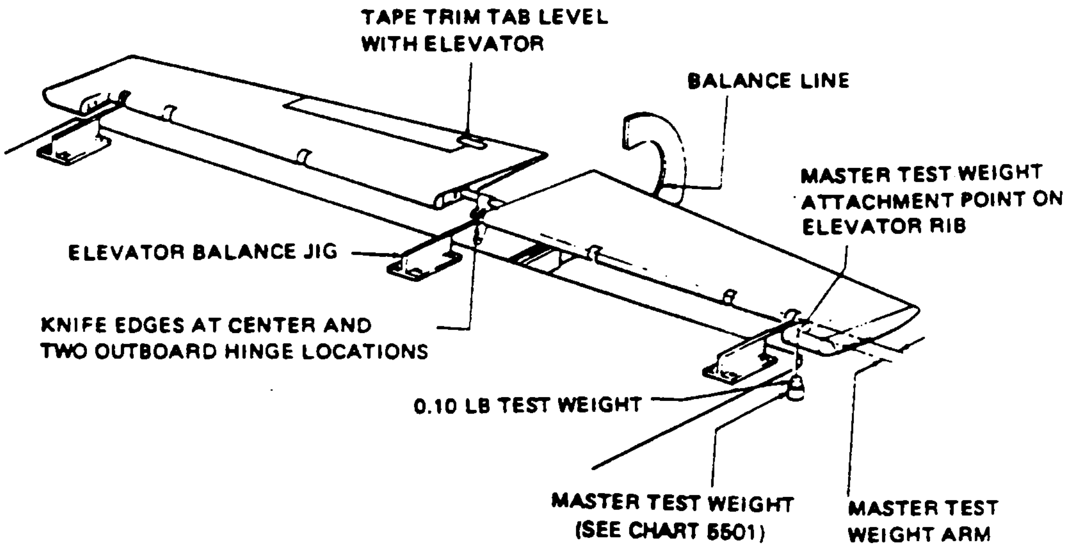

Figure 55-2. Elevator Balancing

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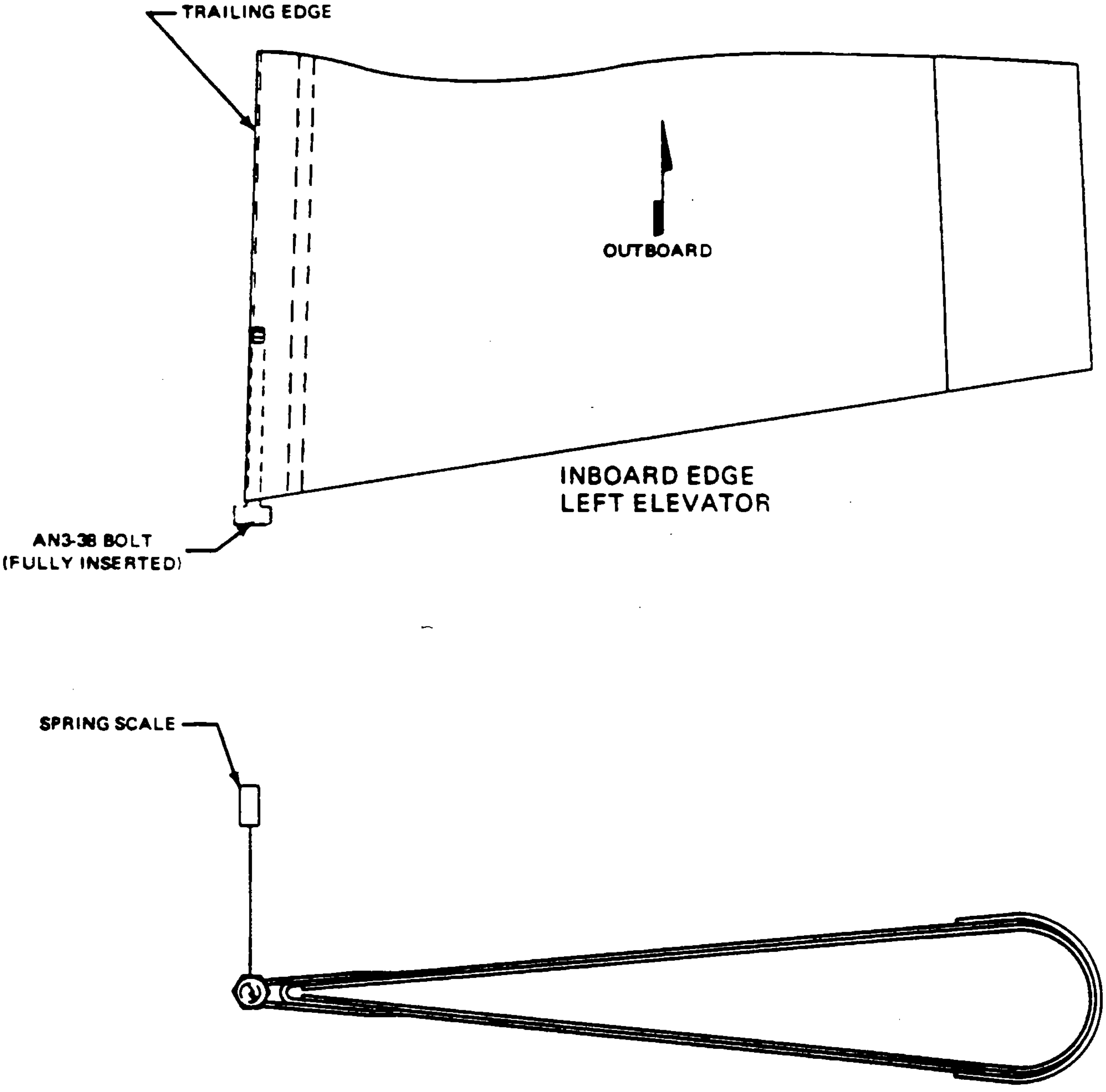

Figure 55-3. Friction Measurement

VERTICAL STABILIZER.

REMOVAL OF VERTICAL STABILIZER. (Refer to Figure 55-1.)

1. Remove the air intake fairing which is a portion of the dorsal fin.
2. Disconnect the rotating beacon wire, rudder tab sender wires, radio antenna cable and deicer line.
3. Disconnect the antenna wire from the top of the stabilizer.
4. Remove the access plates located on each side of the fuselage, under the horizontal stabilizer and the panel located on top of the fuselage, aft of the vertical fin. The tail cone may be removed if desired.
5. Remove the access panel to the aft inside section of the fuselage.
6. Remove the rudder.
7. Locate the rudder trim cable turnbuckles in the aft section of the fuselage, mark the ends of one turnbuckle to facilitate reinstallation and block the cables in the aft section of the fuselage and in the rudder to prevent the cable from unwinding.
8. Disconnect the trim cables.
9. Through the right fuselage access holes, remove the two sets of trim cable pulleys, spacers and bolts.
10. Remove the mounting bolts that attach the front spar to the fuselage bulkhead.
11. Remove the mounting bolts that attach the rear spar to the fuselage bulkhead.
12. Pull the stabilizer directly up from the fuselage.

INSTALLATION OF VERTICAL STABILIZER. (Refer to Figure 55-1.)

1. Trial fit to ascertain gap between stabilizer and fuselage skin is .187 of an inch. Trim to obtain this gap.
2. Ascertain that the sealer extrusion is attached to the lower side of the vertical stabilizer.
3. Install the rear spar mounting bolts and nuts temporarily.
4. Install the front spar mounting bolts, washer and nuts. Tighten, but do not torque at this time.
5. Check to determine if a gap exists between the web area of the rear spar and aft bulkhead of the fuselage. Should a gap exist, it may be necessary to use shim plates to fill this gap. To obtain proper shim thickness, insert a feeler gauge between the spar and bulkhead. (Use shim .032, P/N 43998-00, as required. Maximum of two.)
6. With the correct shims determined, remove the forward and rear spar attaching bolts. Move stabilizer up and aft to obtain enough room to place shim(s) between rear spar and bulkhead.
7. Slide shim(s) into place and install rear mounting bolts, washer and nuts.
8. If removed, position the lower rudder hinge bracket and install mounting bolts.
9. Reinstall the front spar mounting bolts.
10. Torque all mounting bolts.
11. Route the rudder trim cable forward and install the two sets of cable pulleys.
12. Connect the trim sender wires.
13. Connect the trim cable ends, remove cable blocks and set cable tension. (Refer to Chapter 27.)
14. Install the rudder.
15. Check rudder trim and rudder operation. (Refer to Chapter 27 for the rigging and adjustment of rudder and rudder trim controls.)
16. Install all access plates and panels.

RUDDER.

REMOVAL OF RUDDER. (Refer to Figure 55-1.)

1. Relieve cable tension from the control system by removing the floor panel to the left of the control pedestal and loosen one of the rudder cable turnbuckles.
2. Remove the access panel located on top of the fuselage, aft of the vertical fin.
3. With the control cable tension relieved, disconnect the control cable from the rudder horn.
4. Disconnect the rudder trim control rod.
5. Swing the rudder and remove the hinge bolts.
6. Pull the rudder back and up removing the unit.

INSTALLATION OF RUDDER. (Refer to Figure 55-1.)

1. Put the rudder in position, install and torque the hinge bolts.
2. Position the rudder trim control rod, install bolt and torque.
3. Connect the rudder control cables to the rudder horn.
4. Adjust the control cable turnbuckle previously loosened to obtain proper cable tension as given in Chapter 27, with the rudder and control wheels centered.
5. Check rudder for proper operation. (Refer to Chapter 27.)
6. Install fuselage and cabin access panels.

REMOVAL OF RUDDER TRIM TAB. (Refer to Figure 55-1.)

1. Disconnect the control rod at the tab.
2. Remove the hinge bolts securing the tab.

INSTALLATION OF RUDDER TRIM TAB. (Refer to Figure 55-1.)

1. Place the trim tab in position and secure with bolts and bushings.
2. Attach the tab control rod.
3. Refer to Chapter 27 for adjustment and rigging.

RUDDER BALANCING PROCEDURE- (Refer to Figure 55-4.)

1. Remove the rudder from the airplane.
2. Place the rudder horizontally on the balance jig.
3. Fabricate a master test weight per specifications given in Chart 5502 and hang it in the existing tool hole in the rudder counterbalance channel, part number 40045. Ascertain that the tool hole is located to provide the proper master test weight arm as shown in Figure 55-4 and specified in Chart 5502.
4. If the rudder balances with just the specified master test weight, the surface is at the minimum static limits per Chart 5502 and is satisfactory.

5. If the rudder is leading edge heavy with the master test weight installed, trim weights (if installed) or material must be removed from the surface balance weight until a balanced condition is obtained. This would also result in the lower static limit.
6. If the rudder is trailing edge heavy with the master test weight installed, it must be determined that the rudder does not exceed the maximum static limits per Chart 5502.
7. Add individual 0.1 pound test weights to the master test weight until the rudder balances. If the number of 0.1 pound test weights added does not exceed the maximum allowable per Chart 5502, the rudder is within the static limits.
8. If the number of 0.1 pound test weights added to the master test weight to balance the rudder exceeds the maximum allowable per Chart 5502, the rudder balance exceeds the static limits and trim weights must be added to the rudder to produce a balanced condition. (Refer to Chart 5502 for the trim weight part number and the maximum amount allowed for the particular rudder assembly being balanced.)

—NOTE—

During this procedure, the master test weight must carry no more than the maximum number of 0.1 pound test weights as called out in Chart 5502.

10. For rudder assembly, part number 40046-38, the trim weights are mounted below the rudder to support channel. (Refer to Figure 55-5.)
11. With rudder completely reassembled, recheck the balance to insure that it is now within the proper limits.
12. Reinstall the rudder.

CHART 5502. RUDDER BALANCE WEIGHT

	Rudder Part No. 40046-38
Master Test Weight Lbs.	7.60
Master Test Weight Arm in Inches	5.03
Maximum No. of 0.1 Lb. Test Weights Allowed	10
Trim Weight Part No.	53892-2
Maximum No. of Trim Weights Allowed Per Surface	2 per Anchor Nut
Allowable Balance Weights plus Trim Weight	7.95
Balance Limits Inch-Pounds	44 + 0 -5

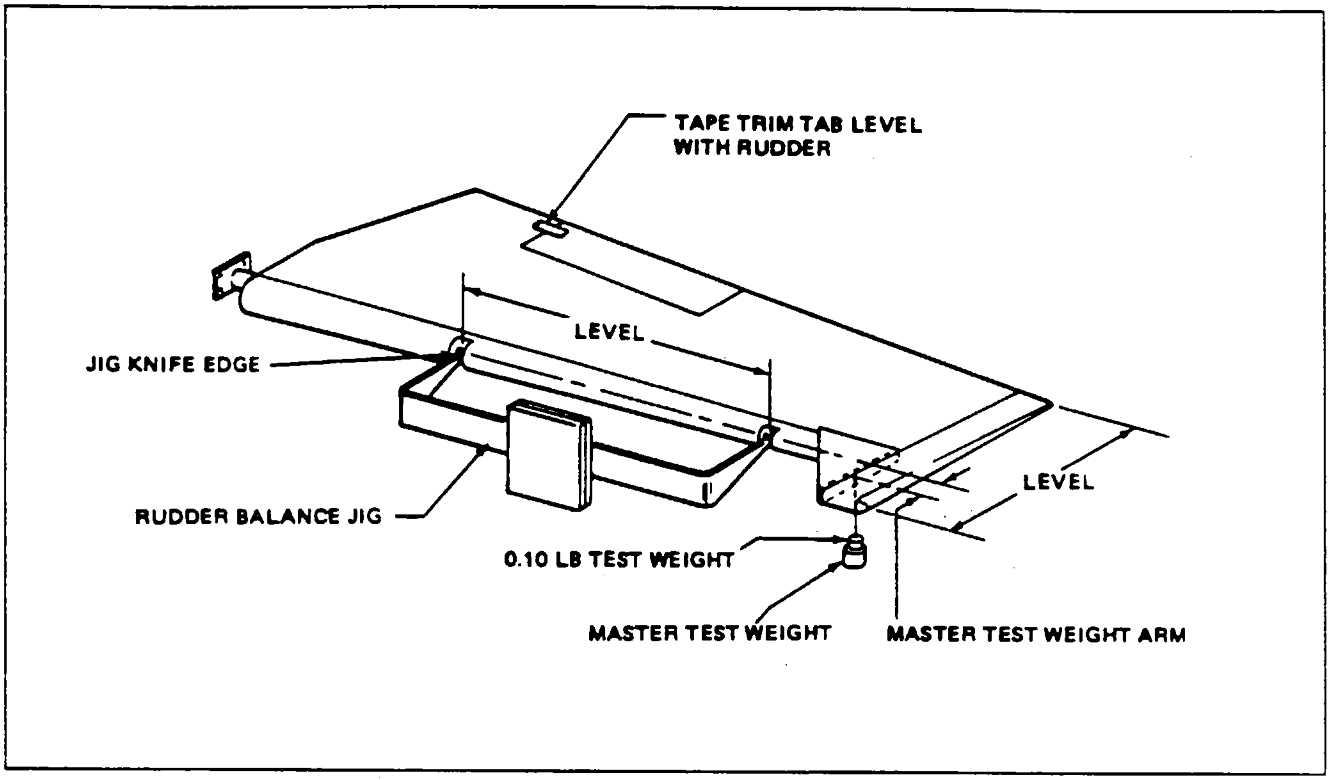

Figure 55-4. Rudder Balancing

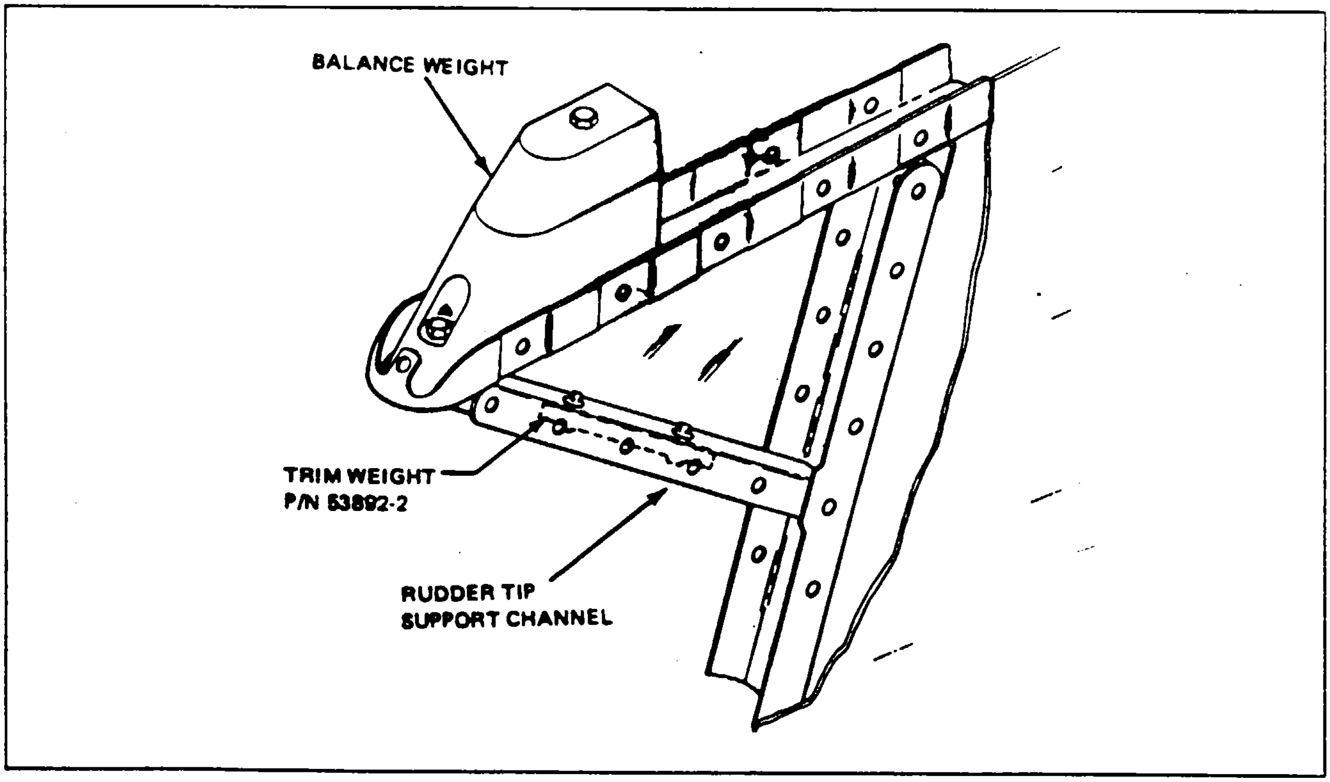

Figure 55-5. Rudder Balance Weight Location

CHAPTER

56

WINDOWS

CHAPTER 56 - WINDOWS

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GENERAL.

This chapter contains information pertaining to the removal and installation of the windshield and windows.

FLIGHT COMPARTMENT.

STANDARD WINDSHIELD.

REMOVAL OF STANDARD WINDSHIELD.

1. Remove the outside trim strip from between the windshield halves by holding the round nuts in the inside channel and turning out the machine screws.
2. Remove the machine screws that secure the collar molding around the bottom of the windshield.
3. Remove the retainer screws from around the top, bottom and outboard side of the windshield.
4. Remove the trim molding from around the inside of the windshield and the switch panel from above the windshield.
5. Loosen the screws that hold the windshield retainer strip around the inside of the windshield.
6. Push the windshield out at the bottom and work out of upper and side channels.
7. Clean old window tape from around inside of channel.

INSTALLATION OF STANDARD WINDSHIELD. (Refer to Figure 56-1.)

1. Ascertain that new windshield is cut to match windshield removed.
2. Apply one piece of Prestite Tape Number 163 or equivalent on each side of windshield. Fold excess around edge. No tape is needed between collar and windshield.
3. Slide the windshield into place with the tape located under the fuselage skin.
4. Install Prestite tape or equivalent on the bottom side of the center windshield trim strip. Install strip, machine screws and round nuts. Do not tighten screws.
5. Install retainer screws around the outside of the windshield. (Apply R.T.V. silicone sealer under the heads of the screws.) Do not tighten screws.
6. Torque the screws that secure the retainer molding around the inside of the windshield.
7. Torque the retainer screws around the outside of the windshield and center trim strip.
8. Apply PRC-383 or PR1425 along the bottom edge of windshield before installation of collar.
9. Install collar molding and tighten until washers begin to compress snug against strip.
10. After installation of collar, apply masking tape around the windshield and along the edge of the collar, skins and trim strip before applying a fillet of PRC-383 or PR1425.
11. Apply a fillet of PRC-383 or PR1425 as indicated in Figure 56-1 and check for water seepage.
12. Install switch panel and trim molding around inside of windshield.

HEATED WINDSHIELD.

REMOVAL OF HEATED WINDSHIELD.

1. Remove the inside cover from the channel that separates the two windshield halves.
2. Disconnect the electrical leads from the windshield. Identify the location of each lead at the center of the windshield to facilitate reinstallation.
3. Remove the trim molding from around the inside of the windshield and the switch panel from above the windshield.
4. Remove the outside trim strip from between the windshield halves by holding the round nuts in the center channel and turning out the machine screws.
5. Remove the collar molding from around the bottom of the windshield by removing the machine screws.
6. Remove the retainer screws from around the top, outboard side and bottom of the windshield.
7. Loosen the screws that hold the windshield retainer strips around the inside of the windshield.
8. Push the windshield out at the bottom and at the same time work the side and top from the retainer channels.
9. Clean old window tape from around the inside of the channels.

INSTALLATION OF HEATED WINDSHIELD. (Refer to Figure 56-2.)

When installing the heated windshield, to prevent damage, the protective paper on the windshield should remain until the installation is complete. Do not allow the vinyl tape used to install the heated glass to contact any surface of the plastic windshield. Use only a non-metallic window sealer.

1. Apply Behr-Manning Vinyl Sponge Tape 1 x 1/16 inches, P/N 542 or equivalent on the outside surface of the windshield, around the outer edges.
2. Apply masking tape around windshield and along the edge of the collar, skins and trim strip before applying SEMKIT SEALER PR 1221-B2 or PR1425 on the outside surface of the windshield around the edges of each side and top.
3. Slide the windshield aft and up into place. Use caution not to dislocate the sealer or vinyl tape around the edges of the windshield.
4. Install outside center trim strip, machine screws and round nuts. Do not tighten.
5. Install the retainer screws around the top, outboard side and bottom of the windshield. Do not tighten.
6. Torque (std. torque) the screws that secure the retainer molding around the inside of the windshield.
7. Torque the retainer screws around the outside of the windshield and center trim strip, using standard torque table.
8. Apply SEMKIT SEALER PR 1221-B2 or PR1425 at the bottom of the windshield in the hollow between the outside edge and the channel. Do not build up the sealer above the inside contour of the collar molding, thus causing a poor fit of molding against the windshield.
9. Install the collar molding around the bottom of the windshield and tighten the retainer screws until washers begin to compress snug against strip.
10. Apply SEMKIT SEALER PR 1221-B2 or PR1425 to any areas around windshield that may allow water to penetrate past the windshield.

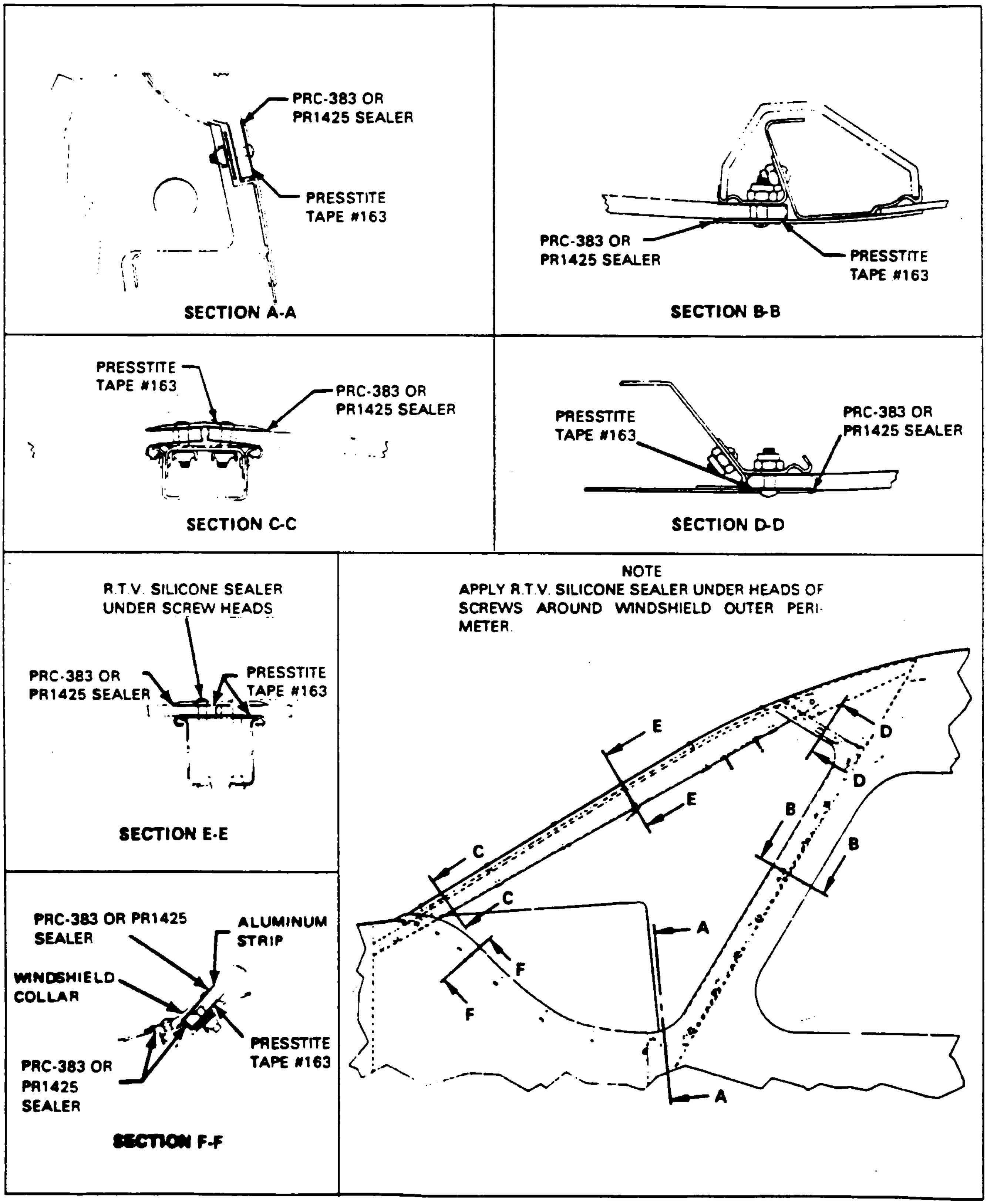

Figure 56-1. Windshield Installation (Standard)

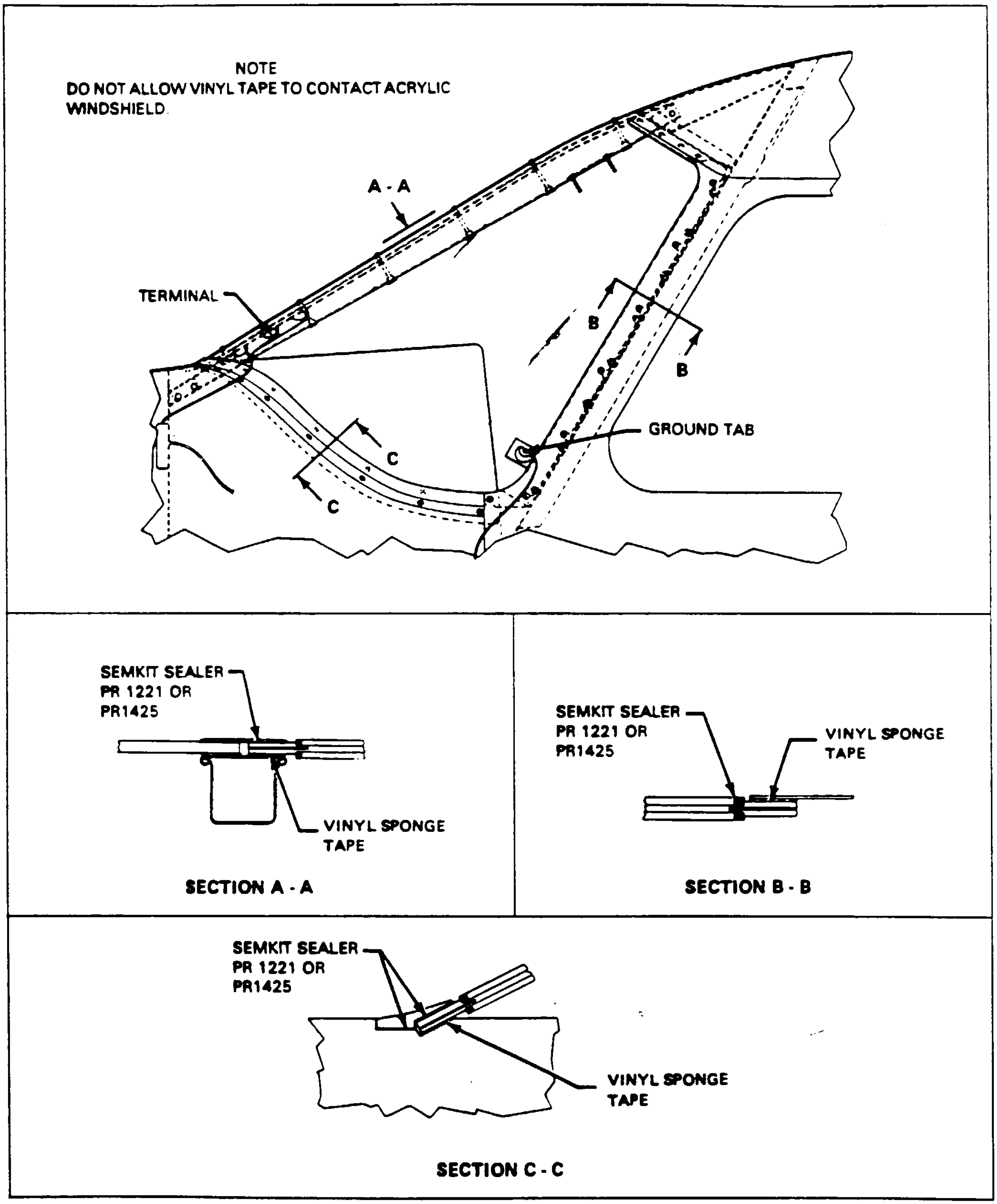

Figure 56-2. Windshield Installation (Heated)

11. Install switch panel and trim molding around inside of windshield.
12. Remove excess exposed sealer or tape.
13. Connect the electrical leads to the windshield. Ascertain that the positive lead at the center of windshield is connected to the red terminal marked "P." The heat sensor leads connect to the white terminals. (Refer to Heated Windshield Schematic, Chapter 91.)
14. Remove protective covering from windshield.
15. Check operation of the windshield heating element and timer by first connecting a 24-volt test light to the positive and negative terminals on the windshield.
16. Turn on the switch labeled "Windshield Heat." The test light should glow indicating current is being delivered to the windshield.
17. Hold a hand against the windshield to determine that the windshield heating element is operating. The test light should go out before it becomes too hot to hold hand against the windshield, indicating that the temperature sensing element is operating properly and it has passed through its thermostatic on/off cycle. Repeat this for one or two more cycles.
18. When check is completed, turn off the switch.

CABIN.

REMOVAL OF SIDE WINDOWS.

1. Remove the screws that hold the trim molding around inside of the window.
2. Remove the nuts that secure the inner window retainer molding and remove window.
3. Remove the rivets that secure the outer window retainer molding and remove window.
4. Remove old window sealer from surfaces.

INSTALLATION OF SIDE WINDOWS. (Refer to Figure 56-4.)

1. Ascertain that the new window is cut to same dimensions as old window.
2. Apply 3/16" Prestite tape number 163 or equivalent over edge of outside window where it contacts the fuselage skin and seal with any of the following: Rubber caulk 5000 White Sealant from Products Research and Chemical Corp. or Chem-Caulk 100 White Sealant from Woodmont Products Inc. or Weatherban 101 White Sealant, 3M Corp.
3. Put outside window and retainer molding in position and secure with rivets.
4. Cement Rubatex strip to inner window using carbolene neoprene cement F-1. Air dry 15 minutes before installing window.
5. Apply black vinyl plastic tape between inside window and retainer strip.
6. Install inner window and bolt inner retainer molding in position.
7. Apply Sil-Glyde Lubricant between edge of window molding and extrusion.
8. Install trim molding around inside of window.

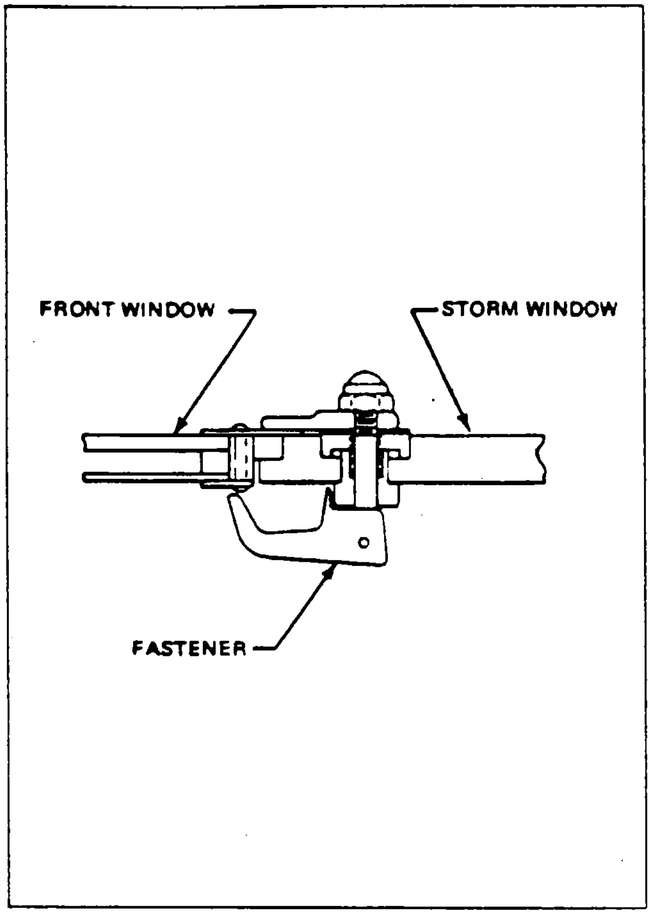

Figure 56-3. Storm Window Latch Installation

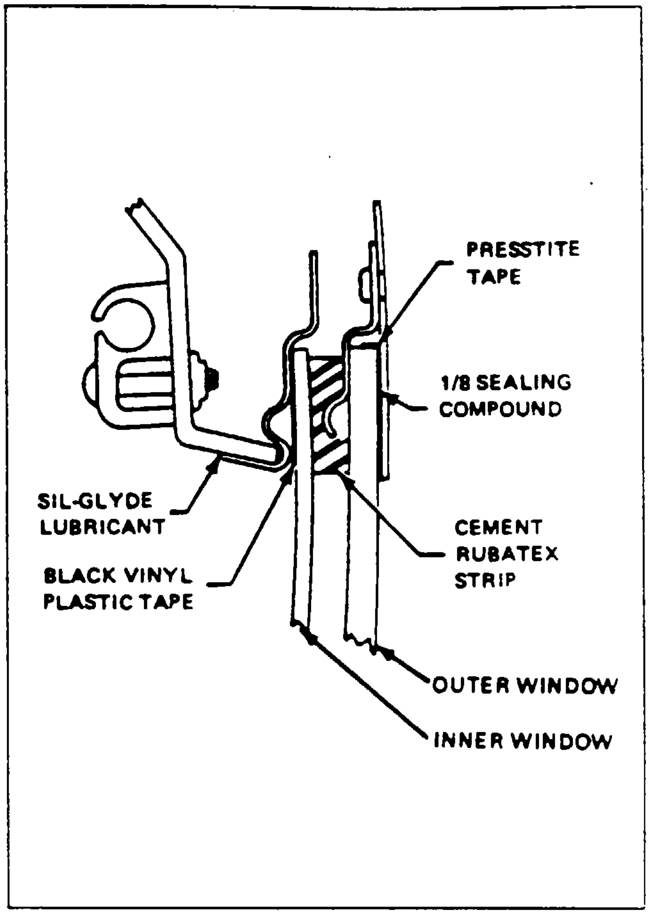

Figure 56-4. Side Window Installation

PILOT DOOR STORM WINDOW.

REMOVAL OF PILOT DOOR STORM WINDOW.

1. Withdraw the storm window hinge pin from the hinge assembly.
2. Disengage the storm window fastener and remove the storm window.

INSTALLATION OF PILOT DOOR STORM WINDOW.

1. Align the storm window hinge halves and insert the hinge pin.
2. Check storm window operation and sealing.

REPLACEMENT OF PILOT DOOR STORM WINDOW SEAL.

To replace the storm window seal, apply a thin coat of Scotch-Grip Industrial Adhesive EC 4475 (3M 911-109) to outboard surface of the lip on the storm window and to the inboard surface of the seal. Allow the surfaces to dry 15-30 seconds and then assemble them.

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CHAPTER

57

WINGS

CHAPTER 57 - WINGS

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GENERAL.

The laminar flow wing is of all-metal stressed-skin, full cantilever design, consisting of two wing panels bolted together at the center of the fuselage. The wing tips are removable. The ailerons are cable and push rod controlled and are statically balanced. The trailing edge wing flaps are electrically operated.

AUXILIARY STRUCTURE.

WING TIP.

REMOVAL OF WING TIP.

1. Remove the screws attaching the wing tip to the wing.
2. Pull the wing tip off far enough to disconnect the navigation light positive wire at the quick disconnect fitting and remove the screw securing the ground wire to the wing structure.
3. Remove the wing tip completely.

REPAIR OF WING TIP.

The wing tip may be repaired in accordance with fiberglass repair procedures in the Structural Repairs portion of Chapter 51.

INSTALLATION OF WING TIP.

1. Attach the ground wire terminal to the wing structure and connect the positive electrical leads together.
2. Position the wing tip on the wing and start all screws with washers.
3. With all screws in place, tighten.

ATTACH FITTINGS.

WING.

REMOVAL OF WING. (Refer to Figure 57-1.)

1. Drain the fuel from the wing to be removed. (Refer to Draining Fuel System, Chapter 12.)
2. Remove the engine from the wing to be removed. (Refer to Removal of Engine, Chapter 71.)
3. Remove the fairing and access panel from around the leading edge of the wing, located between the fuselage and engine nacelle.
4. At the fillet fairing on top of the wing, between the fuselage and wing, remove the rivets that attach the fairing to the wing.

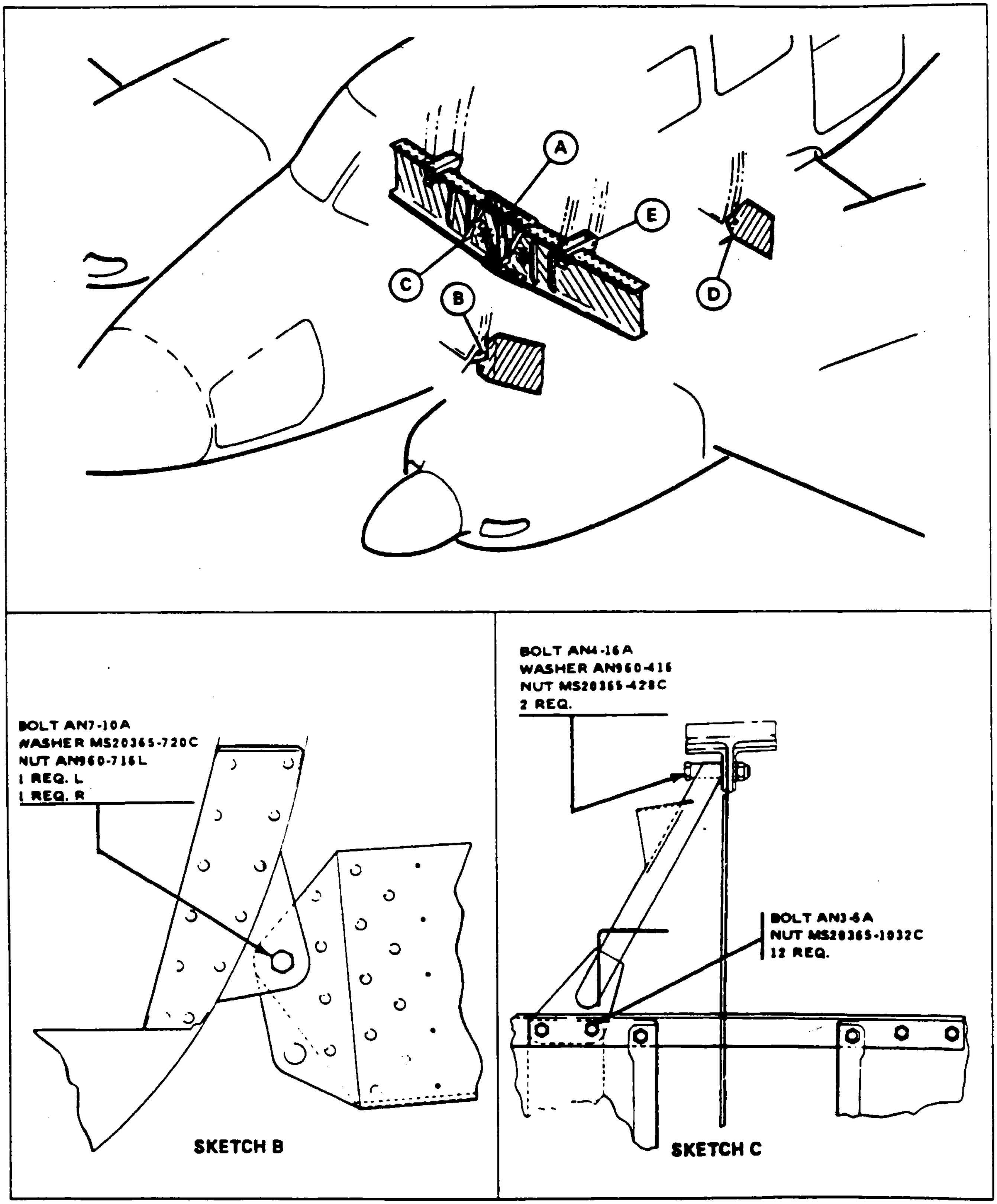

Figure 57-1. Wing Installation

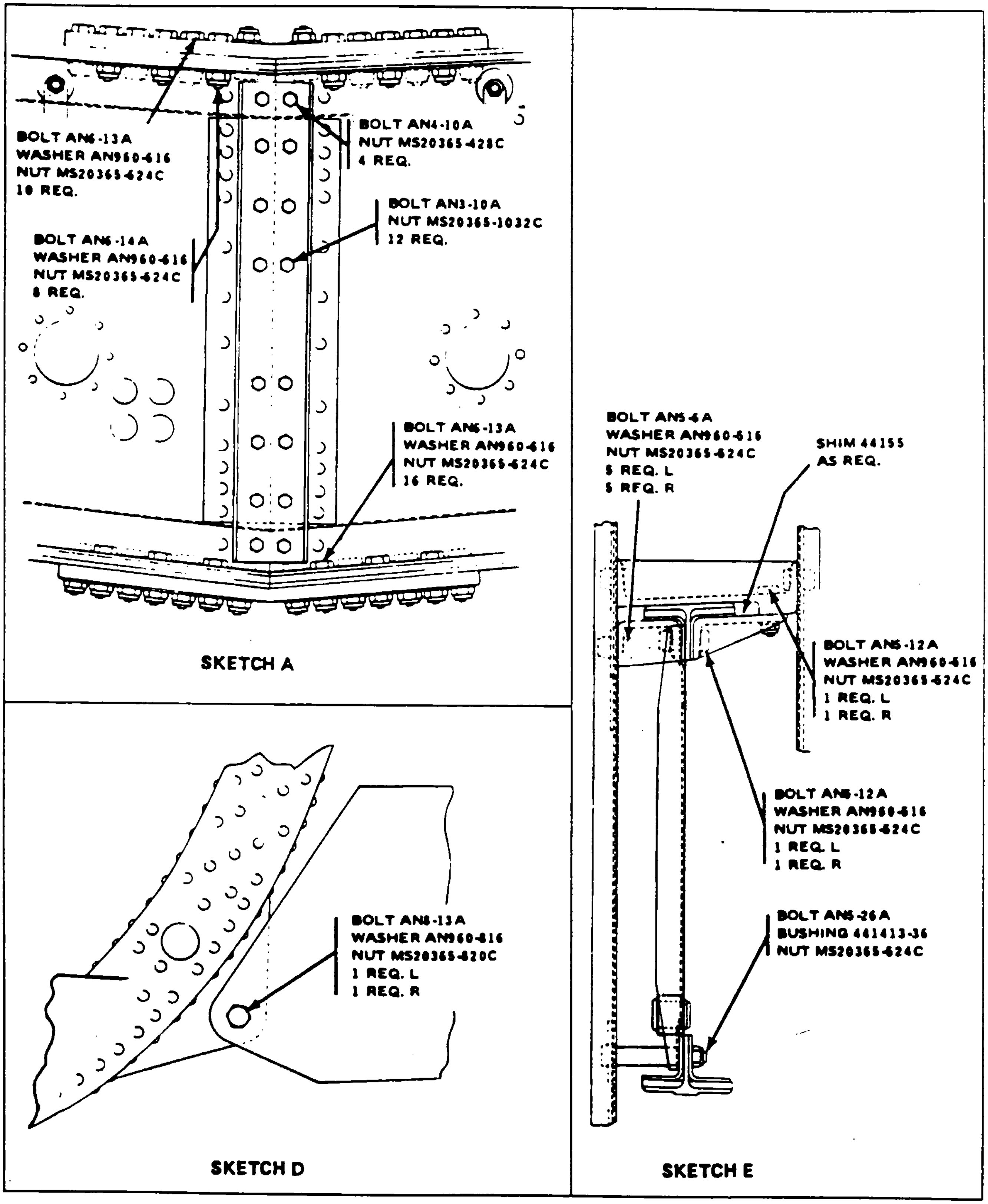

Figure 57-1. Wing Installation (cont)

5. Remove the access plates from the fairing located between the under side of the wing butt and fuselage and the access plate to the spar splice located on the under side of the fuselage.
6. Within the fuselage, remove the spar cover.
7. Remove the fore and aft floor panels adjacent to the main spar and if removing the left wing, remove the left forward floor panel between the fuselage side trim panel and control pedestal.

—NOTE—

To help facilitate reinstallation of control cables and fuel or hydraulic lines, before removing 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.

—CAUTION—

To prevent damage or contamination of fuel, hydraulic and miscellaneous lines, place a protective cover over the line fittings and ends.

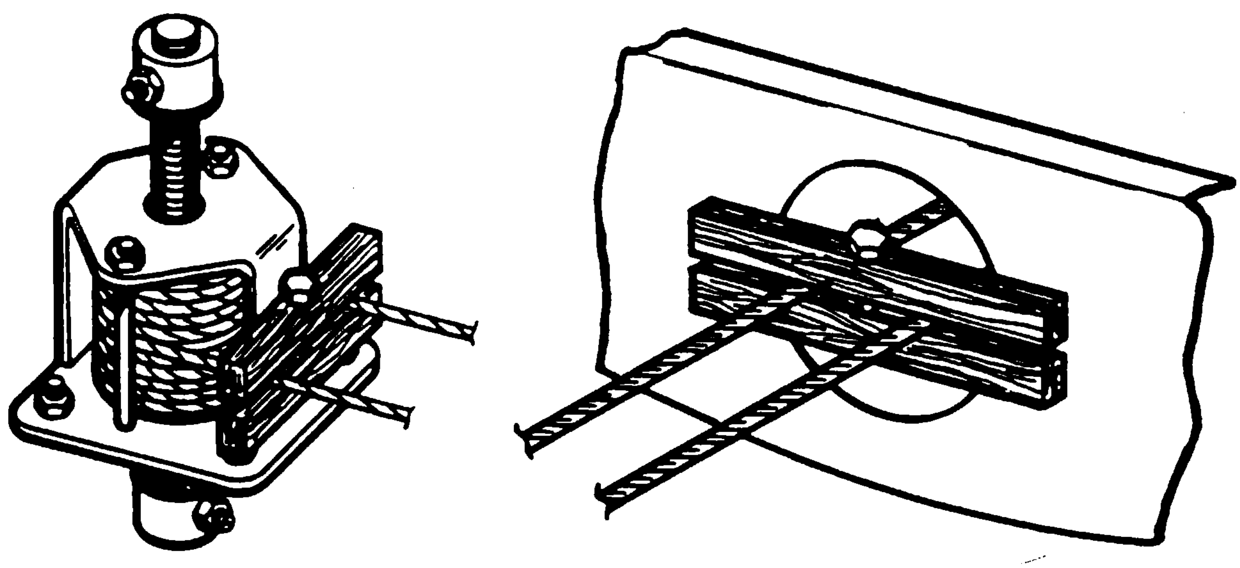

Figure 57-2. Methods of Blocking Trim Cables

8. If the left wing is being removed, the following items pertain to the removal of the left wing only:
   A. Disconnect the primary control cables at the turnbuckles located at stations 76. and 86.50, between the left forward side trim panel and control pedestal. Draw the cables back through the spar. Remove the elevator cable guard pin at station 110. to allow the cable ends to pass through.
   B. Remove the left aileron cable guard pin at station 164.
   C. The balance cable to the left wing may be disconnected at the aileron bellcrank, drawn through the wing and taped out of the way at the side of the fuselage. The cable guard pin at the left wing near the bellcrank and wing butt will have to be removed to allow the cable end to pass through.
9. If the right wing is being removed, the following items pertain to the removal of the right wing only:
   A. Disconnect the aileron control cable at the aileron bellcrank and draw it out through the wing. The cable guard in the wing near the bellcrank and wing butt will have to be removed to allow the cable end to pass through.
   B. Disconnect the aileron balance cable at station 171. and draw the cable from the fuselage. Remove the cable pulley to allow cable to be removed.
   C. Remove the access panel to the aft section of the fuselage. Block the elevator and rudder trim cables ahead of the main spar and in the aft section of the fuselage to prevent the cables from unwrapping at the trim drums. (Refer to Figure 57-2.) Disconnect the elevator and rudder trim cables between stations 274. and 318. and draw the cables forward through the main spar. To allow the cables to be drawn through the fuselage, remove the cable guard at station 244. and rub blocks at station 174. and 215.
   D. Block the aileron trim cable at the side fuselage and within the wing to prevent the trim drum from unwrapping. Disconnect the trim cable turnbuckles at wing station 90. and draw the cables inboard through the wing. Remove cable guard at butt end of wing and tape cables out of the way at the fuselage.
   E. Disconnect the hydraulic lines, which are routed through the spar, at stations 90. and 137. and slide the lines forward through the wing spar.
   F. Disconnect the heater air duct, heat control cable and antenna cables that lead through the spar.

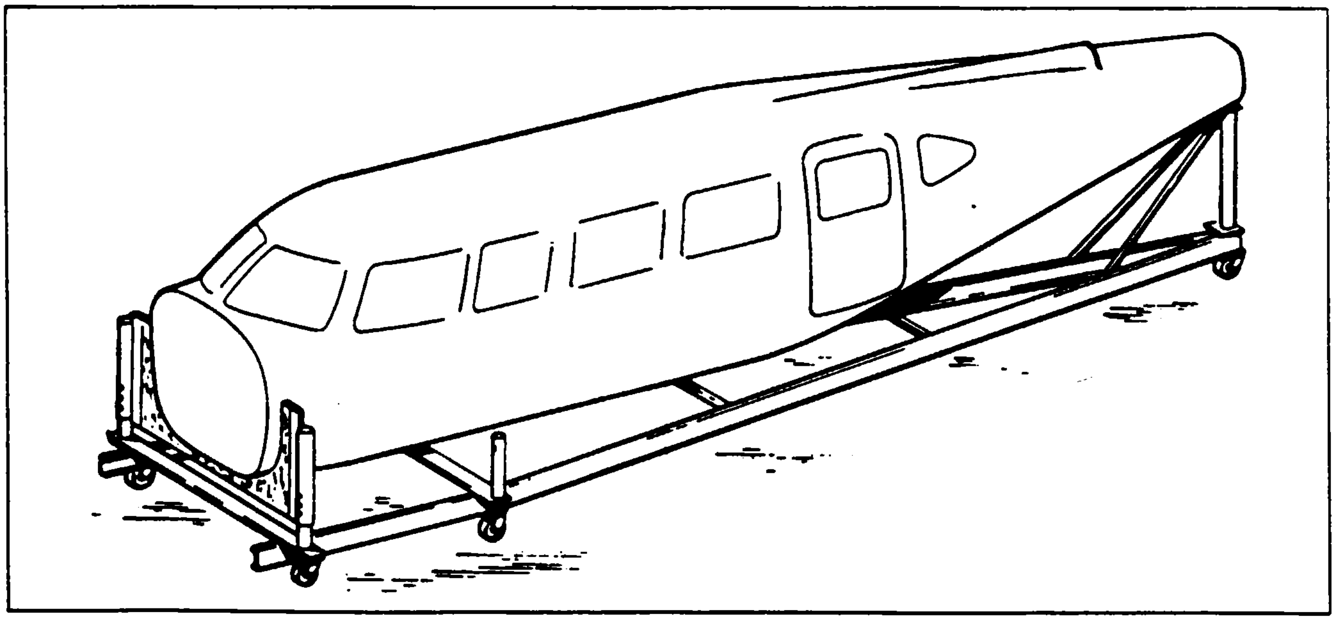

Figure 57-3. Fuselage Cradle

10. At station 174. disconnect the flap control cable from the actuating motor and bulkhead and draw the cable out through the fuselage.
11. Through the wing fairing access openings at the under side of the wing, disconnect the fuel line that is routed through the main spar and pull it back through the spar. Disconnect the hydraulic and fuel lines at the exposed fittings and control cables from fuel valves.
12. Through the access openings at the wing leading edge and butt, disconnect the engine instruments, vacuum, fuel and hydraulic lines. Remove support blocks and clamps.
13. Disconnect electrical wire connectors.
14. Draw engine control cables back through the firewall, engine nacelle and wing.
15. Arrange a suitable fuselage cradle and supports for both wings.
16. Remove the brace assembly that the fuel selector (if installed) attaches to and lay forward. Unbolt and remove the angle support(s) that extend through the spar.
17. To the side of the fuselage, at the top of the main spar, remove the fore and aft lower support fittings. The upper fitting may remain in place.
18. Also to the side of the fuselage, at the bottom of the main spar, remove the support bolt assembly and spacer bushing.
19. Unbolt and remove the vertical spar splice channels.
20. Unbolt and remove the upper and lower horizontal spar cap splice plates.
21. Remove the bolt assembly that attaches the front spar and fuselage fitting.
22. Remove the bolt assembly that attaches the rear spar and fuselage fitting.
23. Pull the wing directly and slowly away from the fuselage, allowing lines, cables, etc., to follow.

INSTALLATION OF WING. (Refer to Figure 57-1.)

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. Turn out the three adjusting screws that draw the bottom fairing against the wing butt.
3. Prepare the various lines, control cables, etc., for inserting into the wing or fuselage when the wing is slid into place.
4. Slide the wing into the fuselage (It may be necessary to insert a metal strip between the fillet fairing and wing butt so as to funnel the wing between the upper and lower fairings) and butt the spar ends. (Maximum distance of 1/32 of an inch is permissible between spar caps.)
5. Install the bolt that attaches the rear spar and fuselage fittings.
6. Install the bolt that attaches the front spar and fuselage fittings.
7. Install and bolt the fore and aft vertical spar splice channels.
8. Install and bolt the upper and lower horizontal spar cap splice plates.
9. To the side of the fuselage, at the top of the main spar, bolt the fore and aft lower support fitting to the upper support fitting and spar.
10. At the lower side of the main spar install support bolt assembly and bushing.
11. Install the angle support that extends through the fuselage and the brace assembly at the forward side of the spar.
12. Tighten bolts of all attachment fittings, plates, etc. Torque bolts securing horizontal spar cap splice plates to 160 to 290 inch-pounds or 13 to 24 foot-pounds; all other bolts use standard torque values.
13. Draw the engine control cables into place.
14. At the wing leading edge and butt, connect the engine instruments, vacuum, fuel and hydraulic lines. Secure the lines and cables in position with support blocks and clamps.

15. Connect electrical wire connectors.
16. Through the wing fairing access openings at the under side of the fuselage, connect the fuel and hydraulic lines and fuel valves control cables.
17. Draw flap control cable into position, ascertain rigging is set (refer to Rigging and Adjustment of Flap Controls, Chapter 27) and secure cable.
18. If the right wing is being installed, the following items pertain to the installation of the right wing only:
    A. Route the heater air duct, heat control cable and antenna cables through the spar and connect.
    B. Route the hydraulic lines through the main spar and connect to their respective fitting at stations 90. and 137.
    C. Draw the aileron trim cables into the wing, connect turnbuckles at station 90. and unblock cables. Install cable guard pin at butt end of wing. Check rigging and adjustment, cable tension (refer to Rigging and Adjustment of Aileron Trim, Chapter 27) and safety turnbuckles.
    D. Draw the elevator and rudder trim cable back through the fuselage, connect turnbuckles in the aft section of the fuselage and unblock cables. Check rigging and adjustment, cable tension (refer to Rigging and Adjustment of Elevator and Rudder Trim, Chapter 27) and safety turnbuckles.
    E. Draw aileron balance cable into fuselage and connect to left balance cable at station 171. Install cable pulley and secure.
    F. Draw the aileron control cable into the wing and connect at the aileron bellcrank. Install cable guard pin at the pulley near the bellcrank and at the wing butt. Check rigging and adjustment, cable tension (refer to Rigging and Adjustment of Aileron, Chapter 27) and safety turnbuckles.
19. If the left wing is being installed, the following items pertain to the installation of the left wing only:
    A. Draw the left balance cable into the wing and connect at the aileron bellcrank. Install the cable guard pin at the cable pulley near the bellcrank and at the wing butt.
    B. Draw the primary control cables through the main spar and connect turnbuckles at stations 76. and 86.50. Install the cable guard pins for the left aileron cable at station 164. and the elevator cables at station 110. Check rigging and adjustment, cable tension (refer to Rigging and Adjustment of Aileron, Elevator and Rudder, Chapter 27) and safety turnbuckles.
20. Install engine (refer to Installation of Engine, Chapter 71).
21. Check hydraulic fluid level (refer to Chapter 12) and with the airplane setting on jacks, operate the gear through several retraction and extension cycles to ascertain that there are no hydraulic fluid leaks.
22. Check brake fluid level, bleed brakes (refer to Bleeding Brakes, Chapter 12) and ascertain that there are no fluid leaks.
23. Check fuel system for leaks and flow.
24. At the top of the wing, rivet the fillet fairing to the wing and fuselage. Apply a bead of Minnesota Mining and Manufacturing Sealant EC750 or equivalent along the edge of the wing root fillet at the fuselage and wing skins, starting at the leading edge and extending aft over the top of the trailing edge.
25. At the fairing between the under side of the fuselage and wing, insert the retaining screws that draw the fairing against the under side of the wing butt and fuselage.
26. Reinstall access plates and panel at the under side of fuselage and wing and leading edge of wing.
27. Install the floor panels and spar covers.

FLIGHT SURFACES.

AILERON.

REMOVAL OF AILERON. (Refer to Figure 57-4.)

1. Remove the wing tip.
2. Remove the wing tip aft attachment rib.
3. Disconnect the aileron control rod.
4. At the right aileron, disconnect the trim tab control rod.
5. Remove the hinge bolts and remove the aileron.

INSTALLATION OF AILERON. (Refer to Figure 57-4.)

1. Place the aileron in position, install hinge bolts and torque.
2. If the right aileron was removed, connect the trim tab control rod.
3. Connect the aileron control rod.
4. Attach the wing tip attachment rib.
5. Install the wing tip.
6. Refer to Chapter 27 for rigging and adjustment procedure.

AILERON BALANCING PROCEDURE. (Refer to Figure 57-5 and Chart 5701.)

1. Remove the aileron from the airplane.
2. Place the aileron on a balancing jig as illustrated in Figure 57-5. Establish a horizontal reference mark which aligns with the trailing edge of the aileron when it is held in a horizontal level position (chord line level).
3. Ascertain that the surface rotates freely with no binding at the knife edges.
4. Assemblies P/N 40200-42 and P/N 40200-43.
   A. If the surface balances, it is within the balance limits and is satisfactory.
   B. If the surface is leading edge heavy, place the master test weight (0.0 to 0.5 lbs.) 6 inches behind the hinge line. (Refer to Figure 57-5, Master Test Weight Arm "B.") If the surface balances or is trailing edge heavy, it is satisfactory.
   C. If the surface is still leading edge heavy, remove material from the surface balance weight until a balanced condition is obtained with master test weight in place.
   D. If the surface is trailing edge heavy, add trim weights (P/N 54395-2) to produce a balanced condition. Do not use more than three (3) trim weights P/N 54395-2, and one (1) trim weight P/N 54395-3.

CHART 5701. AILERON BALANCE WEIGHTS

	Aileron Part No. 40200-42 40200-43
Master Test Weight Lbs.	0.00 to 0.50
Master Test Weight Arm in Inches	6.00
Maximum No. of 0.1 Lb. Test Weights Allowed	None
Trim Weight Part No.	54395-2-3(1)
Maximum No. of Trim Weights Allowed Per Surface	4
Allowable Balance Weights plus Trim Weight	5.2
Balance Limits Inch-Pounds	0 +0 -3

Maximum condition = (3) 54395-2 trim weights and (1) 54395-3 trim weight.

