PIPER

MOJAVE
MAINTENANCE MANUAL

CARD 1 OF 5
PA-31 P-350 MOJAVE

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www.bomar.biz

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 781)

INTRODUCTION.

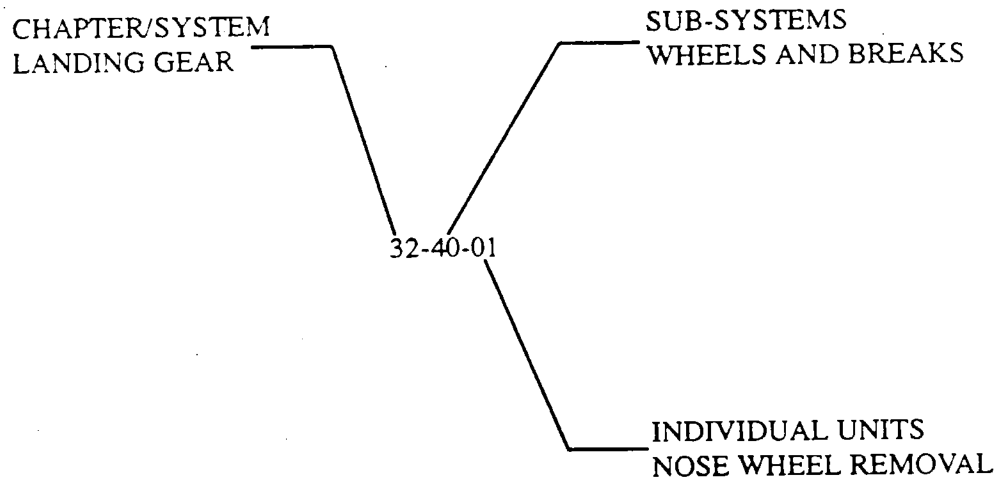
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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 32-4~00 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-31P-350 aircraft I manufactured by the Piper Aircraft Corporation,

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 Parts Catalog P/N 761 776, and FAR 43 for proper utilization,

AEROFICHE EXPLANATION AND REVISION STATUS

The Maintenance Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aircraft Manufacturer's Association, (GAMA). The information compiled in this Aerofiche Maintenance Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set. Grid location J16.

To aid in locating the various chapters and related service information desired, the following is

1. A complete manual System/Chapter Index Guide is for all fiche in this set.
2. A complete list of Illustrations is for all fiche in. this set following System/Chapter Index.
3. A complete list of Charts is for all fiche in this set following list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:

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

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

TABLE OF CONTENTS/EFFECTIVITY CODES

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

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

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

Revisions to this Maintenance Manual 761 781 issued April 25, 1983 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG830425	April 25, 1983	1, 2, 3, 4 and 5
PR830728	July 28, 1983	1, 2, 3, 4 and 5
PR831214	December 14, 1983	1, 2, 3, 4 and 5
IR860430	April 30, 1986	1
IR860723	July 23, 1986	2
IR860925	September 25, 1986	1 and 4
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 chapter 71 of card 4. Please dispose of your current cards 2 and 4, and replace with the revised one. DO NOT DISPOSE OF CARDS 2, 3, 5.

Consult the Customer Service Information Aerofiche for current revision dates for this manual

VENDOR-SUPPLIER INFORMATION.

A partial list of companies, their address and phone numbers are provided to aid service personnel in obtaining information about components not manufactured by Piper Aircraft Corporation.

Air-Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
Alternator	Prestolite Company 511 Hamilton Street Toledo, Ohio (419) 255-4068
Autopilot Avionics	Edo Corporation - Avionics Division P.O. Box 610 Municipal Airport Mineral Wells, Texas 76067 (817) 325-2517
	Bendix Avionics Division 2100 N.W. 62nd Street Fort Lauderdale, Florida 33310 (305) 776-4100
	Collins General Aviation Division Rockwell International Cedar Rapids, Iowa 52406 (319) 395-3625
	King Radio Corporation 400 N. Rogers Road P.O. Box 106 Olathe, Kansas 66061 (913) 782-0400
	Sperry Flight Systems Avionics Division 8500 Balboa Boulevard P.O. Box 9028 Van Nuys, California 91409 (213) 894-8111
	Global Navigation 2141 Michelson Drive Irvine, California 92715 (714) 851-0119

VENDOR-SUPPLIER INFORMATION (cont.).

Battery	Gill-Teledyne P.O. Box 431 Redland, California (714) 793-3131
Deicing, Airfoil	The B.F- Goodrich Company 500 South Main Street Akron, Ohio 4431 (216) 374-3895
Deicing. Propeller	The B.F. Goodrich Company 6400 Goldsboro Road Suite 102 Bethesda, Maryland 20034 (301)229-5000
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington, Penna. 19034 (215)643-2900
Engines	Avco Lycoming Avco Lycoming Division Williamsport, Penna. 17701
Environmental Systems, Heater and Air Conditioner	Janitrol Aero Division 4200 Surface Road Columbus, Ohio 43228 (614) 276-3561
	Sanden International (U.S.A.). Inc. 10710 Sanden Drive Dallas, Texas 75238
Fuel Pumps	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 14137 (216) 662-1000
Fuel System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria, Ohio 44035 (216) 323-4676

VENDOR-SUPPLIER INFORMATION (cont.).

Landing Gear. Hydraulic Actuators Hydraulic Pressure Regulator Hydraulic Power Pack. Hand Pump	Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Magnetos	Bendix Electrical Components Division Sidney, New York 13838
Oxygen System	Scott Aviation Products 225 Erie Street Lancaster, New York 14086 (716) 683-5100
Pneumatic System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria, Ohio 44035 (216) 323-4676
Propellers	Hartzell Propeller, Incorporated 1025 Roosevelt Avenue Piqua, Ohio 45356 (513) 773-7411
Propeller Synchrophaser	Hartzell Propeller Fan Company 910 South Downing Street Piqua, Ohio 45356 (513) 773-7411
Tools. Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Turbocharger	Airesearch Industrial Division 3201 Lomita Boulevard Torrance, California 90505
Wheels and Brakes	Cleveland Wheel and Brake Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011
	B.F. Goodrich Company Transportation Products Division P.O. Box 340 Troy, Ohio 45373

PIPER PUBLICATIONS.

PA-31 P-350

Parts Catalog =	761 776 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961 - 1328
Continuous Inspection =	761 786 Piper Aircraft Corporation P.O. Box 1328 Vero Beach. FL 32961 - 1328

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont.)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont.)

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LIST OF ILLUSTRATIONS (cont.)

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LIST OF ILLUSTRATIONS (cont.)

LIST OF ILLUSTRATIONS (cont.)

—NOTE—

Refer to Card 5, Grid No. 5C5 for Electrical Schematic /Index,

LIST OF ILLUSTRATIONS (cont.)

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CHAPTER

4

AIRWORTHINESS LIMITATIONS

CHAPTER 4- AIRWORTHINESS LIMITATIONS

TABLE OF CONTENTS/EFFECTIVITY

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 for a detailed delineation of the flight limitations of the airplane. The mandatory replacement time and/or inspection intervals of life limited parts are contained in Chapter 5 of this manual.

—END—

CHAPTER

5

TIME LIMITS/MAINT CHECKS

CHAPTER 5 - TIME LIMITS/MAINTENANCE CHECKS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This section provides instructions for conducting inspections. Repair or replacement instructions for those components found to be unserviceable at inspection are given 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 inspection procedures are outlined in the following pages derived from the Piper Programmed Inspection Manual. Additional copies of this Manual are available through the Piper Service Department. This inspection consists of routine and detailed Event Inspections performed every 100 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 the 100 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 the Event Inspections, the following preflight check must be performed.

PREFLIGHT CHECK.

The airplane must be given a thorough preflight and walkaround 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.

PROGRAMMED INSPECTION.

Piper Programmed Inspections meet the requirements of Federal Aviation Regulation (FAR) 135.419, (d) (1), (2), (3) and (e). This Programmed Inspection is available in manual form through Piper Service Centers under Part Number 761 768.

FACTS YOU SHOULD KNOW

Every two weeks the Federal Aviation Administration (FAA) publishes Airworthiness Directives (AD's) 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, Piper Service Centers and Dealers.

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 Piper Service Centers and Dealers, 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 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 Service Centers and Dealers. 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.

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

PROCEDURE MANUAL

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

The purpose of the Piper Programmed 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 Piper Mojave are reminded that certain requirements must be met before the Piper Programmed 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 Programmed Inspection is based on previous Mojave 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/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 Programmed Inspection has the following basic features:

a. Two Event Inspections
b. Special Inspections
c. Operational Inspection
d. Event Inspection Record and Signoff Sheet
e. Continuous Cycle Inspection Record and Signoff Sheet
f. Discrepancy Record
g. Service Publication Compliance Record
h. Federal Aviation Airworthiness Directives Compliance Record
i. Equipment Change Record (ECR)
j. Access Plate and Panel Locations

The basic features of the Programmed Inspection are described in the following paragraphs:

1. Event Inspections

Each Event Inspection consists of a predetermined number of location inspections as indicated on each event sample. The Event Inspection is conducted sequentially each 100 hours and the results are recorded on the Event Inspection Record and Signoff Sheet, which is the running log or current status of the aircraft inspections.

Late compliance with the Event Inspection interval of 100 hours may be extended by not more than 10 flying hours (10 percent of Event Inspection interval). This extension is only permitted for returning the aircraft to the maintenance base performing the inspection. The excess time is included in computing the next 100 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 100-flying-hour interval for the next event inspection will be maintained.

The Event Inspections are arranged so that the 200-flying-hour cycle provides a complete inspection. When both Event Inspections are completed 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 Signoff Sheet.

a. EVENT No. 1. The following inspections are to be performed at odd-hundred flying-hour intervals, i.e., every 100, 300, 500, etc. hours:
   (1.) Left Propeller, Detailed
   (2.) Left Engine, Detailed
   (3.) Left Turbocharger, Detailed
   (4.) Right Propeller, Detailed
   (5.) Right Engine, Detailed
   (6.) Right Turbocharger, Detailed
   (7.) Left Wing, Detailed
   (8.) Right Wing, Routine
   (9.) Landing Gear, Routine
   (10.) Fuselage Forward, Detailed
   (11.) Fuselage Main, Detailed
   (12.) Cabin - Cockpit, Detailed
   (13.) Cabin Main, Detailed
   (14.) Empennage, Detailed
   (15.) Special Inspections
   (16.) Operational Inspections

b. EVENT No. 2. The following inspections are to be performed at even-hundred flying-hour intervals, i.e., every 200, 400, 600, etc. hours:

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

b. EVENT No. 2. (cont.)
   (11.) Fuselage Forward, Routine
   (12.) Fuselage Main, Routine
   (13.) Cabin - Cockpit, Routine
   (14.) Cabin - Main, Routine
   (15.) Special Inspections
   (16.) Operational Inspections

2. Special Inspections - are special inspections performed and recorded with the appropriate Event Inspection. Special Inspections are accomplished at each subsequent hour period.

3. Operational Inspection - to be performed upon completion of each Event Inspection.

4. Event Inspection Record and Signoff Sheet - is a permanent record and contains the following:

   a. Event inspection number
   b. Aircraft hours
   c. Date accomplished
   d. Work order number- FAA approved repair stations only
   e. Signature and certificate number of person conducting inspection
   f, The following Certification Statement:

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

5. Programmed Cycle Inspection Record and Signoff Sheet - is prepared upon completion of two event inspections (200 flying hours). The cycle inspection consists of ten 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.

6. Discrepancy Record (DR) - is a log of discrepancies that require corrective action. FAA Airworthiness Directives (AD's) and/or manufacturer's service publications not requiring immediate action may be entered on the DR provided that compliance with the AD 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.

—NOTE—

At least one cycle must be completed within twelve months.

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

   a. Name of manufacturer
   b. Publication - bulletin - letter - etc.
   c. Number
   d. Compliance date
   e. Aircraft hours
   f. Work order number - FAA approved repair stations only
   g. Certificate number and signature of person accomplishing the compliance

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

   a. AD note number
   b. Compliance date
   c. Aircraft hours
   d. Method of compliance
   e. Work order number - FAA approved repair stations only
   f. Certificate number and signature of person accomplishing the compliance

9. Equipment Change Record (ECR) - 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.

10. Access Plate and Panel Location Chart - this chart shows the location of removable access plates and panels used during inspections.

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

DEFINITIONS

1. **Inspections** - Examinations performed by certified mechanics, using acceptable methods, techniques, and practices to determine physical condition and detect defects.

2. **Checks** - Examinations performed by pilots and/or certified mechanics to verify that condition, accuracy, and tolerances conform to applicable standards.

3. **Detailed Inspections** - Thorough examinations of the appliances, the aircraft, and the components and systems with such disassembly as is necessary to determine condition.

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

5. **Inspection Time Limitations** - The maximum allowable extension of an Event Inspection Interval (EII) permitted for returning an aircraft to a maintenance base, defined as 10 percent of the EII. Any extension time used must be deducted from the next EII to maintain the inspection schedule.

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

7. **Operational Test** - A powered system run with a system component installed in an aircraft to verify that the component is in operable condition. Each operational test must be performed by an apporvpriately rated FAA certified repair station or by a Certified Mechanic who is qualified on this aircraft. Operational test data are entered in the perminent aircraft records by athe authorized individual performing the test.

8. **Functional Text** - An investigation to verify that a system or component is functioning properly in all aspects in conformance with minimum acceptable desing specifications. This test may require the use of supplemental ground support bench text equipment. Functional tests must be performed by an FAA certified repair station with appropriate ratings or by a Certified Mechanic. Functional test data are entered into the permanent aircraft records by the person performing the test.

DEFINITIONS (cont.)

9. **Bench Check (or Test)** - Removal of a 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; and calibration to at least the manufacturer's specifications, using the manufacturer's recommended test equipment or standards or the equivalent.

   Bench tests are performed by a manufacturer, an FAA certified repair station with appropriate rating, or a certified mechanic. This test is 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 who reinstalls the component performs necessary operational tests to ensure that the system is functioning properly and enters test data in the permanent aircraft records. Serviceable parts that were issued will be identified in the aircraft permanent records.

10. **Maintenance** - Inspection, overhaul, repair, preservation, and the replacement of parts, excluding preventive maintenance (as defined in FAR 1). However, 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 Inspection** - Visual examination or check of appliances, aircraft, and components and systems insofar as practicable without disassembly.

12. **Special Inspection** - A peculiar or more extensive examination than is normally made in two event inspections (200 hours).

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 part. 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 revision 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 NO. 1

LEFT PROPELLER, DETAILED (See Chapter 61)

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

NOTE

Engine inspections given below are based on the manufacturer's operators manual (Lycoming Part No, SSP-1570). See Service Letter No. L114 for subscription information.

LEFT ENGINE, DETAILED (See Chapter 71) (Refer to Lycoming Service Bulletin 469.)

CAUTION

Ground magneto primary circuit before working on engine.

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and inspect cowling for cracks, distortion, and loose or missing fasteners.
- ☐ 3. Drain oil sump, Drain while engine is warm. (See Inspection Note 1.)
- ☐ 4. Clean suction oil strainer at oil change. (Inspect 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. (See Inspection Note 2.)
- ☐ 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 No. 1042.)

NOTE

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

Inspection Notes on Page 5-37

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

EVENT NO. 1 (cont.)

- ☐ 13. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 14 Inspect cylinder compression (Ref: 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; torque cover screws 50 inch-pounds. (See Inspection Notes 3 and 4)
- ☐ 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. (Set at 0.016 in.)
- ☐ 20. Inspect magneto retard points for proper retard angle. (15°) (maintain clearance at 0.016 ±0.004 in)
- ☐ 21. Inspect magneto for oil leakage and pressure test. (See Inspection Note 5)
- ☐ 22. Inspect breaker felts for proper lubrication.
- ☐ 23. Inspect distributor block for cracks, burned areas or corrosion, and height of contact springs.
- ☐ 24. Check magneto 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 flanges for tightness.
- ☐ 29. Inspect condition of flexible fuel lines.
- ☐ 30. Inspect fuel system for leaks.
- ☐ 31. Inspect fuel pump for operation (engine and electric).
- ☐ 32. Replace hydraulic filter element (check element for contamination).
- ☐ 33. Inspect hydraulic pump and gasket for leaks. (See Inspection Note 1)
- ☐ 34. Inspect condition of pneumatic pump and security of lines. (See Inspection Note 1)
- ☐ 35. Inspect throttle, alternate air, injector, mixture and propeller governor controls for travel and operating condition.
- ☐ 36. Inspect intercooler for airflow obstructions.
- ☐ 37. Inspect exhaust stacks and gaskets. (Replace gaskets as required.)
- ☐ 38. Inspect breather tube for obstructions and security.
- ☐ 39. Inspect crankcase for cracks, leaks, and security of seam bolts.
- ☐ 40. Inspect engine mounts for cracks and loose mounting.
- ☐ 41. Inspect all engine baffles for cracks and condition of seals.
- ☐ 42. Inspect rubber engine mount bushings for deterioration.(See Inspection Note 6)
- ☐ 43. Inspect fire walls for cracks.
- ☐ 44. Inspect condition of fire wall sealing.
- ☐ 45. Inspect condition and tension of alternator drive belt (65 Lbs.)
- ☐ 46. Inspect condition of alternator and starter.
- ☐ 47. Replace pneumatic inlet filter (if applicable).
- ☐ 48. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)
- ☐ 49. Inspect tachometer generator security and wiring.

Inspection Notes on Page 5-38

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

EVENT NO. 1 (cont.)

LEFT TURBOCHARGER, DETAILED (See Chapter 81)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks, and general condition. (See Inspection Note 1)
- ☐ 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 operation of alternate air control.
- ☐ 8. Inspect linkage between bypass valve and actuator.
- ☐ 9. Inspect vent line from bypass valve for oil leaks.
- ☐ 10. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks.
- ☐ 11. Check fluid power lines for leaks and security.
- ☐ 12. Inspect for oil leakage from controller.
- ☐ 13. Inspect the turbocharger mount for cracks, condition, and security to the engine and turbocharger.
- ☐ 14. Inspect fuel injection nozzle reference manifold for deteriorated hose, loose connections, leaks or obstructions.
- ☐ 15. Check overboost relief valve for security of mounting boss.
- ☐ 16. Check intercooler condition and security.
- ☐ 17. Check intercooler ducts for condition and security.
- ☐ 18 . Reinstall engine cowl. (See Inspection Note 10)

RIGHT PROPELLER, DETAILED (See Chapter 61)

- ☐ 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 and operation of propeller deicer system.
- ☐ 10. Inspect condition of synchronizer (if installed).

RIGHT ENGINE, DETAILED (See Chapter 71) Refer to Lycoming Service Bulletin 469.)

CAUTION

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.)

Inspection Notes on Page 5-38

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

EVENT NO. 1 (cont.)

- ☐ 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. (See Inspection Note 2.)
- ☐ 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 No. 1042.)

NOTE.

If fouling of spark plugs is apparent, rotate boltom plugs to upper plugs.

- ☐ 13. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 14. Inspect cylinder compression (Ref: 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; torque cover screws 50 inch-pounds. (See Inspection Notes 3 and 4.)
- ☐ 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. (Set at 0.016 in.)
- ☐ 20. Inspect magneto retard points for proper retard angle. (15°) (maintain clearance at 0.016 ± 0.004 in.)
- ☐ 21. Inspect magneto for oil leakage.
- ☐ 22. Inspect breaker felts for proper lubrication.
- ☐ 23. Inspect distributor block for cracks, burned areas or corrosion, and height of contact springs.
- ☐ 24. Check magneto 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 flanges for tightness.
- ☐ 29. Inspect condition of flexible fuel lines.
- ☐ 30. Inspect fuel system for leaks.
- ☐ 31. Inspect fuel pump for operation. (Engine and electric.)
- ☐ 32. Replace hydraulic filter element. (Check element for contamination.)
- ☐ 33. Inspect hydraulic pump and gasket for leaks. (See Inspection Note 1.)
- ☐ 34. Inspect condition of pneumatic pump and security of lines. (See Inspection Note 1.)
- ☐ 35. Inspect throttle, alternate air, injector, mixture and propeller governor controls for travel and operating condition.

Inspection Notes on Page 5-37

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

EVENT NO. 1 (cont.)

- ☐ 36. Inspect intercooler for airflow obstruction.
- ☐ 37. Inspect exhaust stacks and gaskets. (Replace gaskets as required.)
- ☐ 38. Inspect breather tube for obstructions and security
- ☐ 39. Inspect crankcase for cracks, leaks, and security of seam bolts.
- ☐ 40. Inspect engine mounts for cracks and loose mounting.
- ☐ 41. Inspect all engine baffles for cracks and condition of seals.
- ☐ 42. Inspect rubber engine mount bushings for deterioration. (See Inspection Note 6)
- ☐ 43. Inspect firewalls for cracks.
- ☐ 44. Inspect condition of firewall sealing.
- ☐ 45. Inspect condition and tension of alternator drive belt (65 Lbs.)
- ☐ 46. Inspect condition of alternator and starter. (Replace at engine T.B.O.)
- ☐ 47. Replace pneumatic inlet filter.
- ☐ 48. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)
- ☐ 49. Inspect tachometer generator security and wiring.
- ☐ 50. Inspect security of air conditioning compressor mount (if installed).
- ☐ 51. Inspect air conditioning compressor oil level (if installed). (See Inspection Note 7.)
- ☐ 52. Inspect condition and tension of compressor (air conditioner) drive belt. (See Chapter 21.)
- ☐ 53. Inspect compressor clutch security and wiring. Clean any traces of oil from the clutch surface.

RIGHT TURBOCHARGER, DETAILED (See Chapter 81)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition. (See Inspection Note 1.)
- ☐ 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 operation of alternate air control.
- ☐ 8. Inspect linkage between bypass valve and actuator.
- ☐ 9. Inspect vent line from bypass valve for oil leaks.
- ☐ 10. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks, (See Inspection Note 8.)
- ☐ 11. Check fluid power lines for leaks and security.
- ☐ 12. Inspect for oil leakage from controller.
- ☐ 13. Inspect the turbocharger mount for cracks, condition and security to the engine and turbocharger.
- ☐ 14. Inspect fuel injection nozzle reference manifold for deteriorated hose, loose connections, leaks or obstructions.
- ☐ 15. Inspect fluid power lines for leaks and security.
- ☐ 16. Inspect for oil leakage from the controllers.
- ☐ 17. Check intercooler ducts for condition and security.
- ☐ 18. Reinstall engine cowl. (See Inspection Note 10)

Inspection Notes on Page 5-38

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

EVENT NO. 1 (cont.)

LEFT WING, DETAILED (See Chapter 57)

- ☐ 1. Remove inspection plates and panels.

CAUTION

The access panel on the upper outboard surlace of the wing that 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 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 wing attachment bolts and brackets for security.
- ☐ 11. Inspect engine mount attaching structure for security and condition.
- ☐ 12. Inspect engine exhaust shield for cracks, severe buckling, or loose rivets at the flange area.
- ☐ 13. Remove, drain and clean fuel filter bowl and screen. (Drain and clean at least every 90 days.)
- ☐ 14. Inspect fuel cells and lines for leaks and water.
- ☐ 15. Check to ascertain that the fuel tanks are marked for capacity and minimum octane rating.
- ☐ 16. Check operation and pressure of electric fuel pumps.
- ☐ 17. Inspect condition of pneumatic deicer (if installed).
- ☐ 18. Check pneumatic inline air filters and clean (if installed). (Replace every 500 hours.)
- ☐ 19. Inspect wing tip navigation and strobe lights for broken lenses and operation.
- ☐ 20. Inspect wing inspection light operation.
- ☐ 21. Lubricate wing areas per lubrication charts in Chapter 12.
- ☐ 22. Reinstall inspection plates and panels.

RIGHT WING, ROUTINE (See Chapter 57)

- ☐ 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.)

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

EVENT 1 (cont.)

- ❐ 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 and operation.

LANDING GEAR, ROUTINE (See chapter 32, maintenance manual) (Refer to Piper Service Bulletin 845)

LEFT	RIGHT	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.	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 down lock springs.
❐	❐	❐	9.	Wipe exposed strut with clean cloth and hydraulic fluid, MIL-H-5606.
❐	❐	❐	10.	Inspect gear fork for damage.

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

EVENT NO. 1 (cont.)

FUSELAGE FORWARD, DETAILED (See Chapter S3)

- ☐ 1. Remove inspection plates and panels.
- ☐ 2. Inspect baggage door latch, hinges, door ajar switch and compartment light for wear, pro per rigging and operation.
- ☐ 3. Check fluid in brake reservoir (fill as required).
- ☐ 4. Inspect oxygen cylinder for security of mounting, condition and pressure. (See Chapter 35.)
- ☐ 5. Inspect electronics installation of wire harness, cannon plugs, ground bus bar, and diplexer for condition and security.
- ☐ 6. Inspect antenna mounts and electrical wiring for security and corrosion in plugs.
- ☐ 7. Inspect battery box and cables for corrosion and security. (Cheek at least every 30 days and clean as required.)
- ☐ 8. Inspect voltage regulators, wiring, harnesses and relays for corrosion and condition.
- ☐ 9. Within the radome inspect the radar and glide slope antenna, wave guide and receiver transmitter for condition and security of mounting (if installed).
- ☐ 10. Inspect bulkheads and stringers for damage, condition and corrosion.
- ☐ 11. Inspect left and right pitot mast security of mounting.
- ☐ 12. Inspect heater and heater fuel regulator and filter for fuel or fume leaks.
- ☐ 13. Inspect heater fuel lines and valve for leaks.
- ☐ 14. Check recommended time for overhaul of heater (Refer to 200-Hour Special Inspection).
- ☐ 15. Inspect hydraulic power pack fluid level (fill as required).
- ☐ 16. Inspect hydraulic power pack, flexible control cable and lines for damage and leaks.
- ☐ 17. Inspect security and condition of all hydraulic lines.
- ☐ 18. Inspect air conditioning system for freon leaks. (See Chapter 21.)

NOTE

Item 18 must be performed with the system in operation.

- ☐ 19. Inspect freon level in system through sight gauge in receiver-dehydrator. (See Chapter 21.)
- ☐ 20. Inspect landing and taxi lights for broken lenses and operation.
- ☐ 21. Inspect external skins for condition, damage and corrosion.

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

EVENT NO. 1 (CONT.)

FUSELAGE MAIN, DETAILED (See Chapter 53)

- ❐ 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, hydraulic and pressurization lines for security.
- ❐ 7. Inspect all flight control cables and pulleys for damage and tension.
- ❐ 8. Inspect aileron, rudder, elevator rod end bearings for condition and freedom of movement. (Refer to AD 93 24 02.) ((See Inspection Note 11)
- ❐ 9. Inspect all electrical wiring for security and condition.
- ❐ 10. Inspect antenna mounts and connections for security and corrosion.
- ❐ 11. Inspect autopilot roll servo for security and condition of bridle cables and wiring (refer to approved autopilot manual).
- ❐ 12. Inspect flap actuator motor.
- ❐ 13. Inspect cabin door for damage, condition of door seal and proper rig and operation.
- ❐ 14. Inspect pressurization system for uncontrolled air leaks.
- ❐ 15. Lubricate fuselage area per lubrication charts in Chapter 12.
- ❐ 16. Replace inspection plates, panels and floor panels.

CABIN COCKPIT, DETAIL

- ❐ 1. Remove inspection panels and plates and floor panels.
- ❐ 2. Inspect upholstery for tears.
- ❐ 3. Inspect pilot and copilot seats and seat belts for damage, security and operation.
- ❐ 4. Inspect trim operation and indication for full travel both mechanical and electrical. (See Chapter 27.)
- ❐ 5. Inspect rudder pedals and brake cylinders for security and operation. (Sec. Chapter 32.)
- ❐ 6. Inspect parking brake for operation. (See Chapter 32.)
- ❐ 7. Inspect control wheels, column, pulleys and cables for damage, operation and full travel. (See Chapter 27.)
- ❐ 8. Inspect flap operation.
- ❐ 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 circuit breakers for condition and security of installation.
- ❐ 13. Check cabin pressure controller filter. (Change as required.) (Refer to 500-hour Special Inspection.)
- ❐ 14. With master switch on, inspect operation of all electrically operated instruments (overhaul and replace as required.)
- ❐ 15. Inspect pitot and static lines for condition, security and pitot heat operation.

Inspection Notes on Page 5-38

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

EVENT NO. 1 (cont.)

- ❒ 16. 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.)
- ❒ 17. Check operation of annunciator lights.
- ❒ 18. Check operation of crossfeed valve.
- ❒ 19. Check operation of emergency shutoff valves.
- ❒ 20. Check operation of heater, and fan.
- ❒ 21. Inspect heaterfuel filter for contamination.
- ❒ 22. Inspect condition of heater ducts.
- ❒ 23. Inspect oxygen outlcts for defects and corrosion (if installed).
- ❒ 24. Inspect oxygen system operation and condition of components and masks (if installed).
- ❒ 2S. Inspect condition of environmental system ducts.
- ❒ 26. Check ponable fire extinguisher for proper service and service time.
- ❒ 27. Check each life preserver condition, service time, locator light attachment and operation (if applicable).
- ❒ 28. Inspect all night control cables and pulleys for damage and tension. (See Chapter 27.)
- ❒ 29. Inspect autopilot roll servo for security and condition of bridle cables and wiring. (Refer to approved autopilot manual.)
- ❒ 30. Check all lights for operation; replace bulbs as required.
- ❒ 31. Check pilot's storm window for condition, operation and seal.
- ❒ 32. Perform operational test of microphones and cabin speaker.
- ❒ 33. Check gear warning horn and lights while on jacks.
- ❒ 34. Lubricate cabin and cockpit area per lubrication charts in Chapter 12.

CABIN MAIN, DETAILED

- ❒ 1. Check that the appropriate certificates are in the airplane and properly displayed.
- ❒ 2. Check upholstery for tears.
- ❒ 3. Check scats, 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).
- ❒ 9. Check isobaric and safety valves. (See latest Garrett Airesearch Service Bulletins No. 5-2243 and 5-2294.)
- ❒ 10. Inspect isobaric valve filter. (Change as required.) (Refer to Chapter 21.)
- ❒ 11. Inspect emergency exit window operation per Chapter 56.

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

EVENT NO. 1 (cont.)

EMPENNAGE, DETAILED (See Chapter- 27)

- ❒ 1. Remove all inspection plates and panels.
- ❒ 2. Inspect condition of skin, interior bulkheads, formers, stingers 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.
- ❒ 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 anti-collision, recognition and navigation lights for security and operation.
- ❒ 19. Inspect condition of pneumatic deicer (if installed).
- ❒ 20. Inspect antenna mounting for security.
- ❒ 21. Inspect security of autopilot servo bridle cable clamps.
- ❒ 22. Inspect electronic installations for security of mounting and operation.
- ❒ 23. Inspect emergency locator transmitter battery for replacement date or time.
- ❒ 24. Lubricate empennage per lubrication charts in Chapter 12.
- ❒ 25. Reinstall inspection plates and panels.

SPECIAL INSPECTIONS

OPERATIONAL INSPECTIONS

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

EVENT NO. 2

LEFT PROPELLER, DETAILED (See Chapter 61)

- ☐ 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 spinner mounting brackets for cracks.
- ☐ 6. Inspect propeller mounting bolts and safety. (Check torque if safety is broken.)
- ☐ 7. Inspect hub parts for cracks and corrosion.
- ☐ 8. Rotate blades and inspect for tightness in hub pilot tube.
- ☐ 9. Check propeller air pressure, Refer to Pressure Temperature Chart. (Check at least once a month.)
- ☐ 10. Inspect condition of propeller deicer system.
- ☐ 11. Inspect condition of synchronizer (if installed).

LEFT ENGINE, DETAILED (See Chapter 71) (Refer to Lycoming Service Bulletin 469.)

CAUTION

Ground Magneto Primary Circuit before working on engine.

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and inspect cowling for cracks, distortion, and loose or missing fasteners.
- ☐ 3. Drain oil sump, Drain while engine is warm. (See Inspection Note 9.)
- ☐ 4. Clean suction oil strainer at oil change. (Inspect 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. (See Inspection Note 2.)
- ☐ 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 No. 1042.)

NOTE

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

Inspection Notes on Page 5-37

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

EVENT NO. 2 (cont.)

- ❒ 13. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ❒ 14. Inspect cylinder compression (Ref: 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; torque cover screws 50 inch-pounds. (See Inspection Notes 3 and 4.)
- ❒ 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. (Set at 0.016 in.)
- ❒ 20. Inspect magneto retard points for proper retard angle. (15°) (maintain clearance at 0.016 ± 0.004 in.).
- ❒ 21. Inspect magneto for oil leakage and pressure test. (See Inspection Note 5.)
- ❒ 22. Inspect breaker felts for proper lubrication.
- ❒ 23. Inspect distributor block for cracks, burned areas or corrosion, and height of contact springs.
- ❒ 24. Check magneto 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 flanges for tightness.
- ❒ 29. Inspect condition of flexible fuel lines.
- ❒ 30. Inspect fuel system for leaks.
- ❒ 31. Inspect fuel pump operation (engine and electric-)
- ❒ 32. Replace hydraulic filter element. (Check element for contamination.)
- ❒ 33. Inspect hydraulic pump and gasket for leaks. (See Inspection Note 1.)
- ❒ 34. Inspect condition of pneumatic pump and security of lines. (See Inspection Note 1.)
- ❒ 35. Inspect throttle, alternate air, injector, mixture and propeller governor controls for travel and operating conditions.
- ❒ 36. Inspect intercooler for airflow obstructions.
- ❒ 37. Inspect exhaust stacks and gaskets. (Replace gaskets as required.)
- ❒ 38. Inspect breather tube for obstructions and security.
- ❒ 39. Inspect crankcase for cracks, leaks, and security of seam bolts.
- ❒ 40. Inspect engine mounts for cracks and loose mounting.
- ❒ 41. Inspect all engine baffles for cracks and condition of seals.
- ❒ 42. Inspect rubber engine mount bushings for deterioration.
- ❒ 43. Inspect fire walls for cracks.
- ❒ 44. Inspect condition of fire wall sealing.
- ❒ 45. Inspect condition and tension of alternator drive belt (65 Lbs.).
- ❒ 46. Inspect condition of alternator and starter.
- ❒ 47. Replace pneumatic inlet filter.
- ❒ 48. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)
- ❒ 49. Inspect tachometer generator security and wiring.

Inspection Notes on Page 5-37

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

EVENT NO. 2 (cont.)

LEFT TURBOCHARGER, DETAILED (See Chapter 81)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks, and general condition. (See Inspection Note 1.)
- ☐ 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 operation of alternate air control.
- ☐ 8. Inspect linkage between bypass valve and actuator.
- ☐ 9. Inspect vent line from bypass valve for oil leaks.
- ☐ 10. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks. and leaks.
- ☐ 11. Check fluid power lines for leaks and security.
- ☐ 12. Inspect for oil leakage from turbocharger.
- ☐ 13. Inspect the turbocharger mount for cracks, condition and security to the engine and turbocharger.
- ☐ 14. Inspect fuel injection nozzle reference manifold for deteriorated hose, loose connections, leaks or obstructions.
- ☐ 15. Check overboost relief valve for security of mounting boss.
- ☐ 16. Check intercooler condition and security.
- ☐ 17. Check intercooler ducts for condition and security.
- ☐ 18. Reinstall engine cowl. (See Inspection Note 10)

RIGHT PROPELLER, DETAILED (See Chapter 61)

- ☐ 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) (Refer to Lycoming Service Bulletin 469.)

CAUTION

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.

Inspection Notes on Page 5-38

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

EVENT NO. 2 (cont.)

- ☐ 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. (See Inspection Note 2.)
- ☐ 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 charts in Chapter 12.
- ☐ 11. Clean engine.
- ☐ 12. Inspect condition of spark plugs. (Clean and adjust gap as required; adjust per latest Lycoming Service Instruction No. 1042.)

NOTE

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

- ☐ 13. Inspect spark plug cable leads and ceramics for corrosion and deposits.
- ☐ 14. Inspect cylinder compression (Ref: 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; torque cover screws 50 inch-pounds. (See Inspection Notes 3 and 4.)
- ☐ 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. (Set at 0.016 in.)
- ☐ 20. Inspect magneto retard points for proper retard angle. (15°) (maintain clearance at 0.016 ± 0.004 in.).
- ☐ 21. Inspect magneto for oil leakage.
- ☐ 22. Inspect breaker felts for proper lubrication.
- ☐ 23. Inspect distributor block for cracks, burned areas or corrosion, and height of contact springs.
- ☐ 24. Check magneto 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 flanges for tightness.
- ☐ 29. Inspect condition of flexible fuel lines.
- ☐ 30. Inspect fuel system for leaks.
- ☐ 31. Inspect fuel pump operation (engine and electric).
- ☐ 32. Replace hydraulic filter element. (Check element for contamination.)
- ☐ 33. Inspect hydraulic pump and gasket for leaks. (See Inspection Note 1.)
- ☐ 34. Inspect condition of pneumatic pump and security of lines. (See Inspection Note 1.)

Inspection Notes on Page 5-37

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

EVENT NO. 2 (cont.)

- ☐ 35. Inspect throttle, alternate air, injector, mixture and propeller governor controls for travel and operating condition.
- ☐ 36. Inspect intercooler for airflow obstructions.
- ☐ 37. Inspect exhaust stacks and gaskets. (Replace gaskets as required.)
- ☐ 38. Inspect breather tube for obstructions and security.
- ☐ 39. Inspect crankcase for cracks, leaks, and security of seam bolts.
- ☐ 40. Inspect engine mounts for cracks and loose mounting.
- ☐ 41. Inspect all engine baffles for cracks and condition of seals.
- ☐ 42. Inspect rubber engine mount bushings for deterioration. (See Inspection Note 6.)
- ☐ 43. Inspect fire walls for cracks.
- ☐ 44. Inspect condition of fire wall sealing.
- ☐ 45. Inspect condition and tension of alternator drive belt (65 lbs.).
- ☐ 46. Inspect condition of alternator and starter.
- ☐ 47. Replace pneumatic inlet filter.
- ☐ 48. Lubricate all controls. (Do not lubricate Teflon liners of control cables.)
- ☐ 49. Inspect tachometer generator security and wiring.
- ☐ 50. Inspect security of air conditioning compressor mount (if installed).
- ☐ 51. Inspect air conditioning compressor oil level (if installed). (See Inspection Note 7.)
- ☐ 52. Inspect condition and tension of compressor (air conditioner) drive belt. (Refer to Chapter 21.)
- ☐ 53. Inspect compressor clutch security and wiring. Clean any traces of oil from the clutch surface.

RIGHT TURBOCHARGER, DETAILED (See Chapter 81)

- ☐ 1. Visually inspect system for oil leaks, exhaust system leaks and general condition. (See Inspection Note 1.)
- ☐ 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 operation of alternate air control.
- ☐ 8. Inspect linkage between bypass valve and actuator.
- ☐ 9. Inspect vent line from bypass valve for oil leaks.
- ☐ 10. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks
- ☐ 11. Check fluid power lines for leaks and security.
- ☐ 12. Inspect for oil leakage from controller.
- ☐ 13. Inspect the turbocharger mount for cracks, condition and security to the engine and turbocharger.
- ☐ 14. Inspect fuel injection nozzle reference manifold for deteriorated hose, loose connections, leaks and obstructions.
- ☐ 15. Inspect fluid power lines for leaks and security.
- ☐ 16. Inspect for oil leakage from the controllers.
- ☐ 17. Check intercooler ducts for condition and security.
- ☐ 18. Reinstall engine cowl. (See Inspection Note 10)

Inspection Notes on Page 5-38

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

EVENT NO. 2 (cont.)

LEFT WING, ROUTINE (See Chapter 57)

- ❒ 1. Inspect surfaces, skins and tip for damage and loose nuts.
- ❒ 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.

RIGHT WING, DETAILED (See Chapter 57)

- ❒ 1. Remove inspection plates and panels.
- ❒ 2. Inspect surfaces, skins and tips for damage and loose nuts.
- ❒ 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 aileron balance weight and arm for security and condition.
- ❒ 6. Inspect flaps and attachments for damage and operation.
- ❒ 7. Inspect wing flap transmission.
- ❒ 8. Inspect flap actuator cable.
- ❒ 9. Inspect wing attachment bolts and brackets for security.
- ❒ 10. Inspect engine mount attaching structure for security and condition.
- ❒ 11. Inspect engine exhaust shield for cracks, severe buckling, or loose nuts at the flange area.
- ❒ 12. Remove, drain and clean fuel filter bowl and screen. (Drain and clean at least every 90 days.)
- ❒ 13. Inspect fuel cells and lines for leaks and water.
- ❒ 14. Ascertain that the fuel tanks are marked for capacity and minimum octane rating.
- ❒ 15. Check operation and pressure of electric fuel pumps.
- ❒ 16. Inspect condition of pneumatic deicer (if installed).
- ❒ 17. Inspect air conditioning condenser air scoop rigging and operation (if installed).
- ❒ 18. Inspect pneumatic inline air filters and cleaners (if installed). (Replace every 500 hours.)
- ❒ 19. Inspect wing tip navigation and strobe light for broken lenses and operation.
- ❒ 20. Check heated stall warning indicator.
- ❒ 21. Lubricate wing area per lubrication charts in Chapter 12.
- ❒ 22. Reinstall inspection plates and panels.

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

EVENT 2 (cont.)

LANDING GEAR, DETAILED (See chapter 32 maintenance manual) (Refer to Piper Service Bulletin 845) 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 charts in chapter 12.
- ☐ 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 cable assemblies for corrosion and fraying.
- ☐ 16. Inspect gear doors and attachments for security.
- ☐ 17. Check warning horn and light for operation.
- ☐ 18. Retract gear and inspect operation.
- ☐ 19. Retract gear and 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.
- ☐ 23. Lubricate gear per lubrication charts in maintenance manual, chapter 12.

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 charts in maintenance manual, chapter 12.
- ☐ 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.

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

EVENT NO. 2 (cont.)

- ☐ 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 cable assemblies for corrosion and fraying.
- ☐ 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.
- ☐ 20. Inspect actuating cylinder for leaks and security.
- ☐ 21. Inspect position indicating switches and electrical wires for condition and security.
- ☐ 22. Lubricate gear per lubrication charts in Chapter 12.

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 charts in Chapter 12.
- ☐ 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 cable assembly for corrosion and fraying.
- ☐ 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. Lubricate gear per lubrication charts in Chapter 12.

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

EVENT NO. 2 (cont.)

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.)
- ❒ 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, 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 instrument lights for operation.
- ❒ 5. Check control wheel for operation. (See Special Inspection.)
- ❒ 6. Check pilot and copilot seat belts and shoulder harnesses for proper security, operation and condition.

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.
- ❒ 6. Check isobaric and safety valve cover screen for obstruction (rear baggage compartment).

EMPENNAGE, ROUTINE (See Chapter 27)

- ❒ 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 condition and operation).
- ❒ 3. Check position and strobe lights for security, damage, and operation.
- ❒ 4. Check condition of pneumatic deicers (if applicable).

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

SPECIAL INSPECTIONS

Special inspections supplement the scheduled inspections with inspection items that must be examined at intervals not compatible with airframe operating time or airframe inspection intervals. Typical of this type are:

1. Inspections required because of special conditions or incidents that arise, and because of these conditions or incidents, an immediate inspection is required to insure further safe flight.
2. Inspection of airframe or components on a calendar basis. This type inspection could be accomplished during the nearest scheduled inspection.
3. Specific definitive inspection on engines based strictly upon engine operating time.

100 HOUR

EMERGENCY EXIT WINDOW

❐ Inspect operation of emergency exit window per chapter 56.

HEATER INSPECTION

❐ Conduct 100 hour inspection of affected heaters per AD82-07-03 and in accordance with Janitrol Maintenance and Overhaul Manual, p/n 24E25-1, dated October 1981.

LANDING GEAR INSPECTION (Refer to Piper Service Bulletin 845)

400 HOUR

LEFT AND RIGHT ENGINE

❐ Lycoming requires a valve inspection be made after every 400 hours of operation.

NOTES

❐ At every 400 hours of engine operation, remove rocker box covers and check for freedom of valve rockers when valves are closed. Look for evidence of abnormal wear or broken parts in area of valve tips, valve keeper, springs, and spring seat. If any indications are found, cylinder and all its components must be removed (including the piston and connecting rod assembly) and inspected for further damage. Replace any parts not conforming to limits shown in latest revision of Lycoming Service Table of Limits SSP-1776.

500-HOUR

LEFT AND RIGHT ENGINE

❐ 1. Remove and flush oil radiator.
❐ 2. Replace pneumatic system filters.
❐ 3. Replace rubber engine mount bushings (see note 1 under 400 hour inspection).

LEFT AND RIGHT MAIN GEAR

❐ 1. Inspect torque link assembly, bolts, and bushings (replace parts 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 (replace parts as required).
❐ 2. Inspect drag link assembly and bolts (replace as required).

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

SPECIAL INSPECTIONS (cont.)

EMPENNAGE

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

LEFT AND RIGHT WING

- ☐ Inspect fuel cell vents for obstruction.

CABIN PRESSURIZATION CHECK

- ☐ Perform inspection and test in accordance with chapter 21 of the maintenance manual.

NOTES

- ☐ 1. Replace all rubbed engine mount bushings every 500 hours.
- ☐ 2. Inspect fuel cells every 2 years or after 500 hours in service, whichever comes first.

1000 HOUR

LEFT AND RIGHT ENGINE

- ☐ Replace flexible fuel lines.

LEFT AND RIGHT WING

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

FUSELAGE FORWARD

- ☐ Overhaul or replace heater fuel valve (as required).

NOSE GEAR **(refer to Piper Service Bulletin 845)**

- ☐ Inspect drag and side brace link bolts for wear (replace as required).

LEFT AND RIGHT PROPELLER

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

LEFT AND RIGHT WING

- ☐ 1. Inspect, clean, and lubricate all exterior bearings (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.
- ☐ 4. Inspect condition of fuel cell material.

FUSELAGE FORWARD

- ☐ 1. Overhaul cabin heater at end of each heating season or after 1000 heater operating hours, whichever comes first.

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

SPECIAL INSPECTIONS (cont.)

ENGINE T.B.O. 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. 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 is charged.

FUSELAGE

- ☐ 1. Perform oxygen bottle hydrostatic inspection. (Refer to AC 43,13-IA, 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, OR LANDING GEAR EXTENSION ABOVE V_{LO}. (Refer to Piper Service Bulletin 845) This inspection must be performed after a rough landing is made or when a landing is made while aircraft is known to exceed design landing weight. Check following areas and items:

- ☐ 1. Wings - for wrinkled skins, loose or missing rivets.
- ☐ 2. Fuel leaks around fuel tanks and fuel fittings throughout 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. An alignment check to clarify any doubt of damage.

SEVERE TURBULENCE INSPECTION. Check same items and locations as stated in Hard or Overweight Landings along with following:

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

ENGINE OVERSPEED, OVERBOOST. (Refer to latest Lycoming Service Bulletin 369), SUDDEN STOPPAGE, LOSS OF OIL AND LIGHTNING STRIKE

- ☐ Refer to chapter 5, maintenance manual.

COMPONENT OVERLIMITS INSPECTION

- ☐ Check with appropriate manufacturer for necessary corrective action.

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

OPERATIONAL INSPECTION

PRE-RUN UP

- ❒ 1. Check fuel supply.
- ❒ 2. Drain all fuel sumps.
- ❒ 3. Check engine oil level.
- ❒ 4. Cheek 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 night 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 night 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.

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

INSPECTION NOTES:

1. Replace or overhaul as required at engine overhaul. Refer to latest Lycoming Service Letter No. L201 and Bendix Service Bulletin 586.
2. Replace flexible oil lines after 1000 hours time-in-service or 8 years, whichever comes first.
3. Cheek cylinders for evidence of excessive heat which is indicated by burned paint on the cylinders- This condition is indicative of internal damage to the cylinder and, if found, its cause must be determined and corrected before the aircraft is returned to service.

   Heavy discoloration and appearance of seepage at the cylinder head and barrel attachment area is usually due to emission of thread lubricant used during assembly of the barrel at the factory, or by slight gas leakage which stops after the cylinder has been in service for awhile. This condition is neither harmful or detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder should be replaced.
4. 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 Service Table of Limits No. SSP-1776.
5. Refer to latest Lycoming Service Instruction No. 1308 for Magneto Pressure Test.
6. It is recommended that all engine mount rubber bushings be replaced every 500 hours.
7. Check compressor oil level anytime the system is discharged.
8. Replace any v-band coupling attaching the exhaust tailpipe to the turbocharger at 1000 hour intervals or sooner if inspection indicates wear, buckling, etc.
9. Intervals between oil changes can be increased as much as 100% on engines equipped with full flow (cartridge type) oil filters, provided the element is replaced each 50 hours of operation.
10. Inspect condition of cowl fastener locked indicator stripes. Touch-up or restore as necessary. Refer to Service Manual Section VIII.
11. Inspect all rod end bearings for freedom of ball movement. Use 10X magnifying glass to check thread end of bearing for cracks and damage. Replace bearing if ball is frozen or hard to move.

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

EVENT INSPECTION RECORD AND SIGNOFF SHEET

I have inspected this aircraft in accordance with Piper Aircraft Corporation's Programmed Inspection Procedures and a list of discrepancies have been given to the owner/operator, and appropriate entries have been made in the Aircraft and Engine Logbooks. Read Notes below before signing sheet.

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. Always check for and use only current information.
2. The signatures signify that this aircraft has been thoroughly inspected and found air worthy in accordance with all appropriate current Federal Aviation Regulations and that appropriate entries have-been made in Aircraft and Engine Logbooks.
3. Work order column is applicable only to FAA Approved Repair Stations.

EVENT #	INSP	A/C TIME	DATE	W.O. #	SIGNATURE - CERTIFICATE #
1	100				
2	200				
1	300				
2	400				
1	500				
2	600				
1	700				
2	800				
1	900				
2	1200				
1	1100				
2	1200				
1	1300				
2	1400				
1	1500				
2	1600				

EVENT #	INSP	A/C TIME	DATE	W.O. #	SIGNATURE - CERTIFICATE #
1	1700				
2	1800				
1	1900				
2	2000				
1	2100				
2	2200				
1	2300				
2	2400				
1	2500				
2	2600				
1	2700				
2	2800				
1	2900				
2	3000				
1	3100				
2	3200				
1	3300				
2	3400				
1	3500				
2	3600				
1	3700				
2	3800				
1	3900				
2	4000				
1	4100				
2	4200				
1	4300				
2	4400				
1	4500				
2	4600				

EVENT #	INSP	A/C TIME	DATE	W.O. #	SIGNATURE - CERTIFICATE #
1	4700				
2	4800				
1	4900				
2	5000				
1	5100				
2	5200				
1	5300				
2	5400				
1	5500				

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

CONTINUOUS CYCLE INSPECTION RECORD AND SIGNOFF 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.				

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:

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

MANUFACTURER	PUBLICATION	NUMBER	COMPLIANCE DATE	A/C HOURS	W.O.#	SIGNATURE AND CERTIFICATE #

SERVICE PUBLICATION COMPLIANCE RECORD

MANUFACTURER	PUBLICATION	NUMBER	COMPLIANCE DATE	A/C HOURS	W.O.#	SIGNATURE AND CERTIFICATE #

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

FAA AIRWORTHINESS DIRECTORIES COMPLIANCE RECORD

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

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

ECR EQUIPMENT CHANGE RECORD RECORD

DATE	A/C HRS	REMOVED PART # SERIAL #	INSTALL PART # SERIAL #	SIGNATURE AND DERTIFICATE #

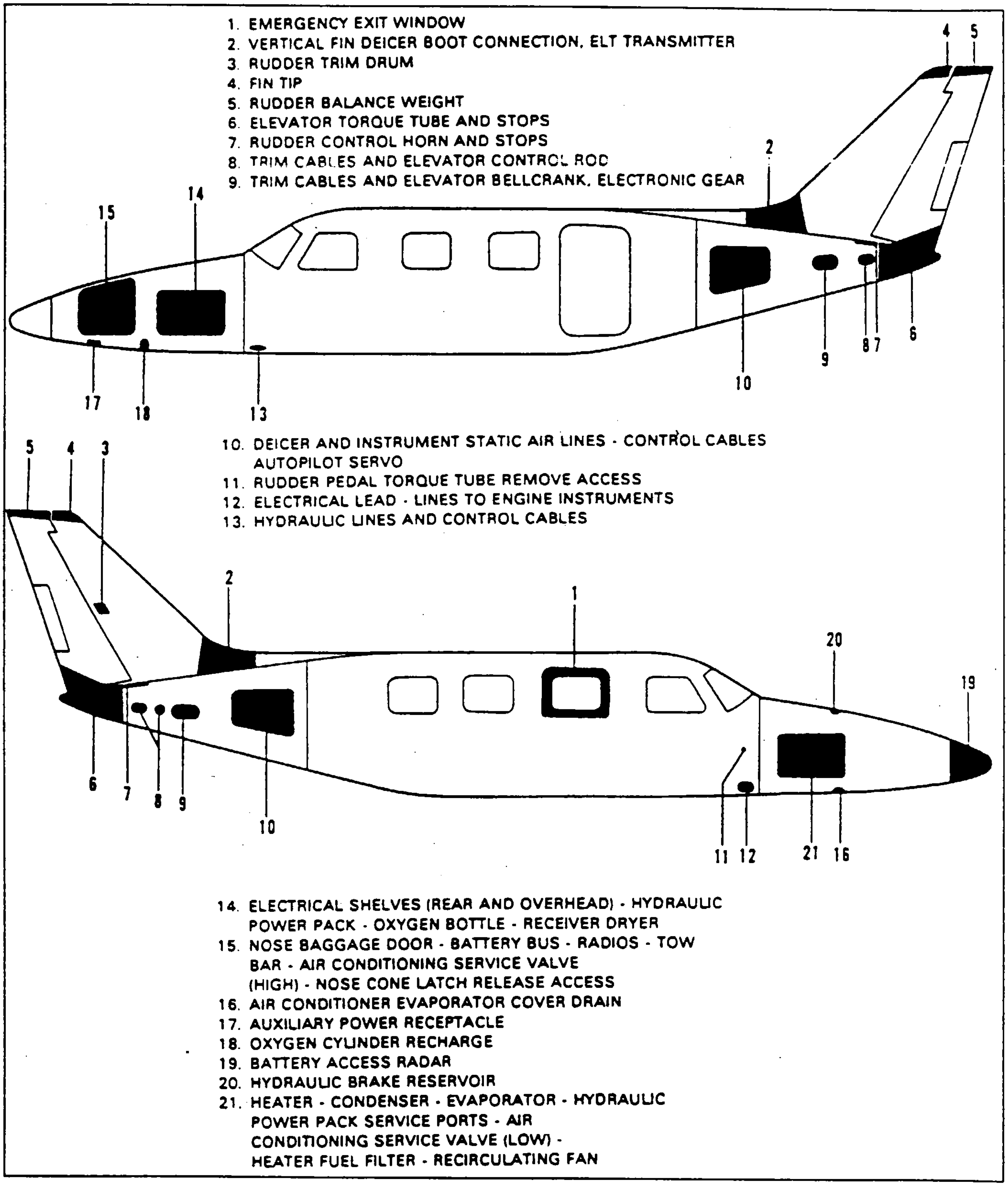
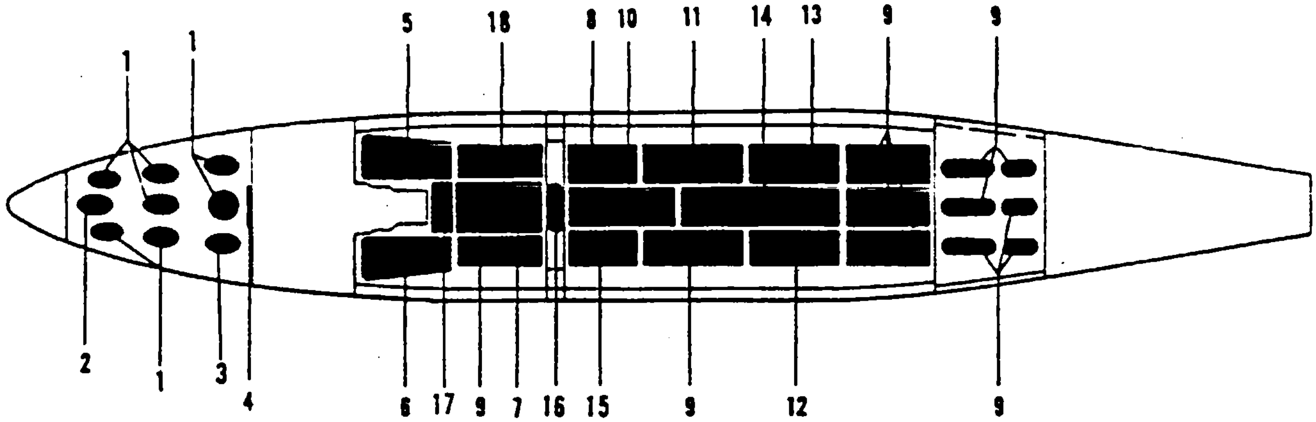
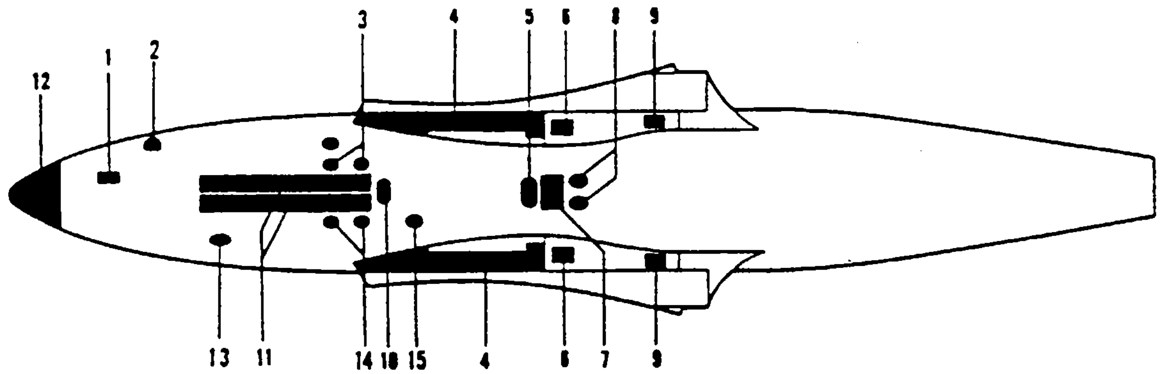


Figure 5-1. Access Plates and Panels

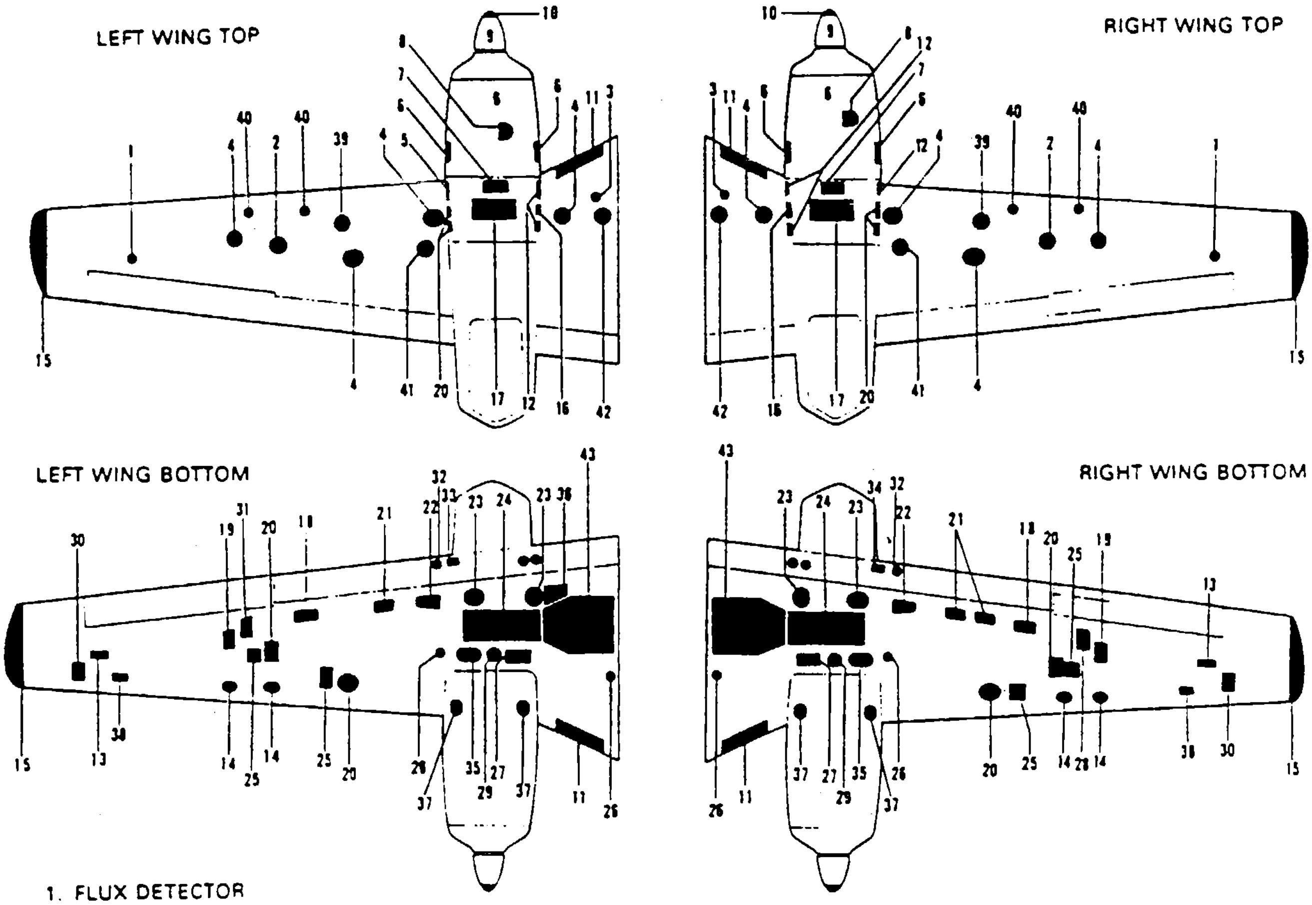


1. ELECTRICAL LEADS
2. BATTERY CABLE - AUXILIARY POWER RECEPTACLE
3. OXYGEN CYLINDER RECHARGE AND BLOW OUT DISC
4. NOSE WHEEL STEERING
5. ENGINE INSTRUMENT LINES - ELECTRICAL LEADS - MISCELLANEOUS AIR AND FLUID LINES
6. ENGINE INSTRUMENT LINES AND CONTROL CABLES - ELECTRICAL LEADS
7. TRIM CABLES - GYRO REGULATOR - STARTER SOLENOIDS - MAIN CIRCUIT BREAKER PANEL - ELECTRICAL LEADS - HAND PUMP (LANDING GEAR)
8. PNEUMATIC LINES, CHECK VALVE AND PRESSURE SWITCH - ELECTRICAL LEADS - HYDRAULIC LINES
9. CONTROL CABLES
10. AUTOPILOT ROLL SERVO - FLAP MOTOR - DEICE VALVES AND LINES - AILERON CABLES - HYDRAULIC LINES - PNEUMATIC EJECTOR - ELECTRICAL LEADS
11. CONTROL CABLE
12. CABIN DOOR SEAL SOLENOID, ACCUMULATOR TANK, TIMER AND RELAY
13. CALCO FLAP RELAYS
14. CONTROL CABLES - CALCO FLAP - AMPLIFIER
15. ELECTRICAL LEADS - HYDRAULIC LINES - PNEUMATIC LINES - CONTROL CABLES
16. SPAR SPLICE
17. TRIM DRUMS AND CABLES
18. ELECTRICAL LEADS - PRESSURIZATION AIR CONTROL BOX



1. AUXILIARY POWER RECEPTACLE
2. OXYGEN CYLINDER RECHARGE
3. ELECTRICAL LEADS - CONTROL CABLES - NOSE GEAR STEERING CABLE - MISCELLANEOUS AIR AND FLUID LINES
4. ELECTRICAL FUEL PUMP - CROSSFEED VALVE (LEFT ONLY) EMERGENCY SHUTOFF VALVE - FIREWALL SHUTOFF VALVE - GASCOLATOR - WING FRONT SPAR ATTACHMENT - FUEL PRESSURE SWITCH - ELECTRICAL LEADS - MISCELLANEOUS AIR AND FLUID LINES
5. MAIN CIRCUIT BREAKER PANEL
6. MISCELLANEOUS AIR AND FLUID LINES
7. SPAR SPLICE
8. DEICER VALVE - BOOT INFLATION SWITCH - HYDRAULIC LINES
9. AILERON CONTROL CABLE - FLAP CABLE - ELECTRICAL LEADS - WING REAR SPAR CONNECTION FITTING
10. QUADRANT - CONTROL CABLES
11. GEAR DOORS
12. BATTERY ACCESS, RADAR
13. AIR CONDITIONER EVAPORATOR COVER DRAIN
14. ELECTRICAL LEADS - MISCELLANEOUS AIR AND FLUID LINES
15. PRESSURIZATION AIR CONTROL BOX

Figure 5-1. Access Plates and Panels (cont.)



1. FLUX DETECTOR
2. FUEL CELL
3. FUEL QUANTITY TRANSMITTER
4. FUEL CELL
5. INSPECTION LIGHT
6. ENGINE
7. NACELLE INTERIOR - COWL FLAP ACTUATOR PNEUMATIC SYSTEM INLINE FILTER - TWO STAGE PNEUMATIC REGULATOR VALVE - MISCELLANEOUS AIR AND FLUID LINES
8. OIL FILLER
9. PROPELLER
10. PROPELLER RECHARGE
11. MISCELLANEOUS AIR AND FLUID LINES - WIRES - CABLES - FUEL FLOW TRANSMITTER - LOW FREON SWITCH (RIGHT WING ONLY)
12. NACELLE INTERIOR
13. STROBE POWER SUPPLY
14. INSPECTION - FUEL LINES
15. WING TIP - ELECTRICAL CONNECTIONS
16. BLEED AIR INTERCOOLER
17. NACELLE FUEL CELL - FUEL FILLER - FUEL QUANTITY TRANSMITTER
18. AILERON CABLE - PULLEYS
19. AILERON BELLCRANK
20. FUEL CELL VENT LINE
21. AILERON CABLE FAIRLEADS
22. AILERON CABLES AND RUB BLOCKS - FLAP TRANSMISSION
23. LANDING GEAR ATTACHMENTS
24. MAIN LANDING GEAR
25. FUEL CELL VENT
26. FUEL CELL DRAIN
27. LANDING GEAR SIDE BRACE ATTACHMENTS
28. AILERON TRIM DRUM
29. FUEL LINE
30. FUEL VENT FLOAT VALVE
31. AILERON CABLES
32. FLAP POTENTIOMETERS
33. FLAP POT - FLAP LIMIT SWITCHES
34. FLAP POTENTIOMETERS
35. LANDING GEAR ATTACHMENT FITTING - FUEL LINE
36. FLAP CABLE - AILERON CABLE - RUB BLOCKS - ELECTRICAL LEADS
37. ENGINE ATTACHMENT BOLT - MISCELLANEOUS LINES
38. FUEL VENT CONNECTION
39. FUEL FILLER
40. INSPECTION ACCESS
41. FUEL QUANTITY TRANSMITTER
42. SUBMERGED FUEL BOOST PUMP
43. INBOARD GEAR DOORS

Figure 5-1. Access Plates and Panels (cont.)

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CHAPTER

6

DIMENSIONS AND AREAS

CHAPTER 6 - DIMENSIONS AND AREAS

TABLE OF CONTENTS/EFFECTIVITY

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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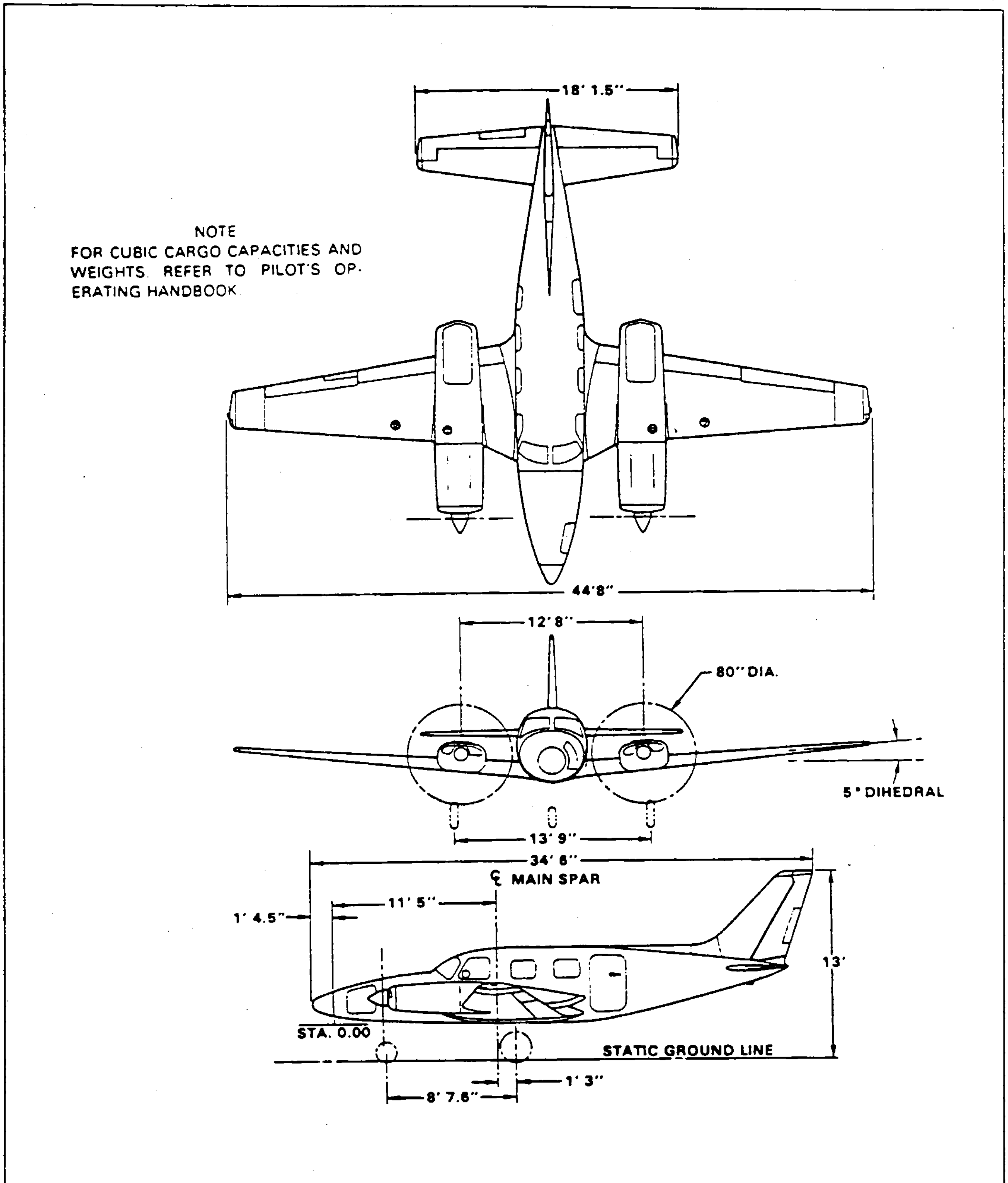


Figure 6-1. Dimensions

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	PA-31 P-350
ENGINE	
Manufacturer	Avco Lycoming
Model	T10-540-V2AD and LT10-540-V2AD
Rated Horsepower, RPM, Altitude	350 - @ 2600- Sea Level to 15,000 feet Refer to Pilot's Operating Manual
Oil. SAE Number	See Lubrication Chart
Oil Sump Capacity	13 qts
Turbocharger, AiResearch	THO8A69
Fuel, Aviation Grade, Minimum Octane	100/ 100LL
Fuel Injector, Bendix	RSA-10DB2
Magnetos, Bendix	
Left Engine	D6LN 3200
Right Engine	D6RN 3200
Magneto Timing (Spark Advance)	20°
Magneto Point Clearance	
Main	0.016 ± 0.004
Retard and Tach	0.016 ± 0.004
Retard Angle	11° (D6LN 3200) 19° (D6RN 3200)
Spark Plugs	Refer to latest issue of Lycoming Service Instruction 1042
Spark Plug Gap Setting	.017 to .021
Firing Order	1-4-5-2-3-6
Starter- Prestolite- 24 Volt	MHB-4016, MHB-4014
Alternator, Prestolite. 24 Volt. 100 Amp	ALV-8402-L
Voltage Regulator, Lamar	B-00286-1
Over Voltage Relay, Lamar	B-00266-1
Fuel Pump: Lear Siegler	RG9080-J8A and J7A
PROPELLER	
Manufacturer	Hartzell
Type	3 Blade, Constant Speed Feathering
Hub	HC-13YR-2UF, HC-13YR-2LUF
Blade	FC7854K, FJC7854K
Diameter	80 in.
Governor Model	
Left	V-1
Right	V-1L (V-2L with Synchrophaser)

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

MODEL	PA-31 P-350
FUEL SYSTEM CAPACITIES	
Total Fuel	243 gal.
Total Usable Fuel	238 gal.
Total Fuel Per Wing	121.5 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.

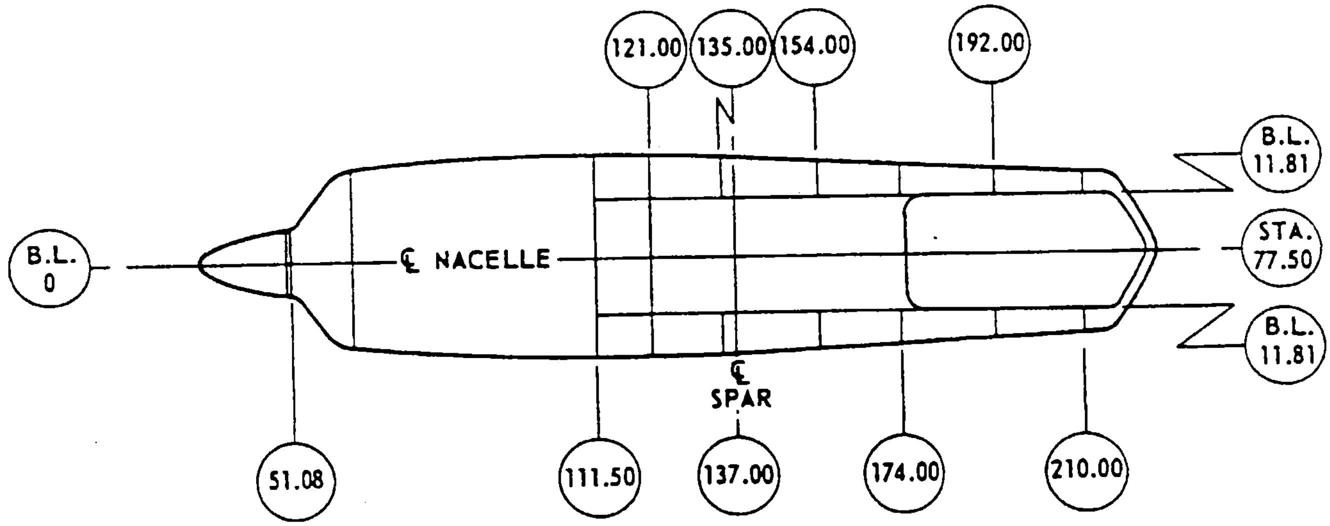


Figure 6-2. Station References

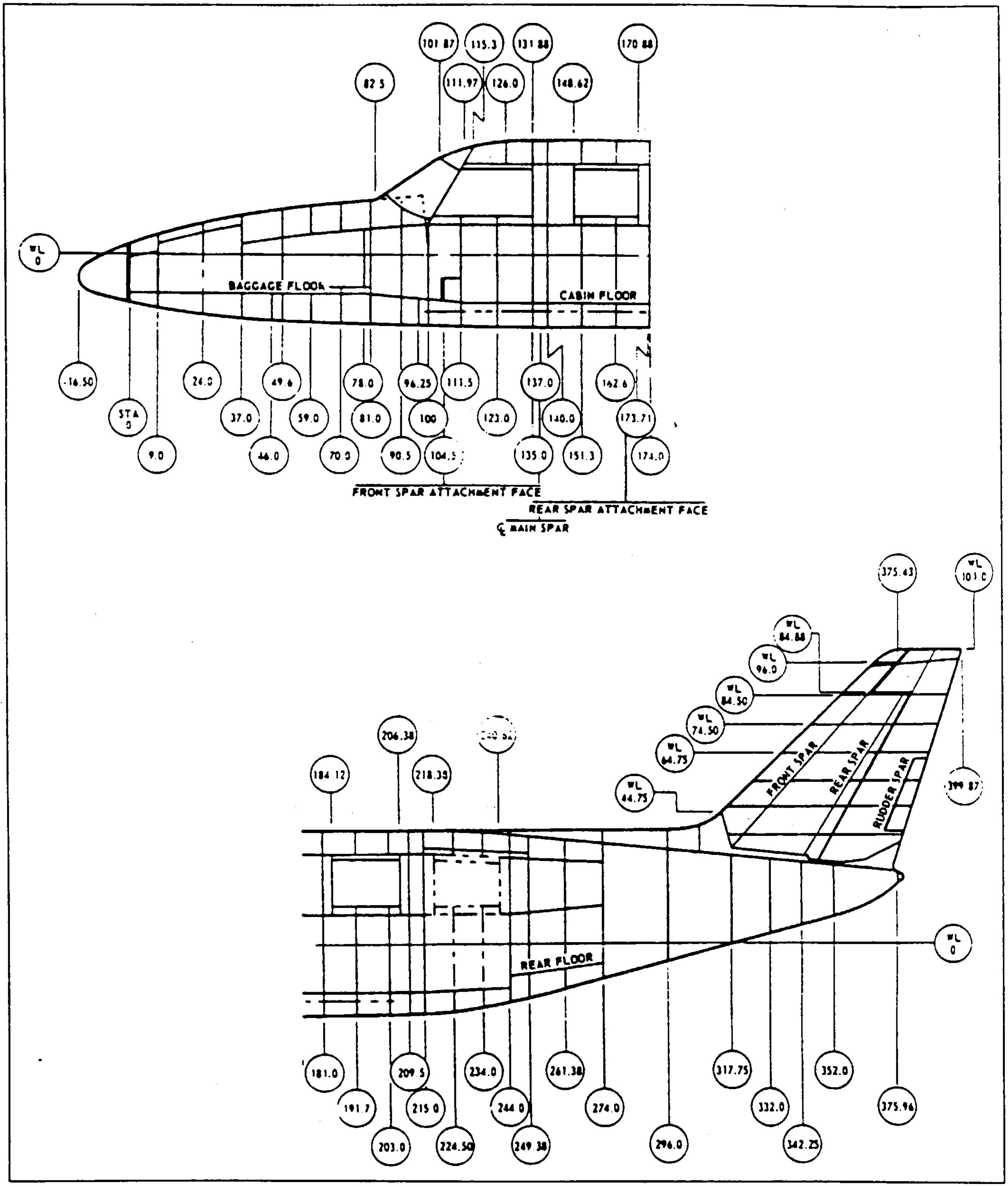


Figure 6-2. Station References (cont.)

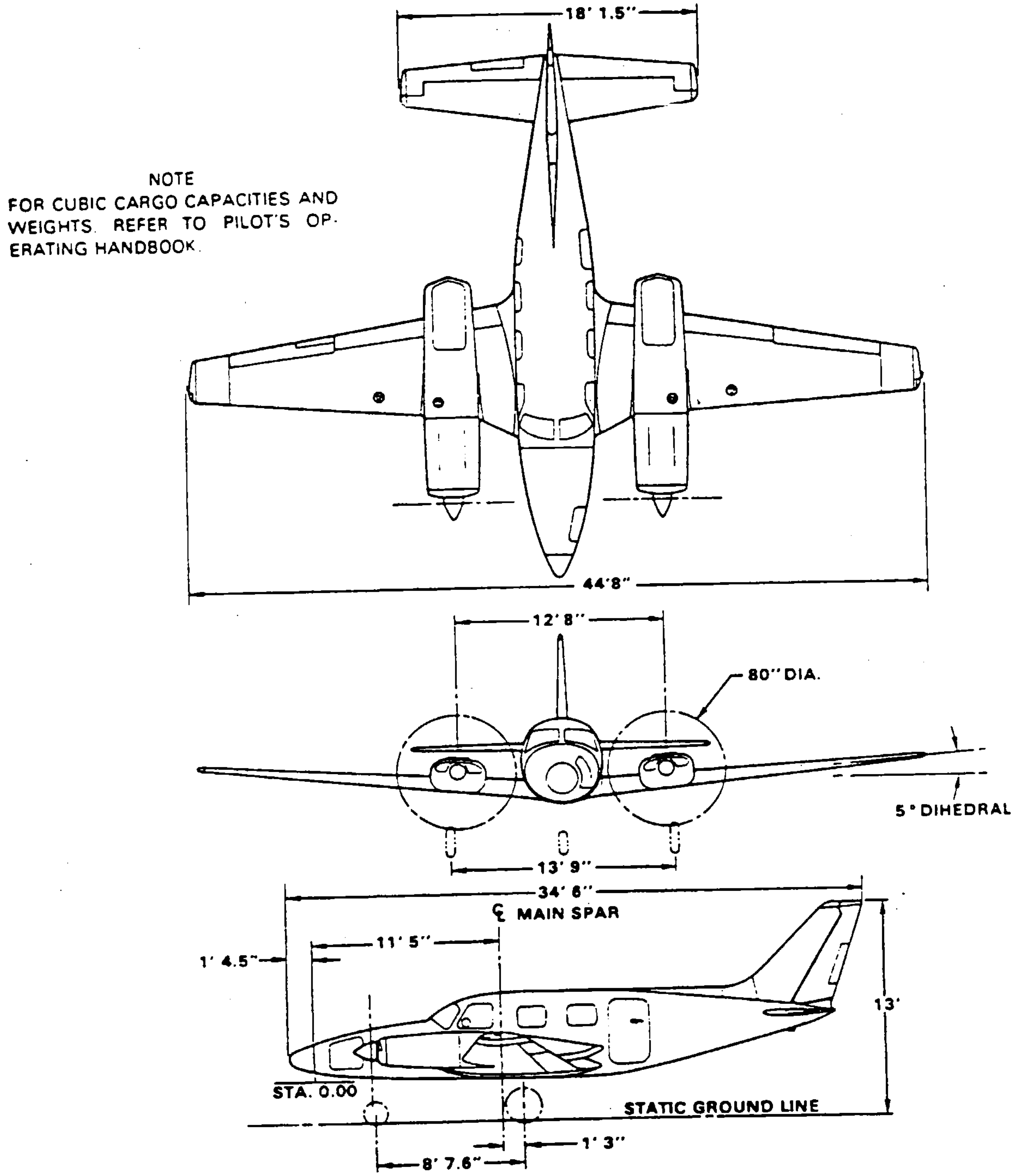


Figure 6-2. Station References (cont.)

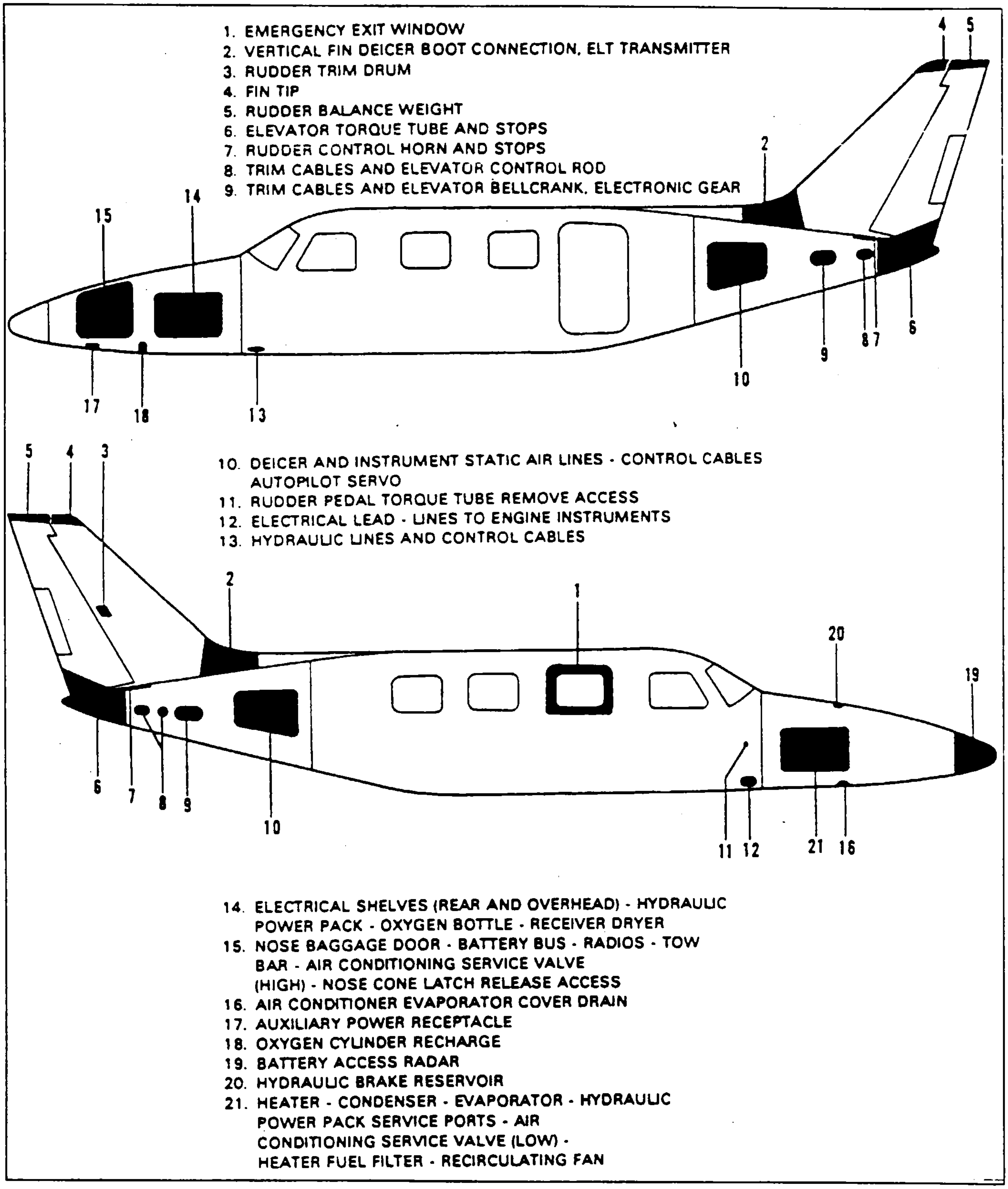
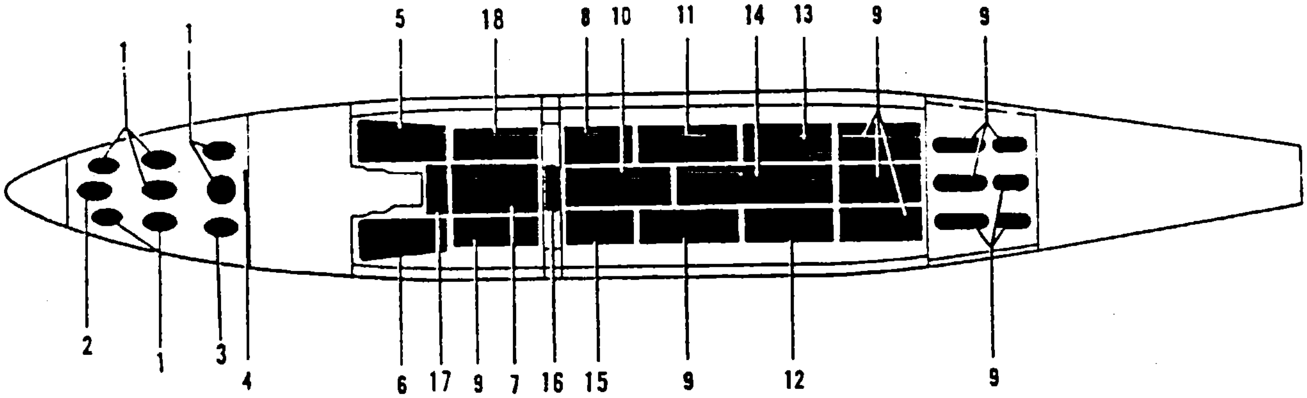


Figure 6-3. Access Plates and Panels



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13. CALCO FLAP RELAYS
14. CONTROL CABLES - CALCO FLAP - AMPLIFIER
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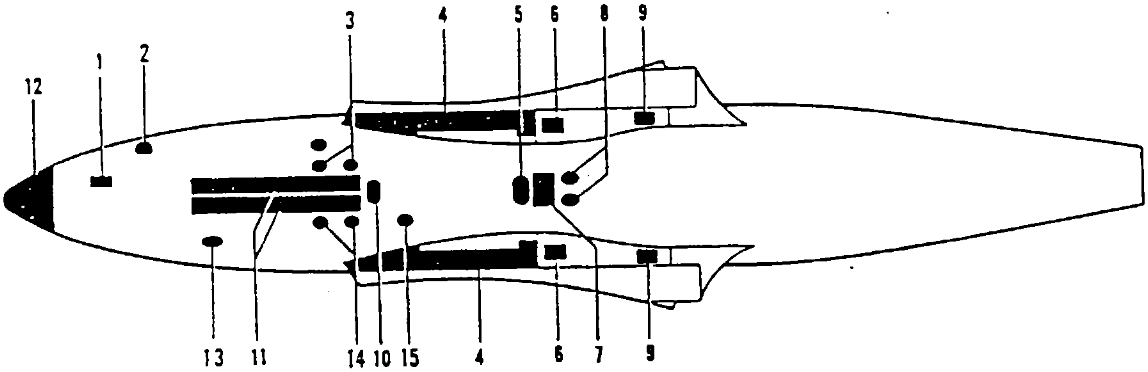
16. SPAR SPLICE
17. TRIM DRUMS AND CABLES
18. ELECTRICAL LEADS - PRESSURIZATION AIR CONTROL BOX



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6. MISCELLANEOUS AIR AND FLUID LINES
7. SPAR SPLICE
8. DEICER VALVE - BOOT INFLATION SWITCH - HYDRAULIC LINES
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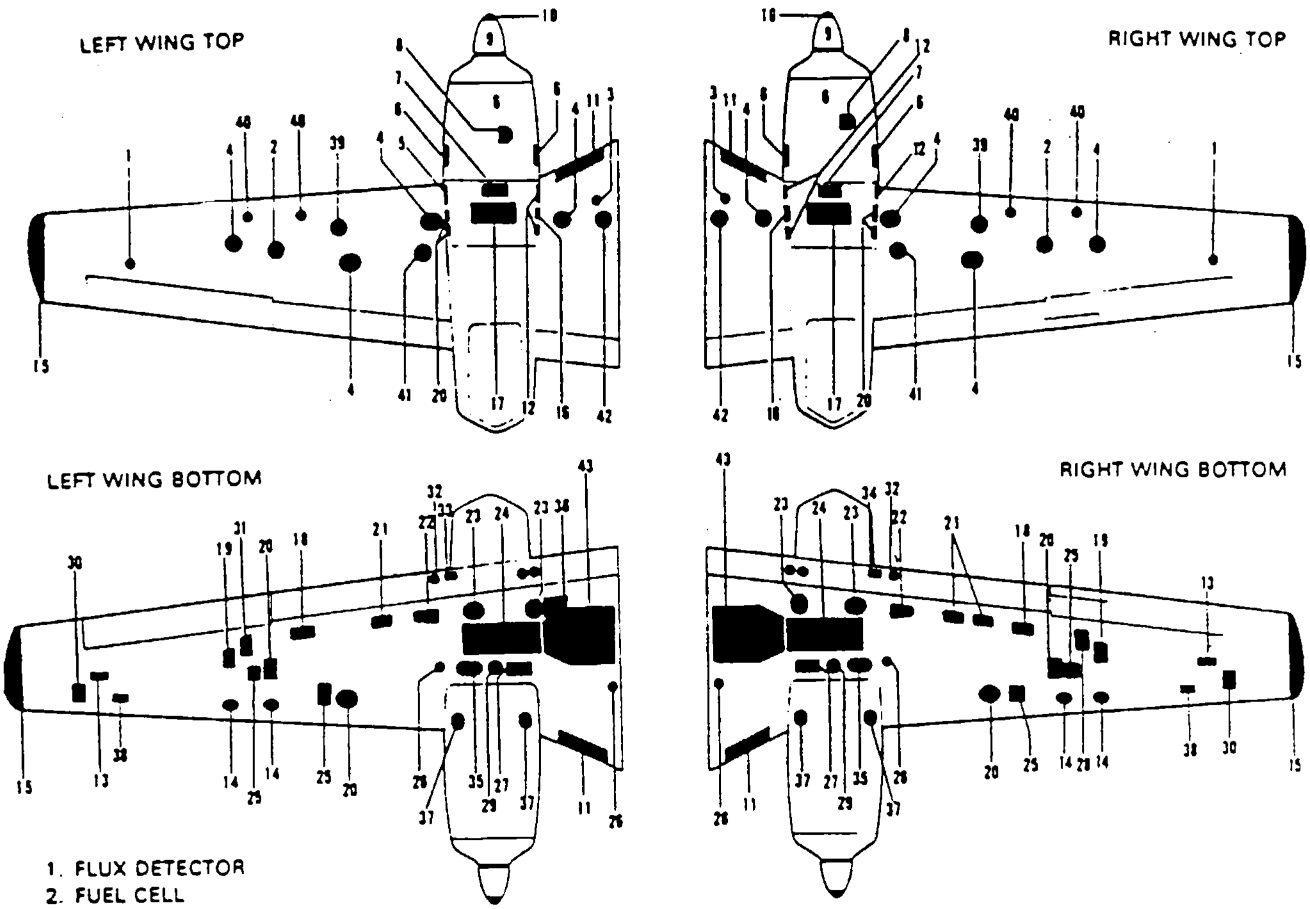
10. QUADRANT - CONTROL CABLES
11. GEAR DOORS
12. BATTERY ACCESS, RADAR
13. AIR CONDITIONER EVAPORATOR COVER DRAIN
14. ELECTRICAL LEADS - MISCELLANEOUS AIR AND FLUID LINES
15. PRESSURIZATION AIR CONTROL BOX

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



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3. FUEL QUANTITY TRANSMITTER
4. FUEL CELL
5. INSPECTION LIGHT
6. ENGINE
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8. OIL FILTER
9. PROPELLER
10. PROPELLER RECHARGE
11. MISCELLANEOUS AIR AND FLUID LINES - WIRES - CABLES - FUEL FLOW TRANSMITTER - LOW FREON SWITCH (RIGHT WING ONLY)
12. NACELLE INTERIOR
13. STROBE POWER SUPPLY
14. INSPECTION - FUEL LINES
15. WING TIP - ELECTRICAL CONNECTIONS
16. BLEED AIR INTERCOOLER
17. NACELLE FUEL CELL - FUEL FILLER - FUEL QUANTITY TRANSMITTER -
18. AILERON CABLE - PULLEYS
19. AILERON BELLCRANK
20. FUEL CELL VENT LINE
21. AILERON CABLE FAIRLEADS
22. AILERON CABLES AND RUB BLOCKS - FLAP TRANSMISSION
23. LANDING GEAR ATTACHMENTS
24. MAIN LANDING GEAR
25. FUEL CELL VENT
26. FUEL CELL DRAIN
27. LANDING GEAR SIDE BRACE ATTACHMENTS
28. AILERON TRIM DRUM
29. FUEL LINE
30. FUEL VENT FLOAT VALVE
31. AILERON CABLES
32. FLAP POTENTIOMETERS
33. FLAP POT - FLAP LIMIT SWITCHES
34. FLAP POTENTIOMETERS
35. LANDING GEAR ATTACHMENT FITTING - FUEL LINE
36. FLAP CABLE - AILERON CABLE - RUB BLOCKS - ELECTRICAL LEADS
37. ENGINE ATTACHMENT BOLT - MISCELLANEOUS LINES
38. FUEL VENT CONNECTION
39. FUEL FILLER
40. INSPECTION ACCESS
41. FUEL QUANTITY TRANSMITTER
42. SUBMERGED FUEL BOOST PUMP
43. INBOARD GEAR DOORS

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

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CHAPTER

7

LIFTING AND SHORING

CHAPTER 7- LIFTING AND SHORING

TABLE OF CONTENTS/EFFECTIVITY

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 25.75 and 43.35, 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 station 25.75 and 43.35.
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,

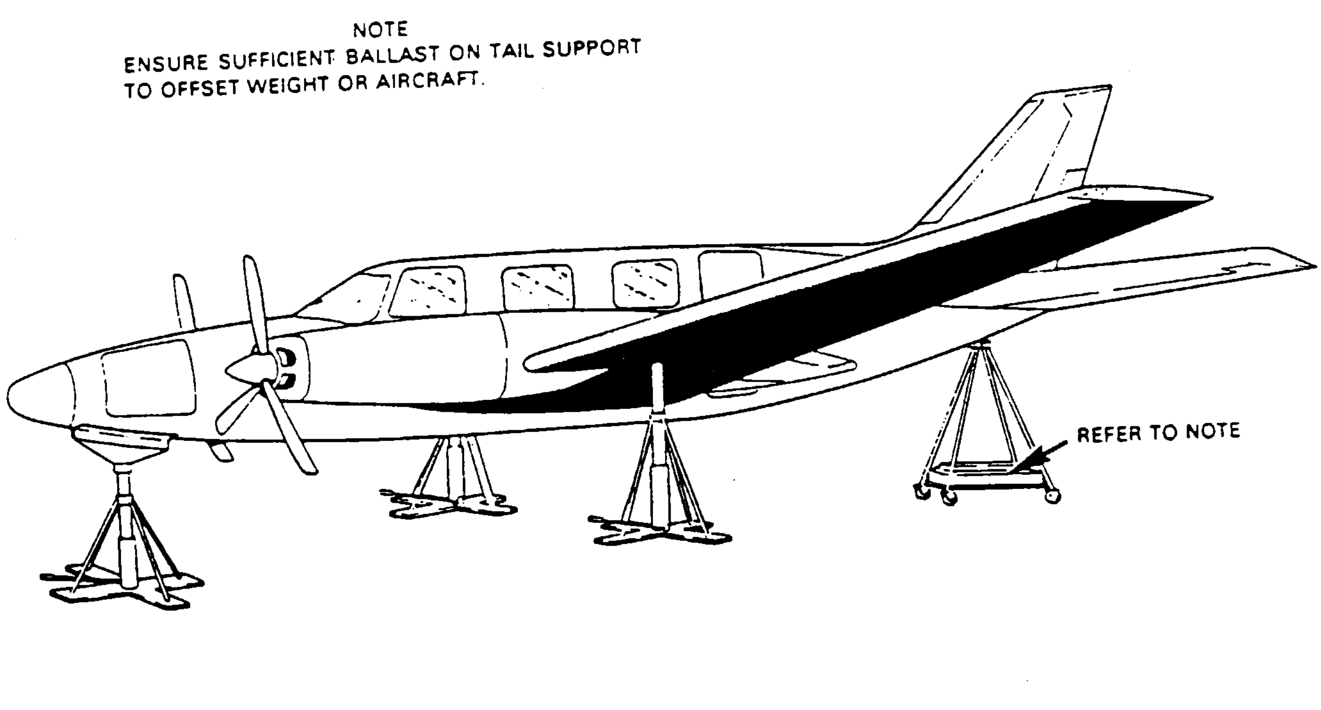

Figure 7-1. Jacking Arrangement

CHAPTER

8

LEVELING AND WEIGHING

CHAPTER 8 - LEVELING AND WEIGHING

TABLE OF CONTENTS/EFFECTIVITY

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 jack 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 .

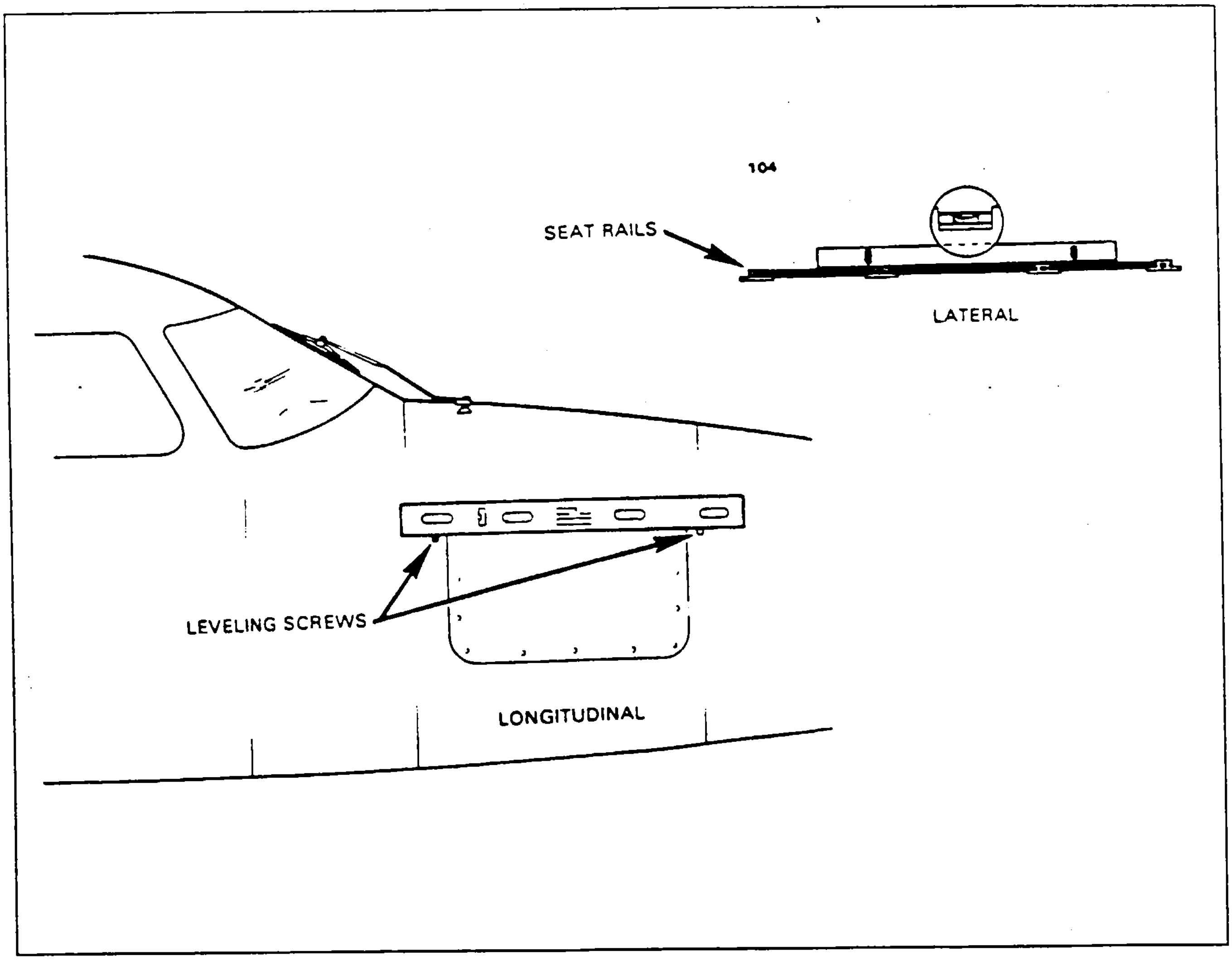

Figure 8-1. Leveling- Longitudinal and Lateral

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 cleaned 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.

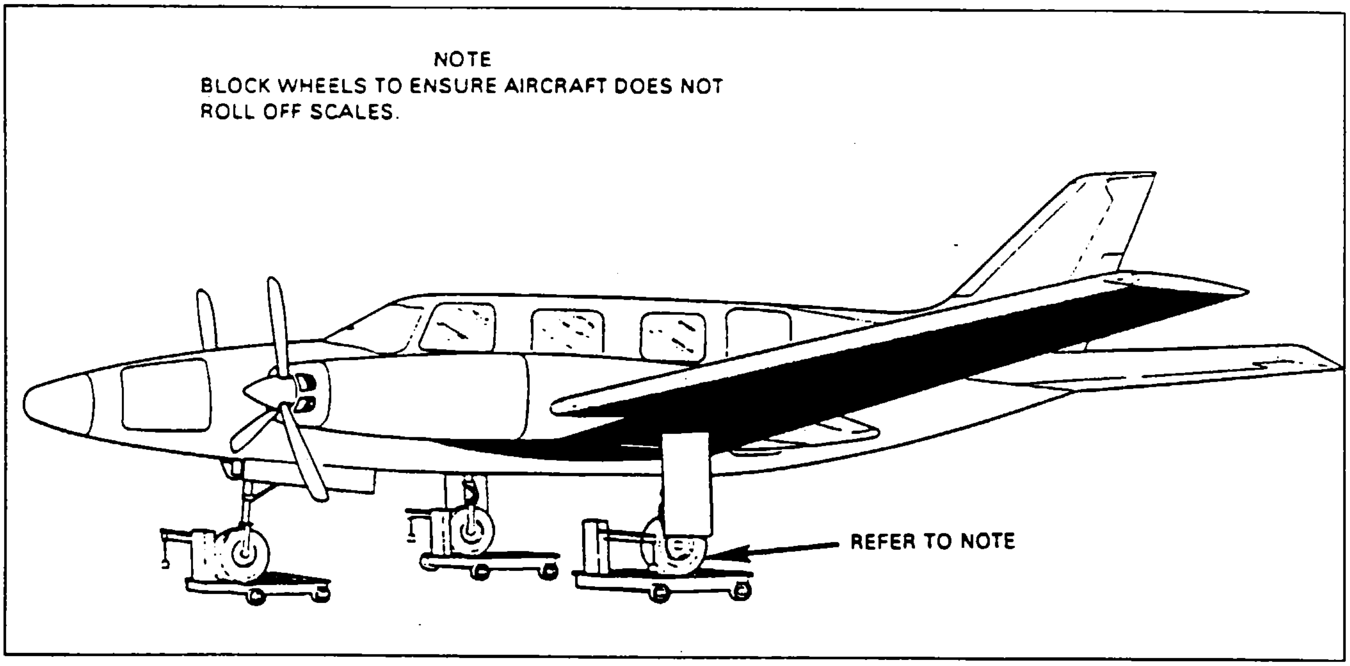

Figure 8-2. Weighing Arrangement

WEIGHING THE AIRCRAFT

1. Place a 3,000 lb. minimum scale and a ramp in front of each main landing gear and a 1,000 Lb. 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

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).

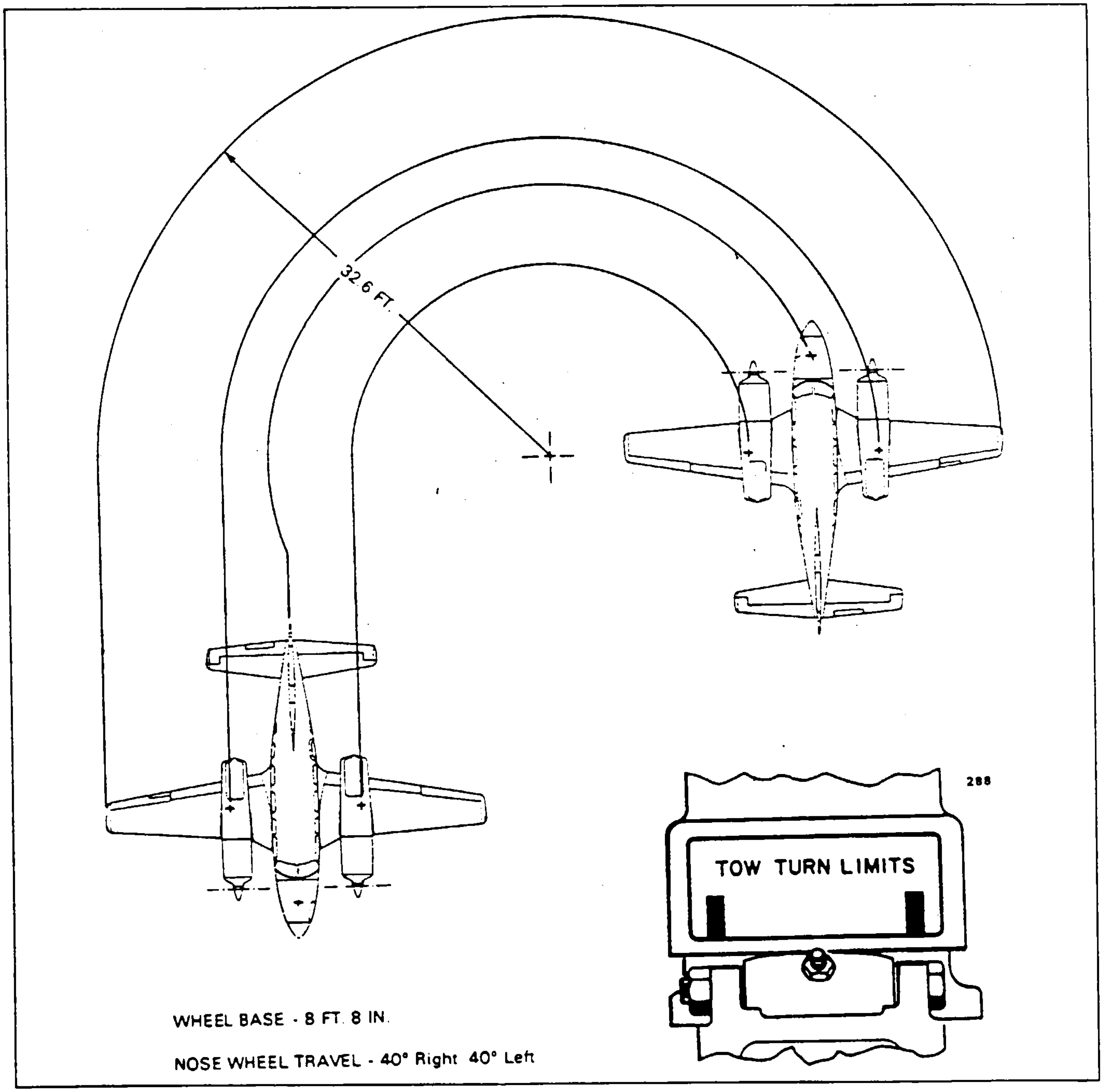

Figure 9-1. Turning Radius and Limits

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 40 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 an 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

TABLE OF CONTENTS/EFFECTIVITY

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 then 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. Secure the control wheel with the seat belt.

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.
2. Block the wheels with wheel chocks.
3. Secure the control heel with the seat belt and or secure the ailerons and elevator with 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.
6. Restrain the propellers to prevent windmilling.

—END—

CHAPTER

11

REQUIRED PLACARDS

CHAPTER 11- REQUIRED PLACARDS

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GENERAL

PLACARDS AND MARKINGS.

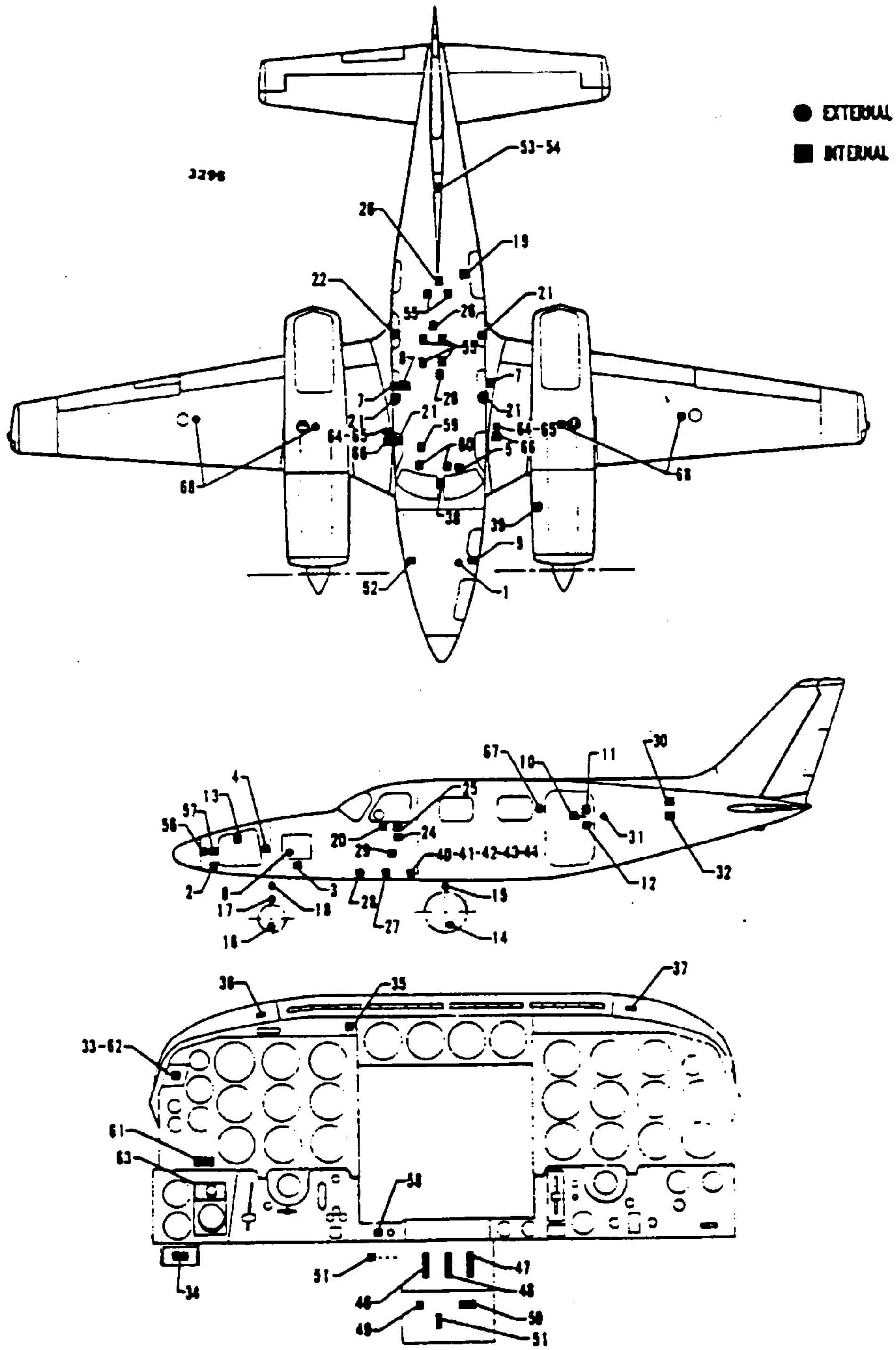


Figure 11-1. Placards and Decals

1. DECAL - BRAKE RESERVOIR
2. PLACARD - STARTING PROCEDURE. EXTERNAL POWER
3. PLACARD - OXYGEN WARNING
4. PLACARD - ACCESS PANEL
5. PLACARD - WARNING, E.L.T.
6. DECAL - ACCESS PANEL, LEFT
7. DECAL - SEAT REQUIREMENTS
8. PLACARD ASSEMBLY - EMERGENCY EXIT LATCH
9. PLACARD - LATCHING OPERATION
10. PLACARD - CABIN DOOR LATCH
11. PLACARD - CABIN DOOR LOCK
12. PLACARD - DOOR AUXILIARY LOCK
13. PLACARD - BAGGAGE CAPACITY
14. PLACARD - TIRE INFLATION, MAIN
15. PLACARD - OLEO SERVICE INSTRUCTIONS
16. PLACARD - TIRE INFLATION, NOSE
17. PLACARD - OLEO SERVICE INSTRUCTIONS
18. PLACARD - TOW TURN LIMITS
19. DECAL - SEAT REQUIREMENTS
20. DECAL - LIMITATIONS/CHECKLIST
21. DECAL - SEAT REQUIREMENTS
22. DECAL - SEAT REQUIREMENTS
23. DECAL - COURTESY LIGHTS
24. DECAL - ARMREST STORAGE
25. DECAL - ANTI-COLLISION LIGHTS WARNING
26. DECAL - OXYGEN
27. PLACARD - CIRCUIT BREAKER. MAIN
28. PLACARD - EMERGENCY GEAR EXTENSION
29. PLACARD - OXYGEN MASK CONTAINER
30. PLACARD - RELIEF VALVE OBSTRUCTION
31. DECAL - MOJAVE
32. PLACARD - BAGGAGE CAPACITY
33. PLACARD - CABIN PRESSURE TEST SWITCH
34. PLACARD - MIKE - PHONE JACKS
35. PLACARD - MASTER CAUTION
36. PLACARD - ANNUNCIATOR TEST
37. PLACARD - ANNUNCIATOR HI-LO
38. PLACARD - COMPASS ERRATIC
39. PLACARD - LUBRICATION
40. PLACARD - FUEL CONTROL, LEFT
41. PLACARD - FUEL CONTROL. RIGHT
42. PLACARD - FUEL CROSSFEED
43. PLACARD - OFF
44. PLACARD - ON
45. PLACARD - THROTTLE CONTROL
46. PLACARD - PROPELLER CONTROL
47 PLACARD - MIXTURE CONTROL
48. PLACARD - ELEVATOR TRIM
49. PLACARD - RUDDER TRIM
50. PLACARD - AILERON TRIM
51. DECAL - BLEED AIR COOLER DOOR
52. PLACARD - HYDRAULIC SYSTEM
53. PLACARD - ISOBARIC VALVE
54. PLACARD . CABIN VENT
55. PLACARD - OXYGEN USAGE WARNING
56. PLACARD - BATTERY CAUTION
57. PLACARD - FUSE FUNCTIONS
58. PLACARD - CABIN CALL
59. DECAL - SEAT BELTS, DOME LIGHT AND NO SMOKING SWITCHES
60. DECAL - MAPLIGHT
61. PLACARD - INVERTER POWER/BUS TIE SWITCHES
62. DECAL - LIMITATIONS
63. PLACARD - CABIN PRESSURE TEST SWITCH
64. DECAL - SECURE SYSTEM (INTERNAL)
65. DECAL - FUEL SHUT-OFF
66. DECAL - FUEL FILTER CLEANING
67. DECAL - PIPER LOGO
68. DECAL - "AVGAS ONLY"

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

CHAPTER

12

SERVICING

CHAPTER 12- SERVICING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 12- SERVICING (CONT.)

TABLE OF CONTENTS/EFFECTIVITY

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.

SCHEDULED SERVICING.

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.

When refueling, remove the nacelle filler cap and if there is no visible fuel in the nacelle tank, refuel at the wing filler first. Install wing filler cap securely after filling and complete refueling through the nacelle filler. If there is fuel in the nacelle tank complete refueling through the nacelle tank only.

—CAUTION—

Never remove wing filler caps when there is fuel in the nacelle tanks.

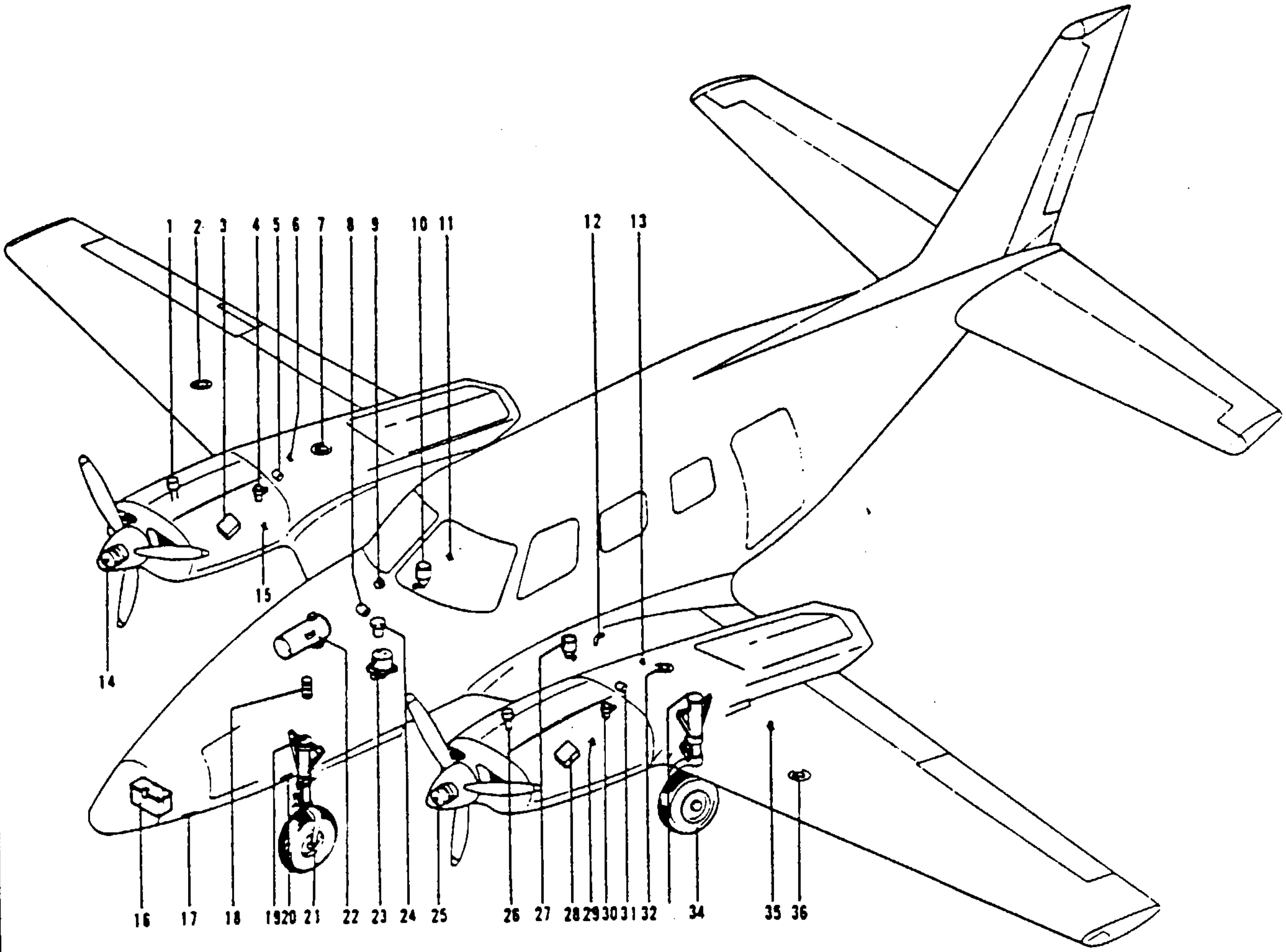
DRAINING MOISTURE FROM FUEL SYSTEM.

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. 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 arm of the drain 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.



1. OIL FILLER, RIGHT ENGINE
2. FILLER, RIGHT MAIN FUEL CELL
3. FILTER, RIGHT ENGINE INDUCTION
4. FILTER, RIGHT HYDRAULIC
5. FILTER, RIGHT PNEUMATIC
6. SUMP DRAIN, RIGHT OUTBOARD FUEL CELL
7. FILLER, RIGHT NACELLE FUEL CELL
8. FILTER, HEATER FUEL
9. GAUGE, OXYGEN PRESSURE
10. FUEL FILTER AND DRAIN, RIGHT
11. SUMP DRAIN, RIGHT INBOARD AND NACELLE FUEL CELLS
12. DRAIN, FUEL CROSSFEED
13. SUMP DRAIN, LEFT INBOARD AND NACELLE FUEL CELLS
14. AIR VALVE, RIGHT PROPELLER
15. OIL SUMP DRAIN, RIGHT ENGINE
16. BATTERY
17. EXTERNAL POWER SUPPLY
18. AIR CONDITIONING, RECEIVER-DRYER
19. FILLER, NOSE OLEO SHOCK STRUT
20. FILLER, OXYGEN
21. TIRE, NOSE
22. HEATER
23. RESERVOIR, POWER PACK
24. RESERVOIR, BRAKE SYSTEM
25. AIR VALVE, LEFT PROPELLER
26. OIL FILLER, LEFT ENGINE
27. FUEL FILTER AND DRAIN, LEFT
28. FILTER, LEFT ENGINE INDUCTION
29. OIL SUMP DRAIN, LEFT ENGINE
30. FILTER, LEFT HYDRAULIC
31. FILTER, LEFT PNEUMATIC
32. FILLER, RIGHT NACELLE FUEL CELL
33. FILLER, LEFT AND RIGHT OLEO SHOCK STRUT
34. TIRE, LEFT AND RIGHT MAIN
35. SUMP DRAIN, LEFT OUTBOARD FUEL CELL
36. FILLER, LEFT MAIN FUEL CELL

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 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

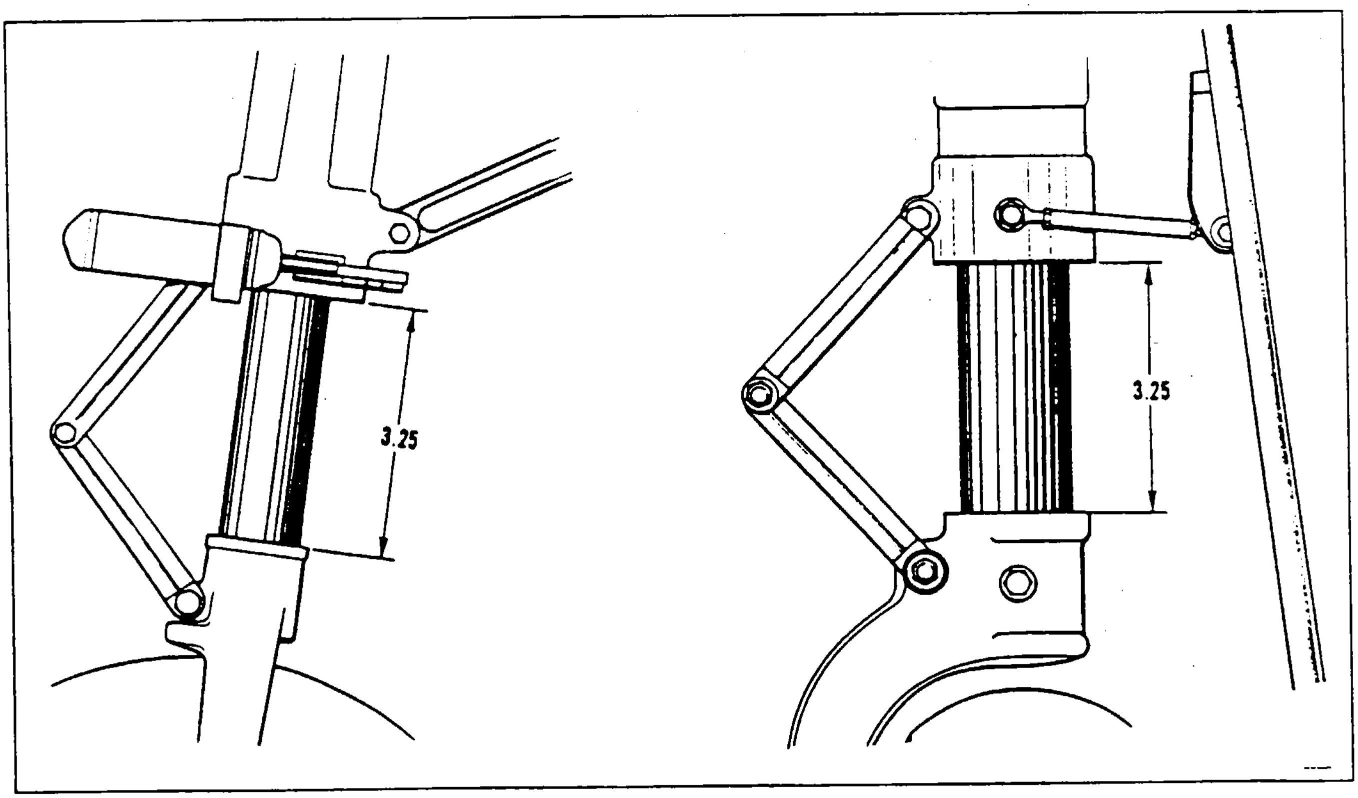


Figure 12-2. Landing Gear Strut Exposure

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). Place a pan under the gear to catch spillage.
2. 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 conntainer 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 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.

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 left 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 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 13 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 13 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 before draining of the old oil.

OIL FILTER (FULL FLOW).

1. The oil filter 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 throwaway filter, remove the element for inspection by using Champion cutter tool CT-470. Available from Champion Spark Plug Co., Toledo Ohio 43601. It will cut open any spin-on type filter for inspection. Examine the material trapped in the filter for evidence of internal engine damage such as chips or particles from bearings. In new or newly overhauled engines, some small 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 filter has been replaced, tighten the attaching bolt within 15 to 18 foot-pounds torque. Lockwire the bolt through the loops on the side of the housing to the drilled head of the thermostatic valve. Be sure the lockwire is replaced at both the attaching bolt head and the thermostatic oil cooler bypass valve.

OIL SCREENS (SUCTION).

The oil suction screen, is located on the left side 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-C11 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 T10-540 series engines are oils that conform with Lycoming Service Instruction No. 1014.
2. Whenever the oil is changed, remove and check the oil suction screen for metal particles. Clean and reinstall. Anyone using Spectrometric oil analysis should read the latest revision of Lycoming's Service Letter No. L171 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.

AIR FILTER.

SERVICING ENGINE AIR FILTER.

Visually inspect the filter to determine its condition. Accumulation of air laden contaminants 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.
2. Insert screws and secure. Tighten screws only enough to hold filter firm.
3. Install engine cowl. (Refer to Chapter 71.)

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 flight 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 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. FILL THE TRANSMISSION GEAR BOX WITH 20% AERO SHELL NO.7 GREASE AND 80% MOBIL JET OIL II. 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.
7. LUBRICATING OIL INTERVALS BETWEEN OIL CHANGES AS CAN BE INCREASED AS MUCH AS 100% ON ENGINES EQUIPPED WITH FULL FLOW CARTRIDGE TYPE) OIL FILTERS - PROVIDED THE ELEMENT IS REPLACED EACH 50 HOURS OF OPERATION. SEE LYCOMING SERVICE INSTRUCTION NO. 1014 FOR USE OF DETERGENT OIL.

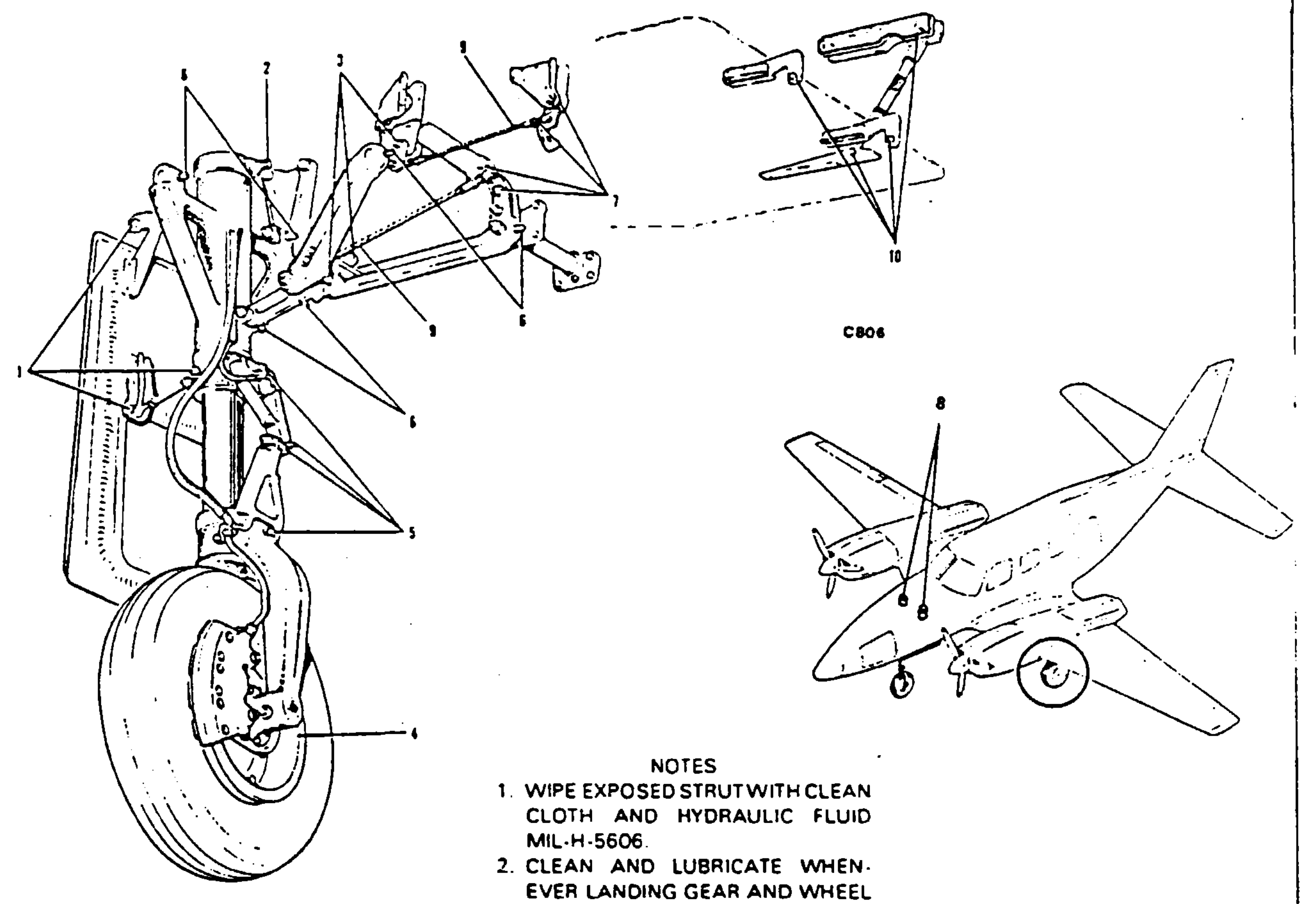
NOTES

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 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, CABLE ENDS, CYLINDER ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS
8. BRAKE AND POWER PACK RESERVOIR (SEE SPECIAL INSTRUCTION 4 AND CAUTION 1)	MIL-H-5606	AS REQUIRED
9. UPLOCK BUSHING	MIL-L-7870	100 HRS
10. GEAR DOOR INBOARD, HINGES AND CYLINDER ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS

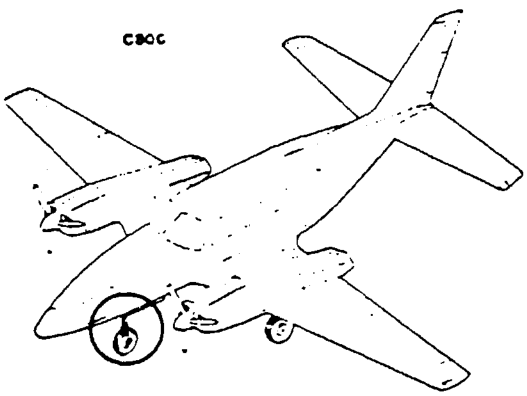


NOTES
1. WIPE EXPOSED STRUT WITH CLEAN CLOTH AND HYDRAULIC FLUID MIL-H-5606.
2. CLEAN AND LUBRICATE WHENEVER LANDING GEAR AND WHEEL AREA HAS BEEN WASHED.

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 CABLE (SEE NOTE 2)	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 MOBILUS 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. 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.



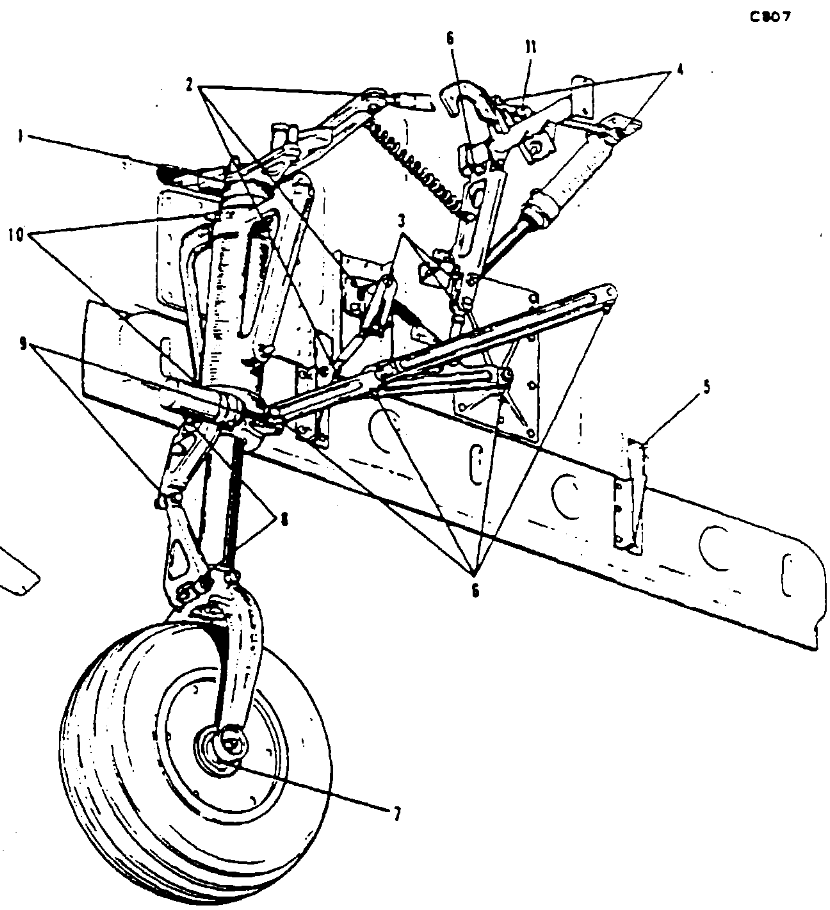


Figure 12-4. Lubrication Chart (Landing Gear. Nose)

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)	MIL-G-23827	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

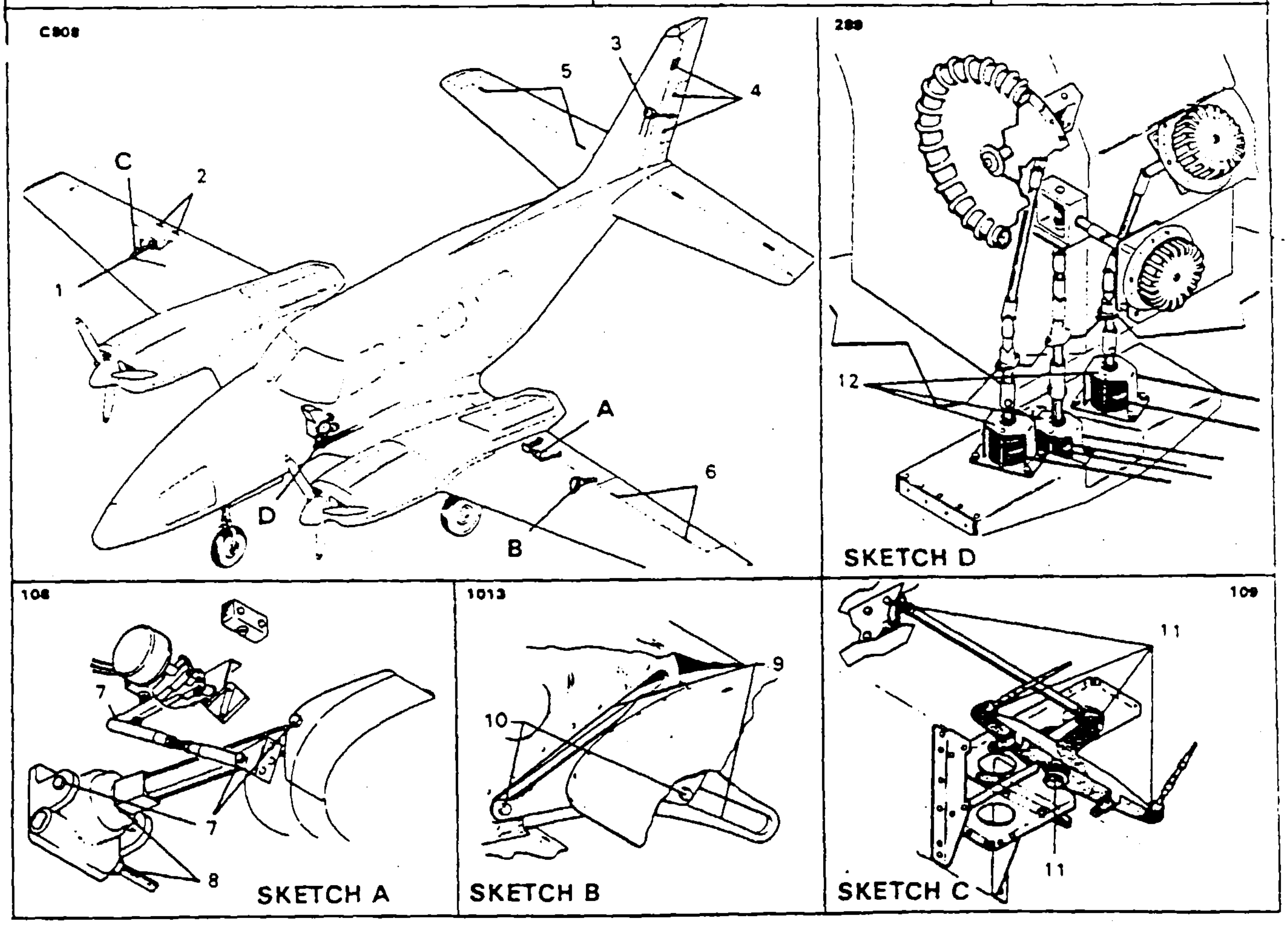


Figure 12-5. Lubrication Chart (Control System)

	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

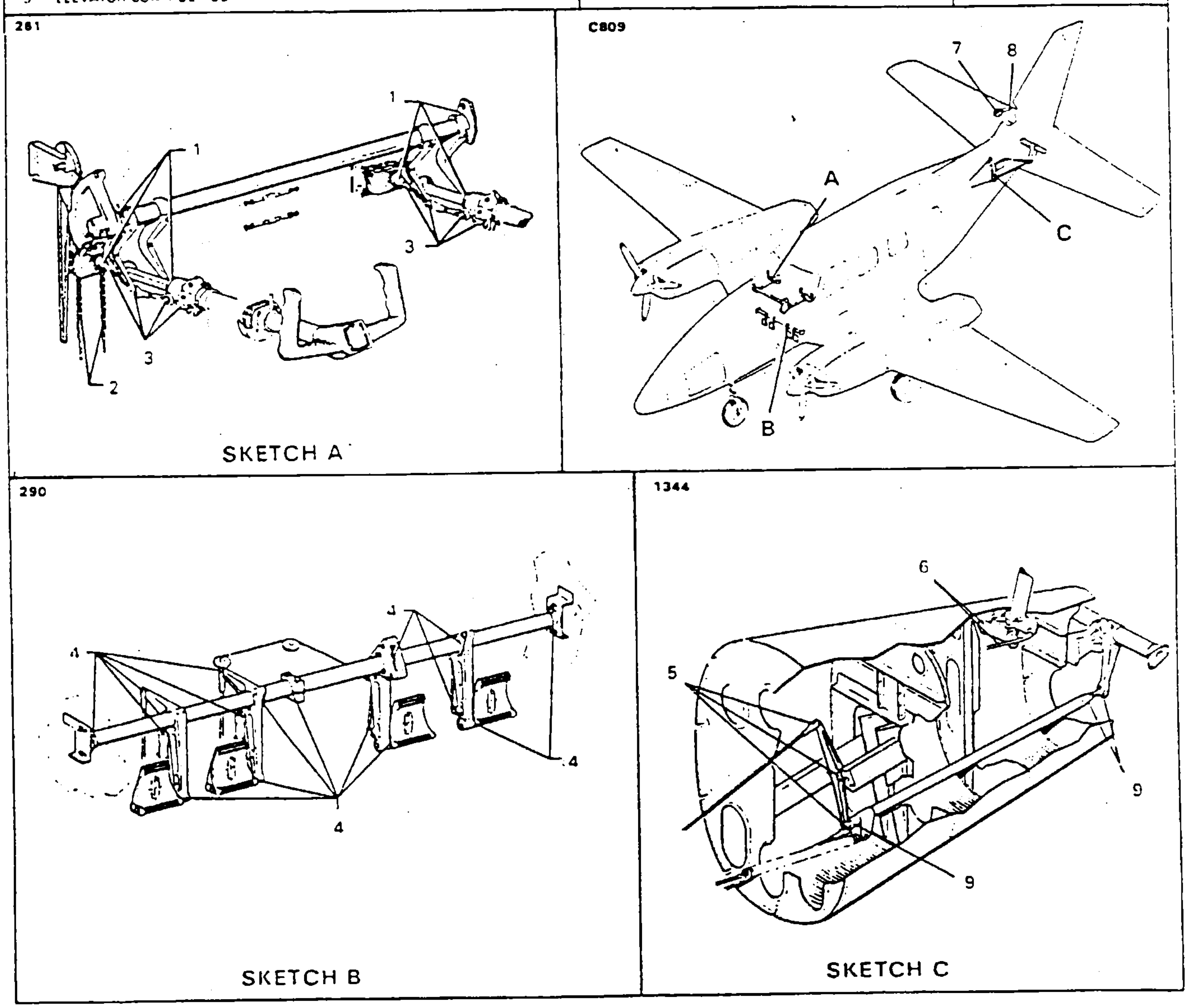


Figure 12-5. Lubrication Chart (Control System) (cont.)

	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 BELLCRANK BEARINGS RIGHT AND LEFT	MIL-L-7870	100 HRS
9	COWL FLAP CONTROL ROD ENDS RIGHT AND LEFT	MIL-L-7870	100 HRS
10	COWL FLAP HINGE	MIL-L-7870	100 HRS

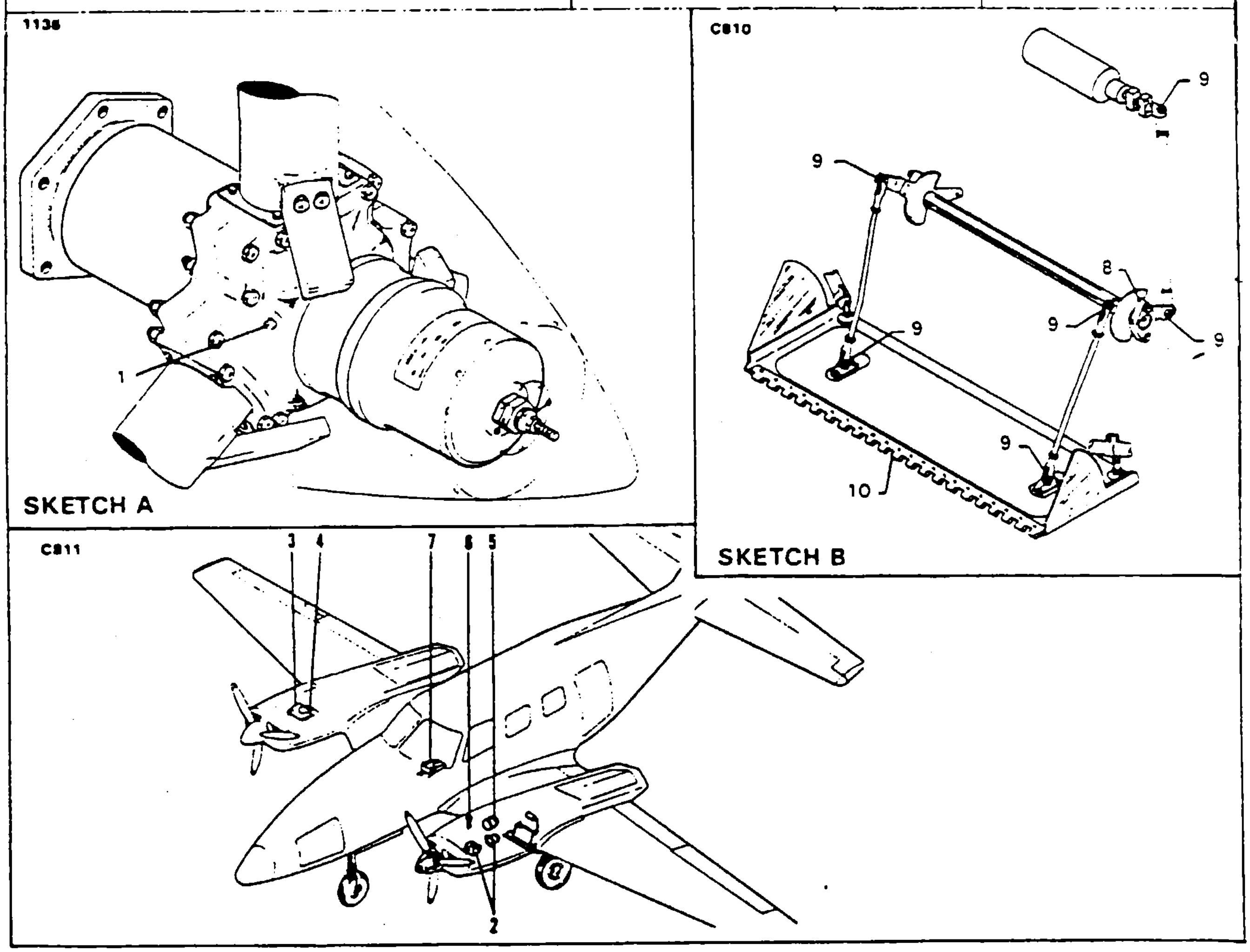


Figure 12-6. Lubrication Chart (Power Plant. Propeller and Cowl Flap)

	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	NACELLE LOCKER HINGES	MIL-L-7870	100 HRS
4	SEAT TRACKS	MIL-L-7870	100 HRS

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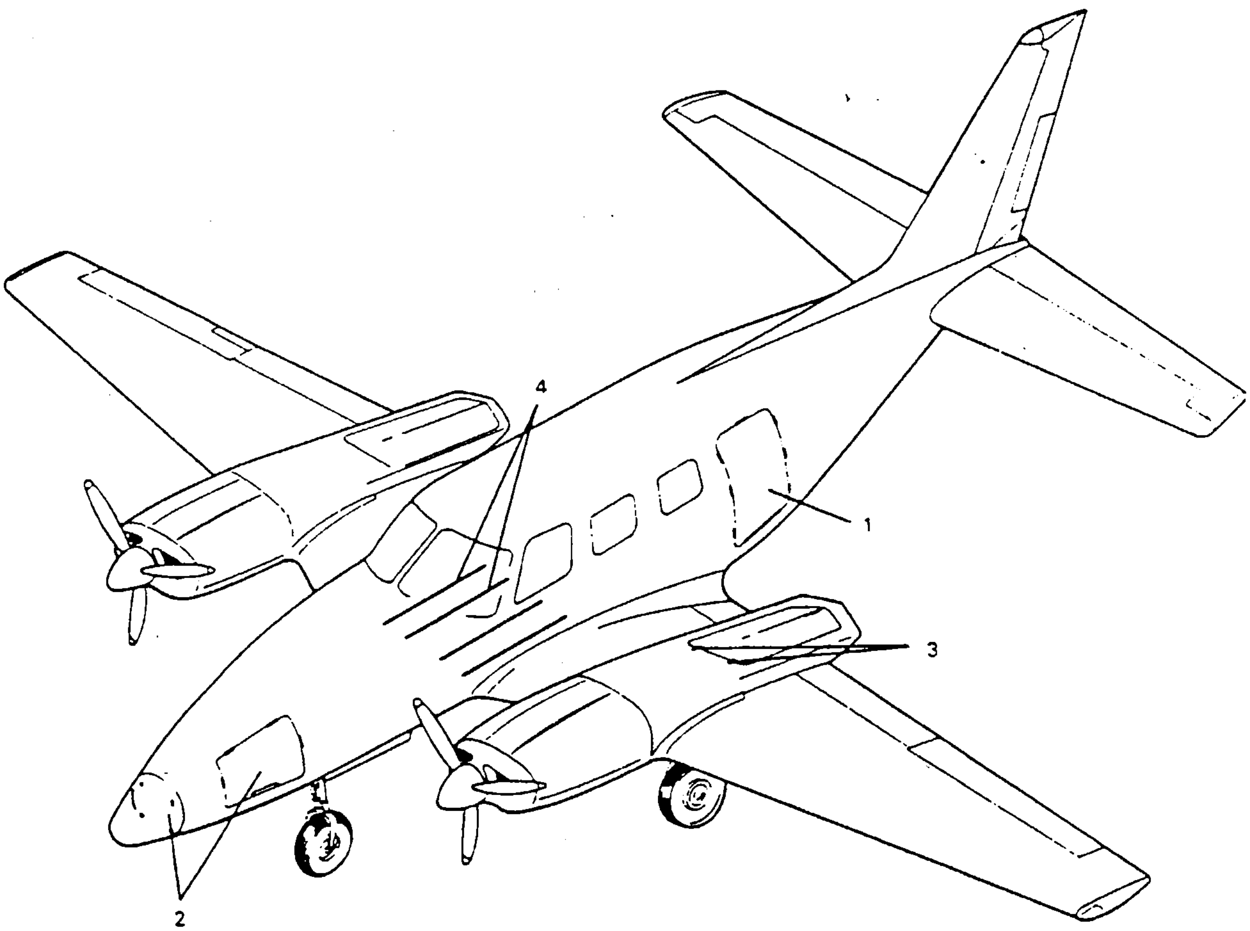

Figure 12-7. Lubrication Chart (Doors and Seats)

UNSCHEDULED SERVICING.