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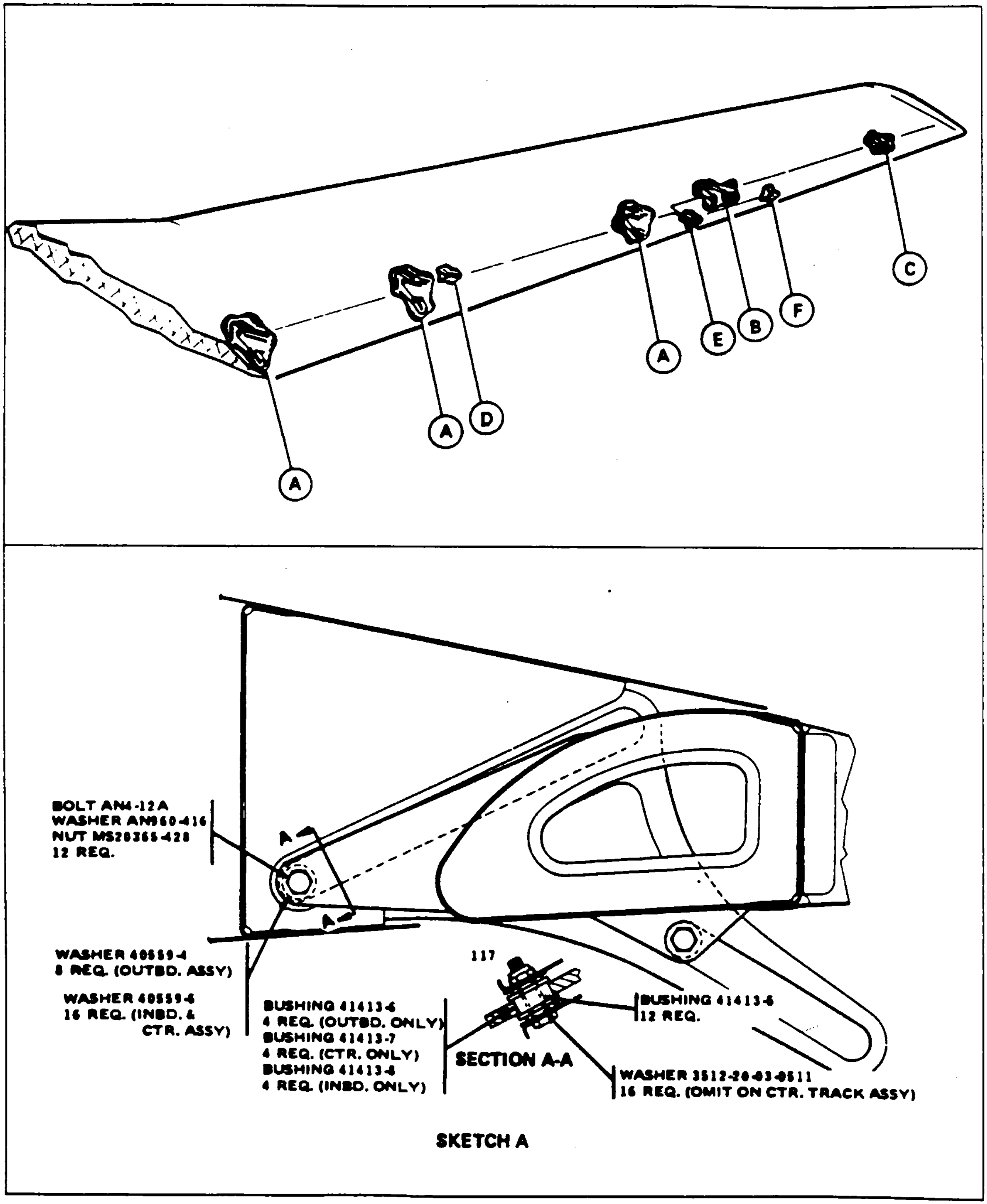

Figure 57-4. Aileron and Flap Installation

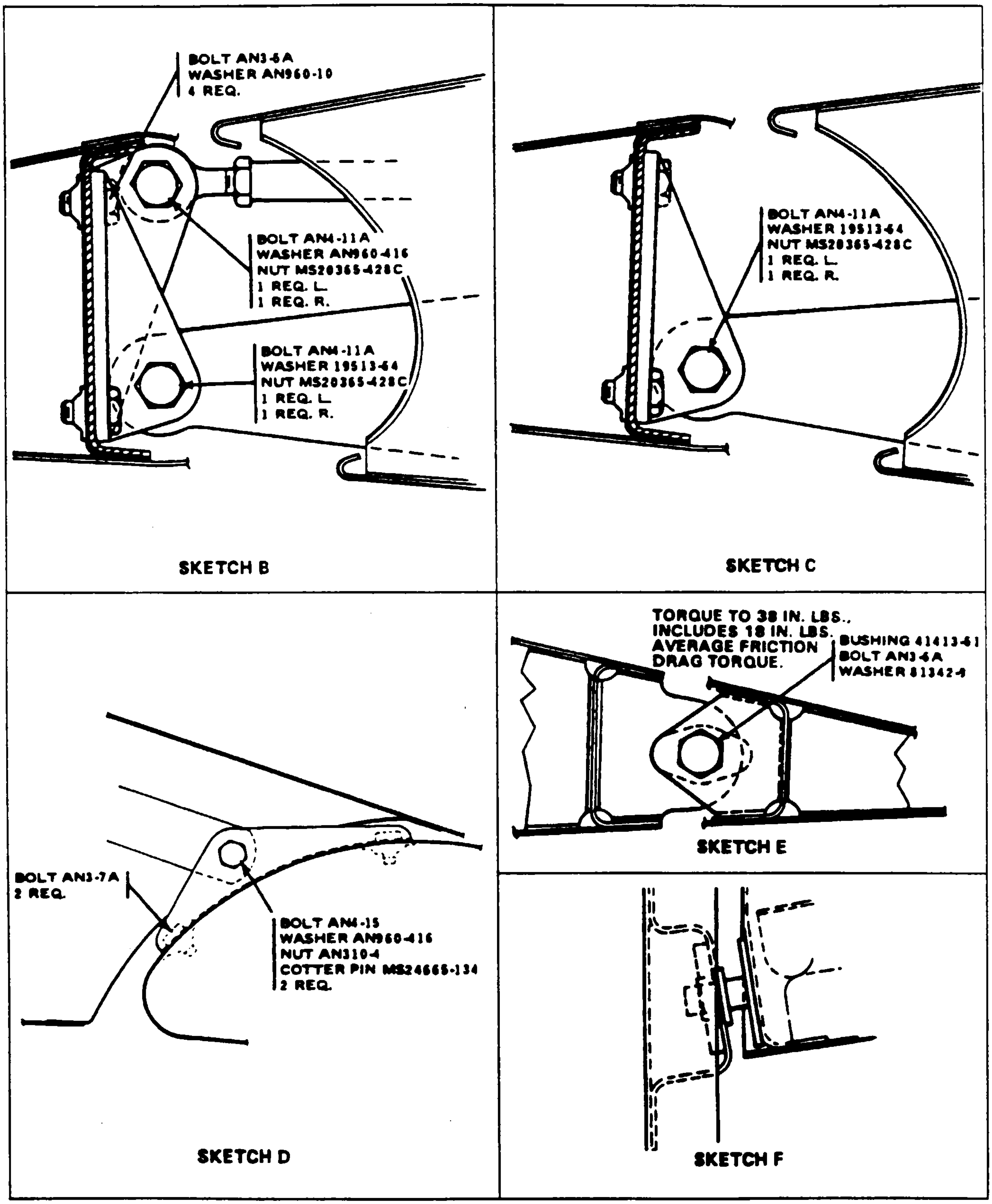

Figure 57-4. Aileron and Flap Installation (cont.)

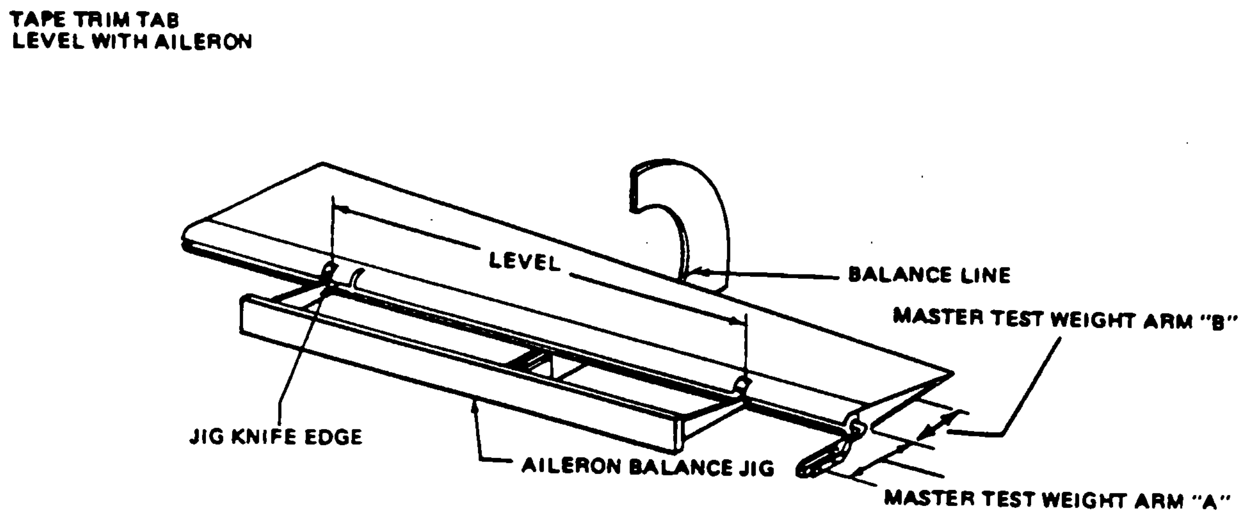

Figure 57-5. Aileron Balancing

AILERON TRIM TAB.

REMOVAL OF AILERON TRIM TAB. (Refer to Figure 57-4.)

1. Disconnect the control rod at the tab.
2. Remove the inboard hinge bolt.
3. Pull the tab back and inboard enough to remove the outboard hinge pin from its bushing. Remove the tab.

INSTALLATION OF AILERON TRIM TAB. (Refer to Figure 57-4.)

1. Insert the tab control rod through the aileron and insert the outboard hinge pin into its bushing.
2. Position the inboard hinge brackets, install hinge bolt and torque to 38 in.-lbs.; includes .18 in.-lbs. average friction torque.
3. Connect the tab control rod.
4. Check tab for proper operation. Refer to Chapter 27 for rigging and adjustment procedures.

FLAP.

REMOVAL OF FLAP. (Refer to Figure 57-4.)

1. Lower flap to within a few degrees of full extension.
2. At the left flap, disconnect the position sender rod by removing the cotter pin from the forward end of the rod.
3. Disconnect the flap control tube at the flap. Do not rotate the control tube unless it is intended to adjust the flap.
4. Remove the upper roller assemblies from the flap brackets.
5. Remove the lower roller assemblies and remove flap.

INSTALLATION OF FLAP. (Refer to Figure 57-4.)

1. Put the flap in position and install the lower roller assemblies on the flap brackets and torque bolts.
2. Install the upper roller assemblies and torque bolts.
3. Connect the control tube.
4. If the left flap was removed, connect the position sender rod.
5. Check flap for proper operation. Rigging and adjustment procedure may be found in Chapter 27.

—END—

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CHAPTER

61

PROPELLER

CHAPTER 61 - PROPELLERS

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GENERAL.

This section contains information pertaining to the maintenance and repair of the propeller and its controlling units the propeller governor and synchrophaser.

DESCRIPTION AND OPERATION.

Propellers are Hartzell full feathering, constant speed, each controlled by a governor mounted on the engine supplying oil through the propeller shaft at various pressures. Oil pressure from the governor moves the propeller blades into low pitch (high RPM). The centrifugal twisting moment of the blade also tends to move the blades into low pitch. Opposing these two forces are blade counterweights, springs and the force produced by compressed gas between the cylinder head and the piston in the propeller dome, which tends to move the blades into high pitch in the absence of governor oil pressure. Thus feathering is accomplished by compressed gas and springs.

PROPELLER ASSEMBLY.

REMOVAL OF PROPELLER. (Refer to Figure 61-1.)

—WARNING—

Before performing any service functions on the propeller, ascertain that the master switch is "OFF," the magneto switches are "OFF" (grounded) and the mixture control is in the "IDLE CUT-OFF" position.

—CAUTION—

Under no condition should blade arms be used on this propeller.

—NOTE—

In some manner identify the position of each part in relation to the other to facilitate installation. Do not scratch the surfaces.

1. Remove the spinner nose cap and release the air charge.
2. 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.
3. Remove the engine cowling.

—NOTE—

It is unnecessary to feather blades when removing propeller.

4. If the airplane is equipped with a propeller deicer system, disconnect electrical leads.
5. Place a drip pan under the propeller to catch oil spillage.
6. Cut the safety wire around the propeller mounting studs and remove the studs from the engine flange. The nuts are frozen and pinned to the studs, so the studs should turn with the nuts.
7. Pull the propeller from the engine shaft.
8. The spinner bulkhead may be removed.

CLEANING, INSPECTION AND REPAIR OF PROPELLER.

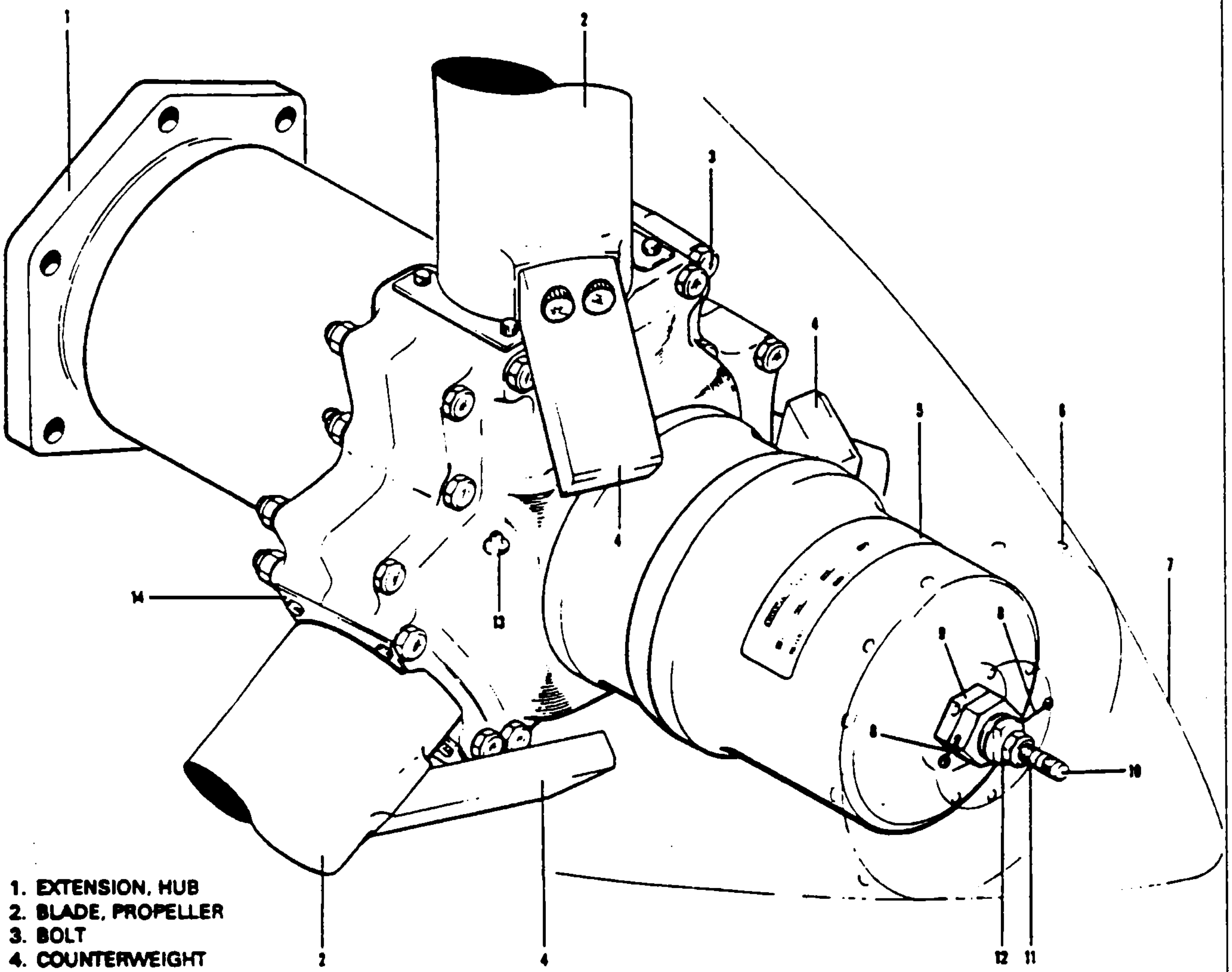
1. Check for oil and grease leaks.
2. Clean the spinner, propeller hub interior and exterior and blades with a non-corrosive solvent.
3. Inspect the hub parts for cracks.
4. Steel hub parts should not be permitted to rust. Use aluminum paint to touch up if necessary, or replate during overhaul.
5. Check all visible parts for wear and safety.
6. Inspect blades for damage or cracks. Nicks in leading edge 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.
7. It is recommended that for severe damage, internal repairs and replacement of parts, the propeller should be referred to the Hartzell Factory or Service Station.
8. Check blades to determine whether they turn freely on the hub pivot tube. This can be done by rocking the counterweights back and forth through the slight freedom allowed by the pitch change mechanism. If they appear tight and are properly lubricated, the pitch change mechanism should be checked further.
9. Grease blade hub through 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 hub gaskets.

INSTALLATION OF PROPELLER. (Refer to Figure 61-1.)

1. Clean propeller and engine flanges.
2. Install spinner bulkhead on propeller and torque bolts to specifications given in Chart 6101.
3. Lubricate and install O-ring in propeller shaft hole.
4. Mount propeller on engine. Screw each stud into its mating flange bushing a few threads at a time until all are tight. Torque bolts to specifications given in Chart 6101. Safety the mounting bolts with MS20995C41 wire, routing the wire through the lock pins.
5. Install spinner, align spinner screw holes with holes in spinner bulkhead. Torque check nut per Chart 6101, safety check nut with MS20995C41 wire and install spinner screw and torque per Chart 6101.
6. Charge the cylinder thru valve with dry air or nitrogen gas to the prescribed pressure. Refer to the placard in the spinner cap or Chart 6101 of this manual for an exact pressure for the existing temperature. It is most important that an accurate air charge be maintained.

—CAUTIONS—

1. ***When Schrader air valve No. 625 in the cylinder dome assembly requires valve core replacement, DO NOT USE low pressure automotive type valve core.***
2. ***Do not check pressure or charge with propeller in feathered position.***



1. EXTENSION, HUB
2. BLADE, PROPELLER
3. BOLT
4. COUNTERWEIGHT
5. PROPELLER DOME
6. SCREW, CAP ATTACHMENT
7. CAP, SPINNER
8. SAFETY WIRE
9. CHECK NUT, SPINNER
10. CAP, AIR VALVE
11. AIR VALVE
12. LOW PITCH ADJUSTMENT
13. GREASE FITTING
14. BALANCE WEIGHT

Figure 61-1. Propeller Installation

CHART 6101. PROPELLER SPECIFICATIONS

Blade Angle (3 Blades)	Low Pitch (High RPM)	13.4° ± .1°[1]
	High Pitch (Low RPM)	82° ± 1°[1] (Feathered)

[1]MEASUREMENT TAKEN AT 30 INCH STATION.

Propeller RPM Setting	Engine Static High RPM	2575 RPM Max.

Propeller Torque Limits	Description	Required Torque (Dry)
	Spinner Bulkhead (Aft)	22 foot-pounds
	Propeller Mounting Bolts	60 foot-pounds
	Spinner Bulkhead Check Nut	35-40 foot-pounds
	Spinner Attachment Screws	40 inch-pounds
	Low Pitch Check Nut	35-40 foot-pounds

CHAMBER PRESSURE REQUIREMENTS
WITH TEMPERATURE

With Feather Assist Spring Assembly

Temp. °F	Press. (psi)
70 to 100	41 ± 1 lb.
40 to 70	38 ± 1 lb.
0 to 40	36 ± 1 lb.
-30 to 0	33 ± 1 lb.

NOTE: DO NOT CHECK PRESSURE OR CHARGE WITH PROPELLER IN FEATHER POSITION.

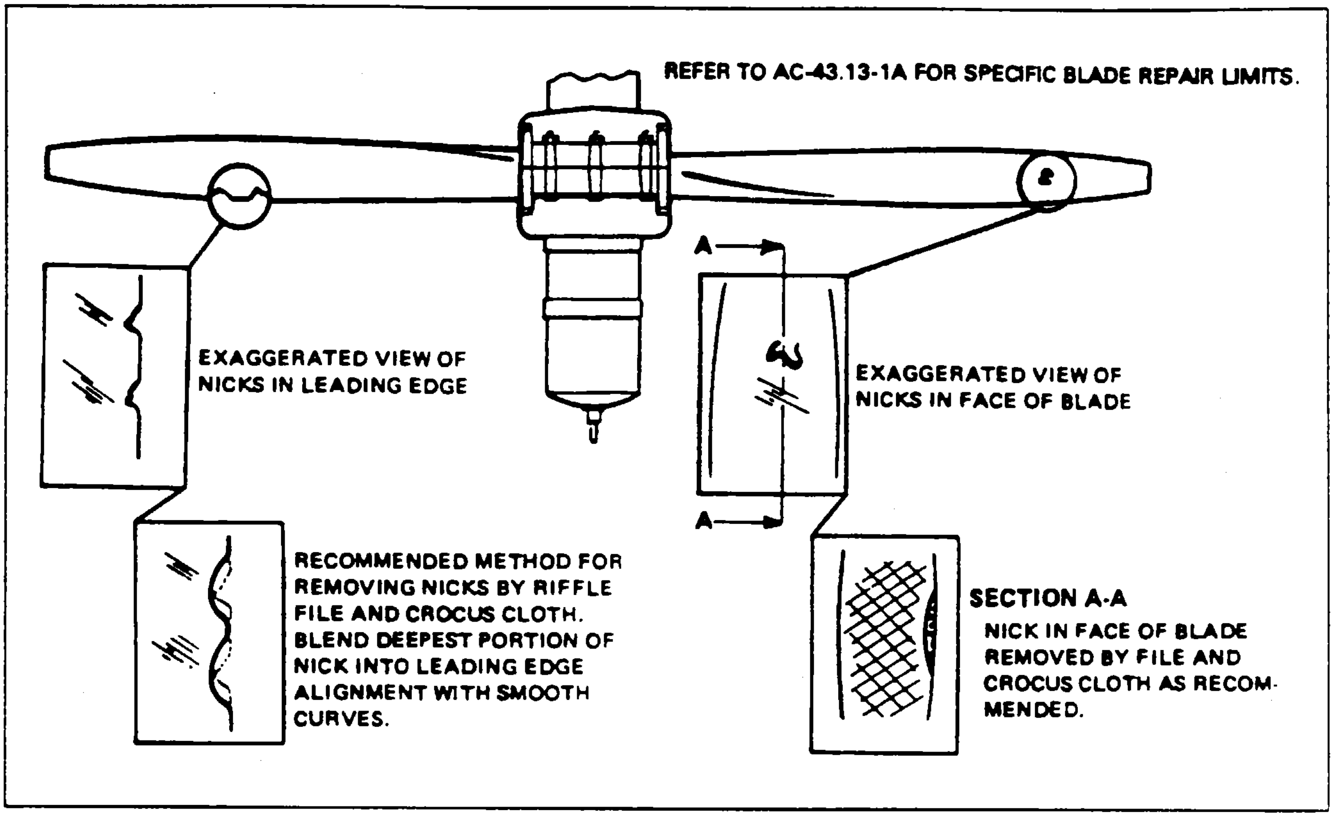


Figure 61-2. Typical Nicks and Removal Method

7. Test for leakage by using a soap solution or equivalent and applying it around the valve stop and at the aft end of the tube. Internal leakage will show up as flow of air through the tube.
8. Install spinner cap and cowling.

ADJUSTMENT OF LOW PITCH BLADE ANGLE AND STOP.

Adjustment of the low pitch blade angle and stop should only be accomplished by an authorized repair station.

BLADE TRACK.

Blade track is the ability of one blade tip to follow the other, while rotating, in almost exactly the same plane. Excessive difference in blade track - more than .062 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 airplane 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 next blade down. Center the tip and scribe a pencil line as before and check that lines are not separated more than .062 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.

PROPELLER GOVERNOR.

REMOVAL OF PROPELLER GOVERNOR.

1. Remove the upper engine cowl.
2. Disconnect the control cable end from the governor control arm.
3. Remove the governor mounting stud nuts. It will be necessary to raise the governor as the nuts are being removed before the nuts can be completely removed.
4. Remove the mounting gasket. If the governor is to be removed for a considerable length of time and another unit not substituted, it is advisable to cover the mounting pad to prevent damage caused by foreign matter.

INSTALLATION OF PROPELLER GOVERNOR.

1. Clean the mounting pad thoroughly, making very certain that there are no foreign particles in the recess around the drive shaft.
2. Place the governor mounting gasket in position with the raised portion of the screen facing away from the engine.

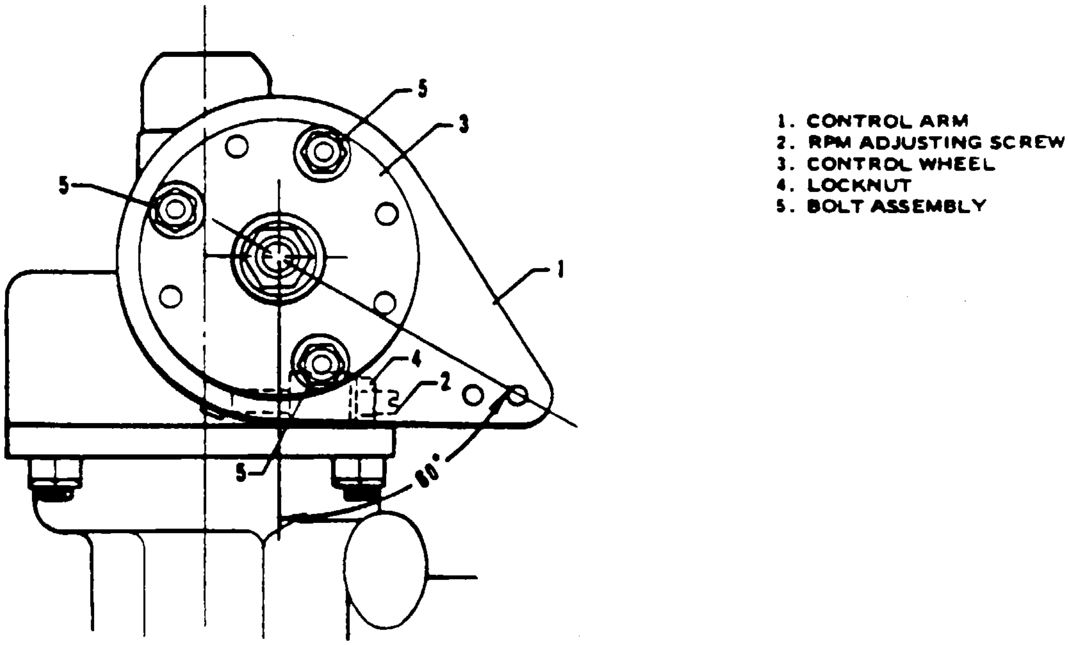


Figure 61-3. Propeller Governor

3. Align the splines on the governor shaft with the engine drive and slide the governor into position.
4. With the governor in position, raise the governor enough to install washers and start mounting nuts. Torque nuts even.
5. Connect the control cable end to the governor control arm. The ball stud is installed in the outer hole of the control arm.
6. Adjust governor control.
7. Install engine cowl.

RIGGING AND ADJUSTMENT OF PROPELLER GOVERNOR. (Refer to Figure 61-3.)

1. Start the engine and warm in the normal manner.
2. To check high RPM, low pitch setting, move the propeller control all the way forward to the INCREASE PROPELLER position. 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 be 2575 RPM with high RPM properly adjusted.
3. Should engine RPM not be as required, the high RPM setting should be adjusted as follows:
   A. Shut down the engine and remove the upper engine cowl.

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. Reinstall upper engine cowl and 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.
E. Ascertain that the governor control arm is adjusted to the proper angle on the control wheel as shown in Figure 61-3.

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 lever is .062 to .125 inch from its full forward stop, which is located in the control pedestal. To adjust the control lever travel, disconnect the control cable end from the control arm, loosen the cable end jam nut and rotate the end to obtain the desired lever clearance. Reconnect the cable end and tighten jam nut.
5. It is usually only necessary to adjust the high RPM setting of the governor control system, as the action automatically takes care of the positive high pitch setting.

PROPELLER SYNCHROPHASER.

DESCRIPTION.

This system consists of two pulse generators, a computer, and an electrical control solenoid on the governor.

The signals from both generators are supplied directly to the computer for comparison. The difference signal is amplified and fed to the governor solenoid to control the slave engine.

The pulse generator is mechanically driven by the camshaft of the left MASTER engine. One rotation of the camshaft constitutes one cycle of engine operation of a four stroke engine. This permits the pulse generator to be timed to any relationship to the firing order of the engine. This gives a latitude of selection, permitting any selection of corresponding operation between master and slave engine.

The selector switch on the panel has two positions, manual or phase. In the manual position, engines and propellers are operated and controlled in the conventional manner. After manually synchronizing engines, the selector switch can be set to the phase position. This permits the synchrophaser to hold engines in RPM agreement and also in the preselected phase relationship.

SYSTEM OPERATING PROCEDURE.

The selector switch should be in the manual position during engine start, taxi and warmup. The switch may be turned to phase position after the take-off run has started, if desired.

—NOTE—

With full throttle and full RPM the governors should be set within the synchrophasing range, if not, consult Rigging and Adjustment of Propeller Governor of this manual for high RPM setting adjustment.

The propeller RPM should be manually adjusted as close to synchronization as possible for cruise, and the quadrant friction control set. Turn the switch to the phase position, if the unit does not synchronize the props, return the selector switch to manual. After 45 seconds, adjust engine RPM manually as close as possible to each other, but not more than 25 RPM difference and return the selector switch to the phase position.

Keep the function switch in manual position except when automatic control is desired. The engine synchrophaser will bring into phase, engines with an RPM difference of over 30 RPM. However, the closer the RPM is set manually the sooner automatic phasing will be established.

Note the lack of an audio beat in flight when the propellers are in phase. When an audible beat is heard with the system operating, it is undoubtedly not holding the slave engine in phase with the master engine. Return the selector switch to its manual position for 45 seconds and readjust engine RPM manually to operating RPM . Set selector switch to phase position for automatic operation. If the phasing is not established after the above procedure, it is possible that some unit of the system is not operating properly, and further ground checks should be made.

TROUBLESHOOTING .

The following checks should be made when a malfunction of the system is suspected. The checks are divided into two parts, Mechanical and Electrical, and should be performed in that order. A troubleshooting chart is also supplied at the end of these instructions.

—CAUTION—

Before proceeding any further be certain that the magneto switches are OFF.

1. A mechanical check should be performed to inspect the short tach cables used to drive the pulse generators, and related components for the following conditions:
   A. Insufficient lubrication. Lubricate with a suitable High Temperature Grease.
   B. The retainer clip on the drive end of the tach cable is not chafing against the bell housing. No signs of chafing should be evident.
   C. The square ends of the tach cable is fraying. If so, dip the end in silver solder or braze it. Then file the end square to fit mating unit core.

D. Be certain the core of the pulse generator rotates when the propeller is turned.
E. Check the dual drive units for possible broken parts.
F. Check the engine drive pad for possible damage.
G. Check tachometer shaft core (engine to pulse generator) to assure that core has 7/16 inch minimum end play. Tachometer shaft core may be cut as required at output (square) end. Too much end play may cause cable core to bind in the housing.

2. Perform a wiring harness check utilizing a Hartzell Test Box (B-4467) to provide assurance that the synchrophaser is properly connected. It also checks the functioning of the governor solenoid coil and the pulse generators.

—NOTE—

These tests are to be made with all parts installed and connected to the wiring harness except for the computer. Do not plug the computer in until all tests have been satisfactorily completed.

A. Connect the Hartzell Test Box B-4467 to the wiring harness in place of the computer.
B. Turn the master switch ON. The Power light and Coil light should come on. Other lights may also be on but they may be disregarded at this time with the exception of the Coil Short light. If it is on turn the master switch OFF and refer to the following NOTE.

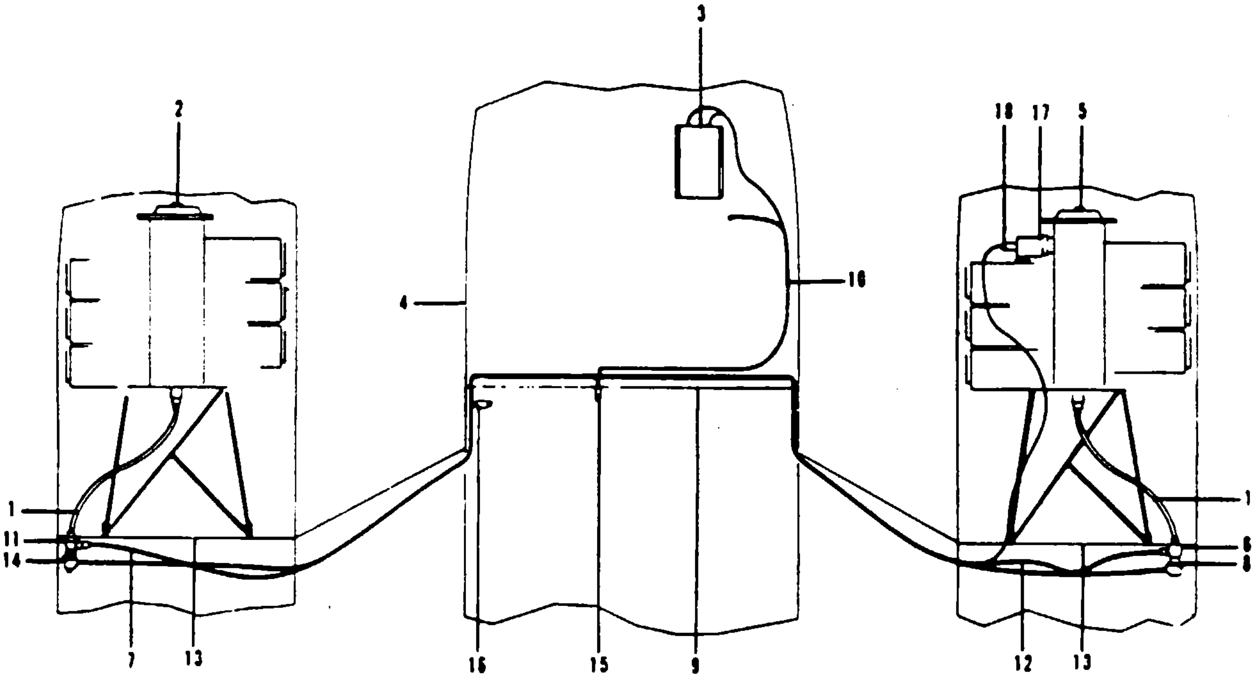
—NOTE—

If any of the lights on the test box fail to operate correctly, check the wiring harness against the wiring diagram. Check for shorts, open circuit breaker, broken wires and wires connected to the wrong pins.

C. Rotate the right engine by hand and watch the Right Engine light. If the light is off rotate the engine until it comes on or vise versa. The engine may need to be rotated two revolutions to obtain a change. Repeat the procedure for the left engine observing the Left Engine light.
D. Place the phase-manual switch in the manual position. The Manual light should come on and the Phase light should go out. When the switch is placed in the phase position the opposite should occur.
E. If the wiring harness checks good but the Right or Left Engine light or the Coil light does not function properly replace the respective pulse generator or the governor.
F. With test box connected to the wiring harness rotate the right engine in the direction of rotation to locate the No. 1 piston at T.D.C. on the ignition stroke (use the engine timing mark). Rotate the pulse generator housing until the Right Engine light just comes on. (You will note that the light will remain illuminated for several degrees of rotation of the pulse generator housing but the correct timing position is at the point where the light just comes on.) Lock the pulse generator into position. Always turn both pulse generators in the same direction when timing unless they are driven in opposite directions. Then the housings must be rotated in opposite directions. Repeat this procedure for the left engine observing the left engine light.

CHART 6102. TROUBLESHOOTING CHART (ENGINE SYNCHROPHASER)

Trouble	Cause	Remedy
No indication solenoid current.	Master switch OFF.	Turn switch ON.
	Bad fuse in computer.	Replace fuse.
	Faulty wiring.	Check wiring and connections.
	Faulty computer.	Replace computer.
System not operating properly.	Pulse generator and lamp amplifier suspected of faulty operation.	Perform operational check.
	Tach shafts and/or dual drive units faulty.	Visually check.
	Pulse generator and glow lamp amplifier in computer not operating.	Perform electrical test.
	Glow lamp or lamps and/or photo conductor or conductors defective.	Replace glow lamp or photo conductor assemblies.
	Faulty computer.	Perform electrical test.
System will not sync. —NOTE— ***Unit will not sync. on the ground.***	Electrical.	Perform electrical test.
	Mechanical.	Check tach shafts and dual drive units.
	Pilot. Engines not set within range of system	Refer to operating procedures.



1. TACH SHAFT
2. MASTER ENGINE (LEFT)
3. COMPUTER
4. NOSE CONE
5. SLAVED ENGINE (RIGHT)
6. DUAL DRIVE ADAPTER, RIGHT ENGINE
7. TACHOMETER SHAFT
8. PULSE GENERATOR
9. INSTRUMENT PANEL
10. WIRE HARNESS
11. DUAL DRIVE ADAPTER, LEFT ENGINE
12. TACHOMETER SHAFT
13. FIRE WALL
14. PULSE GENERATOR
15. COCKPIT CONTROL SWITCH
16. CIRCUIT PROTECTOR
17. GOVERNOR
18. SOLENOID

Figure 61-4. Synchrophaser Installation

REMOVAL OF PULSE GENERATOR.

The pulse generators are located, one in each engine nacelle, aft of the fire wall, at the upper left-hand corner in the area between the nacelle skin and the outboard nacelle bulkhead. (Refer to Figure 61-4.)

1. Remove the access panel on the outboard side of the nacelle, just above the wing leading edge.
2. Disconnect the electrical connector.
3. Loosen the 1 inch hex nut, at the front of the pulse generator, that connects it to the dual tach drive and remove the generator.

INSTALLATION AND ADJUSTMENT OF PULSE GENERATOR. (Refer to Figure 61-5.)

1. Attach the pulse generator to the dual tach drive by securing loosely with hex nut.

—NOTE—

The front of the pulse generator can be defined by the square hole in the center of the unit to accept the square end of a tach shaft.

—CAUTION—

Before proceeding further, be certain the magneto switches are OFF.

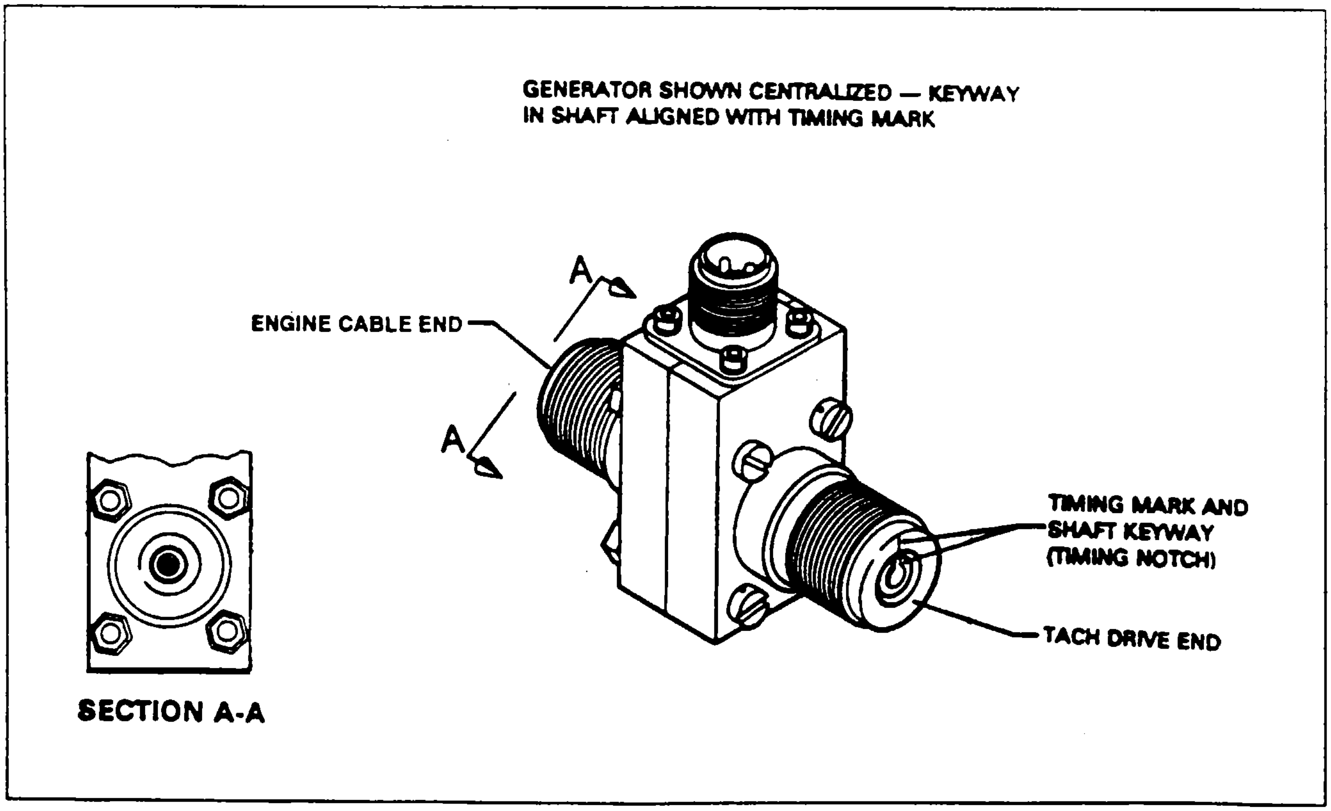


Figure 61-5. Pulse Generator

2. Turn the engine in the direction of rotation to locate No. 1 piston at T.D.C. on the ignition stroke. Use the engine timing mark.

—NOTE—

If this point is missed, do not turn the engine backward, start over.

3. Turn the pulse generator case counterclockwise (viewed from the rear) to align the timing mark with the center of the keyway. This is the phase position. The use of an inspection mirror will be required to view the end of the unit.
4. Tighten the 1 inch hex nut.
5. Pull the prop through (in the direction of rotation) two complete revolutions and stop at the phase position. Check timing mark alignment. Reset if necessary.

—NOTE—

The pulse generator timing mark is always set up when the left engine is at T.D.C. of No. 1 cylinder on the ignition stroke. The right engine is then set at the desired propeller position, cylinder number 2 at T.D.C. on the ignition stroke and rotate the engine an additional 22 teeth on the ring gear beyond the timing mark.

6. Connect the electrical plug connector to the pulse generator and install the access panel on top of the nacelle.

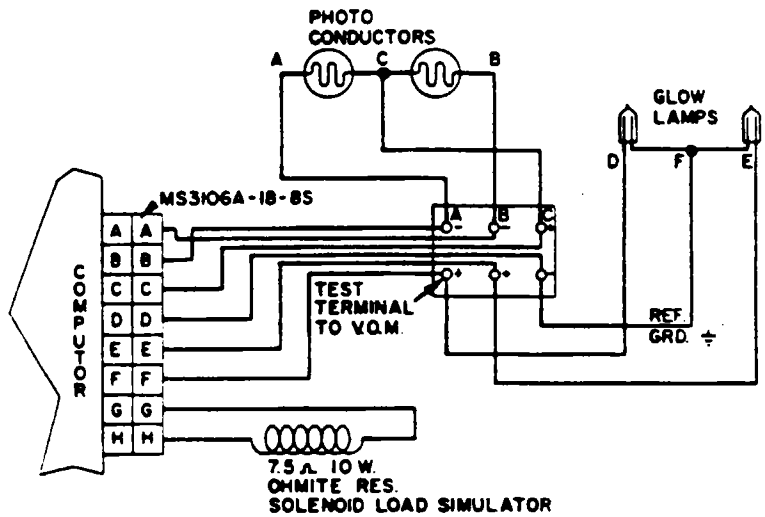
REMOVAL OF COMPUTER ASSEMBLY.

This unit is mounted on a bracket in the upper right rear corner of the nose baggage compartment. (Refer to Figures 61-4 and 61-6.)

1. The computer unit is accessible through the nose baggage compartment.
2. Disconnect the electrical plug connected to the computer unit.
3. Remove the mounting hardware that hold the computer unit to the mounting plate and remove the unit from the mounting plate.

INSTALLATION OF COMPUTER ASSEMBLY. (Refer to Figures 61-4.)

1. Position the computer unit onto the mounting plate.
2. Secure the unit in place with the mounting hardware.
3. Connect the electrical plug to the computer unit.
4. Check the fuse to ascertain that it is in good condition and of the proper size (3 amp - 250 volts).



TEST			
	A to F	0 to 12 V	D.C.
	B to F	0 to 12 V	D.C.
	C to F	12 V	D.C.
	D to F	6 V	A.C.
	E to F	6 V	A.C.

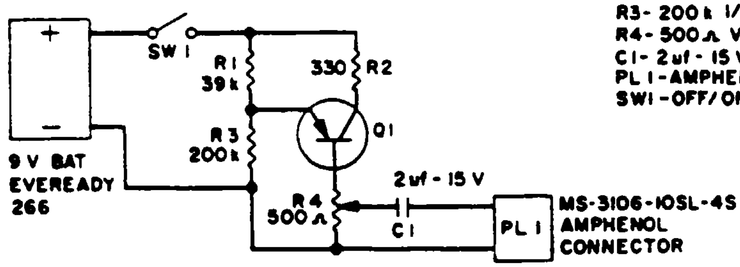
DISCONNECT STROBE SENSOR

TEST			
	A to F	0	
	B to F	0	
	C to F	12 to 14 V	D.C.
	D to F	15 V	A.C.
	E to F	15 V	A.C.

Figure 61-6. Patch Cable and Test Terminal

PULSE GENERATOR SIMULATOR - APPROX. 1200 R.P.M.

Q1 - UNIJUNCTION TRANSISTOR MOTOROLA HEP 310
R1 - 39k 1/2 W. 10% RES.
R2 - 330 Ω 1/2 W. 10% RES.
R3 - 200k 1/2 W 10% RES.
R4 - 500 Ω VAR. V 500 CRL
C1 - 2uf - 15 V CAR UNICON
PL 1 - AMPHENOL CONNECTOR
SW1 - OFF/ON SWITCH



ADJUST R4 FOR PULSE AMPLITUDE OF 1.5 VOLTS. USE OSCILLOSCOPE FOR MEASUREMENTS.

Figure 61-7. Pulse Generator Simulator

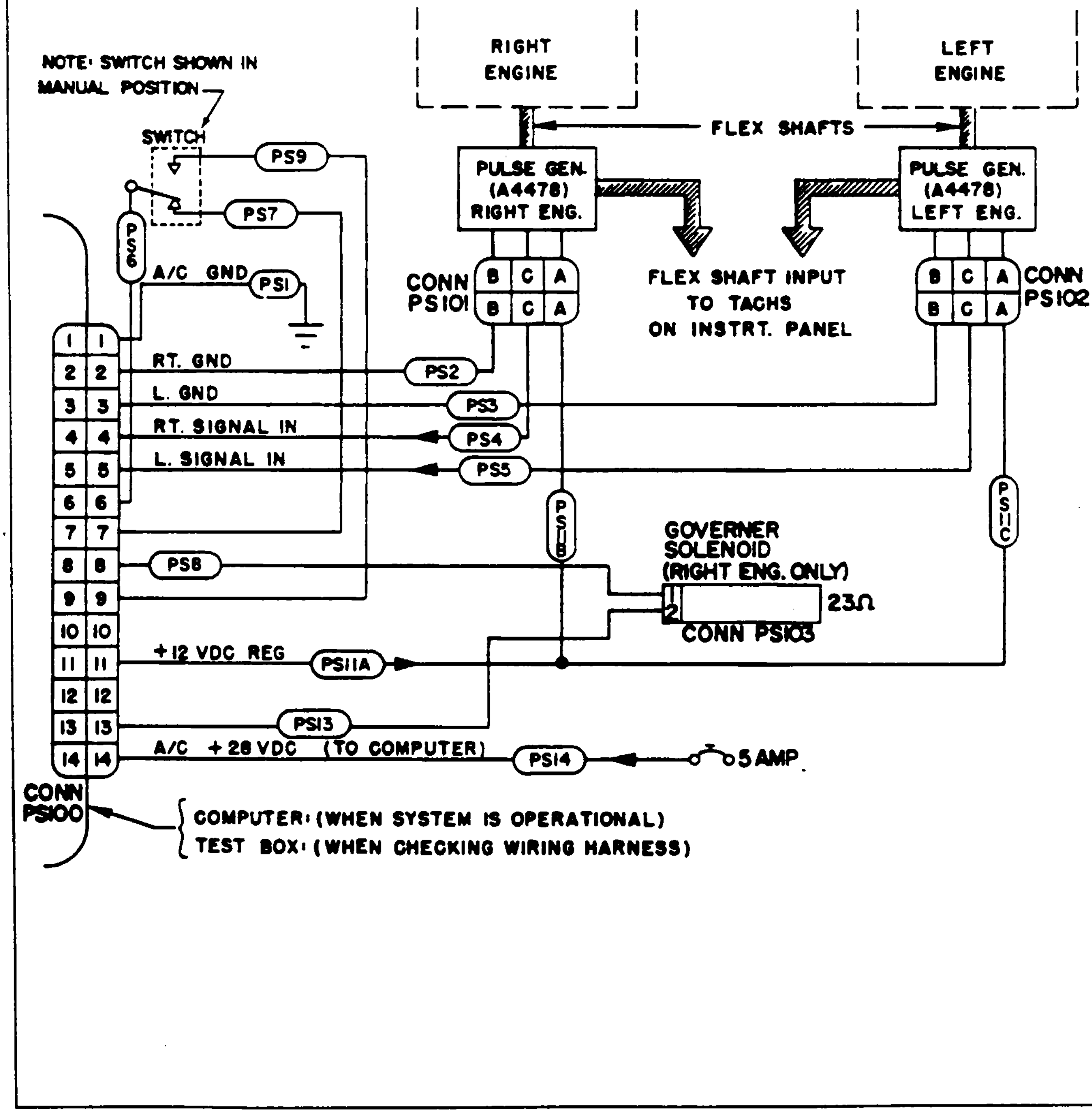


Figure 61-8. Synchrophaser Schematic

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CHAPTER

70

STANDARD PRACTICES
ENGINES

CHAPTER 70 - STANDARD PRACTICES ENGINES

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GENERAL.

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 indications 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, washer, 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 cap 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 of parts.

—END—

CHAPTER

71

POWER PLANT

CHAPTER 71 - POWERPLANT

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GENERAL.

This section provides instructions for remedying difficulties which may arise in the operation of the power plant and its related components. The instructions are organized so the mechanic can refer to: Description and principles of operation for a basic understanding of the power plant and its various components: Troubleshooting for a methodical approach in locating the difficulty; Corrective maintenance for the removal, repair and installation of components; and Adjustments and Tests for the operation of the repaired components.

DESCRIPTION AND OPERATION.

The T-1020 is powered by two Avco Lycoming TIO-540-J2B series six cylinder, direct drive, wet sump, horizontally opposed, fuel injected, turbocharged, air cooled engines with a compression ratio of 7.3:1, rated at 350 HP at 2575 RPM and designed to operate on 100/130 (minimum) octane aviation grade fuel.

Cowlings completely enclose the engines and consist of an upper and lower section. The cowling is cantilever construction attached at the fire wall. Located on both sides of the upper cowl are louvered doors that hinge upward when their quick fasteners are released, to allow inspection of the accessory section and turbocharger area. A cowl flap door is an integral part of the lower cowl and is operated through mechanical linkage and an electric motor. Electric indicators are used to show the position of the cowl flap.

The induction system consists of a dry type air filter, an alternate air door, a Bendix RSA-10ED1 type fuel injector and a Lear-Siegler fuel supply pump as an integral part of the fuel injector system. An AiResearch model TH08A60 turbocharger is mounted as an integral part of the engine. Automatic waste gate control of the turbocharger provides constant air density at the fuel injector inlet from sea level to critical altitude.

Bendix Scintilla S-1200 series magnetos are installed with their associated components. Each system consists of a single contact magneto, a dual contact magneto (to obtain the retard spark necessary for starting), a starter vibrator, magneto switches and starter switch. The magnetos are designed to generate and distribute high tension current through high tension leads to the spark plugs.

In addition to the aforementioned components, each engine is equipped with an alternator, geared starter, hydraulic pump and pneumatic pressure pump. Engine mounts are steel tubing construction attached at the fire wall and incorporate vibration absorbing dynafocal mounts. The two top exhaust stacks and extensions are positioned one for the left and one for the right bank of cylinders. From the exhaust stacks, gases are directed to the turbocharger exhaust plenum, through or around the turbo turbine, as required, and overboard at bottom of the engine nacelle.

The lubrication system is of the pressure wet sump type. The oil pump, which is located in the accessory housing, draws oil through a drilled passage leading from the oil suction screen located in the sump. The oil from the pump then enters a drilled passage in the accessory housing which feeds the oil to a threaded connection on the rear face of the accessory housing, where a flexible line leads the oil to the external oil cooler. Pressure oil from the cooler returns to a second threaded connection on the accessory housing from which point a drilled passage conducts the oil to the oil pressure filter. In the event that cold oil or an obstruction should restrict the oil flow thru the cooler, an oil cooler bypass valve is provided to pass the oil directly from the oil pump to the oil pressure filter.

The oil filter element, located on the accessory housing, provides a means of filtering from the oil any solid particles that may have passed through the suction screen in the sump. After being filtered, the oil is fed through a drilled passage to the oil pressure relief valve, located in the upper right side of the crankcase in front of the accessory housing. This relief valve regulates the engine oil pressure by allowing excessive oil to return to the sump, while the balance of the pressure oil is fed to the main oil gallery in the right half of the crankcase. Residual oil is returned by gravity to the sump, where after passing through a screen it is again circulated through the engine.

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
Failure of engine to start.	Lack of fuel.	Check fuel system for leaks. Fill fuel tank. Clean dirty lines, strainers or fuel valves.
	Overpriming.	Open throttle and "unload" engine by engaging starter. Mixture in Idle Cut-off.
	Incorrect throttle setting.	Open throttle to one fourth of its range.
	Defective spark plugs.	Clean and adjust or replace spark plugs.
	Defective ignition wire.	Check with electric tester and replace any defective wires.
	Defective battery.	Replace with charged battery.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Failure of engine to start. (cont.)	Improper operation of magneto breaker.	Cleaning points. Check timing of magnetos.
	Lack of sufficient fuel flow.	Disconnect fuel line at fuel injector and check fuel flow.
	Internal failure.	Check oil screens for metal particles. If found, complete overhaul of engine may be indicated.
Engine is hard starting.	Low voltage or defective vibrator.	Measure voltage between vibrator terminal marked "IN" and the ground terminal while operating starter. There must be at least 13 volts.
	Inoperative or defective vibrator.	If voltage is adequate, listen for buzzing of vibrator during starting. If no buzzing is heard, either the vibrator is defective or the circuit from the "Output" terminal on the vibrator to the retard contact assembly is open. Check both "Switch and Retard" circuits. Also check for good electrical ground.
	Retard contact assembly in magneto not operating electrically. Engine may kick back during cranking due to advance timing of ignition.	Retard points may not be closing due to wrong adjustment, or may not be electrically connected in circuit due to a poor connection. Inspect retard points to see if they close. Check for proper contact at the "Switch" and "Retard" leads at magneto and at the vibrator. Check wiring.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Engine is hard starting. (cont.)	Vibrator-magneto combination not "putting-out" electrically.	Turn engine in proper direction of rotation until retard points just open No. 1 cylinder position. Remove input connection from starter to prevent engine turning and while holding No. 1 plug lead .19 of an inch from ground energize vibrator by activating the starter switch. Plug lead should throw a .19 of an inch spark. If spark is weak or missing try new vibrator. If this does not correct trouble check magneto for improper internal timing or improperly meshed distributor gears.
	Magneto improperly timed to engine.	Check magneto to engine timing.
	Advance contact assembly out of adjustment (internal timing off).	Check magneto timing.
	Retard points opening too late.	Check timing of retard points.
Failure of engine to idle properly.	Incorrect idle mixture.	Adjust mixture.
	Leak in the induction system.	Tighten all connections in the induction system. Replace any parts that are defective.
	Incorrect idle adjustment.	Adjust throttle stop to obtain correct idle.
	Uneven cylinder compression.	Check condition of piston rings and valve seats.
	Faulty ignition system.	Check entire ignition system.
	Insufficient fuel pressure.	Adjust fuel pressure.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Low power and uneven running.	Mixture too rich as indicated by sluggish engine operation, red exhaust flame at night. Extreme cases indicated by black smoke from exhaust.	Readjustment of fuel injector by authorized personnel is indicated.
	Mixture too lean; indicated by overheating or backfiring.	Check fuel lines for dirt or other restrictions. Check fuel injection nozzles.
	Leaks in induction system.	Tighten all connections. Replace defective parts.
	Defective spark plugs.	Clean and gap or replace spark plugs.
	Improper fuel.	Fill tank with fuel of recommended grade.
	Magneto breaker points not working properly.	Clean points. Check timing of magnetos.
	Defective ignition wire.	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.
	Nozzles clogged.	Clean or replace.
Failure of engine to develop full power.	Leak in the induction system.	Tighten all connections and replace defective parts.
	Throttle lever out of adjustment.	Adjust throttle lever.
	Improper fuel flow.	Check strainer, gauge and flow at fuel injector inlet.
	Restriction in air scoop.	Examine air scoop and remove restrictions.
	Improper fuel.	Drain and refill tank with recommended fuel.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Failure of engine to develop full power (cont.)	Prop out of rig.	Adjust prop.
	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.
Rough engine.	Cracked engine mount.	Repair or replace mount.
	Defective mounting bushings.	Install new mounting bushings.
	Uneven compression.	Check compression.
	Defective spark plugs.	Try new spark plugs.
	Defective plug leads.	Check plug leads for continuity and break down. Check distributor block for moisture and carbon tracking. Check contact springs in distributor block. Check magneto contact assemblies for burning or dirt, (Main and Retard). Check distributor timing.
	Magneto check out-of-limits.	Check magneto-to-engine timing. Inspect contact assemblies for proper opening.
	Blocked fuel injector nozzles.	Check plugs and leads. Clean or replace nozzles.
Low oil pressure.	Insufficient oil.	Fill sump with recommended oil.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line.	Check gasket between accessory housing and crankcase.
	Dirty oil strainers.	Remove and clean oil strainers.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Low oil pressure. (cont.)	High oil temperature.	See "High oil temperature" in "Trouble" column.
	Defective pressure gauge.	Replace gauge.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.
High oil temperature.	Insufficient air cooling.	Check air inlet and outlet for deformation or obstruction.
	Insufficient oil supply.	Fill oil sump to proper level with specified oil.
	Low grade of oil.	Replace with oil conforming to specifications.
	Clogged oil lines or strainers.	Remove and clean oil strainers.
	Excessive blow-by	Usually caused by worn or stuck rings.
	Failing or failed bearings.	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gauge.	Replace gauge.
	Defective thermostatic bypass valve.	Replace.
Excessive oil consumption.	Low grade of oil.	Fill tank with oil conforming to specifications.
	Failing or failed bearings.	Check sump for metal particles.
	Piston rings worn.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Excessive oil consumption. (cont.)	Failure of rings to seat. (New nitrided cylinders.)	Use mineral base oil. Climb to cruise altitude at full power and operate at 75% cruise power setting until oil consumption stabilizes.

REMOVAL OF ENGINE. (Refer to Figure 71-1.)

The removal of either engine is basically the same procedure, though the routing of some wires, cables, lines, etc., does vary between engines. Each line should be identified to facilitate reinstallation and covered, where disconnected, to prevent contamination.

1. Turn off all cockpit switches and then disconnect the battery ground wire at the battery.
2. Move the fuel valve control lever located on the outboard side of the fuel selector panel, labeled "Emergency Fuel Shut-off," to the OFF position.
3. Remove the engine cowling.
4. Remove the access panels on the top, sides and inboard bottom of the nacelle, just aft of the fire wall.
5. Drain the engine oil, if desired, and reinstall drain plug.
6. Remove the propeller per Chapter 61.
7. Disconnect the starter cable at the starter, remove the cable clamps at the left side of the engine and engine mount, and draw the cable aft through the engine baffle to the fire wall.
8. Disconnect the alternator primary cable that leads from the fire wall at the filter box located on the right lower side of the engine mount. Disconnect the field wire.
9. Disconnect the electrical leads to the oil temperature sender at the accessory housing, the cylinder head temperature probe at the number six cylinder and the exhaust temperature at the aft side of the exhaust manifold.
10. Disconnect the magneto ground leads and the retard spark lead of the left magneto at the magneto.
11. Disconnect the propeller deicer electrical wires (optional equipment).
12. Disconnect the pressure pump hose at the upper left side of the fire wall.
13. Disconnect the tachometer drive cable at the engine accessory housing.
14. Disconnect the throttle and mixture control cables at the injector, the governor control cable at the governor and the alternate air door control cable at the left side of the oil filter plenum. Disconnect the cables from their attachment clamps.
15. Disconnect the hydraulic pressure line at the hydraulic oil filter on the fire wall.
16. Disconnect the hydraulic suction, fuel supply, fuel flow pressure, fuel pressure, air deck pressure, oil pressure, manifold pressure, deicer (optional equipment) lines at the fire wall.
17. Attach a one half ton (minimum) hoist to the hoisting hooks and relieve the tension on the engine mount.
18. Remove the nuts and washers from the bolts that attach the engine mount to the fire wall.
19. Remove the engine mount mounting bolts and swing the engine a few inches from the fire wall. Check the engine for any attachments remaining to obstruct its removal.
20. Swing the engine clear and place on a suitable support.

INSTALLATION OF ENGINE.

The installation of either engine is basically the same procedure, though the routing of some wires, cables, lines, etc., does vary between engines. Before starting (Refer to latest revision of Lycoming Servicing Instruction No. 1241 for Pre-Oiling), ascertain that all components of the engine mount, turbocharger unit, exhaust stacks, etc., are installed.

1. With a one half ton hoist (minimum) attached, swing the engine in position.
2. Align the mounting holes in the engine mount with the mounting holes in the fire wall. Install the mounting bolts through from the aft side of the fire wall. Install washers and nuts, and torque.

3. Connect the hydraulic suction, fuel supply, fuel flow pressure, fuel flow, air deck pressure, oil pressure, manifold pressure, and deicer (if installed) lines to the fire wall fittings.
4. Connect the hydraulic pressure line at the hydraulic oil filter on the fire wall.
5. Connect the throttle and mixture control cables to the injector, install cable clamps, and rig.
6. Connect the governor control cable to the governor, install cable clamps and bracket and check rigging.
7. Connect the alternate air door control cable to the air door control arm and adjust the cable end on the control arm so that when the control knob in the cockpit is full in, there will be approximately one eighth inch between the control arm roller and the fully closed door.
8. Connect the tachometer drive cable to the drive on the accessory housing.
9. Connect the pressure pump hose to the fitting on the upper left side of the fire wall.
10. Connect the propeller deicer electrical leads (if installed).
11. Connect the magneto ground leads and the retard spark lead to the left magneto.
12. Connect the electrical leads to the oil temperature sender at the accessory housing, the cylinder head temperature at the probe at the number six cylinder and the exhaust temperature probe at the aft side of the exhaust manifold.
13. Connect the alternator primary cable to the filter box located on the lower right side engine mount. Connect the field wire.
14. Route the starter cable through the lower side of the left aft engine baffle and attach the cable end to the starter. Secure cable with clamps at the engine mount and the engine.
15. Ascertain that the magneto switches are off and install the propeller per Chapter 61.
16. Install the proper grade and amount of engine oil.
17. Connect the battery ground wire at the battery.
18. Turn on the fuel valve, open the throttle full and turn on the electric fuel pump and check the fuel lines for leaks.
19. Install the access plates on the engine nacelle and the cowling.
20. Perform an engine operational check.

COWLING.

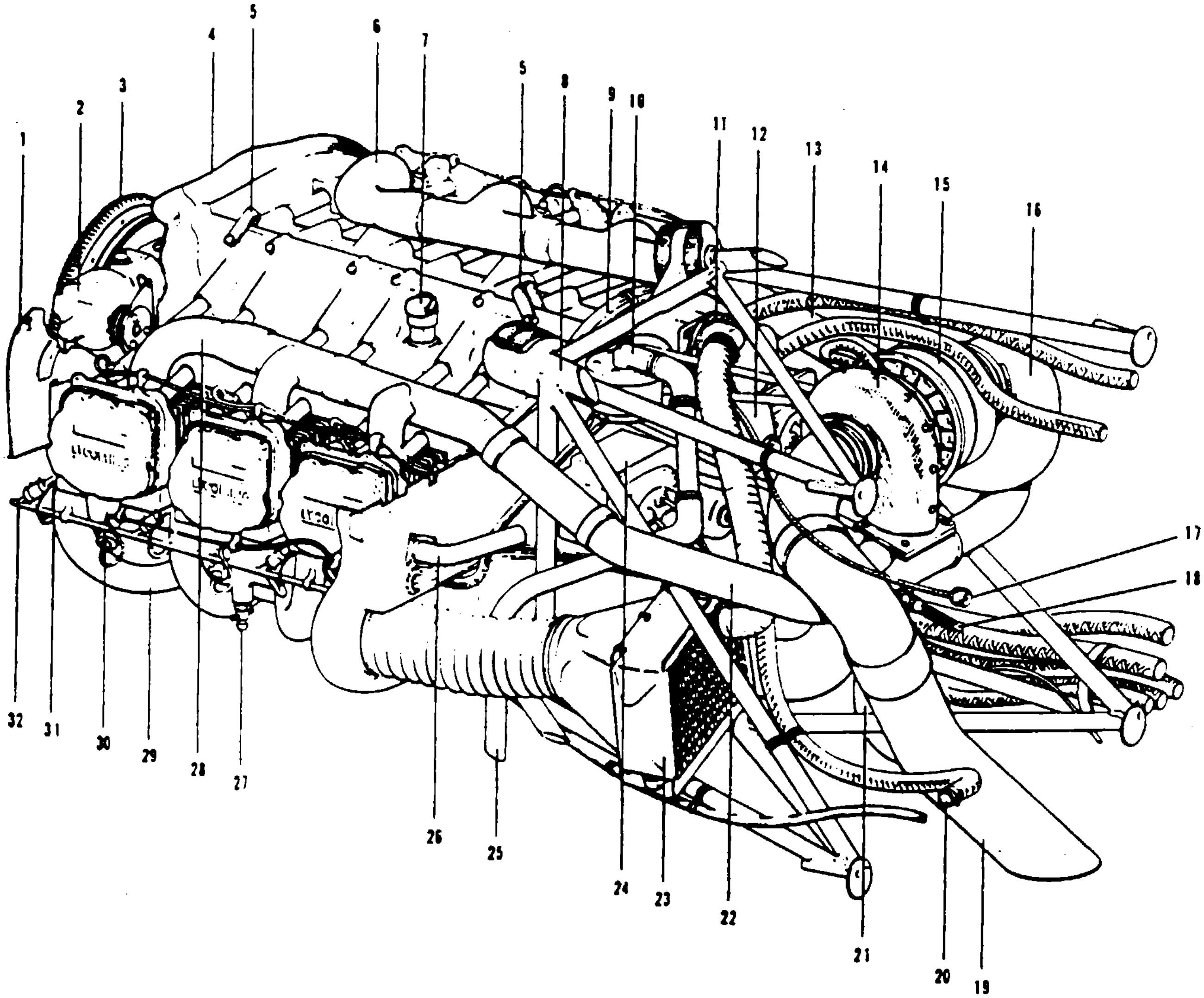
REMOVAL OF ENGINE COWLING. (Refer to Figure 71-2.)