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. 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. (Refer to Chapter 21 for Maintenance Instructions for the air conditioning system.)

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 engine cowl.
2. Remove the filter attachment screws on the outside of the plenum.
3. Remove the filter.

INSTALLATION OF INDUCTION AIR FILTER.

1 Place filter in plenum.
2. Attach plenum with screws.
3. Reinstall 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. Push the valve free of the magnetic catch and firmly press the valve in the fully open position. Upon release the valve should fall free and latch on the magnetic catch.
4. Free the valve from the catch and slowly allow the valve to hang free. The valve should be drawn closed by the magnetic catch.
5. Check to insure both magnetic catch plates make full contact with alternate air door. Full contact can be obtained by adjusting the magnetic catch on its bracket.

OXYGEN SYSTEM.

The oxygen for the breathing system is furnished from a stationary cylinder located in the nose section of the airplane. The storage cylinder is made of a light weight aluminum liner covered with a Kevlar 49 epoxy resin composite. Cylinders are available in the 22 cu. ft, or 50 cu, ft, capacities; also available for compliance with FAR 135 certification is a 50 cu. ft. cylinder with an altitude compensated regulator. 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 filing 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 1537.8 and 2234.5 psi 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 recharger 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 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 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. OXYGEN SERVICING TABLE FOR 22 AND 50 CUBIC FOOT CYLINDERS

Ambient Temperature Degrees Fahrenheit	After Cooling Pressure Static	*Filling Pressure For 1850 PSI At NTP
-20	1417.7	1537.8
-15	1441.8	1561.9
-10	1465.8	1585.9
-5	1489.8	1609.9
0	1513.8	1633.9
5	1537.8	1658.0
10	1561.9	1682.0
15	1585.9	1706.0
20	1609.9	1730.0
25	1633.9	1754.1
30	1658.0	1778.1
35	1682.0	1802.1
40	1706.0	1826.1
45	1730.0	1850.1
50	1754.1	1874.2
55	1778.1	1898.2
60	1802.1	1922.2
65	1826.1	1946.2
70	1850.1	1970.3
75	1874.2	1994.3
80	1898.2	2018.3
85	1922.2	2042.3
90	1946.2	2066.4
95	1970.3	2090.4
100	1994 3	2114.4
105	2018.3	2138.4
110	2042.3	3162.4
115	2066.4	2186.5
120	2090 4	2210.5
125	2114.4	2234.5

*This column assumes about a 25°F rise in temperature due to the heat of compression.

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CHAPTER

20

STANDARD PRACTICES/ AIR FRAME

CHAPTER 20- STANDARD PRACTICES - AIRFRAME

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 20- STANDARD PRACTICES - AIRFRAME (cont.)

TABLE OF CONTENTS/EFFECTIVITY

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 inspection 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 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: $C = A \times T$

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.

$C = 1 \times 30$ or $C = 30 = 24$ft.-lbs.

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

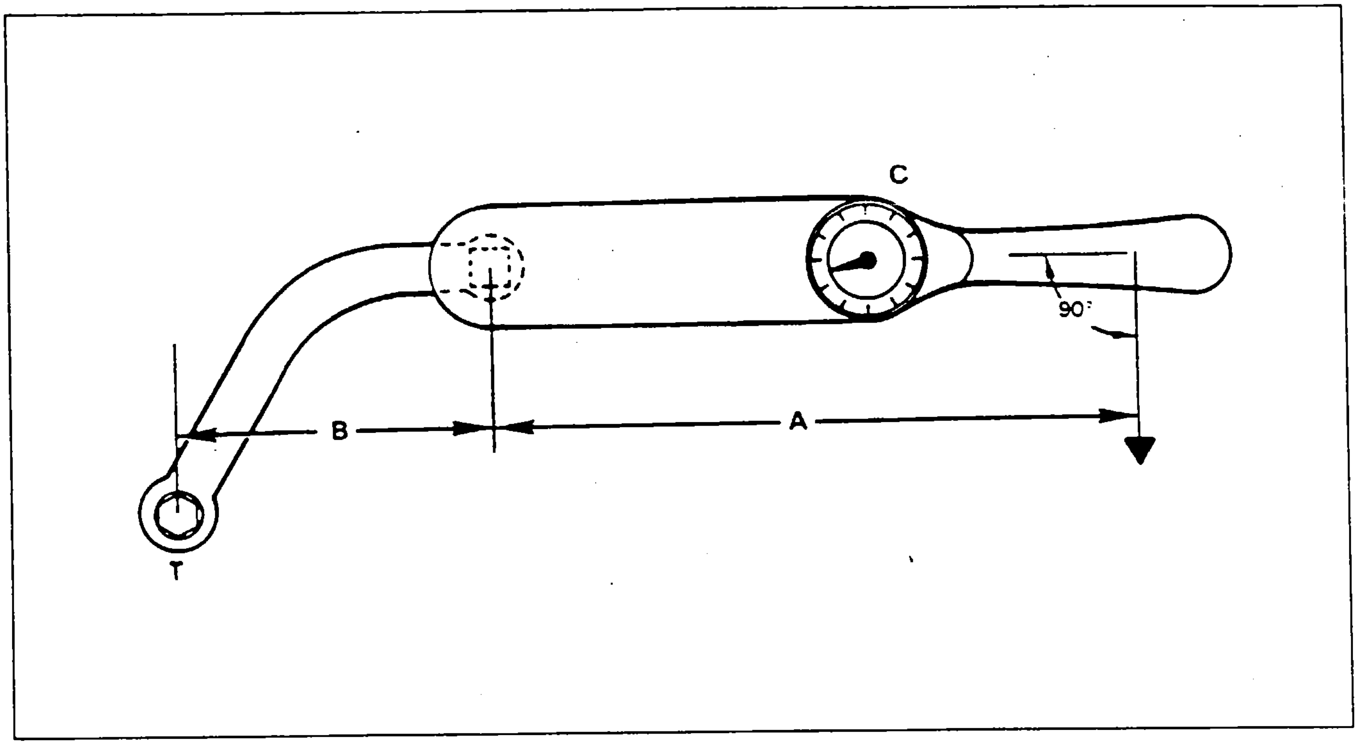


Figure 20-1. Torque Wrench Extension

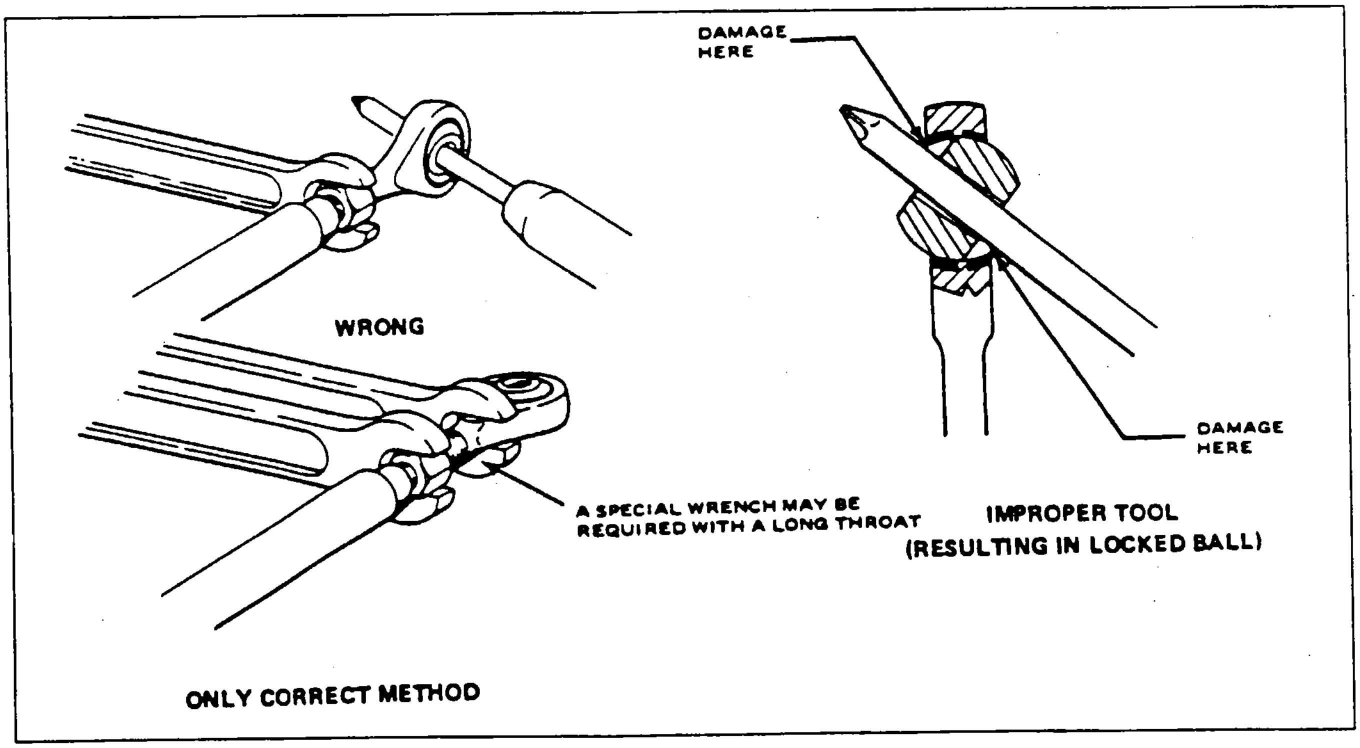


Figure 20-2. Method of Installing Rod End Bearings

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 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 use 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 the same diameter equal to the rivet shank. (See View 6).

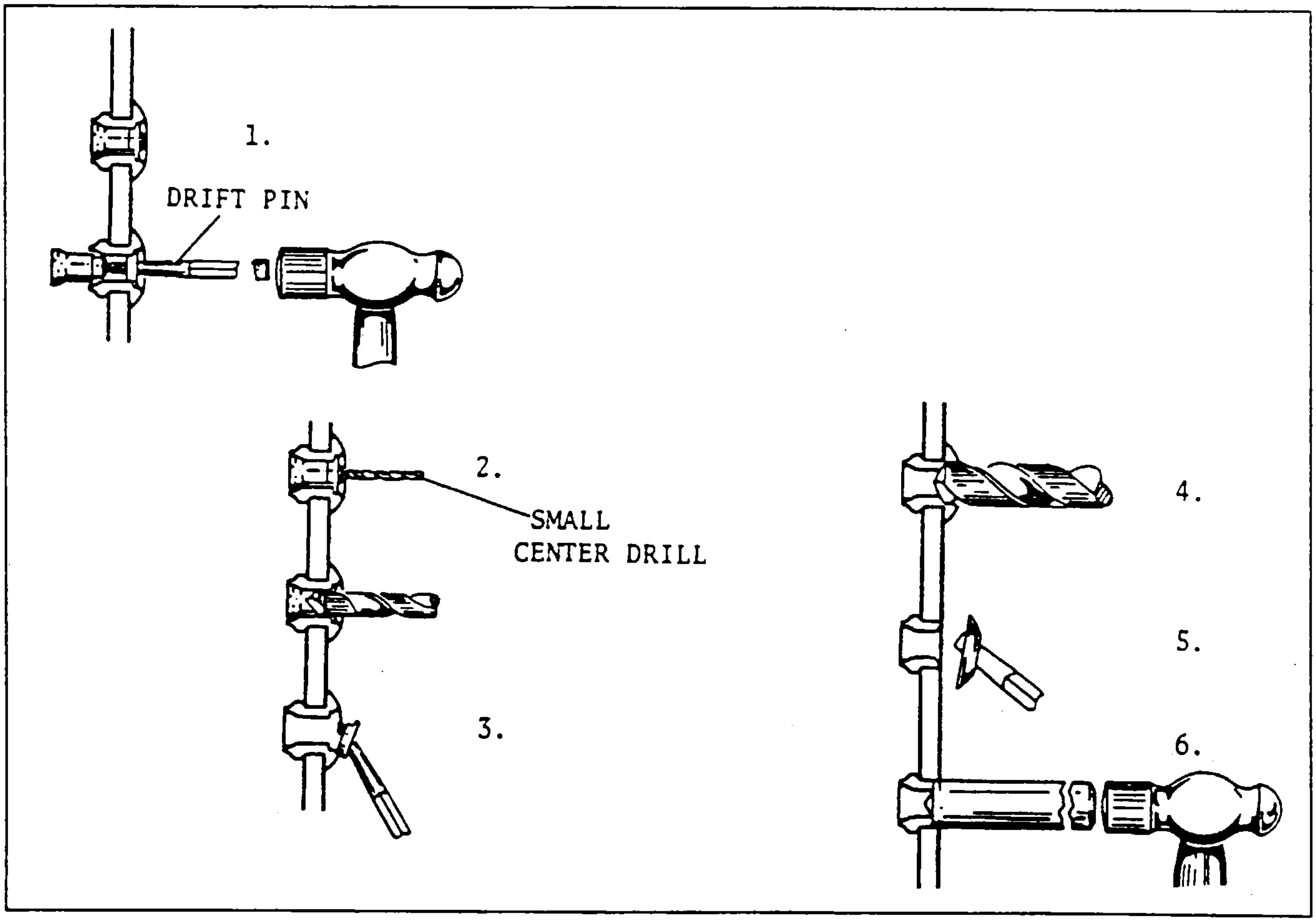


Figure 20-3 Cherrylock Rivet Removal

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

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

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

The aircraft and engine manufacturers are responsible for 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.

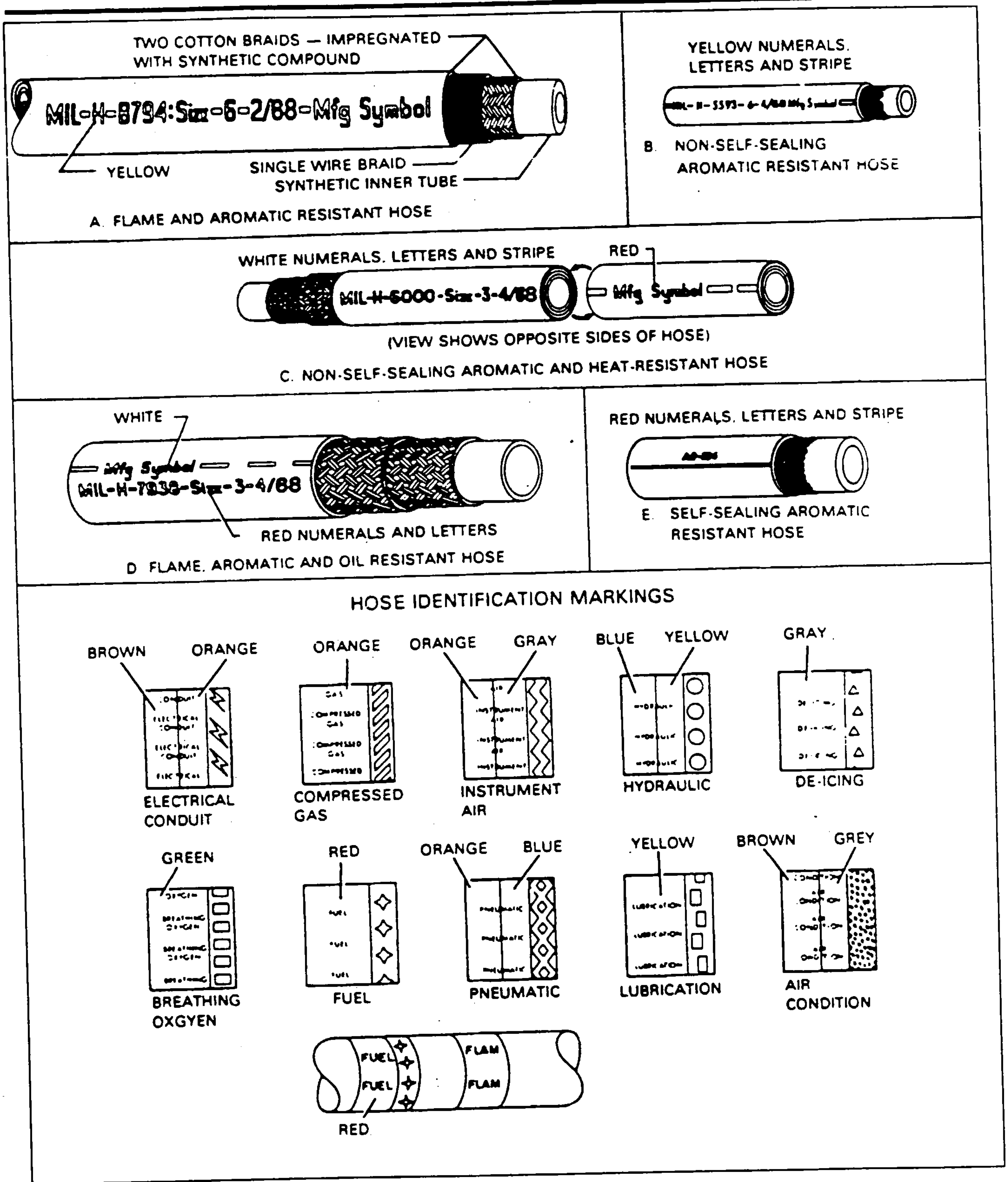
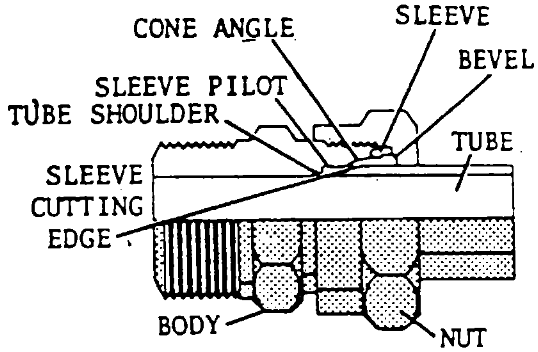


Figure 20-4. Hose Line Markings

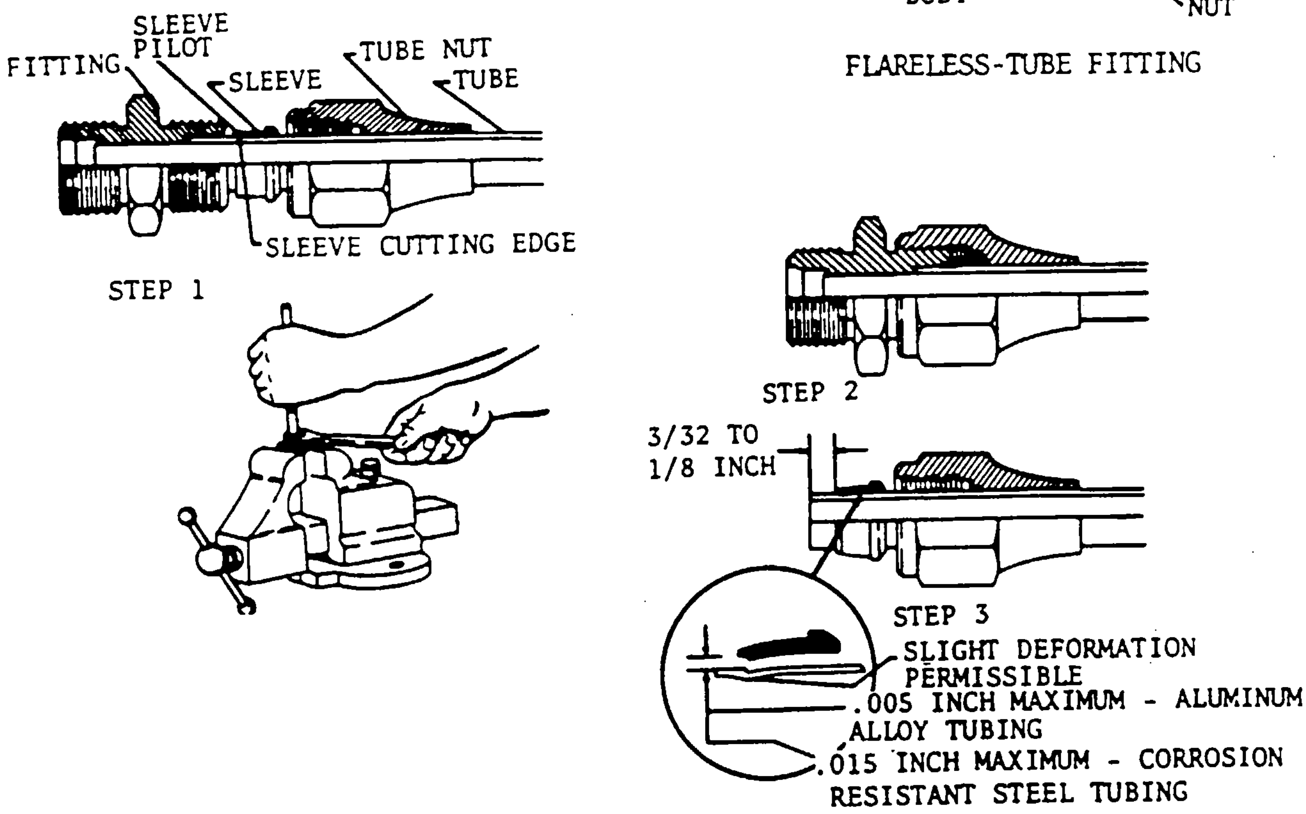
TUBING SYSTEM	LUBRICANT
HYDRAULIC	MIL-H-5606
FUEL	MIL-H-5606
OIL	System Oil
PNEUMATIC	MIL-L-4343
OXYGEN*	MIL-T-5542

*CAUTION-DO NOT USE OIL OR GREASE

TUBING AND HOSE LUBRICANTS



FLARELESS-TUBE FITTING



PRESETTING FLARELESS-TUBE ASSEMBLY

Figure 20-5. Flarless 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 brightness are to be used, insure adequate protection for the windshield by using paper and pasteboard prior to painting.

CLEANING INTERIOR SURFACES

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 non-inflammable dry-cleaning fluid.

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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 windshield 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 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.
5. Lubricate controls, bearing surfaces, etc., per Lubrication Chart.

PAINTING.

This section contains description 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 may be found in the aircraft's logbook, Parts Catalog or the Pilot's Operating Handbook.

PAINTING SAFETY.

The over spray from certain enamels, if swept up and put in a pail of water can catch fire by themselves. Keep all over spray residue in covered containers away from the buildings where spraying is done. Wash out thoroughly rags and sponges which have been use 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 arching 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 sand scratches 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 pressure, 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 can 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.

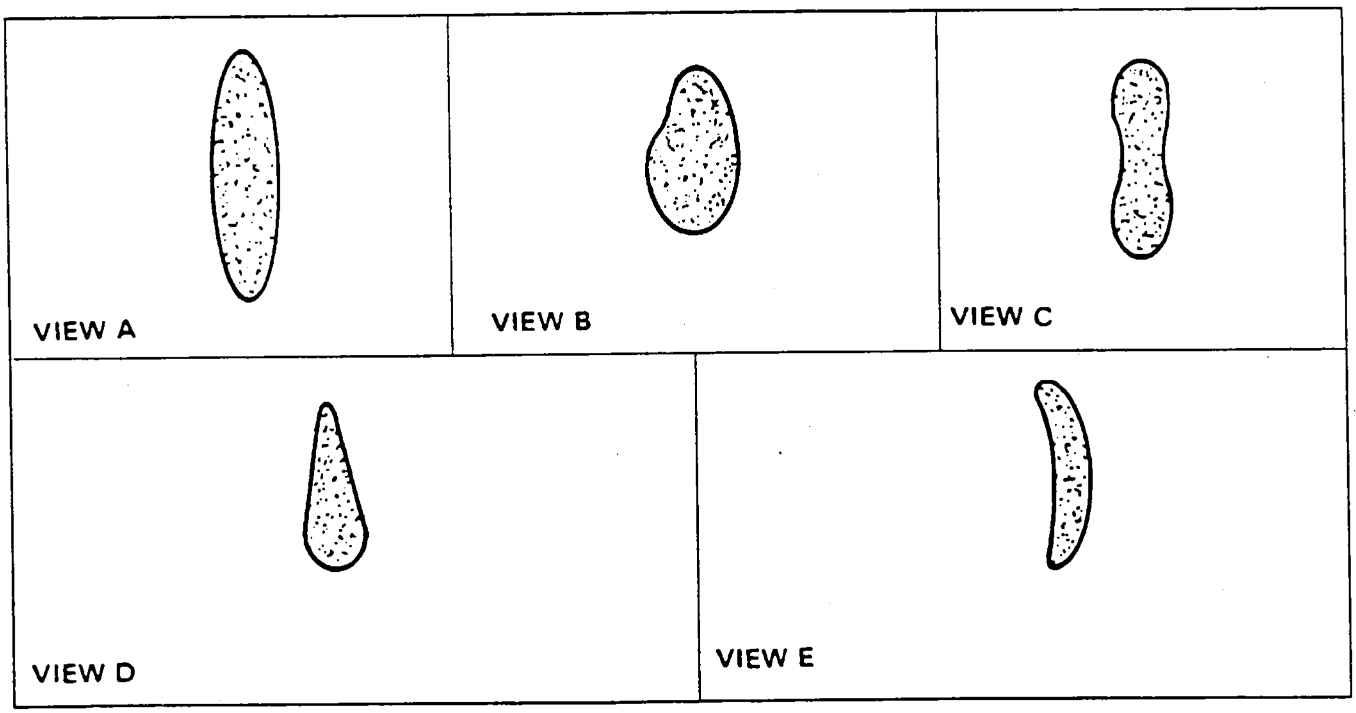

Figure 20-6 Spray Patterns

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 the 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 though 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 part in acetone or MEK. If passages should become plugged up with polyurethane or epoxies, discard hoses and clean the passages by digging 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 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 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 pass. Continue this overlap and the resulting finish will be a nice even film with no runs or sags.

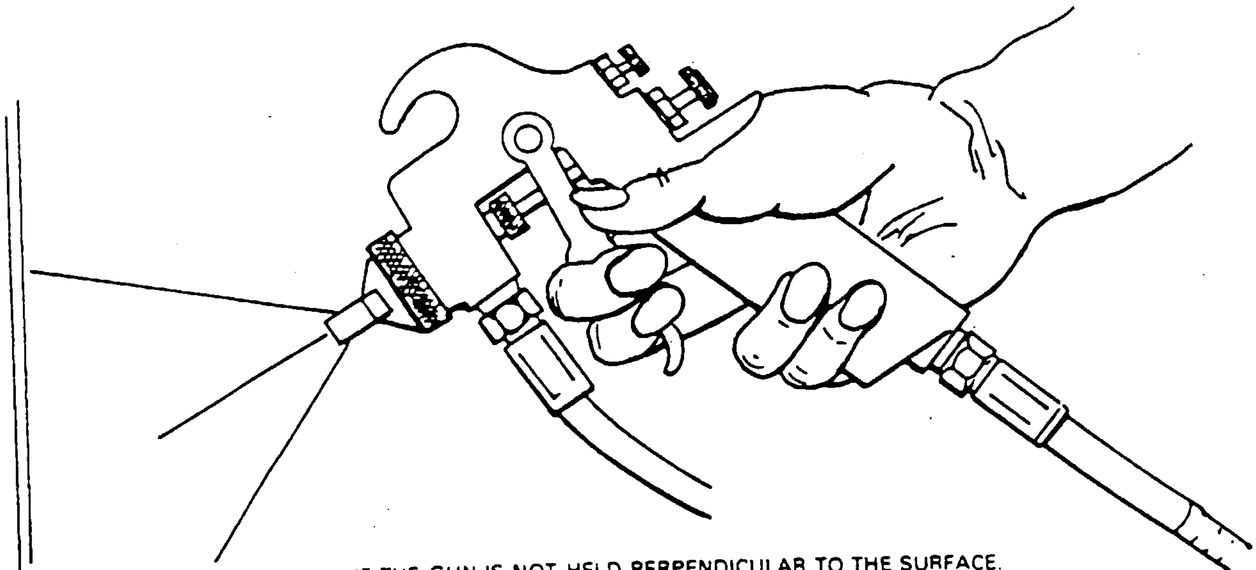

Figure 20-7. Improper Spray Technique

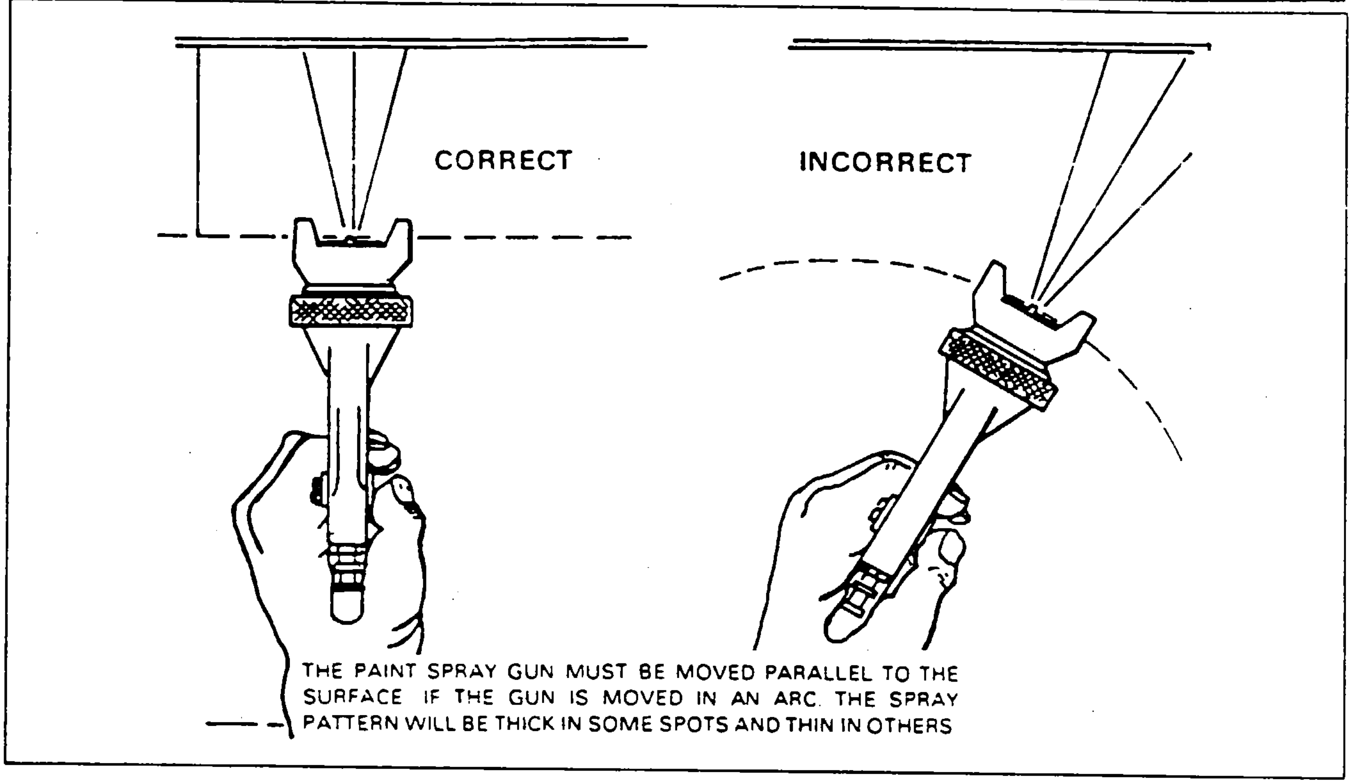

Figure 20-8. Spray Technique

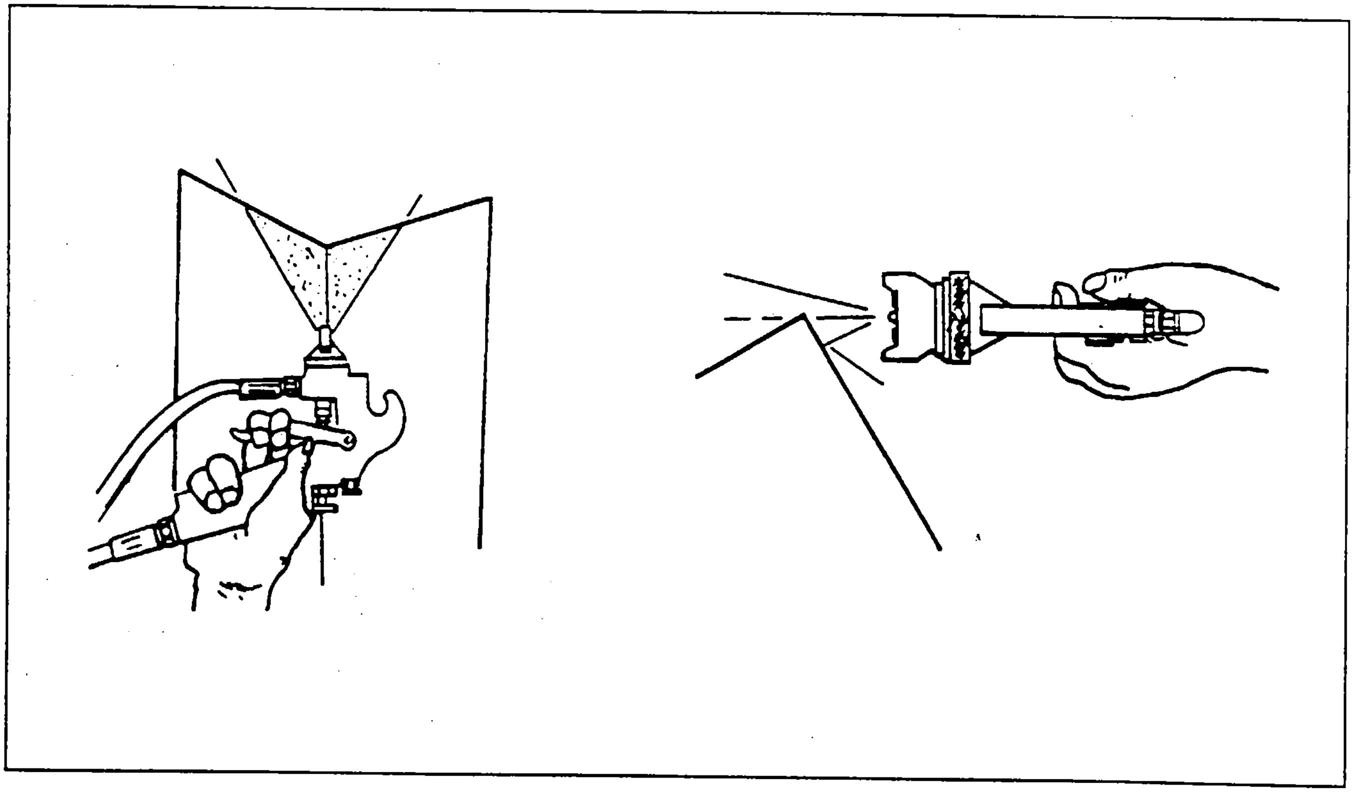

Figure 20-9. Spraying Corners

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 side 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 chord wise. 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 chord wise.

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 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 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 paint as originally used and insure that it is thoroughly mixed. Use either a mechanical shaker for 15 minutes, of if no shaker is accessible, use the following steps:

1. Pour off half of the can of material into a CLEAN can or 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 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 #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 MAY BE 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, Alloy 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 MEK 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.
   Alloy the zinc chromate wash primer to dry 30 minutes minimum before applying 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 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 topcoating 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 air pressure 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-O-Plate 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 over aged "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 is 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. air drying 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 absorbent 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.

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CHAPTER

21

ENVIRONMENTAL SYSTEM

CHAPTER 21- ENVIRONMENTAL SYSTEMS

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CHAPTER 21- ENVIRONMENTAL SYSTEM (CONT.)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The environment control system for this aircraft consists of several units working together to furnish a means of pressurization, heating, cooling and dehumidification.

DESCRIPTION OF OPERATION.

Pressurization air for the cabin of the PA-31P-350 is obtained by bleeding air through a sonic nozzle mounted on each engine turbocharger, and is supplemented by pneumatic engine driven pumps for the control needed of operation for the system. The air leaves the bleed ports on each engine and travels to the heat exchanger and intercooler where an air-to-air heat exchange process takes place. From the intercooler assembly the air is routed to the main pressurization line below the cabin floor. It then passes through the pressurized air control box assembly which controls the flow of air that is to be routed to the cabin or overboard. If the air is not needed for pressurization, the control box is actuated to discharge the air below the cabin floor and allowed to flow overboard. When the control box is closed, the air is directed through the environmental control system and through the air distribution ducts along both sides of the cabin walls. All controls needed for operation and regulation of cabin pressurization are mounted on the lower left side of the instrument panel, along with instruments to simplify the setting and checking of system operation. Both the cabin altitude and rate-of-climb adjustments are made by the pilot, through the use or the cabin altitude selector and the rate-of-change control. This unit is operated pneumatically from the vacuum supply. The rate of ascent or descent is variable from 175 ±125 feet per minute to 2500 ±500 feet per minute. A three position electrical dump switch is incorporated into the system to unload cabin pressure. A squat switch on the left main landing gear prevents the cabin from being pressurized while the airplane is on the ground.

TROUBLESHOOTING.

Probable troubles peculiar to the pressurization system components covered in this chapter are listed in Chart 2101, along with their probable causes and suggested remedies. After the trouble has been corrected, check the entire system for security and operation of its components.

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CHART 2101. TROUBLESHOOTING (PRESSURIZATION SYSTEM)

TROUBLE	CAUSE	REMEDY
Cabin will not pressurize.	Blocked safety valve cabin air filter or orifice.	Replace filter and check orifice.
	Blocked controller cabin air filter with orifice.	Clean filter and check orifice on controller.
	Internal malfunction in the isobaric valve.	Remove and replace.
	Internal malfunction in the safety valve.	Remove and replace.
	Internal malfunction in the controller.	Remove and replace controller.
	Defective landing gear safety switch.	Remove and replace switch.
	Defective dump test switch.	Replace switch.
	No pressure to door seal.	Check and repair door seal
	Excessive leakage in pressurization ducts.	Locate leak and tighten connections.
	Excessive cabin leakage.	Locate and repair leak.
	Solenoid valve malfunctions in the open position.	Replace valve.
	Valve on pressurized air control box won't close.	Adjust or lubricate valve or control linkage.
	Valve on outside air control box won't close.	Adjust or lubricate valve or control linkage.
Cabin pressurization to full positive differential pressure after takeoff.	Vacuum tube not connected to controller.	Connect vacuum tube.
	Malfunction in aircraft vacuum supply.	Check aircraft vacuum supply.
	Rupture in volume tank.	Replace tank.

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

TROUBLE	CAUSE	REMEDY
Cabin pressurizes to full positive differential pressure after takeotf. (cont.)	Internal malfunction in the isobaric valve.	Remove and replace valve.
	Internal malfunction in the controller.	Remove and replace controller.
Cabin altitude decreases below selected altitude.	Low aircraft vacuum supply.	Check aircraft vacuum supply.
	Minor leak in tube between controller and volume tank or in volume tank.	Remove and replace tube or volume tank.
	Minor leak in tube between controller and isobaric valve or in isobaric valve.	Remove and replace tube or isobaric valve.
	Minor leak in the controller.	Remove and replace controller.
Minimum rates unbalanced, down rate faster than up rate.	Minor leak in tube between controller and volume tank or in volume tank.	Remove and replace tube or volume tank.
	Minor leak in the controller.	Remove and replace controller.
Higher unpressurized operation before takeoff and after landing.	Solenoid valve malfunction in the closed position.	Replace valve.
	Landing gear switch or test dump switch malfunction in the open position.	Remove and replace switch.
	Broken wiring to the vacuum relief solenoid.	Repair wiring
	Loose or damaged pneumatic tube between solenoid valve and safety valve.	Check tube connections or replace damaged tube.
	Internal malfunction in the safety valve.	Remove and replace valve.

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

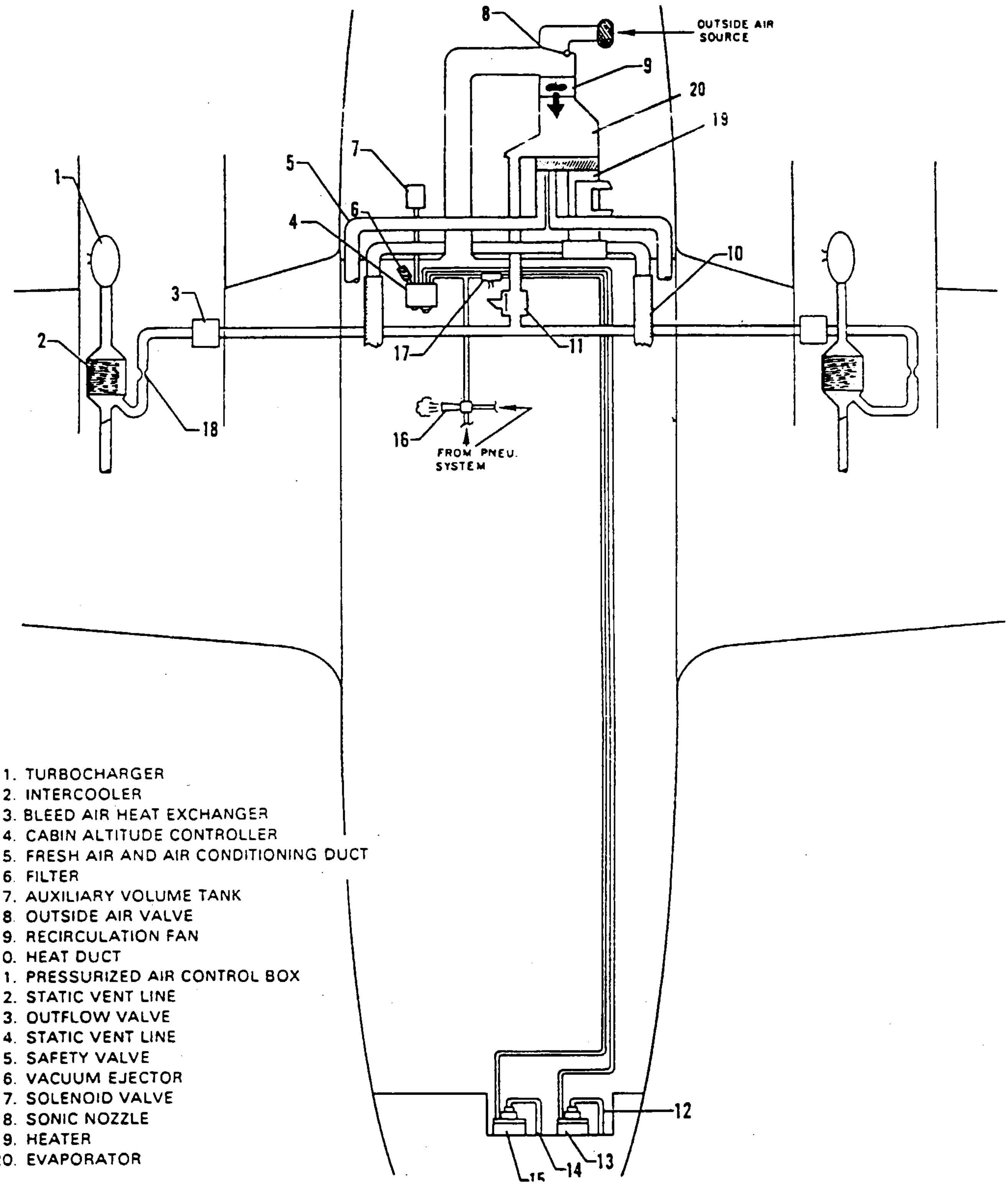
TROUBLE	CAUSE	REMEDY
Cabin exceeds full positive differential calibrated setting.	True static atmosphere tube blocked or not connected on isobaric valve and safety valve.	Securely connect or remove blockage from the true static atmospheric tube on isobaric valve and safety valve.
	Loose or damaged pneumatic tubing from port "1" of safety and isobaric valve to atmosphere.	Repair or replace tubing
Cabin climbs and descends at a fixed rate regardless of rate selection.	Internal malfunction in controller.	Remove and replace controller.
Cabin rate exceeds selected rate valve during aircraft climb to cruising altitude.	Malfunction in controller.	Remove and replace controller.
	Defective cabin rate of climb indicator.	Remove and replace indicator.
Cabin pressure rapidly increases or decreases with reselection of cabin altitude.	Malfunction in controller.	Remove and replace controller.
Cabin altitude exceeds selected value.	Loss of airflow into cabin.	Repair or replace air supply.
	Internal malfunction in isobaric valve.	Remove and replace valve.
	Internal malfunction in safety valve.	Remove and replace valve.
	Internal malfunction in controller.	Remove and replace controller.
	Excessive cabin leak valve.	Seal leaks.
Cabin pressure will not maintain control setting.	Dump valve partially open.	Close valve: adjust valve control cables.
	Defective isobaric control valve.	Remove and replace valve.
	Defective safety valve.	Remove and replace valve.

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

TROUBLE	CAUSE	REMEDY
Cabin pressure will not maintain control setting. cont.)	Defective pressurized air dump valve.	Remove or repair valve.
	Defective cabin altitude controller.	Remove and replace cabin altitude controller.
	Pressurization duct leakage.	Locate leak and tighten connection.
	Cabin leakage.	Locate and repair leak.
	Defective cabin altitude pressure gauge.	Remove and replace gauge.
	Foreign matter on isobaric control valve or safety valve seats.	Clean valve seats.
	Leak in isobaric valve control line.	Locate leak and tighten connection.
Cabin pressure excessively high.	Isobaric static line clogged.	Clean static line.
	Defective cabin over pressure switch.	Remove and replace switch.
	Defective cabin altitude pressure gauge.	Remove and replace gauge.
	Safety valve static vent clogged.	Clean vent line.
	Defective safety valve.	Remove and replace valve.
Cabin door unsafe light will not go out.	Latching relay sticking in the open position.	Lubricate the mechanical parts (sparingly) with "Glide Air" or equivalent.
	Switch or switches in door frame out of adjustment.	Adjust.
	Defective pressure switch.	Replace switch.
	Short to ground.	Check wiring and repair.

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

TROUBLE	CAUSE	REMEDY
Cabin door light will not come on.	Circuit breaker open.	Reset circuit breaker.
	Broken wire or loose connection .	Check wiring and repair
No pressure to door seal.	Leak in door seal pressure system.	Check and repair door seal. pressure system.



1. TURBOCHARGER
2. INTERCOOLER
3. BLEED AIR HEAT EXCHANGER
4. CABIN ALTITUDE CONTROLLER
5. FRESH AIR AND AIR CONDITIONING DUCT
6. FILTER
7. AUXILIARY VOLUME TANK
8. OUTSIDE AIR VALVE
9. RECIRCULATION FAN
10. HEAT DUCT
11. PRESSURIZED AIR CONTROL BOX
12. STATIC VENT LINE
13. OUTFLOW VALVE
14. STATIC VENT LINE
15. SAFETY VALVE
16. VACUUM EJECTOR
17. SOLENOID VALVE
18. SONIC NOZZLE
19. HEATER
20. EVAPORATOR

Figure 21-1. Pressurization System Schematic (Garrett)

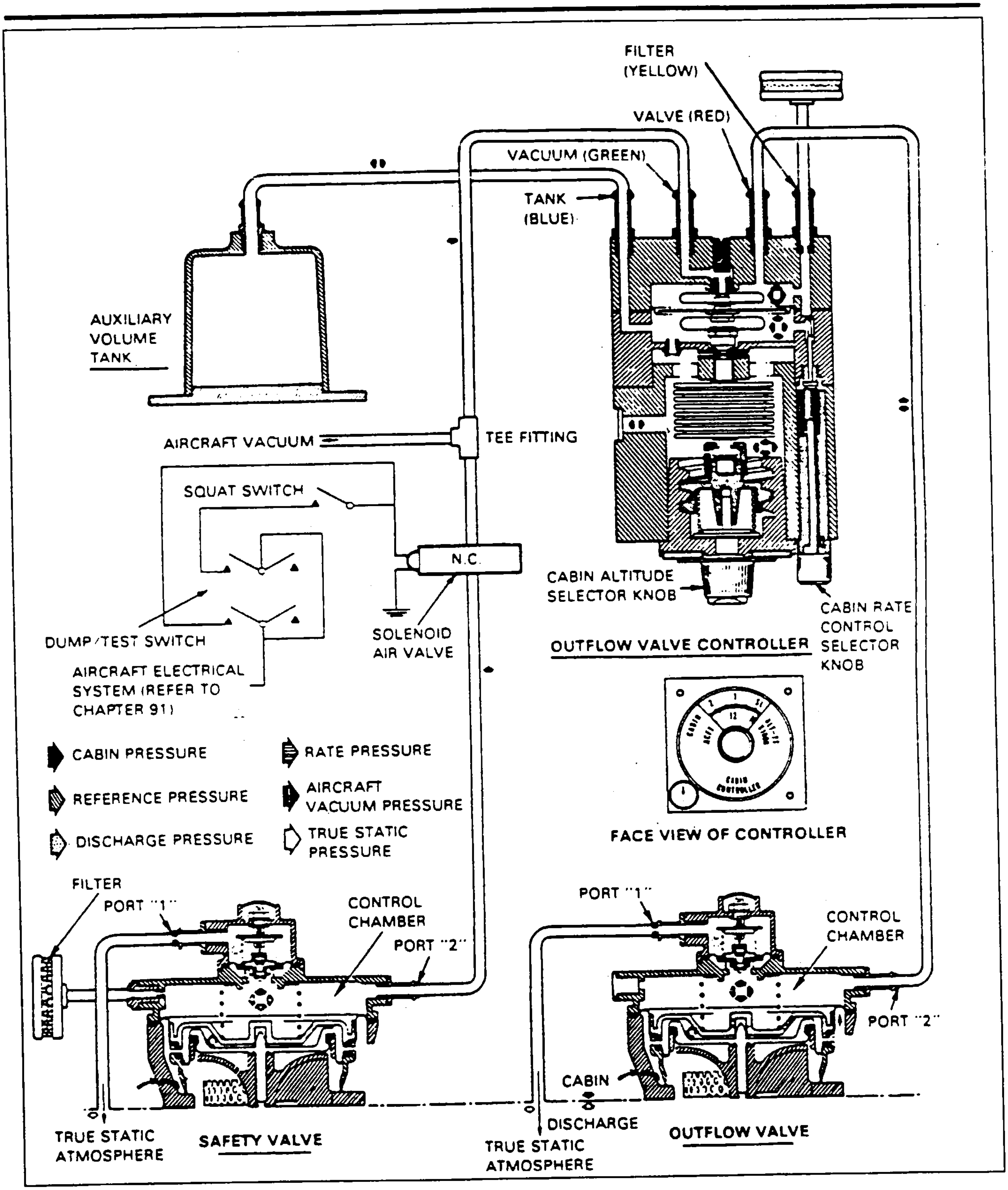


Figure 21-2. Cabin Pressure Control System Schematic (Garrett)

PRESSURIZATION CONTROL. (Refer to Figure 21-2.)

The cabin pressure control system consists of the cabin outflow valve, cabin safety valve, cabin pressure controller, auxiliary volume tank, filter, vacuum solenoid relief valve, cabin pressure test dump switch, cabin differential pressure switch, cabin absolute pressure switch and plumbing and wiring as required. Each of the above items will be given a detailed description of operation following this general description of the cabin pressure control system.

The cabin safety valve is held open on the ground with the engines operating by a vacuum applied to the control chamber of the safety valve. This vacuum holds the safety valve open while on the ground through the action of the landing gear squat switch which energizes the vacuum relief solenoid valve to open it.

The cabin pressure controller is mounted on the lower left side of the instrument panel, and the auxiliary volume tank and filter are located behind the instrument panel. The volume tank provides additional volume for the rate pressure chamber in the controller, thus providing greater accuracy of the cabin rate-of-change control. The air filter eliminates entry of tobacco tar and dust particles greater than .3 microns into the pneumatic control elements of the controller.

A differential pressure warning light is mounted on the annunciator to warn the pilot if the cabin differential pressure passes above 5.15 to 5.25 psi or the absolute cabin altitude goes above 10,250 ±250 feet.

An electrical dump switch having three positions (dump, normal and test) is incorporated in the system. This switch, when placed in the "DUMP" position. energizes the vacuum solenoid and opens the safety valve. The 'TEST' position bypasses the landing gears quat switch thus permitting the cabin to be pressurized on the ground for test purposes only. The normal position is "CABIN PRESS" which allows the system to pressurize after takeoff.

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COMPONENT DETAILED DESCRIPTIONS.

1. Cabin Outflow Valve: (Refer to Figure 21-3.)
   The outflow valve consists of two sections a head section and a base section. The head section contains port "2" (controller connection) and a plugged cabin air port. Mounted on the head is the differential control, which contains port "1" (true static atmosphere connection with orifice). The base assembly encloses a poppet outflow valve which seats on a surface of the base assembly when in the closed position.
2. Cabin Safety Valve: (Refer to Figure 21-3.)
   The safety valve consists of two sections, a head section and a base section. The head section contains port "2" depressurization connection and a cabin air filter with orifice. Mounted on the head is a differential control which contains port "1" (true static atmosphere connection with orifice). The base assembly encloses a poppet outflow valve which seats on a surface of the base assembly when in the closed position.
3. Cabin Pressure Controller: (Refer to Figure 21-4.)
   The body of the controller is composed of three elements. The lower element forms a chamber which is open to cabin pressure and houses the absolute bellows. It also is the face of the controller, and has the cabin altitude selector knob and the cabin rate control knob. The middle element, when assembled to the lower element, completes the cabin pressure chamber and seals the cabin pressure chamber from the rest of the controller with a sealing diaphragm. The opposite side of the middle element forms a rate pressure chamber which houses the rate spring. The upper element, when assembled to the rate diaphragm and other two elements, forms a reference pressure chamber which houses the reference pressure metering valve and metering valve follower spring. This element also contains the various air connections for installation of the controller into the cabin pressure control system.
4. Auxiliary Volume Tank:
   This is a small sealed chamber located close to the controller and when connected to the controller, provides additional volume to the rate pressure chamber in the controller, thus providing greater accuracy of the cabin rate-of-control.
5. Air Filter:
   The filter element is a cylindrical plug of treated paper fabric material, completely enclosed in a thin aluminum case with perforations located around its circumference. The filter effectively eliminates the entry of tobacco tar and dust particles greater than .3 microns in diameter into the pneumatic control elements of the outflow valve controller.
6. Cabin Pressure Switches:
   A. Cabin Differential Switch provides a warning to the pilot by lighting the "CABIN PRESS" caution light on the master caution panel if cabin differential pressure exceeds 5.15 to 5.25 psid. This switch is located on the aft pressure bulkhead.
   B. Cabin Absolute Switch provides a warning to the pilot by lighting the "CABIN PRESS" caution light on the pilot's annunciator panel if the cabin altitude exceeds 10,000 to 10,500 feet. This switch is located on the aft pressure bulkhead.
7. Dump Solenoid Valve:
   The dump solenoid valve when activated applies a vacuum to fully open the safety valve, allowing rapid equalization of the cabin to ambient pressure differential.

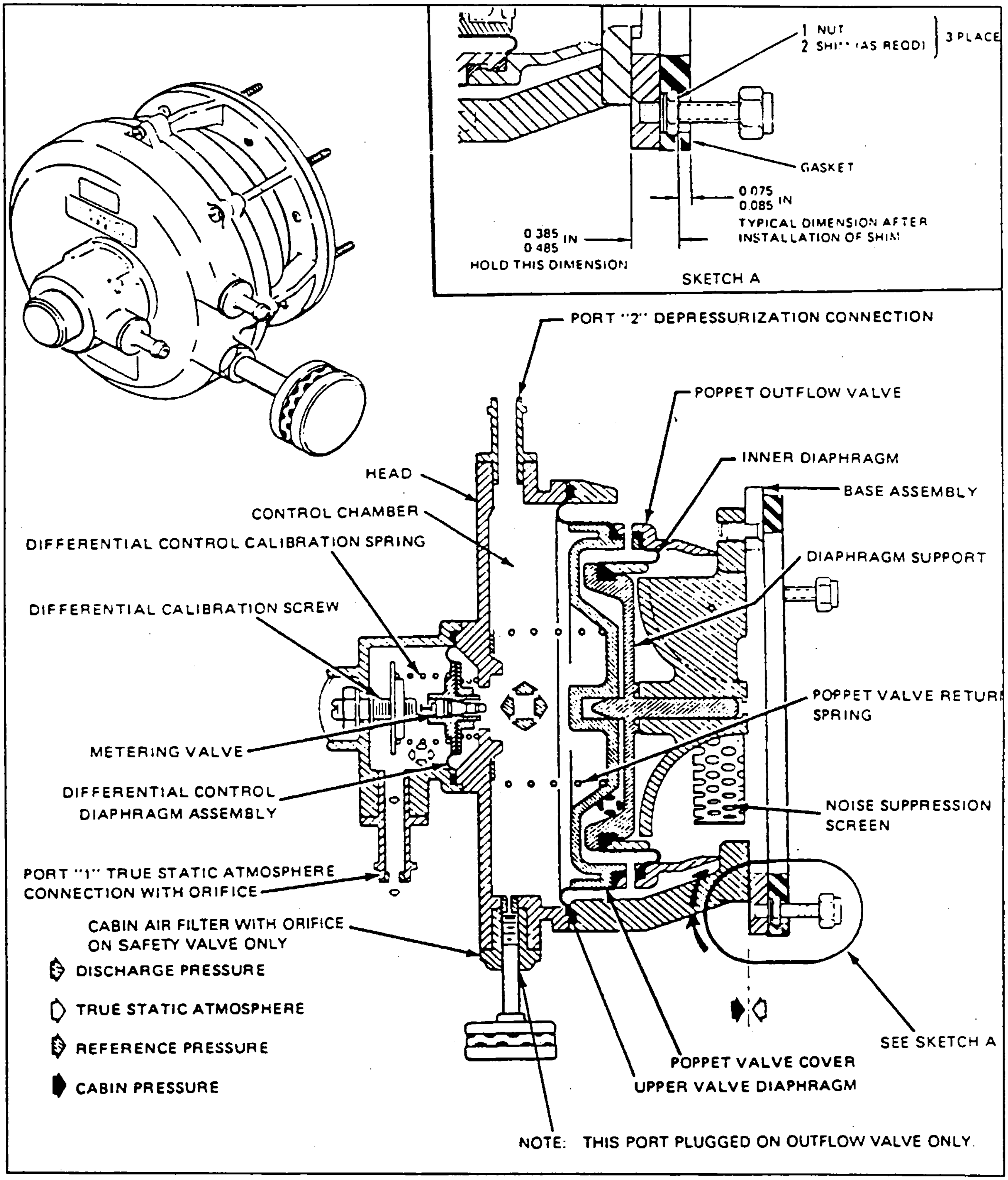

Figure 21-3. Safety and Outflow Valves

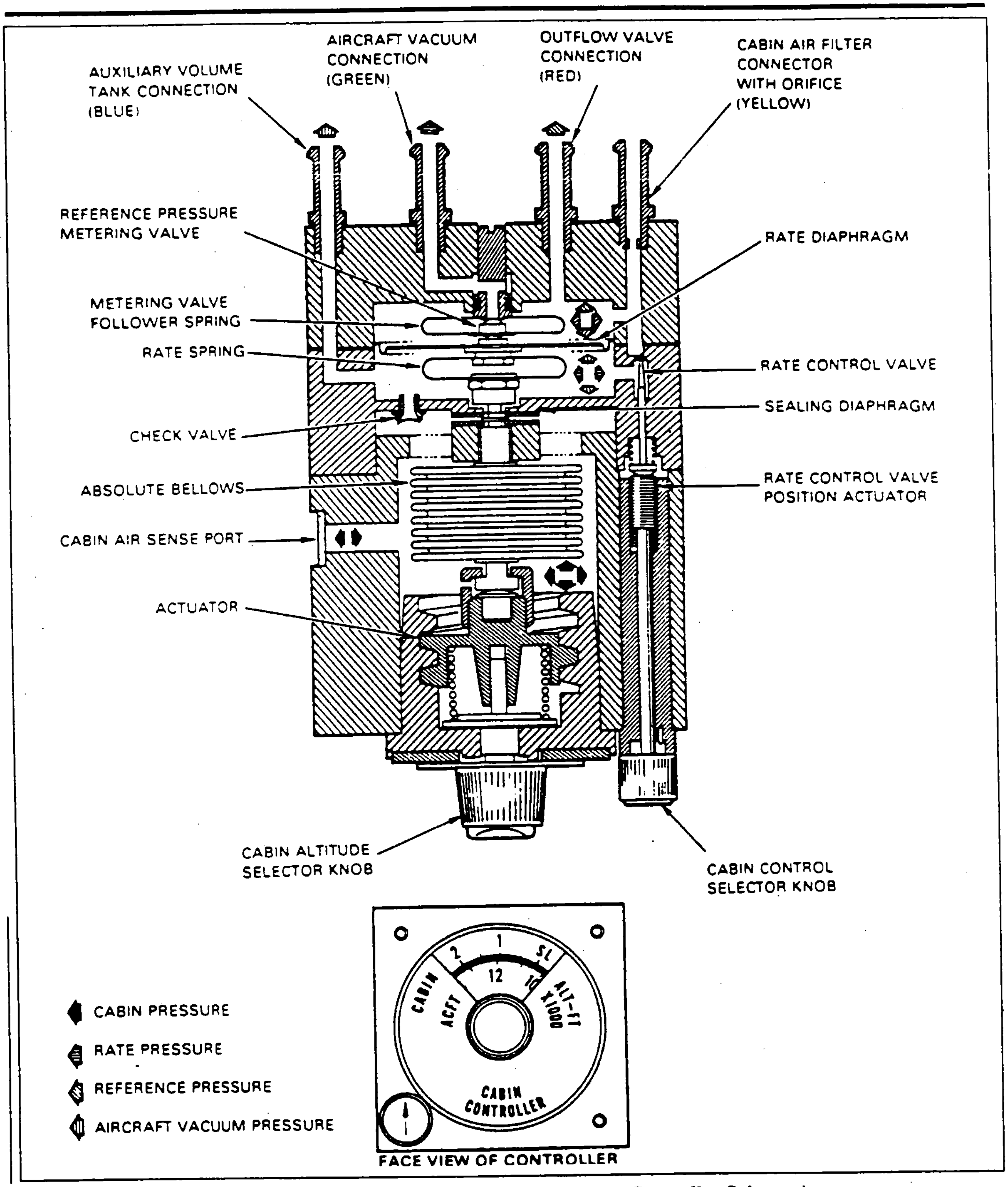

Figure 21-4. Cabin Air Pressure Outflow Valve Controller Schematic

CABIN DEPRESSURIZATION (DUMP) PROCEDURE.

The cabin pressure may need to be dumped for a number of reasons and, in most cases, it is recommended that oxygen be turned ON and masks donned before pressure is dumped. However. if 'fire" is experienced or suspected. the oxygen should be turned ON without the masks activated, until the cabin is depressurized. (Refer to "Emergency Oxygen System" for the appropriate procedure.)

Depressurization can be accomplished in two ways. If pressure needs to be dumped in a hurry, the Cabin Pressure control (Test Dump switch) located on the cabin pressure control panel, should be switched to DUMP. If urgency is not required, it is recommended that the emergency gear extender cover be lifted slowly, until pressure is unloaded, which will prevent a rapid discharge of pressure.

If the Cabin Pressure control (Test Dump switch) has been moved to DUMP, monitor cabin altitude after activation. Should cabin pressure not dump, lift the emergency gear extender cover as well.

For fresh air ventilation move the Cabin Air control to OUTSIDE.

PRESSURIZATION CHECK WITH TEST UNIT.

The following pressurization test procedure is used to determine if the aircraft fuselage has an acceptable leaking rate. A pressurization test unit as shown in referenced figures will be required to perform the pressurization test.

1. Aircraft Preparation:
   A. Remove the access panel on the right side of the nose section to permit access to the pressure bulkhead at fuselage station 81.00.
   B. Remove the access panels on the right and left side of the fuselage tail section at station 275.00.
   C. Remove the trim panel at fuselage station 274.00 in front of the outflow and safety valves. Remove the cotter pin and cap the ambient sense line from the outflow and safety valves.
   D. Place the cabin air control in the pressurized position.
   E. Position all circuit breakers to the OFF position. except the cabin pressure control, door seal and annunciator warning light circuits which should be in the ON position.
   F. Remove access plate and install an AN840-4D test fitting in the door seal solenoid valve at fuselage station 203.00.

- NOTE

If the airplane is not on jacks, disconnect the electrical power to the vacuum relief solenoid valve.

2. Test Unit Hookup: (Refer to Figure 21-7.)
   A. Connect the test unit to the aircraft as shown in Figure 21-7.

—NOTE—

Insure all connections are made in a manner that prevents leakage.

   B. Uncap the door seal test fitting underneath the fuselage near the cabin door to a pneumatic hose and connect it to the door seal inflation hose from the test unit.
   C. Turn on the aircraft electrical power to activate the warning light system.
   D. Close the cabin door and inflate the door seal.

3. Test Unit Operation:
   A. Turn on the aircraft electrical power to activate the warning light system.
   B. Set the pneumatic system pressure on the test unit with the regulator control knob so that 18 psig is shown on the test unit door seal pressure gauge. Do not apply more than 20 psig to the door seal.
   C. Connect the test unit to the proper voltage source. Turn the flow rate valve knob to the full bypass position, thus allowing the machine to be turned ON.

—NOTE—

If a test unit other than the type covered in these instructions is used, activate in accordance with the manufacturer's instructions.

   D. Turn the flow control valve for cabin pressurization to maintain a 1500 foot per minute rate of descent on the rate change indicator. Allow the cabin differential pressure to rise to 4.5 psi on the cabin differential pressure gauge (C.D.P.).

—NOTE—

If no personnel are inside the pressurized cabin, the rate of change can be as high as 6000 feet per minute.

   E. When 4.5 psi is indicated on the C.D.P. gauge, rotate the flow control valve and decrease the air flow rate until the "cabin rate of climb" gauge indicates zero.
   F. Maintain 4.5 psi cabin differential pressure and zero rate of change.
   G. Observe the leak rate on the test unit flow meter. The actual leakage rate in CFM should not exceed 45.5 CFM.
   H. If the allowable leakage rate is exceeded, locate the leak using soap bubbles, mechanics stethoscope or other appropriate method. Repair the leak and repressurize in accordance with the above procedure.

—CAUTION—

Exercise caution during depressurization to avoid damage to the aircraft, test unit or personnel. The test unit cannot be turned off when there is a pressure differential in the cabin for purpose of rapid depressurization, however if the machine is unplugged, the latter results will occur, causing serious discomfort to anyone that may be within the cabin.

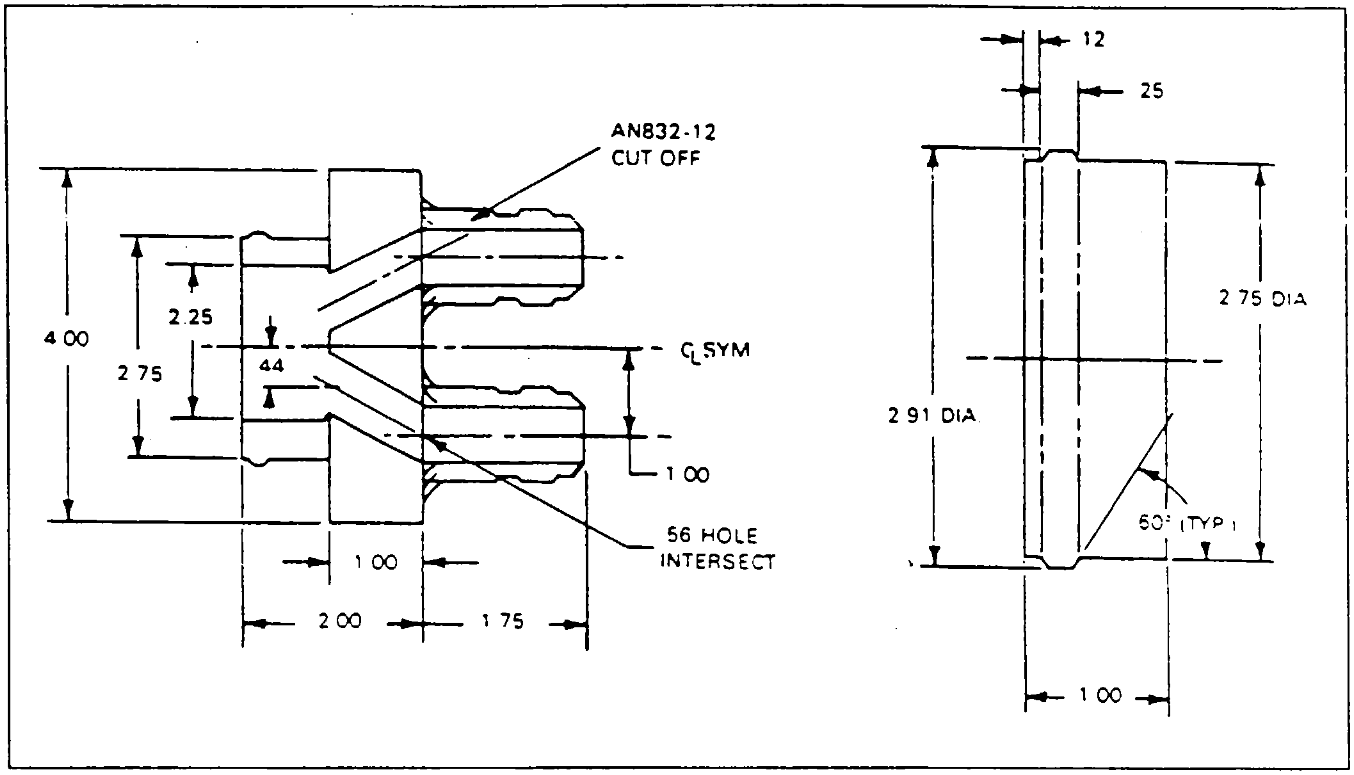

Figure 21-5. Fabricated Pressure Test Adapters

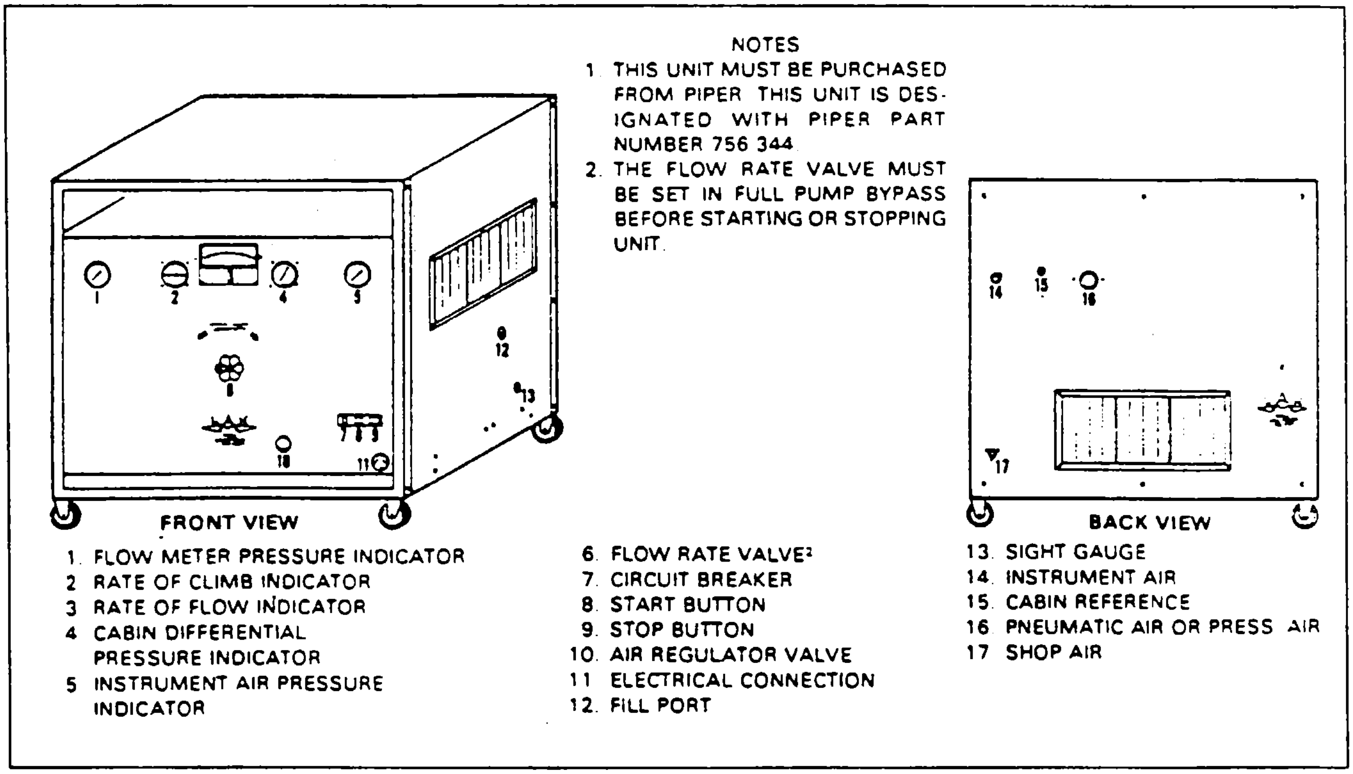

Figure 21-6. Cabin Pressure Test Unit (Typical)

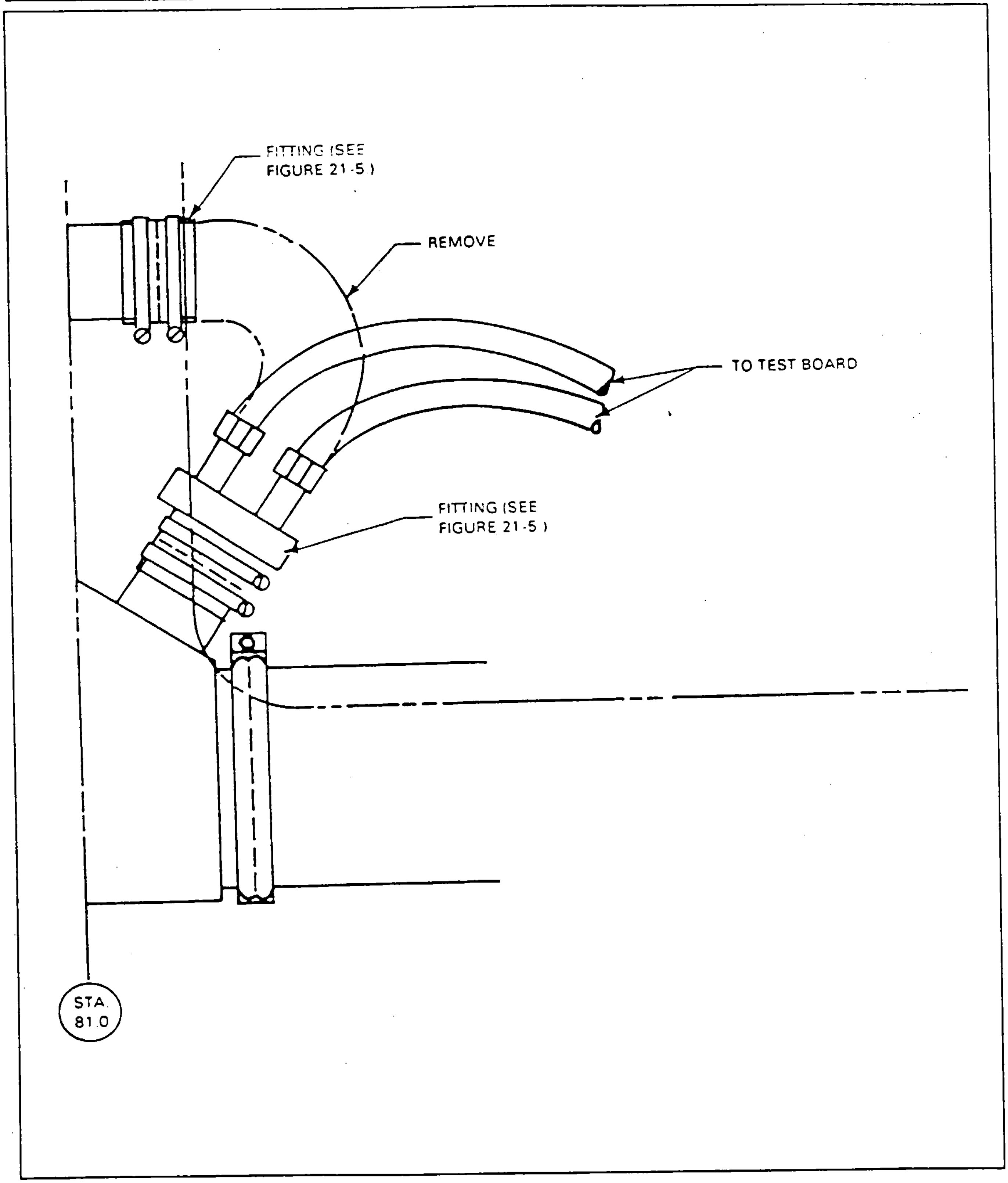

Figure 21-7. Pressurization Test Hookup

I. After completion of the leak rate test, proceed to check the annunciator warning light system as follows:
   (1) Ascertain that the ambient sense line from the outflow and safety valves are capped.
   (2) Slowly increase cabin pressure to 5.15 to 5.25 psig reading on the "cabin differential pressure" gauge.
   (3) Note the activation of the annunciation/warning light system. Do not exceed 5.25 psig cabin pressure. The light should come on at 5.15 to 5.5 psig.

—*CAUTION*—

After completion of the above tests, assure that the caps are removed from the ambient sense lines to the outflow and safety valves and that the cotter pins are replaced.

PRESSURIZATION SYSTEM CHECKOUT PROCEDURE.

The following procedure has been established to systematically check the function of each element of the cabin pressure control system, so that any single or combination of component malfunctions may be safely detected and corrected. Should a malfunction be detected it is imperative that the malfunction be corrected before continuing to the next step.

GROUND OPERATIONAL CHECK.

1. Select outside air source and the normal position of the dump switch prior to engine start up.
2. Start engines.
3. Set cabin altitude selector above field elevation (500 feet).

—*NOTE*—

The isobaric and safety valves should both be wide open. This will establish function of the isobaric and safety valves, vacuum supply, solenoid valve, and integrity of the vacuum line, control line and dump line.

4. Select the test position on the dump switch.

—*NOTE*—

The safety valve must close in less than 12 seconds, which indicates a clear safety valve filter and operation of the test mode of the dump switch

FLIGHT OPERATIONS.

1. Select pressurized air source.
2. Select 5000 feet cabin altitude on the cabin altitude controller.
3. After takeoff, to check the function of the dump mode perform the following steps:
   A. Select the dump position on the dump switch.
   B. Establish a flight altitude of 4500 feet. Both isobaric and safety valves should be wide open.
4. To assure operation of cabin altitude control, rate operation, volume tank and tank line integrity, perform the following steps:
   A. Select the normal position on the dump switch, the safety valve should be in the closed position.
   B. Select the 12 o'clock position on the rate knob.
   C. Slowly rotate the cabin altitude selector knob to 3,000 feet. The isobaric valve should fall toward its seat.

—NOTE—

At no time should the cabin rate of climb exceed 1500 feet per minute.

   D. Select the sea level position on the cabin altitude selector knob and rotate the cabin rate control knob counterclockwise to its stop and note a cabin rate of climb between -50 and -300 feet per minute.
5. To assure for differential control perform the following steps:
   A. When the cabin altitude reaches sea level, climb to, but do not exceed, 11,000 feet: note the cabin altitude at approximately 1,000 feet and the pressure differential gauge at 4.80 psi.
   B. Install a small C-clamp on the isobaric valve ambient sense line and close off the soft rubber tube.

—NOTE—

The cabin altitude should not change more than 400 feet. This shows the capability of differential control of the safety valve.

   C. Remove the C-clamp from the isobaric valve ambient sense line.
   D. Install the C-clamp on the safety valve ambient sense line and close off the rubber tube.

—NOTE—

The cabin altitude should not change more than 400 feet. This shows operation of the isobaric valve assembly.

   E. Remove the C-clamp from the safety valve ambient sense line.

OUTFLOW AND/OR SAFETY VALVE REMOVAL.

1. Remove the trim panel in front of the safety and outflow valves located in the rear pressure bulkhead.
2. Remove the access panel on the left side of the tail section just aft of the entrance door if the outflow valve is being removed or remove the access panel on the right side if the safety valve is being removed.
3. Disconnect the lines to the valve being removed.
4. Working through the tail section access hole, remove the three locknuts which secure the valve to be removed.
5. Remove the valve from the pressure bulkhead.

OUTFLOW AND/OR SAFETY VALVE INSTALLATION.

1. Position the valve being installed onto the shelf in the rear pressure bulkhead.
2. When reinstalling safety and/or outflow valve, gasket dimension shown in Figure 21-3 must be met to ensure sealing requirements. To provide proper clearance between nuts and gasket face, adjust for clearance as follows:
   A. Remove nuts, using a deep socket and remove sufficient shims to meet dimensional requirements. A minimum of one shim is required each place for installation of nut.
   B. Install nuts and tighten.
   C. Apply a drop of locking compound, MIL-S-22473-EV, to the top of nuts between nuts and studs .
3. Working through the tail section access opening install the three locknuts which hold the valve in place and tighten to metal contact and then backing off 1/4 turn.
4. Install the access plate removed from the side of the tail section.
5. Connect the lines removed from the valve.
6. Install the trim panel in front of the valve after making sure acoustical material is in good condition.

OUTFLOW AND SAFETY VALVE CLEANING.

Routine maintenance of components of the cabin pressure control system is limited to the replacement of the filter in the cabin air pressure safety valve and cleaning of seats in the outflow and safety valves. Clean the seats of the outflow and safety valves thoroughly, using Joy detergent or isopropyl alcohol on condition.

Clean the safety valve filter as follows:

1. Remove retaining ring, one screen, copper ribbon, and remaining screen from filter housing.
2. Wash both screens, copper ribbon, and filter housing in dry-cleaning solvent. Make certain that orifice hole in filter housing is free of foreign material.

—WARNING—

Use dry-cleaning solvent in a well-ventilated area. Avoid breathing fumes. Keep away from flame.

3. Install one screen in filter housing.
4. Install copper ribbon in filter housing.

—*NOTE*—

Do not overcompress copper ribbon in filter housing.

5. Install remaining screen. and then install retaining ring.

—*NOTE*—

The air filter on the controller shall not be cleaned as described above. Removal and replacement of this component is on condition.

REMOVAL OF CONTROLLER.

1. Disconnect the lines from the rear of the cabin altitude controller assembly. Cap the open parts of the lines and fittings to prevent dust from entering the system.
2. Remove the screws which secure the electroluminescent panel to the face of the instrument panel.
3. Remove the three screws which secure the selector to the instrument panel.
4. Remove the controller by lifting the assembly from the rear of the instrument panel.

INSTALLATION OF CONTROLLER.

1. Position the controller into the instrument panel cutout from the forward side of the panel.
2. Secure the controller to the instrument panel with three screws.
3. Position the electroluminescent panel to the instrument panel and secure with screws previously removed.
4. Remove the protective caps from the lines and fittings of the selector and connect the lines to the fittings on the rear of the controller.

CONTROLLER FILTER REPLACEMENT.

There is a tobacco filter installed in the pressurization system. This is a disposable type filter which must be replaced at least every 500 hours of normal use. Refer to the Parts Catalog for part number of replacement filter. More frequent filter changes and more frequent cleaning of the outflow and safety valve seats may be required depending on the amount of smoking in the cabin. Replace the controller filter as follows:

1. The filter is accessible from underneath the instrument panel.
2. Remove the filter from behind and discard.
3. Install the new filter in place.

CABIN DOOR SEAL.

DESCRIPTION OF DOOR SEAL.

The constant displacement dry air pumps supply air to the pneumatic regulators. These regulators provide back pressure regulation to maintain the nominal 5.5 psig system pressure until deicer boots or cabin door seal air is required. If the door seal accumulator tank located below the floor under the left rear passenger seat has a pressure drop below 15 psig, the pneumatic regulators increase the system pressure to fill the accumulator tank. A check valve located at the end of the accumulator inlet then prevents the 18 psig air charge from flowing back into the system when the system pressure returns to 5.5 psig. The purpose of the accumulator tank is to store air for the door seal and to smooth out its operation. There is a pressure switch located in the nose of the accumulator tank just aft of the check valve. The switch monitors pressure in the tank. The use of high pneumatic pressure only when required by deicer boots or cabin door seal allows the pump load to remain as low as possible for a large percentage of system operating time. During deicer operation (if installed) or whenever the main entrance door seal accumulator requires repressurization, the pneumatic system pressure will automatically increase to 18 psig.

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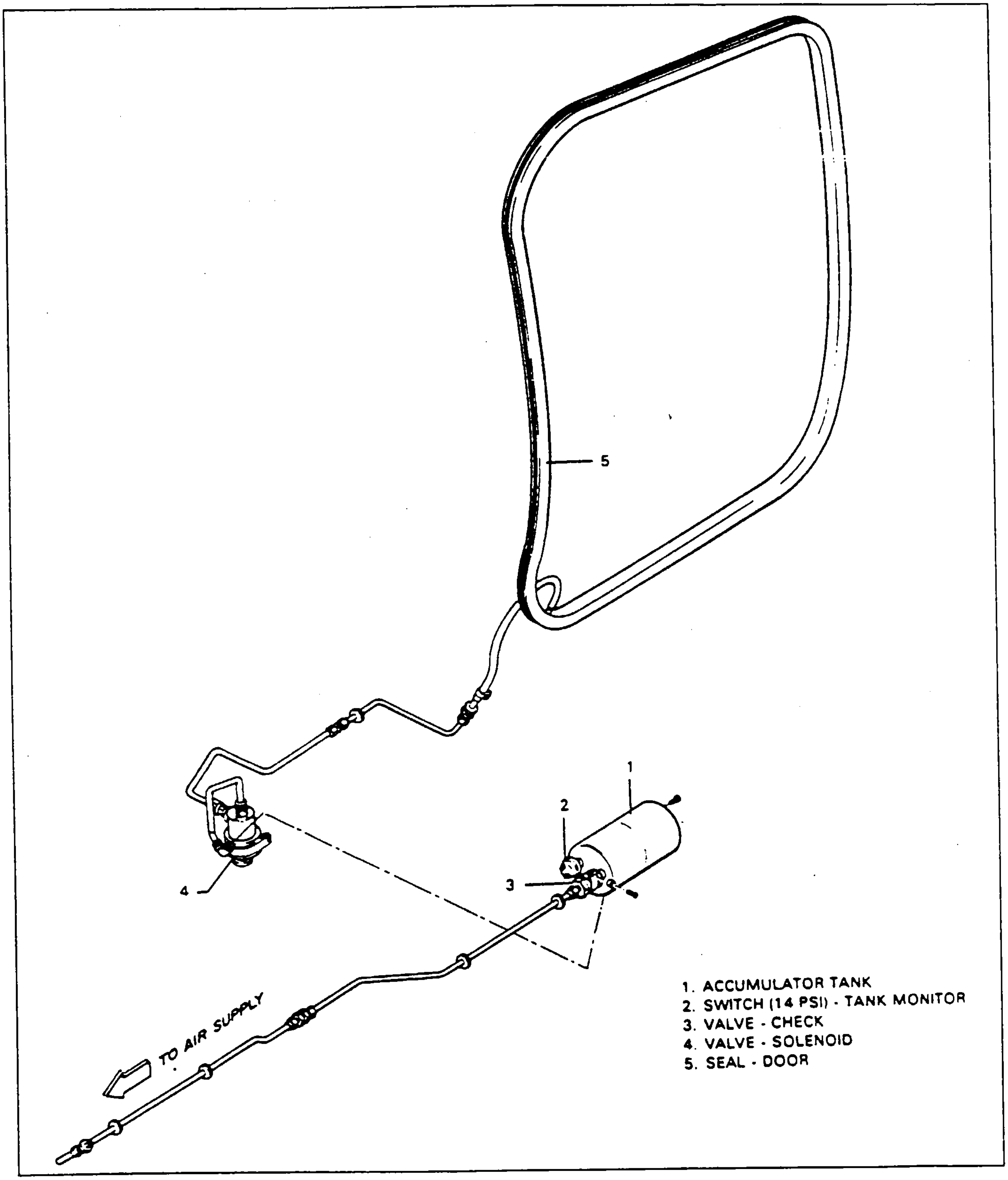

Figure 21-8. Cabin Door Inflation System Installation

HEATING.

DESCRIPTION AND PRINCIPLES OF OPERATION.

The flow of primary air for heating, ventilating and defrosting is taken through the main pressurization airline or from an outside air scoop. Air from the heater is directed to outlets along both sides of the cabin or it can also be routed to the windshield defroster outlets along both sides of the windshield center post. Air for ventilating is routed through ducts along both sides of the cabin and exits out individually controlled eyeball outlets next to each seat. Controls for the gasoline combustion heater are located on the lower right instrument panel. The system is normally operated in the "AUTO" mode position and when the thermostat calls for heat, the controller turns the heater on and will operate at maximum efficiency until the desired temperature is obtained. When the automatic position is selected the pilot need only to select the proper temperature level with the control marked "LEVEL SET."

TROUBLESHOOTING.

Troubles peculiar to the heating and ventilating system are listed in Chart 2102 along with their probable causes and suggested remedies.

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CHART 2102. TROUBLESHOOTING (HEATER 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 shutoff valve or master solenoid.
	Restriction in fuel nozzle orifice.	Remove the nozzle and clean or replace it.
	Fuel heater solenoid not operating.	Remove and check sole-noid. Replace if faulty.
	Fuel lines clogged or broken.	Inspect all lines and con-nections. It may be nec-essary to disconnect lines at various points to determine where the restriction is located.
	Ignition vibrator inoperative.	Replace vibrator. Check for defective radio noise filter.
	Manual reset limit (overheat) switch open.	Press reset button firmly and recheck to de-termine reason for switch opening.
	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.
	Regulator not operating properly.	Check for low pressure or replace regulator.

CHART 2102. TROUBLESHOOTING (HEATING SYSTEM) (cont.)

TROUBLE	CAUSE	REMEDY
Heater fails to light (cont.)	Duct switch open.	Operate control to see it switch will come on. Replace switch if defective.
	Bad spark plug.	Replace plug.
Ventilating air blower fails to run.	Heater switch "OFF." Broken or loose wiring to motor.	Energize the heater switch. Check and repair wiring
	Circuit breaker open.	Close circuit breaker.
	Worn motor brushes.	Replace motor brushes.
	Blower wheel jammed.	Remove and check the ventilating air blower wheel and realign it necessary.
	Motor burned out.	Remove blower assembly and replace motor.
	Defective radio-noise filter.	Replace filter.
Combustion air blower fails to run.	Fault wiring to motor.	Inspect and replace faulty wiring.
	Poor ground connection.	Tighten ground screw.
	Worn motor brushes.	Replace motor brushes.
	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

CHART 2102. TROUBLESHOOTING (HEATING SYSTEM) (cont.)

TROUBLE	CAUSE	REMEDY
Heater fires but burns unsteadily.	Insufficient fuel supply.	Inspect fuel supply to heater, including shutoff valve, solenoid valve and fuel lines. Make necessary repairs.
	Spark plug partially fouled.	Replace spark plug.
	Loose primary connection at ignition assembly.	Tighten the connection.
	Faulty vibrator.	Replace the vibrator.
	Combustion air blower speed fluctuates. (Can be caused by low voltage, 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 assembly.
	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 correction.

CHART 2102. TROUBLESHOOTING (HEATING SYSTEM) (cont.)

TROUBLE	CAUSE	REMEDY
Heater starts then goes out. (cont.)	Inoperative or chattering combustion air pressure switch.	Adjust or replace switch.
	Inoperative overheat switch.	Replace switch.
	Inoperative cycling switch.	Adjust or replace the switch.
Heater fails to shut off.	Fuel solenoid valve in heater stuck open.	Remove and replace solenoid assembly.
	Inoperative duct and heater switch.	Check and repair.
	Defective heater switch.	Replace the heater switch

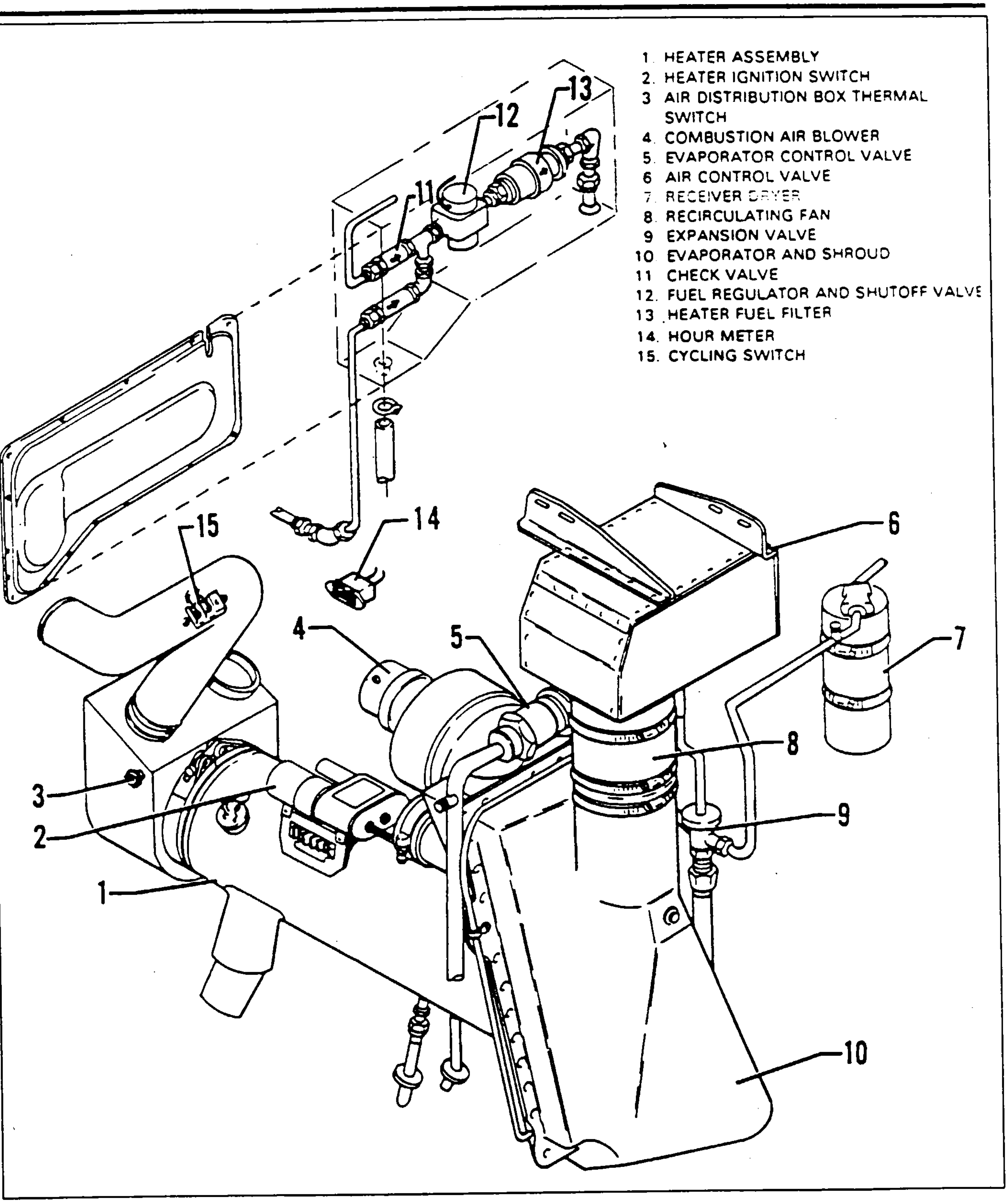


Figure 21-9. Environmental Components

OPERATING CONTROLS.

—NOTE—

The schematic diagram (Chapter 91) 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 Chapter 91.)

1. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air and combustion air blowers should operate.
2. 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 ventilator airflow 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. It corrosion is evident, clean affected components, and wipe with a light oiled cloth.

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. Look in the area of the combustion heater exhaust tube for large or unusual accumulations of soot on the aircraft skin. Soot accumulations indicate that the heater is operating at a "fuel rich" condition. A "fuel rich" condition may be caused by incorrect fuel pressure to the heater, restriction in the combustion air inlet line, loss of performance by the combustion air blower, or partially clogged fuel nozzle.
3. 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 and the heater OVER TEMP light should illuminate.
   B. Operate both the combustion air blower 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. The above procedure should be repeated one or more times.

100-HOUR INSPECTION.

The mandatory 100-Hour inspection is to be conducted on new heaters or overhauled heaters with a new combustion tube assembly upon accumulation of 500 heater hours or twenty-four months, whichever occurs first, and thereafter at intervals not to exceed 100 heater hours or twenty-four months, whichever occurs first.

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. Check 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 attaching 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 air blower and ventilating air blower and check for unusual noise or vibrations .
8. Check condition of spark plug.
9. Perform a Pressure Decay Test as outlined in the latest Janitrol Maintenance and Overhaul Manual. Part No. 24E25-1, or obtain Kit No. 764 963 for test equipment.

OVERHAUL INSTRUCTIONS.

The heater assembly shall be overhauled after 1000 hours or when the "Pressure Decay Test" requirements cannot be met.

The heater should be removed from the airplane, disassembled, all parts thoroughly inspected and necessary repairs and 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, and, if so, those portions of the overhaul procedures may be eliminated.

—NOTE—

For disassembly and reassembly operations refer to the exploded view drawings and the parts list.

INSPECTION OF MISCELLANEOUS COMPONENTS. (Refer to Figure 21-12.)

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. 16AWG stock and cutting them 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 hardware 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 21-11.)
5. Replace the vibrator in the ignition unit only when it no longer functions.

—CAUTION—

Ignition assembly will be damaged if ignition lead is arced to ground other than through correct spark plug gap. Vibrator life will be substantially reduced if ignition lead is improperly grounded.

6. Inspect the ignition assembly (Figure 21-12) 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.
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 buff or scrape off deposits on the tip face. After cleaning, it is advisable to store the nozzle in 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 7.5 psi fuel pressure source. Connect the solenoid leads to a 24 volt current source (battery) to open the solenoid valve. The conical angle spray pattern should be even and dispersed the same in all directions, divergence spray shall have appearance of fog, not droplets. Exercise caution to keep atomized fuel away from fire.

11. Inspect the nozzle holder and solenoid valve assembly for damaged threads at the fuel-tube fitting 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 and 87 ohms should be obtained. If not within these limits or if solenoid shows any form of damage or overheating the solenoid must 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 commutater with a stream of filtered compressed air. Check for brush wear. If brushes are worn to a length of 3/16 inch or less, they must be replaced. Inspect the commutater for grooved brush track, pitting or burning. The commutater surface should be smooth and medium brown in color. Replace the motor if the commutater or other parts show damage.
13. Inspect the combustion air blower motor as described in the preceding step.
14. Inspect the blower wheel for broken or bent vanes and replace it for either condition.

TESTING.

The following tests should be performed as outlined:.

1. Check combustion air motor for correct RPM and current draw.
   A. Connect motor to 24 volt DC power supply. Rotation should be counterclockwise when viewed from the shaft end.
   B. Motor should rotate at approximately 7500 RPM at rated voltage. Current draw is approximately 2.9 amperes.
   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. Refer to "Replacing Motor Brushes."
   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.

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 nozzleholder opening in the combustion tube assembly. (Refer to Figure 21-10.) 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 21-10.) 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 ot between three and seven psi to the combustion tube assembly.

—NOTE—

The Inspection Pressure Decay Test cannot be used in place of the water tank inspection.

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 21-11.)
   A. Connect an adjustable air pressure line that can be controlled in a range of zero to 5.0 inches (Maximum of water to the switch opening with a water manometer and needle valve in the line ahead of switch). Switch must be tested in 45 degree 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. Replace switch if erratic operations, sticking, etc., is observed.
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.

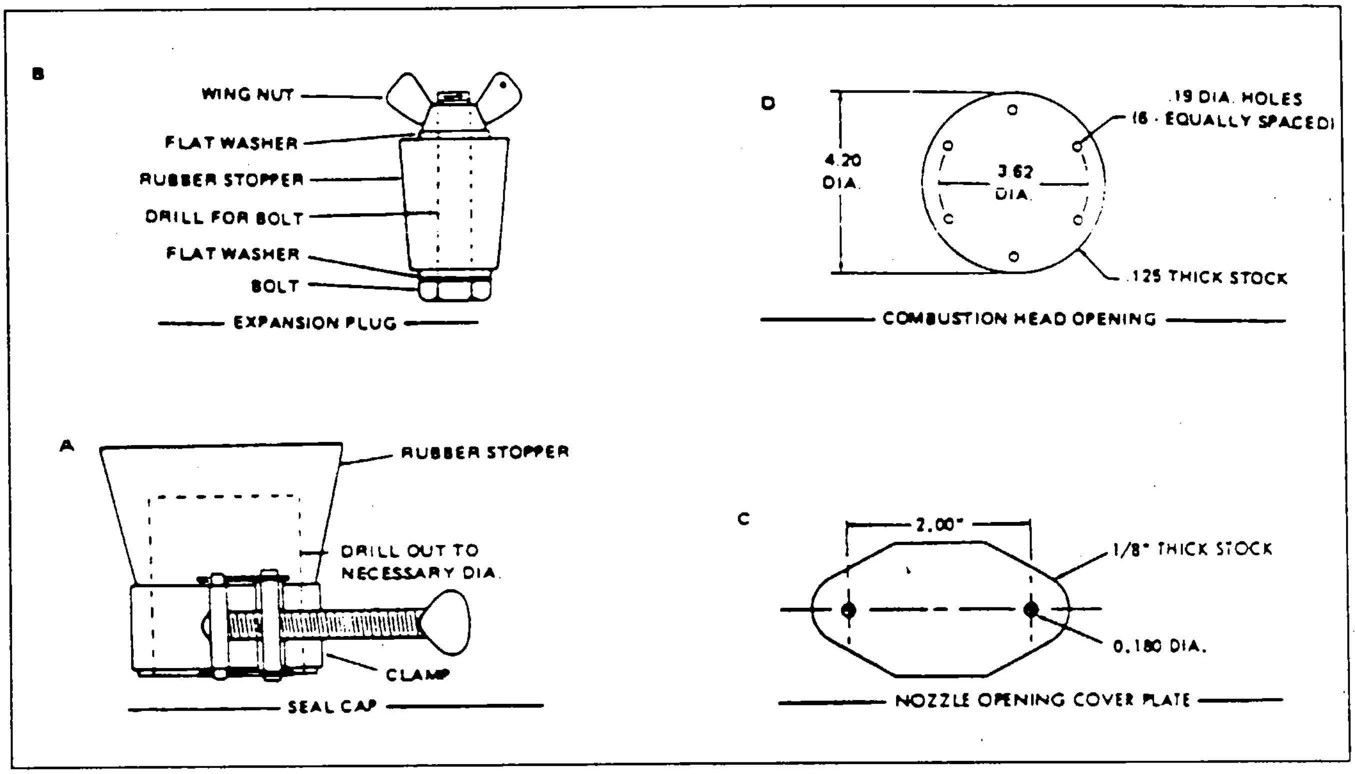


Figure 21-10. Suggested Design for Seal Plate, Plugs and Caps for Combustion Tube Leakage Test

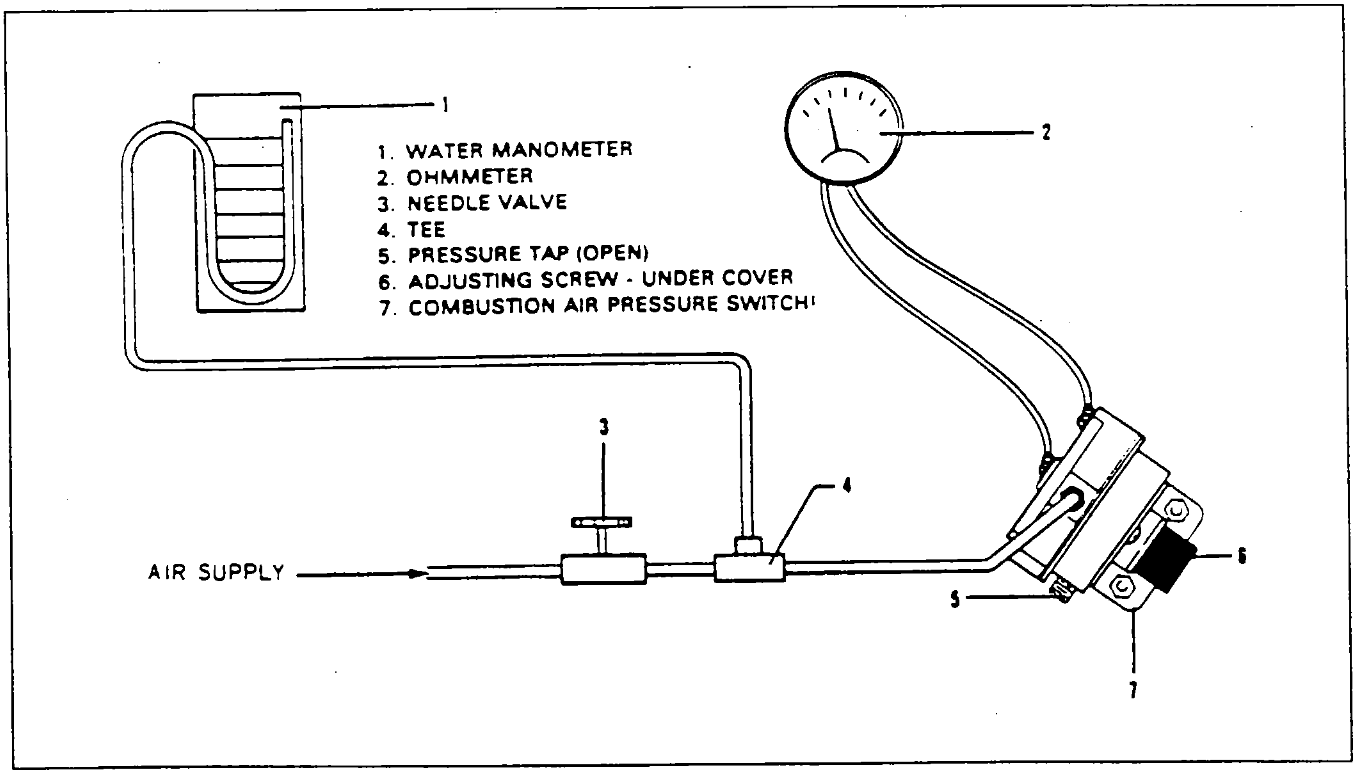


Figure 21-11. Test Set-up - Combustion Air Pressure Switch

5. Spray test the nozzle (Figure 21-12) as follows:
   A. Install the nozzle in the fuel feed and nozzle holder assembly. Connect the fuel tube to a 7.5 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 fuel feed and nozzle holder assembly must be replaced.

MAINTENANCE.

JANITROL HEATER.

The heater is a gasoline operated 24 Vdc electrically controlled unit installed in the nose section just forward of bulkhead Sta. 81.00.

REMOVAL OF HEATER.

1. Ascertain that the heater switches are off.
2. Remove the access panel located on the right side of the airplane's nose section.
3. Remove the air conditioning duct which extends over the heater from the evaporator shroud.
4. Disconnect the wires from the harness to the heater terminal strip.

—NOTE—

For ease of installation, the wires should be marked before removal.

5. Disconnect the combustion air blower intake and exit tubes and electrical leads. Then remove the blower assembly from its mounting bracket.
6. Remove the shroud cover at the fuel line fitting at the heater and disconnect the fuel and drain lines. Also, disconnect the electrical lead from the terminal on the heater which goes to the solenoid valve assembly.
7. Disconnect, the fuel drain fitting below the heater and let it rest against the skin.
8. Disconnect and remove the two air ducts from the air distribution box assembly.

9. Loosen and remove the two V-band clamps which secure the heater to the air distribution and evaporator shroud. Remove the sealing tape from around the heater joints.
10. Loosen the four screws which hold the evaporator shroud in place and move the shroud forward, as far as it will go, to obtain added clearance for heater removal.
11. Remove the heater assembly from the airplane by raising the aft end of the heater to clear the air distribution box assembly; then moving the heater aft to clear the evaporator shroud.

INSTALLATION OF HEATER.

1. Install the forward end of the heater below the outlet on the evaporator shroud and move it forward until the aft end of the heater clears the air distribution box.
2. Align the heater exhaust tail pipe into the hole in the fuselage skin.
3. Move the evaporator shroud aft until it butts against the heater; wrap one overlapped turn of pressure sensitive tape #69EGS (3M) around the joints before installing V-band clamps; then install the V-band clamps at the ends of the heater.

—NOTE—

Do not tighten the clamps at this time, as it may be necessary to move the heater or evaporator assembly to make other hookups.

4. Install the four screws which hold the evaporator shroud in place and secure the shroud.
5. Connect the fuel drain fitting below the heater.
6. Connect the fuel line and fuel shroud drain line at the heater and install the fuel shroud cover.
7. The V-band clamps can be tightened at this time.
8. Mount the combustion air blower to the intake and exit air tubes and secure the connections at the tubes. Now secure the blower to the mounting bracket.
9. Connect the electrical lead to the solenoid valve terminal on the heater jacket.
10. Connect the rest of the electrical leads to the heater terminal strip.

—NOTE—

A wiring schematic of the heater hookup may be found in the Electrical System, Chapter 91.

11. Install and secure the two air ducts from the air distribution box assembly.
12. Install and secure the air conditioning duct extending over the heater from the evaporator shroud.
13. Make a complete inspection of the system installation; then install the access panel and secure it.

DISASSEMBLY OF HEATER. (Refer to Figure 21-12.)

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—

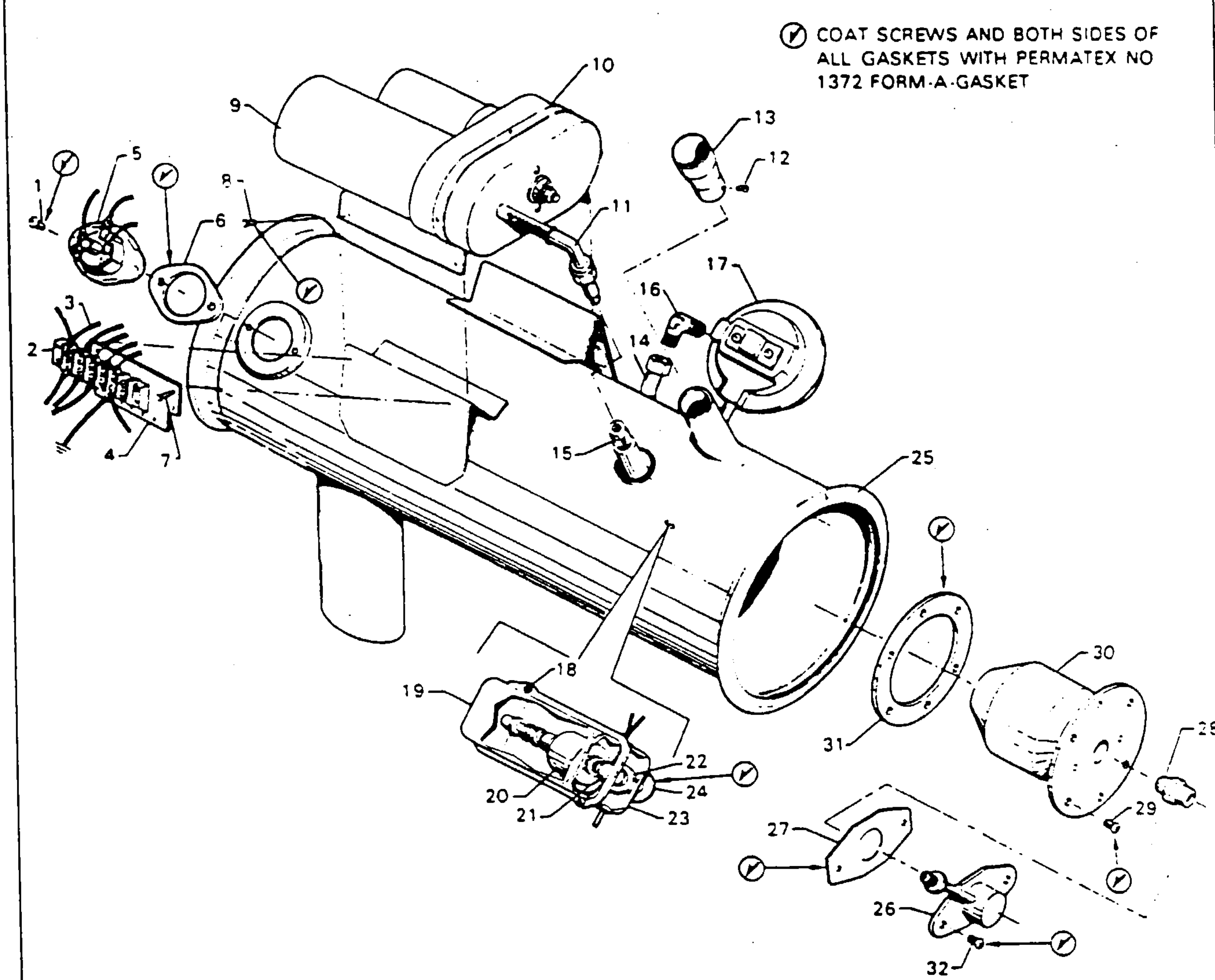
It is advisable to label all wires, prior to removal, to insure correct connections during reassembly, Cable straps and clips must be replaced if removed, as they cannot be re-used.

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 straight away 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 four screws to release the terminal strip and insulator from the jacket.
8. Disconnect the fitting at the combustion air pressure switch. Unscrew and remove the combustion air pressure switch from the combustion air inlet tube.
9. Remove the cover screws and upper cover from solenoid assembly.
10. Disconnect solenoid, elbow and nut. This will free the lower cover gasket and washer.
11. Reach inside the inlet end of the jacket assembly with a 3/4 inch open-end 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 head assembly. Remove the gasket.
13. Carefully unscrew and remove the spray nozzle from the fuel feed and nozzle holder assembly. Remove O-ring.

—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.

14. Remove the six screws that attach the combustion head assembly to the combustion tube and jacket assembly and remove the combustion head assembly.



1 SCREW
2 TERMINAL BOARD
3 WIRE ASSEMBLY
4 INSULATOR
5. OVERHEAT LIMIT SWITCH
6 SWITCH GASKET
7 SCREW
8. MACHINE SCREW
9 COIL (IGNITION)
10 IGNITION ASSEMBLY
11 HIGH TENSION LEAD
12. MACHINE SCREW
13. ADAPTER
14 TUBE (COMBUSTION AIR SWITCH)
15 SPARK PLUG
16 ELBOW
17. COMBUSTION AIR PRESSURE SWITCH
18. SCREW
19 COVER, UPPER
20 SOLENOID
21. ELBOW
22. NUT
23. COVER, LOWER
24. GASKET AND WASHER
25. COMBUSTION TUBE AND JACKET ASSEMBLY
26. FUEL FEED AND NOZZLE HOLDER ASSEMBLY
27 GASKET
28. SPRAY NOZZLE
29 MACHINE SCREW
30. COMBUSTION HEAD ASSEMBLY
31 HEAD GASKET
32. MACHINE SCREW

Figure 21-12. Heater Assembly (47D65-3) Exploded View

REASSEMBLY OF HEATER. (Refer to Figure 21-12.)

—NOTE—

When reassembling the heater use all new gaskets and O-rings, For screw and gasket coating, refer to Note on Figure 21-12.

1. Rotate the combustion air pressure switch onto the threaded fitting on the combustion air tube and tighten it firmly.
2. Place the terminal strip insulation in position on the jacket followed by the terminal strip. Secure both parts by installing the two screws.
3. Attach the overheat limit switch and two spacer gaskets to the jacket assembly with two screws. Tighten the screws securely.
4. Install a new head gasket and the head assembly to the combustion tube assembly with six screws. Leave the screws loose at this time.

—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.

5. 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.
6. If a 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 incorrect tightening could cause improper heater operation and, "drool."

—CAUTION—

The spray nozzle is susceptible to damage if the face is contacted by any object which would alter the original contour of the face. If this happens, the nozzle must be replaced.

7. Install the fuel feed and nozzle holder assembly and gasket on the heater with two screws. Center the fuel inlet fitting in the hole in jacket. Place the fuel fitting gasket, and lower cover on the fuel fitting, and install washer and 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 wrench.
8. Install elbow and solenoid. Carefully pull solenoid lead wires through the hole in the cover and install grommet.
9. Install the ignition assembly on the jacket with four screws. Connect the high voltage lead to the spark plug and tighten it to 20 foot-pounds.
10. Complete the assembly, being sure to install the wiring in the same locations and connected to the same terminals as before disassembly. Also slide adapter onto the combustion air inlet tube and secure with 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 cucuits 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. When installing the spark plug, be sure not to damage the electrode on the plug.

—NOTE—

The spark plug can be checked visually for sparking across the gap prior to installing the plug, Disconnect the wire from the No. 3 terminal on the heater wiring side of the terminal strip to de-energize the fuel solenoid valve. Connect the high voltage lead temporarily and lay the spark plug on the heater jacket. Energize heater system and check for spark between spark plug and ground electrode.

—WARNING—

Be sure to plug the spark plug hole in the heater to prevent any possibility of residual fuel blowing out and igniting. Do not touch the spark plug while energized due to dangerously high voltage.

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 well socket wrench. Tighten to a torque of 28 foot-pounds.
4. Install the grommet (Figure 21-12) 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. Reconnect the wire to the No. 3 terminal on terminal strip if disconnected for test.
7. Operate the heater to check dependability and close all access openings.

SPARK PLUG GAP CHECK AND ADJUSTMENT.

The gap between the center electrode disc and the ground electrode should be .156 to .188. The spark plug used on the heater is non-adjustable. If it is not functioning, it must be replaced.

INSPECTION AND SERVICING SPARK PLUG.

1. If the spark plug appears to be in good condition, the outer surface of the ground electrode sleeve may be wiped clean with a rag and the internal porcelain may be blown clean using shop air. After cleaning, the spark plug gap may be checked.

—NOTE—

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

SPARK-SPRAY IGNITION. (Refer to Figure 21-13.)

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. Fuel is injected into the combustion chamber through the spray nozzle. The resulting cone-shaped fuel spray mixture 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 24 volts to high-voltage, oscillating current to provide a continuous spark. 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.

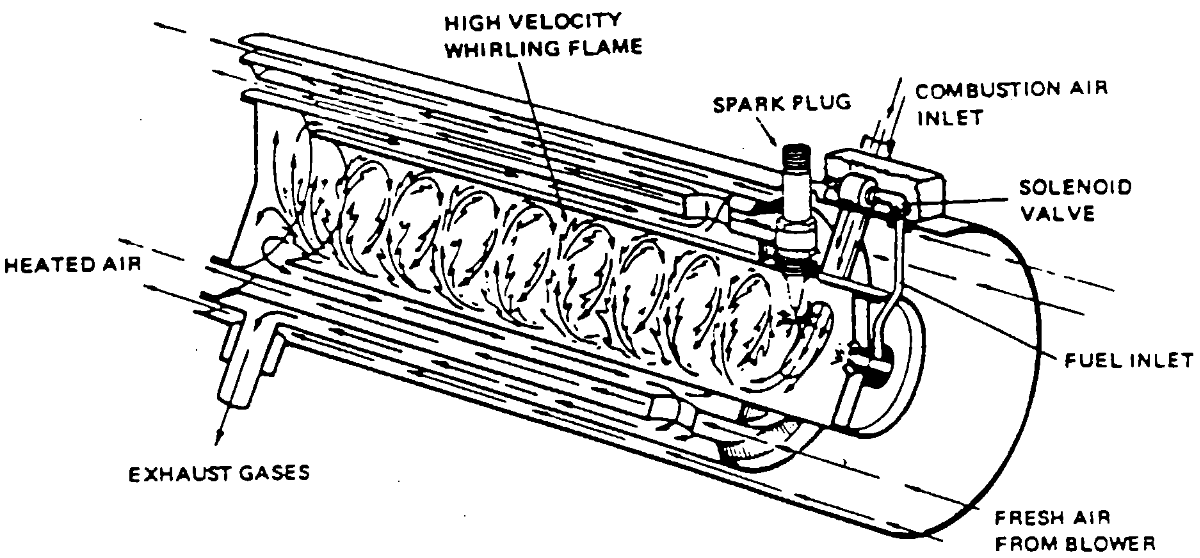


Figure 21-13. Diagramatic Cutaway of Heater to Show Whirling Flame Action

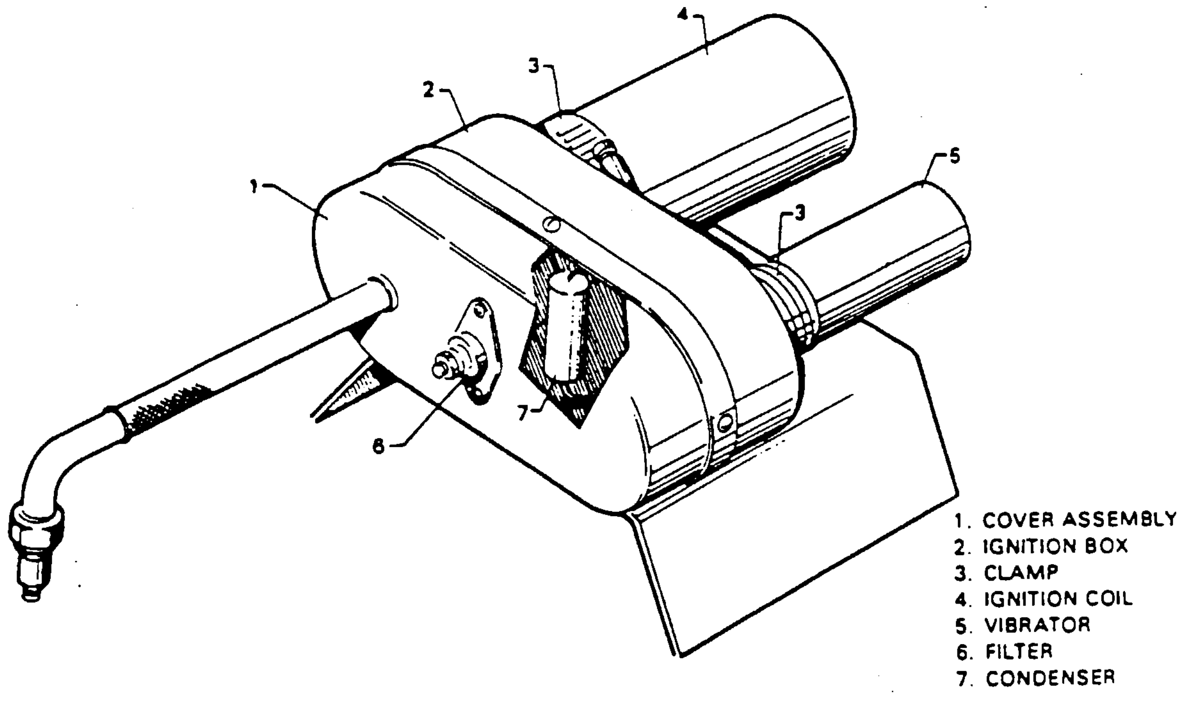


Figure 21-14. Ignition Unit Assembly

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 and shielded lead assembly.

REMOVAL OF IGNITION ASSEMBLY. (Refer to Figure 21-12.)

—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 21-12.)

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. Properly route high-voltage cable so as to avoid grounding to power input connection and/or any other sheet metal parts of heater.
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 24 volts DC.
2. A voltmeter with a range of 0-30 VDC.
3. A lead from the battery to the ignition unit undertest which includes 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 normally functioning spark plug.

—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.

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 DC must be 1.25 ±0.25 amperes.

VIBRATOR.

The vibrator is not a time replacement item, it should be replaced only when it no longer functions.

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.

INSTALLATION OF VIBRATOR.

1. Install the new vibrator. 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.

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 outside 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 24 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 at the quick-disconnect terminal.
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 21-12.)

1. Clean individual metal parts (except the combustion tube and jacket assembly and those parts containing switches and electrical wiring), 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 buff 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 21-12.)

1. Slight scaling and discoloration of the combustion tube assembly is a normal condition for units that have been in service up to 500 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 clear tube by blowing air through it. If combustion product residue has collected in the exhaust end of the tube, it may be necessary to clear tube with a wire.

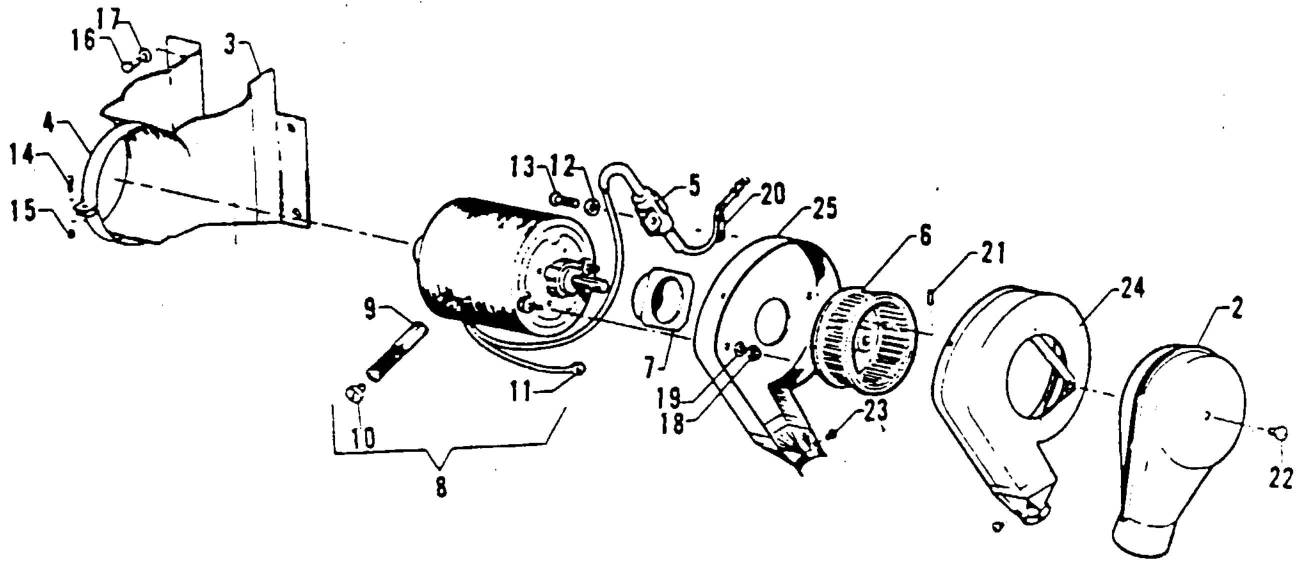
3. The combustion tube assembly may be cleaned by either of two methods:
   A. One method is to soak the combustion tube assembly overnight in a solution of Kelite No. L235. Cleaning solution should be 1 to 12 parts by volume. The solution should be maintained at a temperature of between 190° F and 210° F. After overnight soaking, rinse the combustion tube assembly thoroughly in water to remove all traces of the Kelite 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 glass beads 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.

No weld or braze repairs of the combustion tube assembly 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 back plate 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 blower housing in position on the back plate and install screws and lock washers.
4. Attach the capacitor at the point shown with screws. The motor ground lead terminal can be grounded to the back plate or the airframe.
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 COMBUSTION AIR BLOWER AND MOTOR ASSEMBLY
2 ADAPTER ASSEMBLY - BLOWER INLET
3 BRACKET - MOTOR SUPPORT
4 CLAMP - MOTOR SUPPORT
5 CAPACITOR
6 FAN - COMBUSTION AIR BLOWER
7 SPACER
8 MOTOR ASSEMBLY
9 BRUSH ASSEMBLY
10 CAP - BRUSH ASSEMBLY
11 TERMINAL - PREINSULATED
12 WASHER - LOCK
13 SCREW
14 SCREW
15 NUT
16 SCREW
17 WASHER - LOCK
18 NUT
19 WASHER
20 STRAP - CABLE
21 SET SCREW
22 SCREW
23 SCREW
24 HOUSING - BLOWER, OUTER
25 HOUSING - BLOWER, INNER

Figure 21-15. Exploded View of Combustion Air Blower and Motor Assembly (89D23-1)

RECIRCULATING FAN. (Refer to Figure 21-16.)

REMOVAL OF RECIRCULATING FAN.

1. Remove the access panel on the right side of the nose section.
2. Loosen and remove the four clamps securing the fan to the flexible rubber cuffs and the air control box and evaporator shroud.
3. Disconnect the electrical leads to the fan motor.
4. Slide the lower cuff down onto the evaporator shroud until the end of the fan housing is exposed: then remove lower cuff.
5. Move the fan down to disconnect the upper cuff from the air control box and remove.
6. Rotate the fan's upper end out towards the access opening and remove the fan from the airplane.

INSTALLATION OF RECIRCULATING FAN.

1. If the cuffs were removed when taking the fan out of the airplane, replace them onto the air control box and evaporator shroud.
2. Install the fan into the space between the air control box and evaporator shroud with the motor end of the fan extending into the shroud.
3. Turn the fan upright between the airbox and shroud and slide the upper edge of the fan housing into the cuff on the airbox.
4. Secure the fan, cuff, and air control box together with two clamps.
5. Slide the lower cuff over the lower end of the fan and secure it to the shroud and fan housing with the two other clamps.

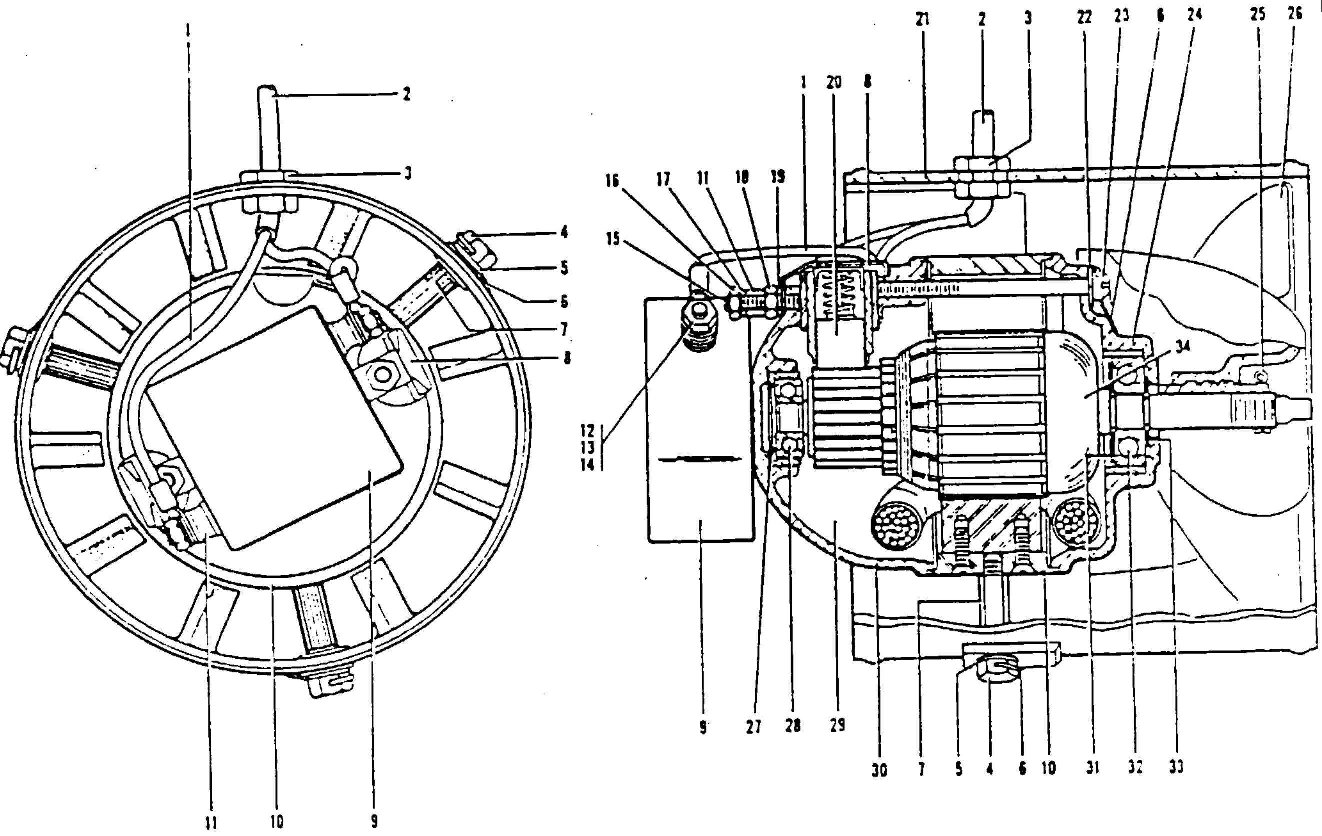
—NOTE—

Ascertain that the fan does not come in contact with any part of the air control box or evaporator shroud The cuffs act to shock mount the fan.

6. Connect the electrical leads to the fan and replace the access panel on the nose section.

DISASSEMBLY OF RECIRCULATING FAN. (Refer to Figure 21-16.)

1. Remove the cotter pin from the shaft end of the motor armature and remove the propeller by unscrewing it from the shaft end.
2. Remove the plastic grommet and insulating sleeve from the electrical leads extending out from the fan housing.
3. Cut the safety wire and remove the three bolts and washer which secure the motor assembly in the fan housing along with the spacers.
4. Disconnect the electrical lead from the radio filter by removing the nut, lock washer and plain washer.
5. Disconnect and remove the nut and washer from the terminal lug and remove the radio noise filter and the sleeve spacer.



1. ELECTRICAL LEAD
2. SLEEVE (INSULATING)
3. GROMMET
4. BOLTS
5. WASHERS
6. SAFETY WIRE
7. SPACERS
8. CAP
9. NOISE FILTER RADIO
10. STATOR
11. SLEEVE (SPACER)
12. NUT
13. LOCK WASHER
14. PLAIN WASHER
15. TERMINAL LUG
16. NUT
17. WASHER
18. NUT
19. WASHER
20. BRUSHES
21. FAN HOUSING
22. WASHERS FLAT
23. MACHINE SCREWS
24. END BELL
25. COTTER PIN
26. PROPELLER
27. FLAT SPRING
28. BEARING
29. MOTOR ASSEMBLY
30. END BELL
31. BEARING SHIELD
32. BEARING
33. SLINGER
34. ARMATURE

Figure 21-16. Recirculation Fan and Motor Assembly (Dynamic Air)

6. Remove the nut and washer on the terminal lug and remove the cap from over the brush holders.
7. Remove the brushes from the motor assembly.
8. Cut the safety wire and remove the machine screws and flat washers from the motor assembly.

—NOTE—

Make some type of reference marks along both bell ends and stator to facilitate reassembly.

9. Remove the end bell being careful not to drop the bearing, slinger and bearing shield.
10. Remove the end bell also being careful not to drop the bearing and flat spring behind the bearing.
11. Remove the motor armature from the stator.
12. Remove the bearings from their respective end bells along with the related parts.

ASSEMBLY OF RECIRCULATING FAN. (Refer to Figure 21-16.)

1. Install the flat spring into the end bell with the tabs toward the bearing; then install the bearing.
2. Install the slinger into the end bell; then install the bearing and bearing shield with the tapered center hole towards the bearing.
3. Install the motor armature into the stator and position the end bell to the stator, aligning the reference marks made before disassembly.
4. Install the forward end bell onto the armature shaft and align the reference marks.
5. Secure the end bells to the stator with the two machine screws and washers. Install safety wire MS20995-C32 to both screws.
6. Install brushes into the brush holders of the motor assembly.
7. Install the cap onto the terminal lug and secure with washer and nut.
8. Install the sleeve spacer over the terminal lugs and position the radio noise filter onto the lugs and secure in place with washer and nut.
9. Connect the electrical leads to the terminals on the filter and secure with plain washer, lock washer and nut.
10. Install the motor assembly into the fan housing and route the electrical leads through the hole in the housing.
11. Align the three mounting holes in the motor assembly with the mating holes in the housing; then install the spacers and secure the motor and housing with the three bolts and washers to secure the assembly and safety the three bolts with MS20995-C32 safety wire.
12. Install the insulating sleeve over the electrical leads extending out of the fan housing and install the plastic grommet over the wires and sleeve into the housing.
13. Install the propeller onto the armature shaft by screwing it in place and align the hole in the propeller bushing with the mating hole in the shaft and secure the propeller to the shelf with a new cotter pin.

CLEANING OF RECIRCULATING FAN MOTOR.

No solvents should be used on the electrical leads or motor parts. Lint-free cloths and compressed air should be used for cleaning. Parts other than electrical may be washed in solvent (Federal Specification P-D-680) and dried with compressed air.

INSPECTION OF RECIRCULATING FAN MOTOR.

1. Check the housing and propeller for any damage.
2. Check the electrical leads and radio noise filter for damage and broken insulation.
3. Check brushes for amount of wear which should not exceed 20 percent of the useful length or 0.125 of an inch.

—*NOTE*—

When brushes are removed for inspection only, each brush and corresponding holder should be marked to identify exact original positioning in the motor.

4. Check bearings and bearing seats for any damage of rotating bearings.
5. Check armature for commutator wear and eccentricity. Evidence of wear requires finish and undercutting.
6. If further electrical tests are required on the motor, it should be done in an electrical shop familiar with maintenance and overhaul of rotating electro-mechanical devices such as starters, generators, etc. (Refer to Chart 2103, Leading Particulars.)

REPAIR OF RECIRCULATING FAN MOTOR.

1. Replace damaged leads and insulation on all parts.
2. If commutator or armature is worn, it should be turned down enough to eliminate evidence of wear, and the mica between the bars undercut approximately 0.031 of an inch deep and 0.030 of an inch wide. Remove all particles of mica and polish the commutator with 3/0 sandpaper and remove all particles of copper between the bars. Coat the commutator with "long life" manufactured by Magnus Chemical Company, Inc., Garwood, New Jersey.
3. Replace all rejected parts. (Refer to Chart 2103, Leading Particulars for tolerances of parts.)
4. Replace bearings if unit has 500 hours service or at any time the brushes are replaced.

—*NOTE*—

Bearings used in this unit are critical parts. Great care should be taken to protect bearings in handling and assembly to prevent damage to fits.

5. If holder and lead or holder has to be replaced, extreme care must be exercised to get them positioned to clear the commutator by 0.031 of an inch and to align the rectangular portion exactly parallel with the centerline of the shaft.
6. If finish on any parts is damaged, touch up and refinish it.

CHART 2103. LEADING PARTICULARS (AXIAL FLOW FAN) (DYNAMIC AIR)

Electrical Current	27 Volts D.C.
Service	Continuous, Sea Level to 40,000 feet
R-F Interference	Filtered per Spec. MIL-I-6181
Operating Temperature	-54°C to +121°C: -65°F to +250°F
Motor Brushes	Body Length, New, 0.56 inch Useful Length, 0.44 inch
Minimum Useful Diameter of Commutator	0.935 inch
Bearing Insert Seat, Shaft End, Inside Diameter	Min. 1.1811 inch: Max. 1.1814 inch
Bearing Insert Seat, Comm. End, Inside Diameter	Min. 0.8661 inch: Max. 0.8664 inch
Weight	5.25 lbs.
Requirements	300 cfm at 3.0" H20 static pressure with standard air density of 0.0765 lbs. cu., ft.

TESTS OF RECIRCULATING FAN MOTOR.

1. Electrical: The following should be done by an electrical shop:

—CAUTION—

Before making dielectric tests, be sure all carbon dust has been removed with compressed air.

A. Perform a dielectric test between the commutator and shaft at operating temperature. The commutator and shaft must pass a hi-potential test of 500 RMS volts at 60 cycles AC for one minute, and insulation resistance shall measure 200 megohms or more. If test cannot be met, replace the armature.

B. Make a dielectric test of the stator between the leads at operating temperature. It must pass a hi-potential test of 500 R MS volts at 60 cycles AC for one minute, and insulation resistance shall measure 200 megohms or more. If the test cannot be met, replace the stator.

2. Prior to Reassembly:

—*WARNING*—

Before energizing fan or motor on bench test, strap it down and provide some type of wire guard around propeller to protect personnel. The fan has high suction and can draw a persons hand into the intake end.

A. The motor should be run on a low voltage of 8 to 14 volts until the brushes are 75 to 90 percent seated before full voltage is used. During this process, the motor can be loaded by installing the propeller on the shaft.
B. Check performance of motor with propeller installed on shaft. After operating at full voltage for 20 minutes, the maximum current input should not exceed 12.5 amperes and minimum speed should be 11,300 RPM.

CHART 2104. TROUBLESHOOTING (RECIRCULATING FAN) (DYNAMIC AIR)

TROUBLE	CAUSE	REMEDY
No rotation.	Power not supplied.	Turn on power supply. Check for open in wiring.
	Brushes not making contact to commutator.	Brushes worn. need replacement.
Excessive current and low speed.	Bearings misaligned or preloaded.	Move armature back and forth to relieve pre-load.
	Faulty bearings.	Replace bearings.
Low speed.	Brushes not properly seated.	Longer run-in.
Excessive current and high speed.	Shorted turns in field.	Replace stator.
Excessive current and bucking.	Shorted turns in armature.	Replace armature.
Exccessive vibration.	Armature out of balance.	Rebalance armature.
	Propeller damaged.	Replace and balance propeller.
	Propeller out of balance.	Rebalance propeller.

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 21-12.)

1. Disconnect the electrical leads from the terminals of the combustion air pressure switch. (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 21-12.)

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, Chapter 91.
4. Check for proper heater operation.

OVERHEAT LIMIT SWITCH.

Located on 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 switch is located on the downstream end of the jacket, 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 OVERHEAT LIMIT SWITCH.

1. If the limit switch is damaged or defective, disconnect the three electrical leads from the switch terminals. Be sure to mark the leads for proper reassembly. (The switch terminals are identified by numbers "1," "2" and "3.")

2. Remove the two attaching screws and lift the limit switch and spacers (gaskets) from the jacket opening.

—*NOTE*—

No attempt should be made to repair the switch. If it does not operate properly, it should be replaced.

INSTALLATION OF OVERHEAT LIMIT SWITCH.

1. Install the limit switch and two spacers (gaskets) by placing them in position in the heater jacket 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, Chapter 91.)

—*NOTE*—

The overheat switch operates at 300°- 400°F.

CYCLING SWITCH.

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 a differential of 15°F ± 5° at any given setting.

REMOVAL OF CYCLING SWITCH.

1. If the cycling switch is damaged or defective, disconnect the electrical leads from the switch terminals. Be sure to mark the leads for proper reassembly.
2. Remove the attaching screws and lift the cycling switch, gasket and switch plate from the fresh air distribution tube.

—*NOTE*—

No attempt should be made to repair the cycling switch. If it does not operate properly, it should be replaced.

INSTALLATION OF CYCLING SWITCH.

1. Install the cycling switch, gasket and switch plate by placing them in position in the fresh air distribution tube 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, Chapter 91.)

HEATER THERMOSTAT.

A manual reset thermostat has been attached to the outboard side of the hot air distribution box to prevent overheating of the heated air ducts. If the thermostat should sense a temperature of 300° F ± 3° F. electrical power will be interrupted to the heater control valve, thereby, precluding further heater operation until the thermostat is manually reset by removing the access panel on the right side of the nose section and depressing the reset button.

THIS SPACE INTENTIONALLY LEFT BLANK

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 21-18.
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.)

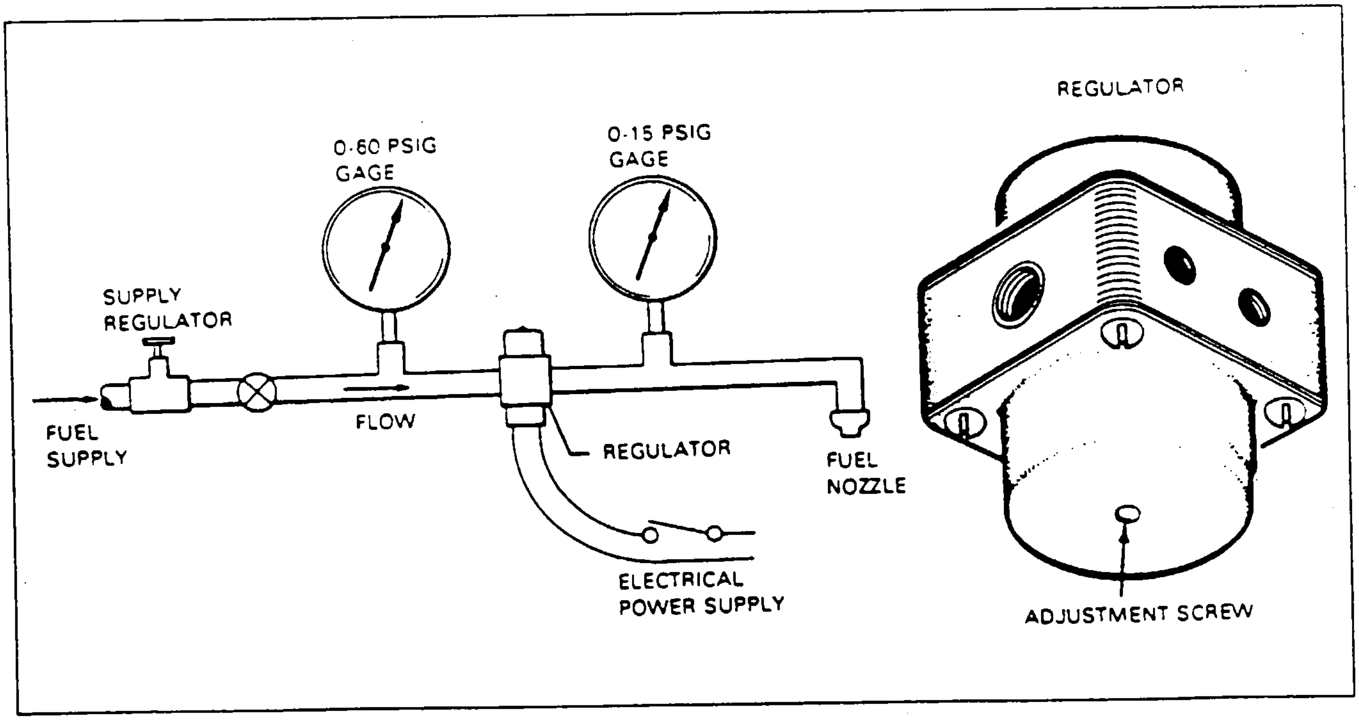


Figure 21-18. Test Setup for Fuel Regulator and Shutoff Valve

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.
4. Check for proper heater operation.

TEST PROCEDURE.

GENERAL.

A test of all components should be made after overhaul too insure proper operation. Some shops may not have complete testing facilities for measuring airflows, 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 routine described in Janitrol Maintenance and Overhaul Manual, P/N 24E25-1 should be made.

COOLING.

DESCRIPTION AND PRINCIPLES OF OPERATION.

The air conditioning system consists of a variety of parts which make up the complete system. The compressor is mounted to the right engine and is a belt driven piston type unit. The condenser is a fin and tube heat exchanger mounted above the heater. 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 evaporator is mounted in front of the heater. and is a fin and tube heat exchanger which cools and dehumidifies the air. The evaporator is equipped with an expansion valve. This valve controls the flow of freon into the evaporator core. A capillary coil mounted to the suction line at the evaporator regulates the operation of the valve.

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 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 2105. along with their probable cause and suggested remedies.

CHART 2105. TROUBLESHOOTING (AIR CONDITIONER)

TROUBLE	CAUSE	REMEDY
High discharge pressure indicated on gauge.	Overcharge of refrigerant.	Purge excess refrigerant.
	Air in system.	Check for leaks. Bleed charge from system. Evacuate and recharge system.
	Overheated condenser due to blocking air passage.	Clean bugs and dirt from condenser fins. Straighten fins if bent.
	Flooded evaporator indicated by heavy frosting on suction line and compressor suction service valve.	Check that capillary bulb is securely clamped to suction line. If capillary bulb OK, replace expansion valve.
	Restriction in liquid line from condenser.	Check for kinked hoses and stopped up filter.
Low discharge pressure indicated on gauge.	Undercharge of refrigerant. Sight glass shows bubbles or foam.	Add refrigerant until bubbles disappear. Check system for leaks.
	Damaged compressor. Worn or broken piston or piston rings.	Isolate compressor. Repair or replace compressor.

CHART 2105. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

TROUBLE	CAUSE	REMEDY
Low suction pressure indicated on gauge. (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 indicated on gauge. (Evaporator not cold enough) suction gauge may read a vacuum indicating evaporator lacks refrigerant.	Undercharge of refrigerant. Moisture freezing in expansion valve. Valve will show frost.	Add Freon. Install new dryer. Evacuate and recharge system.
	Expansion valve inlet screen clogged. Inoperative expansion valve. Valve stuck closed or capillary bulb has lost its charge.	Remove screen. Clean with solvent and replace. Warm capillary by holding in hand. If suction pressure does not change. replace expansion valve.
	Restriction anywhere in liquid line. Restric tion will show frost.	Locate restriction and repair.
High suction pressure indicated on gauge.	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 2105. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

TROUBLE	CAUSE	REMEDY
High suction pressure indicated on gauge. (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.
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 dis connected.
	Clutch coil burned out or disconnected.	Check current flow to clutch - replace if inoperative.
	Thermostat sensing element defective.	If system works in manual mode. check thermostat and cabin comfort control panel.

CHART 2105. 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 replacement.
	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 .
	Clogged screen or screens in receiver dehydrator or expansion valve; plugged hose or coil.	Repair as necessary.

CHART 2105. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

TROUBLE	CAUSE	REMEDY
	—*NOTE*— ***After completing repairs of any above causes, the system must have the receiver-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.

CHART 2105. 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-dehydrator.	Purge system; replace receiver-dehydrator
	Excessive moisture in system.	Purge system; replace receiver-dehydrator.
	Air in system.	Purge, evacuate, and charge system. (Replace receiver.)

—NOTE—

When a unit must be removed from the system for service or replacement, the system must have the receiver-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.	Replace or repair is necessary.
	Mechanical	
	Loose or excessively worn drive belts	Tighten or replace as required

CHART 2105. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

TROUBLE	CAUSE	REMEDY
Excessively noisy system. (cont.)	Mechanical (cont.)	
	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 amount of 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 receiver-dehydrator: purge. evacuate and charge system

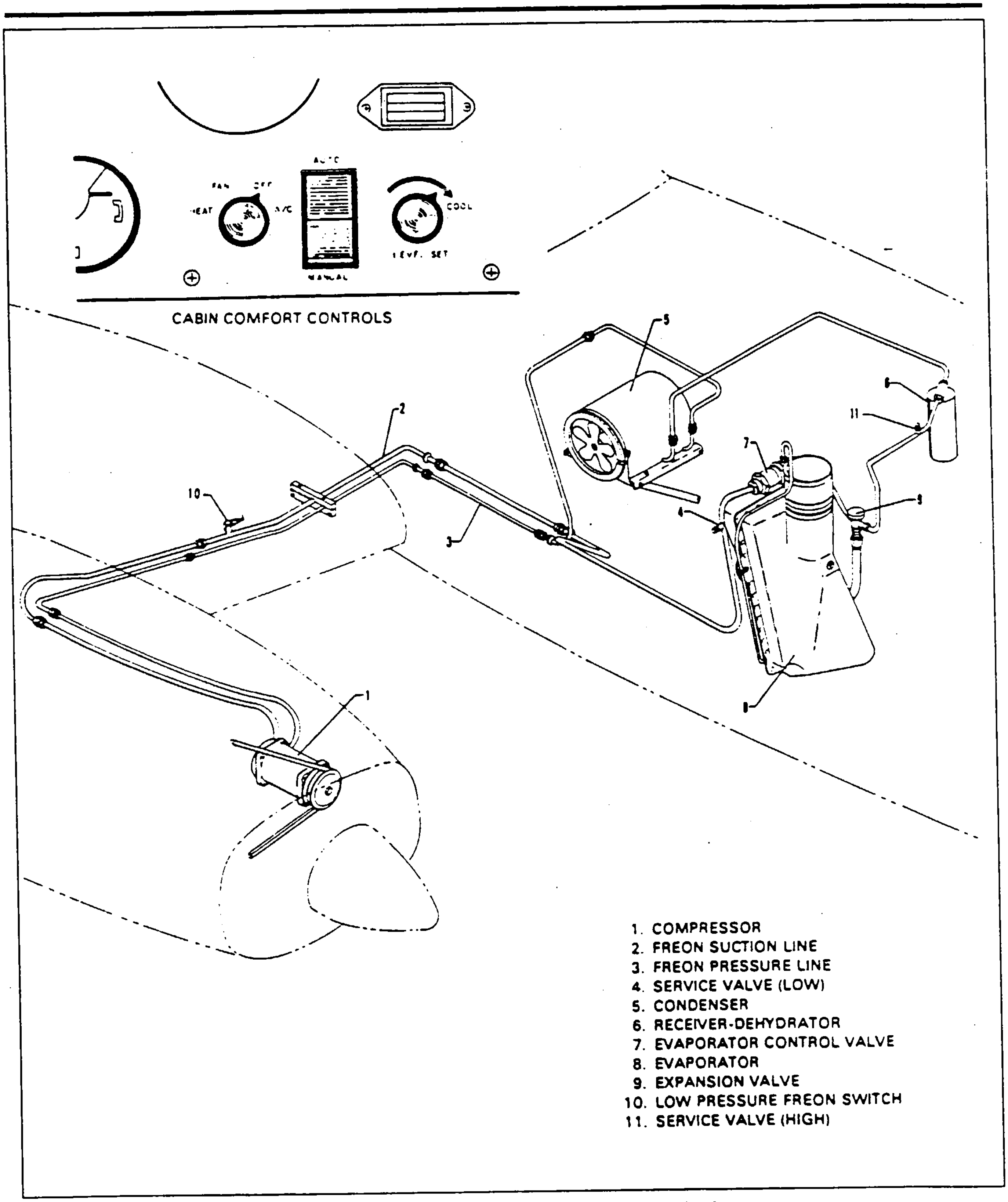


Figure 21-19. Air Conditioning System Installation

CHART 2106. TEMPERATURE/ PRESSURE CHART

Evaporator Pressure Gauge Reading p.s.i.	Evaporator Temperature °F.	High Pressure Gague 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	81
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 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.

SPECIAL SERVICING PROCEDURES.

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

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

1. GENERAL REFRIGERATION SYSTEM PROCEDURES.
   A. REFRIGERANT SAFETY PRECAUTIONS.
      (1) Refrigerant 12 (combine known as R-12 or "Freon" 12) is odorless and colorless in either the liquid or gaseous state. R-12 for charging refrigeration systems is supplied in pressurized containers (approx. 70 psi at 70°F.) in liquid form. Since this material is essentially inert at room temperatures the dangers are primarily associated with the pressure and the refrigeration effects of the release and subsequent evaporation of this pressurized liquid.
      (2) Wear suitable eye protection when handling R- 12 due to the possibility of freezing of the eye if contacted by escaping liquid refrigerant. If liquid R-12 does strike the eye, the following actions should be taken:
         (a) DO NOT RUB THE EYE.
         (b) Splash large quantities of cold water into the eye to raise the temperature.
         (c) Tape on an eye patch to avoid thc possibility of dirt entering the eye.
         (d) Rush to a physician or hospital for immediate professional aid.
         (e) DO NOT ATTEMPT TO TREAT IT YOURSELF.
      (3) If liquid R-I2 strikes the skin, frost bite can occur. Treat with cool water and protect with petroleum jelly.
      (4) Do not discharge large quantities of R-12 into closed rooms. It may displace most of the air in the room and this could cause oxygen starvation. Gaseous R-12 is heavier than air and flows to the bottom of a container.
      (5) Do not discharge R-12 into an open flame or onto a very hot surface (500° F+). Poisonous phosgene gas is generated by the action of the heat on the refrigerant.
      (6) Do not apply direct flame or other high heat source to a R-12 container due to the high pressures which will result. If any heating is done to R-12 containers the container pressure should be monitored and kept below 150 psi.
   B. SYSTEM SERVICING PRECAUTIONS.
      (1) Systems should be discharged slowly to prevent the escape of liquid refrigerant and the loss of the lubricating oil.
      (2) Systems should not be left open to the atmosphere when discharged. Moisture and other contamination may enter and damage open systems.
      (3) Never introduce anything but pure refrigerant and refrigerant oil into a system.
      (4) Keep refrigerant oil containers tightly sealed and clean to prevent absorption of moisture or other contamination.
      (5) Use only approved refrigeration oil in the compressor. If any doubt exists about the cleanliness of the compressor oil, replace it with new oil.
      (6) Never reuse oil removed from the system. Discard it.

(7) When Loctite Refrigerant Sealant has been used on a joint it must be heated to 400°F prior to disassembly. Loctite must be used to seal any pipe threads in the system lines.
(8) Replace the receiver-dehydrator assembly on any system which has been operating with a leak allowing air to enter the system. If a receiver-dehydrator is left open to the atmosphere it should be replaced due to the loss of effectiveness of the drying compound it contains.
(9) Replace O-rings when a connection has been broken. Dip new O-rings in refrigeration oil before using.

—NOTE—

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

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

(10) Recommended torque values must be used on all flare fitting and O-ring joints. See Chart 2107.

CHART 2107. 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.

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SERVICE VALVES.

The purpose of the service valve is to service the air conditioning system. (Testing, Bleeding, Evacuating and Charging.) This aircraft is equipped with service valves mounted in the suction and discharge lines of the evaporator assembly. All normal air conditioning service should be performed at the evaporator assembly mounted valves.

—NOTE—

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

—NOTE—

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

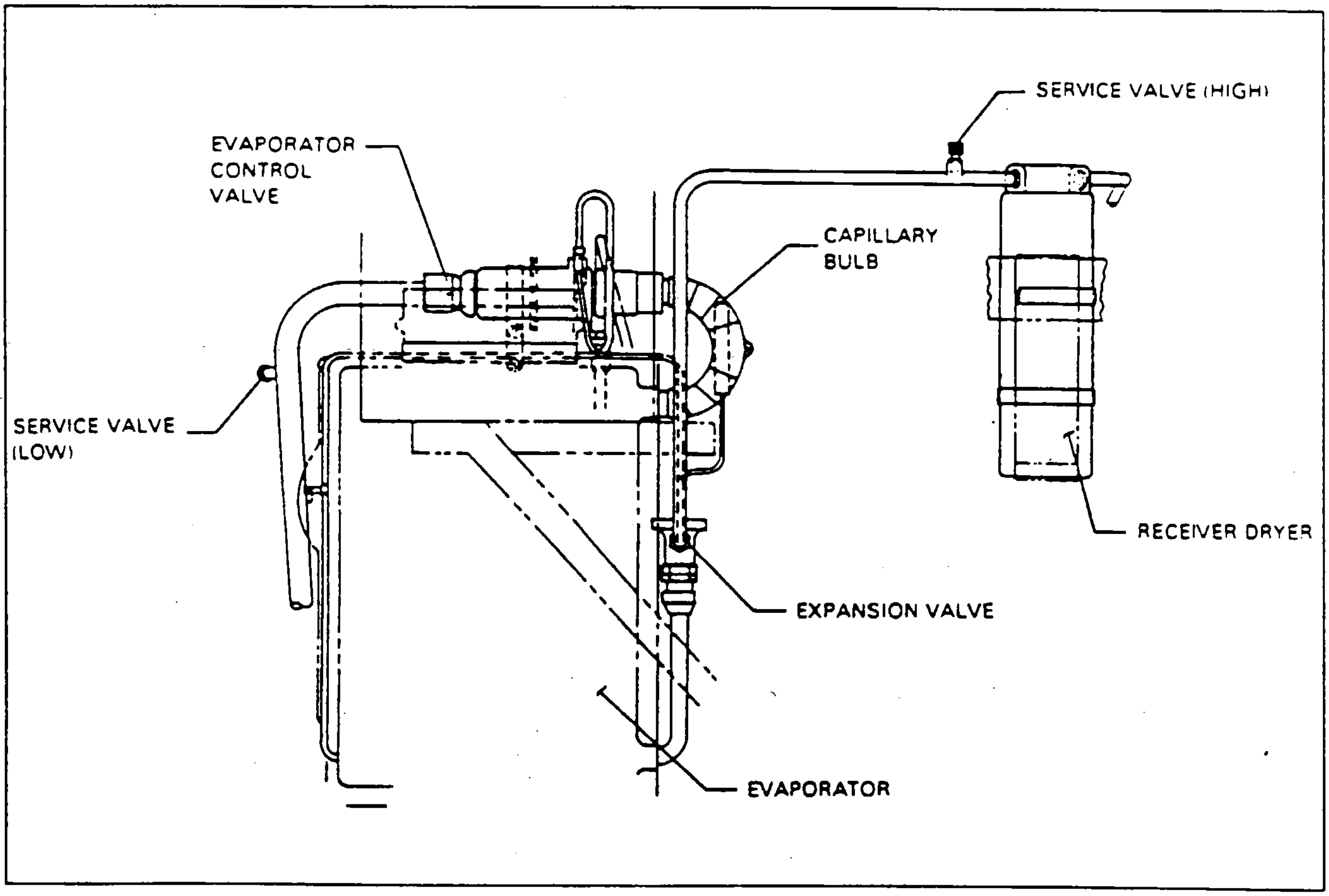

Figure 21-20. Service Valves Location

TEST GAUGE AND MANIFOLD SET.

The proper testing and diagnosis of the air conditioning system require that a manifold gauge set be attached into the system. This set consists of two gauges mounted to a manifold. One gauge is a high pressure gauge used in the discharge side of the system. The other is a low pressure gauge used in the suction side of the system. The manifold is a device having fittings for both gauges and connection hoses with provisions for controlling the flow of refrigerant through the manifold. (See Figures 21-21 and 21-22.)

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 shut-off valves. When the hand valve is turned all the way in, in a clockwise direction, the manifold is closed. The pressures on the 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 21-21 and 21-22.)

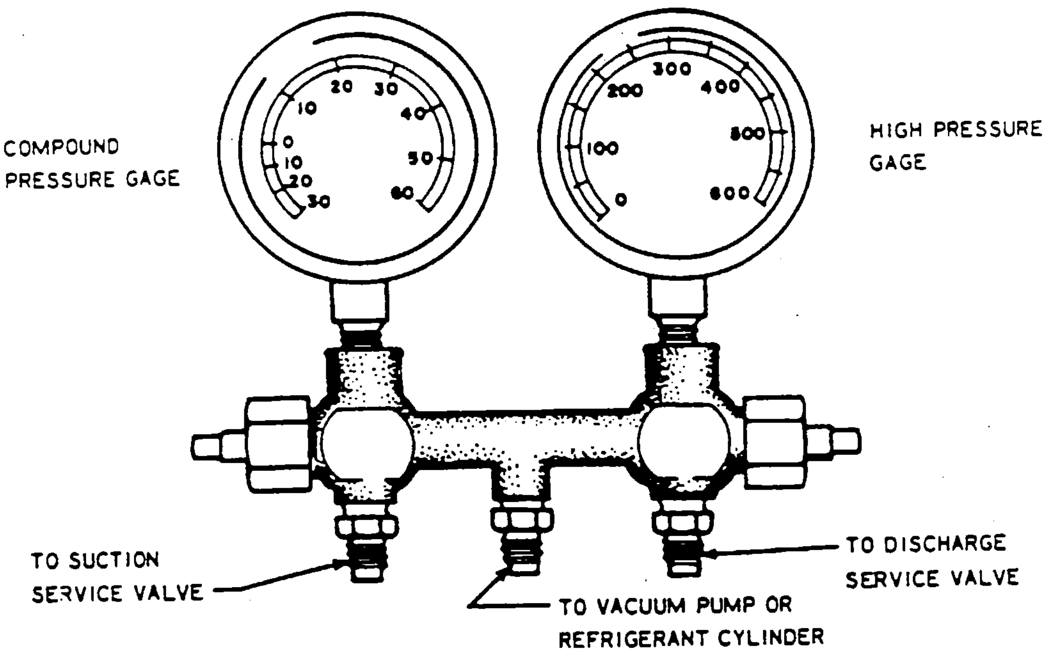

Figure 21-21. Test Gauge and Manifold Set

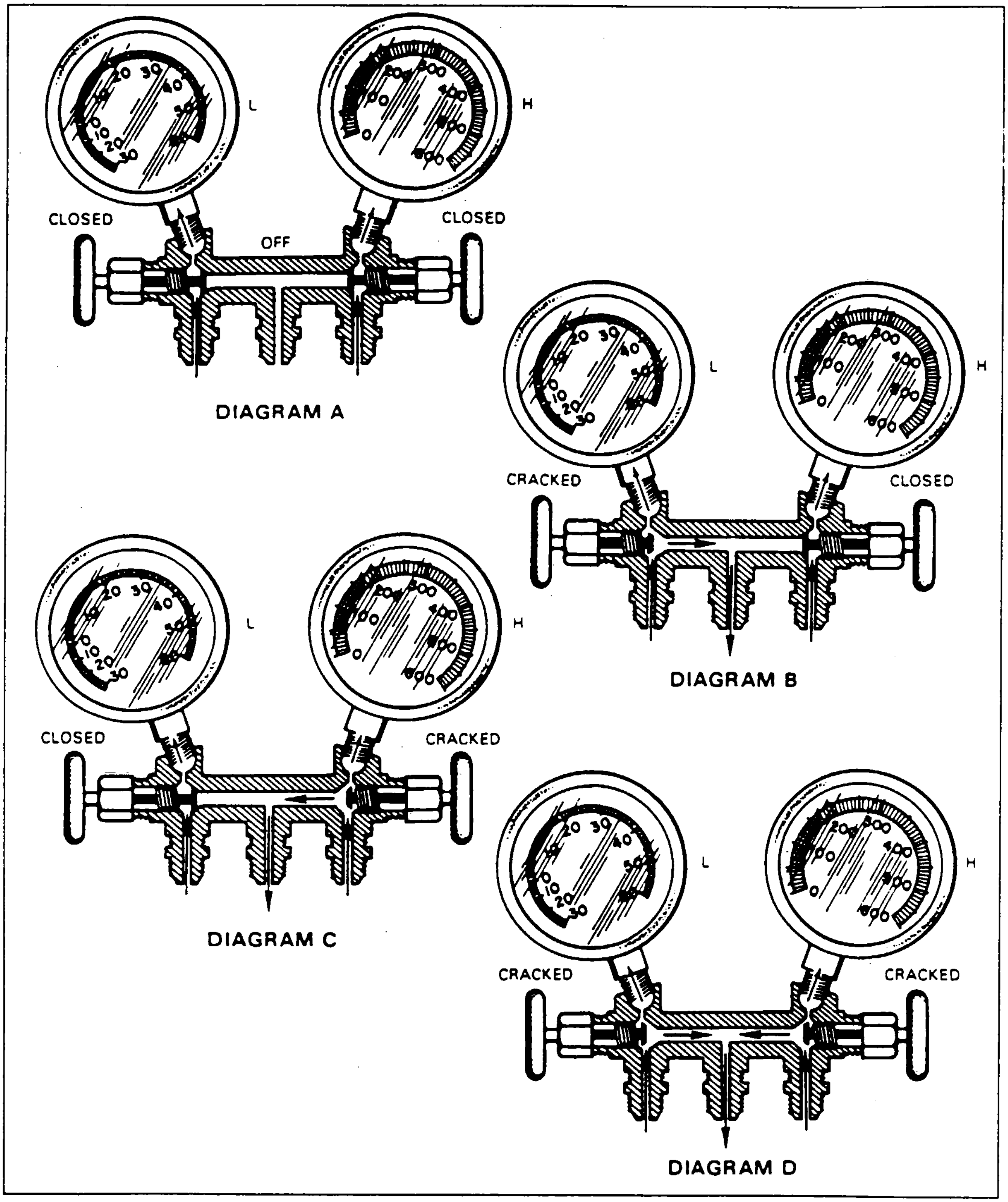

Figure 21-22. Manifold Set Operation

CHECKING SYSTEM FOR LEAKS.

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

—*NOTE*—

Evacuate system prior to leak check

LEAK CHECK - METHOD I.

1. Connect the manifold gauge set into the system and determine if there is any refrigerant in the system. A minimum of 50 psi refrigerant pressure in the system is needed for leak detection. (Refer to Figure 21-23.)
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 valves.
3. Close the low side manifold valve and open the high side manifold valve.
4. Open the refrigerant container service valve and allow the pressure at the low side gauge to reach 50 psi at which time close the high side manifold valve.
5. Close the refrigerant container service valve and remove the hose if no leaks are evident.
6. It is advisable to use an electronic leak detector to check this system instead of an open flame leak detector due to the possible presence of gasoline fumes in the heater area.

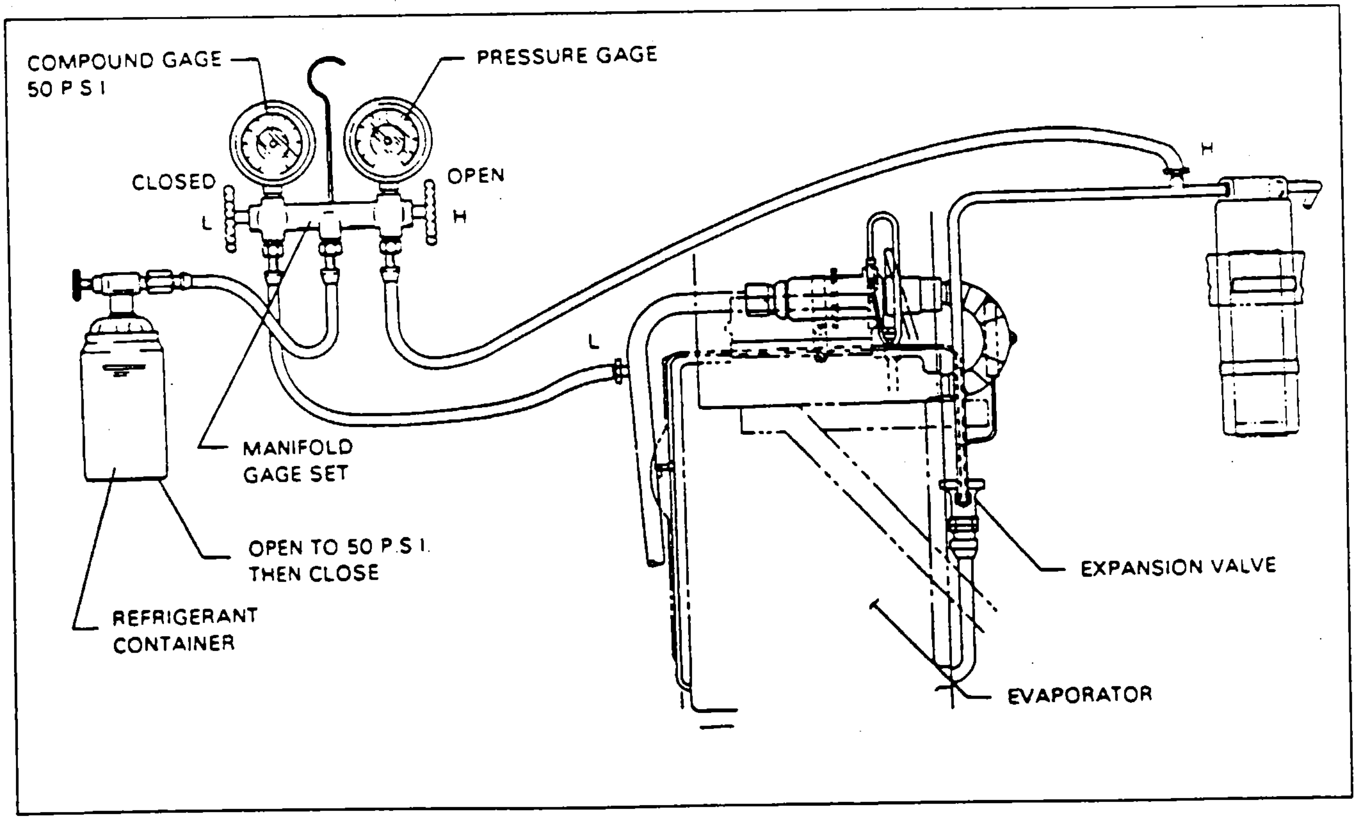

Figure 21-23. Leak Test Hookup

7. If any leaks are found, purge the system of refrigerant, make the necessary repairs and check the compressor oil.
8. Add oil, if required, refer to "Checking Compressor Oil," then repeat Steps 1 thru 5.

—CAUTION—

Many electronic leak detectors do not reduce the hazard of igniting an explosive mixture. Read the instructions supplied with the unit and be sure to properly ventilate any area to be checked.

9. If no further leaks are found, the system may be evacuated and charged. (Refer to paragraphs "Evacuating the System" and "Charging the System.")

LEAK CHECK - METHOD II.

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

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DISCHARGING. (Required only if system contains refrigerant.)

—NOTE—

Applies to Kent Moore J23500 or similar charging station, (Refer to Figure 21-25.)

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

—CAUTION—

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

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

EVACUATING THE SYSTEM.

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

CHART 2108. SYSTEM VACUUM

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

—NOTE—

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

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

1. Remove access panel located on the right side of the nose section to gain access to the service valves.

—*CAUTION*—

Ascertain that all system pressure is released before attempting the evacuation. (Refer to paragraph "Service Valves.")

2. Connect the manifold gauge set to the airplane service valves. (Refer to Figure 21-24.)
3. The high and low manifold hand valves should be in the closed position. (Refer to Figures 21-21 and 21-24.)
4. Connect the center manifold hose to the inlet of the vacuum pump.

—*VOTE*—

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

5. Start the vacuum pump and open the low side manifold hand valve. Observe the compound, low pressure gauge needle, it should show a slight vacuum.
6. Continue to operate the vacuum pump until 26 to 28 inches of vacuum is attained on the low pressure gauge, then extend the operation for another 25 minutes.

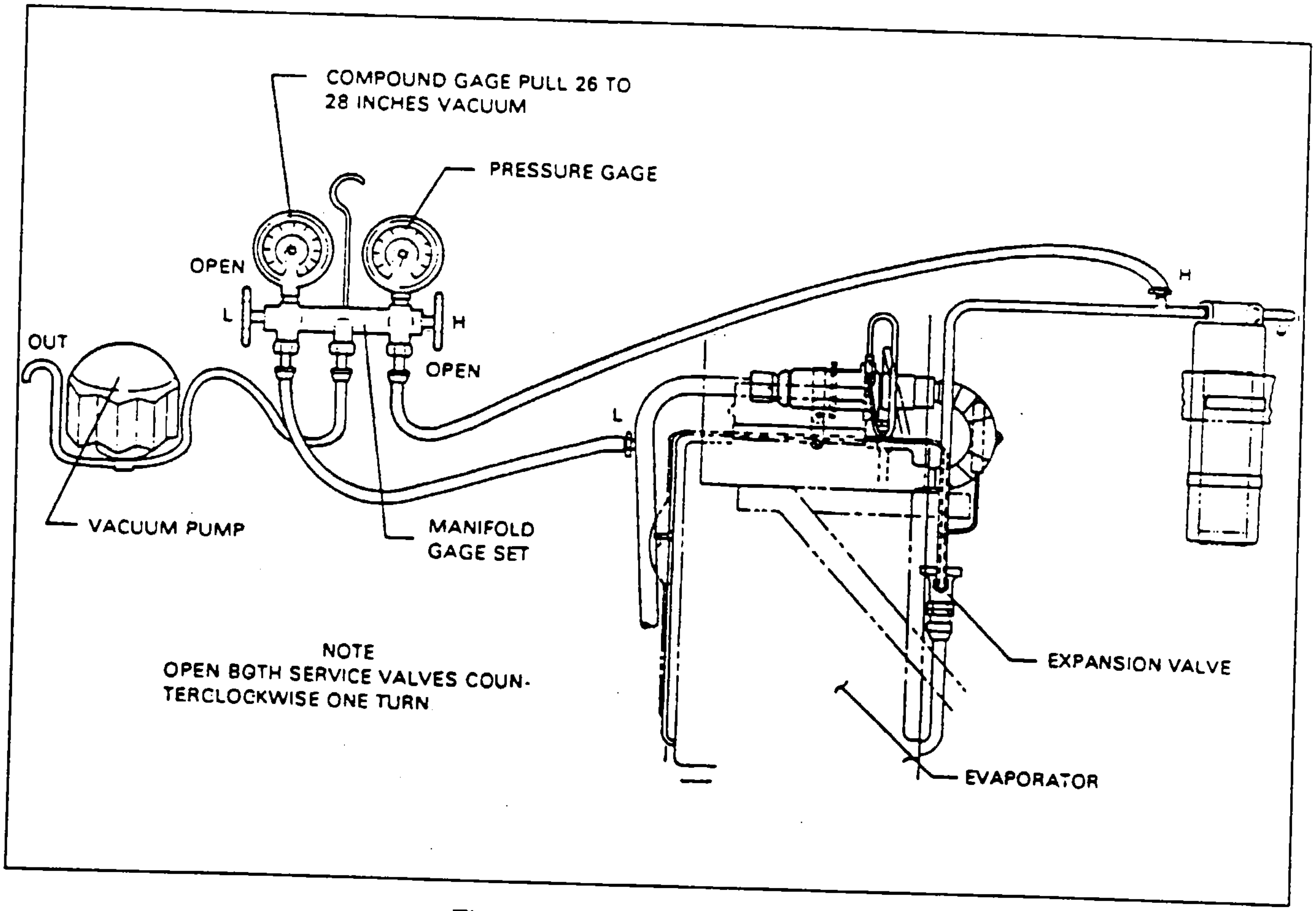

Figure 21-24. Evacuation Hookup

7. If the system cannot maintain 26 to 28 inches of vacuum, close both 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 the paragraph "Charging the System."

—NOTE—

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

CHARGING THE SYSTEM.

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

USING A CHARGING STAND.

This is the preferred method of charging the system.

—NOTE—

The following instructions apply to Kent Moore, J23500 charging stand (Refer to Figure 21-25.)

1. With the system discharged and evacuated, proceed to hook-up the charging stand. (Refer to Figure 21-26.)
2. Fill the charging cylinder by opening the valve at the base of the charging cylinder and filling the sight glass with two pounds of liquid refrigerant.
3. As refrigerant stops filling the sight glass. open the valve at the top of the gauge neck assembly intermittently to relieve head pressure and allow refrigerant to continue filling the sight glass to the required amount.
4. When refrigerant reaches the required level in the sight glass, close both the valve at the base of the cylinder and the valve at the bottom of refrigerant tank. Be sure the top valve is fully closed.

—NOTE—

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

5. Connect the heating element plug to a 110 volt outlet.
6. Turn cylinder sight glass to match pressure reading on cylinder pressure guage. This scale should be used during entire charging operation.
7. Close valve 1 (low pressure control), fully open valve 4 (refrigerant control) and allow all the liquid refrigerant contained in the charging cylinder to enter high side of aircraft system.
8. When the full charge of refrigerant has entered the system, close valve 4 (refrigerant control) and valve 2 (high pressure control).
9. After completion of charging, close all valves on the charging stand. Disconnect the high and low pressure charging lines from the aircraft system. (A small amount of refrigerant remaining in the lines will escape.) Replace lines on holder of charging stand to keep air and dirt out of lines. Open the valve at the top of cylinder to relieve any remaining pressure, then reclose the valve.
10. Reinstall protective caps of service valves and any access panels previously removed.

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

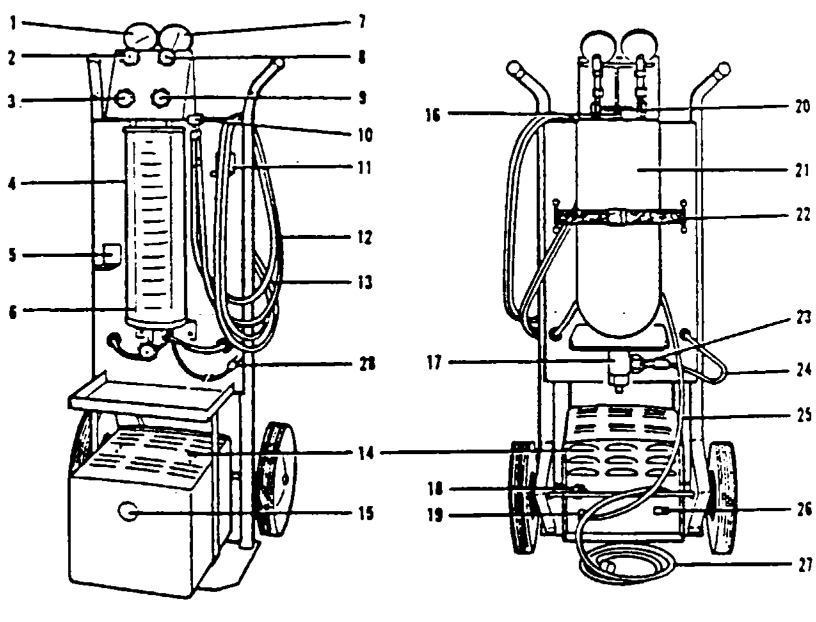

Figure 21-25. Charging Stand

PARTIAL CHARGE TO SYSTEM.

1. Remove the right access panel located on the nose section of the airplane.
2. Connect a charging hose to a refrigerant cylinder and also to the Schrader gauge fitting on the evaporator control valve. (Refer to Figure 21-26.)
3. Purge the charging hose by allowing a small amount of refrigerant gas to escape at the Schrader Gauge fitting.
4. Operate the right engine at 900 to 1000 RPM and place the cabin air selector in the pressurized air position. Turn the air conditioner on in the manual mode.
5. Remove the plastic plug from the sight glass in the top of the receiver-dryer.

—NOTE—

This sight glass can be safely viewed with a mirror through the removable panel at the rear of the nose baggage compartment.

6. With a low refrigerant charge in the system, bubbles will be seen passing thru the sight glass when the system is operating.
7. Open the valve on the refrigerant cylinder.
8. Allow refrigerant to flow into the system until the bubbles disappear from the sight glass.
9. Close the refrigerant valve and check to see that the sight glass remains clear during system operation.
10. When the sight glass stays clear of bubbles, add an additional 1/2 pound of refrigerant to the system.
11. Shut off the air conditioner and engine. Remove the charging hose from the evaporator control valve with care due to refrigerant remaining in the line.
12. Replace the access panels.

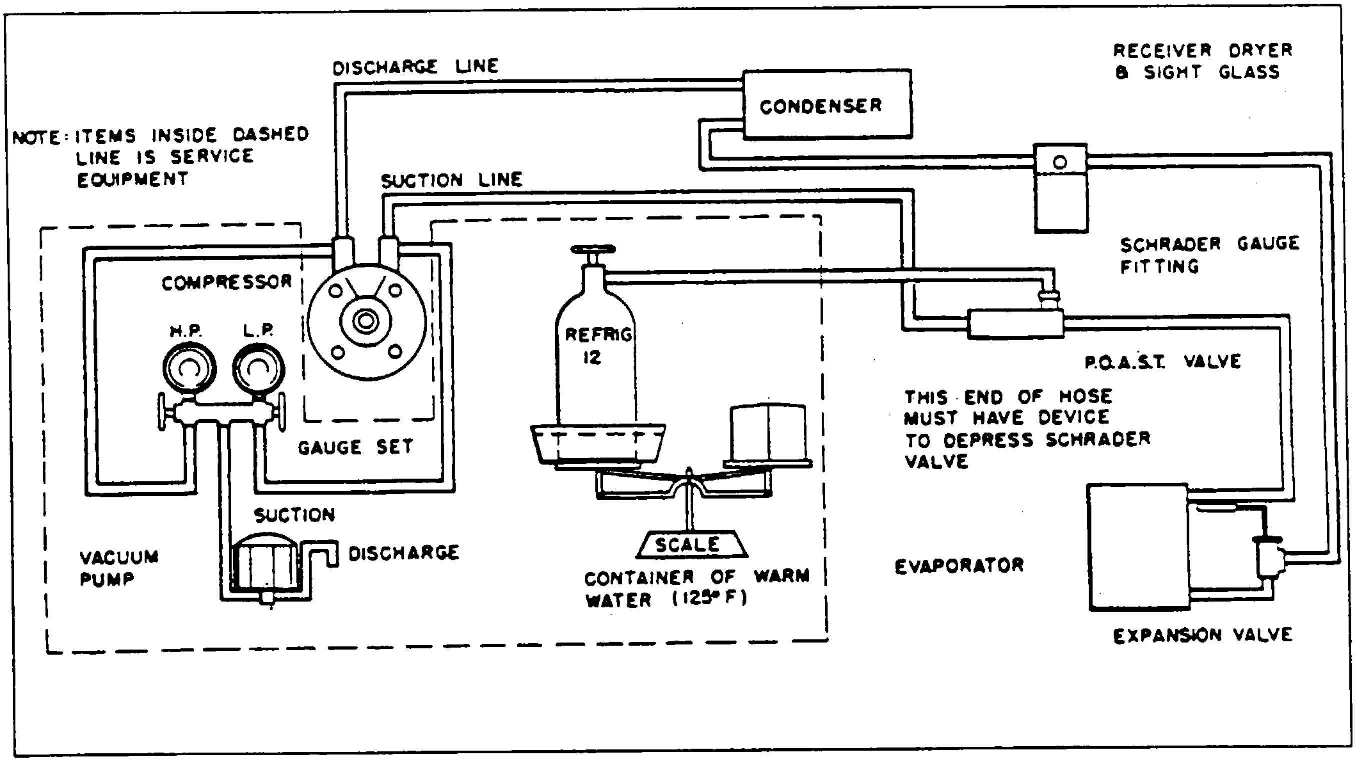

Figure 21-26. Charging Hookup (Typical)

COMPONENT MAINTENANCE.

COMPRESSOR SERVICE.

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

Maintenance to the Sankyo compressor is limited to replacement of worn drive belt and magnetic clutch. Contact Sankyo International, 10710 Sanden Drive, Dallas, Texas 75238 for special tools and instructions for detailed compressor maintenance.

—NOTE—

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

COMPRESSOR REMOVAL.

The system must be discharged per paragraph "Discharging" before removing compressor. The removal instructions for the Sankyo compressor are as follows:

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

—NOTE—

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

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

COMPRESSOR INSTALLATION.

The installation instructions for the Sankyo compressor are as follows:

1. Place the compressor in the mounting brackets and install attachment bolts. Do not torque attachment bolts at this time.
2. Install compressor drive belt. Rotate compressor in mounting bracket slots to obtain a belt tension of 6.32 pounds (4.0 pounds for used belts). Deflection should be .16 of an inch, if less, belt is too tight. Torque the attachment bolts.
3. Check the oil level in the compressor in accordance with instructions given in the next paragraph.
4. Connect the discharge and suction lines to their respective fittings.
5. Evacuate and charge the system per previous instructions.

—WARNING—

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

CHECKING COMPRESSOR OIL.

The oil level should be checked any time the system is discharged. Use the following instructions for checking Sankyo compressor oil level:

1. Run the compressor for 10 minutes with engine at idle RPM.
2. Discharge the system as previously instructed: be careful not to lose any oil.
3. Loosen the bolts securing the compressor in the mounting brackets. Rotate the compressor in the bracket slots to disconnect drive belt.
4. Rotate compressor so that oil filler plug is in a top dead center position.
5. Remove the oil filler plug.
6. Position the rotor to top dead center (refer to Figure 21-27) by rotating the clutch front plate until the casting mark is visible in the center of the hole.
7. Rotate the clutch front plate clockwise by approximately 110°. (Refer to Figure 21-28.)
8. Insert dipstick No. 32447 purchased from Sankyo. (See ''Compressor Service'' paragraph for Sankyo address.)
9. Remove the dipstick and count the number of increments of oil. The acceptable oil level in increments is 4 to 6.
10. When oil is added. Frigidaire refrigerant oil 525 or Suniso No. 5 or Texaco Capella E refrigerant oil must be used.
11. When installing the oil filler plug. make sure the sealing O-ring is not twisted and that no dirt or particles are on the O-ring or seat. Torque the plug to 6-9 foot-pounds. Do not overtighten the plug to stop a leak; remove the plug and install a new O-ring.
12. Evacuate and charge the system as previously described.

—CAUTION—

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

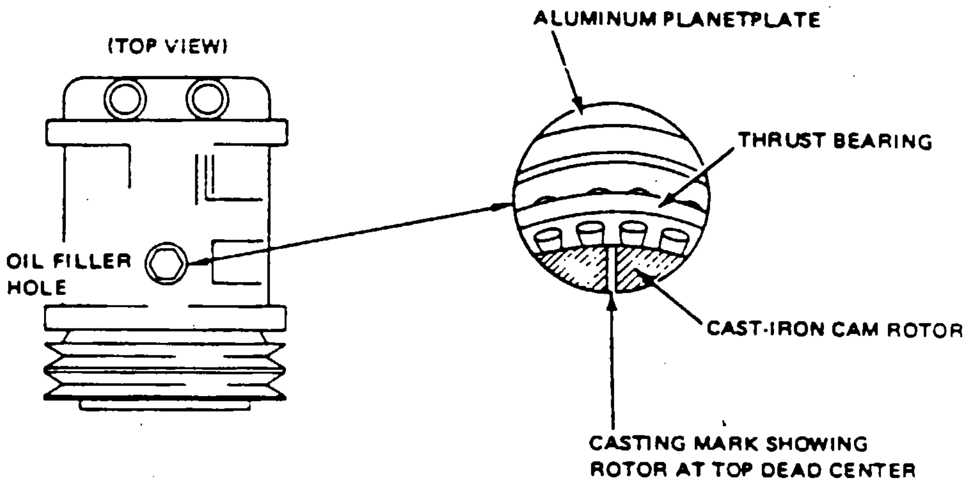

Figure 21-27. Top Dead Center Casting Mark (Sankyo Compressor)

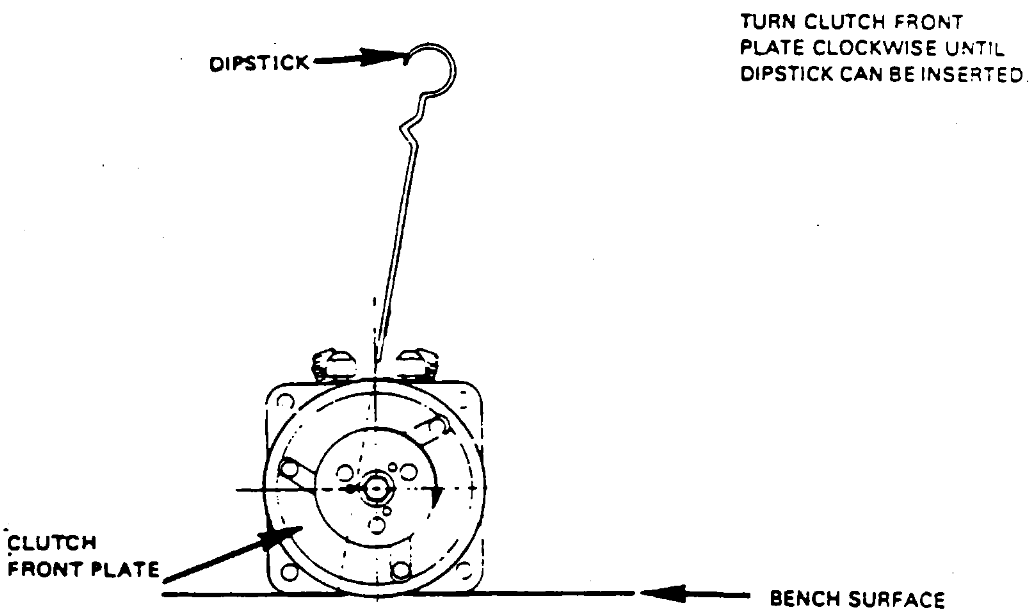

Figure 21-28. Rotation of Clutch Front Plate (Sankyo Compressor Oil Check)

BELT INSPECTION. (Refer to Figure 21-29.)

Belt conditions, alignment, and tension are very critical. Carefully inspect old belts and the new belts before replacement. The existence of any one of the following conditions is sufficient cause for rejection of a belt:

1. Unevenness - look for areas where the interflat area is uneven.
2. Cords broken or fuzzy or where the cord appears to be coming out of the belt.
3. Holes in belt side wall.
4. Obvious flaws in the belt. lumps, thin spots. etc.

ADJUSTMENT OF DRIVE BELT TENSION.

Adjust the Sankyo compressor as follows:

1. Rotate the compressor to obtain tension of 6.32 pounds (4.0 pounds for used belts). Deflection should be .16 of an inch, if less belt is too tight.

—WARNING—

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

2. Run the engine for a 15 minute period at engine idle RPM with the compressor engaged.
3. Shut down engine and recheck the belt tensions. New belt tension should fall back to desired tension of 4.0 pounds with .16 of an inch deflection. Old belts reinstalled should retain the same tension.
4. This tension check should be made at everv 100 hours or annual inspection whichever occurs first.

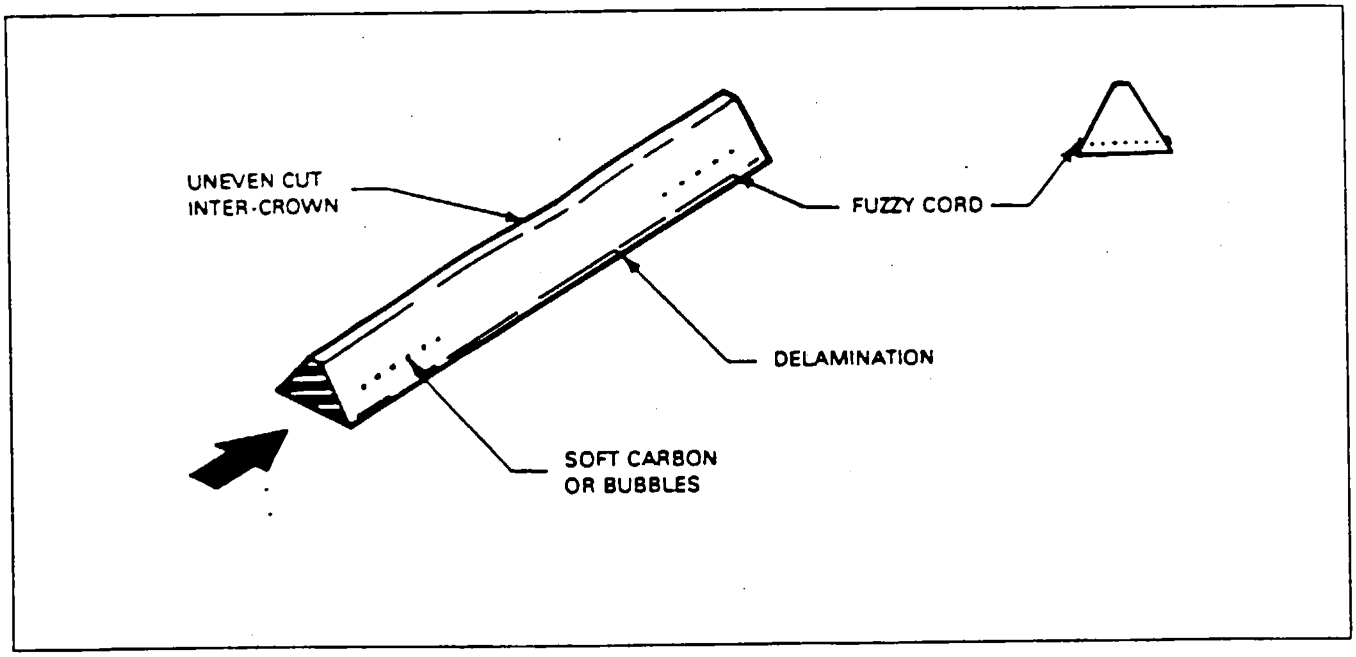

Figure 21-29. Belt Inspection

MAGGNETIC CLUTCH, PULLEY AND COIL.

—*NOTE*—

For all special tools used in the removal and installation of clutch, pulley and coil, refer to Chapter 95.

REMOVAL OF CLUTCH, PULLEY AND COIL. (Refer to Figure 21-30.)

1. Insert front plate spanner into any two threaded holes of the clutch front plate. Hold clutch plate stationary and remove hex nut with 3/4 inch socket.
2. Install puller 32416 center bolt over compressor shaft and thumb tighten the three puller bolts into the threaded holes. Using a socket turn forcing bolt clockwise to remove front plate.
3. Using a slot head screwdriver and hammer, lightly tap the shaft key and remove. Also remove shims.
4. With snap ring pliers remove the external and internal snap rings by the bearing inner and outer races.
5. Remove rotor pulley with puller 32418. Ascertain shaft protector is in place over shaft and turn puller forcing bolt clockwise using a socket until the pulley is free.
6. To remove the field coil remove the lead wire from the compressor front housing.

INSTALLATION OF CLUTCH, PULLEY AND COIL, (Refer to Figure 21-30.)

1. Place coil into position over flange protrusion and secure in this position with snap ring previously removed. Also connect coil lead wire to compressor front housing.
2. Support compressor on mounting ears at compressor rear. If a vice is used, clamp only on mounting ears, never on compressor body.
3. Align rotor assembly squarely on hub of front housing.
4. Using tool set 32435, place ring part of set into the bearing cavity. Make certain the outer edge rest firmly on outer race of rotor bearing
5. While guiding the rotor use a hammer and tap the end of the driver until rotor bottoms against compressor front housing hub.
6. Secure rotor bearing in position with snap rings previously removed.
7. Secure front housing into its position.
8. Reinstall the front plate as follows:
   A. On compressor shaft place the original shims.
   B. Install compressor shaft key and align the front plate keyway with compressor shaft key.
   C. Use shaft protector and tap front plate on shaft until it bottoms to clutch shims.
   D. Replace shaft hex nut and torque to 25 to 30 foot-pounds.

9. With feeler gauge check for an air gap of .016 to .031 of an inch. If air gap is inconsistent around circumference, lightly pry up at the minimum variations. Lightly tap down at points of maximum variations.

—NOTE—

The air gap is determined by the spacer shims. When reinstalling or installing a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously had no clutch, use .040, .020 and .005 shims from clutch accessory sack.

If the air gap does not meet the specification in Step 9, add or subtract shims by repeating Step 8, C and D.

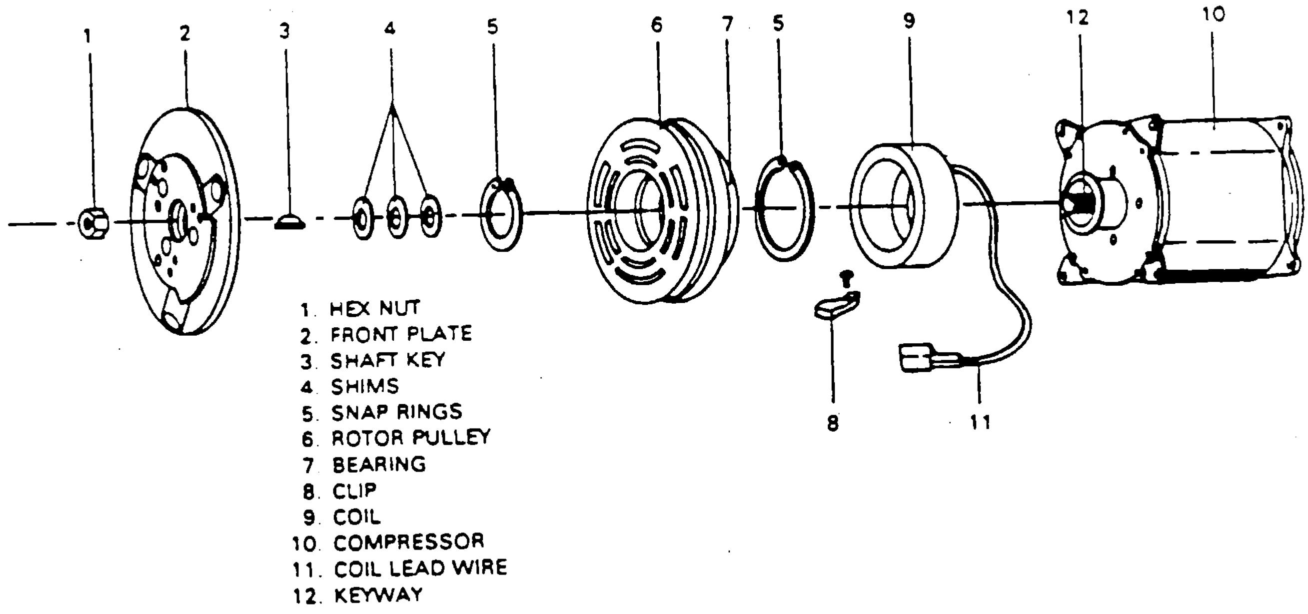

Figure 21-30. Magnetic Clutch Assembly

RECEIVER-DEHYDRATOR.

RECEIVER-DEHYDRATOR REMOVAL.

This unit is mounted next to the evaporator in the nose section of the airplane.

1. Remove the right access panel on the nose section.
2. Discharge the system of all refrigerant.
3. Uncouple the refrigerant lines at the receiver-dehydrator as described in "Special Servicing Procedures." Cap the ends of the lines to prevent contamination of the system.
4. Remove the clamps attaching the unit to its mounting bracket.

—NOTE—

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

RECEIVER-DEHYDRATOR INSTALLATION.

1. Slip the mounting bracket around the receiver and align the fittings to the proper line before securing the mounting bracket.
2. Uncap and connect refrigerant lines to the receiver with new O-rings installed on the fittings. Lubricate the O-rinsgs with refrigeration oil before using.

—NOTE—

Torque the fittings. (See Chart 2107.)

3. Evacuate and recharge the system in accordance with previous instructions.
4. Install the right access panel on the nose section of the airplane.

CONDENSER.

The condenser is mounted above the heater assembly in the nose section of the airplane.

CONDENSER REMOVAL.

1. Remove the right access panel on the nose section.
2. With the system completely discharged, disconnect the hoses at the condenser fittings. (See "Special Servicing Procedures.")

—NOTE—

Cap the open lines to prevent moisture and dust from contaminating the system.

3. Remove the bolts which hold the condenser to the mounting brackets.
4. Disconnect electrical wiring.
5. Remove the condenser from the nose section, being careful not to bend the fins of the core or damage connecting tube.

—NOTE—

Cap the lines till reinstalled

CONDENSER INSTALLATION.

1. Place the condenser in the nose section with the line connections on the forward side.
2. 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.

3. Seal and couple the hose fittings. Apply a small amount of Loctite refrigerant sealant to the flare only to insure leak free connections.
4. Connect electrical wiring.
5. With the condenser secured, proceed to evacuate and recharge the system.
6. When the system is completely charged. check it for any leaks.
7. Replace and secure the right access panel on the nose section of airplane.

EXPANSION VALVE. (Refer to Figure 21-32.)

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

REMOVAL OF EXPANSION VALVE.

1. Remove the access panel on the right side of the airplane nose section.
2. Discharge the system before trying to remove any components.
3. Remove the evaporator, shroud, receiver-dryer, and related hardware from the airplane.
4. With the evaporator removed, it is now possible to remove the expansion valve.

—NOTE—

Do not link the capillary tube during removal or installation.

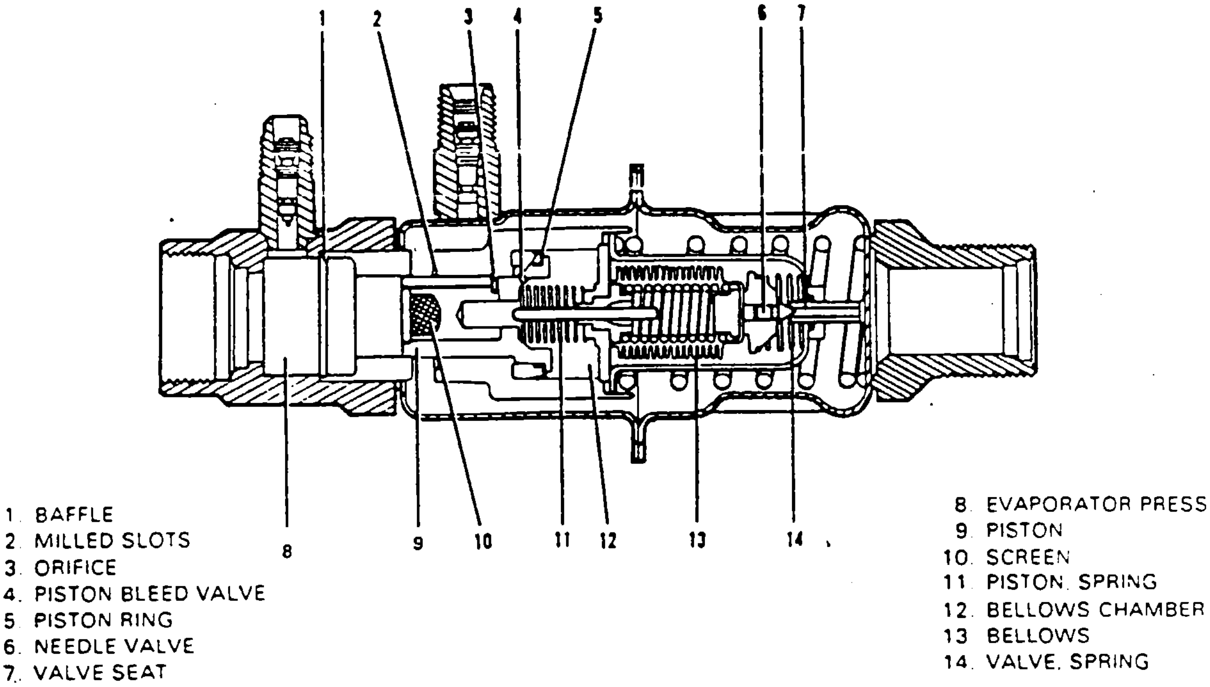

Figure 21-31. Evaporator Control Valve.

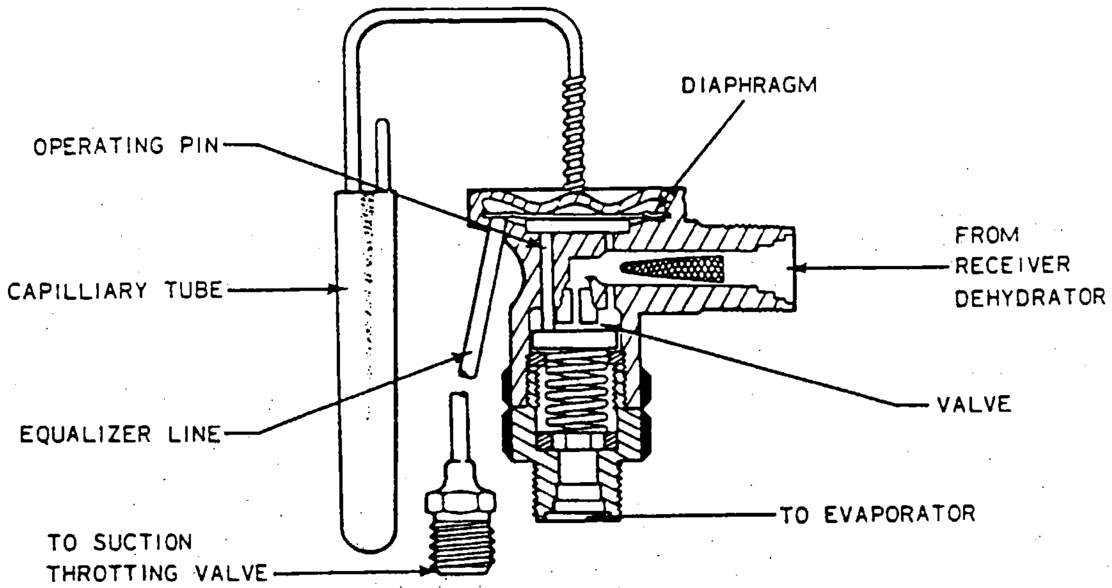

Figure 21-32. Expansion Valve.

INSTALLATION OF EXPANSION VALVE.

1. Install the expansion valve to the evaporator and secure the capillary tube to the evaporator outlet line and apply Presstite insulating tape. (Refer to Figure 21-33.)
2. Install the assembled evaporator into the airplane.
3. When all the connections are secured and the Presstite insulating tape is installed, proceed to evacuate and charge the system.
4. After charging the system. it should be checked for any leaks. (Refer to paragraphs on "Evacuating and Charging" the system.)
5. Install the access panel on the right side of the nose section.

EVAPORATOR CONTROL VALVE. (Refer to Figure 21-31.)

REMOVAL OF EVAPORATOR CONTROL VALVE.

1. Remove the access panel on the right side of the nose section.
2. Discharge the system before trying to remove any of the components.
3. Remove the insulating tape from around the evaporator control valve.
4. Disconnect the lines from the evaporator control valve and cap the open ends.
5. Disconnect the clamp which holds the evaporator control valve to the evaporator shroud and remove the valve from the airplane.

INSTALLATION OF EVAPORATOR CONTROL VALVE.

1. Install the evaporator control valve into the airplane as shown in Figure 21-33 and secure it to the evaporator with the existing clamp and connect the freon lines to the valve.
2. Apply the Presstite insulating tape around the valve and related lines as shown in Figure 21-33.
3. Evacuate and charge the system in accordance with paragraphs on "Evacuating and Charging" the system.
4. Test the system for leaks.
5. Install the access panel on the airplane and secure it.

EVAPORATOR ASSEMBLY.

The evaporator assembly consists of the evaporator core, receiver-dehydrator, expansion valve, and the necessary housing and plumbing. The condensed moisture is dumped overboard through a hose clamped to a fitting on the bottom of the evaporator housing.

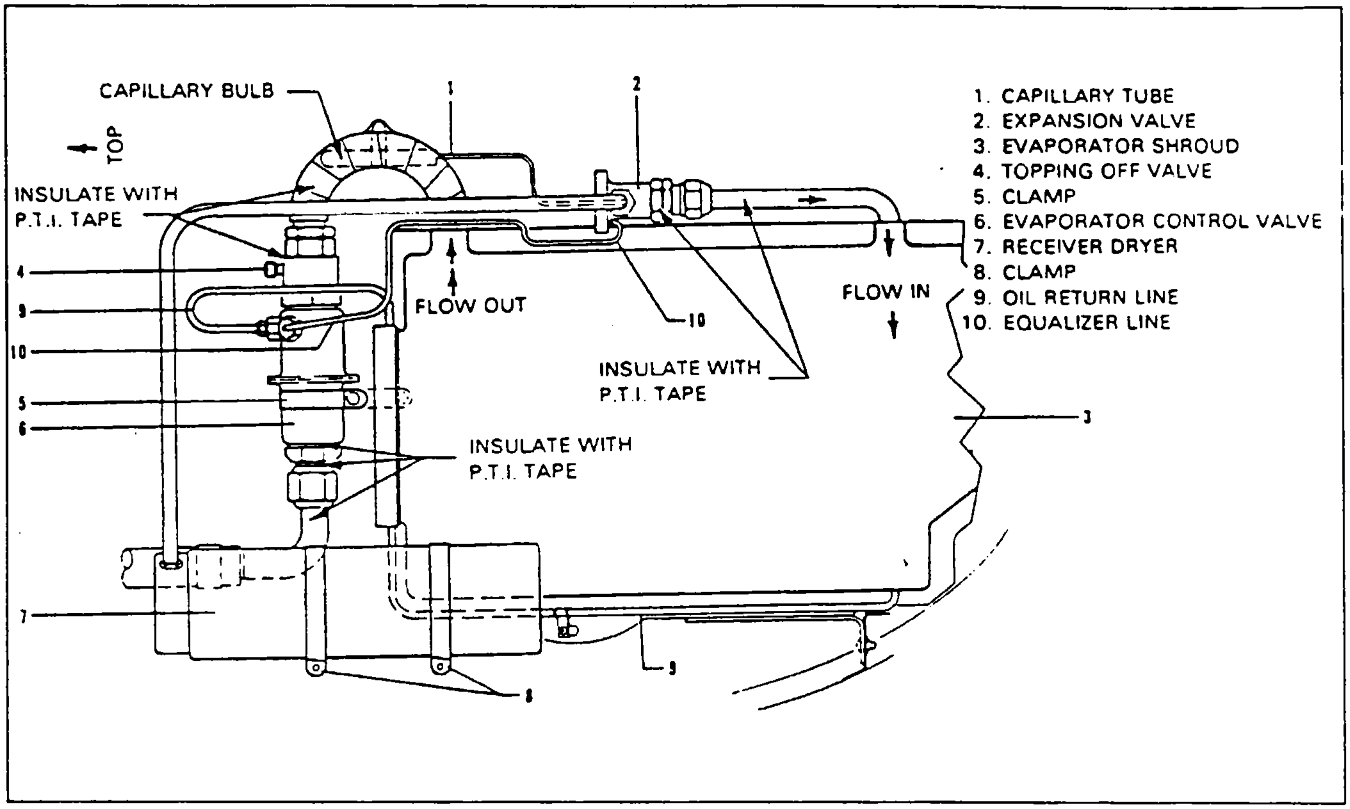

Figure 21-33. Component Installation

REMOVAL OF EVAPORATOR.

This unit is mounted in front of the heater and is enclsoed in a fiberglass shroud.

1. The air conditioning system must be completely discharged of refrigerant.
2. Remove the air conditioning duct extending over the heater from the evaportator shroud.
3. Disconnect the forward V-band clamp between the heater and evaporator shroud.
4. Remove the four screws which hold the evaporator in place.
5. Disconncct the refrigerant lines from the receiver-dryer and loosen the clamps and remove the dryer.
6. Remove the insulation on the evaporator contol valve and disconnect the refrigerant line which leaves the evaporation control valve.

—*NOTE*—

It is advisable to cap all open refrigerant lines when the system is opened to prevent entrance of moisture and dirt.

7. Remove the recirculation fan.
8. Open the access plate on the airplane below the evaporator shroud and disconnect the pressurized air inlet line to the shroud. The removal of the heater assembly would expedite the removal of the evaporator.
9. The complete shroud, evaporator, evaporator control valve, and expansion valve can now be lifted out of the compartment for service.
10. The shroud can be separated to remove the evaporator by removing the machine screws and nuts around the edges of the shroud.

INSTALLATION OF EVAPORATOR.

If installing a new evaporator, add an amount of refrigerant oil equal to the amount removed from the old unit (not, however, to exceed 2 ounces). After addition of the oil proceed with installation as follows:

1. Secure the two halves of the shroud together around the evaporator with machine screws and nuts: if it was separated. Apply a bead of fuselage sealant between the two halves before securing them. Unit must not leak as it forms part of the Pressurization Envelope.

—NOTE—

Before installing new O-ring seals, lubricate the O-rings with refrigerant oil and torque the fittings.

2. Install the expansion valve and evaporator control valve to the evaporator shroud as shown in Figure 21-33.
3. Install the complete shroud, evaporator, evaporator control valve, and expansion valve into the airplane.
4. Connect the pressurized air line to the lower end of the evaporator shroud and secure with clamp. Also, route the drain hose through the grommet in the fuselage.
5. Install the recirculation fan.
6. Connect the refrigerant lines to the evaporator control valve and replace P.T.I. Presstite Insulation Tape around the evaporator control valve.
7. Install a new receiver-dryer in the mounting bracket and secure it in place with two clamps.
8. Connect the other refrigerant lines to the receiver-dryer.
9. Move the evaporator shroud assembly aft till it is tight against the end of the heater; then install the four screws to secure the shroud assembly in place. (Do not tighten mounting screws until V-band clamp is installed.)
10. Install and secure the V-band clamp around the end of the heater and evaporator shroud.
11. Install the air conditioning air duct over the heater and secure it to the evaporator shroud outlet.
12. Evacuate and recharge the system in accordance with paragraphs on "Evacuating and Charging" the system.
13. Install the access plate and panels on the nose section of the airplane.

INSTALLATION OF LINES AND FITTINGS.

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. If leaks are suspected, inspect the flares carefully for tool marks and that the flares do not extend over the fitting collar. (Refer to Figure 21-35.)

—NOTE—

Hoses should not be removed from the compressor fittings unless they are suspected of damage or leaks. Repetitive removal will damage the hose to fitting seal and thus cause leaks.

Reseal joints with Loc-Tite sealer.

2. An area that is subject to damage due to nut over torque is shown in Figure 21-35. Inspect this line for twist or kinks. An alternate method of tightening "B" nuts in lieu of torque values is as follows:
   A. Hand tighten "B" nut while moving the tube from side to side. This will aid in the seating of 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 1 and 2.
3. Flared fittings are sometimes difficult to seal on the hard-to-get fittings: it may be necessary to install Seco 7 seals. (Refer to Figure 21-34.) Install Seco 7 seals as follows:
   A. Lubricate threads with refrigerant oil.
   B. Run nut back and forth on fitting and then tighten finger tight.
   C. From the finger tight position tighten flared fitting 1 to 1 1/2 hex flats.
   D. If connection is broken. replace seal.

—CAUTION—

When installing conical seals check for cracks and scored flared ends and nipple ends. Replace parts as necessary.

4. After assembly or replacement of components, the component and lines should be flushed with freon.

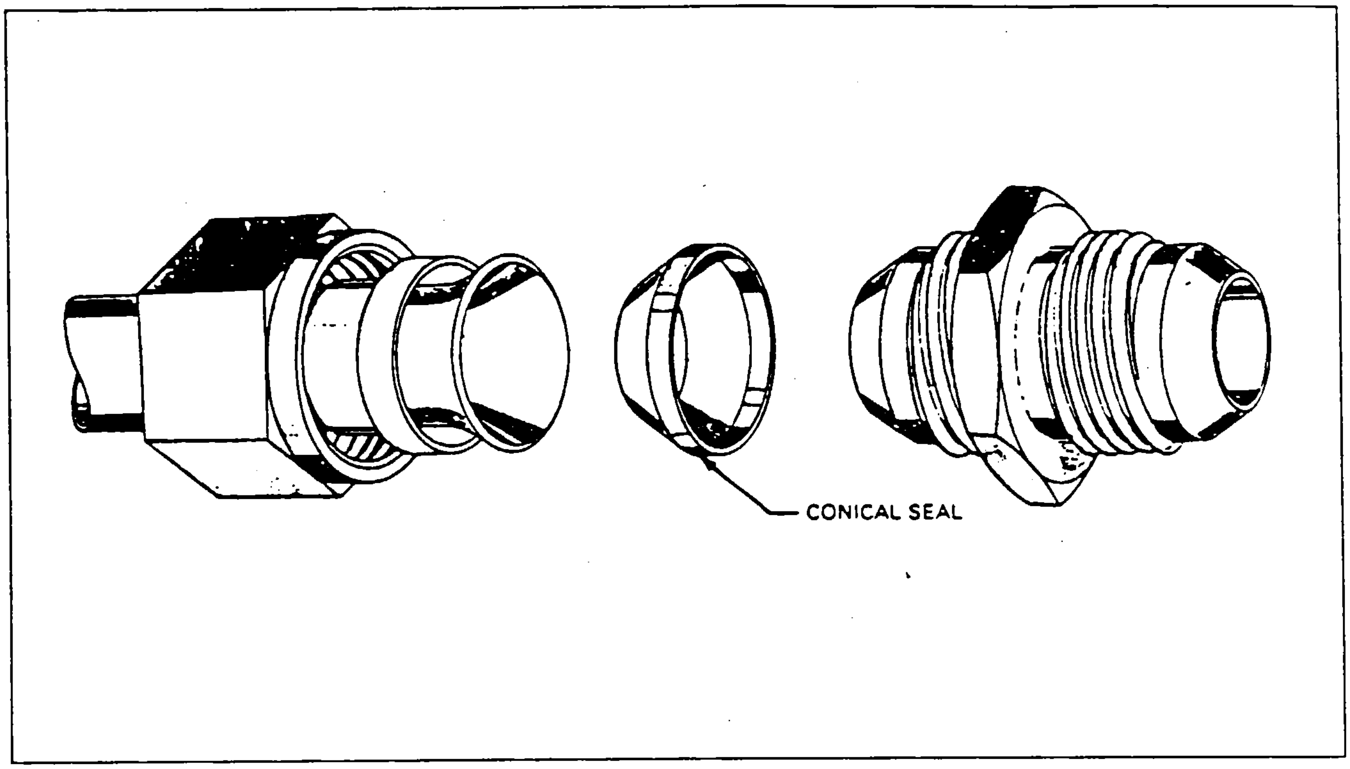

Figure 21-34. Installation of Seco 7 Seals

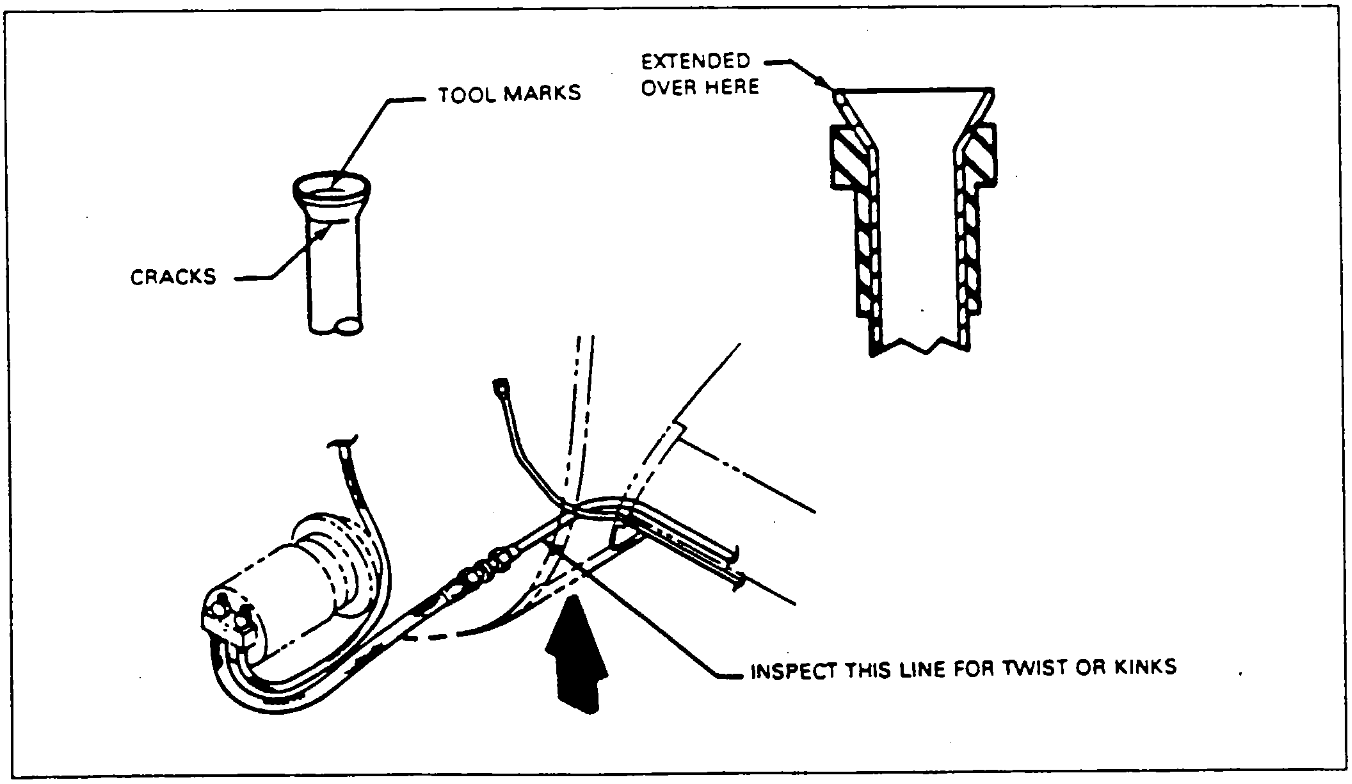

Figure 21-35. Inspection Points (Air Conditioning System) (Typical)

FLUSHING CONTAMINATED SYSTEM.

Whenever a system is suspected of contamination it should be flushed in accordance with the following steps:

1. Remove the cowling from the right engine.
2. Discharge system by removing gauge port cap and cracking one of the compressor service valves to allow any remaining refrigerant to slowly escape.
3. Remove the access panel on the right side of the nose section of the airplane.
4. Replace any known defective components of the system.
5. Disconnect the pressure and suction lines from the top of the compressor, and place in container.
6. Remove the protective cap on the Schrader valve fitting on the evaporator control valve and connect a charging hose to the fitting. The charging hose must have Schrader fitting or adapter to fit the valve.
7. Connect the other end of the charging hose to a small cylinder of Refrigerant-11 "clean-up solvent."

—NOTE—

Refrigerant-12 may be used but bottle must be inverted

8. Invert bottle and back flush system until the liquid running from the pressure and suction lines in the nacelle is observed to be clean and free of particles.
9. Purge liquid from system by same method using Refrigerant-12 (gas) until all liquid is removed and only gas flows from pressure and suction lines.
10. Replace the receiver-dryer, and reconnect pressure and suction lines.
11. Due to loss of lubricant from the system during flushing, the compressor oil level must be checked.
12. Evacuate and recharge the system in accordance with paragraphs on "Evacuating and Charging" the system.

TEMPERATURE CONTROL.

BLEED AIR COOLER SCOOP.

Bleed air is used for pressurization, heating and cooling and is taken from each engine through a sonic nozzle mounted on each engine turbocharger. The air leaves the bleed ports on each engine and travels to the intercooler in the nacelle where ram air is taken by the scoop to cool the bleed air supply before entering the main pressurization line below the cabin floor. It then passes through the pressurized air control box assembly which controls the flow of air that is to be routed to the cabin or overboard.

ADJUSTMENT OF BLEED AIR COOLER SCOOP.

1. Place bleed air cooler door control knob to its full open position.
2. Adjust clevis end to obtain a snug fit of cooler scoop when in the closed position.

—END—

GRIDS IL17 THRU LL24
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PIPER

MOJAVE

MAINTENANCE MANUAL

CARD 2 OF 5

PA-31P-350 MOJAVE

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 781)

INTRODUCTION.

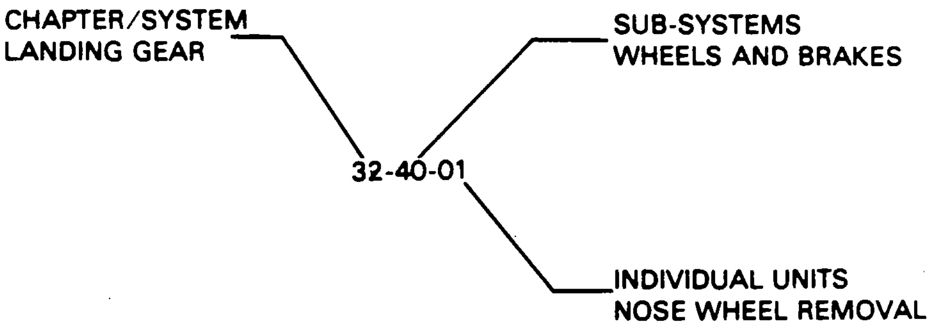
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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-31P-350 aircraft manufactured by the Piper Aircraft Corporation of Lock Haven. Pennsylvania.

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 Parts Catalog P/N 761 776. and FAR 43 for proper utilization.

AEROFICHE EXPLANATION AND REVISION STATUS

The Maintenance Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aircraft Manufacturer's Association, (GAMA). The information compiled in this Aerofiche Maintenance Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set, Grid location J16.

To aid in locating the various chapters and related service information desired, the following is provided:

1. A complete manual System/Chapter Index Guide is for all fiche in this set.
2. A complete list of Illustrations is for all fiche in this set following System/Chapter Index.
3. A complete list of Charts is for all fiche in this set following list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:
   Revised text and illustrations are indicated by a black vertical line along the left-hand margin of the frame, opposite revised, added or deleted material. Revision lines indicate only current revisions with changes and additions to or deletions of existing text and illustrations. Changes in capitalization, spelling, punctuation, indexing, the physical location of the material or complete page additions are not identified by revision lines.
   A reference and record of the material revised is included in each chapter's Table of Contents/Effectivity. The codes used in the effectivity columns of each chapter are defined as follows:

TABLE OF CONTENTS/EFFECTIVITY CODES

Original Issue: None
First Revision: Revision Identification, (1R Month-Year)
Second Revision: Revision Identification, (2R Month-Year)
All subsequent revisions will follow with consecutive revision numbers such as 3R, 4R, etc., along with the appropriate month-year.
Added Subject: Revision Identification, (A Month-Year)
Deleted Subject: Revision Identification, (D Month-Year)

Revisions to this Maintenance Manual 761 781 issued April 25, 1983 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG830425	April 25, 1983	1, 2, 3, 4 and 5
PR830728	July 28, 1983	1, 2, 3, 4 and 5
PR831214	December 14, 1983	1, 2, 3, 4 and 5
IR860430	April 30, 1986	1
IR860723	July 23, 1986	2
IR860925	September 25, 1986	1 and 4
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.**

Consult the Customer Service Information Aerofiche for current revision dates for this manual

VENDOR-SUPPLIER INFORMATION.

A partial list of companies, their address and phone numbers are provided to aid service personnel in obtaining information about components not manufactured by Piper Aircraft Corporation.

Air-Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
Alternator	Prestolite Company 511 Hamilton Street Toledo, Ohio (419) 255-4068
Autopilot/Avionics	Edo Corporation - Avionics Division P.O. Box 610 Municipal Airport Mineral Wells, Texas 76067 (817) 325-2517
	Bendix Avionics Division 2100 N.W. 62nd Street Fort Lauderdale, Florida 33310 (305) 776-4100
	Collins General Aviation Division Rockwell International Cedar Rapids, Iowa 52406 (319) 395-3625
	King Radio Corporation 400 N. Rogers Road P.O. Box 106 Olathe, Kansas 66061 (913) 782-0400
	Sperry Flight Systems - Avionics Division 8500 Balboa Boulevard P.O. Box 9028 Van Nuys, California 91409 (213) 894-8111
	Global Navigation 2144 Michelson Drive Irvine, California 92715 (714) 851-0119

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Gill-Teledyne P.O. Box 431 Redland. California (714) 793-3131
Deicing. Airfoil	The B.F. Goodrich Company 500 South Main Street Akron. Ohio 44318 (216) 374-3895
Deicing. Propeller	The B.F. Goodrich Company 6400 Goldsboro Road Suite 102 Bethesda. Maryland 20034 (301) 229-5000
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington. Penna. 19034 (215) 643-2900
Engines	Avco Lycoming Avco Lycoming Division Williamsport. Penna. 17701
Environmental Systems. Heater and Air Conditioner	Janitrol Aero Division 4200 Surface Road Columbus. Ohio 43228 (614) 276-3561
	Sanden International (U.S.A.). Inc. 10710 Sanden Drive Dallas. Texas 75238
Fuel Pumps	Lear Siegler. Incorporated 17602 Broadway Avenue Maple Heights. Ohio 44137 (216) 662-1000
Fuel System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria. Ohio 44035 (216) 323-4676

VENDOR-SUPPLIER INFORMATION (cont).

Landing Gear. Hydraulic Actuators. Hydraulic Pressure Regulator. Hydraulic Power Pack. Hand Pump	Wiebel Tool Company Port Jefferson. New York 11777 (516) 928-9500
Magnetos	Bendix Electrical Components Division Sidney. New York 13838
Oxygen System	Scott Aviation Products 225 Erie Street Lancaster. New York 14086 (716) 683-5100
Pneumatic System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria. Ohio 44035 (216) 323-4676
Propellers	Hartzell Propeller. Incorporated 1025 Roosevelt Avenue Piqua. Ohio 45356 (513) 773-7411
Propeller Synchrophaser	Hartzell Propeller Fan Company 910 South Downing Street Piqua. Ohio 45356 (513) 773-7411
Tools. Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson. Michigan 49203 (517) 784-8561
Turbocharger	Airesearch Industrial Division 3201 Lomita Boulevard Torrance. California 90505
Wheels and Brakes	Cleveland Wheel and Brake Aircraft Wheel and Brake Division 1160 Center Road Avon. Ohio 44011 B.F. Goodrich Company Transportation Products Division P.O. Box 340 Troy. Ohio 45373

PIPER PUBLICATIONS.

PA-31P-350

Parts Catalog =	761 776 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961-1328
Continuous Inspection =	761 786 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961-1328

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont.)

LIST OF ILLUSTRATIONS

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— NOTE —

Refer to Card 5, Grid No. 5C5 for Electrical Schematic Index.

LIST OF ILLUSTRATIONS (cont.)

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CHAPTER

22

AUTO FLIGHT

CHAPTER 22 - AUTOFLIGHT

TABLE OF CONTENTS/EFFECTIVITY

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

TABLE OF CONTENTS/EFFECTIVITY

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. (NARCO)

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.

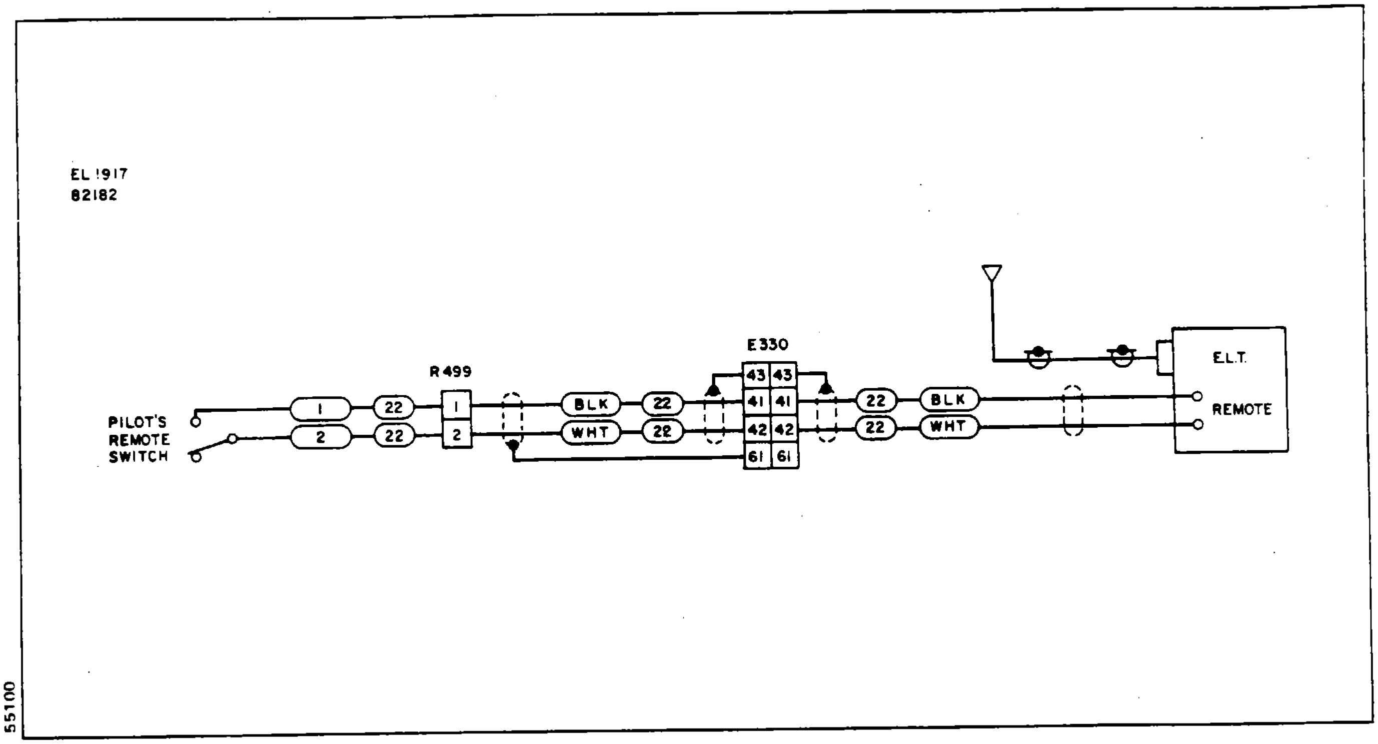

Figure 23-1. Emergency Locator Transmitter Schematic (Narco)

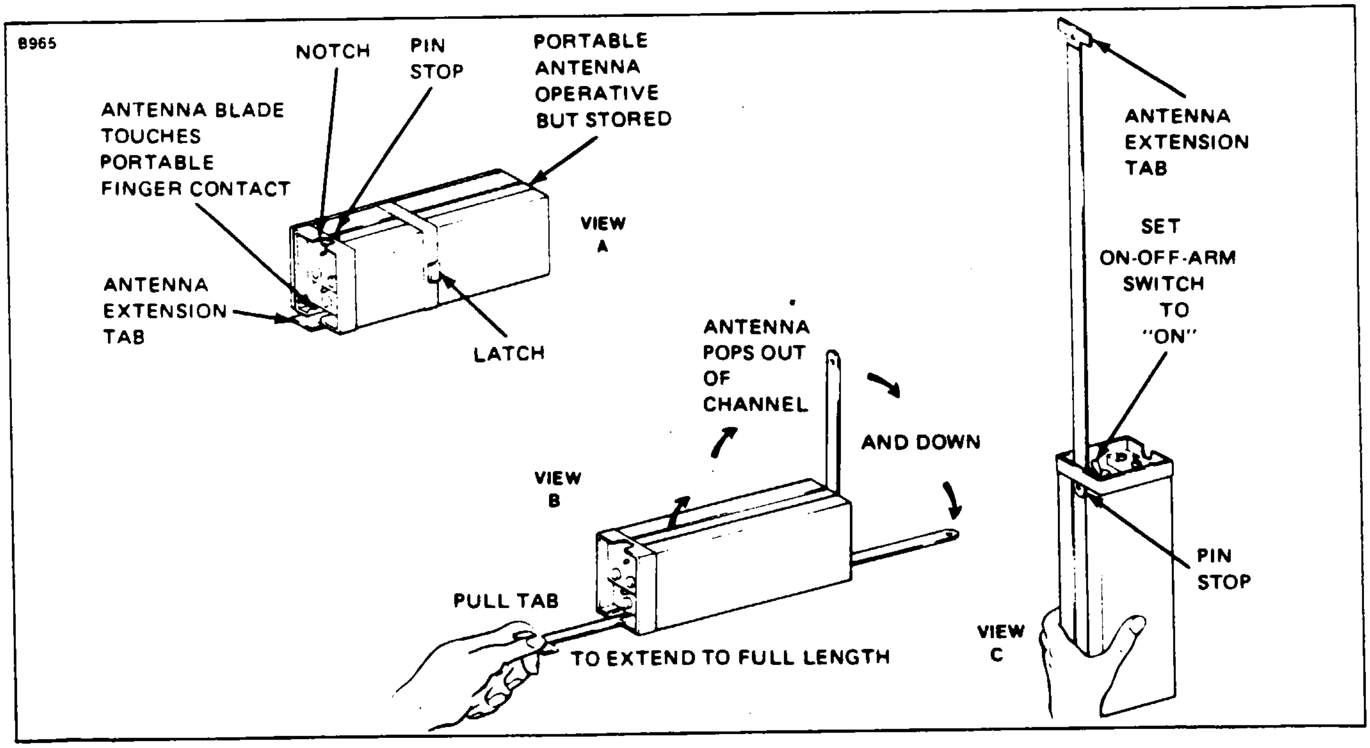

Figure 23-2. Portable Folding Antenna (Narco)

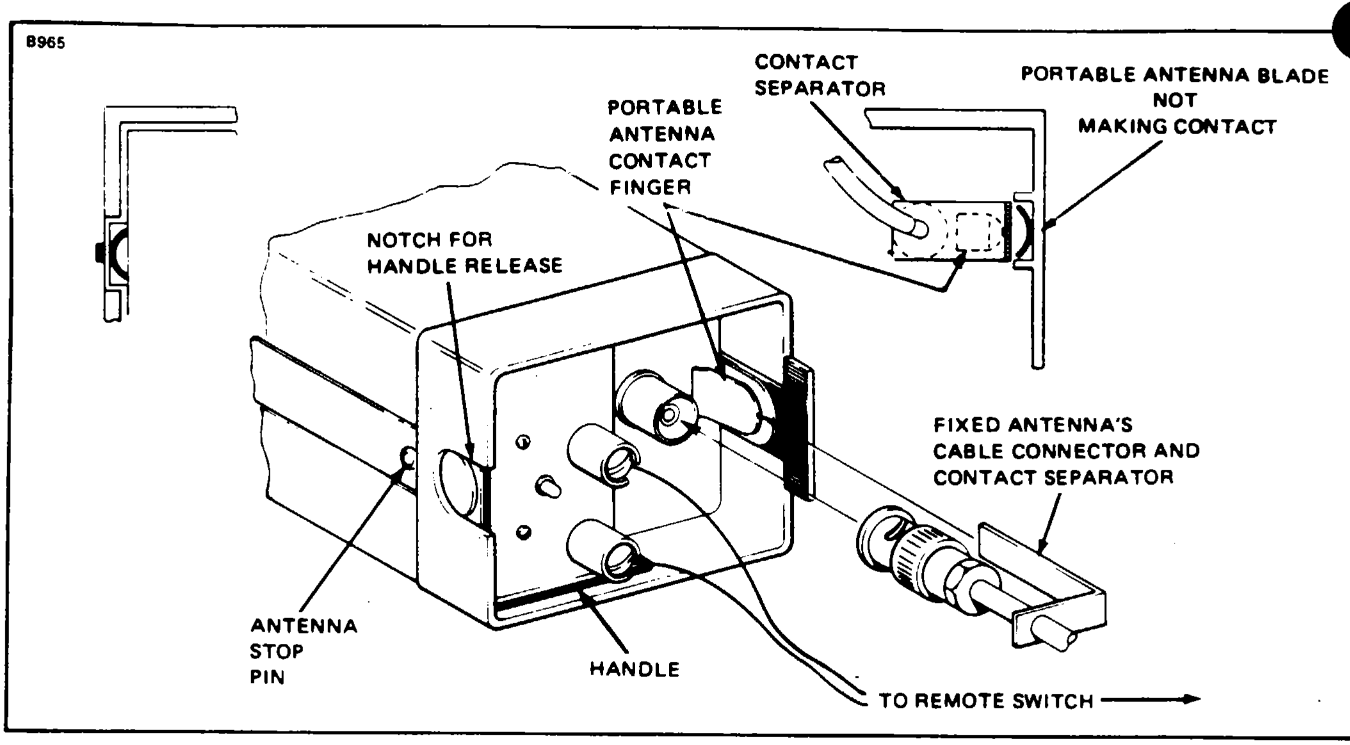

Figure 23-3. ELT Using Fixed Aircraft Antenna (Narco)

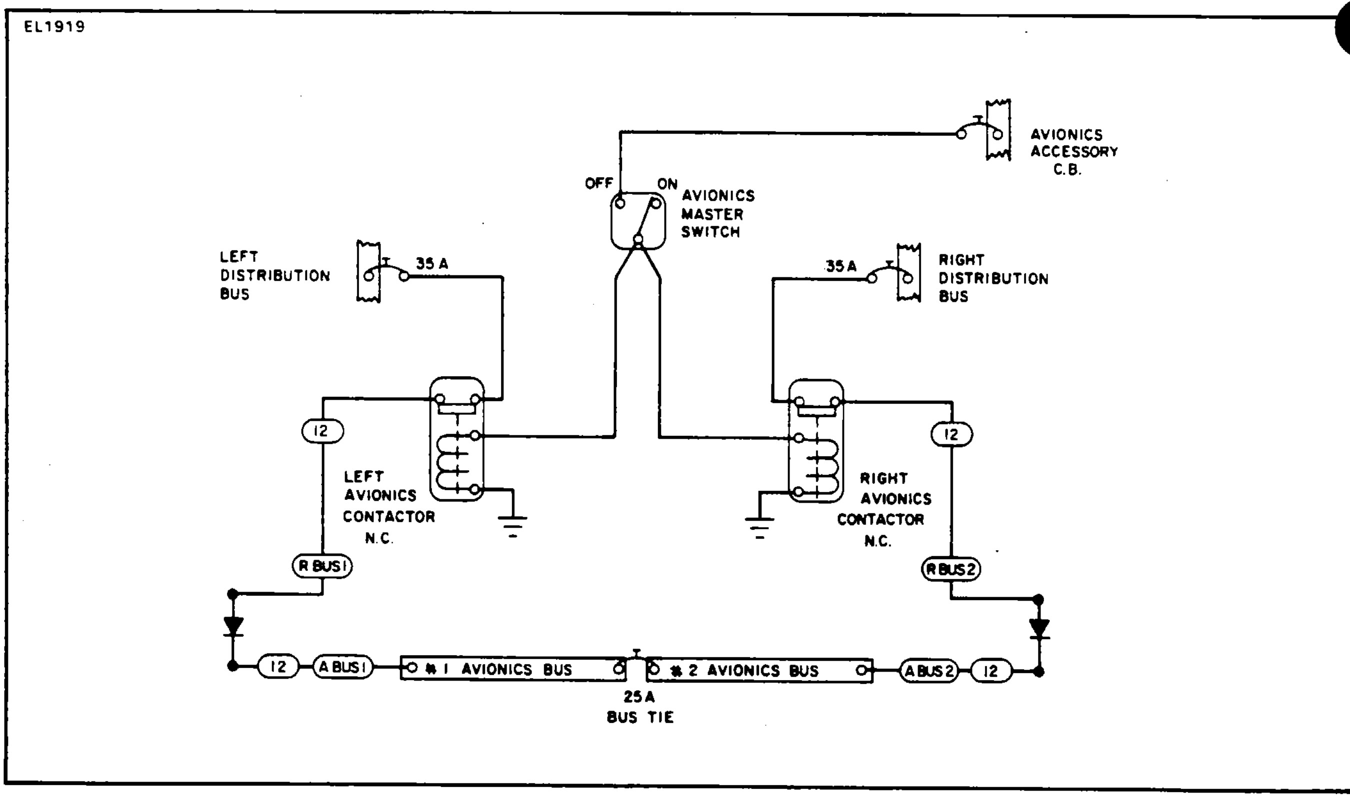

Figure 23-4. Avionics Master and Emergency Switch Circuit

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CHAPTER

24

ELECTRICAL POWER

CHAPTER 24 - ELECTRICAL POWER

TABLE OF CONTENTS/EFFECTIVITY

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.

The electrical system of the PA-31P-350 is a 24 V.D.C. system, consisting of:

1. Two 100 AMP Prestolite Alternators.
2. One Teledyne, lead acid battery.
3. One acid recovery jar with battery venting system.
4. Two solid state Lamar Alternator Control Units.
5. Two ammeters for systems monitoring.
6. External Power Receptacle.
7. Visual system failure annunciation.

The Power Distribution System is of split-bus design with individual circuit protection and separate pilot accessible bus tie circuit breakers, including diode protection, providing operational flexibilities during single alternator or single engine operation.

External Power facilities have been designed into the system to satisfy ground operational requirements. Further, a shelf-mounted relay accessory panel assembly in the nose of the aircraft centralizes main accessory components for efficient service.

All circuit breakers and switches are within easy reach of the pilot within the cockpit environment.

TROUBLESHOOTING.

Typical troubles peculiar to electrical systems are offered in Chart 2401, along with their probable causes and suggested remedies. Also, Figure 24-2, Alternator System Description presents a general circuits overview for system diagnosis reference. For in depth, wire to wire, troubleshooting, refer to index and electrical systems schematics located in Chapter 91.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM)

Trouble	Cause	Remedy
	ALTERNATOR	
No output from alternator.	Malfunction of alternator, alternator output circuit or field circuit.	Check for voltage at alternator field terminal. Check alternator.
Reduced output alternator.	Open diode. High resistance in alternator output cabling.	Check alternator. Check cables and connections.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
	STARTER	
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. 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.***

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Starter motor fails to operate. (cont.)	Binding, worn, or improperly seated brush, or brushes with excessive side play. (cont.)	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.
Starter motor operates at proper speed but fails to crank engine.	Faulty Bendix drive.	Remove Bendix drive assembly. Clean and check, replace.
Low starter motor and cranking speed.	Worn, rough, or improperly lubricated starter motor.	Disassemble, clean, inspect and relubricate, replacing ball bearings if worn.
	Same electrical causes listed under "Starter motor fails to operate."	Same remedies listed for these troubles.
Excessive arcing of starter 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.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
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.
	Equipment left "ON" accidentally.	Remove and recharge.
	Impurities in electrolyte.	Replace battery.
	Short circuit (ground) in wiring.	Check wiring.
	Broken cell partitions.	Replace battery and recharge acid recovery jar.
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.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
Electrolyte runs out of vent plugs.	Too much water added to battery.	Drain and keep at proper level and clean and recharge battery and acid recovery jar.
Excessive corrosion.	Spillage from overfillings.	Use care in adding water.
	Vent lines leaking or clogged.	Clean and repair vent lines and clean and recharge battery and acid recovery jar.
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 cell.	Replace.
Battery polarity reversed.	Connected backwards on airplane or charger.	Battery should be slowly discharged completely and then charged correctly and tested. Check acid recovery jar.
Battery consumes excessive water.	Charging rate too high (if in all cells).	Correct charging rate.
	Cracked cell.	Replace battery and check acid recovery jar.
BATTERY-DISCONNECT SOLENOID		
Does not operate.	Open circuit.	Repair wiring.
	Dirty contacts on connector plug.	Clean contacts.
	Open-circuited solenoid coil.	Replace unit.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
Does not operate. (Cont.)	Plunger binding.	Remove and wash plunger and housing thoroughly with stoddard solution. Change spring compression only as a last resort.
Intermittent operation.	Short-circuited coil. Loose electrical connection. Plunger binding. Badly burned points.	Replace coil. Clean and tighten electrical connections. See remedy pertaining to "Plungerbinding" under "Does not operate." 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 rectifiers, wiring or other components of the charging system. Battery polarity should be checked with a voltmeter before connecting the battery. This aircraft is negative ground.
6. If a booster battery or fast charger is used, its polarity must be connected correctly to prevent damage to the electrical system components.

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 (mΩ). 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 leads (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 24-1 and Chart 2402.

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 3 mΩ or less, from end to end.
5. Don't measure m 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.

Write down a list of the wires and connections to be measured, followed by how many mΩ a 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.

CHART 2402. 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			

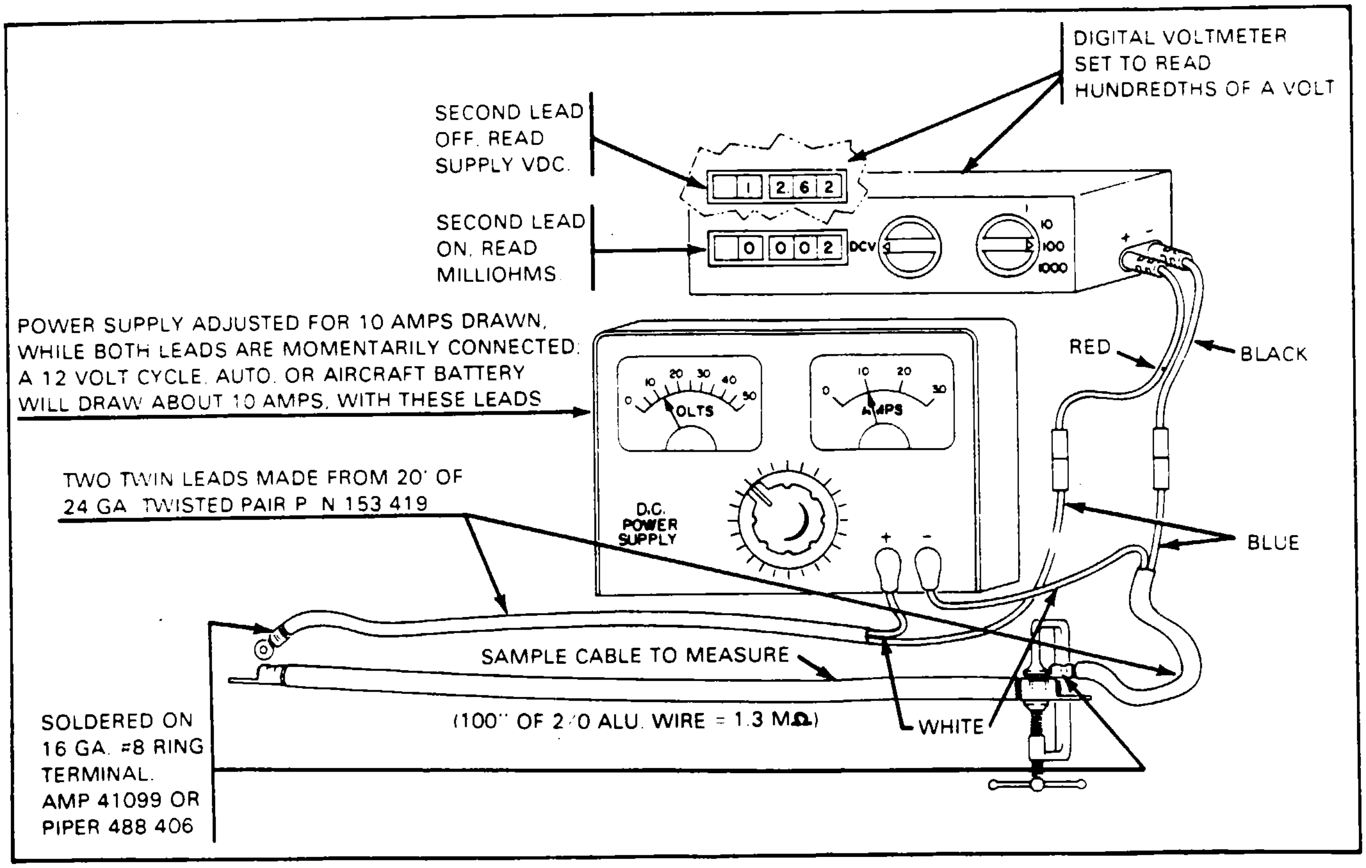


Figure 24-1. Kelvin Low Resistance Bridge

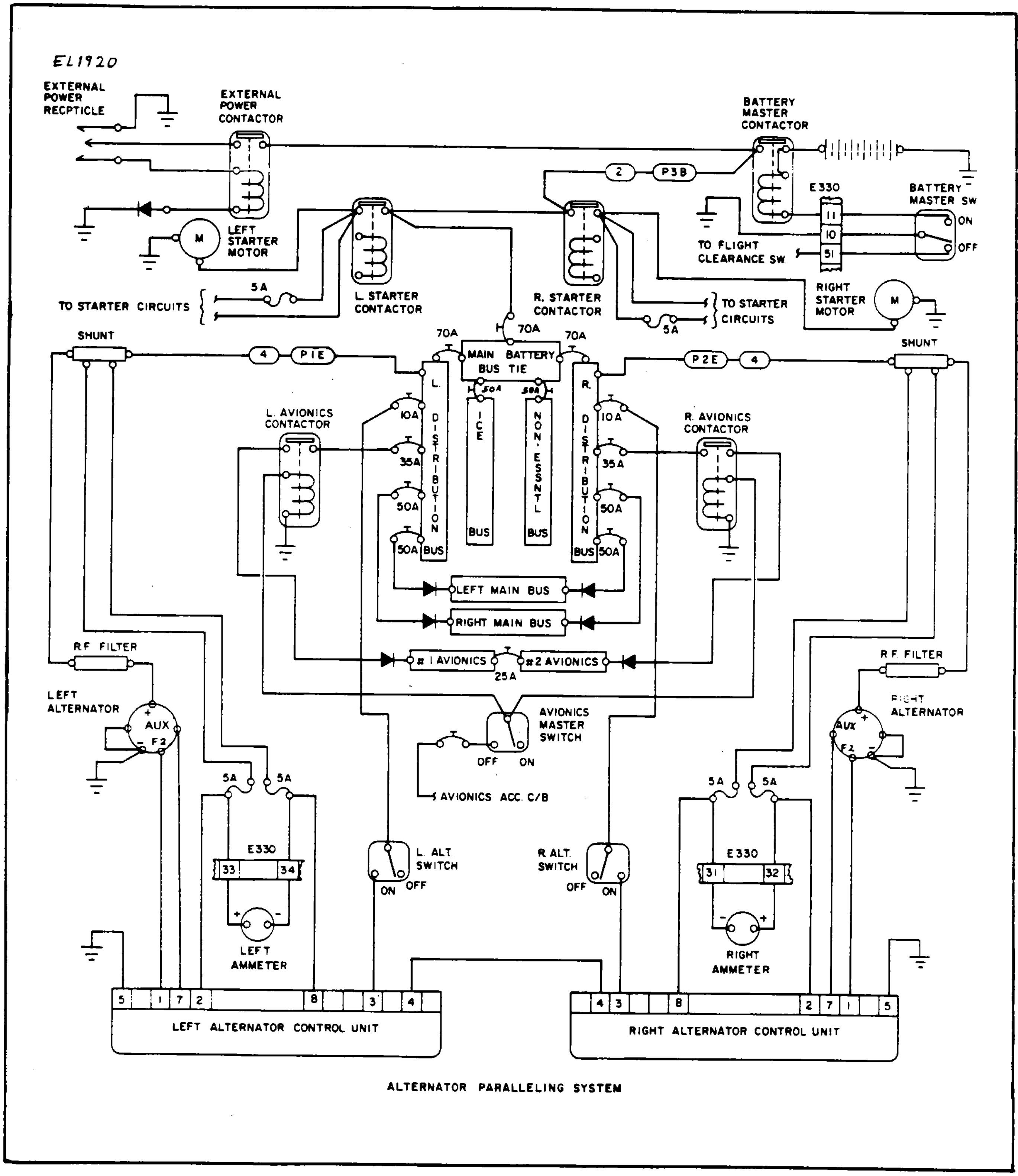


Figure 24-2. Electrical Power Distribution System (TYPICAL)

ALTERNATORS.

DESCRIPTION. (Refer to Figure 24-2.)

Prestolite alternators Model ALV 8402L are provided as standard equipment.

The alternator positive outputs feed the left right distribution buses via their shunt load resistors (100 M.V. @ 100 AMPS - shunt load). The shunt resistor taps feed the ammeters and alternator control units through separate 5 AMP in-line fuses. Each ammeter monitors current flow through its alternator system.

Each alternator is connected to the appropriate left right distribution bus through the alternator field 10 AMP circuit breakers in parallel with the left right alternator switches.

The voltage regulators paralleling circuitry monitors both alternator outputs and field current for voltage regulation. Each alternator switch manually removes or applies field voltage to its system.

The Main Bus Tie is connected to the left and right Distribution Buses through 70 AMP circuit breakers.

— *NOTE* —

Figure 24-2 is a typical system schematic for reference, refer to Chapter 91 - Electrical Schematics for troubleshooting the system.

ALTERNATOR SERVICE TEST SPECIFICATIONS - PRESTOLITE - 100 AMP (ALV 8402-L).

Prestolite specifications for the 24-volt 100 AMP alternators installed as optional equipment on the PA-31P-350 series airplanes are as follows:

CHART 2403. ALTERNATOR TEST SPECIFICATIONS

Alternator Model	ALV 8402-L	
Voltage	24-volts	
Rated Output	100 amperes	
Ground Polarity	Insulated System	
Rotation	Bi-Directional	
Rotor:		
Current Draw (70° to 80°F)	2.03 to 2.42 amps @24.0-volts	
Resistance (70° to 80°F)	9.9 to 11.8 ohms	
Output Test (70° to 80°F):		
Alternator R.P.M.	3000 min.	6000 min.
Amperes Output	53.0	88.0
Field Amperes	2.1	2.25
Voltage	28.0	28.0

DESCRIPTION OF 100 AMP PRESTOLITE ALTERNATOR.

The principle components of these alternators are:

1. The Slip Ring End Head provides the mounting for the heat sink diode rectifier assemblies, the output, auxiliary and ground terminal studs, brush holders and assemblies, and slip ring end head assemblies.
2. The Heat Sink and Diode Rectifier Assemblies used in the units are different in construction than any other Prestolite aircraft alternator. Each heat sink has six (6) diodes attached to it. Each stator lead connects to four (4) diodes, two positive and two negative. Each diode is rated at a minimum of 150 Peak Inverse Volts for transient protection. All soldered connections are made with very high temperature solder. The stator and rectifier leads are anchored to the sink with epoxy cement to provide vibration protection. Because of this construction, special service procedures must be followed.
3. The Stator contains a center tap lead which is connected to the center of the three phase windings and is used to activate low voltage systems' warning relays. The stator has been treated with an epoxy varnish for high temperature protection and vibration protection.
4. The Rotor winding and leads have been specially treated with a high temperature varnish and cement, to provide high temperature and vibration protection. High temperature solder is used to secure the winding leads to the slip rings.
5. The Drive End Head supports a sealed, pre-lubricated bearing in which the rotor shaft rotates.

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.
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 2404. 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.

BUS TIE DIODE TESTS. (Refer to Figure 24-2.).

The bus ties provide alternate current paths for power distribution in the event of single engine or single alternator operation. These components are tested, for open or shorted conditions, under load, by the following steps:

Test for open diodes:

1. With both engines running, pull "OFF" ICE BUS and NON-ESSENTIAL BUS circuit breakers, and leave "OFF", during the following tests.
2. Pull "OFF" Left Distribution bus tie circuit breaker 35A (70A OPT'L), and turn "OFF" Left Alternator Switch.
3. Observe Left Main, Right Main, and Avionics Buses #1 and #2 are still powered.
4. If any bus power is lost, that particular bus diode which is connected to the Right Distribution Bus is open and must be replaced.
5. Reset Left Distribution bus tie circuit breaker and turn "ON" Left Alternator Switch.
6. Repeat the above steps substituting opposite buses and circuit breakers to test diodes connecting the Left Distribution bus in the same manner.

Test for shorted diodes:

7. With Right Distribution bus tie circuit breaker (35A/70A) pulled "OFF" and Right Alternator Switch turned "OFF", shut down right engine.
8. Pull "OFF" Left Main (50A) and #1 Avionics bus (35A) circuit breakers.
9. Observe only Right Main bus is powered. If either Left Main or either Avionics bus is still powered, the diode connecting that bus to the Right Distribution bus is shorted and must be replaced.
10. Reset Left Main and #1 Avionics bus circuit breakers and pull "OFF" Right Main bus circuit breaker.
11. Observe Right Main bus loses power. If power is not lost, diode connecting Right Main bus to Right Distribution bus is shorted and must be replaced.
12. Reset Right Main bus circuit breaker, Right Distribution bus circuit breaker (35A 75A); turn "ON" Right Alternator Switch and re-start right engine.
13. Repeat Steps 7 through 12, substituting opposite buses, circuit breakers and engine to test diodes connecting the Left Distribution bus in the same manner.
14. Reset ALL circuit breakers, turn "ON" Left Alternator Switch and re-start left engine. This completes the diode testing.

DESCRIPTION OF ALTERNATOR PARALLELING SYSTEM.

The left and right alternator outputs are paralleled by the solid-state Alternator Control Units. (Refer to Figure 24-2.)

The Alternator Control Units (ACU's) continuously control alternator output and load sharing by controlling alternator rotor (field) current electronically.

If either alternator experiences an overvoltage condition, the Alternator Control Unit for the offending system, removes the field voltage and that alternator's output from the aircraft's electrical system.

Shunt resistors (100 M.V. @ 100 AMPS) are inserted in the alternator output leads. These shunts drive two ammeters (left and right) to provide continuous current flow information. The shunt leads are protected by two 5 AMP fuses.

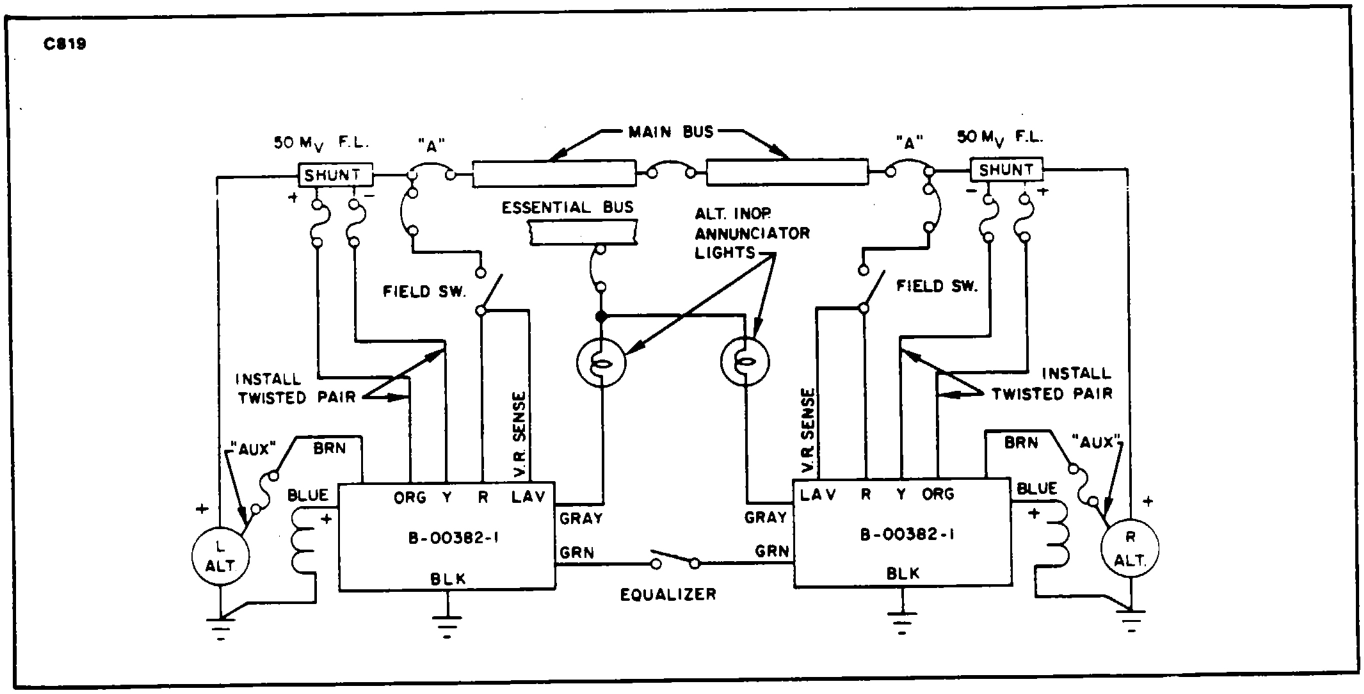


Figure 24-3. Lamar Model B-00382-1, Typical System Application

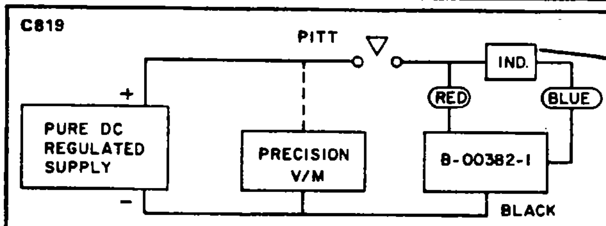
DESCRIPTION LAMAR B-00382-1, ALTERNATOR CONTROL UNITS.

The Lamar alternator control unit Model B-00382-1 regulates alternator output voltage by controlling field current, provides built in overvoltage protection, and automatically controls lead balance (equilizing) through an equalizer circuit. Both alternator systems operate independently except for the balance connection. Should the balance (equalizer) connection become shorted to ground or to bus voltage no damage will result, however, load sharing will be lost and overvoltage protection will be affected by an increase of approximately 2.0 volts above the normal D.V. trip calibration point. To reset from an overvoltage condition, momentary removal of 28 V.D.C. is required. Should a short develop between alternator A+ and Field A+, an uncontrolled overvoltage condition will occur and the related A+ circuit breaker must be pulled "OFF".

ADJUSTING LAMAR ALTERNATOR CONTROL UNITS (B-00382-1).

ADJUSTMENTS.

The only adjustment necessary to maintain the alternator system is the voltage control adjustment on the alternator control unit. A voltage of 28.5 V.D.C. is to be maintained.



TEMPORARY INDICATOR (28V BULB OR A RELAY) NO OTHER CONNECTIONS ON THE BLUE CIRCUIT DURING THIS TEST PROCEDURE.

SPECIFICATIONS:	B-00382-1
TEMPERATURE:	-50°C TO +55°C
ALTITUDE:	30,000 FT. MSL
DUTY:	CONTINUOUS
WEIGHT:	0.5 LB.
VOLTAGE:	28 NOMINAL
FIELD CURRENT:	4A MAX.
REGULATION:	0.5V NO LOAD TO F.L.
LOAD BALANCE (WITH 2 UNITS)	WITHIN 10% OF ALTERNATOR RATING
BALANCE INFORMATION:	FROM 50 Mv. (FULL LOAD) SHUNT, EACH ALT. OUTPUT
AUTHORITY OF BALANCE CIRCUIT:	1V MAX. RISE OF REGULATOR VOLTAGE SETTING
REGULATOR SET TO:	28.8 V
O/V TRIP (CAL.)	32.0V
O/V TRIP TIME:	0.5V ABOVE CAL. -0.25 SEC. 3.0V ABOVE CAL. -0.07 SEC.
O/V SELECTIVIY:	SEE "OPERATION"
ALT. INOP. INDICATOR:	0.1A MAX.
ALT. INOP. SENSING POINT:	10.25V = 0.75V

Figure 24-4. Lamar B-00382-1 A.C.U. Test Specifications

ALTERNATOR CONTROL UNITS TEST SPECIFICATIONS - LAMAR B-00382-1.

The temporary lamp or relay, indicator called out below is not critical, as long as the device represents a load and current flow. A voltmeter is not sufficient.

BATTERY - LEAD ACID.

SERVICE OF BATTERY SYSTEM. (Refer to Figure 24-5.)

Service includes the entire battery system consisting of: The battery, acid recovery jar, vents and battery compartment. These services shall be completed every 50 operating hours or 30 days, whichever occurs first, and at every 100 hour inspection. The battery system is located in the nose section, directly behind the nose cone. (Refer to Figure 24-5.)

— *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.*

REMOVAL OF BATTERY AND ACID RECOVERY JAR.

1. Open the forward baggage compartment door and unlatch the nose cone locking handle located to the left, inside the baggage door opening, and swing open the nose cone.
2. Pull back the rubber battery terminal boots, loosen the wing nuts, and remove battery cables.

— *CAUTION* —

Remove NEGATIVE battery cable FIRST, before exposing and loosening wing nut on positive terminal to avoid short circuits and possible electrical burns.

3. Remove positive vent hose connected to the front of the battery manifold.
4. Remove negative vent hose connected to rear connection of acid recovery jar.
5. Cut safety wire and remove battery hold down wing nuts and lift battery manifold cover straight up to clear hold down bolts, and remove cover.
6. Release fasteners of battery floor support angle and remove support from aircraft.
7. Slide battery out of nose section.
8. Remove remaining vent hose from recovery jar connection.
9. Loosen recovery jar clamp screw and lift jar upward and remove from aircraft holding jar in a vertical position.

INSTALLATION OF BATTERY SYSTEM.

Install the components in reverse order of removal instructions.

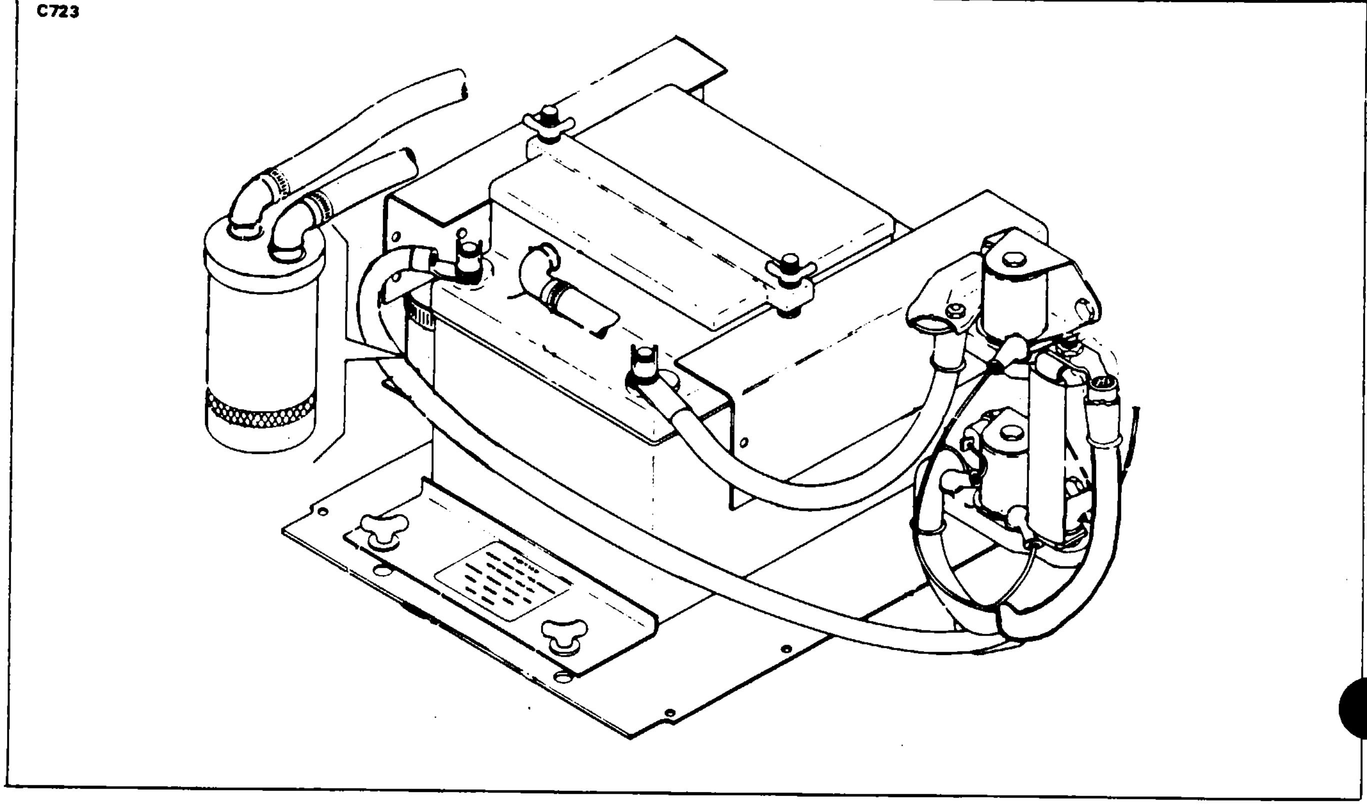


Figure 24-5. Battery System Installation

CLEANING BATTERY.

1. Remove all accumulated contamination from the battery exterior with a stiff bristle brush. (Do not use a metal brush or abrasive materials.) Wipe exterior of battery and interior of manifold with a cloth saturated with a solution of bicarbonate of soda mixed - one part soda to twenty parts water. (Check cell plugs are tight - do not allow any soda solution to enter any cells.)
2. Wash entire battery with clear water and dry thoroughly.
3. Wash down, with soda solution, followed by clear water, the floor area, floor support angle, battery hold down supports, connectors and cable ends, the battery compartment and dry entire area and component parts.

CLEANING OF VENT HOSES AND VENTS.

Due to the required length of the vent lines the following cleaning process should be used:

1. Visually inspect the vent hoses for cracks, kinks, and loose connections. Replace only with special acid proof hoses from the parts manual. (DO NOT REPLACE VENT LINES WITH ORDINARY RUBBER HOSE.)
2. At the disconnected ends, in the battery compartment, slowly pour the soda solution into the vent hoses via a small funnel. The height of the hoses at this end will provide a siphon effect and the solution will flow out the bottom fuselage vents.
3. Follow with a final purge of clear water and blow out the lines with low air pressure.

— *NOTE* —

This procedure proves the vent lines are not kinked or restricted and that they are neutralized.

4. Wipe down the vents, pitot tubes, and aircraft belly with the soda solution and rinse with clear water. Then apply a fresh coating of high quality aircraft wax to this entire area.

CLEANING ACID RECOVERY JAR.

1. Unscrew the bottom of the recovery jar and separate from the top.
2. Remove the jar pad and empty jar contents into suitable container for proper disposal.
3. Thoroughly wash and neutralize jar, pad, and jar top (including short vent hose previously removed) with the soda solution and rinse with clear water and dry thoroughly.
4. Recharge the acid jar with .75" of bicarbonate of soda and replace dry jar pad in jar on top of soda charge.
5. Screw jar back together and keep in upright position.
6. Reinstall in aircraft.

BATTERY CHARGING.

The battery must be removed for charging as described in "Removal of Battery."

1. Remove cell plugs and ensure vents in plugs are open and that vent valves operate freely.
2. Check electrolyte level in each cell and ensure electrolyte level is at the bottom of the split ring.
3. A hydrometer check of each cell shall be accomplished. (Refer to "Hydrometer Reading and Battery Charge.")

4. If charging is required, the battery may be charged at any rate, in amperes, not to exceed that point which would produce gassing or bubbling of the electrolyte or a cell temperature in excess of 115° F in any case.

— NOTE —

If cell temperature reaches the 115° F limit, the charging rate shall be reduced and the charge completed at 3 amperes or lower. DO NOT CHARGE AT A HIGHER RATE WHEN CELLS ARE GASING.

5. If a constant current charge is available, the charge may be started at 6 amperes and finished at 3 amperes.
6. If at any time cells sputter or flood during charging, the electrolyte level is too high and excess electrolyte must be removed.
7. Clean battery after charging, as described in previous steps, before reinstalling in airplane.

HYDROMETER READING AND BATTERY CHARGE.

Whenever checking the battery, ascertain that all connections are clean and tight and the fluid level is above the baffle plates. If it is necessary to add fluid, fill cell with distilled water to the bottom of the split ring. After adding water, charge the battery until gassing before taking a hydrometer reading. Otherwise, the water and electrolyte will not be mixed, giving a false reading. Temperatures different from the established norm will also effect the hydrometer readings. Refer to Chart 2406 for the temperature corrections. Specific gravity values for a fully charged battery are as follows:

CHART 2405. ELECTROLYTE TEMPERATURE CORRECTIONS

Electrolyte Temperature	Specific Gravity
47° F	1.280 to 1.300
77° F	1.280 to 1.290
107° F	1.260 to 1.280
Temperature change of 30° F changes the reading 0.010.	

To adjust low specific gravity, charge the battery (see Charging Battery) until it is gassing and until the specific gravity rises no higher over a 3 hour period. Then remove some electrolyte and replace with 1.300 specific gravity electrolyte. Repeat this step if after one hour of charging the specific gravity is still too low. DO NOT ADJUST A CELL THAT DOES NOT GAS.

To adjust high specific gravity, charge the battery (see Charging Battery) until it is gassing and until the specific gravity rises no higher over a 3 hour period. Remove some electrolyte and replace with distilled water. Repeat this step if after one hour of charging the specific gravity is still too high.

— CAUTION —

In the operation of the battery, gases are formed which may be explosive if ignited. Never create sparks of any kind or bring an open flame near the battery. Ventilate the battery when charging to dispose of the gas generated by the battery.

CHART 2406. SPECIFIC GRAVITY TEMPERATURE CORRECTION

Electrolyte Temperature °C	°F	Correction	
60	140	+1.024	
55	130	+1.020	
49	120	+1.016	Add to
43	110	+.012	Reading
38	100	+.008	
33	90	+.004	
27	80	.000	
23	70	-.004	
15	60	-.008	
10	50	-.012	
5	40	-.016	Subtract
-2	30	-.020	From
-7	20	-.024	Reading
-13	10	-.028	
-18	0	-.032	
-23	-10	-.036	
-28	-20	-.040	
-35	-30	-.044	

BATTERY DISCHARGE.

The capacity of a storage battery is measured in units of ampere hours, which is the product of the electrical current in amperes multiplied by the time in hours. Although current may be obtained after the end of the time, the voltage of the battery has dropped to a point beyond which it is not very useful. The ampere hours which may be obtained from a battery are greater for a long low-rate or intermittent rate discharge than for a short high-rate discharge because the voltage will drop faster at the higher discharge rate. The maximum permissible rate of discharge is limited only by the current-carrying ability of the wiring, motor, or other apparatus to which the battery is connected or by the current-carrying ability of the cell terminals and connectors and not by the plates themselves. Listed below are recommended discharge rates:

CHART 2407. RECOMMENDED DISCHARGE RATE

TELEDYNE Battery Type	Volts	(5 HRS.) Ampere Hours
GILL-G247	24	28

BATTERY TEMPERATURE CONSIDERATIONS.

Operation of storage batteries beyond their ambient temperature or charging voltage limits will result in excessive cell temperatures leading to electrolyte boiling, rapid deterioration of the cell, and finally battery failure. The relationship between the maximum charging voltage and the number of cells in the battery is also significant, since this will determine (for a given ambient temperature and state of charge) the rate at which energy is absorbed as heat within the battery. The maximum voltage per cell should not exceed 2.35-volts, and the maximum temperature should not exceed 115°F.

Low electrolyte temperatures temporarily reduce the battery capacity and the freezing point depends on the specific gravity. To prevent freeze damage, maintain the specific gravity at a reasonably high level as indicated by Chart 2408.

— *NOTE* —

Lead-acid batteries are subject to a constant discharge due to the internal chemical action.

CHART 2408. ELECTROLYTE FREEZING POINTS

	Freezing Point	
Specific Gravity	°C	°F
1.300	-70	-95
1.275	-62	-80
1.250	-52	-62
1.225	-37	-35
1.200	-26	-16
1.175	-20	-4
1.150	-15	+5
1.125	-10	+13
1.100	-8	+19

BATTERY REPAIRS, STORAGE AND SERVICE TIPS.

The internal parts of the battery have been designed to wear at approximately the same rate, making it uneconomical to replace any of the parts with new ones. Replacing the entire battery is simpler and cheaper.

Before storing the battery, it should be properly charged, the vent plugs put tightly in place, and the leads disconnected to prevent use during idle periods. The battery should be charged at intervals during the idle period. Before returning the battery to service, it should be thoroughly charged. The battery will be sufficiently charged when, after a 3 hour period, the specific gravity does not rise any higher with the electrolyte gassing and a charging rate of 1-1 2 amperes.

Long battery life and trouble-free service is obtained from the battery if the following simple tips are observed:

1. Keep it clean.
2. Keep it charged.
3. Maintain proper electrolyte levels.
4. Keep specific gravity equal among all cells.

PREPARING NEW DRY CHARGED BATTERY FOR INSTALLATION.

The Teledyne, dry-charged, Model GILL G-247 Battery shall be stored as received from Teledyne. Do not remove vent seals, add acid, nor attempt to charge a dry-charged battery until the time arrives to install the battery into an airplane.

— *CAUTION* —

Prior to installing a new dry-charged battery, follow the preparation/ installation instructions furnished with the battery by Teledyne.

EMERGENCY STARTING THROUGH EXTERNAL POWER RECEPTACLE.

— *CAUTION* —

DO NOT CONNECT EXTERNAL POWER PLUG TO AIRCRAFTS' EXTERNAL POWER RECEPTACLE WITH A DISCHARGED OR "RUN-DOWN" AIRCRAFT BATTERY, UNLESS THE AIRCRAFTS' BATTERY MASTER SWITCH IS TURNED "OFF" AND LEFT "OFF."

1. Place ground power unit on the pilot's side of the nose in full view of pilot's window. Upon connecting ground power to the aircraft, the External Power Contactor will energize immediately, supplying electrical power to all aircraft electrical buses. (Refer to Figure 24-2.)
2. With Battery Master Switch left in "OFF" position, turn "OFF" all unnecessary electrical loads as in a normal start.
3. Also, pull Circuit Breaker Cover and "PULL-OFF" 70 AMP Left and Right Distribution bus tie circuit breakers.
4. Start right engine and move ground power unit well away from aircraft before starting left engine.

— *CAUTION* —

Exercise great care disconnecting ground power plug exiting nose area only from the pilot's side of airplane.

5. Turn "ON" Battery Master Switch.
6. "PUSH ON" Right Distribution Bus circuit breaker. Observe Right Ammeter indicates Right Alternator electrical power is available.
7. Start left engine and "PUSH ON" Left Distribution Bus circuit breaker. Observe Left Ammeter indicates Left Alternator electrical power is available.
8. With both alternators on-line, observe charging current on ammeters.
9. Do not take-off until charging current falls below 20 AMPS.

— *NOTE* —

The aircraft battery must be removed from the airplane if it is to be charged with a ground power D.C. supply.

CHART 2409. CAPACITY RATINGS AT DISCHARGE RATES

Battery Type	Volts	Capacity Ratings			
Gill Teledyne		1 Hour (Amp Hours)	5 Hours (Amp Hours)	Emergency Capacity (Amp)	Cold Temp. Cranking (Amp @ 0°F)
G247	24	-	28	32.0	215

DEFINITION OF BATTERY CAPACITY RATINGS

1 Hour (Amp Hours):	The ampere hours shown divided by one hour is the rate of discharge to 1.5-volts per cell.
5 Hours (Amp Hours):	The ampere hours shown divided by five hours is the rate of discharge to 1.75-volts per cell.
Emergency Capacity (Amp):	The amperes shown is the rate of discharge for 25 minutes to a cut-off voltage of 1.75-volts per cell.
Cold Temp. Cranking (Amp @ 0°F):	The amperes shown in discharge current used to crank an engine for 30 seconds at 0°F to 1.2-volts per cell.

CHART 2410. ELECTROLYTE FREEZING POINTS

Specific Gravity	Freezing Point °C	Freezing Point °F
1.300	-70	-95
1.275	-62	-80
1.250	-52	-62
1.225	-37	-35
1.200	-26	-16
1.175	-20	-4
1.150	-15	+5
1.125	-10	+13
1.100	-8	+19

CHART 2411. CIRCUIT LOAD CHART

CIRCUIT IDENTIFICATION	CIRCUIT BREAKER VALUE	ELECTRICAL LOAD DESCRIPTION	DUTY CYCLE	NO. OF UNITS IN SIMUL-TANEOUS OPERATION	CURRENT FLOW IN AMPERES @28 V.D.C.
AIR CONDITIONING	20	MOTOR	INT.	2	17.10
		CLUTCH	INT.		2.20
CABIN COMFORT	5	CONDENSER RELAY	INT.	5	.32
		SENSOR	INT.		.01
		FAN RELAY	INT.		.10
		HEATER RELAY	INT.		.10
		AUTO/CYCLE RELAY	INT.		.10
RECIRCULATING FAN	15	MOTOR	CONT.	1	11.60
HEATER	5	IGNITION	INT.	4	.70
		MOTOR	INT.		3.43
		FUEL VALVE	INT.		.32
		HOUR METER	INT.		N/A
		SHUT-OFF VALVE	INT.		.22
CABIN PRESSURE CONTROL	5	DOOR SOLENOID	CONT.	3	1.20
		VACUUM SOLENOID	CONT.		1.20
		INDICATOR	CONT.		.04
HEATED THERMOS	7.5	HEATING ELEMENT	INT.	2	7.00
CIGAR LIGHTER	7.5	HEATING ELEMENT	INT.	2	11.40
RAZOR INVERTER	5	SOLID STATE - INDUCTIVE	INT.	1	.60
DIGITAL CABIN DISPLAY	5	SOLID STATE - COMPUT'R/ READOUT	CONT.	1	.35
VOLTMETER	5	METER - INDUCTIVE	CONT.	1	.01
HOUR METER/O.A.T.	5	SOLID STATE - INDUCTIVE	CONT.	2	.10
ANNUNCIATOR MASTER CAUTION INDICATOR LAMPS	5	LAMP AND HORN	INT.	ANY COMBINA-TION	.28
		(48) INDICATOR LAMPS	INT.		1.92
		SOLID STATE UNIT	INT.		.50
#1 GYRO INVERTER	10	INDUCTIVE	CONT.	1	1.00
#2 GYRO INVERTER	10	INDUCTIVE	CONT.	1	1.00
LEFT ATTITUDE HORIZON	2	INDUCTIVE	CONT.	1	1.00
RIGHT ATTITUDE HORIZON	2	INDUCTIVE	CONT.	1	1.00
LEFT DIRECTIONAL GYRO	2	INDUCTIVE	CONT.	1	1.00
RIGHT DIRECTIONAL GYRO	2	INDUCTIVE	CONT.	1	1.00

CHART 2411. CIRCUIT LOAD CHART (cont.)

CIRCUIT IDENTIFICATION	CIRCUIT BREAKER VALUE	ELECTRICAL LOAD DESCRIPTION	DUTY CYCLE	NO. OF UNITS IN SIMUL-TANEOUS OPERATION	CURRENT FLOW IN AMPERES @28 V D.C.
RATE GYRO - TURN & BANK	2	INDUCTIVE	CONT.	1	1.00
LEFT FUEL QUANTITY	5	INDUCTIVE	CONT.	1	.40
RIGHT FUEL QUANTITY	5	INDUCTIVE	CONT.	1	.40
FUEL PRESSURE	5	INDUCTIVE	CONT.	1	1.60
LEFT OIL AND CYLIN-DER HEAD TEMP.	5	INDUCTIVE	CONT.	1	.50
RIGHT OIL AND CYLIN-DER HEAD TEMP.	5	INDUCTIVE	CONT.	1	.38
LEFT-PITOT HEAT	10	HEATING ELEMENT	INT.	1	3.60
RIGHT-PITOT HEAT	10	HEATING ELEMENT	INT.	1	3.60
LFT./RT. COWL FLAP INDICATORS	5	METERS - INDUCTIVE	CONT.	2	.08
GEAR POSITION INDICATORS		LAMPS - (3)	CONT.	2	.12
GEAR WARNING AND MASTER SOLENOID	4	LANDING LIGHT SOLENOID LOCK SOLENOID RELAY LAMP IN TRANSIT	INT. INT. INT. INT.		.30 1.10 .20 .04
STALL WARNING	5	TIME DELAY UNIT HORN	INT. INT.	2	.01 .20
STALL WARNING HEAT	10	VANE/PLATE HTG. ELEMENTS CORE HTG. ELEMENTS RELAY	INT. INT. INT.	4	5.90 2.00 .10
SURFACE DEICE	5	TIMER WING BOOT VALVE INBR'D. AND TAIL VALVE GYRO SHUT-OFF VALVE LEFT REGULATOR VALVE RIGHT REGULATOR VALVE	INT. INT. INT. INT. INT. INT.	6	.11 .22 .22 .22 .22 .22
LEFT WINDSHIELD HEAT CONTROL	5	SOLENOID TIMER RELAY	INT. INT. INT.	3	.56 .05 .30
LEFT WINDSHIELD HEAT		HIGH TEMP. HT'G. ELEMENT LOW TEMP. HT'G. ELEMENT	INT. INT.	1	32.15 23.90

CHART 2411. CIRCUIT LOAD CHART (cont.)

CIRCUIT IDENTIFICATION	CIRCUIT BREAKER VALUE	ELECTRICAL LOAD DESCRIPTION	DUTY CYCLE	NO. OF UNITS IN SIMUL-TANEOUS OPERATION	CURRENT FLOW IN AMPERES @28 V.D.C.
PROP. DEICE - CURRENT SENSOR	5	SOLID STATE	INT.	1	.10
PROPELLER DEICE	15	RELAY	INT.	1	.32
		TIMER	INT.		.01
		LEFT - HEATING ELEMENTS	INT.		12.53
		RIGHT - HEATING ELEMENTS	INT.		12.53
FLAP MOTOR	35	MOTOR	INT.	1	22.00
FLAP CONTROL	3	SOLENOID	INT.	6	.86
		AMPLIFIER	INT.		1.20
		METER	INT.		.01
		RHEOSTAT - (3)	INT.		.03
LEFT COWL FLAP	5	MOTOR	INT.	1	1.00
RIGHT COWL FLAP	5	MOTOR	INT.	1	1.00
PROP. SYNC.	5	SOLID STATE	CONT.	2	1.00
MASTER CONTACTOR	N/A	SOLENOID	CONT.	1	.60
LEFT STARTER CONTROL	5	VIBRATOR	INT.	1	3.00
		SOLENOID	INT.		.60
		MOTOR	INT.		182.00
RIGHT STARTER CONTROL	5	VIBRATOR	INT.	1	3.00
		SOLENOID	INT.		.60
		MOTOR	INT.		182.00
LEFT ALTERNATOR FIELD	10	SOLID STATE	CONT.	1	4.00
RIGHT ALTERNATOR FIELD	10	SOLID STATE	CONT.	1	4.00
LEFT FUEL PUMP	5	MOTOR	INT.	1	3.50
RIGHT FUEL PUMP	5	MOTOR	INT.	1	3.50
LEFT FUEL BOOST PUMP	10	MOTOR	INT.	1	9.00
RIGHT FUEL BOOST PUMP	10	MOTOR	INT.	1	9.00
POSITION LIGHTS	7.5	LEFT WING - LAMP	CONT.	3	1.80
		RIGHT WING - LAMP	CONT.		1.80
		TAIL - LAMP	CONT.		1.00

CHART 2411. CIRCUIT LOAD CHART (cont.)

CIRCUIT IDENTIFICATION	CIRCUIT BREAKER VALUE	ELECTRICAL LOAD DESCRIPTION	DUTY CYCLE	NO. OF UNITS IN SIMUL-TANEOUS OPERATION	CURRENT FLOW IN AMPERES @28 V D C
ANTI-COLLISION - STROBES	5	LEFT SIDE	CONT.	2	1.60
		RIGHT SIDE	CONT.		1.60
ANTI-COLLISION - GROUND RECOGNITION BEACON	5	LAMP	CONT.	1	2.60
		FLASHER	CONT.		.10
RECOGNITION LIGHTS	10	SOLENOID	INT.	3	.30
		LAMPS - (2)	INT.		3.62
LOGO LIGHTS	7.5	LAMPS - (2)	INT.	2	3.72
WING INSPECTION LIGHTS	5	LAMP	INT.	1	1.81
LANDING LIGHT	10	SOLENOID	INT.	2	.30
		LAMP	INT.		8.90
TAXI LIGHT	10	SOLENOID	INT.	2	.30
		LAMP	INT.		8.90
CABIN MAP LIGHTS	7.5	MAP LAMPS - (2)	INT.	15	.60
		SIGN LAMPS - (5)	INT.		.20
		READING LAMPS - (5)	INT.		2.55
		CABINET LAMPS - (2)	INT.		.76
		CHIMES - SOLID STATE	INT.		.01
COURTESY LIGHTING	5	BAGGAGE	INT.	9	.38
		DELAY UNIT	INT.		.01
		AISLE - LAMPS - (2)	INT.		.76
		REAR EXIT - LAMPS - (2)	INT.		.80
		EXIT STEPS	INT.		.66
COCKPIT LIGHTING	5	LAMPS - (2)	CONT.	2	1.02
LEFT PANEL LIGHTS	5	LAMPS - (36)	CONT.	40	1.44
		MAG. SWITCH - LAMPS - (4)	CONT.		.56
RIGHT PANEL LIGHTS	5	LAMPS - (21)	CONT.	21	.84
PLACARD LIGHTS	5	LAMPS - (13)	CONT.	14	1.86
		INVERTER	CONT.		.25
WINDSHIELD WIPER	10	MOTOR	INT.	1	4.6

CHAPTER

25

EQUIPMENT/FURNISHINGS

CHAPTER 25 - EQUIPMENT/FURNISHINGS

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GENERAL.

The PA-31P-350 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 divider between the crew and passenger compartments is made up of divider panels, refreshment cabinet, storage cabinet and jepp. case cabinet. The passenger compartment can be equipped with five seats, two folding tables, refreshment and storage cabinet with divider panel, toilet seat, aft refreshment cabinet and cabin divider. (Refer to the Parts Catalog for part no.) This chapter provides instructions for removal and installation of the equipment listed above.

FLIGHT AND PASSENGER COMPARTMENTS (SEATS).

REMOVAL AND INSTALLATION OF SEATS. (Refer to Figures 25-1, 25-2 and 25-3.)

1. To remove the crew and passenger seats, the following procedures are suggested:
   A. Remove the seat track end covers or seat stops.
   B. Move the seat forward or aft to slots in seat tracks and lift seat off of tracks.
   C. To remove the toilet seat disconnect the relief tube, remove attaching hardware and remove seat.
2. Installation is the reverse of removal.

REMOVAL AND INSTALLATION OF FOLDING TABLE.

1. Remove attaching screws and remove table assembly.
2. Installation is the reverse of removal.

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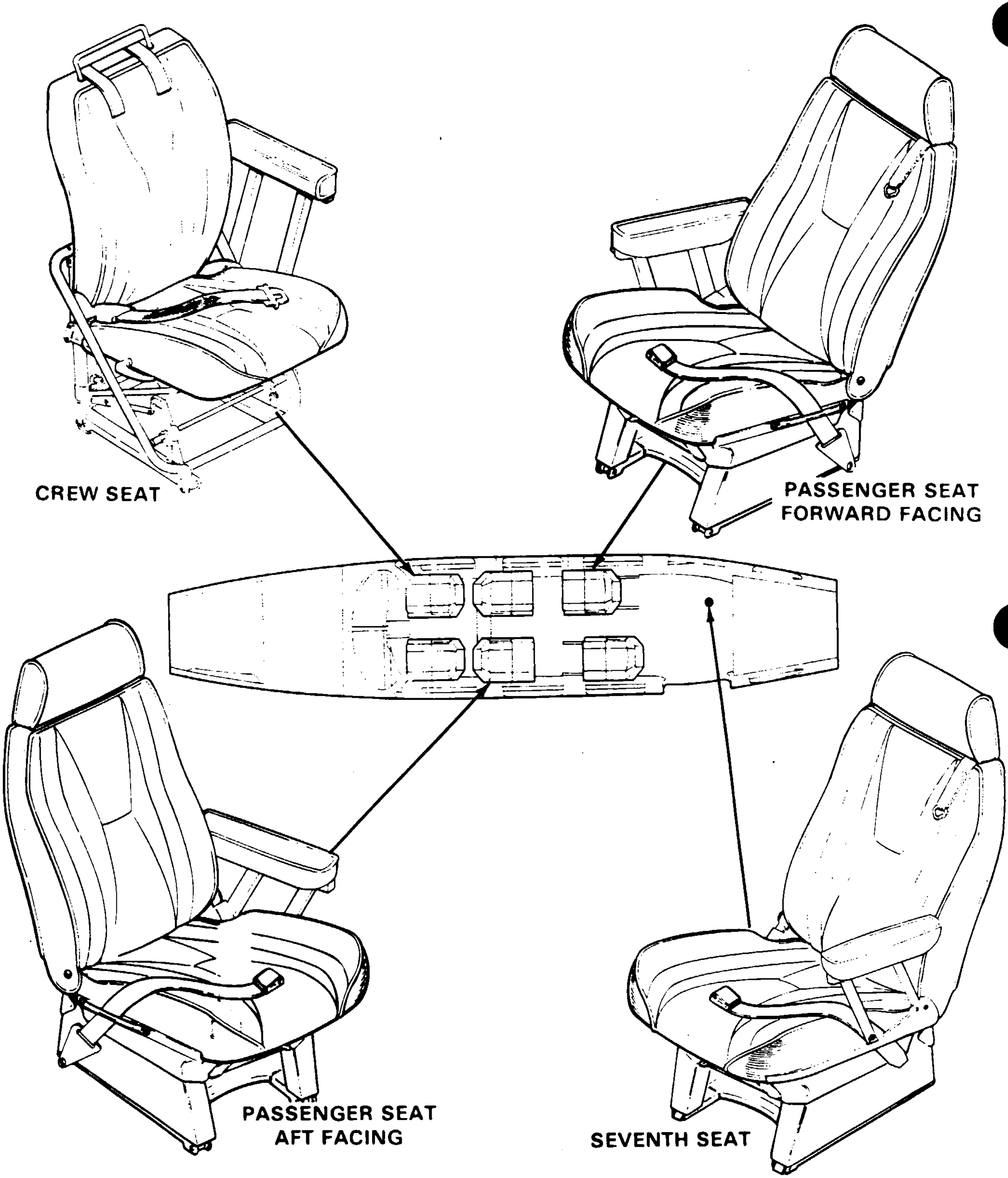
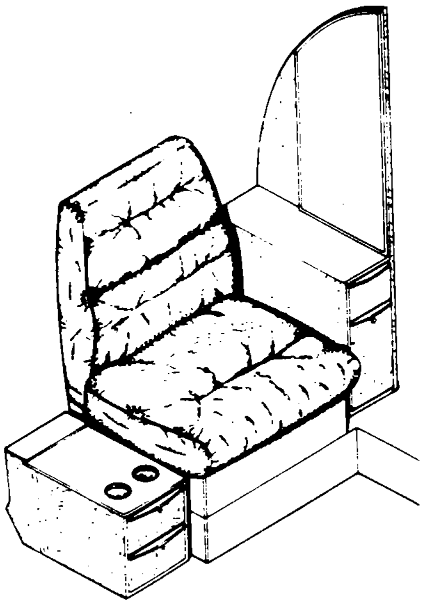
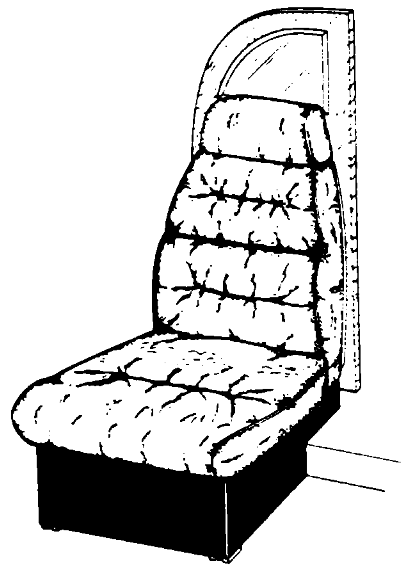


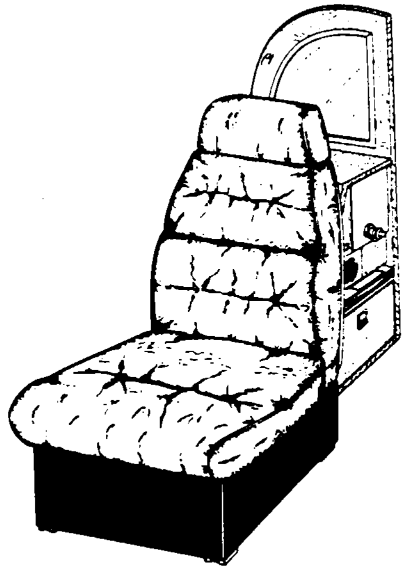
Figure 25-1. Crew and Passenger Seat Installation



TOILET - SIDE FACING



TOILET - FORWARD FACING
STEP MOUNTED



TOILET - FORWARD FACING
FLOOR MOUNTED

Figure 25-2. Toilet Seat Installation

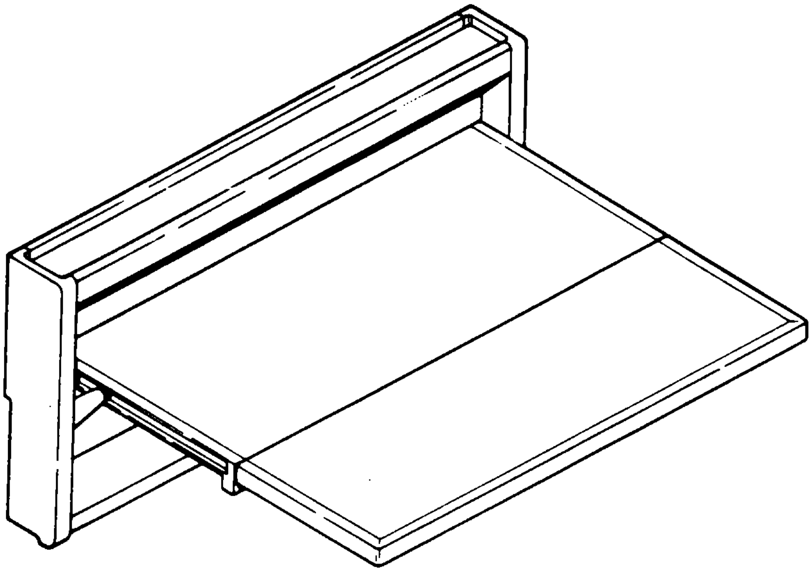


Figure 25-3. Folding Table

REMOVAL AND INSTALLATION OF CABINETRY AND DIVIDER. (Refer to Figures 25-5 and 25-6.)