The procedure for removing the cowling is the same for either engine.

1. Release the fasteners that attach the two cowl halves.
2. To remove the cowl half, disconnect the cowl flap control rods from the flap, support the cowl and release the screw fasteners that secure the aft section to the nacelle.

—CAUTION—

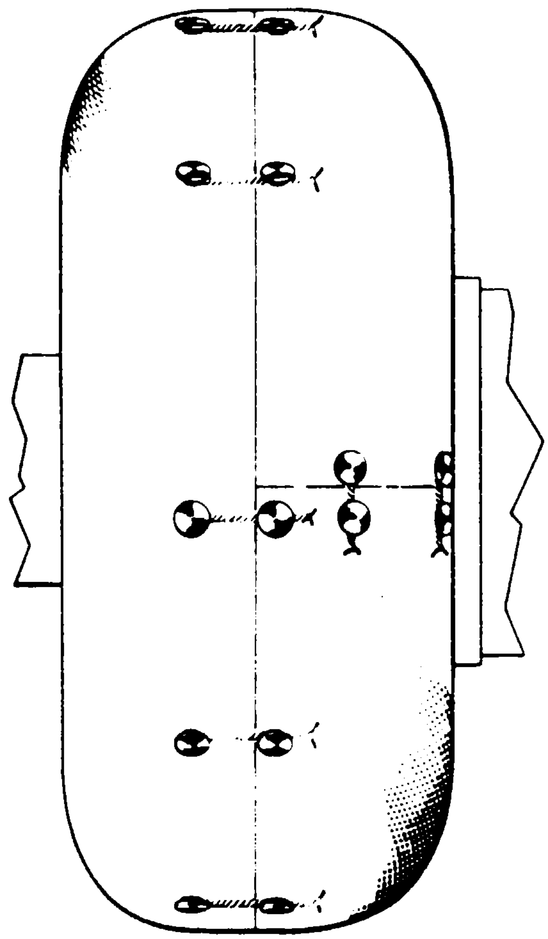
Ground running with the cowling removed, maximum power ground running is limited to two minutes or cylinder head temperature of 450° F, whichever is reached first. Prolong ground running with the cowling removed could cause local hot spots in the cylinders and irreversible engine damage.



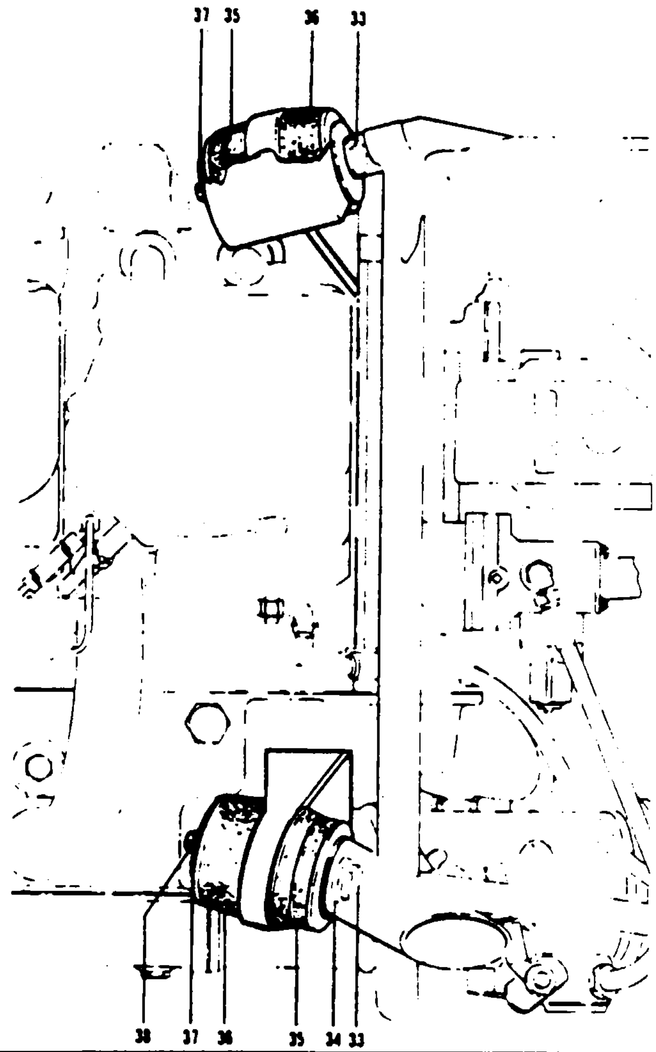
NOTE

Torque nuts on AN6-41A bolts attaching the engine mount to the firewall 17 to 20 foot-pounds.

Figure 71-1. Engine Installation



SKETCH A



SKETCH B

1. BAFFLE, LEFT FRONT
2. GOVERNOR, PROPELLER
3. RING GEAR, STARTER
4. BAFFLE, RIGHT FRONT
5. STRAP, LIFTING
6. EXHAUST STACK, RIGHT
7. OIL FILLER
8. ENGINE MOUNT ASSEMBLY
9. HARNESS ASSEMBLY
10. OIL SEPARATOR
11. PUMP, PRESSURE
12. FILTER, OIL
13. EXHAUST STACK EXTENSION, R
14. TURBINE ASSEMBLY
15. COMPRESSOR ASSEMBLY
16. EXHAUST, TAIL PIPE, UPPER
17. SHAFT, TACHOMETER
18. THERMOCOUPLE
19. TAIL PIPE, BOTTOM
20. HOSE, INTAKE, PRESSURE PUMP
21. EXHAUST PLENUM
22. EXHAUST STACK EXTENSION, L
23. COOLER, OIL
24. MAGNETO ASSEMBLY
25. TUBE, BREATHER
26. TUBE, MAGNETO COOLING
27. DRAIN, ENGINE SUMP
28. EXHAUST STACK, LEFT
29. PIPE, INTAKE
30. SPARK PLUG
31. NOZZLE, INJECTOR
32. TUBE, AIR BLEED
33. BOLT
34. BUSHING
35. SHOCK MOUNT, (GOLD CODING)
36. SHOCK MOUNT, (SILVER CODING)
37. WASHER
38. NUT
39. TUBE, INDUCTION AIR

Figure 71-1. Engine Installation (cont.)

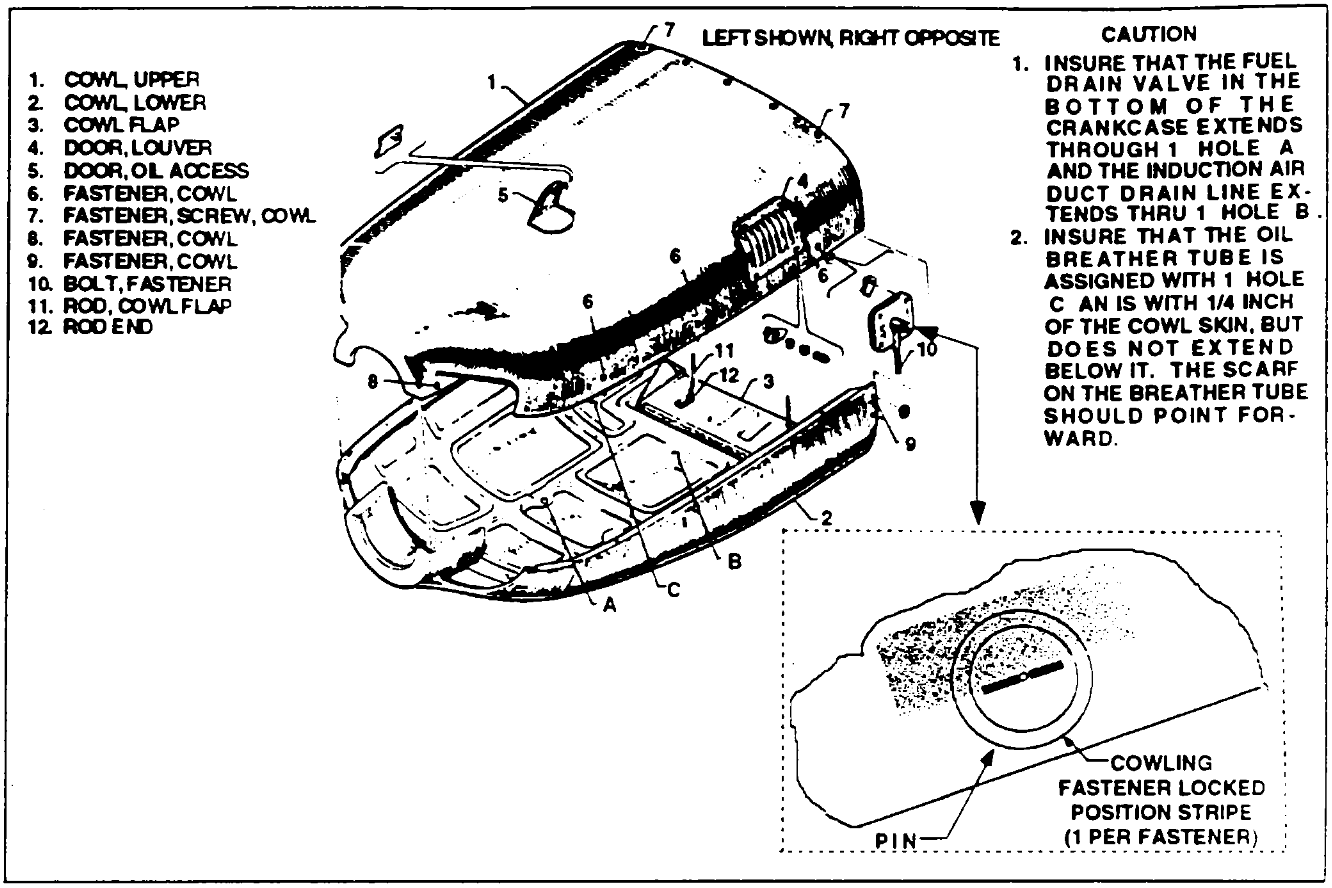


Figure 71-2. Engine Cowling

CLEANING, INSPECTION AND REPAIR.

1. The cowling 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 ENGINE COWLING. (Refer to Figure 71-2.)

The procedure for installing the cowl is the same for either engine.

1. Position the upper cowl half and secure with screw fasteners along the aft section of the cowl.

WARNING

The cowling fastener locked position stripe must be maintained.
Refurbish or replace stripe if faded, missing or cowling is repainted

2. Raise the lower half to join the upper half using caution so as not to damage the tubes which extend through the cowl bottom. Secure the screw fasteners along the aft section of the cowl and lock the fasteners that join the two halves. Fasteners have a dark line painted along the top half of the fastener and cowling. This is done so a visual check can distinguish when the fasteners are open or closed. In addition to the paint stripe, each fastener has a pin in the center of the screw slot that will protrude into the slot, if properly locked, when screw driver is removed.

ENGINE COWL FLAP.

REMOVAL OF COWL FLAP TRANSMISSION. (Refer to Figure 71-3.)

1. Remove the access plate on the top and left side of the engine nacelle just aft of the fire wall.
2. Disconnect the electrical leads at the transmission motor.
3. Disconnect the transmission actuating rod from the torque tube arm.
4. Disconnect the transmission from its mounting bracket and remove it from the engine nacelle.
5. The torque tube may be removed by disconnecting the two cowl flap control rods from the torque tube and removing the cap bolts that secure the torque tube bearing blocks.

CLEANING, INSPECTION AND REPAIR OF COWL FLAP TRANSMISSION.

1. Clean the transmission assembly with a suitable solvent.
2. Inspect the transmission tube for excessive end or side play on the transmission screw.
3. Ascertain that the transmission tube, screw and rod are not distorted or bent.
4. Check that the screw bearing is not loose on the transmission screw or within the transmission housing. Excess wear can be determined by holding the transmission and moving the screw up and down.
5. Check for excess wear within the transmission by turning the screw by hand and noting the end and side play in the transmission drive shaft. End play should not be great enough to cause end pressure on the motor drive shaft.
6. Should any of these checks show excess wear, corrosion or damage, the transmission or its components should be replaced.
7. After the transmission screw and tube have been cleaned and dried, a coating of Aircraft Grease and Actuator Grease, Specification MIL-G-23827 should be applied to the screw on Dukes transmission.
8. When the transmission assembly is disassembled for any reason or at 500 hours, the Dukes transmission should be repacked 3/4 minimum full with Dukes Formula No. 2 P/N 2196-74-1 grease.

INSTALLATION OF COWL FLAP TRANSMISSION. (Refer to Figure 71-3.)

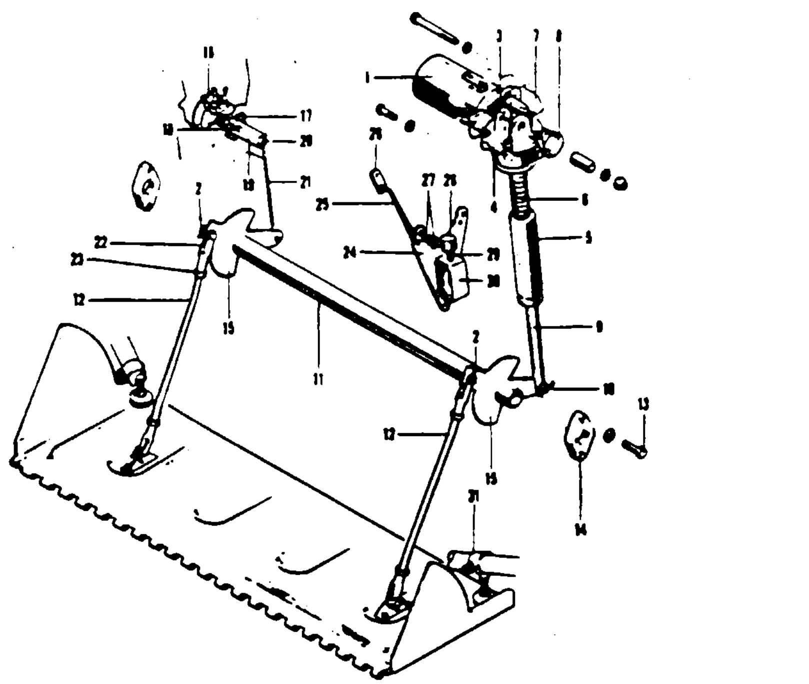
1. Install the torque tube with bearing blocks. Tighten the bearing block bolts after the tube and both blocks are in position.
2. Position the transmission assembly on its mounting bracket and secure. Allow the transmission to rotate on its mounting bolt.
3. Attach the transmission actuating rod on the left torque tube arm. Tighten connecting bolt finger tight and safety.
4. Attach the rods to the torque tube.
5. Connect the electrical leads.
6. Check adjustment of cowl flap and position sender.
7. Install access plates.

RIGGING AND ADJUSTMENT OF COWL FLAP. (Refer to Figure 71-3.)

1. With the cowl flap actuator set to full open position, adjust the rod assemblies to obtain 4.50 inches opening, measured vertically to the bottom of the cowl, at the rear edge of the cowl flap.
2. With the cowl flap actuator set to the closed position, adjust the support assemblies to contact the cowl flap plus .12 of an inch preload. (Approximately .75 to 1.00 inch open measured vertically to the bottom of the cowl, at the rear edge of the cowl flap.)
3. Secure all jam nuts after adjustments have been completed.

REMOVAL OF COWL FLAP POSITION SENDER ASSEMBLY. (Refer to Figure 71-3.)

1. Remove the access plate located on top of the engine nacelle aft of the fire wall.
2. Disconnect the electrical leads from the sender unit.
3. Loosen the bolt assembly that locks the arm on the sender shaft.
4. Turn off the locknut that secures the sender from its mounting bracket.



1. MOTOR, FLAP
2. PIN AND COTTER PIN
3. COUPLING
4. COVER, TRANSMISSION
5. TUBE, TRANSMISSION
6. SCREW, TRANSMISSION
7. BRACKET, MOUNTING
8. TRANSMISSION
9. ROD, TUBE
10. BOLT ASSEMBLY
11. TUBE TORQUE
12. ROD, COWL FLAP
13. BOLT
14. BLOCK, BEARING
15. ARM, TORQUE TUBE
16. SENDER
17. BOLT ASSEMBLY
18. SHAFT, SENDER
19. ARM, SENDER
20. BOLT, PIVOT
21. ROD
22. ROD END
23. NUT,LOCK
24. SOLENOID MOUNTING BRACKET
25. ROD, MOTOR BRAKE SUPPORT
26. LINK, BRACKET ATTACHMENT
27. WASHER & NUT
28. PLUNGER, BRAKE SOLENOID
29. SPRING, SOLENOID PLUNGER
30. SOLENOID, MOTOR BRAKE
31. SUPPORT ASSEMBLY

Figure 71-3. Cowl Flap Transmission and Sender Assembly

INSTALLATION OF COWL FLAP POSITION SENDER ASSEMBLY. (Refer to Figure 71-3.)

1. Start the sender unit through its mounting hole far enough to start the locknut and the sender arm on its shaft.
2. Position the sender by placing the index tab on the sender into the index slot in the mounting bracket and secure the sender. Allow the arm free to rotate on its shaft until the sender is rigged to the position indicator.
3. Connect the electrical leads to the sender.
4. Rig the sender.
5. Install access plate.

RIGGING AND ADJUSTMENT OF COWL FLAP POSITION SENDER. (Refer to Figure 71-3.)

1. Remove the access plate located on top of the engine nacelle aft of the fire wall.
2. Ascertain that there is approximately 4.75 inches between the center of the pivot bolt on the sender arm and the rod hole in the torque tube arm by adjusting pivot bolt on the rod that connects the two arms.
3. Ascertain that the cowl flap is properly adjusted.
4. With the sender arm free to rotate and the cowl flap door aligned with the bottom cowl, rotate the sender shaft, as viewed from the shaft end, in a clockwise direction to its stop position.
5. Turn on the master switch. A minimum of 24 volts must be supplied to the electrical system when making this adjustment.
6. Rotate the sender shaft slowly counterclockwise, when viewed from the shaft end, until the flap indicator on the instrument panel reads flap closed. Tighten the arm on the sender shaft.
7. Operate the flap to the open and close positions and observe the indicator reading. Indicator pointer should travel to both opened and closed position on the indicator dial.
8. Install the access plate.

MOUNTS.

REPLACING ENGINE SHOCK MOUNTS.

The engine shock mounts may be replaced with the engine installed as well as removed from the airplane. Refer to Figure 71-1 for the arrangement of the shock mount assemblies. The top shocks are assembled so the silver colored shocks are aft and the gold colored shocks are forward. The lower shock mounts are installed opposite of the top shock mounts. The procedure described in this paragraph is with the engine installed.

1. Remove the engine cowling.
2. Attach a one half ton (minimum) hoist to the engine hoisting hooks and relieve tension from the shock mounts.
3. Loosen the upper shock mount attachment nuts.
4. Remove the lower mount attachment nuts, washers, forward shock mounts and spacers.

5. Remove the lower attachments bolts just far enough to allow the aft shock mounts to be removed. The bushing in each lower mount must be removed with the bolt.

—NOTE—

Due to limited access, it may become necessary to cut off a portion of the attachment bolts to aid in removal. Should this be the case, use care not to damage other equipment.

6. Raise the nose of the engine enough to remove the lower aft shock mounts and replace with new ones.

—NOTE—

Care should be taken not to introduce adverse stresses on the control cables, electrical cables, hoses and other items attached to the engine while hoisting the engine

7. Lower the engine, slide the attachment bolts with bushings into place and install the spacers, forward shock mounts, washers and nuts. Start nuts only a few threads.
8. Remove the upper mount attachment bolts, nuts, washers, heat shield, forward shock mounts and spacers.
9. Lower the engine enough to replace the upper aft shock mounts. Raise the engine into position.
10. Install the spacers, forward shock mounts, heat shield, mounting bolts, washers and nuts. Rotate the shield to provide greatest protection against exhaust heat.
11. Tighten attachment bolts 34 to 42 foot-pounds.

—END—

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CHAPTER

73

ENGINE FUEL AND CONTROL

CHAPTER 73 - ENGINE FUEL AND CONTROL

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GENERAL.

DISTRIBUTION.

FUEL INJECTOR.

FUEL INJECTOR MAINTENANCE.

1. In general, little attention is required between injector overhauls. However, it is recommended that the following items be checked during periodic inspection of the engine:
   A. Check tightness and lock of all nuts and screws which fasten the injector to the engine.
   B. Check all fuel lines for tightness and evidence of leakage. A slight fuel stain adjacent to the air bleed nozzles is not cause for concern.
   C. Check throttle and mixture control rods and levers for tightness and lock.
   D. Remove and clean the injector fuel inlet strainer at the first 25 hour inspection and each 50 hour inspection thereafter. Damaged strainer O-rings should be replaced.
2. Tests prove that gasoline which becomes stale due to prolonged storage absorbs oxygen rapidly. This stale oxidized gasoline acquires a very distinctive odor similar to varnish, causes rapid deterioration of synthetic rubber parts, and also forms a gummy deposit on the internal metal parts. This condition, however, does not occur during normal operation of the injector where fresh fuel is being constantly circulated.

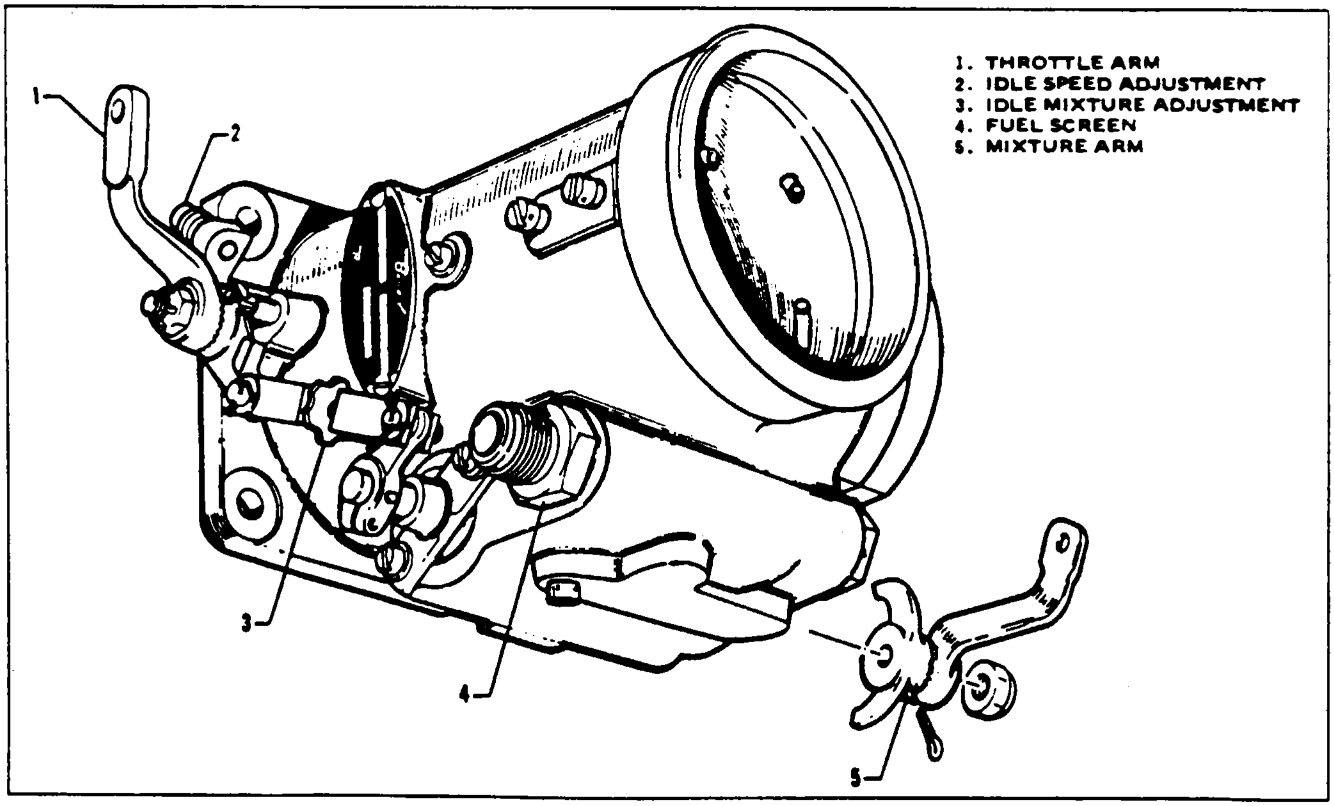

Figure 73-1. Fuel Injector

LUBRICATION OF FUEL INJECTOR.

1. There is very little need for lubrication of the injector in the field between regular overhauls. However, the clevis pins used in connection with the throttle and manual mixture control levers should be checked for freedom of movement and lubricated, if necessary.
2. Place a drop of engine grade oil on the end of the throttle shaft in such a manner that it can work into the throttle shaft bushings.

REMOVAL OF FUEL INJECTOR.

1. Remove the lower cowl panel.
2. Disconnect the throttle and mixture control cables at the injector.
3. Disconnect the fuel inlet, flow, pressure and discharge lines at the injector.
4. Remove the bolts securing the injector to the engine.
5. Loosen the two clamps securing the hose that is between the injector and injector inlet plenum.
6. Disconnect the necessary hoses and lines to the injector inlet plenum, so that the plenum may be moved aft far enough to allow the injector to be removed.

PREPARATION FOR STORAGE.

Any unit taken out of service, or units being returned for overhaul, must be flushed with preserving oil (Specification MIL-O-6081, Grade 1010), using the following procedure:

1. Remove plugs and drain all fuel from the injector. If available, apply 10 to 15 psi air pressure to the fuel inlet until all fuel is discharged from the injector.
2. Replace plugs and apply flushing oil filtered through a 10 micron filter at 13-15 psi to the injector fuel inlet until oil is discharged from the outlet.
3. Replace fuel inlet shipping plug.

—CAUTION—

Do not exceed 15 psi air pressure as internal damage to the injector may result.

4. After filling with preservative oil, the injector should be protected from dust and dirt and given such protection against moisture as climatic conditions at the point of storage require. In most cases, storing the unit in a dry area will be sufficient.
5. If the unit is to be stored near or shipped over salt water, the following precautions should be observed:
   A. Spray the exterior of the injector with an approved preservative oil.

B. Pack in a dustproof container, wrap the container with moisture and vapor-proof material, and seal. Pack the wrapped unit in a suitable shipping case. Pack a one-half pound bag of silica gel crystals in the dustproof container with injector. The bag must not touch the injector.

—CAUTION—

Extreme caution should be exercised when handling or working around the injector to prevent oil or fuel from entering the air sections of the injector. As explained previously, damage to the air diaphragm will result. Fluid can easily enter the all section of the injector through the impact tubes or the annular groove around the venturi. For this reason, a protective plate should be installed on the scoop mounting flange when performing routine maintenance on the engine, such as washing down the engine and air scoop, servicing the air filter (surplus oil on the element), or when injecting preservative into the engine prior to storing or shipping.

INSTALLATION OF FUEL INJECTOR.

1. Move the injector inlet plenum aft enough to allow the injector with gasket to be installed. Install attachment bolts and torque (refer to Lycoming Torque Specs).
2. Install and secure the hose between the injector and turbocharger.
3. Connect the hoses and links that were disconnected from the turbocharger.
4. Connect the fuel inlet, flow, pressure and discharger lines to the injector.
5. Connect the throttle and mixture control cables to the injector. Rig controls.
6. Pressure check for leaks.
7. Replace cowling.
8. Adjust idle speed and mixture.

FUEL AIR BLEED NOZZLE.

REMOVAL OF FUEL AIR BLEED NOZZLE.

The nozzles must be carefully removed as they or the cylinders may be damaged.

1. Remove the lower engine cowl.
2. Disconnect the fuel line from the nozzle.
3. Remove the spring retainer and spring from the nozzle stem.
4. Disconnect the nozzle shroud from the vent hose and remove it from the nozzle.
5. Carefully remove the nozzle, using the correct size deep socket.

CLEANING AND INSPECTION OF FUEL AIR BLEED NOZZLE.

1. Clean the nozzle with acetone or equivalent and blow out all foreign particles. Do not use wire or other hard objects to clean orifices. (Refer to the latest revision of Lycoming Service Instruction No. 1275.)
2. Inspect and replace nozzle O-rings if found to be cracked, brittle or distorted.
3. A test procedure for air bleed nozzles is described on latest revision of Lycoming Service Instruction No. 1275.

INSTALLATION OF FUEL AIR BLEED NOZZLE.

1. Install the nozzles and torque to 60 inch-pounds.
2. Ascertain that the O-rings are properly installed on the nozzle stem and install the nozzle shroud. (Refer to Figure 73-2.)
3. Connect the vent to the nozzle shroud.
4. Install the spring and spring retainer on the nozzle stem.
5. Connect the fuel line to the nozzle and clamp the fuel lines as described in latest revision of Lycoming Service Bulletin No. 335.
6. Install the engine cowl.

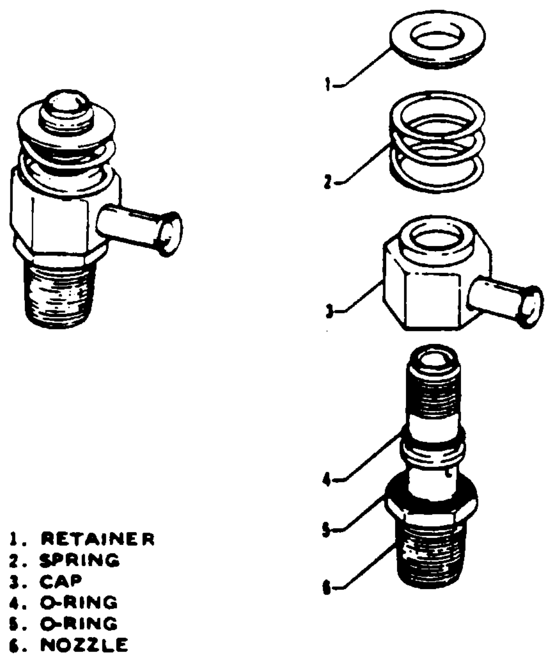

Figure 73-2. Fuel Air Bleed Nozzle

INDICATING.

FUEL PRESSURE GAUGE.

The fuel pressure gauge instrument is mounted in the cluster on the instrument panel. This gauge is connected to the fuel system at the injector fuel inlet fitting.

TROUBLESHOOTING.

CHART 7301. TROUBLESHOOTING (FUEL PRESSURE GAUGE)

Trouble	Cause	Remedy
No fuel pressure indication.	Fuel valve stuck. Fuel valve off.	Check valve.
	No fuel in tanks.	Check fuel, fill.
	Defective fuel pump.	Check pump for pressure build-up. Check diaphragm and relief valves in engine pump. Check for obstruction in electric pump. Check bypass valve. Air leak in intake lines.
	Defective gauge.	Replace gauge.
Pressure low or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty bypass valve.	Replace.
	Faulty diaphragm.	Replace or rebuild pump.
Needle fluctuation.	Surge dome on pump filled with fuel.	Remove and empty.
	Air in line.	Loosen line at gauge, turn on electric pump. Purge line of air and retighten.

CHART 7301. TROUBLESHOOTING (FUEL PRESSURE GAUGE) (cont)

Trouble	Cause	Remedy
High fuel pressure with engine shut off right after flight.	Fuel in line expanding due to heat build up in cowling.	Normal.
Right fuel pressure fluctuates.	Heater in operation.	Normal.

REMOVAL AND INSTALLATION OF FUEL PRESSURE GAUGE.

1. Remove the hoses from the rear of the gauge.
2. Remove the mounting screws and withdraw the instrument from its position in the instrument panel.
3. Installation of the fuel pressure gauge will be in the reverse of removal.

FUEL FLOW GAUGE.

The fuel flow gauge is a non-electric differential pressure gauge mounted in the bottom of the instrument panel.

TROUBLESHOOTING.

CHART 7302. TROUBLESHOOTING (FUEL FLOW GAUGE)

Trouble	Cause	Remedy
Pointer oscillates.	Air in fuel line.	Purge line.
Gauge reads low at altitude.	Vent line restricted.	Check line and fittings.
Pointer does not return to zero.	Fuel in diaphragm of gauge.	Replace gauge.

REMOVAL OF FUEL FLOW GAUGE.

1. At the back of the instrument panel disconnect the plumbing from the instrument.
2. Remove the post light(s) by turning off nut.
3. Remove the screws which secure the instrument.
4. Remove the instrument from the panel.

INSTALLATION OF FUEL FLOW GAUGE.

1. Place the instrument in its proper panel cutout and secure with screws.
2. Install the post light(s) and secure. Do not overtighten the nut.
3. Thread tru-seal nut onto fittings until about four and one-half threads protrude beyond the teflon seal.
4. Thread fittings a minimum of three threads engagement into port of fuel flow gauge.
5. Using light to medium torque, tighten down tru-seal nut against port to complete leak-proof assembly.

FUEL FLOW LOW WARNING LIGHT.

Illumination of the Fuel Flow Low Warning Light, located in the annunciator panel, indicates impending fuel starvation due to insufficient fuel in the applicable inboard fuel tank.

—END—

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CHAPTER

74

IGNITION

4G11

CHAPTER 74 - IGNITION

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GENERAL.

DESCRIPTION AND OPERATION.

Bendix Scintilla S-1200 series magnetos are installed with their associated components. Each system consists of a single contact magneto, a dual contact magneto to obtain the retard spark necessary for starting, a starter vibrator, magneto switches and starter switch. The magnetos are designed to generate and distribute high tension current through high tension leads to the spark plugs.

With the magneto switches ON and the starter switch depressed the right side of the magneto is grounded and rendered inoperative while left side of the magneto (with retard breaker) continues to function. At the slow cranking speed of the engine the vibrator provides the high energy spark necessary to fire the spark plugs. The vibrator provides interrupted battery current to the primary coil of the magneto. The pulsating DC current is then stepped up by transformer action, producing a shower of sparks at the plugs for improved starting. When the engine fires and begins to increase speed, the starter switch is released, which in turn de-energizes the starter, opens the vibrator circuit and retard breaker circuit, thus rendering them inoperative. The right side of the magneto is no longer grounded and thus both magneto sides are simultaneously firing in full advance.

ELECTRICAL POWER SUPPLY.

MAGNETO.

INSPECTION OF MAGNETO.

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 distributor block. Check height of block contact springs (0.422 max. from top of block tower to spring). Also check for broken leads or damaged insulation. If either is present, remove magneto and replace. (Refer to Figure 74-1.).
5. 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 74-2 shows how the average contact point will look when surfaces are separated for inspection. Desired contact surfaces have a dull gray, sand-blasted (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.

6. Minor irregularities or roughness of point surfaces are not harmful. (Refer to Figure 74-2 center.) Neither are small pits or mounts, if not too pronounced. If there is a possibility of pit becoming deep enough to penetrate pad. Figure 74-2, right, reject contact assembly.

—*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.

7. Check the condition of the cam follower felt. Squeeze felt tightly between thumb and finger. If fingers are not moistened with oil, re-oil using 2 or 3 drops of Bendix 10-391200 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.
8. Check the capacitor mounting brackets for cracks or looseness. Using the Scintilla 11-1767-1, -2 or -3 Condenser Tester of equivalent, check capacitor for capacitance, series resistance and leakage. Capaciance shall be at lease 0.30 microfarads.
9. Check magneto to engine timing as follows:
   A. Connect Scintilla 11-851 timing light or equivalent across the main contact assembly.
   B. Slowly bring the engine up to number one cylinder advance firing position. At this instant the timing light should go out. If it does, the magneto is properly timed to the engine. If the timing light does not go out, removal of the magneto for internal timing check and inspection is recommended.

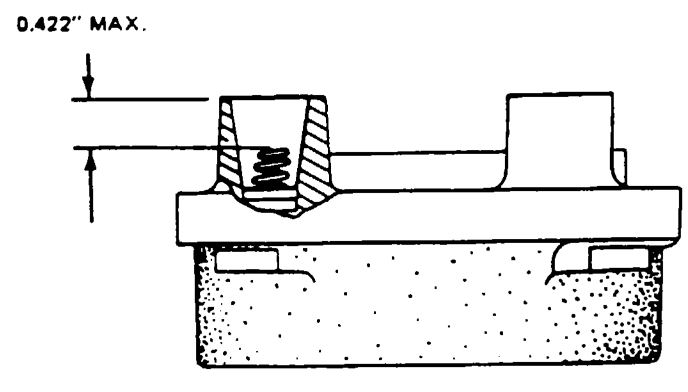


Figure 74-1. Height of Spring in Distributor Block Tower

—*NOTE*—

The magneto service instructions in this manual are to cover minor repairs and timing. For further repairs and adjustments of the magneto, it is recommended that the manufacturers recommended service instructions be followed.

REMOVAL OF MAGNETO.

Before removing the magneto, make sure magneto switches are off.

1. Remove the harness assembly terminal plate from the magneto.

—*WARNING*—

The magneto is not internally grounded; when the ground lead is disconnected, the magneto is hot. Removing the harness assembly terminal plate first and installing it last minimizes the danger of starting the engine accidentally when the ground lead is removed from the magneto.

2. Disconnect the ground lead and the retard spark lead on the left magneto, at the magneto.
3. Remove the nuts and washers and draw the magneto from the engine.

TIMING PROCEDURE (INTERNAL TIMING).

1. Remove the cover to the contact(s), distributor block, etc.
2. To internally time the main contact assembly of either the dual-breaker magnetos or the single-breaker magnetos, proceed as follows:

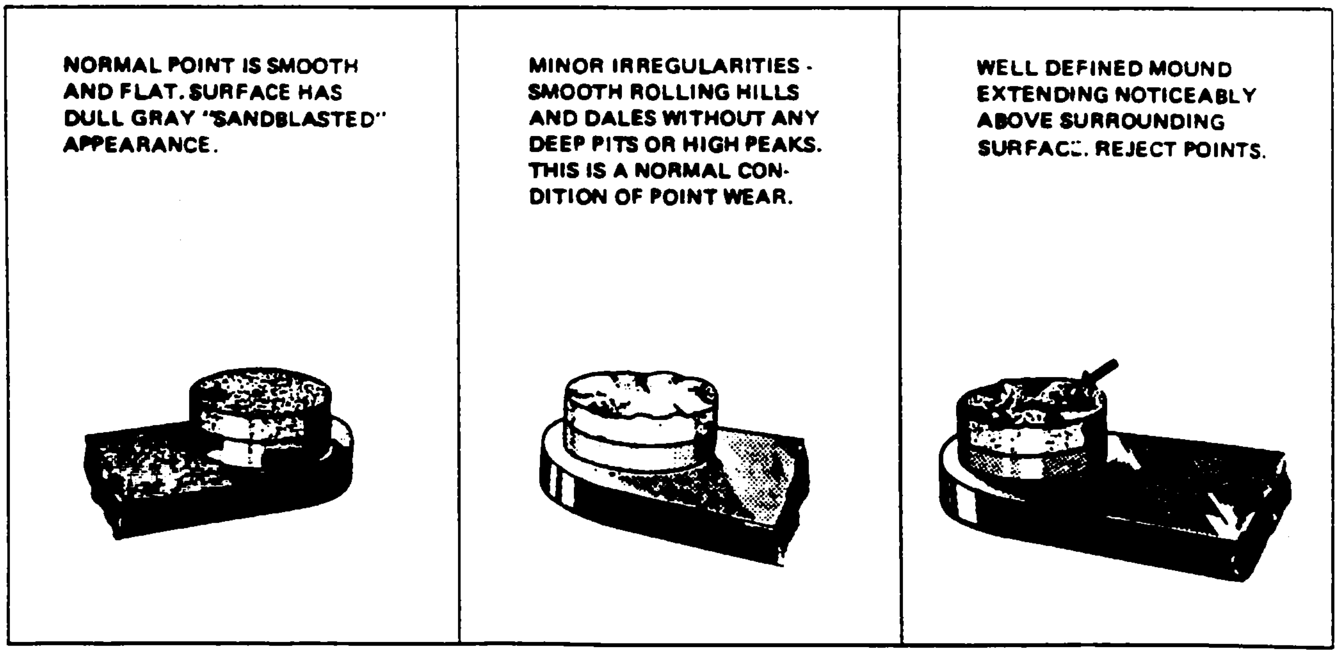


Figure 74-2. Contact Points

A. Loosen the nut securing the drive plate to the magneto shaft sufficiently in order to install the Scintilla 11-8465 Rotor Holding Tool under the nut and flat washer as shown in Figure 74-3. Tighten the nut securely.
B. Remove the timing inspection plug from the top of the magneto. Turn rotating magnet to proper neutral position. This position is determined by locating keyways on drive end of magnet shaft at 12 o'clock with respect to name plate on housing. Tighten adjusting knob of 11-8465 Rotor Holding Tool until pressure is applied on housing flange preventing magnet from turning.
C. Loosen and rotate cam until cam follower of main contact assembly rests on highest point of cam lobe. Adjust main contact assembly to obtain the clearance of 0.016 ± 0.003 of an inch. Tighten main contact assembly securing screws to 20-25 inch-pounds.
D. Install the 11 -8693 Timing Plate Assembly and the 11-8149 Pointer Assembly of the 11-8150 Scintilla Timing Kit to breaker compartment of magneto. (Refer to Figure 74-4.) Align pointer assembly with the 0° mark on timing plate. Loosen adjusting knob of 11-8465 Rotor Holding Tool and turn rotating magnet in normal direction of rotation until pointer indexes with the respective E gap mark (15° ± 2°).Tighten adjusting knob of 11-8465 Tool and remove the 11-8149 Pointer Assembly from magneto. Using a timing light, adjust main contact points to just open. This adjustment shall be made by rotating cam, in opposite direction of rotation, a few degrees beyond point where contacts close. Then rotate cam in normal direction of rotation until contacts just open. While holding cam in this exact position, push cam on magnet shaft as far as possible with the fingers. Extreme care must be exercised in this operation. If cam adjustment is changed in the slightest degree, the timing of the magneto will be thrown off. Do not drive cam on shaft with a mallet or other instrument. Tighten the securing screw thereby drawing the cam down, evenly and tightly. Torque screw to 16-20 inch-pounds. Loosen the 11-8465 Rotor Holding Tool adjusting knob and return rotating magnet to neutral position. Reinstall the 11-8149 Pointer Assembly over 0° mark on timing plate. Rotate magnet shaft in normal direction of rotation and check for opening of main contact points at E gap setting (15° ± 2°).

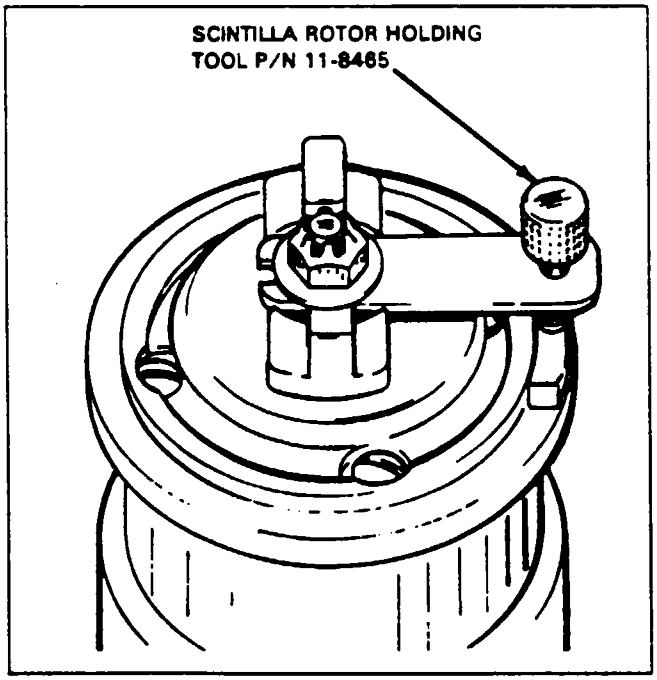


Figure 74-3. Rotor Holding Tool Installed

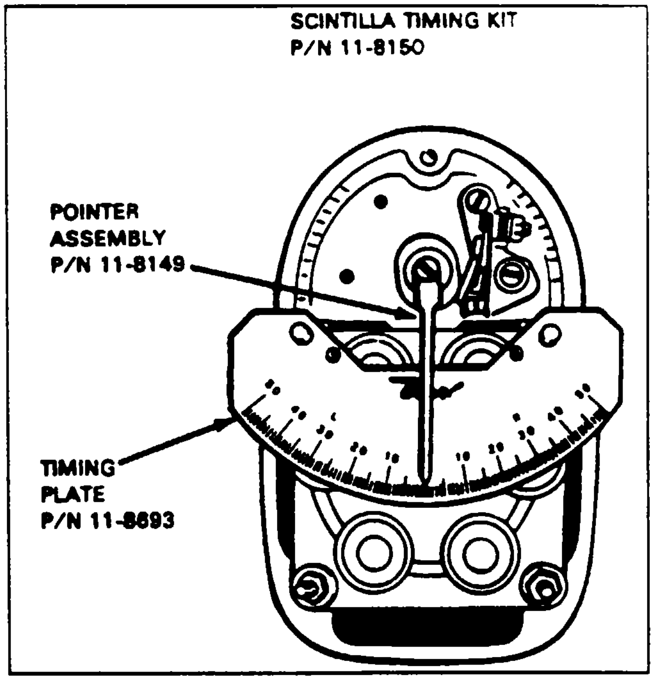
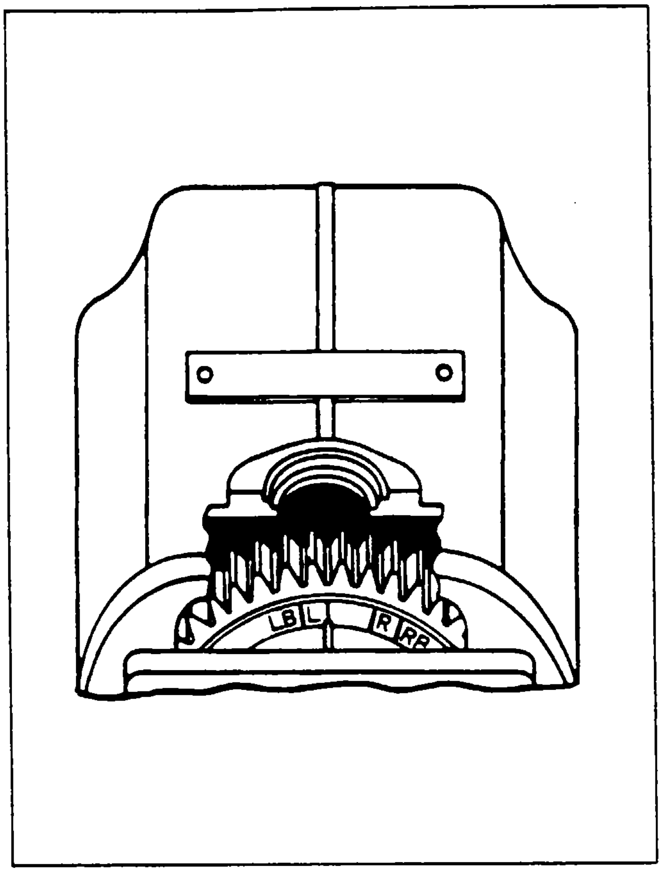


Figure 74-4. Timing Kit Installed

3. The retard contact assembly of the dual-breaker magnetos may be timed as follows:
   A. The retard contact assembly is adjusted to open a predetermined number of degrees after the main contact assembly opens. The degree of retard for any particular magneto is stamped in the bottom of the breaker compartment.
   B. Locate the exact point of main contact assembly opening and set the 11-8149 Pointer Assembly over the 0° mark on the 11-8693 Timing Plate Assembly. Turn rotating magnet in the direction of normal rotation until pointer indexes with the degree of retard. Tighten adjusting knob of 11-8465 Holding Tool and set retard contact assembly to just open, within +2° -0°. Tighten securing screws to 20-25 inch-pounds. Loosen adjusting knob of holding tool and turn rotating magnet until cam follower is on high point of cam lobe. Contact clearance shall be 0.016 ± 0.006 inch. If dimension is not within limits, re-adjust contact assembly and recheck to be sure that points will open within retard degree tolerance. Remove the 11-8150-1 Timing Kit and two studs from the magneto.
4. If the distributor block was not removed from the housing, the internal timing may be checked by turning the magneto in the normal rotation to number one firing position (keyway up and main points just opening). At this position, the reference line on the distributor block should line up between the L and LB marks on the gear. On single contact magnetos the line should favor the L mark and on the dual contact magnetos the line should favor the LB mark, if possible.
5. If the distributor block was removed from the housing, the distributor gear alignment and internal check may be accomplished as follows:
   A. Turn rotating magnet in direction of rotation until it is located in firing position (keyway up and main points just opening). Tighten adjusting knob of 11-8465 Rotor Holding Tool. Apply a light coating of Bendix Grease P/N 10-27165 to teeth of distributor gear, if needed. The large distributor gear incorporates four timing marks, L and LB for left hand rotation and R and RB for right hand rotation.
   B. With distributor gear assembled to block, turn gear until raised rib on block lines up between the L and LB marks. Assemble block and gear into housing, meshing the distributor gears together. For the dual contact assembly magneto, distributor block rib must align between painted marks. However, the rib should favor the LB mark, if possible. (Refer to Figure 74-5.) On the single contact magneto the rib should favor the L mark.
   C. Secure distributor block to housing with studs and washers. Tighten studs finger tight. Loosen the 11-8465 Rotor Holding Tool and turn rotating magnet in reverse direction of rotation until timing light indicates main contact assembly has just opened and check to make certain timing marks align within tolerance indicated above. Tighten block securing studs, first to 4-8 inch-pounds torque and then final torque to 18 to 22 inch-pounds.
   D. Insert the tip of your small finger through timing hole in housing and against large distributor gear teeth. Rock distributor gear back and forth slightly. There must be perceptible backlash between teeth of large and small gears. This check should be made at three different points, 120° apart on gear. If backlash is not evident, replace large distributor gear.
   E. Install the breaker cover and complete reassembly of the magneto. Refer to the manufacturer's publications for complete disassembly and reassembly procedures.
6. Install and time magneto, removed from engine.
7. Secure external switch and retard leads to the breaker cover terminals. Connect harness assembly to the magneto.

INSTALLATION AND TIMING PROCEDURE. (Timing Magneto to Engine.)

1. Remove a spark plug from No. 1 cylinder and turn crankshaft in direction of normal rotation until the compression stroke is reached.



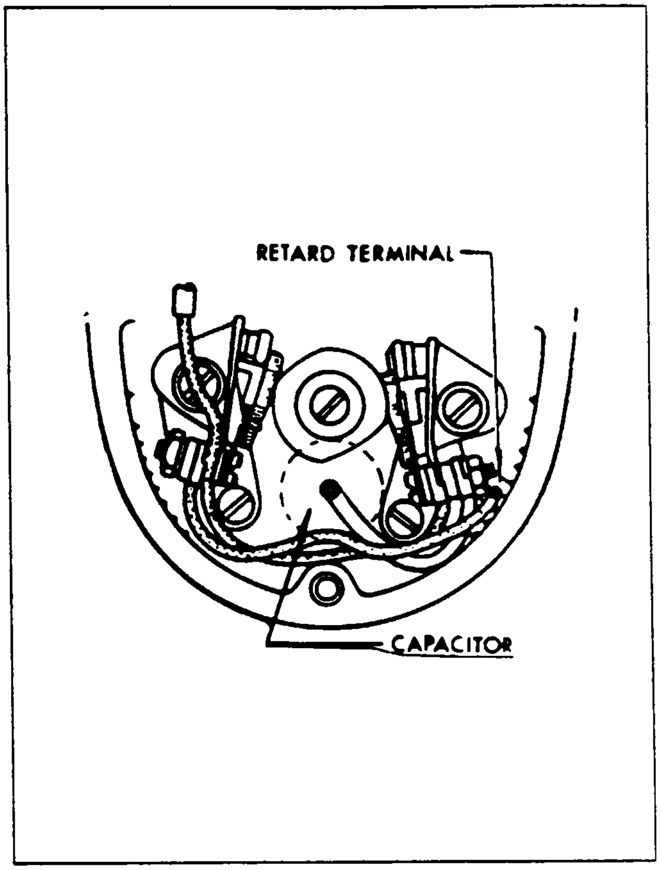


Figure 74-5. Aligning Timing Marks Figure Single Contact Assembly Magneto

74-6. Forming Leads in Breaker Compartment

—NOTE—

The advance timing mark on the top face of the starter ring gear is marked at both 20° and 25° BTC. Use only the 20° BTC mark when timing the magnetos to the engine.

2. Continue turning the crankshaft until the 20° advance timing mark is in alignment with the small hole located on the top face of the starter housing at the two o'clock position. (Refer to Figure 74-7.)
3. Remove the inspection plug on the left magneto and turn the drive coupling in direction of normal rotation until the first painted chamfered tooth is aligned in the center of the inspection hole. (Refer to Figure 74-8.) Without allowing the gear to turn from this position, assemble gasket and magneto to the engine. Secure in place with washers and nuts; tighten only finger tight.
4. Fasten ground wire of electric timing light to any unpainted portion of the engine, and one of the positive wires of the timing light to a suitable terminal connected to the ground terminal of the magneto. Then turn the engine crankshaft several degrees from the advance timing mark in direction opposite to that of normal rotation.
5. Turn on the switch of the timing light, which should be lit. Turn the crankshaft slowly in direction of normal rotation until the mark on the starter gear aligns with the hole in the starter housing, at which point the light should go out. If not, turn the magneto in its mounting flange and repeat the procedure until the light goes out. Repeat the same procedures with the right magneto.

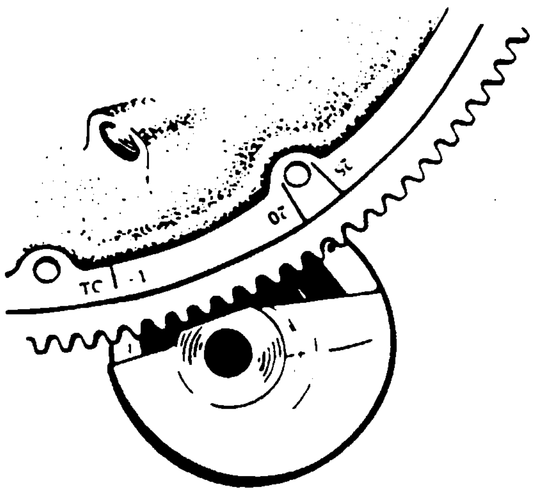


Figure 74-7. Engine Timing Marks

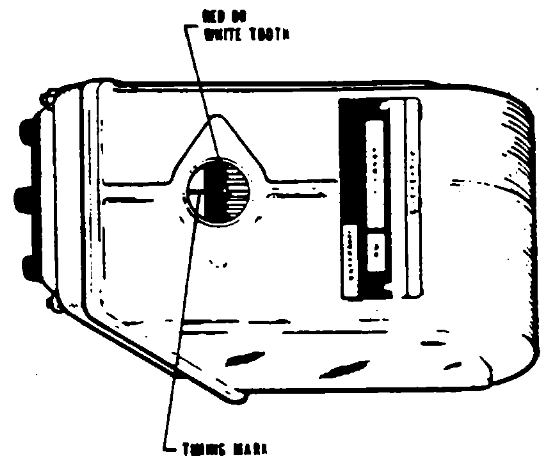


Figure 74-8. Magneto Timing Marks

—NOTE—

Battery powered timing lights operate in the reverse manner from that described above; the light goes on when the marks align.

6. After both magnetos have been timed, leave the timing light wires connected and recheck magnetos as previously described to make sure that both magnetos are set to fire together. If timing is correct, both timing lights will go out simultaneously when the timing marks are in alignment. Tighten nuts to specified torque.
7. After magnetos have been properly timed, replace breaker cover and secure.
8. Install the ground lead and the retard spark lead on the left magneto.
9. Place the harness terminal plate on the magneto and tighten nut around the plate alternately to seat cover squarely on magneto. Torque nuts to 18 to 22 inch-pounds.

STARTING VIBRATOR.

STARTING VIBRATOR CHECKING PROCEDURE.

1. Disconnect all spark plug leads from the left magneto at the spark plugs.

—*WARNING*—

Be sure an magneto spark plug leads are removed, thus preventing the hazardous condition of plug firing during test.

2. Rotate engine crankshaft until number one cylinder is in its retard firing position. Using the timing light, check to see that the retard contact assembly and both magneto main contact assemblies are open.
3. Electrically disconnect starter solenoid or remove battery cable from starter so that the engine will NOT crank during this test.

—*WARNING*—

It is necessary that the starter be electrically removed from the circuit before the vibrator is put into operation to eliminate possibility of starter being energized during the test.

4. Place the magneto switch in its "ON" position and actuate the starter switch. At the same time observe the No. 1 cylinder spark plug lead which is fired by the left magneto circuit. A series of sparks should be seen when holding the lead approximately .19 of an inch from engine ground.

—*WARNING*—

Grasp the spark plug lead far enough away from the connection so as not to produce any dangerous electrical shock.

5. If the spark does not jump the gap, check the applied voltage to the starting vibrator. The voltage should be 24 volts.
6. If voltage is correct, check the contact points of the magneto. Both sets of contact points shall be opened.
7. Reject all units not complying with the preceding requirements or which show any visual defects.

REMOVAL OF STARTING VIBRATOR.

1. Remove the left access panel to the nose section interior.
2. The starter vibrator is attached to the extreme left front side of the forward fuselage bulkhead.
3. Disconnect the electrical lead from the vibrator.
4. Remove the vibrator from the bulkhead by removing the attaching screws.

INSTALLATION OF STARTING VIBRATOR.

1. Position the vibrator on the bulkhead and secure with screws.
2. Connect the electrical leads to the vibrator.
3. Check operation.
4. Install access panel.

DISTRIBUTION.

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IGNITION HARNESS.

INSPECTION OF HARNESS.

1. Inspect cover for cracks or other damage. Inspect lead assemblies for abrasions, mutilated braid or other physical damage.
2. Inspect grommets for tears and eyelets for spark erosion.
3. Disconnect harness coupling nuts from the spark plugs and extract the lead terminations. Inspect contact springs and compression springs for any damage or distortion. Inspect sleeves for cracks or carbon tracking.
4. Inspect coupling nuts and elbow assemblies for damaged threads or other defects.

—NOTE—

Replace any damaged components.

5. Test continuity of each harness lead using a High Tension Lead Tester, Part No. 11-8888-1 from Bendix, as follows:
   A. Connect black test lead to contact spring and red lead to eyelet of the same lead.
   B. Observe that the continuity lamp illuminates.

6. Test insulation resistance of each harness lead by using the 11-8888-1 tester as follows:
   A. Attach the red high voltage test lead to contact spring of harness lead. (Refer to Figure 74-10.)
   B. Attach the black test lead to the ferrule of the same harness lead. (Refer to Figure 74-10.)
   C. Depress PRESS-TO-TEST push-button switch.
   D. Observe that indicator lamp flashes and GAP fires simultaneously as long as the PRESS-TO-TEST switch is held depressed. Whenever indicator lamp flashes and GAP fails to fire, lead under test is defective and must be replaced.

MAINTENANCE OF HARNESS.

Minor repairs of the harness assembly, such as replacement of contact springs, sleeves, compression springs, eyelets, or grommets, can be accomplished with the harness mounted on the engine. Lead assemblies may also be replaced with harness mounted on the engine unless inaccessibility of installation or number of leads to be replaced makes it unreasonable.

To replace grommets or eyelets, pull the conductor through the shielding sufficiently to make eyelet accessible. Remove the eyelet being careful not to damage conductor wire. Replace grommet and eyelet using the "AB" groove of Crimping Tool No. 11-4152 or a pair of diagonal pliers modified as shown in Figure 74-11. Work the wire back into the shielding so the grommet fits properly against the ferrules in the plate. Slack in shielding or wire can be removed by grasping the lead in one hand and sliding the other hand firmly along the lead towards the magneto cover.

To replace contact springs, insulating sleeves, compression spring or elbows proceed as follows:

1. 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 74-12.