1. Turn electrical power off.
2. Slide crew seat full forward and passenger seat full aft to remove forward dividers or cabinetry.
3. Tag and disconnect electrical wiring.
4. Remove attaching hardware securing divider panels, cabinetry, remove divider panels and cabinetry.
5. Remove the heating elements by disconnecting wires and screw them out of the unit.
6. Remove the razor invertor, razor outlet and razor or heating unit switches by disconnecting the electrical wires and removing the attaching hardware.
7. Remove the armrest by removing two nuts that secure it to the oven cabinet.
8. Installation is the reverse of removal.

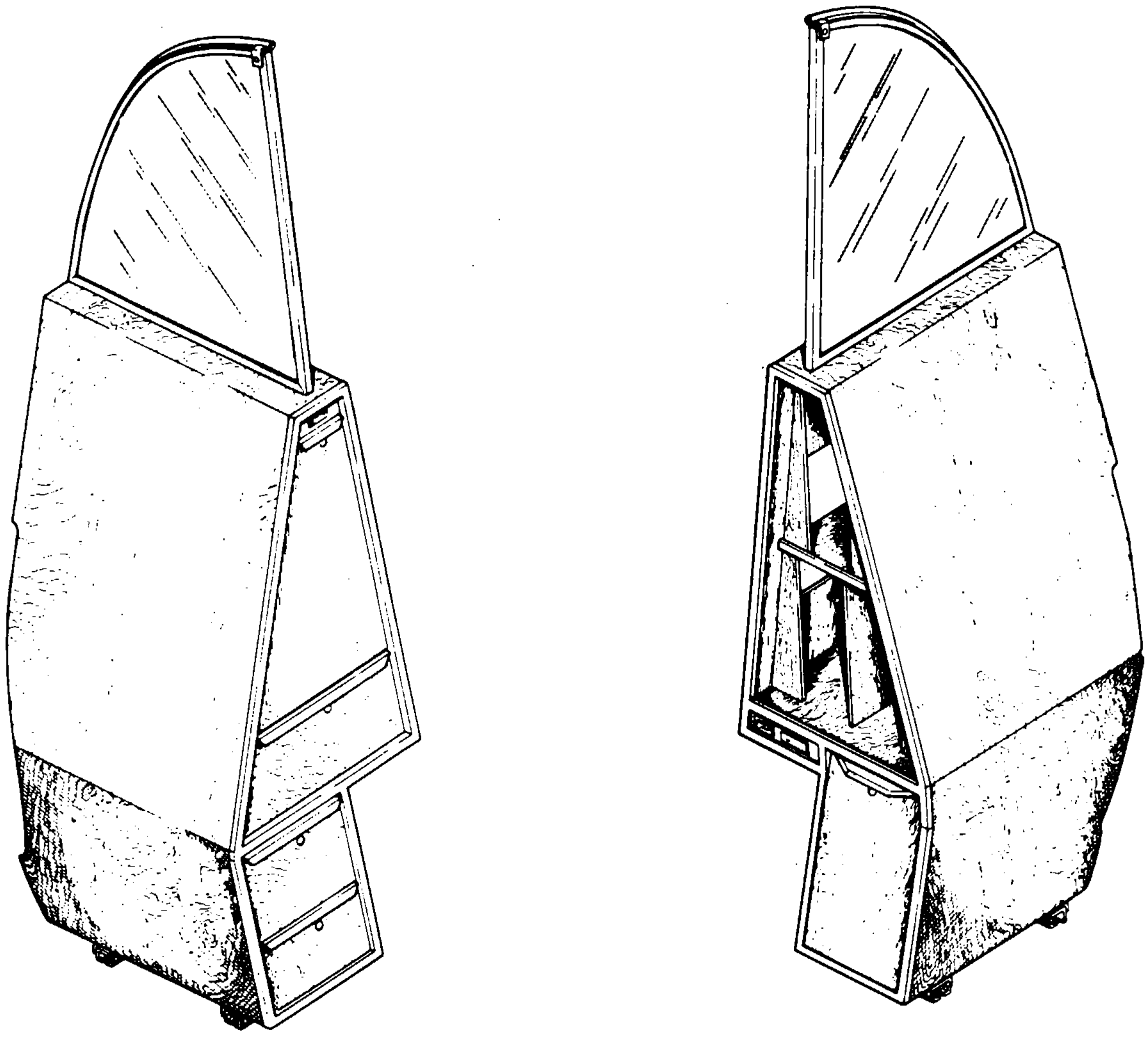
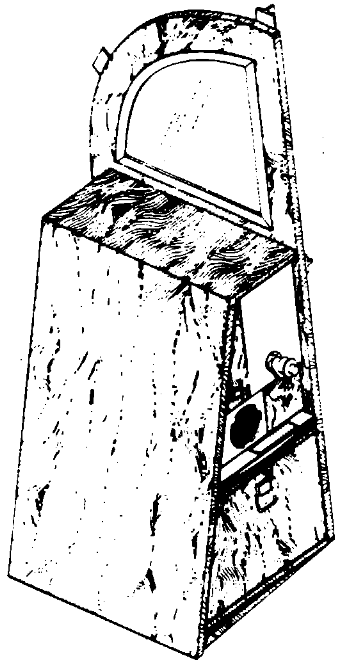
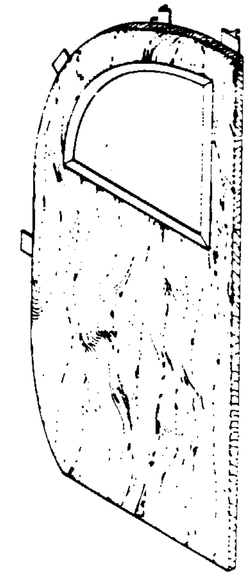


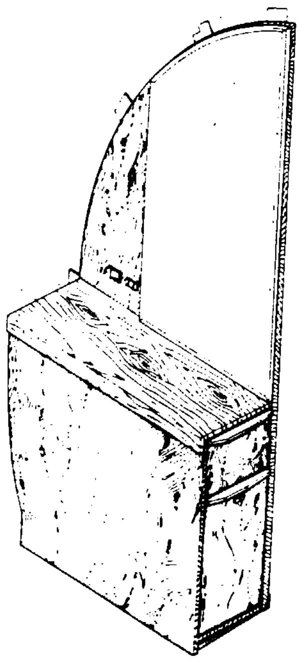
Figure 25-4. Forward Cabinetry and Divider Panel



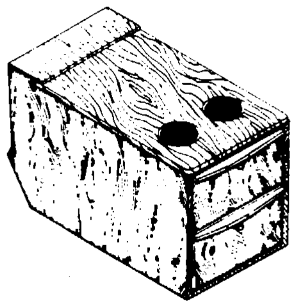
REFRESHMENT CABINET
WITH DIVIDER PANEL



REAR DIVIDER PANEL



REFRESHMENT CABINET
WITH DIVIDER PANEL



REFRESHMENT CABINET

Figure 25-5. Aft Refreshment Cabinets and Divider Panels

CHAPTER

27

FLIGHT CONTROLS

CHAPTER 27 - FLIGHT CONTROLS

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CHAPTER 27 - FLIGHT CONTROLS (cont.)

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CHAPTER 27 - FLIGHT CONTROLS (cont.)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter covers the removal, installation, 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 indicator unit not adjusted properly.	Adjust indicator unit.
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.
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.

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

Trouble	Cause	Remedy
ELEVATOR CONTROL SYSTEM (cont.)		
Resistance to elevator control movement. (cont.)	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.
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.

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

Trouble	Cause	Remedy
ELEVATOR TRIM CONTROL SYSTEM (cont.)		
Trim control wheel moves with excessive resistance. (cont.)	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 indicator unit not adjusted properly.	Adjust unit.
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.

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

Trouble	Cause	Remedy
RUDDER CONTROL SYSTEM (cont.)		
Excessive resistance to rudder pedal movement. (cont.)	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Rudder pedals not neutral when rudder is 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.

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

Trouble	Cause	Remedy
RUDDER TRIM CONTROL SYSTEM (cont.)		
Trim control wheel moves with excessive resistance. (cont.)	Trim tab hinge binding.	Lubricate hinge. Replace if necessary.
	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 indicator unit not adjusted properly.	Adjust indicator unit.
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.

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

Trouble	Cause	Remedy
FLAP CONTROL SYSTEM (cont.)		
Flaps fail to extend or 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.
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.

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

Trouble	Cause	Remedy
FLAP CONTROL SYSTEM (cont.)		
Flap on one side fails to operate.	Broken flexible actuator shaft.	Replace flexible shaft.
	Defective transmission.	Determine cause and replace or repair.
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.
	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.	Probably flap amplifier circuit breaker. Reset breaker and or check system.

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

Trouble	Cause	Remedy
FLAP CONTROL SYSTEM (cont.)		
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.
Motor power circuit breaker tripped.	Outboard flexshaft or connection failure.	Replace worn part.
	Screwjack actuator failure.	Remove and service actuator.
	Motor bearing failure.	Repair motor.
	Motor short circuit.	Repair motor.
System shutdown.	Improper system hookup.	Perform rigging electrical tests.
	Malfunctioning amplifier.	Replace amplifier.
	Open ground to amplifier.	Check electrical system and repair.
System stall in position.	Power or ground circuit open.	Check circuit for open line and repair.
	Bearing seize - motor stall. Circuit breaker tripped.	Replace bearings affected.
	Synchronization shutdown.	Check inboard flexshafts and coupling.
	Excessive brush wear in motor.	Replace brushes.
	Motor open circuit.	Service motor and check circuit.
	Malfunctioning flap amplifier.	Replace amplifier.

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

Trouble	Cause	Remedy
	FLAP CONTROL SYSTEM (cont.)	
Synchronization shut-down.	Flexshaft or coupling failure.	Replace worn part.
	Failure of screwjack actuator.	Remove and service actuator.
	Improper adjustment of flap potentiometers.	Perform rigging test and procedure.
Wracked flap.	Screwjack housing failure.	Remove applicable screw-jack and repair.
	Ball screw fracture.	Remove applicable screw-jack and repair.
	Flap connection failure.	Replace shaft or connection.
	Outboard flexshaft and or coupling failure.	Replace the required item.
Frozen screwjack actuator.	Worm bearing failure, compression bearing failure on screw, tension bearing failure on screw, ball nut failure or seize.	Remove and service actuator.
Heavy wear on worm gear.	Worm bearing failure.	Remove and service actuator.
System will not hold in preset position.	Flap control box: Detent Failure Drag Brake Failure	Repair flap control.
Fault lamp indicating a failure during no demand periods.	Malfunctioning amplifier.	Replace amplifier.
Flap position indicator wrong.	Malfunctioning amplifier.	Replace amplifier.

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

Trouble	Cause	Remedy
FLAP CONTROL SYSTEM (cont)		
System won't turn on.	Bad flap control.	Check flap control box for proper operation and continuity in flap control box; repair or replace as necessary.
	Malfunctioning amplifier.	Replace amplifier.
	Disconnected flap control potentiometer in flap-control box.	Locking pin failure - service the control box.
Frozen flap lever.	Shaft failure.	Service the control box.
	Gearing failure.	Service the control box.
No flap movement.	Flap control box: Lever shaft failure. Locking pin failure. Gearing failure.	Service the control box.
	Flexshaft or coupling failure.	Replace worn part.
	Open circuit.	Check circuitry (refer to schematic in this chapter).
Slow system cycle.	Excessive motor brush wear.	Remove and service flap motor.
	Motor open circuit.	Check circuit per rigging and test procedures. Check circuit continuity.
Motor stall.	Malfunctioning screw-jack.	Inspect all screwjacks for excessive wear and free travel. If inspection does not uncover problem, disconnect screwjacks from flaps and flexshaft and check for free travel. Remove and service damaged screwjack.

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

Trouble	Cause	Remedy
FLAP CONTROL SYSTEM (cont)		
Motor stall. (cont.)	Excessive brush wear.	Remove and service motor.
	Motor open circuit.	Check circuit for proper installation.
Annunciator light on, but flaps operate.	Malfunctioning amplifier.	Replace amplifier.
Annunciator light on, with flaps inoperative.	Flap motor circuit breaker pulled or tripped.	Reset circuit breaker.
	Flaps asymmetric.	Check and rerig flaps.
	Potentiometer failure.	Replace potentiometer.
	Motor and or relay failure.	Replace component.
Flaps inoperative, annunciator light off and flap indicator pointing off.	Power loss to amplifier.	Probably flap amplifier circuit breaker. Reset breaker if applicable and or check system.

STANDARD PROCEDURES.

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

1. It is recommended, but not required, that the aircraft be placed 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/TENSION							
	30° F	40° F	50° F	60° F	70° F	80° F	90° F	100° F
AILERON CABLE TENSION	21 LBS.	23 LBS.	25 LBS.	28 LBS.	32 LBS.	35 LBS.	39 LBS.	45 LBS.
RUDDER CABLE TENSION	18 LBS.	19 LBS.	20 LBS.	21 LBS.	23 LBS.	25 LBS.	27 LBS.	32 LBS.
ELEVATOR CABLE TENSION	14 LBS.	15 LBS.	16 LBS.	17 LBS.	18 LBS.	20 LBS.	22 LBS.	26 LBS.

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.

— NOTE —

Cable tensions given apply only to airplanes without autopilot bridle cables attached. Refer to the appropriate autopilot service manual for proper cable tensions when attaching bridle cables.

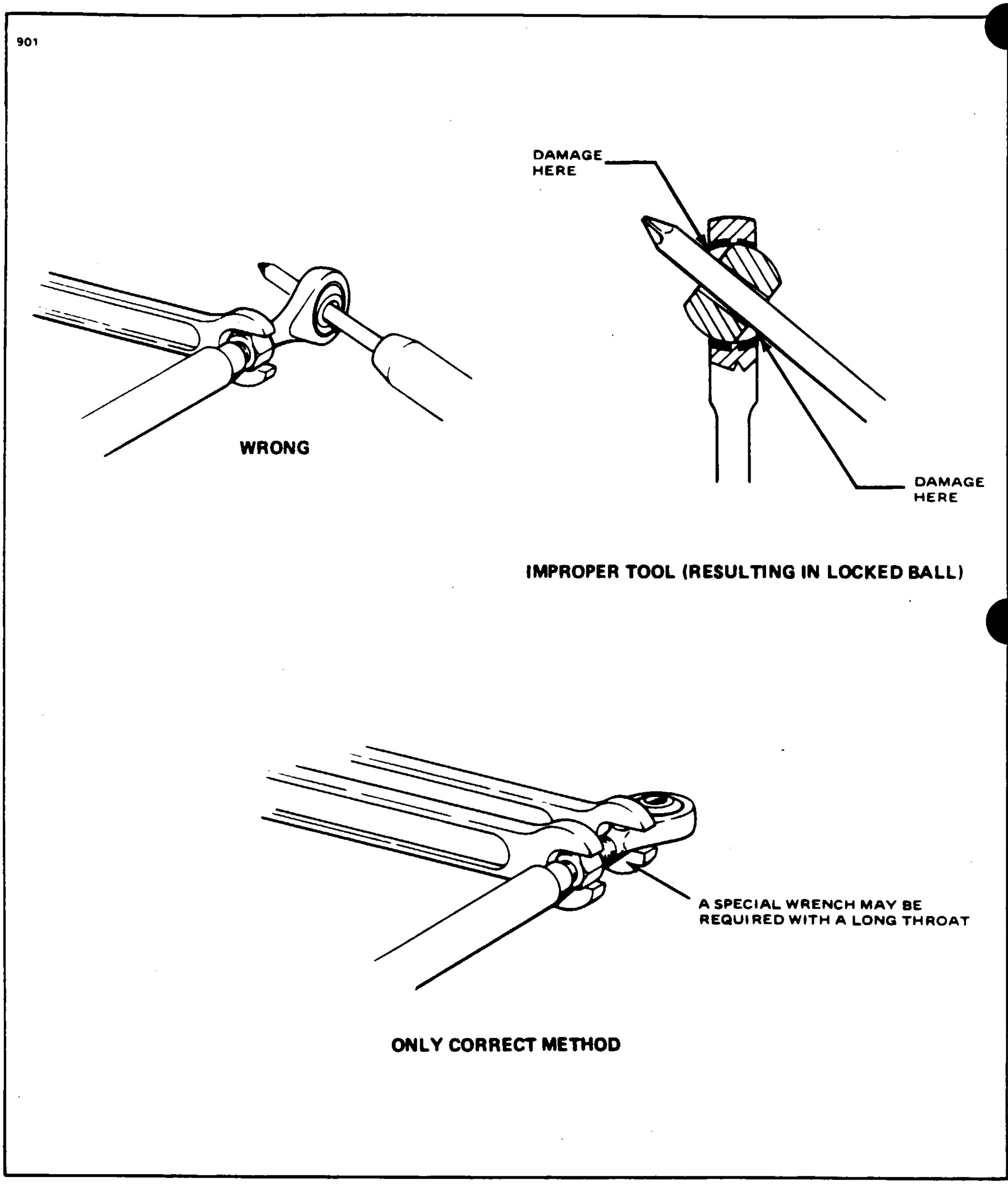

Figure 27-1. Correct Method of Installing Rod End Bearings

WRAPPING TRIM DRUMS. (Refer to Figure 27-2.)

All trim drums are wrapped basically in the same manner except as noted in the following procedures 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 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 on the forward trim drums (located beneath the control pedestal) or the aileron trim drum:
   A. Locate the center of the cable.
   B. Insert the cable into the cable slot in the trim drum. Insure that the center of the cable is in line with the center of the cable slot. Install the cable lockpin.
   C. Hold the drum with its base down. Wrap the cable that leads from the base end of the drum nine and one-quarter turns in a counterclockwise direction up towards the center of the drum. Wrap the cable that leads from the upper end of the drum nine and one-quarter turns in a clockwise direction down towards the center of the drum.

7A. To install and wrap the trim cable on the rudder trim drum:
   A. Insert the cable into the slot in the trim drum.
   B. Insert the cable lock pin.
   C. Hold the drum with the counterbored end down. Position cable ends even before wrapping. Wrap the one cable end in a counterclockwise direction six and one-half turns up towards the center of the drum. Wrap the other cable end in a clockwise direction twelve turns down towards the center of the drum.

7B. To install and wrap the trim cable on the elevator trim drum:
   A. Insert the cable into the slot in the trim drum. (Refer to Figure 27-2.) The shorter length of cable should come out of the slot end which is nearest the base of the housing bracket.
   B. Insert the cable lock pin.
   C. Hold the drum with its base end down. Wrap the shorter end of the cable six and one-half turns clockwise up towards the center of the drum. Wrap the longer end of the cable twelve turns counterclockwise down towards the center of the drum.

8. Insert the drum in the housing bracket, position the drum and route the cables from the assembly as shown in Figure 27-2.
9. Install the screw and screw stop or the drum shaft and secure with the roll pin (if used).
10. Block the trim cables (Refer to Figure 27-6) in the center position to keep them from loosening.

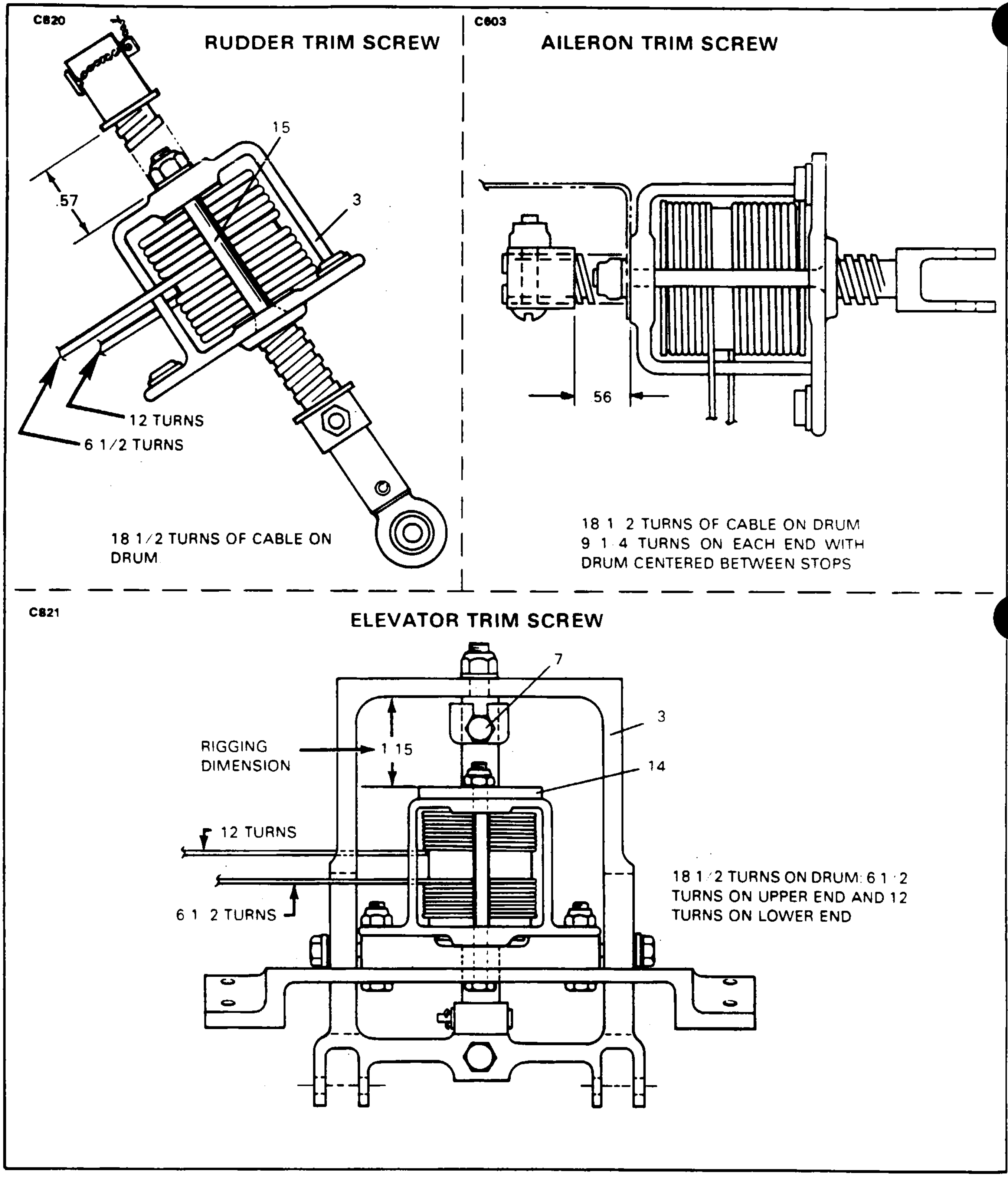

Figure 27-2. Trim Screw Assemblies

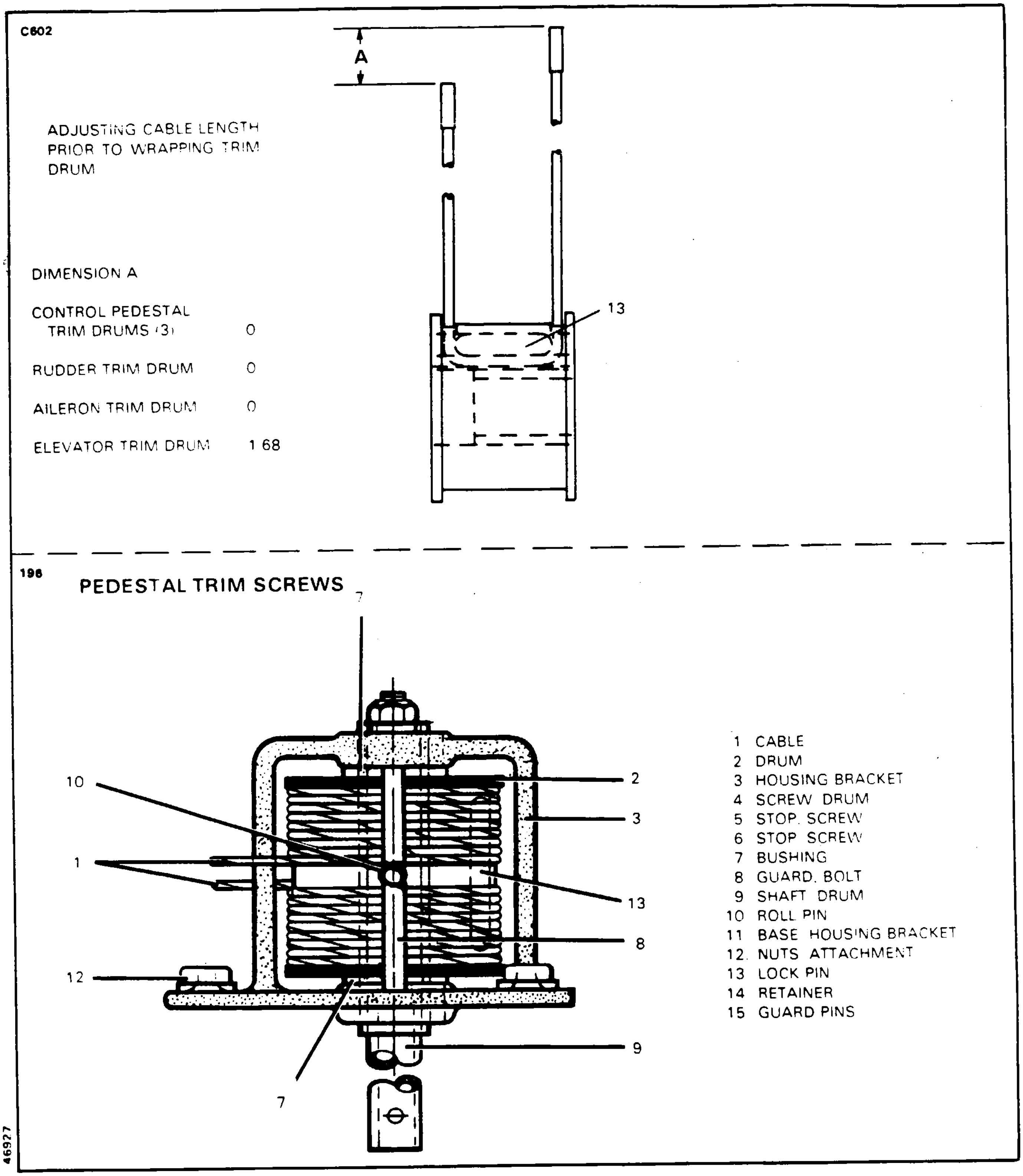

Figure 27-2. Trim Screw Assemblies (cont.)

11. For the aileron trim drum, center the drum between the stops on the screw by rotating the screw.
12. For the elevator trim drum, insure there is .38 in. between the lower surface of the plate and the boss on the bracket. (Refer to Fig. 27-2.)

CONTROL COLUMN.

REMOVAL OF CONTROL COLUMN. (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 100.00 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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   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 110.50 enough to relieve cable tension.
   B. Remove the bolts and roll pins that secure the elevator control sector and the right set of control arms to the torque tube.
   C. Loosen the bolts that secure the right tube bearing.
   D. Slide the tube to the right and remove the control sector from the tube. If desired, the cables may be removed from the sector.
   E. Slide the tube from the left bearing, lower the left end of the tube and slide it from the right bearing.
   F. The control arms and bearings may be removed, if desired.
5. The control tube guide located on the right side of the instrument panel may be removed by removing the assembly cover and the screws that secure the housing.
6. The control tube guide and lock assembly, located on the left side of the instrument panel may be removed by removing the assembly cover and the four nuts which hold the bushing and collar to the panel.

INSTALLATION OF CONTROL COLUMN. (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 110.50 and set cable tension per specifications given in Figure 27-19.
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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   C. Install the stud washers and nut, and tighten enough to allow the sprocket to rotate freely 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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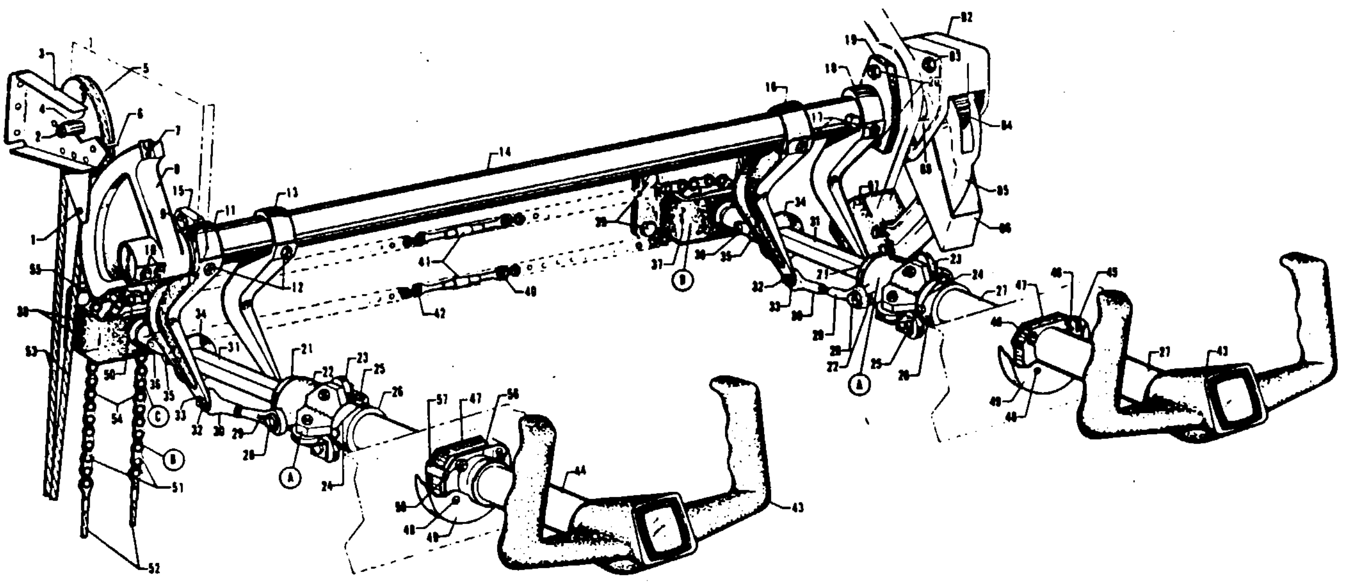

1. PIN, CABLE GUARD
2. BOLT ASSY.
3. BRACKET, MOUNTING
4. BUSHING
5. PULLEY
6. PIN, CABLE GUARD
7. PLATE, CABLE ATTACH
8. SECTOR, CONTROL
9. BOLT ASSY.
10. BOLT ASSY. AND ROLL PIN
11. ARM, CONTROL, L.O.
12. BOLT ASSY. AND ROLL PIN
13. ARM, CONTROL, L.I.
14. TUBE, TORQUE
15. BEARING, BLOCK
16. ARM, CONTROL, R.I.
17. BOLT ASSY. AND ROLL PIN
18. ARM, CONTROL, R.O.
19. BEARING, BLOCK
20. BOLT ASSY.
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 ASSY.
31. SQUARE TUBE
32. BOLT ASSY.
33. COTTER PIN
34. COLLAR, STOP
35. BOLT ASSY.
36. UNIVERSAL ASSY.
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 ASSY.
48. SCREW
49. COVER
50. SPROCKET
51. LINK ASSY.
52. CONTROL CABLE, AILERON
53. CONTROL CABLE, AILERON
54. CHAIN, AILERON
55. PLATE, CABLE ATTACH
56. BUSHING
57. COLLAR
58. NUT
59. CAP BOLT
60. WASHER
61. ROLLER
62. BLOCK
63. BEARING
64. WASHER, SPACER
65. BOLT ASSY.
66. ANGLE
67. BUSHING, ECCENTRIC
68. PLATE, LINK
69. LOCK, CHAIN
70. PIN LINK
71. CABLE END
72. GUARD, CHAIN
73. BUSHING
74. BOLT ASSY.
75. HOUSING, SPROCKET
76. BUSHING
77. NUT, KAYNAR
78. WASHERS
79. BULKHEAD
80. SHIM .032
81. SHIM .012
82. SUPPORT FITTING
83. BOLT ASSY.
84. SPUR GEAR
85. ARM, BOBWEIGHT
86. STOP, BOBWEIGHT
87. BOBWEIGHT
88. GEAR BUSHING

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Figure 27-3. Control Column Installation

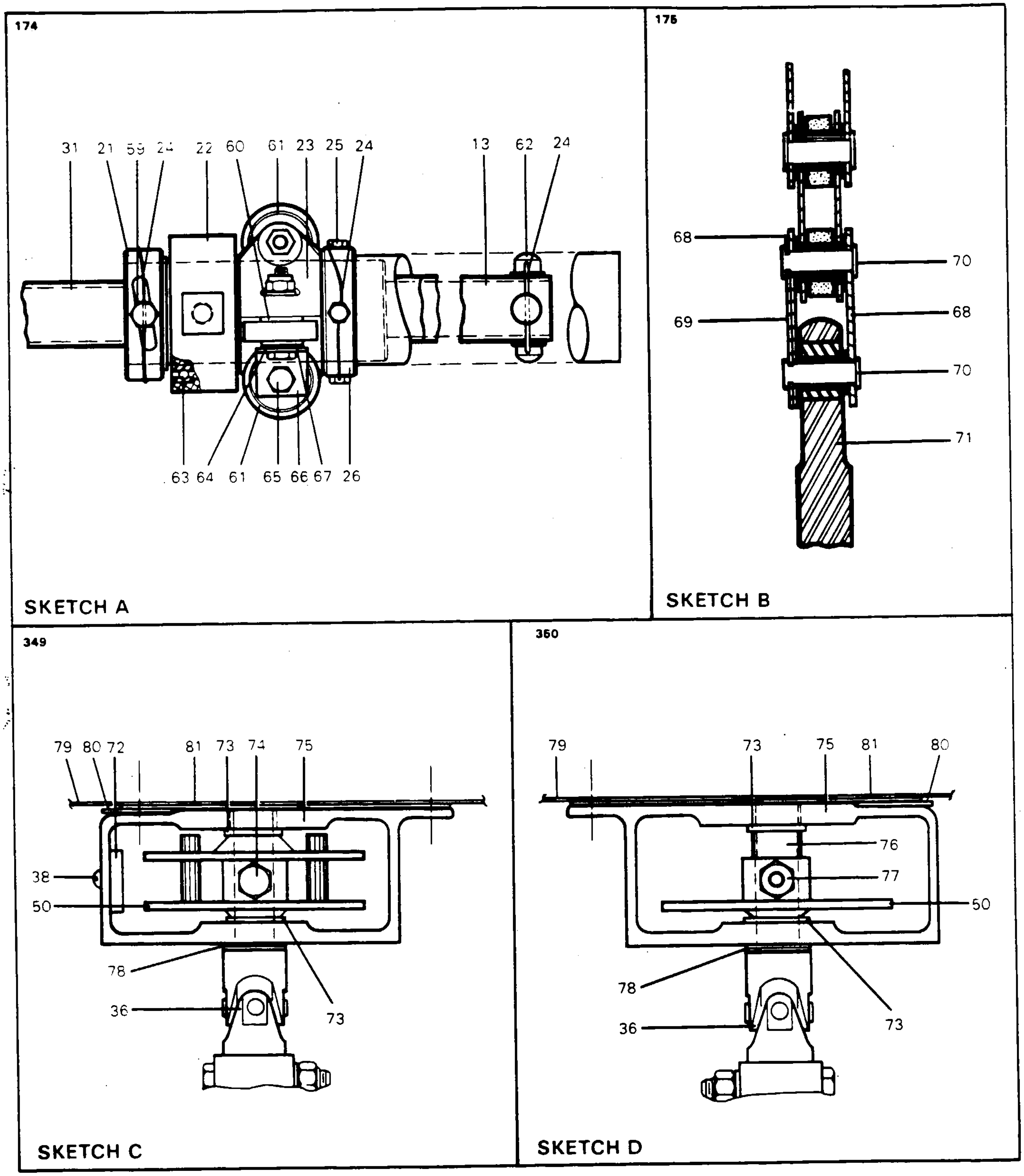


Figure 27-3. Control Column Installation (cont.)

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 27-11 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 eccentric bushings in each roller to allow .002 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.
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. Attach the left control tube guide block and lock assembly by positioning the collar onto the studs, being sure the slotted end is toward the center control pedestal. Install the bushing with the holes in a vertical position and secure the complete assembly with four nuts. Leave the two bottom nuts loose until the final adjustment is made.

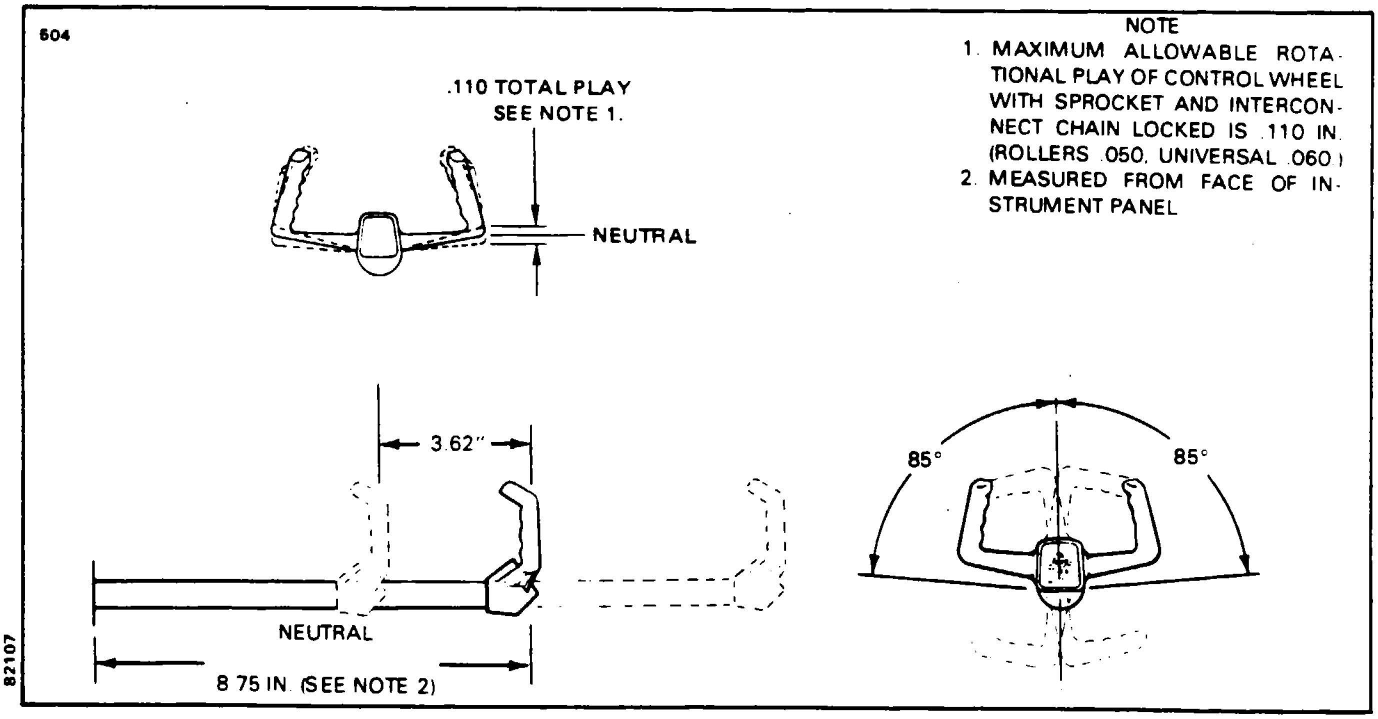


Figure 27-4. Control Wheel Travel

6. 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.
7. 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.
8. 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.
9. Rig the bobweight so that with control wheels in their neutral position, the center of bolt A (refer to Figure 27-5) will be in line with the edge of the bracket.
10. Check control operation and install access panels removed.

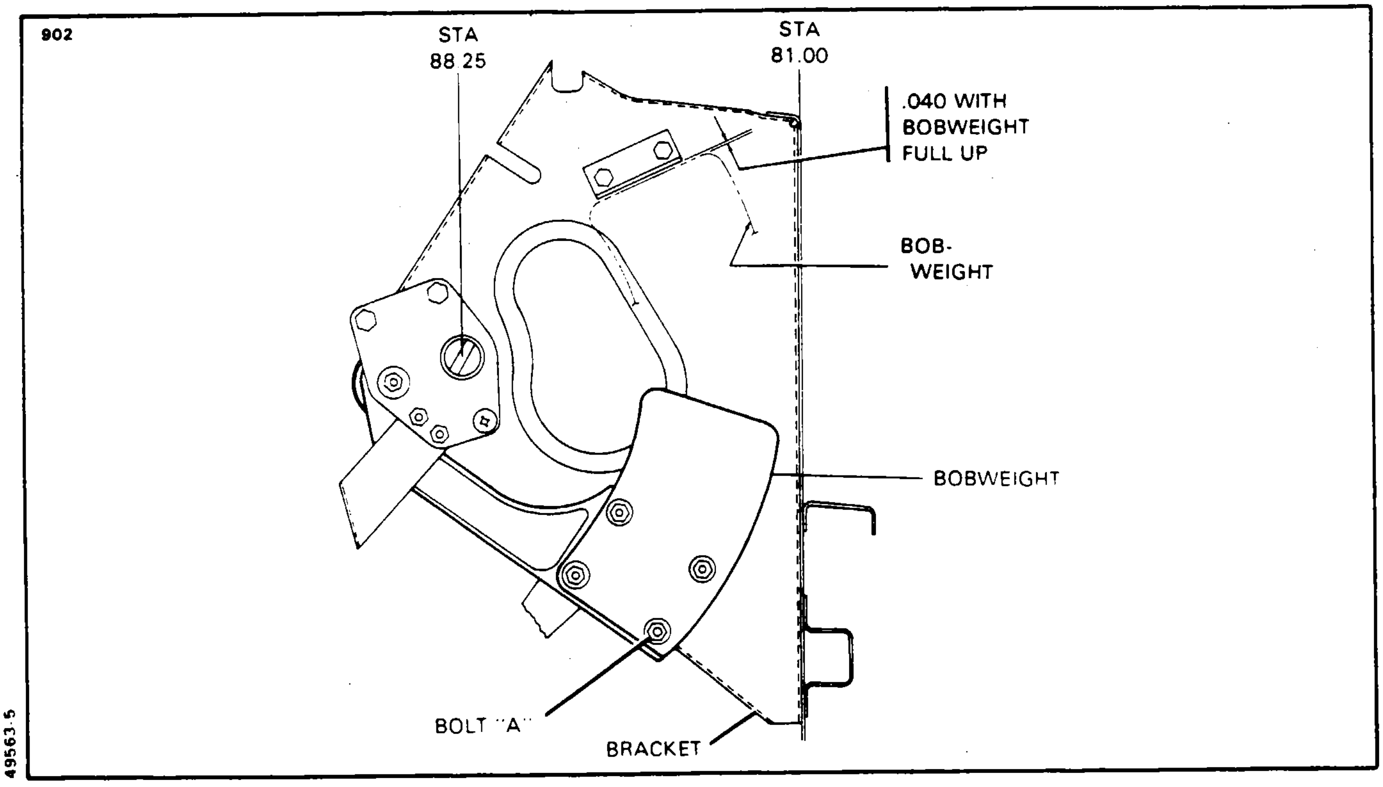


Figure 27-5. Rigging Bobweight

AILERON AND TAB SYSTEM.

The aileron control system components are as follows: control column, cables, pulleys, bellcranks, actuator rods, interconnecting cable and right and left aileron control surfaces. The aileron trim system consists of a trim wheel and trim screw located on the cockpit control pedestal, a trim screw, trim tab and interconnecting rod located on the right wing and related pulleys and cables. The information contained herein is provided to assist the mechanic in removing and installing system components and in rigging and adjusting the aileron system.

AILERON CONTROL CABLES.

REMOVAL OF AILERON CONTROL CABLES. (Refer to Figure 27-7.)

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 174.50 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 100.00.
   B. Loosen the turnbuckle, separating the ends at the forward end of the aileron bellcrank.
   C. Remove the cable guard pins at wing station 29.00 and 150.00 and within the fuselage at station 164.50 and 168.50. Remove the fairleads at the fuselage.
   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 station 29.00 and 150.00 and fuselage station 171.25.
   D. Draw the cable through the wing into the fuselage.
6. The left balance cable may be removed by the following procedure:
   A. Loosen the turnbuckle, separating the turnbuckle end 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 283.00.
   C. If not previously accomplished, remove the cable guard pins at wing stations 29.00 and 150.00 and fuselage station 172.50 and 171.25.
   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 242.50 and 274.92.
   G. Draw the interconnecting cables forward through the fuselage.

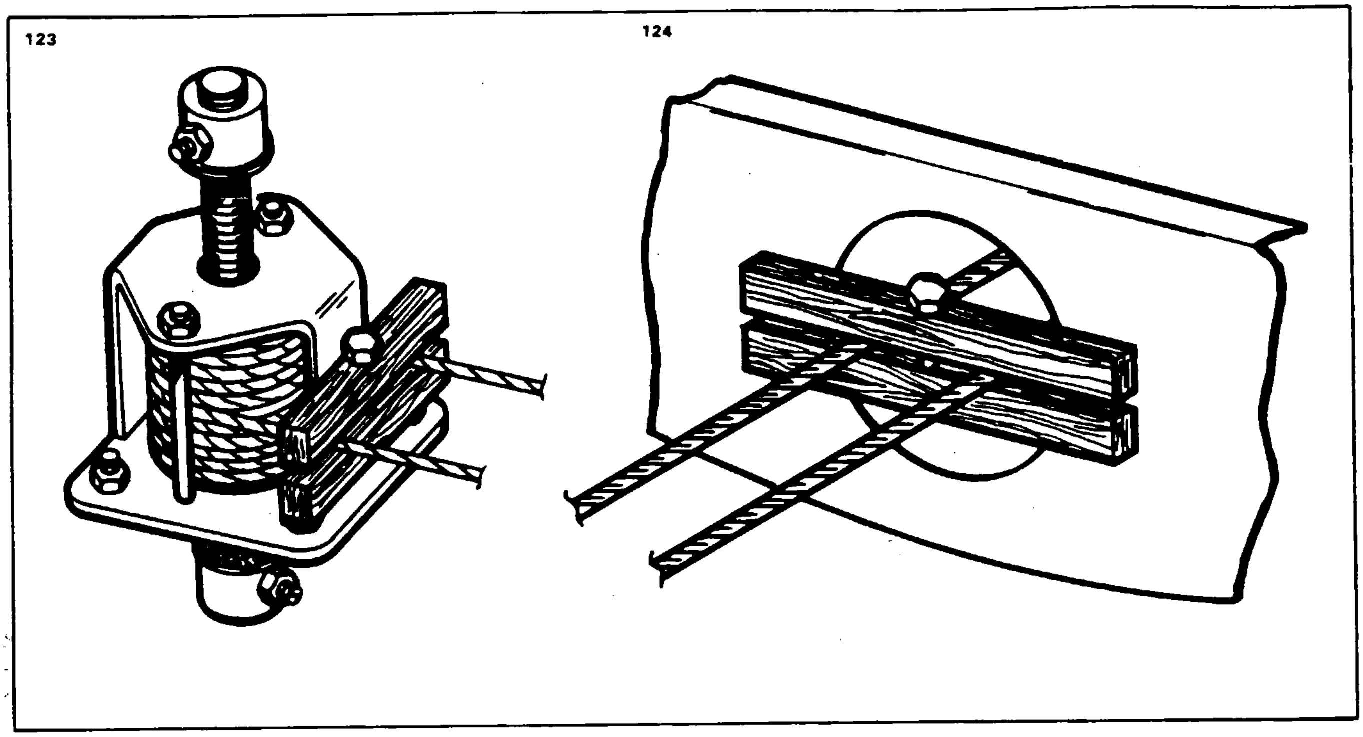
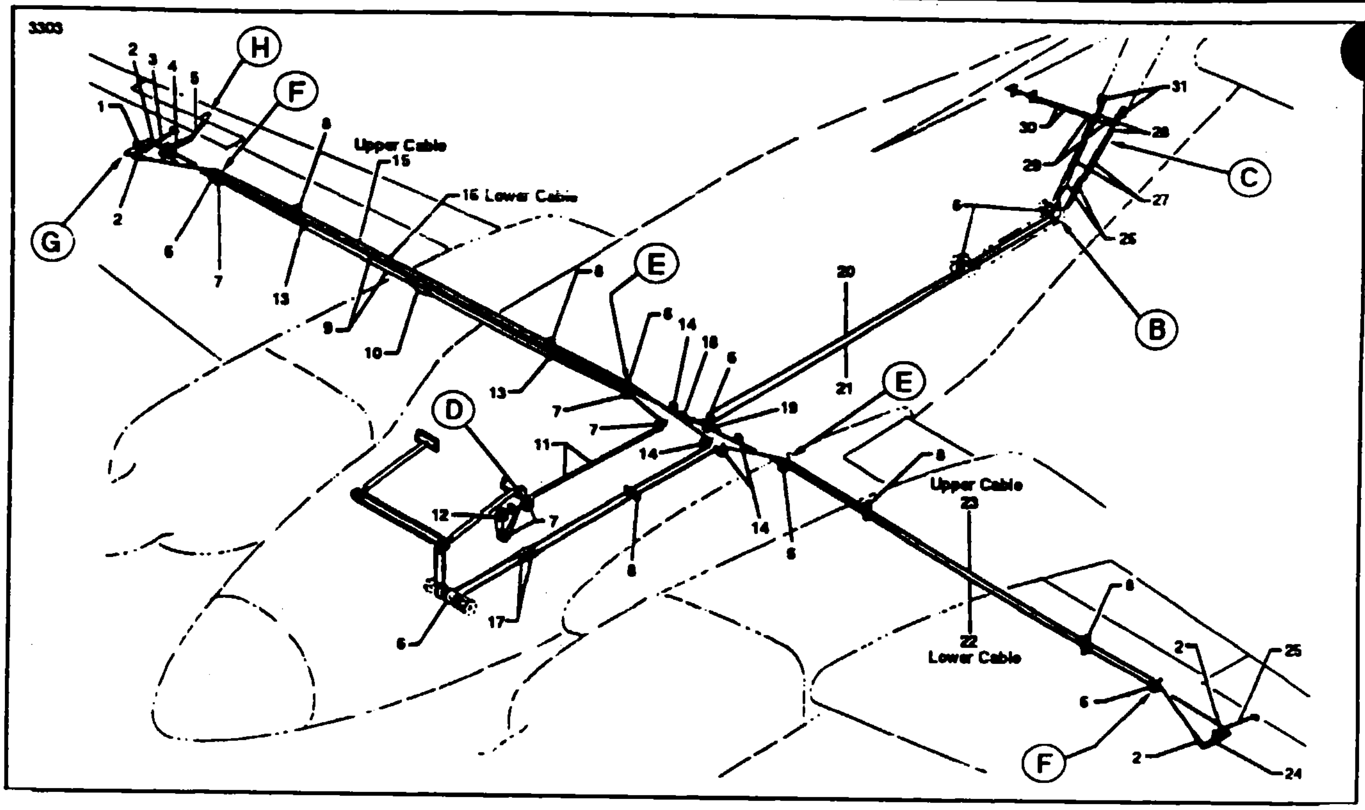


Figure 27-6. Methods of Blocking Trim Cables

INSTALLATION OF AILERON CONTROL CABLES. (Refer to Figure 27-7.)

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 turnbuckle end to the forward control cable turnbuckle within the fuselage at station 100.00.
   D. If balance cable is installed, install the cable guard pins at wing stations 29.00 and 150.00 and fuselage stations 164.50 and 168.50. Install the fairleads at fuselage station 137.00.
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 171.25.



1.BELLCRANK. RIGHT	16.CABLE, BALANCE (R)	31 CONNECTOR	46 BOLT ASSY
2 TURNBUCKLE	17.TURNBUCKLE	32 BOLT. GUARD	47 END, TURNBUCKLE
3 ROD, AILERON CONTROL	18.CABLE ENDS	33 DRUM	48 END, TURNBUCKLE
4 TRIM SCREW ASSY	19. RUB BLOCK	34. HOUSING	49 BOLT ASSY
5 ROD, TRIM CONTROL	20. INTERCONNECTING CABLE (R)	35 BOLT, CAP	50. ROD END
6.PULLEY CLUSTER	21.INTERCONNECTING CABLE (L)	36 STOP. SCREW	51.NUT, JAM
7.PULLEY CLUSTER	22.CABLE. BALANCE (L)	37.SCREW	52.STOP BOLT
8.FAIRLEAD	23.CABLE, CONTROL (L)	38.BOLT ASSY	53.NUT, JAM
9.TRIM CABLE	24.BELLCRANK. LEFT	39.JAM NUT	54.STOP BLOCK
10.TURNBUCKLES	25.ROD, CONTROL	40.CLEVIS	55.BOLT. PIVOT
11.TRIM CABLE	26.TURNBUCKLE	41.BOLT ASSY	56.BOLTS ASSY
12.TRIM SCREW ASSY	27.SPRING	42.BRACKET	57.ROD, CABLE GUARD
13. RUB BLOCK	28. SPRING	43 BRACKET	
14 PULLEY	29 SPRING	44 ROD END	
15 CABLE, CONTROL (R)	30 CABLE	45 JAM NUT	

Figure 27-7. Aileron and Aileron Trim Controls

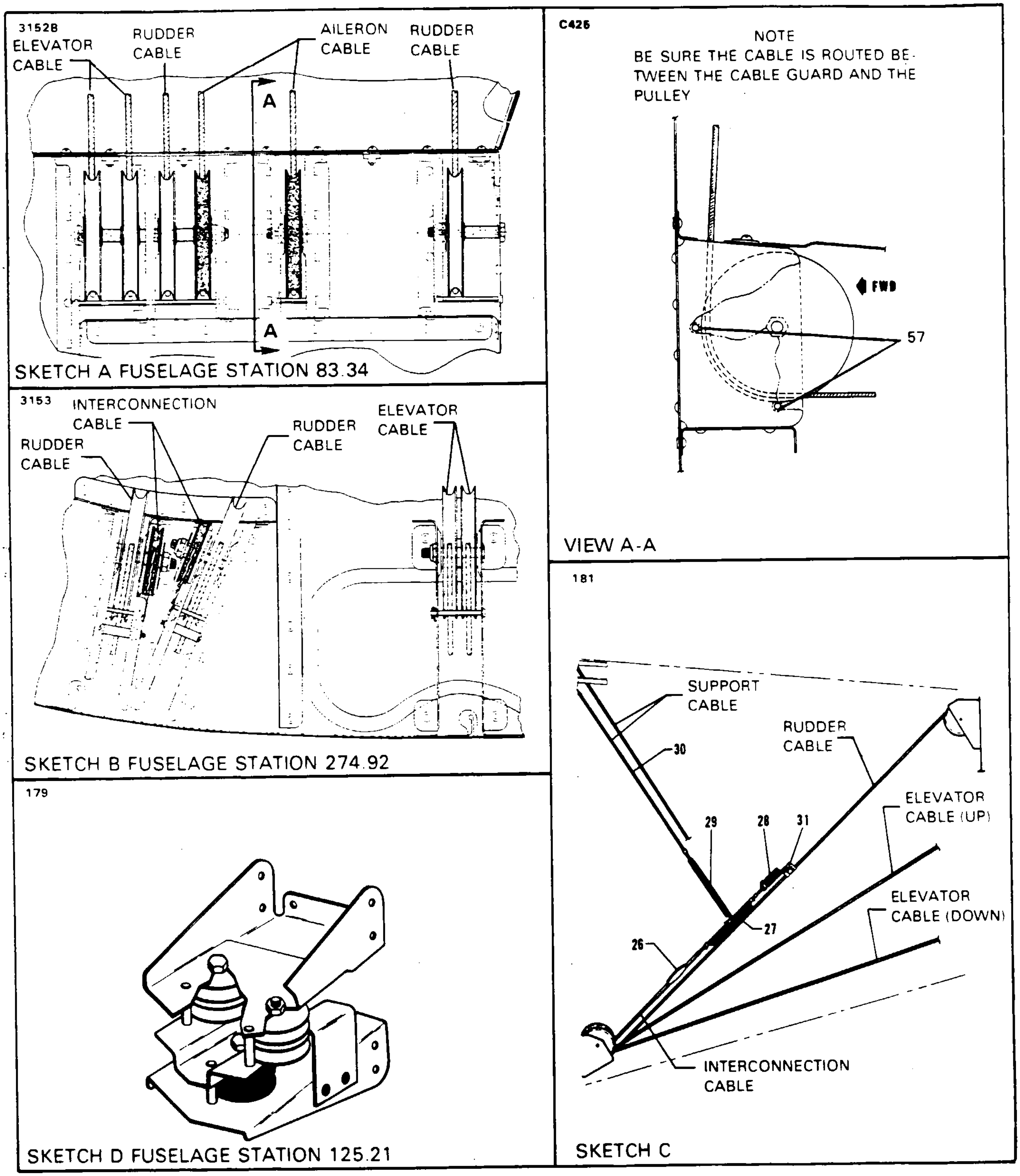


Figure 27-7. Aileron and Aileron Trim Controls (cont.)

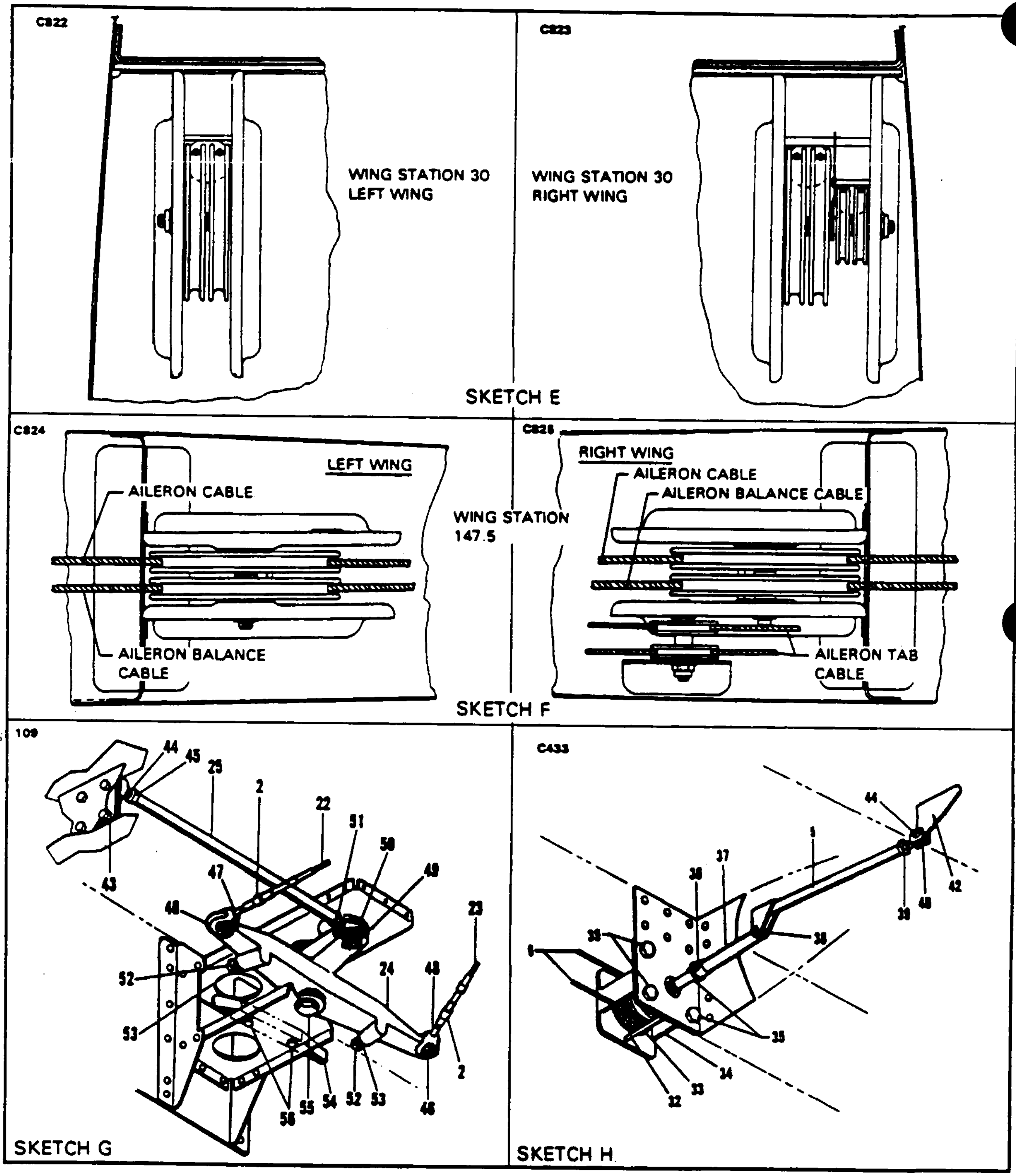


Figure 27-7. Aileron and Aileron Trim Controls (cont.)

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 283.00.
   C. Install cable guard pins at fuselage stations 242.50 and 274.92.
   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.
   F. Install cable guard pins at fuselage station 171.25 and 172.50 and wing stations 29.00 and 150.00.
4. Set cable tension per Figure 27-11 and check control cable rigging and adjustment. Also check cable clearance.
5. Install access plates and panels.

AILERON BELLCRANK.

REMOVAL OF AILERON BELLCRANK. (Refer to Figure 27-7.)

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. (Refer to Figure 27-7.)

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.

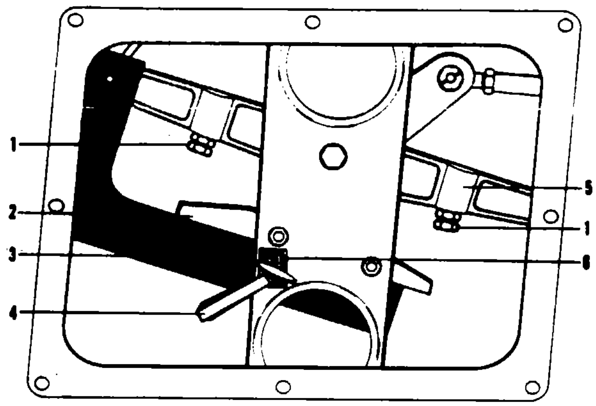


Figure 27-8. Installation of Bellcrank Rigging Tool

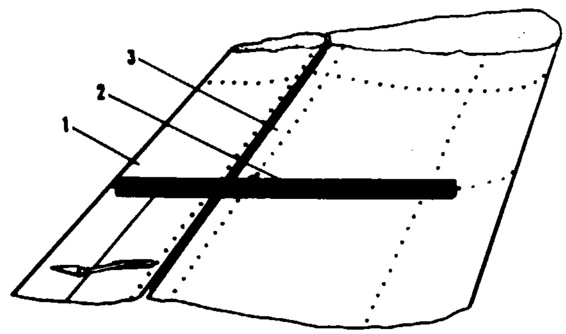


Figure 27-9. Installation of Aileron Rigging Tool

RIGGING AND ADJUSTMENT OF AILERON CONTROLS.

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 27-8. (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 174.50
   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 similiar material between the clamp and lower bracket so as not to damage the bracket or bend the turned edge that is around the bracket lightening hole.
2. Check or adjust the aileron for neutral position by the following procedure:
   A. Place a modified straightedge, as shown in Figure 27-9 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 27-11 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 100.00. 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 283.00 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 27-11. 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 MS20995C32 as shown in Figure 27-12.

7. Check control operation, bolts and turnbuckles for safety and installation of cable guard pins.
8. Install access plates and panels.

AILERON TRIM (CONTROL PEDESTAL).

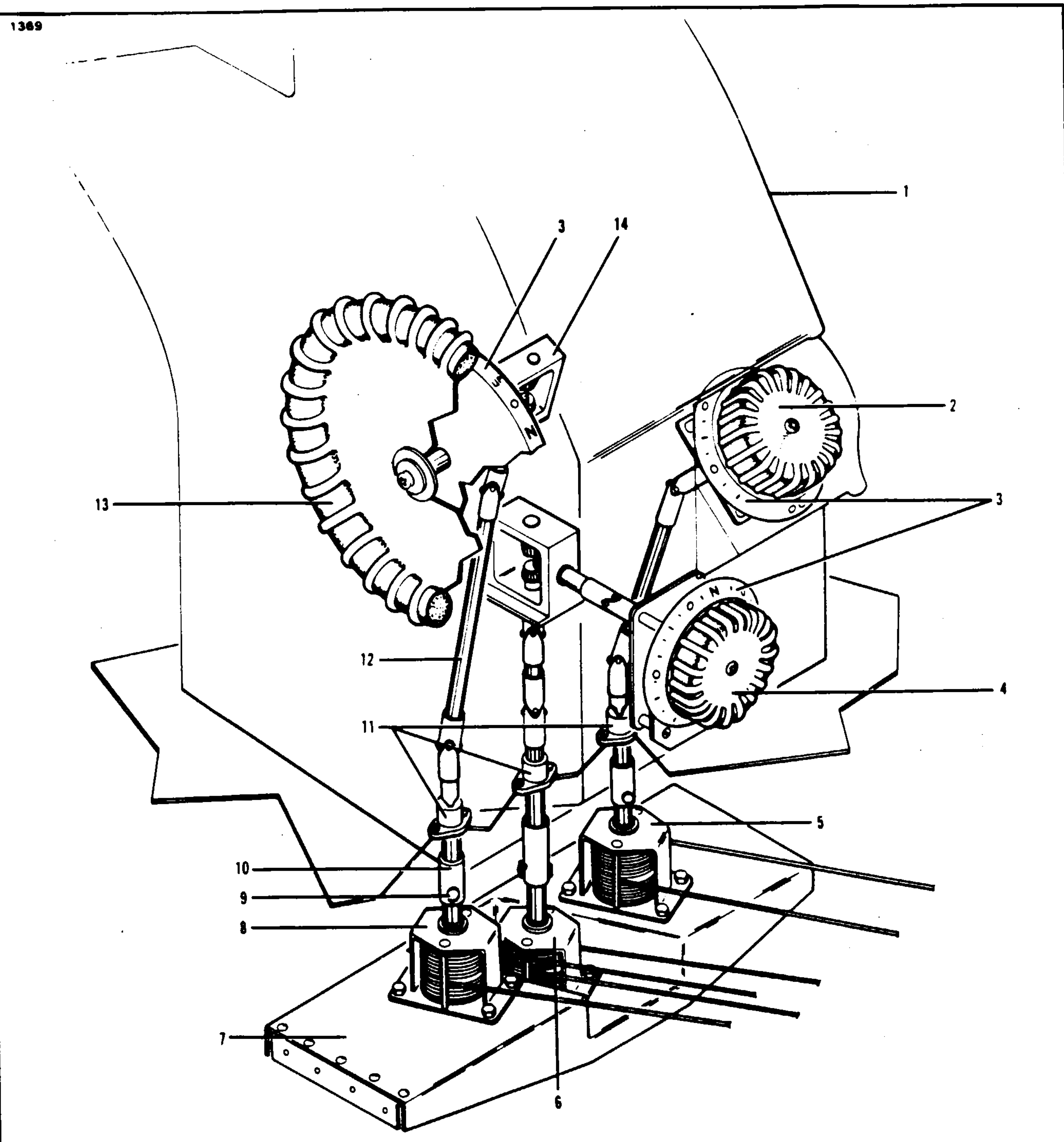
REMOVAL OF AILERON TRIM (CONTROL PEDESTAL). (Refer to Figure 27-7 and 27-10.)

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 100.00.

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 snap bushings from wing station 58.50 and 121.50 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.
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 27-6. (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 104.00 and the cable guard pins at stations 125.00 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 (CONTROL PEDESTAL). (Refer to Figure 27-7.)

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 104.00 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 27-11 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 125.00 and 163.00.
10. Reinstall the snap bushings within the wing at stations 58.50 and 121.50.
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 27-11 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.



1. CONTROL PEDESTAL
2. RUDDER TRIM CONTROL
3. TRIM POSITION INDICATOR
4. AILERON TRIM CONTROL
5. RUDDER TRIM SCREW
6. AILERON TRIM SCREW
7. MOUNTING BRACKET
8. ELEVATOR TRIM SCREW
9. PIN AND COTTER PIN
10. SLEEVE
11. BUSHING AND PLATE
12. SHAFT
13. ELEVATOR TRIM CONTROL
14. GEAR BOX

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Figure 27-10. Trim Controls Installation

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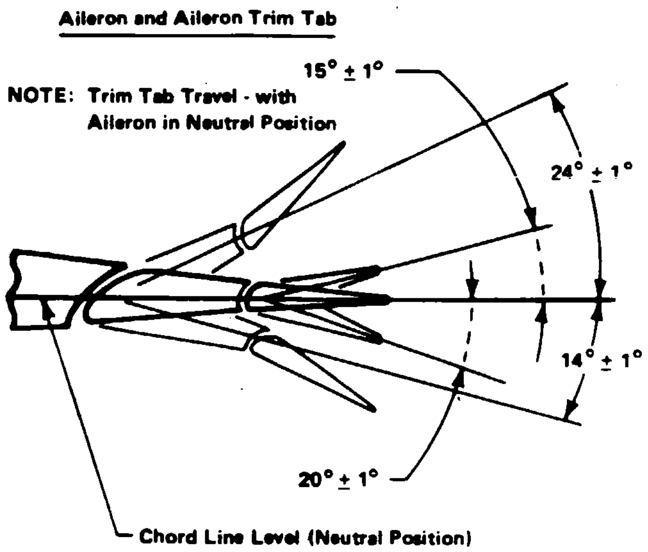

Cable Tensions

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.

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Figure 27-11. Aileron Control Travels and Cable Tension

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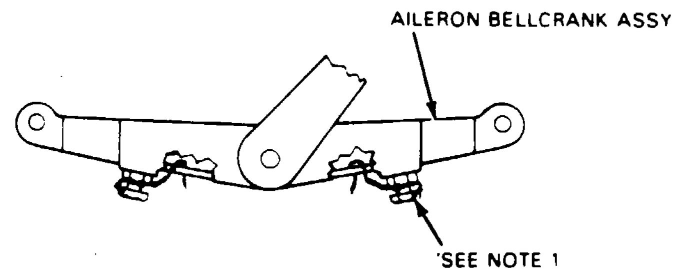
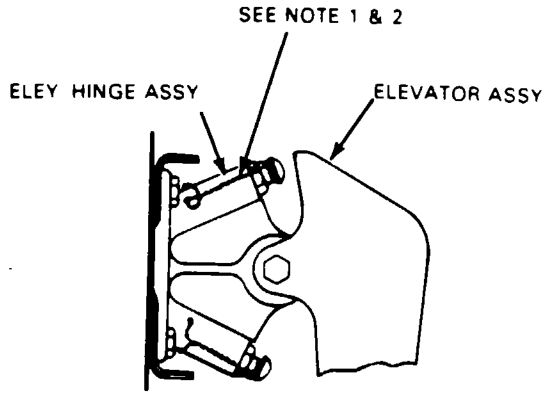
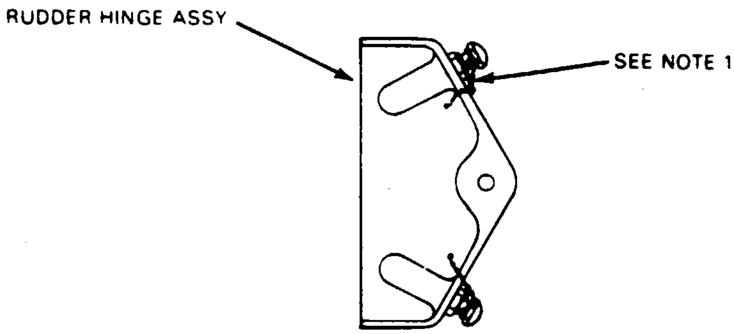






NOTES

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.

82107-2

Figure 27-12. Safety Wiring Control Surface Stops

AILERON TRIM (WING).

REMOVAL OF AILERON TRIM (WING). (Refer to Figure 27-7.)

1. Remove the access plates located under the wing along the trailing edge at wing stations 92.50. 121.50. 147.50 and 174.50.
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 27-6. (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 and remove the snap bushings at wing station 121.50 to allow the cable ends to pass through.
6. Remove the cable guard pin within the wing at station 150.00.
7. Remove the cap bolts that attach the screw assembly to the rear spar and remove the assembly from the wing.

INSTALLATION OF AILERON TRIM (WING). (Refer to Figure 27-7.)

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 from next to the trim screw assembly and from the trim cables leading from the fuselage.
5. Connect the control rod to the trim screw.
6. Install the cable guard pin at wing station 150.00.
7. Reinstall the snap bushings at wing station 121.50.
8. If the complete cable system is installed. set cable tension with the turnbuckles at wing station 90.00 per Figure 27-11 and check rigging and adjustment.
9. Install access plates.

RIGGING AND ADJUSTMENT OF AILERON TRIM. (Refer to Figure 27-7.)

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 27-11.
2. Remove the access plates on the underside of the right wing at stations 92.50 and 174.50.

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 27-11 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 indicator.

RUDDER AND TAB.

The rudder and tab system consists of: rudder pedals, pulleys, pulley clusters, tension springs, rudder sector, rudder and interconnecting cables. The information in this section is to aid the mechanic in performing maintenance, repairs, rigging and adjustment on the rudder system.

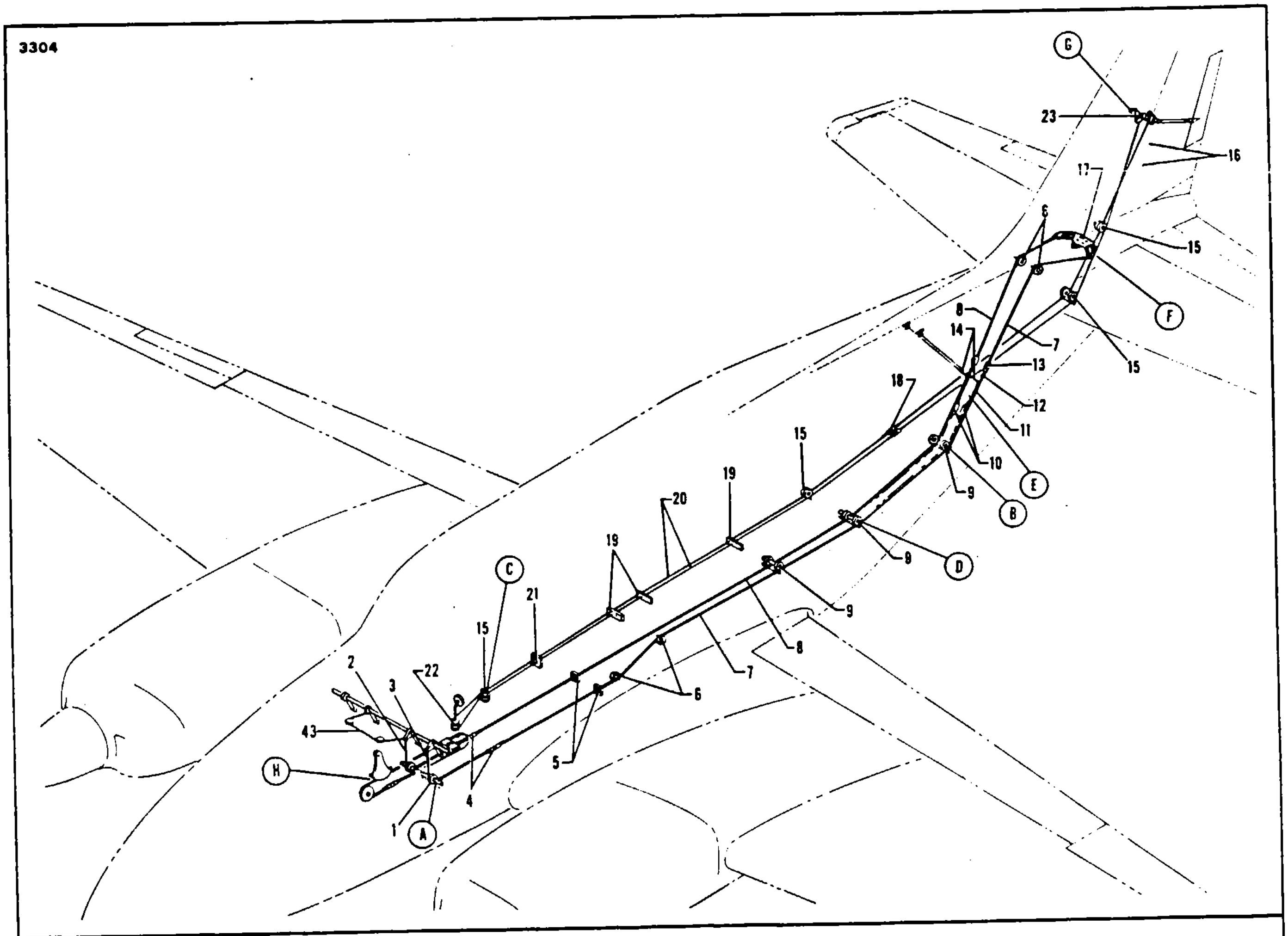
RUDDER CONTROL CABLES.

REMOVAL OF RUDDER CONTROL CABLES. (Refer to Figure 27-13.)

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.
5. Loosen the aileron and rudder interconnecting cables at the turnbuckles at station 283.00 in the aft section of the fuselage, enough to allow the large connecting spring at station 290.00 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 100.00.
7. Mark and disconnect the cables from the rudder sector.
8. Remove the cable guard pins at fuselage stations 213.00, 242.50, 274.92 and 315.00. In addition, when removing the left cable, remove pins at stations 140.00 and 160.60.
9. Draw the cables aft through the fuselage and remove.

INSTALLATION OF RUDDER CONTROL CABLES. (Refer to Figure 27-13.)

1. Connect the cables to the rudder sector.
2. Draw the cables forward through the fuselage and connect to the forward cables at the turnbuckles at station 100.00.
3. Install the cable guard pins at stations 213.00, 242.50, 274.92 and 315.00. If the left cable was removed, install pins at stations 140.00 and 160.60.
4. Connect the aileron and rudder interconnecting cables to the rudder cables.
5. Set cable tension per Figure 27-14 and check rigging and adjustment.
6. Install access plates, panels and seats.



1. PULLEY CLUSTER, FWD.
2. CONTROL CABLE, R. FWD.
3. CONTROL CABLE, L. FWD.
4. TURNBUCKLE
5. FAIRLEAD
6. PULLEY
7. CONTROL CABLE, L. AFT.
8. CONTROL CABLE, R. AFT.
9. PULLEY CLUSTER
10. TURNBUCKLE, INTERCONNECTING
11. SPRING, SLACK TAKE-UP
12. SPRING, SLACK CONTROL
13. BALL CLAMP
14. SPRING, TENSION
15. PULLEY CLUSTER
16. TRIM CABLE, AFT
17. RUDDER SECTOR
18. TURNBUCKLE
19. RUB BLOCK
20. TRIM CABLE, FWD.
21. FAIRLEAD
22. SCREW ASS'Y., TRIM FWD.
23. SCREW ASS'Y., TRIM AFT.
24. STOP, TRIM SCREW
25. SCREW, TRIM
26. SAFETY WIRE
27. DRUM, TRIM
28. CONTROL ROD
29. STOP, TRIM SCREW
30. BOLT ASSEMBLY
31. RUDDER TUBE
32. BOLT ASSEMBLY
33. BOLT ASSEMBLY
34. CABLE END
35. BRACKET
36. BOLT ASSEMBLY
37. SECTOR STOPS
38. STEERING SECTOR
39. PULLEY
40. STEERING CABLE
41. TURNBUCKLE
42. SLEEVE
43. RUDDER BALANCE CABLE
44. ROD, CABLE GUARD

82114-2, 82108-2, 82100-2

Figure 27-13. Rudder and Rudder Trim Controls

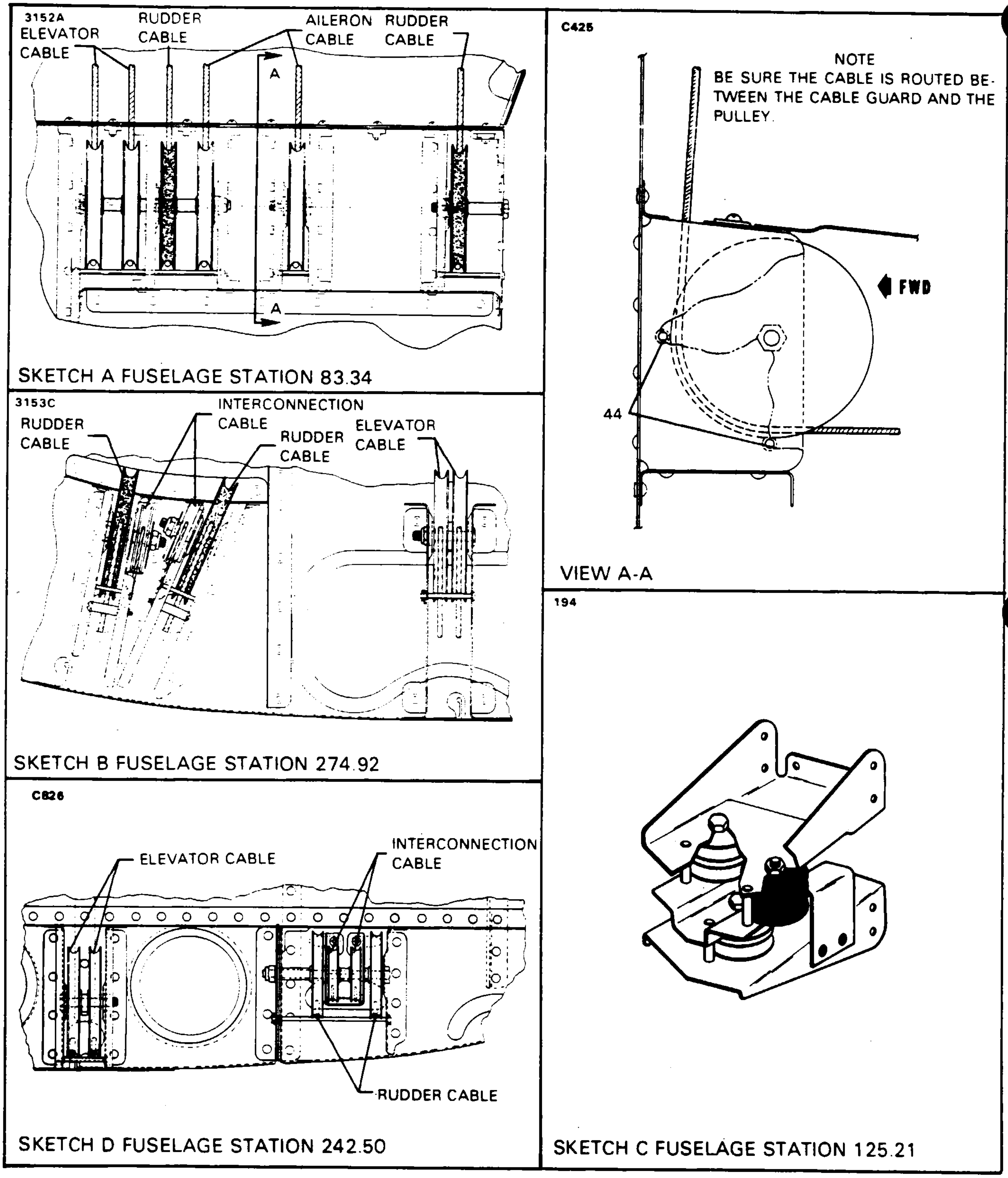


Figure 27-13. Rudder and Rudder Trim Controls (cont.)

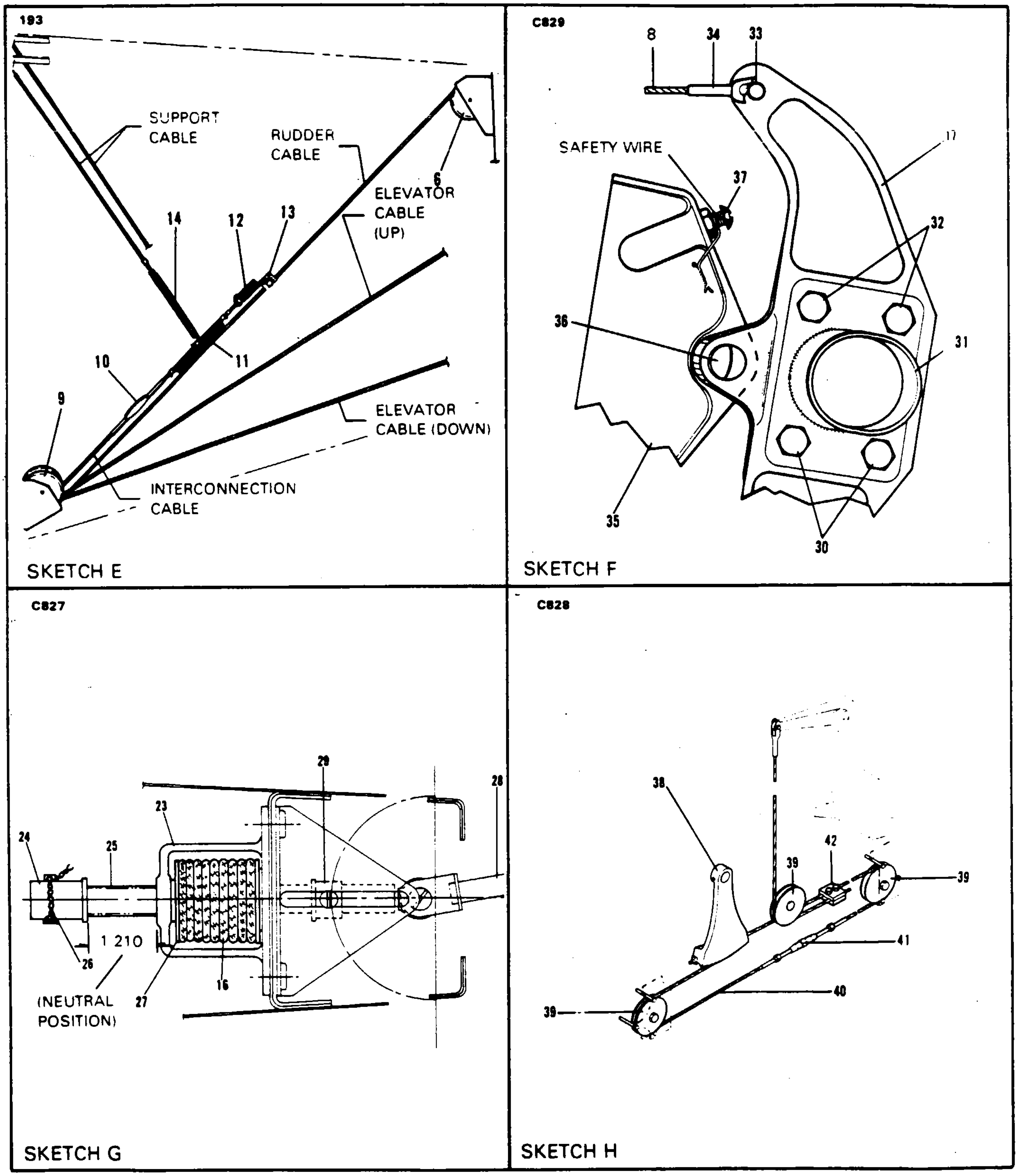


Figure 27-13. Rudder and Rudder Trim Controls (cont.)

RUDDER SECTOR.

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

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 100.00.
4. Mark one end of the rudder sector and cable end to facilitate installation and disconnect the cables from the rudder sector ends.
5. Unbolt the rudder sector from the rudder torque tube and the hinge bracket. Remove the sector.

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

1. Position the rudder sector under the rudder torque tube and hinge. Install bolts and torque.
2. Connect the rudder cables to the sector and secure. Allow the cable ends to rotate freely.
3. Set cable tension per Figure 27-14 and rigging and check adjustment.
4. Install access plate, panel and seat.

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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.

RUDDER AND RUDDER TRIM TAB

NOTE: Trim Tab Travel with Rudder in Neutral Position

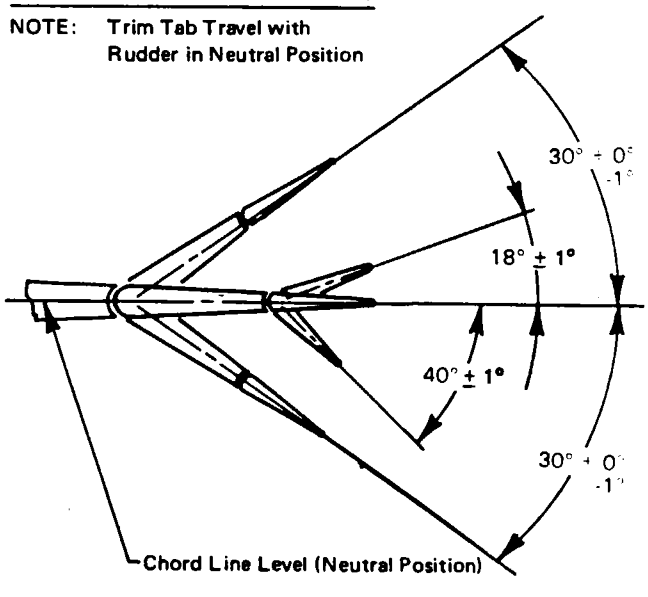

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Figure 27-14. Rudder and Trim Tab Control Travels and Cable Tensions

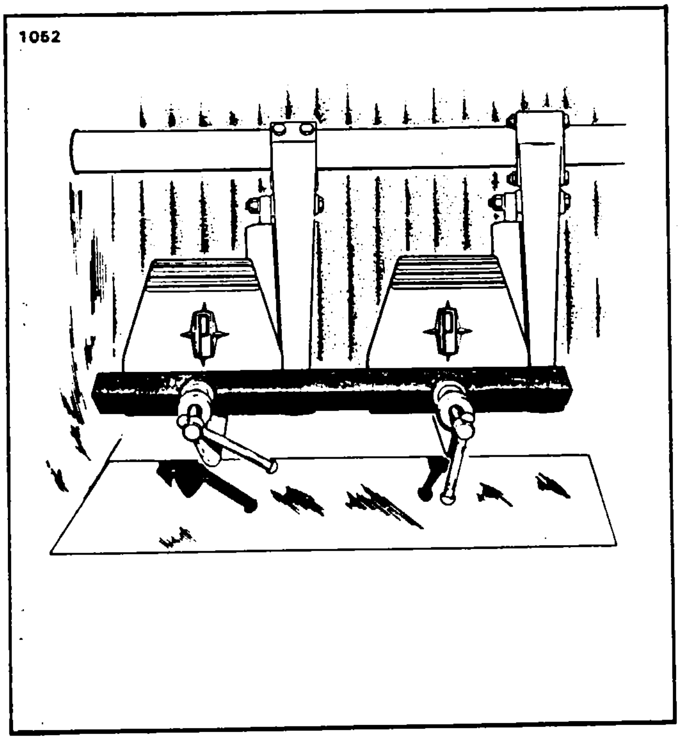


Figure 27-15. Clamping Rudder Pedals in Neutral Position

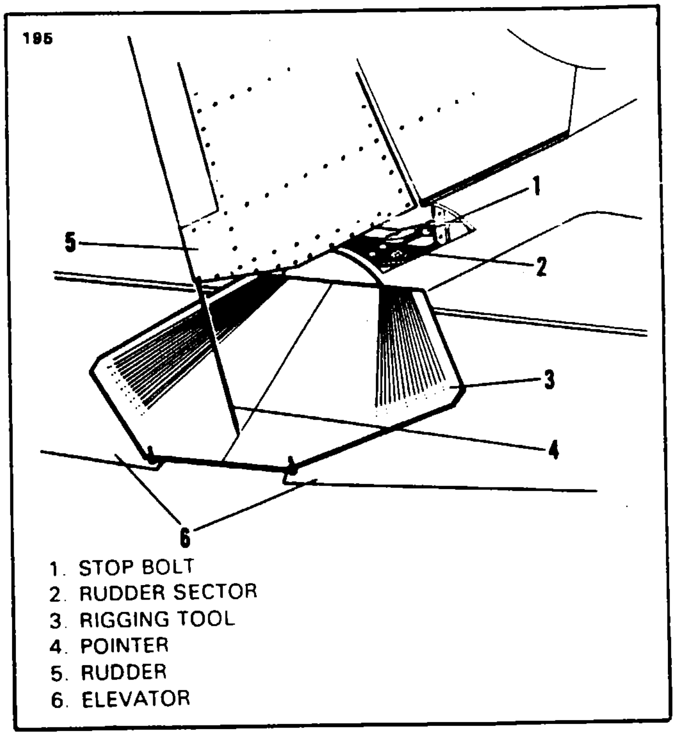


Figure 27-16. Installation of Rudder Rigging Tool

RUDDER PEDALS.

REMOVAL OF RUDDER PEDAL ASSEMBLY. (Refer to Figure 27-17.)

1. Remove the left pilot's seat and the floor panel to the left of the control pedestal.
2. Relieve the tension from the rudder control cables by loosening one of the cable turnbuckles.
3. Disconnect the rudder control cables from the pedal assembly.
4. Disconnect the brake master cylinder from the pedal assembly.
5. Disconnect the balance cable from the two inboard pedals, by removing the flat head pins at rudder pedals.
6. Remove the rudder torque tube guards 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.
8. Remove the bolts securing 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 retainers 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 the 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.
14. To remove the balance cable, remove the clevis pins at both ends and remove the pulley guard pins at both pulleys.

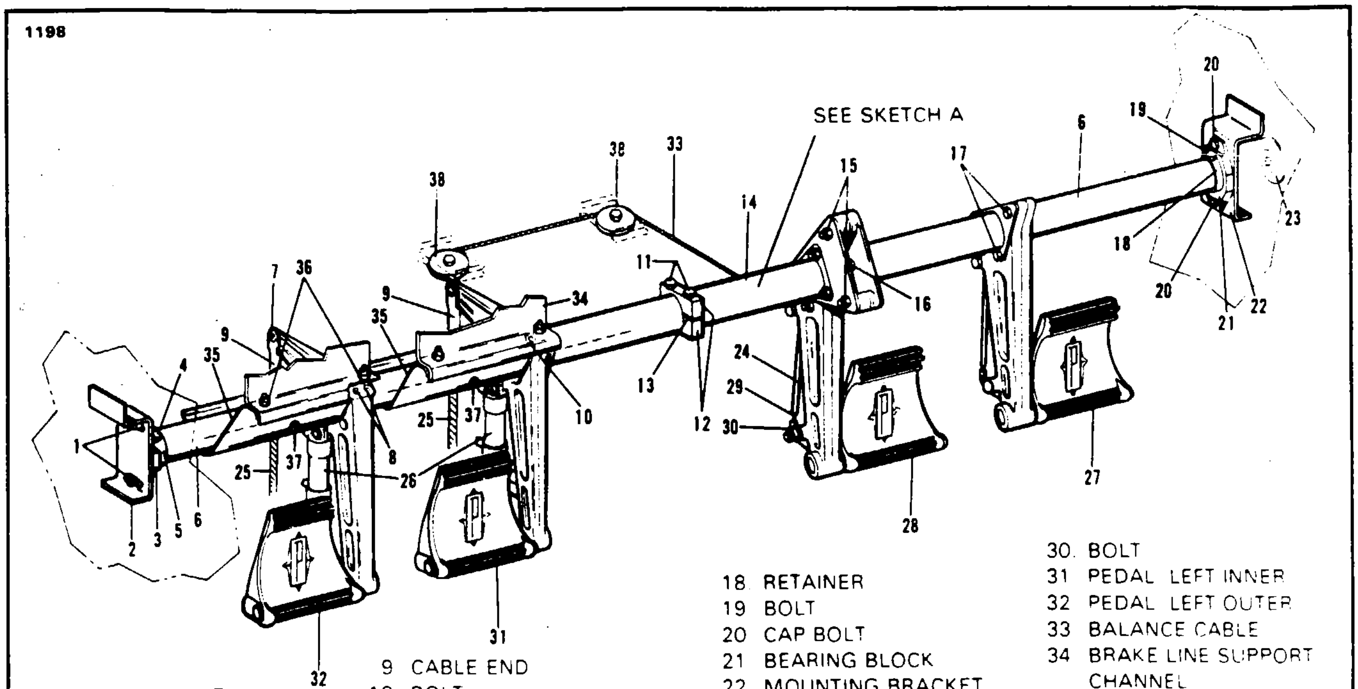
INSTALLATION OF RUDDER PEDAL ASSEMBLY. (Refer to Figure 27-17.)

1. If the balance cable is removed, install before proceeding with the rest of the installation. Replace pulley guard pins.
2. Install and secure the torque tube bearings to their mounting brackets with cap bolts.
3. Assemble the outer torque tube assembly, including both right pedals.
4. 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 together, the tube will be free to rotate with minimum up and down play. (Spacers are available in thickness of .012 ± .02; P/N 81102-35, .018 ± .02, P/N 81102-36 and .032, P/N 81102-37.)
5. Lubricate and slide the torque tube through side of the fuselage and right bearing far enough to slide the right retainer collar on the tube.
6. Slide the tube through the outer torque tube assembly, installing the left pedals and left retainer collar.
7. 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.
8. With the spacer washers installed, install the bolts through the retainers and both left rudder pedals. Install nuts with washers and secure.
9. Wipe off excess lubricant from torque tube.
10. Install the rudder torque tube guards by positioning each guard in front of the torque tube and securing it in place with 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.

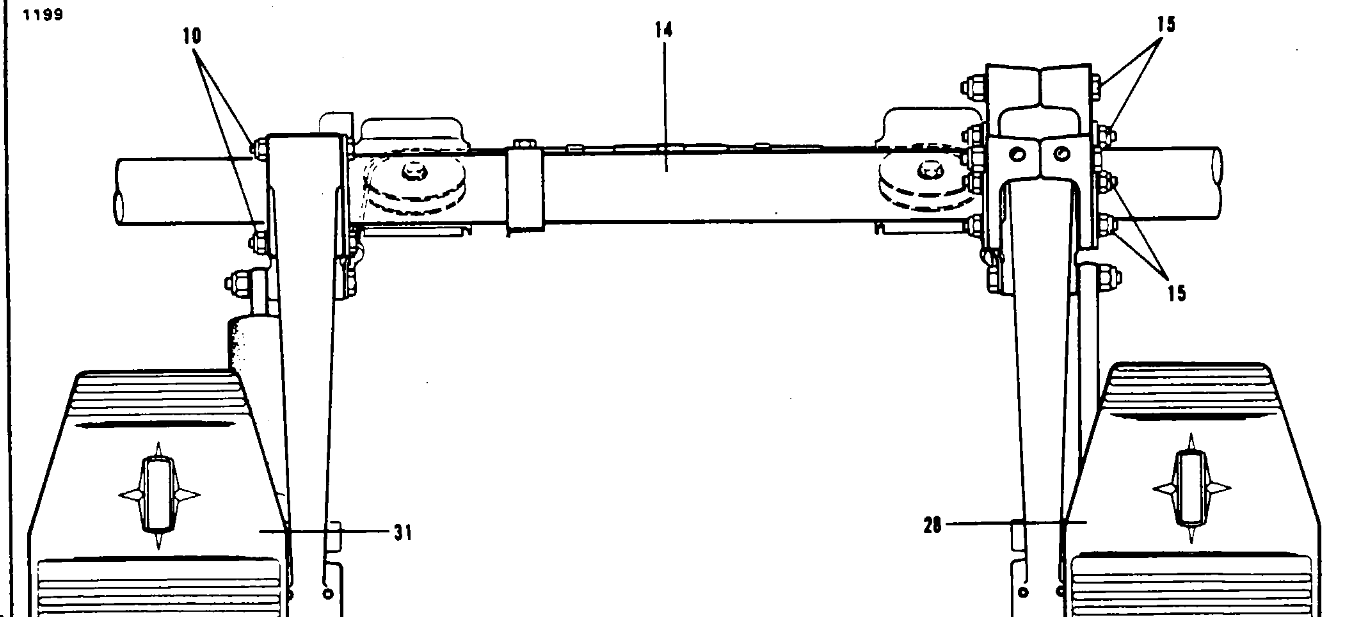
— NOTE —

The clamps around the torque tube must not be deformed or permitted to interfere with the rotation of the torque tube.

11. Connect the balance cable to the rudder pedals.
12. Connect rudder cables to the pedal assembly and set cable tension per Figure 27-14 and check rigging and adjustment per instructions given in this chapter.
13. Install access plates, panels and seats.



1 ANCHOR NUT
2 MOUNTING BRACKET
3 BEARING BLOCK
4 BOLT
5 RETAINER
6 TORQUE TUBE
7 BOLT
8 ROLL PIN BOLT
9 CABLE END
10 BOLT
11 BOLT
12 BEARING BLOCK
13 SPACER
14 OUTER TORQUE TUBE
15 BOLT
16 ROLL PIN BOLT
17 BOLT
18 RETAINER
19 BOLT
20 CAP BOLT
21 BEARING BLOCK
22 MOUNTING BRACKET
23 PLATE
24 ROD
25 CONTROL CABLE
26 BRAKE CYLINDER
27 PEDAL, RIGHT OUTER
28 PEDAL, RIGHT INNER
29 JAM NUT
30 BOLT
31 PEDAL, LEFT INNER
32 PEDAL, LEFT OUTER
33 BALANCE CABLE
34 BRAKE LINE SUPPORT CHANNEL
35 TORQUE TUBE GUARD
36 MACHINE SCREWS AND NUTS
37 SCREWS, NUTS AND CLAMPS
38 PULLEY
39 FLAT HEAD PINS



SKETCH A

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Figure 27-17. Rudder Pedal Installation

RIGGING AND ADJUSTMENT OF RUDDER CONTROLS. (Refer to Figure 27-13.)

1. Remove the left pilot's seat, the floor panel to the left of the control pedestal and tail cone.
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 27-15.
   B. Adjust the turnbuckles at fuselage station 100.00 to obtain proper cable tension, per Figure 27-14, 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 27-16) 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. Position the pointer along 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 27-14 and lock stops.

— NOTE —

If provisions are provided for safety wiring the nut and screw on the rudder hinge assembly, safety wire with MS20995C32 as shown in Figure 27-12.

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 283.00 so that the spring will extend .060 of an inch.
5. Safety turnbuckles and install access plates, panels and seats.

RUDDER TRIM (CONTROL PEDESTAL).

The rudder trim system consists of : a rudder trim wheel and trim screw assembly mounted in the control pedestal; a trim screw mounted in the vertical fin; a rudder trim tab and control rod mounted in the rudder assembly and interconnecting cables and pulleys.

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

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 27-6. (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 124.41 and 243.25.
8. Remove one screw from each set of rub blocks at stations 137.00, 162.60, 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 (CONTROL PEDESTAL). (Refer to Figure 27-13.)

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 cables installed and connected, install the cable guard pins at station 124.41 and 243.25 and close and secure the rub blocks at stations 137.00, 162.60, 174.00 and 215.00.
6. Remove the cable blocks.
7. Set cable tension with the turnbuckles at station 287.50 per Figure 27-14 and check rigging and adjustment.
8. Install cover on face of control pedestal, access plates and panels and seats.

RUDDER TRIM (RUDDER).

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

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 27-6. 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 342.25.
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 cap bolts that attach the screw assembly to the spar.
9. Remove the screw assembly through the access hole and draw the trim cables from the fuselage and fin.

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

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. Install the cable guard pin at fuselage stations 332.00 and 342.25.
8. With the complete trim system installed, set cable tension with the turnbuckles at station 287.50 per Figure 27-14 and check rigging and adjustment.
9. Install access plates and panel.

RIGGING AND ADJUSTMENT OF RUDDER TRIM. (Refer to Figure 27-13.)

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 27-14.

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 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 27-14 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 indicator.

ELEVATOR AND TAB.

The elevator control system consists of: control column, pulleys, springs, bellcrank, control rod, elevator torque tube assembly and interconnecting cables. This section contains information for the maintenance, repair, rigging and adjustment of the elevator control system.

ELEVATOR CONTROL CABLES.

REMOVAL OF ELEVATOR CONTROL CABLES. (Refer to Figure 27-18.)

— CAUTION —

Exercise care that the elevator control tube does not incur nicks, dents or deep scratches during installation, removal or rigging operations. Visually reinspect the elevator control tube each time it is removed or reinstalled in the aircraft.

1. To remove the control cables that connect between the elevator control sector and the aft control cables, beginning at fuselage station 110.50, 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 110.50.
   C. Remove the cable guard pins at the forward pulley cluster at station 83.34.
   D. The inboard (right) cable may be removed by removing the three cable guard pins at the control sector 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 110.50 to the elevator bellcrank, the following procedure may be used:
   A. Remove the right and left pilot's seat and the left and 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, and the center panels aft of the main spar back to station 244.00.

— *CAUTION* —

Exercise care that the elevator control tube does not incur nicks, dents or deep scratches during installation, removal or rigging operations. Visually reinspect the elevator control tube each time it is removed or reinstalled in the aircraft.

   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 110.50.
   F. Mark and disconnect the cables from the elevator bellcrank.
   G. To remove the cable that leads to the upper end of the bellcrank (right cable), remove the cable guard pins at stations 121.38, 153.35, 193.73, 242.00 and 276.00.
   H. To remove cable that leads to the lower end of the elevator bellcrank (left cable), remove the cable guard pins at stations 121.38, 160.20, 200.98, 242.00 and 276.00.
   I. Remove the fairleads at fuselage station 137.00.
   J. Draw the cable aft through the fuselage.

INSTALLATION OF ELEVATOR CONTROL CABLES. (Refer to Figure 27-18.)

— *CAUTION* —

Exercise care that the elevator control tube does not incur nicks, dents or deep scratches during installation, removal or rigging operations. Visually reinspect the elevator control tube each time it is removed or reinstalled in the aircraft.

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 110.50 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 110.50, 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 110.50.
   D. Install cable guard pins at forward pulley cluster.

2. The control cables that route aft, beginning at fuselage station 110.50 to the elevator bellcrank, may be installed by the following procedure:
   A. Connect the cables to the top of elevator bellcrank and draw the cables forward through the fuselage.
   B. Connect the cables to the forward cables at station 110.50.
   C. Install the cable guard pins for the cable that connects to the upper end of the elevator bellcrank (right cable) at stations 121.38, 153.35, 193.73, 242.00 and 276.00.
   D. Install the cable guard pins for the cable that connects to the lower end of the elevator bellcrank (left cable) at stations 121.38, 160.20, 200.98, 242.00 and 276.00.
   E. Install fairleads at fuselage station 137.00.
3. Set cable tension (per Figure 27-19), check rigging and adjustment.
4. Install access plates, panels and seats.

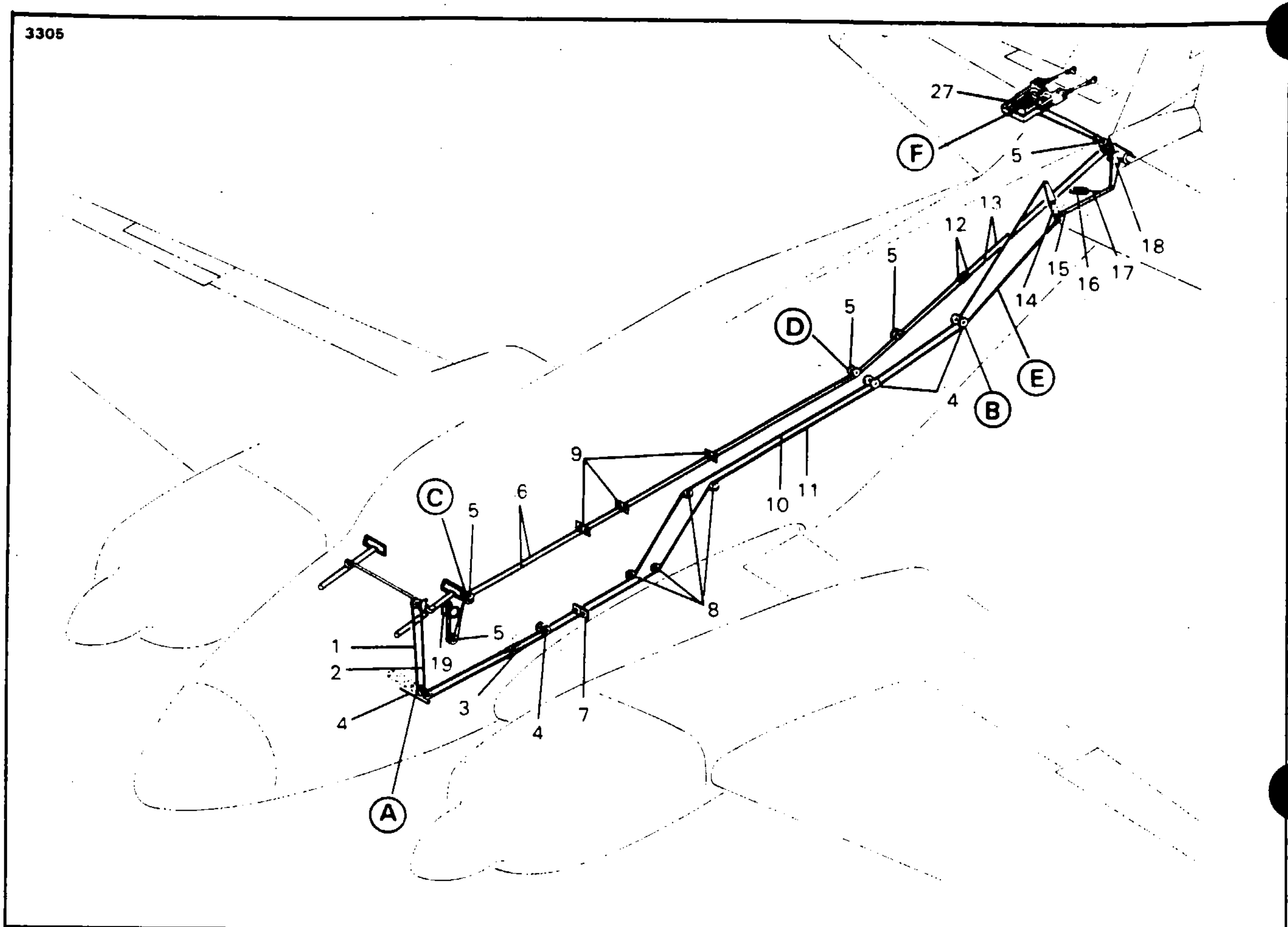
ELEVATOR BELLCRANK.

REMOVAL OF ELEVATOR BELLCRANK. (Refer to Figure 27-18.)

— CAUTION —

Exercise care that the elevator control tube does not incur nicks, dents or deep scratches during installation, removal or rigging operations. Visually reinspect the elevator control tube each time it is removed or reinstalled in the aircraft.

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 110.50.
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 control rod from the elevator bellcrank.
6. Remove the pivot bolt and remove the bellcrank from its mounting bracket.



1 CONTROL CABLE (FWD R)	13. TRIM CABLE	25 BOLT ASSEMBLY
2 CONTROL CABLE (FWD L)	14. BELLCRANK	26. JAM NUT
3 TURNBUCKLE	15. ROD, CONTROL	27. TRIM SCREW ASSY
4 PULLEY CLUSTER	16. SPRING	28. PULLEY
5 PULLEY CLUSTER	17. LINK	29. TRIM CABLE
6 TRIM CABLE	18. ARM, ELEVATOR	30. GUIDE BRACKET
7 FAIRLEAD	19. TRIM SCREW ASSY	31. TRIM SCREW CLEVIS
8 PULLEY	20. CABLE END	32. BUSHING
9 RUB BLOCK	21. BOLT ASSEMBLY	33. TRIM TAB ROD
10 CONTROL CABLE (UP)	22. BOLT ASSEMBLY	34. BOLT ASSEMBLY
11 CONTROL CABLE (DOWN)	23. BOLT, PIVOT	35. ROD END
12 TURNBUCKLE	24. ROD END	36. ROD, CABLE GUARD

82114 2. 82108 2. 82100 2

Figure 27-18. Elevator and Elevator Trim Controls

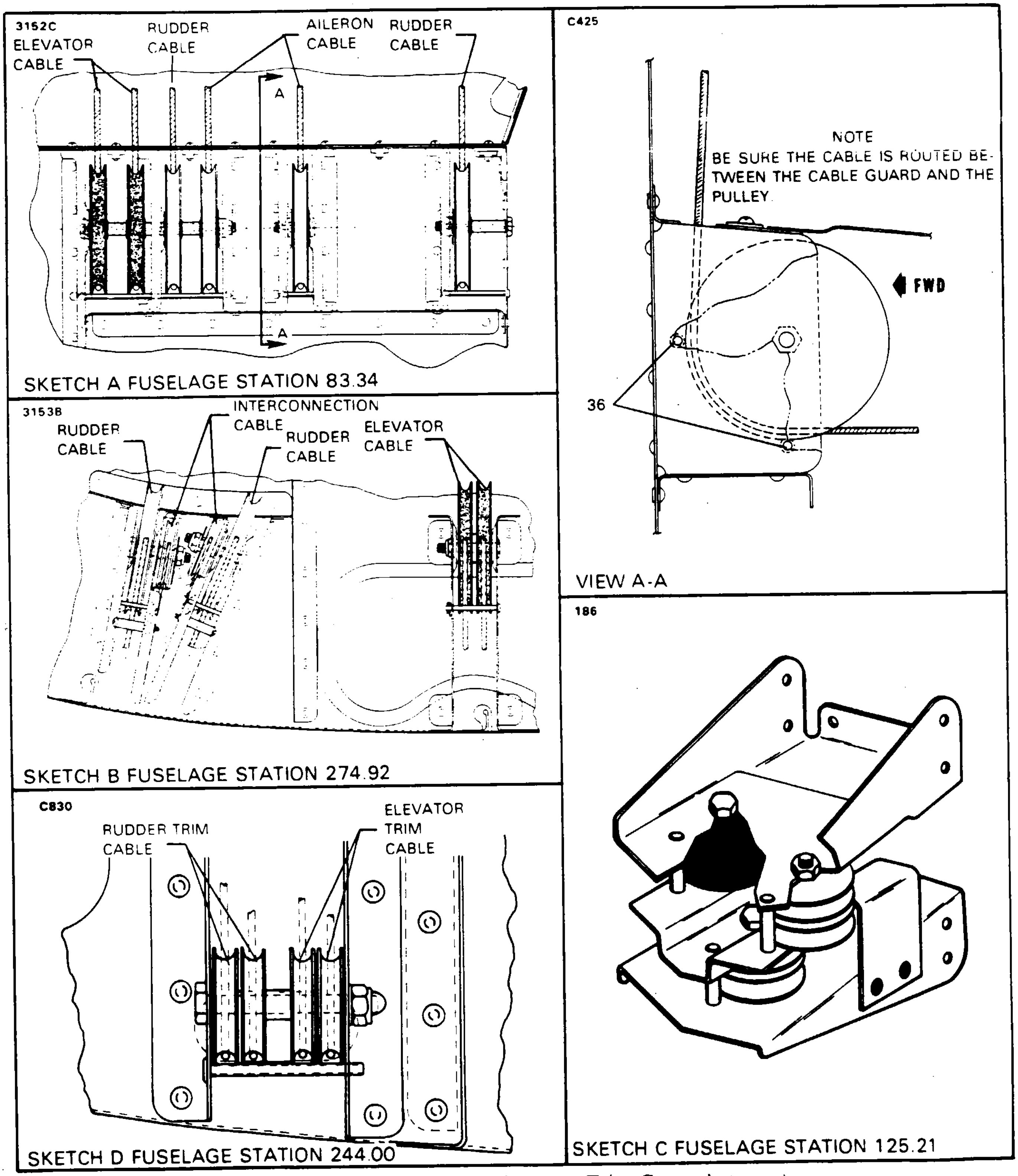
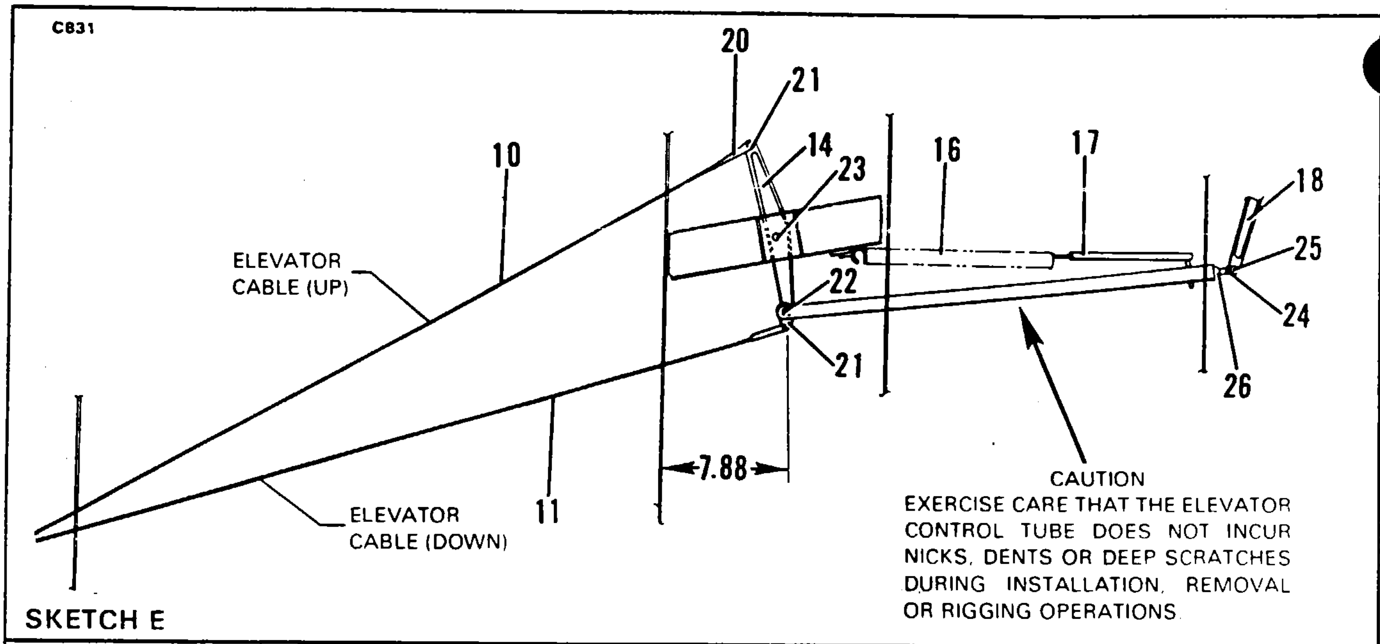


Figure 27-18. Elevator and Elevator Trim Controls (cont.)



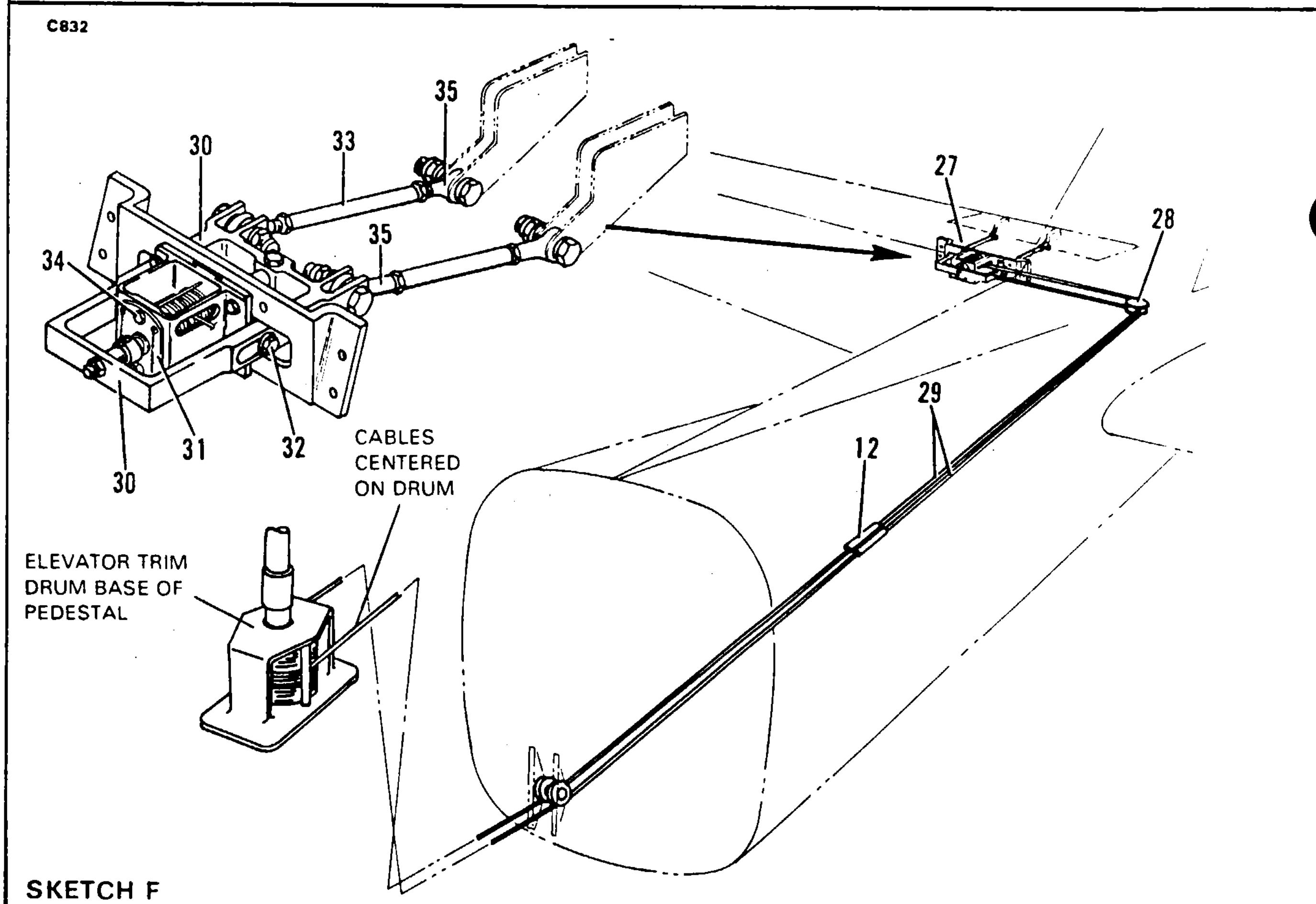


Figure 27-18. Elevator and Elevator Trim Controls (cont.)

INSTALLATION OF ELEVATOR BELLCRANK. (Refer to Figure 27-18.)

— CAUTION —

Exercise care that the elevator control tube does not incur nicks, dents or deep scratches during installation, removal or rigging operations. Visually reinspect the elevator control tube each time it is removed or reinstalled in the aircraft.

1. Position the bellcrank in its mounting bracket. Lubricate and 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. Connect the control cables to the bellcrank. Tighten bolts so that the cable ends may turn freely on the bellcrank and safety.
4. Check cable tension per Figure 27-19 and rigging and adjustment.
5. Install access plates, tail cone and seat.

RIGGING AND ADJUSTMENT OF ELEVATOR CONTROLS. (Refer to Figure 27-16.)

— CAUTION —

Exercise care that the elevator control tube does not incur nicks, dents or deep scratches during installation, removal or rigging operations. Visually reinspect the elevator control tube each time it is removed or reinstalled in the aircraft.

1. Ascertain that the left pilot's seat, the floor panel to the left of the control pedestal, the access plate on the side of the fuselage under the horizontal stabilizer and the tail cone are all removed.
2. Put the elevator in neutral position by placing a modified straightedge, as shown in Figure 27-20, against the underside of the horizontal stabilizer, next to and outboard of the row of rivets at station 38.00 with the aft end of the tool even with 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 7.88 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 27-19 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 inches as measured from the instrument panel along the underside of the control column to the wheel.

— NOTE —

Safety wire the nut and screw on the elevator hinge assembly with MS20995C32 as shown in Figure 27-12. 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.

Hold up or place a block under bobweight prior to checking cable tension.

5. 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 27-21.) Check the up travel as given in Figure 27-19. 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 20-40 inch pounds. The elevator control arm should contact its stops before the control wheel contacts its stops.
6. "TOTAL FRICTION" must not be in excess of ten pounds with elevator control spring adjusted to 45 ± 1 pounds tension with elevator in neutral position.
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.

ELEVATOR TRIM (CONTROL PEDESTAL).

The elevator trim system consists of: an elevator trim wheel and trim screw mounted in the control pedestal; pulleys; and trim screw, connecting rods and trim tab located in each elevator.

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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.

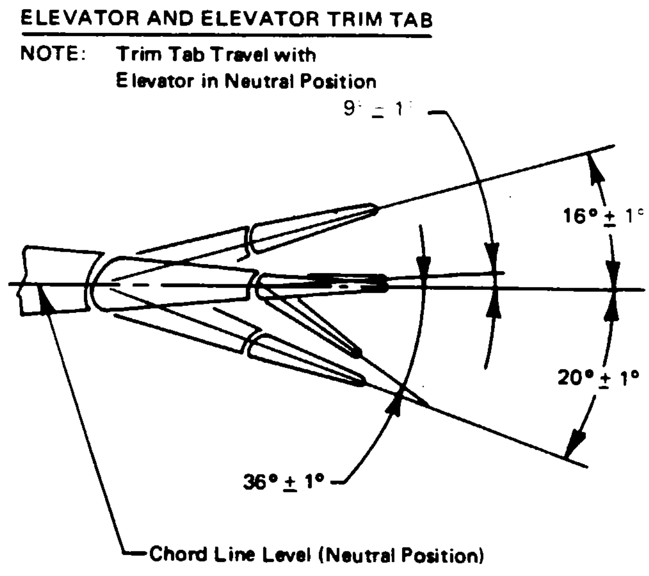

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Figure 27-19. Elevator and Elevator Trim - Travels and Cable Tensions

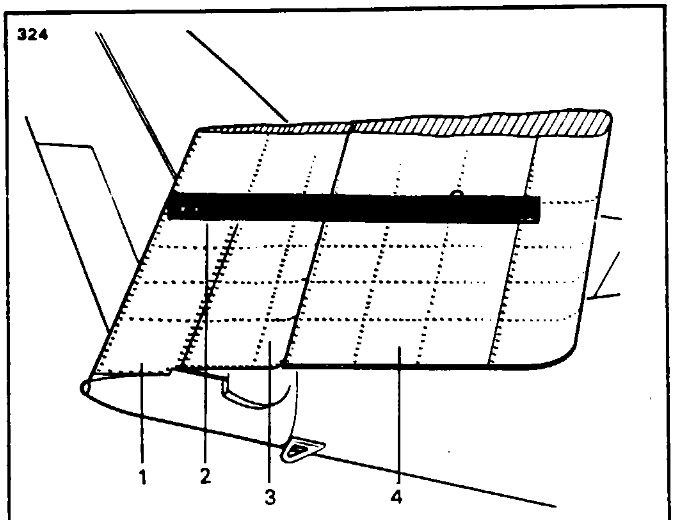

Figure 27-20. Installation of Elevator Rigging Tool

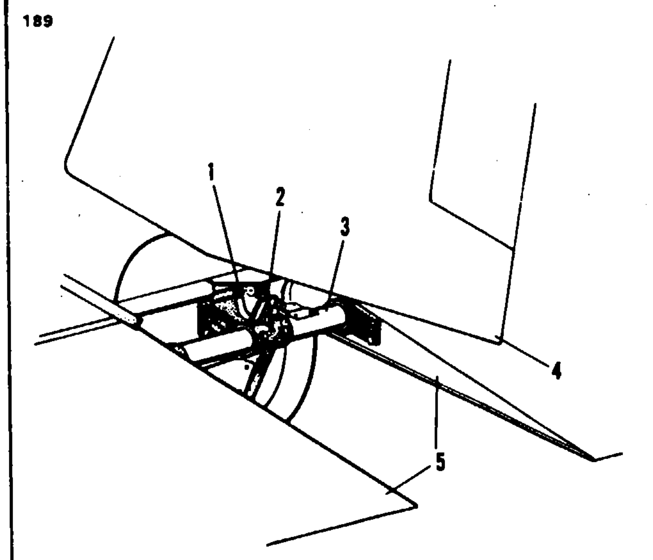

Figure 27-21. Elevator Travel Stops

REMOVAL OF ELEVATOR TRIM (CONTROL PEDESTAL). (Refer to Figure 27-18 and 27-10.)

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 aft baggage area.
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 27-6. (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 the cable ends at station 291.00 to facilitate installation and disconnect the cables at the turnbuckles.
8. Remove the cable guard pins at fuselage stations 125.91, 244.00 and 261.38.
9. Remove one screw from each set of rub blocks at stations 137.00, 162.60 and 174.00 and open them far enough to allow the cable ends to pass through.
10. Remove the cotter pin and pin which secure the bushing on the split shaft and slide the bushing upward to separate the two halves of the trim screw assembly.
11. Remove the screw that secures the elevator trim control wheel on the spline shaft and remove wheel.
12. Remove the screws that attach the screw assembly to the control pedestal.

INSTALLATION OF ELEVATOR TRIM (CONTROL PEDESTAL). (Refer to Figure 27-18 and 27-10.)

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 274.00.
5. With the cables installed and connected, install the cable guard pins at stations 125.91, 244.00 and 261.38, and close and secure the rub blocks at stations 137.00, 162.60 and 174.00.
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 27-19 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.

ELEVATOR TRIM (ELEVATOR).

REMOVAL OF ELEVATOR TRIM (ELEVATOR). (Refer to Figure 27-18.)

1. Remove the access plates located on each side of the fuselage and on the bottom side of the elevator, and also remove the tail cone assembly.
2. Block the forward trim cables at bulkhead station 274.00 by one of the methods shown in Figure 27-6, to prevent the cables from unwrapping. (If the forward trim assembly is also being removed, block the cables at the forward trim screw below the pedestal.)
3. Mark the cable ends within the fuselage at stations 291.00 to facilitate installation. Disconnect the cables at the turnbuckles.
4. Remove the cable guard pins from the pulley located at station 352.00.
5. Disconnect the trim tab rods from the trim screw clevis by removing the attachment hardware and bushings.
6. Remove the bolts that attach the trim screw and guide bracket to the elevator spar; remove the trim screw assembly and guide bracket and draw the trim cables from the fuselage and elevator through the access openings in the elevator.

INSTALLATION OF ELEVATOR TRIM (ELEVATOR). (Refer to Figure 27-18.)

1. Check to be certain the trim cables are properly wrapped on the trim drum. If a new cable is installed, the cable must be wrapped with the drum removed from the bracket as follows:
   A. Position cable in the drum and install the cable pin in the drum slot.
   B. Wrap the cable in opposite directions toward the center with six turns on upper end and twelve and one-half turns on lower end. (Refer to Figure 27-2.)

C. Reassemble the trim screw and block the trim drum to prevent the cables from unwrapping during installation.

2. Position the trim screw and guide bracket on the elevator spar and secure with attachment hardware.

— CAUTION —

Do not tighten bolts until tab linkage hookup is complete; then tighten equally as required to remove drum end play, being careful not to overtighten causing bearing preload.

3. Draw the trim cables through the elevator around the pulleys mounted on the stabilizer rear spar, into the fuselage.

— NOTE —

If the autopilot is installed check to determine that the trim cable is properly wrapped around the capstan of the elevator trim servo located on the aft side of bulkhead station 317.75. Route the inboard trim cable (side with turnbuckle) from the forward part of the airplane around the bottom groove of the idler pulley, to the capstan and around the top groove of the idler pulley to the aft section of the airplane, completing a figure eight. (Refer to Figure 27-22.)

4. If the forward trim cables are not installed, draw the rear cables tight and block the cables at bulkhead station 317.75. Install the forward trim assembly.
5. Install the cable guard pins in the pulley at station 352.00.
6. Connect the rod end from the trim tab to the trim screw clevis by inserting the bolt and bushing assembly that rides in the guide bracket.
7. With the trim control completely installed, set the cable tension with turnbuckles per specifications given in Figure 27-19. Check to be certain the trim screw moves freely in both directions and check the rigging and adjustments per Rigging and Adjustment of Elevator Trim.
8. Install the access and tail cone assembly.

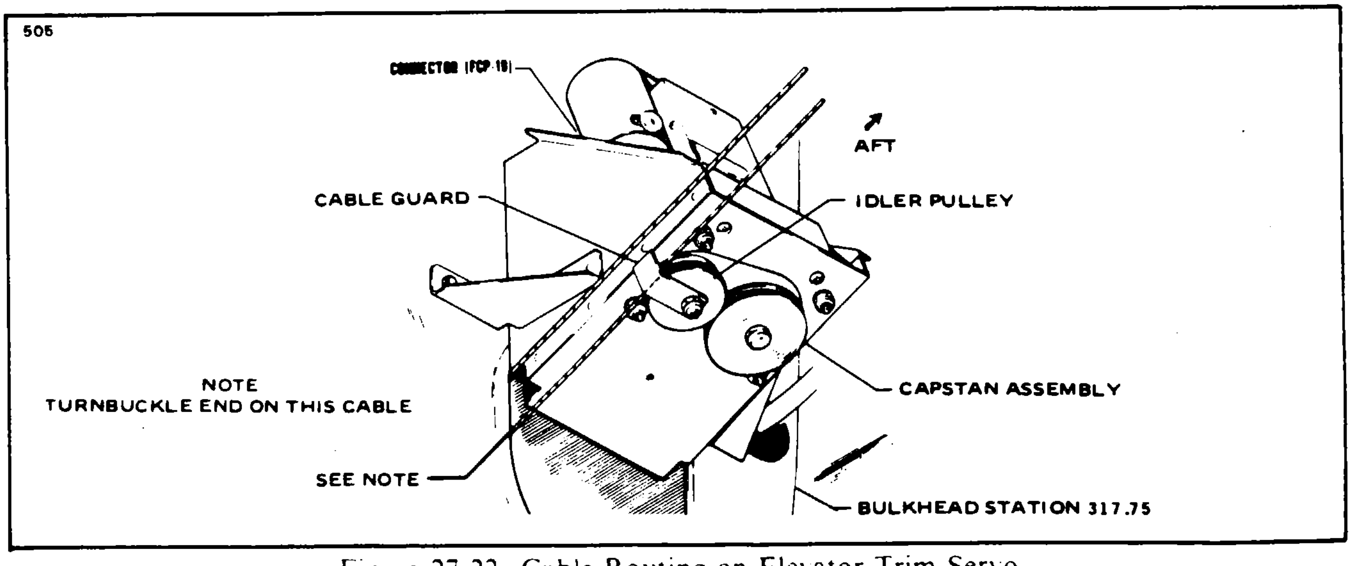

Figure 27-22. Cable Routing on Elevator Trim Servo

RIGGING AND ADJUSTMENT OF ELEVATOR TRIM.

1. To adjust the elevator trim, the following steps should be accomplished during installation or as an adjustment check.
   A. Remove the access panels on the left and right side of the fuselage aft of the pressure bulkhead and also the access panels on the bottom of the elevator. Remove the access panel located in the floor of the control pedestal.
   B. Check to be certain the trim cables are correctly wrapped.
   C. Determine that the trim cable tension is set in accordance with specifications given in Figure 27-19.
   D. Ascertain that the actuating screw is positioned so that the anti-rotation bushings are at midpoint of slots.
2. Rotate the trim control wheel in the cockpit to the full nose up position. Be sure that turnbuckle terminal does not strike center pulley.

— NOTE —

If turnbuckle terminal does strike center pulley before actuating screw is at its stop, disconnect the trim tab rods and rotate the screw in drum until screw is at stop before terminal of turnbuckle strikes center pulley. It may be necessary to back off the trim wheel to reinstall the trim tab rods and anti-rotation bushings.

3. Adjust the trim tab rods so that the tab is in specified down position per Figure 27-19 with the elevators neutral.
4. Check the rod ends for adequate thread engagement.
5. Rotate the trim control wheel in the cockpit to the full nose down position and check tab position per Figure 27-19 with the elevators neutral. Adjust the screw stops to obtain proper travel.
6. Coordinate the trim wheel indicator with the tab position.

DETERMINING FRICTION IN THE ELEVATOR CONTROL SYSTEM.

The complete control system (including autopilot if installed) shall be rigged to its proper travels and cable tensions prior to determining friction in the system.

"TOTAL FRICTION" must not be in excess of ten pounds with elevator control spring adjusted to 45 ± 1 pounds tension with elevator in neutral position. Friction can be determined as follows:

1. Attach a spring scale to the inboard trailing edge of the elevator, outboard of the tab.
2. With a spring scale attached, position the elevator trailing edge down approximately 2.00 inches from the neutral position.
3. Record the force required to raise the elevator thru the neutral position until the trailing edge is approximately 2.00 inches above neutral.
4. Record the restraining force lowering the elevator from the 2.00 inches up position thru the neutral position to the original 2.00 inches down.
5. Repeat the above raising and lowering processes until average forces are obtained.

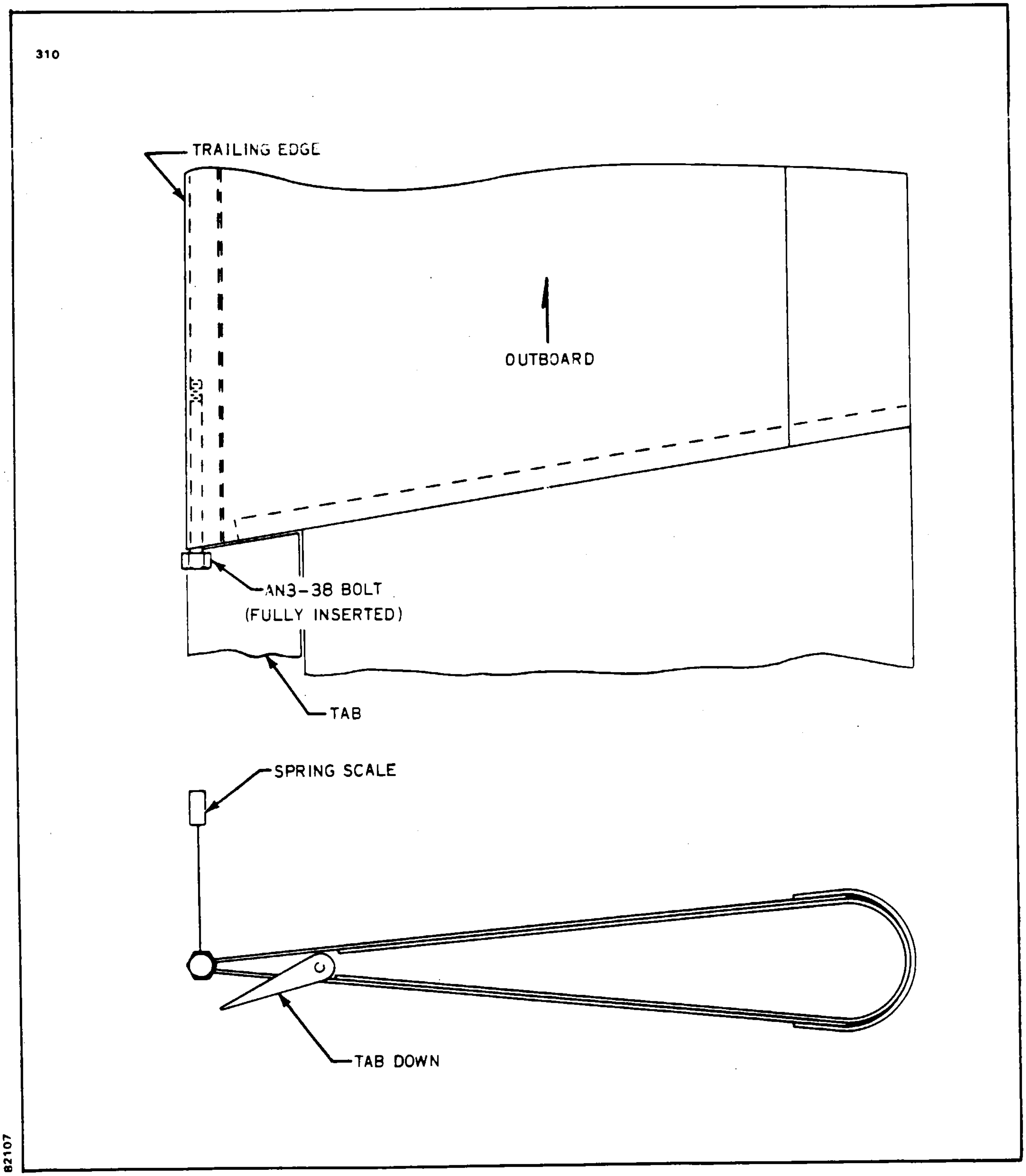

Figure 27-23. Elevator Friction Measurement

6. The total friction is obtained by subtracting the two forces.

— *NOTE* —

Do not exceed 60 pounds force for any measurement.

7. The elevator shall be rotated with a steady movement and the force reading taken when the elevator is passing thru the neutral position. Do not stop rotation when taking reading.

CHECKING ELEVATOR TRIM TAB FREE PLAY.

— *NOTE* —

Pay particular attention to wear or looseness at each tab hinge pivot point, the push-pull attachments and trim tab screw assembly.

1. Position the trim tab so that the trailing edge of the tab is 0.50 ± .12 of an inch below the trailing edge of the elevator.
2. With tab positioned per (1), the total "Free Play" must not exceed .10 of an inch as measured between the outboard end of the tab trailing edge and the trailing edge of the elevator.
3. If excessive play is found, inspect the elevator trim screw and hinge assemblies to determine the location of excessive play. Repair or replace the worn parts as required.

FLAPS.

This section contains removal, installation, service, disassembly and assembly, rigging and adjustment and functional test procedures for the flap system and its components.

DESCRIPTIONS AND OPERATION. (Refer to Figures 27-24 and 27-25.)

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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 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 amplifer 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.

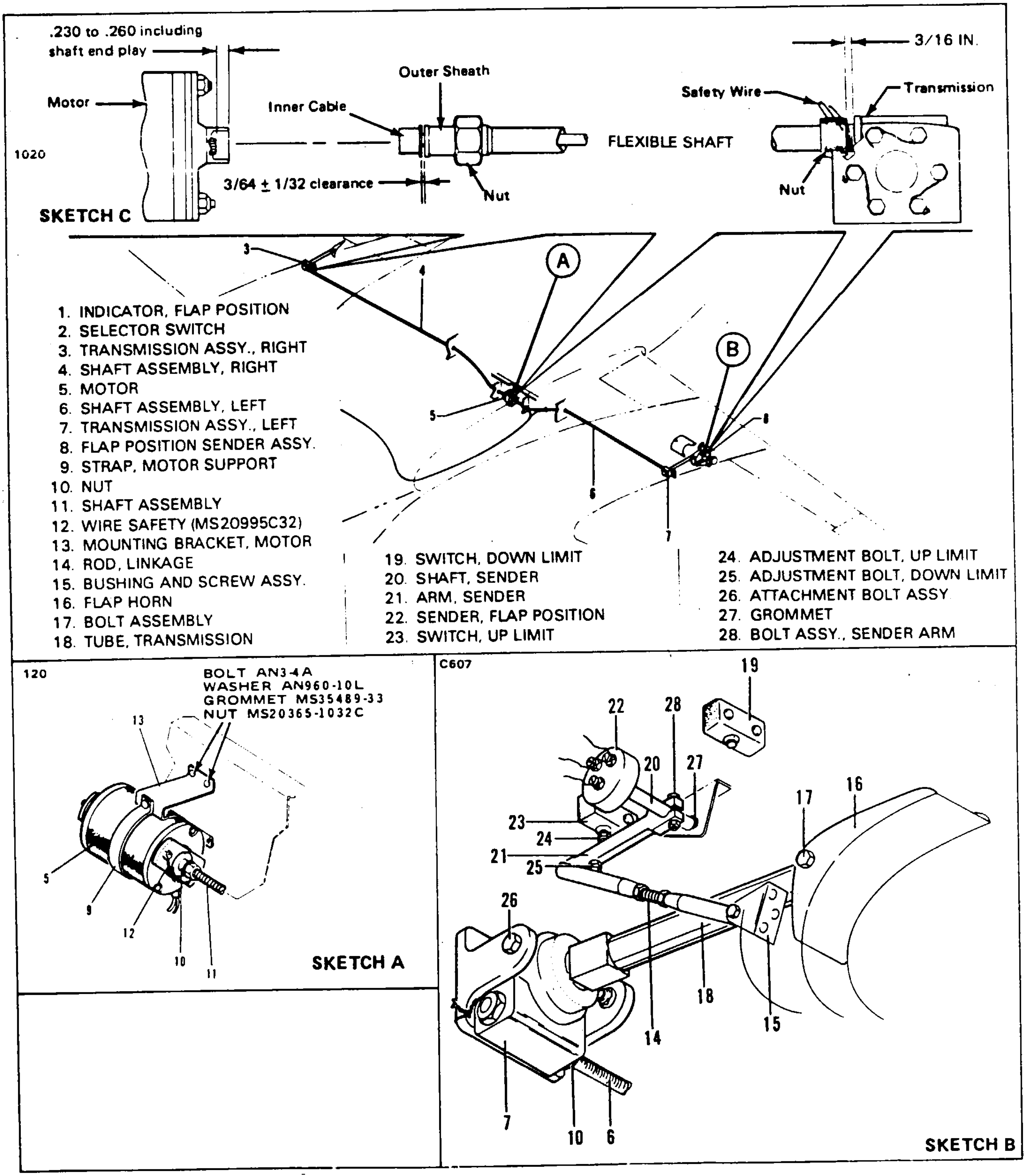


Figure 27-24. Flap Installation

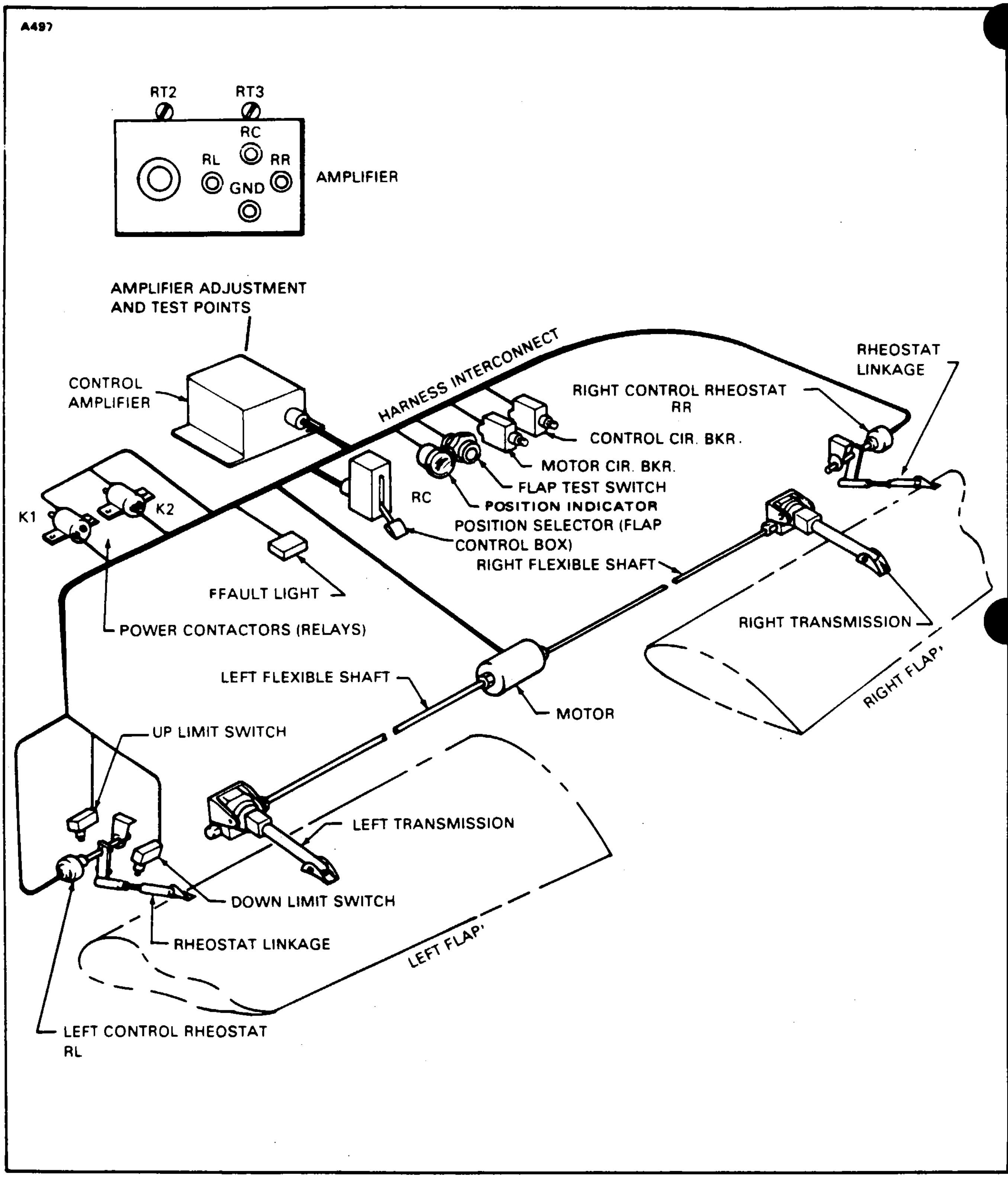


Figure 27-25. Flap System Diagram

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 27-24.)

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 174.00.
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 brackets may be removed together by removing the bracket mounting bolts at the bulkhead.

DISASSEMBLY OF FLAP ACTUATOR MOTOR. (Refer to Figure 27-26.)

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 the front end bell.
8. Remove nuts, lockwashers, contact studs and nylon shoulder washers from front end bell.

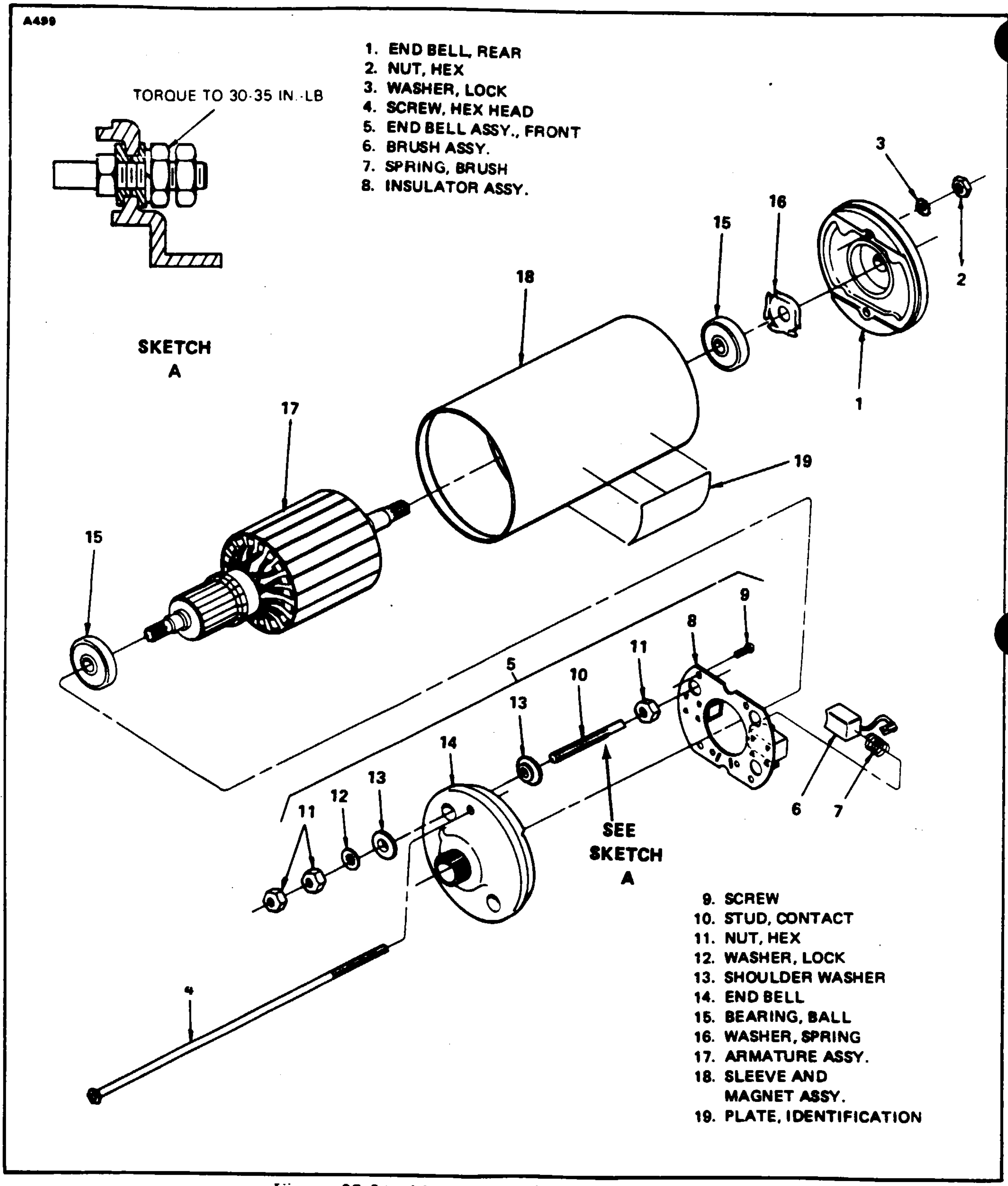


Figure 27-26. Motor Assembly, Exploded View

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 27-26.)

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 to 35 inch-pounds. (See Sketch A of Figure 27-26.)
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 enountered when inserting armature assembly into sleeve and magnet assembly.

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 lock washers and hex nuts. Torque nuts 30-40 inch pounds.

INSTALLATION OF FLAP ACTUATOR MOTOR. (Refer to Figure 27-24.)

1. Install the shock grommets in the bulkhead at station 174.00.
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 electrical leads.
5. Check flap rigging and adjustments per instructions given in this chapter.
6. Install access plates and panels.

FLEXIBLE ACTUATOR SHAFT. (Refer to Figure 27-24.)

REMOVAL OF FLEXIBLE ACTUATOR SHAFT. (Refer to Figure 27-24.)

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 27-24.)

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 attachng nut on finger tight. Safety the nut with MS20995-C41 safety wire.

3. Check the flap rigging and adjustments per instructions given in this chapter.
4. Install the access plates, panels, clamps, grommets and seats.

FLAP TRANSMISSION.

REMOVAL OF FLAP TRANSMISSION. (Refer to Figure 27-24.)

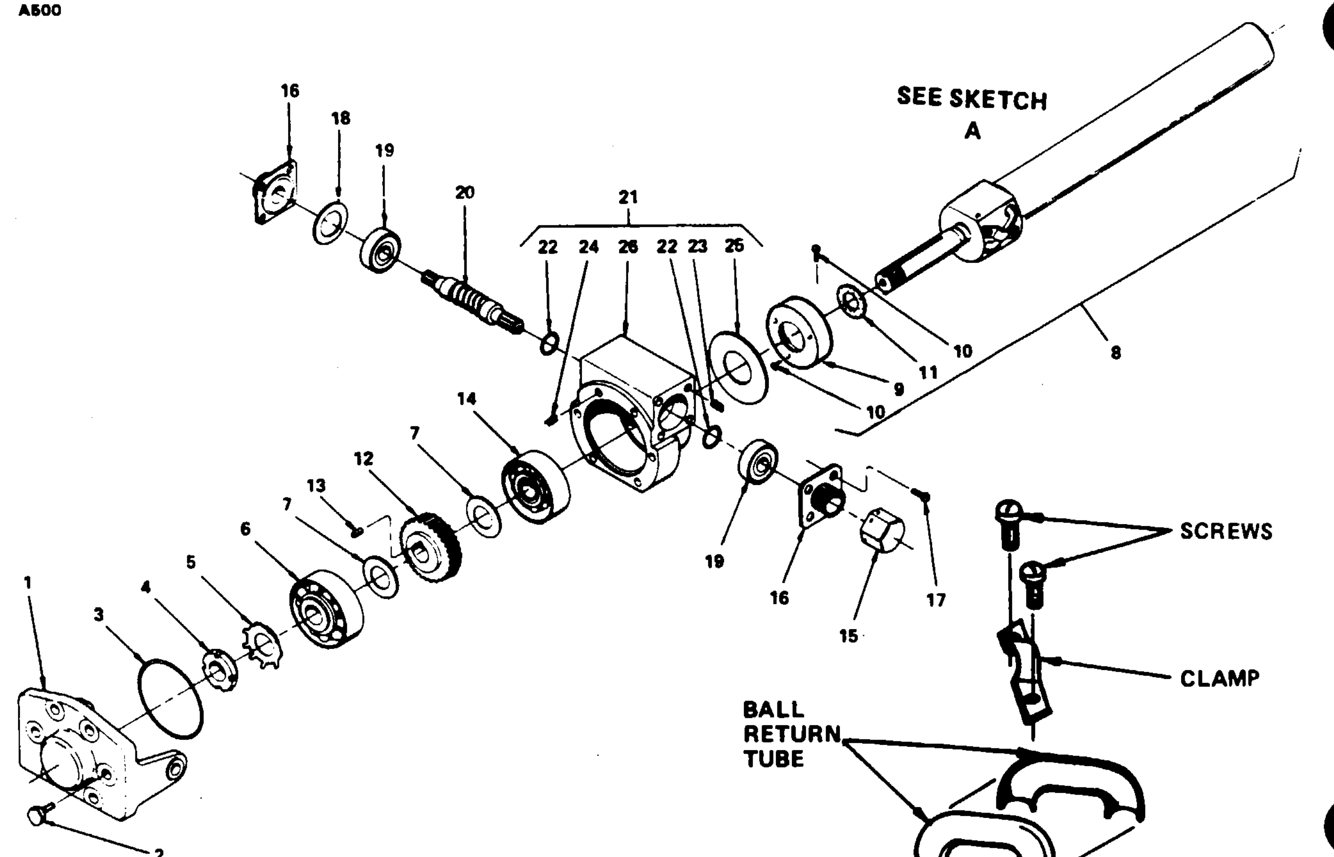
1. Lower the flap and remove the access plate on the aft underside of the wing and at the false spar area, both of which are at station 92.50.
2. Disconnect the transmission tube from the flap horn bracket.
3. Remove the safety wire and disconnect the flexible actuator shaft.
4. Remove the spreader bushing 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.

DISASSEMBLY OF FLAP TRANSMISION. (Refer to Figure 27-27.)

1. Remove safety wire, bolts and rear housing.
2. Remove O-ring.
3. Straighten tang on lockwasher so that locknut and lockwasher can be removed.
4. Remove ball screw and tube assembly.
5. Remove bearing assembly and shim.
6. Remove worm gear, key and shim.
7. Remove front bearing assembly from housing.
8. Remove protective cap if used.
9. Remove screws and both output flanges.
10. Push worm shaft and bearings out of housing.
11. Remove O-rings from housing.
12. Bumper washer is attached to the housing with Loctite adhesive. Use Loctite solvent, if necessary to remove washer.
13. Remove safety wire, screws, wiper block and wiper from ball screw and tube assembly.
14. Place a container or tray under the ball screw and tube assembly and remove the two screws securing the ball return tube clamp to the ball nut.

— *NOTE* —

Keep these two screws separated from other screws (item 17).



1. HOUSING REAR
2. BOLT, MACHINE
3. O-RING
4. NUT, LOCK
5. WASHER, LOCK
6. BEARING ASSY, REAR
7. SHIM
8. BALL SCREW AND TUBE ASSY
9. BLOCK, WIPER
10. SCREW, MACHINE
11. WIPER
12. GEAR, WORM
13. KEY
14. BEARING ASSY, FRONT
15. CAP, PROTECTOR
16. FLANGE, OUTPUT
17. SCREW, MACHINE
18. SHIM
19. BEARING, BALL
20. SHAFT, WORM
21. HOUSING ASSY, FRONT
22. O-RING
23. INSERT, HELI-COIL
24. INSERT, HELI-COIL
25. WASHER, RUBBER BUMPER
26. HOUSING, FRONT

Figure 27-27. Flap Transmission, Exploded View

15. Carefully remove the ball return tube and separate the two halves allowing the steel balls to drop into a container. Turn the ball nut over and rotate the ball screw until all steel balls (67-69 total) have dropped out, allowing the ball screw to be removed from the ball nut.

— *CAUTION* —

Do not attempt to remove the output tube from the ball nut. The output tube is form rolled to the ball nut during manufacture and must be serviced as an assembly.

SERVICE OF FLAP TRANSMISSION.

1. Wash all disassembled parts in a suitable dry cleaning solvent.
2. Examine all parts for cracks, burrs and corrosion.
3. Visually inspect balls and grooves in ball screw for pitting, scoring, corrosion and flat spots. If any one part of the ball screw and tube assembly appears defective, the entire ball screw and tube assembly must be replaced.
4. Discard and replace all bearings, O-rings, wiper and bumper washer.
5. Inspect worm shaft and worm gear for excessive wear. If worm gear is worn more than 0.015 inch. (Refer to Figure 27-29) the worm gear and worm shaft must be replaced as a set.
6. All defective or worn parts must be replaced. Do not attempt to repair defective parts.

ASSEMBLY OF FLAP TRANSMISSION. (Refer to Figure 27-27.)

1. Assemble ball screw and tube assembly as follows:
   A. Apply a thin coat of Aeroshell No. 7 grease to entire thread of ball screw.
   B. Insert ball screw part way into ball nut and output tube assembly.
   C. Lay one half of ball return tube flat on table and fill groove with steel balls. Place the other half of ball return tube on the assembled balls.

— *NOTE* —

A light coating of Aeroshell No. 7 grease may be used to hold the balls in place.

   D. Insert the remaining steel balls into the ball nut by placing them in one of the holes and turning the ball shaft until all the balls are in place.

— *CAUTION* —

Do not allow the balls to roll out either end of ball nut.

E. Carefully install the ball return tube onto the ball nut and secure with clamp and two screws. Apply a coat of Dow Corning 732 RTV adhesive to the ball return tube to seal external openings.
F. Apply a lubricant consisting of 20% Aeroshell No. 7 grease and 80% Mobil Jet Oil II to the wiper. Install wiper and wiper block onto the ball nut and secure with screws.
G. Safety wire the screws on the ball nut.

2. Clean bumper washer with chlorothane or equivalent and attach to housing with a thin film of Loctite 495 adhesive.

— NOTE —

Special tools, part numbers 7801-T1, 7801-T2 and 7801-T3 can be purchased from the Calco Manufacturing Co., 205 Factory Road, Addison, Illinois.

3. Insert tool fixture 7801-T1 and 7801-T2 into worm shaft bearing bores. Insert pin through tool fixtures and bearing bores (refer to Figure 27-28). Take measurement with depth gauge from milled surface of housing to O.D. of pin, add 1/2 diameter of pin and record this dimension (Z dimension). Remove tool fixtures.
4. Install new O-rings in worm shaft bore of housing. Apply a thin film of 20% Aeroshell No. 7 grease and 80% Mobil Jet Oil II lubricant to O-rings.
5. Insert worm shaft into housing.
6. Insert both ball bearings into housing, making sure bearings are seated.
7. Attach one output flange and secure with four screws. On opposite side attach output flange with two screws. Using a dial indicator, check end play of worm shaft and add shim as required to obtain 0.004 to 0.010 inch end play. Secure with four screws.
8. Insert tool 7801-T3 onto spline of worm shaft and check that shaft torque does not exceed 12 in. oz.
9. Insert front bearing assembly into front housing assembly.

— NOTE —

Shoulder of bearing is to be pressed into bumper washer.

10. Take measurement from milled surface of housing to inner race ("Y" dimension). Subtract "Z" dimension taken in first measurement from "Y" dimension to obtain "A" dimension (refer to Figure 27-28).
11. Take worm gear, measure width of gear face. Take half the thickness and subtract from "A" dimension obtained in second measurement. Subtract 0.001/0.002 inch from results. This is the shim required (refer to Figure 27-28).
12. Place shim over top of front bearing. Place worm gear over shim, shoulder end up.
13. Take measurement from milled surface of housing to shoulder of worm gear ("W" dimension) (refer to Figure 27-28). Measure width of rear bearing ("K" dimension). Subtract the two measurements. Subtract 0.001/0.002 from results. This is the shim required.

— NOTE —

Do not install the shim at this time.

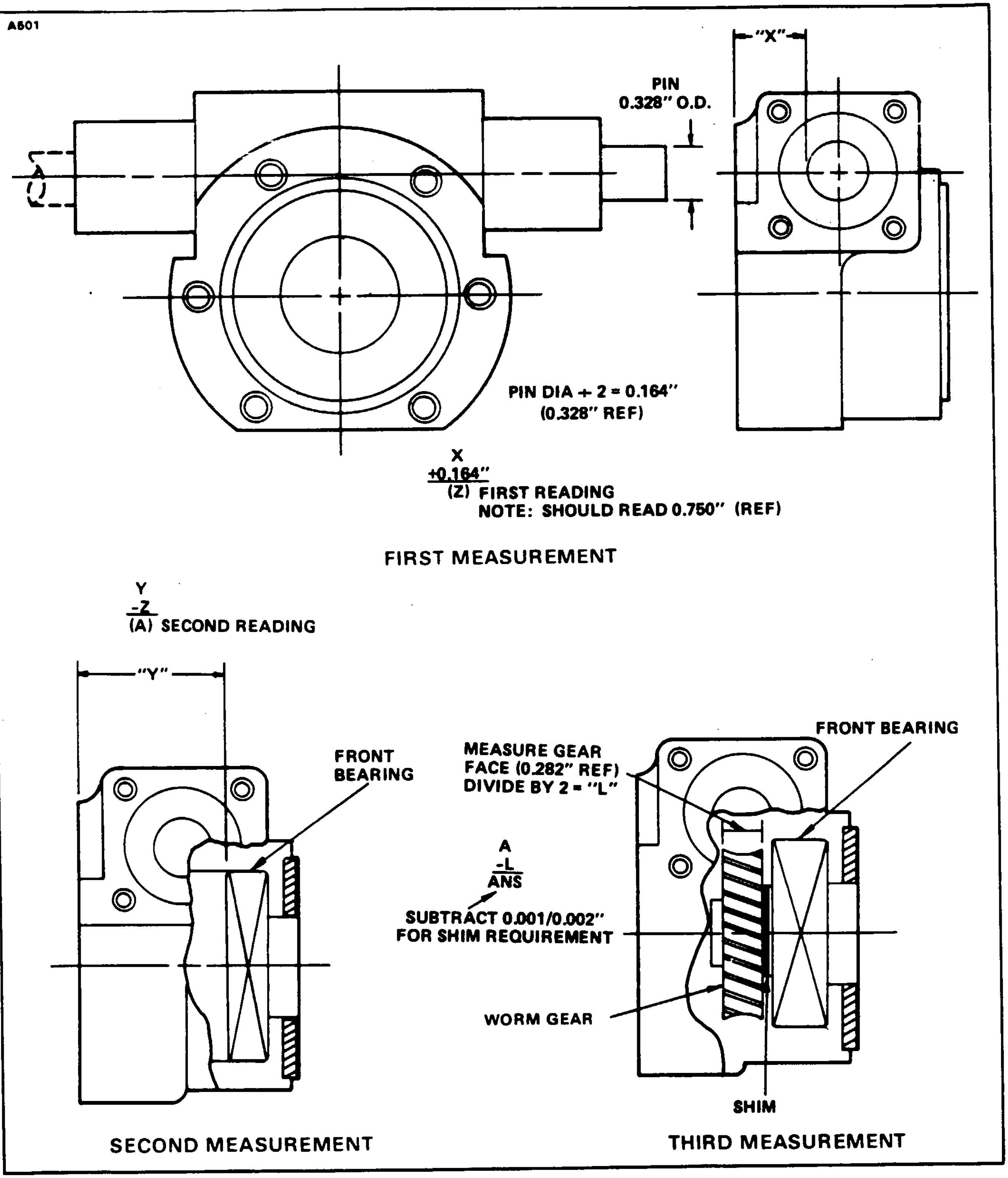


Figure 27-28. Flap Transmission Measurements

14. Apply approximately 1/8 oz. of lubrication consisting of 20% Aeroshell No. 7 grease and 80% Mobil Jet Oil II to worm shaft and worm gear. Rotate worm shaft while applying.
15. Install ball screw and tube assembly through bearing and worm gear in front housing and line up keyways.

— *NOTE* —

Keep worm gear and worm shaft in mesh while inserting.

16. Insert key in keyway.
17. Place shim, previously determined, on top of worm gear.
18. Place rear bearing, flange side up, in housing.
19. Place lockwasher over ball screw. Thread locknut (chamfered side down) onto screw.

— *CAUTION* —

Make sure ball nut and tube assembly is positioned away from housing before tightening locknut.

20. Torque locknut to 80 inch pounds minimum to align lockwasher tang with slot in nut. Bend tang into slot.

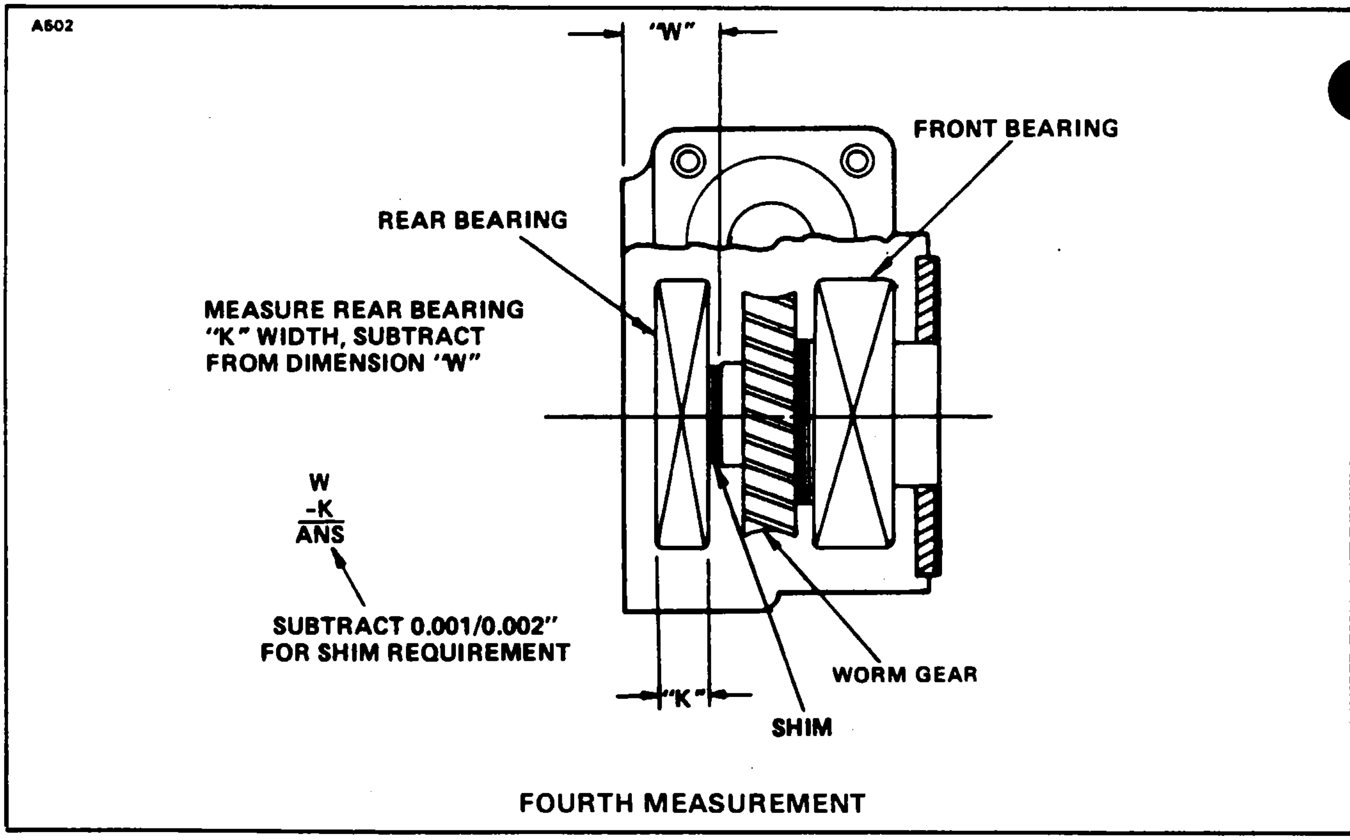


Figure 27-28. Flap Transmission Measurement (cont.)

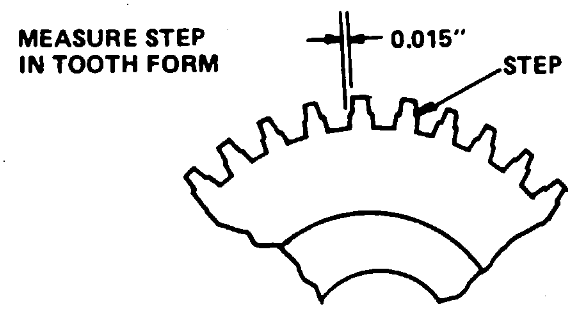


Figure 27-29. Checking for Worm Gear Wear

— CAUTION —

Make sure no chips incur during tightening of nut.

21. After tightening nut, measure distance from milled surface of housing to outer race of rear bearing. Reading should be between 0.0001 0.004 inch.
22. Place O-ring into O-ring groove in housing. Install rear housing and attach with bolts. Torque bolts to 35-40 inch pounds.

FUNCTIONAL TEST OF FLAP TRANSMISSION.

1. Test equipment required:
   A. Tool 7801-T3
   B. Torque Wrench
2. Check no load torque as follows:
   A. Attach torque wrench to input pinion.
   B. Measure torque to rotate pinion with no load applied to screwjack.
   C. No load torque to be 12 in. oz. maximum.
3. Lockwire all bolts and screws.
4. Install protective cap. Do not lockwire.

INSTALLATION OF FLAP TRANSMISSION. (Refer to Figure 27-24.)

Ascertain that the correct flap transmission assemblies are being installed by checking the part numbers on the assemblies with information in the latest 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 fingertight 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 chapter.
6. Install access plates.

RIGGING AND ADJUSTMENT OF FLAPS. 1H-2091

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

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.

Adjustment procedures require that a digital voltmeter be used.

— *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 27-30. Sketch A.)
D. With the transmission assemblies not attached to the flap and 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. By manually moving the flap, adjust the UP limit actuating bolt so that the switch is actuated with a .03 inch maximum gap between the rollers and the end of the flap track slots. (See Figure 27-30. Sketch B.)

— *NOTE* —

It is the intent here that the electrical limits be reached just prior to the mechanical bottoming-out of the rollers in the slot.

F. Repeat the procedure of Step E preceding, to adjust the DOWN limit switch. (See preceding NOTE.)
G. With the flaps resting on a .06 of an inch diameter rod between the rollers and end of the flap track slots, turn the transmission sleeves out from the forward stop (recording the number of turns) until the attachment holes in the sleeve align with the hole in the flap horn and temporarily install the attachment bolt.
H. Repeat the procedure of step G for the opposite flap. The difference in number of turns between the right and left transmission sleeves should not exceed 1/2 turn.
I. Check for proper alignment of the sleeve and flap horn. Should the sleeve and horn not align, loosen the bolts attaching the horn to the flap enough to allow the horn to be moved by tapping to achieve proper alignment. Retorque horn attachment bolts.
J. With the sleeve and the horn properly aligned, connect the sleeve to the horn with bolt and castellated nut. Tighten the nut so as to allow .03 of an inch thrust play of the bolt. Install cotter pin in bolt and nut.

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 flap control amplifier and ascertain that both trimmers are in their full clockwise position (maximum resistance).
M. Apply external power to the aircraft and establish bus voltage at 28 ± .5 volts.
N. Place the flap selector in the DOWN position.
O. Engage flap control circuit breaker — DO NOT engage flap motor circuit breaker at this time. Allow five minutes warm-up time.
P. Measure voltage at VC and adjust voltages of RL and RR to 0.20 volts below VC by rotating the shafts on rheostats RL and RR in the wing. (If VC is 9.0: VL and VR are to be 8.80 volts.)
Q. 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.
R. Move flap selector to the UP position. Listen for audible click of motor solenoid. If solenoid does not actuate check wiring for proper interconnect.
S. Move flap selector back to full DOWN position.
T. Engage the flap motor circuit breaker and move selector to full UP flaps. 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

U. The values at the DOWN position have already been established for VC, VL and VR in Step P preceding. At this time enter the readings 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	4.42 (see step 3 & 4)	4.36 (see step 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 in the preceding example differ by more than .5 volts, an out of sync shutdown has occured due to an actuator arm being loose on the rheostat shaft. If this has happened, select flaps full DOWN and place a jumper wire between RL and RR at the amplifier. Pull flap motor circuit breaker and readjust voltages at RR and RL as per Step P preceding and begin again.
4. If VL is equal to or less than VC, the system has shut down because the amplifier sees that voltage inputs from the position selector (VC) and the position sensor (VL) have been satisfied.
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.)
6. If position and/or indicator criteria are not satisfied, proceed as follows:

— *CAUTION* —

No adjustments are to be made at the wing rheostats (RL and RR) until the flap motor circuit breaker is pulled.

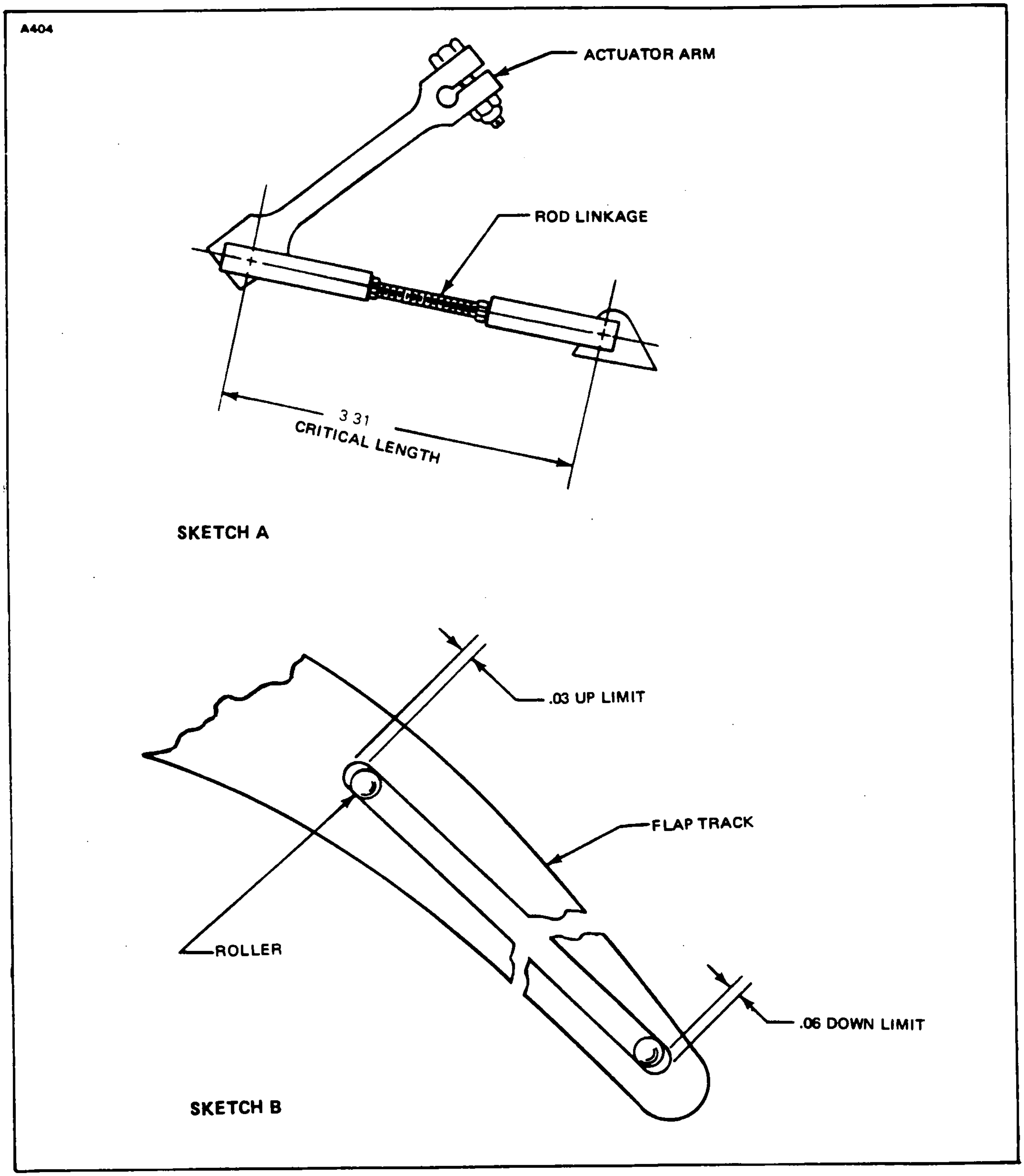


Figure 27-30. Flap Rigging Adjustments

A. VL at the UP position should be equal to VC plus .1 volt +0-.05 volts. From the example in Step U preceding; it can be seen that VL is too high in relation to VC by .32 volts.

B. In order to correct this condition, it is necessary to adjust the value of VL both mechanically and electrically while in the DOWN position as follows:

(1) Loosen the actuator arm and mechanically rotate the rheostat shaft until the voltage at RL is equal to twice the value that VL was too high, as explained in step A above, below what VL actually reads (i.e. VL is 8.95. Adjust mechanically down to 8.31 [8.95-2 x .32 = 8.95-.64 = 8.31]).

(2) Tighten the actuator arm and return VL electrically back to its original value of 8.95 volts by turning the trim pot, RT2, in the amplifier counterclockwise.

C. Make the same adjustment to RR in the same sequence as done on RL; i.e., first mechanically to twice the difference of the voltage error, then electrically (with RT3) back to the original value (of 8.95 volts). However, VR may be adjusted to within .01 volts of VC in order to give a correct indicator presentation.

D. Reinstate flap motor circuit breaker and select flaps full UP. Record voltages as per Step T of Rigging and Adjustment of Flaps and repeat procedures if required. No more than two repeats should be necessary.

E. 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 lead in 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.

F. It is considered to be a proper flap position indication if the centerline of the indicator pointer is tangent to either edge of the target instrument marking.

FLAP POSITION SENDER.

REMOVAL OF FLAP POSITION SENDER. (Refer to Figure 27-24.)

1. Lower the flap and remove the access plates on the left wing false spar at stations 92.50 and 101.00.
2. Loosen the sender arm and the flap position actuator on the sender shaft.
3. Disconnect the electrical leads from the sender.
4. Loosen the sender attachment nut and slide the sender from its mounting bracket.
5. The flap limit switches and the flap approach position switch may also be removed through the access opening.

INSTALLATION OF FLAP POSITION SENDER. (Refer to Figure 27-24.)

1. Start the sender shaft through its mounting bracket hole and install the attachment washer and nut over the shaft. Continue to slide the shaft through the hole and install the arm and actuator on the shaft. Secure the sender in position. Allow the sender arm and the actuator to be free to rotate.
2. Connect the electrical leads.
3. Check rigging and adjustment per Rigging and Adjustment of Flap Position Sender.

RIGGING AND ADJUSTMENT OF FLAP POSITION SENDER.

1. Lower the flaps and remove the access plates on the left wing false spar at stations 92.50 and 101.00.
2. Lower the flap to an angle of 15° ± 1° (lift flap trailing edge to obtain angle measurement): loosen sender arm on the sender shaft and rotate the shaft until the wing flap indicator on the instrument panel shows the flap at the takeoff position (bottom of white arc).
3. Tighten the arm on the sender shaft. Check the three flap positions (retracted, takeoff and extended) with respect to the angular settings and indicated positions on the wing flap indicator.
4. Laterally locate the approach switch arm (14) on the sender shaft so the arm will contact the roller on the switch actuator in the center. Position the arm on the sender shaft as shown in Figure 27-24. Check that the approach flap switch is activated when the flaps are lowered to 15° ± 1° (lift flap trailing edge to obtain angle measurement).
5. Install the access plates.

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 be sent back to the manufacturer for servicing. Environ Division Of Calco MFG. Co., 506 Highway 27, North Haines City, Florida 33844.

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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. Gain access to amplifier under R.H. floor panel at mid-cabin.
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 chapter.
4. Reinstall floor panel.

ELECTRICAL SYSTEM FUNCTIONAL TEST PROCEDURE.

— NOTE —

The serviceman should refer to 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 is 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 and 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 0.55 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 shafts nuts must be lockwired to motor assembly.

STALL WARNING.

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 right 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 switch closes and for four seconds after the detector switches opens.

A heated lift detector is available with the deice 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.

LIFT DETECTOR.

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.

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, determining 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* —

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CHAPTER

28

FUEL

CHAPTER 28 - FUEL

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 28 - FUEL (cont.)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The fuel system components covered in this chapter consist of fuel cells, fuel 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.

Both the left and right fuel systems are independent of each other and are connected only by a crossfeed system. The fuel cells are of the bladder type giving a total fuel load of 243 U.S. gallons of which 237 U.S. gallons are usable. Fuel is supplied to the engine by a submerged boost pump located in the inboard main tank, drawn through the filters, emergency electric fuel pump, fuel shutoff valves, fuel flow transmitter and onto the engine driven pumps. Vents for the system are NACA anti-icing, non-siphoning type which incorporate flame arrestors.

Only one fuel shutoff valve per wing is used. This valve is operated by a push-pull control on the fuel control panel in the cockpit. The valve is used as an ON-OFF valve for the fuel system. A manually operated shutoff valve is also provided at the tank outlet to shut the fuel off for filter cleaning. The only other valve in the system is the crossfeed which is mechanically operated from the fuel control panel. This valve should always remain OFF except under single engine operation, when crossfeed to the operating engine is desired. There is an access door beneath the wing for access to these valves.

The aircraft is equipped with capacitance probe fuel quantity indicating system with one probe located in each cell. All fuel cells in each wing are interconnected and fuel drains are provided at the low point of each wing fuel cell.

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 identical unit or units, tested and known to be good installed in their place.

CHART 2801. TROUBLESHOOTING (FUEL SYSTEM)

Trouble	Cause	Remedy
Fuel gauge fails to indicate proper tank level.	Circuit breaker out.	Check and reset.
	Broken wire.	Check and repair.
	Gauge inoperative.	Replace.
	Incomplete ground.	Check ground connection at gauge and at fuel transmitters in the wings.
	Vent holes in fuel transmitter clogged.	Clear vent holes.
Fuel valves leak.	Worn O-rings.	Replace O-rings or valve.
Pressure low or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty pump.	Replace pump.
Low fuel pressure.	Fuel valve stuck.	Check valve.
	No fuel in tanks.	Check and fill.
	Filters dirty.	Clean filters.
Unidentified leak.	Fuel lines damaged or improperly installed.	Locate and repair.
	O-rings improperly installed.	Locate and repair or tighten.
Fuel leaking from NACA vents.	Full fuel tanks and fuel expansion due to exposure to heat.	Defuel aircraft or park in a shaded or cooler location.
	Float valve in wing tip sticking open or leaking.	Defuel aircraft and inspect valves for condition.

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

Trouble	Cause	Remedy
Fuel leaking from filler caps.	Filler caps improperly adjusted and not sealing properly.	Adjust filler caps to obtain tight seal.
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.
No fuel pressure indication.	Shutoff valve off.	Turn on.
	Fuel valve stuck.	Check valve.
	No fuel in tanks.	Check fuel, fill.
	Filters dirty.	Clean filters.
	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.

CHART 2802. TROUBLESHOOTING (FUEL GAUGING SYSTEM)

The biggest source of malfunction will probably be shorted or electrically "leaky" TANK SENSOR UNITS. This can be caused by their exposure to contaminated fuel or corrosive environments. The first test on a troublesome system should be to USE SPECIAL TEST EQUIPMENT FROM CHART 2805, to run a 10 or more megohm test of the tank sensor system in each wing. CAUTION - DO NOT USE A HIGH VOLTAGE "MEGGER". See CAUTION under paragraph titled CLEANING OF TANK UNITS.

Trouble	Cause	Remedy
Dead-gauge does not come up to zero pounds.	No D.C. power to gauge.	Correct loss of +24VDC to gauge pin "J" or ground to pin "A".
	Dead gauge even with 24VDC from "J" to "A".	Replace Fuel Quantity Indicator.
Gauge is not dead but does not appear to work.	Gauge gets 24VDC, but only reads on bench because system is shorted.	Clear short or electrical leakage from wing tank sensors or their wiring.
Gauge appears to work properly on part of its range only.	One or more bad Tank Sensor Units.	Test each Tank Sensor Unit per Chart 2807.
Gauge appears to work properly but is not properly calibrated.	Tanks are partly or completely filled with other than Avgas fuel.	Test Fuel Quantity Indicator per Chart 2806 and then re-calibrate system.

A short anywhere between a "LO Z" wire (or a Tank Sensor Unit outside tube) and airframe ground will make the whole system (both sides) appear to be turned off. If so, disconnect the Fuel Quantity Indicator Connector and measure for possible short from pin "D" (right wing) or pin "E" (left wing) to airframe ground, to determine which side of the airplane has the short.

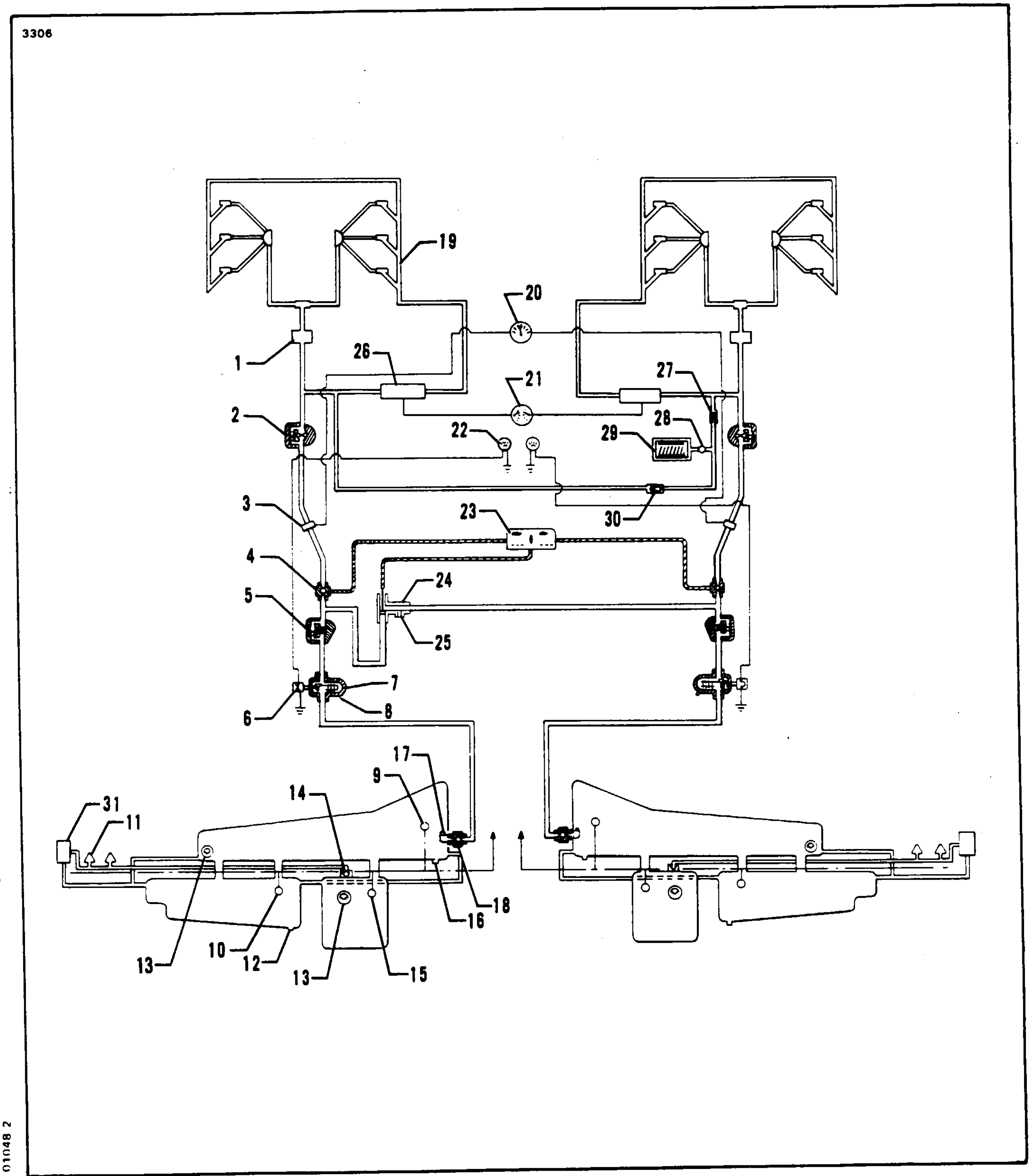


Figure 28-1. Fuel System Schematic

1. FUEL INJECTOR
2. ENGINE DRIVEN FUEL PUMP
3. FUEL FLOW TRANSMITTER
4. FIREWALL SHUTOFF VALVE
5. EMERGENCY FUEL PUMP (ELECTRIC)
6. PRESSURE SWITCH
7. FILTER
8. FILTER DRAIN
9. SENDER UNIT-INBOARD FUEL CELL
10. SENDER UNIT-OUTBOARD FUEL CELL
11. VENT NACA NON-ICING
12. SUMP DRAIN VALVE
13. FILLER CAP
14. CHECK VALVE
15. SENDER UNIT-NACELLE FUEL CELL
16. SUMP DRAIN VALVE
17. SUBMERGED FUEL BOOST PUMP
18. SHUTOFF VALVE
19. NOZZLES AND NOZZLE LINES
20. FUEL FLOW GAUGE
21. FUEL PRESSURE GAUGE
22. INDICATOR LIGHT-BOOST PUMP FUEL PRESSURE
23. FUEL SELECTOR PANEL
24. CROSSFEED VALVE
25. CROSSFEED DRAIN VALVE
26. TRANSDUCER - PRESSURE
27. CHECK VALVE
28. PRESSURE REGULATOR AND SHUTOFF VALVE
29. HEATER
30. CHECK VALVE
31. VENT FLOAT VALVE

Figure 28-1. Fuel System Schematic (cont.)

STORAGE.

WING FUEL CELLS.

REMOVAL OF WING FUEL CELLS. (Refer to Figures 28-2 or 28-3.)

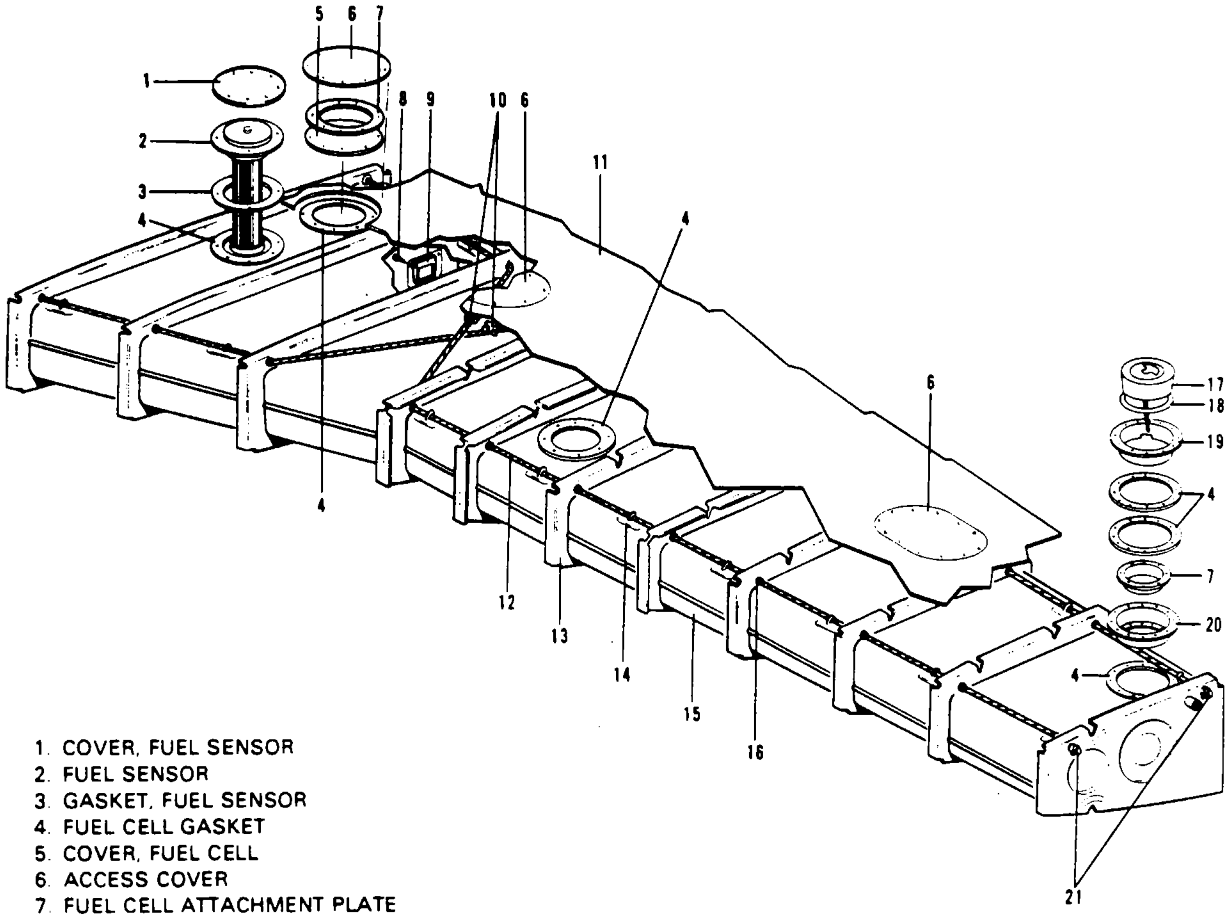
1. Drain the fuel system. (Refer to Draining Fuel System, Chapter 12.)
2. Remove the fuel cell and fuel sender access plates from the top of the wing.
3. Remove the lower wing root fairing and fuel cell drain fitting plates from the underside of the wing.
4. Disconnect the wires from the fuel cell sender units; remove the screws that secure the sender and carefully draw the sender, with gasket from the cell. Note the position of the installed sender unit and gaskets to facilitate reinstallation.
5. By reaching into each fuel cell, remove the clamps from the nipples in each tank that connect the crossover tubes between the fuel cells and pull each tube out of the cells. The tubes may be removed from the wing by disconnecting the ground strap from the spar.
6. Disconnect fuel lines from cells.
7. On the underside of the wing, draw the fuel cell drains down enough to release the clamps and remove the drain.
8. Disconnect the electrical connections and fuel lines to the submerged fuel pump; remove the shutoff valve and disconnect the fuel line that connects to the cell just aft of the pump by loosening the clamp.
9. Loosen the mounting bolts that attach the submerged fuel pump to the wing rib; reach through access hole above the pump and remove pump.
10. Reach through the proper access holes for each fuel cell and untie the nylon cords that secure the cell.
11. Remove all the cap bolts at all the access holes that attach the cells to the skin brackets. Push the cell down and work the nylon cord back through the cell hangers and rib bushings to the ends of the cell compartment.
12. Remove the screws that attach the adapter brackets to the wing skin in each of the elongated access holes and remove the brackets from the holes.
13. Place tape or another protective material around the cell access opening to prevent damage to the cell when removing.
14. Fold the cell neatly within the wing and tape or tie it, whichever suits, and remove it gently through the elongated opening on top of the wing.

— NOTE —

Be careful not to damage the small flapper valve installed in the interior baffle close to the fuel pump mounting location.

3307

NOTE
FUEL SENSORS ARE NOT INTERCHANGEABLE. CONSULT PARTS CATALOG FOR PROPER REPLACEMENT PART.



1. COVER, FUEL SENSOR
2. FUEL SENSOR
3. GASKET, FUEL SENSOR
4. FUEL CELL GASKET
5. COVER, FUEL CELL
6. ACCESS COVER
7. FUEL CELL ATTACHMENT PLATE
8. SCREW ASSEMBLY, FLAPPER VALVE ATTACHMENT
9. FLAPPER VALVE
10. TIE KNOTS
11. WING SKIN
12. CORD
13. RIB ASSEMBLY
14. LOOP ATTACHMENT
15. LINER ASSEMBLY
16. SNAP BUSHING
17. FILLER CAP
18. O-RING
19. ADAPTER - FILLER CAP
20. BRACKET - FUEL CELL FILLER NECK
21. KNOT AND WASHER

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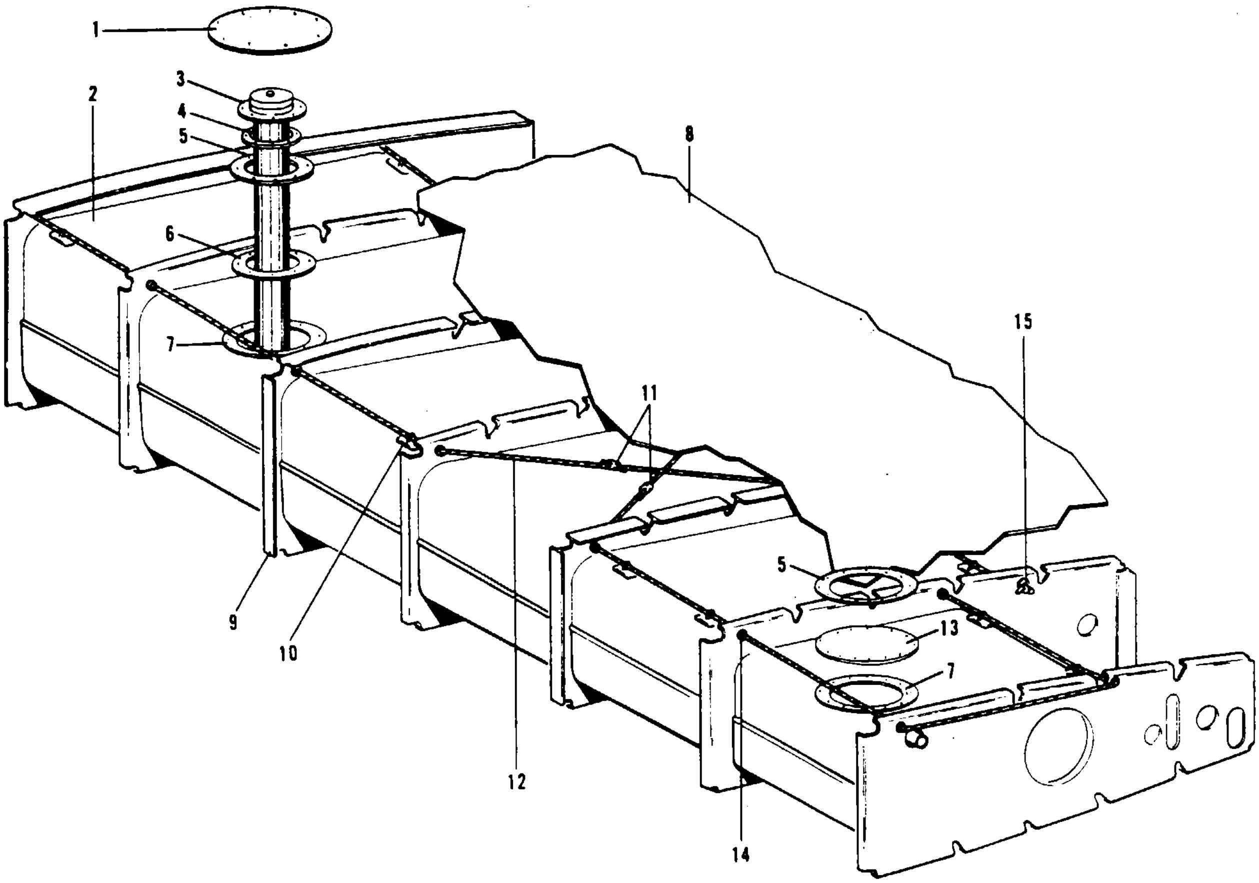
Figure 28-2. Fuel Cell Installation (Inboard)

3308

NOTE
FUEL SENSORS ARE NOT INTERCHANGEABLE. CONSULT PARTS CATALOG FOR PROPER REPLACEMENT PART.



1. COVER ASSEMBLY, ACCESS
2. LINER ASSEMBLY
3. FUEL SENSOR
4. GASKET, FUEL SENSOR
5. FUEL CELL ATTACHMENT PLATE
6. FUEL SENSOR SUPPORT PLATE
7. FUEL CELL GASKET
8. WING SKIN
9. RIB ASSEMBLY
10. LOOP ATTACHMENT
11. TIE KNOTS
12. CORD
13. FUEL CELL COVER
14. SNAP BUSHING
15. KNOT AND WASHER

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Figure 28-3. Fuel Cell Installation (Outboard)

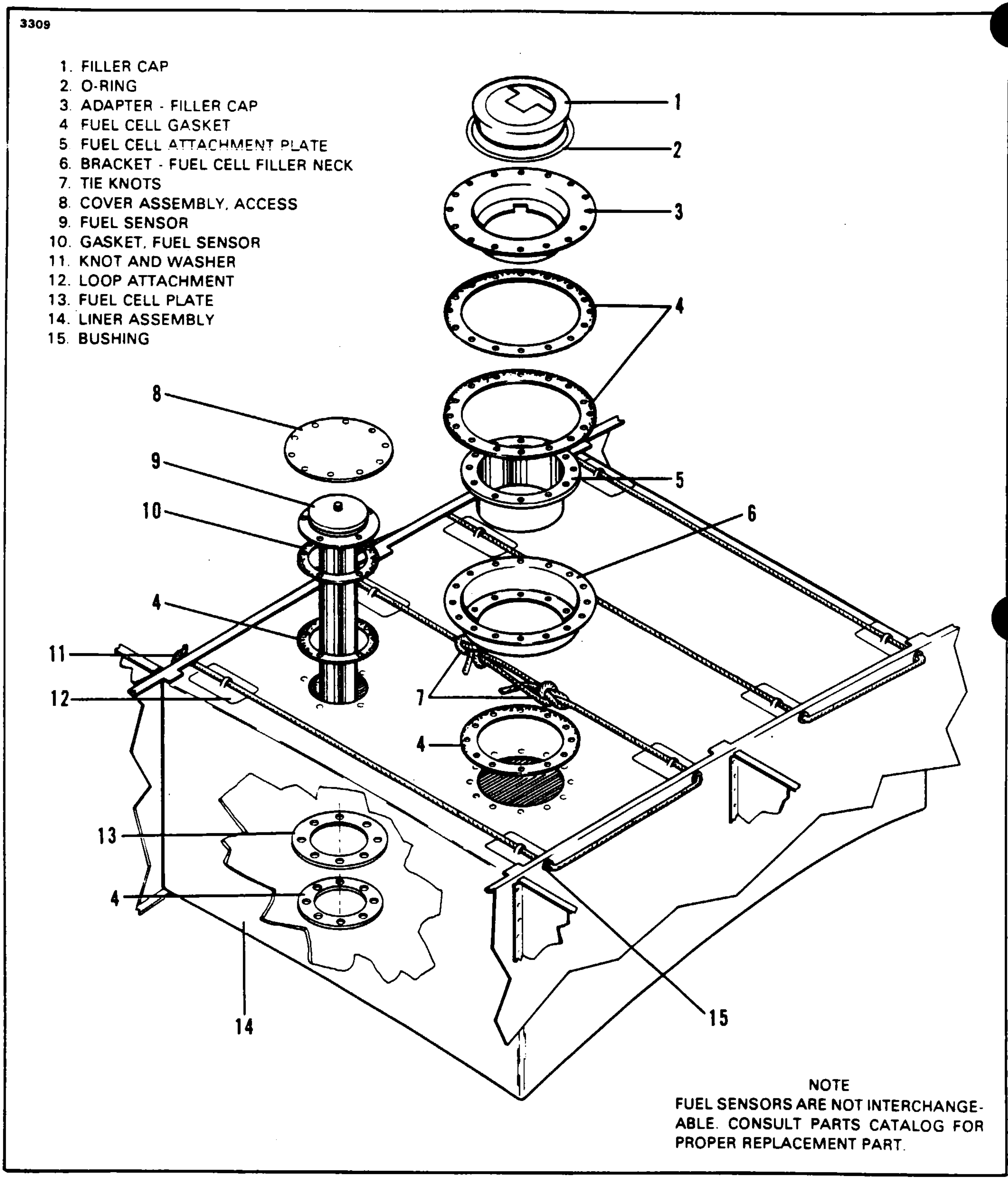

Figure 28-4. Fuel Cell Installation (Nacelle)

INSTALLATION OF WING FUEL CELLS. (Refer to Figures 28-2 or 28-3.)

1. Inspect the cell compartment. (See Paragraph titled Fuel Cell Compartment.)
2. Should the cell be in its shipping container, do not remove until ready for installation.
3. Check to be sure the cell is warm enough to flex. Do not use sharp tools such as screwdrivers, files, etc. for installation purposes.
4. Place tape or another protective material over the edges of the elongated access opening to prevent damage to the cell.
5. Roll the cell into the shape and size which can be inserted through the access opening of the wing.
6. After fitting the cell into the wing, unroll the cell and establish correct relationship of the cell to the compartment.
7. From each end of the cell compartment, feed the cord through the cell hangers and rib bushings until the cords can be joined at the access openings. Do not tie cord yet. The cords are routed as shown in Figures 28-2 and 28-3.

— *NOTE* —

The nylon cord used to hold the fuel cells is .125 diameter, with a minimum breaking strength of 550 pounds and conforming to MIL-T-5040C Type III specifications. Obtain through Goodyear.

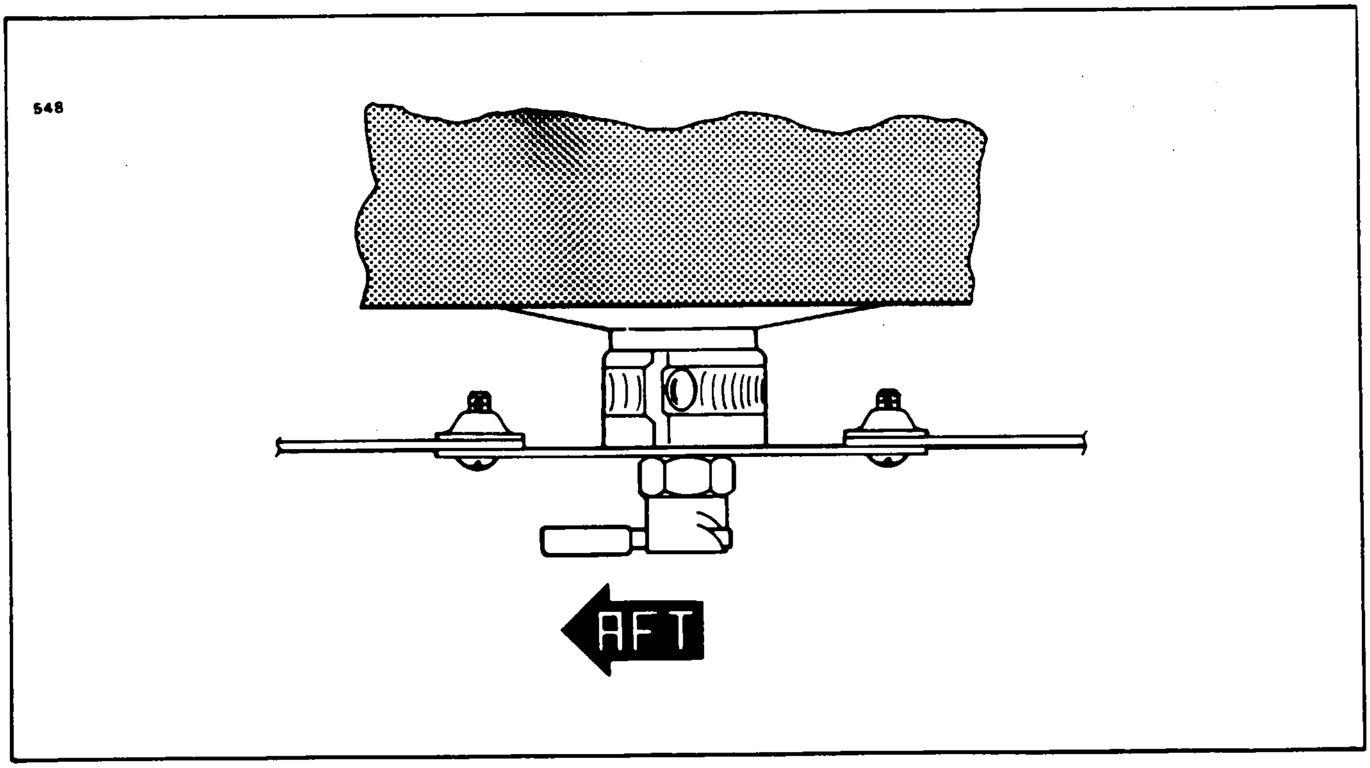

Figure 28-5. Fuel Valve Drain Plate

8. Connect the fuel drain plate by inserting the threaded end of a 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 2 or 2-1/2 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.
9. Remove the bolt or rod: secure the plate to the wing panel and install the drain valve.
10. Install the submerged fuel pump, through the access opening in the wing top, and secure to the inboard rib with the four bolts that attach the pumps.
11. Connect the electrical wires to the submerged fuel pump and install the shutoff valve onto the fuel pump and connect the fuel line to the valve fitting.
12. Install the fuel cell flange mounting brackets in the elongated access holes with screws.
13. 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.
14. Attach the fuel cell nut flange fittings to the brackets on the nacelle tank floor by reaching through a nearby access hole and holding the cell and gasket up against the attachment bracket and inserting several bolts, or by inserting a threaded rod or bolt through a hole in the bracket down into the corresponding hole in the cell nut flange and pull the cell up against the bracket in the nacelle floor and install several cap bolts to hold the fuel cell until the rod is removed; then install all cap bolts and torque to 35 ± 5 inch-pounds.
15. Connect the fuel lines that attach to the outboard ends of the fuel cells, and the drain line that runs from the inboard end of the main outboard fuel cell to the inboard end of the main inboard cell.
16. Connect the crossover tubes between the main inboard and outboard fuel cells by inserting the tubes into the nipples in each cell and install clamps from inside the cell. Torque the clamps 25 to 30 inch-pounds. (Refer to Paragraph titled Molded Nipple Fittings.) Make sure the ground strap on the crossover tubes is attached to the spar.
17. Install fuel senders, gaskets (one on each side of the bracket) and screws. Tighten screws to 25 + -5 inch-pounds.
18. Connect the sender wires and insure that the insulator sleeve insulates to the point where the wires attach to the sender. Install sender access plates.
19. 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 28-6.
20. Install the remaining cell cover access plates on top of the wing. Torque the cell cover cap bolts to 35 ± 5 inch-pounds.
21. Put enough fuel in cell to check for fitting leaks.
22. Install remaining access plates, lower wing root fairing and nacelle top panel.

REMOVAL OF NACELLE FUEL CELL. (Refer to Figure 28-4.)

1. Drain the fuel from the cell.
2. Remove the access plates to the fuel cell outlet, fuel sender unit and the tierope connection.
3. Loosen the clamps and disconnect the fuel outlet at the aft end of the cell and the vent line at the forward outboard end of the cell.
4. Disconnect the wires from the sender unit, remove the screws that secure the sender and carefully draw the sender with gasket from the fuel cell. Note the installed position of the sender for proper reinstallation.
5. Reach through the access hole and untie the nylon cord that secures the fuel cell to the nacelle.
6. Remove the filler cap and machine screws that secure the cap adapter and gasket.
7. Place tape or another protective material around the cell access opening to prevent damage to the cell when removing it.
8. Push the cell down and work the nylon cord back through the cell hangers and bushing to the outboard ends of the cell compartment.
9. Fold the cell neatly within the nacelle and remove it gently through the opening at the top of the nacelle.

INSTALLATION OF NACELLE FUEL CELL. (Refer to Figure 28-4.)

1. Inspect fuel cell compartment. (See Paragraph titled Fuel Cell Compartment.)
2. Should the cell be in its shipping container, do not remove until ready for installation.
3. Check to be sure the cell is warm enough to flex. Do not use sharp tools such as screwdrivers, files, etc., for installation purposes.
4. Place tape or another protective material over the edges of the access opening to prevent damage to the cell.
5. Roll the cell into the shape and size which can be inserted through the access opening of the cell compartment.
6. 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.
7. 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 cord yet. The cord is routed as shown in Figure 28-4.
8. Connect the fuel drain valve below the cell, the fuel outlet and vent line to the fuel cell.
9. 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.
10. Connect the crossover tubes to the cell by inserting the tubes into the nipples and install clamps from inside the cell. Torque the clamps 25 to 30 inch-pounds. (Refer to Paragraph titled Molded Nipple Fittings.)
11. Position the cap adapter and gaskets; one gasket on each side of the skin bracket, with the attachment holes in the skin bracket and adapter bracket. Install machine screws and secure.
12. Install fuel sender, gaskets (one on each side of bracket), and screws. Tighten screws to 25 +, -5 inch-pounds.
13. Connect sender wires and ascertain that insulator sleeve insulates to the point where wire attaches to the sender. Install sender access plates.

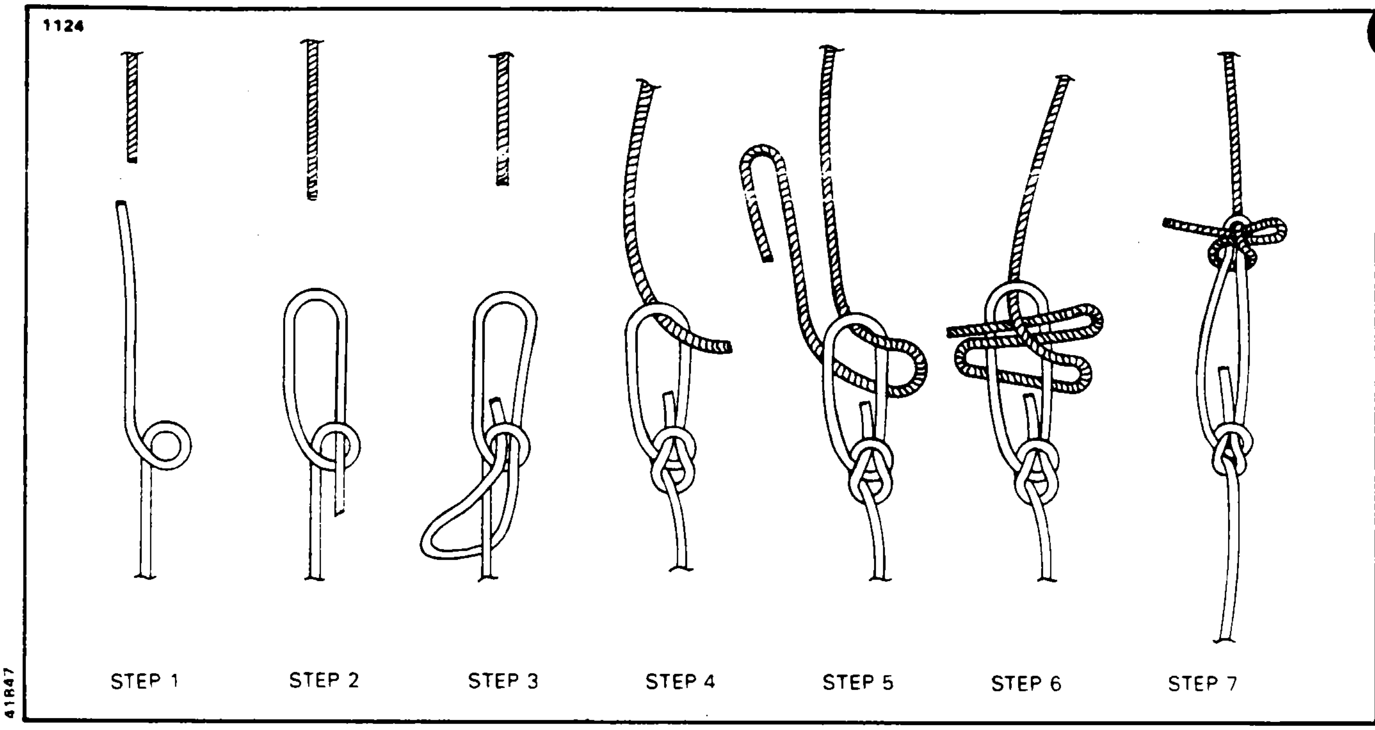

Figure 28-6. Fuel Cell Tie Detail

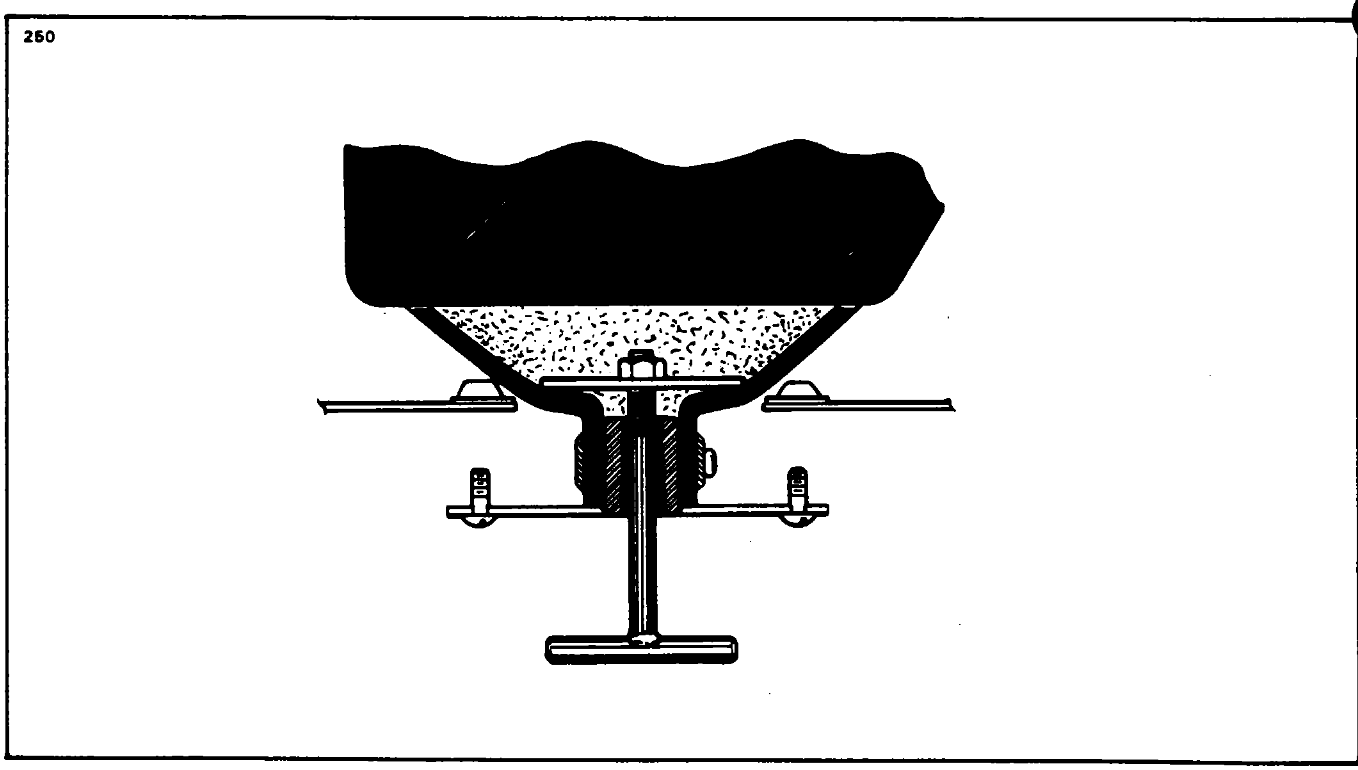

Figure 28-7. Installation of Fuel Valve Drain Plate

14. 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 28-6.
15. Install the remaining cell cover access plates on top of the nacelle. Torque cell cover cap bolts to 35 ± 5 inch-pounds.
16. Put enough fuel in cell to check for fitting leaks.
17. Install remaining access plates.

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, should be inspected for cuts, abraded (scuffed) areas and accessory damage on the inside and outside of the cell surface. Reach through the fuel access plate and take a section of cell between the thumb and forefinger. Wipe the ridge created by this action with a cloth wet with Methylethylketone. If fine cracks are evident, the fuel cell is not repairable and must be replaced.
   C. Baffled Fuel Cells: Inspect every 2 years or after 500 hours in service whichever comes first, conduct 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 color.

(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 1/4-28 self-locking nut at base of cap 1/2 turn. (If castle nut is used in lieu of self-locking nut, remove chain assembly, adjust nut 1/2 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 foreign material such as trimmings, loose washers, bolts or nuts.
2. Round off any sharp edges in 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 each fuel line into each nipple until the end is flush with the inside edge of the cell.
2. The hose clamp must be clear of the end of the fitting by .25 inch where possible.
3. Locate the hose clamp on the fabric-reinforced area of the nipple.
4. Torque the hose clamps 15 to 20 inch-pounds. Do this once. Do not retighten unless the hose clamp is loosened completely and allow to set for 15 minutes before retightening.
5. Do not use sealing paste or gasket compound.
6. Apply a thin film of Simonize Wax to metal tubes to facilitate installation and removal.

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, to install in airframe cavities and when 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.

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.

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REPAIR OF FUEL CELLS.

GENERAL.

The following is the repair procedure recommended for field repair of fuel cells constructed of Goodyear BTC-85 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, permanent 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.

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.

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 between +30° F to +85° 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 6.0 inches maximum length require and 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, 30153, 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 Methylethylketone solvent.
3. Abrade cell wall surface about injury and contact side of patch with fine emery cloth to remove shine.
4. Repeat Methylethylketone washings two more times. A total of three washings each surface.

CHART 2803. 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.

Alodine 1200 - to be ordered as required from cell manufacturer

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 fifteen 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" clamps, 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.

13. Connect repair iron into 110-volt electrical outlet and cure repair for two hours. After two hours cure, unplug repair iron and allow 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.

— *NOTE* —

For each 10° drop in temperature from 75° F, add 20 hours cure time.

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 Methylethylketone. 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.

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 peel 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 using 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 Methylethylketone. 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 of Ethyl Alcohol, mix, then add 1/2 gallon of water.
   C. Pour ammonia on an absorbent 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.

FUEL VENT SYSTEM.

The main fuel vent line extends from the upper portion of the nacelle fuel tank down through the wing, out to the wing tip. A float valve is installed on the end of the vent line at the wing tip to prevent fuel from escaping through the vent system. Two NACA anti-icing, non-siphoning, flame arrestor type vent assemblies are installed along the vent line.

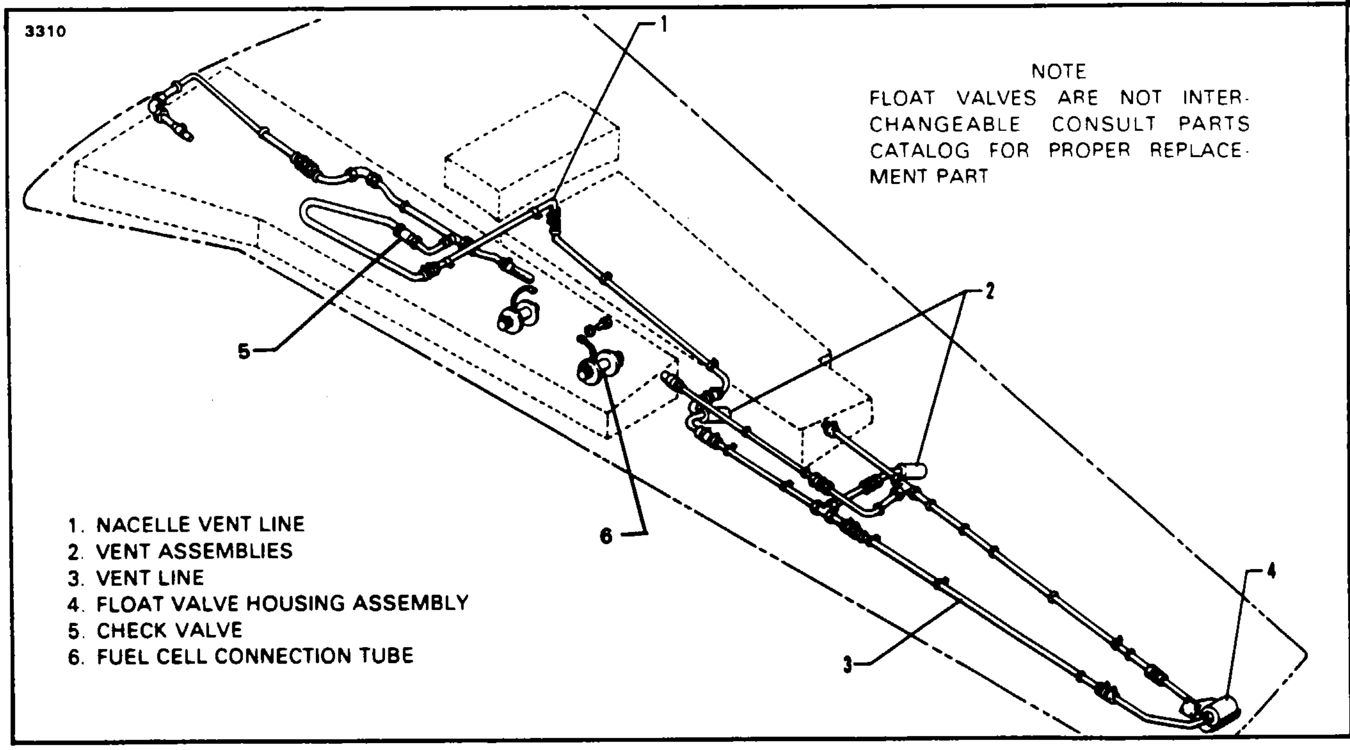

Figure 28-8. Fuel Vent System

DISTRIBUTION.

FUEL VALVES. (Refer to Figures 28-9 and 28-10.)

REMOVAL OF FUEL VALVES.

There are two fuel shutoff valves and one crossfeed valve. The fuel shutoff valves are located in the wing root cavity just aft of the leading edge of each wing. The crossfeed valve is located in the wing root cavity, also, just ahead of the main spar on the left side of the aircraft.

1. To remove either of the fuel shutoff valves, make sure the crossfeed valve is in the OFF position.
2. Drain all the fuel from the wing, from which the valve is to be removed.
3. Remove the lower wing root fairing for the particular wing.
4. Locate the shutoff valve and disconnect the fuel lines from each end of the valve and also remove the nut and screw that attaches the control cable to the actuator arm.
5. Remove screws from the mounting clamps and remove the valve.
6. To remove the crossfeed valve in the left-hand wing gap cavity, the same basic procedure is followed except, place the fuel shutoff valves in the OFF position.
7. Disconnect the fuel line from the aft end of the valve and control cable from the actuator arm on the valve.
8. Disconnect the valve from the mounting bracket and unscrew and remove the valve from the cross fitting.

DISASSEMBLY OF CROSSFEED VALVE AND FUEL SHUTOFF VALVE. (Refer to Figures 28-9 and 28-10.)

1. Crossfeed Valve:
   A. Disconnect the control arm from the valve step by removing nut from the pin.
   B. Push the stem out of the valve body.
   C. Remove seal(s) requiring replacement.
   D. If seat valve is removed, replace O-ring packing.
2. Fuel Shutoff Valve:
   A. Remove the two clamps.
   B. Remove the snap ring on the bottom of the valve.
   C. Push the valve from the valve body.
   D. Remove and discard the O-rings.

CLEANING, INSPECTION AND REPAIR OF FUEL SHUTOFF VALVE AND CROSSFEED 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.
   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 the reconditioning of parts such as smoothing out minor nicks and scratches and replacing O-rings.

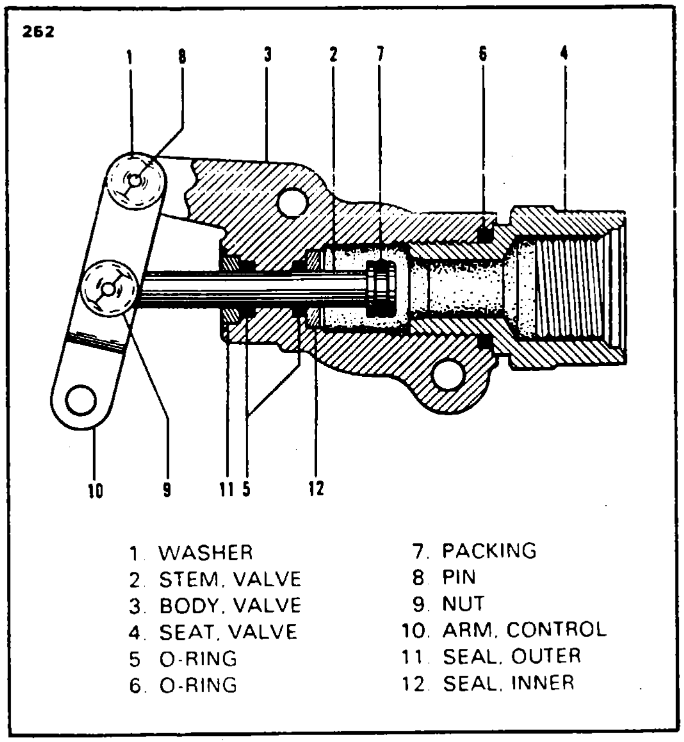

Figure 28-9. Crossfeed Valve

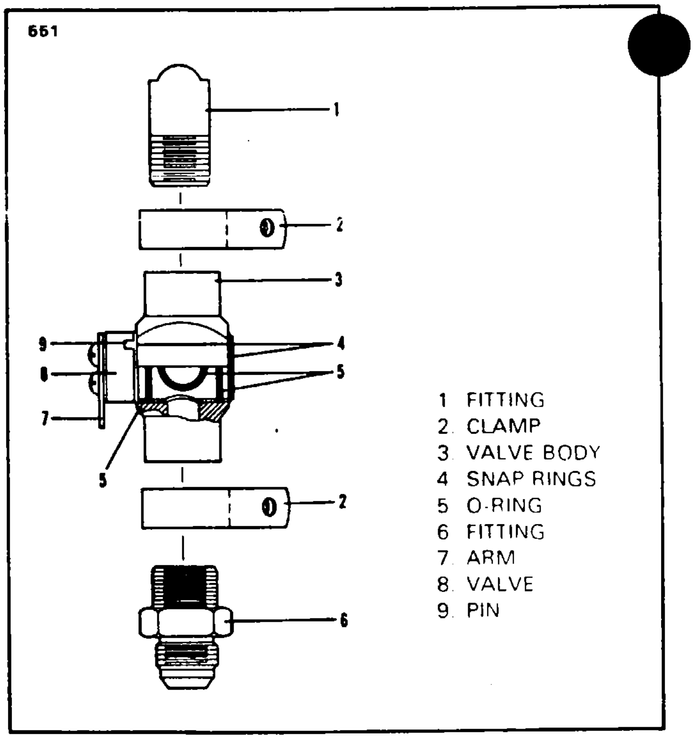

Figure 28-10. Fuel Shutoff Valve

ASSEMBLY OF FUEL SHUTOFF AND CROSSFEED VALVE. (Refer to Figures 28-9 and 28-10.)

1. Fuel Shutoff Valve:
   A. Ascertain that the snap ring is installed on the upper portion of the valve.
   B. Place new O-rings on the valve.
   C. Lubricate the O-rings with DC-55 (MIL-G-4343) and insert the valve in the valve body. Place the valve in the valve body so that the valve is allowed only 90° travel between stops.
   D. Lock the valve in the valve body by installing the snap ring on the valve.
   E. For the fuel shutoff valve, install the two clamps. For the crossfeed valve, install one clamp.
2. Crossfeed Valve:
   A. If seat valve was removed, install the O-ring packing and assemble the seat fitting on the valve body.
   B. Lubricate the O-ring packings with a thin coat of stop-lock grease and install.
   C. Push the stem into the valve.
   D. Connect the control arm with the stem and secure with pin and nut.
   E. Check valve operation.

LEAK TEST OF FUEL SHUTOFF AND CROSSFEED VALVE.

1. Fuel Shutoff Valve:
   A. Connect the inlet port of the valve to a 50 psi air source.
   B. Close the valve and apply air pressure up to 50 psi and submerge the valve in kerosene or a similar petroleum base fluid for two minutes.
   C. There should be no evidence of leakage through the valve port or around the seat.
   D. Disconnect the air source and wipe fluid from the exterior of the valve.

— NOTE —

Max. allowable torque required to actuate valve: 4 in.-lbs. valve may be immersed in Stoddard fluid or Av gas prior to/or during test.

2. Crossfeed Valve:
   A. Connect one port of the valve to a 50 psig air source.
   B. Close valve, apply pressure to 50 psig and submerge in kerosene or a similar petroleum base fluid for two minutes.
   C. Depressurize and connect the air source to the other port of the valve.
   D. Repeat Step B.
   E. There shall be no evidence of leaking through the valve seat or around the valve stem.
   F. Disconnect and wipe fluid from exterior.

INSTALLATION OF FUEL VALVES.

1. Place the valve in its proper position and secure it to its mounting bracket or with attachment clamps whichever valve is being installed.
2. Connect the proper fuel lines to the valve and also connect the control cable to the actuator arm with the attaching hardware.
3. Put enough fuel in tank, if not already there, and check valve and end fittings for leaks.
4. Install lower wing root fairing.

ADJUSTMENT OF FUEL SHUTOFF AND CROSSFEED VALVE.

1. Fuel Shutoff Valve:
   A. Remove the lower wing root fairing on the particular side that the valve adjustment is to be made.
   B. Disconnect the control cable at the actuator arm on the particular valve and loosen the jam nut at the clevis fitting.
   C. Place the shutoff valve actuator arm firmly against the CLOSED position stop pin. Place the appropriate cockpit control lever against its OFF stop position; then carefully move .06 inches off the stop.
   D. Carefully align the clevis hole with the mating hole in the actuator arm of the valve, turning the clevis either way if necessary to align with the hole in the arm; then secure with attaching hardware.
   E. Work the particular control several times to make sure the actuator arm on the valve contacts the stop pin before the control lever in the cockpit contacts its stop.

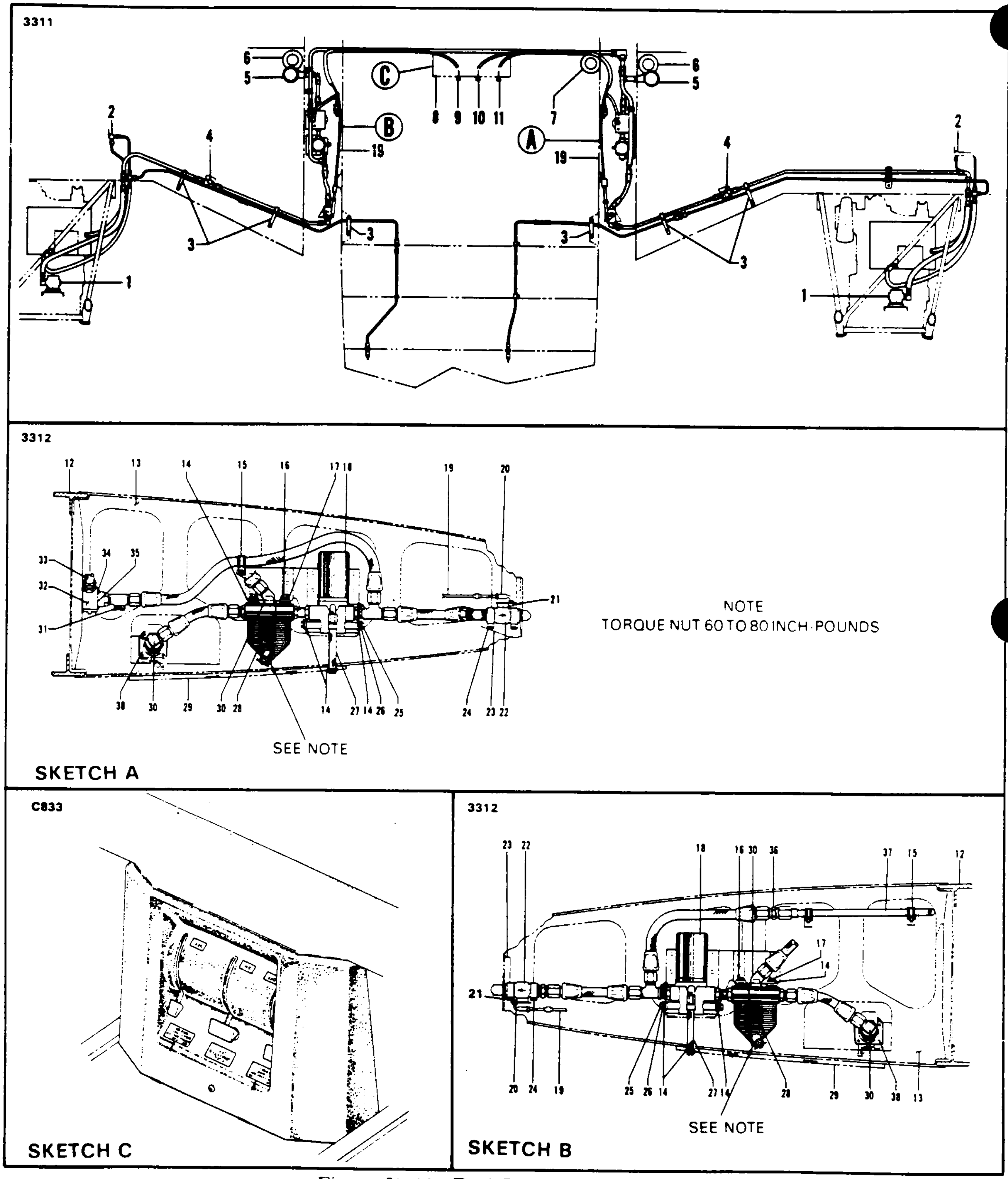

Figure 28-11. Fuel System Installation

1 MAIN FUEL SUPPLY TO PUMP
2 PRESSURE TRANSMITTER
3 RUB BLOCK
4 TRANSDUCER
5 SUBMERGED FUEL PUMP
6 DRAIN FUEL SUMP
7 DRAIN FUEL CROSSFEED
8 PANEL FUEL CONTROL
9 FIREWALL SHUTOFF - RIGHT ENGINE
10 CROSSFEED CONTROL
11 FIREWALL SHUTOFF - LEFT ENGINE
12 MAIN SPAR
13 WING RIB
14 GROMMET
15 CLAMP, SCREW AND NUT
16 SCREW, BUSHING AND WASHER
17 LOCK WASHER
18 PUMP ASSEMBLY
19 CABLE FUEL SHUTOFF VALVE
20 BALL JOINT AND NUT
21 NUT AND WASHER
22 VALVE ASSEMBLY, FUEL SHUTOFF
23 PLATE ASSEMBLY
24 SCREW AND NUT
25 SCREW, BUSHING AND WASHER
26 LOCK WASHER
27 HOSE ASSEMBLY
28 SAFETY WIRE
29 WING FILLET
30 ELBOW
31 LINE, TO DRAIN
32 VALVE ASSEMBLY, CROSSFEED
33 CROSSFEED LINE
34 SCREW
35 CROSSFEED VALVE
36 UNION
37 CROSSFEED LINE
38 FUEL SHUTOFF VALVE

Figure 28-11. Fuel System Installation (cont.)

2. Crossfeed Valve:
   A. 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.
   B. Ascertain that the control cable clevis end is connected to the crossfeed valve. The clevis on the valve handle should be free to rotate.
   C. Place the crossfeed handle in the cockpit in the OFF position.
   D. 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 28-12.)
   E. 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.
   F. Install safety wire through roll pin and around crossfeed control shaft.
   G. Reinstall the access and selector panels.

FUEL FILTER.

REMOVAL OF FUEL FILTER. (Refer to Figure 28-11.)

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 shutoff 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 pump.
4. Disconnect the fuel lines to the filter and fuel pump. Cover the line ends to prevent contamination.
5. Remove the bolts that secure the filter and pump to their mounting brackets.
6. Separate the filter from the fuel pump.

DISASSEMBLY OF FUEL FILTER. (Refer to Figure 28-13.)

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 outlet 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.
8. The fuel pressure switch fitting may be removed by unscrewing it from the top of the filter body.

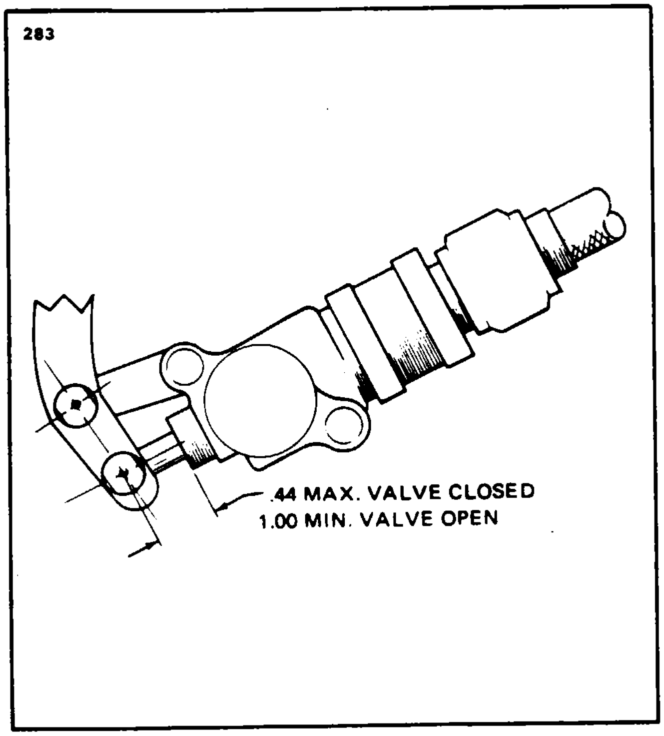

Figure 28-12. Adjustment of Crossfeed Valve

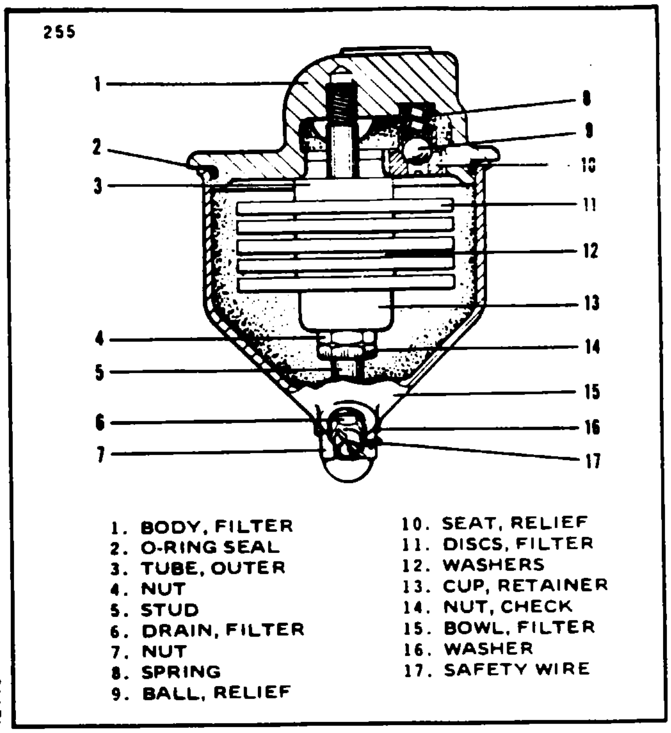

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Figure 28-13. Fuel Filter

CLEANING, INSPECTION AND REPAIR OF FUEL FILTER. (Refer to Figure 28-13.)

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.

ASSEMBLY OF FUEL FILTER. (Refer to Figure 28-13.)

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 and fitting on top of filter.
6. Connect the lines to the filter and pump.

INSTALLATION OF FUEL FILTER. (Refer to Figure 28-11.)

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 line from the pressure switch to the fitting on the filter.
5. Connect the electrical leads to the fuel pump.
6. Turn on the fuel valve and check for fuel leaks.
7. Install the access plate.

CLEANING FUEL SYSTEM.

1. To flush the fuel system disconnect fuel line at the injector.
2. 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 cells. During this operation, agitation of the fuel within the cell will help pick up and remove any dirt.
3. When the system is flushed, clean the filter assembly.

FUEL PUMPS.

REMOVAL OF ELECTRIC FUEL PUMP. (Refer to Figure 28-11.)

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 selector 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 pump.
4. Disconnect the fuel lines from the fuel pump and filter assembly. Cover the line ends to prevent contamination.
5. Remove the bolts that secure the pump 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 28-14.)

The motor of the pump assembly may be separated from the pump by removing the four motor attachment screws. After separation of the pump and motor, disassembly of the pump can be accomplished as follows:

1. Remove seal spring and washer.
2. Unscrew hex cap with O-ring seal from pump body and remove wear plate spring and wear plate.
3. Insert number 5-40 screws into tapped hole on 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 seal cage containing seal O-ring from pump shaft. Long thin nose pliers may be used to facilitate removal of seal cage.
5. Remove rotor from insert by pushing on the end of rotor shaft. Remove blade retaining spring and blades. Also O-ring seals.
6. 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.
7. Remove the valve spring and piston assembly.

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 2804.)
3. Repair is limited to replacing parts that are defective or worn.

ASSEMBLY OF ELECTRIC FUEL PUMP. (Refer to Figure 28-14.)

1. Lubricate O-ring seals with Parker O-Lube or equivalent to facilitate reassembly.
2. Replace the valve spring and piston assembly. Check for free movement of plunger.
3. With the piston assembly, valve spring, adjustment guide and adjustment screw in place, secure with Tru-Arc retaining spring.
4. 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.
5. Replace the two O-ring seals on the insert.

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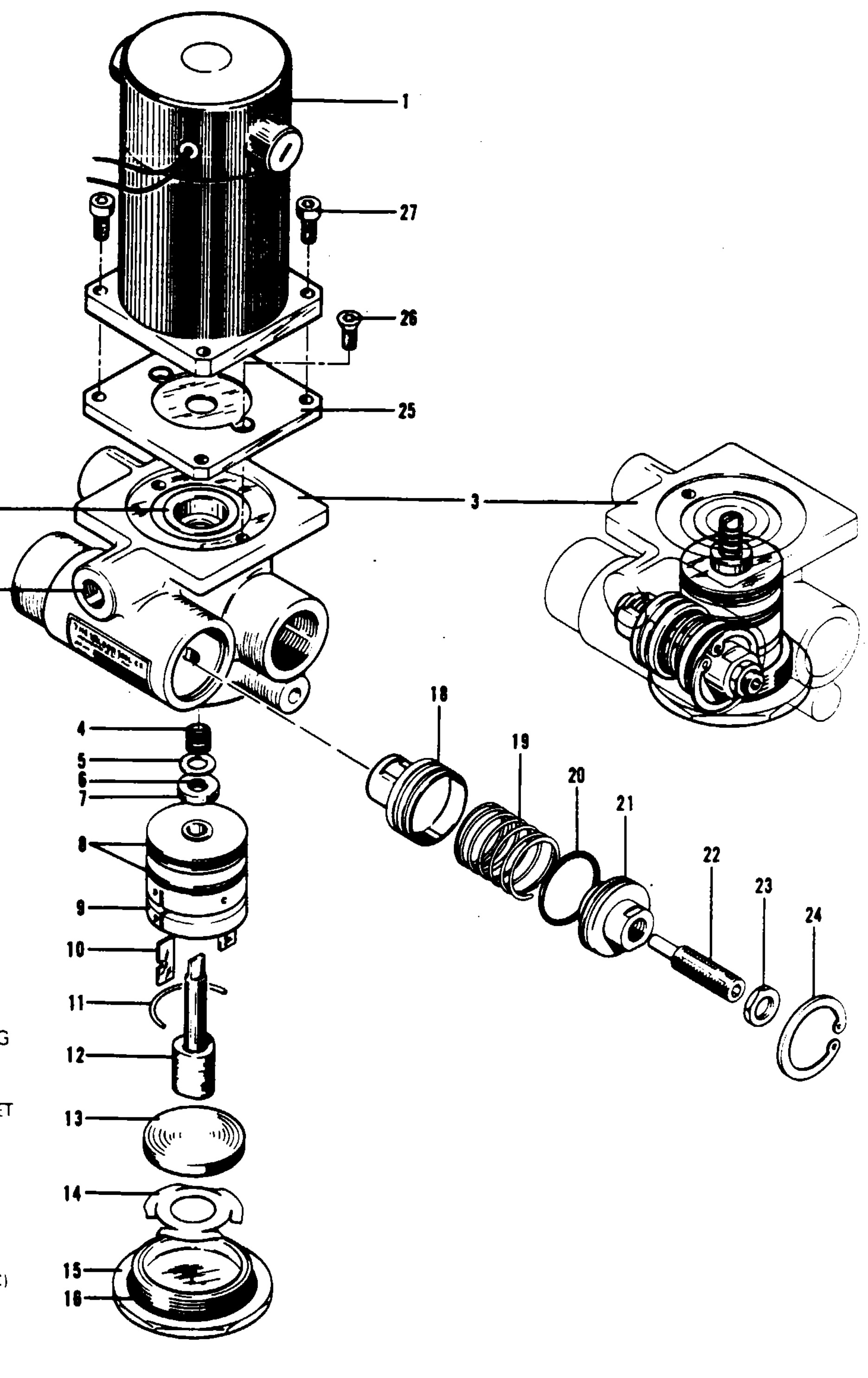

1. MOTOR
2. PLUG, DRAIN
3. PUMP BODY
4. SPRING, SEAL
5. WASHER, SEAL
6. O-RING
7. CAGE, SEAL
8. O-RING
9. INSERT
10. BLADE
11. RING, BLADE RET.
12. ROTOR
13. WEAR PLATE
14. WEAR PLATE SPRING
15. PLUG, INSERT
16. O-RING
17. INSERT, BEARING RET
18. PISTON
19. SPRING, VALVE
20. O-RING
21. GUIDE, ADJ
22. SCREW, ADJ
23. LOCKNUT, VALVE
24. RING, RET. (TRU-ARC)
25. ADAPTER
26. SCREWS
27. SCREWS

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Figure 28-14. Electric Fuel Pump

6. Install the insert and rotor assembly into the pump body.
7. Install plug into pump body. Be sure the wear plate spring is between the wear plate and the plug, before installing plug into pump body.
8. Replace the seal cage, seal washer and seal spring on the rotor shaft before installing the motor to the pump body.
9. 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.
10. 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 40 ± 1 psi, maximum no flow.

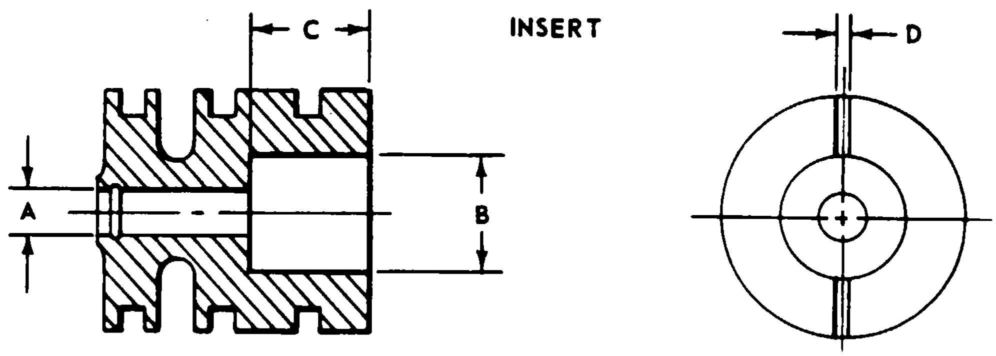
5. Run the pump with the bypass valve open until a steady flow of fuel is obtained. Then close the bypass valve and check the pressure gauge for the proper reading of 40 ± 1 psi, maximum no flow. If boost pump is operated in conjunction with electric fuel pump pressure reading should be 47 to 54 psi, 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.

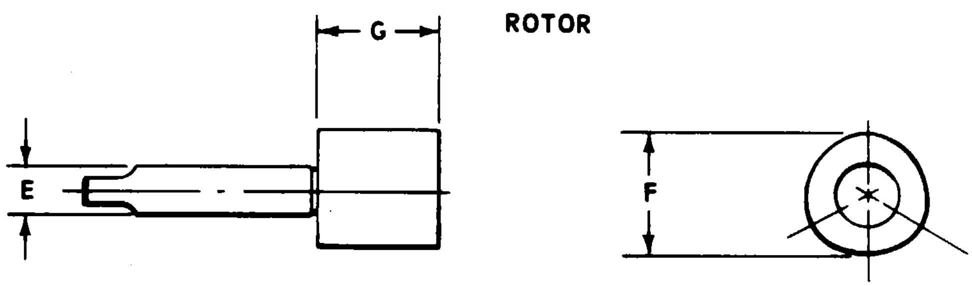
ADJUSTMENT OF ELECTRIC FUEL PUMP (IN THE AIRPLANE).

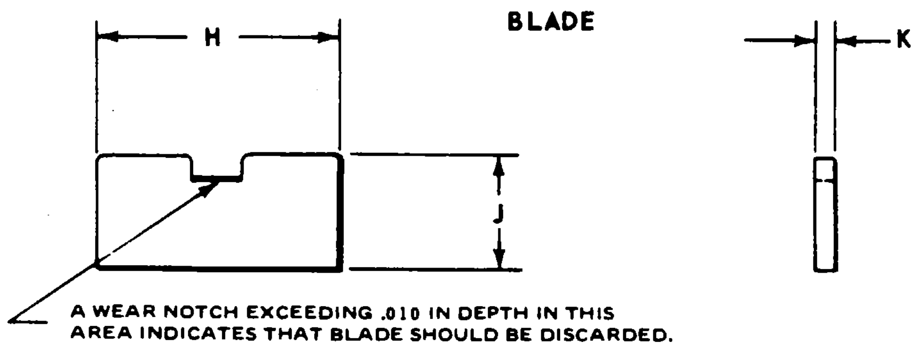
1. With the access panels removed and the fuel shutoff valves in the OFF position, remove the fuel line from the outlet end of the pump.
2. Connect a test line with a bypass valve and pressure gauge to the outlet end of the pump.
3. Place a container below the pump to catch any fuel from the test line during the adjustment of the pump.

CHART 2804. 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.







4. Turn the fuel shutoff valve 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 40 ± 1 psi. maximum no flow. If boost pump is 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 shutoff valve. 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 shutoff valve and secure. Run the pump to check for any fuel leaks.
9. Shut off the pump 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, safety and check for fuel leaks.
6. Install the access plate and secure it.

REMOVAL OF SUBMERGED FUEL PUMPS. (Refer to Figure 28-15.)

1. Drain either the entire system or make sure the crossfeed valve is in the OFF position and either wing may be drained separately without fuel from the opposite side draining also. (Refer to Draining Fuel System. Chapter 12.)
2. Remove the lower wing root fairing from the underside of the wing of which the pump is to be removed.
3. Remove the access plate on top of the wing just ahead of the main spar and next to the fuselage. This will expose the fuel cell cover plate which must be removed also to obtain access to the fuel pump.

4. In the wing root cavity disconnect the electrical connections, fuel and drain lines and shutoff valve from the pump.

— *CAUTION* —

Care should be exercised when removing the fuel line from the shut-off valve and shutoff valve from the pump; so as not to disassemble the shutoff valve.

5. While holding the pump through the cell access opening in the top of the wing, have an assistant remove the four pump mounting bolts in the wing root cavity; then pull the pump up and out of the fuel cell. Either pump is removed in this manner.

INSTALLATION OF SUBMERGED FUEL PUMP. (Refer to Figure 28-15.)

1. Installation of either fuel pump is accomplished by first installing a new gasket on the fuel pump mounting boss; then insert the pump into the cell and hold it in place while an assistant attaches it to the wing butt rub with the four mounting bolts.
2. Reconnect the electrical connections, fuel and drain lines and shutoff valve to their respective positions.
3. Install the fuel cell cover plate and access plate on top of the wing. Fill fuel cell just enough to check for leaks by observing all connections in the wing root cavity.
4. Install the lower wing root fairing.

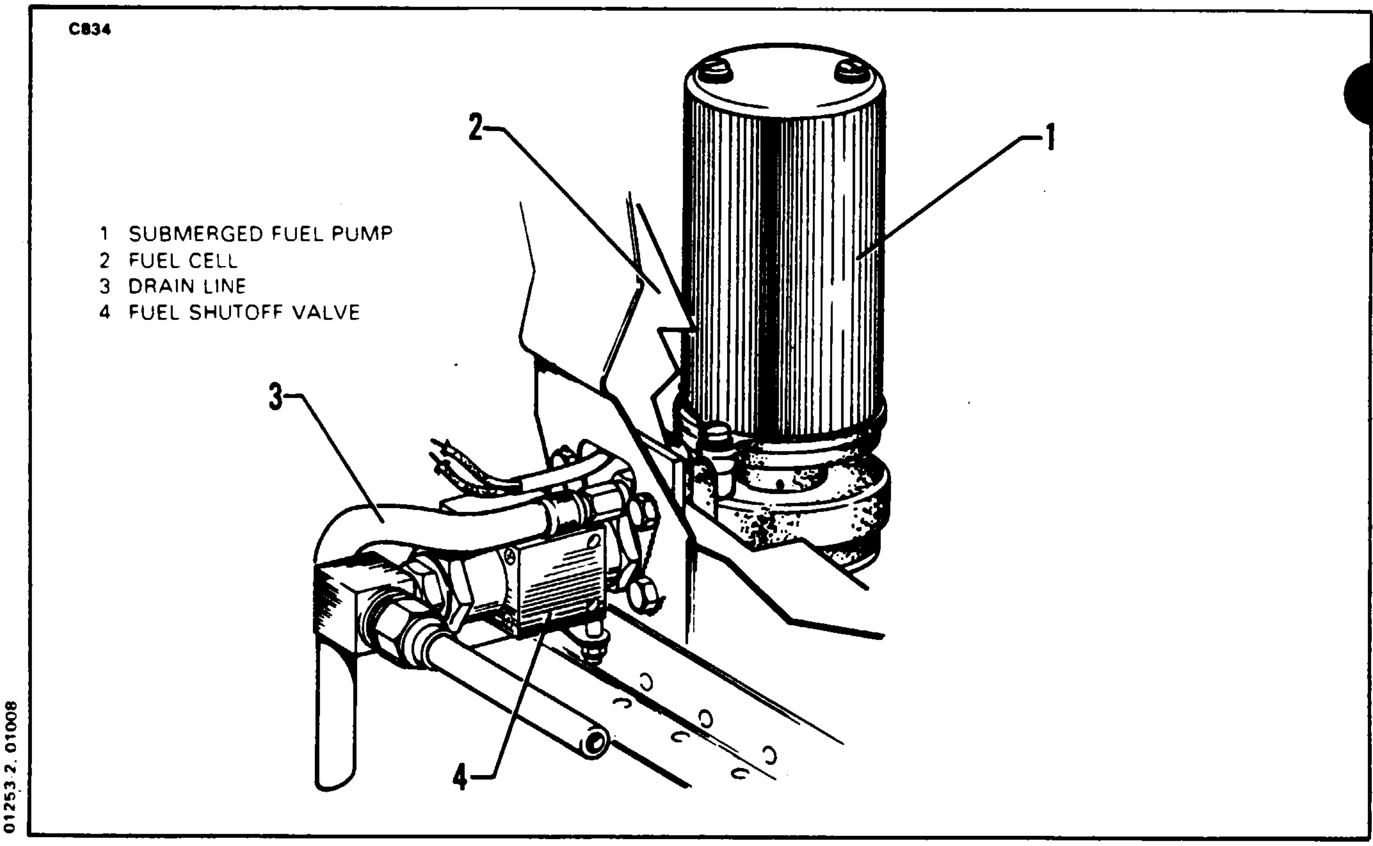


Figure 28-15. Submerged Fuel Boost Pump

INDICATING

DESCRIPTION AND OPERATION

This aircraft incorporates a capacitance sensing fuel gauging system. The system comprises six fuel sensor probes (tank units), two signal conditioner units, and a single indicator with two independent meter displays. A tank unit is installed in all fuel tanks (inboard, outboard, and nacelle) in each wing. These tank units sense the change in capacitance as the portion of the unit immersed in fuel varies. A single tank unit comprises two concentric tubes. A stable ac voltage is applied to the outer tube while the inner tube is held at ground. The tank unit becomes a variable capacitor. Air is a dielectric when the tank is empty; fuel a dielectric as fuel is added to the tank. The fuel indicating system responds to changes in capacitance. As fuel is added to the tank, air is replaced as the dielectric constant by fuel. Since fuel has a higher dielectric constant than air, the tank unit capacitance value increases. This increase changes fuel quantity indication.

The signal conditioner unit is the source for stable ac voltage and the conditioner for the Lo-Z electrical signal which is returned to the indicator. Shielded wire is used for the Hi-Z lead to the fuel sensor probes to minimize the effects of stray capacitance on system accuracy. Termination continuity of the shields and wires must be maintained to ensure system accuracy.

Test equipment as specified in chart 2805 is required for system test and calibration. See figure 28-16 for system component interconnection.

SYSTEM COMPONENT LOCATION

1. Tank units are located under access covers in each wing fuel tank location:
   a. Nacelle tank: Under access cover inboard of fuel filler cap.
   b. Main outboard tank: Under access cover aft of main spar at W.S. 104.50.
   c. Main inboard tank: Under access cover forward of main spar at W.S. 36.00.
   d. Tank unit electrical connectors: Located at each tank unit. Shielded wire center conductor is connected to tank unit H terminal, unshielded wire is connected to L terminal. Both H and L terminations are rubber silicon covered to prevent moisture contamination. The series wiring for each wing tank unit system terminate at connectors E109 (left) and E203(right). The connectors are located under wing leading edge covers between the nacelle and fuselage.
   e. Signal conditioners: On vertical shelf aft of nose baggage compartment (left side).

TEST EQUIPMENT

CHART 2805. TEST EQUIPMENT

Nomenclature	Model No.	Manufacturer	Use
Test Set	2548-H	Barfield Instrument Corp. P.O. Box 420537 4101 N.W. 29th Street Miami, FL 33142	Test Sensor Units or Gauge in aircraft or on bench for electrical leakage, or capacitance, and calibration.
Lead Package	101-00431 -or- 2 coax/BNC jumper cables	Phone: 305-871-3900 Telex: 51-8808	
		or	
Test Set	89-108-2	Ragan Data Systems 3 Oval Drive P.O. Box 417 Central Islip, NY 11722 Phone: 516-234-3800 Telex: 685-2305	(See above)
Probe Harness	Comes with test set		
		or	
Test Set	GTF-12	Gull Airborne 395 Oser Avenue Smithtown, NY 11787 Phone: 516-231-3737 Telex: 968-518	(See above)
Test Harness	Field fabricated		

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NOTES:

1. CONTINUITY OF ALL SHIELDS MUST BE MAINTAINED THROUGHOUT THE SYSTEM WIRING. THE SHIELDS MUST NOT BE CONNECTED TO THE AIRFRAME STRUCTURE AT ANY POINT.
2. ALL WIRE TO BE AWG NO. 20 UNLESS OTHERWISE SPECIFIED.
3. THE EXTENSION OF THE INNER CONDUCTOR OF THE SHIELDED LEADS BEYOND THE POINT OF SHIELD TERMINATION, SHALL NOT EXCEED 3/8 INCH.

GULL PN	NOMENCLATURE	QTY	ITEM
302-918-002	INDICATOR "DUAL"	1	5
360-968-002	SIGNAL CONDITIONER	2	4
014-943-013	NACELLE TANK UNIT	2	3
014-943-012	OUT BD-MAIN TANK UNIT	2	2
014-943-011	INBD-MAIN TANK UNIT	2	1

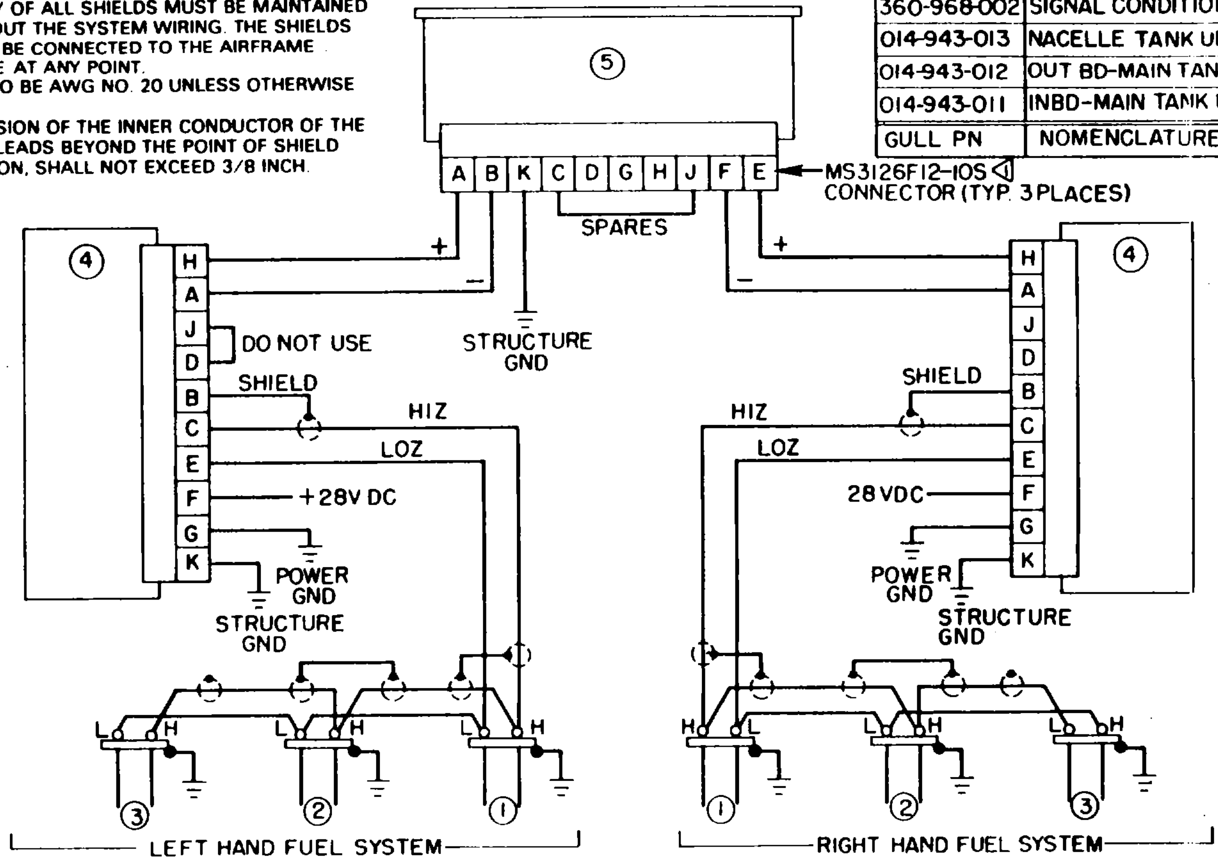

Figure 28-16. System Component Interconnect

REPAIR OF INDICATING SYSTEM

TANK SENSOR UNITS

Periodic overhaul of all tank units is not recommended. If a unit appears to be defective, either clean and retest it, or replace.

CLEANING OF TANK UNITS

All tank sensor units used in this system can be cleaned with trichloroethylene or similar degreasing agent. Cleaning may restore units found unserviceable due to high electrical leakage (under 10 megohms). One to five hundred megohms is normal.

— WARNING —

Trichloroethylene or other type dry cleaning solvents may produce toxic effects. Use in well ventilated area. Repeated contact of these solvents with the skin can produce skin irritation. The use of rubber gloves is recommended.

— CAUTION —

Handle sensor units carefully as any damage to the tubes will destroy the accuracy of the unit

After cleaning the sensor units allow them to air dry. Then check electrical leakage and capacitance.

TESTING TANK SENSOR UNITS

— WARNING —

Use of a hand cranked megohm tester or some other kinds of test equipment CAN CAUSE AN EXPLOSION, if used on TANK UNITS OR THEIR WIRING HARNESS, when in the presence of fuel or combustible vapors. The special equipment listed in Chart 2805 is sold complete with operation instructions to be used for proper calibration of the fuel quantity indicating system components.

The test equipment listed in chart 2805 can be inserted in between an installed fuel quantity indicator and its installed aircraft harness. This allows a quick electrical leakage test of the tank sensor units and their harness, or functional and calibration testing of the fuel quantity indicator. The test equipment can also be used to perform a capacitance calibration test of an individual tank sensor unit mounted in an empty tank.

INDIVIDUAL SYSTEM COMPONENT TESTS

— CAUTION —

Do not touch tank units with hands during capacitance measurement tests. This could result in erroneous capacitance value readings.

TANK UNITS

1. Connect tank unit to be tested. (refer to figure 28-18.)
2. Tank unit empty values must comply with chart 2806

CHART 2806

LOCATION	GULL PART NO.	DRY CAPACITANCE	TOLERENCE
Main Inboard	014-943-011	12.97 pf	+/- 0.50 pf
Main Outboard	014-943-012	24.03 pf	+/- 0.50 pf
Nacelle	014-943-013	11.23 pf	+/- 0.50 pf

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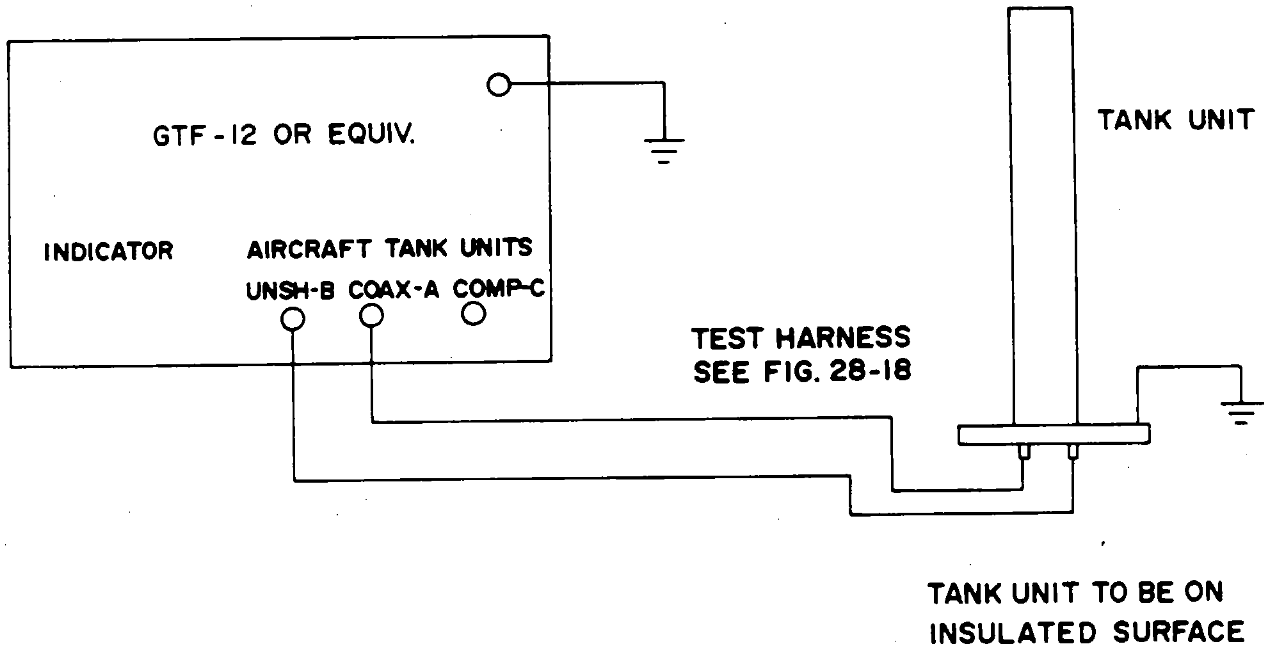

Figure 28-17. Tank Unit Test Set-Up

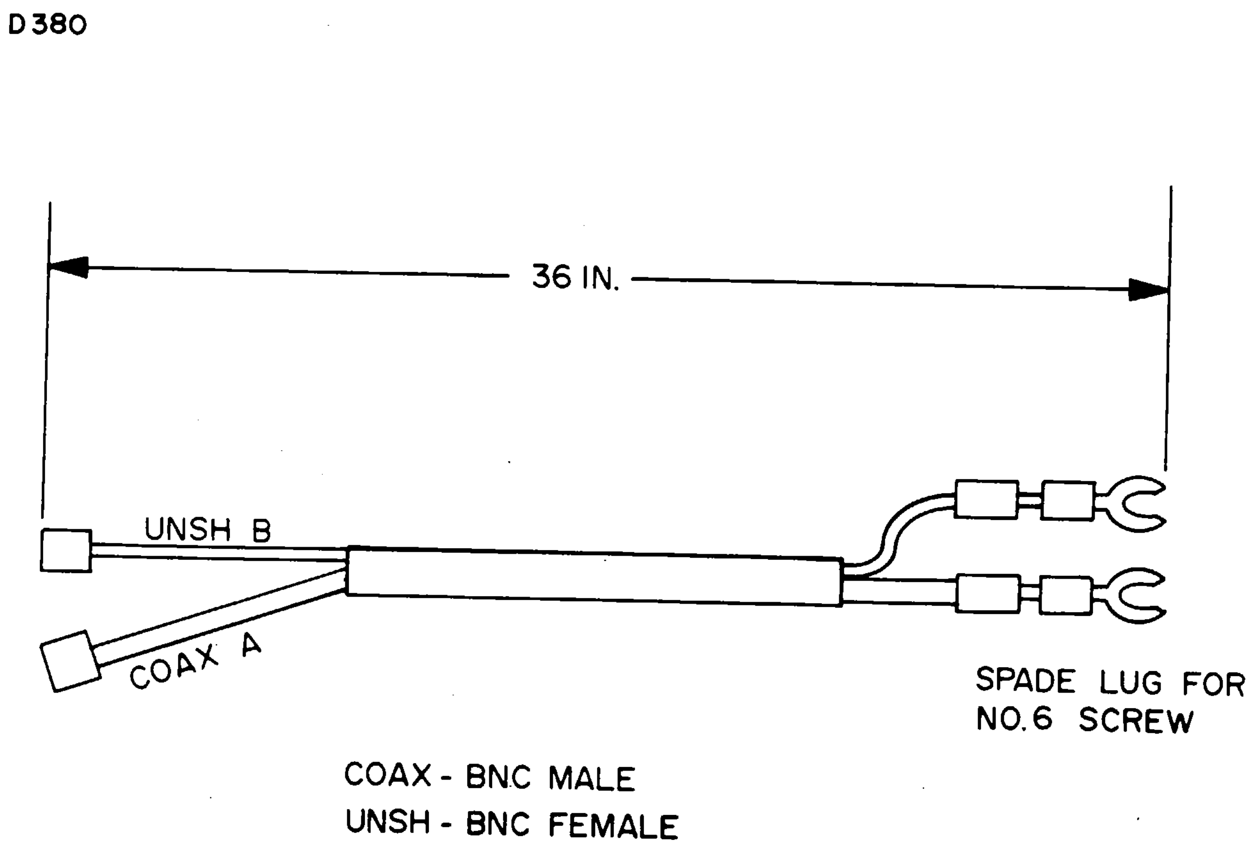

Figure 28-18. Test Harness Tank Units

TESTING INDICATOR

1. Connect indicator to test equipment (refer to figure 28-19).
2. Check indicator balance by positioning pointer at 400 pounds. Rotate indicator 90° clockwise. Pointer must not deviate from 400 pound increment by more than +/- 0.010 ua.
3. Scale error must comply with chart 2807.

CHART 2807

DIAL x 100	MIN. ma	MAX. ma
0	0.029	0.039
3	0.270	0.302
4	0.354	0.386
6	0.522	0.554
9	0.785	0.795

— *NOTE* —

Above readings are valid only when last dial graduation is set to nom. ma 0.794.

— *NOTE* —

Lightly tap indicator before taking reading.

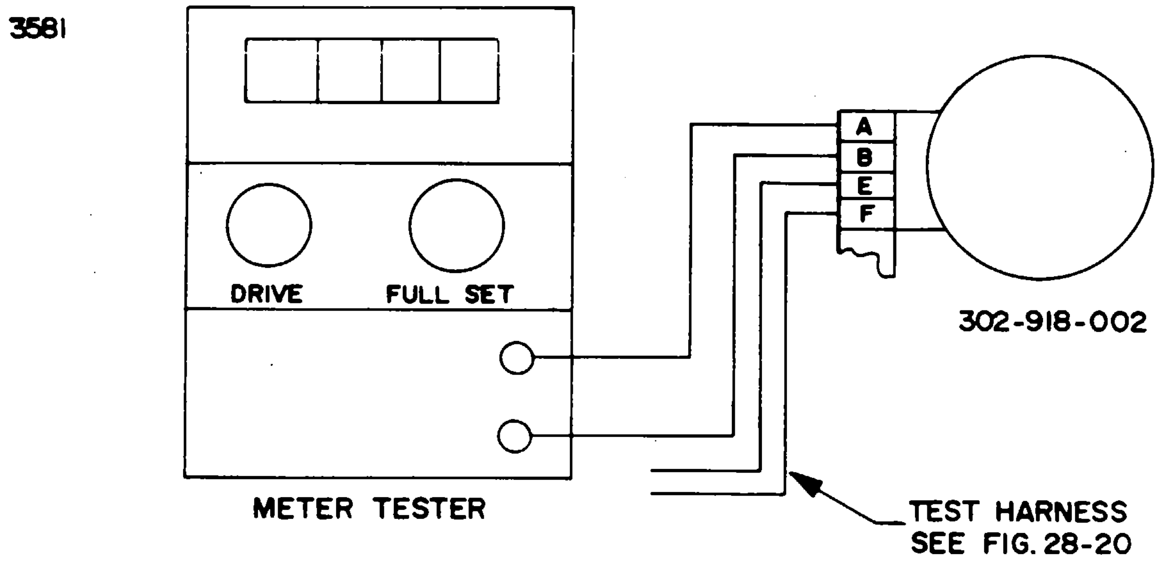

Figure 28-19. Indicator Test Set-Up

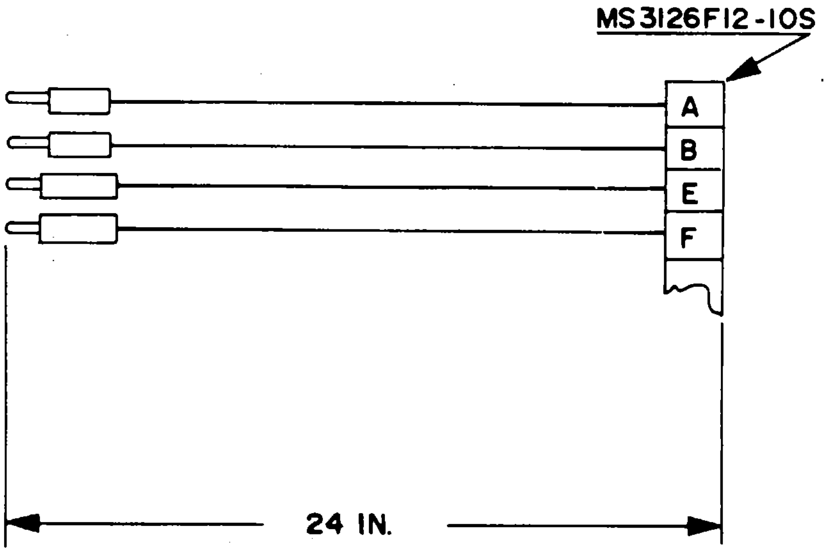

Figure 28-20. Test Harness Indicator

TROUBLESHOOTING

— *WARNING* —

Do not use a hand cranked megohn tester. If used on tank units or their harnesses can cause an explosion when in the presence of fuel or vapors.

CHART 2806. TROUBLESHOOTING (FUEL GAUGING SYSTEM)

The most common source of malfunction is shorted or electrically leaky tank sensor units. This can be caused by exposure to contaminated fuel or corrosive environments. The first test on a troublesome system should be to run a 10 or more megohm test of the tank sensor system in each wing.

Trouble	Possible Cause	Remedy
Dead - gauge does not come up to zero pounds.	No D.C. power to gauge.	Correct loss of +24 VDC to gauge pin F, or ground to pin G.
Dead gauge even with 24 VDC from F to G.	Shorted Lo Z wire or open meter circuit.	Remove Signal Conditioner - check for short from pin E to ground - check between pins H and A for open meter circuit . . . about 320 ohms is normal.
Power to Signal Conditioner OK and pin E (Lo Z) not shorted and meter OK . . . still dead.	Dead Signal Conditioner.	Swap with a working Signal Conditioner (other side OK?) to see if Conditioner is bad.
Meter still won't read, but D.C. power OK, E not shorted, meter OK, Conditioner works on other side.	Open probe or shorted probe wiring.	Use the special test equipment to verify more than 10 megohms from C (Hi Z) to B (its shield) or to G (ground). Then measure capacitance for reasonably between 52 pf. (EMPTY) and 96 pf. (FULL).
Both meters read something, but one side is too high or too low.	One Signal Conditioner is not calibrated.	Recalibrate per the section on CALIBRATION.
One side will not properly calibrate or reads uneven fuel burn.	Dirty or contaminated probe.	Measure resistance between Hi Z and Lo Z, and between either of them and the Hi Z shield or airframe ground. A resistance of under 10 megohms must be cleaned or cleared . . . 100 to 500 megohms is normal.

TESTING OF SIGNAL CONDITIONER (p/n 360-968-002)

1. Connect signal conditioner to test equipment (refer to figure 28-21).
2. Set GTF probe for 51.70 pf (normal empty tank value of all tank units and cable strays).
3. Apply 28 Vdc to the signal conditioner being tested.
4. Digital multimeter should be at 0.034 ma. If not, adjust EMPTY pot. on signal conditioner for 0.034 ma.
5. Set probe simulator for 108.60 pf (normal value for full tanks.
6. Digital multimeter should read 0.790. If not, adjust FULL pot. for 0.790.
7. Repeat steps 2 through 6 until no further adjustment is necessary.

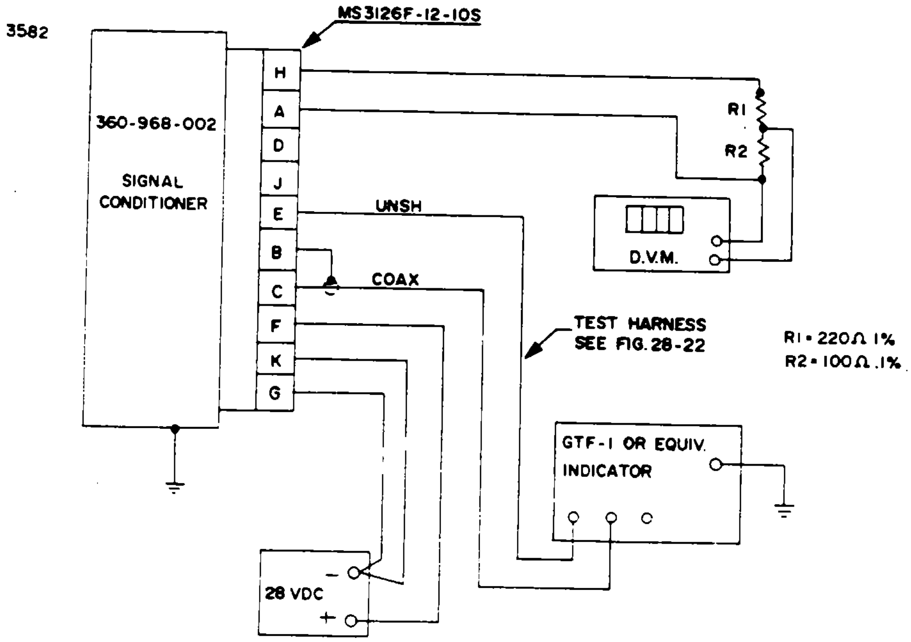

Figure 28-21. Signal Conditioner Test Set-Up.

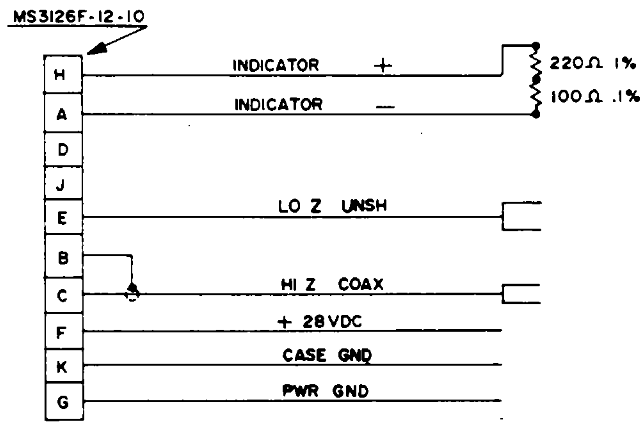

Figure 28-22. Test Harness Signal Conditioner

CALIBRATION PROCEDURE (DRY)

1. Completely drain the fuel system.
2. Check that the fuel quantity circuit breaker on the essential bus is in.
3. Check that all distribution circuit breakers forward of the crossfeed shutoffs are in.
4. Set the battery master switch to OFF.
5. Connect external power to the aircraft. Increase voltage until 28 +/- Vdc is observed on the voltmeter on the overhead panel.
6. Use a Barfield #2548-H Capacitance Fuel System Test Set or other appropriate equipment (refer to chart 2805) to test the capacitance of the left and right fuel system probes. Measure capacitance of ship system probes and harnesses at the signal conditioner (refer to figure 28-33).
7. System capacitance must be 51.80 +/- 2.2 pf. If capacitance value is not within limits, the probes and system must be corrected and rechecked individually.
8. Remove Barfield unit. Hook up ship system and add 2½ gallons of fuel to each side. Adjust quantity indicator to read zero (needle lined up with the inside edge of the white zero line) by adjusting the EMPTY screw on the signal conditioner (refer to figure 28-23).
9. Reinstall test equipment. Add 44.4 pf to the capacitance obtained from step 6 to simulate 120 +/- 2 gallons by adjusting the FULL screw o the signal conditioner (refer to figure 28-23). If no adjustment is necessary, stop with this step.
10. If indicator is off by more than 4 gallons, it is necessary to repeat steps 7 through 10 to calibrate the fuel gauge within limits.
11. After fuel gauge reads within limits, proceed to wet calibration procedure (this chapter).

— CAUTION —

Dry calibration procedure is not sufficient to ensure system accuracy. It is always necessary to conduct the wet calibration procedure to ensure complete accuracy.

— NOTE —

No error allowed at zero reading.

CALIBRATION PROCEDURE (WET)

1. Level airplane both laterally and longitudinally. Block the struts.
2. Drain all fuel from fuel tanks (both sides).
3. Check that the fuel quantity circuit breaker on the essential bus is in. Check that all distribution circuit breakers forward of the crossfeed shutoff are in. Set the battery master to OFF.
4. Connect external power to the airplane. Increase voltage until 28 +/- 1 Vdc is observed on the voltmeter located on the overhead panel.
5. Add 2½ gallons of fuel to each side. Wait ten minutes and adjust indicator (if necessary) to read zero by adjusting the EMPTY screw on the signal conditioner (refer to figure 28-23).
6. Add fuel in measured increments of 225 pounds to each side. Wait ten minutes between each addition of fuel and check indicator for accuracy after each increment. System accuracy +/- 5% of full scale for each side.
7. Adjust when full by adjusting the FULL screw on the signal conditioner (see figure 28-23) to agree with the known weight of fuel added. Do not make any adjustment at full if accuracy of indicator is within +/- 30 pounds of known weight. Make no adjustment in excess of +/-45 pounds.
8. If system accuracy does not meet allowable tolerances, test individual components and replace faulty units. Repeat calibration procedure.

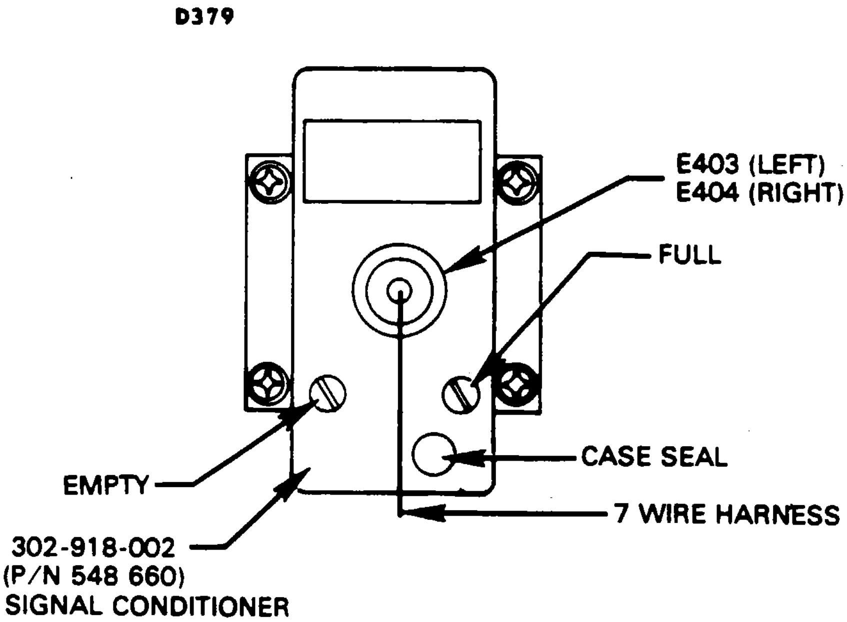

Figure 28-23. Signal Conditioner

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CHAPTER

29

HYDRAULIC POWER

CHAPTER 29 - HYDRAULIC POWER

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CHAPTER 29 - HYDRAULIC POWER (cont.)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 29 - HYDRAULIC POWER (cont.)

TABLE OF CONTENTS/EFFECTIVITY

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, 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.	Refer to Hydraulic System Failure. Fill the power pack with hydraulic fluid.
	Leak or obstruction in hydraulic lines.	Refer to Hydraulic System Failure. 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 out of adjustment.	Adjust control.
	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.

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont.)

Trouble	Cause	Remedy
Selector handle returns to neutral before cycle is complete. (cont.)	If gear completes cycle (red light out) but doors do not close battery output may be low	Check voltage.
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.	Improper rigging of door actuator.	Check for proper rigging.
NOTE Refer to Landing Gear Troubleshooting Chart 3201.	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.
	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.)

MAIN HYDRAULIC SYSTEM.

SERVICING HYDRAULIC 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. Flush the system as follows:

1. Remove the engine cowlings as explained in Chapter 71.
2. Drain the hydraulic fluid from the power pack reservoir.
3. Disconnect the hydraulic lines at the engine driven pumps.
4. Disconnect the hydraulic lines at the actuating cylinders and drain the fluid from all the hydraulic lines.
5. Remove the filter elements, flush out the filter bowls and install new filter elements.
6. Flush the hydraulic system with clean hydraulic fluid (MIL-H-5606). Examine seals and cylinder bores for damage.
7. When the hydraulic system is completely flushed and there is no further 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.

FILLING HYDRAULIC RESERVOIR.

Refer to Chapter 12, Filling Hydraulic System Reservoir.

BLEEDING THE HYDRAULIC SYSTEM.

1. Jack the airplane. Refer to 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.

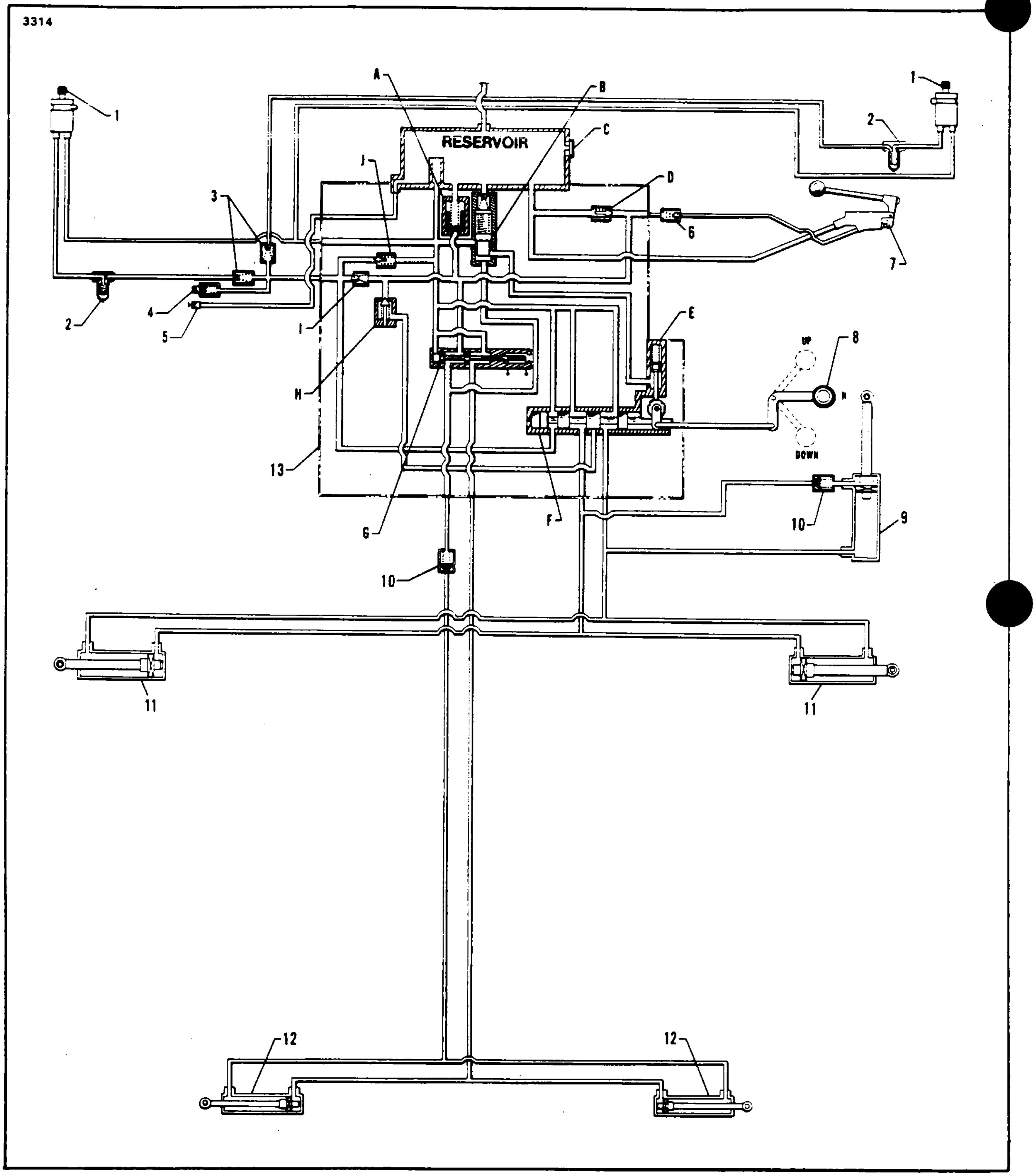

Figure 29-1. Schematic Diagram of Hydraulic System

1. ENGINE DRIVEN HYDRAULIC PUMP
2. HYDRAULIC FILTER
3. DUAL PUMP CHECK VALVES
4. PRESSURE PORT
5. SUCTION - FILL
6. HAND PUMP CHECK VALVE
7. HAND PUMP
8. GEAR SELECTOR HANDLE
9. NOSE GEAR ACTUATOR
10. RESTRICTOR VALVE
11. MAIN GEAR ACTUATOR
12. MAIN GEAR DOOR ACTUATOR
13. POWER PACK ASSEMBLY
    - A. LOW PRESSURE THERMAL RELIEF VALVE
    - B. TIME DELAY VALVE
    - C. SIGHT GAUGE
    - D. HAND PUMP RELIEF VALVE
    - E. PISTON RELEASE (LOCK)
    - F. LANDING GEAR SELECTOR VALVE
    - G. DOOR SOLENOID VALVE
    - H. PRIORITY VALVE
    - I. ENGINE PUMP CHECK VALVE
    - J. MAIN RELIEF VALVE

Figure 29-1. Schematic Diagram of Hydraulic System (cont.)

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NOTE

1. GEAR IS SHOWN DOWN AND LOCKED. DOORS CLOSED AND SELECTOR HANDLE IN DOWN NEUTRAL, POWER ON.

2. POWER ON - DOORS CLOSED
   POWER OFF - DOORS OPEN

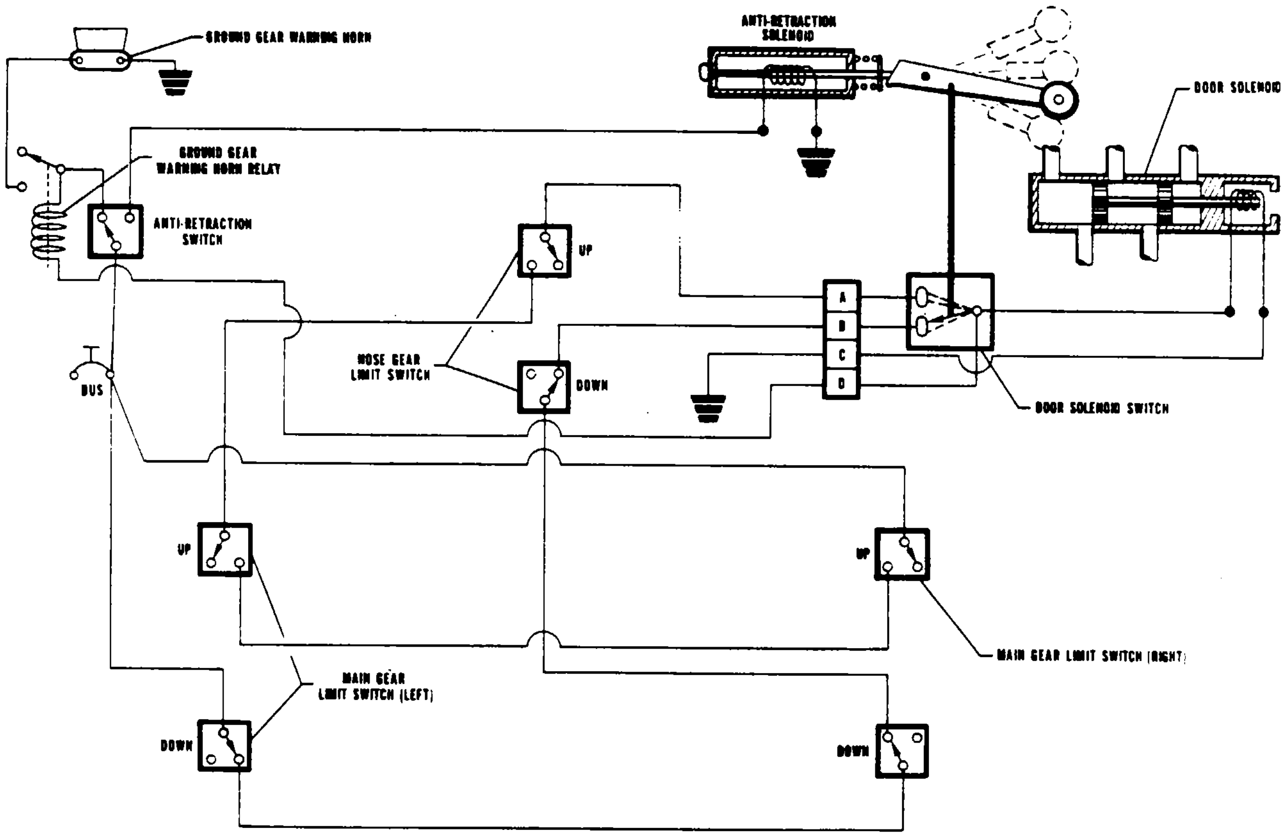

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Figure 29-2. Schematic of Power Pack Electrical System

TESTING SYSTEM.