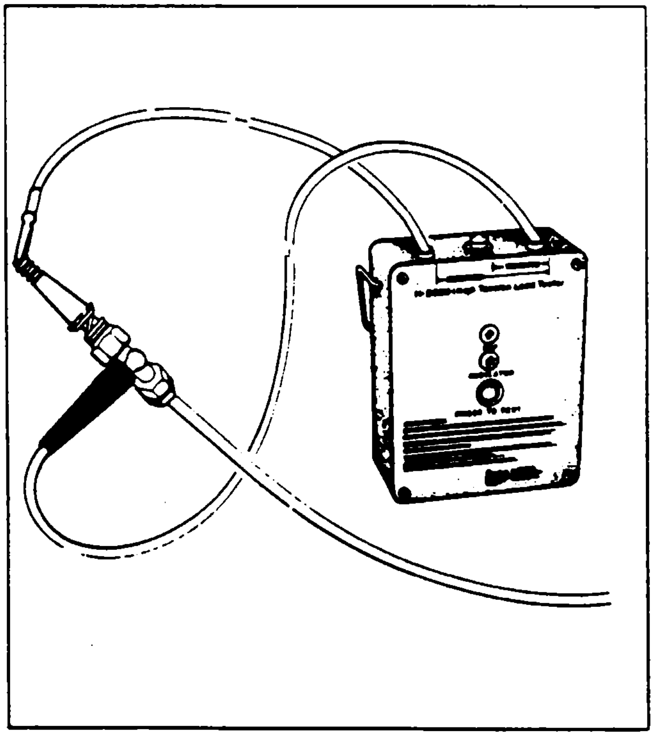

Figure 74-10. Checking Harness Lead Insulation Resistance

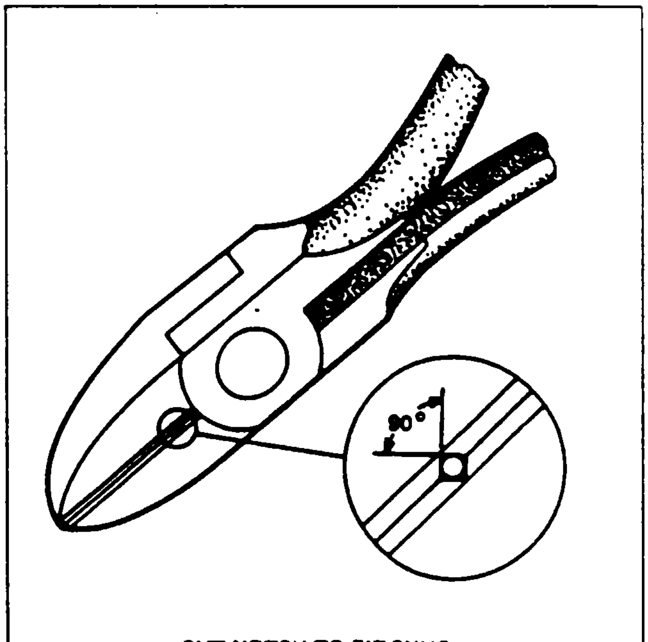

Figure 74-11. Modified Pliers

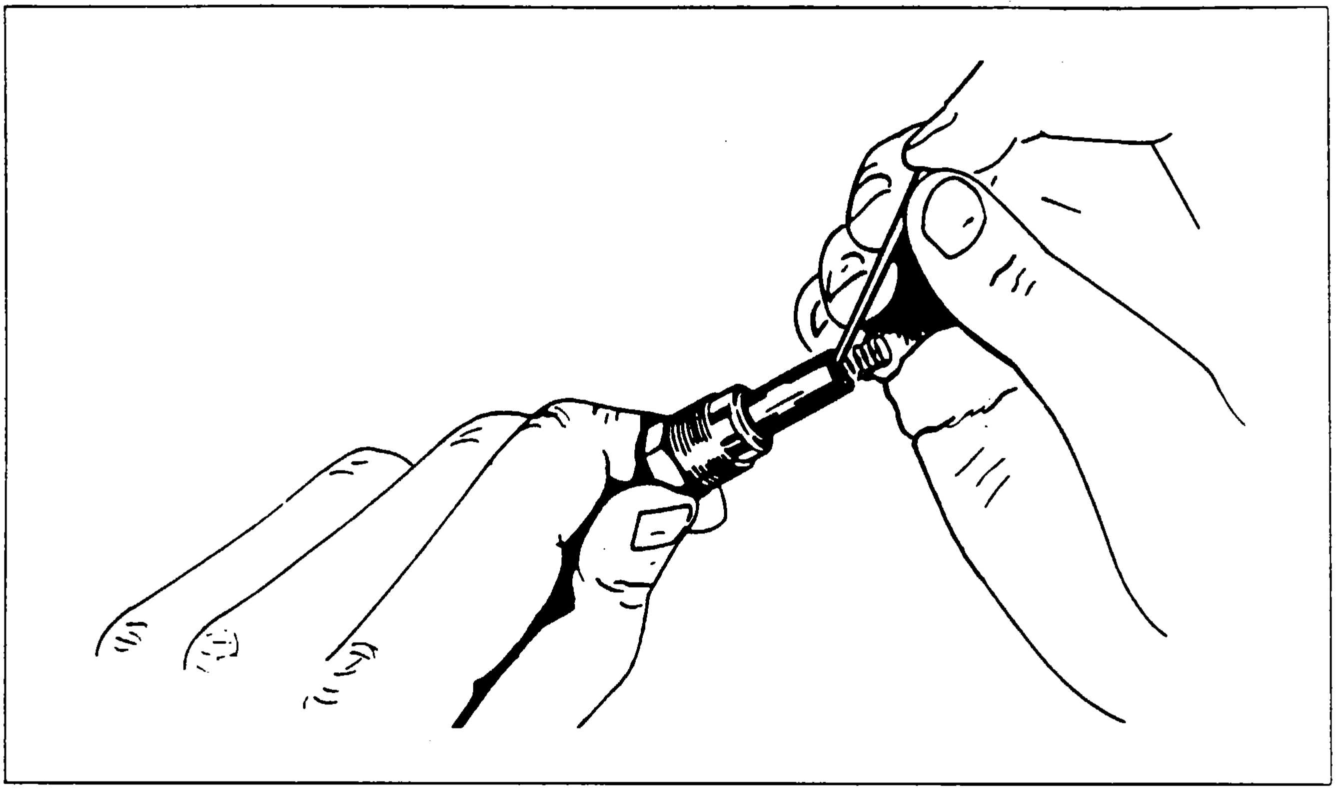

Figure 74-12. Removing Spring From Lead Assembly

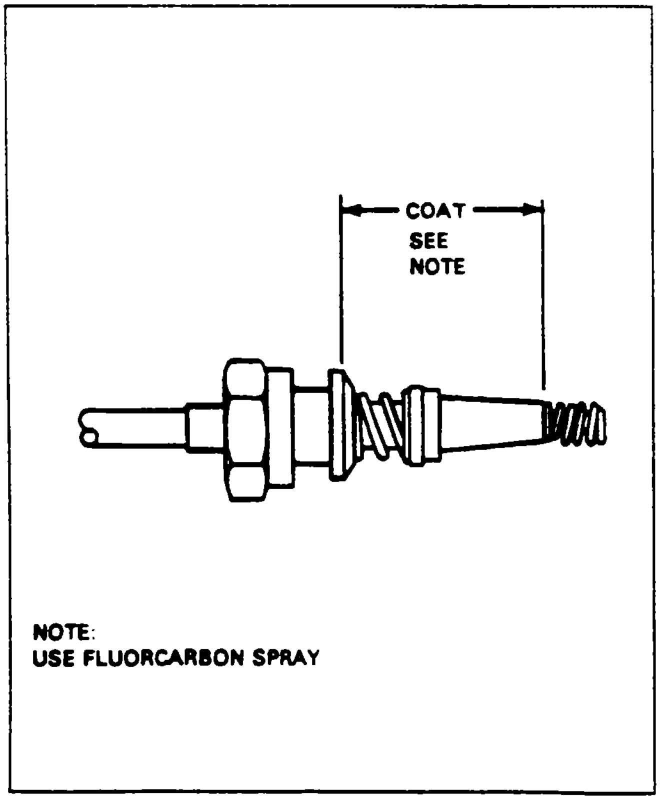

Figure 74-13. Lubricating Sleeve

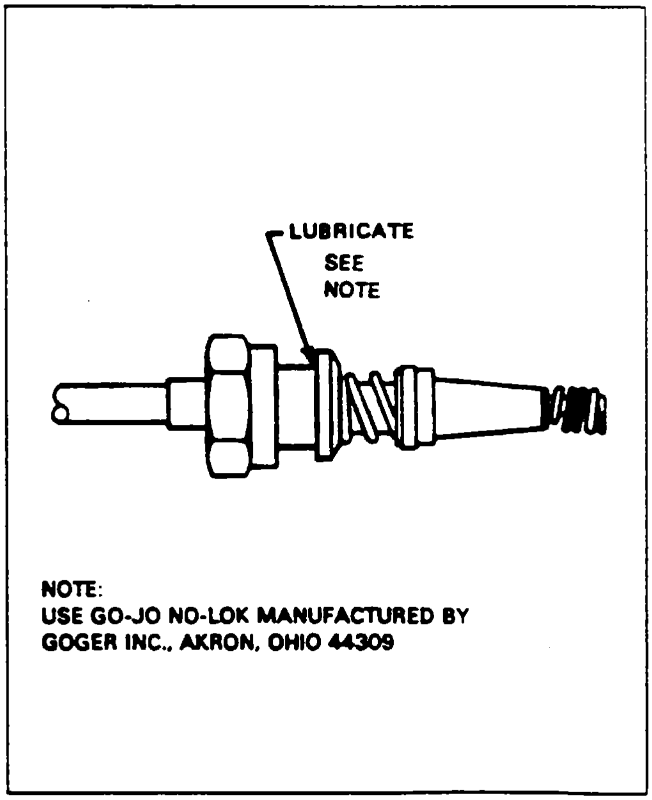

Figure 74-14. Lubricating Ferrule Shoulder

2. Using the needle or pencil unscrew the spring.
3. Slide insulating sleeve and spring retainer assembly.
4. Replace defective component and reassemble as follows:
   A. Fabricate a tool as shown in Figure 74-15 for installing the insulating sleeves over the cable terminals.
   B. Slide elbow assembly over lead and attach nut finger tight to ferrule.
   C. Push the fabricated tool through insulating sleeve and spring retainer assembly as shown in Figure 74-16. Screw the cable terminal into the tool.
   D. Work insulating sleeve and retainer assembly into position over the cable and unscrew the tool. Install contact spring on cable terminal.

—NOTE—

It may be necessary to lubricate the cable and insulating sleeve with a thin film of DC 200 (200,000 centistokes) or commercial grade alcohol to facilitate assembly.

5. To replace one of the lead assemblies proceed as follows:
   A. Remove clamps and brackets from defective lead assembly. Cut ties from assembly and discard.
   B. Cut the eyelet from the lead and remove grommet.
   C. Grip the ferrule of the lead with a pair of vise grip or water pump pliers and with a twist-pull action remove the ferrule from the cover and discard ferrule. Pull lead from cover.
   D. Thread pre-stripped end of replacement lead through cover.

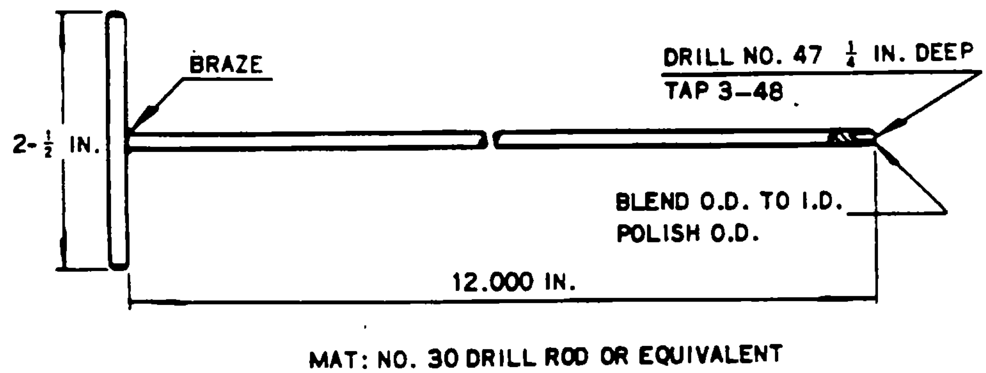

Figure 74- 15. Assembly Tool

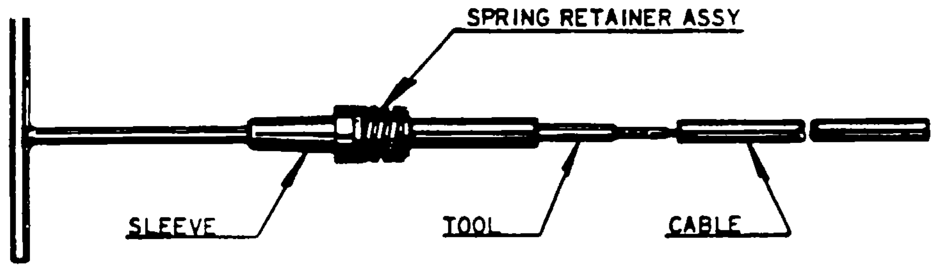

Figure 74-16. Using Assembly Tool

—*NOTE*—

Replacement leads are available from Bendix in lengths of 17 thru 74 inches in 3 inch increments. Use nearest next longer length to replace defective lead.

E. Scrape blue coating being careful not to cut braid for .50 of an inch from end of lead.
F. Push back braid and thread a new ferrule over wire and under braid until braid just covers knurling. (Refer to Figure 74-17.)

—*NOTE*—

New ferrules must be used and inserted under the braid exactly as stated in step F.

G. Pull the lead back into the cover to wedge the braid between the tapers of the cover and ferrule.
H. Provide a back up support for the cover, and seat the ferrule, using the 11-7074 Ferrule Seating Tool (Refer to Figure 74-18 and a mallet. Ferrule must be driven straight into the cover and fully seated.
I. Thread the pre-stripped end of the conductor through grommet. Place a new eyelet on conductor and crimp per instructions given in second paragraph of Maintenance of Harness.

6. When lead being replaced is of the elbow type, salvage the used elbow and compression springs for installation on replacement lead. Install these and new sleeve and contact spring, (Refer to Figures 74-19 and 74-20) furnished with replacement lead per instructions given in steps 1 thru 4.
7. Reposition clamps and brackets and replace cable ties removed earlier. Clean the grommets, sleeves and the inside of the cover with methylethylketone or denatured alcohol.
8. Spray grommets and sleeves with Fluorocarbon Spray, such as MS S-122, supplied by Miller-Stephenson Chemical Co., Inc., 16 Sugar Hollow Road, Danbury, Connecticut 06810, or equivalent.
9. Prior to seating spark plug lead terminal in plug barrel use fluorocarbon spray on spark plug terminal insulating sleeve. (Refer to Figure 74-13) to prevent heat from sticking sleeve to spark plug barrel. Lightly lubricate the shoulder of ferrule to minimize twisting of ferrule. (Refer to Figure 74-14.) Use GO-JO NO-LOK manufactured by Goger Inc., Akron, Ohio 44309.
10. Check cam securing screw. Screw must be torqued to 21-25 inch-pounds.
11. With all high tension terminal grommets seated against the ferrules in the cover, attach the bottom capacitor lead to the right main breaker and then the top capacitor lead to the left main breaker. Position the cover on the magneto and secure. Torque cover screws to 30-35 inch-pounds.

—NOTE—

Do not connect leads to spark plugs until after completing test of starting vibrator.

12. Carefully route the high tension spark plug leads away from any hot spots such as manifolds, and sharp edges which might cause heat damage or chafing. Check leads for proper location in clamps so when clamps are tightened the leads will not be crushed. Leads should be taut to prevent chafing due to vibration, but not so taut as to produce undue strain on leads.
13. After all leads have been properly routed and secured to the engine, recheck all clamp securing screws for tightness. Fasten coupling nuts to proper spark plugs and torque as specified in Chart 7401. Do not allow ferrules to turn while torquing nuts.

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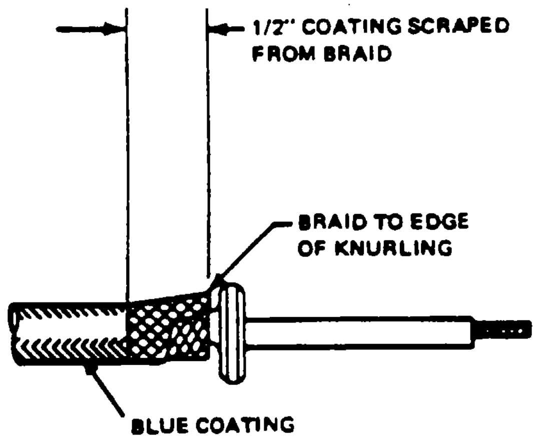

Figure 74-17. Ferrule Positioned Under Braid

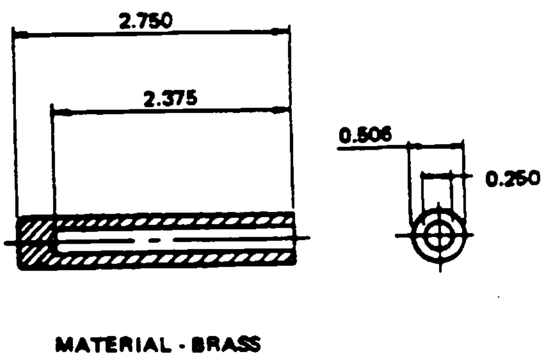

Figure 74-18. Ferrule Seating Tool 11-7074

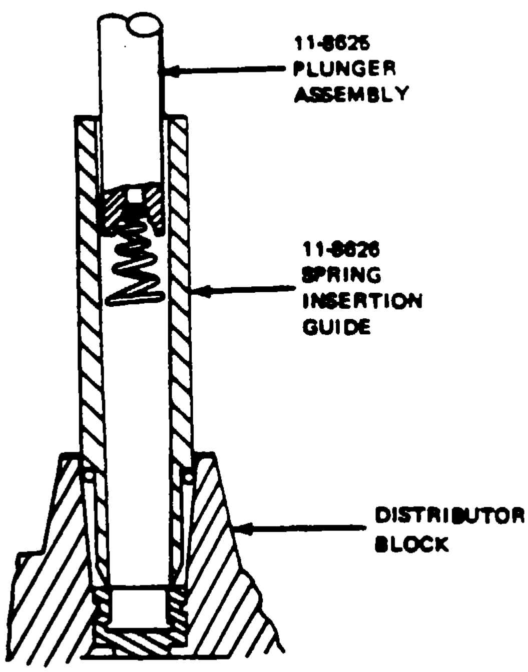

Figure 74-19. Position of 11-8627 Kit and Contact Spring at Start of Installation

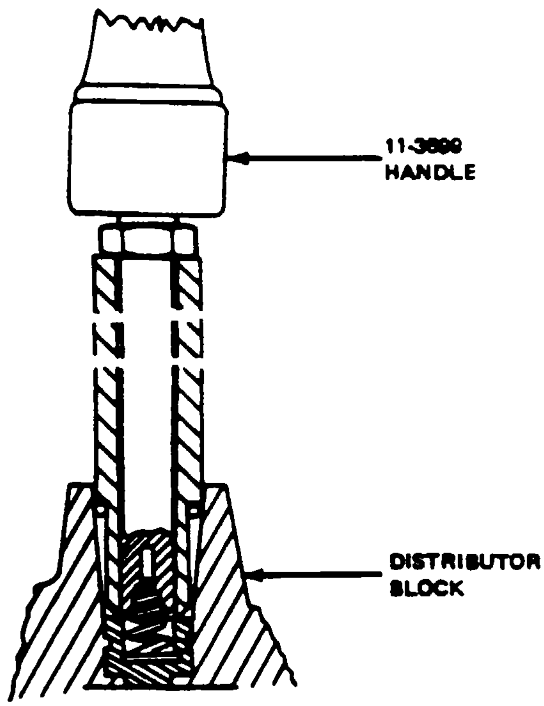

Figure 74-20. Position of 11-8627 Kit and Contact Spring after Installation

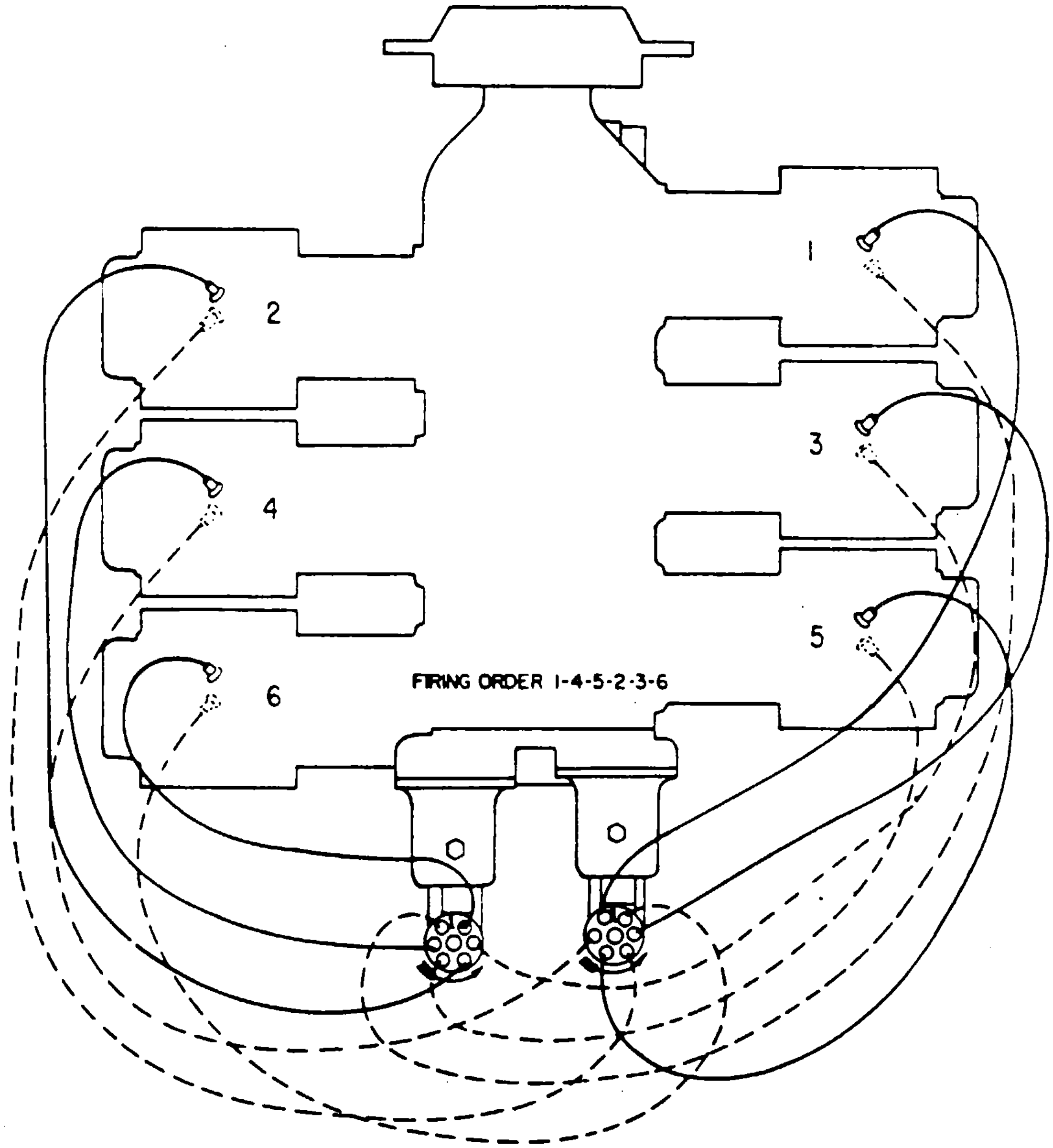

Figure 74-21. Ignition System Schematic

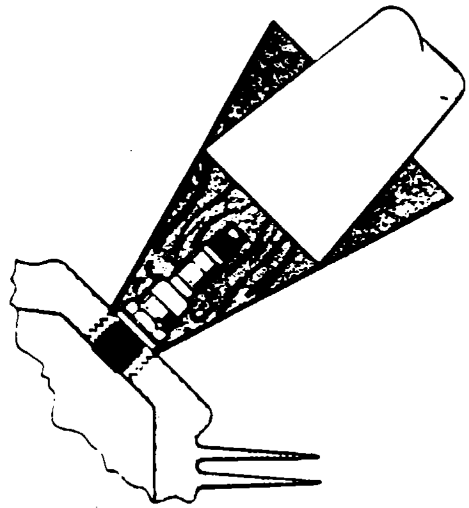

Figure 74-22. Removing Frozen Spark Plug

CHART 7401. COUPLING TORQUES

Spark Plug Coupling Threads	Torque (lb.-in.)
5/8-24	90-95
3/4-20	110-120

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.

—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 centerline 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 installations 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 location.

—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 installed 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.

INSPECTION AND CLEANING OF SPARK PLUG.

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 plug as required, removing carbon and foreign deposits.
3. Set the electrode gap 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 nut.

—END—

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CHAPTER

76

ENGINE CONTROLS

CHAPTER 76 - ENGINE CONTROLS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
76-00-00	GENERAL	4H12	
76-10-00	POWER CONTROL	4H12	
76-10-01	Adjustment Of Throttle And Mixture Controls	4H12	
76-10-02	Adjustment Of Idle Speed And Mixture	4H12	

GENERAL.

POWER CONTROL.

ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS.

The throttle and mixture controls are adjusted so that when the throttle arm on the injector is rotated forward against its full throttle stop and the mixture arm is rotated forward against its full rich stop, their respective cockpit control levers should be .062 to .125 inch in from their full forward stops, which are located in the control pedestal.

1. At the injector, disconnect the throttle and/or mixture control cable end from its control arm.
2. Loosen the jam nut securing the cable end.
3. Adjust the linkage by rotating the cable end to obtain the .062 to .125 inch spring back of the cockpit control lever when the throttle or mixture control arm contacts its stop.
4. Reconnect the cable end to its control arm and secure jam nut.
5. Pull the throttle and mixture control lever in the cockpit full aft to ascertain that the injector idle screw contacts its stop and the mixture control arm contacts its lean position.

ADJUSTMENT OF IDLE SPEED AND MIXTURE.

1. Start the engine and warm up in the usual manner until oil and cylinder head temperatures are normal.
2. Check magnetos. If the "mag-drop" is normal, proceed with idle adjustment.
3. Close the throttle to idle. If the RPM changes appreciably after making the idle mixture adjustment during the succeeding steps, readjust the idle speed to the desired RPM.

—NOTE—

The idle mixture must be adjusted with the fuel boost pump "ON."

4. When the idling speed has been stabilized, move the cockpit mixture control lever with a smooth, steady pull toward the "Idle Cut-Off" position and observe the tachometer for any change during the "leaning" process. Caution must be exercised to return the mixture control to the "Full Rich" position before the RPM can drop to a point where the engine cuts out. An increase of more than 50 RPM while "leaning out" indicates an excessively rich idle mixture. An immediate decrease in RPM (if not preceded by a momentary increase) indicates the idle mixture is too lean.
5. If the above indicates that the idle adjustment is too rich or too lean, turn the idle mixture adjustment in the direction required for correction, and check this new position by repeating the above procedure. Make additional adjustments as necessary. Each time the adjustment is changed, the engine should be run up to 2000 RPM to clear the engine before proceeding with the RPM check. Make final adjustment of the idle speed adjustment to obtain the desired idling RPM with closed throttle. The above method aims at a setting that will obtain maximum RPM with minimum manifold pressure. In case the setting does not remain stable, check the idle linkage; any looseness in this linkage would cause erratic idling. In all cases, allowance should be made for the effect of weather conditions and field altitude upon idling adjustment.

—END—

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CHAPTER

77

ENGINE INDICATING

CHAPTER 77 - ENGINE INDICATING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
77-00-00	GENERAL	4H16	
77-10-01	POWER	4H16	
77-10-02	Manifold Pressure Gauge	4H16	
77-10-03	Troubleshooting	4H16	
77-10-04	Removal And Replacement	4H17	
77-10-05	Manifold Pressure Gauge Filters	4H17	
77-10-06	Tachometer Indicator	4H17	
77-10-07	Troubleshooting	4H17	
77-10-08	Removal And Replacement	4H18	
77-20-00	TEMPERATURE	4H18	
77-20-01	Cylinder Head Temperature Gauge	4H18	
77-20-02	Troubleshooting	4H19	
77-20-03	Removal And Replacement	4H19	
77-20-04	Exhaust Gas Temperature Gauge	4H19	
77-20-05	Cleaning And Inspection	4H19	
77-20-06	Installation Of EGT Probe	4H20	
77-20-07	Troubleshooting	4H21	
77-20-08	Removal And Replacement	4H21	

GENERAL.

Included in this section are brief descriptions of the instruments which monitor engine operation and charts to assist in troubleshooting those instruments.

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 instrument.
Excessive error when engine is running.	Line leaking.	Tighten line connections.
Sluggish or jerky pointer movement.	Defective instrument. Restricted filter element.	Replace instrument. Replace filter.
Dull or discolored marking.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line. Restricted filter element.	Disconnect lines and blow out. Replace filter.
Broken or loose cover glass.	Vibration or excessive pressure.	Replace glass and reseat case.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

MANIFOLD PRESSURE GAUGE FILTERS.

The manifold pressure gauge has two filter assemblies secured to the rear of the gauge. The removal of the top instrument access panel is necessary to gain access to the filter assemblies. Remove the two filter assemblies and replace the filter elements during the 500 hour inspection of the airplane, or sooner, if conditions indicate a restricted filter element.

TACHOMETER INDICATOR.

Each tachometer is connected to the engine accessory cover by a flexible cable and provides an indication of crankshaft speed in revolutions per minute. The right-hand tachometer has a reversing drive to correct for the counter-rotation of the right-hand engine.

TROUBLESHOOTING. (Refer to Chart 7702.)

CHART 7702. TROUBLESHOOTING (TACHOMETER)

Trouble	Cause	Remedy
No reading on indicator, either permanent or intermittent.	Broken drive cable.	Replace cable.
	Springs weak.	Replace instrument.
	Loose cable connections.	Tighten cable.
Pointer oscillates excessively.	Rough spot on, or sharp bend in cable.	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.

CHART 7702. TROUBLESHOOTING (TACHOMETER) (cont.)

Trouble	Cause	Remedy
Pointer jumps at idle.	Speed cup hitting rotating magnet.	Replace instrument.
Tachometer cable breaks .	Cable bent too sharply.	Reroute cable, replace shaft.

—NOTE—

Ascertain that the drive cable from the engine to the tachometer will rotate properly.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

TEMPERATURE.

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. This gauge is an electrical instrument and is wired through the instruments circuit breaker.

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TROUBLESHOOTING. (Refer to Chart 7703.)

CHART 7703. TROUBLESHOOTING (CYLINDER HEAD TEMPERATURE GAUGE)

Trouble	Cause	Remedy
Instrument shows no indication.	Engine is cold.	Warm up engine.
	Power supply wire open.	Repair wire.
	Defective sender.	Replace sender.
	Defective instrument.	Replace instrument.
	Open circuit breaker.	Troubleshoot for fault.
Instrument goes all the way to upper stop.	Wire grounded between sender and gauge.	Repair wire.
	Defective sender.	Replace sender.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

EXHAUST GAS TEMPERATURE GAUGE.

This dual instrument, which is commonly referred to as EGT, is used to aid the pilot in setting the economical fuel-air mixture for cruising flight at a power setting of 75% or less. It is a sensing device to monitor the temperature of exhaust gases leaving the engine cylinders. If it is found defective after checking with the troubleshooting chart, it should be replaced. If the leads to the gauge are defective in any way, they must be replaced. When replacing leads, it is necessary to use the same type and length of wire, because the resistance of the leads is critical for the proper operation of this gauge. When troubleshooting this instrument, be certain the system being checked coincides with the system on the indicator.

CLEANING AND INSPECTION.

Unless mechanical damage such as broken glass, bent or broken pointer, broken case, the following checks should be performed before removing the instrument:

1. The thermocouple probe should be removed and cleaned as required. The following procedure should be used:
   A. Detach the thermocouple leads from the extension lead if necessary. (Do not detach if the probe can be removed and cleaned with leads attached.)
   B. Unscrew the nut and lift out the thermocouple assembly very carefully from the manifold. (Do not attempt to pull the thermocouple by squeezing the spacer washers in a vice-grip pliers.)

C. Clean the probe with solvent and check for broken weld (at tip end) or burnt off end.
D. Replace the assembly carefully and retighten the nut. If leads were disconnected, reconnect them using a new pair of Thomas and Betts "Sta-Kon" connectors, make certain connections are tight.

2. Examine the extension lead wires for any evidence of chafing on sharp edges. This could cause erratic fluctuation of the EGT indicator.
3. Ascertain that the connectors which mate the extension leads to the thermocouple are properly seated. Poor contact may cause indicator fluctuation also.

—CAUTIONS—

1. DO NOT cut off any excess lead wire from the thermocouples to the indicator, at any time This will cause the system to be inaccurate.
2. NEVER attempt to check indicator operation or resistance with an ohmmeter. A special bridge is required which is accurate and will not damage the instrument.
3. DO NOT attempt to adjust the indicator. The system was accurately calibrated at the factory.

—NOTE—

Local instrument shops can replace broken glass in the bezel and check operation and calibration of the indicator. It is recommended that the indicator be returned to the manufacturer for re-calibration.

4. If trouble still exists after making the above checks, REMOVE the leads from the indicator and using an ohmmeter check the extension cables and thermocouples for the following:

PROBE RESISTANCE:	1 ohm
EXT. LEAD RESISTANCE:	7 ohms
TOTAL RESISTANCE:	8 ohms
INDICATOR IMPEDANCE:	8 ohms

INSTALLATION OF EGT PROBE. (Refer to Figure 77-1.)

The EGT probe is mounted in the exhaust manifold directly below the turbocharger exhaust turbine inlet.

1. Ensure that the tip of the probe measures 1.31 inches. This measurement is critical! If adjustment of the probe is required to meet this specification, proceed as follows:
   A. Loosen the packing nut and lightly tap the fitting mount in the direction required to obtain the desired dimension (1.31 inches).
   B. Use caution not to damage the fitting.
   C. Apply Fel-Pro C5A Thread Compound to threads of packing nut and retighten nut.
2. Prior to installing EGT probe, coat threads with Fel-Pro C5A High Temperature Thread Compound.
3. Install the EGT probe and tighten.

TROUBLESHOOTING. (Refer to Chart 7704.)

CHART 7704. TROUBLESHOOTING (EXHAUST GAS TEMPERATURE GAUGE)

Trouble	Cause	Remedy
Gauge inoperative.	Defective gauge, probe or wiring.	Check probe and lead wires for chafing, breaks or shorting between wires and/or metal structure.
Fluctuating reading.	Loose, frayed or broken electrical leads or faulty connections.	Clean and tighten connections. Repair or replace defective leads.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

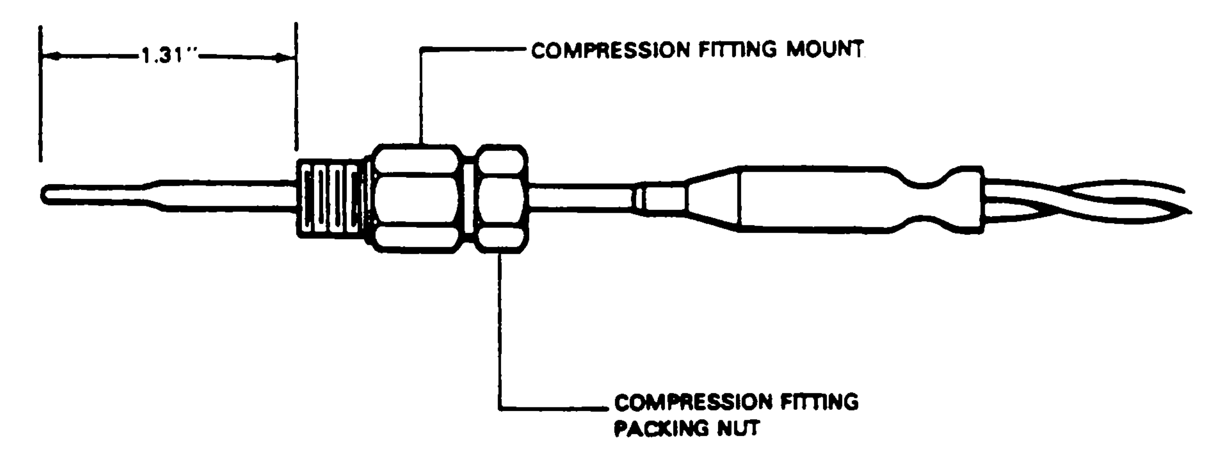

Figure 77-1. EGT Probe (Adjustable)

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CHAPTER

79

OIL SYSTEM

CHAPTER 79 - OIL SYSTEM

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GENERAL.

Contained in this chapter are a description of the Oil System and its components, troubleshooting guide recommendations for changing oil and a brief statement concerning spectrometric oil analysis.

DESCRIPTION AND OPERATION.

The lubrication system is of the pressure wet sump type. The oil pump, which is located in the accessory housing, draws oil through a drilled passage leading from the oil suction screen located in the sump. The oil from the pump then enters a drilled passage in the accessory housing which feeds the oil to a threaded connection on the rear face of the accessory housing, where a flexible line leads the oil to the external oil cooler. Pressure oil from the cooler returns to a second threaded connection on the accessory housing from which point a drilled passage conducts the oil to the oil pressure filter. In the event that cold oil or an obstruction should restrict the oil flow to the cooler, an oil cooler bypass valve is provided to pass the oil directly from the oil pump to the oil pressure filter.

The oil filter element, located on the accessory housing, provides a means of filtering from the oil any solid particles that may have passed through the suction screen in the sump. After being filtered, the oil is fed through a drilled passage to the oil pressure relief valve, located in the upper right side of the crankcase in front of the accessory housing. This relief valve regulates the engine oil pressure by allowing excessive oil to return to the sump, while the balance of the pressure oil is fed to the main oil gallery in the right half of the crankcase. Residual oil is returned by gravity to the sump, where after passing through a screen it is again circulated through the engine.

TROUBLESHOOTING.

Troubles pertaining to the Oil System are listed in Chart 7901 along with possible causes and suggested remedies. When troubleshooting consult all available sources for any pertinent information which might assist in diagnosing the trouble.

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CHART 7901. TROUBLESHOOTING (OIL SYSTEM)

Trouble	Cause	Remedy
High oil temperature.	Insufficient air cooling.	Check air inlet and outlet for deformation or obstruction.
	Insufficient oil supply.	Fill oil sump to proper level with specified oil.
	Low grade of oil.	Replace with oil conforming to specifications.
	Clogged oil lines or strainers.	Remove and clean oil strainers.
	Excessive blow-by.	Usually caused by worn or stuck rings.
	Failing or failed bearings.	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gauge.	Replace gauge.
	Defective thermostatic bypass valve.	Replace.
Excessive oil consumption.	Low grade of oil.	Fill tank with oil conforming to specifications.
	Failing or failed bearings.	Check sump for metal particles.
	Worn or cracked piston rings.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.
	Failure of rings to seat. (New nitrided cylinders.)	Use mineral base oil. Climb to cruise altitude at full power and operate at 75% cruise power setting until oil consumption stabilizes.

CHART 7901. TROUBLESHOOTING (OIL SYSTEM) (cont.)

Trouble	Cause	Remedy
Low oil pressure.	Insufficient oil.	Fill sump with recommended oil.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line.	Check gasket between accessory housing and crankcase.
	Dirty oil strainers.	Remove and clean oil strainers.
	High oil temperature.	See "High oil temperature" in "Trouble" column.
	Defective pressure gauge.	Replace gauge.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.

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DISTRIBUTION.

ADJUSTMENT OF OIL PRESSURE RELIEF VALVE.

Engines are furnished with an adjustable oil pressure relief valve, which enables the operator to maintain engine oil pressure within the specified limits (60 to 90 psi). The valve is located above and to the rear of No. 5 cylinder. If the pressure under normal operating conditions should consistently exceed 90 psi or run less than 60 psi, adjust valve as follows:

1. With the engine thoroughly warmed up and running at a maximum of 2200 RPM, observe the reading on the oil pressure gauge. If the pressure is above 90 psi, stop engine, back off the adjusting screw one or two full turns.
2. If pressure is too low, turn adjusting screw further into the relief valve plug, thereby increasing the tension on the relief valve spring.

OIL SCREEN.

The suction screen located in the left side of the engine sump should be cleaned at each oil change to remove any accumulation of sludge and to examine for metal filings or chips. If metal particles are found in the screen, the engine should be examined for internal damage. The suction screen is removed from the sump by removing the hex head plug at the lower left side of the sump. Clean and inspect the screen and gasket and replace the gasket if over compressed or damaged.

OIL FILTER ELEMENT.

1. The oil filter element should be replaced after each fifty hours of engine operation; this is accomplished by removing the lock wire from the bolt-head at the end of the filter housing, loosening the bolt, and removing the filter assembly from the adapter.
2. Before discarding the filter element, remove the outer perforated paper cover, and using a sharp knife, cut through the folds of the element at both ends, close to the metal caps. Then, carefully unfold the pleated element and 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 particle 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 element has been replaced, tighten the attaching bolt with 20 to 25 foot-pounds torque. Lock wire the bolt through the loops on the side of the housing to the drilled head of the thermostatic valve. Be sure the lock wire is replaced at both the attaching bolt-head and the thermostatic oil cooler bypass valve. (Refer to latest revision of Lycoming Service Letter No. L157.)

INSTALLATION OF OIL COOLER.

1. When installing fittings in the oil coolers, care should be used to prevent excessive torque being applied to the cooler. When a rectangular fitting boss is provided, backup wrench should be used, employing a scissor motion, so that no load is transmitted to the cooler. When the oil cooler has a round fitting boss, care should be taken not to permit excessive torque on the fittings.
2. When attaching lines to the cooler, a backup wrench should be used.
3. After installation, inspect the cooler for distorted end cups.
4. Run-up engine. After run-up, check for oil leaks.

INDICATING.

ENGINE OIL PRESSURE GAUGE.

The oil pressure gauge is mounted in the cluster on the instrument panel. This gauge will indicate the amount of oil pressure available at the pressurized engine oil passage in psi.

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TROUBLESHOOTING.

CHART 7902. TROUBLESHOOTING (ENGINE OIL PRESSURE GAUGE)

Trouble	Cause	Remedy
Excessive error at zero.	Pointer loose on shaft. Overpressure 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 valve.	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.
	Line restriction to instrument.	Clean and check.
	Loss of oil in engine or other engine failure.	Shut down engine refer to Chart 7901.

—NOTE—

Gauge will take longer to indicate in cold weather.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

OIL TEMPERATURE INDICATOR.

The oil temperature indicator is mounted in the instrument cluster on the instrument panel. This instrument will provide a temperature indication of the engine oil in degrees Fahrenheit. The instrument has a temperature bulb located in the oil filter adapter, on the engine accessory section.

TROUBLESHOOTING.

CHART 7903. TROUBLESHOOTING (OIL TEMPERATURE INDICATORS)

Trouble	Cause	Remedy
Instrument fails to show any reading.	Wiring open.	Check engine unit and wiring to instrument.
Excessive error.	Improper calibration adjustment.	Replace instrument.
Pointer fails to move as engine is warmed up.	Open wiring.	Check engine unit and wiring.
Dull or discolored marking.	Age.	Replace instrument.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

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CHAPTER

80

STARTING

CHAPTER 80 - STARTING

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GENERAL.

DESCRIPTION AND OPERATION. (Refer to Figure 80-1.)

The gear reduction starting motor consists of six major components: The Commutator End Head Assembly, The Armature, The Frame and Field Assembly, The Gear Housing, The Pinion Housing, and The Bendix Drive Assembly.

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.

The gear cut on the drive end of the armature shaft extends through the gear housing, where it is supported by a roller bearing. The gear mates with the teeth of the reduction gear that drives the bendix shaft. The shaft is keyed to the reduction gear. The Bendix drive is held in position on the shaft by a "spirol" pin. The shaft is supported in the gear housing by a closed end roller bearing and in the pinion housing by a graphitized bronze bearing.

When the armature turns the reduction gear, the Bendix drive pinion meshes with the flywheel ring gear by inertia and action of the screw threads within the Bendix sleeve. A detent pin engages in a notch in the screw threads which prevents demeshing if the engine fails to start when the starting circuit is de-energized.

When the engine reaches a predetermined speed, centrifugal action forces the detent pin out of the notch in the screw shaft and allows the pinion to demesh from the flywheel.

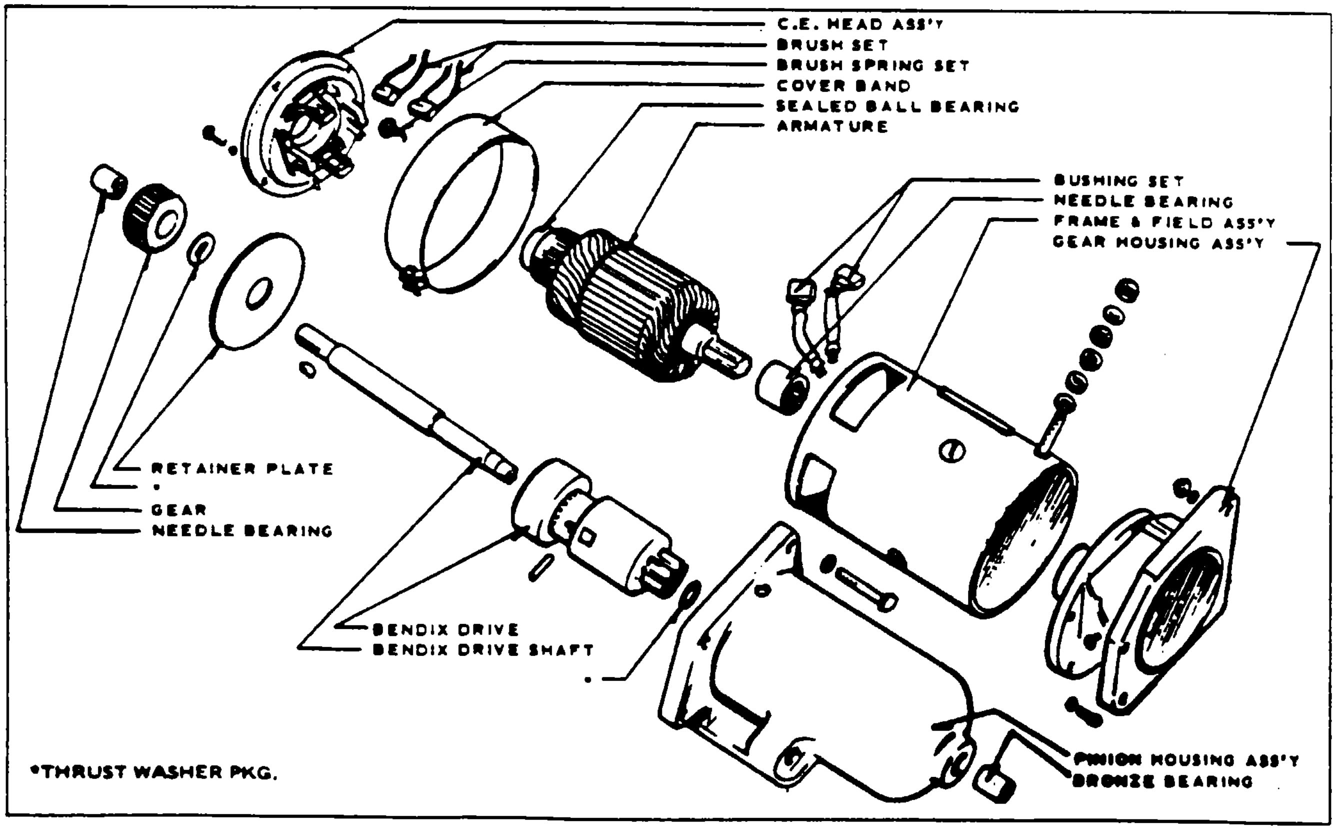

Figure 80-1. Exploded View Starting Motor

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 least twice a year 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 batttery 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 limits outlined in steps A and B, additional tests should be made over each part of the circuit to locate the high-resistance connections.

3. No lubrication is required on the starting motor except at the time of overhaul. Then lubricate the entire shaft under Bendix Drive, fill grooves in armature shaft at drive end and pack gear box with 1.3 to 2.0 ounces of Lithium Soap Base Grease #1925 Molytex "O" or equivalent.
4. The starting motor should be operated for a few seconds with the ignition switch off to make sure that the pinion engages properly and that it turns freely without binding or excessive noise. Then the engine should be started two or three times to see that the pinion disengages properly when the engine is turned off.

STARTING MOTOR.

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.

DISASSEMBLY OF STARTING MOTOR.

1. Remove the frame screws from the commutator end head and pull end head and armature from frame. Lift the brushes and lock in elevated position with brush springs. Use a puller to remove the end head from the armature. Use a special bearing puller to remove the sealed ball bearing from the armature shaft.
2. Remove the frame screws that secure the gear housing to the frame. Remove bolts and nuts holding the gear housing to the pinion housing and separate the two units. Pull Bendix shaft from pinion housing. Do not lose the steel spacer that is located on the pinion end of the shaft. Remove reduction gear, woodruff key and steel spacer from shaft.
3. Turn the Bendix pinion until it locks in the extended position. Locate "spirol" pin and use a punch to remove. Slide drive assembly off the shaft. Do not attempt to disassemble the drive and do not dip it in cleaning solvent.
4. To remove the roller bearings from the gear housing, use an arbor press and the correct bearing arbor. DO NOT HAMMER OUT. Each part should be cleaned and inspected for excessive wear or damage. Bearings 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.

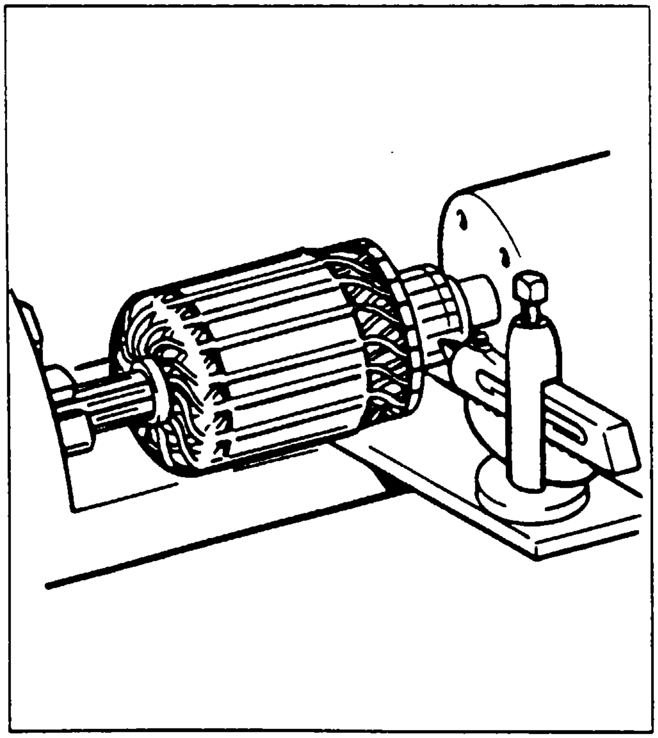

Figure 80-2. Turning Motor Commutator

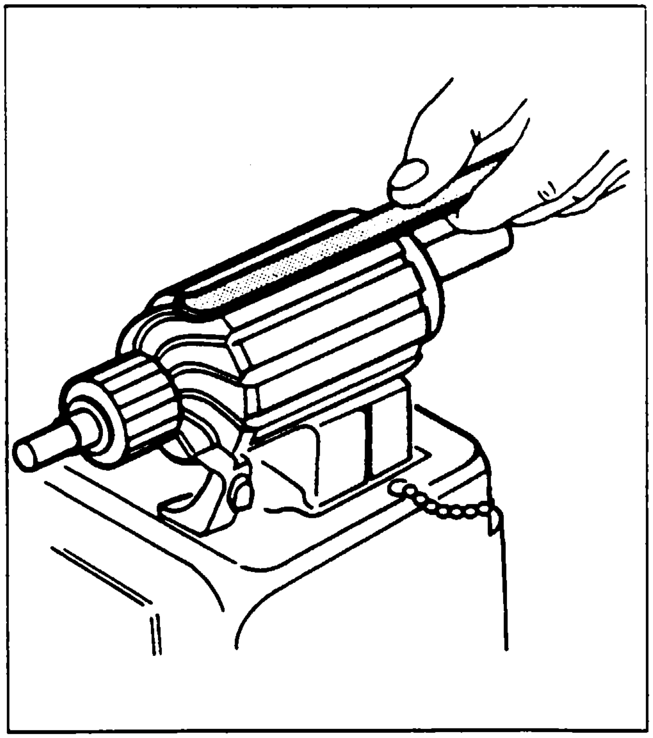

Figure 80-3. Testing Motor Armature for Shorts

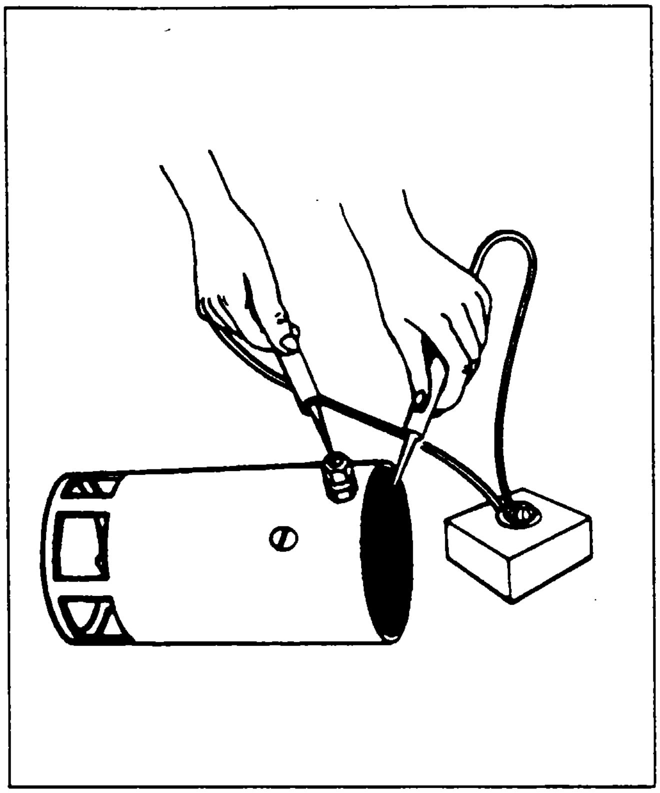

Figure 80-4. Testing Motor Fields for Grounds

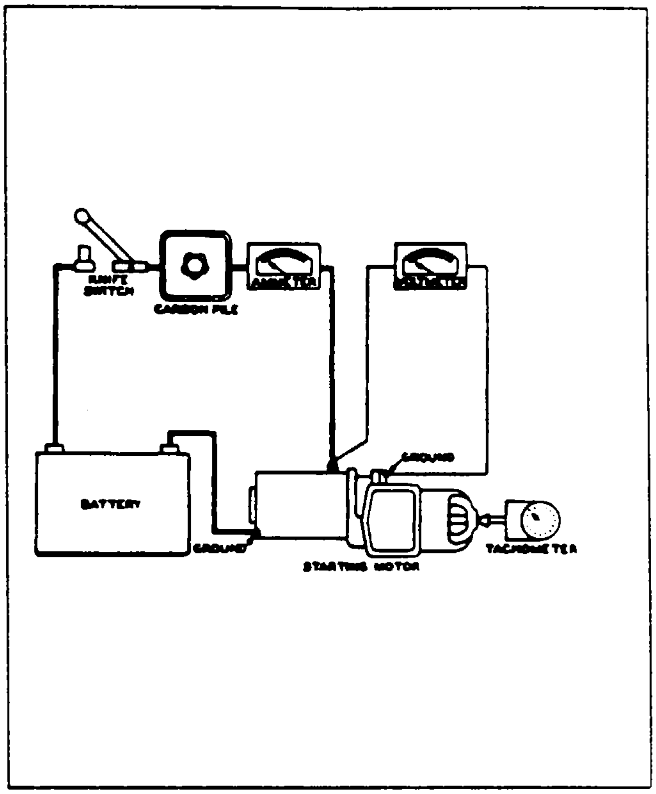

Figure 80-5. No-Load Test Hook-up

BRUSH HOLDERS.

1. To test brush holders, 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.

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 steel strip is held over the core so that it passes over each armature core slot. If a coil is shorted, the steel strip will vibrate.
4. A quick check for opens 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 .

GEAR AND PINION HOUSING.

Inspect housings for cracks and bearings for excessive wear. Remove rust, paint or grease from mounting surfaces.

BENDIX DRIVE.

The Bendix Drive should be wiped clean with a dry cloth. The pinion should turn smoothly in one direction and should lock in the other direction. Replace drive if it fails to check as above or if the pinion teeth are excessively worn or damaged.

ASSEMBLY OF STARTING MOTOR.

1. When assembling the starting motor, always use an arbor press and the proper bearing arbor for installing graphitized bronze and roller bearings. The Bendix shaft should have a thin film of Lubriplate #777 or equivalent on the Bendix portion of the shaft. End play should be .005 to .050 of an inch.
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.

3. Check the position of the pinion to be sure the unit will mesh properly with the flywheel ring gear. See specifications for unit for correct dimensions.

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. 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.

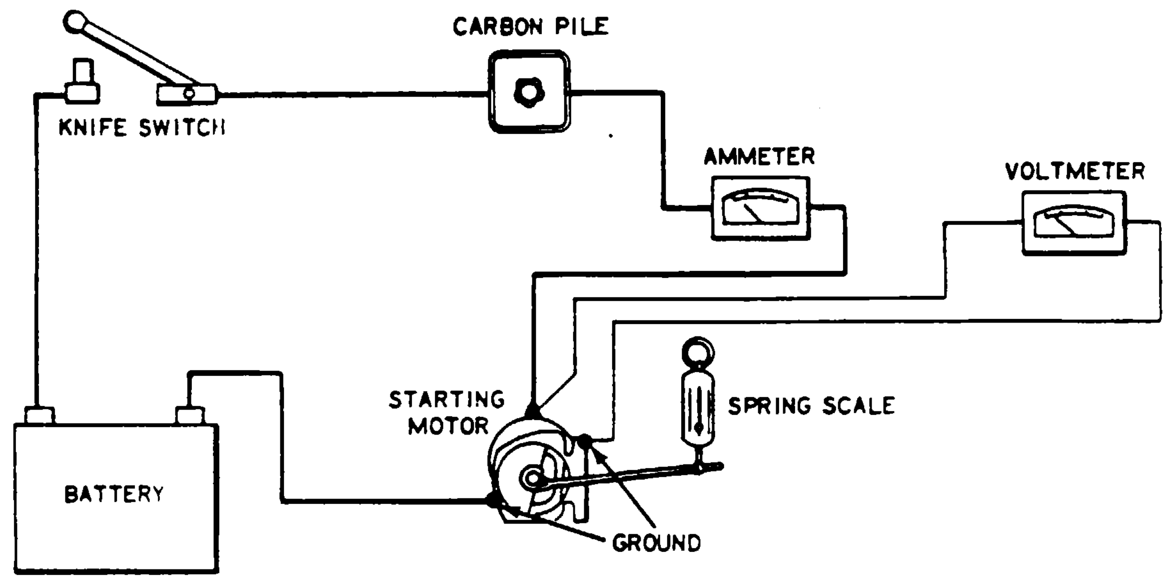

Figure 80-6. Stall - Torque Hook-Up

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.
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 switch is turned on or if it fails to release when the manual switch is released, it should be removed and tested to specifications. If either opening or closing voltages are not specified, replace the solenoid.

STARTING MOTOR SERVICE TEST SPECIFICATIONS.

Prestolite specifications for 24 volt starting motors installed as standard equipment on the T-1020 are as follows:

CHART 8001. STARTING MOTOR TEST SPECIFICATIONS

Motor Model	MHB-4014 (Right Engine) MHB-4018 (Left Engine)
Min. Brush Tension Max. Brush Tension	32 oz. 40 oz.
No-Load Test (75° F) Volt Max. Amps Min. R.P.M.	 20 35 1300
Stall Torque Amps Min. Torque, Ft. Lbs. Approx. Volts	 260 27.0 14.0
Pinion Position* Drive at rest Drive extended	 1.748" - 1.855" 2.388" - 2.496"
*This dimension is measured from the centerline of the mounting hole nearest the drive end head to the edge of the pinion.	

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CHAPTER

81

TURBINES

CHAPTER 81 - TURBINES

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GENERAL.

This chapter contains information pertinent to the maintenance, troubleshooting and repair of the turbochargers installed on the T-1020.

DESCRIPTION AND OPERATION.

The Turbocharger System consists of a turbine and compressor assembly, an automatic waste gate control and the necessary hose and engine air intake ducts. The turbocharger system requires little attention between turbo overhauls. However, it is recommended that the items outlined in the Inspection Report be checked during required inspection intervals. Should trouble occur, refer to the Troubleshooting Chart for assistance in determining the probable cause. Do not break the clamp seal joining the turbine and compressor units.

TROUBLESHOOTING.

Troubles peculiar to the Turbocharger System may be found in Troubleshooting Chart 8101 along with the probable causes and remedies.

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CHART 8101. TROUBLESHOOTING (TURBOCHARGER)

Trouble	Cause	Remedy
Excessive noise or vibration.	Improper bearing lubrication.	Supply required oil pressure. Clean or replace oil line; clean oil strainer. If trouble persists, overhaul turbocharger.
	Leak in engine intake or exhaust manifold.	Tighten loose connections or replace manifold gaskets as necessary.
	Dirty impeller blades.	Disassemble and clean.
Engine will not deliver rated power.	Clogged manifold system.	Clear all ducting.
	Foreign material lodged in compressor impeller or turbine.	Disassemble and clean.
	Excessive dirt build-up in compressor.	Thoroughly clean compressor assembly. Service air cleaner and check for leakage.
	Piston seal in actuator leaking. (Usually accompanied by oil leakage at drain line.)	Remove and replace actuator or disassemble and replace packing.
	Waste gate controller malfunction.	Adjust or replace unit.
	Waste gate butterfly not closing.	Low pressure. Clogged orifice in inlet to actuator. Butterfly shaft binding. Check bearings.
	Turbocharger impeller binding, frozen or fouling housing.	Check bearings. Replace turbocharger.
	Leak in engine intake or exhaust.	Tighten loose connections or replace manifold gaskets as necessary.

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Engine will not deliver rated power. (cont.)	Rotating assembly bearing seizure.	Overhaul turbocharger.
	Waste gate controller is in need of adjustment.	Have waste gate controller adjusted.
	Oil pressure too low.	Tighten fittings. Replace lines or hoses. Increase oil pressure to desired pressure.
	Inlet orifice to actuator clogged.	Remove inlet line at actuator and clean orifice.
Critical altitude lower than specified.	Controller not getting enough oil pressure to close the waste gate.	Check pump outlet pressure, oil filters and external lines for leaks or obstructions.
	Chips under metering valve in controller holding it open.	Replace controller.
	Metering jet in actuator plugged.	Remove actuator and clean jet.
	Actuator piston seal failed and leaking excessively.	If there is oil leakage at actuator drain, clean cylinder and replace piston seal.
	Waste gate valve sticking or rigged incorrectly.	Clean and free action.

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Engine surges or smokes.	Air in oil lines or actuator.	Bleed system.
	Controller metering valve stem seal leaking oil into manifold.	Replace controller.
	Actuator to waste gate linkage binding.	Correct cause of binding.
	Clogged breather.	Check breather for restrictions to air flow.
	Bootstrapping.	Operate engine within range outlined in operation manual.
—NOTE— *Smoke would be normal if engine has idled for a prolonged period.*		
High deck pressure. (Compressor discharge pressure.)	Controller metering valve not opening. Aneroid bellows leaking.	Replace controller assembly or replace aneroid bellows.
	Waste gate sticking closed.	Shut off valve in return line not working. Butterfly shaft binding. Check bearings. Replace bypass valve or correct linkage binding.
	Controller return line restricted.	Clean or replace line.
	Oil pressure too high.	Check pressure 75 to 85 psi (80 psi desired) at waste gate actuator inlet. If pressure on outlet side of actuator is too high, have waste gate controller adjusted.
	Waste gate controller malfunction.	Replace controller.

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
High deck pressure. (Compressor discharge pressure.) (cont.)	Waste gate actuator piston locked in full closed position. (Usually accompanied by oil leakage at actuator drain line.) —NOTE— ***Waste gate normally closed in idle and low power conditions. Should open when actuator inlet line is disconnected or power to engine is increased.***	Remove and disassemble actuator, check condition of piston and packing or replace actuator assembly.
Oil in induction housing.	Oil leaking past seal in controllers.	Replace faulty controller.
	Engine idles too slow - turbo doesn't turn allowing oil to leak from compressor seal.	Increase engine idle speed to a maximum of 700 RPM, if turbo still smokes, it must be replaced. —NOTE— ***New turbos may smoke for a short period of time.***
White exhaust.	Leaking oil seal in turbine (coked oil drain passages).	Clean drain passages. It is sometimes necessary to overhaul or replace turbo.
	Engine idles too slow - turbo not turning.	Increase engine idle speed to a maximum of 700 RPM, if turbo still smokes, it must be overhauled or replaced.

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Waste gate won't open.	Jammed piston seal in bypass valve or bearing seizure.	Remove and replace unit.
	Obstruction in oil outlet.	Clean return lines.
	Blocked oil drain return line.	Clean line.
	Broken linkage.	Replace linkage and adjust waste gate to open and close position to specifications in overhaul manual.
	Controller malfunction.	Replace controller.
Waste gate won't close completely.	Obstruction in oil inlet orifice.	Replace controller.
	Leaking valves in controller.	Replace controller.
	Piston seal in bypass valve worn or broken.	Replace controller.
	Broken linkage.	Repair linkage and adjust waste gate to open or close position to specifications in overhaul manual.
Split throttles.	Exhaust or intake leak.	Replace defective part.

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Turbine won't come up to speed.	Worn or coked bearings.	Replace or overhaul turbo charger.
	Damage to turbine or compressor wheel.	Replace or overhaul turbo charger.
	Exhaust leaks.	Repair leaks.
	Controller or waste gate malfunction.	Replace controller.

—*NOTE*—

When it has been determined that a controller is malfunctioning, it should be removed and replaced. The old unit should be sent to approved facilities for overhaul of turbochargers or repaired in accordance with current Avco-Lycoming Overhaul Instructions SSP266.

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TURBOCHARGER.

TURBOCHARGER NOMENCLATURE.

Many unfamiliar terms may appear on the following pages of this manual. An understanding of these will be helpful in performing maintenance and troubleshooting. The following is a list of commonly used terms and names as applied to turbocharging and a brief description of each.

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.
Waste Gate and Actuator (Exhaust By-Pass)	The waste gate is a butterfly type valve in the exhaust by-pass which, through out 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.
Density Controller	The density controller is designed to allow the engine to develop full rated power no matter what ambient temperature and pressure conditions are. This controller regulates waste gate bleed oil only at full throttle position to maintain a constant air density at the injector inlet. The pressure and temperature sensing bellows of the controller react to pressure and temperature changes between the fuel injector inlet and the turbocharger compressor. The bellows, filled with dry nitrogen gas, maintains a constant density by allowing the pressure to increase as temperature increases. Movement of the bellows re-positions the bleed valve, causing a change in quantity of bleed oil, which changes oil pressure to the wastegate piston.

—NOTE—

The density controller is designed to keep the air density constant at the injector entrance. As ambient air temperature increases or density decreases due to change in altitude a higher manifold pressure is required to maintain a constant density, also resulting in a higher injector inlet temperature. This is why wide open throttle manifold pressure increases with either altitude or outside air temperature. In a full throttle climb, a gain of 3 to 4 inches of manifold pressure between sea level and critical altitude will be seen.