The Piper Hydraulic Test Unit (Part No. 753 080) offers 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.

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.
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 forward 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.

DISCONNECTING TEST UNIT.

1. Ascertain that the landing gear selector is in the down position, and the landing gear is down and locked.
2. Shut down the test unit per instructions supplied with the unit.
3. Close the suction-fill-drain valve in the airplane by placing the control lever in the down position 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. Install the access panel on the right side of the nose section.

CYCLING LANDING GEAR.

— *CAUTION* —

DO NOT use the manual hand pump located between the pilot and copilot seats for this operation.

1. Connect the hydraulic test unit as described in Connecting Test Unit and jack the airplane as outlined in Chapter 7.
2. Set the hydraulic test unit bypass valve open.
3. Start the test unit pump motor.
4. Slowly close the bypass valve.
5. Using the landing gear control handle in the airplane, operate the gear as desired.

— *NOTE* —

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, open the test unit bypass valve and stop the pump motor.
7. Disconnect the hydraulic test unit as described in Disconnecting Test Unit.
8. Ascertain that the landing gear selector handle is in the down neutral position, and that the landing gear is down and locked.
9. Check the indicator lights for proper operation.
10. Remove the airplane from jacks.

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. (Refer to Checking Time Delay Valve for cycle time).

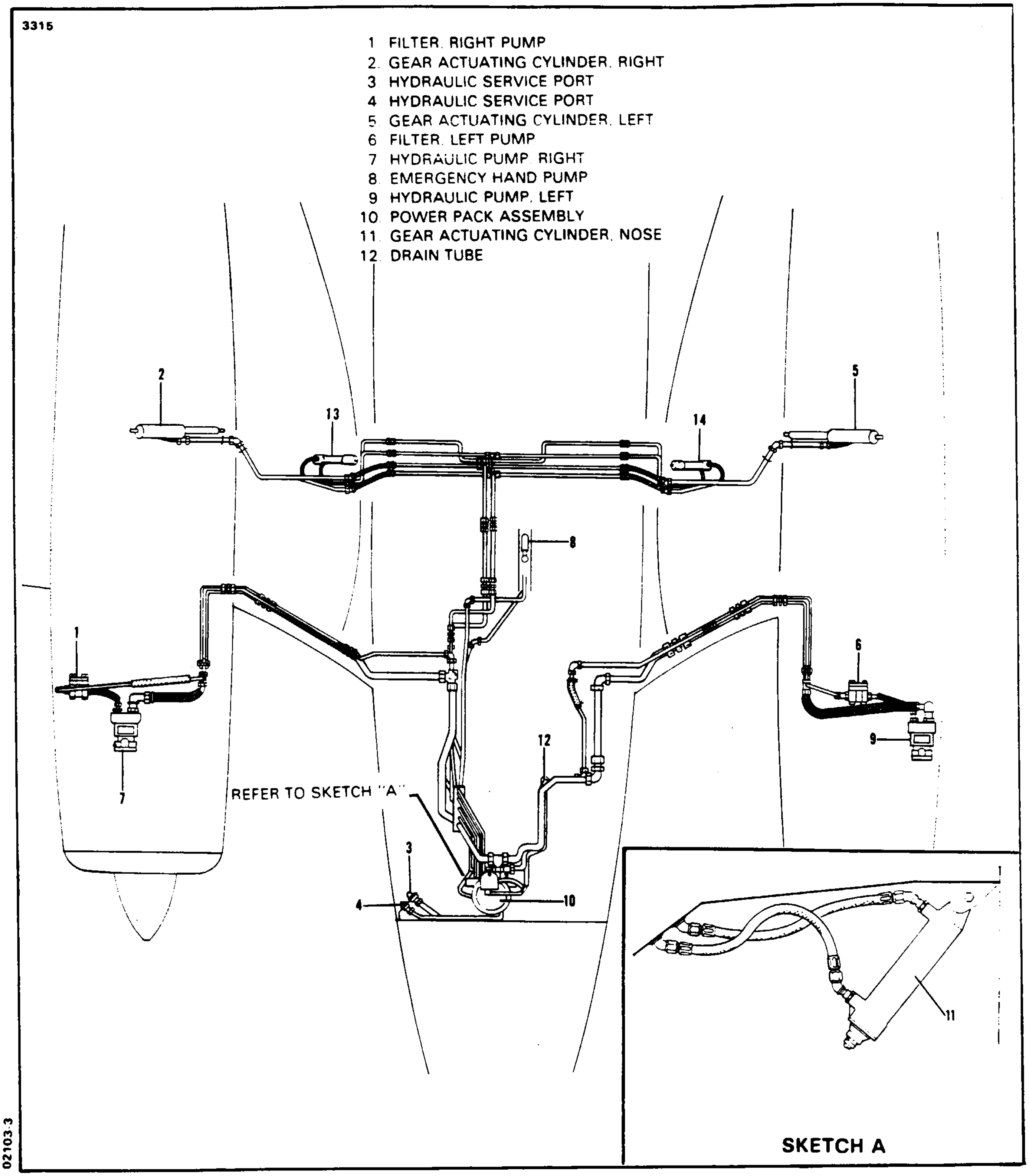


Figure 29-3. Hydraulic System Installation

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 9 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.

CHECKING TIME DELAY VALVE.

1. Place the airplane on jacks.
2. Connect the hydraulic test unit as described in "Connecting Test Unit."
3. 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 5 to 9 seconds at room temperature. Colder temperature will cause a longer delay.

4. If the time delay fails specification given ascertain that the 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.
5. There is no adjustment of the time delay valve. If it is defective, replace it.
6. 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 inboard 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 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.

CHART 2902. LEADING PARTICULARS, HYDRAULIC POWER PACK (WIEBEL)

NOMENCLATURE	WTC 2135-1
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 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	800 - 1250 P.S.I.
Time Delay Valve	5 to 9 seconds
Hydraulic Fluid Required	MIL-H-5606
Weight Dry - Power Pack	10.5 pounds
Hydraulic Fluid Flow Rate (Both Pumps Operating)	1.6 G.P.M.

— *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 is listed in Chart 2902.
5. The power pack main relief valve adjustment is accomplished with the power pack installed in the airplane. Remove the cover 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 as indicated in Chart 2902.
5. The Power Pack hand pump relief valve adjustment is accomplished with the Power Pack installed in the airplane. Remove the cover to gain access to adjusting screw.
6. Open bypass valve on test unit to release the pressure and 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.

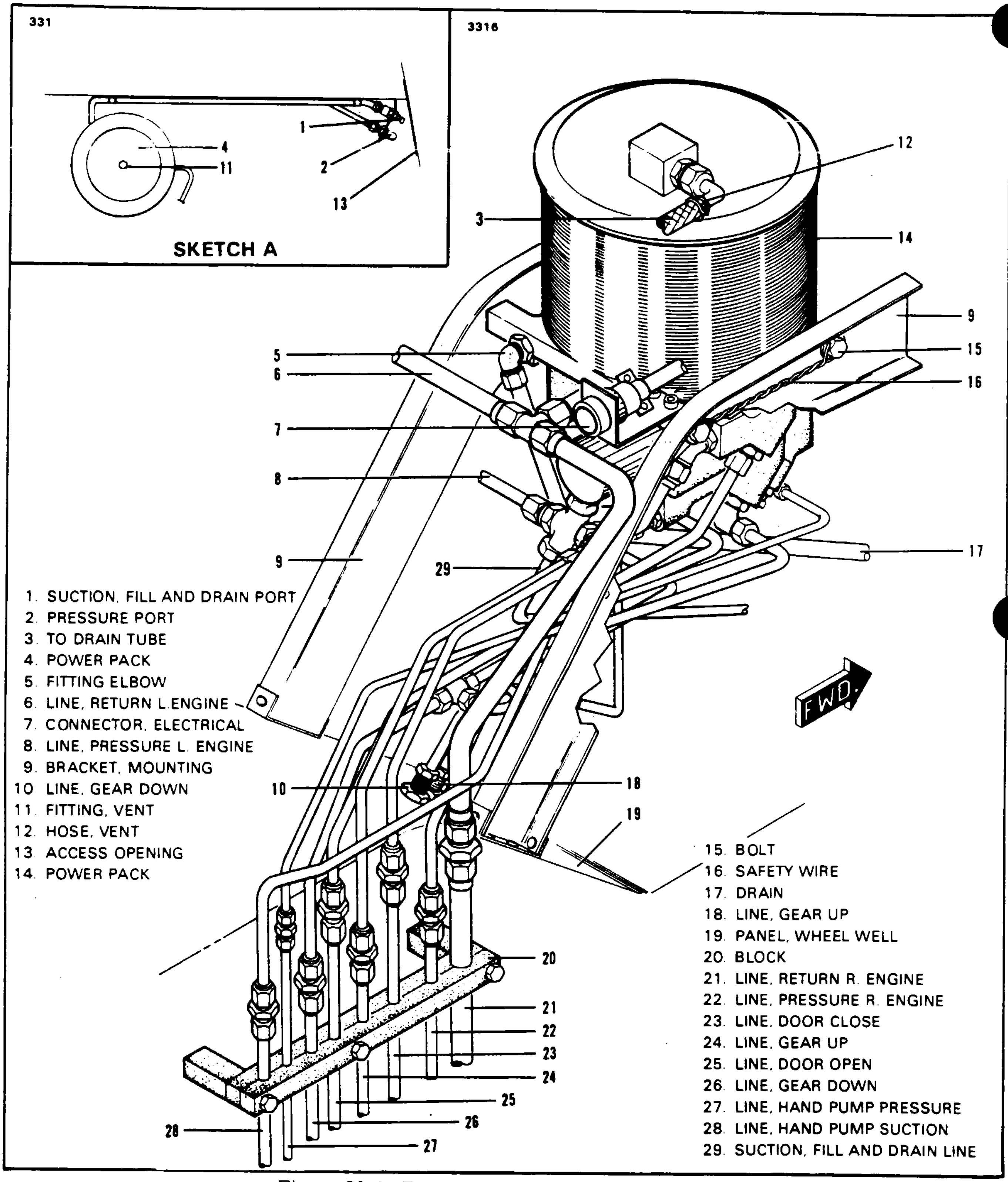


Figure 29-4. Power Pack Installation (Typical)

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.

HYDRAULIC POWER PACK.

REMOVAL OF POWER PACK.

1. Remove the access panels to the Power Pack on both sides of the fuselage nose section. Also, remove the upper access panel on the aft bulkhead of the forward baggage compartment.

— NOTE —

All disconnect and removal work can be accomplished from the upper baggage compartment access or right access panel.

2. Drain the Power Pack by removing the drain cap from the end of the drain line on the right side of the fuselage nose section. Place a suitable container under the drain to catch the fluid. Replace the cap after the reservoir is empty.
3. To gain access to Power Pack, remove combustion air blower, condenser and appropriate hoses from right side of fuselage nose section.
4. Disconnect the electrical connector located at the aft end of the Power Pack.
5. Disconnect the vent line from the Power Pack cap.
6. Disconnect the gear selector control cable from the Power Pack control arm on the left side of the Power Pack.
7. Disconnect the various hydraulic lines from the Power Pack. Cap the open lines to prevent contamination.
8. Cut the safety wire and remove the attachment bolts which secure the Power Pack to the mounting brackets.
9. Move the Power Pack to the rear and then out the right access panel.

INSTALLATION OF POWER PACK.

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 aft end of the Power Pack and the landing gear selector cable to the selector arm.
4. Replace the combustion air blower, condenser and appropriate hoses from right side of fuselage nose section.
5. Fill the Power Pack as described in Chapter 12.
6. Bleed the system as described in Bleeding the Hydraulic System, Chapter 29.
7. Replace the access panels on both sides of the airplane nose section.
8. Check the system operation.

DISASSEMBLY, CLEANING, INSPECTION AND REPAIR OF HYDRAULIC POWER PACK AND COMPONENTS.

POWER PACK. (Refer to Figure 29-5.)

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 the 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.

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.)

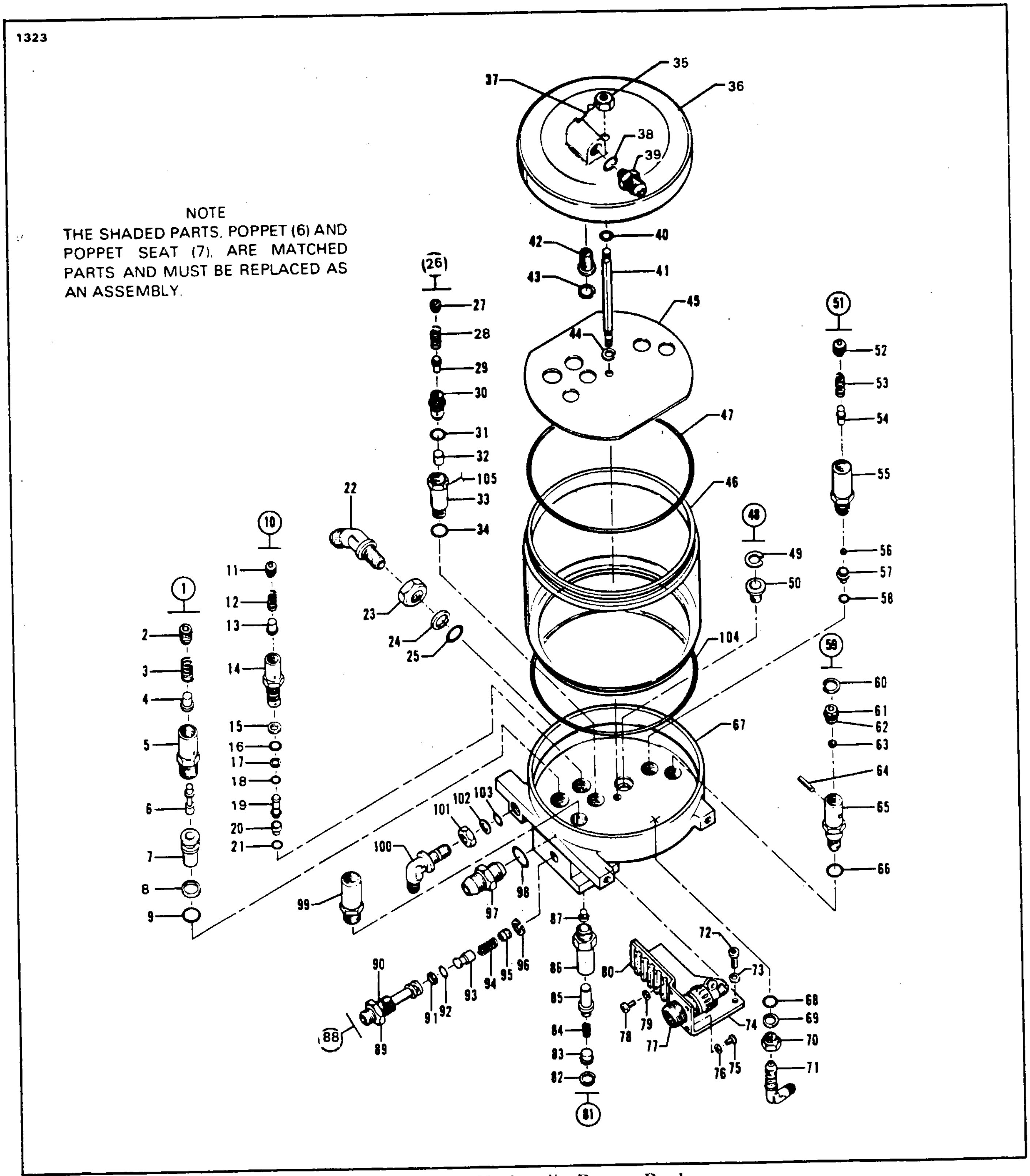
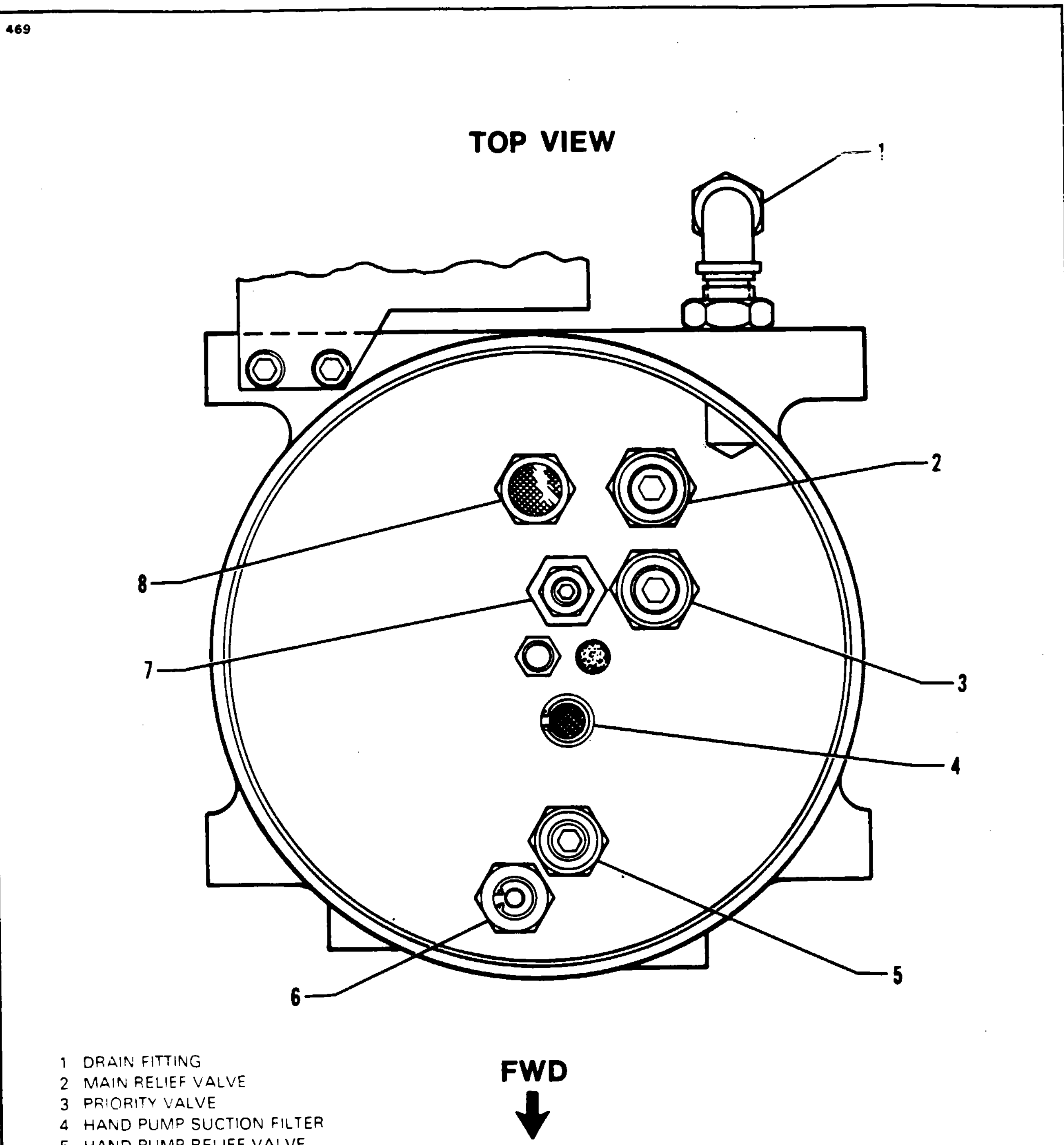


Figure 29-5. Hydraulic Power Pack

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 29-5. Hydraulic Power Pack (cont.)



1 DRAIN FITTING
2 MAIN RELIEF VALVE
3 PRIORITY VALVE
4 HAND PUMP SUCTION FILTER
5 HAND PUMP RELIEF VALVE
6 TIME DELAY CHECK VALVE
7 DOOR VENT VALVE
8 STANDPIPE FILTER

Figure 29-6. Location of Power Pack Components. - Wiebel

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.

MANIFOLD. (Refer to Figure 29-7.)

1. Remove the door solenoid by unscrewing it from the manifold. Use 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.

— 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 P-S-661 or equivalent) and dry with filtered, compressed air. Be sure internal passages are clean. Reinstall caps on fittings.

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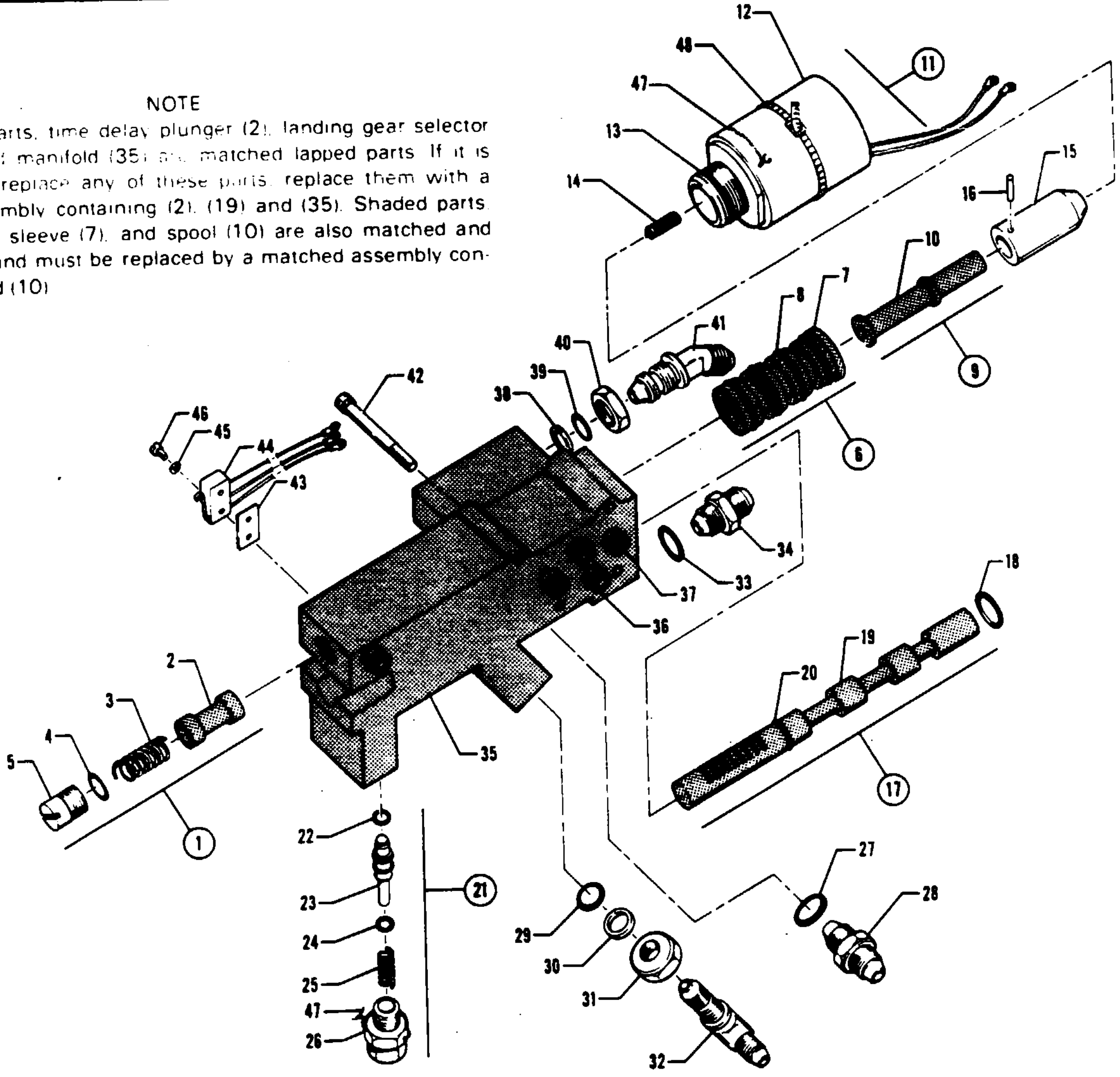
NOTE

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 BACK UP
31 NUT
32 FITTING
33 O-RING
34 FITTING
35 MANIFOLD ASSEMBLY
36 SLEEVE TRANSFER
37 O-RING
38 O-RING
39 BACK UP
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

HAND PUMP SUCTION SCREEN. (Refer to Figure 29-5.)

1. Remove the suction screen by removing the snap ring.

HAND PUMP RELIEF VALVE. (Refer to Figure 29-5.)

1. Remove the adjusting screw at the top of the hand pump relief valve.
2. Remove the hand pump relief valve body by unscrewing from the body.
3. Remove the spring and the stem from body.
4. Remove ball.
5. Use a brass hook and remove the seat from the body. Be careful not to score the bore.
6. Remove the O-ring from the bottom of the cavity.

MAIN RELIEF VALVE. (Refer to Figure 29-5.)

1. Remove the adjusting screw at the top of the main relief valve.
2. Remove relief valve body with 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 body. Hook through the holes in the side of the seat and use care not to damage the bore in the body.
5. Reassemble the poppet into poppet seat. The poppet and poppet seat are matched parts.

PRIORITY VALVE. (Refer to Figure 29-5.)

1. Remove the adjusting screw at the top of the priority valve.
2. Remove priority valve body with 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. Remove the O-ring from the bottom of the cavity.

HAND PUMP CHECK VALVE. (Refer to Figure 29-5.)

1. Remove the fitting from the body.
2. Remove the snap ring from fitting.
3. Remove guide, spring and poppet.

STANDPIPE-FILTER. (Refer to Figure 29-5.)

1. Remove the standpipe-filter from body.

VENT FILTER. (Refer to Figure 29-5.)

1. Remove snap ring and pull out filter.

DOOR VENT VALVE. (Refer to Figure 29-5.)

1. Remove adjusting screw from top of retainer.
2. Remove vent valve body from body.
3. Remove spring and stem.
4. Cut wire and remove retainer from vent valve body.
5. Remove O-ring and piston.

TIME DELAY CHECK VALVE. (Refer to Figure 29-5.)

— 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.

1. Remove check valve body from body.
2. Remove snap ring.
3. Using a brass hook, pull out seat.
4. Remove ball.

LANDING GEAR SPRING CARTRIDGE ASSEMBLY. (Refer to Figure 29-5.)

1. Remove the two handle-release bodies from body.
2. Remove snap rings, buttons, springs and plungers.

— CAUTION —

Take care when removing snap rings, cartridges are spring loaded.

POWER PACK HANDLE-RELEASE MECHANISM. (Refer to Figure 29-8.)

1. Remove lockwire.
2. Using a punch, drive the roll pin out of the arm and remove arm.
3. Using a punch, drive the roll pin out of the return cam, and remove return cam.
4. Pull the input shaft assembly from Power Pack.

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.
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.

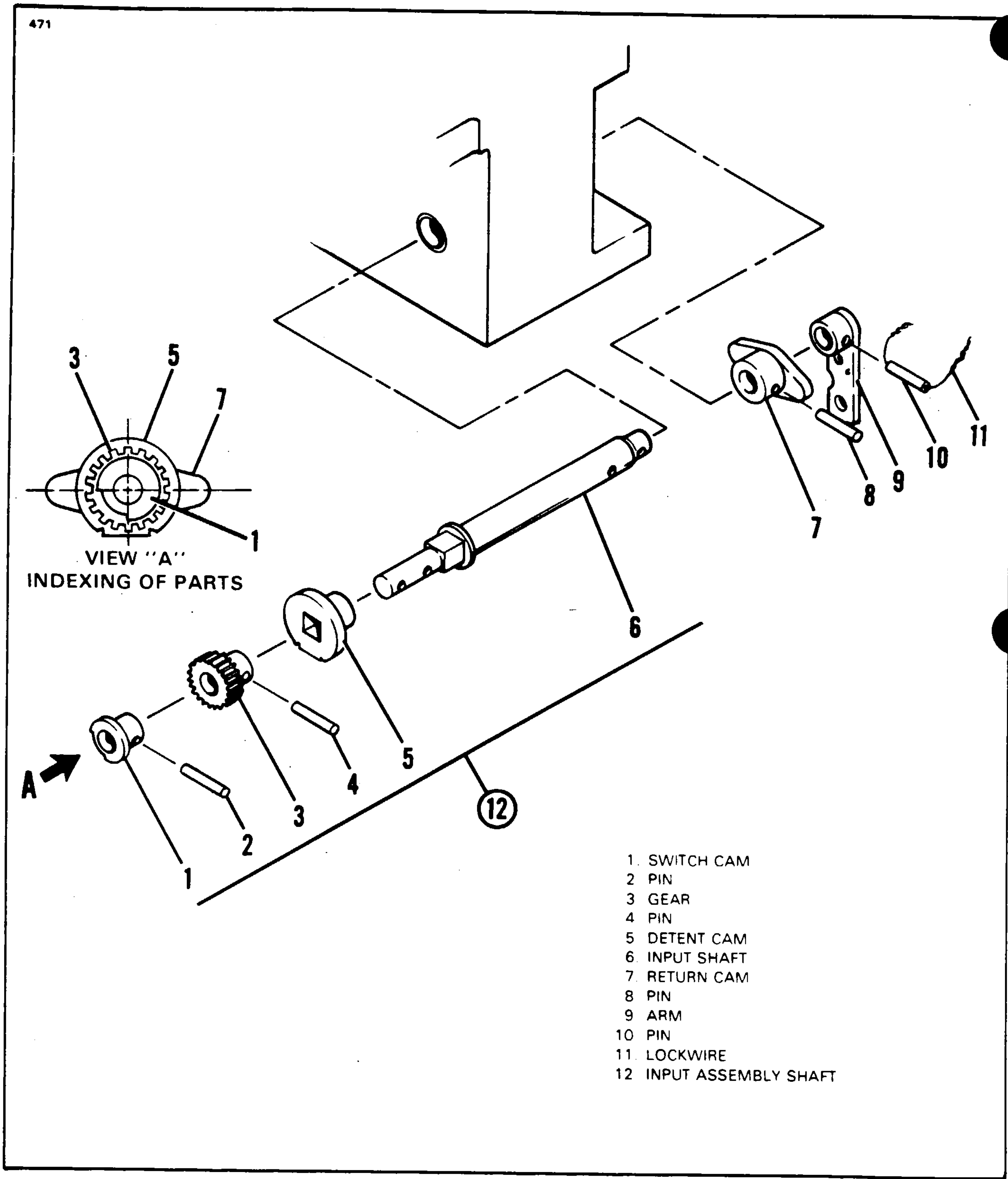


Figure 29-8. Power Pack Handle Release Mechanism - Wiebel

ASSEMBLY, INSTALLATION AND ADJUSTMENT OF POWER PACK COMPONENTS.

There are three basic rules to remember when reassembling the Power Pack and its component parts.

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.

TIME DELAY CHECK VALVE. (Refer to Figure 29-5.)

1. Install ball into check valve body.
2. Lubricate and install the O-ring in the seat.
3. Install seat into check valve body and secure with snap ring.
4. Lubricate threads, install O-ring on the valve body and install the assembly into the body. Torque to 45 inch-pounds.

DOOR VENT VALVE. (Refer to Figure 29-5.)

1. Install the piston into the vent valve body.
2. Lubricate and install the O-ring on the retainer, screw retainer into the valve body, tighten and secure with safety wire.
3. Install stem, spring and adjusting screw into the retainer. Install adjusting screw flush.
4. Lubricate threads, install O-ring on the valve body and install assembly into body. Torque to 55 inch pounds.

VENT FILTER. (Refer to Figure 29-5.)

1. Install vent filter into reservoir cover and secure with snap ring.

STANDPIPE-FILTER. (Refer to Figure 29-5.)

1. Install standpipe-filter into body. Torque to 55 inch pounds.

HAND PUMP CHECK VALVE. (Refer to Figure 29-5.)

1. Install poppet, spring and guide into fitting and secure with snap ring.
2. Lubricate threads, install O-ring, back up and O-ring on the fitting and install assembly into body. Torque to 55 inch-pounds.

PRIORITY VALVE. (Refer to Figure 29-5.)

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 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 install assembly into body. Torque to 70 inch-pounds.
4. Install button and spring and secure with adjusting screw. The adjusting screw provides adjustment for the priority valve. Install flush at this time.

MAIN RELIEF VALVE. (Refer to Figure 29-5.)

1. Inspect the poppet and the poppet seat for 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 into the body.
3. Lubricate threads and install relief valve body into the 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 for the main relief valve. Install flush at this time.

HAND PUMP RELIEF VALVE. (Refer to Figure 29-5.)

1. Lubricate and install O-ring into the body.
2. Inspect the seating surface of the seat. Seating edge has to be sharp, lap if necessary to obtain a clear sharp edge.
3. Drop ball into the cavity of the hand pump relief valve body and install seat into the body, trapping the ball between the two parts.
4. Lubricate threads and install assembly into the body. Torque to 70 inch-pounds.
5. Insert the stem and the spring into the valve body and install adjusting screw. The adjusting screw provides adjustment for the hand pump relief valve. Install flush at this time.

HAND PUMP SUCTION SCREEN. (Refer to Figure 29-5.)

1. Install the filter into the body and secure with snap ring.

RESERVOIR. (Refer to Figure 29-5.)

1. Install center stud into body and torque to 45 inch-pounds.
2. Lubricate both large O-rings and install on reservoir.
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.

MANIFOLD (ASSEMBLY). (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, replace as an assembly.

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.

— CAUTION —

If the selector spool is not protruding .06 inches out of the manifold opposite the rack when installing into the body (see Figure 29-5), 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. O-ring could be caught and damaged, and would have to be replaced by a new 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 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 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 assembly into manifold. Screw to be flush with outside of manifold.

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 face on return cam boss and reinstall 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 29-8 and 29-9.)

MANIFOLD (INSTALLATION). (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 the 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 the 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 O-rings and install on plunger.
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.

INSTALLATION AND ADJUSTMENT OF INBOARD GEAR DOOR SWITCH.

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 29-5) and secure to solenoid using plastic strap.

— *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 29-5.) Install plungers, springs and button into the handle release bodies and retain with snap rings.
6. (Refer to Figure 29-5.) Install the handle release assemblies in the body. Install assemblies loose, they will be adjusted later.

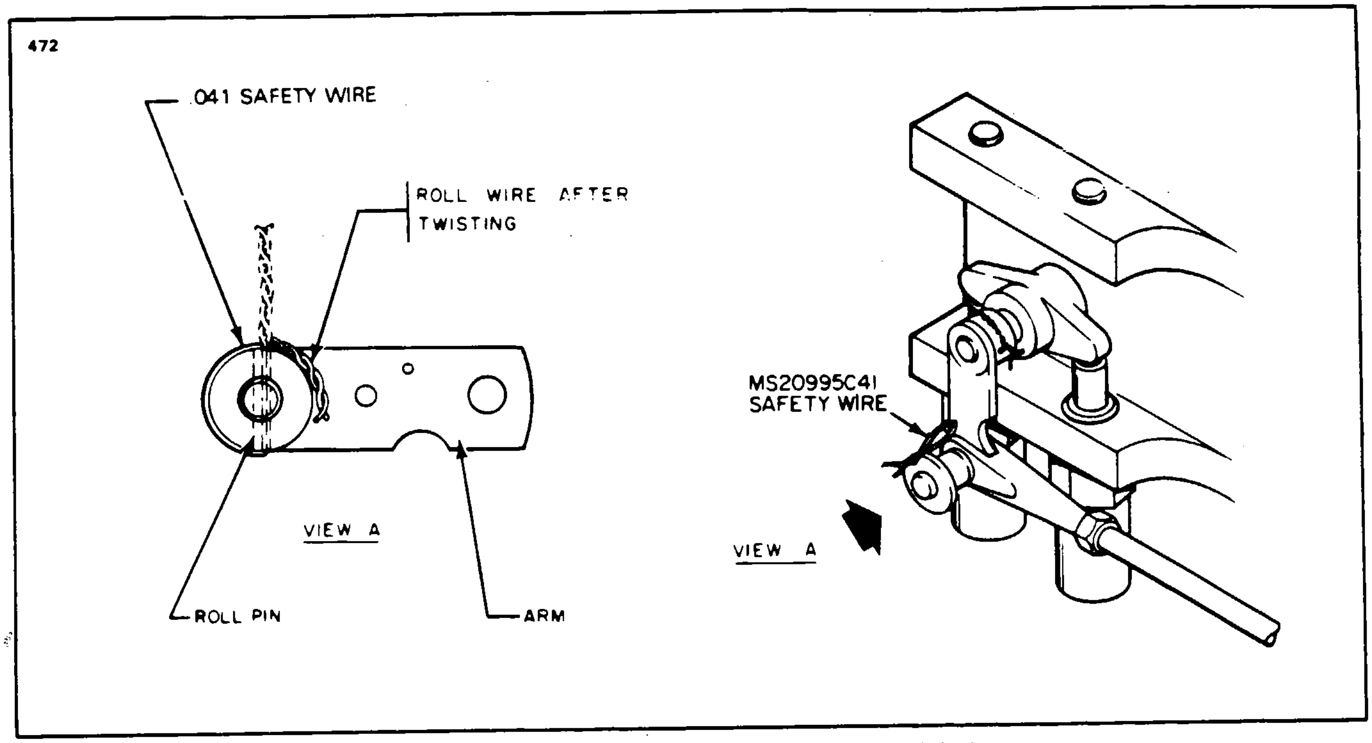


Figure 29-9. Safetying Control Arm - Wiebel

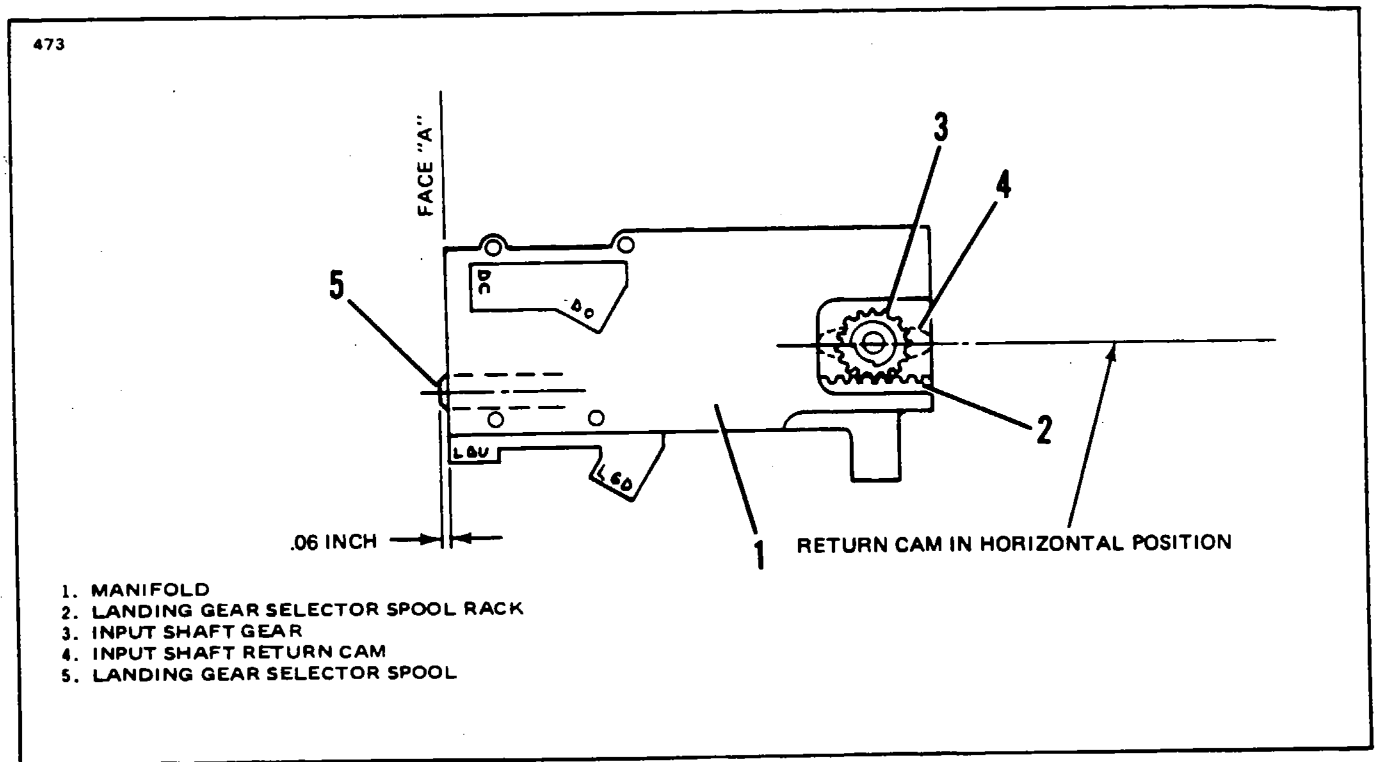


Figure 29-10. Indexing of Selector Spool - Wiebel

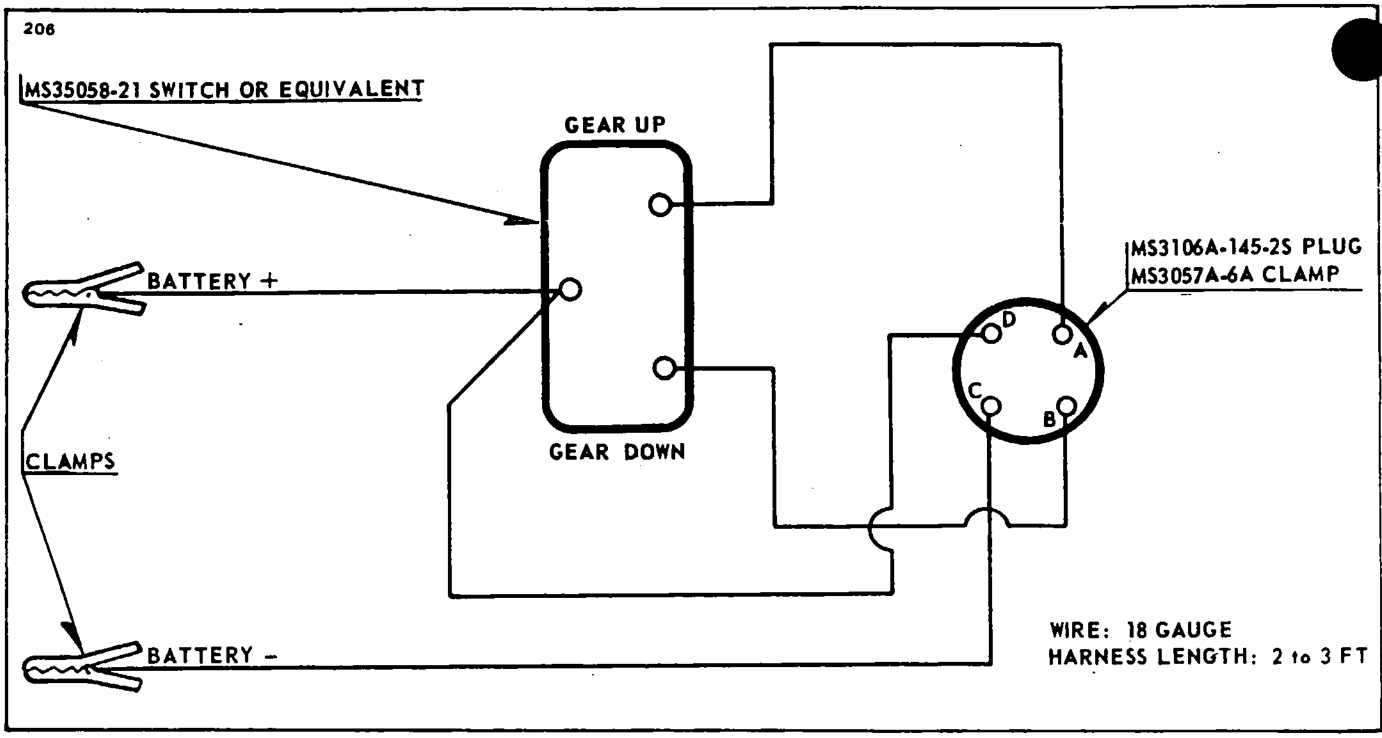


Figure 29-11. Power Pack Test Harness Schematic

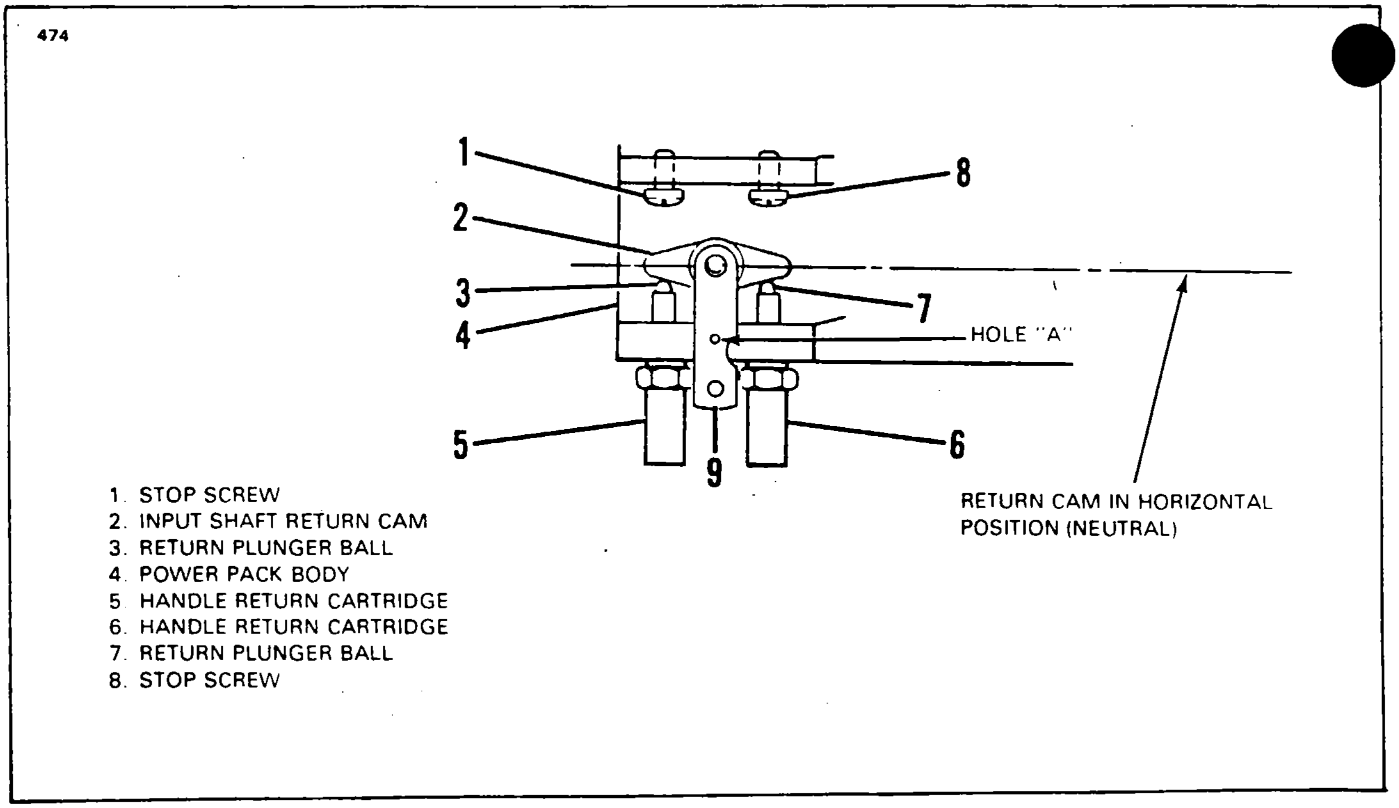


Figure 29-12. Handle-Release Adjustment

POWER PACK BENCH TEST 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 is 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 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 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 be necessary to fabricate an electric harness as shown in Figure 29-11. 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.

ADJUSTMENT OF HANDLE-RELEASE MECHANISM. (Refer to Figure 29-12.)

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 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 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.

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 29-12. 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.

ADJUSTMENT OF HAND PUMP RELIEF VALVE. (Refer to Figure 29-5.)

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 the maximum required pressure as given in Chart 2902, pumping slowly. Bleed pressure by cracking the cap on the "door open" fitting after each adjustment.

ADJUSTMENT OF MAIN RELIEF VALVE. (Refer to Figure 29-5.)

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 the required pressure given in Chart 2902. Bleed pressure after each adjustment by cracking the cap on the "door open" fitting.

ADJUSTMENT OF PRIORITY VALVE. (Refer to Figure 29-5.)

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 adjusting screw until the valve cracks at the required pressure given in Chart 2902. Bleed pressure after each adjustment by cracking the cap on the "door open" fitting.
4. Disconnect the test unit and cap all open fittings.

ADJUSTMENT OF DOOR SOLENOID. (Refer to Figure 29-6.)

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 29-11.)
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.

ADJUSTMENT OF DOOR VENT VALVE. (Refer to Figure 29-5.)

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.

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ASSEMBLY OF POWER PACK. (Refer to Figure 29-5.)

To complete the reassembly of the Power Pack, proceed as follows:

1. Install the reservoir cover on the reservoir and secure with nut and safety wire nut to reservoir cover by using safety wire. Torque nut to 35 inch-pounds.

— *NOTE* —

When positioning reservoir cover make sure that the vent fitting points to the left when Power Pack is installed in the airplane. Also when installing reservoir cover, be sure large O-ring is not being pinched.

TESTING RESERVOIR FOR LEAKAGE.

1. Remove the drain fitting as applicable, and attach 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 fittings.
7. The hydraulic Power Pack is now ready to be installed in the airplane.

HYDRAULIC SYSTEM COMPONENT SERVICING.

OPERATION OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 29-13.)

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 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.

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.

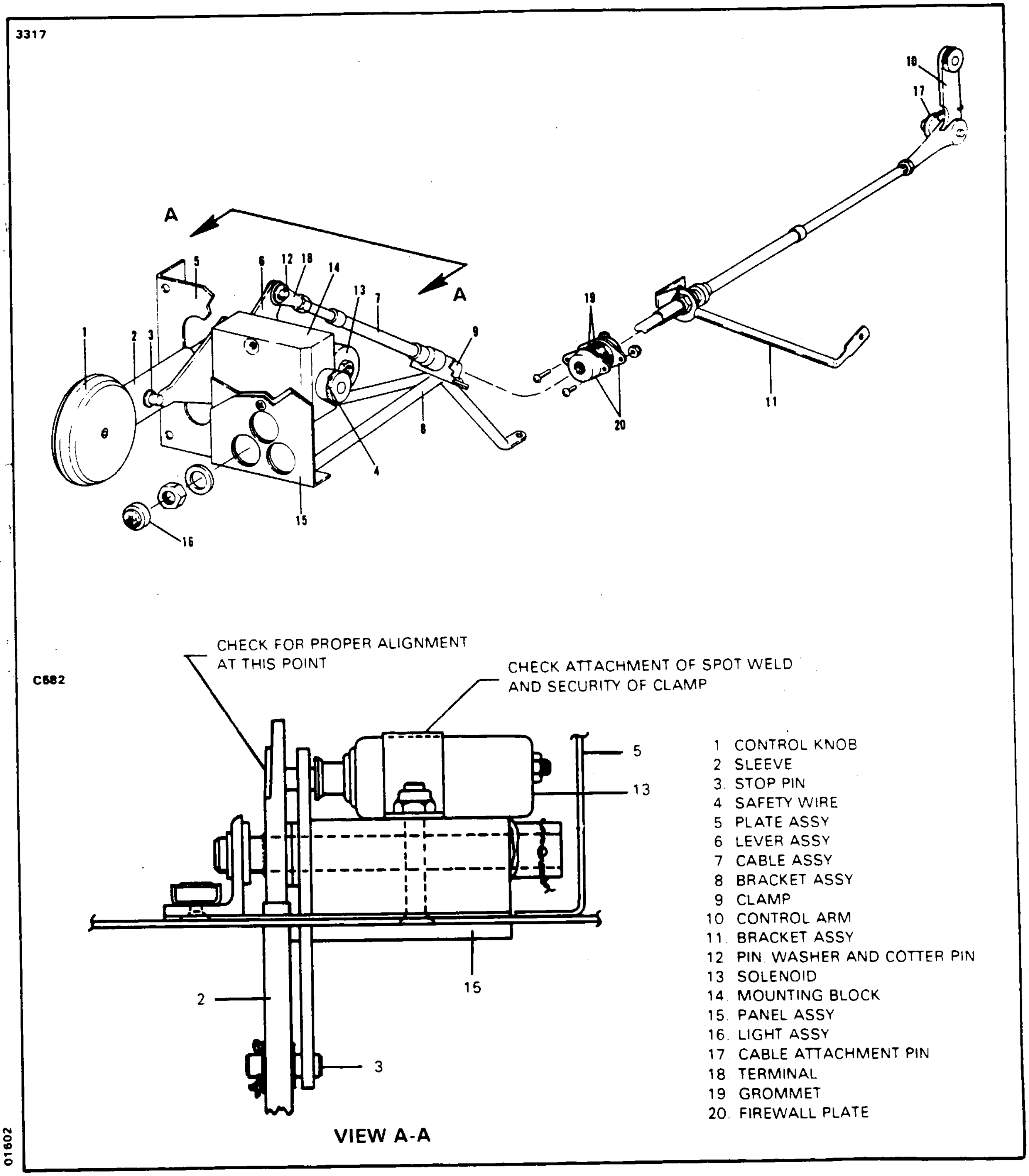

Figure 29-13. Landing Gear Selector Mechanism Installation

ADJUSTMENT OF GEAR SELECTOR HANDLE MECHANISM.

1. Ascertain that the selector arm on the lever assembly is safety wired as shown in Figure 29-9.
2. Depress the button on the solenoid lock to allow the handle to travel freely between the two neutral positions.
3. To check the handle-release mechanism, disconnect the control cable from the arm at the Power Pack. Connect a spring scale to the 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 + 1-2 pounds. If it does not release at the required force, adjust the mechanism in accordance with instructions given in Adjustment of Handle-Release Mechanism.
4. Position the control arm on the Power Pack in neutral and the selector handle in the down neutral position. Refer to Adjustment of Handle-Release Mechanism for a method of holding the control arm in the neutral rigging position.
5. Connect the terminal ends of the cable assembly to the Power Pack control arm and the selector handle.
6. The terminal ends can be adjusted to obtain the neutral position in both the control arm and selector handle.
7. Recheck that the handle will leave the detent at 3 1/2 to 6 pounds.

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. 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 lock nuts are to be tightened so that the O-ring seals are on the non-threaded portion of the fitting.

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 lower engine cowl and the right access plate on the engine nacelle aft of the firewall.
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.

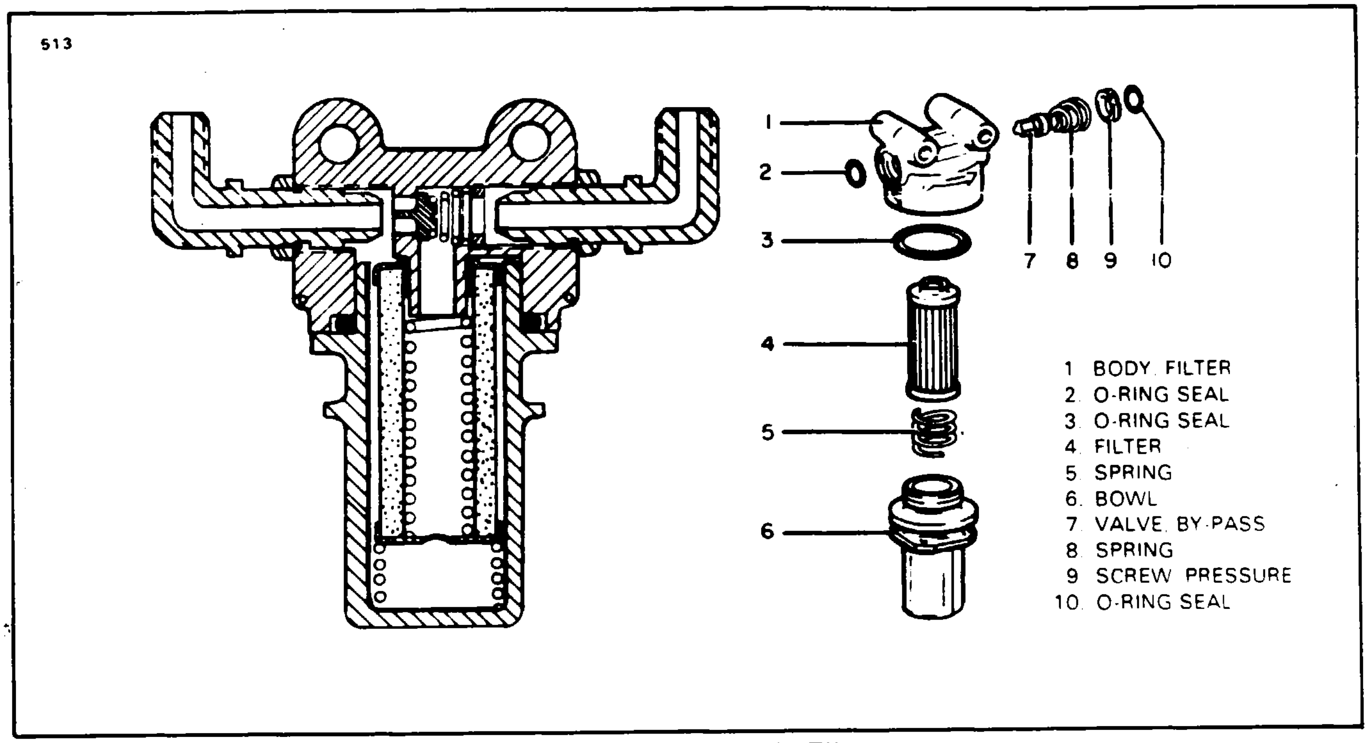

Figure 29-14. Hydraulic Filter

REPLACEMENT OF FILTER ELEMENTS. (Refer to Figure 29-14.)

1. Remove the lower engine cowl.
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 with 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 1200 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.
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 29-7.)

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 screwdriver 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.

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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, SOC. HD. CAP
13 REAR SIDE ASSEMBLY
14 STUD
15 O-RING
16 DRIVE PIN
17 SECONDARY SHAFT
18 SECONDARY GEAR
19 DRIVE GEAR

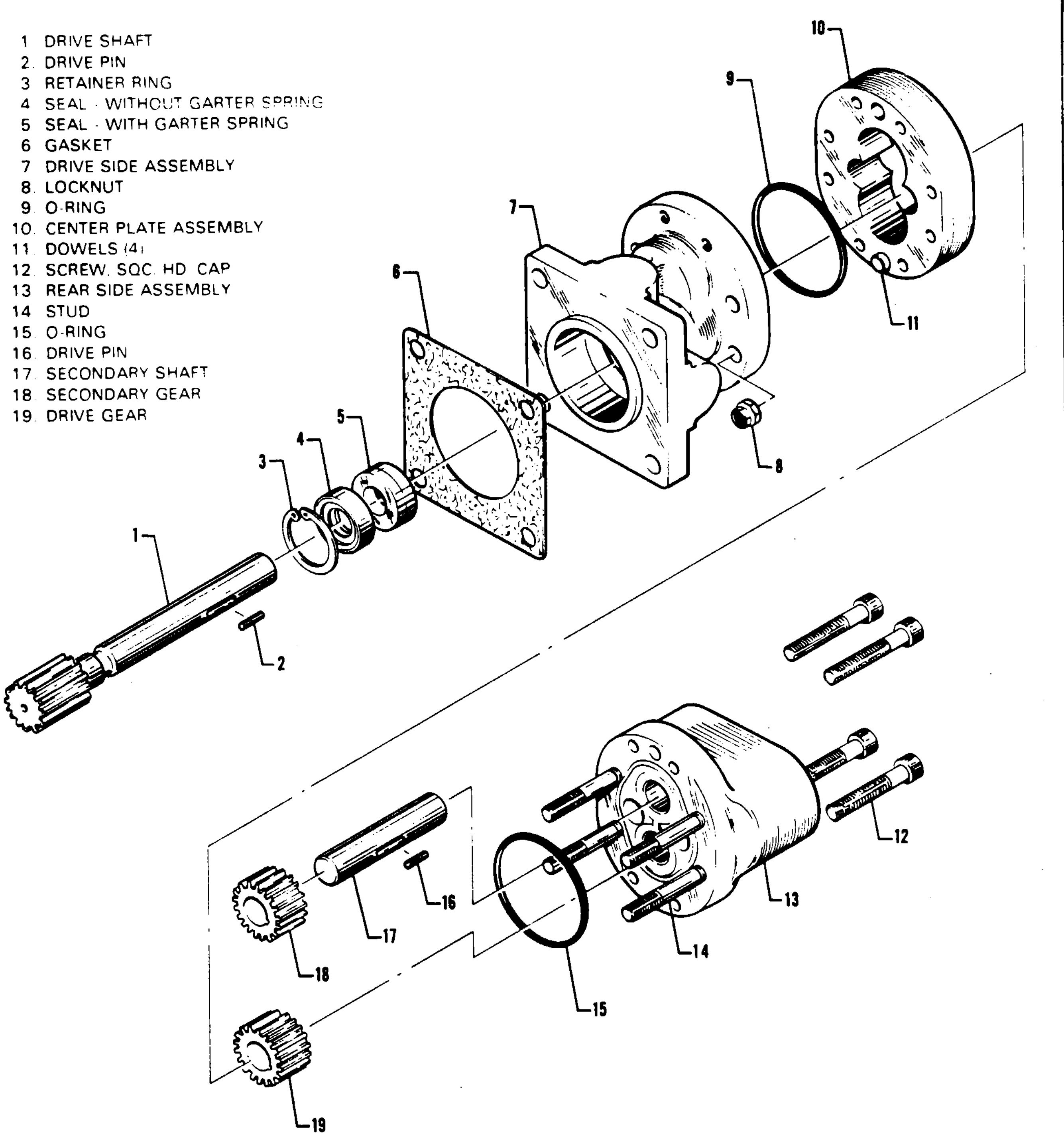

Figure 29-15. Hydraulic Pump

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 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, 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 preferably 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 conditions 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 29-7.)

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 lock nuts 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 lock nut 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.

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CHART 2903. INSPECTION AND REPAIR, HYDRAULIC PUMP

ITEM (Refer to Figure 29-7.)	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 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 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 form 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, lock 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.

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.

HIGH ALTITUDE GEAR OPERATION.

Should it be necessary to operate the landing gear at altitudes above 15,000 feet, the landing gear selector may return to its neutral powition 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.

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.

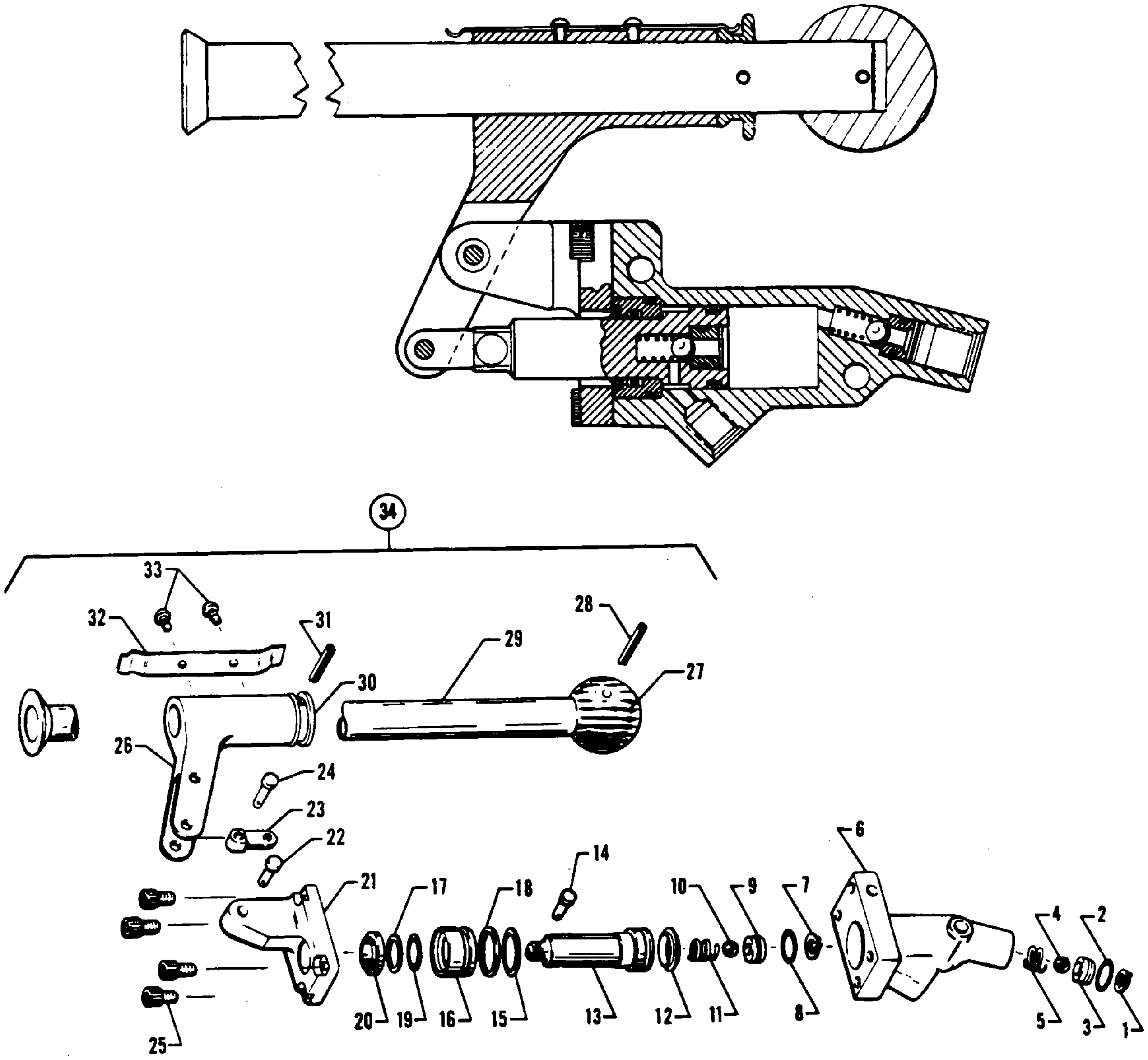
DISASSEMBLY OF HAND PUMP. (Refer to Figure 29-16.)

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 depth 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 the 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 the spring.



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

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Figure 29-16. Hand Pump

CLEANING, INSPECTION AND REPAIR OF HAND PUMP.

1. Clean the pump parts with a suitable solvent and dry thoroughly.
2. Inspect the pump body for scratches, burrs, etc., that could damage O-rings and threaded areas for damage.
3. Inspect the plunger for englarged 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 for 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 into 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.
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.

— END —

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MOJAVE
MAINTENANCE MANUAL

CARD 3 OF 5

PA-31P-350 MOJAVE

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 781)

INTRODUCTION.

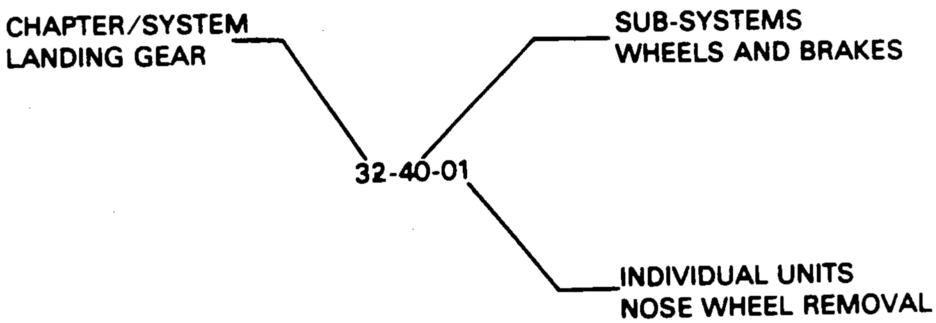
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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-31P-350 aircraft manufactured by the Piper Aircraft Corporation of Lock Haven, Pennsylvania.

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 Parts Catalog P/N 761 776, and FAR 43 for proper utilization.

AEROFICHE EXPLANATION AND REVISION STATUS

The Maintenance Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aircraft Manufacturer's Association, (GAMA). The information compiled in this Aerofiche Maintenance Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set, Grid location J16.

To aid in locating the various chapters and related service information desired, the following is provided:

1. A complete manual System/Chapter Index Guide is for all fiche in this set.
2. A complete list of Illustrations is for all fiche in this set following System/Chapter Index.
3. A complete list of Charts is for all fiche in this set following list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:

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

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

TABLE OF CONTENTS/EFFECTIVITY CODES

Original Issue: None
First Revision: Revision Identification, (1R Month-Year)
Second Revision: Revision Identification, (2R Month-Year)
All subsequent revisions will follow with consecutive revision numbers such as 3R, 4R, etc., along with the appropriate month-year.
Added Subject: Revision Identification, (A Month-Year)
Deleted Subject: Revision Identification, (D Month-Year)

Revisions to this Maintenance Manual 761 781 issued April 25, 1983 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG830425	April 25, 1983	1, 2, 3, 4 and 5
PR830728	July 28, 1983	1, 2, 3, 4 and 5
PR831214	December 14, 1983	1, 2, 3, 4 and 5
IR860430	April 30, 1986	1
IR860723	July 23, 1986	2
IR860925	September 25, 1986	1 and 4
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.

Consult the Customer Service Information Aerofiche for current revision dates for this manual

VENDOR-SUPPLIER INFORMATION.

A partial list of companies, their address and phone numbers are provided to aid service personnel in obtaining information about components not manufactured by Piper Aircraft Corporation.

Air-Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
Alternator	Prestolite Company 511 Hamilton Street Toledo, Ohio (419) 255-4068
Autopilot/Avionics	Edo Corporation - Avionics Division P.O. Box 610 Municipal Airport Mineral Wells, Texas 76067 (817) 325-2517
	Bendix Avionics Division 2100 N.W. 62nd Street Fort Lauderdale, Florida 33310 (305) 776-4100
	Collins General Aviation Division Rockwell International Cedar Rapids, Iowa 52406 (319) 395-3625
	King Radio Corporation 400 N. Rogers Road P.O. Box 106 Olathe, Kansas 66061 (913) 782-0400
	Sperry Flight Systems - Avionics Division 8500 Balboa Boulevard P.O. Box 9028 Van Nuys, California 91409 (213) 894-8111
	Global Navigation 2144 Michelson Drive Irvine, California 92715 (714) 851-0119

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Gill-Teledyne P.O. Box 431 Redland. California (714) 793-3131
Deicing. Airfoil	The B.F. Goodrich Company 500 South Main Street Akron. Ohio 44318 (216) 374-3895
Deicing. Propeller	The B.F. Goodrich Company 6400 Goldsboro Road Suite 102 Bethesda. Maryland 20034 (301) 229-5000
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington. Penna. 19034 (215) 643-2900
Engines	Avco Lycoming Avco Lycoming Division Williamsport. Penna. 17701
Environmental Systems. Heater and Air Conditioner	Janitrol Aero Division 4200 Surface Road Columbus. Ohio 43228 (614) 276-3561
	Sanden International (U.S.A.). Inc. 10710 Sanden Drive Dallas. Texas 75238
Fuel Pumps	Lear Siegler. Incorporated 17602 Broadway Avenue Maple Heights. Ohio 44137 (216) 662-1000
Fuel System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria. Ohio 44035 (216) 323-4676

VENDOR-SUPPLIER INFORMATION (cont).

Landing Gear, Hydraulic Actuators, Hydraulic Pressure Regulator, Hydraulic Power Pack, Hand Pump	Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Magnetos	Bendix Electrical Components Division Sidney, New York 13838
Oxygen System	Scott Aviation Products 225 Erie Street Lancaster, New York 14086 (716) 683-5100
Pneumatic System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria, Ohio 44035 (216) 323-4676
Propellers	Hartzell Propeller, Incorporated 1025 Roosevelt Avenue Piqua, Ohio 45356 (513) 773-7411
Propeller Synchrophaser	Hartzell Propeller Fan Company 910 South Downing Street Piqua, Ohio 45356 (513) 773-7411
Tools, Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Turbocharger	Airesearch Industrial Division 3201 Lomita Boulevard Torrance, California 90505
Wheels and Brakes	Cleveland Wheel and Brake Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011
	B.F. Goodrich Company Transportation Products Division P.O. Box 340 Troy, Ohio 45373

PIPER PUBLICATIONS.

PA-31P-350

Parts Catalog =	761 776 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961-1328
Continuous Inspection =	761 786 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961-1328

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont.)

LIST OF ILLUSTRATIONS

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LIST OF ILLUSTRATIONS (cont.)

LIST OF ILLUSTRATIONS (cont.)

— NOTE —

Refer to Card 5, Grid No. 5C5 for Electrical Schematic Index.

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CHAPTER

30

ICE AND RAIN PROTECTION

CHAPTER 30 - ICE AND RAIN PROTECTION

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CHAPTER 30 - ICE AND RAIN PROTECTION (cont.)

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CHAPTER 30 - ICE AND RAIN PROTECTION (cont.)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This Chapter provides service and maintenance procedures for the deicing system.

DESCRIPTION AND PRINCIPLE OF OPERATION.

Each deicer boot is essentially a fabric reinforced rubber sheet, containing built-in inflation tubes. The deicers are attached by cement to the leading edge of the surfaces to be protected.

The deicers are installed along the leading edges of the wings both inboard and outboard of the engine nacelles and on the tail surfaces. Upon actuation of the deicer switch the outboard wing boots inflate for six ±.5 seconds and then the tail and inboard boots inflate for six ±.5 seconds. There are flexible air connections on the backside of the deicers 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 air supply system.

Vacuum is applied to the deicer boots at all times by means of the deicer ejector, except when they are being inflated. Deicer inflation is affected by the deicer system control switch. When the switch is actuated, the timer energizes the outboard wing deicer valve for six ±.5 seconds. This valve shuts off the vacuum to the outboard wing boots and directs pressurized air to the deicers. Upon automatic deenergization of the valve by the timer, outboard wing boot pressure is bled off to ambient and vacuums reapplied to the boots. The timer is now repeating the cycle for the tail and inboard wing deicer boots through another valve. A pressure switch and indicator light are also installed to monitor the tail and inboard wing boots. Pneumatic system pressure can be monitored during deicer inflation through the pneumatic pressure gauge located on the instrument panel.

TROUBLESHOOTING.

In the utilization of the troubleshooting charts, it must be assumed that the engine bleed air system 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
Deicers do not inflate.	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.
	Deicer valves not functioning.	Make electrical test. Replace as required.
	Lines blocked or not connected.	Blow out lines and inspect connections. Make air leakage test.
Deicers inflate slowly. (Inflation time - 6 ±.5 seconds.)	Lines partially blocked or not connected securely.	Blow out lines and inspect connections. Make air leakage test.
	Deicer valve not functioning.	Test or replace as required.
	System pressure not being attained.	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 regulator set too slow.	Readjust pressure regulator.

CHART 3001. TROUBLESHOOTING (PNEUMATIC DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Deicers deflate slowly. (cont.)	Lines partially blocked.	Inspect and blow out lines.
	Overboard line from control valve partially blocked.	Inspect and blow out lines.
	Leakage in system plumbing.	Leak check and correct leakage.

AIRFOIL DEICE SYSTEM.

SYSTEM TEST AND ADJUSTMENT.

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 fluctuate 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.

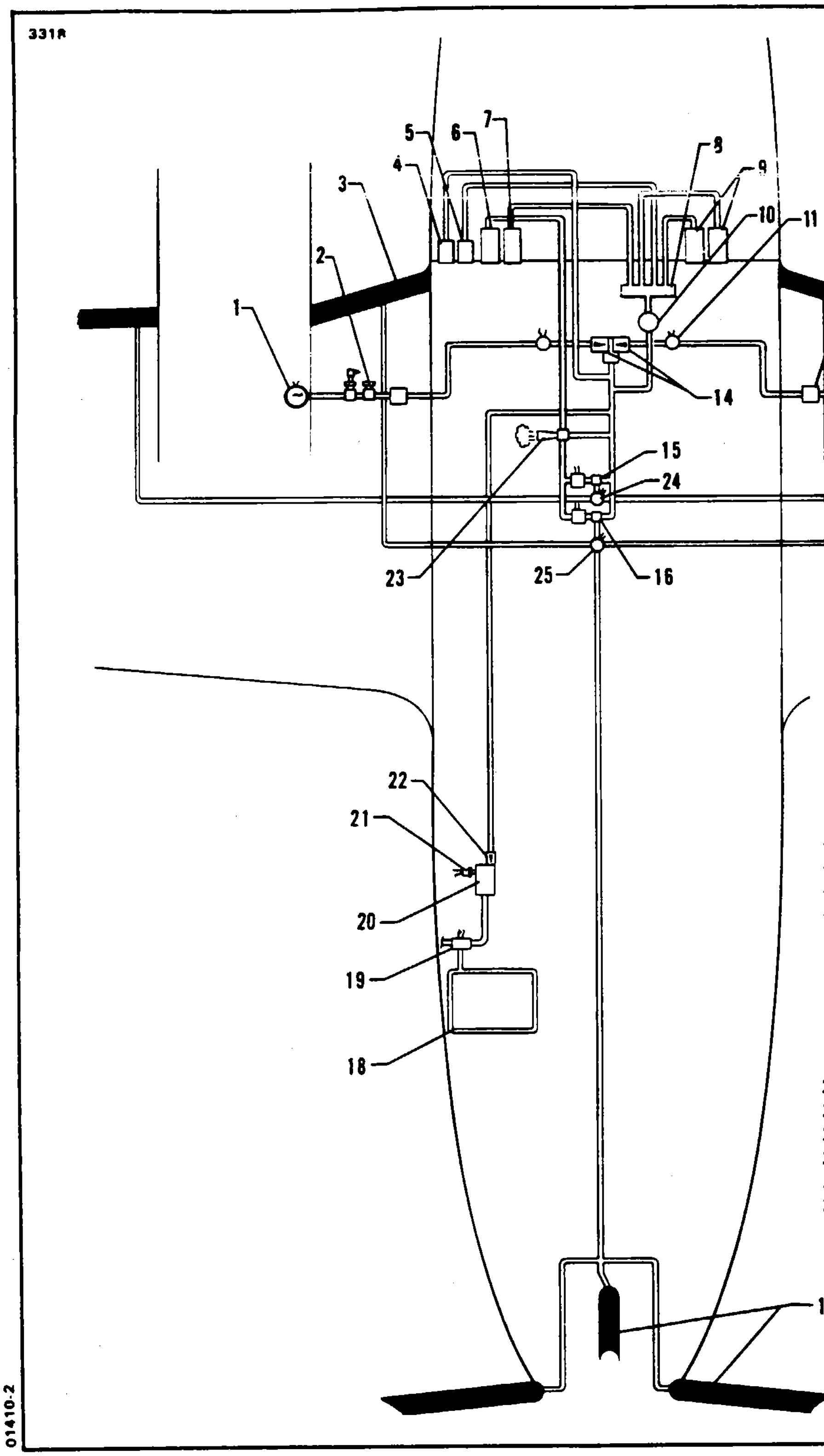
ELECTRICAL TEST.

With engines off, turn airplane battery switch to ON position.

1. Deicer Valves: Check the valves located beneath the center floorboard. Turn the system switch ON. One valve should actuate immediately for 6 ± .5 seconds, as evidenced by an audible "click" that can also be felt if a hand is placed on the valve. The other valve should actuate 6 ± .5 seconds after the first and remain actuated for 6 ± .5 seconds also. If either valve does not function follow instructions below:
   A. Disconnect the wires at the particular valve. Attach a test light or other suitable test equipment to the connector and reactuate the system switch. If the test equipment does not indicate a complete circuit, make the following checks:
      (1) Check the circuit from the timer, to valve connector, to ground.
      (2) Replace the timer - Refer to PA-31P-350 Parts Catalog for Part No.
   B. Use an ohmmeter to check the valve for an open circuit. If the valve circuit is open, replace the valve.

PRESSURE LEAKAGE TEST.

1. Connect a source of clean air to the deicer air system at the outlet port of the deicer solenoid engage valve. It is necessary that the inlet pressure be 20 psig to perform this test. Observe the system pressures on the airplane's pneumatic pressure gauge.
2. Apply 20 psig pressure to the system by means of a hand operated on-off valve.
3. Wait until system pressure stabilizes; then turn hand valve OFF trapping the pressure in the deicer system.
4. Obseve the system for leakage. The leakage rate should not exceed a pressure drop of 4 psig per minute.
5. Release system pressure; remove test equipment; lubricate all threads and replace any components that were removed.



1. PNEUMATIC PUMP
2. DUAL REGULATOR VALVE
3. INBOARD WING DEICER
4. PNEUMATIC PRESSURE GAUGE
5. GYRO PRESSURE GAUGE
6. CABIN ALTITUDE CONTROLLER
7. PILOT'S AIR DRIVEN INSTRUMENTS
8. INSTRUMENT AIR MANIFOLD
9. COPILOT'S AIR DRIVEN INSTRUMENTS
10. GYRO PRESSURE REGULATOR
11. PNEUMATIC PRESSURE SWITCH
12. INLINE FILTER
13. OUTBOARD DEICE BOOT
14. DUAL CHECK VALVE
15. DEICE INFLATION VALVE A
16. DEICE INFLATION VALVE B
17. EMPENNAGE DEICE BOOTS
18. CABIN DOOR SEAL
19. SOLENOID VALVE
20. ACCUMULATOR TANK
21. CABIN DOOR SEAL PRESSURE SWITCH
22. CABIN DOOR SEAL CHECK VALVE
23. VACUUM EJECTOR
24. DEICE INFLATION SWITCH A
25. DEICE INFLATION SWITCH B

Figure 30-1. Pneumatic Deicing System Schematic

PNEUMATIC REGULATOR ADJUSTMENT.

The pneumatic pressure regulator is adjusted by the manufacturer to provide adequate pressure for the aircraft pneumatic system. The regulator may be checked by removing the fuselage floorboard panel closest to fuselage station 162.60. The regulator is located on the right side of the fuselage. To check for proper operation of the regulator, start one engine and observe pneumatic pressure gauge. The gauge should read 18 psi. The regulated air pressure can be increased by loosening the jam nut on the top of the regulator and turn the adjustment screw clockwise; then tighten jam nut. To decrease pressure the adjustment screw is turned counterclockwise. When proper pressure is set, reconnect the pneumatic line to the regulator outlet port; start one engine and check the pneumatic pressure gauge against that of the test instrument just used. If the reading differs, the pneumatic pressure gauge is inaccurate and should be replaced.

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, disconnect the pneumatic system (engine bleed air) line at the engine and connect a hose from shop air to the pneumatic line with air regulated to 22 psig. The system operating pressure is 18 psig.

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, a deicer piping diagram drawing is necessary to determine the operatng pressure and the inflation time alotted to the deicers.

CHART 3002. OPERATING PRESSURES

Recommended Operating Pressure PSIG	Test Pressure in PSIG	
	MIN.	MAX.
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. A check valve in the line prevents air from being forced back through the engine bleed air ports. Activate the system and check the operating pressure. The pressure should be within 1 psig of the recommended operating pressure with each inflation.

If the deicers do not reach the operating pressure, check the solenoid valve for proper operation. If the boots deflate slowly, the lines or ejector assembly may be plugged. The system should inflate in approximately 6 ± .5 seconds per section (outboard wings, inboard wings and empennage).

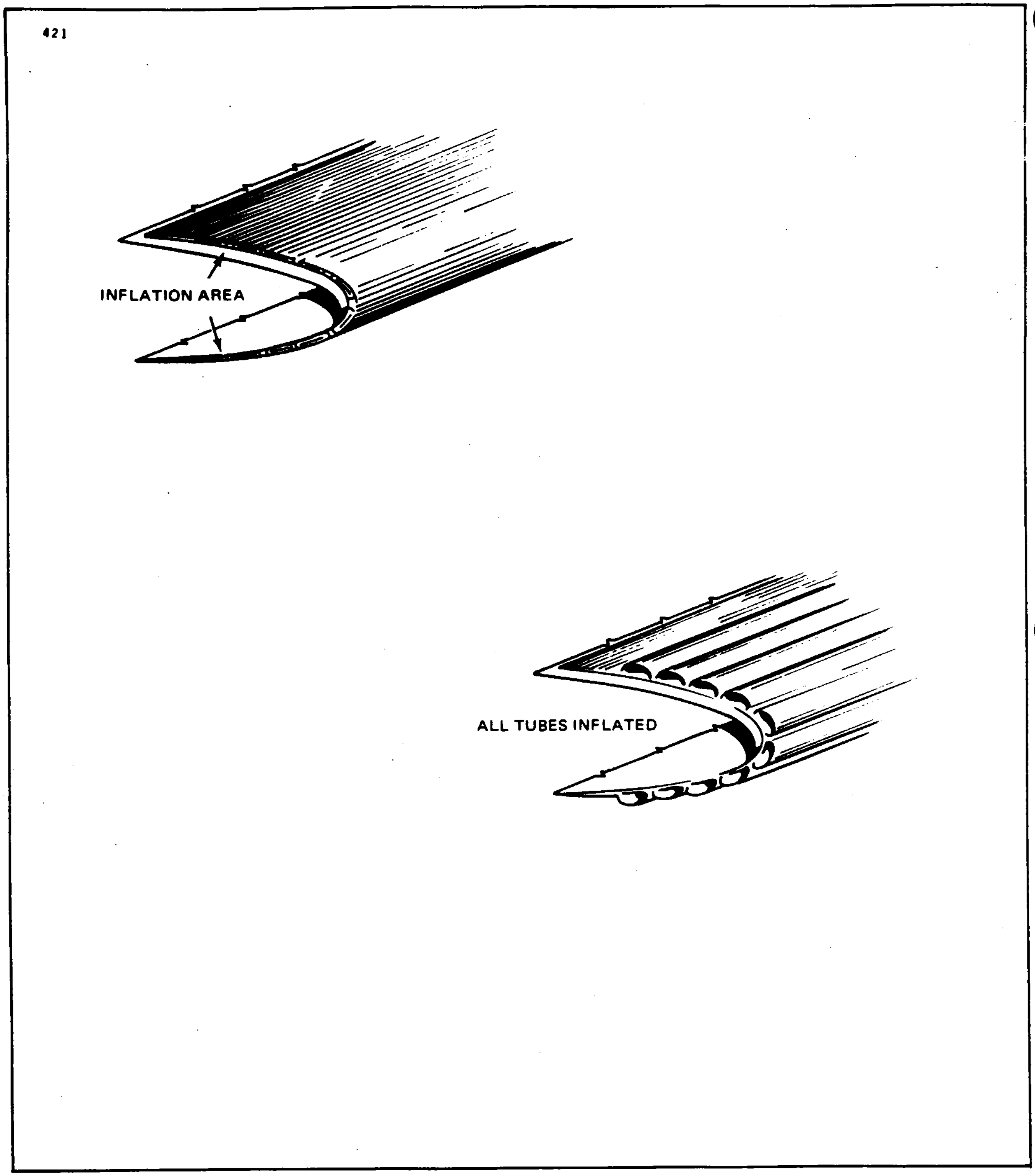


Figure 30-2. Pneumatic Deicer Boots Operation (Typical)

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. Check the on-off control switch for freedom of action. Check associated electric wiring.

TIMER.

No field maintenance is recommended. Refer to Parts Catalog for replacement timer.

CONTROL VALVES.

No service is recommended for these valves except for their replacement in the event of failure.

REMOVAL OF AIRFOIL DEICE 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 (Methylethylketone) 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 AIRFOIL DEICE 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.

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, -17, -18 or -23 depending on size of damage area. Proceed as follows:
   A. Clean the area around the damage with a cloth dampened slightly with solvent. Buff the area around the damage with steel wool 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-56B conductive cement to seal and feather edge.
   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 action so the injury is closed. Do not trap air between patch and deicer surface.

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	steel wool pads
	As required	Hypodermic needles (22 gauge or smaller)
	As required	3M-EC-801
Methylethylketone (MEK) can be used instead of Toluol, however MEK causes very rapid drying and provides only 10 seconds working time compared with 40 seconds for Toluol.		

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. 74-451-20, 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 2.
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 thoses 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.

It is recommended that vulcanized repairs be made by an approved Deicer Installation Station. The prime purpose of making vulcanized repairs is to make the deicer completely fit for further service. Careful consideration must be given to the overall condition of the deicer. If large parts of the stretch area of a deicer are cracked or checked to a depth of over 0.005 inch, no attempt to repair should be made. Deicers with occasional slight checks in the stretch area may be given a coating of conductive cement to make them serviceable. If the checking is rather deep but restricted to a small area, the deicer may be made serviceable by repairing the damaged area. Deicers which have been swelled or softened by contact with oil or other harmful agents, should be scrapped. Injuries will vary from minor ripping of the tube or stretch areas which may make repair exceedingly difficult or actually impossible. The determination of just where this division between repairable and unrepairable damage exists will, of necessity, depend upon the careful judgement of the inspector and upon the experience and training of the workman.

MATERIALS FOR VULCANIZED REPAIR.

The effectiveness of any repair largely depends upon an analysis of the damage and the selection of correct repair material. Deicers are compounded to resist sunlight and weather and retain flexibility. It is recommended that only materials as listed in Chart 3004 be used in making vulcanized repairs. They are sufficient to supply a one or two man unit for a period of from four to six weeks, repairing deicers with the average amount of miscellaneous types of repairs. Select materials specified for making each repair and avoid substitution. Since many of the materials are dusted with soapstone, wash all materials carefully with washing or cleaning solvent before using. Chart 3005 lists the tools and equipment which have been found suitable for repair work. They are designed for a one or two man repair unit.

CHART 3004. MATERIALS FOR VULCANIZED REPAIRS

Part No.	Description	Qty.
74-451-B	SUPPORT KIT, High pressure Deicer vulcanized repairs	1
74-451-B-1	. MATERIALS KIT	1
74-451-2	. . NON-STRETCH FABRIC, Uncured rubber coated	15 ft. x 8 in.
74-451-3	. . FABRIC TAPE, Uncured rubber coated	15 ft. x 1 in.
74-451-4	. . TUBE FABRIC, Uncured	15 ft. x 8 in.
74-451-5	. . GUM, 0.005 Uncured	15 ft. x 2¼ in.
74-451-6	. . GUM, 0.020 Uncured	15 ft. x 8 in.
74-451-7	. . TREATED PAPER, Holland or silicone	30 ft. x 8 in.
74-451-8	. . VULCANIZING CEMENT, No. 60	1 qt.
74-451-9	. . VULCANIZING CEMENT, No. 61	1 qt.
74-451-10	. . SOAPSTONE	1 qt.
74-451-11	. . CONDUCTIVE CEMENT, *A-56-B	½ pt.
74-451-12	. . *NEOPRENE PUTTY	½ pt.

*These cements have an extended shelf life if kept under refrigeration from 0° to 40° F.

DEFINITION OF TERMS.

Terms used in the following instructions are explained below:

1. Wash - to clean a surface by means of a clean cloth moistened with Toluol or MEK. (Benzine or non-leaded gas may be used in place of cleaning solvent.) Do not permit free solvents to remain on any surfaces.
2. Route - to remove rubber surfaces around area to be repaired with a hex nut on a shaft attached to electric buffer.
3. Buff - to roughen surfaces with Carborundum buffing sticks or abrasive paper.
4. Cement - to apply two light coats of fifty-fifty mixture of No. 60 and 61 vulcanizing cements, unless otherwise specified. Let each coat dry before proceeding.
5. Gum - uncured rubber stock. If cured stock is to be used, it will be so stated.
6. Face Side of Deicer - the side exposed when installed; the conductive surface side.
7. Restore Conductive Surface - after curing a repair on the surface size; apply two coats of A-56-B conductive cement.

— *NOTE* —

Do not apply A-56-B conductive cement in any area of any electrical transmitting or receiving equipment.

8. Stitch - to force fabrics or gum elements together with metal or rubber roller; stitch from the center toward the edges to prevent trapping air between the elements.

CHART 3005. EQUIPMENT FOR VULCANIZED REPAIRS

Part No.	Description	Qty
74-451-B	SUPPLY KIT, High pressure Deicer vulcanized repairs	1
74-451-B-2	. Tool Kit, Complete	1
74-451-B-3	. . Tool Kit, Special	1
74-451-40	. . . VULCANIZER, Large 2½ x 8	1
74-451-41	. . . PADS, Sponge rubber, 3½ x 11	3
74-451-42	. . . CURING METAL, 6 x 10	2
74-451-B-4	. . Tool Kit, Standard	1
74-451-70	. . . BRUSH, Cement, ½ in.	2
74-451-71	. . . BRUSH, Cement (Artist)	2
74-451-72	. . . SHEARS, 10 in.	1
74-451-73	. . . STITCHER, ⅛ in. Steel	1
74-451-74	. . . ROLL, Sponge rubber 2½ in.	1
74-451-75	. . . STICKS, Emery buffing	6
74-451-76	. . . KNIFE HANDLE	1
74-451-77	. . . KNIFE BLADE	3
74-451-78	. . . WHETTING STONE	1
74-451-79	. . . HYPODERMIC NEEDLE	6
74-451-80	. . . ELECTRIC BUFFER	1
74-451-81	. . . MANDREL (for felt wheels)	3
74-451-82	. . . WHEELS (felt buffing)	24
74-451-83	. . . STONE, Grinding, pointed	3
74-451-84	. . . STONE, Grinding, flat	4
74-451-85	. . . NUT, Hex	3

GENERAL PROCEDURE.

Select a repair room with adequate ventilation and air free of dust and foreign matter. Keep the work bench clean so that foreign objects will not contaminate cement, sovlents, or damage deicers, and perform the following steps:

1. Before starting a vulcanized repair, thoroughly clean a fairly large area surrounding the damaged portion, as well as the damage portion itself, of any grease, dirt or talc. Use a neutral soap and water solution; rinse clean and dry with clean cloth.
2. Immediately around area to be repaired, wash carefully with clean cloth moistened in Toluol or Methylethylketone (MEK) Federal Specifications TT-M-261.
3. When routing around a deicer injury, remove or cover all cement containers so that dust particles flying from grinding stone will not contaminate the cement.
4. After buffing or routing an area, remove all dust from the surface of deicer and table.
5. Protect all completed repairs from dust and dirt with a clean piece of holland cloth. Hold holland in place with masking tape. Remove masking tape before curing.
6. Release all air trapped between gum and fabric surfaces and/or deicer surfaces by inserting a hypodermic needle through the ply to the air pocket.
7. Before vulcanizing, remove all excess cement and dust particles by washing with solvent.
8. Use clean brushes when making repairs. Oil, paint, or other residue may impair adhesion. Clean cement brushes with Benzine or non-leaded gasoline at end of each work day.
9. Use approved safety can for Toluol or MEK. Take screen and spring out of solvent cans before filling so that all sediment may be removed.
10. Cements should be of such a consistency that they can be applied in a thin smooth coating. If they are partially set up or lumpy, addition of the proper solvent may restore their usable characteristics. Otherwise, do not use.
11. Do not attempt repairs in temperatures under 40°F with listed materials.
12. When humidity is high, moisture may form on freshly washed or cemented areas. If this condition occurs, wipe moisture off with a clean cloth slightly dampened in solvent before proceeding with repair.
13. If but a small area is involved in repair, and temperature or drying conditions are prohibitive, a small canopy erected over the area, under which a lighted electric light bulb is placed, may make repair possible.
14. When repairing deicers, cleanliness is of prime importance. Keep materials, tools, equipment, and hands clean at all times.

CURING.

The vulcanizer listed in Chart 3005 is adjusted at the factory to heat to 285° ± 5° F with the line voltage as specified on the name plate. All curing times called for in this manual are for 285° F. If line voltage is low, the vulcanizer will not heat to 285° F, and, therefore, curing times must be longer than specified.

Since curing time varies with the type and position of repair being cured, the times are given for each specified type of repair. Cure repairs as follows:

— NOTE —

Over-curing destroys the flexibility of the deicer. Under-curing prevents the proper bond from taking place. Therefore, always watch cure time and temperature carefully.

1. Preheat vulcanizer.
2. Place sponge pad over bottom of unheated plate.
3. Place a piece of clean, unwrinkled holland (or silicone treated paper) over sponge pad; then place deicer in position over holland, with area to be cured centrally located over bottom platen. (Repair side up.)
4. Place another piece of smooth, clean holland over spot to be cured.

— *NOTE* —

If holland or silicone treated paper is not available, spread a thin coat of soapy water over surfaces of metal curing sheet and sponge pad. Allow to dry thoroughly. This will prevent sticking.

5. Place a metal curing sheet over holland and clamp heating element in place. The size of the metal curing plate must be at least one inch larger overall than the heating plate. Tighten heater by hand firmly but not excessively.
6. Cure for full time as given for each type of repair.
7. Test each repair thoroughly after it has cured to determine if fully cured. Test also the strength and soundness of repair. If, in the stretch or other area (except tube), flex and stretch the area by hand several times, and then carefully examine for soundness. If in a tube, inflate to 25 psig.

SURFACE SCUFFS.

Repair as follows:

1. Wash surface to be restored and apply one coat of conductive cement. Allow to dry thoroughly. Add another coat and allow to dry. Dip finger in conductive cement solvent (Isopropyl Acetate) and rub down with light circular movement. Do not allow finger to become dry.
2. Wipe surface lightly with cloth moistened in Isoproply Acetate.
3. Inspect for high or low places. High places require additional rubbing down. For low spots, repeat the last three steps.
4. Allow to dry thoroughly and dust lightly with soapstone.

DEEP SCUFF THROUGH NEOPRENE SURFACE.

1. Mark off area to be routed and carefully cut the 0.010 inch Neoprene surface ply with knife. This will prevent the surface ply from peeling beyond the area marked when using buffer. Area should include full width of the tube and approximately 1/2 inch beyond scuff.
2. Using buffer, route down until pits are removed. Buff 1/8 around outer edge of routed area. Mask off outside of buffed area and cement.
3. Using mill knife or putty knife, apply Neoprene putty, filling cavity flush with surface. Make sure cavity is completely filled. Remove masking tape and cure for 20 minutes.
4. Restore conductive surface.

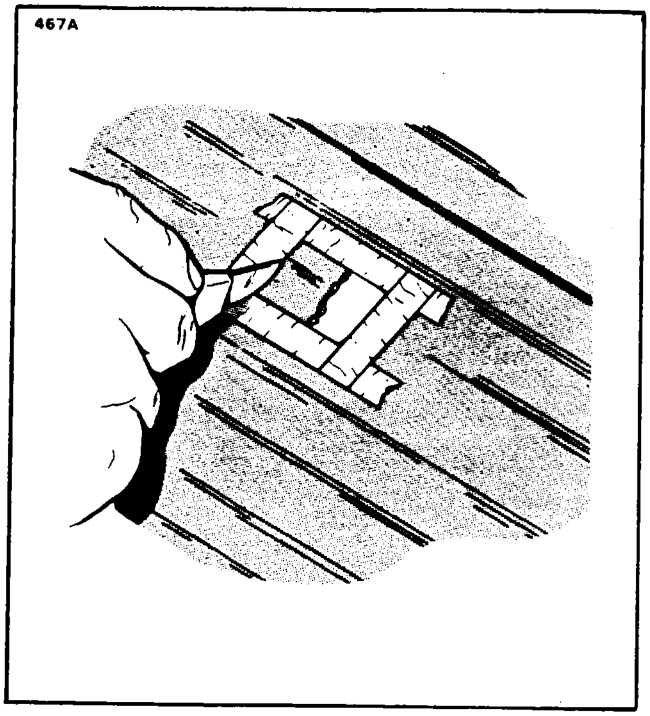


Figure 30-3. Marking and Cutting Scuff

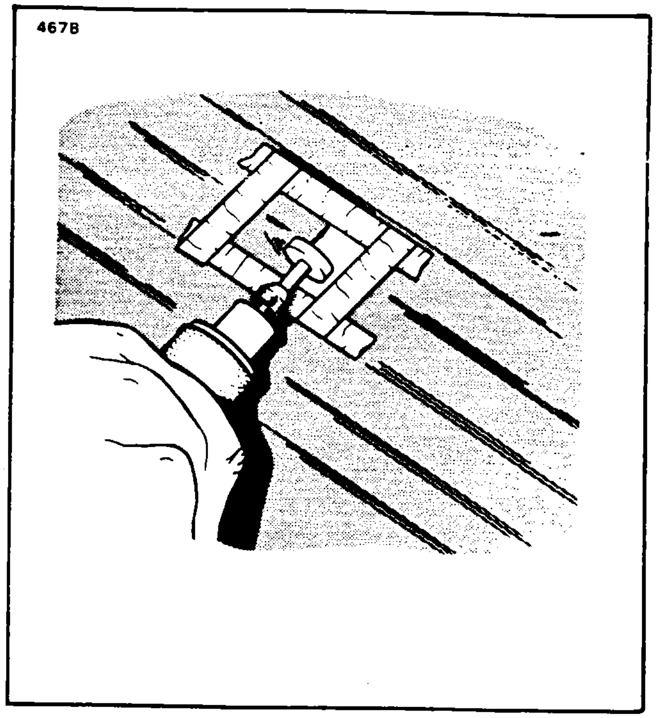


Figure 30-4. Routing Scuff

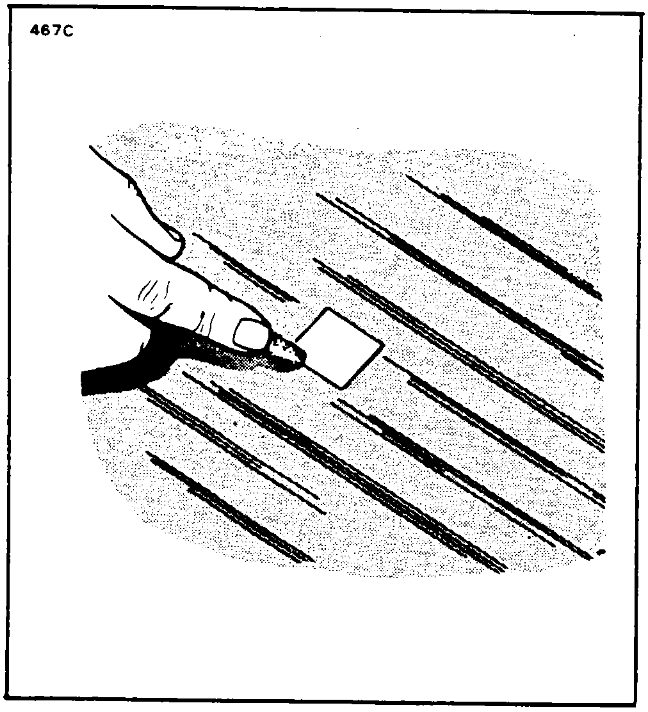


Figure 30-5. Buffing Edge of Repair

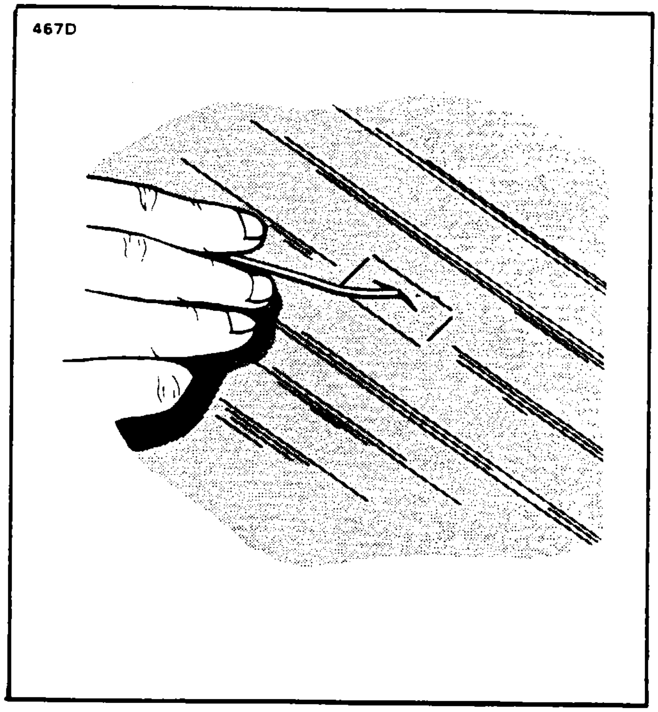


Figure 30-6. Hole through Surface of Tube

HOLES OR TEARS THROUGH SURFACE SIDE OF TUBE AREA.

Repair as follows:

1. Mark off area to be routed and carefully cut the 0.010 inch surface ply with knife. This will prevent the surface ply from peeling beyond the area marked when using buffer. Area should include full width of tube and approximately 1/2 inch beyond cut.
2. Using buffer, route down to tube fabric. Extreme care should be taken while using buffer so that surface ply beyond repair area is not loosened, and tube fabric is not injured. Wash out area.
3. Cut tube fabric patch slightly larger than size of cavity, making sure that stretch of fabric is across width of tube.
4. Cement buffed area and contact surface of tube fabric patch. Apply tube fabric full size of cavity and stitch. Remove any trapped air using hypodermic needle. Roll up a small piece of 0.005 inch gum (about 1/32 inch diameter and 3/4 inch long) and work in around edge of tube fabric using a sharp pointed object, such as shears. Stitch gum well and cure for 20 minutes.
5. After cure, using Carborundum stick, scratch shine off gun and buff surface ply 1/8 inch around repair. Wash repaired area and apply cement.
6. Mask off 1/16 inch beyond repair. Using mill knife or putty knife, apply Neoprene putty, filling cavity flush with surface. Make sure cavity is completely filled. Remove masking tape and cure for 15 to 20 minutes.
7. Restore conductive surface.

HOLES OR TEARS THROUGH BACKSIDE OF TUBE AREA.

Repair as follows:

1. Route off coating down to fabric at least 3/4 inch beyond cut and wash thoroughly, entire buffed area and cement.
2. Cut fabric patch; wash and cement; then apply fabric patch and stitch. Remove any trapped air using hypodermic needle.
3. Wash and cement repaired area; then apply a thin coat Neoprene putty with mill knife and cure for 22 minutes.

HOLES OR TEARS THROUGH TWO SIDES.

Repair one side at a time as described in two preceding sections.

HOLE THROUGH DEICER EXTENDING FROM ONE TUBE INTO ANOTHER.

Repair as follows:

1. Route and buff one side at a time as described in "Holes and Tears through Surface Side and Backside of Tube Area".
2. Working on surface side, remove in between tube tape 3/4 inch each direction from tear. Route out in between tube fillet. Do not damage tube fabric wall.
3. Slit fabric on backside of deicer in between tubes 3/4 inch beyond tear.
4. Cut two fabric patches large enough to extend 1/2 inch beyond tear. Stretch of fabric patches must be with width of tube.
5. Wash and cement entire buffed area of deicer and one side of fabric patches.

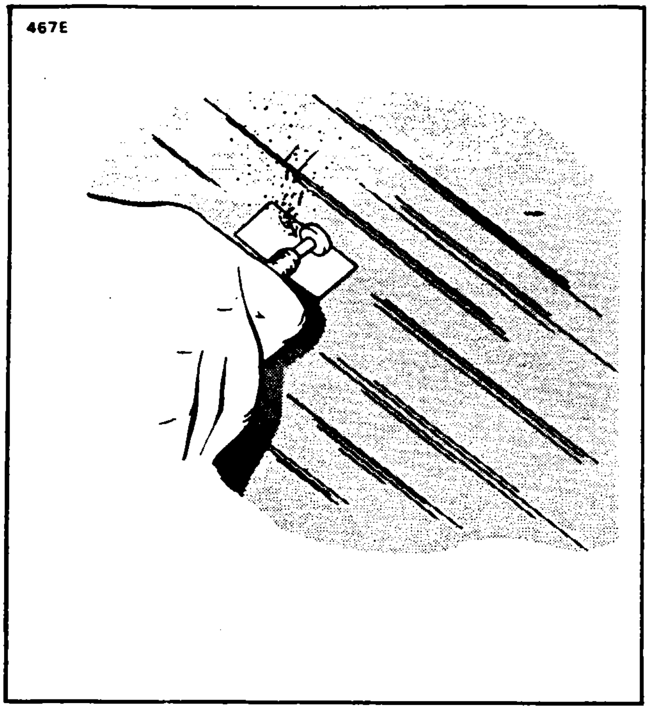


Figure 30-7. Routing to Tube Fabric

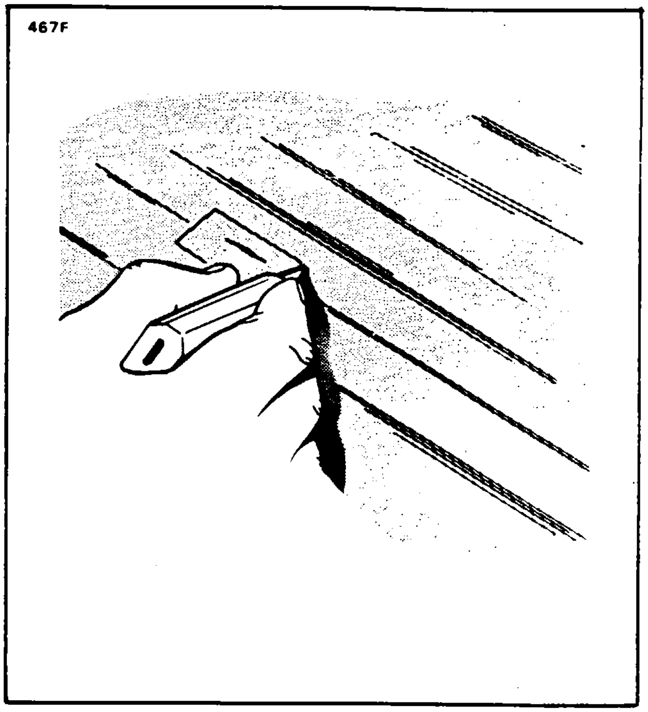


Figure 30-8. Cutting Surface of Tube

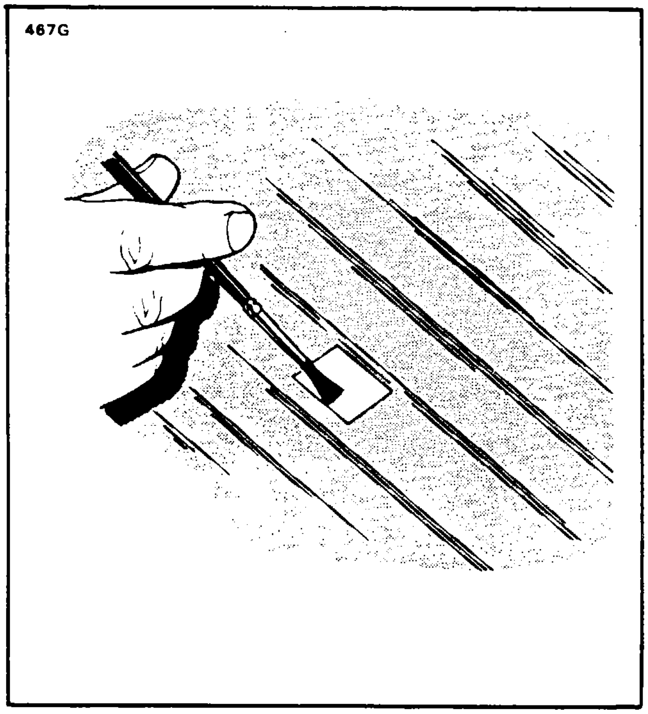


Figure 30-9. Cementing Buffed Area and Patch

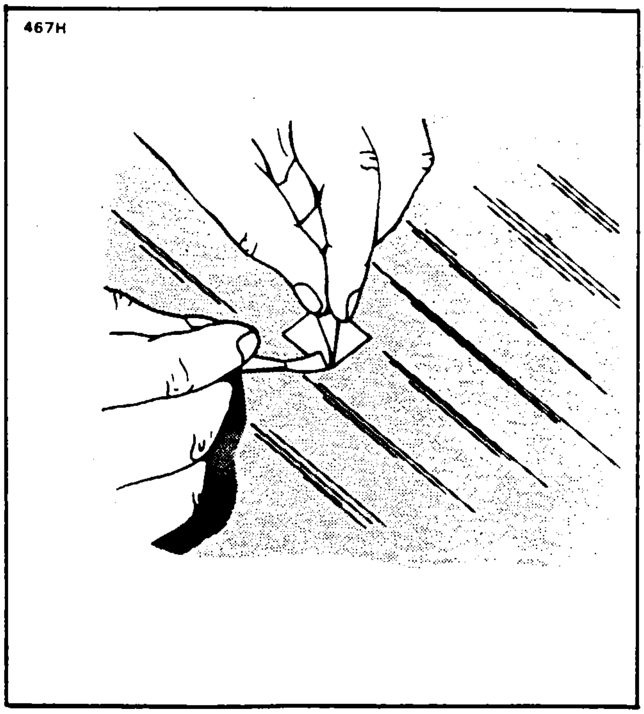


Figure 30-10. Applying and Stitching Fabric

6. Apply patches, one for each tube, inserting each patch through slit with uncemented sides of patches back to back. Then stitch each patch to surface side first; tension other ends slightly and stitch in place on backside.
7. Wash and cement exposed surfaces of fabric patches.
8. Replace gum in between tubes and apply patch to backside.
9. On surface side, mask off the repaired area and fill flush with Neoprene putty.
10. Cure surface side first for 22 minutes; then the backside for 10 minutes.
11. Restore conductive surface on surface side of boot.

HOLE THROUGH DEICER OUTSIDE OF TUBE AREA.

Repair surface side. Then, patch backside and cure complete repair for 22 minutes. Now, restore conductive surface.

INSTALLATION OF AIRFOIL DEICE BOOTS.

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 sump 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.

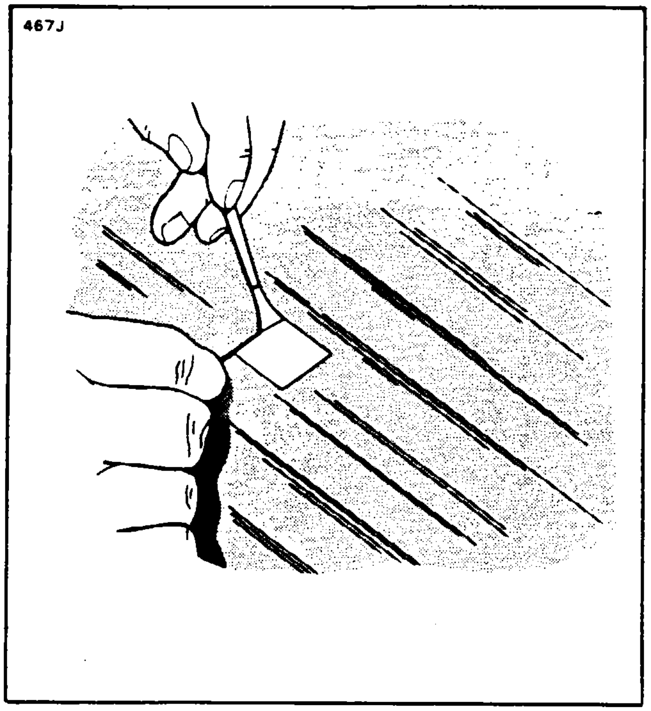


Figure 30-11. Placing and Stitching Gum

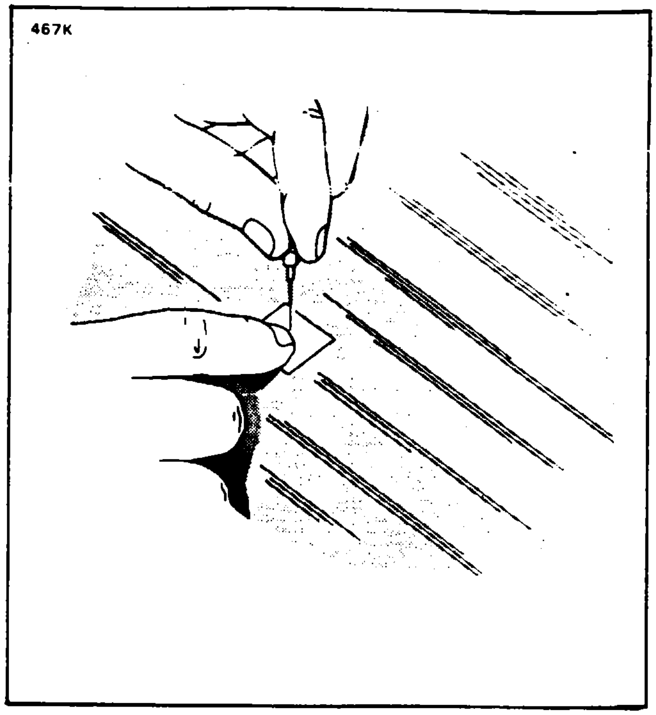


Figure 30-12. Removing Trapped Air

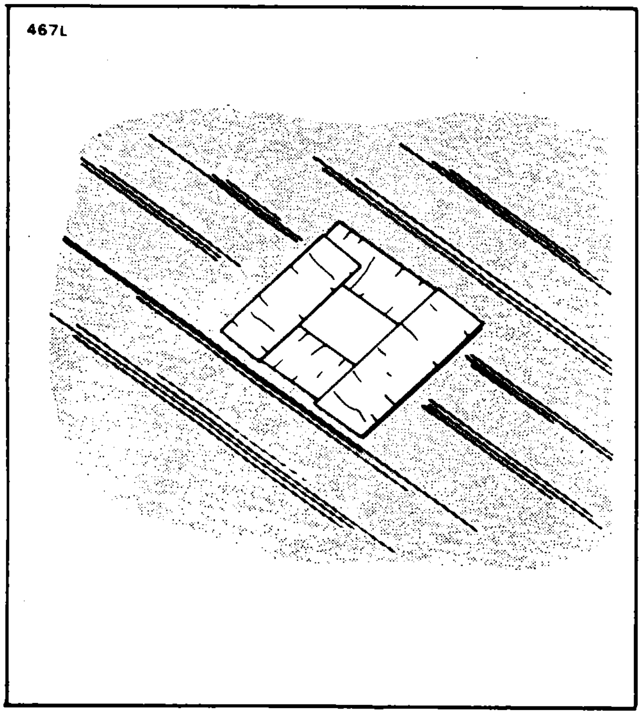


Figure 30-13. Masking Repair

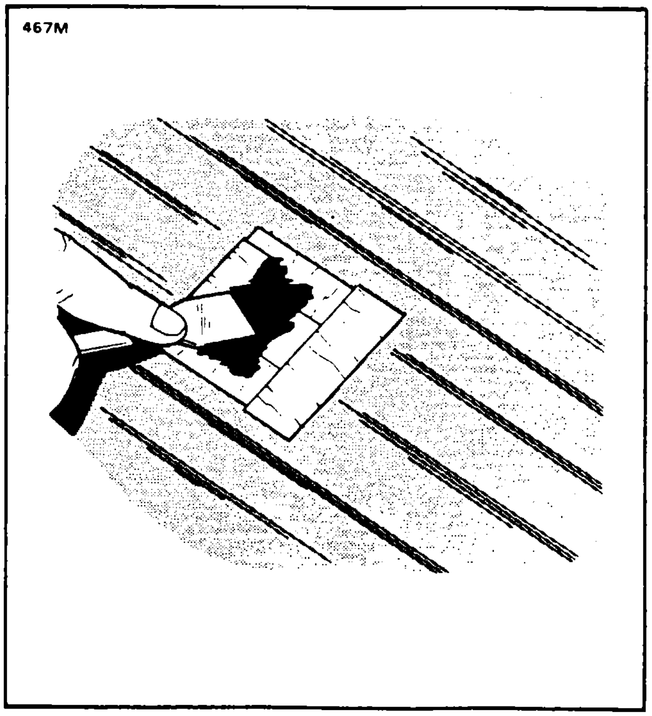


Figure 30-14. Applying Neoprene Putty

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 the 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 attach "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 excess 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 3M 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 speciman for each deicer installed. This speciman 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 uncemented 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 acceptibility 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 48 hours of installation.

MAINTENANCE OF AIRFOIL DEICE BOOTS.

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.

AGEMASTER NO. 1 AND ICEX APPLICATION.

Agemaster No. 1 and Icex are chemical treatments that will when properly applied increase the life and efficiency of the deicer boots. Although not required it is recommended that both the Agemaster and Icex treatments be applied when treating boots.

Agemaster No. 1 is a chemical treatment that penetrates and bonds to the rubber surfaces, protecting them effectively from ozone attack and premature deterioration. To insure proper protection of the deicer boots, Agemaster No. 1 should be applied at 150 flight hour intervals and prior to Application of Icex.

Icex is a specially compounded silicone base material which effectively reduces the adhesion of ice to rubber. This compound was developed for use on deicer boots, rubber abrasion boots and other rubber surfaces. When properly applied and renewed at recommended intervals (at 150 flight hour intervals), Icex will increase the life and efficiency of the deicer boots and provide a smooth polished film that evens out the microscopic irregularities on the rubber surfaces to assist the boots in removing ice quickly and cleanly. Although not required it is recommended that Icex treatments be applied when treating boots.

Agemaster No. 1 and Icex are applied as follows:

1. There are four approved methods of applying Agemaster No. 1: brushing, swabbing, rolling and dipping (prior to boot installation).

— *WARNING* —

Agemaster should never be sprayed as aeration will occur causing an extreme fire hazard as well as the loss of vital compounds needed for the protective agents to penetrate the rubber. Container should be kept tightly closed when not in use. Apply Agemaster only in a well ventilated area.

A. Thoroughly clean the boot surfaces of oil, grease and wax with a mild soap and water solution.
B. Rinse boots with clean water to ensure that all soap is removed.

— *NOTE* —

Ensure all soap is removed from under the leading edges.

C. To prevent staining the surfaces, adjacent to the boots, mask around each edge of the boot being treated.

— *NOTE* —

To insure proper treatment of the boots, a minimum of two coats of Agemaster No. 1 is required. A total of 0.75 fluid ounces per square foot (200 millimeters per square meter) should be applied. One gallon will treat approximately 150 to 170 square feet (14 to 18 square meters).

D. Of the four application methods mentioned above swabbing is the preferred method for installed deicer boots. If the swabbing method is selected, plastic or rubber gloves should be used to prevent the staining of the skin. Apply Agemaster by moistening a two inch by four inch swab of lint-free cloth and tub into the boot surface with smooth uniform strokes. The swab should be kept wet but not dripping. Cover the surface evenly and completely. Allow the first coat to dry five to ten minutes before applying a second coat.
E. If the brush or roller method is to be used: apply a single heavy coat at the rate of 0.4 to 0.5 fluid ounces per square feet (130 to 160 millimeters per square meter) using a three inch trim roller. Cover the surface completely and evenly and allow to dry five to ten minutes. A second coat may be applied after the first coat has dries thoroughly.
F. If the boots are to be handled, allow to dry for at least 30 to 40 minutes before doing so. Allow boots to dry for a minimum of 24 hours before applying Icex.

2. Icex, like Agemaster, is best applied using the swabbing method. Application of Icex should be made whenever the boots require treatment (approximately every 150 flight hours). It is recommended that Icex be applied only after the boots have been treated with Agemaster No. 1.

1. If Icex is to be applied without first applying Agemaster No. 1:
   A. When applying Icex with a swab apply in a continuous back and forth (spanwise) motion.
   B. Thoroughly clean the deicer boots with a mild soap and water solution. Isopropyl alcohol may be used sparingly on stubborn stains. However, after using alcohol the surface must again be cleaned with a mild soap and water solution. After cleaning the boots, thoroughly rinse with clean water and allow to dry completely. Apply Icex as described previously. (One quart will cover approximately 400 square feet.)

— *NOTE* —

It should be noted that Icex is not a cure-all for icing problems in that it will not prevent or remove ice formations nor will it effectively protect against ozone attack. Its only function is to prevent ice from strongly adhering to the rubber boots allowing easy and efficient removal.
Too heavy an application of Icex will result in a sticky surface and cause dirt and dust to collect on the boot reducing the efficiency of the Icex and the boot.

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.

— 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.

HEATED WINDSHIELD.

For servicing of pilot's heated windshield. Refer to Chapter 56.

WINDSHIELD WIPER MECHANISM.

REMOVAL OF WIPER MECHANISM. (Refer to Figure 30-15.)

1. Remove the access panel to the left side of the nose section.
2. Cut the lockwire at the bolt which secures the arm to the serrated converter shaft and remove the bolt.
3. Loosen the adjustment nut and lift the wiper arm off the converter shaft. Refer to wiper blade replacement and adjustment.
4. Remove two screws from seal cover around converter shaft and remove cover and old sealant from shaft.
5. Disconnect the electrical connection to the wiper motor.
6. Remove the remaining screws holding the motor and converter to the airplane, and remove the complete assembly.
7. 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.

INSTALLATION OF WIPER MECHANISM. (Refer to Figure 30-15.)

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. 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 the 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 30-15.)

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 center-post by approximately 2.00 to 2.25 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.

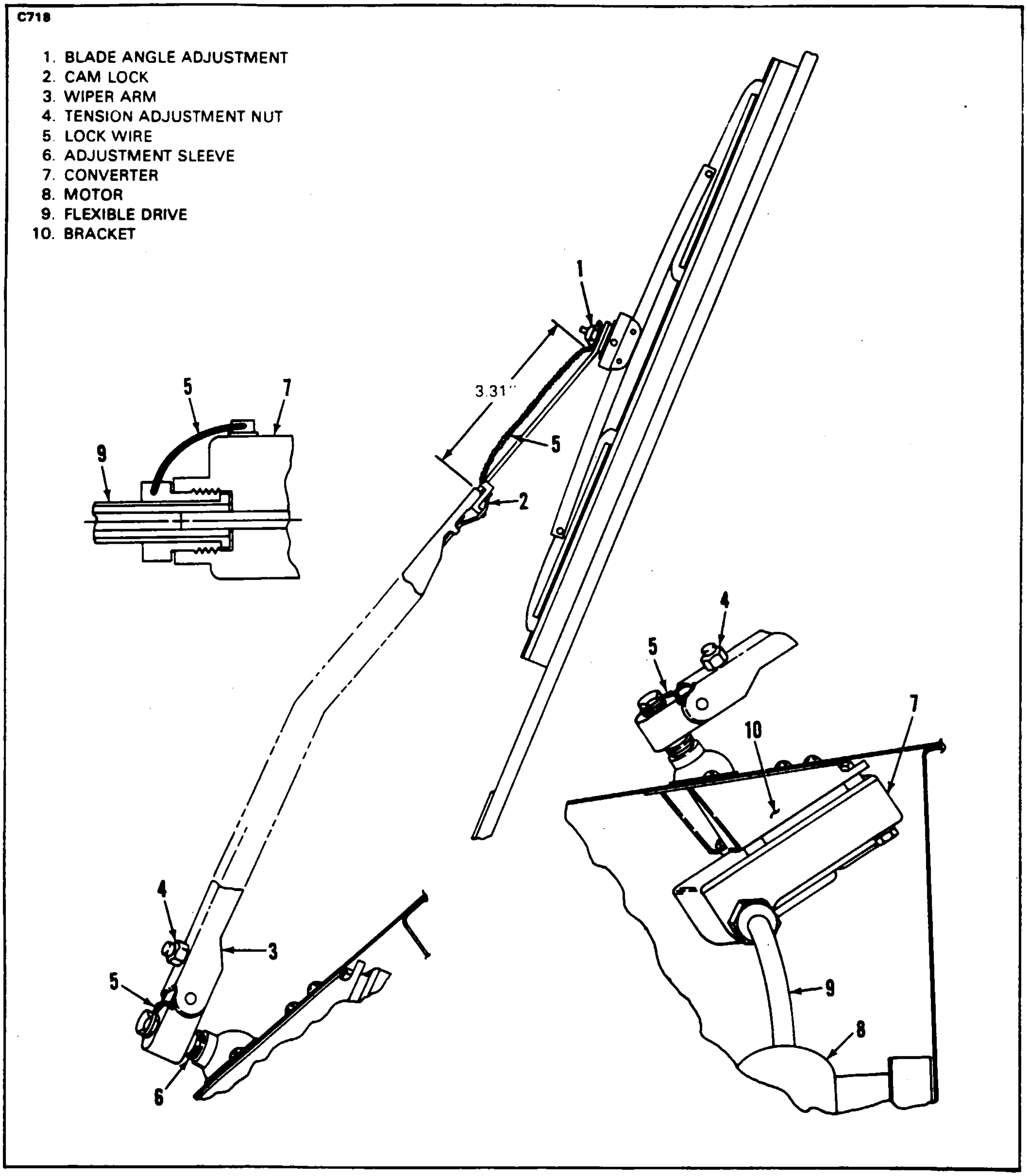


Figure 30-15. Windshield Wiper

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 30-15.)

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 2.50 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. With the wiper in the PARK position, adjust the wiper arm tension to obtain 3 to 4 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.

5. After wiper has been adjusted and adjustment latch locked; install lockwire.

PROPELLERS.

DESCRIPTION AND PRINCIPLES OF OPERATION.

The propeller deicer system consists of an electrically heated deicer bonded to each propeller blade; slip ring assemblies to distribute electrical power to the propeller deicers; modular brush assemblies to transfer electrical power to the slip rings; a timer, a PROP DEICE annunciator light; a deice system switch, circuit breaker and relay for each propeller deice system (right and left); and the wiring harness necessary to complete the circuit. Power is drawn from the aircraft electrical system.

The design of the propeller deicer system allows the application of heat to the surfaces of the propeller blades where ice normally would adhere. This heat combines with centrifugal force and airstream pressure to remove accumulated ice.

TROUBLESHOOTING.

Refer to Chart 3006 for troubleshooting procedures.

CHART 3006. TROUBLESHOOTING (PROPELLER DEICER SYSTEM)

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.	Locate and correct.
	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.
Rapid brush wear or frequent breakage.	Brush block out of alignment.	Check brush alignment.
	Slip ring wobbles.	Check slip ring alignment with dial indicator.

MAINTENANCE PRACTICES.

PROPELLER DEICE SYSTEM OPERATIONAL CHECK.

Since the deicing system is normally interlocked out by the landing gear safety switches, ground operation is not possible - If the system is powered, but interlocked out, it may be tested prior to flight as follows:

1. Ground Test: To properly test the system, depress the test switch for a period of at least 10 seconds while observing the annunciator malfunction lights. The lights should clear after two seconds with no further annunciation for the balance of the test period if no failures are detected. If a failure is detected, the annunciator could stay on for 45 seconds, 90 seconds or continuously. A fault indication of 45 seconds illumination, indicates an open circuit on one of the shedding areas of the air inlet lip. 90 second illumination indicates an inoperative propeller deicing system. Continuous illumination indicates an open circuit of the inlet parting strip.
2. Flight Test: Testing of the system in flight is similar to the ground test procedure. With the system powered and the test switch depressed, the malfunction annunciator will illuminate and then automatically clear itself after a period of two seconds with no further annunciation if no failures are detected.

— NOTE —

The malfunction annunciator will illuminate when the deice system is turned off in flight.

RECOMMENDED OVERHAUL OF DEICE SYSTEM TIMER.

International Avionics Incorporated has established a recommended overhaul period of 5,000 flight hours for contactor inspection and/or replacement.

100 HOUR INSPECTION.

1. Remove cowling in accordance with Removal of Engine Cowling, Chapter 71.
2. Ascertain that all clamps, clips, mountings and electrical connections are tight. Check for loose, or broken or missing safety wire.
3. Deicers: Closely check deicers for wrinkled, loose or torn areas, particularly around the outboard end. 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.
4. 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 Limekin Pike, Dresher, PA (19025.)
   B. If uneven wear is found or if wobble is noticed, set up dial indicator as shown in Figure 30-16 to check alignment of slip rings to propeller shaft.

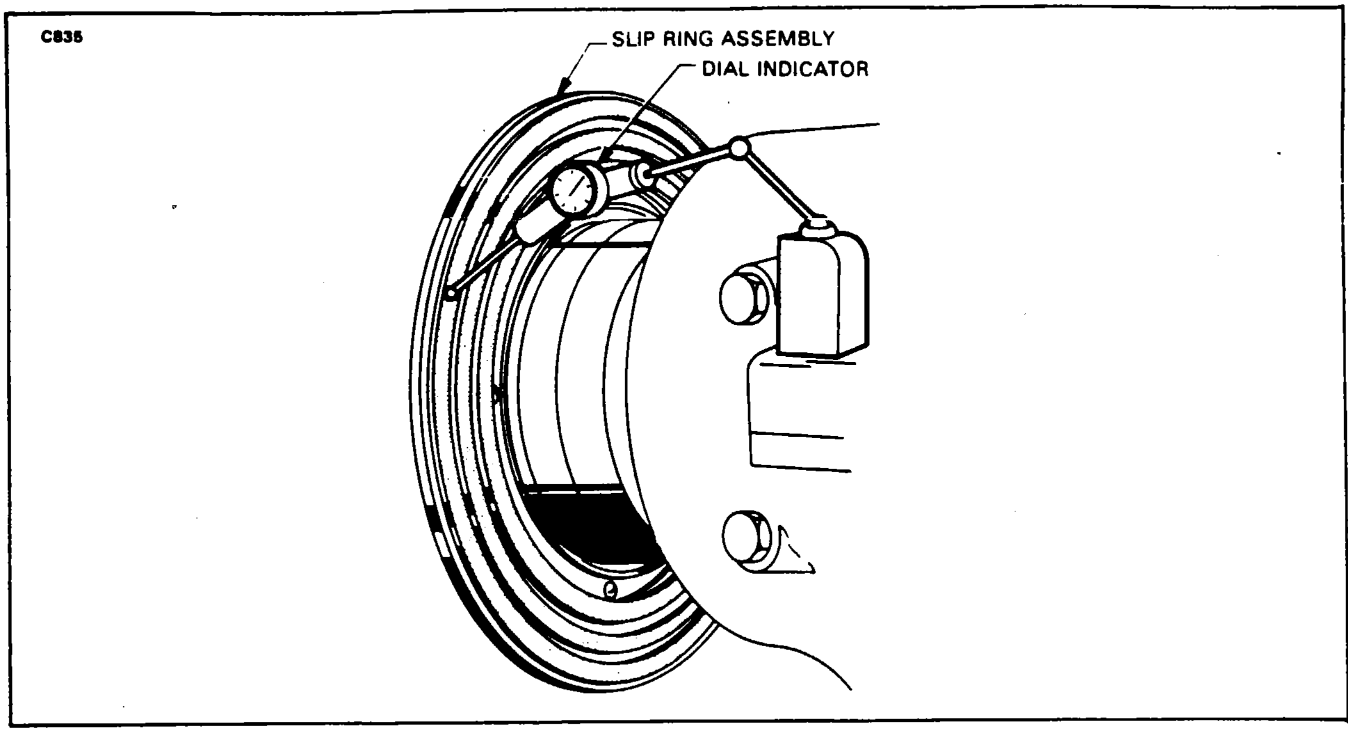


Figure 30-16. Typical Use of Dial Indicator

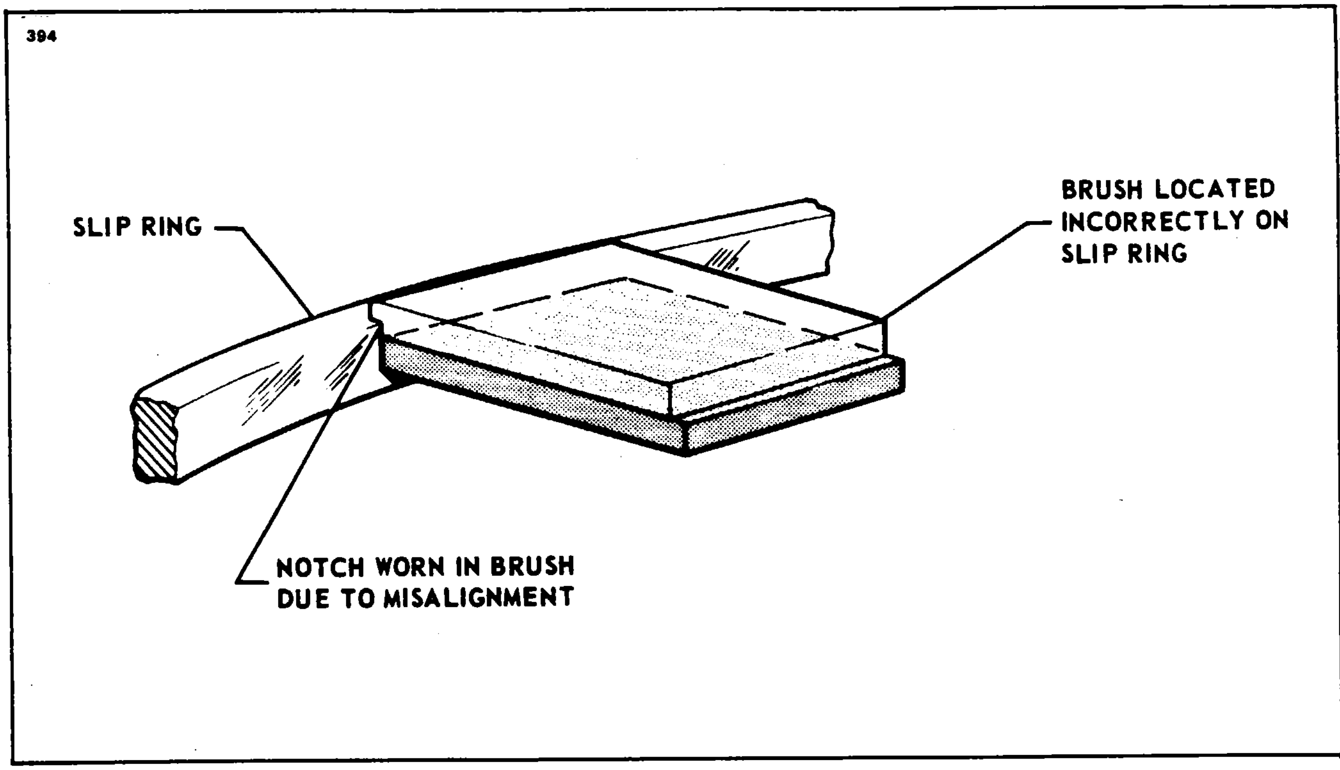


Figure 30-17. Centering of Brushes on Slip Rings

5. Modular Brush Assemblies: 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 30-17 shows wear pattern if condition is not corrected. If alignment is off, shim where modular brush assembly attaches to mounting bracket.
   B. Check for proper clearance of modular brush assembly to slip rings as shown in Figure 30-19. If not correct, loosen mounting screws and move in elongated holes to correct block position before maintaining securely.
   C. Check brush block for wear limitation. Refer to Checking for Brush Wear and Figure 30-18.
   D. Visually check brush block for approximately 2° angle of attack, (Refer to Figure 30-19.) If not, loosen mounting screws and twist block, but be sure to hold clearance limits shown when tightening.

BRUSH MODULES/MODULAR BRUSH ASSEMBLIES.

Each 3E2071 modular brush assembly consists of one 3E2011-1 brush module, one 3E2011-2 brush module and a 4E2218-6 spacer. The brush modules, which consist of a plastic housing with an integral brush and spring, are held together by screws, washers, lockwashers and nuts to form a modular brush assembly. (Refer to Figure 30-21.)

A407

NOTE

DURING MEASUREMENT ONLY 1/16 INCH OF BRUSH SHOULD BE ALLOWED TO PROTRUDE FROM MODULAR BRUSH ASSEMBLY. THIS IS THE NORMAL POSITION OF THE BRUSH WHEN INSTALLED ON THE AIRCRAFT.

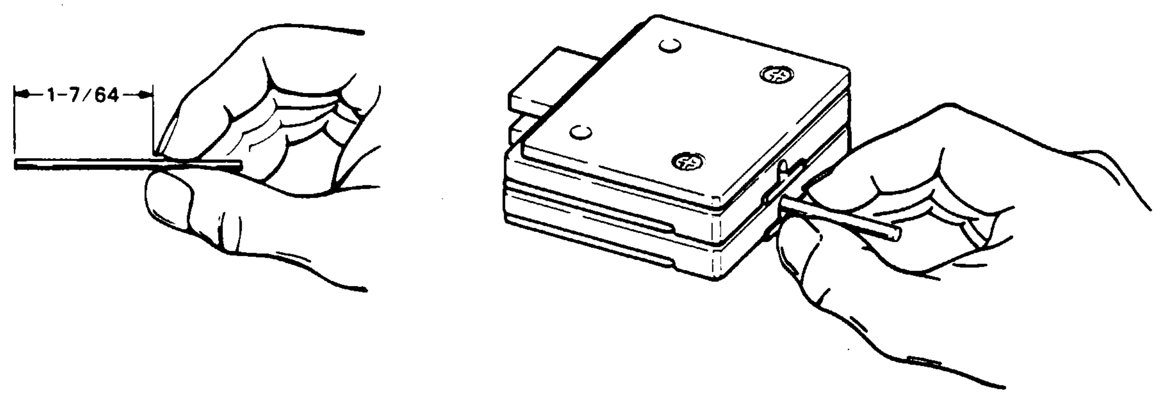


Figure 30-18. Modular Brush Assembly Wear Check

REPLACEMENT OF BRUSH MODULES.

Brushes are not offered, individually, as replacements. When a brush wears out, the entire brush module must be replaced. Refer to Figure 30-18 for procedure to use in determining brush wear.

1. Remove the modular brush assembly from the aircraft by removing the attachment hardware and disconnecting the engine wire harness.
2. Remove assembly screws, nuts and washers and separate modules and spacer.

— NOTE —

The part number of each module is etched into the surface of the plastic housing. Replace with the same part number module.

3. Reassemble modules and spacer as shown in Figure 30-21.

— 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 for proper alignment.

ALIGNMENT OF NEW BRUSHES. (Refer to Figure 30-19.)

Any time the brush block is dismounted, the alignment at 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.

SLIP RINGS.

MACHINING OF SLIP RINGS.

Slip rings with roughened or damaged surfaces can be machined to restore to serviceability. Remove the slip ring 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 two slip rings must be parrallel 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 .020 to .030 inch below the contact surface of the slip rings. The minimum dimension for refacing slip ring assemblies should not be less than .187 inch between the copper slip ring surfaces and the legs of the slip ring assembly. (Refer to Figure 30-22.)

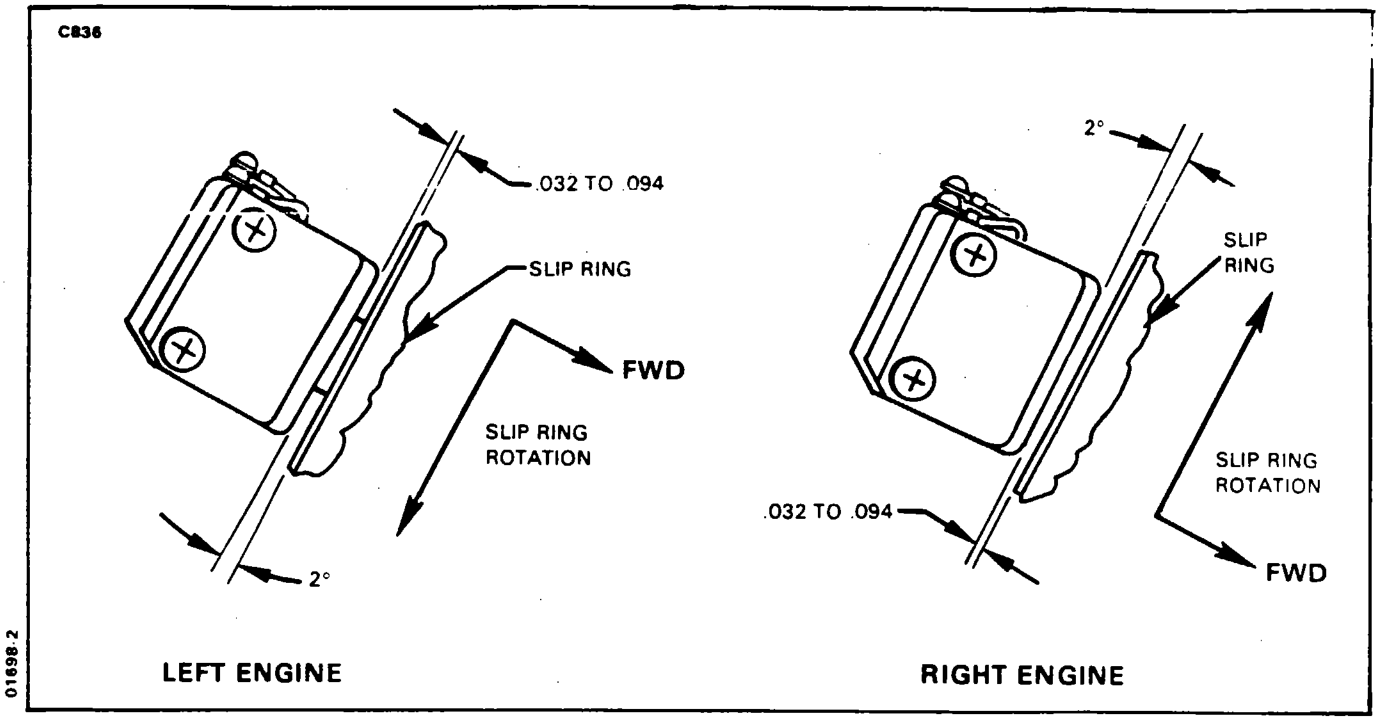


Figure 30-19. Angle of Contact Brushes to Slip Rings

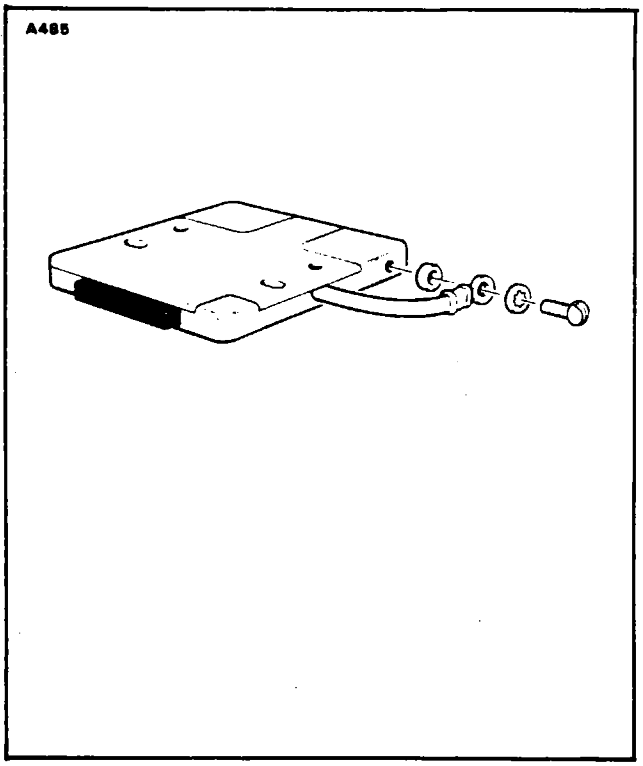


Figure 30-20. Brush Module Assembly (3E2011)

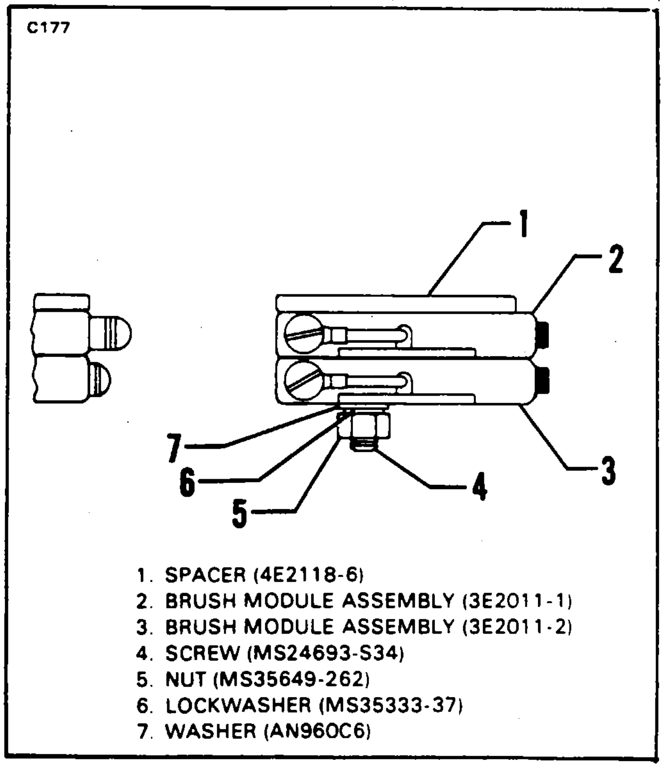


Figure 30-21. Modular Brush Assembly 3E2071

— *NOTE* —

If in machining, the solder or braze connection on the underside of the slip ring is exposed, replacement of the assembly will be necessary.

REPLACEMENT OF SLIP RINGS.

Slip 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 slip 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 to ground; it should read 1.58 to 1.64. If this reading is not obtained, disconnect the deicer leads to measure heater resistances individually. Individual heater should be 4.74 to 4.90. 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.

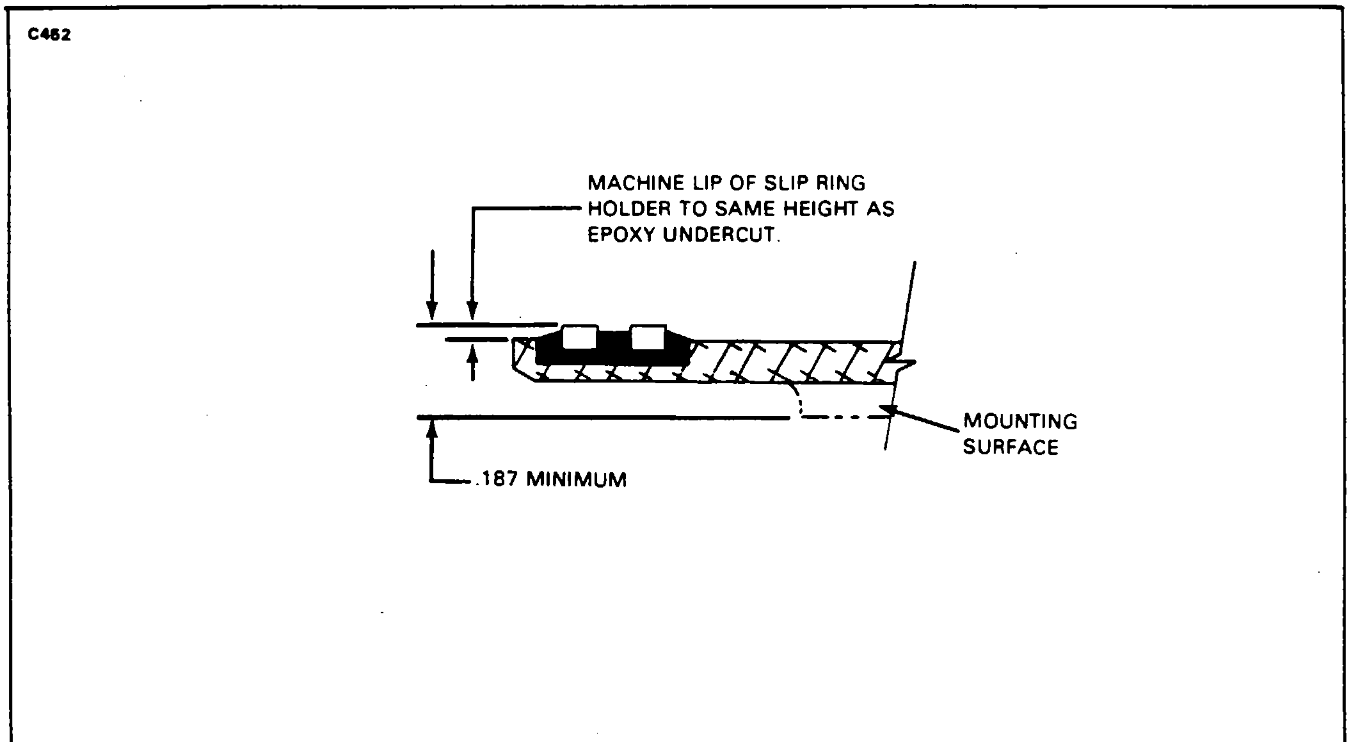


Figure 30-22. Machining of Slip Rings

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.