Differential Pressure Controller	This controller uses a diaphragm rather than a bellows as is found in the density controller. It is used in conjunction with the density controller. Its function is to override the density controller so that the compressor discharge pressure is not held at an unnecessarily high level when lower manifold pressure is being used. The differential controller will usually maintain a compressor discharge pressure (deck pressure) approximately 6.5" Hg above the selected manifold pressure. In this system, the density controller is only effective at wide open engine throttle conditions.
Ground Boosted or Ground Turbocharged	These phrases indicate that the engine depends on a certain amount of turbocharging 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 waste gate in the automatic system or by pilot error in a manual controlled system.
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 as 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 turbocharged engine above critical altitude (waste gate 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 waste gate will be in a partially open position at sea level. As the aircraft is flown to higher altitude (lower ambient pressures) the waste gate closes gradually to maintain the preselected manifold pressure. At the point where the waste gate reaches its full closed position, the preselected manifold pressure will start to drop and this is considered critical altitude.

REMOVAL OF TURBOCHARGER.

1. Remove the engine cowling.
2. Remove the turbocharger compressor and turbine assembly by the following procedure:
   A. Disconnect the oil supply line from the center section of the turbo and the return line from the hose connection near the accessory housing.

   —CAUTION—

   Do not spread the v-band couplings to force them over the outside of the pipe. They must be passed over the end of the pipe. If the v-band couplings are spread open excessively, their sealing properties will be destroyed.

   B. Disconnect the air duct from the compressor inlet and the exhaust from the turbine discharge.
   C. Disconnect the support rods connecting the turbo and engine.
   D. Loosen the upper clamp of the hose that connects the turbo compressor and injector inlet plenum.
   E. Remove the bolts that attach the turbo to the mounting pad on the exhaust plenum and remove the turbo from the airplane.
3. The injector inlet plenum may be removed by the following procedure:
   A. Remove the lines to the lower portion of the plenum, the density controller and the differential pressure controller.
   B. Loosen the clamp on the hose that connects the plenum to the injector. If not previously accomplished in Step 2, loosen the clamp on the hose that connects plenum and compressor.
   C. Move the plenum aft and down to remove from the airplane.

4. The exhaust by-pass valve may be removed by the following procedure: (Refer to the latest revision of Lycoming Service Bulletin No. 450 or Airesearch Service Bulletin No. TP60-0119.)
   A. Ascertain that the exhaust by-pass valve is removed according to Step 4.
   B. Disconnect and remove the left exhaust stack extension by disconnecting it from the exhaust stack and the bracket that is attached to the turbo mounting bracket. Slide the extension from the exhaust plenum.
   C. Disconnect the plenum from the main mounting bracket. If not previously accomplished in Step 1, disconnect the plenum from the turbo.
   D. Remove the plenum from the right exhaust extension and from the airplane.
5. For service maintenance and overhaul of the turbocharger, refer to the manufacturer's recommended instructions.
   A. Remove the tailpipe assembly by disconnecting it at the exhaust plenum and the turbine discharge.
   B. Disconnect the lines from the by-pass valve actuator.
   C. Disconnect the by-pass valve from the exhaust plenum.

TURBOCHARGER LUBRICATION SYSTEM PRIMING.

Immediately prior to mounting the unit, prime the lubrication system as follows:
1. Invert turbocharger and fill center housing with new clean engine oil through oil drain.
2. Turn rotating assembly by hand to coat bearings and thrust washer with oil.
3. Coat threads of attaching bolts or studs with high temperature thread lubricant.
4. After installing turbocharger, flush oil through oil inlet line and ensure that line is clean and unobstructed .
5. Fill engine and oil inlet line with new, clean lubricating oil, and connect line.
6. Connect oil return line. (Refer to latest copy of Lycoming Service Instruction No. 1241.)

—NOTE—

If the turbocharger is to be installed on a new or newly overhauled engine, operate the engine with a separate oil filter in the oil supply line to the turbocharger during the first hour of operation. This must be done to ensure that no metal particles are carried from the engine into the turbocharger lubrication system.

INSTALLATION OF TURBOCHARGER.

1. The exhaust plenum may be installed by the following procedure:
   A. Slide the plenum on the right exhaust extension and secure it to the main mounting bracket. If the turbo is in place, secure to the turbo.
   B. Install the left exhaust extension on the plenum and connect to the exhaust stack. A gasket is installed between the exhaust stack and its extension.
   C. Secure the brackets that lead from the mounting bracket to the right and left exhaust extensions.

—NOTE—

For all "V"-band couplings on the exhaust system, be sure parts are concentric before tightening coupling. Coupling will not center parts automatically.

2. The exhaust by-pass valve may be installed by the following procedure: (Refer to latest revision of Lycoming Service Bulletin No. 450 or Airesearch Service Bulletin No. TP60-0119.)
   A. Attach and secure the by-pass valve to the exhaust plenum. A gasket is installed between the by-pass valve and exhaust plenum.
   B. Connect the lines to the by-pass actuator.
   C. Connect the tail pipe assembly to the by-pass valve and the turbine discharge. A gasket is installed between the by-pass valve and tail pipe assembly.
3. The injector inlet plenum may be installed by the following procedure:
   A. If the turbo is installed, connect the plenum to the compressor outlet with hose and clamps.
   B. Connect the lower portion of the plenum to the injector with hose and secure clamps.
   C. Connect the air duct to the compressor inlet and the exhaust to the turbine discharge.
   D. Connect the oil supply and return lines to the center section of the turbo.
4. Install the engine cowling.

ADJUSTMENT OF TURBOCHARGER.

It is recommended that adjustments of the turbocharger be conducted by an authorized overhaul facility, in accordance with the latest revision of Avco-Lycoming Service Instruction No. 1187.

DENSITY CONTROLLER.

REMOVAL OF DENSITY CONTROLLER.

1. Remove engine cowling.
2. Disconnect oil lines at controller unit.
3. Remove the screws securing the controller to the compressor discharge housing.
4. Remove the controller from the engine compartment.

INSPECTION AND REPAIR OF DENSITY CONTROLLER.

Refer to Garrett Airesearch Publication No. TP21-0108.

INSTALLATION OF DENSITY CONTROLLER.

1. Ascertain that all oil inlet and outlet lines are clean.
2. Mount the controller on the compressor discharge housing and secure with mounting screws.
3. Reconnect inlet and outlet oil lines to the controller.

ADJUSTMENT OF DENSITY CONTROLLER.

Refer to the latest issue of Avco-Lycoming Service Instruction No. 1187 for adjustment procedures. A list of special tools required to accomplish this adjustment is included in the Service Instructions.

DIFFERENTIAL PRESSURE CONTROLLER.

REMOVAL OF DIFFERENTIAL PRESSURE CONTROLLER.

1. Remove engine cowling.
2. Disconnect oil lines from controller.
3. Remove mounting screws securing controller to the compressor discharge housing.
4. Remove the controller from the engine.

INSPECTION AND REPAIR OF DIFFERENTIAL PRESSURE CONTROLLER.

Refer to the latest revision of Garrett Airesearch Publication No. TP21-019 for detailed information.

—NOTE—

This is a non-adjustable (in the field) controller, unless the proper equipment is available. Refer to the latest revisions of Garrett Airesearch Publication No. TP21-0109 and Lycoming Service Letter No. L184.

INSTALLATION OF DIFFERENTIAL PRESSURE CONTROLLER.

1. Ascertain that all oil inlet and outlet lines are clean.
2. Position the controller on the compressor discharge housing and secure with mounting screws.
3. Reconnect inlet and outlet oil lines to the controller.

EXHAUST WASTE GATE ASSEMBLY.

REMOVAL OF EXHAUST WASTE GATE ASSEMBLY.

1. Remove engine cowling.
2. Disconnect oil lines and drain line from waste gate assembly.
3. Remove v-band clamps securing waste gate to exhaust transition and tail pipe.

EXHAUST WASTE GATE VALVE SETTINGS. (Refer to Figure 81-3.)

The butterfly valve in the exhaust waste gate assembly is set to a predetermined open and closed clearance. A table of these clearances is given in Figure 81-3. With 50-60 psi pressure in the waste gate cylinder, adjust the closed position (A) of the valve so that clearance between the butterfly and side of housing is in accordance with specifications given in Figure 81-3. After adjusting the closed position and with no pressure in the waste gate cylinder, adjust the full open (B) position by adjusting the stop screw to provide the specified clearance between the valve and the side of the housing with backlash taken up towards the open position.

—NOTE—

All adjustments to the waste gate valve must start from the closed position first and then to the open position.

INSTALLATION OF EXHAUST WASTE GATE ASSEMBLY.

1. Install waste gate assembly with gasket between exhaust transition and tail pipe.
2. Secure waste gate with v-band clamps and torque clamps to specifications given in Chart 8102.
3. Connect oil lines and drain line to waste gate assembly.

—NOTE—

It is recommended that the waste gate valve be lubricated with a decarbonizing agent (Mouse Milk, WD-40 or equiv.) at the butterfly pivot points every 50 hours. (Refer to List of Consumable Materials, Chapter 91.)

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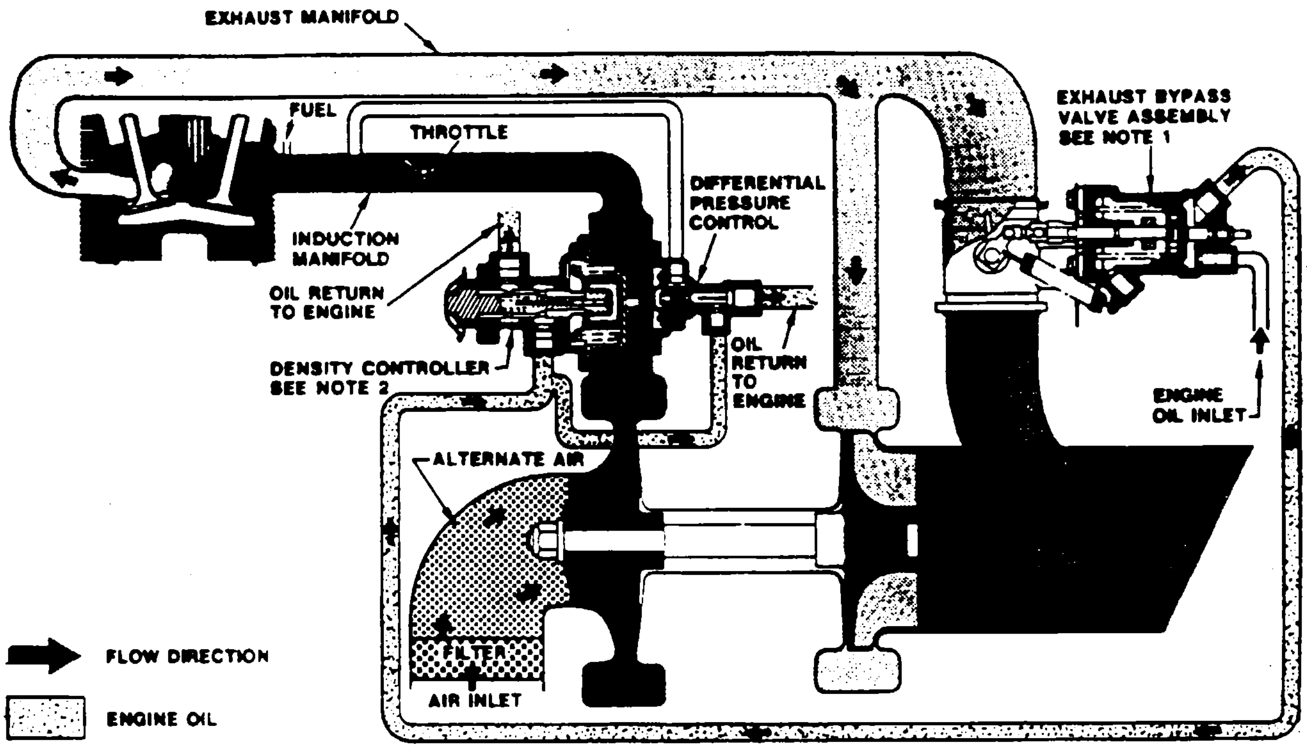
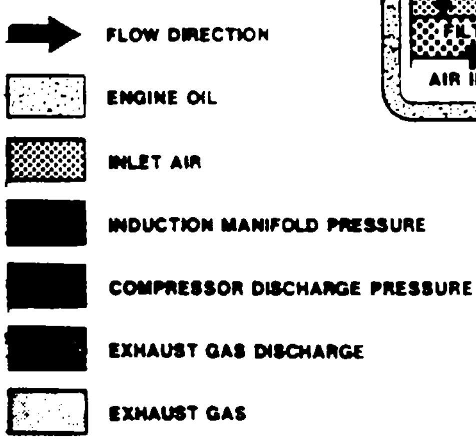




NOTE 1

SPRING TENSION HOLDS WASTE GATE OPEN. ENGINE OIL PRESSURE AGAINST DIAPHRAGM CLOSES WASTE GATE. OIL PRESSURE DECREASED OR INCREASED BY PRESSURE CONTROLLER.

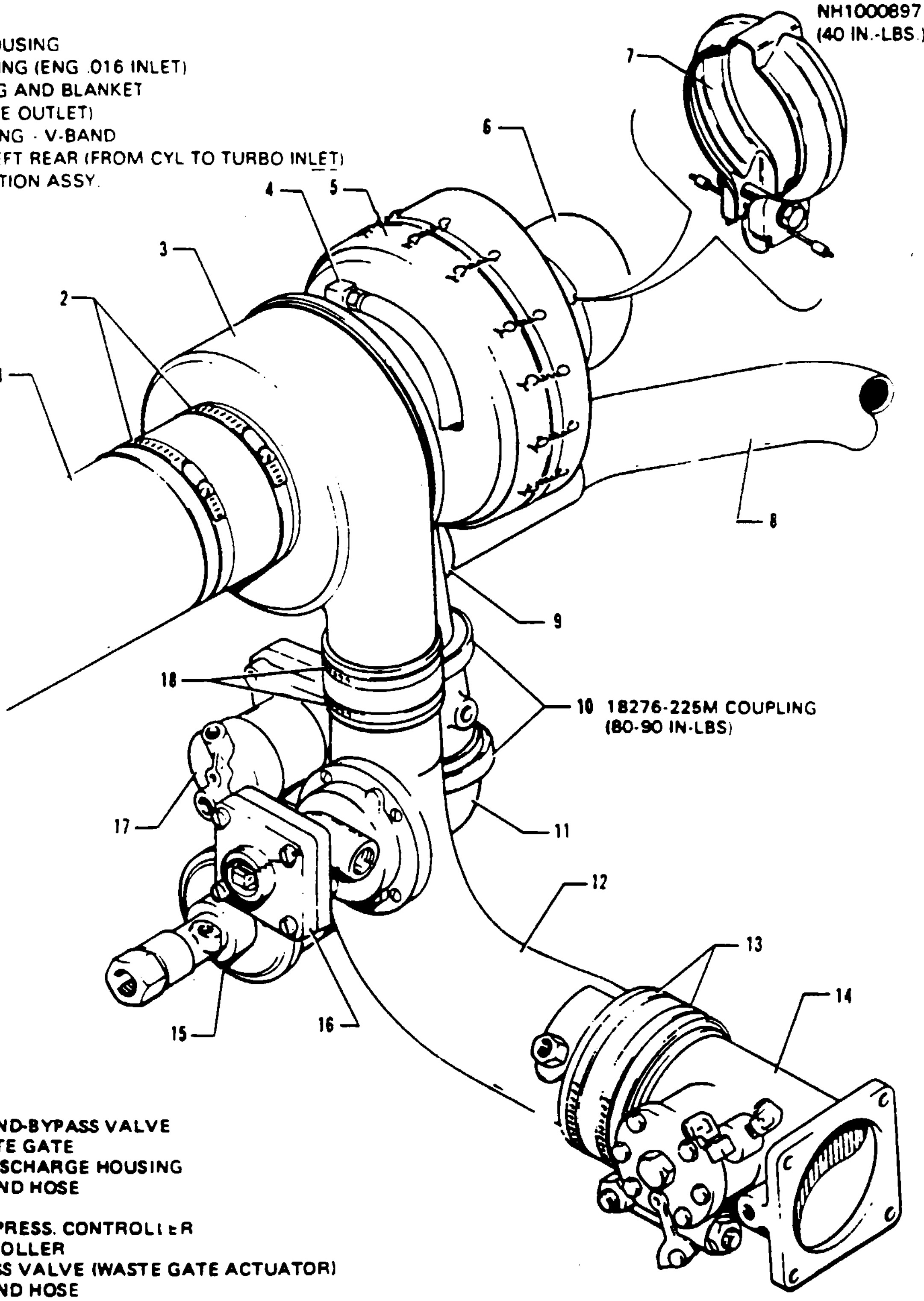
NOTE 2

INCREASED ENGINE SPEED CAUSES HIGHER PRESSURE AIR TO ACT AGAINST THE SPRING AND VACUUM OPERATED VARIABLE SETTING PRESSURE CONTROLLER. INCREASED PRESSURE CAUSES POPPET VALVE TO OPEN, STARTING THE ACTUATOR DRAIN FLOW.

THE BUILD UP OF OIL PRESSURE IN THE ACTUATOR CAUSES THE PISTON TO MOVE THE WASTE GATE TOWARD THE CLOSED POSITION. AS THE WASTE GATE CLOSES, MORE EXHAUST GASES ARE DIVERTED INTO THE TURBINE, CAUSING THE SHAFT TO INCREASE IN SPEED, INCREASING THE COMPRESSOR DISCHARGE PRESSURE.

Figure 81-1. Schematic Diagram of Turbocharger System

1. INDUCTION TUBE
2. HOSE CLAMPS
3. COMPRESSOR HOUSING
4. TURBO LUBRICATING (ENG .016 INLET)
5. TURBINE HOUSING AND BLANKET
6. TAIL PIPE (TURBINE OUTLET)
7. EXHAUST COUPLING - V-BAND
8. EXHAUST PIPE, LEFT REAR (FROM CYL TO TURBO INLET)
9. EXHAUST TRANSITION ASSY.



10. COUPLING V-BAND-BYPASS VALVE
11. TAIL PIPE - WASTE GATE
12. COMPRESSOR DISCHARGE HOUSING
13. HOSE CLAMPS AND HOSE
14. FUEL INJECTOR
15. DIFFERENTIAL PRESS. CONTROLLER
16. DENSITY CONTROLLER
17. EXHAUST BYPASS VALVE (WASTE GATE ACTUATOR)
18. HOSE CLAMPS AND HOSE

Figure 81-2. Turbocharger Installation

CHART 8102. TURBOCHARGER INSTALLATION TORQUE VALUES IN INCH-POUNDS

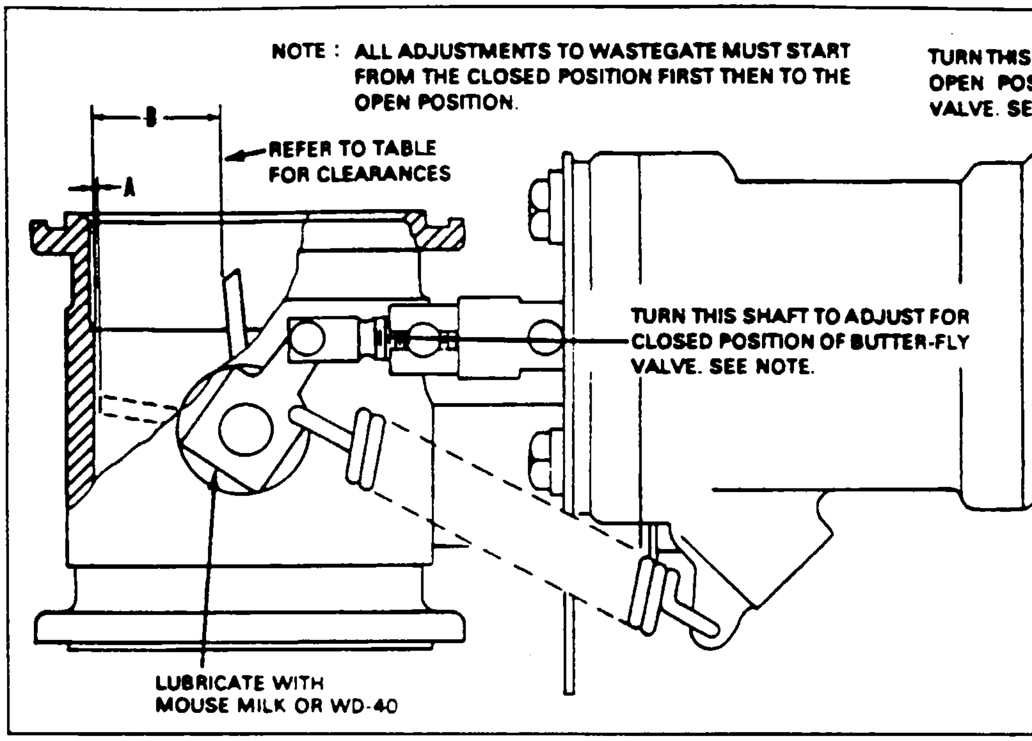
Turbine and compressor mount to engine	225-300
Turbine housing to center housing capscrews	100-130
Turbo oil inlet and outlet flange capscrews	200-270
Compressor housing to center housing clamp	40-60
Compressor housing to controller housing duct clamps	40-45
Turbine to exhaust transition bolts	225-300
Exhaust manifolds to transition clamps (V-Band)	See Note 1
Waste gate to transition clamp (V-Band)	See Note 2
Tail pipe to waste gate clamp	65 lbs. to 85 lbs.
Tail pipe to turbine clamp (V-Band)	See Note 3

—CAUTION—

Do not spread the couplings to force them over the outside of the pipe. They must be passed over the end of the pipe. If the clamps are spread open excessively, their sealing properties will be destroyed

—NOTES—

1. Before installing the coupling around the adapter pipes, make sure the entire exhaust assembly is in alignment: that is, mating flanges must match each other. Support the exhaust system in this position and proceed to install couplings around flange and engage latch. Tighten coupling nut to 50 inchpounds initial torque. Tap outer periphery of coupling with mallet to distribute band tension. Check torque and continue tightening to a final torque of 70-80 inch-pounds. Tapping coupling until torque reading stabilizes.
2. With the flanges together, position the coupling over the flanges. Press the coupling around the flanges and engage the latch. Tighten the coupling nut to about 60 inch-pounds torque. Then tap around the outer periphery of the coupling with a mallet to distribute band tension. Check the torque on the coupling nut and this time tighten to 80-90 inch-pounds. Again tap around the periphery of the coupling and recheck the torque. Repeat this procedure until the maximum torque of 80-90 inchpounds is attained.
3. Fit tail pipe flange to turbine flange making certain flange faces are butted together with no gap. Position tail pipe for clearance with exhaust pipe. Slide clamp over flanges, position and tighten. Tap the coupling gently to distribute band tension while tightening the coupling nut. Torque clamps 45-55 inch-pounds.



VALVE CLEARANCE	
	TIO-540-J SERIES
A	.023 - .037
B	.730 - .750

Figure 81-3. Exhaust Waste Gate

TURBOCHARGER DECOKING.

Mouse Milk, penetrating oil, or equivalent, may be used for decoking the turbine and compressor drive shaft by the following procedure:

1. Disconnect the oil inlet and outlet lines from the turbocharger and allow all oil to drain.
2. Cap the oil outlet port on the turbocharger.
3. Pour the Mouse Milk into the oil inlet port of the turbocharger and allow the unit to soak overnight.
4. Drain all Mouse Milk from the turbocharger and flush the unit with engine oil.
5. Prime the turbocharger.

—END—

GRIDS 4J17 THRU 4L24
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T1000

AIRLINE DIVISION

T1020

MAINTENANCE MANUAL

CARD 5 OF 5

PA-31-350 T1020

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 768)

INTRODUCTION.

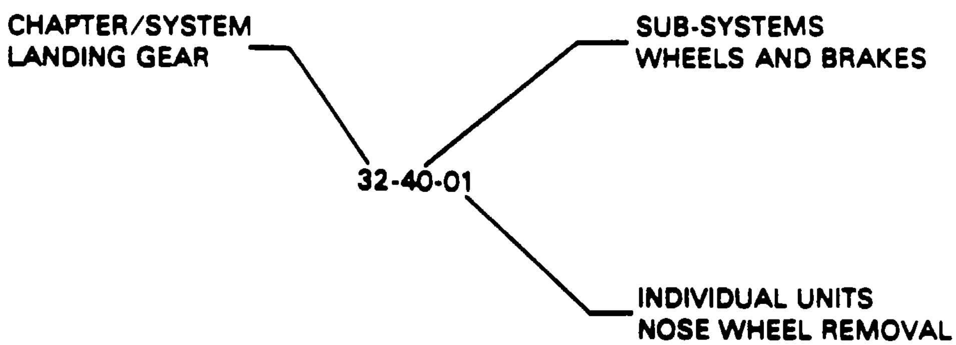
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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 Maintenance Manual is provided to support and maintain the Piper Model PA-31-350 T-1020 aircraft manufactured by the Piper Aircraft Corporation of Lakeland, Florida.

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 T-1020 Parts Catalog P/N 761 775, 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. 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 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, or 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 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:

SAMPLE EFFECTIVITY CODES

First Revision:	Month and Year (11-80)
Second Revision:	Revision Indication, Month and Year(2R 12-80)
Third Revision:	Revision Indication, Month and Year (3R 1-81)
Fourth Revision:	Revision Indication, Month and Year (4R 2-81)
Added Subject:	Identification, Month and Year (A 3-80)

Revisions to this Maintenance Manual 761 768 issued September 2, 1981 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
PR820223	February 23, 1982	1, 2, 3, 4 and 5
PR821015	October 15, 1982	1, 2, 3, 4 and 5
PR831117	November 17, 1983	1, 2, 3, 4 and 5
PR840703	July 3, 1984	1, 2, 3, 4 and 5
IR860430	April 30,1986	1
IR860920	September 20, 1986	1
IR871009	June 15, 1988	3
IR900313	March 13, 1990	2

INTERIM REVISION

**Revisions appear in chapter 27 of card 2. Please dispose of your current card 2 and replace with the revised one.
DO NOT DISPOSE OF CARDS 1, 3, 4, or 5.**

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VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual =	AVCO LYCOMING = OVERHAUL MANUAL DIRECT DRIVE ENGINE - P/N 60294-7 Avco Lycoming Division Williamsport, PA 17701
Parts Catalog =	AVCO LYCOMING - P/N PC-315 Avco Lycoming Division Williamsport, PA 17701
Operators Handbooks =	AVCO LYCOMING TIO-540 and LTIO-540 SERIES AIRCRAFT ENGINES - P/N 60297-23 Avco Lycoming Division Williamsport, PA 17701

PROPELLER:

Overhaul Instructions =	HARTZELL CONSTANT SPEED AND FEATHERING PROPELLER - P/N 117D Hartzell Propeller Inc. P.O. Box 1458, 1800 Covington Avenue, Piqua, Ohio 45356

MAGNETOS:

Installation, Operation and Maintenance Instructions =	S-1200 SERIES MAGNETO IGNITION SYSTEM - P/N-L-609-3 Bendix Electrical Components Division Sidney, New York 13838

WHEELS AND BRAKES:

PARTS CATALOGS and Maintenance Instructions =	CLEVELAND WHEEL AND BRAKE Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011

VENDOR-SUPPLIER INFORMATION.

Refer to the following list of manufactures, to obtain Service Manual and field service data:

Autoflite	BENDIX AVIONICS DIVISION 2100 N.W. 62nd Street Fort Lauderdale, Fla. 33310 (305) 776-4100 TWX 510-995-8884

VENDOR-SUPPLIER INFORMATION (cont.)

Autoflite (cont.)

EDO-CORPORATION
AVIONICS DIVISION
Box 610
Municipal Airport
Mineral Wells, Texas 76067
(817) 325-2517

SPERRY FLIGHT SYSTEMS
AVIONICS DIVISION
7500 Balboa Blvrd.
P.O. Box 9028 Van Nuys, Ca. 91409
(213) 894-8111 Telex: 65-1367

COLLINS GENERAL AVIATION
DIVISION
Rockwell International
Cedar Rapids, Iowa, 52406
(319) 395-3625 Telex: 46-4421

KING RADIO CORPORATION
400 N. Rodgers Rd.
Olathe, Kansas, 66061
(813) 782-0400 Telex: 4-2299
Kingrad

GLOBAL NAVIGATION
2144 Michelson Drive
Irvine, Ca. 92715
(714) 851-0119

PIPER PUBLICATIONS.

PA-31-350 T-1020
Parts Catalog = 761 775
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, FL 32960

CONTINUOUS
INSPECTION = 761 770
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, FL 32960

GAMA SYSTEM/CHAPTER INDEX GUIDE

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8		LEVELING AND WEIGHING	1E16
9		TOWING AND TAXIING	1E21
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28		FUEL	2G19
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GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

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53	FUSELAGE	4B21
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56	WINDOWS	4C17
57	WINGS	4D4
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70	STANDARD PRACTICES ENGINES	4E22
71	POWER PLANT	4F1
73	ENGINE FUEL AND CONTROL	4G1
74	IGNITION	4G11
76	ENGINE CONTROLS	4H10
77	ENGINE INDICATING	4H14
79	OIL SYSTEM	4I1

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

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81		TURBINES	4I21
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CHAPTER

91

CHARTS AND WIRING DIAGRAMS

CHAPTER 91 - CHARTS AND WIRING DIAGRAMS

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GENERAL.

This chapter contains miscellaneous charts which are applicable to various chapters and systems covered in this manual. All electrical schematics are also included in this chapter.

CONSUMABLE MATERIALS.

Refer to back of Consumable Materials List for Vendor Information.

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CHART 9101. LIST OF CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Grease, High Temperature	MIL-G-3545 OPL-3545-15	High Temp. Grease Marfax All Purpose	Texaco, Inc., 135 East 42nd, New York, New York 10017
		Shellaire Grease HT, Alvania EP Grease 2, Aeroshell Grease 5	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Grease 77, Mobilux EP2	Mobil Oil Corporation, Shoreham Building, Washington, D.C. 20005
		Royco 45A	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
		L-1231	Sinclair Refining Co., 600 Fifth Avenue, New York, New York 10020
Hydraulic Fluid	MIL-H-5606 QPL-5606-12	Aircraft Hydraulic Oil AA	Texaco, Inc., 135 East 42nd, New York, New York 10017
		RPM Aviation Oil No. 2 Code PED 2585, PED 3337	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		3126 Hydraulic Oil	Exxon Company, U.S.A., Box 2180, Houston, Texas 77001
		Aeroshell Fluid 4, Aeroshell Fluid 4 SL-7694	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Aero HF	Mobil Oil Corporation, Shoreham Building, Washington, D.C. 20005
		Royco 756, 75A, 756B	Royal Lubricants Co., River Road, Hanover, New Jersey 07936

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Lubricating Grease	MIL-G-7711 QPL-7711-15	Regal AFB2, Regal Starfak Premium 2	Texaco, Inc., 135 East 42nd, New York, New York 10017
		PED 3040	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		Aeroshell Grease 6	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Royco 11	Royal Lubricants, Co., River Road, Hanover, New Jersey 07936
Lubricating Oil General Purpose, Low Temperature	MIL-L-7870 QPL-7870-9	1692 Low Temp. Oil	Texaco, Inc., 135 East 42nd, New York, New York 10017
		Aviation Instrument Oil	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		Royco 363	Royal Lubricants, Co., River Road, Hanover, New Jersey 07936
		Sinclair Aircraft Orbit Lube	Sinclair Refining Co., 600 Fifth Avenue, New York, New York 10020
		Caltex Low Temp. Oil	Caltex Oil Products Co., New York, New York

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Grease Aircraft and Instrument, Gear and Actuator Screw	MIL-G-23827 QPL-23827-10	Low Temp. Grease EP	Texaco, Inc., 135 East 42nd, New York, New York 10017
		5114 EP Grease, AV 55	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		Aeroshell Grease 7, Braycote 627S	Shell Oil Co., 50 West 50th St., New York, New York 10020
		Mobil Grease 27	Mobil Oil Corporation, Shoreham Building, Washington, D.C. 20005
		Royco 27A	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
		Castrolease A1	Castrol Oils Inc., Newark, New Jersey
		Supermil Grease No. A72832	American Oil Company, 165 N. Canal, Chicago, Illinois 60606
		BP Aero Grease 31B	BP Trading Limited Moore Lane, Britannic House, London E.C. 2 England
Grease, Aircraft, General Purpose Wide Temperature Range	MIL-81322 QPL-81322-3	Aeroshell Grease 22	Shell Oil Co., 50 West 50th St., New York, New York 10020
		Mobil Grease 28	Mobil Oil Corporation, Shoreham Building, Washington, D.C. 20005
		Royco 22	Royal Lubricants Co., River Road, Hanover, New Jersey 07936

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Grease, Aircraft and Instruments, High and Low Temperature	MIL-G-3278 QPL-3278-24	Unitemp EP	Texaco, Inc., 135 East 42nd, New York, New York 10017
		RPM Avn. Grease 5, Supermil Grease No. 8723	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		Aeroshell Grease 7A	Shell Oil Co., 50 West 50th St., New York, New York 10020
		Mobil Grease 22	Mobil Oil Corporation, Shoreham Building, Washington, D.C. 20005
		Royco 78	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
		L-1212	Sinclair Refining Co., 600 Fifth Avenue, New York, New York 10020
		1916 Uni-Temp. Grease	California Texas Oil Corp., 380 Madison Ave., New York, New York 10017
Lubricating Grease Molybdenum Disulfide	MIL-G-21164 QPL-21164-15	Aeroshell Grease 17	Shell Oil Co., 50 West 50th St., New York, New York 10020
		Royco 64C	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
		Castrolease MSA (C)	Castrol Oil Inc., 254-266 Doremus Avenue, Newark, New Jersey 07105

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Grease, Ball and Roller Bearing	MIL-G-18709 QPL-18709-55	Regal ASB-2 Formula TG-10293	Texaco, Inc., 135 East 42nd, New York, New York 10017
		Andok B	Exxon Company, U.S.A., Box 2180, Houston, Texas 77001
		Code 1-20481, Darina Grease 1 XSG-6213 Code 71-501, Darina Grease 2 XSG-6152 Code 71-502, Alvania Grease 2 XSG-6151 Code 71-012, Cyprina Grease 3 XSG-6280 Code 71-003	Shell Oil Co., 50 West 50th St., New York, New York 10020
Lubricating Grease, Plug Valve, Gasoline and Oil Resistant	MIL-G-6032 QPL-6032-10	Royco 32	Royal Engineering Co., Whippany, New Jersey
		Castrolease PV	Castrol Oils Inc., Newark, New Jersey
		Parker Fuel Lube 44	Parker Seal Co.
		BP Aero Grease 32	BP Trading Limited, Moore Lane, Brittanic House, London, E.C. 2, England
Anti-Seize Compound Graphite Petroleum	MIL-T-5544 TT-S-1732 (TT-A-580)	Royco 44	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
Silicone Compound	MIL-S-8660 (MIL-C-21567) (QPL-8660-7)	DC-4, DC-6 Compound	Dow Corning, S. Saginaw Road, Midland, Michigan 48641
		G-624	General Electric Co., Silicone Products Dept., Waterford, New York 12188
		Y 2900	Union Carbide

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Dry Lubricant, Fluorocarbon Release Agent	MIL-L-60326	MS-122, 607S	Miller-Stephenson Chemical Co. Inc. 16 Sugar Hollow Road, Danbury, Conn. 06810
Waterproof Grease, High and Low Temperature		Aero Lubriplate	Fiske Brothers Refining Company, 129 Lockwood, Newark, New Jersey 07105
Rain Repellent		Repcon FSCM 50159	UNELKO Corporation, 727 E. 110th St., Chicago, Illinois 60628
Lubricant & Decoke Agent for Turbo-charger		Mouse Milk	Worldwide Aircraft Filter Corporation, 1685 Abram St., San Leandro, CA 94577
Lubricant Ignition Harness Ferrule Shoulder		GO-JO NO-LOK	Goger Inc., Akron, Ohio 44309

TORQUE REQUIREMENTS.

The torque values given in Chart 9103 are derived from oil free cadmium-plated threads and are recommended for all airframe installation procedures where torquing is required, unless otherwise noted in sections where other values are stipulated. Engine torque values are found in the latest revision of Lycoming Special Service Publications SSP-1776, and propeller torque values are found in Chapter 61 of this manual. Chart 9102 lists the torque values for flared fittings of various sizes and material.

— NOTE —

When flared fittings are being installed, ascertain that the male threads are properly lubricated. Torque the fittings in accordance with Chart 9102.

— CAUTION —

Do not overtorque fittings.

CHART 9102. FLARE FITTING TORQUE VALUES

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	---	---	---	---	---	---

CHART 9103. RECOMMENDED NUT TORQUES

TORQUES: The importance of correct application cannot be overemphasized. 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 threaded areas. There are a few simple, but very important, procedures that should be followed to assure that the correct torque is applied:

1. Calibrate the torque wrench periodically to assure accuracy; and recheck frequently.
2. Unless otherwise specified, torque all nuts to the applicable torque in the Recommended Nut Chart. If the nut (or the bolt) is listed but not its mating fastener, use the lower torque specified for the listed nut (or bolt).

NOTE

If normal operation requires movement between any of the components being clamped together, tighten the nut (or bolt) without regard to the nut torque chart, to insure intended operation of the assembly.

3. Bolt and nut threads should be clean and dry unless otherwise specified. If the threads are to be lubricated and no torque is specified, reduce the recommended nut torque (plus the friction drag torque) by 50%.
4. For other bolt sizes, determine the friction drag torque by turning the nut to near contact with the bearing surface. Attach a scale type torque wrench to the nut and determine the torque required to turn the nut on the bolt (before the nut makes contact with the bearing surface). Add this, the friction drag torque, to the specified torque to get the final torque.

NOTE

If the bolt is stationary and the nut is torqued, use the lower side of the torque range. If the nut is stationary and the bolt is torque, use the higher side of the torque range.

5. When torquing castellated nuts, begin with minimum torque plus friction drag torque, but do not exceed maximum torque plus friction drag torque when trying to align slot on nut with the hole in the bolt shank. If they do not align, change washers and try again. When using castellated nuts on moveable joints, do not torque as described above. Tighten nuts only to remove looseness in the joint and then install the cotter pin.
6. After the final torque has been applied, the nut (or bolt or screws if no nut is used) should be permanently marked red and should not be further tightened or disturbed.

NOTE

Nut and bolt sizes 8 through 7/16 include friction drag torque values.

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	
SEE NOTE	Min.	Max.	Min.	Max.
8 -32	27	30	22	24
10 -24	38	43	30	33
1/4-20	70	80	55	60
5/16-18	140	150	108	115
3/8-16	240	265	175	190
7/16-14	330	335	240	255
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 9103. 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.
	NOTE: BOLT AND NUT SIZES 10 THROUGH 7/16 INCLUDE FRICTION DRAG TORQUE.											
8 -36	12	15	7	9					5	10	3	6
10 -32	38	43	30	33	43	48	33	38	28	33	23	28
1/4-28	80	100	60	70	110	130	80	90	60	75	45	60
5/16-24	160	200	120	145	180	205	130	150	100	125	85	100
3/8-24	240	270	175	190	280	330	200	230	155	190	125	150
7/16-20	550	600	370	400	620	730	400	500	280	380	210	270
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	2,600	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

PPS 20016

LUBRICATION OF THREADS.

All fittings on external lines, including their points of attachment at the engine and other components, should be lubricated with the proper lubricant as specified in Chart 9104.

The following steps should be followed when applying thread lubricants:

1. Thoroughly clean threads before applying lubricant.
2. Use selected thread lubricant sparingly.
3. Apply thread lubricant to male threads only.
4. Lubricate the first three threads on straight fittings.
5. Do not lubricate the first two threads on tapered fittings. Apply the lubricant to the next three threads only.
6. Ascertain that lubricant does not enter fittings or flared areas.
7. Any fittings going to the engine should be lubricated with the type of fluid going through the lines.

CHART 9104. THREAD LUBRICANTS

TYPE OF LINE	TYPE OF LUBRICANT
Brakes/Hydraulic	MIL-H-5606
Deicer (Air)	TT-A-580 (JAN-A-669), Anti-Seize Compound (White Lead Base)
Fuel	MIL-T-5544, Anti-Seize, Graphite Petrolatum
Oil	MIL-G-6032, Lubricating Grease (Gasoline and Oil Resistant)
Oxygen	MIL-T-5542, Thread Compound, Anti-Seize and Sealing, Oxygen System
Pitot and Static	TT-A-580 (JAN-A-669), Anti-Seize Compound (White Lead Base)
NOTE Lubricate engine fittings only with the fluid contained in the particular lines.	

LUBRICATION OF GASKETS AND SEALS.

Gaskets and O-ring seals which require lubrication should be lubricated with the same type of fluid they are sealing.

CONVERSION CHARTS.

CHART 9105. DECIMAL CONVERSION

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 9106. TORQUE CONVERSION

INCH POUNDS TO CENTIMETER KILOGRAMS (cmkg.)

5 in. lbs.	5.76 cmkg.	45 in. lbs.	51.84 cmkg.	85 in. lbs.	97.92 cmkg.
10 in. lbs.	11.52 cmkg.	50 in. lbs.	57.60 cmkg.	90 in. lbs.	103.68 cmkg.
15 in. lbs.	17.28 cmkg.	55 in. lbs.	63.36 cmkg.	95 in. lbs.	109.44 cmkg.
20 in. lbs.	23.04 cmkg.	60 in. lbs.	69.12 cmkg.	100 in. lbs.	115.20 cmkg.
25 in. lbs.	28.80 cmkg.	65 in. lbs.	74.88 cmkg.	105 in. lbs.	120.96 cmkg.
30 in. lbs.	34.56 cmkg.	70 in. lbs.	80.64 cmkg.	110 in. lbs.	126.72 cmkg.
35 in. lbs.	40.32 cmkg.	75 in. lbs.	86.40 cmkg.	115 in. lbs.	132.48 cmkg.
40 in. lbs.	46.08 cmkg.	80 in. lbs.	92.16 cmkg.	120 in. lbs.	138.24 cmkg.

(cmkg.) CENTIMETER KILOGRAMS TO INCH POUNDS

50 cmkg.	43.4 in. lbs.	300 cmkg.	260.4 in. lbs.	550 cmkg.	477.4 in. lbs.
100 cmkg.	86.8 in. lbs.	350 cmkg.	303.8 in. lbs.	600 cmkg.	520.8 in. lbs.
150 cmkg.	130.2 in. lbs.	400 cmkg.	347.2 in. lbs.	650 cmkg.	564.2 in. lbs.
200 cmkg.	173.6 in. lbs.	450 cmkg.	390.6 in. lbs.	700 cmkg.	607.6 in. lbs.
250 cmkg.	217.0 in. lbs.	500 cmkg.	434.0 in. lbs.		

FOOT POUNDS TO METER KILOGRAMS (mkg.)

2½ ft. lbs.	.346 mkg.	67½ ft. lbs.	9.332 mkg.	165 ft. lbs.	22.813 mkg.
5 ft. lbs.	.691 mkg.	70 ft. lbs.	9.678 mkg.	170 ft. lbs.	23.504 mkg.
7½ ft. lbs.	1.037 mkg.	72½ ft. lbs.	10.024 mkg.	175 ft. lbs.	24.195 mkg.
10 ft. lbs.	1.383 mkg.	75 ft. lbs.	10.369 mkg.	180 ft. lbs.	24.887 mkg.
12½ ft. lbs.	1.728 mkg.	77½ ft. lbs.	10.715 mkg.	185 ft. lbs.	25.578 mkg.
15 ft. lbs.	2.074 mkg.	80 ft. lbs.	11.060 mkg.	190 ft. lbs.	26.269 mkg.
17½ ft. lbs.	2.419 mkg.	82½ ft. lbs.	11.406 mkg.	195 ft. lbs.	26.960 mkg.
20 ft. lbs.	2.765 mkg.	85 ft. lbs.	11.752 mkg.	200 ft. lbs.	27.652 mkg.
22½ ft. lbs.	3.111 mkg.	87½ ft. lbs.	12.097 mkg.	105 ft. lbs.	28.343 mkg.
25 ft. lbs.	3.456 mkg.	90 ft. lbs.	12.443 mkg.	210 ft. lbs.	29.034 mkg.
27½ ft. lbs.	3.802 mkg.	92½ ft. lbs.	12.789 mkg.	215 ft. lbs.	29.726 mkg.
30 ft. lbs.	4.148 mkg.	95 ft. lbs.	13.134 mkg.	220 ft. lbs.	30.417 mkg.
32½ ft. lbs.	4.493 mkg.	97½ ft. lbs.	13.480 mkg.	225 ft. lbs.	31.108 mkg.
35 ft. lbs.	4.839 mkg.	100 ft. lbs.	13.826 mkg.	230 ft. lbs.	31.800 mkg.
37½ ft. lbs.	5.185 mkg.	105 ft. lbs.	14.517 mkg.	235 ft. lbs.	32.491 mkg.
40 ft. lbs.	5.530 mkg.	110 ft. lbs.	15.208 mkg.	240 ft. lbs.	33.182 mkg.
42½ ft. lbs.	5.876 mkg.	115 ft. lbs.	15.900 mkg.	245 ft. lbs.	33.873 mkg.
45 ft. lbs.	6.222 mkg.	120 ft. lbs.	16.591 mkg.	250 ft. lbs.	34.565 mkg.
47½ ft. lbs.	6.567 mkg.	125 ft. lbs.	17.282 mkg.	255 ft. lbs.	35.256 mkg.
50 ft. lbs.	6.913 mkg.	130 ft. lbs.	17.974 mkg.	260 ft. lbs.	35.947 mkg.
52½ ft. lbs.	7.258 mkg.	135 ft. lbs.	18.665 mkg.	265 ft. lbs.	36.639 mkg.
55 ft. lbs.	7.604 mkg.	140 ft. lbs.	19.356 mkg.	270 ft. lbs.	37.330 mkg.
57½ ft. lbs.	7.950 mkg.	145 ft. lbs.	10.047 mkg.	275 ft. lbs.	38.021 mkg.
60 ft. lbs.	8.295 mkg.	150 ft. lbs.	20.739 mkg.	280 ft. lbs.	38.713 mkg.
62½ ft. lbs.	8.641 mkg.	155 ft. lbs.	21.430 mkg.	285 ft. lbs.	39.404 mkg.
65 ft. lbs.	8.987 mkg.	160 ft. lbs.	22.121 mkg.	290 ft. lbs.	40.095 mkg.
				295 ft. lbs.	40.786 mkg.
				300 ft. lbs.	41.478 mkg.

(mkg.) METER KILOGRAMS TO FOOT POUNDS

1 mkg.	7.23 ft. lbs.	8 mkg.	57.86 ft. lbs.	15 mkg.	108.49 ft. lbs.
2 mkg.	14.46 ft. lbs.	9 mkg.	65.09 ft. lbs.	16 mkg.	115.72 ft. lbs.
3 mkg.	21.69 ft. lbs.	10 mkg.	72.32 ft. lbs.	17 mkg.	122.95 ft. lbs.
4 mkg.	28.93 ft. lbs.	11 mkg.	79.56 ft. lbs.	18 mkg.	130.19 ft. lbs.
5 mkg.	36.16 ft. lbs.	12 mkg.	86.79 ft. lbs.	19 mkg.	137.42 ft. lbs.
6 mkg.	43.39 ft. lbs.	13 mkg.	94.02 ft. lbs.	20 mkg.	144.65 ft. lbs.
7 mkg.	50.63 ft. lbs.	14 mkg.	101.26 ft. lbs.	21 mkg.	151.89 ft. lbs.
				22 mkg.	159.12 ft. lbs.

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CHART 9107. 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 9107.)

   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 9107.)

   A. Read number in middle column. if in degrees Celsius (°C). read Fahrenheit equivalent in right-hand 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 9107. 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 9107. CONVERSION TABLES (cont.)

CENTIGRADE — FAHRENHEIT CONVERSION CHART

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 9107. 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

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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DECIMAL/MILLIMETER EQUIVALENTS OF DRILL SIZES.

CHART 9108. 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.

CIRCUIT LOAD CHART.

CHART 9109. CIRCUIT LOAD CHART

CIRCUIT	CIRCUIT BREAKER SIZE	ITEM	NO. OF UNITS OPERATING SIMUL-TANEOUSLY	MAX. CURRENT PER UNIT 28.5V
AIR CONTROL	10	LEFT VENT FAN MOTOR RIGHT VENT FAN MOTOR COMPRESSOR CLUTCH CONDENSER FAN RELAY	1 1 1 1	2.70 2.70 2.50 0.20
ANTI-COLLISION LIGHTS	5	ROTATING BEACON (INCANDESCENT)	2	1.94
ANTI-COLLISION LIGHTS	10	RED STROBE	2	2.60
ANTI-COLLISION LIGHTS	10	WHITE STROBE (WING TIP)	2	2.60
ANTI-COLLISION LIGHTS	10	STROBE, (STANDARD) 2 WING TIP, 1 TAIL	1 SYSTEM 3 UNITS	1.85
AUX. VOLTAGE REG.	5	ALTERNATOR FIELD CIRCUIT	1	4.00
CABIN, MAP AND DOOR	5	CABIN READING LIGHTS	3	0.51
UNSAFE LIGHTS		MAP LIGHTS DOME LIGHTS DOOR UNSAFE LIGHT NO SMOKING/FASTEN SEAT BELT	1 1 1 1	0.13 0.79 0.04 0.12
CONDENSER BLOWER	15	FAN MOTOR	1	12.0
COWL FLAP	10	LEFT FLAP MOTOR RIGHT FLAP MOTOR	1 1	4.10 4.10
FUEL PUMP	10	LEFT FUEL PUMP RIGHT FUEL PUMP	1 1	3.40 3.40
GEAR, OIL TEMP., CYL. HD. & FUEL QUAN. IND.	5	FUEL QUAN. INDICATORS OIL TEMP. INDICATORS CYL. HD. TEMP. INDICATORS GEAR POSITION LIGHTS	2 2 2 3	0.39 0.39 0.39 0.04
GEAR SAFETY	5	SELECTOR LOCK SOLENOID MOTION LIGHT WARNING HORN LANDING LIGHT GROUND SOLENOID GROUND WARNING RELAY	1 1 1 1 1	1.14 0.04 0.30 0.50 0.30
GROUND VENT FAN	5	FAN MOTOR	1	4.60
HEATER BLOWER	20	FAN MOTOR	1	18.5
HEATER & LIGHTER	15	HEATER ASSEMBLY BLOWER MOTOR SOLENOID CIGAR LIGHTER	1 1 1	3.80 0.50 12.0

CHART 9109. CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT BREAKER SIZE	ITEM	NO. OF UNITS OPERATING SIMUL-TANEOUSLY	MAX. CURRENT PER UNIT 28.5V
LANDING & TAXI LIGHT	20	LANDING LIGHT TAXI LIGHT WING INSPECTION LIGHT	1 1 1	8.90 8.90 1.80
MAIN VOLTAGE REG.	5	ALTERNATOR FIELD CIRCUIT	1	4.00
PANEL LIGHTS	5	INSTRUMENT LIGHTS DUAL INSTRUMENT LIGHTS ELECTROLUMINESCENT PANELS	40 13 5	0.04 0.04 0.01
L & R PITOT HEAT	10	HEATED PITOT TUBE	1	7.10
POSITION LIGHTS	5	WING TIP LIGHTS TAILLIGHT	3 3	0.90 1.04
PROP DEICE	20	TIMER PROP HEATER ELEMENT	1 3	0.01 16.0
PROP SYNC	5	ARKORP PROP SYNC SYSTEM	1	0.60
STALL WARNING	5	LIGHT, HORN & FLASHER	1	0.16
STARTER & FLAP SOLENOID	10	STARTER SOLENOID FLAP MOTOR SOLENOID HOURMETER	1 1 1	2.80 0.50 0.01
SURFACE DEICE	5	TIMER LEFT RELIEF VALVE RIGHT RELIEF VALVE GYRO ENGAGE VALVE DISTRIBUTOR VALVE TIMER RELAY CONTROL RELAY INDICATOR LIGHT	1 1 1 1 1 1 1 1	0.24 0.50 0.50 0.50 0.50 0.20 0.20 0.04
TRIM & PNEU. SOURCE IND.	5	TRIM INDICATOR SYSTEM PNEUMATIC SOURCE INDICATOR	5 1	0.42 0.04
L & R TURN & BANK	5	TURN & BANK INDICATOR	1	0.82
WINDSHIELD HEAT	25	HEATED WINDSHIELD	1	22.6
WINDSHIELD WIPER	10	WIPER MOTOR	1	4.60
WING FLAP MOTOR	25	MOTOR	1	12.0
		AVIONICS		
ADF 1	5	ADF-T12C OR ADF-T12D, BENDIX KR-85, KING KDF-800, KING	1	0.52 1.04 1.35

CHART 9109. CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT BREAKER SIZE	ITEM	NO. OF UNITS OPERATING SIMUL-TANEOUSLY	MAX. CURRENT PER UNIT 28.5V
ADF 2	5	SIMILAR TO ADF 1		
AUDIO	5	KA-25, AMPLIFIER, KING	1	1.14
		KA-37, LAMPS ONLY	1	0.20
		KAA-445, AMPLIFIER, KING	IDLE	0.16
			OPER.	2.18
		KMA-20, AUDIO, CONTROL, KING	1	1.25
		CP-125, AUDIO CONTROL, NARCO	1	0.15
AUTOPILOT	5	ALTIMATIC IIIB-1, MITCHELL	1	4.15
	OR	ALTIMATIC V-1, BENDIX	1	6.80
	10	ALTIMATIC V F D-1, BENDIX	1	6.80
DME	5	KN-60B, KING	1	1.45
		KN-60C, KING	1	1.50
		KN-65, KING	1	1.60
		KN-65 WITH OPTIONAL KA-43	1	1.70
		KDM-700, TRACK MODE, KING	1	2.85
		KDM-700A, TRACK MODE, KING	1	3.50
		KDM-705, KING	1	3.00
ELECTRIC TRIM	5	PITCH TRIM SERVO, MITCHELL	1	0.60
MARKER BEACON	5	MBT-24, NARCO	1	0.25
		KGM-690, KING	1	0.39
		PM-1, PIPER	1	0.25
NAV COMM 1	10	KNI-500 OR KNI-500L, KING		.095
		KTR-900 OR KTR-900A, KING	XMITT.	6.20
			RCV.	0.62
		KX-170A, KING	XMITT.	5.40
			RCV.	1.25
		KX-175, KING	XMITT.	5.40
			RCV.	1.25
		COMM III, NARCO	XMITT.	4 MAX.
			RCV.	0.80
		COMM IIA, NARCO	XMITT.	5.80
			RCV.	1.90
		MP-10 CONVERTER	XMITT.	5.00
			RCV.	1.50
		VOA-8 & VOA-9 INDICATORS		0.18
		VOA-40 & VOA-50M INDICATORS		.065
		NAV III, NARCO		0.30
		NAV 12, NARCO		0.70
		NAV 112, NARCO		0.30
		NAV 14, NARCO		0.60
		NAV 114, NARCO		0.60
NAV/COMM 2	10	SIMILAR TO NAV/COMM 1		

CHART 9109. CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT BREAKER SIZE	ITEM	NO. OF UNITS OPERATING SIMUL-TANEOUSLY	MAX. CURRENT PER UNIT 28.5V
HF COMM	15	SA-14RA, SUNAIR	XMITT.	9.55
			RCV.	2.85
		ASB-130, SUNAIR	XMITT.	15.0
			RCV.	2.50
RADAR	10	AVQ-47, RCA	1	6.00
		RDR-110, BENDIX	1	9.17
RADAR ALTIMETER	5	TRN-71, BONZER	1	0.90
TRANSPONDER	5	KXP-750 OR KXP-750A, KING	1	1.14
		KT-76, KING	1	1.35

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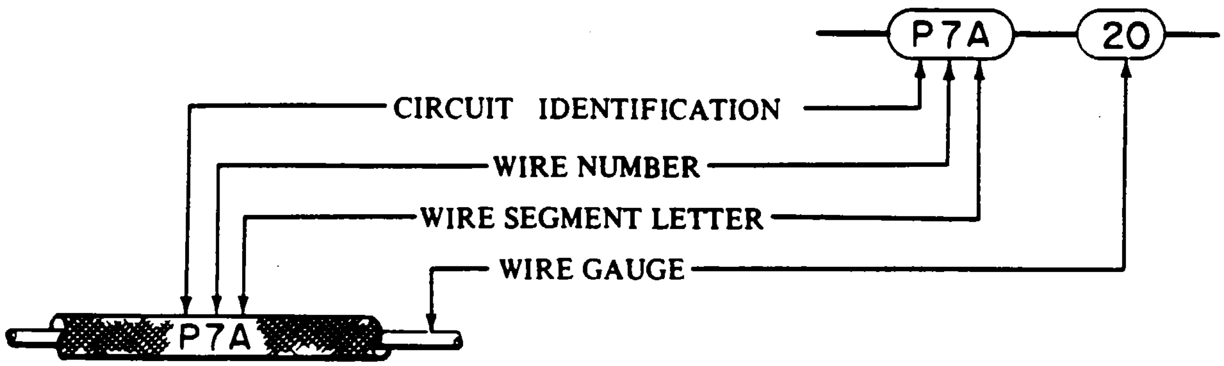
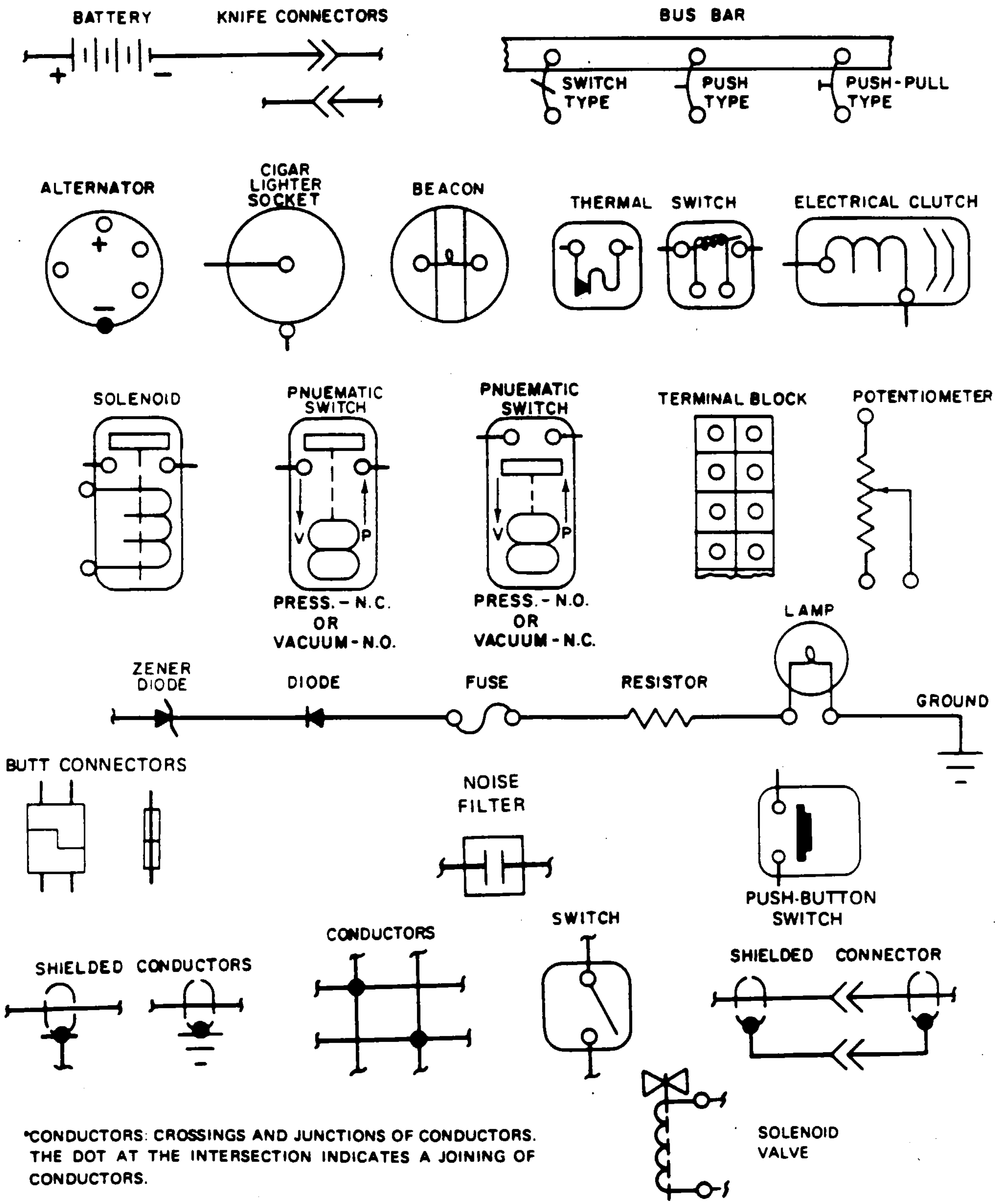
ELECTRICAL WIRE CODING AND SYMBOLS.

CHART 9110. ELECTRICAL WIRE CODING



CIRCUIT IDENTIFICATION	CIRCUITS	HARNESS CONNECTOR NUMBER'S AND LOCATIONS
A	AUTOPILOT	E 100 Series = Left Wing and Nacelle.
C	CONTROL SURFACE	E 200 Series = Right Wing and Nacelle.
F	FLIGHT INSTRUMENT	E 300 Series = Aft Fuselage
G	LANDING GEAR	E 400 Series = Forward Fuselage
H	HEATER - VENTILATING & DEICING	
L	LIGHTING	
P	POWER	
Q	FUEL. OIL & ENGINE INSTRUMENT	
RP	RADIO POWER	
RZ	RADIO AUDIO	
J	IGNITION	

CHART 9111. ELECTRICAL SYMBOLS



*CONDUCTORS: CROSSINGS AND JUNCTIONS OF CONDUCTORS. THE DOT AT THE INTERSECTION INDICATES A JOINING OF CONDUCTORS.

ELECTRICAL SCHEMATIC INDEX

FIGURE NO.	SCHEMATIC	GRID NO.
	ANNUNCIATOR SYSTEMS	
91-3	Annunciator Controller Panel	5C11
	COMFORT SYSTEMS	
91-15	Cigar Lighter	5C21
	DEICE SYSTEMS	
91-37	Lift Detector - Heated	5D20
91-29	Pitot Heat (Left and Right)	5D13
91-6	Propeller Deice	5C14
91-30	Surface	5D14
91-23	Windshield - Electrically Heated	5D3
	ELECTRICAL SYSTEM	
91-2	Alternator, Battery, Master Controller	5C9
91-20	Avionics - Ground Clearance (Optional)	5D2
91-4	Avionics - Master and Emergency Switching (Optional)	5C13
	ENGINE SYSTEMS	
91-38	Magnetos, Hour Meter	5D21
91-38	Starters	5D21
	ENVIRONMENTAL SYSTEMS	
91-1	Air Control, Nacelle Scoop, Blower Motor, With or Without Air Conditioning	5C8
91-24	Heater and Combustion Blower With Hour Meter	5D4
91-5	Ground Vent Fan	5C13
	FLAP SYSTEMS	
91-16	Cowl Flap Motors, Solenoid (Also see Indicators)	5C22
91-13	Deleted	
91-40	Wing Flap (Calco System)	5D24
	FUEL SYSTEMS	
91-17	Boost Pumps and Low Fuel Warning	5C23
91-18	Fuel Pump - Left	5D1
91-19	Fuel Pump - Right	5D1
91-17	Fuel Pressure and Flow Sensors	5C23

ELECTRIC SCHEMATIC INDEX

FIGURE NO.	SCHEMATIC	GRID NO.
	INDICATORS	
91-2	Ammeter	5C9
91-14	Chimes	5C21
91-34	Cowl Flap Indicators	5D17
91-27	Fuel Quantity Gauges	5D9
91-38	Hour Meter - Engine	5D21
91-24	Hour Meter - Heater	5D4
91-25	Landing Gear Indicators	5D5
91-31	Pneumatic Indicators	5D15
91-27	Temperature - Cylinder Head and Oil	5D9
91-34	Trim Indicators	5D17
91-39	Turn and Bank	5D23
91-34	Voltmeter	5D17
	LANDING GEAR SYSTEM	
91-25	Gear and Safety Solenoid	5D5
	LIGHTING - EXTERNAL	
91-33	Anti-Collision - Strobe	5D16
91-21	Anti-Collision - Beacon	5D2
91-26	Landing, Taxi	5D7
91-32	Position	5D15
91-22	Recognition	5D2
91-26	Wing Inspection	5D7
91-12	Logo - Tail Flood	5C18
	LIGHTING - INTERNAL	
91-11	Baggage	5C18
91-8	Door Ajar	5C16
91-9	Fasten Seat Belts/No Smoking	5C17
91-10	Map	5C17
91-28	Panel	5D11
91-7	Reading/Exit Steps	5C15
	PROPELLER	
91-35	Propeller Synchrophaser	5D18
	WARNING SYSTEMS	
91-3	(See Annunciator)	5C11
91-13	Chimes	5C19
91-17	Fuel Flow Low - Sensors	5C23
91-36	Stall Warning	5D19
91-37	Stall Warning With Time Delay	5D20
91-41	**WINDSHIELD WIPER**	5E1

SCHEMATIC DRAWING LIST WITH LAST REVISION INCORPORATED
(FOR PIPER INTER-OFFICE USE ONLY)

DWG-REV.	DWG-REV.	DWG-REV.	DWG-REV.	DWG-REV.
42637-AD	52616-A	71131-E		
44115-U	59372-	71619-		
44741-BO	71047-			
49501-C	71103-C			
49515-	71110-D			

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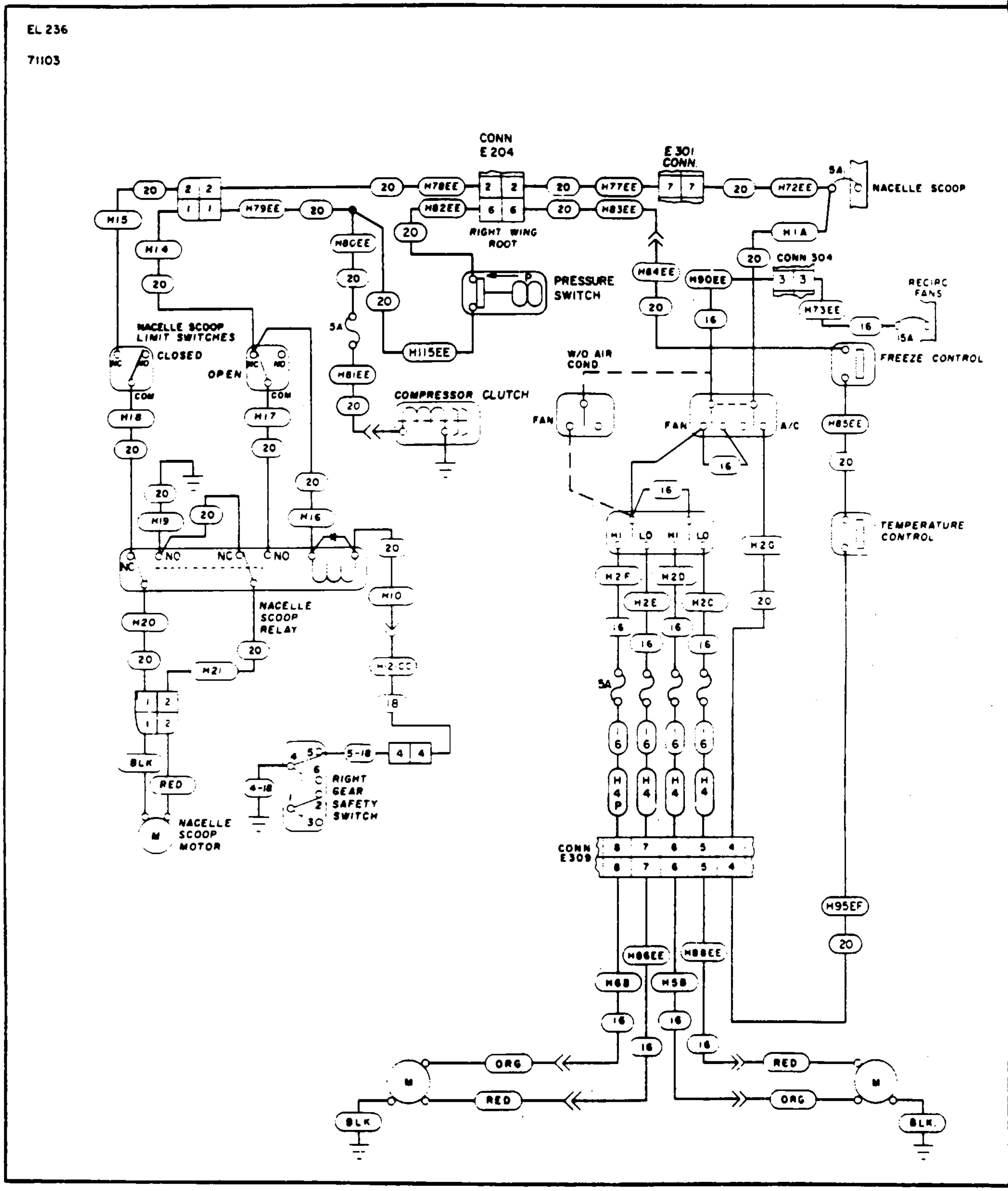

Figure 91-1. Air Control With or Without Air Conditioning

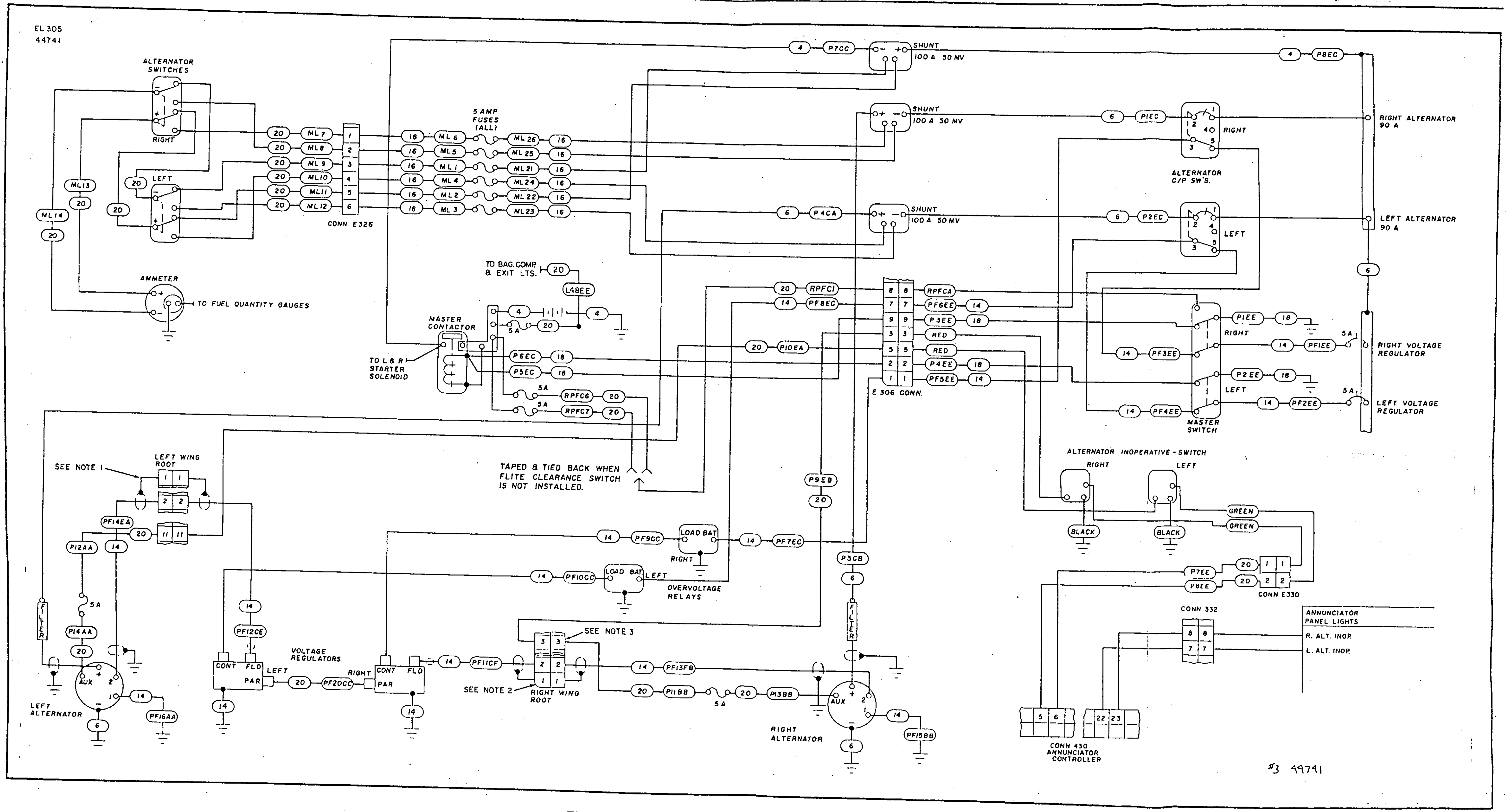

Figure 91-2. Alternators, Master Contactor and Battery

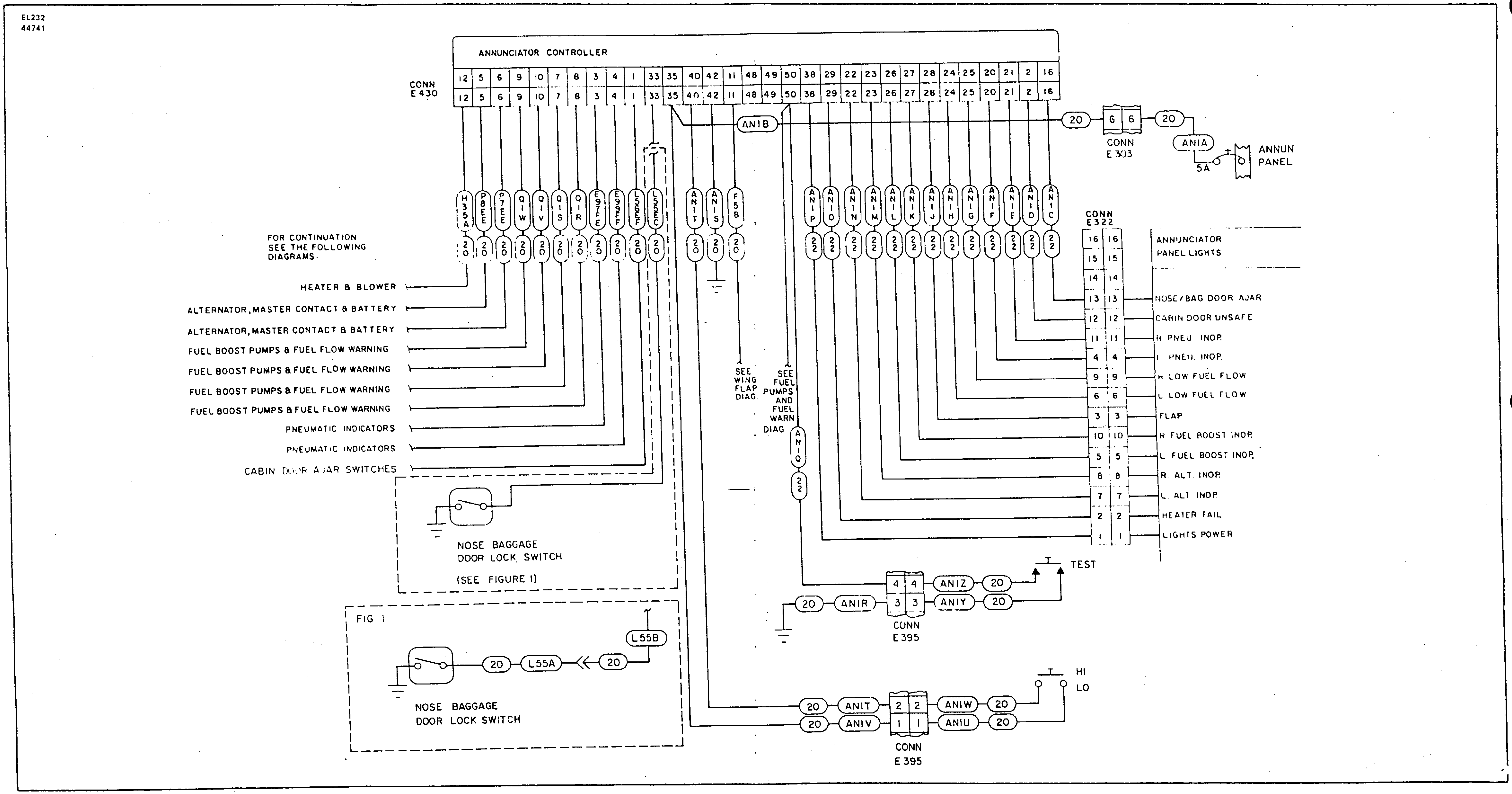

Figure 91-3. Annunciator Controller and Annunciator Panel Lights

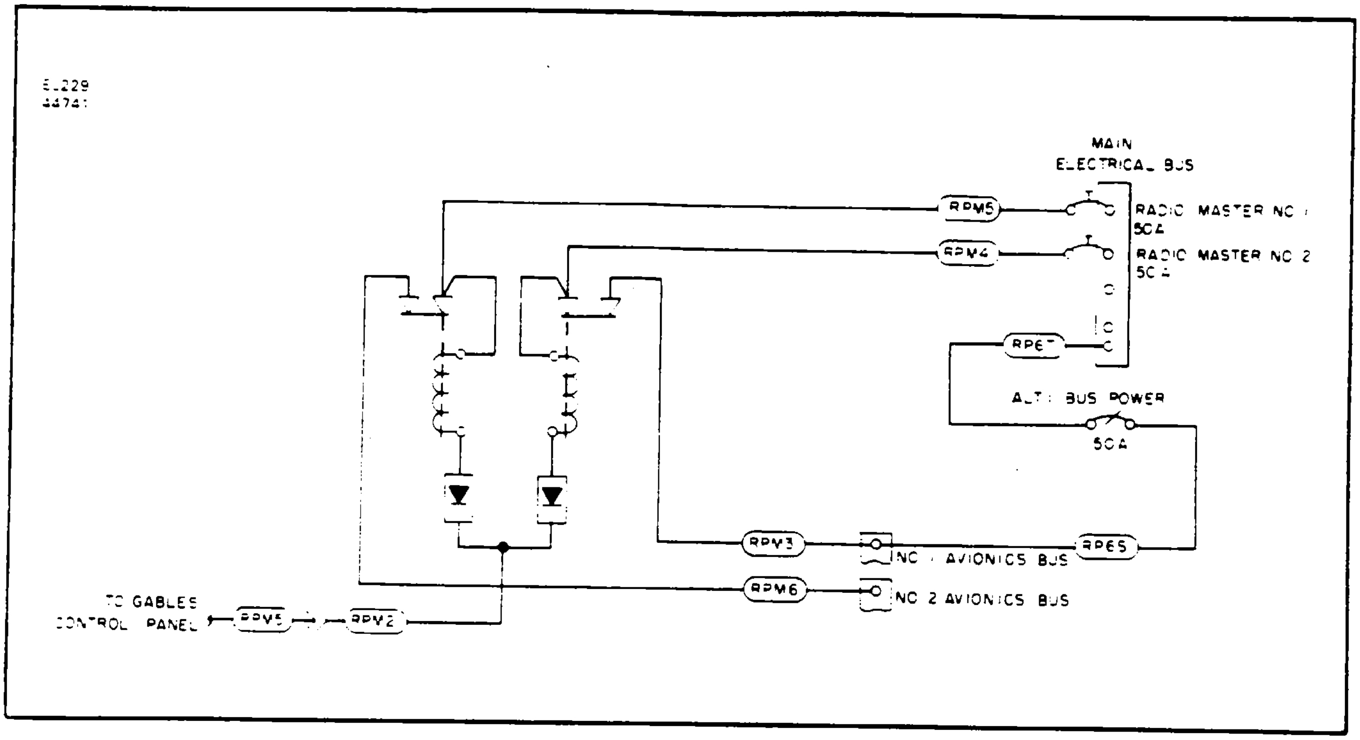

Figure 91-4. Avionics Master and Emergency Switch Circuit

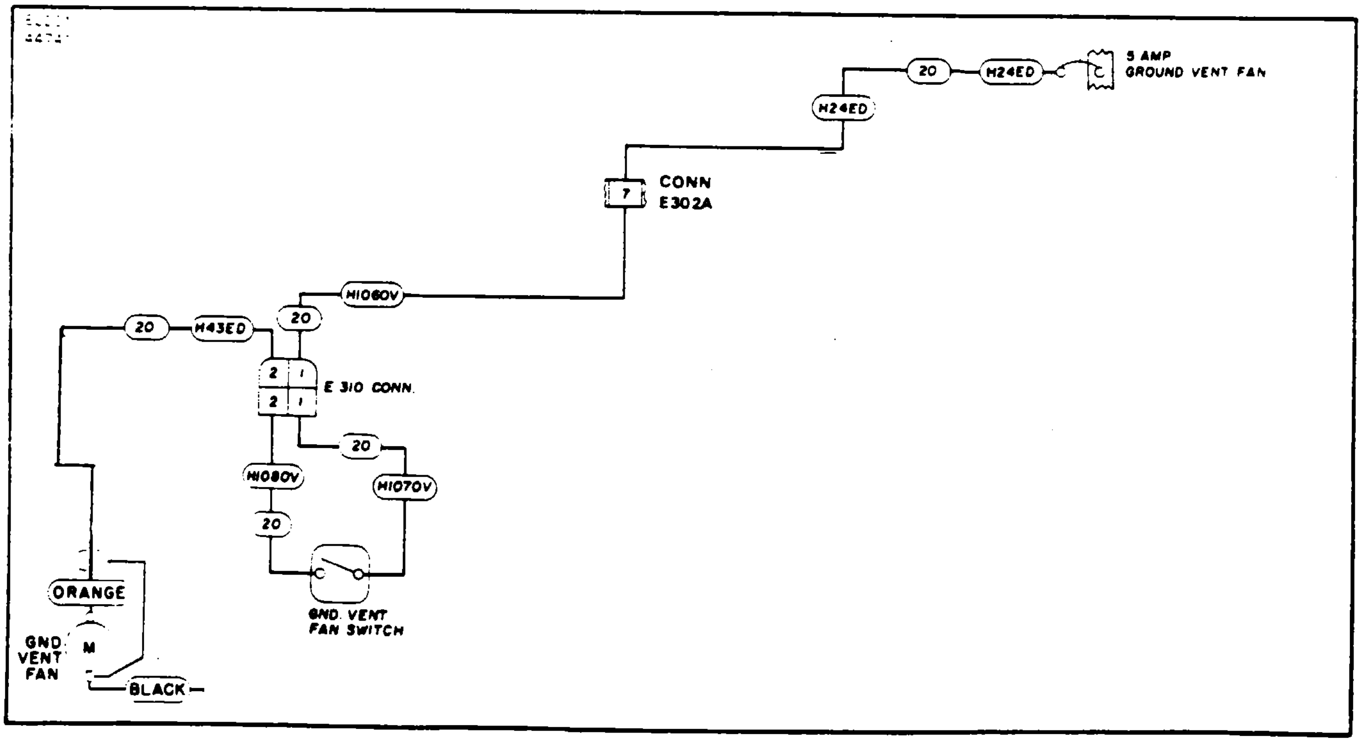

Figure 91-5. Ground Vent Fan

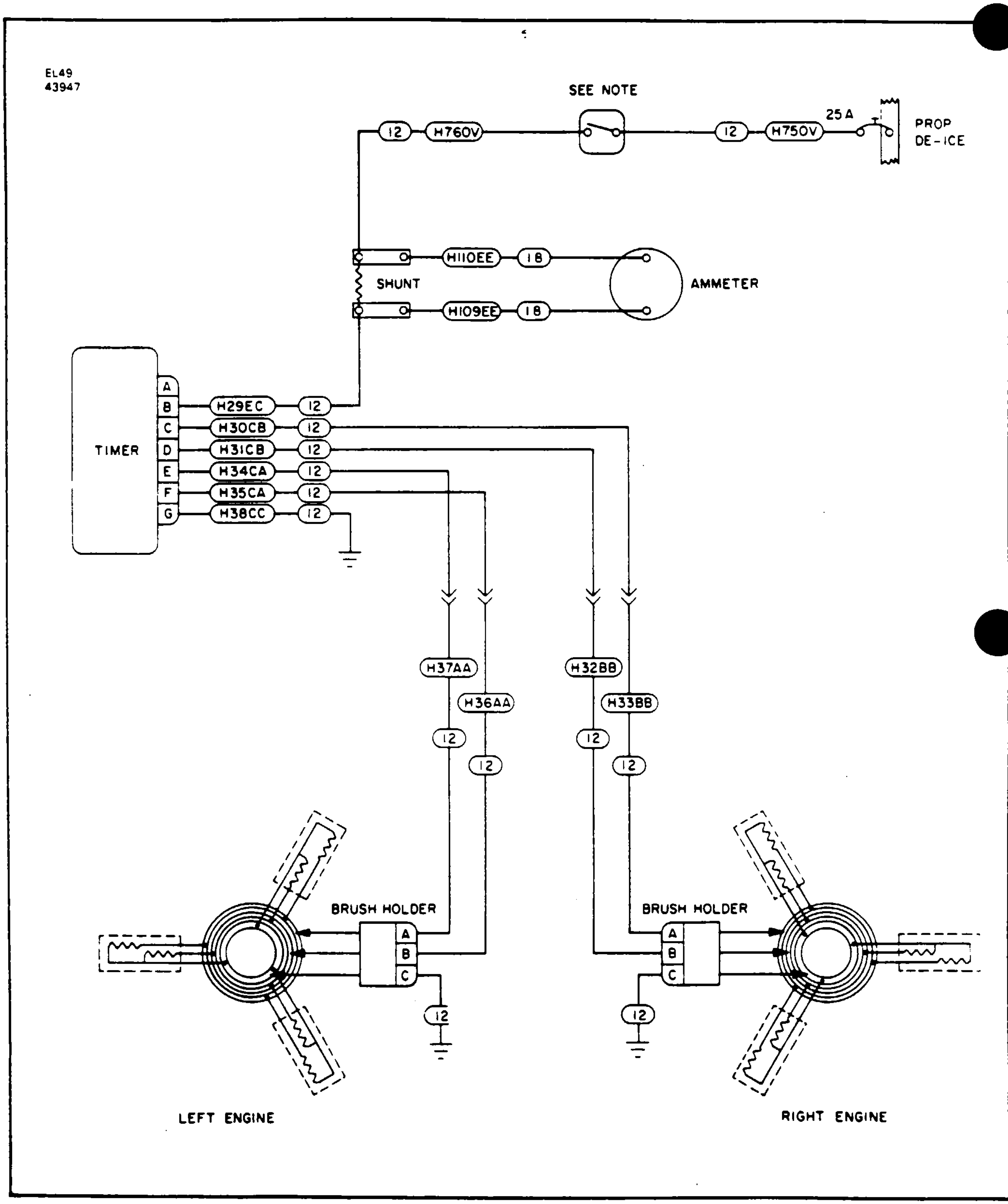

Figure 91-6. Propeller Deice

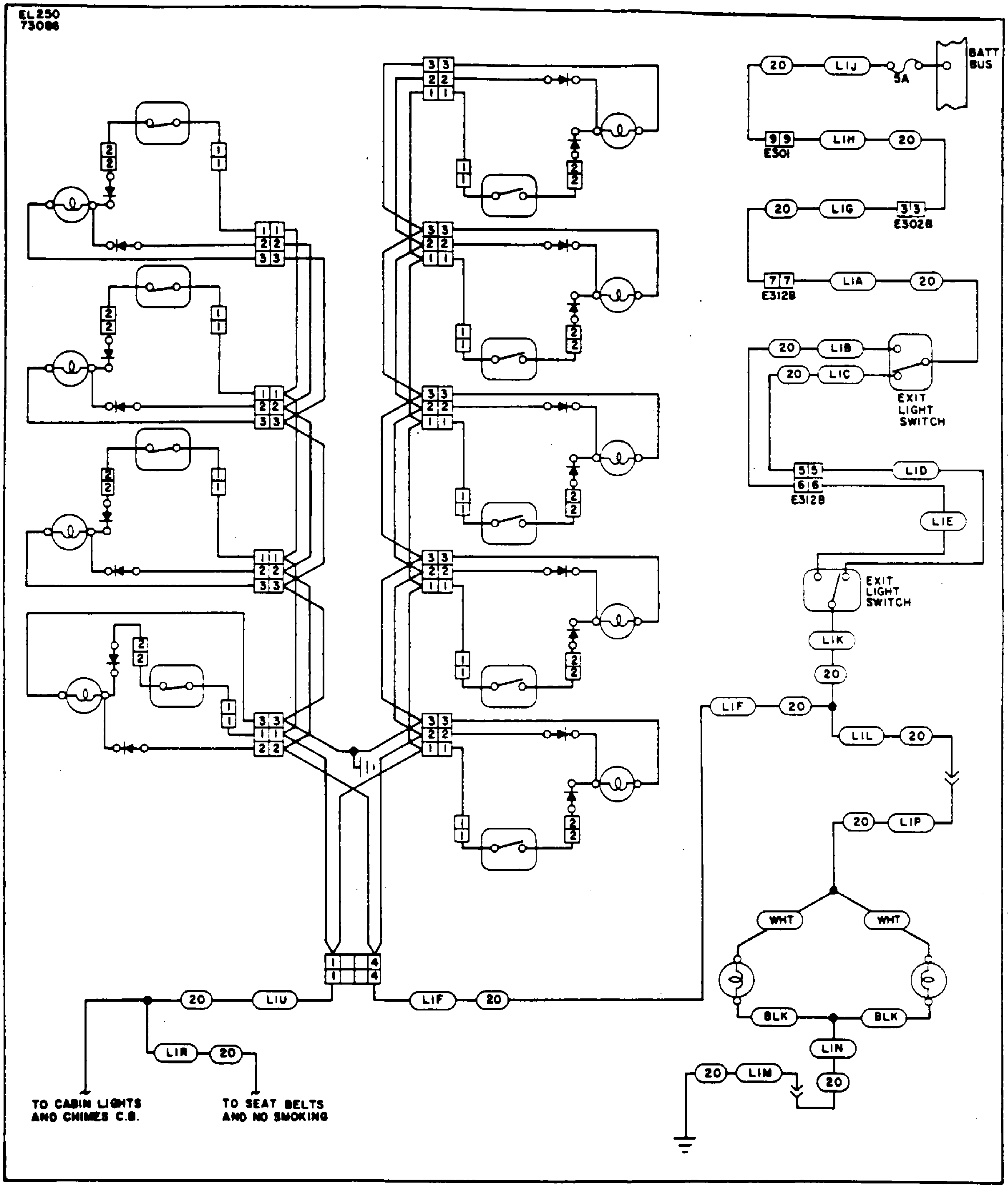

Figure 91-7. Reading and Exit Steps

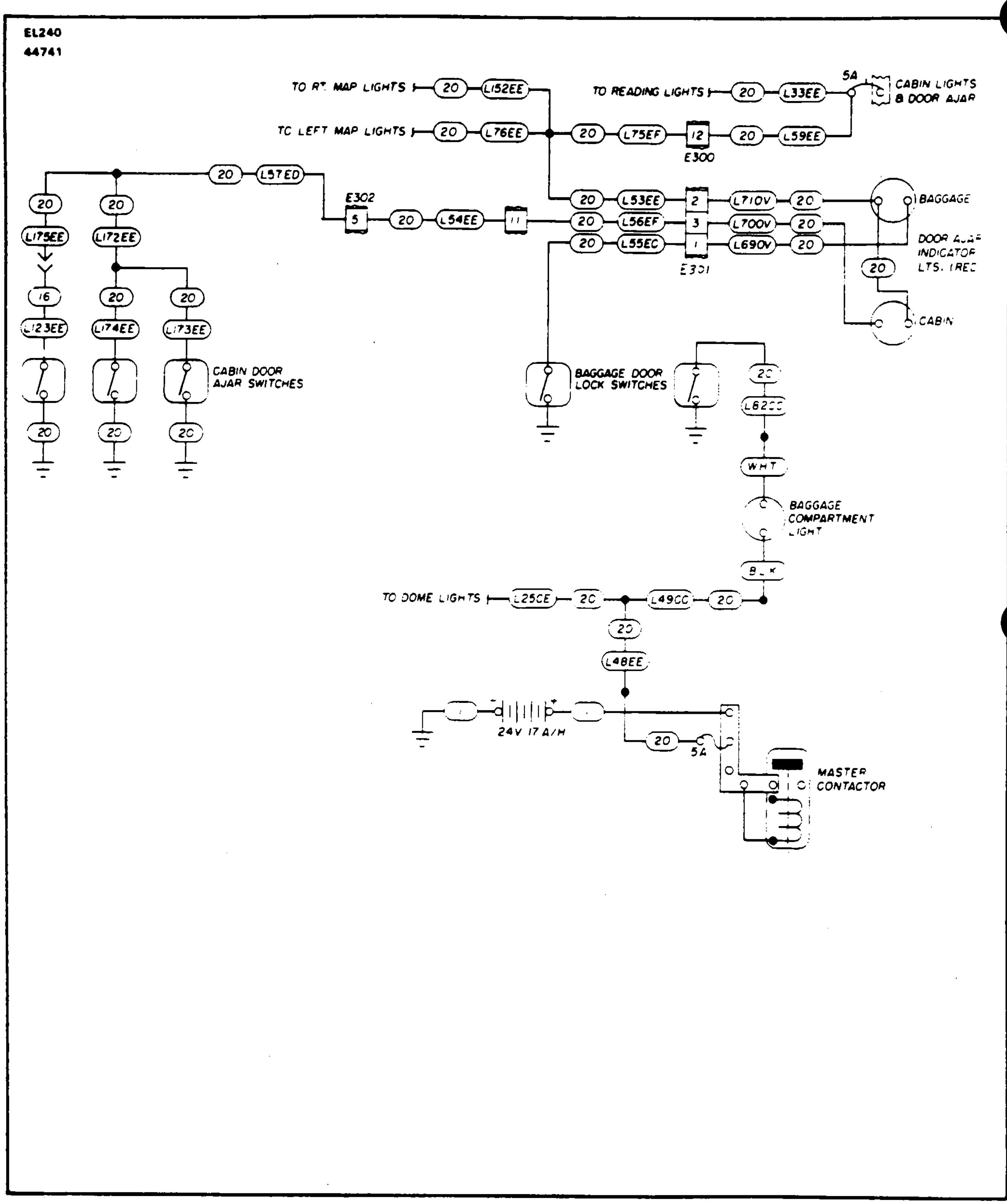

Figure 91-8. Door Ajar

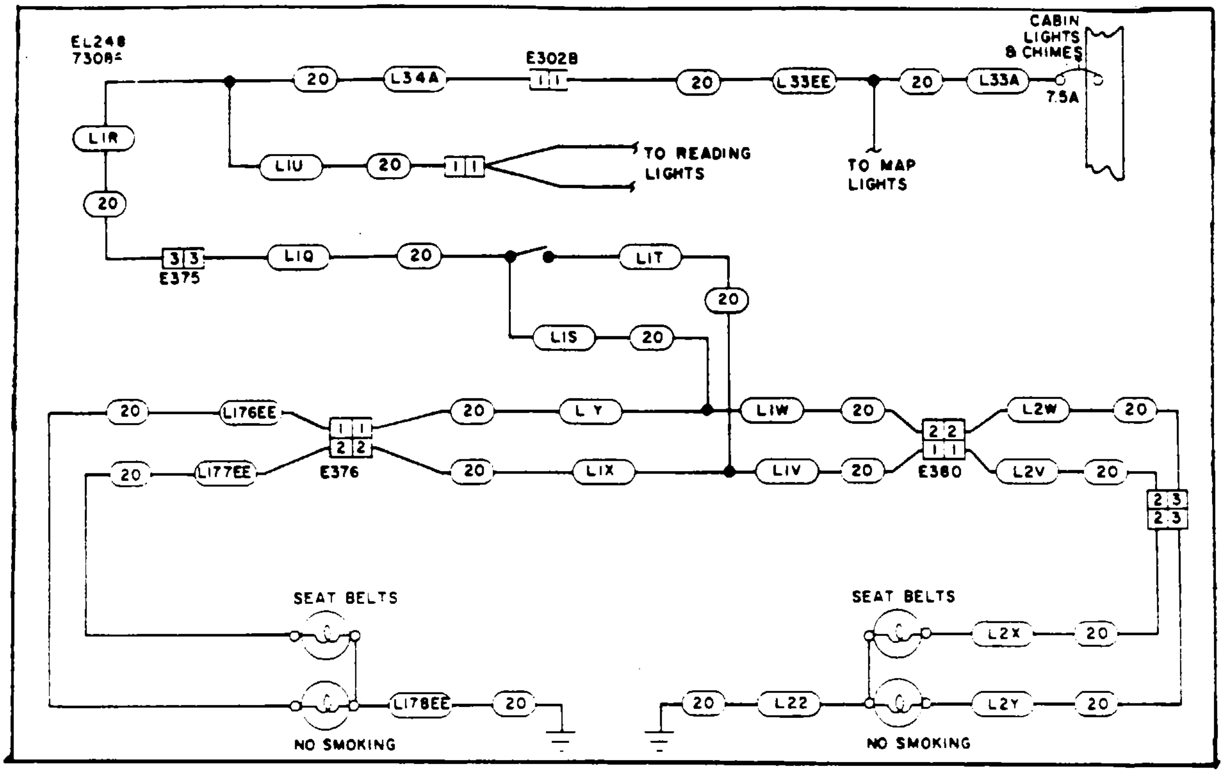

Figure 91-9. Fasten Seat Belts, No Smoking

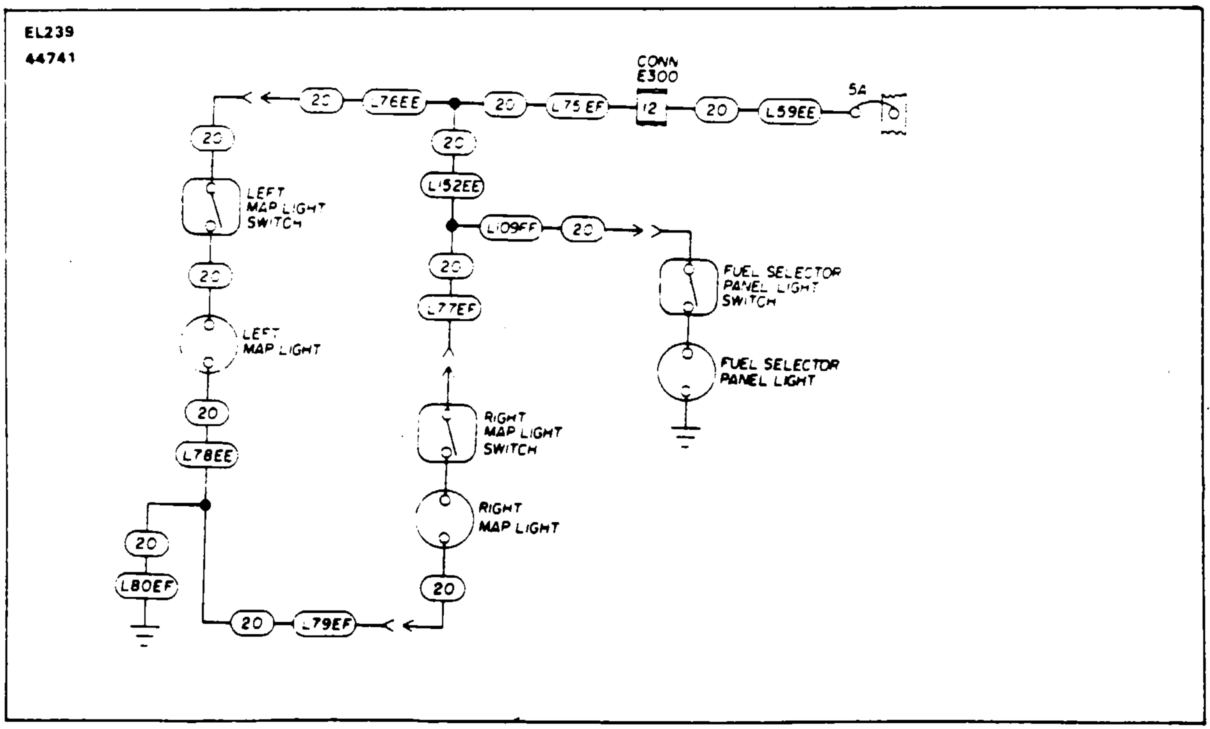

Figure 91-10. Map Lights

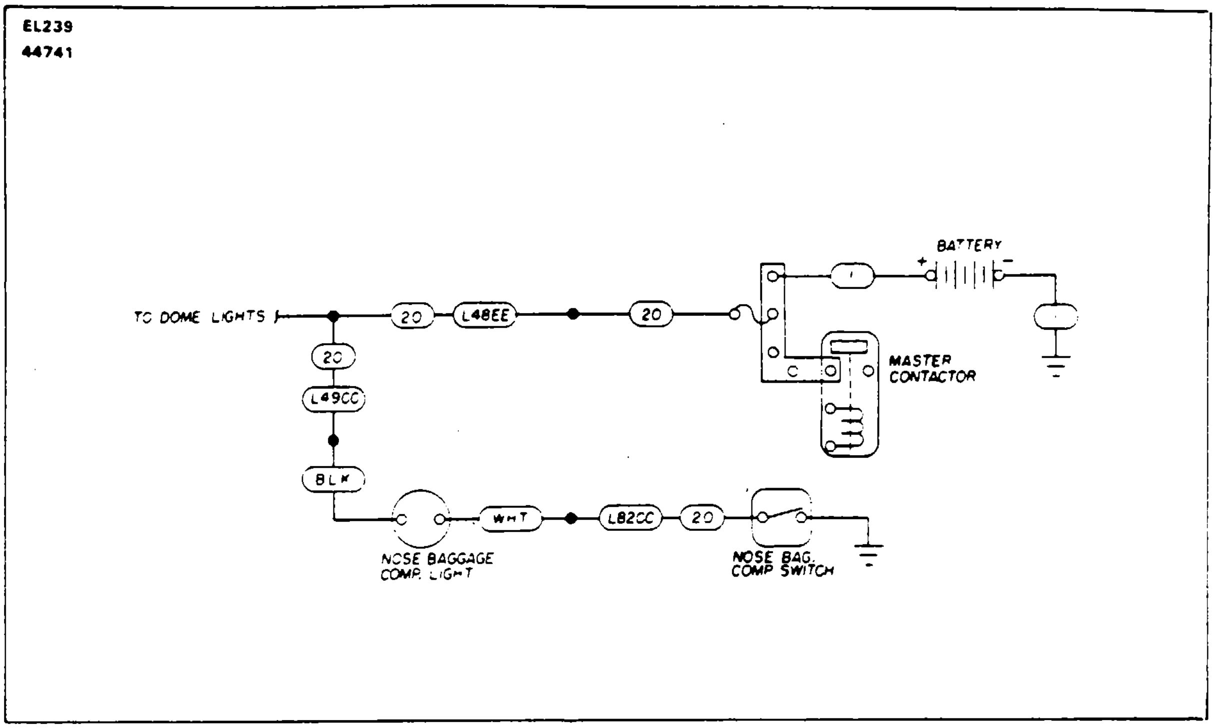

Figure 91-11. Baggage Lighting

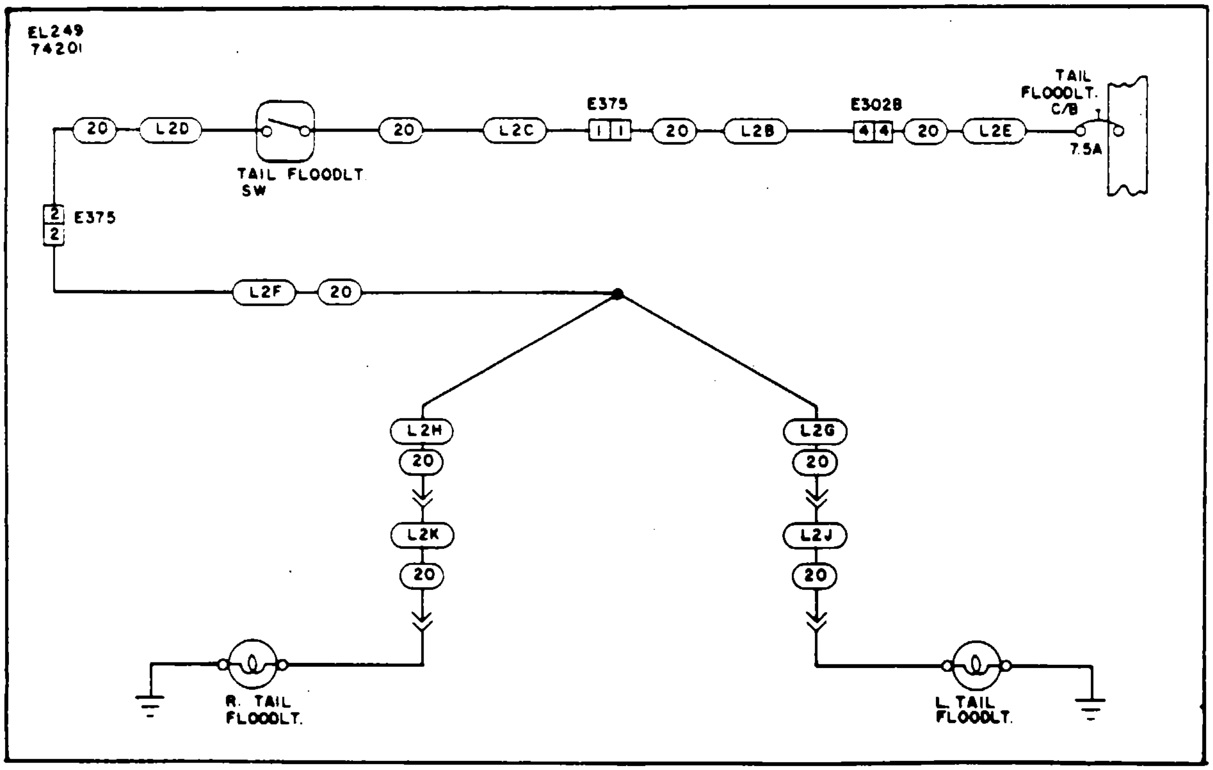

Figure 91-12. Logo Light

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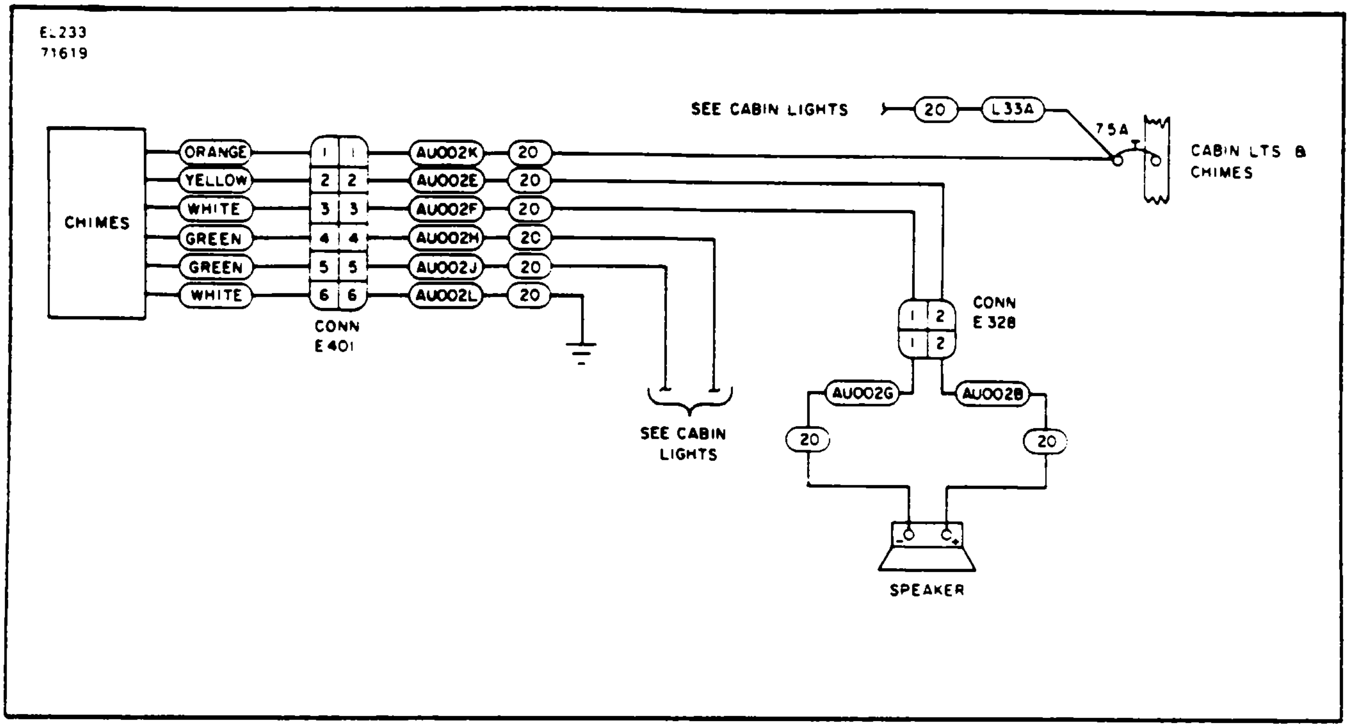

Figure 91-14. Chimes

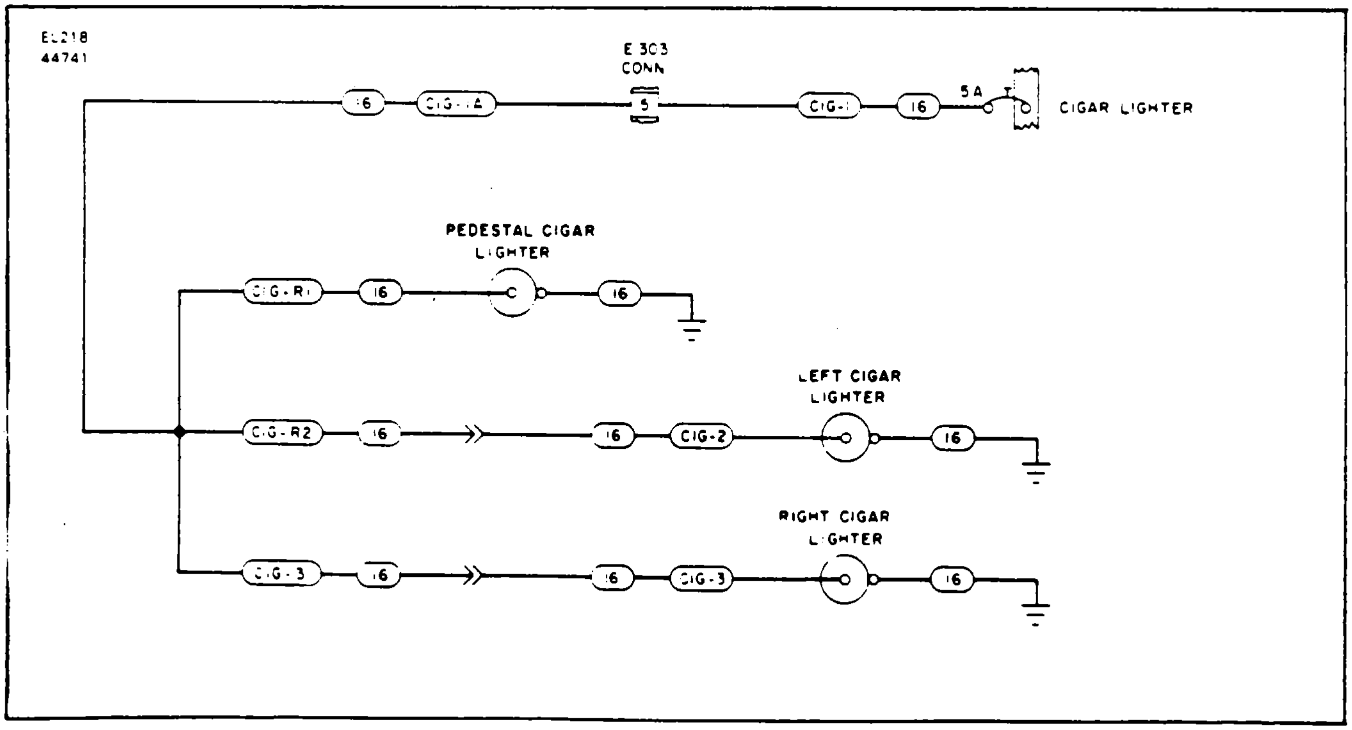

Figure 91-15. Cigar Lighter

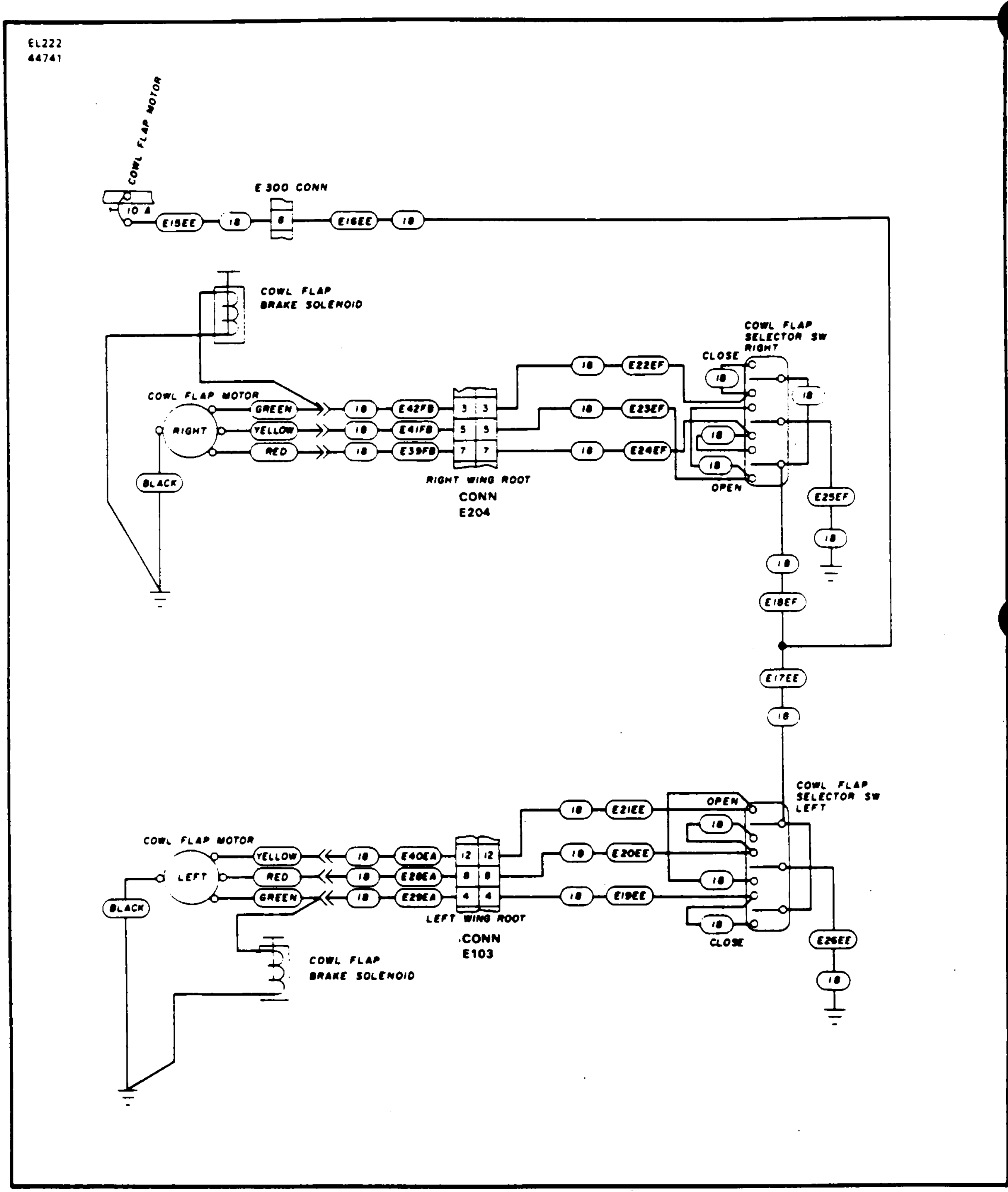

Figure 91-16. Cowl Flap Motors

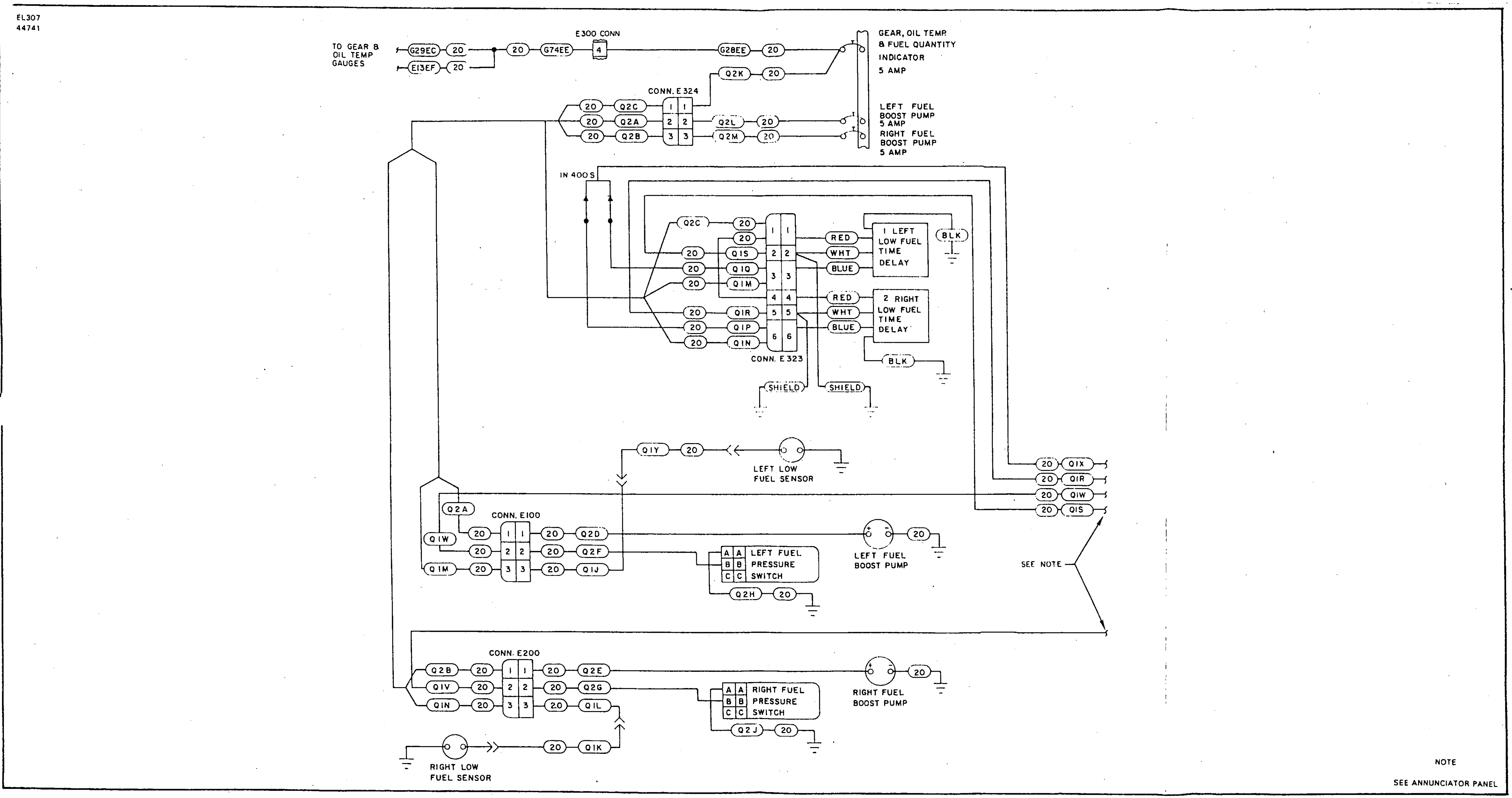

Figure 91-17. Fuel Boost Pumps and Fuel Flow Warning

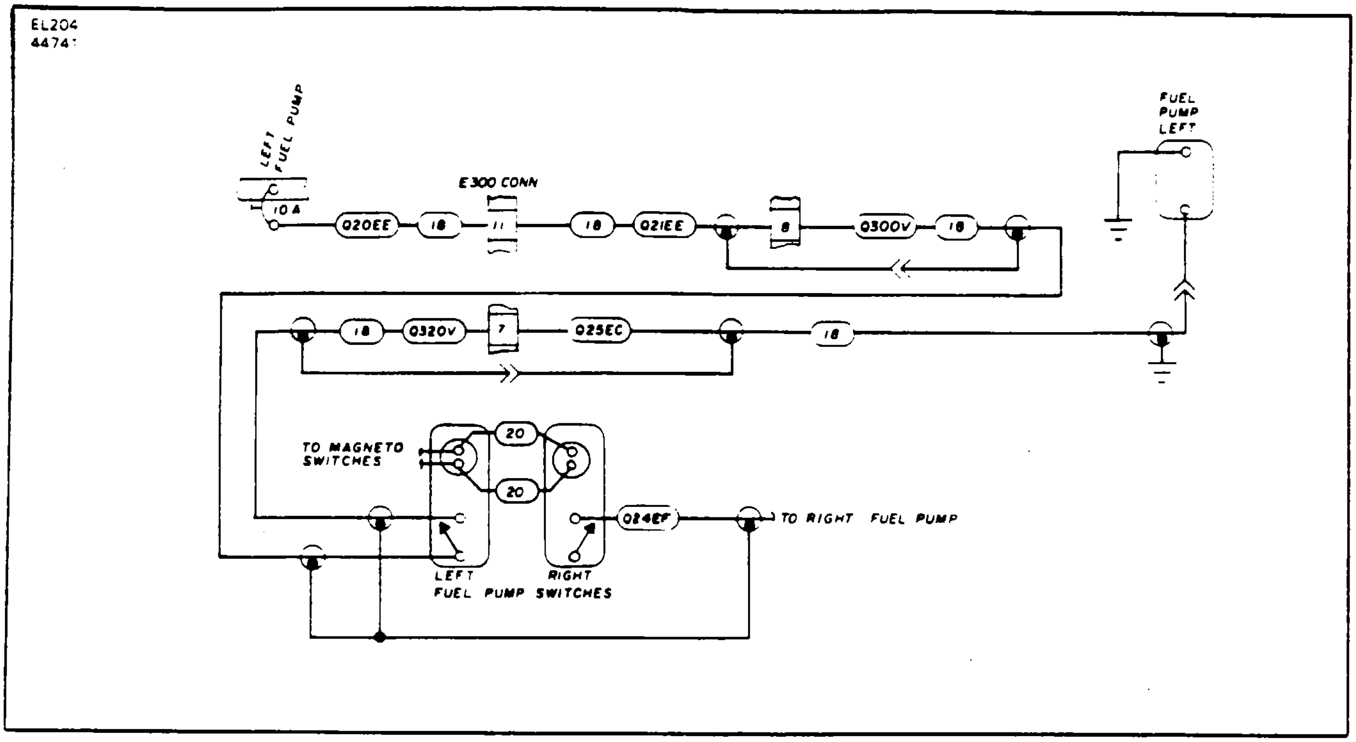

Figure 91-18. Fuel Pump (Left)

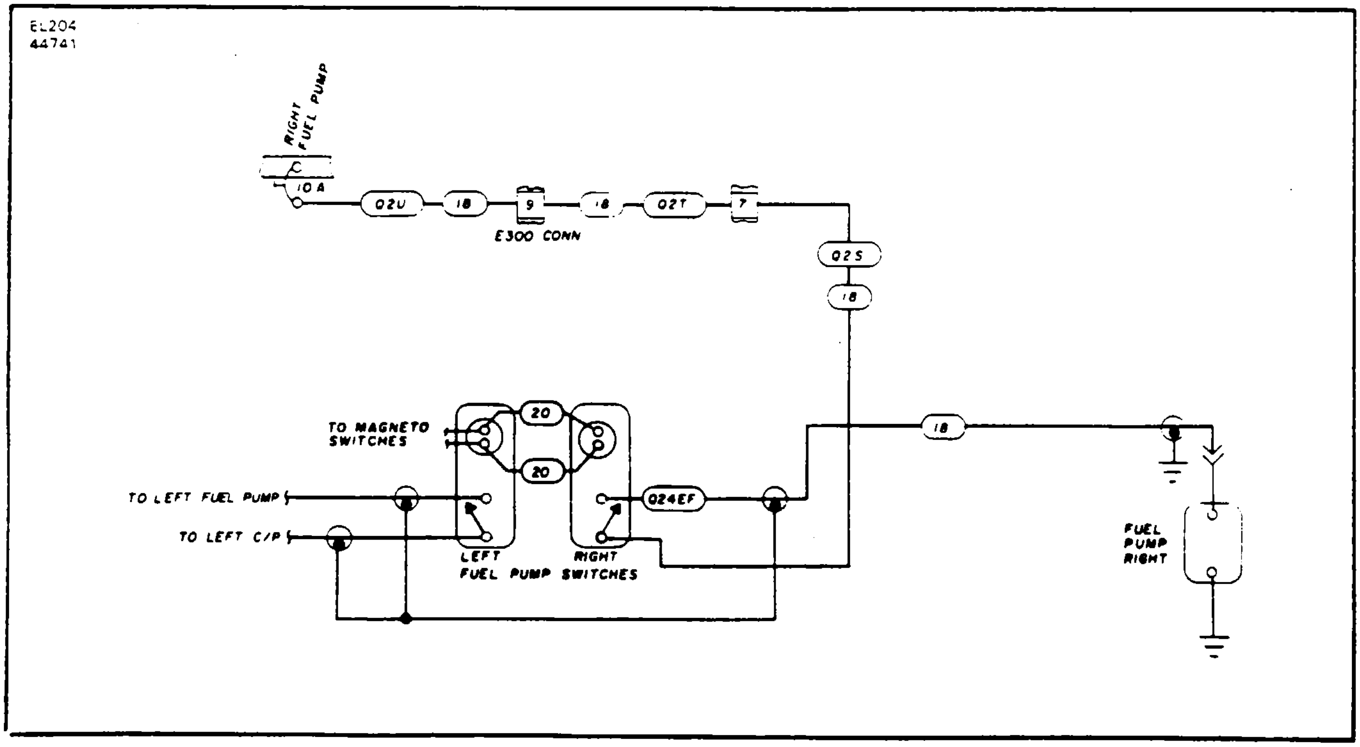

Figure 91-19. Fuel Pump (Right)

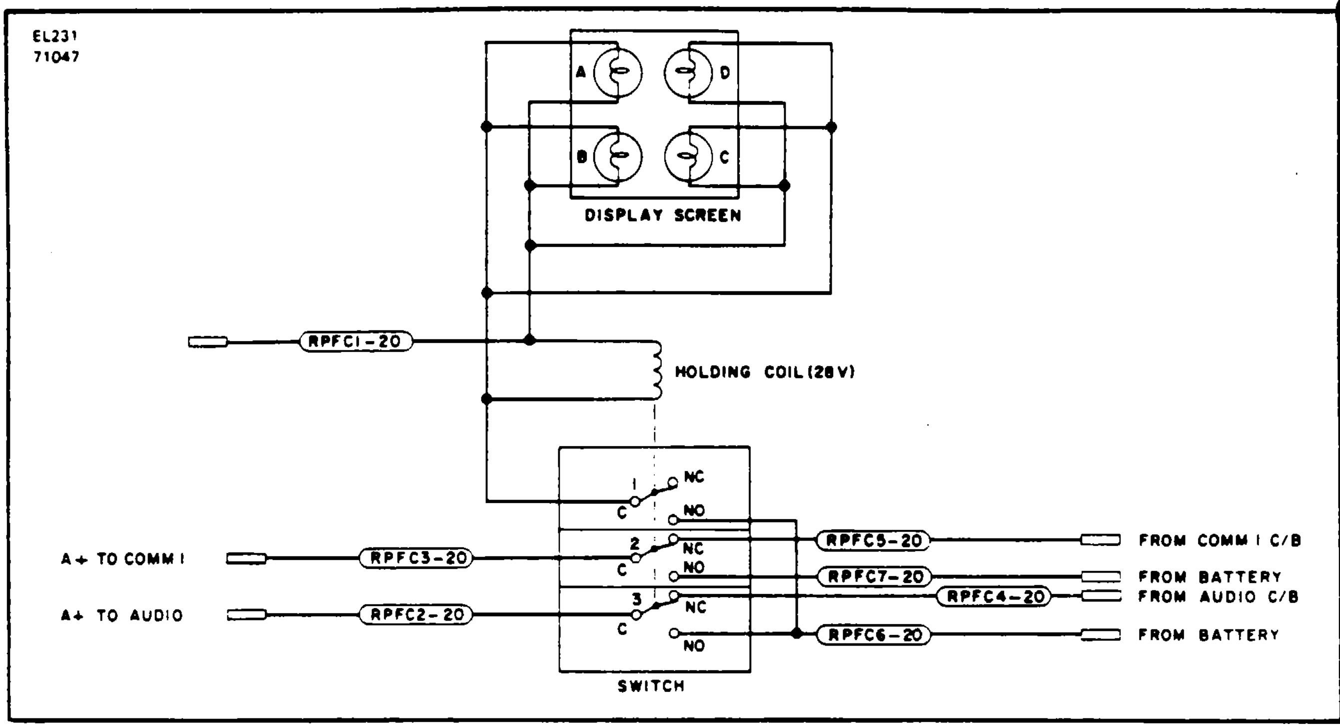

Figure 91-20. Ground Clearance Switch (Optional)