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 surface. 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.

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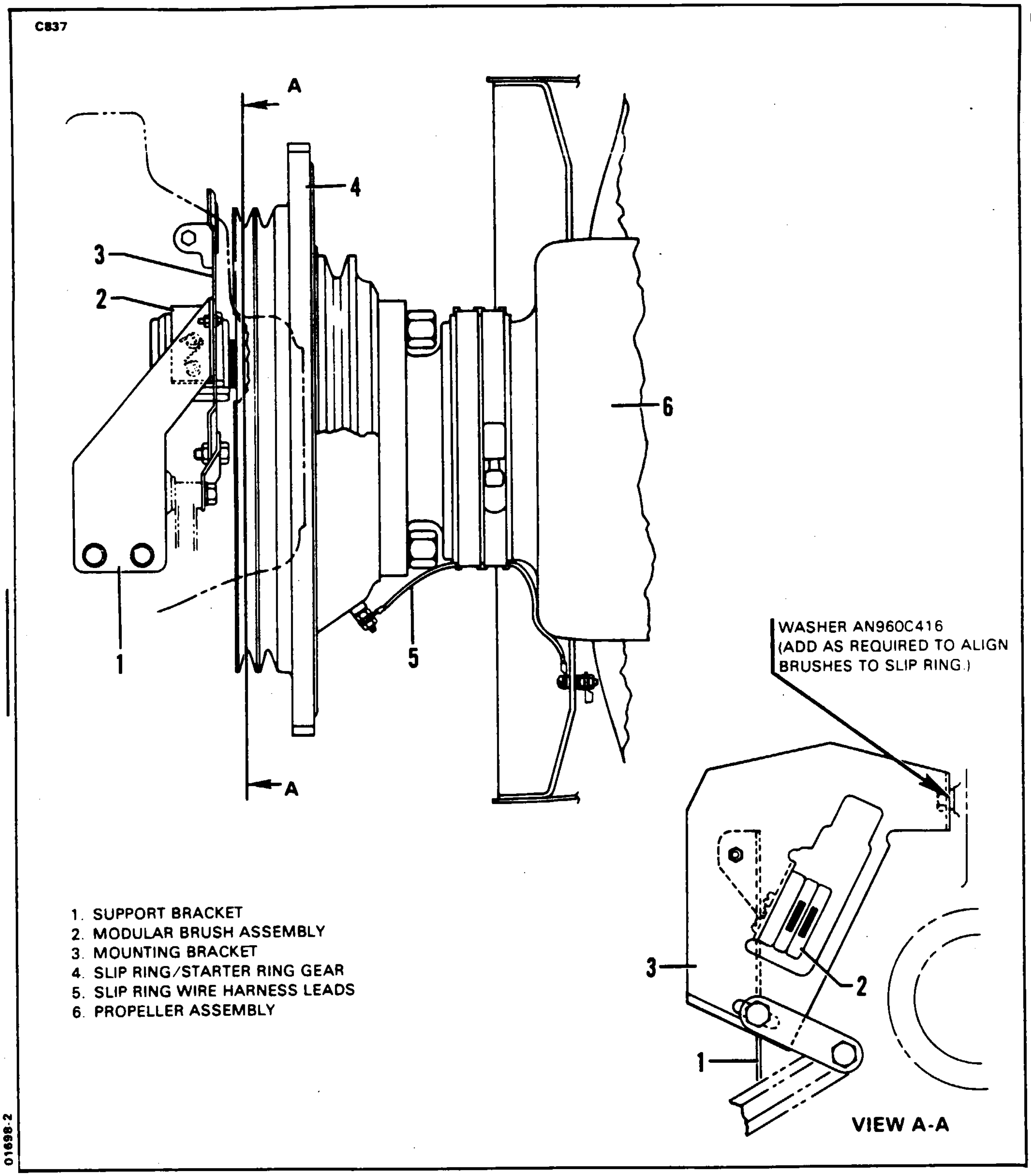

Figure 30-23. Modular Brush Assembly Installation

PREPARATION OF SURFACE PRIOR TO INSTALLATION OF DEICER.

1. Mark and cut from masking tape a pattern the size of propeller deicer. (Refer to Figure 30-24.)
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.

— *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.

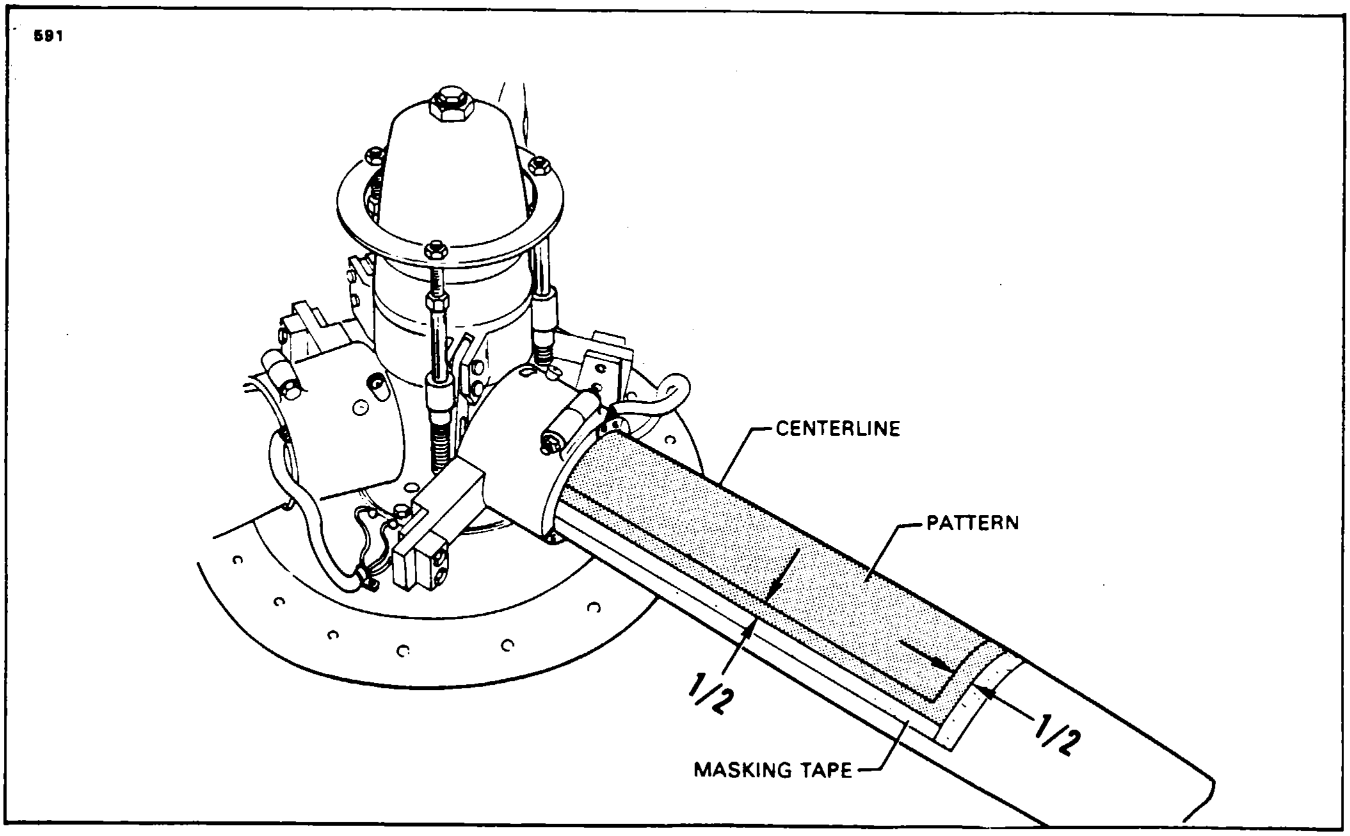

Figure 30-24. Installation of Deicer Boots (Typical)

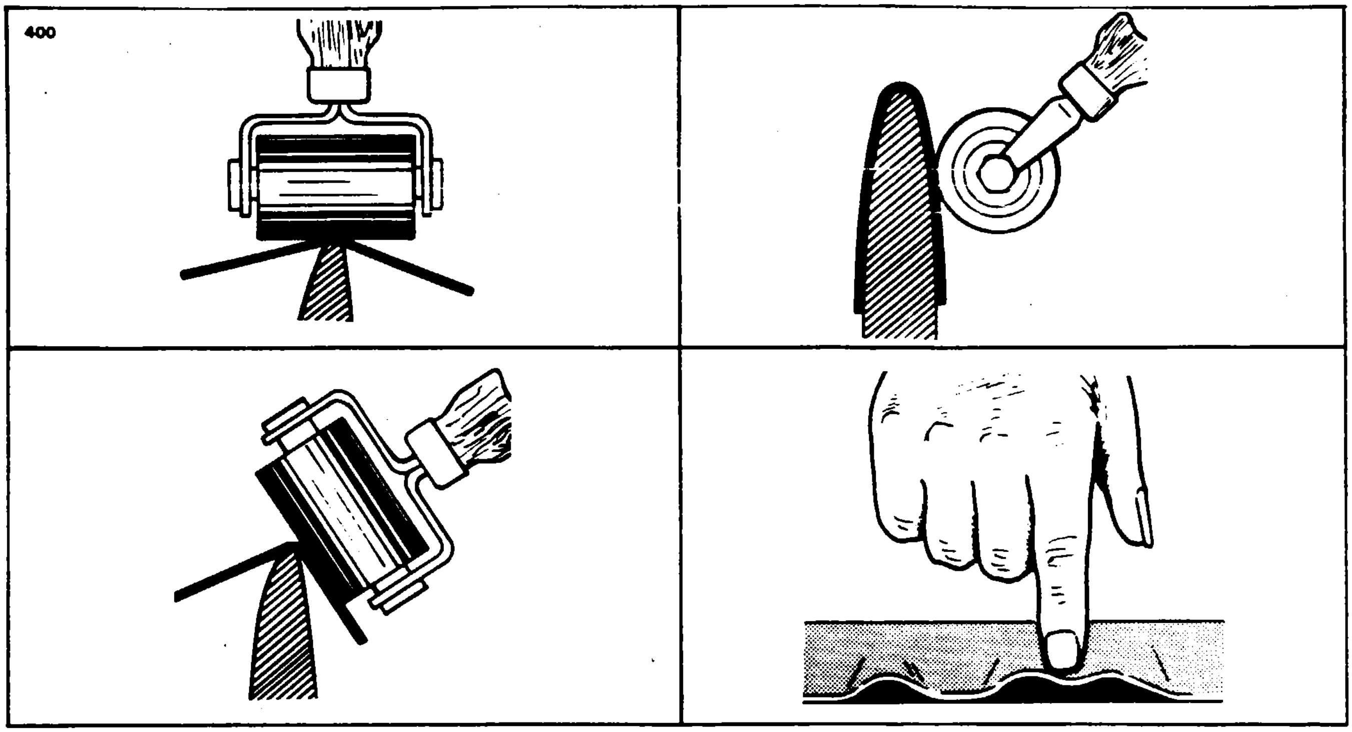

Figure 30-25. Wrinkled Deicers

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 1300L cement. Apply one even brush coat of cement to the unglazed back surface of the deicer. Allow to air dry for a minimum of one hour at 50° 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 appling 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 30-24.) 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 30-25.
   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 24 hours cement curing time before turning up propeller. Allow 72 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.

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 parts 801.
   D. C-19861/C-21871/C-16176 - one part 19861/seven parts 21871/two and two thirds parts 16176.

CHART 3007. 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.

5. Locate masking tape at approximately .125 inch beyond cemented area around the propeller deicer to allow application of filler directly to metal. Apply one even brush coat of 82-075A/B filler (or EC-801 sealer) over the .125 inch of bare metal, cemented, area about .125 inch of the boot for the propeller deicers.
6. Immediately remove masking tape from propeller and allow filler to dry for 24 hours.
7. Apply new masking tape approximately .125 inch beyond filler to allow application of sealer directly to the mounting surface. Apply one even brush coat of 82-076-1/2 sealer (or C-19861, C-16176 paint) over .125 inch of mounting surface filled area and .250 inch of deicer. (See Figure 30-27.)
8. Insure that sealer completely covers area between deicer and blade on propeller. (See Figure 30-27.) Immediately remove masking tape and allow sealer to dry for 24 hours before starting engine.

WRINKLED DEICERS. (Refer to Figure 30-25.)

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 Actone 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 deicer. Refer to Schematic, Chapter 91 and Resistance Readings. Refer to Chart 3008.
2. Check for intermittent open circuits by tensioning the deicer wire harness slightly while measuring the resistance. Also, press lightly on the entire deicer surface and in the area adjacent to the harness 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, Chapter 91. 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 4.74 to 4.90.

— NOTE —

These resistance 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 deice terminals or between the slip rings. The reading should be:

CHART 3008. ELECTRICAL RESISTANCE - PROPELLER DEICE BOOTS

Resistance Check	Max.	Min.
1 Blade	4.90	4.74
2 Blades in Parallel	2.45	2.37
3 Blades in Parallel	1.64	1.58

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 modular brush assembly.
   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 circuit that may have been disconnected, or remove paper shims that might have been used for making the final electrical check.

INSTALLATION OF DEICER LEADS AND WIRE HARNESS.

1. The deicer leads are fastened to the bulkhead in the same positions from which they were removed.
2. The deicer leads are to be attached to the studs on the spinner bulkhead.
3. The propeller deicer wiring harness is secured to the propeller counterweight as follows:
   A. Insert the deicer wire harness through the hole in the propeller counterweight.
   B. Connect the plugs of the prop deicers and the deicer wire harness.
   C. Install tie strap (P/N MS3367-2-9) between the leads along the length of the plugs. Do not tighten at this time.
   D. Install two (2) tie straps (P/N MS3367-1-9) under the tie strap installed in the previous step and around the counterweight. Do not tighten at this time.
   E. Install transflux tubing over deicer wire harness.
   F. Route transflux tubing under both tie straps (P/N MS3367-1-9) and tighten tie straps.
   G. Tighten tie strap around plugs.
   H. Install the terminals on the deicer wire harness.
   I. Install the terminals of the harness to the screws on the spinner bulkhead and tighten the lead clip over the harness.
   J. If damage occurs to slip ring, wire harness or tie straps, replace damaged parts.

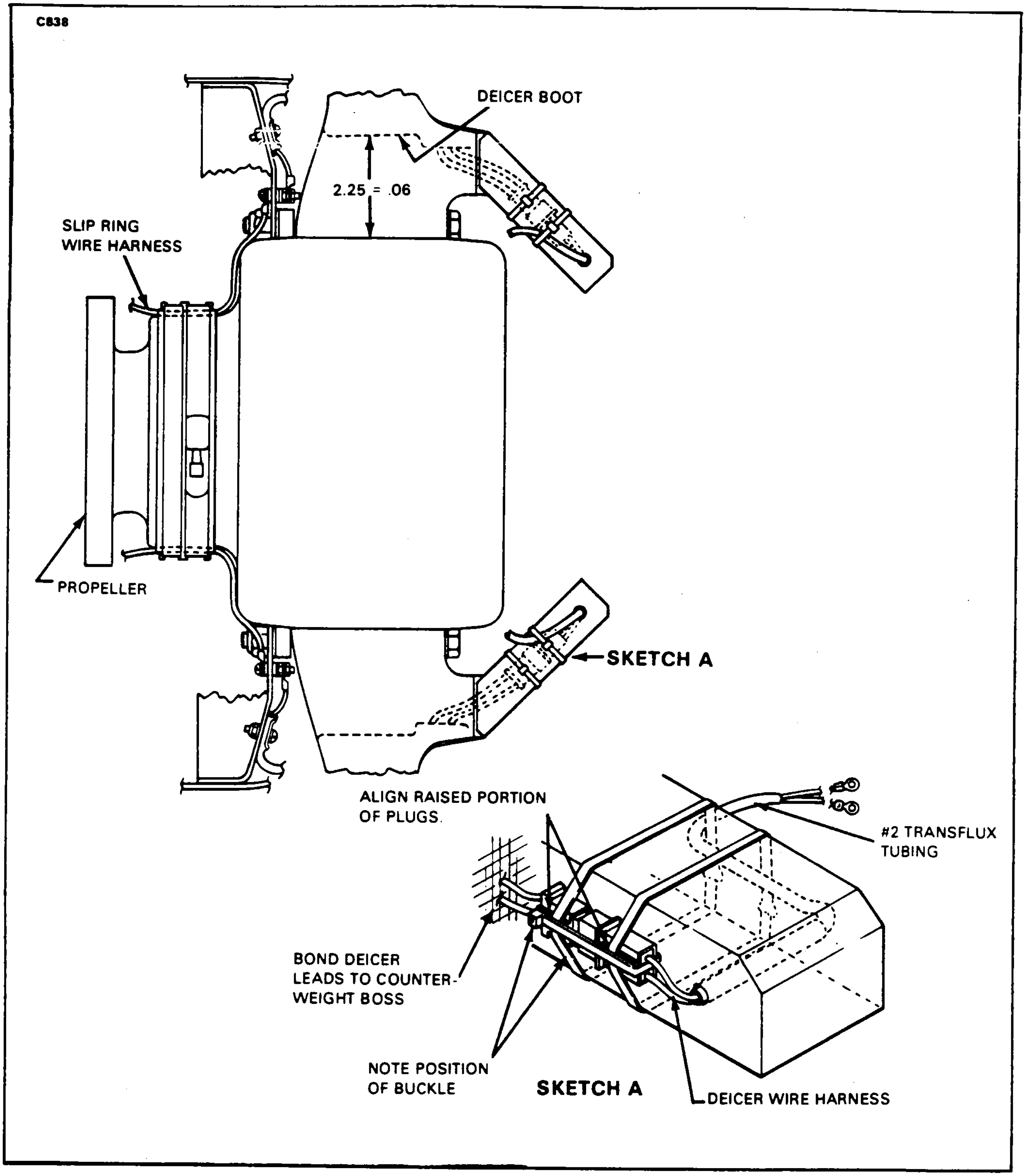

Figure 30-26. Prop Deicer Wiring Harness Installation

BALANCING.

To assure balance of the propeller assembly, the original balance 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.

PROPELLER ICE SHIELD.

The propeller ice shield consists of a 4.75 inch by 29.50 inch contoured fiberglass shield attached to the fuselage at station 49.60 whose sole purpose is to protect the fuselage skin from damage caused by ice shed from the propeller blades.

REMOVAL OF PROPELLER ICE SHIELD.

1. Using a sharp plastic or hardwood sealant removal tool, remove the sealant from around the shield.
2. Remove the 14 screws (MS35206-227) which secure the shield to the fuselage and remove shield.
3. Remove all traces of sealant from the fuselage using sealant removal methods described in Chapter 51.

INSTALLATION OF PROPELLER ICE SHIELD.

1. Position the ice shield in position on the fuselage and secure 14 screws (MS35206-227).
2. Seal around edges with MIL-S-7502B sealant.

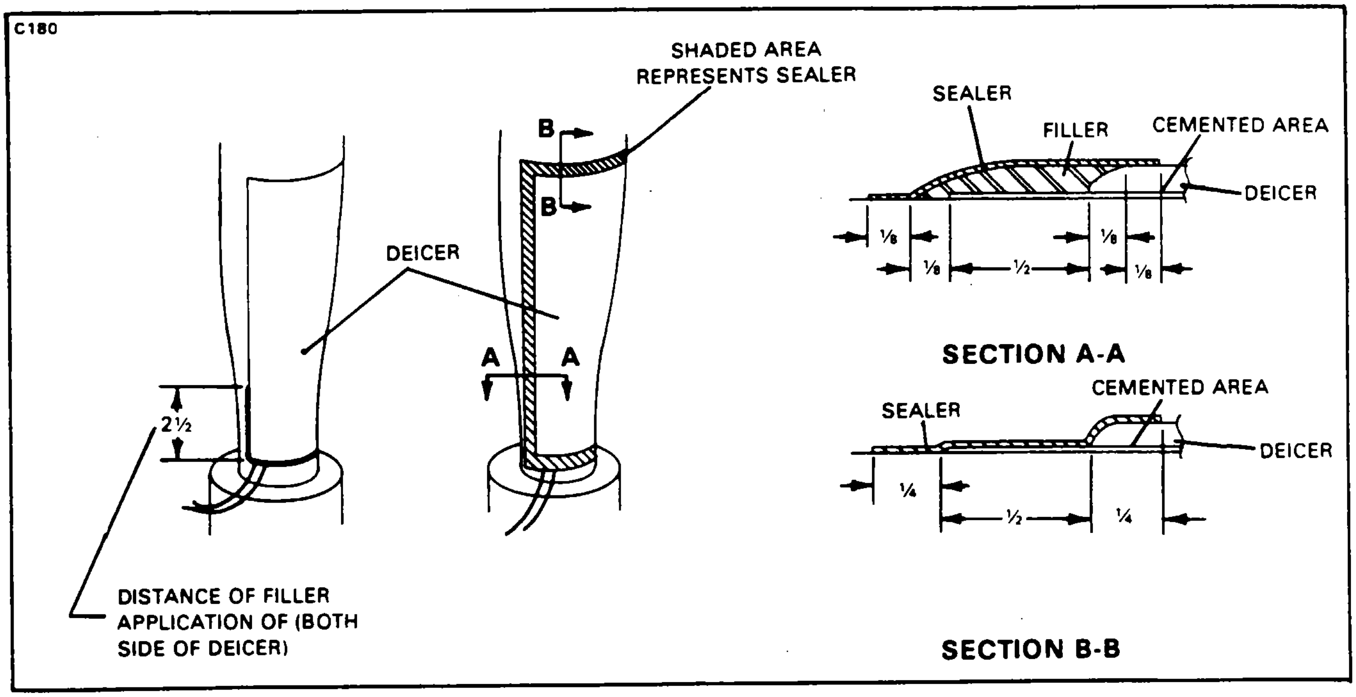

Figure 30-27. Typical Deicer Boot Sealer Application

ICE DETECTION.

WING INSPECTION LIGHT.

The wing inspection light is used in conjunction with the pneumatic deicing system and will aid the pilot in detecting the formation of ice on the left wing leading edge during night flying operations.

The light is mounted in the left outboard surface of the left nacelle just above the leading edge of the wing. It is a sealed beam, 24 volt unit which is controlled by a rocker type switch mounted on the overhead switch panel. The light is positioned so as to illuminate the leading edge of the wing when the switch is activated.

SERVICING.

The only service required of this unit is the replacement of a burned out lamp with a new lamp (GE4593).

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CHAPTER

32

LANDING GEAR

CHAPTER 32 - LANDING GEAR

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 32 - LANDING GEAR (cont.)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 32 - LANDING GEAR (cont.)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 32 - LANDING GEAR (cont.)

TABLE OF CONTENTS/EFFECTIVITY

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 or retraction, and closing again when the gear has fully extended and/or retracted. 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.

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.
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 cable out of adjustment.	Adjust cable.
	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. Throttle switches out of adjustment.	Replace switches. Adjust throttle switches.
Red indicator light stays on with gear up and locked.	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. Throttle switches are defective. Horn or light defective. Defective wiring.	Adjust throttle switches. Replace switch. Replace defective part. Check wiring.
Nose gear shimmies during fast taxi, take-off and landing.	Internal wear in shimmy dampener. Shimmy dampener or bracket loose at mounting. Tire out of balance. Worn or loose wheel bearings. Worn torque link bolts and/or bushings.	Replace shimmy dampener. Replace necessary parts and bolts. Check balance and replace tire if necessary. Replace and/or adjust wheel bearings. Replace bolts and/or bushings.
Main landing gear shimmies during fast taxi, take-off and landing.	Tire out of balance. Worn or loose wheel bearings. Worn torque link bolts and/or bushings.	Check balance and replace tire if necessary. Replace and/or adjust wheel bearings. 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.
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.
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.
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.

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 jacks.

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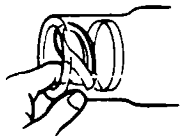
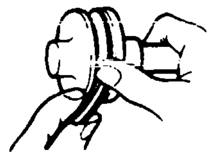
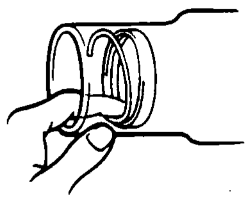


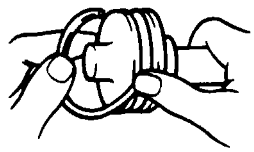
INSTALLATION OF SEALING
RING IN ROD END
SKETCH A



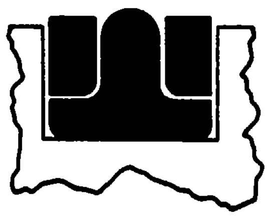
INSTALLATION OF SEALING
RING ON PISTON
SKETCH B



INSTALLATION OF NON-EXTRUSION
RINGS IN ROD END
SKETCH C



INSTALLATION OF NON-EXTRUSION
RINGS ON PISTON
SKETCH D



CROSS SECTION OF INSTALLED
T-RING ASSEMBLY
SKETCH E

PROPER MATING OF SCARF
CUT ON NON-EXTRUSION RINGS
SKETCH F

Figure 32-1. Installation of T-Rings

REPLACEMENT OF T-RINGS ON LOWER BEARINGS. (Refer to Figure 32-1.)

1. Place synthetic sealing ring into groove. Insure that seal is not twisted and that it lies flat in the groove. (Refer to Sketches A and B.)
2. Orient each non-extrusion ring so that the radiused corner (if there is one) will be mated to the seal when installed. (Refer to Sketch E.)
3. Insert one end of the non-extrusion ring (formed by the scarf cut) into the space between the side of the groove and the side of the seal. (Refer to Sketch E.)
4. Work the entire circumference into this space, insuring that the scarf cut of the non-extrusion ring is properly mated. (Refer to Sketch F.)
5. Repeat steps 3 and 4 for the second non-extrusion ring.
6. Spread a few drops of system hydraulic oil evenly around the sealing edge of the packing.

MAIN GEAR AND DOORS.

MAIN GEAR OLEO STRUT.

DISASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 32-2.)

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 —

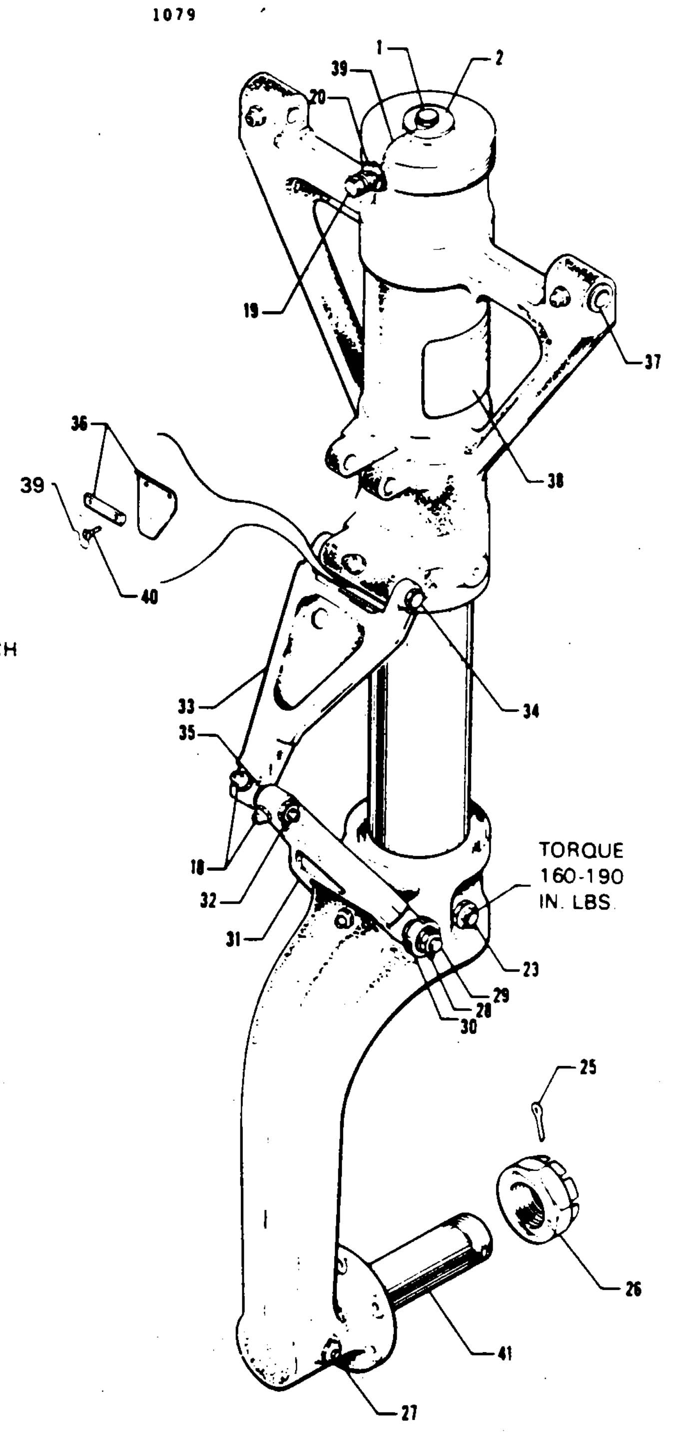
Prior to disassembling the upper bearing with retaining pins from the piston tube, place a reference mark with a grease pencil from the upper bearing to the piston tube. This will insure proper indexing of parts upon reassembly.

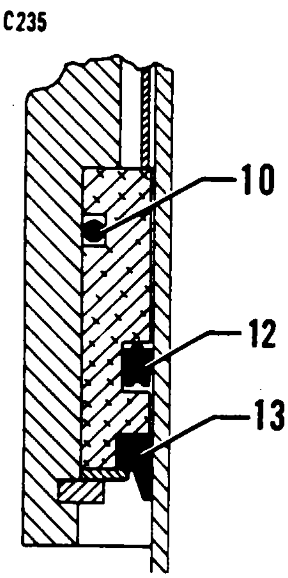
7. The fork tube components may be removed by reaching in the tube and pushing out the upper bearing retaining pins. Slide off the upper bearing, spacer, lower bearing with O-rings, wiper, washer and retainer ring.
8. To remove the orifice tube from the oleo housing, cut safety wire and remove cap bolt 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.

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, WASHER
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. WASHERS, BUSHINGS
36. CONTACT, SAFETY SWITCH
37. BUSHING
38. PLACARD, SERVICE
39. SAFETY WIRE
40. SCREW
41. AXLE





VIEW A-A
(Refer to following page)

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Figure 32-2. Main Gear Oleo Strut Assembly

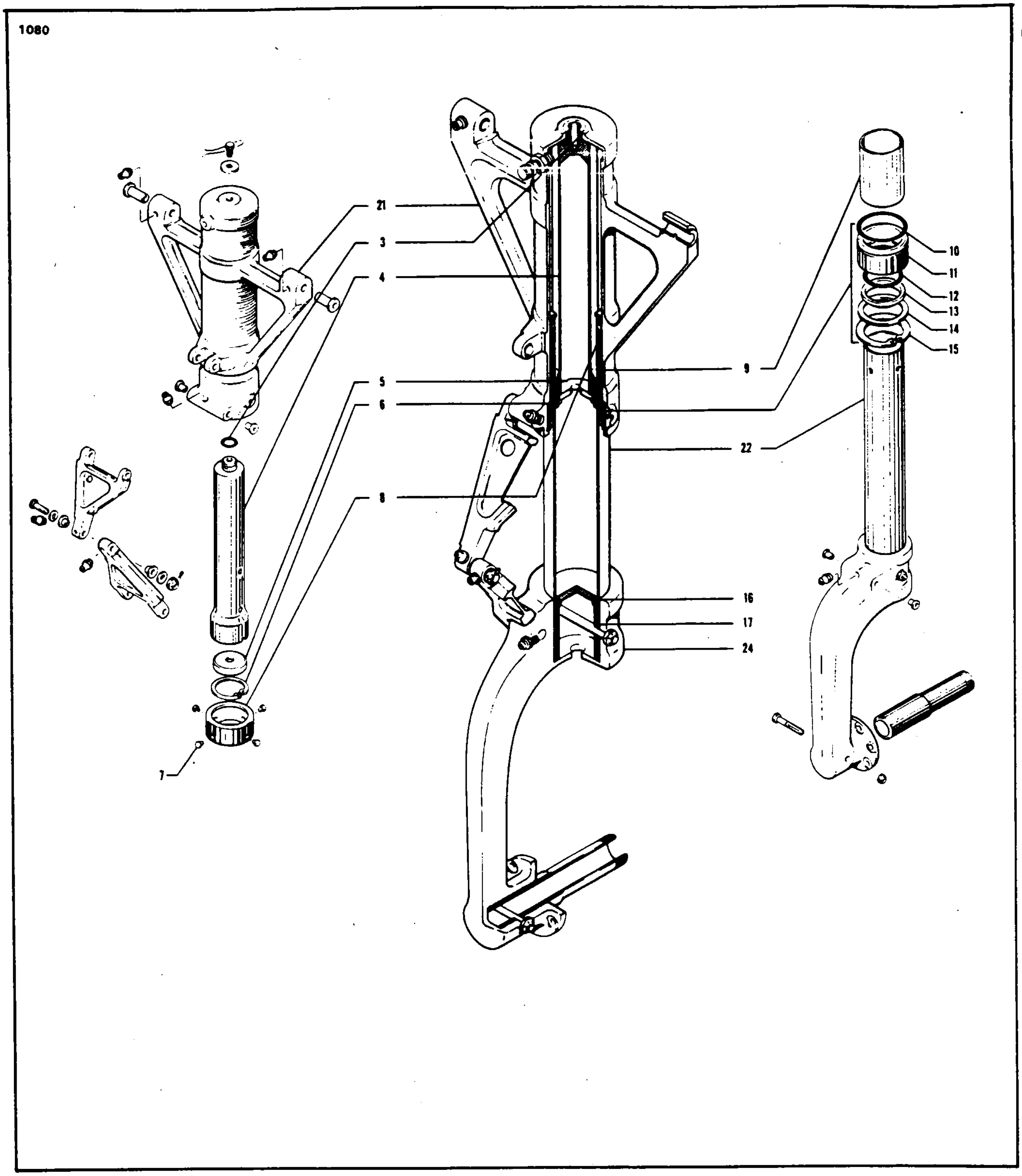


Figure 32-2. Main Gear Oleo Strut Assembly (cont.)

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 32-2.)

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 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 32-3.)

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 cable from the upper side brace link arm by removing clevis bolt. Disconnect the other end of the downlock 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 cable from the hook and then the hook pivot bolt.
8. The uplock cable may be removed by disconnecting the rod 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 for 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 cable end bearings and surface for corrosion, damage and fraying of the cable.
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 32-3.) 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 32-3.)

— 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 with one end attached to the hook and the other end to the crank fitting.
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 may be installed by bolting the one end of the 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.
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 32-3.)

1. With the airplane on jacks and the gear extended, disconnect the inboard and outboard gear door operating rods and secure the doors in the open position.
2. Disconnect the downlock operating cable from the downlock hook.
3. 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.)

4. Use the fabricated tool in the following procedure:
   A. The gear is down and locked with no hydraulic pressure on the system.

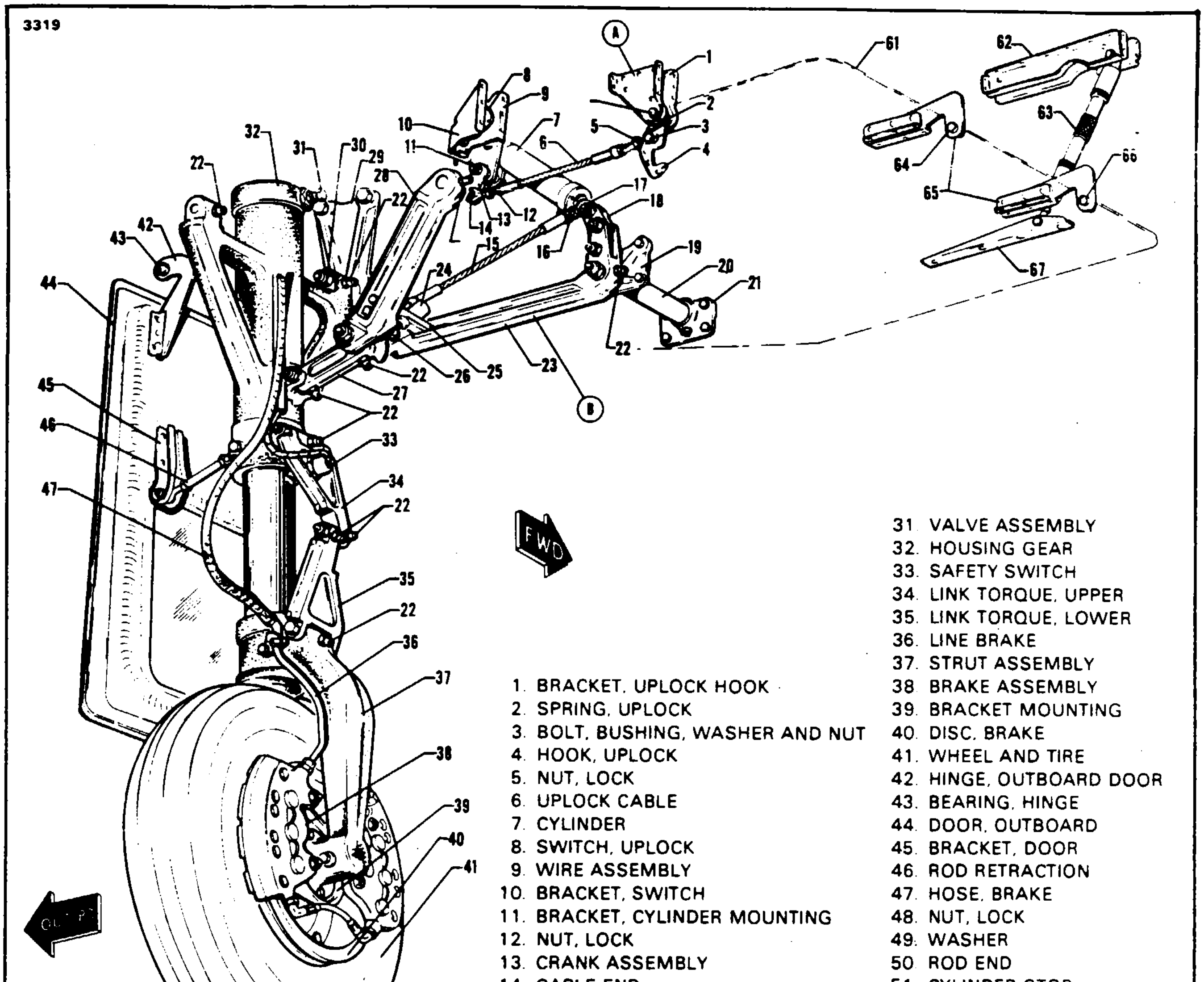
— NOTE —

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.

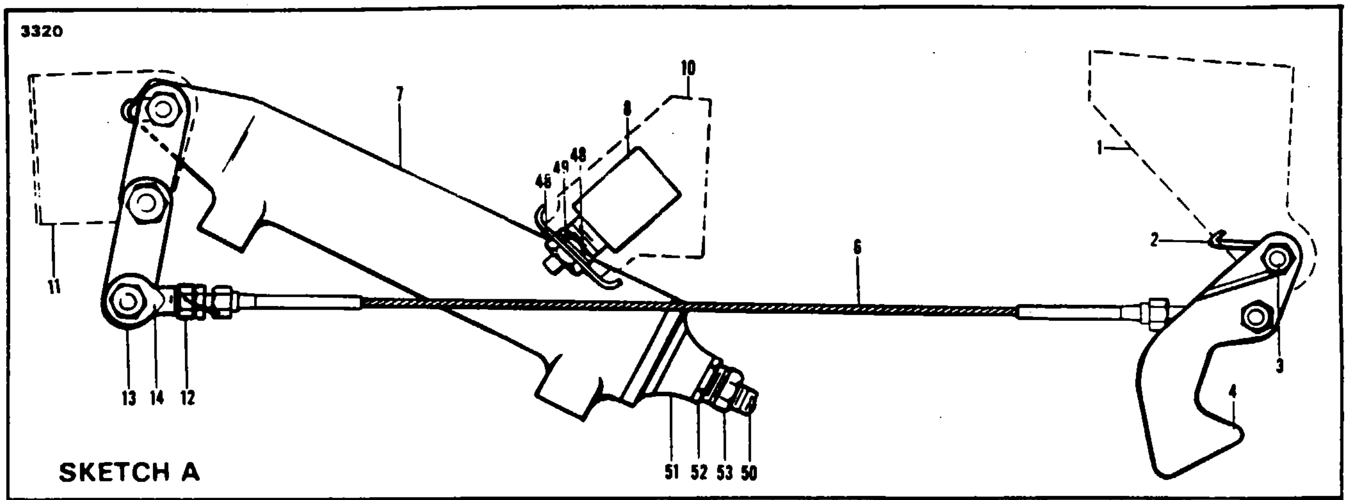
— NOTE —

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.



1. BRACKET, UPLOCK HOOK
2. SPRING, UPLOCK
3. BOLT, BUSHING, WASHER AND NUT
4. HOOK, UPLOCK
5. NUT, LOCK
6. UPLOCK CABLE
7. CYLINDER
8. SWITCH, UPLOCK
9. WIRE ASSEMBLY
10. BRACKET, SWITCH
11. BRACKET, CYLINDER MOUNTING
12. NUT, LOCK
13. CRANK ASSEMBLY
14. CABLE END
15. GEAR LOCK CABLE
16. NUT, LOCK
17. CABLE END
18. ARM, GEAR RETRACTION
19. PLATE, ATTACHMENT
20. SHAFT
21. FITTING, SHAFT
22. FITTING, GREASE
23. SIDE BRACE, UPPER FWD.
24. SWITCH, DOWNLOCK
25. BRACKET, SWITCH
26. HOOK, DOWNLOCK
27. SIDE BRACE LOWER
28. SIDE BRACE, UPPER AFT
29. PLATE, MOUNTING
30. BOLT, WASHER, NUT AND COTTERPIN
31. VALVE ASSEMBLY
32. HOUSING GEAR
33. SAFETY SWITCH
34. LINK TORQUE, UPPER
35. LINK TORQUE, LOWER
36. LINE BRAKE
37. STRUT ASSEMBLY
38. BRAKE ASSEMBLY
39. BRACKET MOUNTING
40. DISC, BRAKE
41. WHEEL AND TIRE
42. HINGE, OUTBOARD DOOR
43. BEARING, HINGE
44. DOOR, OUTBOARD
45. BRACKET, DOOR
46. ROD RETRACTION
47. HOSE, BRAKE
48. NUT, LOCK
49. WASHER
50. ROD END
51. CYLINDER STOP
52. NUT, LOCK
53. NUT, LOCK
54. PIN, DOWNLOCK
55. CLEVIS BOLT
56. BUSHING
57. WASHER
58. BOLT, HOOK PIVOT
59. BOLT
60. SPRING, DOWNLOCK
61. BRACKET, LOCK CYLINDER
62. LOCK CYLINDER
63. BEARING, HINGE
64. BRACKET, INBOARD DOOR
65. HINGE, INBOARD DOOR
66. BEARING, HINGE
67. DOOR, INBOARD

Figure 32-3. Main Landing Gear Installation (Left)



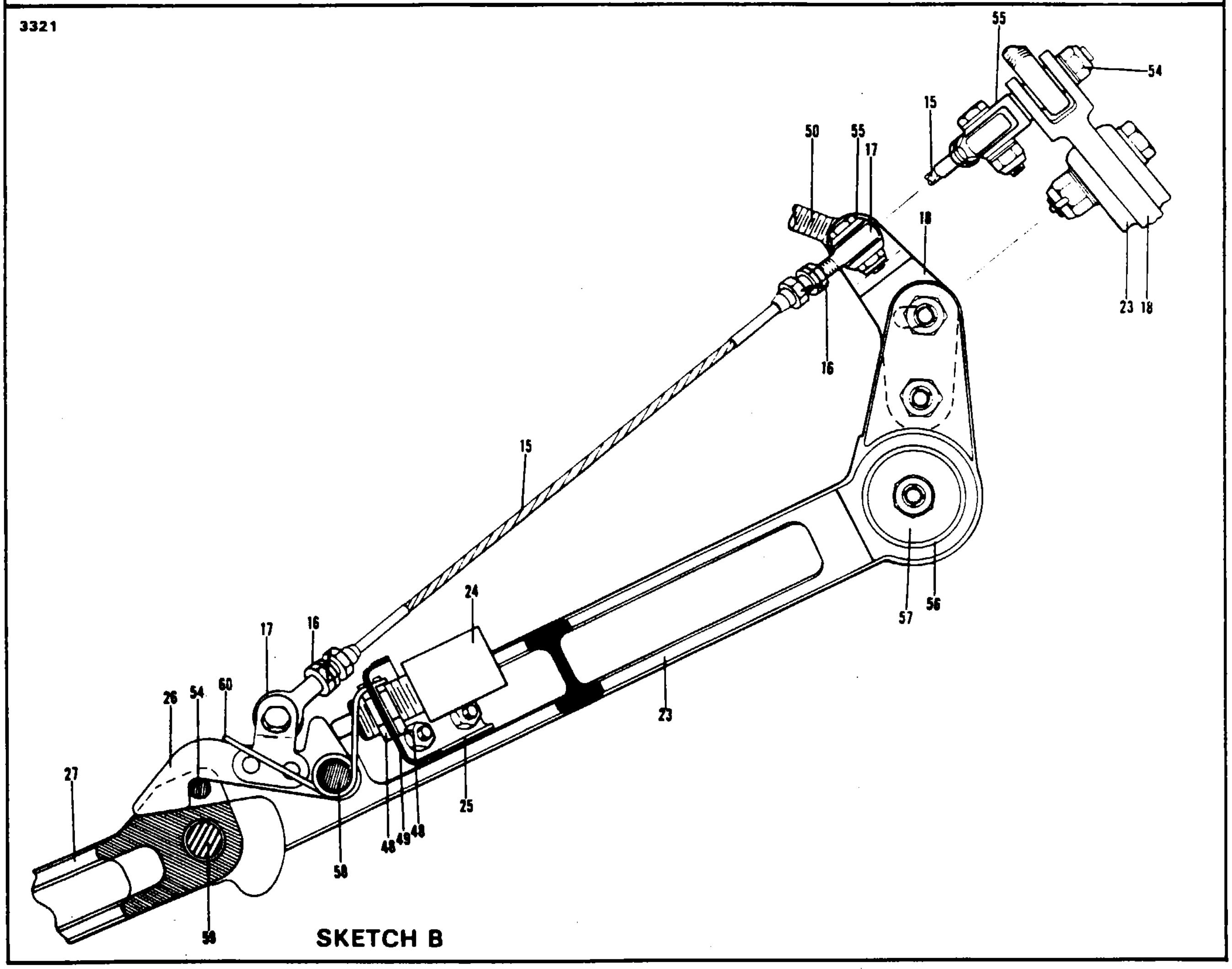


Figure 32-3. Main Landing Gear Installation (Left) (cont.)

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.

5. 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.
6. 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.
7. 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.

8. 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.
9. 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 cable out to its full length and adjust the cable end until the hook bolt can be freely inserted through the hook lugs.
10. Remove the bolt and extend the cable end one full turn, tighten the locknut and install the attaching bolt.
11. To adjust the uplock hook, use the following procedure, and put the airplane on jacks.
    A. Disconnect the uplock operating cables from the hook.
    B. Retract the gear, being careful to keep the cables 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 cables out to their full length and adjust the cable ends until the attaching bolt can be freely inserted. Remove the bolt and turn the cable ends out one full turn and install bolt and spacer bushing. Tighten the locknut on the cable ends.

12. 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.

13. 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.
14. 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.
15. 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 32-4 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.

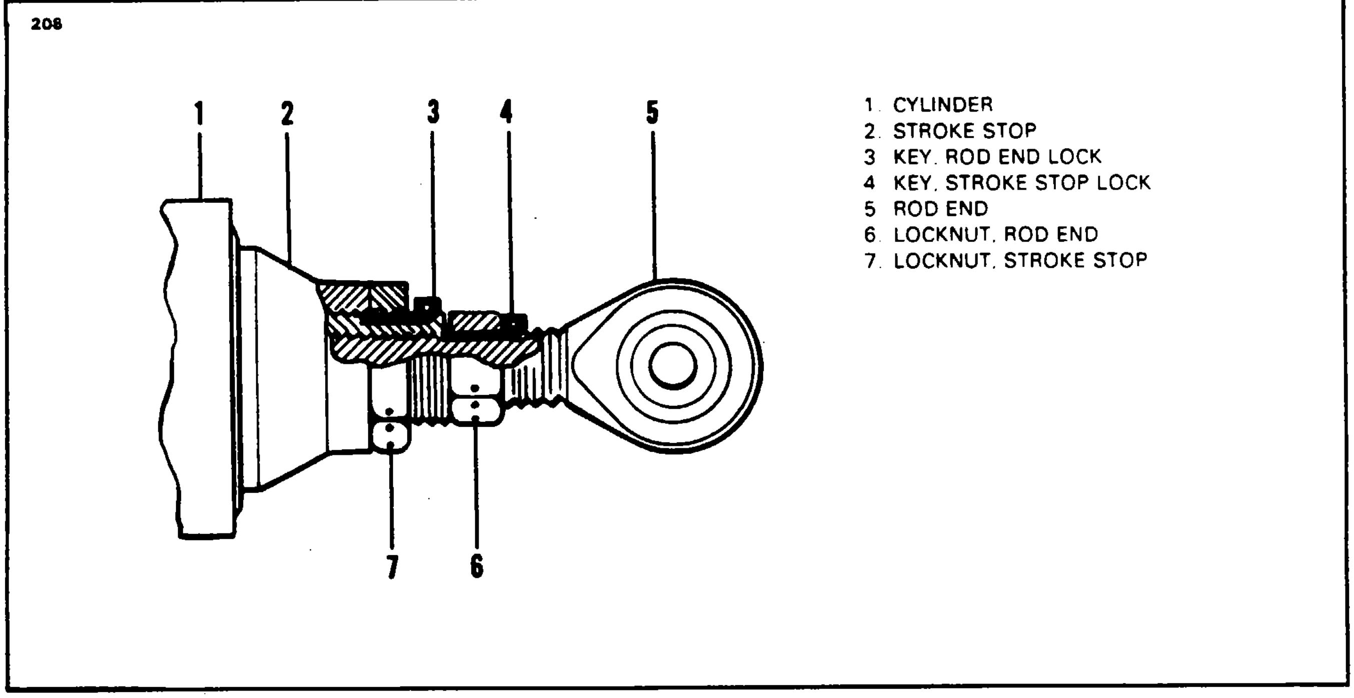


Figure 32-4. Actuator Cylinder

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 32-5.) 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.

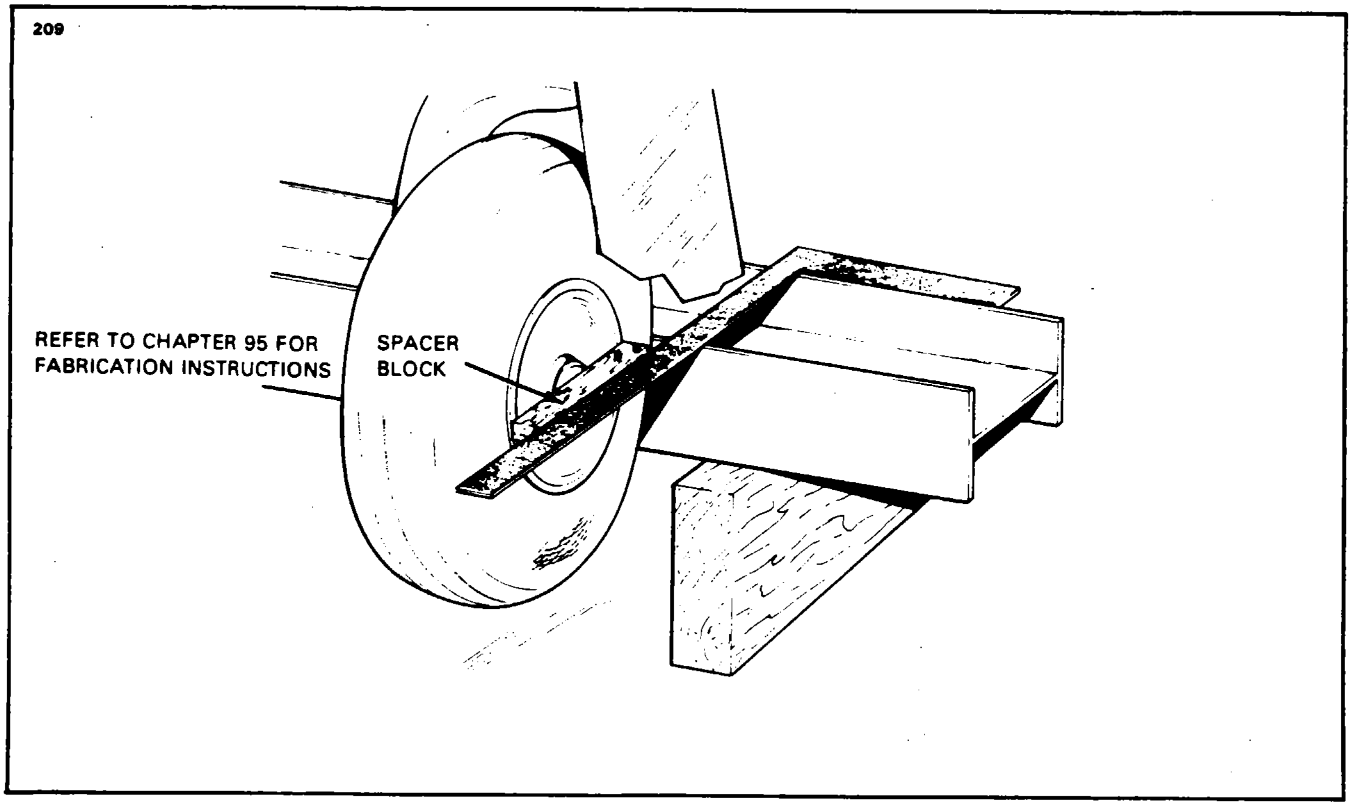


Figure 32-5. Aligning Main Gear

MAIN GEAR DOOR ASSEMBLY.

REMOVAL OF MAIN GEAR 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.

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 them 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 —

It is important that the actuator rod end not be adjusted too short as the decrease in actuator piston travel will prevent reliable engagement of the actuator's internal piston lock.

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 Figure 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, cut the safety wire and remove the cap bolts that attach the steering arm and aligner guide bracket 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.
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.

— *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.

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.

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1. PIN, RETAINER
2. BEARING, UPPER
3. SPACER
4. "T"-RING
5. BEARING, LOWER
6. "T"-RING
7. WIPER STRIP
8. WASHER
9. RING, RETAINR
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, WASHER AND NUT
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. BOLT, CAP
38. BOLT
39. PLUG, FILLER
40. ALIGNER GUIDE BRACKET
41. VALVE, AIR
42. ARM, STEERING
43. PIN, COTTER
44. SAFETY WIRE
45. PISTON RING
46. STEERING ROLLER
47. O-RING PACKING
48. PLUG, PISTON TUBE
49. SAFETY SWITCH
50. BUSHING

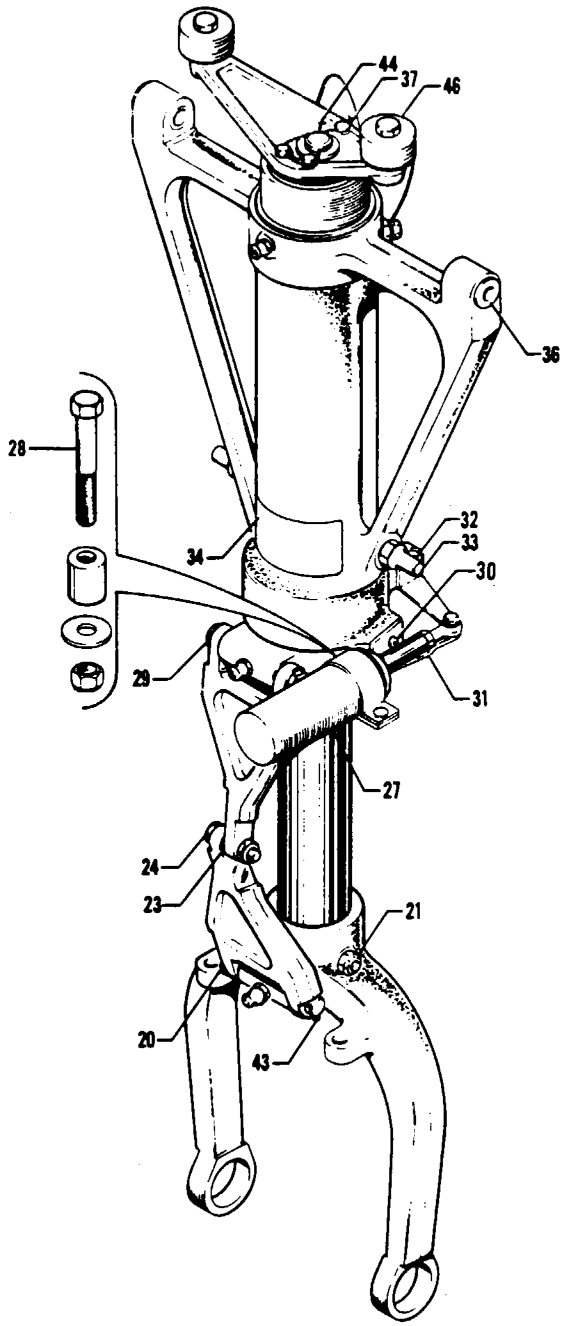

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Figure 32-6. Nose Gear Oleo Strut Assembly

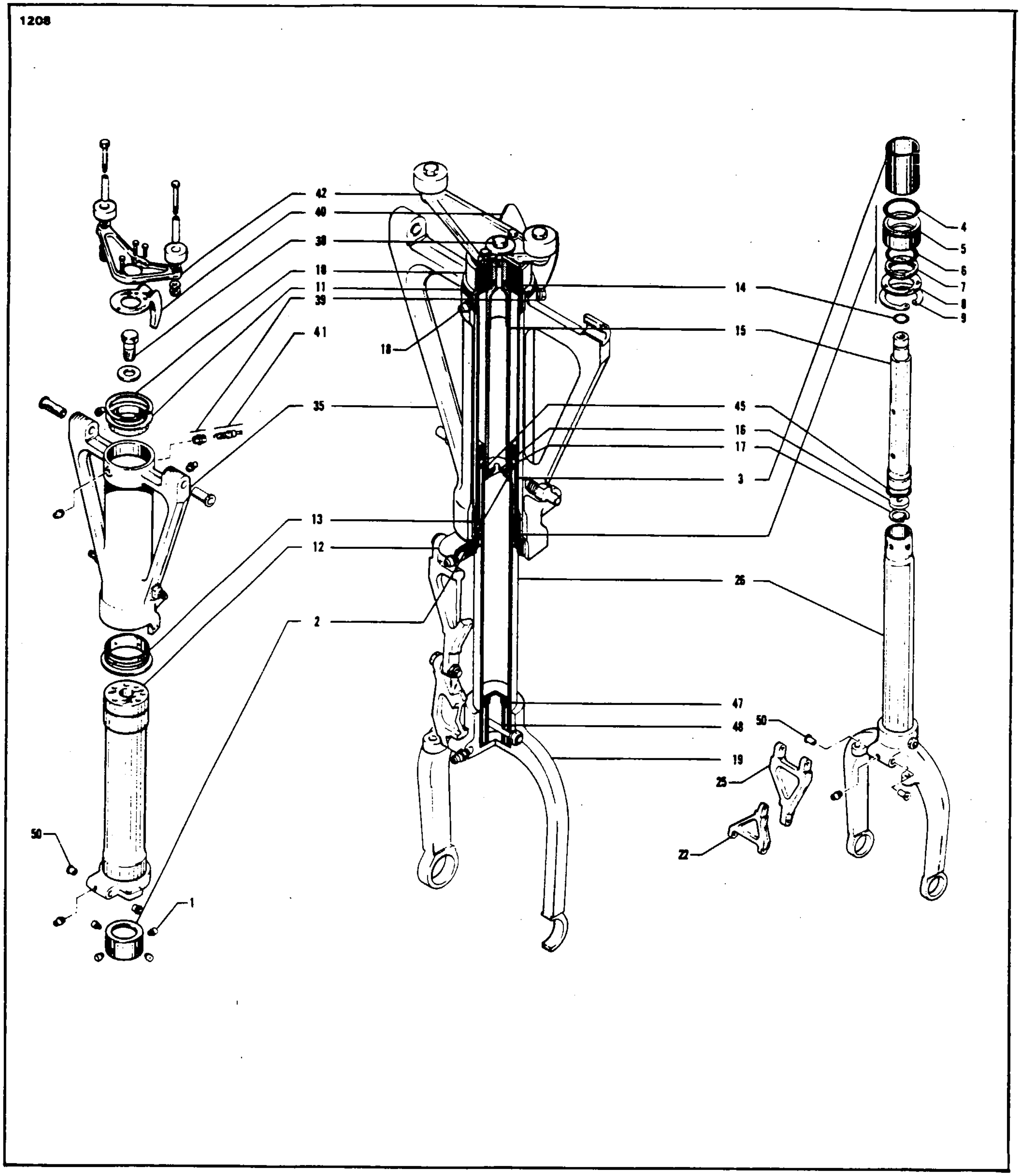

Figure 32-6. Nose Gear Oleo Strut Assembly (cont.)

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 components 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 Figure 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. With the tube exposed through the top of the cylinder; install the piston ring.
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.
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. Install the shimmy dampener.
11. Lubricate the gear assembly. (Refer to Lubrication Chart, Chapter 12.)
12. Service oleo strut with fluid and air. (Refer to Oleo Struts, Chapter 12.)
13. Check the nose gear for alignment and operation.

NOSE LANDING GEAR.

REMOVAL OF NOSE LANDING GEAR. (Refer to Figure 32-7.)

1. Remove right and left nose section side access panels.
2. Remove lower radios and radio shelf.
3. Remove the oxygen cylinder. (Refer to Chapter 35.)
4. Remove the heater assembly. (Refer to Chapter 21.)
5. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
6. With the hand pump, retract the nose gear slightly to relieve the gear from its downlocked position.
7. To remove the drag link assembly, the following procedure may be used:
   A. Disconnect the 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.
8. 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.
9. 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.
10. The uplock cable may be removed by removing the bolt assembly from the actuating cylinder support bolt and sliding the cable off the bolt. Retain the bolt in place to support the cylinder.
11. The uplock hook may be removed after the removal of the uplock cable and the hook pivot bolt. Remove the hook with the uplock spring.

— NOTE —

The idler link, uplock cable and uplock hook may also be removed with the support tube as one unit.

12. To remove the support tube, first remove the up limit switch and wire support clamps. Hold the support nuts within the nose section with a wrench, while removing the bolts. Then remove the support tube.
13. The gear housing attachment plates may be removed by grinding the rivet heads flush with the plate and removing the rivets.
14. The upper drag links and attachment plates may be removed by holding the attachment nuts within the nose section with a wrench, while removing the support bolts.

CLEANING, INSPECTION AND REPAIR OF NOSE LANDING GEAR.

1. Clean all parts with a suitable cleaning solvent.
2. Inspect bolts, bearings, bushings and ball joints for excessive wear, corrosion and damage.
3. Inspect the gear housing, drag links, idler links, rods and attachment plates for cracks, bends or misalignment.
4. Inspect the downlock spring for the following:
   A. Check for excess wear or corrosion, especially around the lock portion of the spring. The spring must return to complete compression. 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 right and left gear door actuator springs for load tensions below the minimum allowable tolerances. The minimum tension for the actuator springs is 10 pounds at 3 inch extension. If one spring is rejected, replace both springs.
   C. Check the downlock spring at the idler link for load tension. The minimum tension is 20.5 pounds at 7.312 inches extension and 47 pounds at 11.312 inches extension.
   D. Check the uplock spring at the uplock hook for load tension. The minimum tension is 4 pounds. This check is performed by fastening a fish type scale to the hook and spring and pulling steadily against the hook and spring to get a reading.
5. Inspect the uplock hook for wear and oversized bearing surfaces.
6. Inspect the uplock roller for freedom of movement and minimum wobble.
7. Inspect the uplock cable for corrosion.
8. Check the 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 touch, linkage is 0.063 to 0.156 inch through center. (Refer to Figure 32-7.) Should this distance exceed the required through-center travel and bolt and bushings are tight, replace one or all drag links.
10. The shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, the dampener should be replaced rather than repaired.
11. 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.

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 a 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 them in place.

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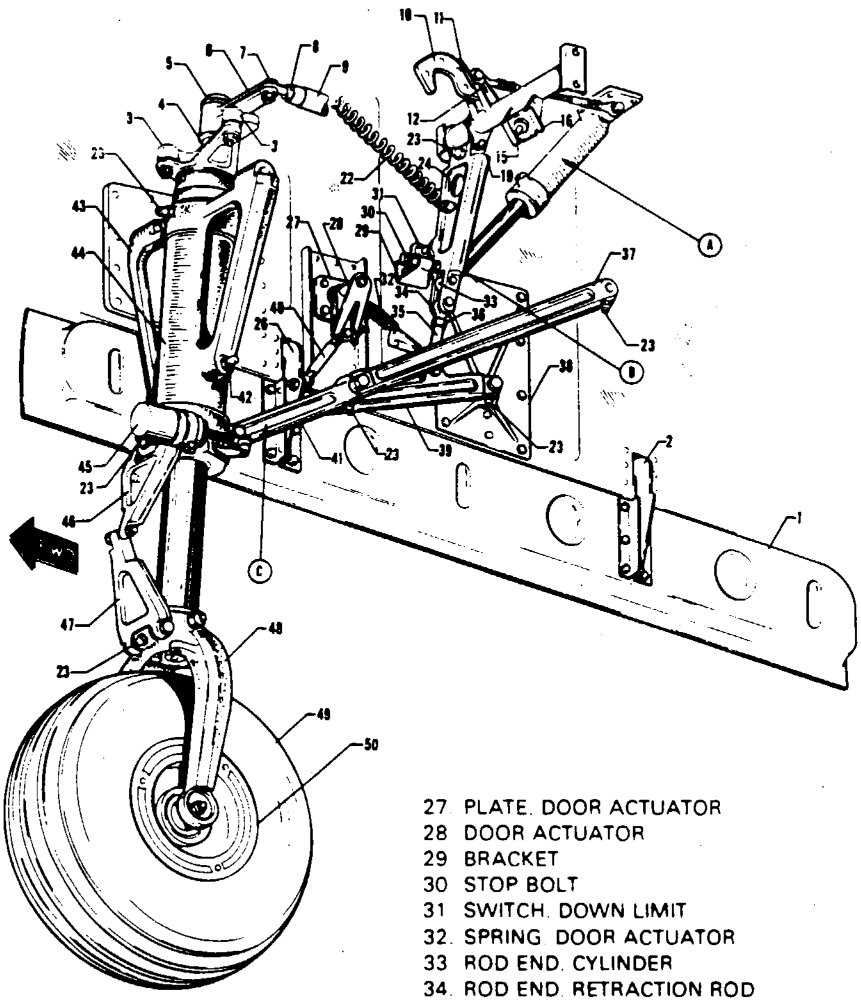

1. DOOR
2. HINGE, AFT
3. BUSHING, STEERING
4. ARM, STEERING
5. BUSHING ASSEMBLY
6. BELLCRANK ASSEMBLY
7. ROD END, STEERING
8. NUT, LOCK
9. ROD, STEERING
10. HOOK, UPLOCK
11. SPRING, UPLOCK
12. BOLT, UPLOCK
13. ROD END, UPLOCK CABLE
14. NUT, LOCK
15. SWITCH, UP LIMIT
16. BRACKET, SWITCH
17. TUBE, SUPPORT
18. CABLE, UPLOCK
19. BOLT ASSEMBLY
20. BOLT ASSEMBLY
21. BRACKET
22. SPRING, DOWNLOCK
23. FITTING, GREASE
24. LINK, IDLER
25. CYLINDER, ACTUATOR
26. HINGE, FWD
27. PLATE, DOOR ACTUATOR
28. DOOR ACTUATOR
29. BRACKET
30. STOP BOLT
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. BOLT ASSEMBLY
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
54. BEARING, UPLOCK
55. BOLT ASSEMBLY
56. KEY, LOCK

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Figure 32-7. Nose Landing Gear Installation

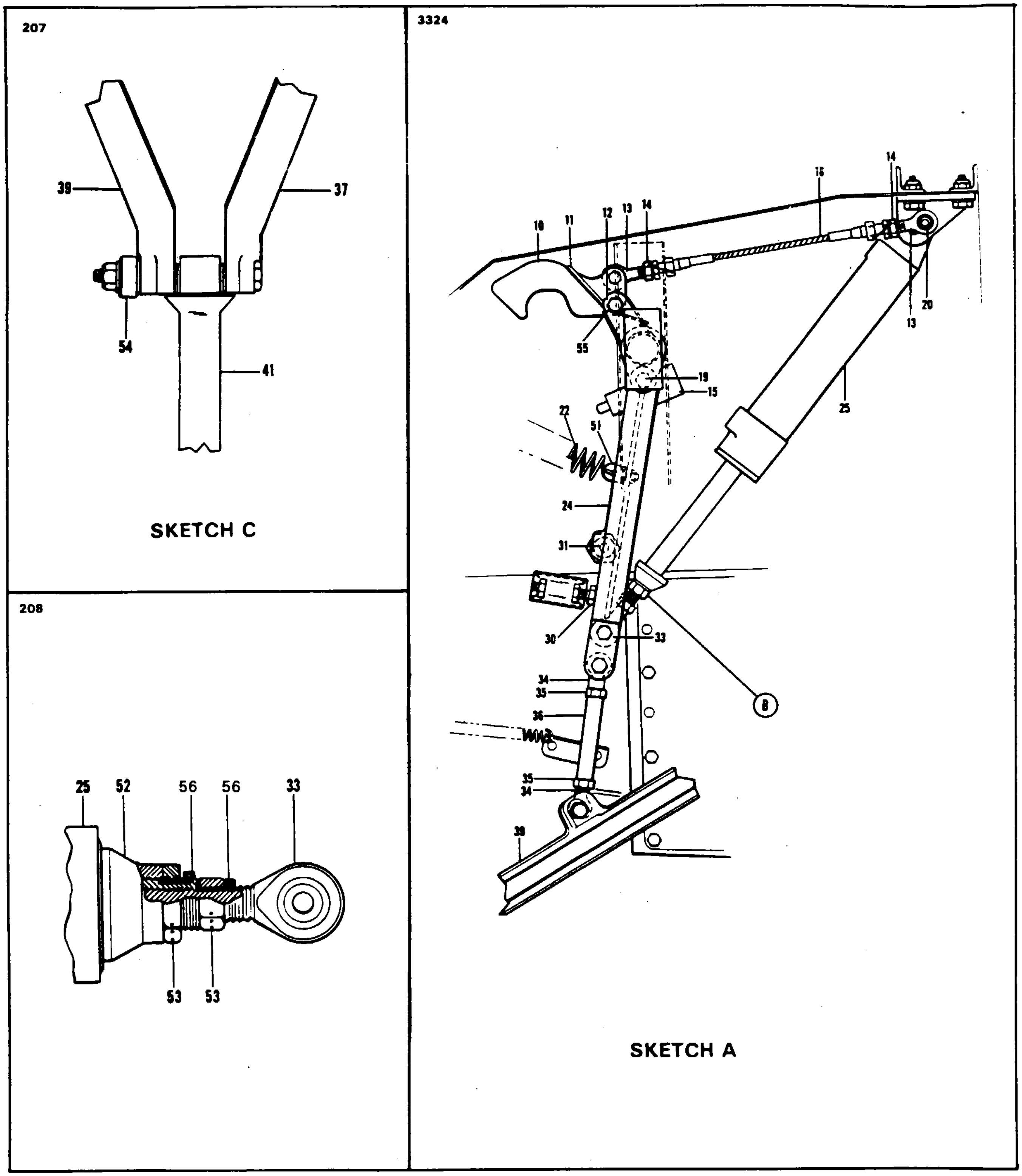


Figure 32-7. Nose Landing Gear Installation (cont.)

3. Install the support tube and secure. Connect the up limit switch and secure electrical wiring to the tube.

— NOTE —

The uplock hook, uplock 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 may be 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 and safety.
5. Install the uplock cable by attaching and securing the end to the uplock hook and the other end on the gear actuating cylinder support bolt. Lubricate end of rod per lub chart.
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 into 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 the retraction rod and actuating cylinder rod end to the link. Do not connect the retraction rod to the 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, and safety wire the 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 wire the nuts.
   D. Attach the lower drag link to the landing gear housing and temporarily install bolt. Secure and safety the bolt after the 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 right drag link and adjust the rod to obtain approximately .06 of an inch clearance between the lower locknut and link.

— NOTE —

Ascertain that the locknuts are tightened against the retraction rod.

9. Grasp the gear fork and rotate it 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. Adjustment should be made when there is no load at these points.
10. Lubricate the landing gear assembly. (Refer to Lubrication Chart, Chapter 12.)
11. Check the nose gear for alignment and operation.

RIGGING AND ADJUSTMENT OF NOSE LANDING GEAR. (Refer to Figure 32-7.)

— NOTE —

Use the hydraulic test unit to supply hydraulic pressure for adjustment operations.

1. With the airplane on jacks and gear extended, disconnect door retraction rods and secure the doors in the open position.
2. To facilitate adjustment of the uplock, observe the following steps:
   A. Disconnect the lower drag link from the gear oleo housing.
   B. Disconnect the actuating cylinder rod end from the idler link.
   C. Disconnect the end of the downlock spring from the idler link.
   D. Disconnect the uplock cable end until adjustment is complete.
   E. Pull the actuating cylinder barrel down and forward until the actuator attaching bolt is at the bottom of the slots in the attachment bracket.
   F. Rotate the drag links assembly by hand until the uplock hook engages the uplock bearing.
   G. With the uplock cable fully extended and the hook resting fully on the uplock roller, adjust the cable end until the attaching bolt on the hook can be freely inserted. Remove the bolt and extend the cable end one full turn and lock. Reinstall the bolt and secure.

— NOTE —

The actuating cylinder and uplock cable attaching bolt must remain in the bottom of the attachment bracket slots during this adjustment.

   H. Lubricate uplock cable ends and secure it after the adjustment of nose gear is complete. (Refer to Lubrication Chart, Chapter 12.)
3. Return the drag links to the down position and attach the lower drag link to the landing gear housing; secure and safety unless checking the link through its travel.
4. The through travel of the link is checked by using the following procedure:
   A. With the gear in the down position and the stop surfaces of the drag links touching, ascertain that the linkage is 0.063 to 0.156 inches through center.

— NOTE —

The linkage must not exceed 0.156 inches 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.)

B. To use the fabricated tool, ascertain that the gear is in the downlocked position with no hydraulic pressure on the system.
C. Remove the cotter pins that safety the nuts which secure both upper drag links to their attachment plates and the lower link to the gear housing.
D. Place the tool tube through the elongated hole in the tool plate, and place the tube over and between the upper link attaching nuts.
E. 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.
F. Look through the right 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.
G. Remove the tool and reinstall the cotter pins.

5. The retraction rod is adjusted to provide a distinct snap-through action as the idler linkage passes through center.
6. Adjust the idler link stop bolt on the right side of the wheel well so that the idler linkage is .22 to .28 inches through center.
7. Connect the downlock spring to the idler link.
8. Extend the actuator cylinder with hydraulic pressure and adjust the rod end until the attaching bolt can be freely inserted. Release pressure and extend the rod end one full turn. Reinstall the bolt and secure. Tighten the rod end locknut.

— NOTE —

The actuating cylinder attaching bolt must remain at the top of the attachment bracket slot during adjustment.

— NOTE —

Rod end and stroke control are locked with an NAS559 type locking method. Use the proper technique. (Refer to Figure 32-7, Sketch B.)

9. Reinstall attaching bolt and secure. Place the key locks between the locknuts and the keyway in the rod. Screw the locknut on the rod and keep the key lock centered in the keyway while tightening the locknuts. Refer to Figure 32-7 which shows the proper installation of the locks on the piston rod end.
10. Adjust "Gear Down" limit switch until green indicator light comes on. Check switch operation by partially retracting and extending gear several times.

— NOTE —

It may be necessary to partially retract the gear to tighten the locknuts.

11. Retract the gear and adjust the stroke control stop on actuator until the uplock bearing clears the inside of the uplock hook surface by 0.030 to 0.060 of an inch. Adjust the gear up limit switch until the red cockpit light goes out. Tighten the locknut on the stroke control stop. (Refer to Figure 32-7.)

— *NOTE* —

Main gear uplimit and inboard gear door switches must be actuated also to extinguish red light.

12. Connect landing gear doors and adjust.
13. Retract gear slowly and observe that all parts are operating satisfactorily.
14. If gear fails to remain retracted after the cockpit handle returns to neutral, it will be necessary to readjust one or all of the following until the gear will lock up:
    A. Increase the actuator stroke by turning out the stroke control stop.
    B. Relieve door "pinch" by lengthining the door operating rods.
    C. Retract and extend the gear slowly using the primary gear extension system and observe that all parts are operating satisfactorily.
    D. Reinstall gear door retraction rods.

ALIGNMENT OF NOSE LANDING GEAR.

1. Place the airplane on a smooth level floor that will accommodate the striking of a chalk line.
2. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
3. Level the airplane laterally and longitudinally. (Refer to Leveling, Chapter 8.)
4. From the center of the tail skid, extend a plumb bob and mark the contact point on the floor.
5. Extend and attach a plumb bob 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.
6. Using the two plumb bob marks as a guide, snap a chalk line, extending several feet beyond each mark.
7. Clamp the rudder pedals in neutral position. (Refer to Figure 32-8.)

— *NOTE* —

The rudder control system must be properly rigged before aligning the nose gear steering.

8. Adjust the rod end bearings of the steering rod to align the nose wheel with the chalk line. 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 chalkline. One end of the rod must be disconnected and jam nuts loosened to make this adjustment. Do not attempt to make the adjustment by means of one bearing, but divide the adjustment between the bearings at each end of the rod. Check that rod ends have sufficient thread engagement, reinstall the rod and secure jam nuts.

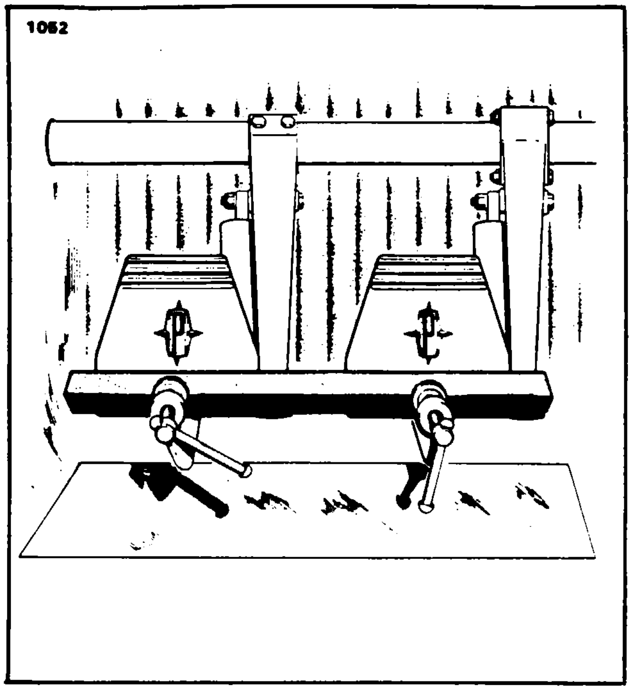


Figure 32-8. Clamping Rudder Pedals in Neutral Position

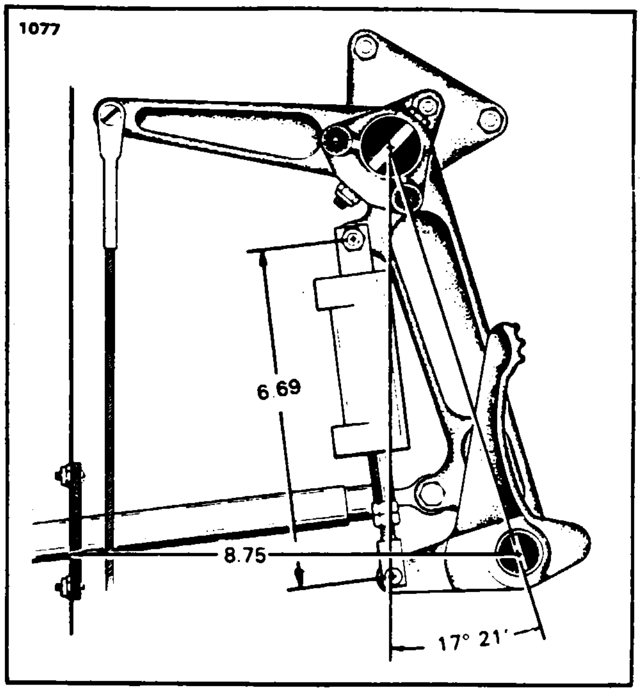


Figure 32-9. Rudder Pedals Neutral Angle

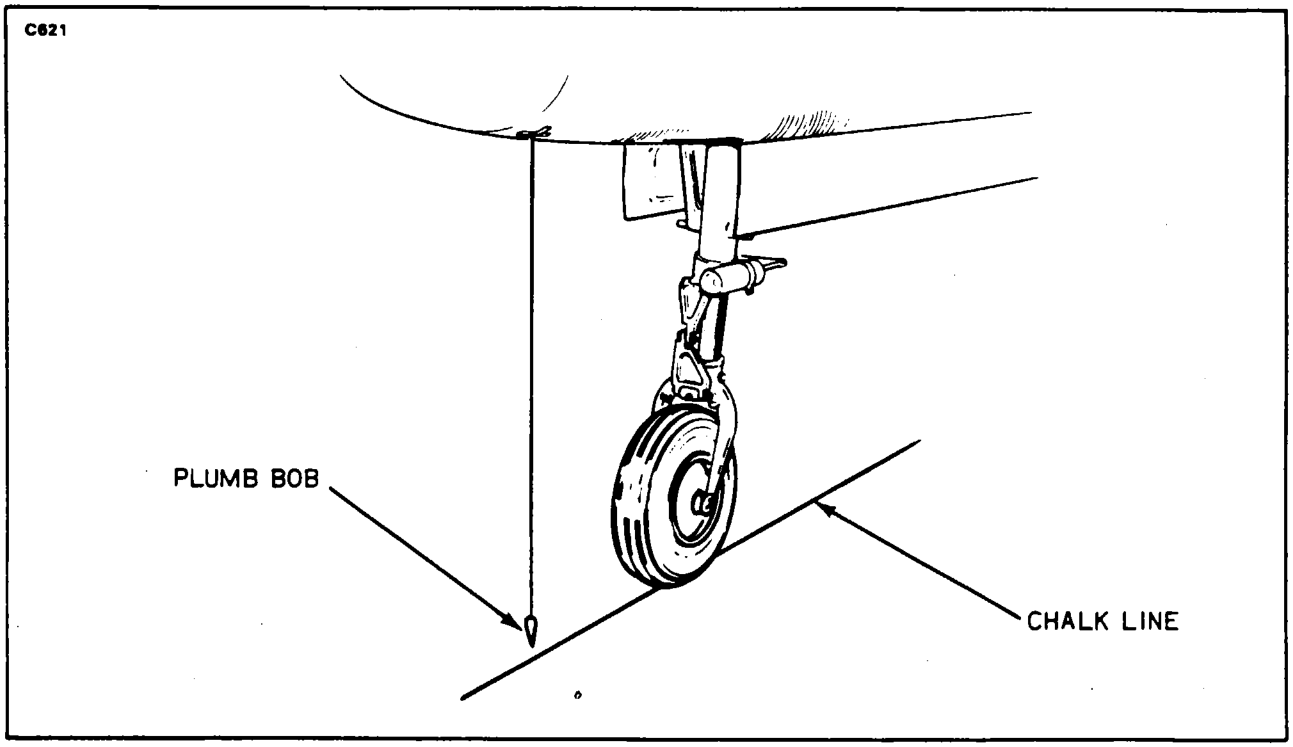


Figure 32-10. Aligning Nose Gear

9. Before checking the nose gear steering travel, disconnect the shimmy damper pushrod from its bracket on the strut housing, and center the nose gear with the centerline of the aircraft. From the inter-section formed by the nose tire centerline and wheel pivot point, measure and mark radial lines on the ground surface, at 40° to the left and right of the tire centerline (80° total). Turn the wheel to its maximum travel in both directions to check for allowable travel. Should travel be exceeded in one direction and not enough in the other, check for possible damage to the gear fork, torque links, or steering torque tube.

— NOTE —

To insure full travel of the nose wheel, make sure no gaps exist at points where the steering arm travel bushings contact with the steering bellcrank.

10. Proceed as follows to reconnect Gar Kenyon shimmy damper:
    A. Rotate the nose gear to its full right tow limit and make sure it is retained in that position.
    B. Pull the piston rod of the shimmy damper to its full extension.
    C. Adjust the pushrod end bearing until the attachment bolt fits freely through the rod end and bracket.
    D. Remove bolt and turn the rod end bearing out one full turn.
    E. Bolt the rod end bearing to the bracket.

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 re-adjust 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.
   C. Delay the actuating of up limit switches.

EXTENSION AND RETRACTION.

GEAR ACTUATING CYLINDERS.

REMOVAL OF GEAR ACTUATING CYLINDER.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Disconnect the hydraulic lines 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 cable.
5. Remove the cylinder from the wheel well.

DISASSEMBLY OF GEAR ACTUATING CYLINDER (WTC-2115-1). (Refer to Figure 32-11.)

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.

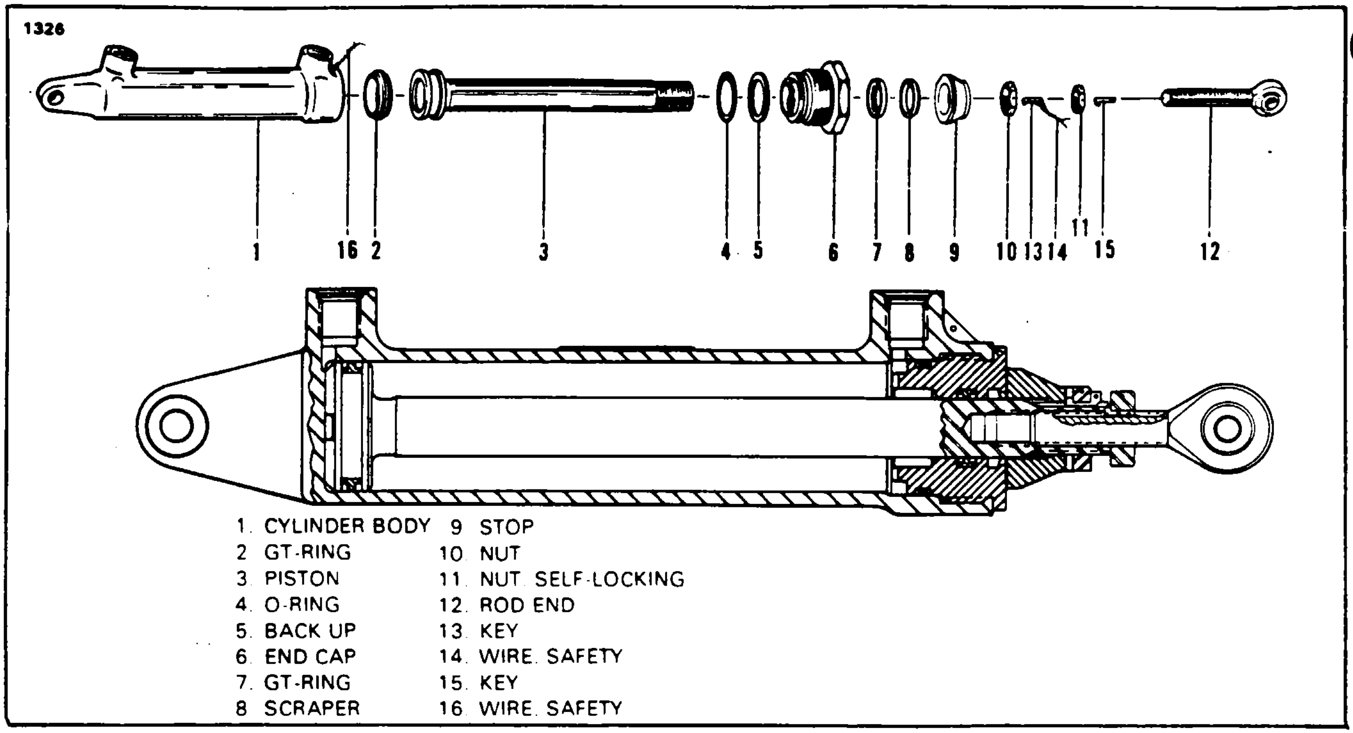


Figure 32-11. Gear Actuating Cylinder (Wiebel Tool WTC 2115-1)

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 (WTC 2115-1). (Refer to Figure 32-11.)

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 cable end of the nose gear to the 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 to the cylinder.
4. Check operation of the installation and landing gear rigging.
5. Remove the airplane from jacks.

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 32-12.)

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 32-12.)

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.

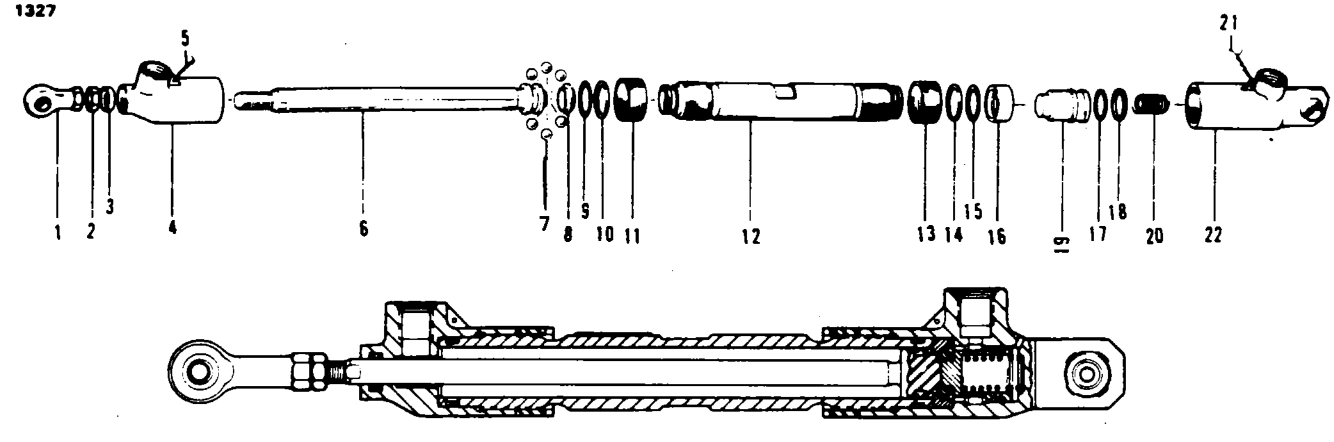
ASSEMBLY OF GEAR DOOR ACTUATING CYLINDER. (Refer to Figure 32-12.)

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 the 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.

INSTALLATON 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.



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 32-12. Gear Door Actuating Cylinder (Wiebel Tool WTC 2114-1)

GEAR SELECTOR HANDLE MECHANISM.

REMOVAL OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 32-13.)

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 lock nuts 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.

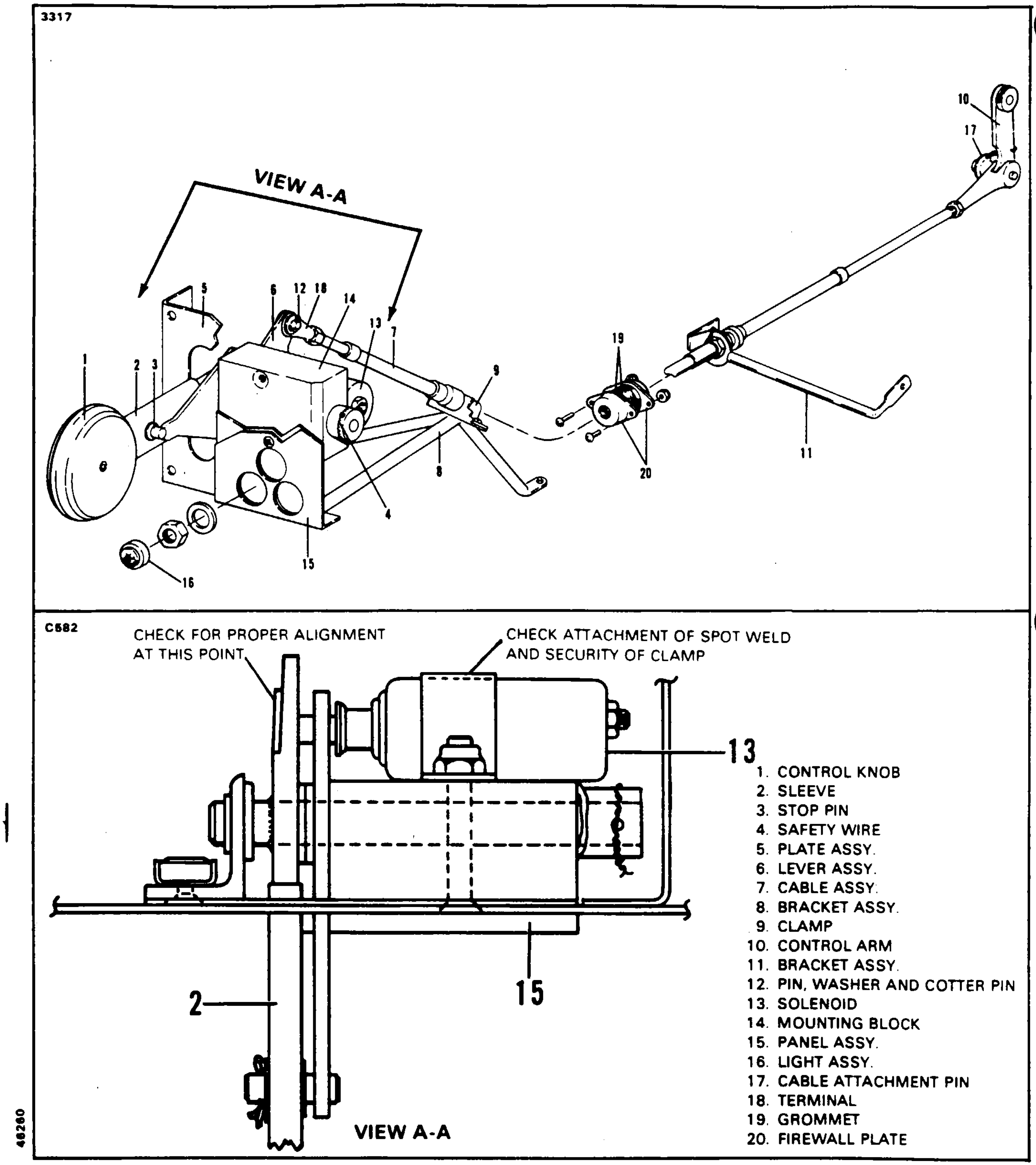


Figure 32-13. Landing Gear Selector Mechanism

INSTALLATION OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 32-13.)

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.
   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 lock nut, 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 lock nuts.
   B. Connect the solenoid wires to their appropriate terminals.

WHEELS AND BRAKES.

MAIN WHEEL ASSEMBLY.

REMOVAL AND DISASSEMBLY OF MAIN WHEEL. (Refer to Figure 32-14.)

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.

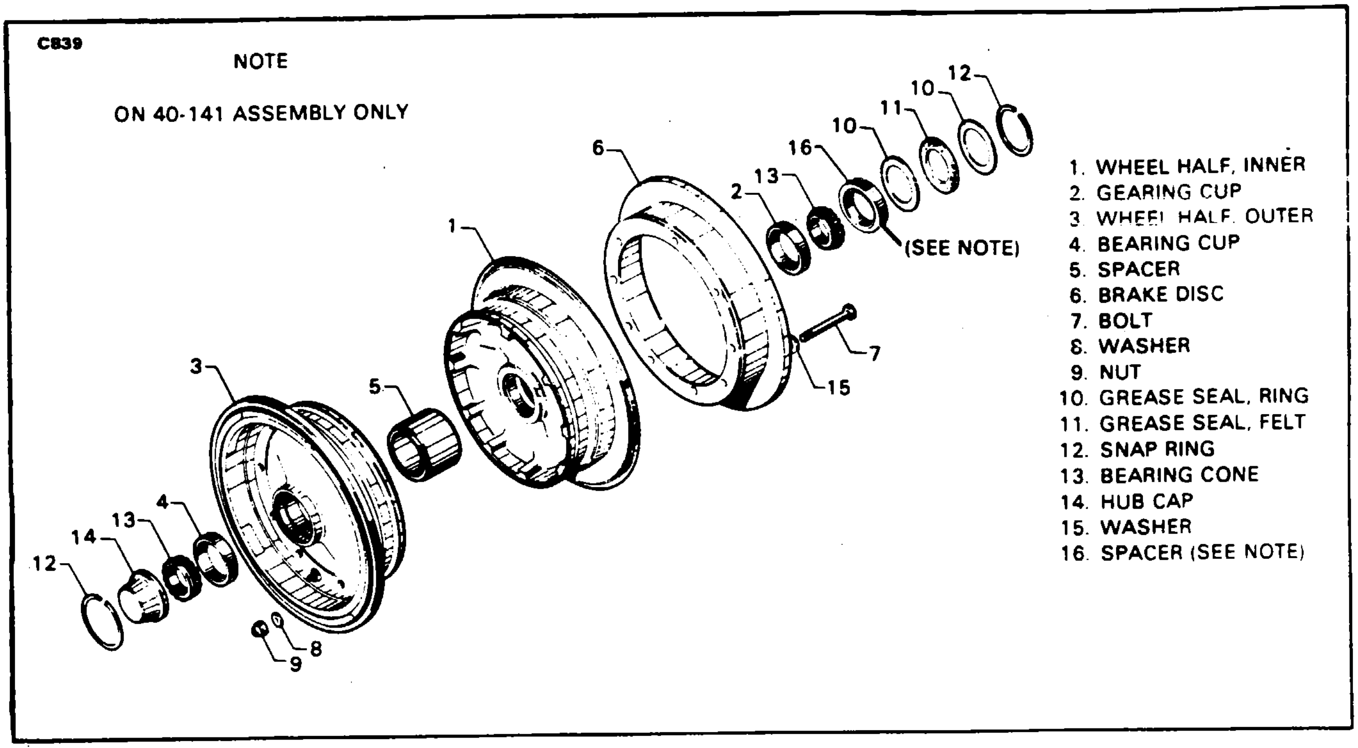


Figure 32-14. Main Wheel Assembly (Cleveland 40-130 and 40-141)

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 32-15.)

REPAIR OF MAIN WHEEL ASSEMBLY.

Repairs are limited to blending out small nicks, scratches, gouges and areas of slight corrosion, plus 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 32-14.)

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 32-14) and inner wheel half into positon 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.

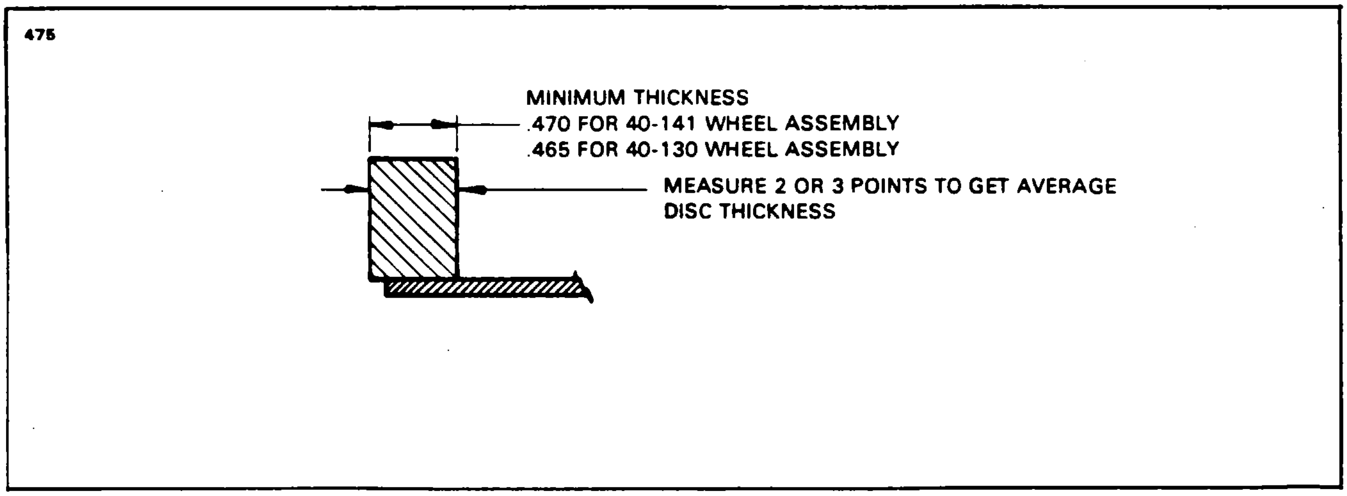


Figure 32-15. Brake Disc Minimum Thickness

NOSE WHEEL ASSEMBLY.

REMOVAL AND DISASSEMBLY OF NOSE WHEEL (CLEVELAND). (Refer to Figure 32-16.)

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. To remove the nose wheel, remove the axle tie rod and the tie rod 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 first deflating the tire. With the tire completely deflated, remove the six wheel bolts. Pull the wheel halves from the tire by removing the wheel half opposite the valve stem first and then the other half.
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 and may be removed by tapping out evenly from the inside.

INSPECTION OF NOSE WHEEL ASSEMBLY (CLEVELAND).

1. Degrease all parts and dry thoroughly.
2. Visually check all parts for cracks, distortion, defects and excess wear and corrosion.
3. Check tie bolts for looseness or failure.
4. Check internal diameter of felt grease seals. Replace the felt grease seal if surface is hard or gritty.
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 (CLEVELAND).

The instructions for repair and replacement of the nose gear wheel assembly are the same as those given for the main gear wheel.

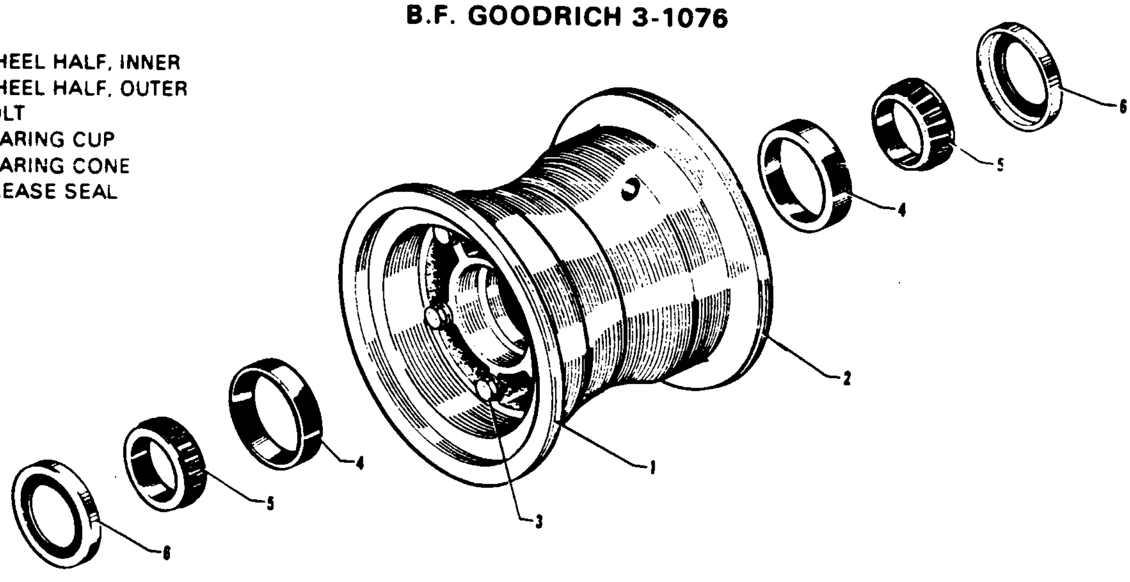
ASSEMBLY AND INSTALLATION OF NOSE WHEEL (CLEVELAND). (Refer to Figure 32-16.)

1. Ascertain that the bearing cup in each wheel half is properly installed. Install the tire and join the two wheel halves. Install the through bolts with the nuts to the wheel stem side, torque to the specification given on the wheel, inflate the tire and test for leakage. Lubricate the bearing cones and install the cones, grease seals and seal retainer rings. Secure with snap rings.
2. Flex the fork enough to allow for the installation of the wheel and spacer tubes. Refer to Parts Catalog for the correct spacers required. 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.

2589

B.F. GOODRICH 3-1076

1. WHEEL HALF, INNER
2. WHEEL HALF, OUTER
3. BOLT
4. BEARING CUP
5. BEARING CONE
6. GREASE SEAL



1086

CLEVELAND 40-140

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

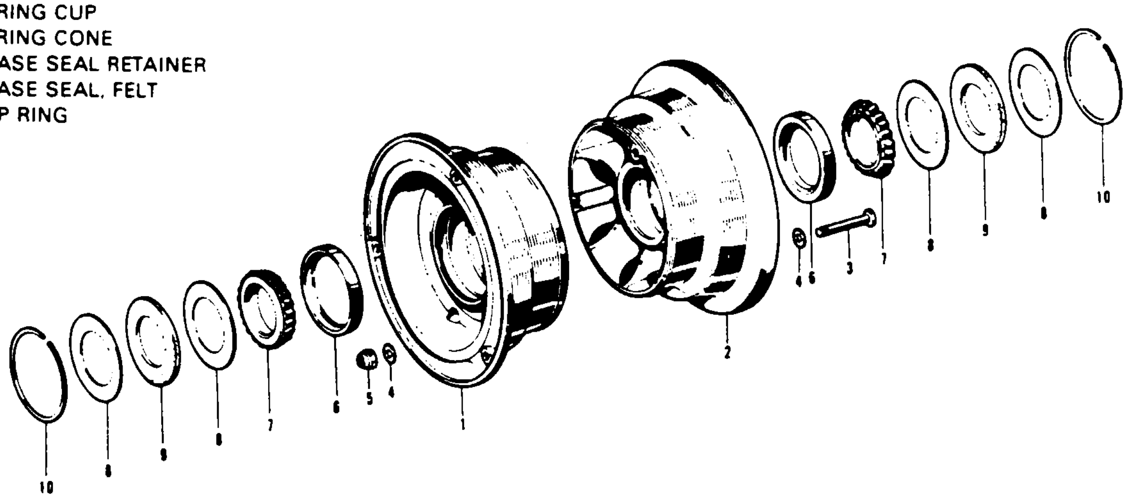


Figure 32-16. Nose Wheel Assembly

REMOVAL AND DISASSEMBLY OF NOSE WHEEL (B.F. GOODRICH). (Refer to Figure 32-16.)

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. To dismount the nose wheel, remove the axle nut, bolt and axle plugs. Tap the axle out of the wheel assembly and fork using a 7 16 inch O.D. tube.
3. Flex the fork enough to allow the wheel and wheel spacers to clear the fork assembly.
4. To disassemble the wheel, deflate the tire and break the tire beads away from the flanges by pressing with the heels of the hands or with a tire press.
5. Remove nuts, washers and tie bolts from the wheel. Separate the wheel halves and remove the tire, also remove the valve stem assembly if installed.

— NOTE —

Bearing cups area a press fit into the wheel halves and should not be removed unless replacement is necessary. If cups are to be replaced, heat the wheel half to (275° to 300° F); then press out the cups with a plug. Support the wheel hub while removing cups.

6. The wheel bearing and seal can be removed by tapping out evenly from the inside with a brass drift. Be careful not to damage the bearing cage.

INSPECTION OF NOSE WHEEL ASSEMBLY (B.F. GOODRICH).

1. Clean metal parts in solvent, and air dry thoroughly. Clean rubber parts by wiping with a clean lint-free cloth.
2. Magnaflux bolts for cracks, breaks, and surface blemishes on the bolt head radius or shank.
3. With dye check or Zyglo, inspect wheel halves for cracks and breaks, noting in particular the bead seat, tubewell and web junction areas.
4. Visually inspect all metal parts for pitting, corrosion, cracks, breaks, uneven wear, and other surface defects.
5. Inspect packing sealing surfaces for smoothness.
6. Inspect packing for pits, cuts, and other defects. Replace as necessary.

REPAIR AND REPLACEMENT OF NOSE WHEEL ASSEMBLY (B.F. GOODRICH).

1. Repair scratches, nicks, and other minor surface blemishes on the wheel halves by sanding with emery cloth, removing as little metal as possible. Polish and surface treat the repaired surface with Dow No. 7.

— NOTE —

Do not remove more than 0.020 inch below original surface in local areas for general blending.

2. Paint repaired surfaces with two coats zinc chromate primer and one coat aluminum lacquer.

— *NOTE* —

Use only one coat of zinc chromate primer and no finish coat on mating surfaces and in the packing groove.

3. Replace all parts which have visible cracks or are damaged beyond repair.
4. Replace packing and grommet at each overhaul.

ASSEMBLY AND INSTALLATION OF NOSE WHEEL (B.F. GOODRICH). (Refer to Figure 32-16.)

1. If cups have been removed, reinstall as follows:
   A. Heat wheel halves to (275° to 300°F) and cool cups to (0°F).
   B. Support the wheel hub and paint the inside diameter of the hub with zinc chromate primer. Then press the cups into the wheel half.

— *NOTE* —

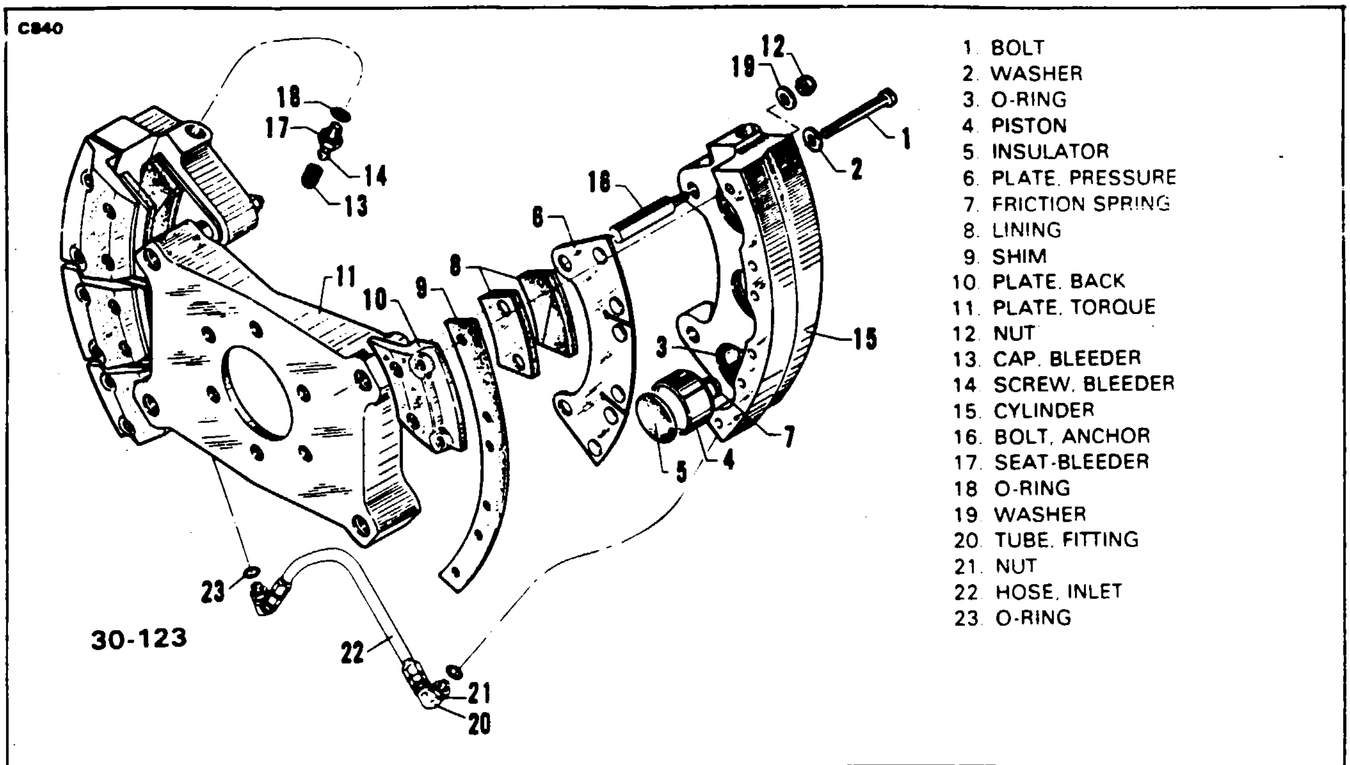
The wet zinc chromate primer lubricates the parts to be pressed together and assists in preventing galvanic corrosion between parts.

2. Reinstall valve stem and balance weights if removed.
3. Lubricate the packing with grease (MIL-G-3545C or equivalent), and install in the packing groove on the wheel half.
4. Install the tire and join the two wheel halves. Apply a generous coat of thread compound, MIL-T5544 to threads of bolts, faces of washers, and bearing face of nuts. Tigthen two nuts diametrically opposite, to 100 inch-pounds. Using the same procedure, retighten all nuts.

— *NOTE* —

Do not use an impact wrench to apply final torque. Use a preset hand torque wrench only.

5. Inflate the tire (refer to Chapter 6) and test for leakage.
6. Repack wheel with grease (MIL-G-3545C) and lubricate cups. Place bearings in the wheel assembly and install grease seals.
7. Install the wheel and spacers in the fork and insert the axle. Refer to Parts Catalog for the correct spacers required for particular tire installed.
8. Adjust the axle bolt to allow the wheel to turn freely with no side play.



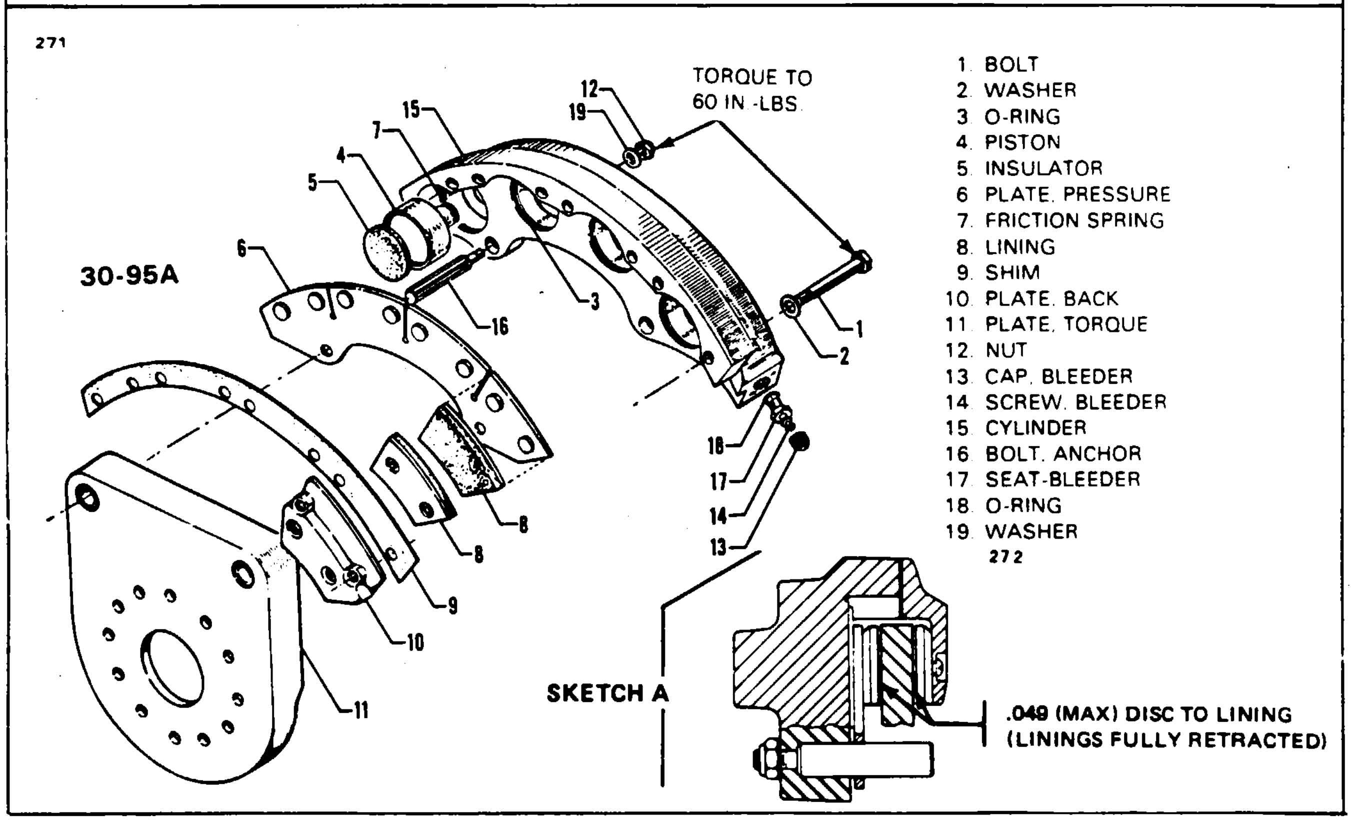


Figure 32-17. Wheel Brake Assembly (Cleveland 30-95A and 30-123)

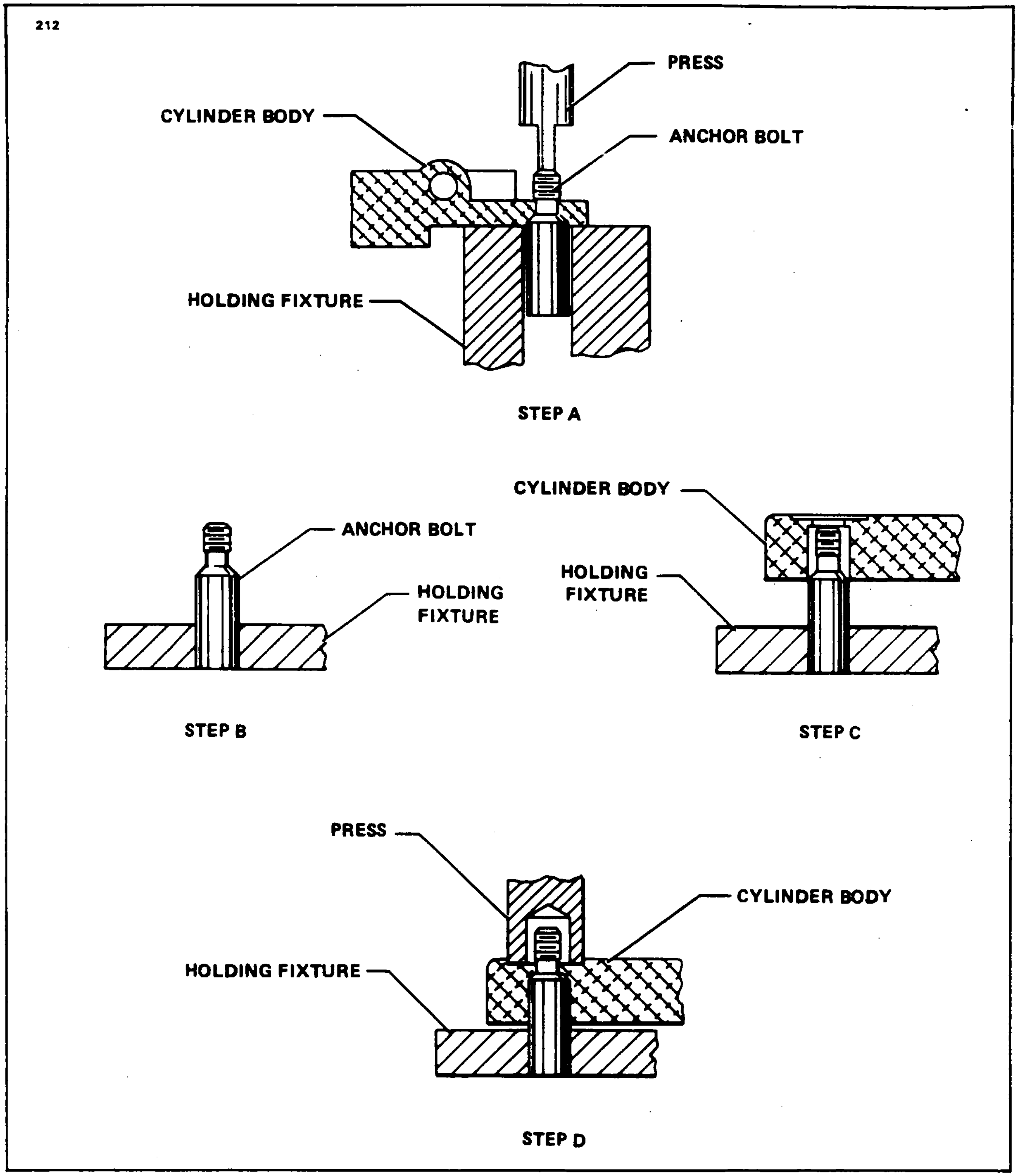


Figure 32-18. Removal and Installation of Anchor Bolts

BRAKE ASSEMBLY.

REMOVAL AND DISASSEMBLY OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-17.)

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 32-18, Step A.)
   B. Use a suitable arbor press and remove the anchor bolt from the cylinder body.

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 32-17.)

1. If anchor bolts have been removed, they should be reinstalled as follows:
   A. Support anchor bolt in a holding fixture. (Refer to Figure 32-18, Step B.)
   B. Align cylinder body over anchor bolt. (Refer to Figure 32-18, Step C.)
   C. Using a suitable arbor press, apply pressure on the spot face directly over the anchor bolt. (Refer to Figure 32-18, 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 32-17) 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.
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 for 30-95A brake assemblies and 80 to 90 inch pounds for 30-123 brake assemblies.
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 32-17. 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.

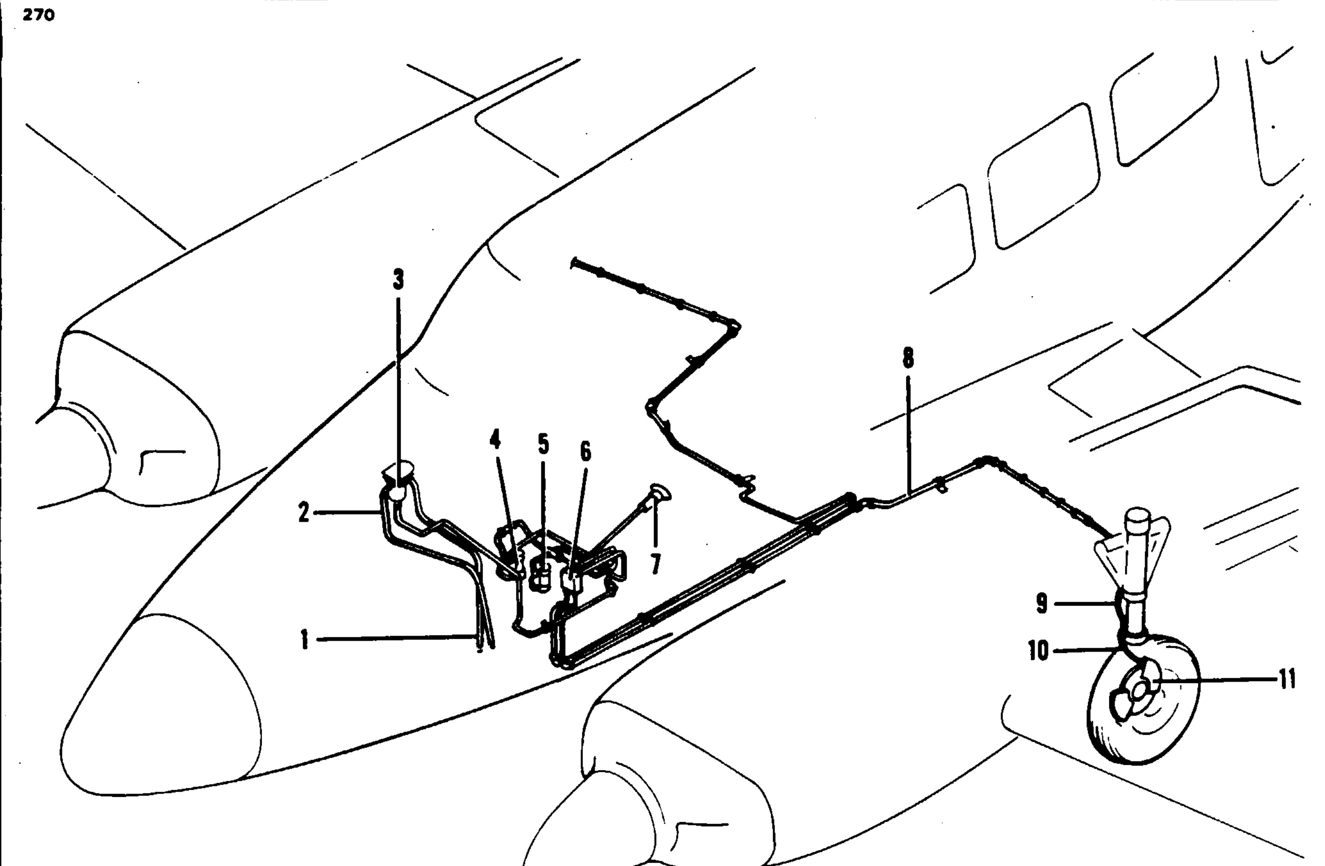
BRAKE MASTER CYLINDER.

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.

DISASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 32-20.)

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.



1. DRAIN TUBE
2. VENT TUBE
3. RESERVOIR
4. MASTER CYLINDER (RIGHT)
5. MASTER CYLINDER (LEFT)
6. PARKING BRAKE VALVE
7. PARKING BRAKE HANDLE
8. FUSELAGE LINK
9. FLEXIBLE HOSE
10. GEAR LINK
11. BRAKE ASSEMBLY

Figure 32-19. Brake Installation (Typical)

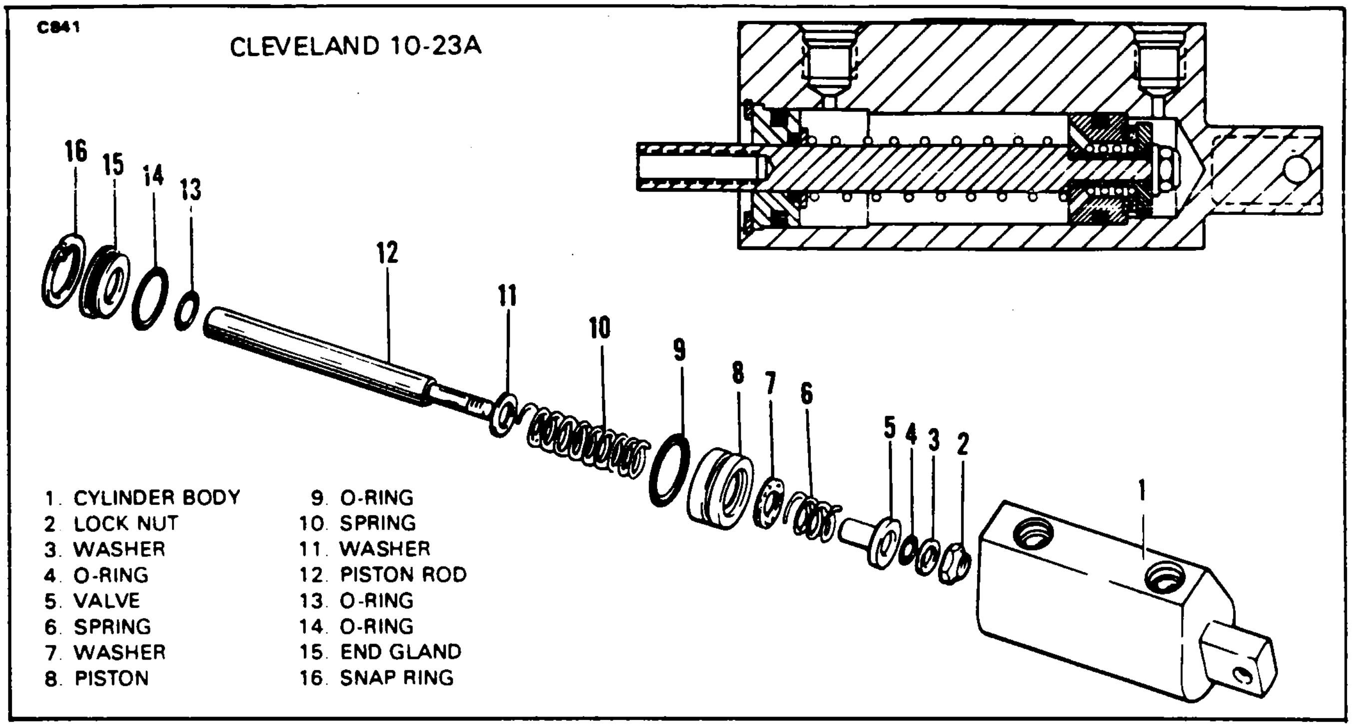


Figure 32-20. Brake Master Cylinder Assembly

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 32-20.)

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 32-21.)

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.

ASSEMBLY OF PARKING BRAKE VALVE. (Refer to Figure 32-21.)

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.

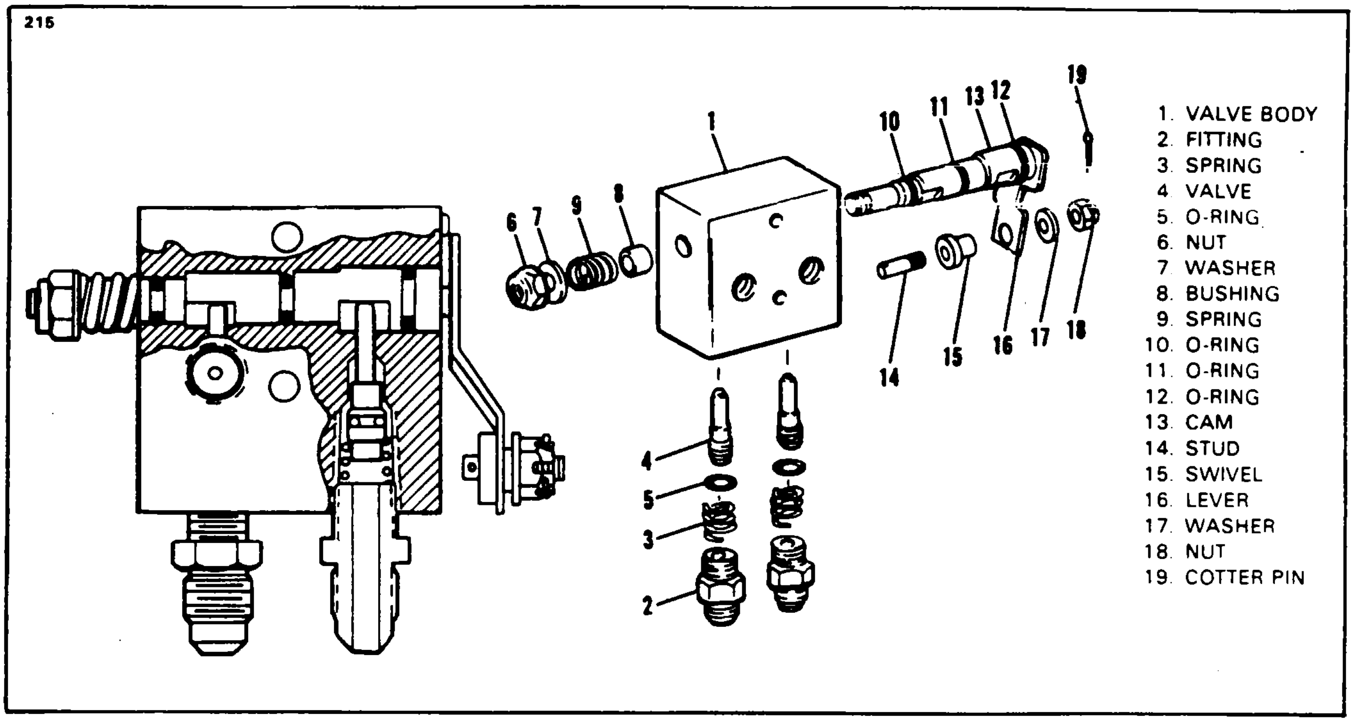


Figure 32-21. Parking Brake Valve Assembly

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.
4. Bleed the brake system.

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.

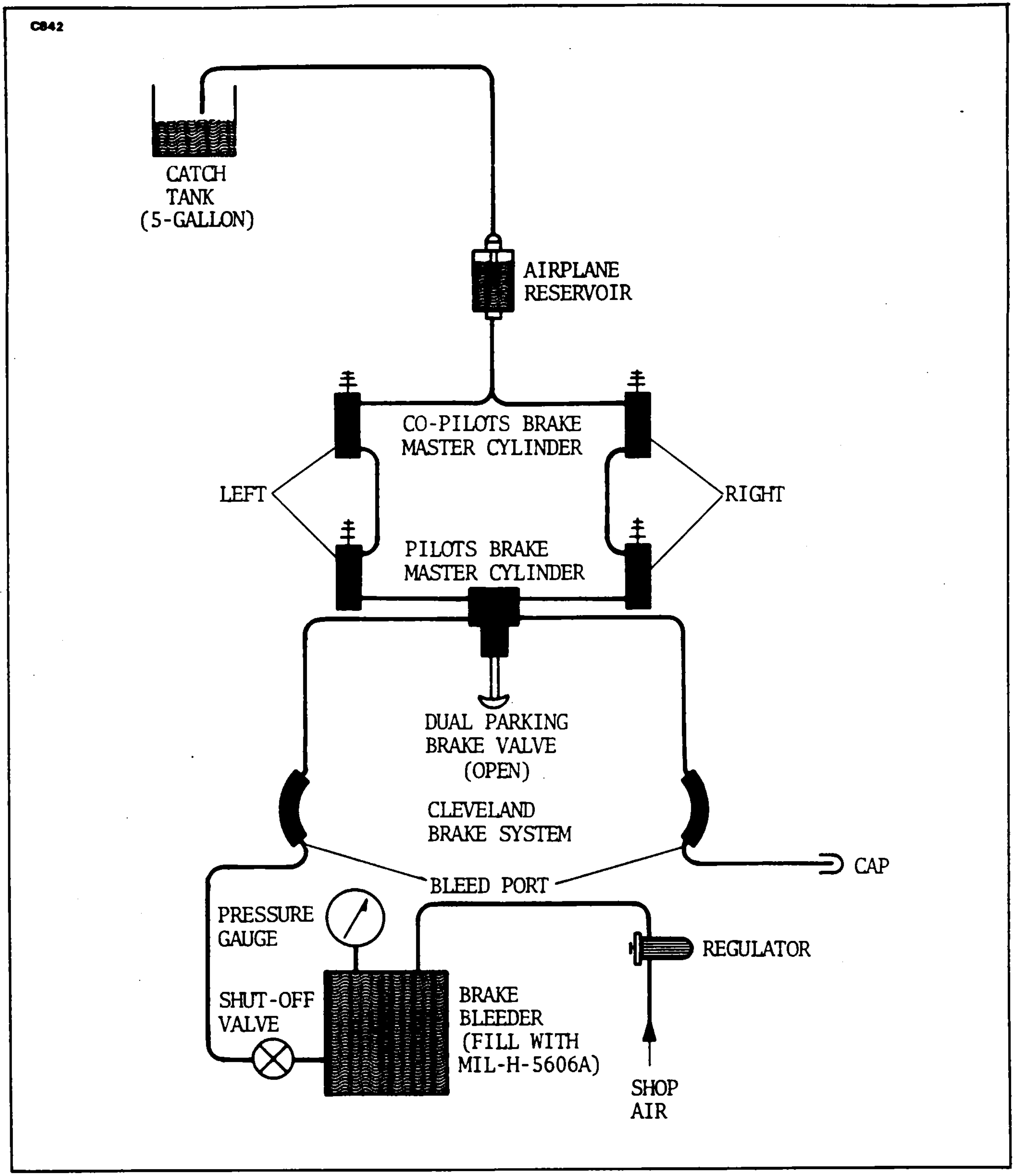


Figure 32-22. Bleeding Brake (Pressure Pot)

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 32-22.)

— 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.

STEERING.

RUDDER AND STEERING PEDAL ASSEMBLY.

REMOVAL OF PEDAL ASSEMBLY. (Refer to Figure 32-23.)

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.
3. Disconnect the rudder control cables from the pedal assembly.
4. Disconnect the brake master cylinder from the pedal assembly.
5. Disconnect the balance cable from the two inboard pedals by removing the flat head pins at rudder pedals.
6. Remove the rudder torque tube guards, 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.
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.
14. To remove the balance cable, remove the clevis pins at both ends and remove the pulley guard pins at both pulleys.

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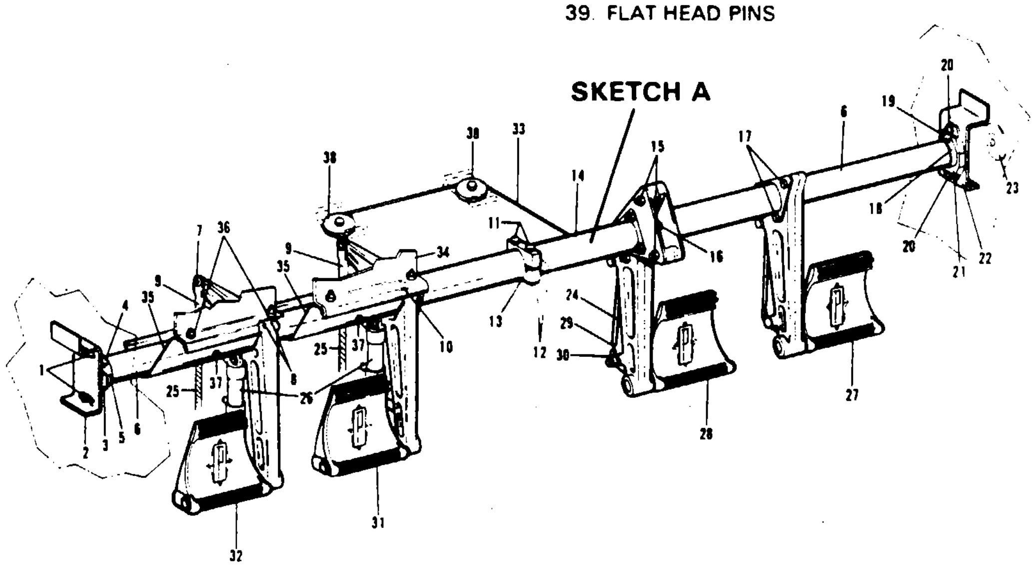
1. NUT, ANCHOR
2. BRACKET, MOUNTING
3. BLOCK, BEARING
4. BOLT ASSEMBLY
5. RETAINER
6. TORQUE TUBE
7. BOLT ASSEMBLY
8. ROLL PIN-BOLT
9. CABLE END
10. BOLT ASSEMBLY
11. BOLT ASSEMBLY
12. BLOCK, BEARING
13. SPACER
14. TORQUE TUBE, OUTER
15. BOLT ASSEMBLY
16. ROLL PIN-BOLT
17. BOLT ASSEMBLY
18. RETAINER
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. NUT, JAM
30. BOLT ASSEMBLY
31. PEDAL, LEFT INNER
32. PEDAL, LEFT OUTER
33. BALANCE CABLE
34. BRAKE LINE SUPPORT CHANNEL
35. TORQUE TUBE GUARD
36. MACHINE SCREWS AND NUTS
37. SCREWS, NUTS AND CLAMPS
38. PULLEY
39. FLAT HEAD PINS



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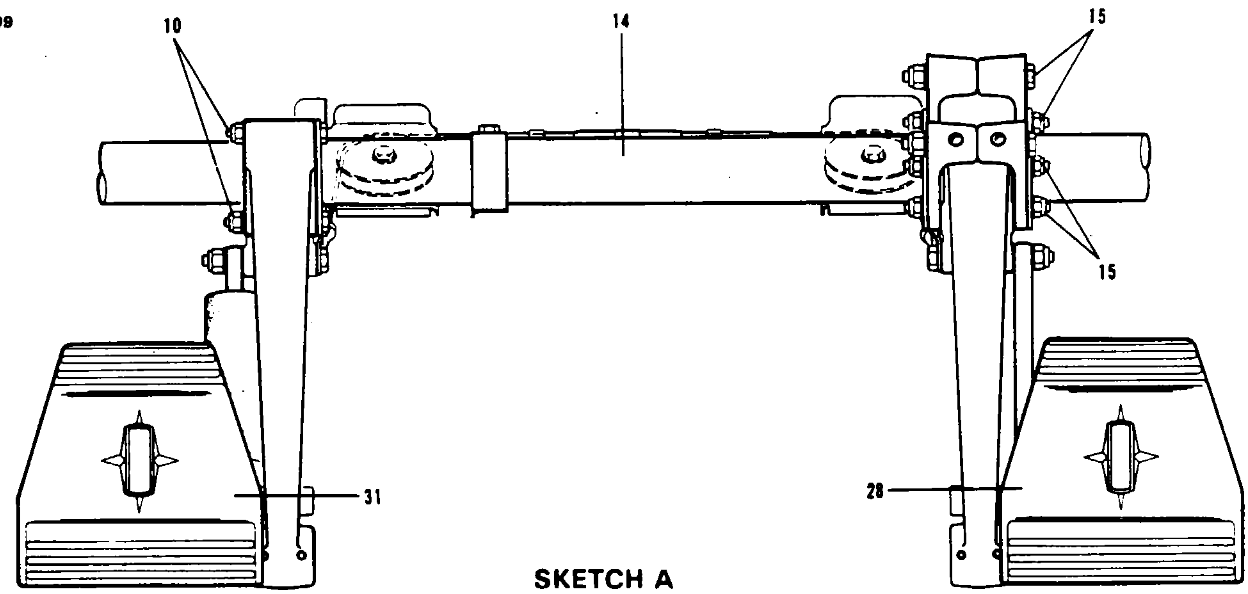

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Figure 32-23. Rudder Pedal Installation

INSTALLATION OF PEDAL ASSEMBLY. (Refer to Figure 32-23.)

1. If the balance cable is removed, install before preceeding with the rest of the installation. Replace pulley guard pins.
2. Install and secure the torque tube bearings to their mounting brackets with cap bolts.
3. Assemble the outer torque tube assembly, including both right pedals.
4. 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 together the tube will be free to rotate with minimum up and down play. (Spacers are available in thickness of .012 ± .02, P/N 81102-35; .018 ± .02, P/N 81102-36 and .032, P/N 81102-37.)
5. 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.
6. Slide the tube through the outer torque tube assembly installing the left pedals and left retainer collar.
7. 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.
8. With the spacer washers installed, install the bolts through the retainers and both left rudder pedals. Install nuts with washers and secure.
9. Wipe off excess lubricant from torque tube.
10. 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.

— NOTE —

The clamps around the torque tube must not be deformed or permitted to interfere with the rotation of the torque tube.

11. Connect the balance cable to the rudder pedals.
12. Connect rudder cables to the pedal assembly.
13. Set cable tension per Chart 2702 and check rigging and adjustment.
14. Install and seal access plates, panels and seats.

POSITION AND WARNING.

POSITION.

ADJUSTMENT OF NOSE GEAR UP LIMIT 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 LIMIT 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 LIMIT 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 LIMIT SWITCH. (Refer to Figure 32-24.)

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 .069 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 32-24.)
   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 ± .13 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 ± .13 inch of oleo extension.
5. Remove airplane from jacks.

WARNING.

REMOVAL OF GEAR WARNING SWITCHES. (Refer to Figure 32-25.)

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.

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 32-25.)

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.

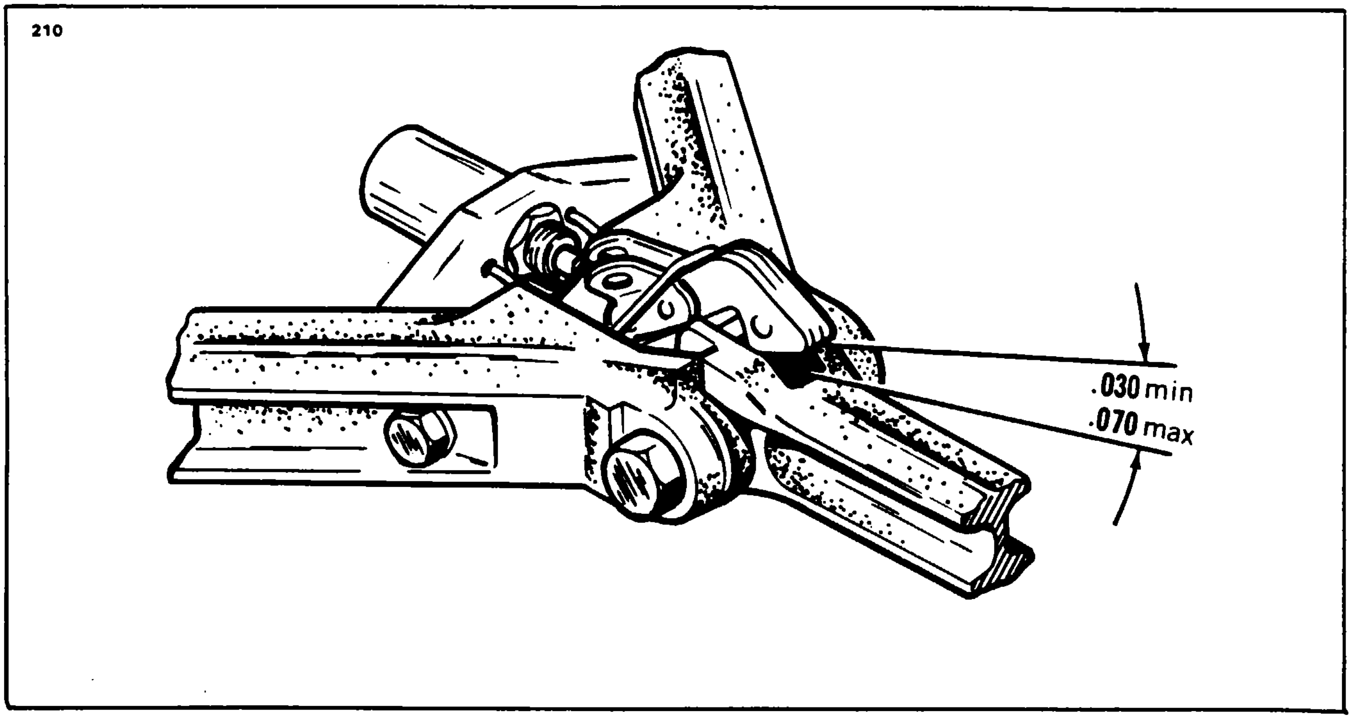

Figure 32-24. Adjusting Main Gear Down Light Switch

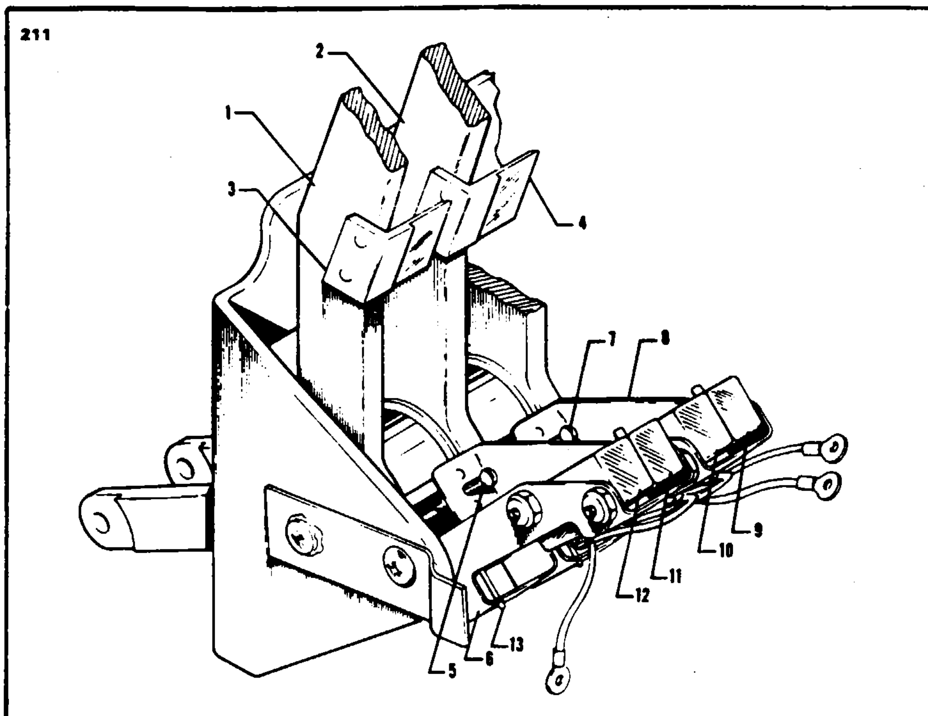

Figure 32-25. Gear Warning Switches Installation

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.

— END —

GRIDS 3G2 THRU 3G10
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CHAPTER

33

LIGHTS

CHAPTER 33 - LIGHTS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 33 - LIGHTS (cont.)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter, used in conjunction with the electrical schematics in Chapter 91, provides assistance in troubleshooting and repair of aircraft lighting systems.

All lighting is 24 V.D.C. powered, except for high voltage Anti-Collision strobes and the 400 Hertz A.C. powered electroluminescent panel and placard lighting. The strobe power supplies and the electroluminescent inverter are sourced from 24 V.D.C. aircraft bus power.

FLIGHT COMPARTMENT.

TROUBLESHOOTING GUIDELINES.

First determine if fault is confined to only the incandescent system or the electroluminescent system. Make sure Dimmer Control is placed to FULL BRIGHTNESS.

If only one bulb is "OUT" replace with a new bulb, if fault persists check voltage at light socket and work through harness to Dimmer Control. If all incandescent lighting is faulty, check 24 V.D.C. bus power to Dimmer Control and the Dimmer Control outputs. If circuit breaker does not hold disconnect Dimmer Control Box. If short still exists work from Dimmer Control connector through harness to circuit breaker and bus. If circuit breaker holds after disconnecting Dimmer Control, check from Dimmer Control Box connection forward to ground. In any case conventional troubleshooting methods are employed.

Finally, if Dimmer Control is faulty, it must be replaced, and a point to point check must be made within each lighting circuit before replacing Dimmer Control.