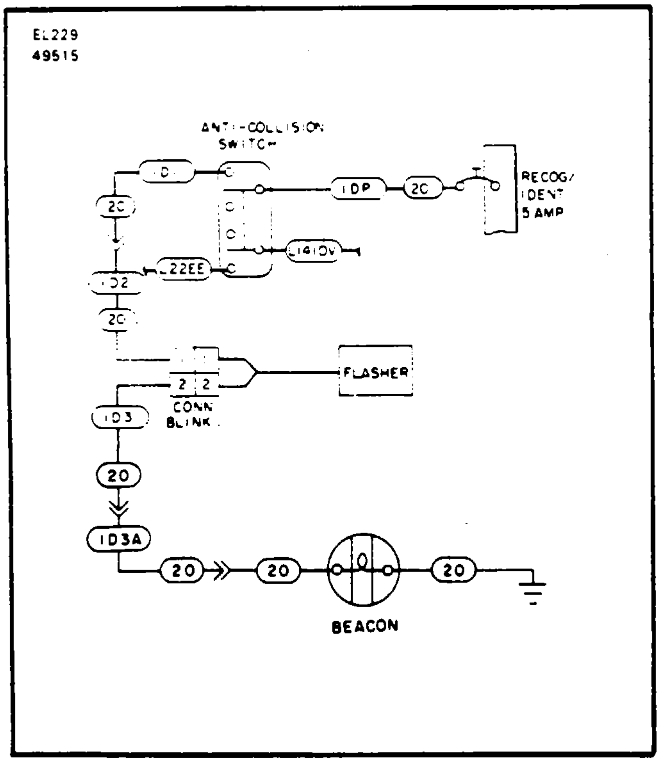

Figure 91-21. Anti-Collision Beacon

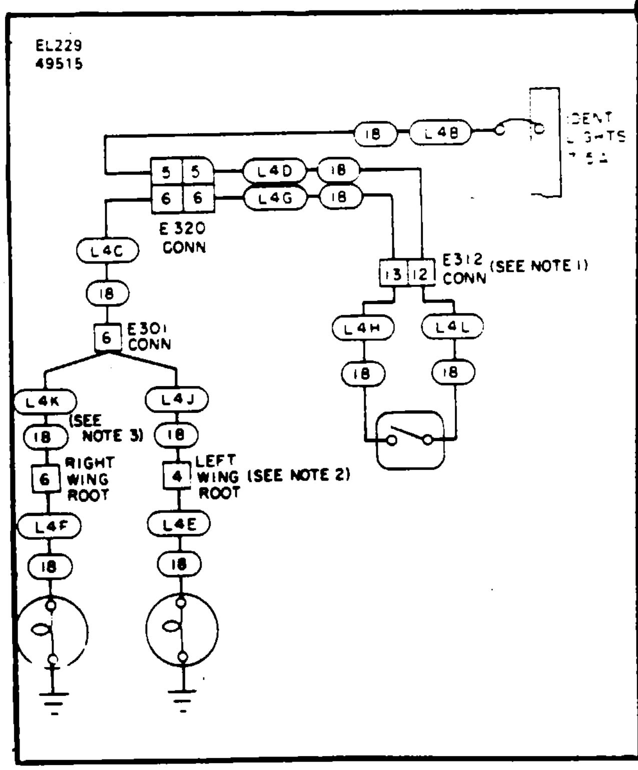

Figure 91-22. Recognition Lights

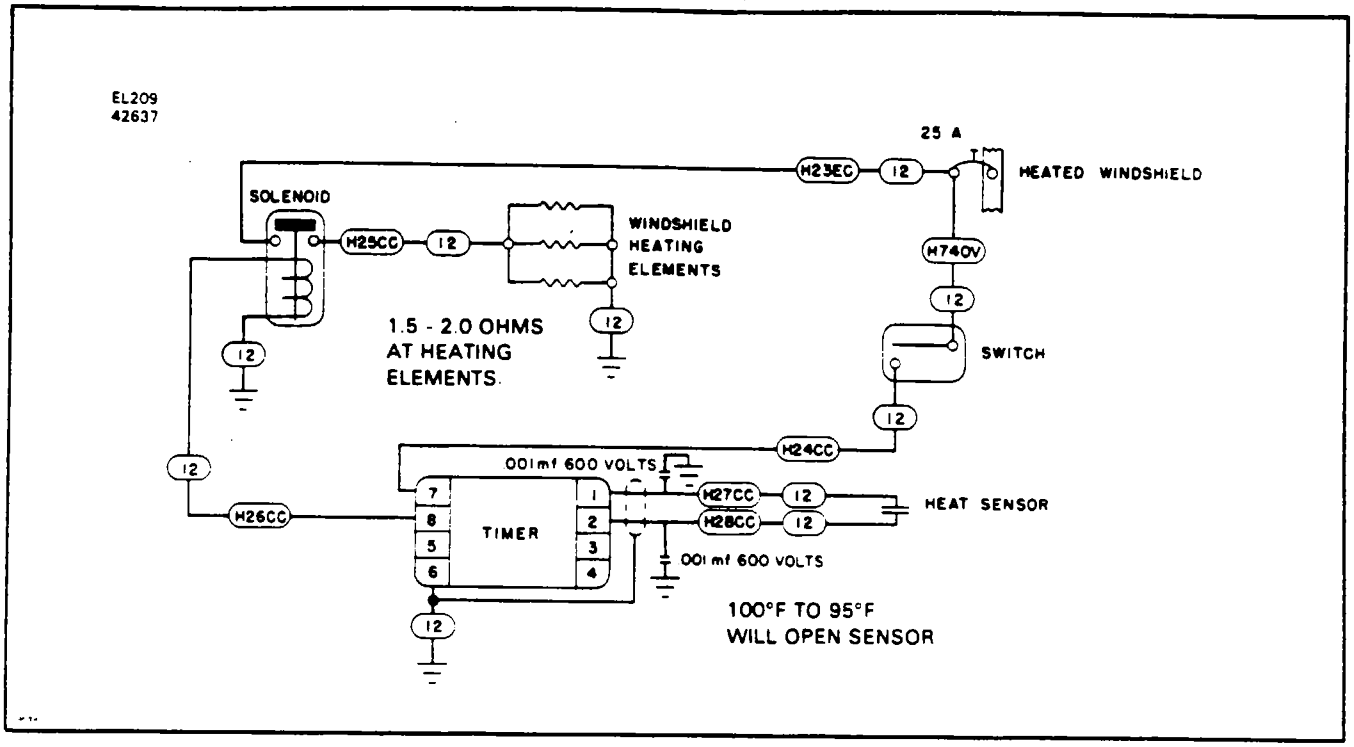

Figure 91-23. Heated Windshield

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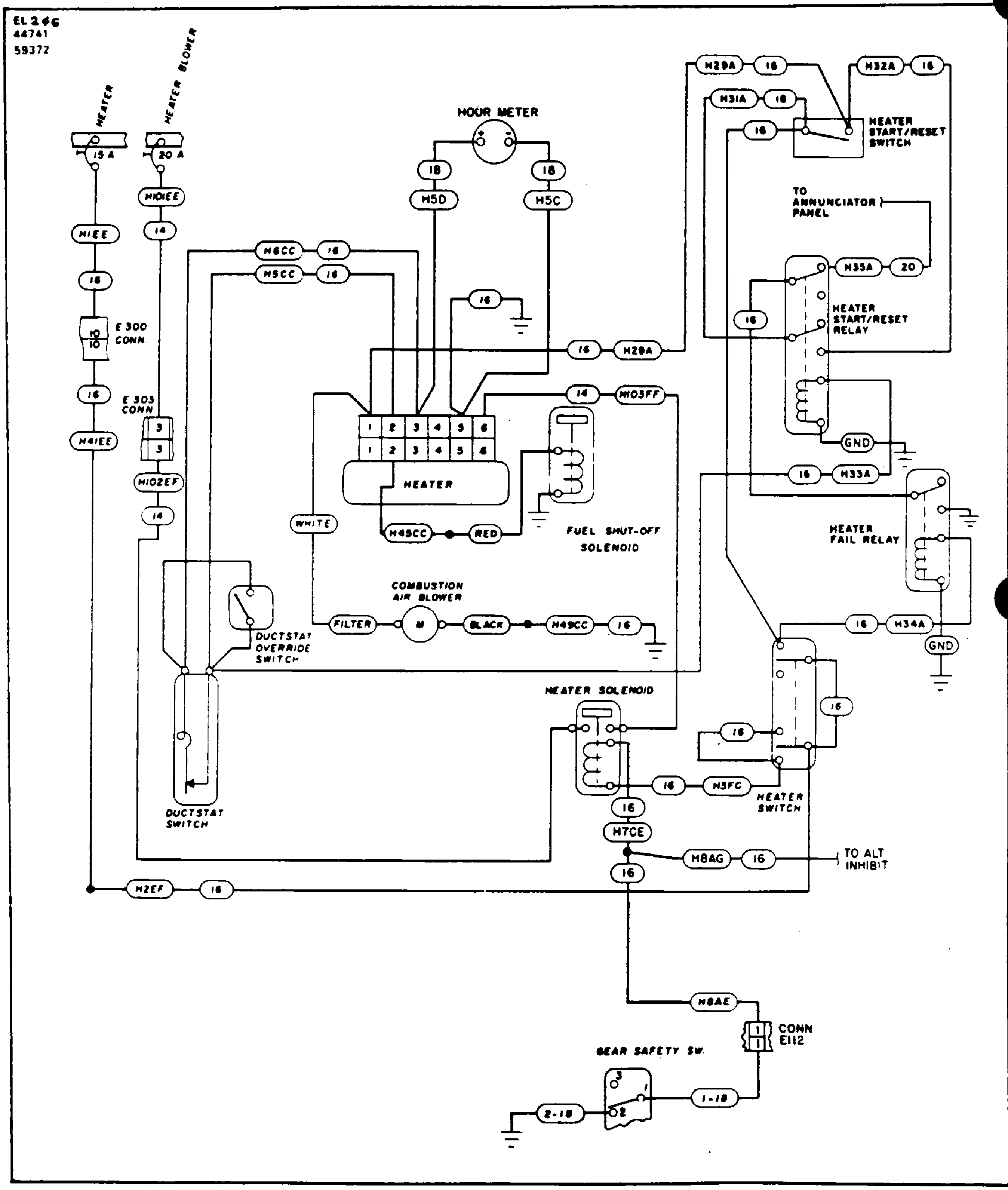

Figure 91-24. Heater and Blower

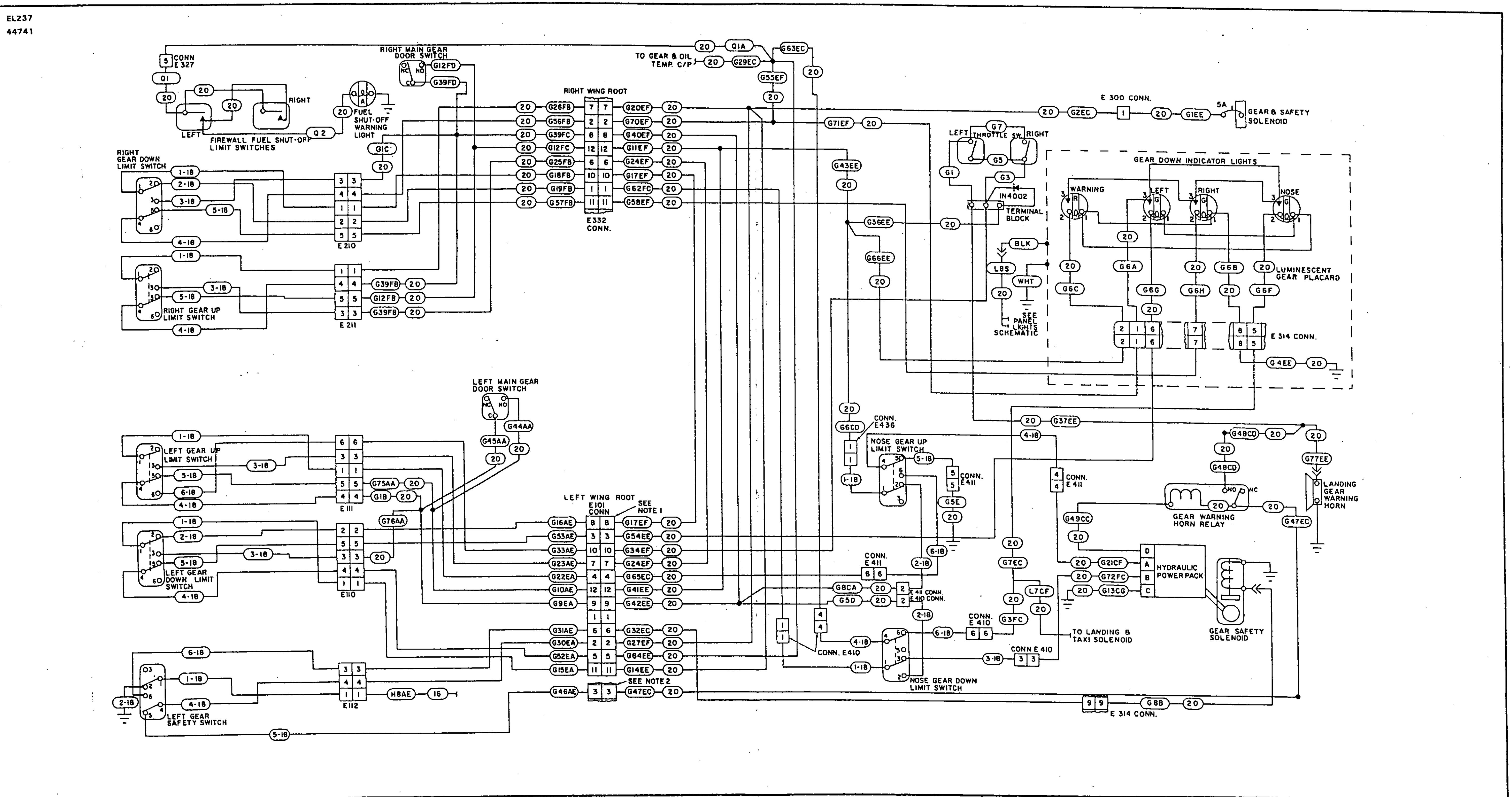

Figure 91-25. Landing Gear and Safety Solenoid

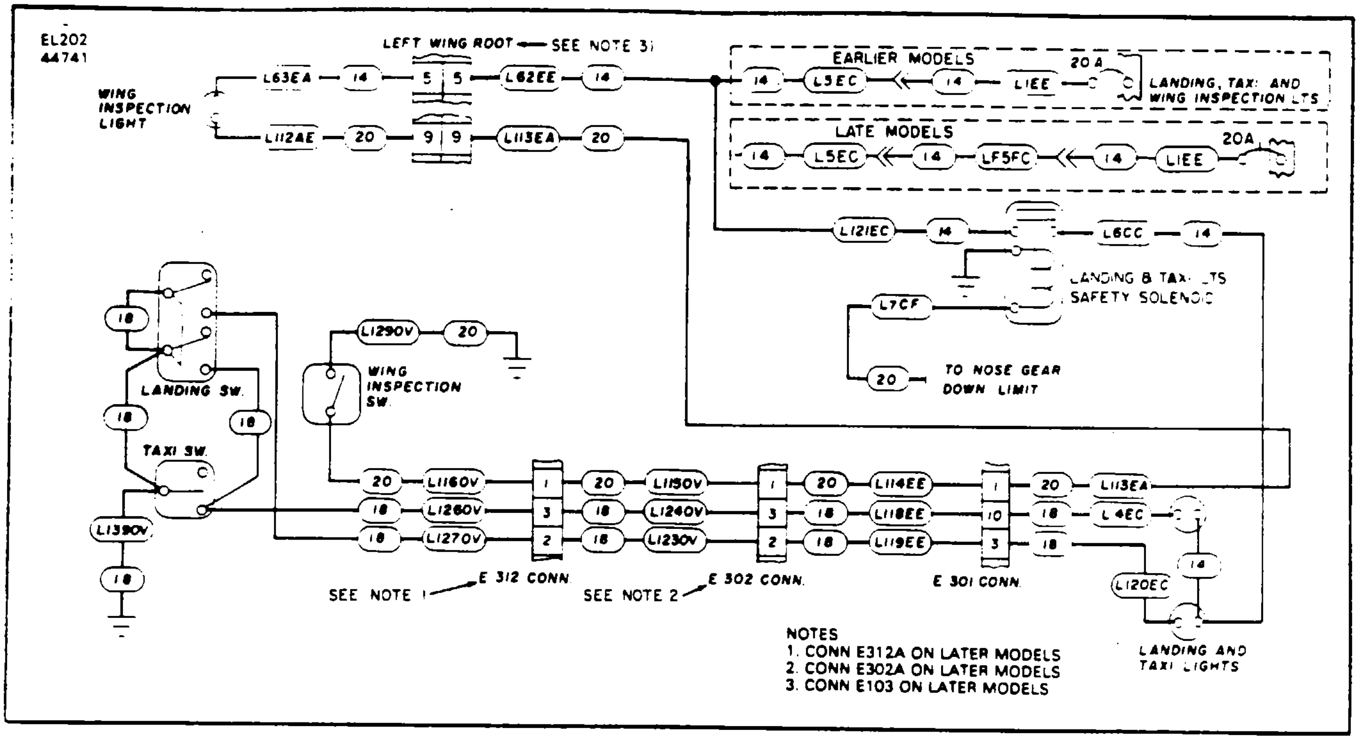

Figure 91-26. Landing. Taxi and Wing Inspection Lights

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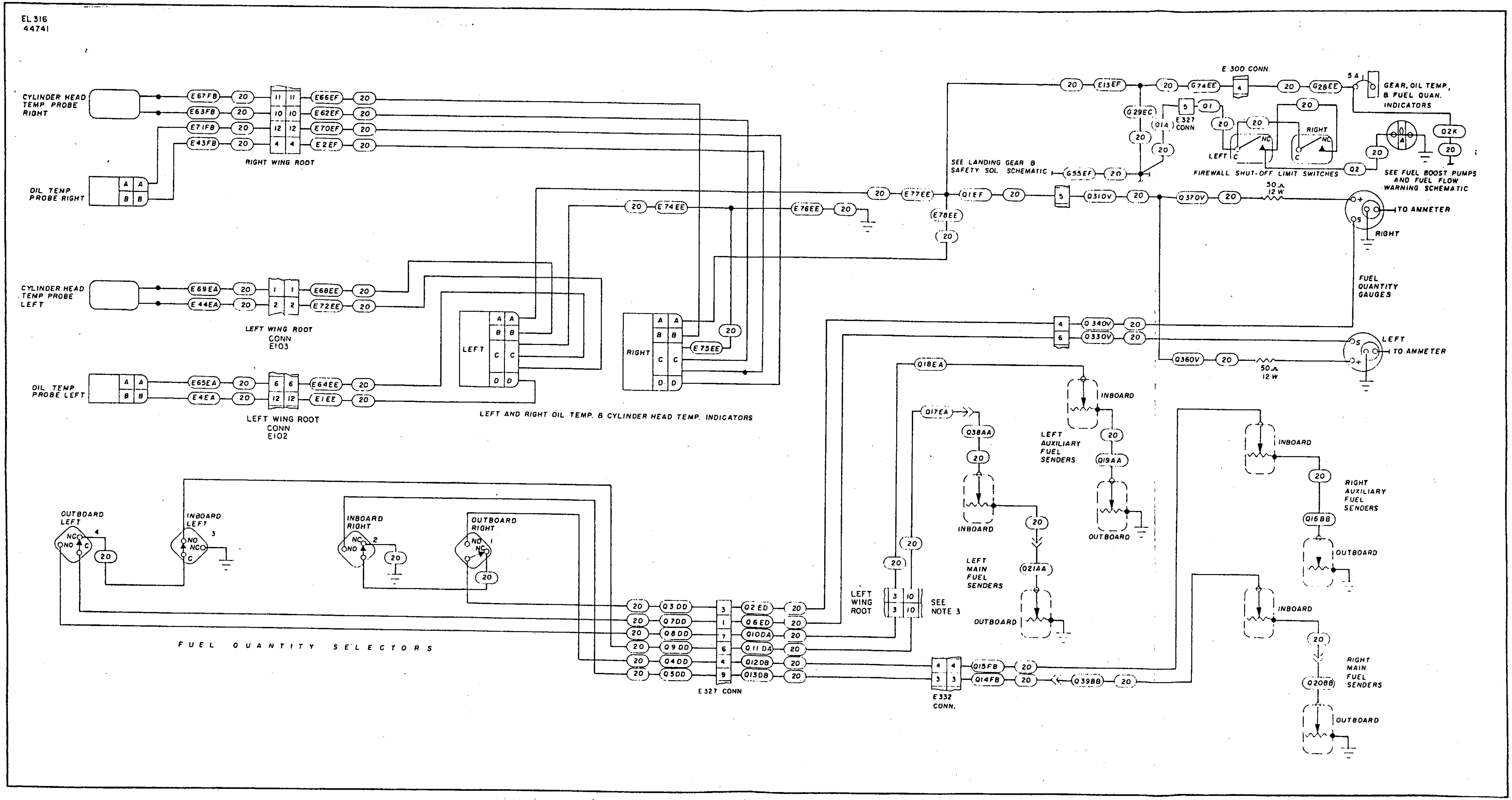

Figure 91-27. Oil and Cylinder Head Temperature and Fuel Quantity Gauges

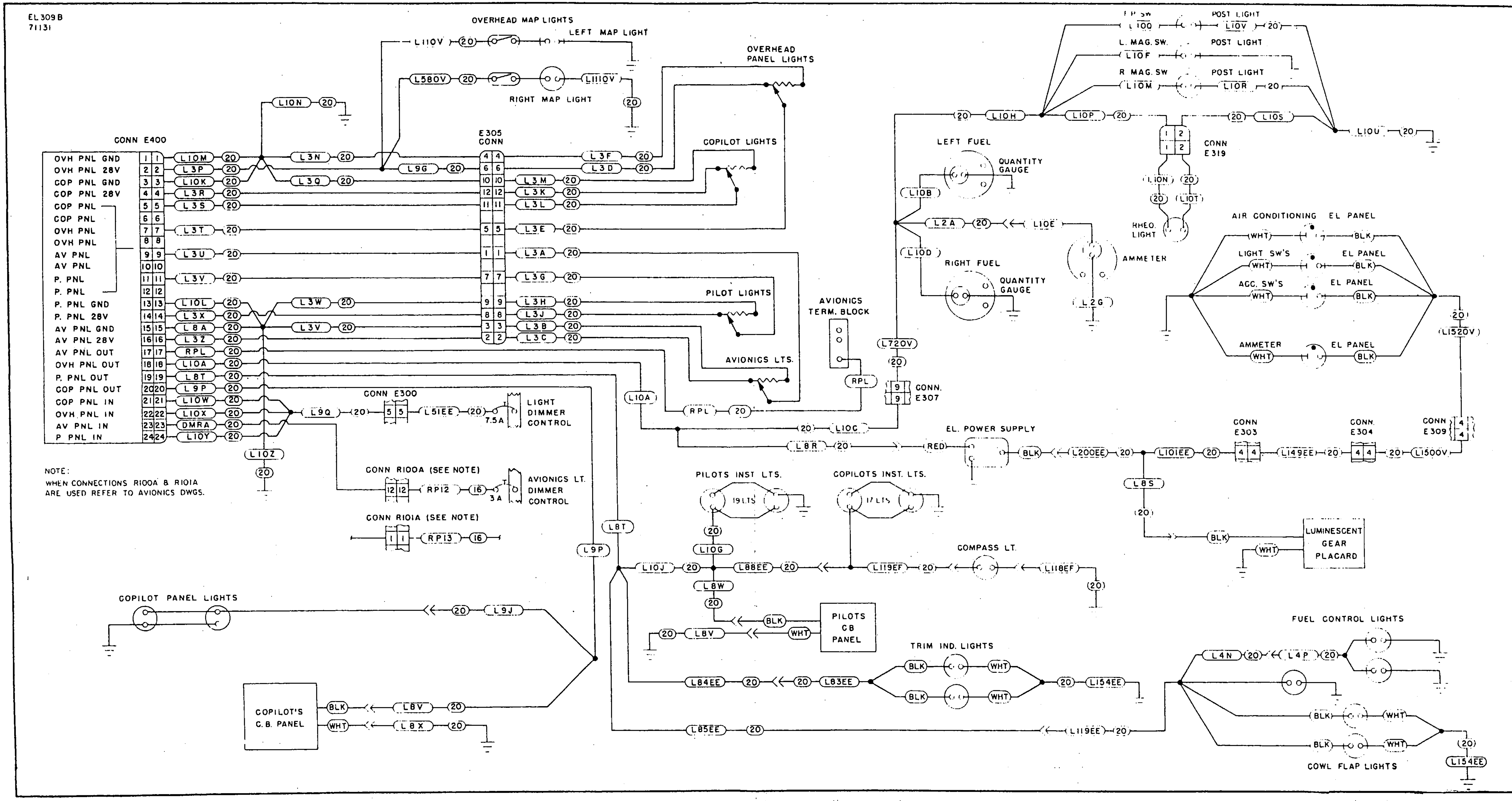

Figure 91-28. Panel Lights

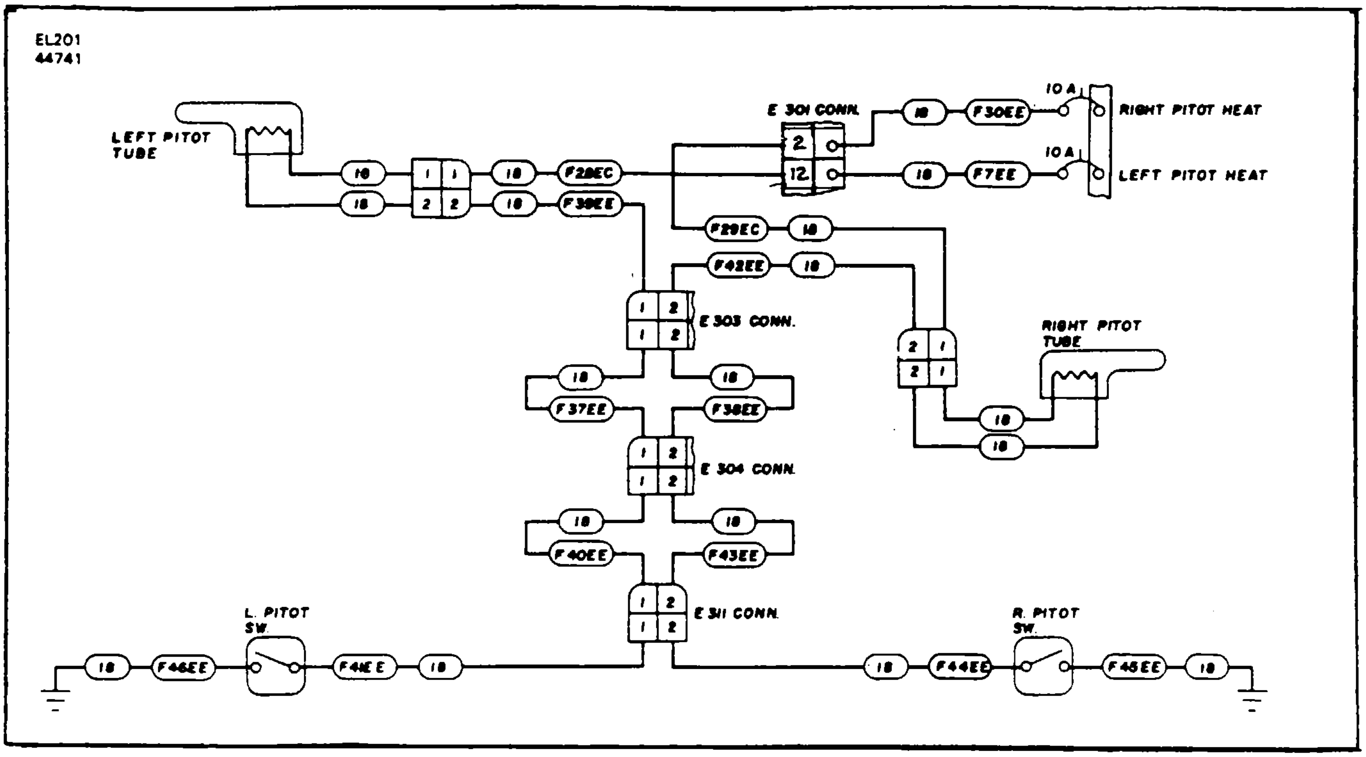

Figure 91-29. Pitot Heat (Right and Left)

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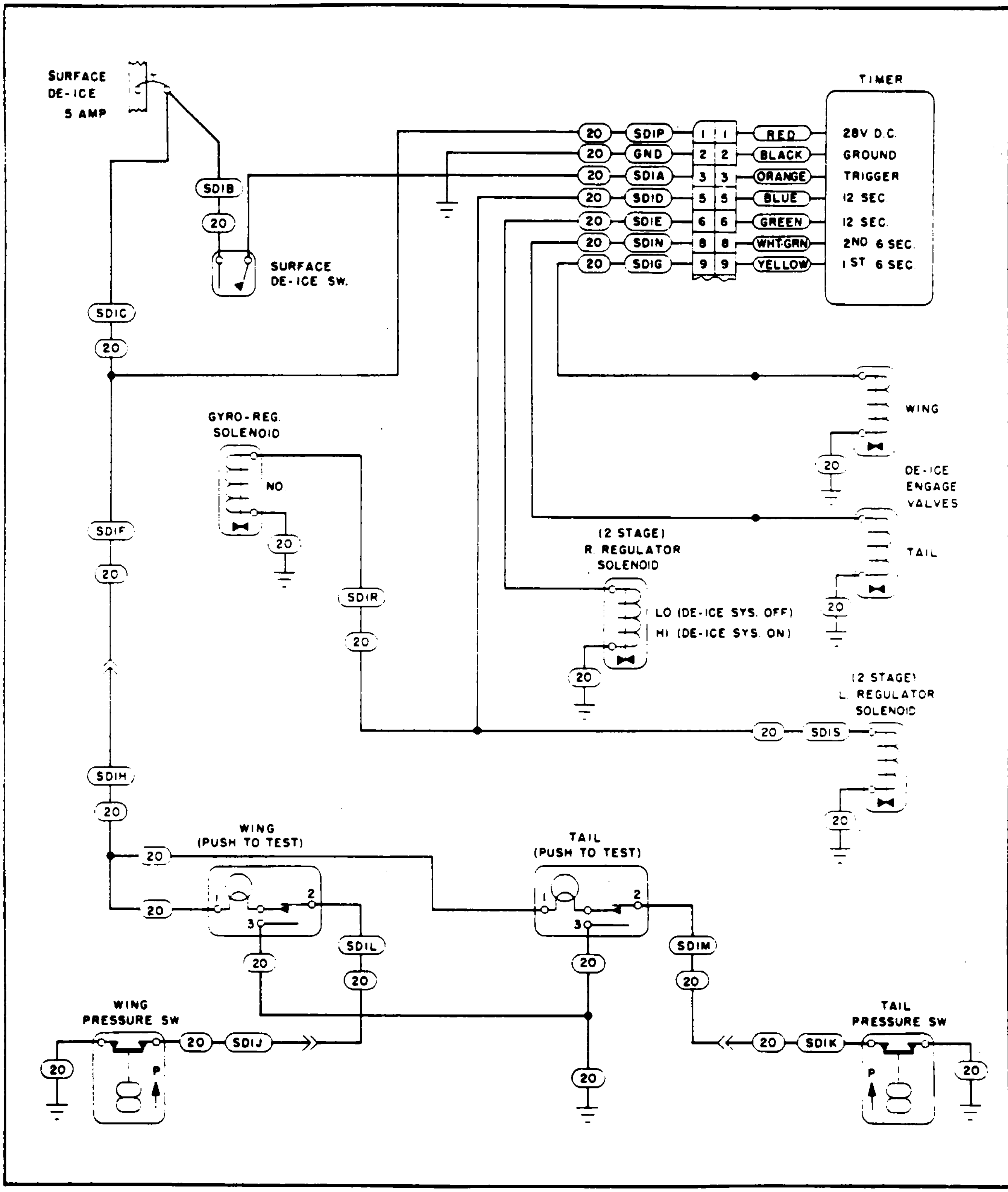

Figure 91-30. Surface Deicing System

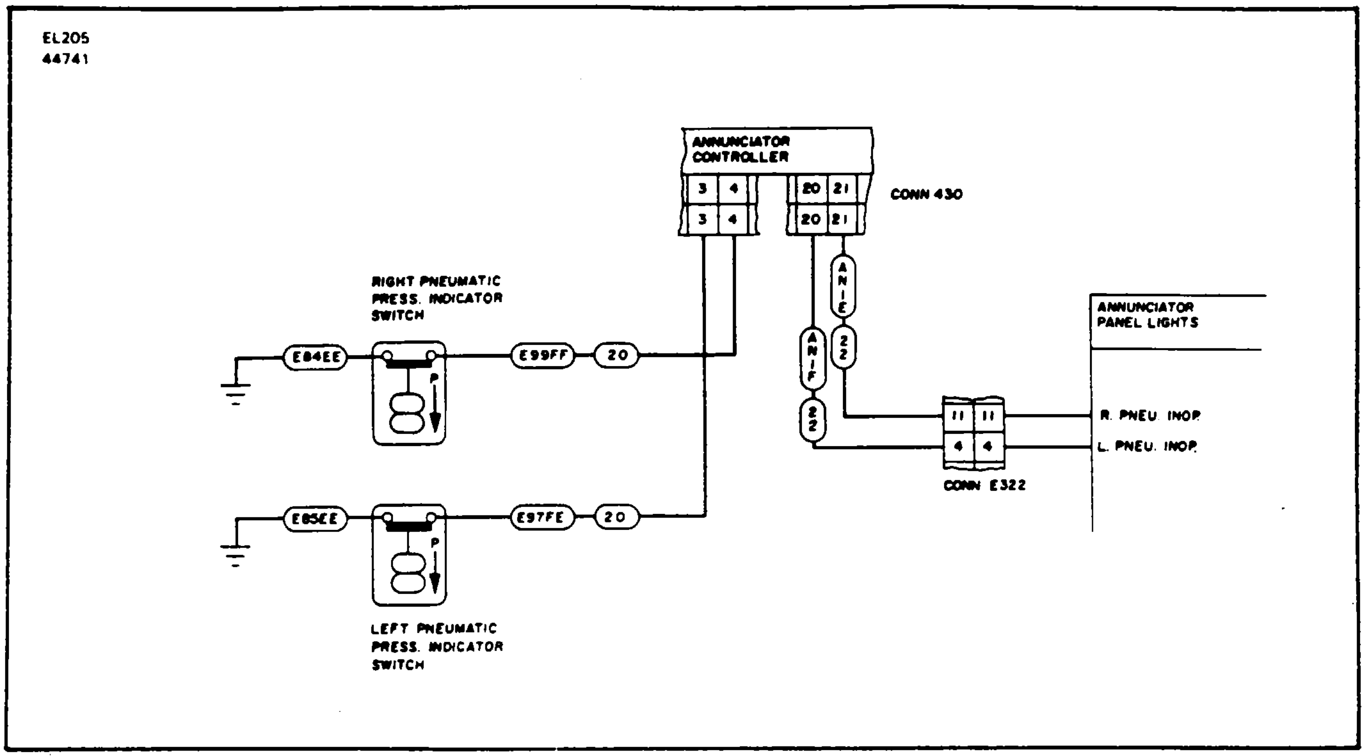

Figure 91-31. Pneumatic Indicators

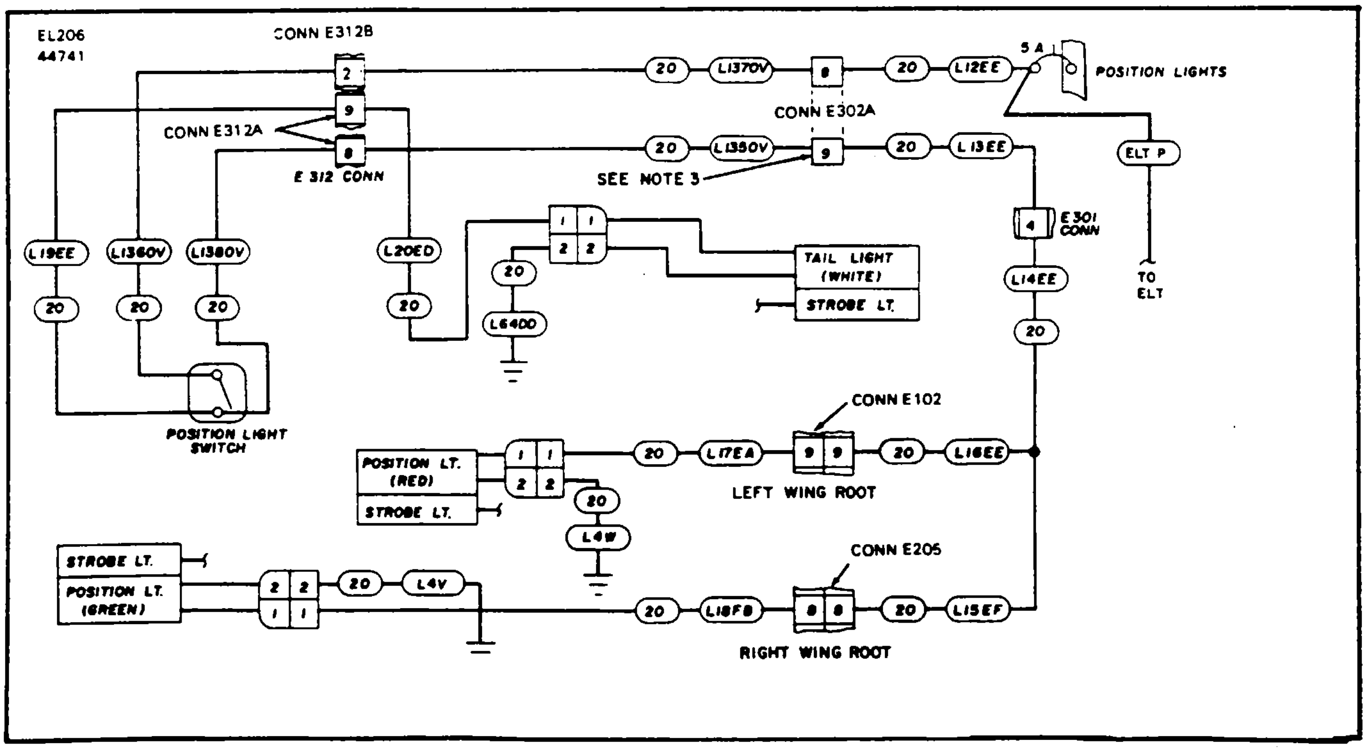

Figure 91-32. Position Lights

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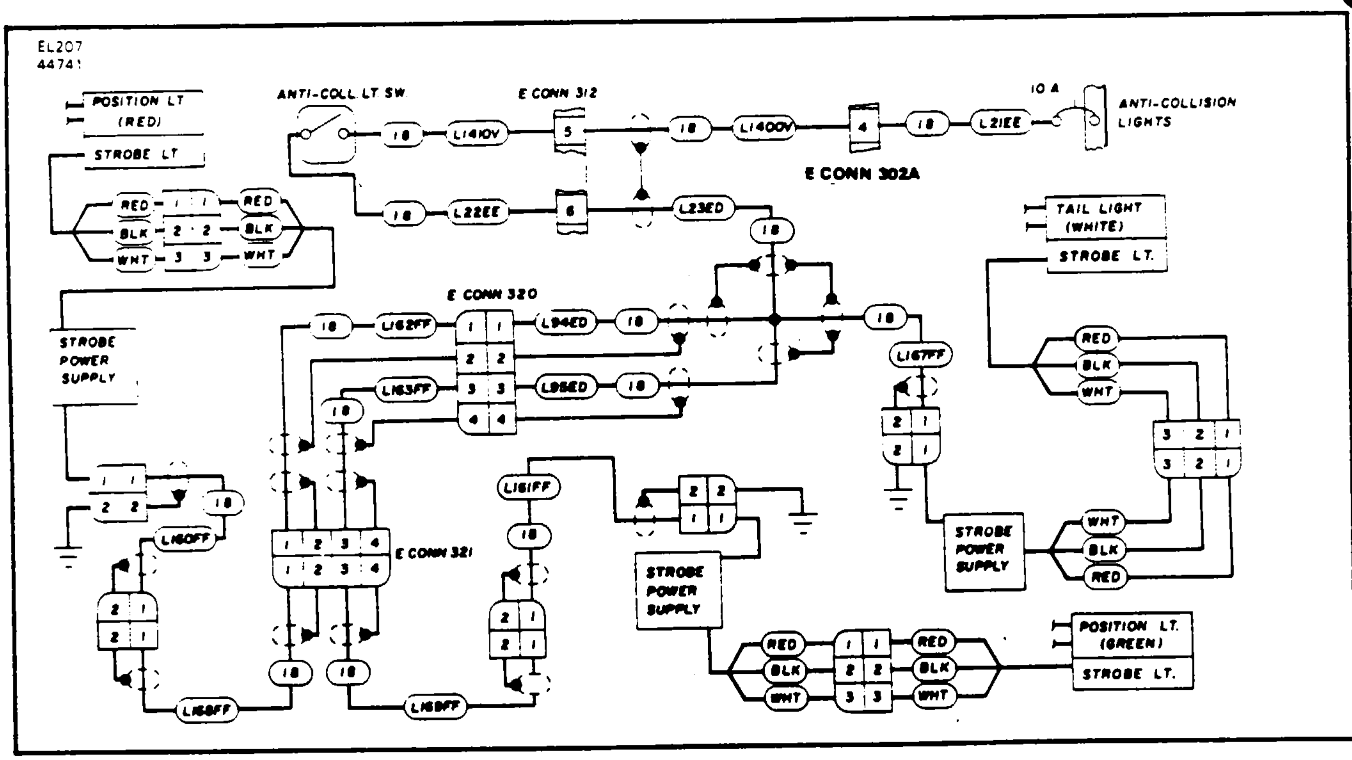

Figure 91-33. Strobe Lights

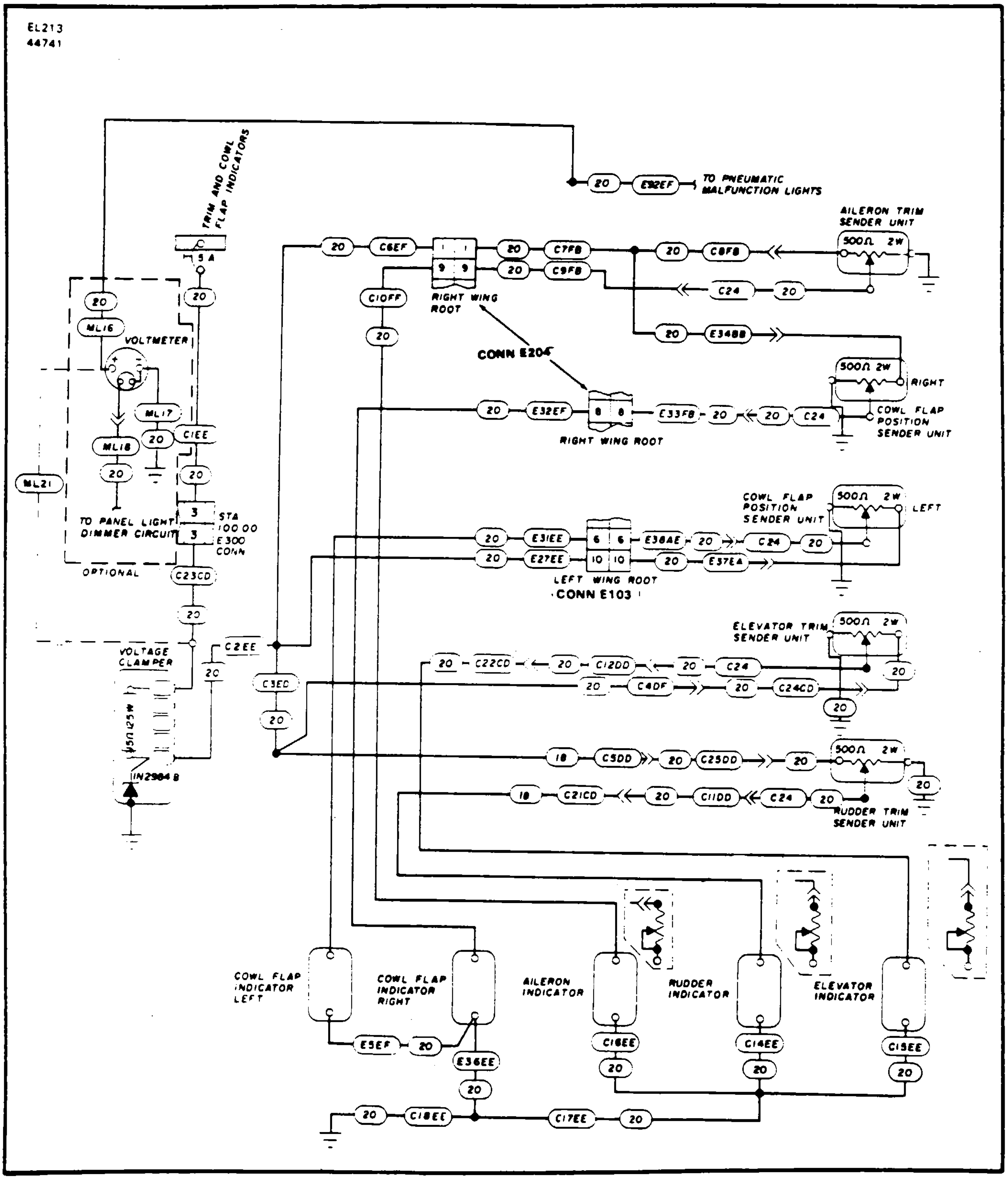

Figure 91-34. Trim and Cowl Flap Indicators/Voltmeter

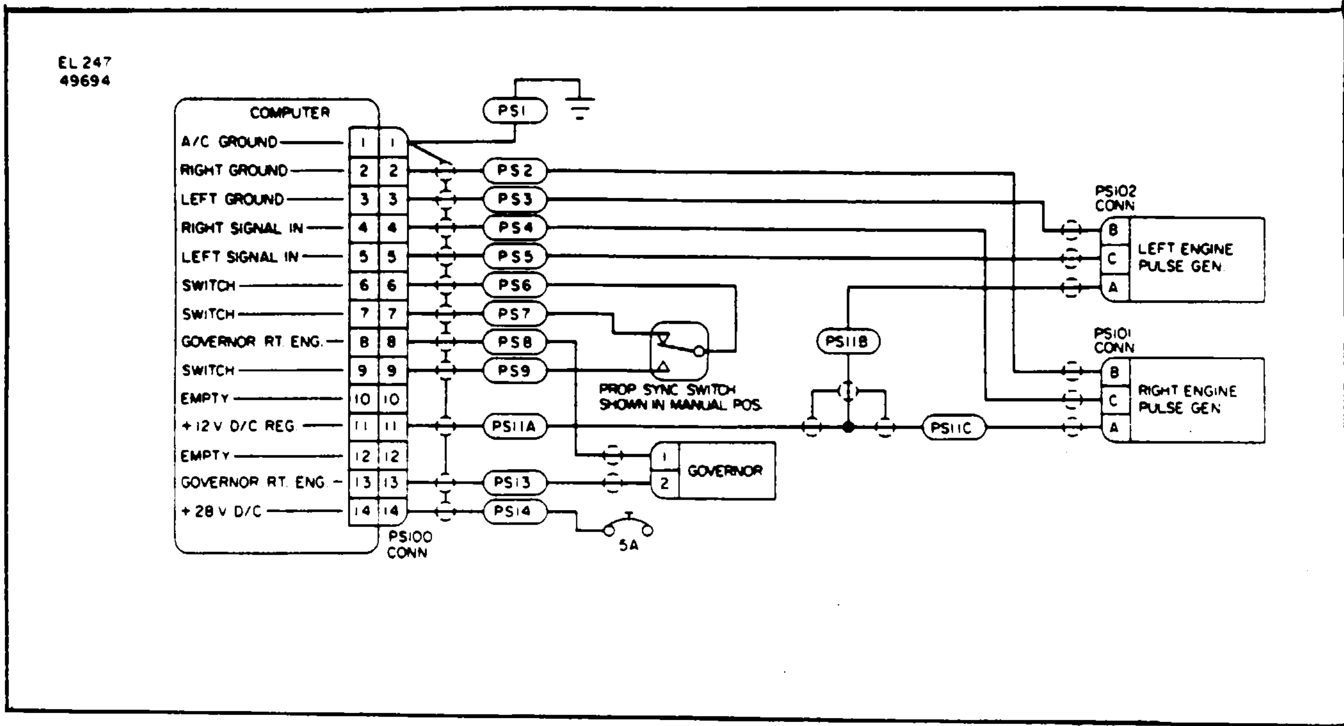

Figure 91-35. Synchrophaser Schematic

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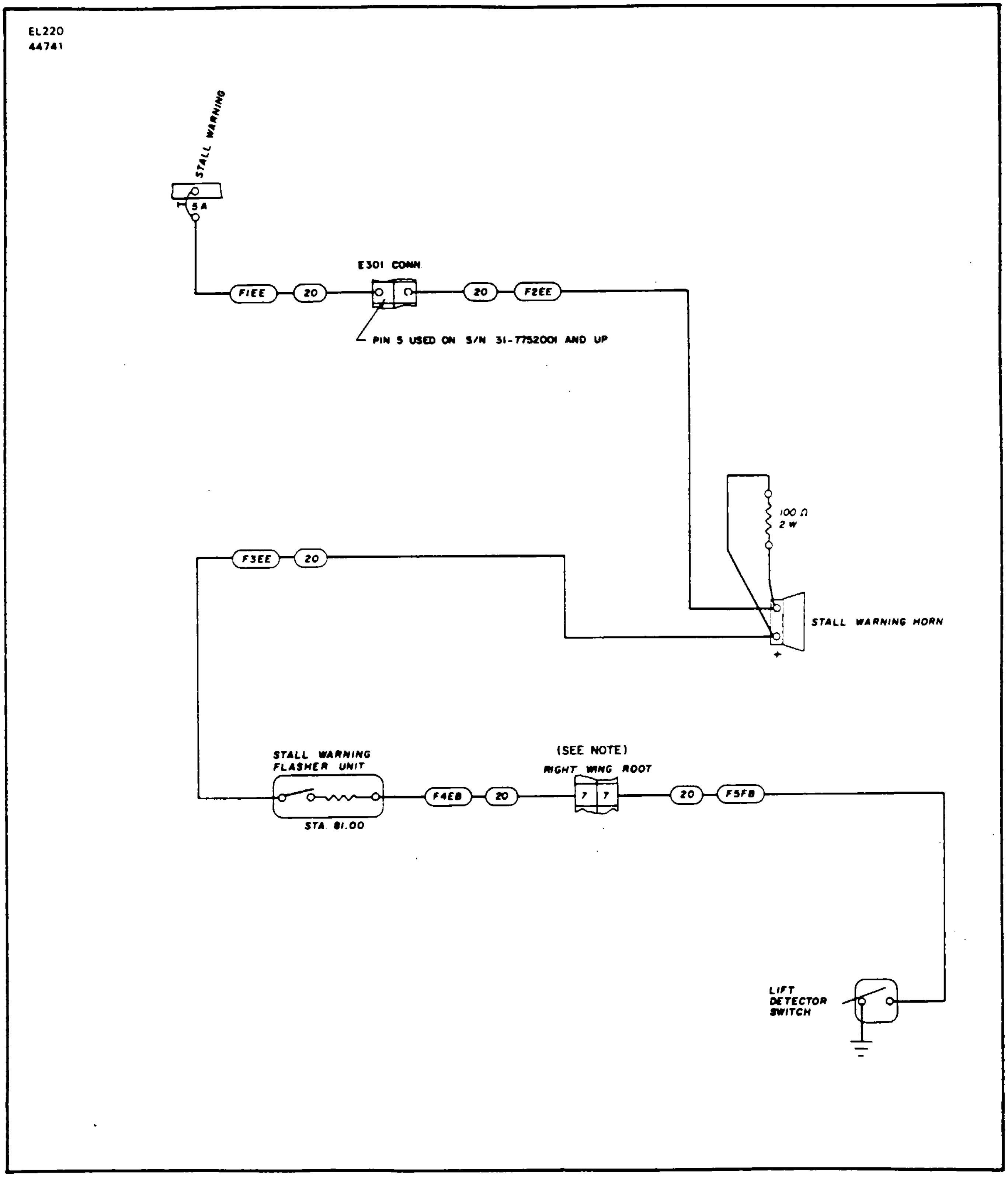

Figure 91-36. Stall Warning

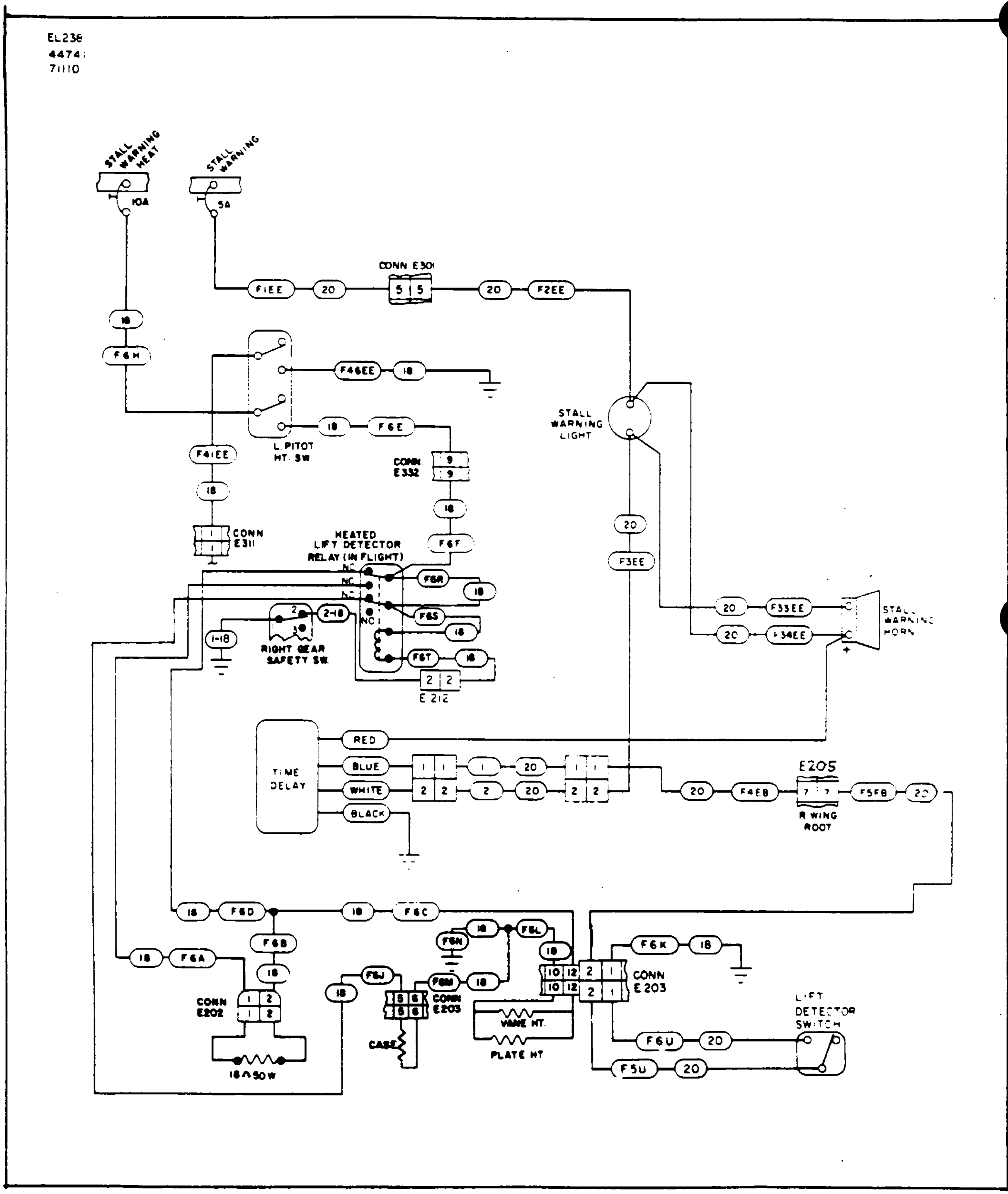

Figure 91-37. Stall Warning (With Time Delay)

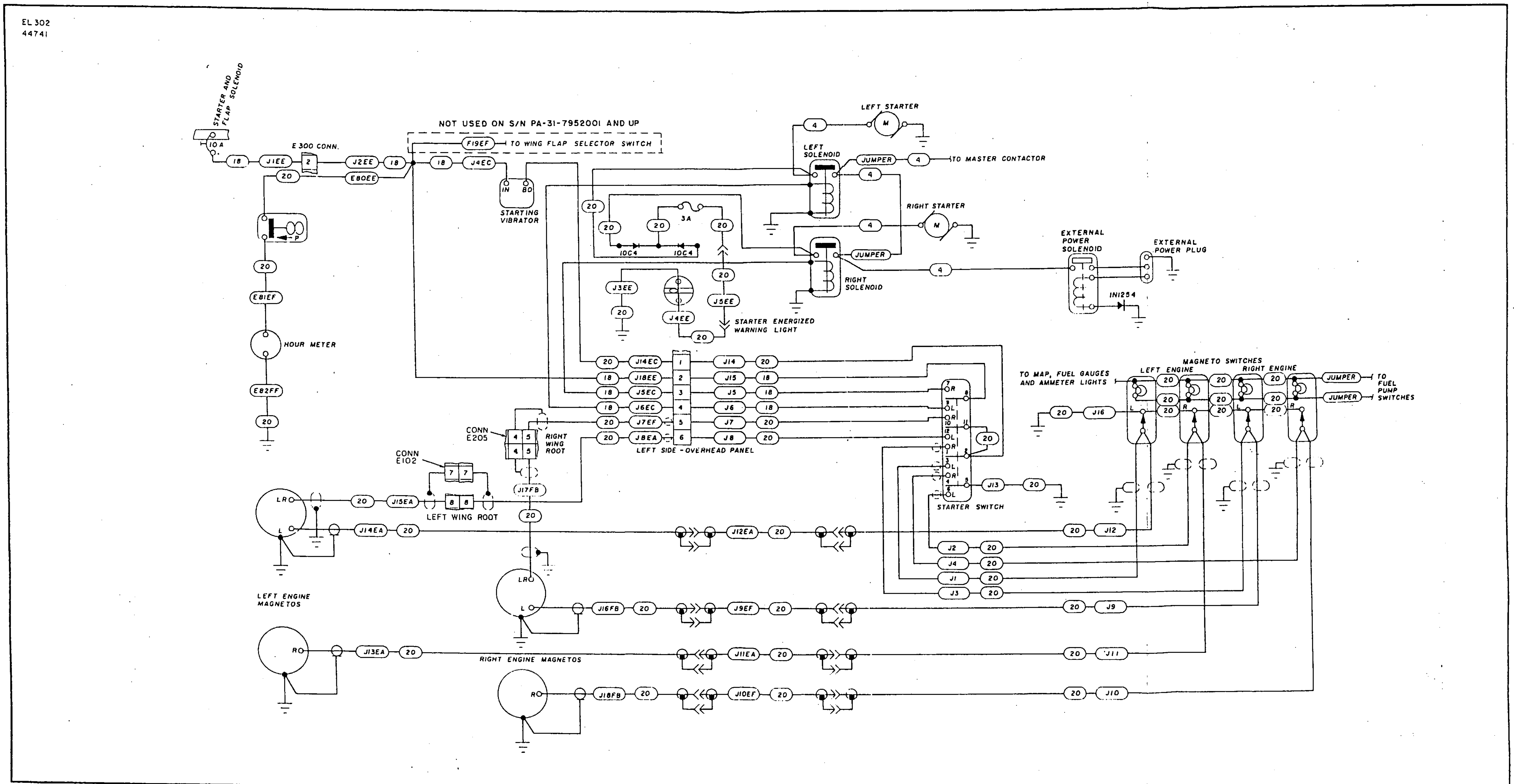

Figure 91-38. Starter and Hourmeter

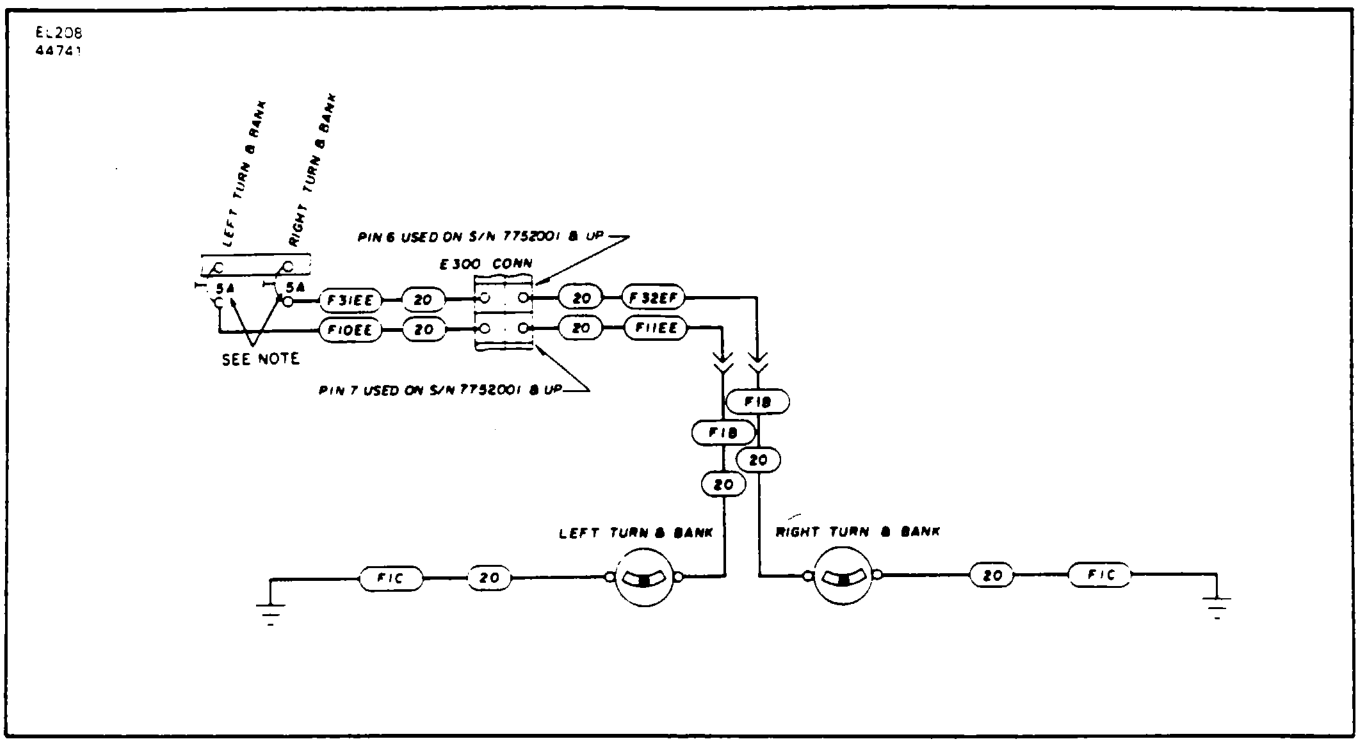

Figure 91-39. Turn and Bank

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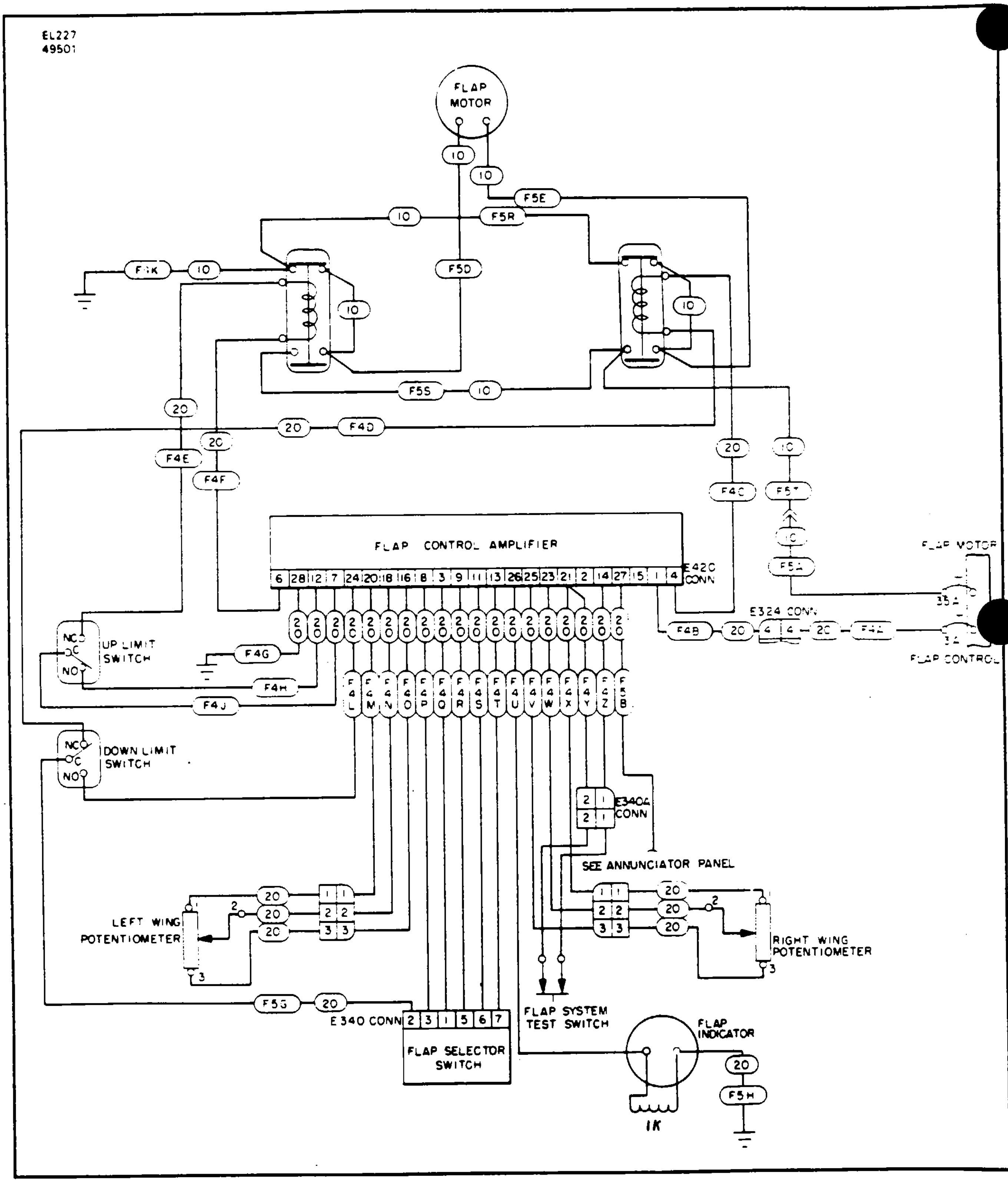

Figure 91-40. Wing Flap Motor (Calco)

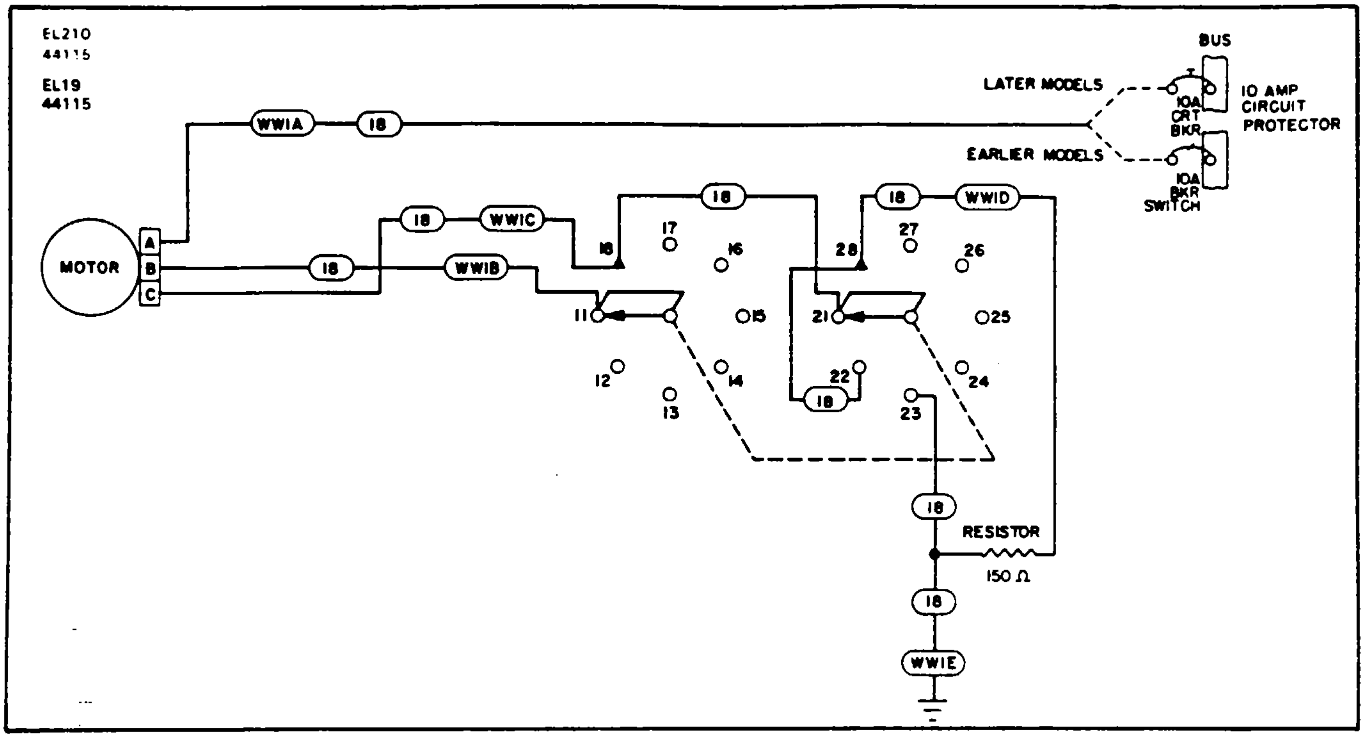

Figure 91-41. Windshield Wiper

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CHAPTER

95

SPECIAL PURPOSE EQUIPMENT

5F1

CHAPTER 95 - SPECIAL PURPOSE EQUIPMENT

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
95-00-00	GENERAL	5F3	
95-10-00	TOOLS AND TEST EQUIPMENT	5F3	
95-10-01	Construction Of Tire Balancer	5F4	

GENERAL.

This chapter contains various equipment of a special nature used to perform maintenance on this airplane.

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 by referring to the appropriate illustration Figure number in the maintenance manual following the list of tools.

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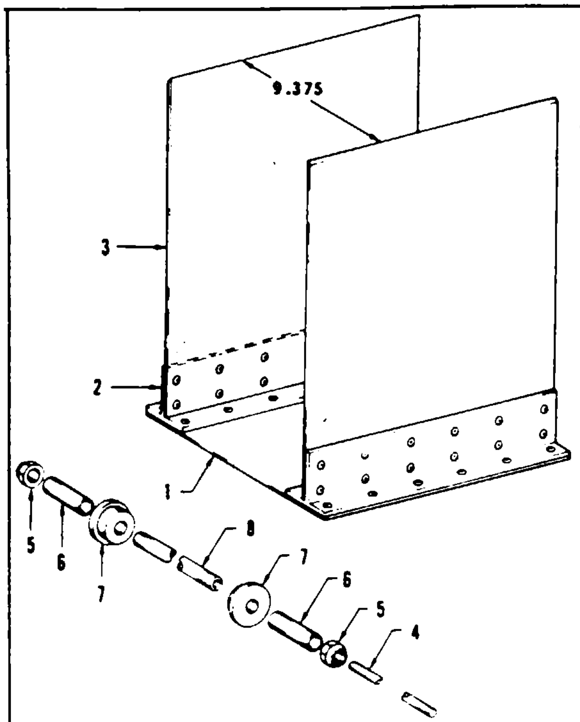


The following list of materials were used in making the balancer:

-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

CONSTRUCTION OF TIRE BALANCER. (Refer to Figure95-1.)

1. The following instructions will help in building the balancer: 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 paralleled and 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 bushing may be bench made from one inch phenolic or aluminum using a 1 1/2 inch hole saw to cut out the smaller bushing and 1 3/4 inch 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.

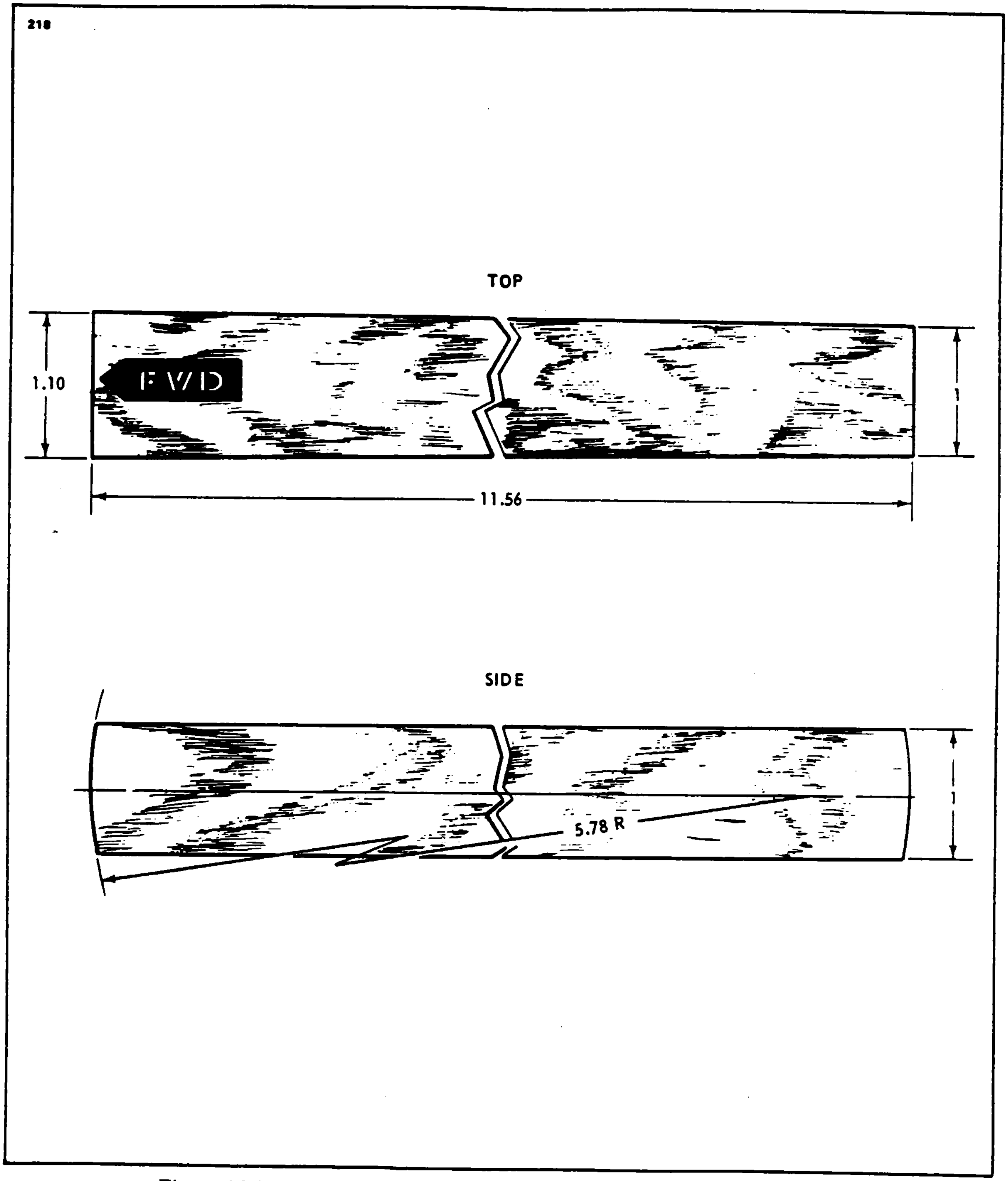


Figure 95-2. Fabricated Tool, Checking Main Gear Toe-in Adjustment

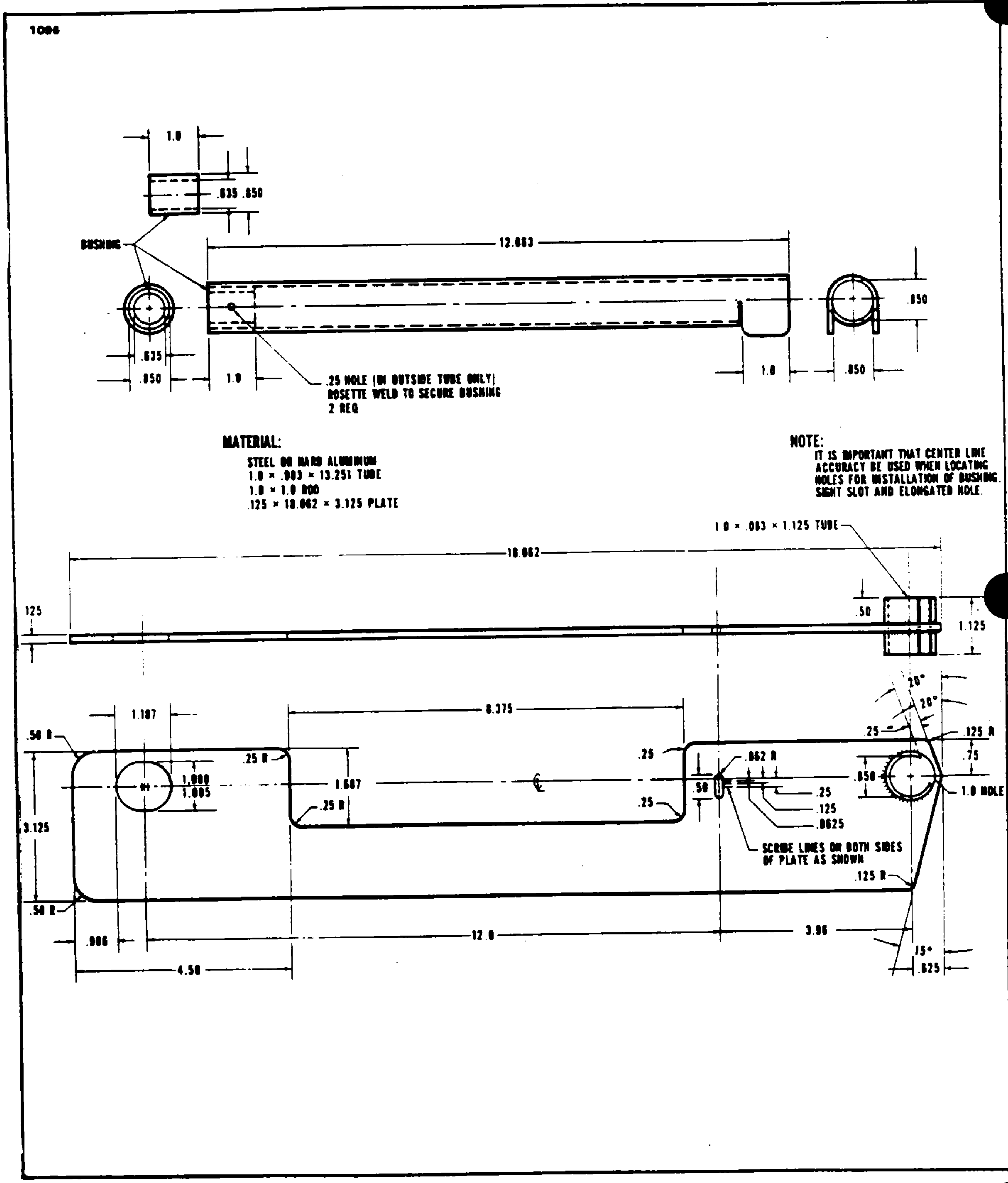


Figure 95-3. Fabricated Tool, Checking Main Gear Side Brace Link Travel

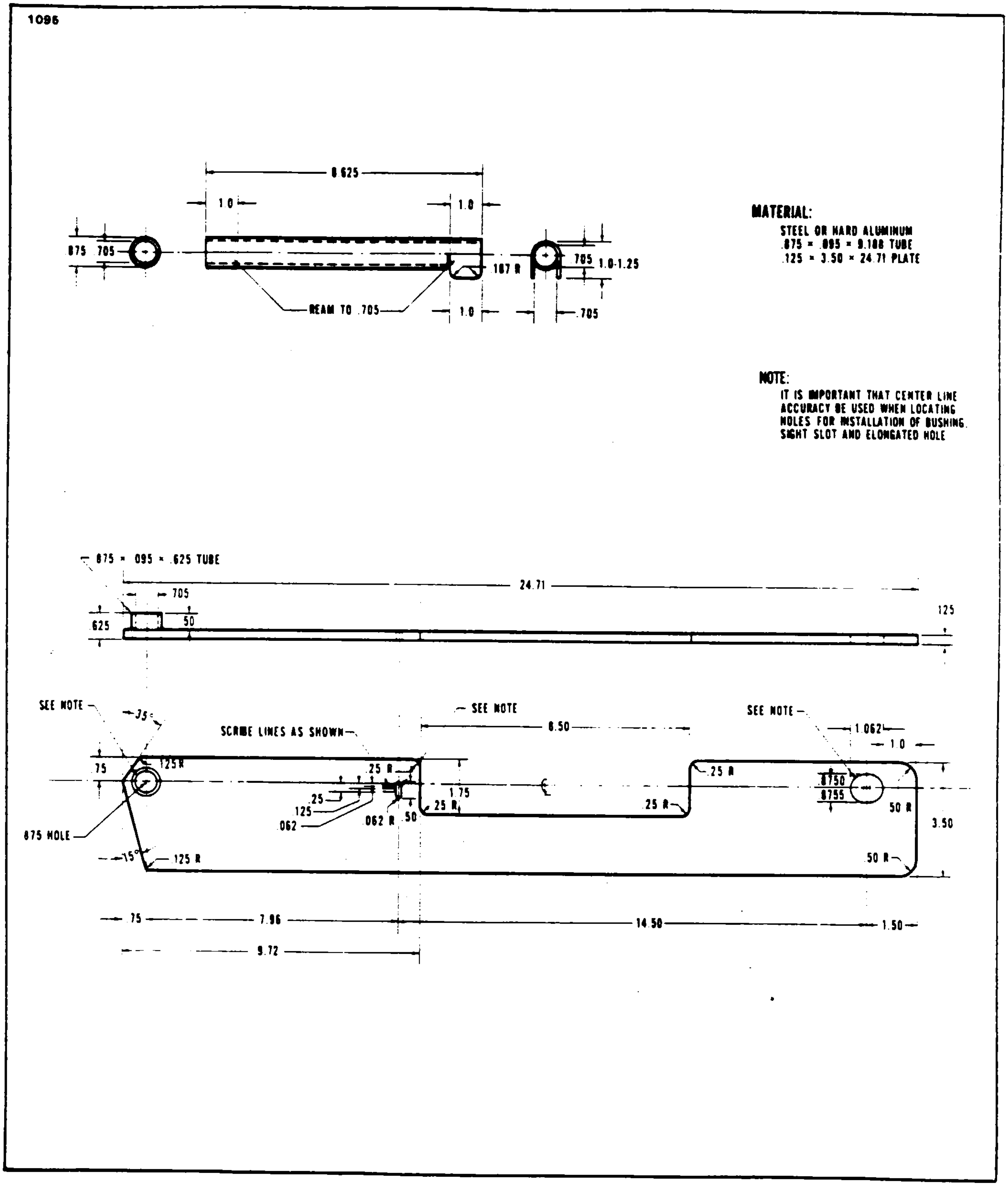


Figure 95-4. Fabricated Tool, Checking Nose Gear Link Travel

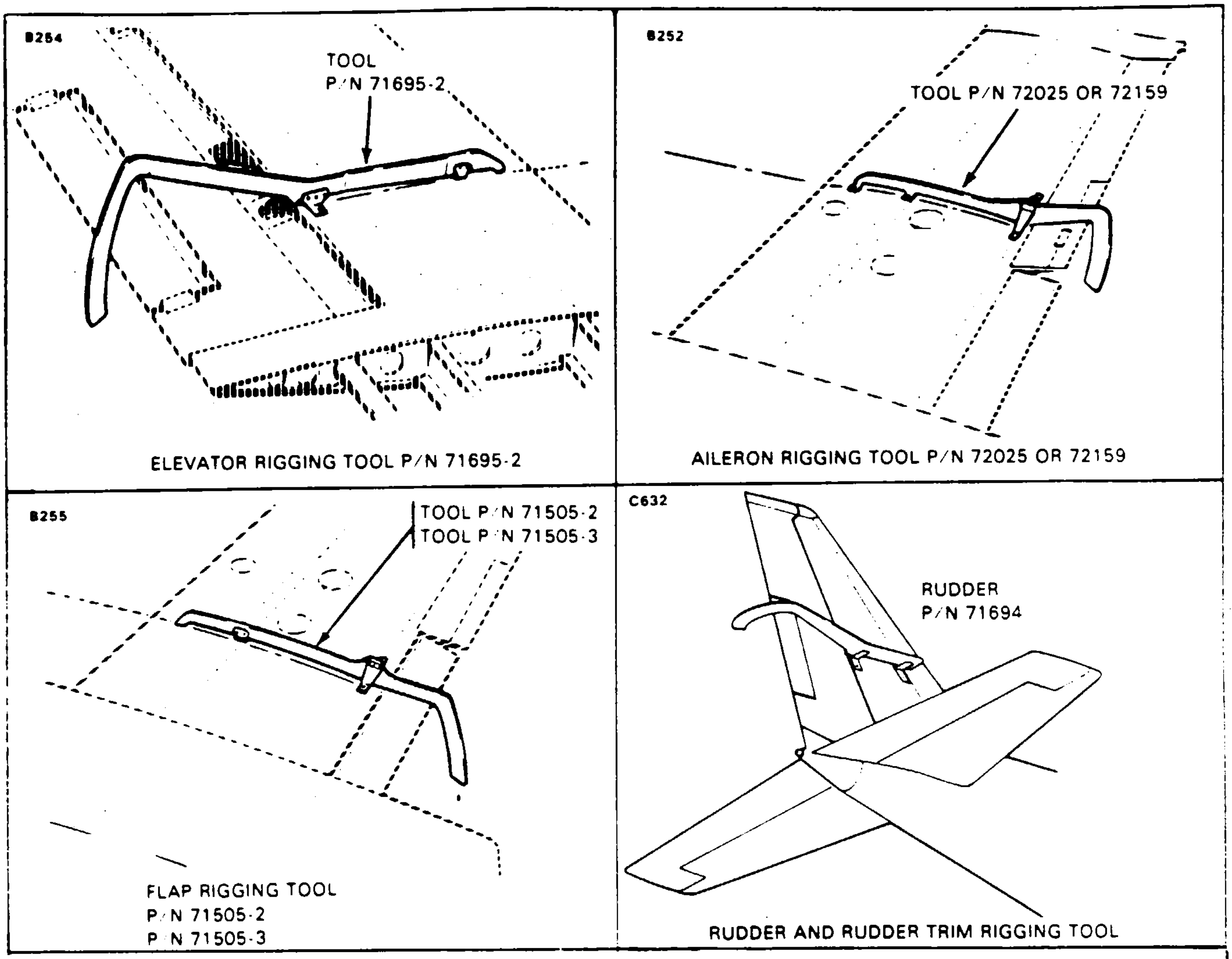


Figure 95-5. Flight Control Rigging Tools

1094

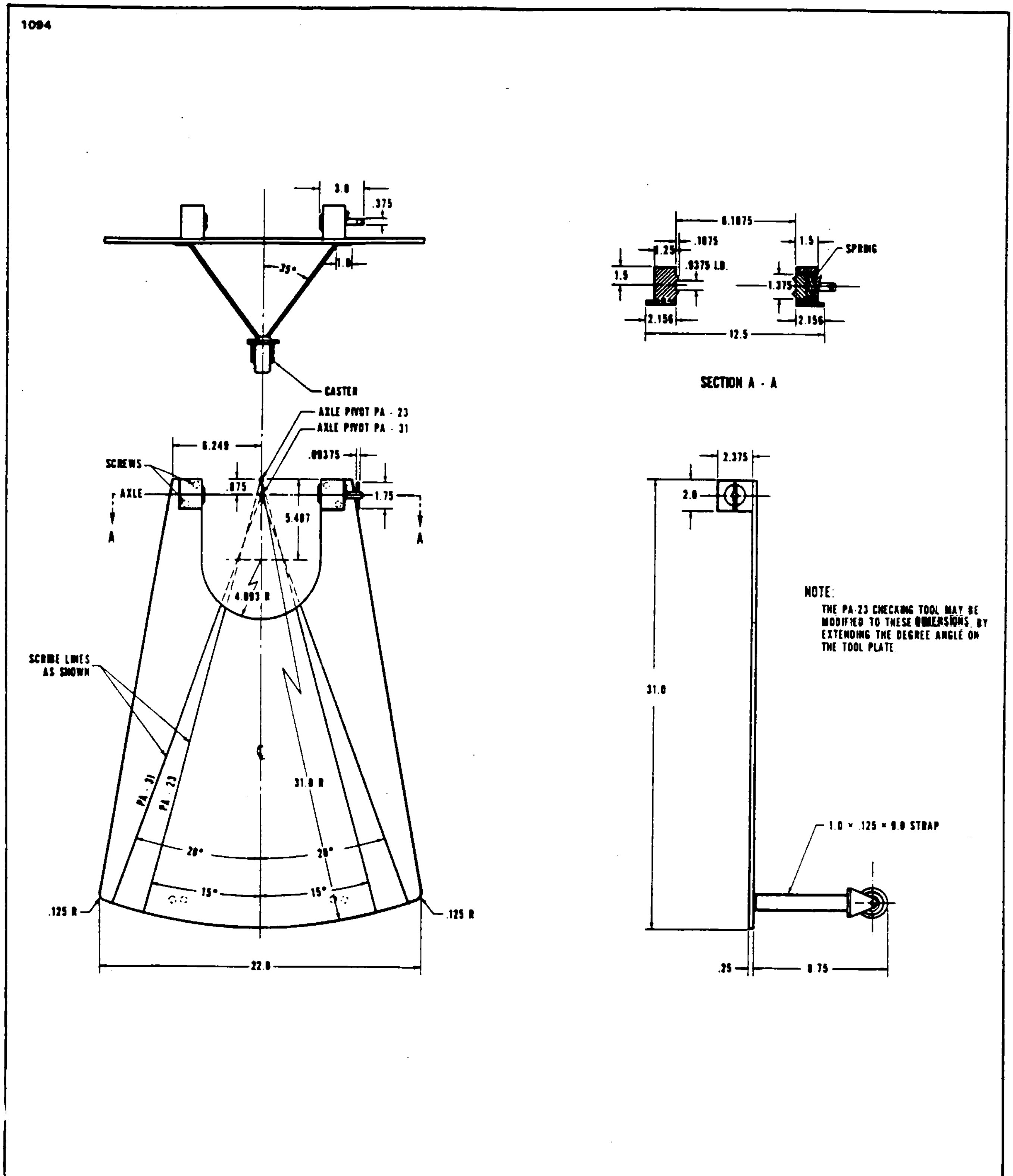


Figure 95-6. Fabricated Tool, Checking Nose Wheel Alignment

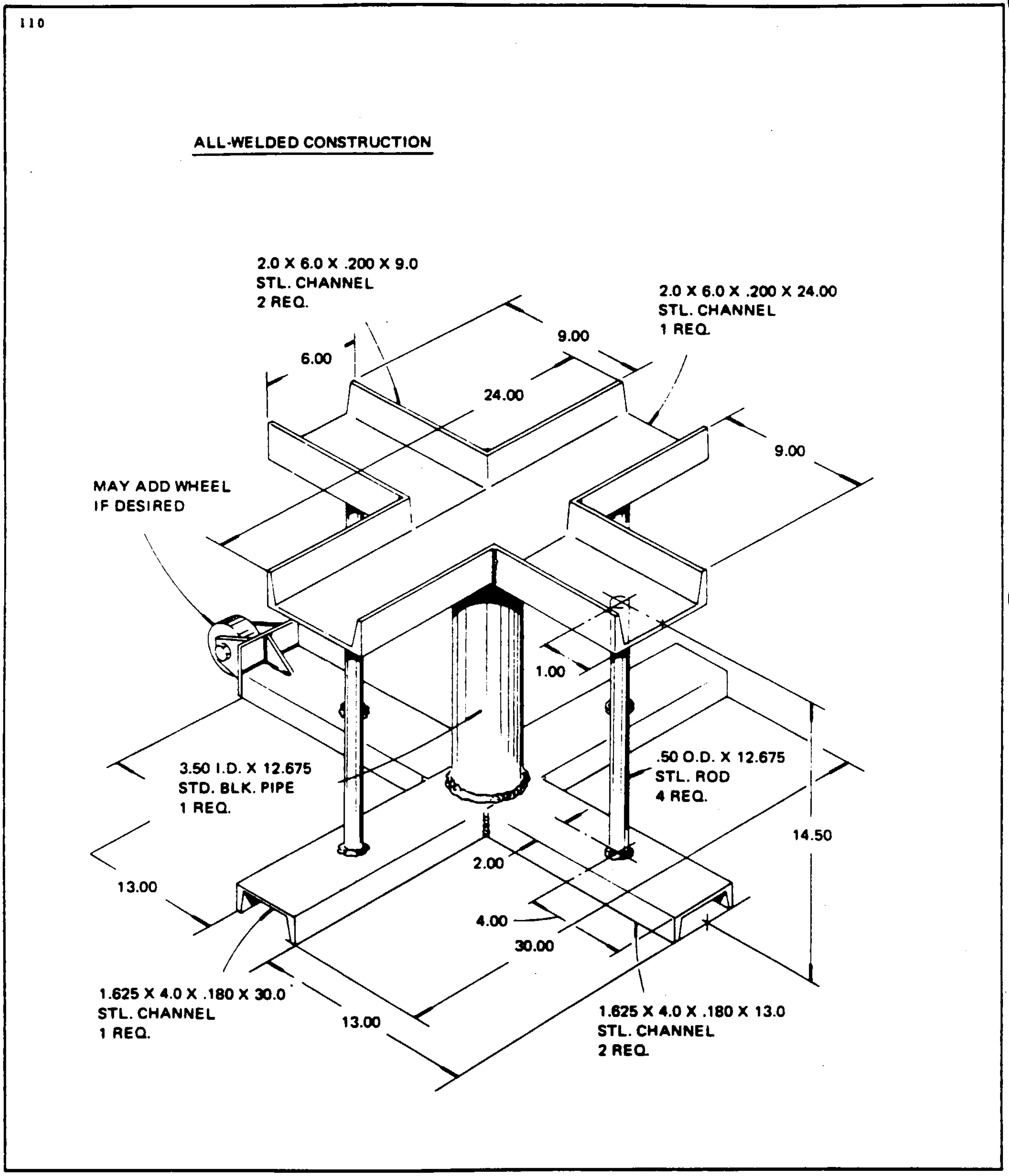


Figure 95-7. Fabricated Jack Stand for Piper Jack, Part No. 18338-00

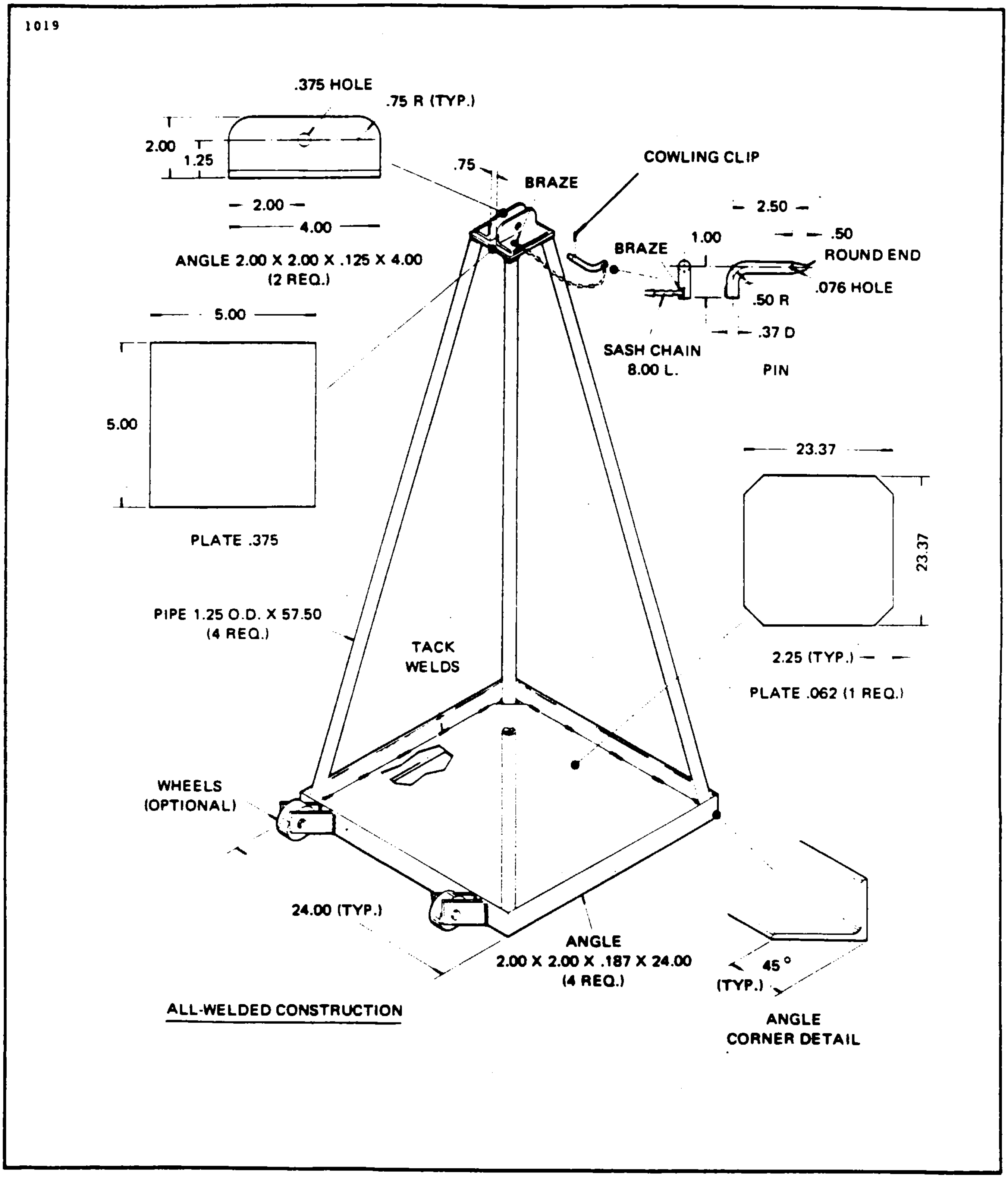


Figure 95-8. Fabricated Tail Stand

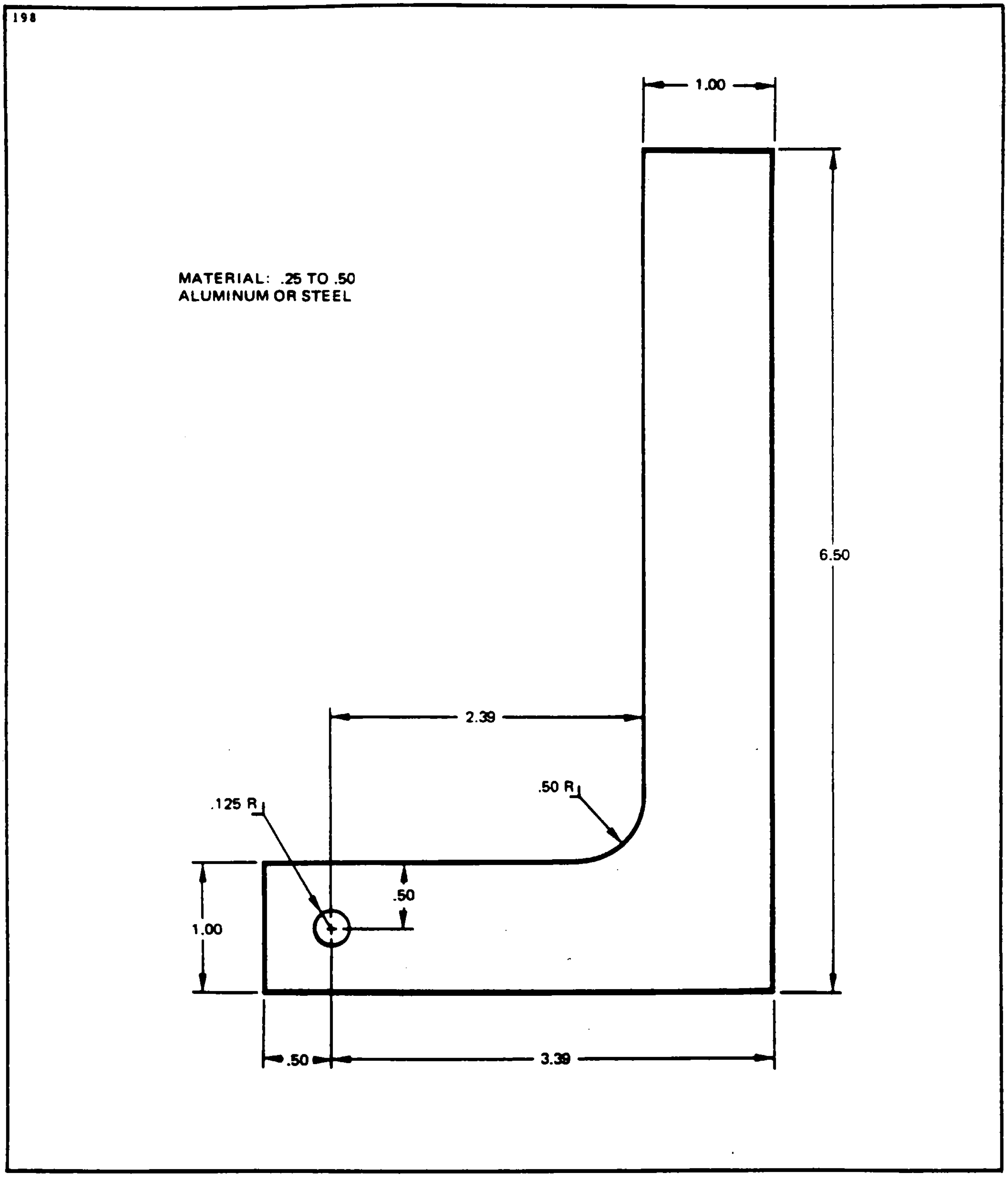


Figure 95-9. Fabricated Bellcrank Rigging Tool

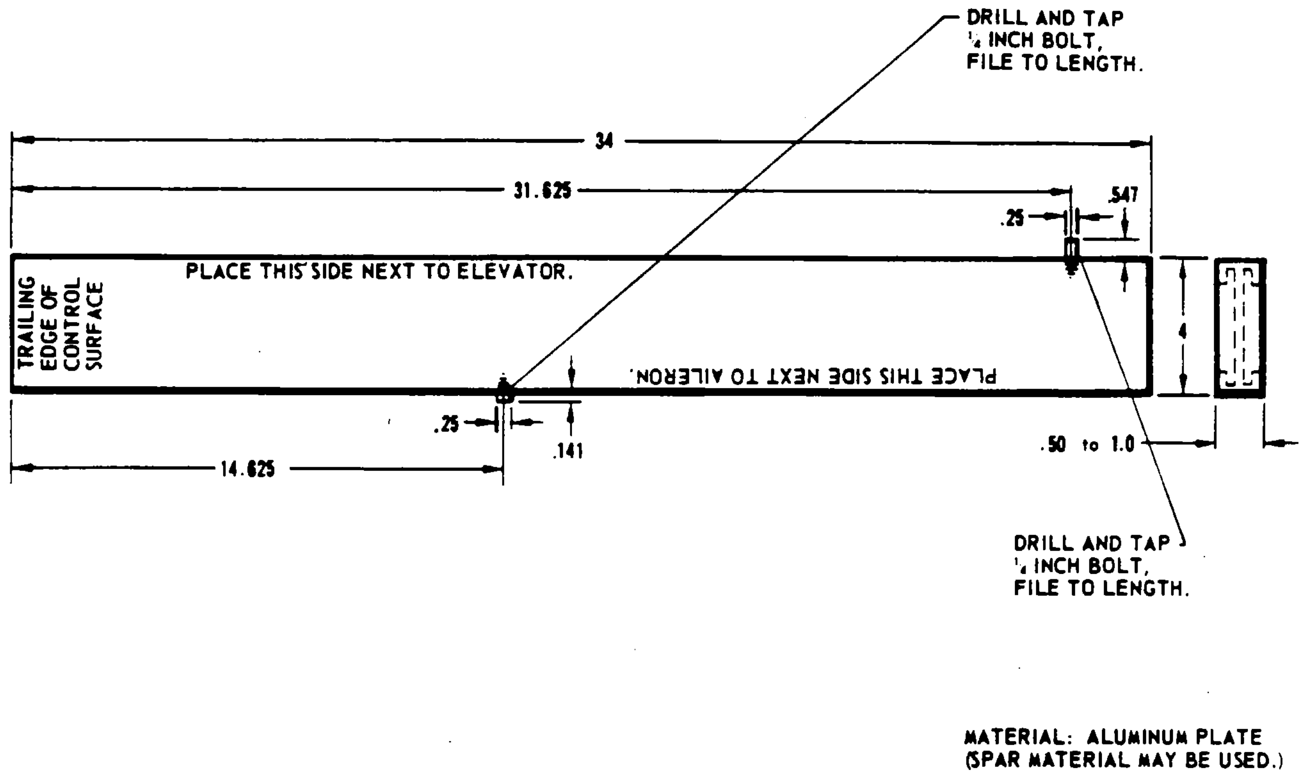


Figure 95-10. Fabricated Aileron and Elevator Rigging Tool

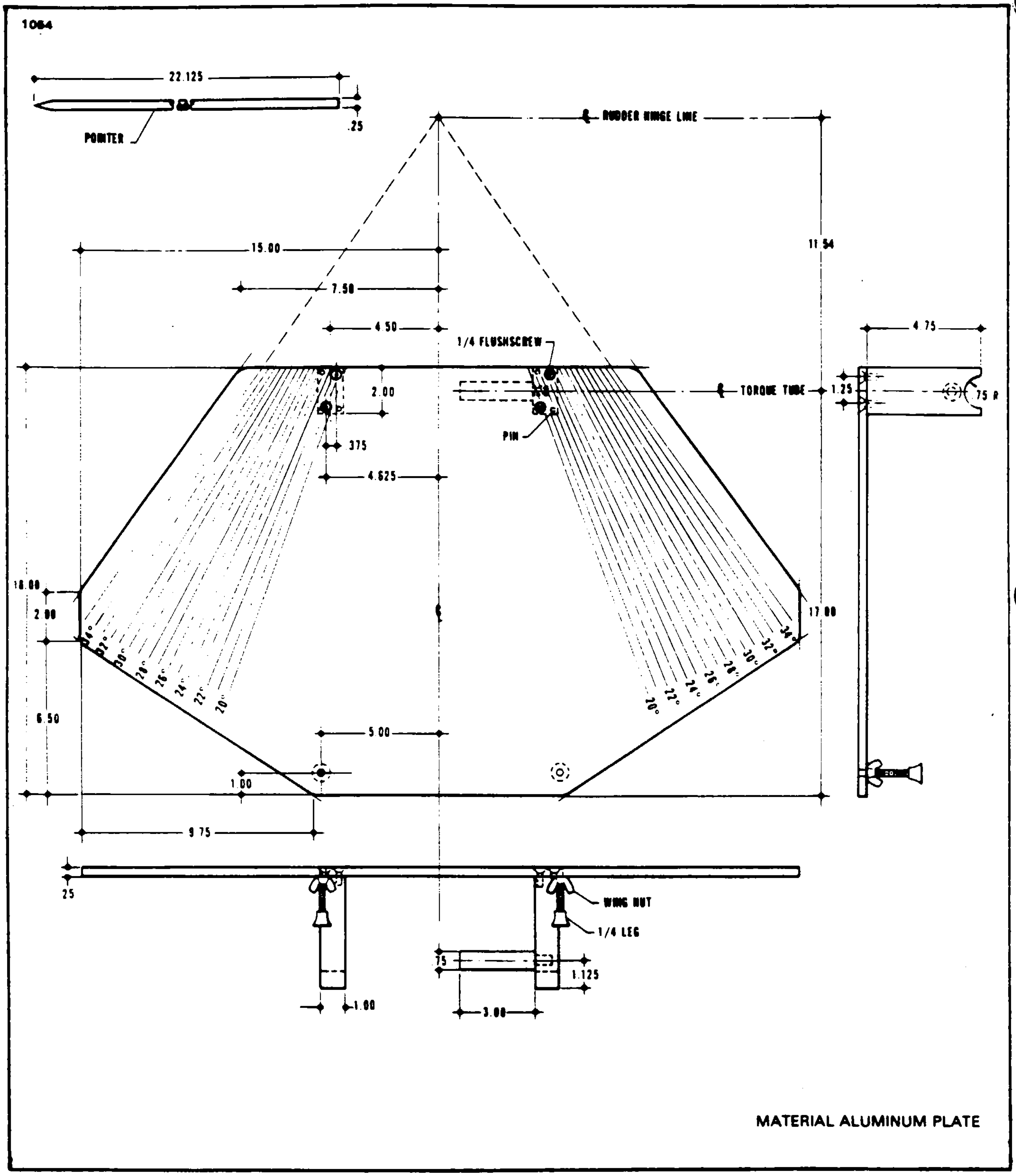


Figure 95-11. Fabricated Rudder Rigging Tool

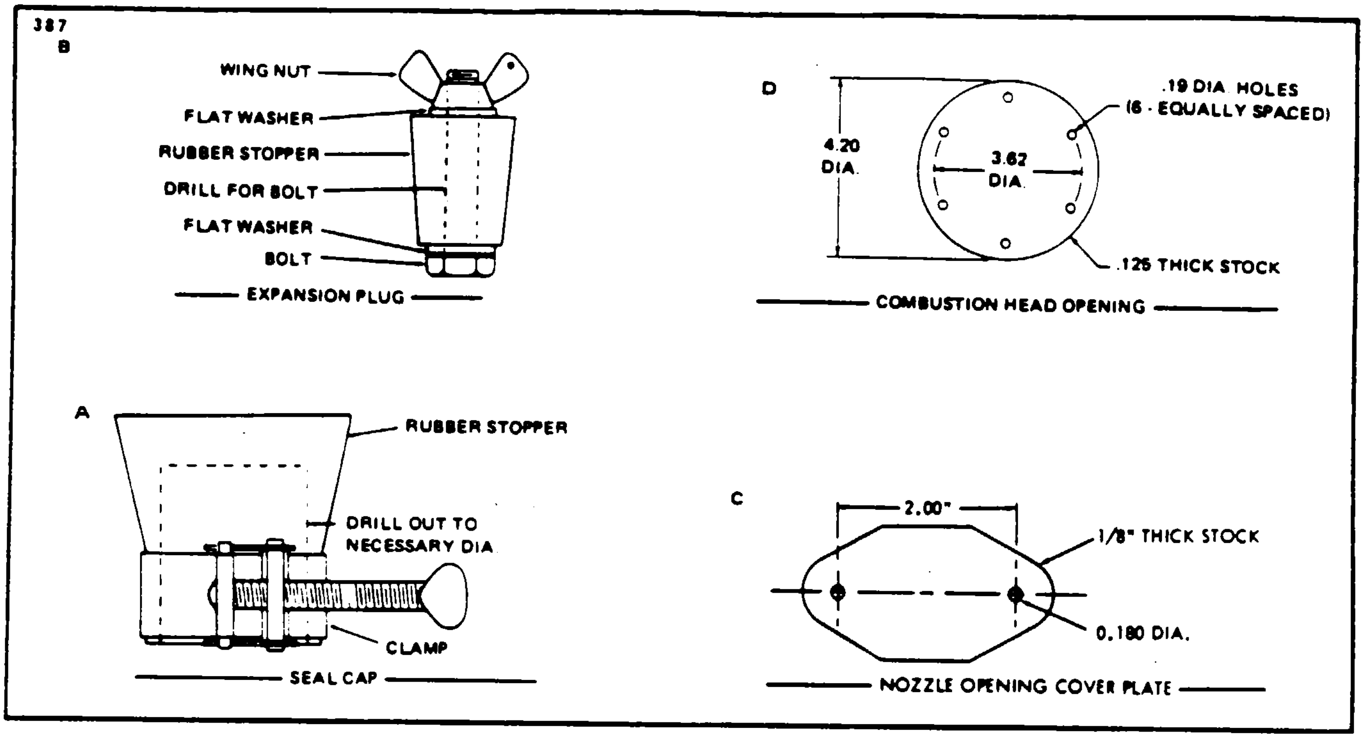


Figure 95-12. Suggested Design for Seal Plate, Plugs and Caps for Combustion Tube Leakage Test (Janitrol Heater)

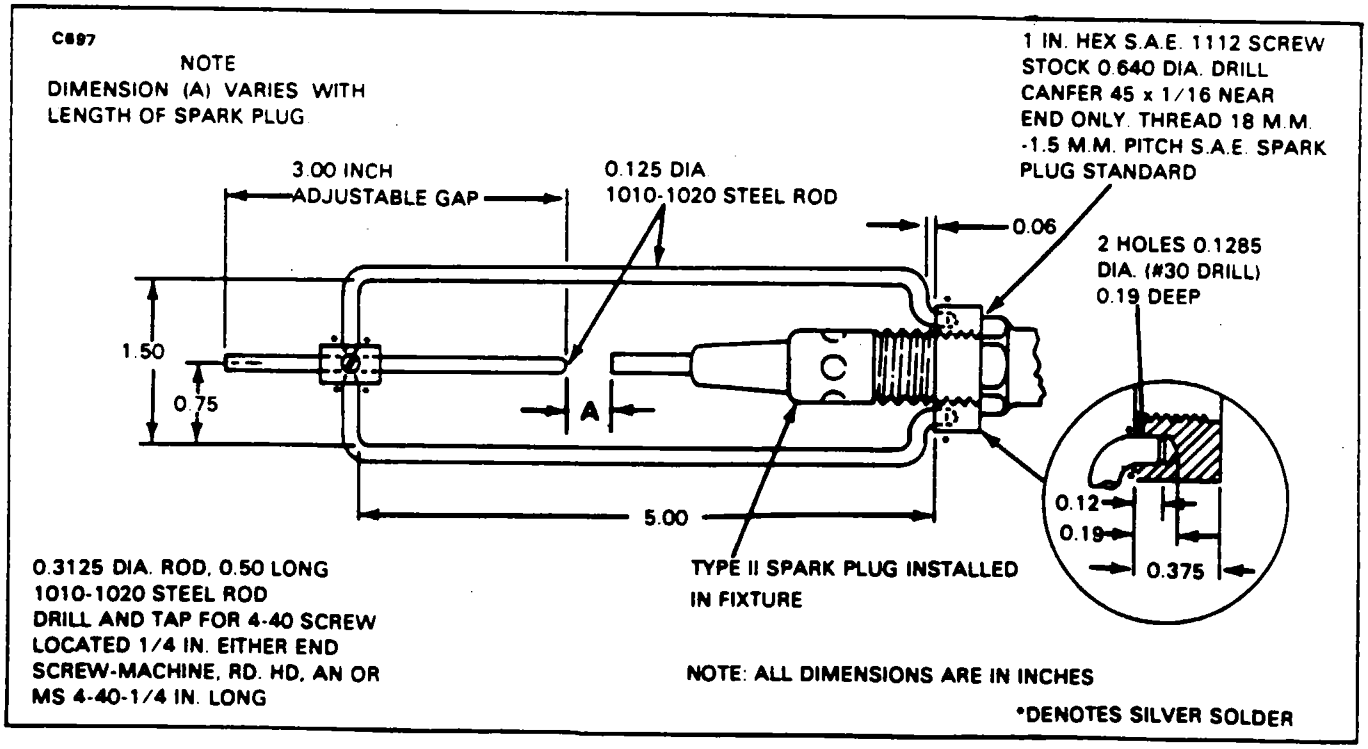


Figure 95-13. Spark Plug Fixture (Janitrol Heater)

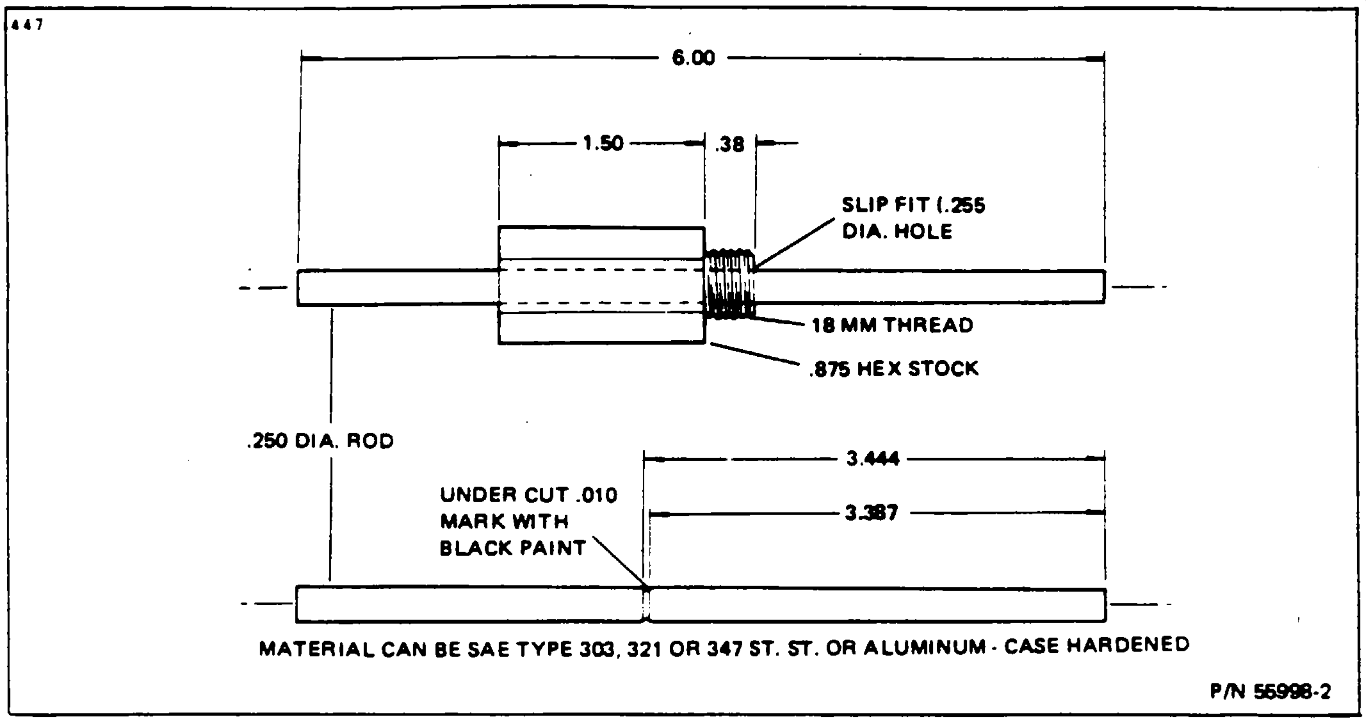
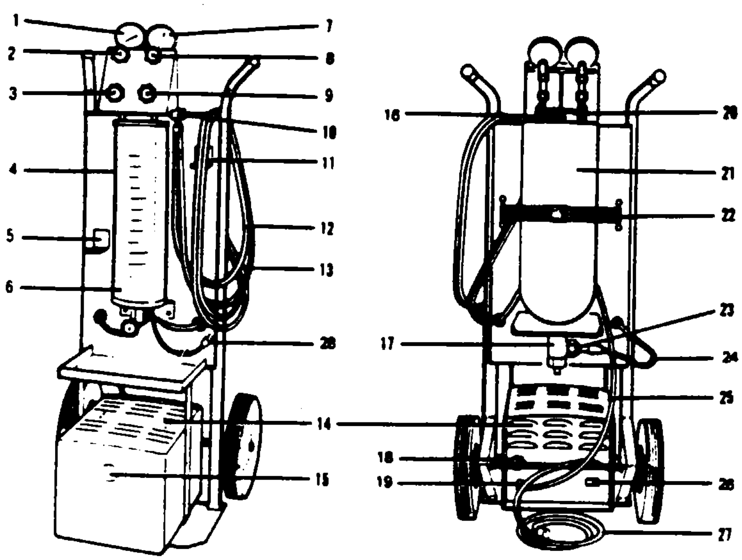


Figure 95-14. Spark Plug Gap Adjustment and Tool (Janitrol Heater)



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

Figure 95-16. Charging Stand (Kent Moor J8393-02)

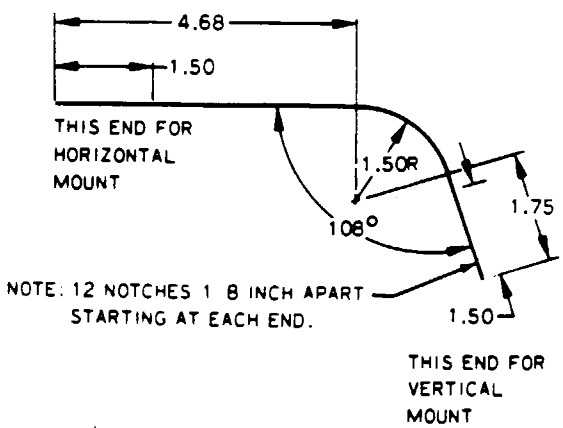


Figure 95-17. Fabricated Oil Dipstick

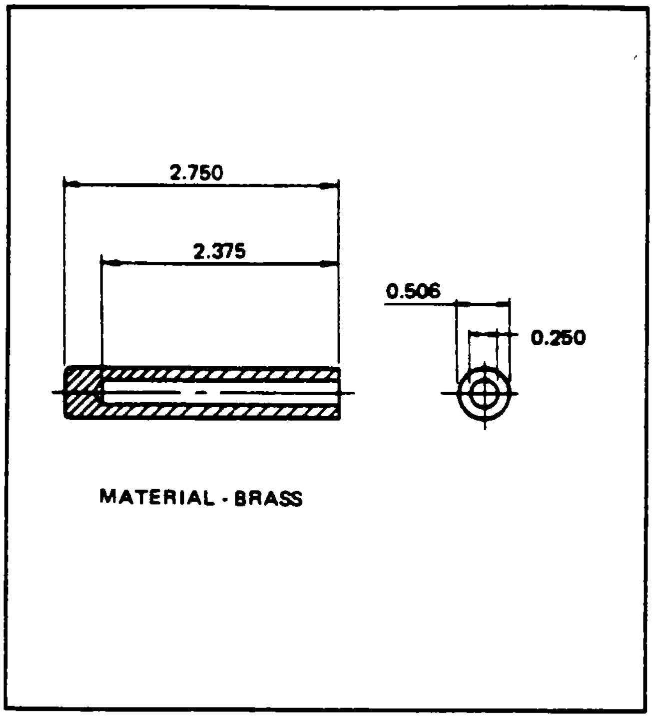


Figure 95-18. Ignition Harness Ferrule Seating Tool 11-7074

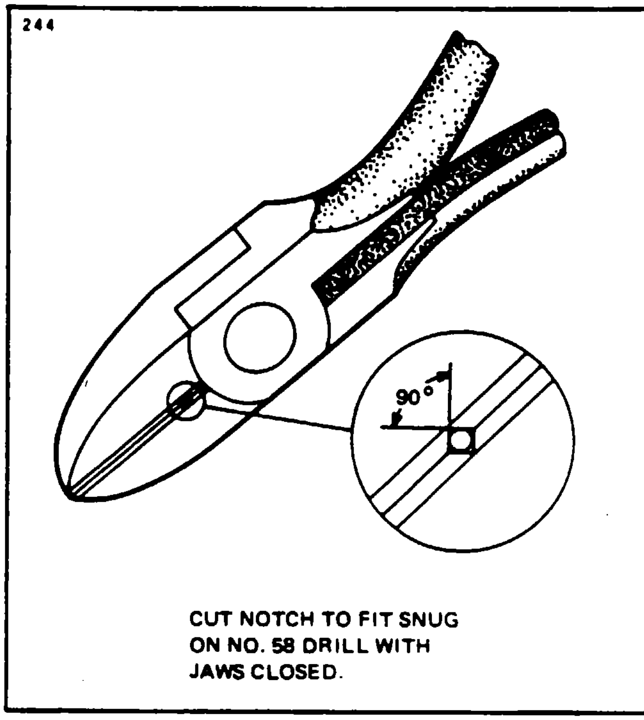


Figure 95-19. Modified Pliers For Ignition Harness Grommet And Eyelet Installation

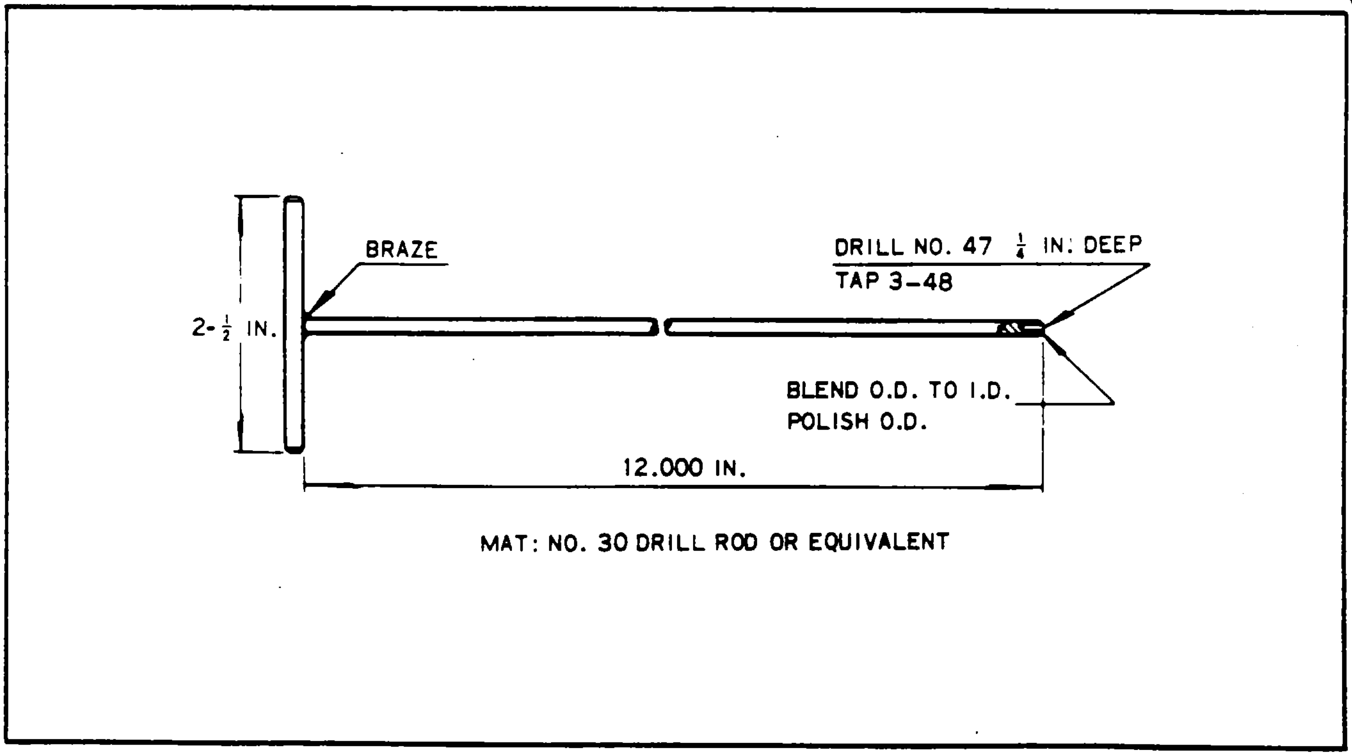


Figure 95-20. Assembly Tool For Ignition Harness Insulating Sleeve Installation

GRIDS 5F19 THRU 5L24
INTENTIONALLY LEFT BLANK