If only one E.L. Panel is "OUT", unplug the panel and check for 140 V.A.C., 400 Hertz at panel connection, then work back through the harness to the inverter. Each E.L. panel can be bench tested at 117 V.A.C., 60 Hertz.

If any E.L. Lighting is operating, the inverter can be considered to be good. If all E.L. Lighting is inoperative, check 24 V.D.C. supply to inverter and the Dimmer Control Unit. In any case, follow standard point to point troubleshooting procedures.

If a lighting system should exhibit "Flashing", it is probably due to a misadjustment of the Dimmer Control Unit.

DIMMER CONTROL UNIT.

ADJUSTMENT OF DIMMER CONTROL UNIT.

Four adjustment potentiometers are located under the Serial No./Nameplate of the Dimmer Control Unit. (Remove covers for adjustment accessability.) These four (4) pots modify lighting intensity in relation to the Dimmer Slide Control positions. (Refer to Schematic Chapter 91.)

One pot controls - LEFT PANEL LIGHTING SLIDE CONTROL.
One pot controls - RIGHT PANEL LIGHTING SLIDE CONTROL.
One pot controls - PLACARD LIGHTING.
One pot controls - OPTIONAL - AVIONICS RADIO LIGHTING.

1. Ascertain all panel lighting (refer above) is connected and Bright/Dim Switch is selected to (DIM) position.
2. Set Dimmer Slide Controls to one-third brightness position.
3. Adjust the potentiometers on the Dimmer Control Box to the point where the lighting just stops flashing.

— *NOTE* —

If system is not adjusted properly or there is a short circuit, an entire lighting channel may flash continuously.

REMOVAL OF DIMMER CONTROL UNIT.

The dimmer assembly is located on the electrical accessory shelf. (Refer to illustration of Electrical Accessory and Relay Shelf, Chapter 39, for location of electrical accessory shelf.

1. Access to the dimmer is through the avionics bay access panel on the left side of aircraft.
2. Locate the dimmer assembly on the electrical accessory shelf and disconnect connector E412.
3. Remove the screws securing the dimmer assembly to the bulkhead.
4. Remove the dimmer assembly from the airplane.

INSTALLATION OF DIMMER CONTROL UNIT.

1. Position the solid state dimmer in place on the electrical accessory shelf and secure with appropriate screws.
2. Connect plug connector E412 to the dimmer assembly.

REMOVAL OF DIMMER SLIDE CONTROLS.

The slide controls are located together in the overhead switch panel.

1. Remove the knobs from the slide controls.
2. Remove the screws securing the placard panel to the switch panel and remove placard panel.
3. Remove the screws securing the royalite trim panel containing the overhead switch panel and let hang.
4. Remove wires from slide control making note of the placement of the wires to facilitate reinstallation.
5. Bend tabs on slide control to allow removal from panel and pull slide control from panel.

INSTALLATION OF DIMMER SLIDE CONTROLS.

1. Position slide control in overhead switch panel where previously removed.
2. Bend tabs down to secure slide control to panel.
3. Reconnect the wires to the slide control in the same positions as noted when removed from the old assembly.
4. Position the overhead trim panel and secure with the appropriate screws.
5. Attach placard panel to switch panel with screws previously removed.
6. Replace the knob previously removed from the slide controls.

ELECTRO-LUMINESCENT PANEL INVERTER.

REMOVAL OF E.L. INVERTER.

The inverter is located on the electrical accessory shelf in the avionics bay.

1. Gain access to the electrical accessory shelf in the avionics bay.
2. Remove the retaining screws and remove the inverter.
3. Make note of wire positions.

INSTALLATION OF E.L. INVERTER.

1. Position the inverter in place on the electrical accessory shelf and secure.
2. Connect the red wire to L160 connector and the black wire to L17J and L22J of the harness leads.

ANNUNCIATOR CONTROLLER AND ANNUNCIATOR PANEL.

DESCRIPTION OF OPERATION.

The annunciator system is comprised of the annunciator controller and the annunciator panel (indicator). The annunciator controller monitors various systems. (Ref. Schematic Chapter 91) and displays results on the annunciator panel in the cockpit. Display channels are either Master Caution Warnings or Advisory Displays.

Main +28 V.D.C. essential power is applied from the left main bus via 5 amp circuit breaker. and alternate power +28 V.D.C. is applied from battery bus No. 2 via a 5 amp fuse. Three redundant air frame ground pins are used and shall remain connected.

A loss of essential power (or internal flasher) is indicated on master caution channel 22.

Fire extinguisher channels (if extinguishers are not installed) become alternate power channels and may be connected in parallel with annunciator power master caution channel 22. Display master caution channel is connected to the common bus of all indicator annunciator display lamps. (In any case alternate power shall be obtained from a source other than +28 V.D.C. essential bus.)

Three redundant display power master caution channels are provided. and a minimum of two shall be connected: also. three redundant display power indicator channels are provided. and a minimum of two shall be connected.

Display power master caution channels are fed +28 V.D.C. in both the bright and dim modes. The display power indicator channels. however. receive +28 V.D.C. in bright mode and +10 V.D.C. in dim mode. When master caution display is dimmed. the lamp returns of all active master caution malfunctions are alternately +28 V.D.C. and ground. at a very low frequency assymetrical duty cycle.

REMOVAL OF ANNUNCIATOR.

1. The controller is located on top of the nose wheel floor area inside the avionics bay.
2. Remove electrical power by disconnecting battery.
3. Remove plastic straps that secure connect plugs springs, and disconnect electrical connectors.
4. Remove securing screws and remove annunciator controller.

INSTALLATION OF ANNUNCIATOR.

1. Position annunciator and secure with appropriate screws.
2. Reconnect electrical connectors, and secure connect springs with plastic straps.
3. Reconnect battery.

ANNUNCIATOR PANEL LAMP REPLACEMENT.

The annunciator panel is located beneath the glareshield at the top of the instrument panel.

Replacement of a defective lamp does not require removal of the annunciator panel. To replace a lamp, simply push in on the appropriate light cover assembly until it clicks (approximately 1/16 inch) and release. The cover assembly will be partially ejected from the base assembly. Pull the cover assembly from the base and rotate to expose the lamps. Replace the defective lamp with a new T-1-3/4 bulb, midget flange base lamp. Rotate the cover assembly to align with the base and push into base until it clicks. The cover assembly is now locked into place. Depress the "Annunciator Test" switch to check operation of the lamp.

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CHART 3301. LAMP REPLACEMENT GUIDE

Lighting Identification	Piper Part No.	Lamp No.
Annunciator Display Bulbs	472 058	387
Bolt Lights, Instrument	472 028	327
Compass - Magnetic	472 028	327
Dome	758 151	MS15584-15
Door Step	472 027	1495
Forward Baggage	472 057	313
Fuel Control	472 028	327
Gear Down	472 028	327
Gear Warning	472 028	327
Gear Unlocked	472 028	327
Landing	472 769	4596
Map (Grimes)	472 057	313
Map (Whelen)	472 027	1495
No Smoking - Fasten Seat Belts Sign	472 029	327
Reading	453 886	1309
EXTERNAL LIGHTING		
Anti-Collision - Wing Tip Strobe	762 003	A-610
Landing Taxi	472 769	4596
Logo	761 207	DA-27
Position - Tail	761 208	A-508
Position - Wing	753 769	W1290-28
Wing Inspection	472 049	4593

Refer to Parts Catalog for current part numbers.

TRIM INDICATOR LIGHTING.

REPLACEMENT OF TRIM INDICATOR LAMPS.

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.

COWL FLAP INDICATOR LIGHTING.

REPLACEMENT OF COWL FLAP INDICATOR LAMPS.

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.

PASSENGER COMPARTMENT.

SPEAKER PANEL/ DOME LIGHTS.

REMOVAL OF SPEAKER PANEL/DOME LIGHTS.

The lamp is located between speakers on 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 8 attachment screws and lower the speaker panel assembly from the headliner.
2. Remove the screws holding the light assembly to the panel and remove the light assembly.
3. The lamp can now be replaced.

INSTALLATION OF SPEAKER PANEL/DOME LIGHTS.

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 LIGHTS.

REMOVAL OF READING LAMP.

The lamp is located above each passenger seat with the oxygen outlets.

1. Placing a flat tool between the trim molding and plate at the center, between the two control units, pry the plate out, being careful not to bend it.
2. Remove the ground wire from the light assembly and remove the cover over the lamp.
3. Replace the lamp using the proper number.

INSTALLATION OF READING LAMP.

1. Replace the cover over the lamp and connect the ground wire to the light assembly.
2. Install the plate into the trim molding.
3. Press the plate into position to secure it in place.

OVERHEAD ENTRANCE LIGHT.

REMOVAL OF ENTRANCE LAMP.

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 ENTRANCE LAMP.

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.

NO SMOKING, FASTEN SEAT BELTS, CHIMES.

REMOVAL OF LAMPS.

The annunciator is recessed in the cabin headliner.

1. Remove legend plate from annunciator by sliding plate lengthwise from the right side and lifting up on the left side.
2. Remove the particular lamp for replacement by pulling on the lamp.

INSTALLATION OF LAMPS.

1. Replace legend plate in reverse manner of removal.
2. Access to wiring on back of annunciator may be gained by removing the small access plate directly aft of annunciator.

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.

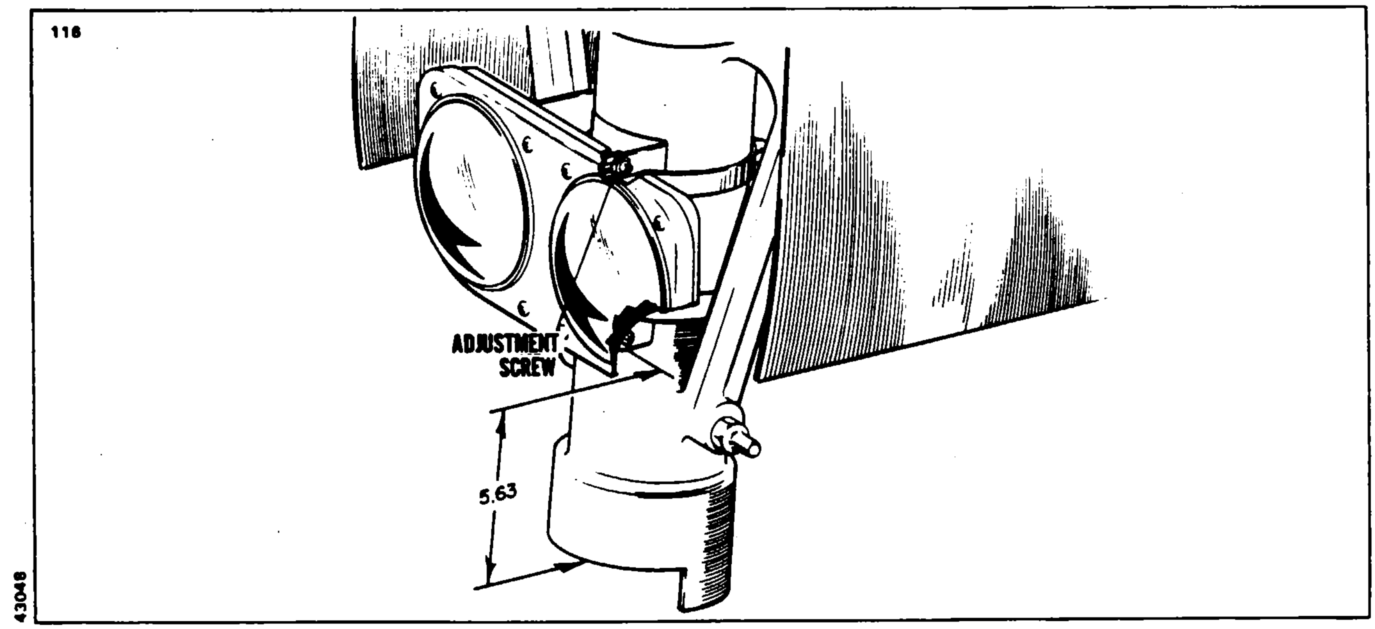

Figure 33-1. Landing/Taxi Light Installation

EXTERNAL LIGHTING.

ANTI-COLLISION LIGHTS.

STROBE LIGHT DESCRIPTION.

Each strobe light is powered by its individual power supply, (Ref. Chapter 91 Anti-Collision Lights Schematic), mounted on the outboard side of wing rib at station No. 238. Both power supplies receive power from the "Strobe" portion of the anti-collision lights switch. If either strobe is operating correctly, the strobe switch control circuit can be considered to be good and troubleshooting can begin at the strobe power supplies.

The strobe light assembly functions as a condenser high voltage discharge system. An audible tone of 1.0 K. to 1.5 K. Hertz is emitted during the charge cycle of the strobe power supply in a normally functioning unit, however, the audible tone does not necessarily mean the power supply firing (trigger) circuit is good. A voltage of approximately 450 volts is developed on a capacitor, after which the audible tone ceases. The capacitor is paralleled across the Xenon flash tube which holds off the voltage until the tube is triggered by a separate pulse generated by a solid state timing circuit.

After the trigger pulse causes ionization of the Xenon gas in the envelope, an intense light is given off for a brief moment as the capacitor discharges. Following discharge across the tube, the oscillator again chops up the D.C. aircraft current into A.C. current and again develops a high voltage through transformer action. After full voltage is again impressed on the capacitor, the cycle repeats itself, occuring at about 50 flashes per minute.

Since each wing tip strobe is powered by its own power supply, and if BOTH POWER SUPPLIES ARE EMITTING AUDIBLE TONES, simply switch power supplies from each wing tip. If the trouble follows the power supply, replace it, if the faulty strobe still malfunctions replace that strobe tube. Refer to Installation and Removal of Strobe lamps and strobe power supplies.

STROBE XENON TUBES, AND POWER SUPPLY, GENERAL SERVICE INFORMATION.

1. Never reverse power supply input connections for even an instant. Reverse polarity will permanently damage the circuitry, even though damage may not be immediately apparent, the power supply will fail in use.
2. Wait five minutes for high voltage bleed down to occur before handling a strobe power supply to avoid electrical shock.
3. Never allow connection between Pins 1 and 2 of the flash tube connector, since this will discharge the capacitor and destroy the trigger circuit.
4. An Xenon flash tube can be photo-sensitive. Some may flash normally when exposed to light, but may become difficult to fire in darkness.
5. Xenon flash tubes become harder to fire with age, or when exposed to very high temperatures.
6. A tube with a great deal of service life left in it, should fire on a reduced voltage of 10 volts in a 14 volt system, or 22 volts in a 24 volt system.
7. A hard firing tube can fire with an engine running, but fail to fail on battery voltage.

8. The installation of only one new strobe tube, operating from a common power supply, will sometimes cause the remaining tube to misfire or skip, indicating the remaining tube is nearing the end of its service life. (The PA-31P-350 has individual power supplies.)
9. Under hot and cold cycling during normal operation, "egg-shelling" of the glass envelope can occur, or leaks may develop in the glass seal.
10. Xenon strobe tubes can sometimes go into "self-ionization" continuously glowing a light blue rendering the system inoperative.

— *NOTE* —

All of the above conditions are considered to require tube replacement.

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 an 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 of wing rib at station No. 238.

1. Remove wing access panel at station No. 238 to reach strobe power supply L or R.
2. Remove mounting screw on strobe power supply containing the ground wires.
3. Remove the other three screws mounting power supply 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. Connect the three electrical connectors inside the wing.

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.

LANDING/TAXI LIGHTS.

REMOVAL OF LANDING/TAXI LAMPS.

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 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.

INSTALLATION OF LANDING/TAXI LAMPS.

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 secure with clamps. The light beam angle may be adjusted by the adjustment screws at the side of the bracket and tilting as desired.

LOGO LIGHTS.

The logo lights are located on the upper surface of the left and right stabilizer for vertical tail illumination. The circuit consists 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" position, 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.

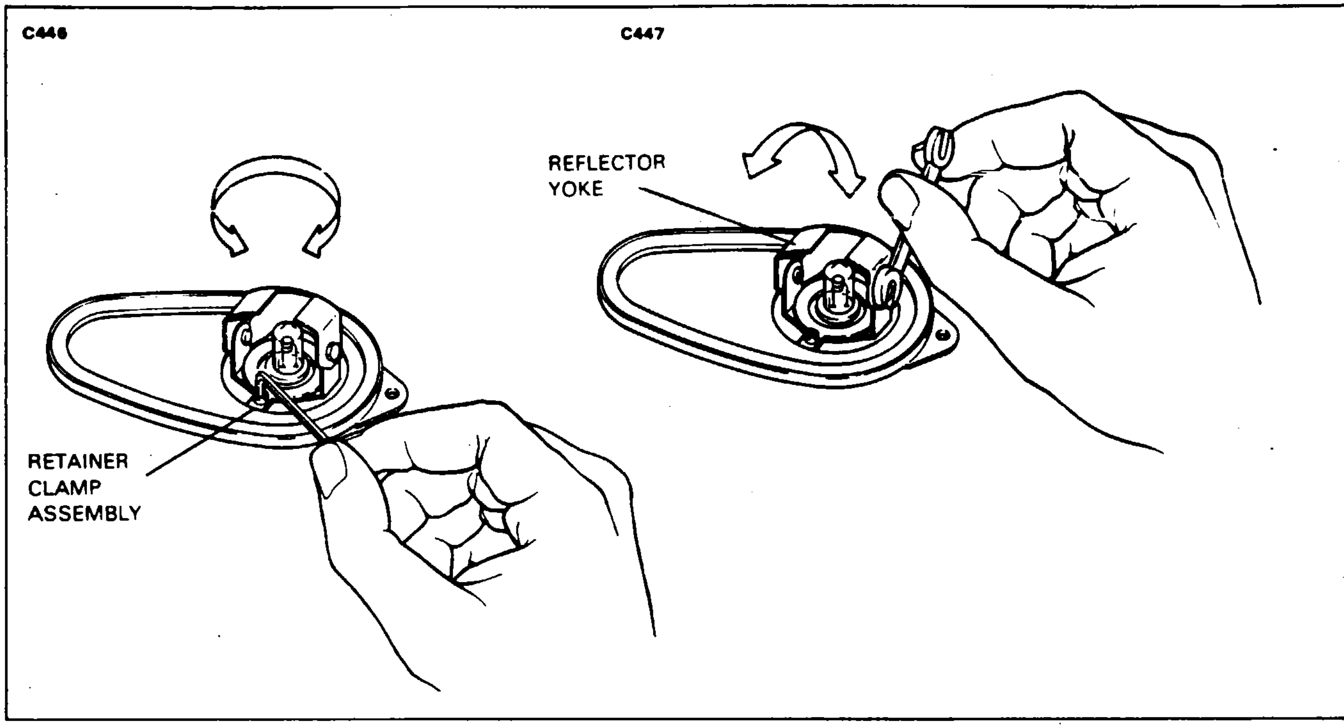

Figure 33-2. Logo Light Assembly Adjustments

POSITION LIGHTS.

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 tail cone.

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 retaine and secure with the appropriate screws.

WING INSPECTION LIGHT.

DESCRIPTION AND OPERATION.

The light is mounted in the outboard side of the left nacelle just above leading edge of the wing. It is a sealed beam, 24 volt unit, which is controlled from a rocker type switch mounted in the overhead switch panel. The light is positioned in the nacelle to illuminate the leading edge of the wing when the switch is activated in the cockpit.

REMOVAL OF WING INSPECTION LIGHT.

1. Be sure the switch is in the "OFF" position.
2. Remove the nacelle side access panel that the lamp assembly is mounted to and disconnect the wire connections on the back of the lamp.
3. Remove the four clips holding the lamp to the panel and remove the lamp.

INSTALLATION OF WING INSPECTION LIGHT.

1. Position the gasket and lamp on the panel.
2. Install the four clips and secure with screws and nuts.
3. Connect the electrical leads to the back of the lamp assembly.
4. Position the entire panel on the nacelle side and secure with screws.
5. Activate the switch in the cockpit to check the lamp operation.

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CHAPTER 34

NAVIGATION AND PITOT/ STATIC

CHAPTER 34 - NAVIGATION AND PITOT/STATIC

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This Chapter provides maintenance information concerning the Pitot Static Pressure System and related instrumentation of the PA-31P-350.

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. These ports are interconnected as shown in Figure 34-1 and the tubing is then routed forward through the fuselage to the back of the instrument panel, where it is connected to the airspeed indicator, altimeter and rate of climb indicator. The purpose of the static system is to vent the flight instruments, pneumatic pressure gauge and cabin differential pressure gauge to ambient atmospheric pressure.

TROUBLESHOOTING.

For troubleshooting of the various instruments, refer to the Chart with each particular instrument.

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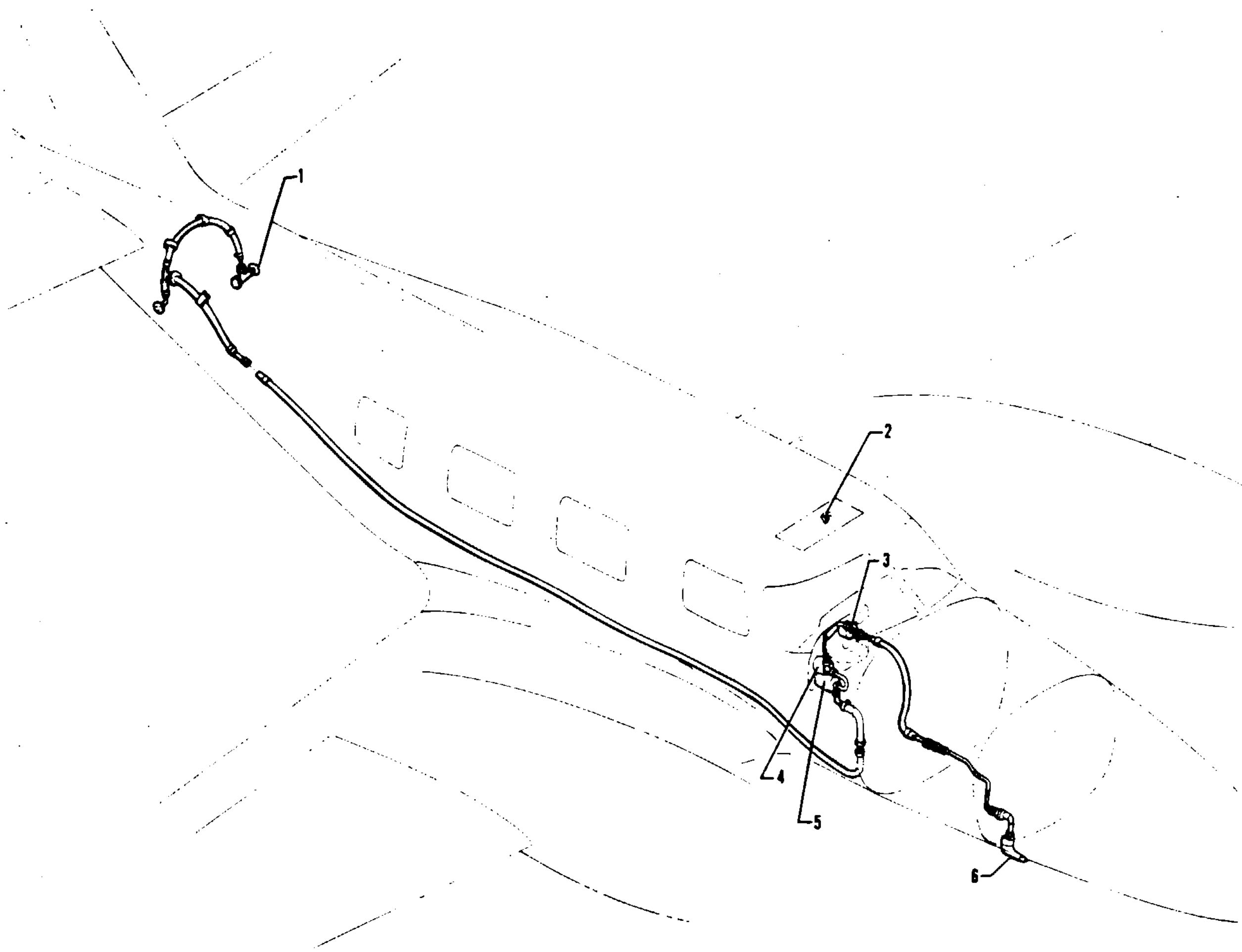

NOTE
ADVISORY CIRCULAR AC 43-203A DESCRIBES AN ACCEPTABLE MEANS OF COMPLYING WITH STATIC SYSTEM TEST REQUIRED BY FAR PART 91, SECTION 91.170 FOR AIRCRAFT OPERATED UNDER IFR CONDITIONS. FOR STATIC SYSTEM TEST FOR AIRCRAFT NOT OPERATED IN CONTROLLED AIRSPACE UNDER IFR CONDITIONS SEE ADVISORY CIRCULAR AC 43.13-1A, SECTION 4 OF CHAPTER 16. REFER TO PARTS CATALOG FOR TYPICAL SYSTEM ROUTING.

1. STATIC SOURCE FOR PILOT'S AND COPILOT'S STATIC INSTRUMENTS
2. CIRCUIT BREAKER
3. AIRSPEED INDICATOR
4. ALTIMETER
5. RATE OF CLIMB INDICATOR
6. PITOT HEAD

60880

Figure 34-1. Instrument Air System Installation (Typical)

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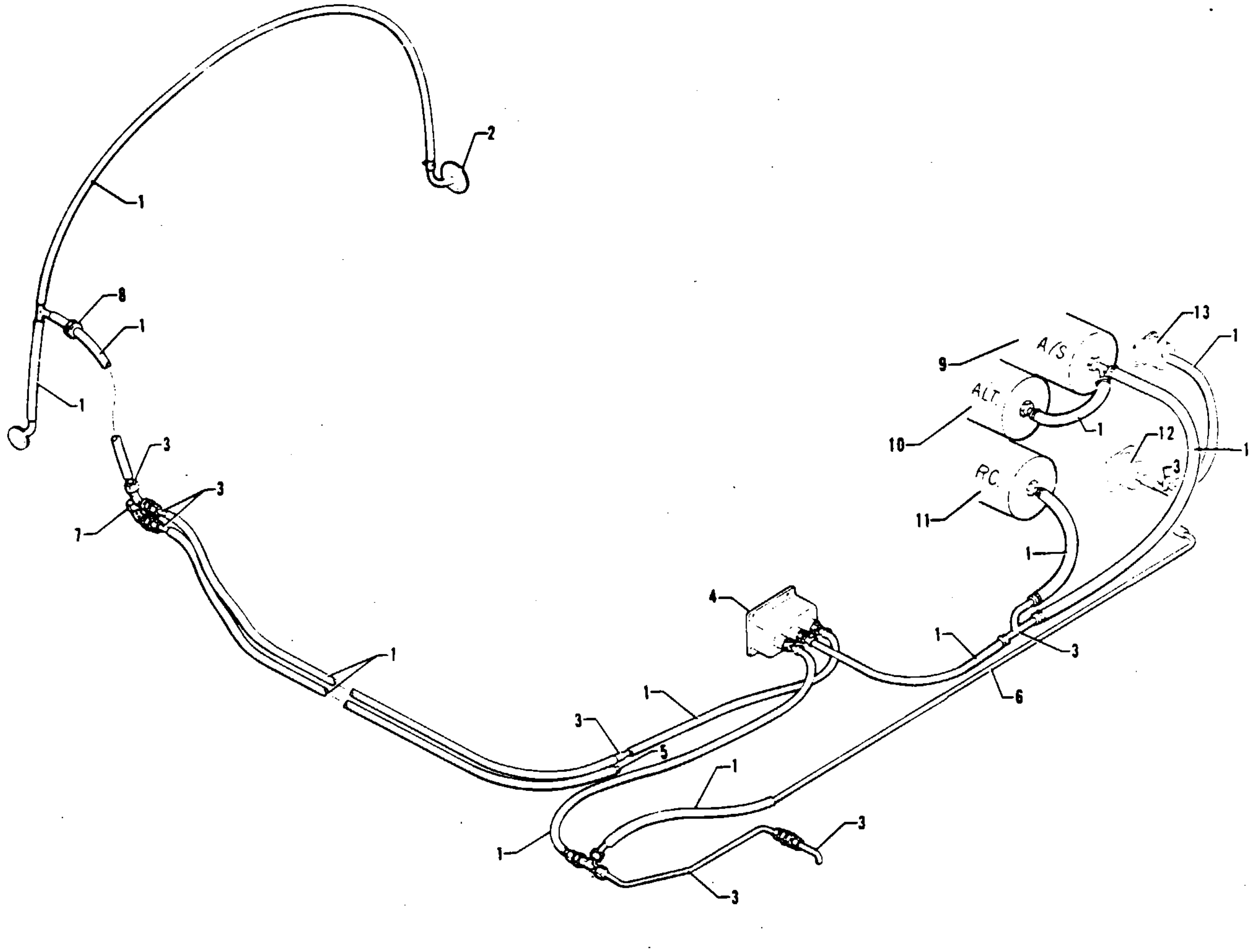

1. HOSE, STATIC PRESSURE
2. STATIC LINE VENT, LEFT & RIGHT
3. LINE ASSEMBLY - STATIC PRESSURE
4. VALVE, STATIC AIR PRESSURE
5. PLUG, BUTTON
6. MANIFOLD ASSEMBLY, STATIC AIR
7. CAP ASSEMBLY
8. GROMMET
9. INDICATOR, AIRSPEED
10. ALTIMETER
11. INDICATOR, RATE OF CLIMB
12. CABIN DIFF. PRESSURE & ALTITUDE
13. PNEUMATIC PRESSURE

50880 - 82106

Figure 34-2. Pitot-Static Installation

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 knobs, 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, 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, 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 to the ventilation openings in equipment housings to insure that they 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 static port.
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. External magnetic interference.	Compensate instrument. Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Improper mounting on instrument panel. Insufficient liquid.	Align instrument. Replace or repair instrument.
Card sluggish.	Weak card magnet. Instrument too heavily compensated. Excessive pivot friction or broken jewel.	Replace or repair instrument. Remove excess compensation. Replace or repair instrument.
Liquid leakage.	Loose bezel screws. Broken cover glass. Defective sealing gaskets.	Replace or repair instrument. Replace or repair instrument. 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?
8. Is proper voltage available?
9. Is electrical grounding in tact?
10. Is circuit breaker correct or faulty?
11. Are all electrical plugs and connections secure?

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.	Replace instrument.
	Insufficient bearing clearance.	Replace instrument.
Pointer sluggish in returning to zero and does not set on zero when stationary.	Oil or dirt between damping pistons and cylinder.	Replace instrument.
	Excessive clearance between rotor and rotor pivots.	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

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter provides supplemental information for servicing the PA-31P-350 oxygen system.

DESCRIPTION AND OPERATION.

The oxygen for the breathing system is furnished from a stationary cylinder located in the nose section of the airplane. Other components of the oxygen system are: a filler valve, pressure gauge, regulator assembly, mask outlet ports and masks, distribution lines and an ON/OFF control.

The storage cylinder is made of a lightweight aluminum liner covered with Kevlar 49 epoxy resin composite. This epoxy resin offers a exterior finish resistance against the exposure to phosphate ester hydraulic fluids, cleaning solvents, jet fuel, fresh water and sea water. Cylinders are available in the 22 cu. ft. capacity or 50 cu. ft. capacity.

— NOTE —

Also available for compliance to FAR 135 certification is a 50 cu. ft. cylinder with an altitude compensated regulator.

The storage cylinder is filled through the filler valve and supplies high pressure oxygen to the regulator assembly.

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 I is authorized for use in the oxygen system.

TROUBLESHOOTING.

Chart 3501 lists the troubles which may be encountered along with their probable cause and suggested remedy.

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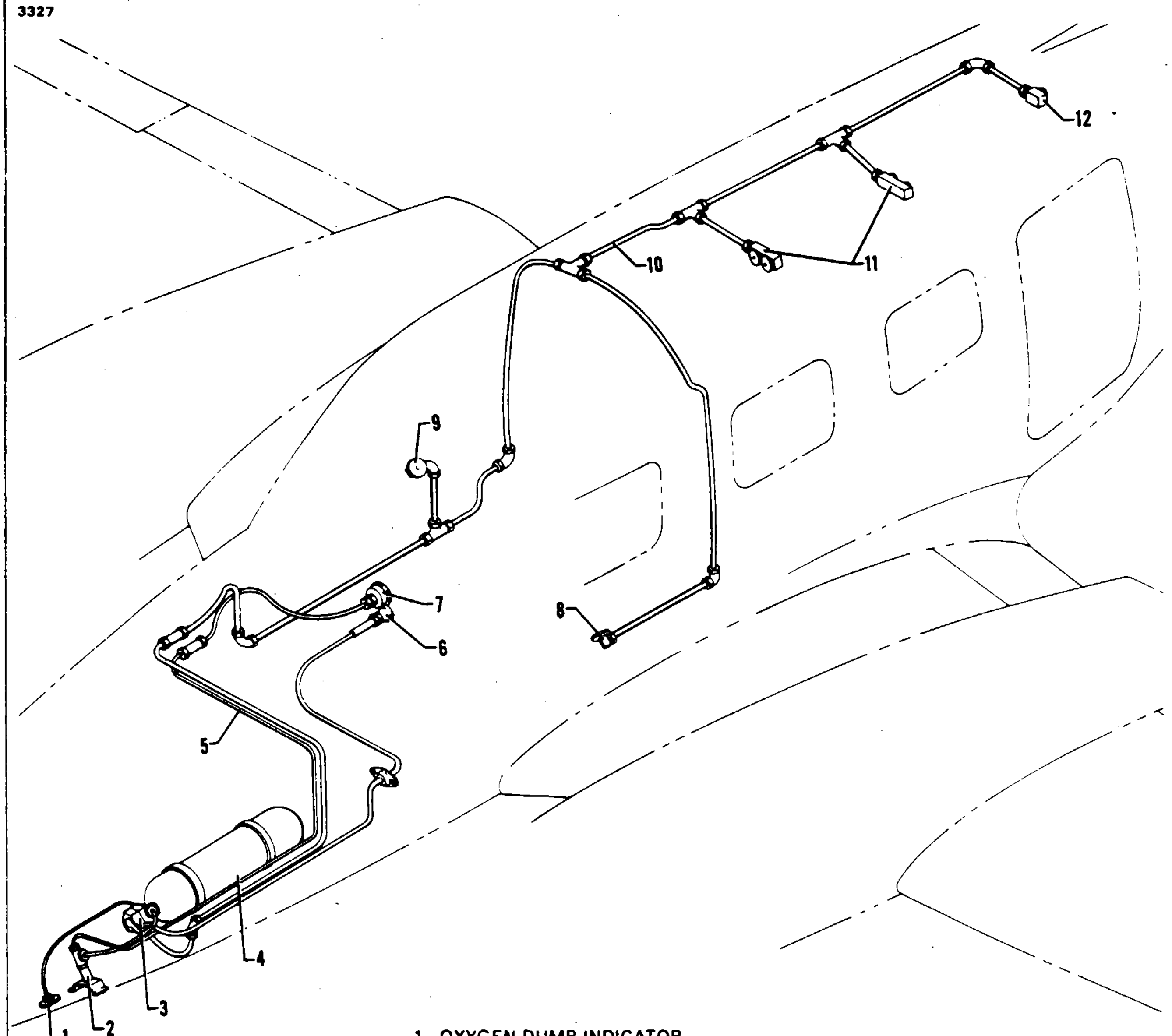

1. OXYGEN DUMP INDICATOR
2. OXYGEN CHARGING VALVE
3. PRESSURE REGULATOR
4. OXYGEN CYLINDER
5. HIGH PRESSURE LINE
6. OXYGEN FLOW CONTROL KNOB
7. OXYGEN SUPPLY PRESSURE GAUGE
8. PILOT PLUG-IN OXYGEN OUTLET
9. COPILOT PLUG-IN OXYGEN OUTLET
10. LOW PRESSURE LINE
11. PASSENGER OXYGEN OUTLETS
12. SEVENTH SEAT PASSENGER OXYGEN OUTLET

Figure 35-1. Oxygen System Installation

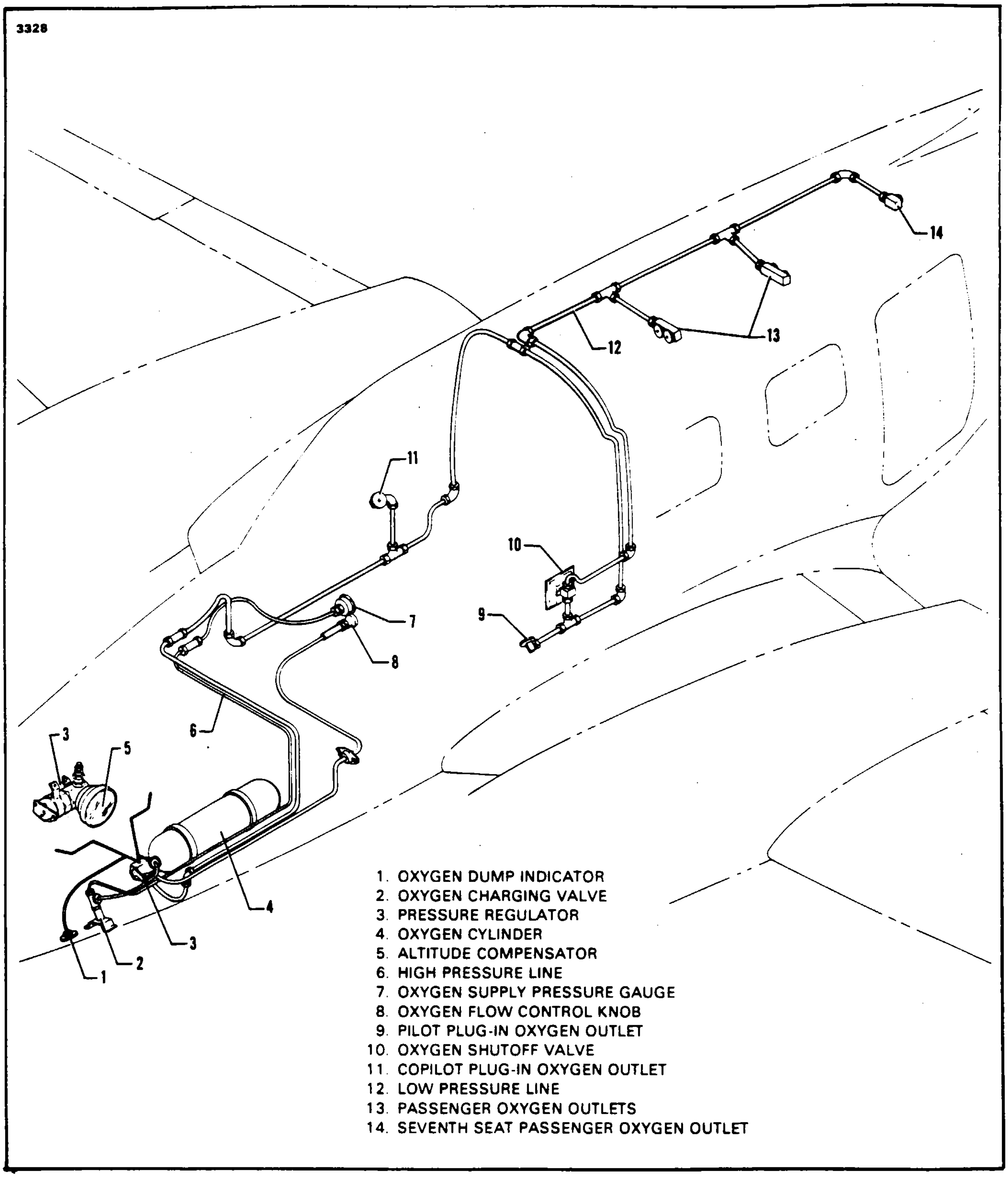

Figure 35-2. Oxygen System Installation for FAR 135 Certification

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.	Oxygen cylinder valve closed.	Open valve.
	Pressure gauge defective.	Replace gauge.
	Defective regulator.	Replace regulator.
	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.

PASSENGER/CREW.

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, solvent contamination and other foreign matter.
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-25567A or PAR 4.5.6 of MIL-I-5585A. 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. Do not attempt to open cylinder shut-off valve more than 3 1/2 turns.
13. Every two (2) years, oxygen system components (except tubing) should be removed, serviced, cleaned/replaced.
14. Never allow electrical equipment to come in contact with the oxygen cylinder.

TESTING FOR LEAKS.

Apply leak detector fluid conforming to MIL-L-25567A or PAR 4.5.6 of MIL-I-5585A. 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 tag on cylinder for the DOT identification number and for the date of the last 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 in accordance with Spec. MIL-I-5585A, PAR 331. Refer to Cleaning Oxygen System Components.
6. Ribbon Dope Thread Sealant (Permacel 412) should be applied to male pipe threads only. Apply the sealant by starting at the second thread and wrap threads in direction of thread spiral with a 1/4 inch or more overlap, after joint is made, remove excessive 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.

8. Identify all high and low pressure lines at both ends with oxygen identification tape.

CHART 3502. OXYGEN SYSTEM COMPONENT LIMITS

PARTS	INSPECTION	OVERHAUL
Regulator	300 Flight Hrs.	5 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 5 Yrs.
External Recharge Valve	Each Use	Replace Every 5 Yrs.
Masks	Each Use	Replace as Necessary
Cylinder	Each Use	Replace Every 15 Yrs.

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-I-5585A, PAR 331 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.

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. If the bottle is left below 200 psi it may develop odors from bacterial growth.

1. Close cylinder fill valve. (If cylinder is not installed, cap "T" fitting.)
2. Inspect charging (nitrogen) connector for cleanliness. 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).
9. Open oxygen cylinder shutoff valve.
10. Open regulator just enough to allow oxygen to purge out any nitrogen remaining in lines then close regulator.
11. 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.

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.

OXYGEN CYLINDER.

REMOVAL OF OXYGEN CYLINDER AND REGULATOR.

The forward mounted cylinder is located in the left side of the nose section below and to the rear of the baggage compartment. Access to the cylinder is provided by removing the left-hand floor panel from the rear of the baggage compartment and the access panel on the left side of the nose section just aft of the baggage compartment door.

— *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. Remove the cylinder from the airplane using caution not to bump the neck of the cylinder, regulator, and compensator (if installed).

— *CAUTION* —

The cylinder must be completely discharged of all pressure prior to removing the regulator or compensator (if installed).

INSTALLATION OF OXYGEN CYLINDER AND REGULATOR.

1. With the regulator and compensator (if installed) attached to the cylinder, place the cylinder in the mounting brackets with the regulator and compensator (if installed) forward. Be careful not to bump the regulator, compensator (if installed) and cylinder during installation.
2. Secure the cylinder in place by connecting and tightening the mounting bracket assembly clamps.
3. Connect the pressure lines and control cable to the regulator.
4. Replace the floor and access panels.

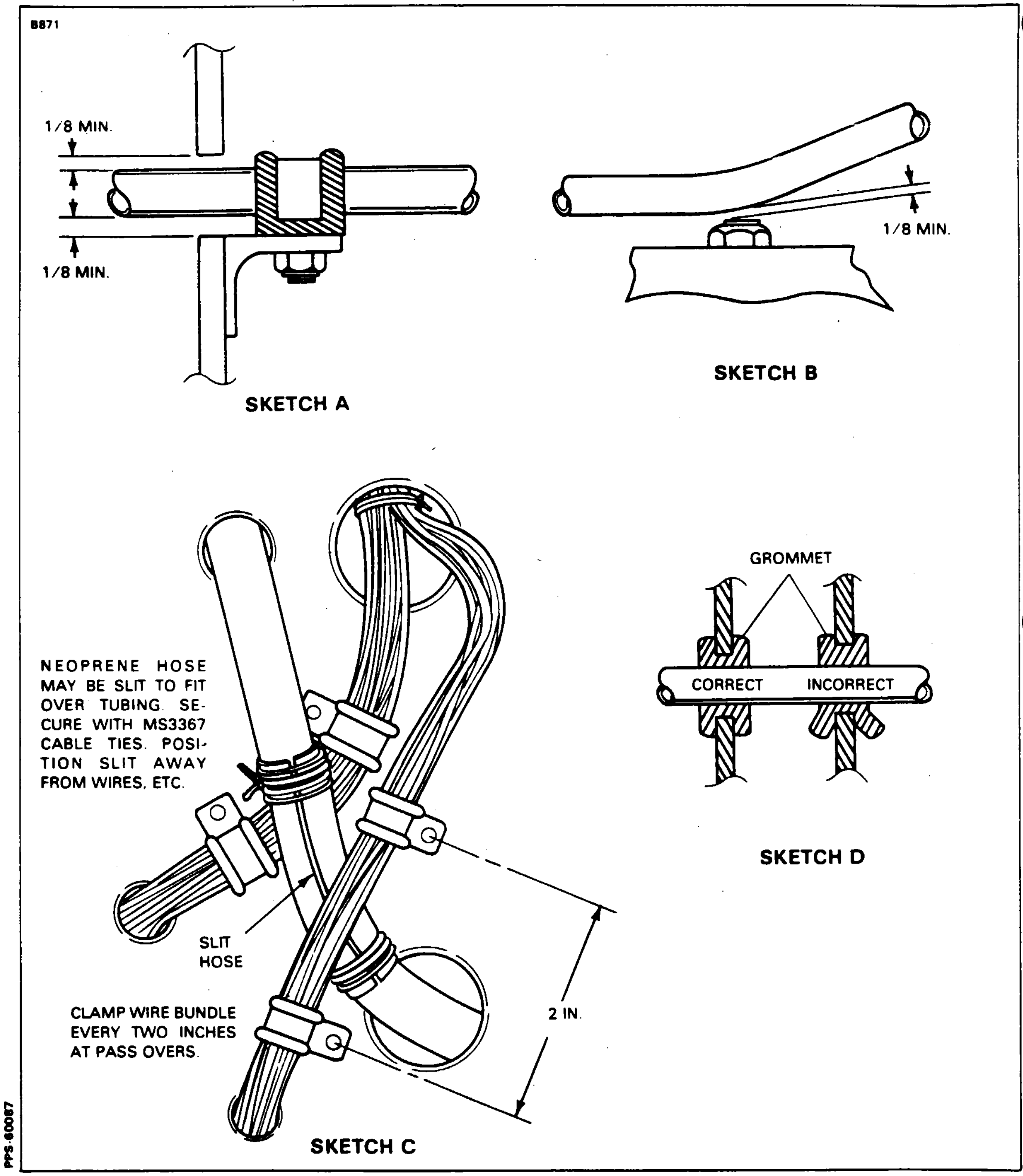

Figure 35-3. Oxygen Tubing Installations

CHARGING VALVE.

REMOVAL OF OXYGEN SYSTEM CHARGING VALVE.

1. Remove the access panel on the left side of the nose section.
2. Verify cylinder valve is closed.
3. Disconnect the tee fitting from the charging valve.
4. 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. Replace the access panel on the side of the nose section.

PRESSURE GAUGE.

REMOVAL OF PRESSURE GAUGE.

Ascertain that the control valve is closed and there is no pressure in the system.

1. Disconnect the connector from the back of the pressure gauge.
2. Loosen and remove the retainer nut and clamp holding the gauge in place.
3. Pull the gauge out from the front of the panel.

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.

OVERPRESSURE DISC.

REMOVAL OF OVERPRESSURE DISCHARGE DISC (VISUAL). (Refer to Figure 35-1 or 35-2.)

The green overpressure disc is located on the lower left section of the nose section at fuselage station 38.50 and can be removed per the following instructions:

1. Remove snap ring holding overpressure disc in place and remove disc or any remaining pieces, if disc was blown out.

2. Check frame and dump outlet for damage if disc was blown out and repair as required.
3. Flush purge if required.

— *NOTE* —

If cylinder safety disc has ruptured, remove cylinder and return to a qualified overhaul facility.

INSTALLATION OF OVERPRESSURE DISCHARGE DISC (VISUAL). (Refer to Figure 35-1 or 35-2.)

1. Insure dump outlet is clean.
2. Insert overpressure disc into frame.
3. Install snap ring.
4. Install good cylinder if cylinder was previously removed.

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 tag or DOT identification stamped on the cylinder. The lightweight cylinder (ICC or DOT 3HT 1850) must be hydrostatic tested every 3 years and must be retired from service after 15 years or 10,000 pressurizations, whichever comes first. The month and year of the last test is stamped on the cylinder beneath the ICC or DOT identification. The lightweight cylinder used with FAR 135 certification must be retired from service after 15 years.
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 1/16 inch diameter 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.)

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CHAPTER

36

PNEUMATIC SYSTEM

CHAPTER 36 - PNEUMATIC SYSTEM

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter contains maintenance information on the pneumatic system components.

DESCRIPTION.

The PA-31P-350 uses a dry pneumatic pump system consisting of two engine driven pneumatic pumps, pressure control valves, inline filters, pressure switches, check valves 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 left side of the instrument panel. Should one of the pressure pumps fail this would be indicated at the pneumatic source malfunction lights on the annunciator panel.

DISTRIBUTION.

PNEUMATIC SYSTEM FILTER REPLACEMENT.

There are four pneumatic system filters located throughout the pneumatic system. Two inlet filters located in the induction air system on the left-hand side of each engine and two inline filters located along the outlet side of the pneumatic pumps. The following instructions will cover the removal and installation of the inline filters along with recommended cleaning and replacement time as required. Refer to Chapter 71 for maintenance instructions for induction air filters.

1. 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.

2. Installation of inline filter. The filter has an arrow on the case indicating the direction of airflow, 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. Secure with hose clamps.
   B. Install and secure the access panel previously removed.

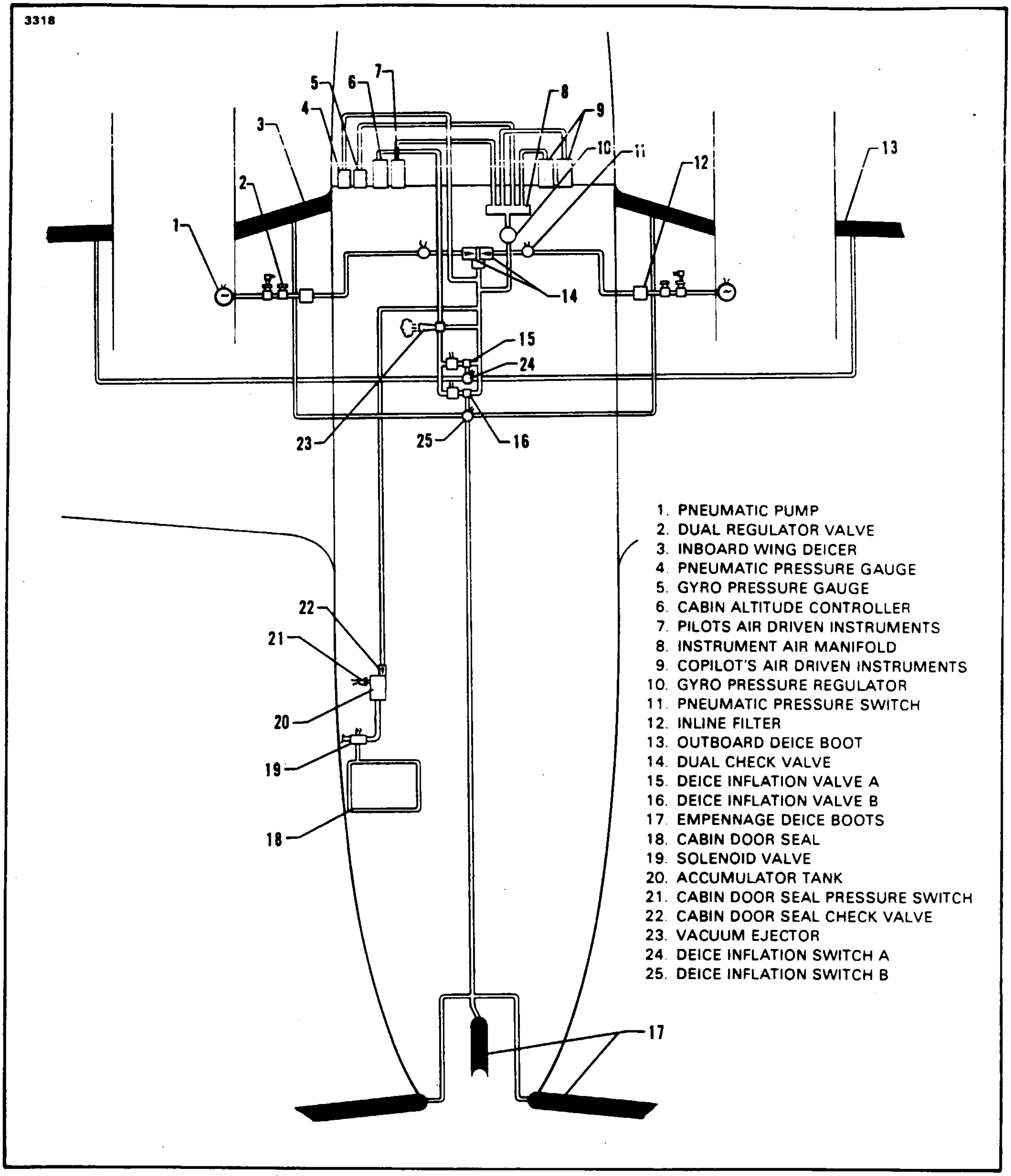

Figure 36-1. Pilot's and Copilot's Gyro Installation With Deicer

DRY PNEUMATIC PUMP.

REMOVAL OF DRY PNEUMATIC PUMP.

1. Remove engine cowling and locate the pneumatic pump at the 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.

REGULATING VALVE.

REMOVAL OF TWO STAGE REGULATING 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 TWO STAGE REGULATING VALVE.

1. Secure valve to bracket.
2. Connect hoses to valve.
3. Secure hoses to valve with hose clamps.
4. Reinstall access panel.

CHECK VALVE.

REMOVAL OF CHECK VALVE.

1. Gain access to the check valve by removing the center floorboard panel between fuselage stations 140 and 151.30.
2. Remove three lines going to check valve.
3. Cap lines.
4. Remove check valve.

INSTALLATION OF CHECK VALVE.

1. Remove caps from lines.
2. Attach lines to check valve. Torque fittings.
3. Reinstall previously removed floorboard panel.

PRESSURE SWITCH.

REMOVAL OF PRESSURE SWITCH.

1. Remove center floorboard panel at fuselage station 151.30.
2. Disconnect electrical leads.
3. Remove the switch by placing an open end wrench on the bottom of the switch and unscrew the switch from the line.

INSTALLATION OF PRESSURE SWITCH.

1. Screw the switch into the line and tighten.
2. Connect the electrical leads.
3. Reinstall floorboard panel.

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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

ELECTRICAL/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The instrumentation of the PA-31P-350 portrays attitude, performance and condition of the aircraft. The instruments are divided into electrical and non-electrical instrumentation. The electrically operated instruments are protected with circuit breakers to isolate the individual instruments in the event of trouble. Indicator and warning lights are installed to provide the pilot with information regarding safe operation of the various systems.

An annunciator panel is incorporated into the center of the glare shield to provide the crew with a visual warning of a malfunction or potential problem within the aircraft's systems.

An overhead panel contains lighting and engine switches, ice protection and de-ice switches, an ELT switch, voltmeter and two ammeters.

Power, fuel and trim controls are located in the pedestal which is located below the center of the instrument panel.

Circuit breaker panels are located on both sides of the cabin.

INSTRUMENT PANEL.

The instrument panel is arranged to accomodate flight instruments on the left side, in front of the pilot; engine instruments and avionics equipment in the center. A second set of flight instruments may be installed in the right panel for use by the copilot. The flight instrument panels are shock mounted to minimize vibration and shock transmitted to the instruments. (Refer to Figure 39-5.)

INSTRUMENTS.

REMOVAL OF INSTRUMENTS.

The majority of instruments are mounted in a similar manner; therefore, 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. The non-shock mounted instruments 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. To remove instruments mounted in the overhead panel assembly, it is necessary to remove the panel to gain access to the back of the intruments.

3. The shock mounted instruments may be removed by the following procedure:

— *CAUTION* —

Gyro instruments can be permanently damaged quite easily after removal from the shock mounts. Ball dents in the rotor bearings will occur unless gyro instruments are placed on foam or other cushioning type material.

   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 backside 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.
4. Typical removal for a front mounted instrument is as follows:
   A. Release the instrument by removing the attaching hardware from the front of the instrument.
   B. Carefully slide the instrument out of the panel exposing all plumbing and/or electrical connections at the rear of the instrument.
   C. Disconnect and label all plumbing and/or electrical lines. Remove instrument and cap disconnected pneumatic lines.

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 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. 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. Ascertin 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 protrude 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.
3. Install front mounted instruments in the reverse order of removal.

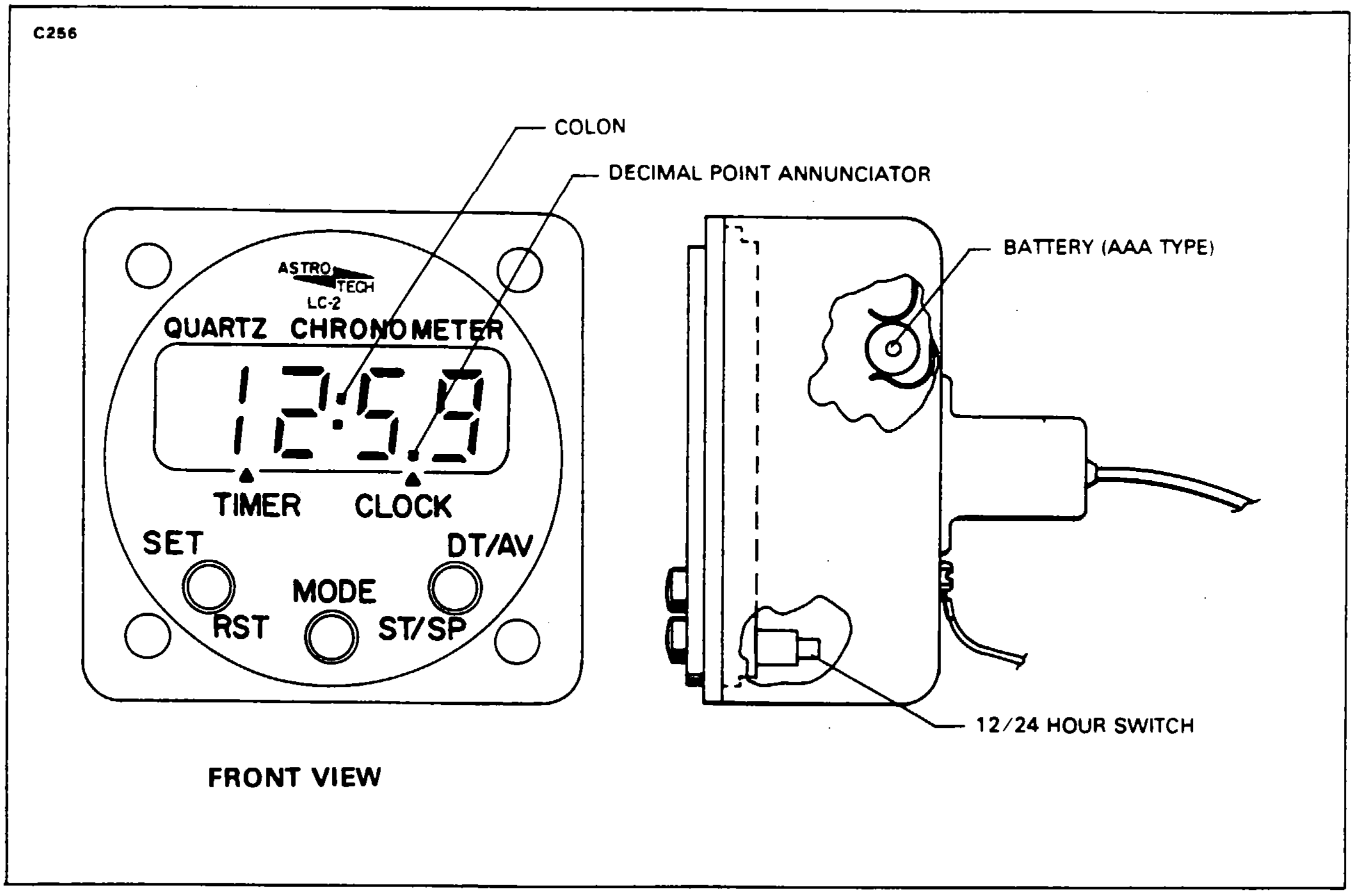

Figure 39-1. Quartz Digital Clock

INSTRUMENTS (Electrical).

Refer to Chapter 34 for gyro, and air driven instruments. Refer to Chapter 28 for engine system indicators. See Chapter 91 for electrical wiring information for all systems.

DIGITAL CLOCK (Option).

REPLACEMENT OF BATTERY (Digital Clock).

The "AAA" type alkaline battery has a useful life of approximately 24 months. To replace the battery, it will be necessary to remove the clock from the instrument panel.

1. Remove the four screws which secure the clock to the panel.
2. Reach up behind the instrument panel, remove the clock from its position and move it to a more accessible location.
3. Remove the screw from the back of the clock and gently separate the case from the face.
4. Replace the battery and reinstall the case.
5. Install the clock in the instrument panel and reset according to the directions given in DIGITAL CLOCK TIMER, CHRONOMETER OPERATION.

DIGITAL CLOCK, TIMER, CHRONOMETER OPERATION. (Refer to Figure 39-1.)

The face of the digital clock contains a digital display, set/reset button, mode button and date advance, start/stop button. The digital display indicates either the time in hours and minutes, the date in month and day or the timer which counts minutes and seconds for the first hour then hours and minutes to 24 hours. The desired display is selected by pressing the mode button; the mode is then indicated by a decimal point annunciator in either the TIMER CLOCK position.

1. TIMER operation.
   A. Press the MODE button to position the decimal point annunciator over the TIMER legend and to place the display in the TIMER mode.
   B. Press the ST/SP button once to begin counting and again to stop the count.
   C. To reset the digital display to zero, press the RST button.
2. CLOCK operation.

— NOTE —

The annunciator appears over the CLOCK legend in 12 hour clock only. When using 24 hour clock, utilize TIMER annunciator to indicate mode.

   A. Press the MODE button to position the decimal point annunciator over the CLOCK legend and to place the display in the CLOCK mode.
   B. Press the SET button once. The digital display will indicate the date. Advance to the desired month by pressing the DT/AV button.
   C. Press the SET button once. Advance to the desired day by pressing the DT/AV button.
   D. Press the SET button twice. Advance to the desired hour by pressing the DT/AV button.
   E. Press the SET button once. Advance to the desired minute by pressing the DT/AV button.
   F. Press the SET button once. The clock will hold the time at which it was set.
   G. Press the DT/AV button once to start the clock.

— *NOTE* —

To change the hour without changing the minutes set the hour as described above, then press SET button twice to continue the time. If the clock colon is missing or does not blink, press the DT/A V button for two seconds until the date returns to the digital display. Colon activity will resume.

To display the date, press the DT/A V button momentarily. The date display will return to clock display automatically.

3. Display Test.
   A. Select CLOCK mode.
   B. Hold the SET and DT/AV buttons down together to display all characters.
   C. The display should return to the SET mode.
   D. Press the MODE button twice to get out of the SET mode.

CABIN INSTRUMENTS DISPLAY (B & D Instruments Inc. - Model 2504)

GENERAL DESCRIPTION.

The model 2504 is an independent passenger compartment digital display system. annunciating: True Airspeed. Altitude. Outside Air Temperature. and Time. The system is powered by the #2 Battery Bus. (Ref. Chapter 91 - Electrical Schematics) and by NI-Cad batteries. located within the computer unit. which power the clock function in the event of power interruption. These batteries should be replaced approximately every two years.

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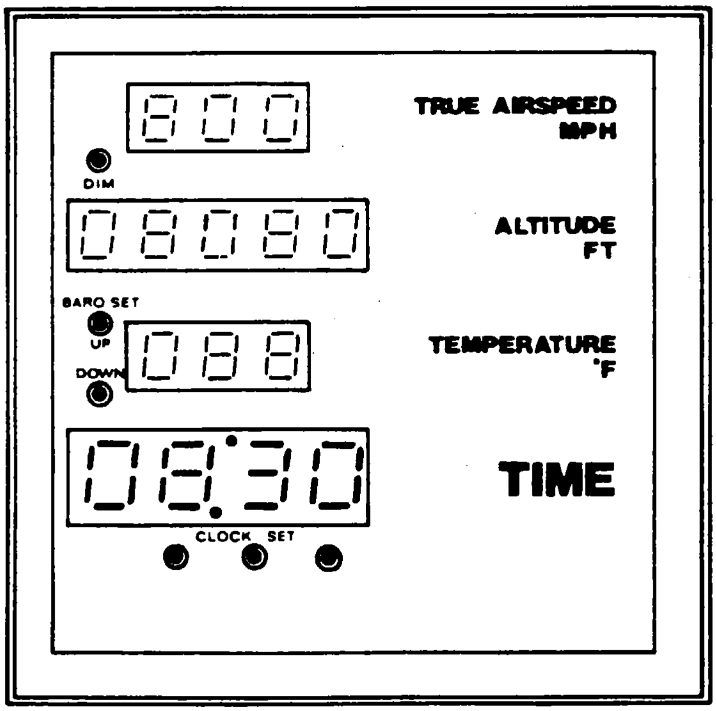

Figure 39-2. Cabin Instruments Display

Six faceplate controls are available for operational adjustments. (Refer to Figure 39-2.)

1. Dimmer Control Switch - This control provides four levels of intensity, to adapt to all ambient cabin light conditions.
2. Two Altimeter "Up" and "Down" Switches are provided for calibration of the altitude display with the aircraft's altimeter due to changing barometric pressure.
3. Three Clock Set Switches are provided to control the time set into the clock display. These switches control: minutes, tens of minutes, and hours.

Input data is received from two pressure transducers and a temperature probe. These transducers are connected to the aircraft pitot/static system, and sense absolute pressure (ind. alt.) and pitot static differential pressure (ind. airspeed). The temperature probe provides a thermistor type temperature input.

A micro-processor, within the computer, acts on the inputs and provides a "true airspeed" readout. The micro-processor also provides compressability corrections to correct true airspeed and temperature for mach numbers up to 1.2 mach.

The range of the Digital Cabin Display is from 0-999 knots, (M.P.H. or Km/hr. are available) -60° Celsius to +65° Celsius, and altitudes from - 1,900 feet to 65,000 feet.

SERVICE GUIDELINES.

Service of the Digital Cabin Display System is confined to a "Black-Box" replacement. Refer to Figure 39-3.

— CAUTION —

NOTE 1

Use only teflon tape on pitot/static port threaded fittings. Liquid sealers will cause damage due to chemical migration.

NOTE 2

Provide electrical power only to the switched input source to avoid permanent damage. (Example: If transducer receives power before computer, the computer's multiplexer will be damaged.)

NOTE 3

The voltage to the display readout unit shall never exceed 7.5 V.D.C. to prevent permanent damage.

NOTE 4

A minimum of approximately 15 V.D.C. at 1 AMP is required for correct startup. Do not supply any voltage from any source which can fall below this minimum.

All system components are interchangeable with no recalibration required. Troubleshooting Table 3901 is provided as a reference guide when troubleshooting the digital display system. A high quality accurate volt/ohm meter is required when taking measurements.

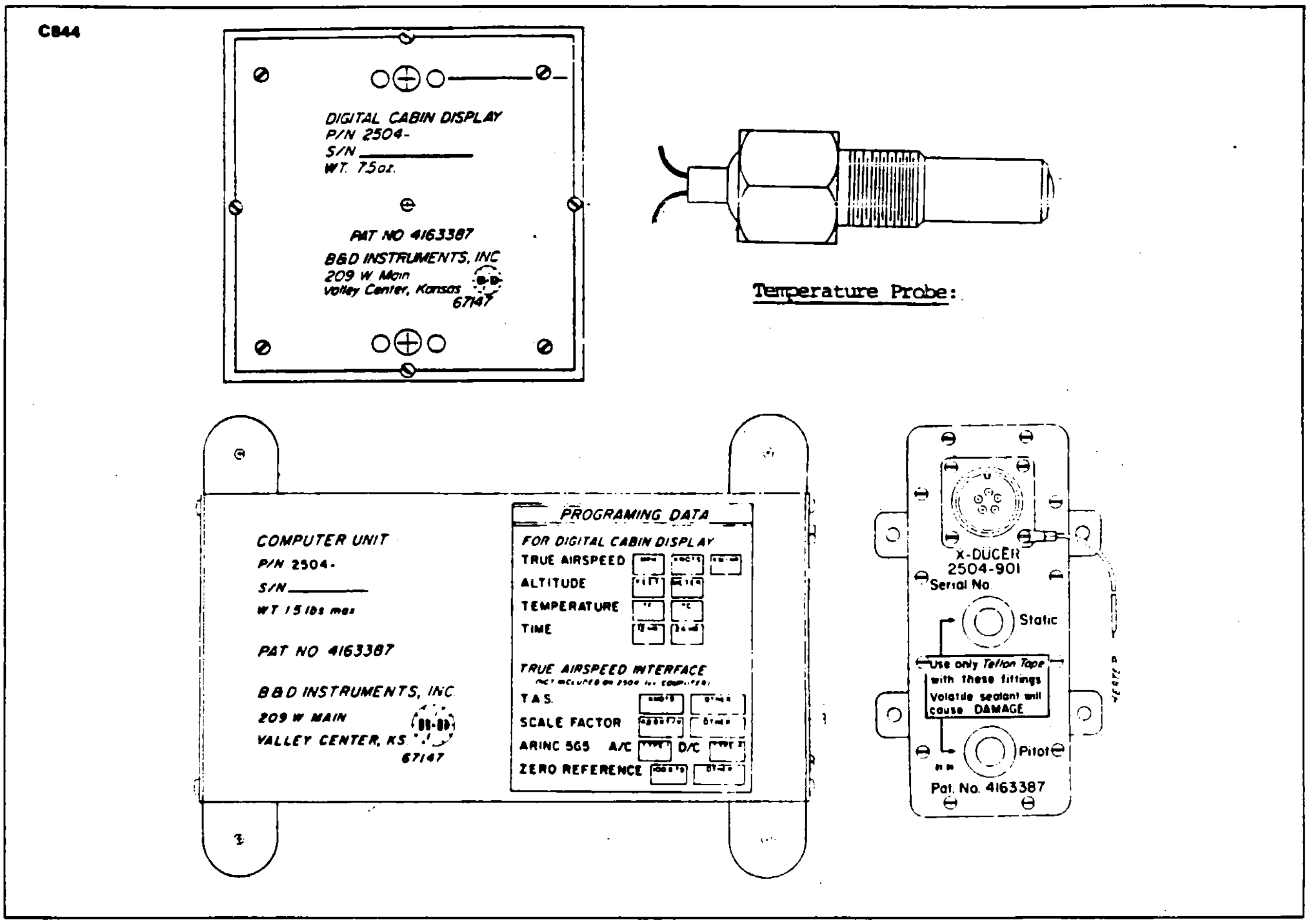

Figure 39-3. System Components - Cabin Display

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TROUBLESHOOTING DIGITAL CABIN INSTRUMENTS DISPLAY.

TABLE 3901. CABIN INSTRUMENTS DISPLAY

NOTE: Meter ground connections should be made where indicated as significant errors may be seen by using the wrong ground point.

Symptom	Check Point	Probable Malfunction
No lights on display unit when power is applied.	Check + 28 volts at P1-1 on the computer unit. (P1-14 is power ground).	Main switch or circuit breaker.
	Check 7.2 volts (display power) at P1-7, 8, 19, or 20. (P1-9, 10, and 21 are display ground).	Computer unit (internal) switching power supply.
	Check wiring to display. (Red wire connected to 7.2 volts, black wire ground).	Display unit.
Display lighted incorrect altitude and/or airspeed indication. (63,400 feet displayed on altitude indicated a missing voltage or open wire).	If only slightly off, check that the transducer assembly heater ground (separate black wire on the connector) is connected to airframe ground.	Transducer Assembly (internal heater circuit).
	Check +28 volts to transducer assembly at cannon plug Pin "A" (Pin "B" is ground). If missing, check wiring continuity from the computer unit. (P1-2 to Pin "A", P1-15 to Pin "B").	Transducer Assembly.

TABLE 3901. CABIN INSTRUMENTS DISPLAY (cont)

Symptom	Check Point	Probable Malfunction
Display lighted incorrect altitude and or airspeed indication. (63,400 feet displayed on altitude indicates a missing voltage or open wire). (cont.)	Check reference voltage at Pin "C" of connector plug. This must be within a few millivolts of 5.500 volts D.C. (Pin "B" ground). If missing or incorrect, check at P1-17 (P1-15 ground). If missing or incorrect at this point the computer unit is faulty.	Transducer Assembly.
	Check the altitude signal at Pin "D" of the connector plug. It should be approx. 1.25 volts at "0" feet and increase with altitude to approx. 2.3 volts at 10,000 feet. (Pin "B" ground). If missing or incorrect, the malfunction is in the transducer assembly. If good at Pin "D" check at P1-3 for wiring continuity.	Computer Unit.
	Check the airspeed at Pin "E" of the connector plug. It should be approx. 4.6 volts at "0" knots and decrease to 1.5 volts at 500 knots. (Pin "B" ground). If missing or incorrect, the malfunction is in the transducer assembly. If good at Pin "E", check at P1-16 for wiring continuity.	Computer Unit.

TABLE 3901. CABIN INSTRUMENTS DISPLAY (cont)

Symptom	Check Point	Probable Malfunction
Display lighted, temperature flashes random numbers on and off.	Indicates an open temperature probe or wire. With P1 disconnected, check resistance between P1-4 and P1-5. Probe should be approx. 3,000 ohms at +25° C. Resistance will increase as temperature decreases and vise-versa (i.e. 6,000 ohms at +10° C and 1,600 ohms at +40° C).	Computer Unit.
Clock keeps incorrect time.	None.	Computer Unit.
Clock resets when power is turned off then on again.	Check internal batteries at P1-18 (pos.) and P1-6 (neg.) for 3.6 volts. If missing or incorrect, check internal batteries for good connections, proper polarity, etc.	Computer Unit.

ANNUNCIATOR PANEL.

GENERAL.

The annunciator panel display presents visual information of various systems equipment functions. The Master Caution Channels present alpha indications of malfunctions of selected priority systems equipment, and the Advisory Channels present alpha information of selected operational systems functions.

ADVISORY CHANNEL IDENTIFICATION

Starters - L/R	External Power	Free Gyros
Prop. Deice - L/R	Outboard Wing Deice	Inboard WInboard Wing Deice

MASTER CAUTION CHANNELS

Alternator Inop. - L/R	Fuel Boost - L/R	Pneu. Inop. - L/R
Inverter Power	Nose/Bag. Door Ajar	Cabin Door - Unsafe
System Voltage	Unpress. Air Source	Cabin Press.
Annun. Power	Door Seal Press. - Lo	

TROUBLESHOOTING.

Refer to Chapter 91 for electrical schematics for annunciator and systems interface and employ conventional troubleshooting techniques.

AVIONICS MASTER SWITCHING.

GENERAL.

Electrical power is provided to the avionics buses in a "fail-safe" configuration. When the Avionics Master Switch is placed to the position labeled "ON" the switch is electrically "OFF" (open), and when placed to the position labeled "OFF" the switch is electrically "ON" (closed). Reference Chapter 91 for schematics.

The avionics contactor provides power to Avionics Bus #1, from the Left Distribution Bus, and to Avionics Bus #2 from the Right Distribution Bus, when the contactor is in the disengaged (non-powered) position. The Avionics Master Switch in the "OFF" position applies power to the Master Contactor, thereby shutting down the avionics system.

TROUBLESHOOTING.

Employ conventional electrical system troubleshooting methods utilizing schematics in Chapter 91.

ELECTRICAL SWITCHES AND CIRCUIT BREAKERS.

REMOVAL OF OVERHEAD ROCKER SWITCHES.

1. Make sure Battery Master Switch is in "OFF" position.
2. Remove electro-luminescent panel attachment screws.
3. Pull electro-luminescent (E.L.) panel away from the Royalite trim panel. The switch mounting clip can be reached from the rear of the E.L. panel.
4. Insert a thin blade screwdriver between the clip and the switch body, and alternating between the top and bottom, remove clip from switch body to release switch from rear of E.L. panel.
5. Identify the electrical wires as they are unsoldered to aid in rewiring new switch.
6. Discard switch and mounting clip.

INSTALLATION OF OVERHEAD ROCKER SWITCHES.

1. Solder the previously identified electrical wiring to the new switch.
2. Push new switch through the E.L. panel mounting cutout from the rear.
3. Place new mounting clip through front of E.L. panel mounting cutout to engage new switch assembly.
4. Carefully engage mounting clip to switch body, using thin blade screwdriver if necessary, alternating between top and bottom of switch.

— *NOTE* —

The mounting clip has two positions built into it for positioning. Be sure upper and lower prongs are in the same position on the switch body.

5. Install the E.L. panel into position on the Royalite panel, and secure with previously removed attachment screws.
6. Check the operation of the replacement switch under load to verify integrity of installation.

DESCRIPTION OF CIRCUIT BREAKER PANELS.

Six circuit breaker panels are installed in the cockpit. The left hand, pilots side, groups the Ice Bus, Left Main, and Non-Essential Bus, circuit breaker panels along the left side wall. The right side wall, co-pilots side, groups the Right Main Bus, Avionics #1 Bus, and Avionics #2 Bus circuit breakers. The Main Battery Bus circuit breakers are installed under the cockpit floor and are accessed through the floor plate cover. The circuit breakers are manual "Pull-Off" "Push-to-Reset" type breakers. The circuit breaker panels are electro-luminescent and each breaker function is readily identified by name.

REPLACEMENT OF CIRCUIT BREAKERS.

Should a circuit breaker be replaced or added, exercise extreme caution ensuring the breakers are mechanically in proper alignment, any insulators that are called out are installed correctly, and all electrical wiring and connections meet aviation standards. Do not deviate from the Parts Manual requirements when replacing circuit breakers.

DESCRIPTION OF ENGINE STARTER SWITCHES.

The push-button (ALCO) starter switch is a modular design. The electrical contacts of this switch are packaged in a switch contact module, several of which can be added to, or removed from, the main switch assembly via attached mounting clips. Refer to Figure 39-4 and Chapter 91 - Electrical Schematics.

REMOVAL OF MODULAR STARTER SWITCH.

1. Make sure Battery Master Switch is in "OFF" position and "Pull-Off" left main right main bus "Start Control" circuit breakers.
2. Remove electro-luminescent (E.L.) panel attachment screws.
3. Pull E.L. panel away from the Royalite trim panel exposing the rear electrical connections to the starter switches.
4. Unscrew and remove convex knurled mounting ring from the front of the starter switch and also remove the spacer behind it.
5. Slide complete switch unit out of E.L. panel cutout from the rear of the panel.
6. Label and disconnect each wire from the offending switch contact module. Using a thin bladed screwdriver, carefully pry the module mounting clips open to release the contact module and discard the failed switch contact module.

INSTALLATION OF ENGINE STARTER SWITCH.

1. Snap replacement switch contact module into position making sure both clips are secure. Actuate push-button several times to ensure mechanical interface functions properly.
2. Reconnect wiring previously labeled and reinstall switch assembly in E.L. panel from the rear of the panel.
3. Align and install spacer and convex mounting ring on switch shaft from front of panel and tighten. Ring may "bottom" on shaft.

— *NOTE* —

To adjust for panel thickness two slot head rear panel mount screws are available at rear panel portion of switch. Alternately tighten these two screws to ensure uniform pressure occurs.

— *CAUTION*—

DO NOT OVERTIGHTEN REAR ADJUSTMENT SCREWS TO PREVENT DAMAGE TO THE E.L. PANEL.

4. Reinstall E.L. panel into position on Royalite panel using previously removed attachment screws.
5. Test replacement switch contacts for proper operation.

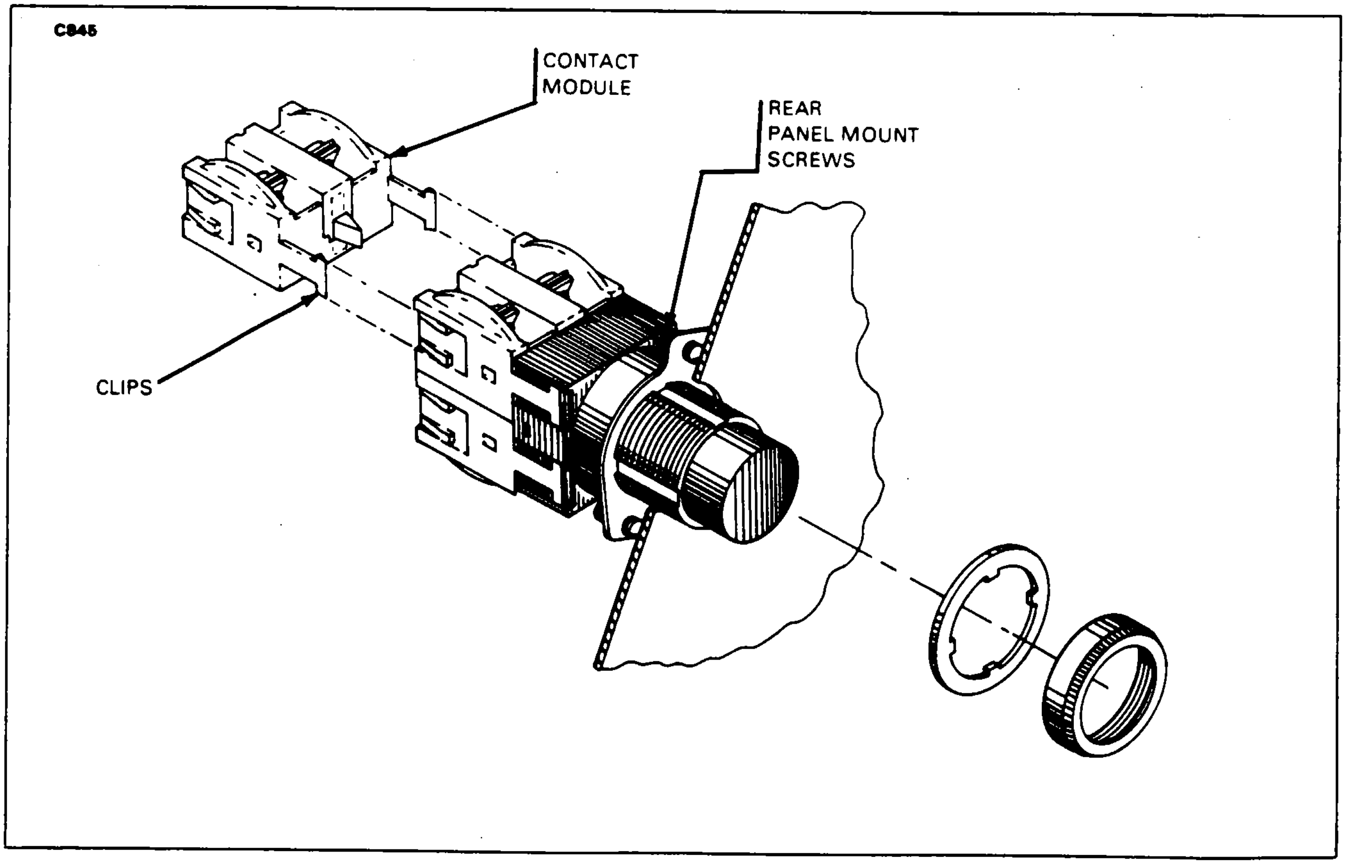
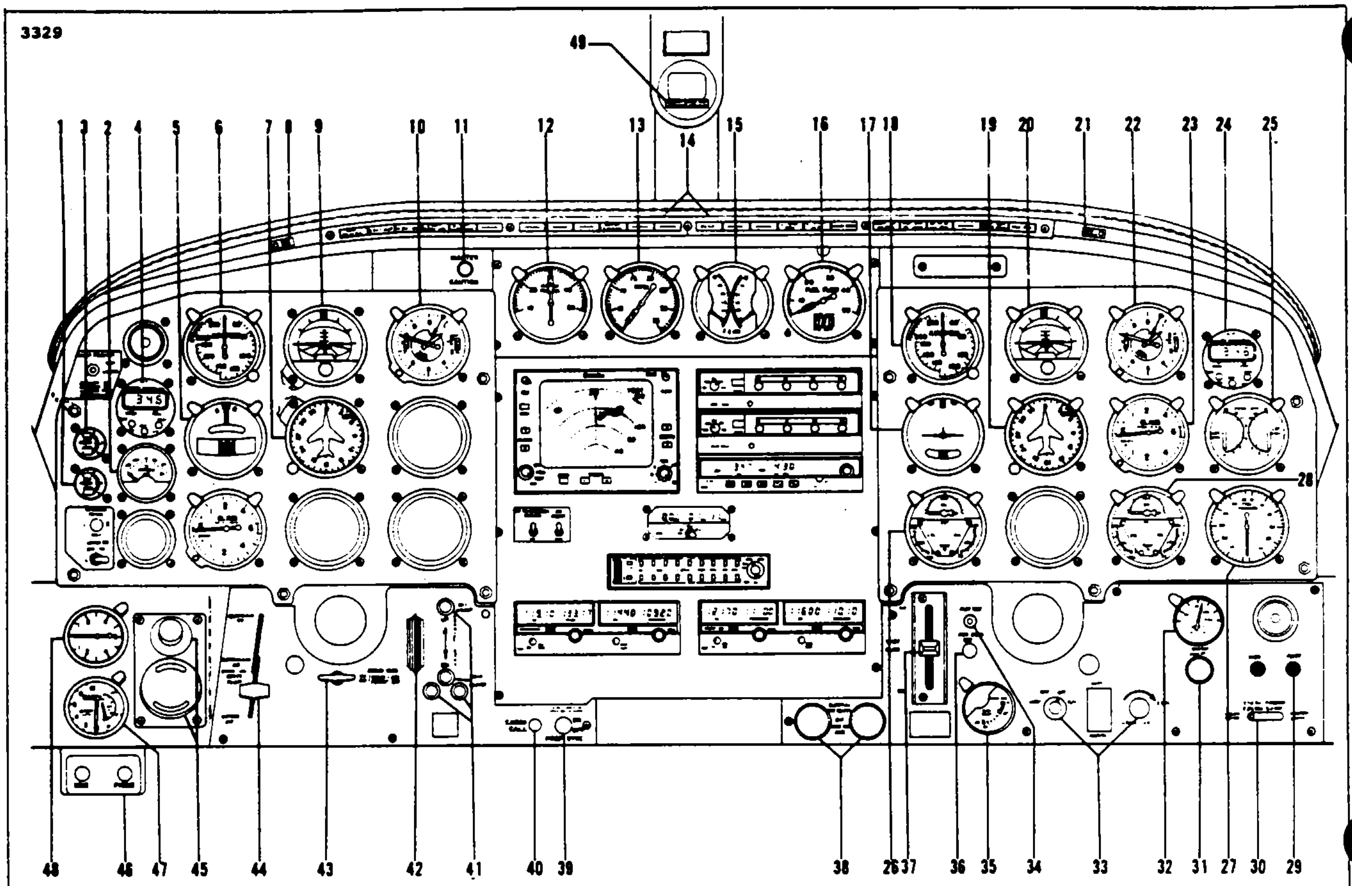
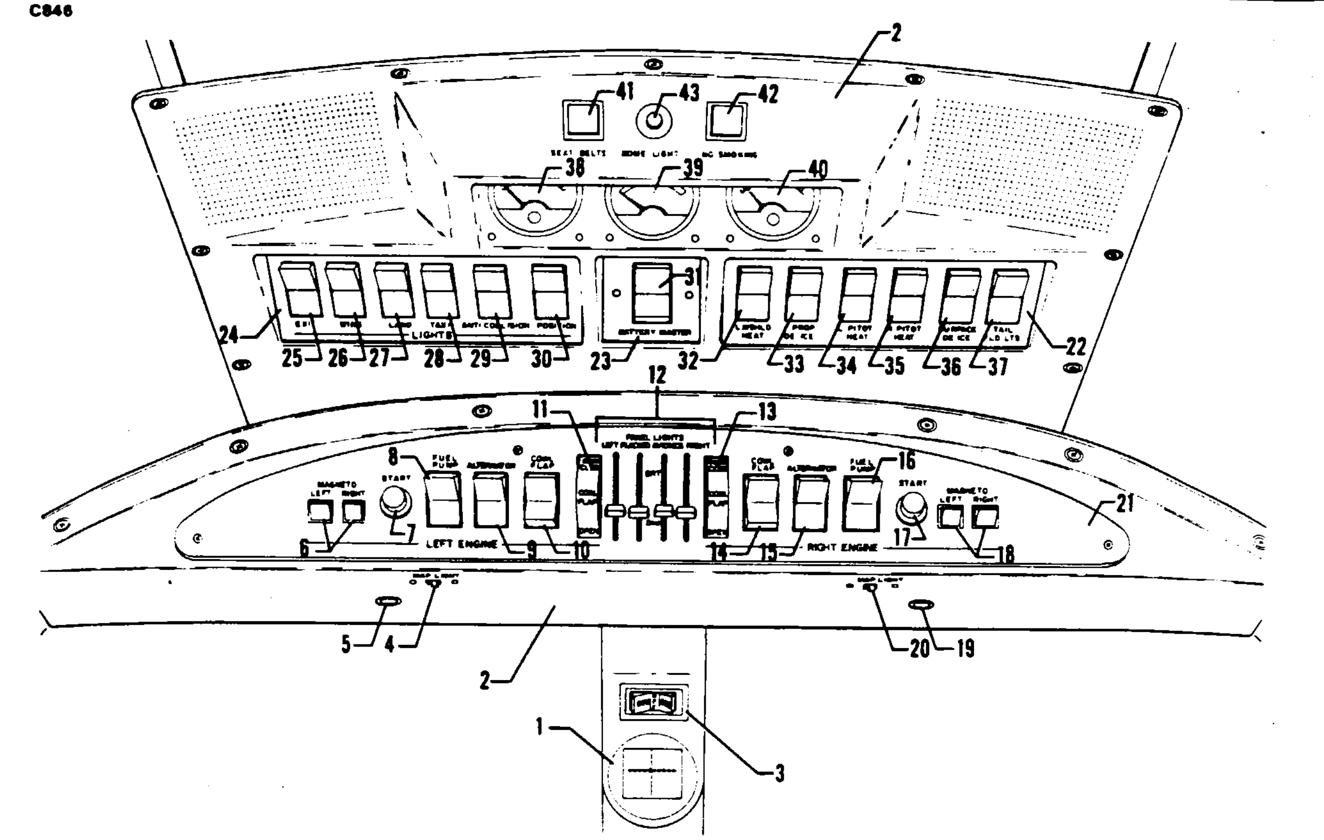


Figure 39-4. Starter Switch



1. PNEUMATIC PRESS. INDICATOR
2. OUTSIDE AIR TEMPERATURE
3. GYRO PRESS INDICATOR
4. CLOCK
5. TURN & BANK
6. AIRSPEED INDICATOR
7. DIRECTIONAL GYRO
8. ANNUNCIATOR TEST SWITCH
9. ATTITUDE GYRO
10. ALTIMETER
11. MASTER CAUTION INDICATOR
12. MANIFOLD PRESSURE - L/R
13. TACHOMETER - L/R
14. ANNUNCIATOR PANEL
15. EXHAUST GAS TEMPERATURE - L/R
16. FUEL FLOW - L/R
17. PICTORIAL RATE GYRO
18. AIRSPEED INDICATOR
19. DIRECTIONAL GYRO
20. ATTITUDE GYRO
21. ANNUNCIATOR - DIMMER SWITCH
22. ALTIMETER
23. RATE OF CLIMB
24. CLOCK
25. FUEL QUANTITY
26. OIL TEMP/OIL PRESS./CYL. HD. TEMP - LEFT
27. FUEL PRESSURE
28. OIL TEMPERATURE/OIL PRESS./CYL. HD. TEMP - RIGHT
29. MIKE/EARPHONE JACKS
30. ALTERNATE STATIC SOURCE
31. OXYGEN CONTROL KNOB
32. OXYGEN PRESS
33. CABIN TEMP. CONTROLS
34. WING FLAP TEST SWITCH
35. WING FLAP POSITION INDICATOR
36. PROP DEICE TEST SWITCH
37. WING FLAP CONTROL
38. MANUAL ALTERNATE AIR
39. PROP SYNC. SWITCH
40. CABIN CALL - CHIMES
41. LANDING GEAR IND. LIGHTS
42. LANDING GEAR SELECTOR
43. PARKING BRAKE
44. AIR CONTROL LEVER
45. CABIN PRESSURIZATION CONTROLS
46. MIKE/EARPHONE JACKS
47. CABIN ALTITUDE
48. CABIN RATE OF CHANGE
49. MAGNETIC COMPASS

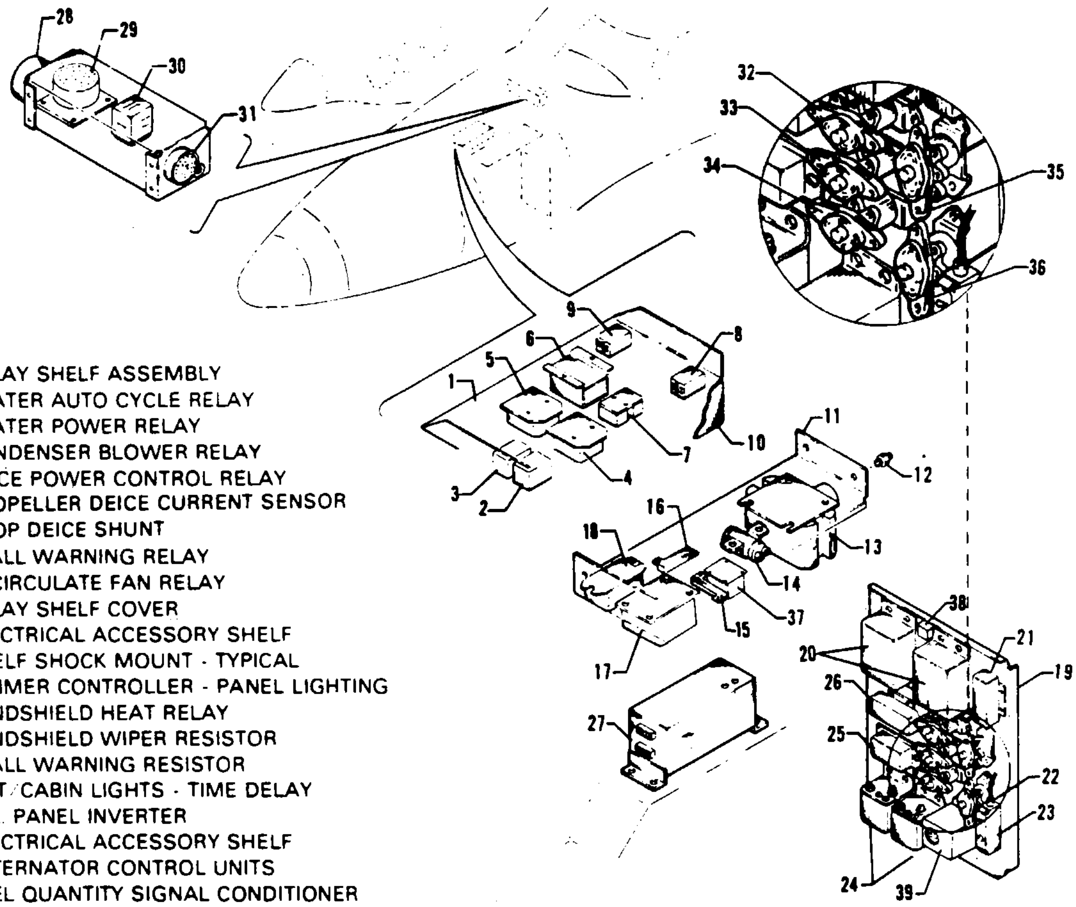
Figure 39-5. Description of Instrument Panel (TYPICAL)



1. MAGNETIC COMPASS
2. ROYALITE COVER PANEL
3. FIXED DIMMING SELECTOR SWITCH
4. PILOTS MAP LIGHT SWITCH
5. PILOTS MAP LIGHT
6. LEFT/RIGHT MAG. SWITCHES - LFT. ENG.
7. STARTER SWITCH - LFT. ENG.
8. FUEL PUMP SWITCH - LFT. ENG.
9. ALTERNATOR SWITCH - LFT. ENG.
10. COWL FLAP SWITCH - LFT. ENG.
11. COWL FLAP INDICATOR - LFT. ENG.
12. E.L. PANEL LIGHTING DIMMER CONTROLS (A.C.)
13. COWL FLAP INDICATOR - RT. ENG.
14. COWL FLAP SWITCH - RT. ENG.
15. ALTERNATOR SWITCH - RT. ENG.
16. FUEL PUMP SWITCH - RT. ENG.
17. STARTER SWITCH - RT. ENG.
18. LEFT/RIGHT MAG. SWITCHES - RT. ENG.
19. COPILOT MAP LIGHT SWITCH
20. COPILOT MAP LIGHT
21. ELECTROLUMINESCENT (E.L.) PANEL
22. ELECTROLUMINESCENT (E.L.) PANEL
23. ELECTROLUMINESCENT (E.L.) PANEL
24. ELECTROLUMINESCENT (E.L.) PANEL
25. EXIT LIGHTING SWITCH
26. WING INSPECTION LIGHT SWITCH
27. LANDING LIGHTS SWITCH
28. TAXI LIGHT SWITCH
29. ANTI-COLLISION LIGHTING SWITCH
30. POSITION LIGHTS SWITCH
31. BATTERY MASTER SWITCH
32. LEFT WINDSHIELD HEAT SWITCH
33. PROPELLER DEICE SWITCH
34. LEFT PITOT HEAT SWITCH
35. RIGHT PITOT HEAT SWITCH
36. SURFACE DEICE SWITCH
37. TAIL FLOOD (LOGO) LIGHTS SWITCH
38. AMMETER - LEFT ELECTRICAL SYSTEM
39. VOLTMETER - ELECTRICAL SYSTEM
40. AMMETER - RIGHT ELECTRICAL SYSTEM
41. FASTEN SEAT BELTS SIGN - SWITCH
42. NO SMOKING SIGN - SWITCH
43. DOME LIGHT SWITCH

Figure 39-6. Description Overhead Panels (TYPICAL)

3330



1. RELAY SHELF ASSEMBLY
2. HEATER AUTO CYCLE RELAY
3. HEATER POWER RELAY
4. CONDENSER BLOWER RELAY
5. DEICE POWER CONTROL RELAY
6. PROPELLER DEICE CURRENT SENSOR
7. PROP DEICE SHUNT
8. STALL WARNING RELAY
9. RECIRCULATE FAN RELAY
10. RELAY SHELF COVER
11. ELECTRICAL ACCESSORY SHELF
12. SHELF SHOCK MOUNT - TYPICAL
13. DIMMER CONTROLLER - PANEL LIGHTING
14. WINDSHIELD HEAT RELAY
15. WINDSHIELD WIPER RESISTOR
16. STALL WARNING RESISTOR
17. EXIT/CABIN LIGHTS - TIME DELAY
18. E. L. PANEL INVERTER
19. ELECTRICAL ACCESSORY SHELF
20. ALTERNATOR CONTROL UNITS
21. FUEL QUANTITY SIGNAL CONDITIONER
22. DIODE - IN29848
23. VOLTAGE CLAMPER ASSEMBLY (COWL FLAP)
24. STARTER VIBRATOR - LEFT & RIGHT
25. WINDSHIELD HEAT TIMER
26. FUEL QUANTITY SIGNAL CONDITIONER
27. ANNUNCIATOR CONTROLLER ASSEMBLY
28. LANDING GEAR WARNING HORN
29. STALL WARNING HORN
30. LANDING GEAR WARNING RELAY
31. ANNUNCIATOR MASTER CAUTION WARNING
32. TAXI LIGHT SOLENOID
33. LANDING LIGHT SOLENOID
34. HEATED WINDSHIELD SOLENOID
35. LANDING GEAR SOLENOID
36. RECOGNITION LIGHT SOLENOID
37. SURFACE DEICE
38. LOW VOLTAGE MONITOR
39. PROP DEICE

Figure 39-7. Description of Electrical Panels (TYPICAL)

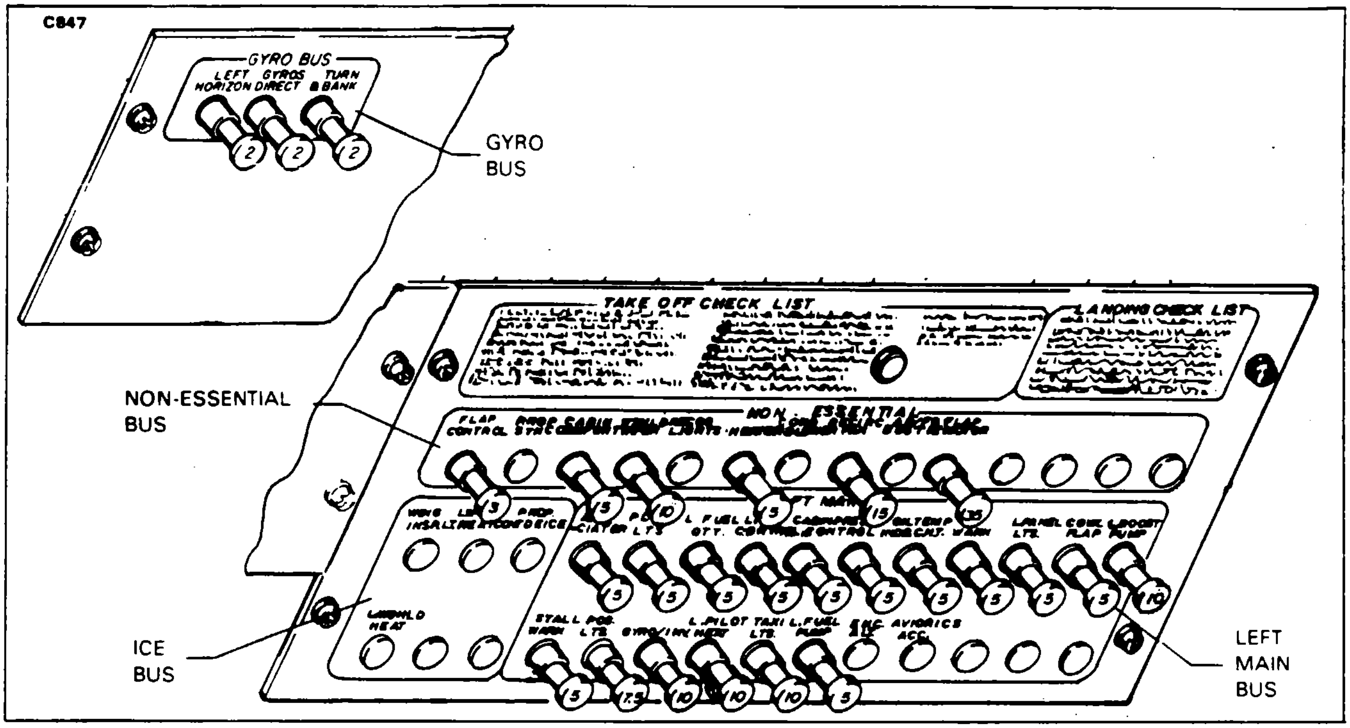


Figure 39-8. Left Side Circuit Breaker Panel

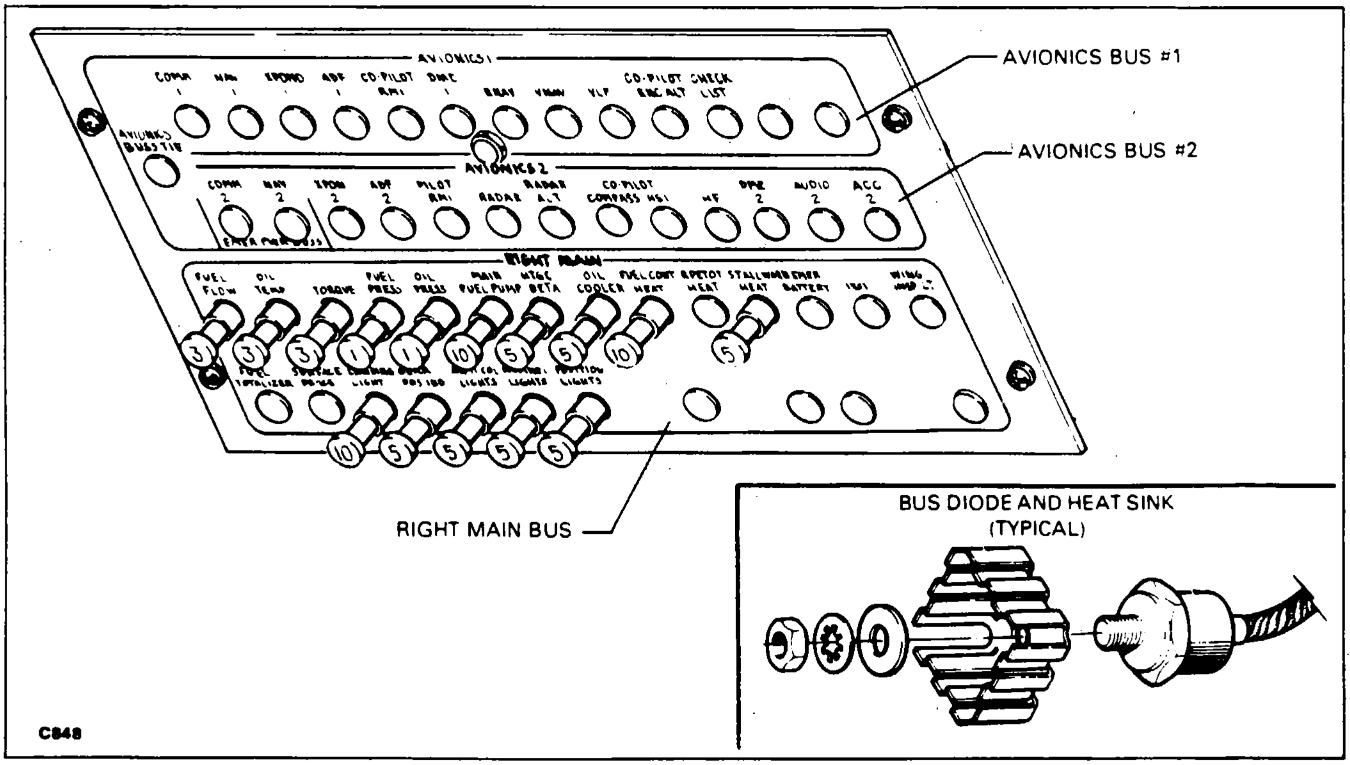


Figure 39-9. Right Side Circuit Breaker Panel

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CHAPTER

51

STRUCTURES

CHAPTER 51 - STRUCTURES

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

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 —

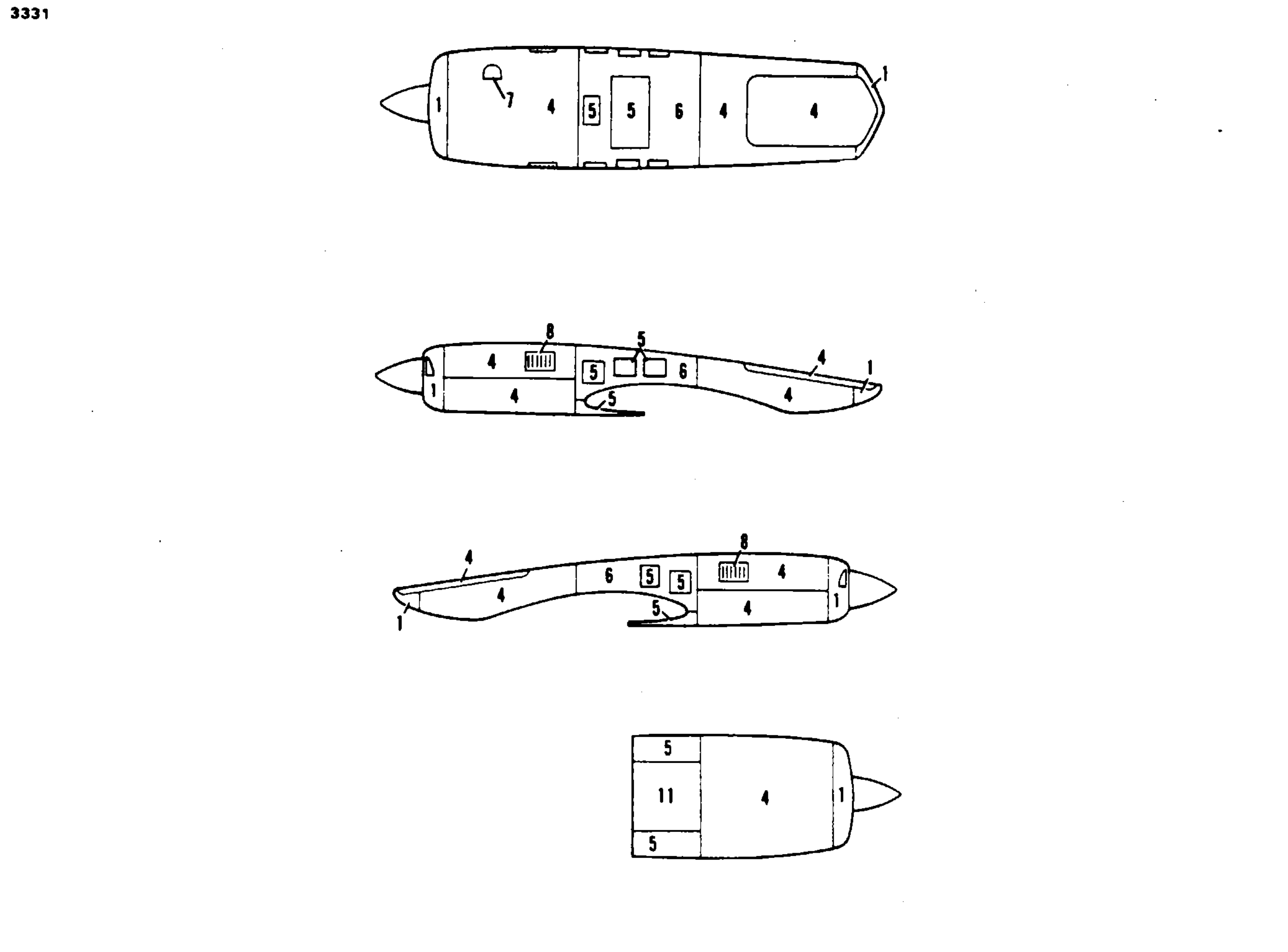
Any time service is accomplished on the elevator control system, a friction check must be made to insure that the system friction is within limits.

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.) In pressurized areas all skins, formers, stringers, etc., are considered structural members and should be treated as such. All repair material must be free of any defects such as nicks, scratches, etc., which can cause stress risers. Do not dimple a structural member by driving the rivet head into the part.

Scratches in acrylic plastic windows may be removed by buffing, providing not more than .031 of an inch of material is removed. No crazing or cracks are permitted in the pressure windows.

DESCRIPTION.

The PA-31P-350 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 door is 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.



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	2024-T3	.081

NOTE
LEFT WING SHOWN. RIGHT OPPOSITE AND NOTED MATERIAL OUTLINED IN DOTS USED ON RIGHT WING ONLY. CIRCLED MATERIAL NUMBERS INDICATE LEFT WING ONLY.
*HEAT TREAT TO 2024-T4 AFTER FORMING.

Figure 51-1. Skin Thickness

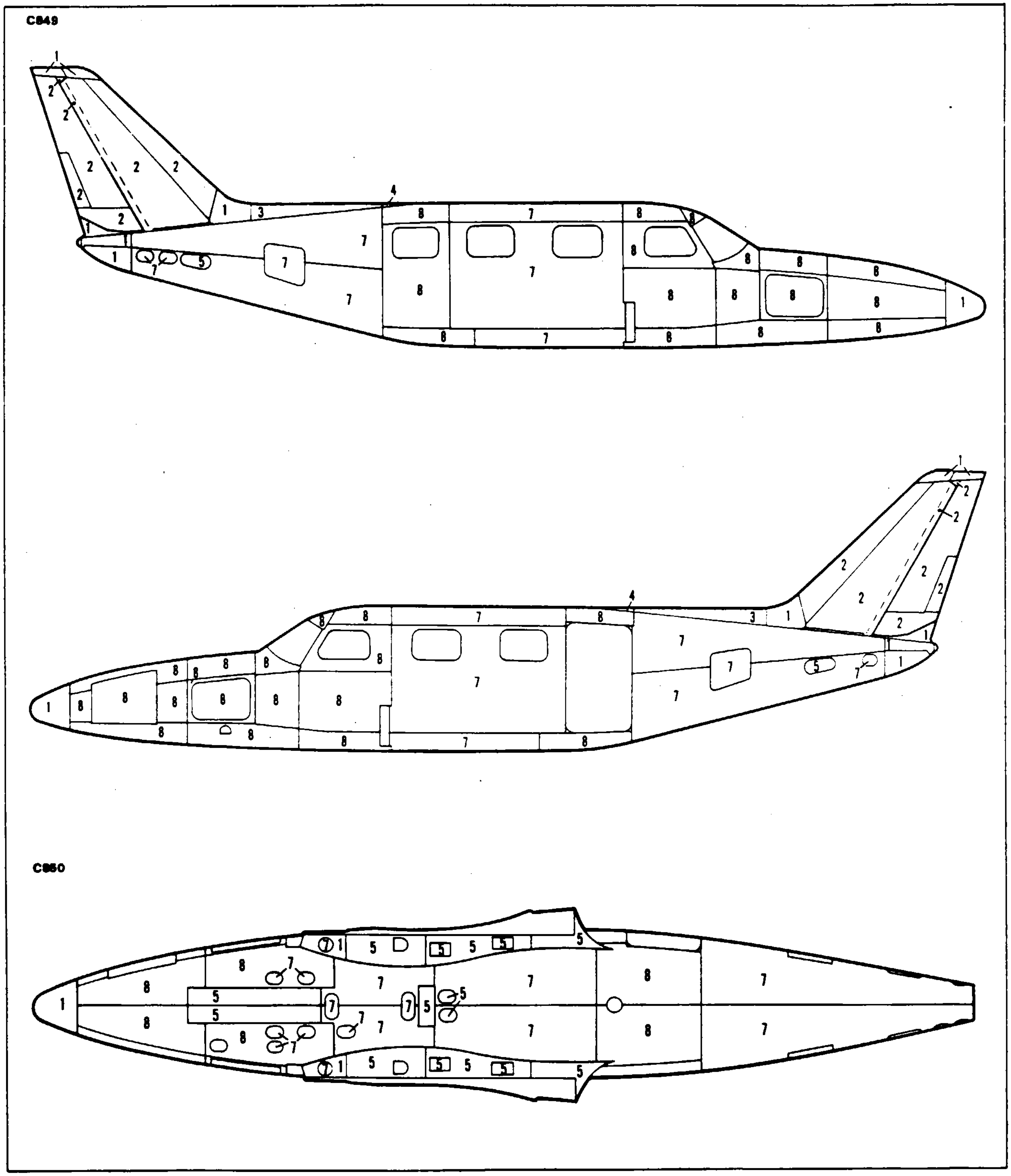


Figure 51-1. Skin Thickness (cont)

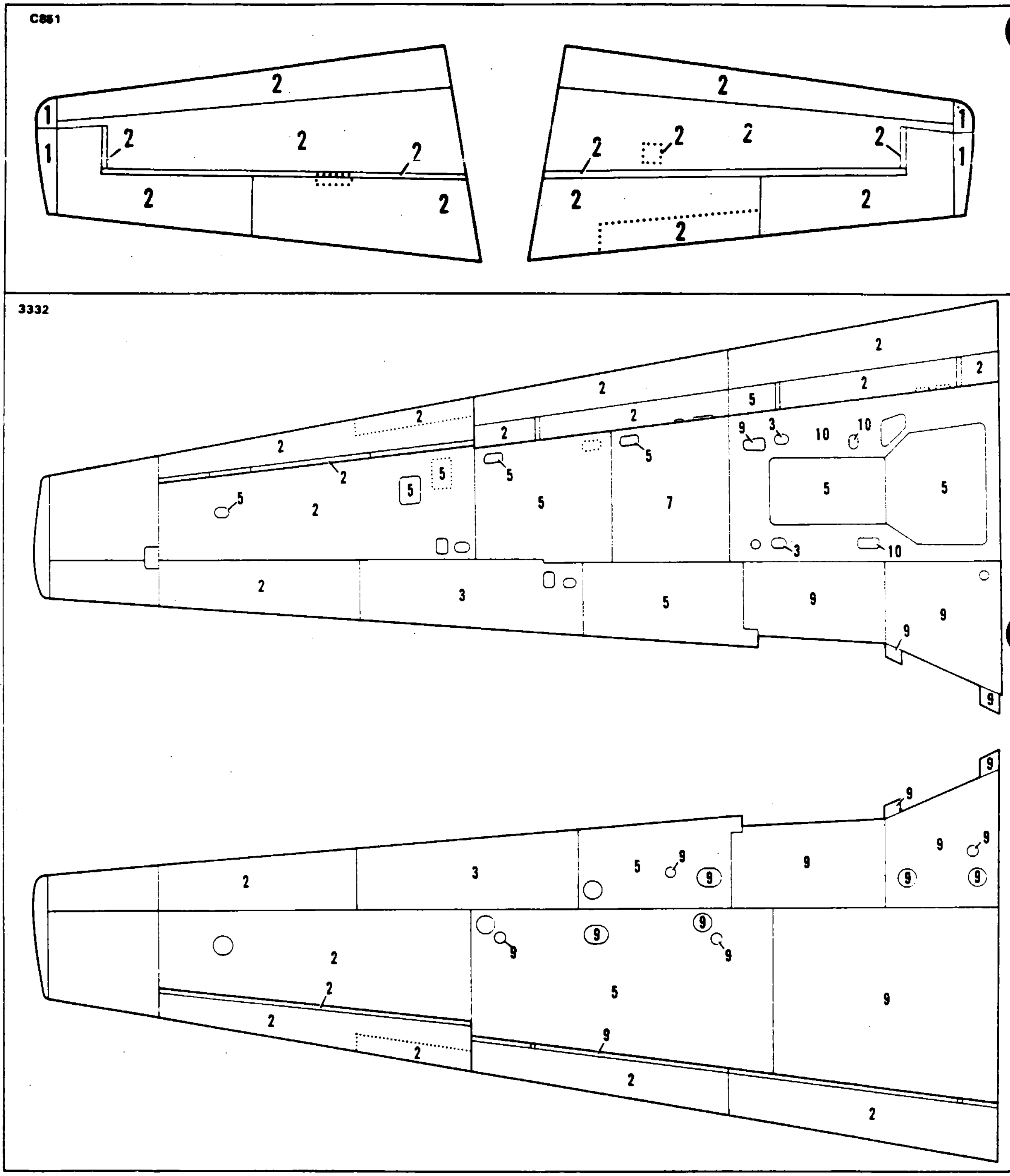


Figure 51-1. Skin Thickness (cont)

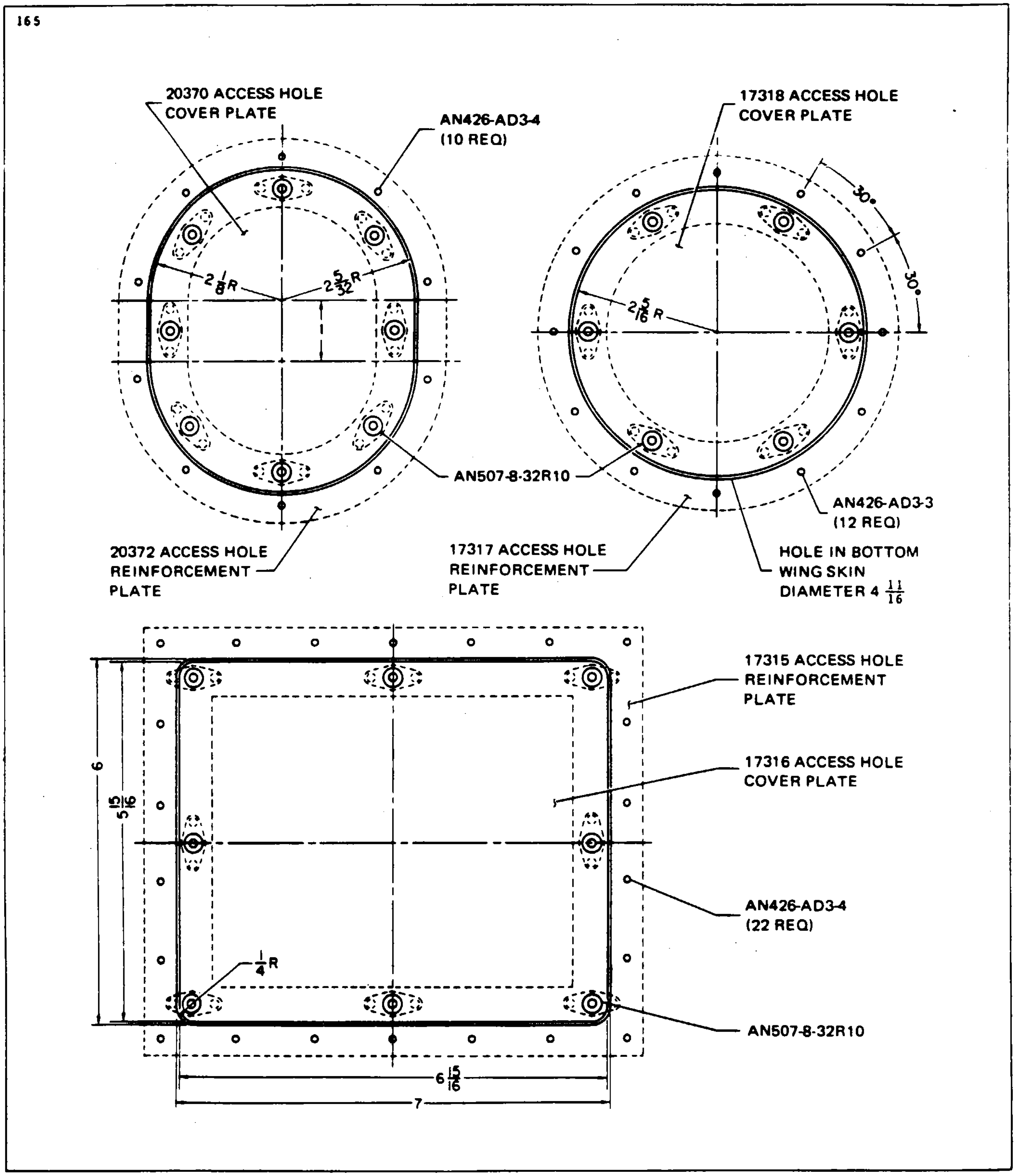


Figure 51-2. Typical Access Plates and Panels

REPAIRS.

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 occured 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 a 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

CHART 5101. LIST OF MATERIALS (THERMOPLASTIC REPAIRS) (cont)

ITEMS	DESCRIPTIONS	SUPPLIERS
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°	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.

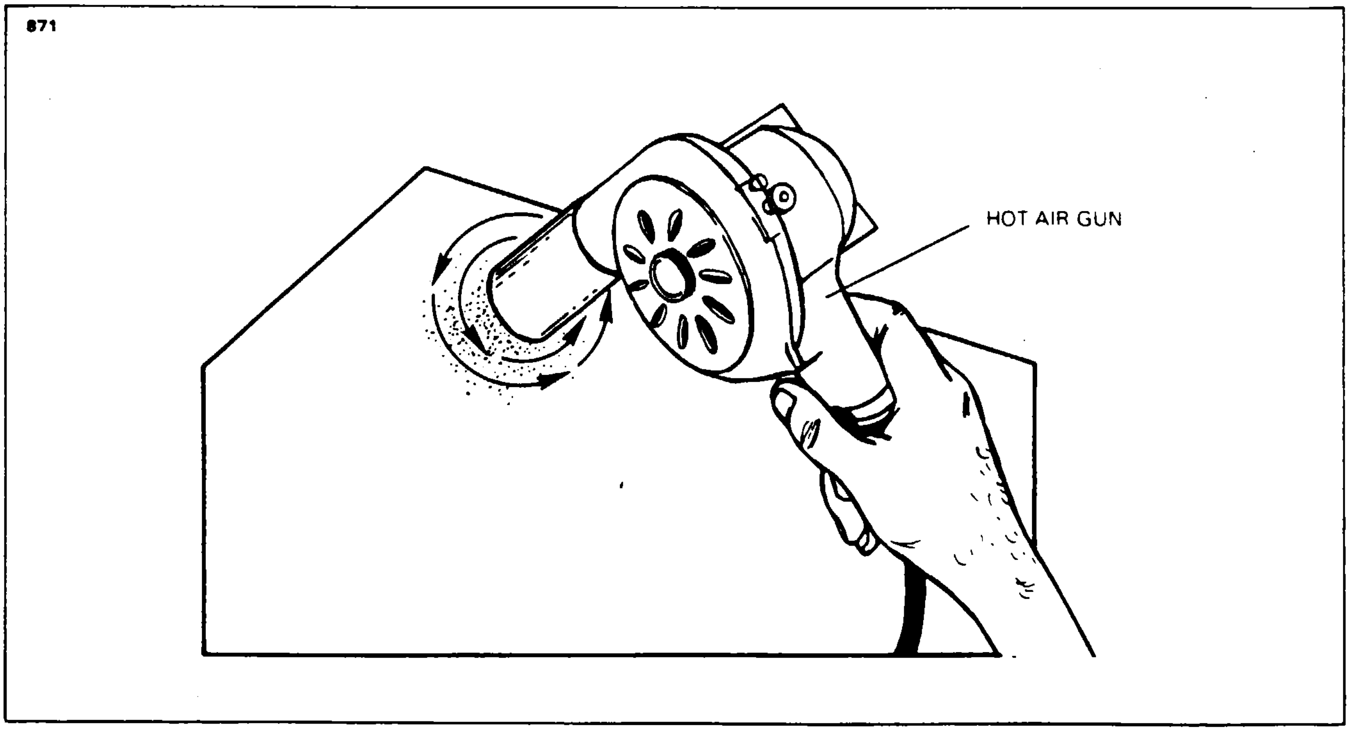


Figure 51-3. Surface Scratches, Abrasions or Ground-in-Dirt

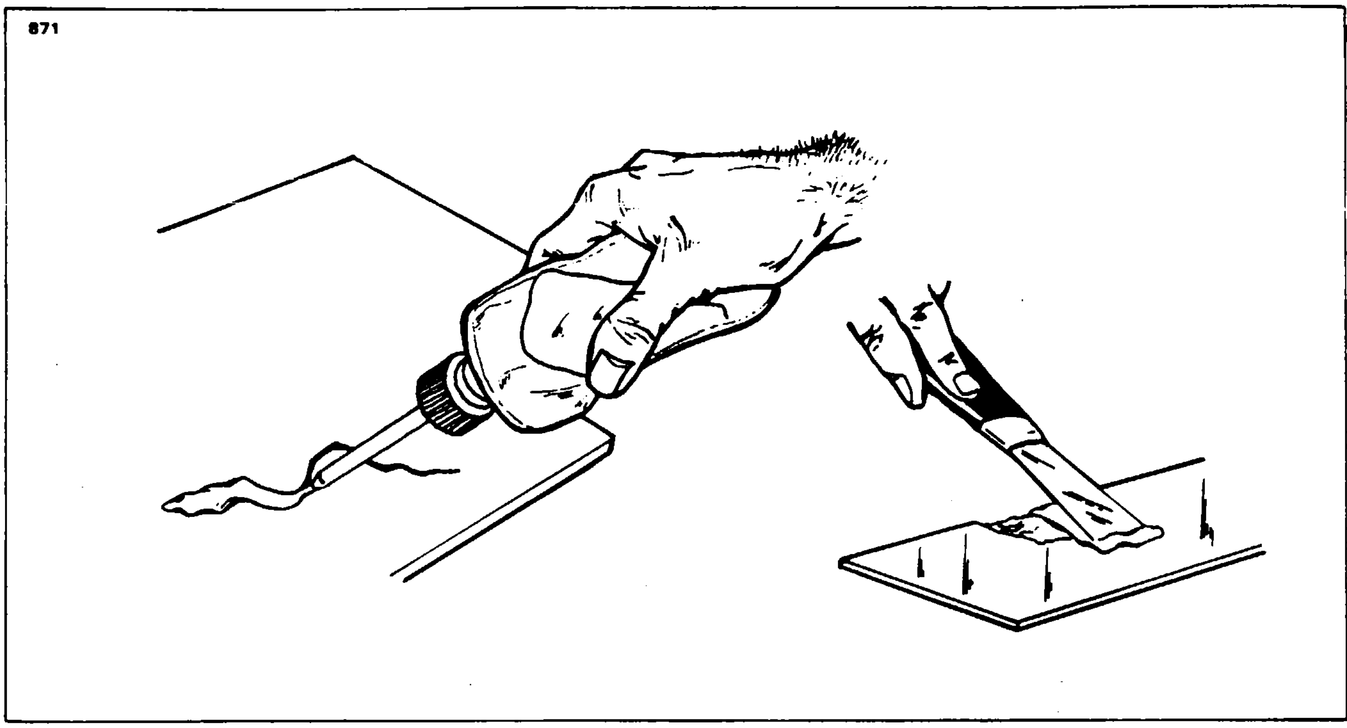


Figure 51-4. Deep Scratches. Shallow Nicks and Small Holes

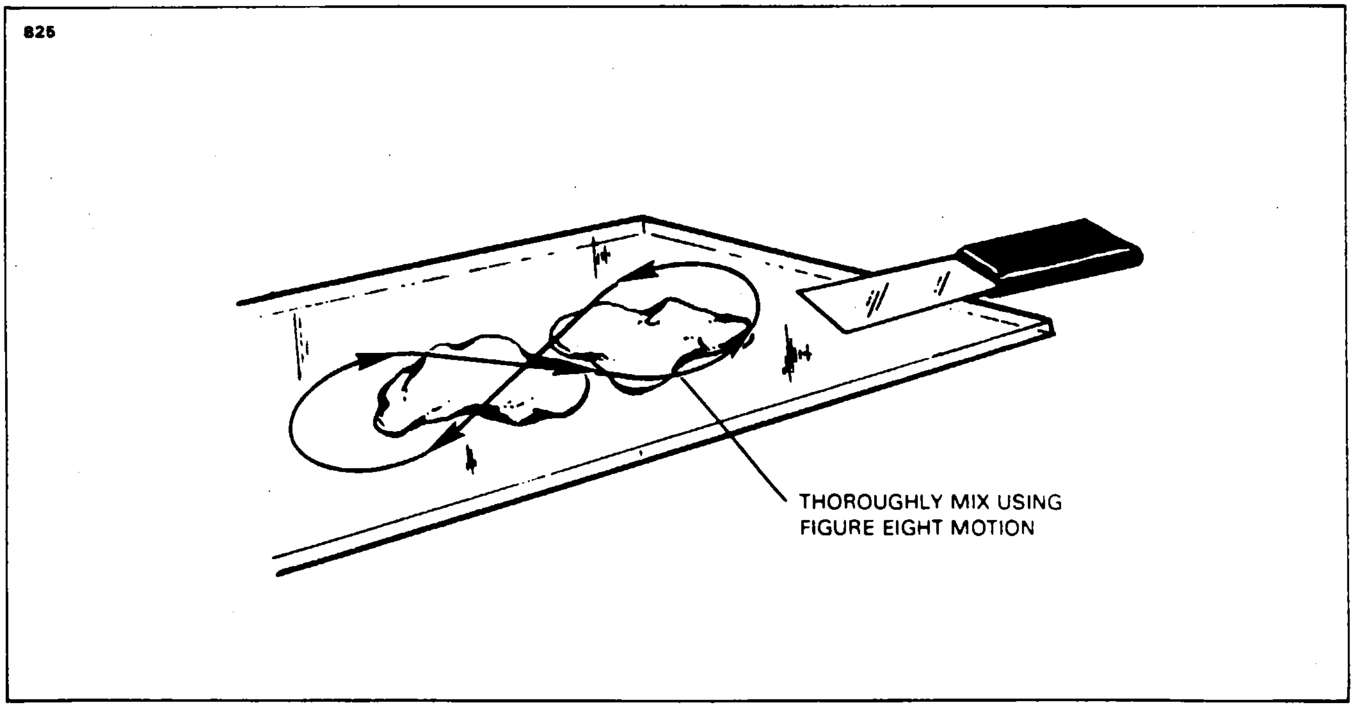


Figure 51-5. Mixing of Epoxy Patching Compound

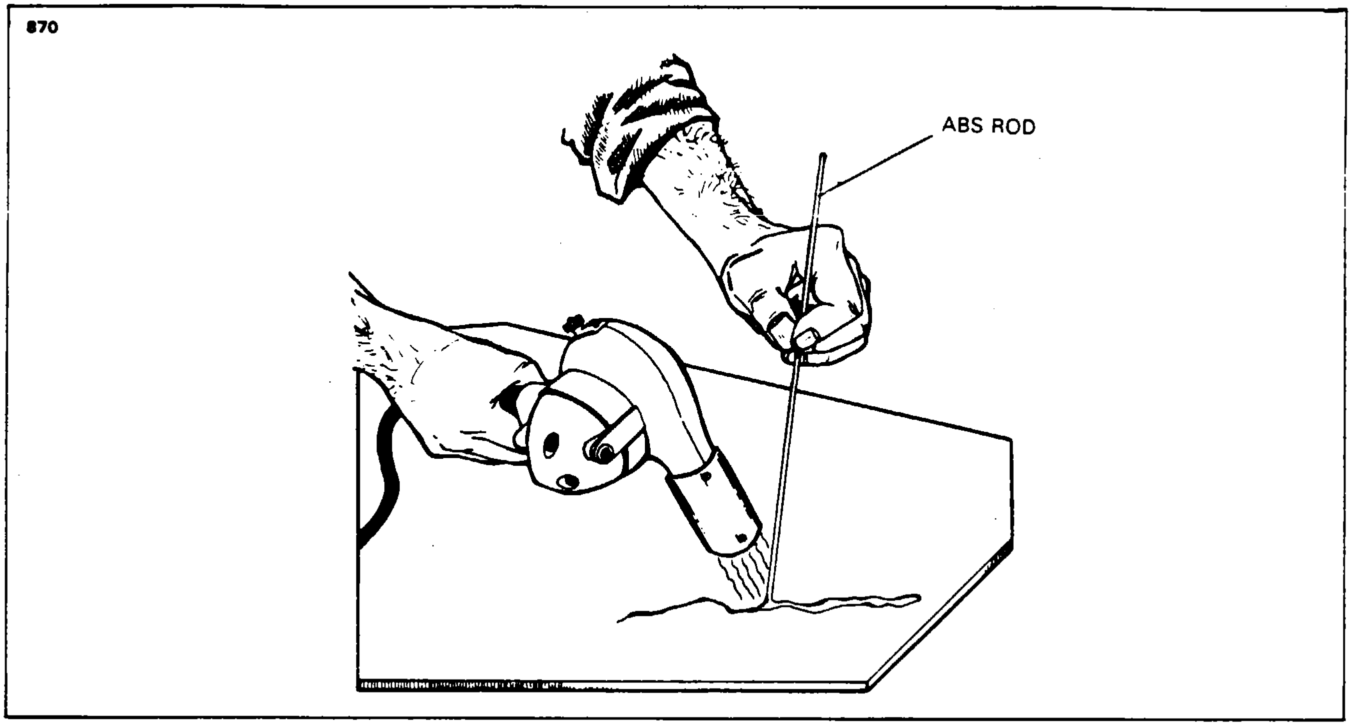


Figure 51-6. Welding Repair Method

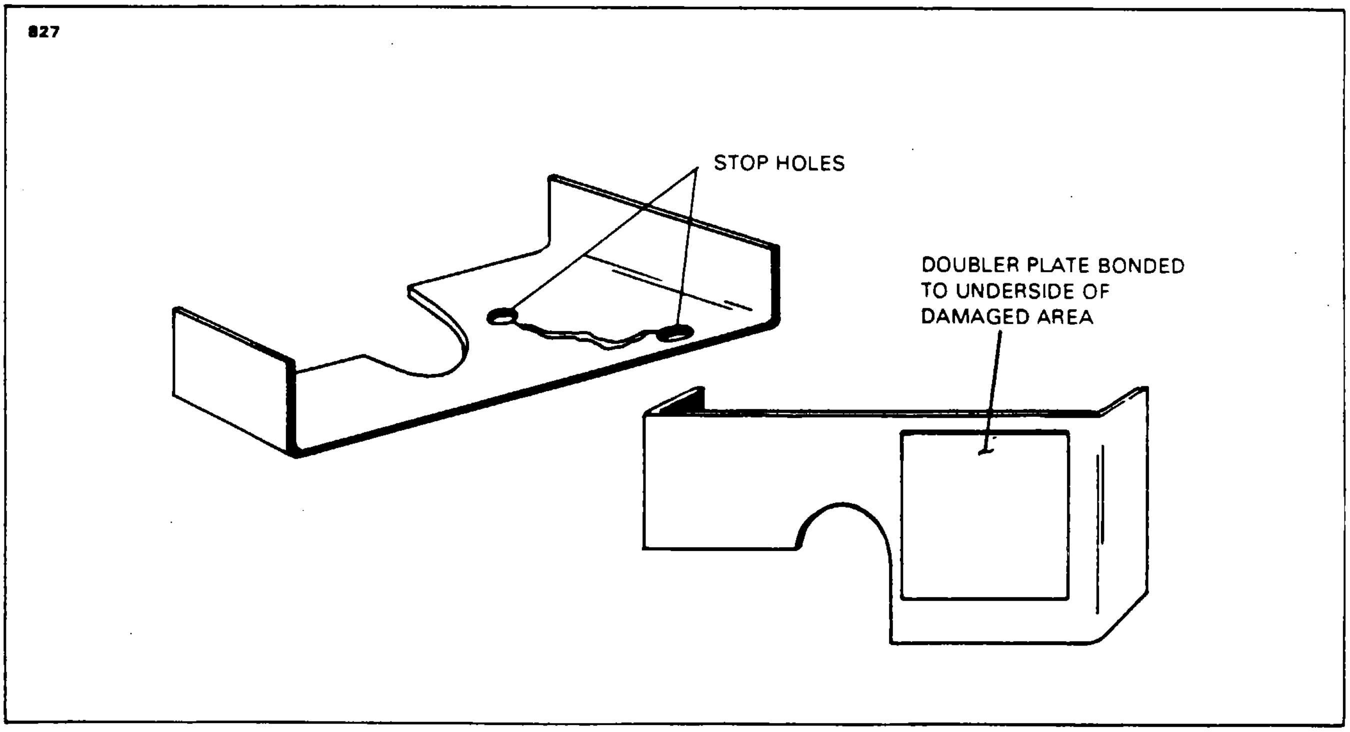


Figure 51-7. Repairing of Cracks

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 1/4 of an inch away from the surface and apply heat with a circular motion until the area is sufficiently soft to remove the dirt particles.
   C. The thermoplastic will return to its original shape upon cooling.
3. Deep Scratches, Shallow Nicks and Small Holes: (Less than 1 inch in diameter.) (Refer to Figure 51-4.)
   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 1/4 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 Naphtha 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 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 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 1/2 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.

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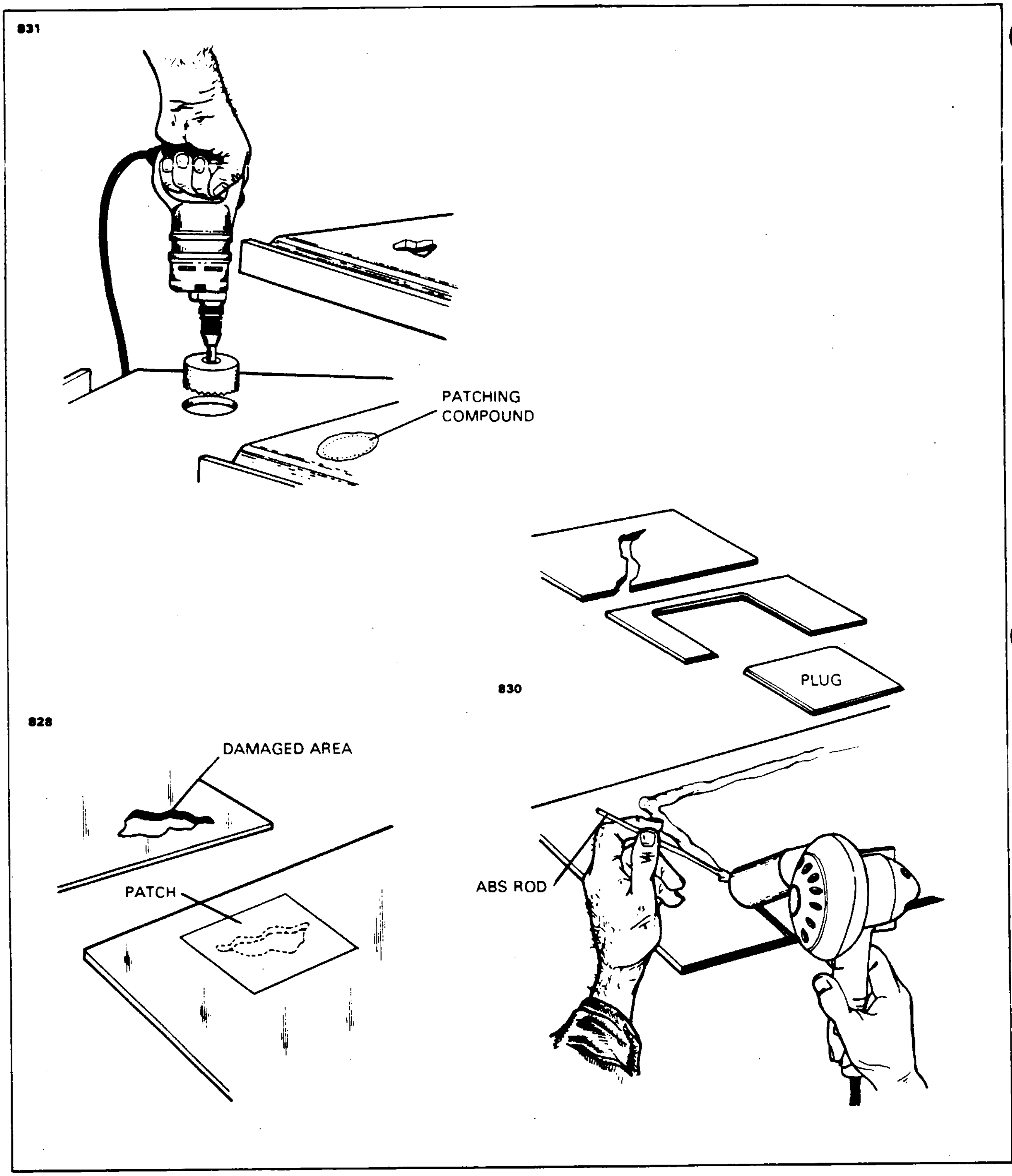

Figure 51-8. Various Repairs

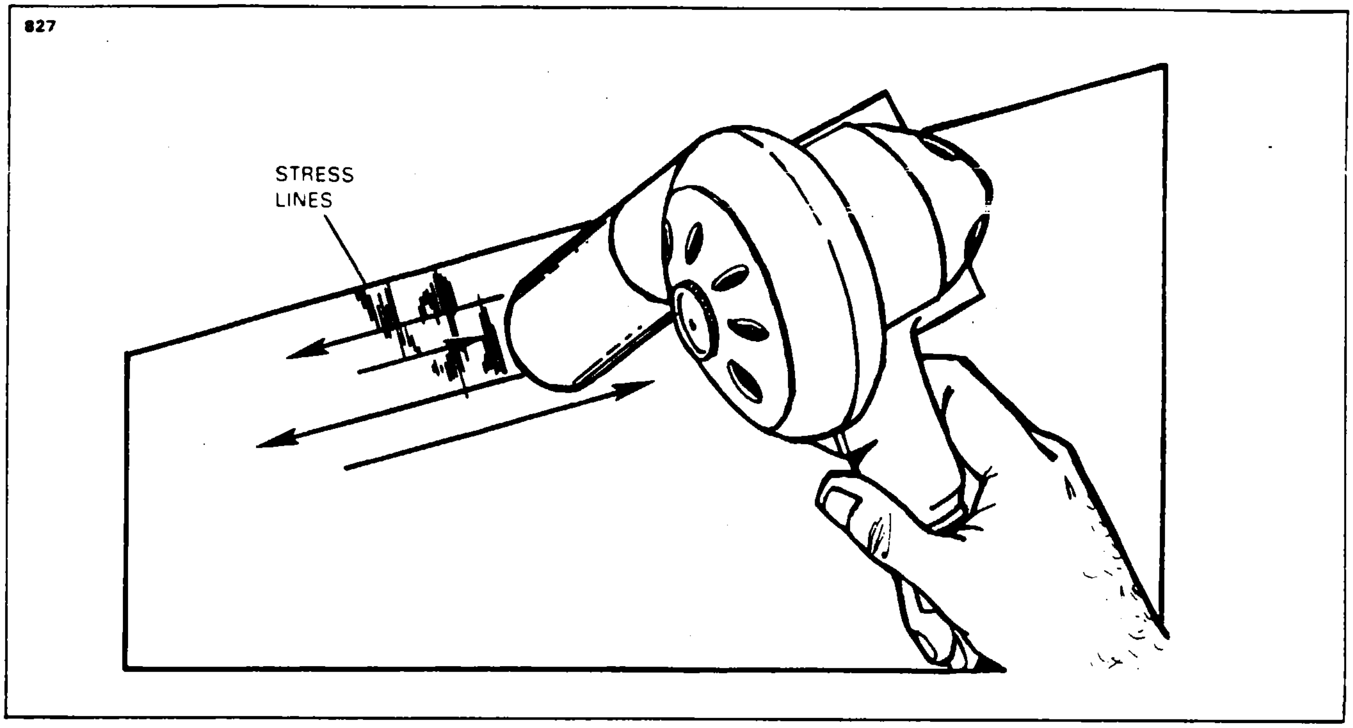

Figure 51-9. Repair of Stress Lines

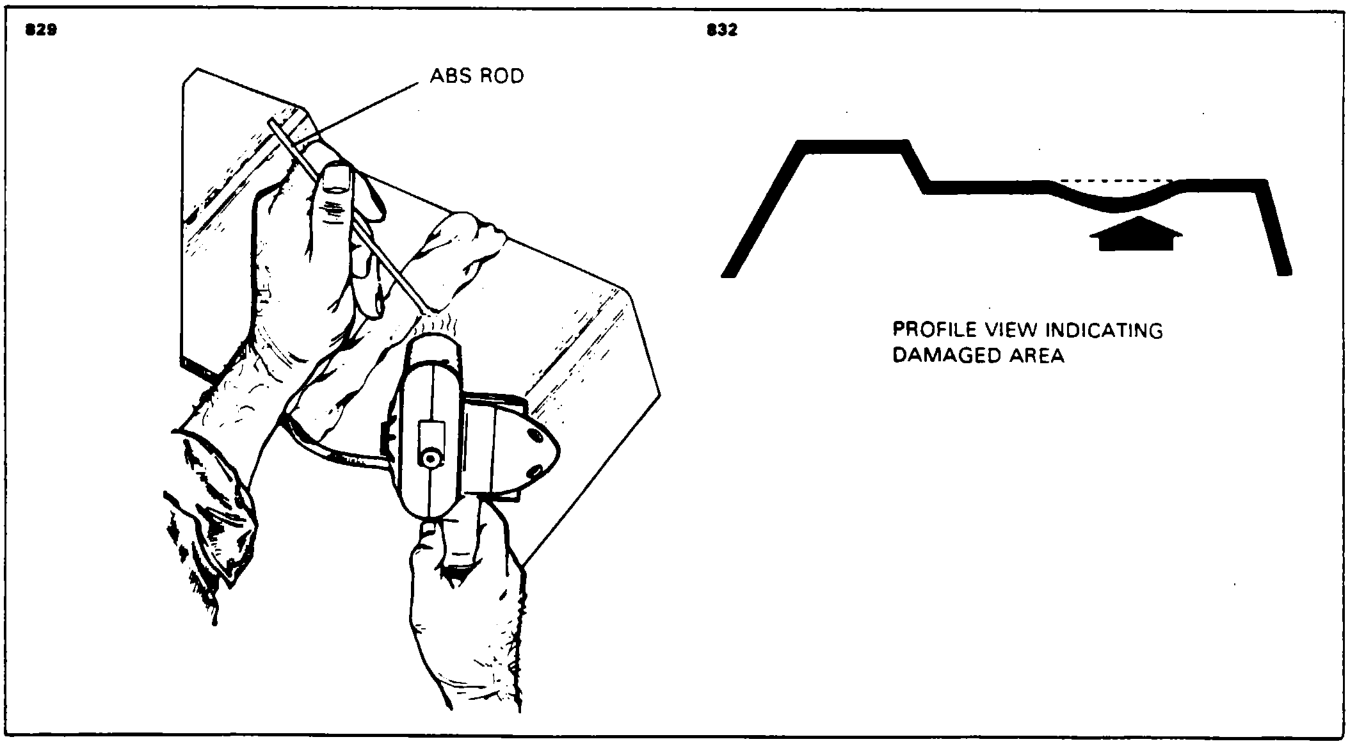

Figure 51-10. Repair of Impacted Damage

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.

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.

FORMS 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 stuctural 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 occurance 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 corrision 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 5102. 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 heads, 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.

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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.
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. Spotwelded 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.

SEALING PROCEDURES.

FUSELAGE SEALING. (Refer to Figures 51-11 and 51-12.)

Special sealing compounds have been used to seal sections of the aircraft against leakage of pressurized air. This sealing is done during the course of construction. Any air leakage throughout the pressurized fuselage can normally be detected when carrying out the fuselage pressure check given in Chapter 21.

SURFACE PREPARATION.

All parts which must be sealed should be thoroughly cleaned. Methlethylketone (MEK) or Aliphatic Naphtha are recommended cleaning agents.

— NOTE —

Aliphatic Naphtha is preferable since it will not damage painted surfaces or acrylic plastic (Plexiglas) windows.

1. All parts, sub-assemblies, and assemblies to be sealed should be alodined and primed with zincchromate, except pressurized air duct work, airboxes, etc., which should be alodined only.
2. Remove all filings, chips, loose dirt, and other foreign objects on the surfaces to be sealed by forced air or vacuum cleaning and brush.
3. Clean all surfaces or voids to be sealed, to remove all fingerprints, oil or grease. To clean, wipe the affected areas with naphtha, using a clean cotton cloth. The cleaned surfaces should be ***wiped*** dry immediately and not allowed to air dry, as to prevent redisposition of contaminants on the surface.

— CAUTION —

When using these cleaning solvents in a closed area, forced ventilation should be used to protect personnel from toxic fumes.

4. It is essential that only clean cloths be used for cleaning. When a cloth becomes soiled, it should be cleaned or discarded. To avoid contamination of the cleaning solvent, it should be ***poured*** on the cloth. Repeat the cleaning procedures above until it is certain no contaminates are left on the surfaces to be sealed.

— NOTE —

The importance of proper cleaning prior or applying sealant cannot be over emphasized. Sealant will not adhere properly to a dirty, oily surface. The entire purpose of the sealant is defeated if it lifts from the structure after it has been applied.

MATERIAL PREPARATION.

The instructions of the sealant manufacturer should be followed exactly with regard to both the mixing and storage of the sealants.

Mix only enough sealant to accomplish the work at hand. The application life of the A-2 and B-2 class sealants is two hours at 75 degrees Fahrenheit and 50 percent relative humidity. For every 10 degrees temperature rise, the application life is reduced by half, and for every 10 degrees drop in temperature the application life is doubled. Increased humidity decreases application life and decreased humidity increases application life.

The application life of A-1/2 class sealant is one-half hour under the same 75 degrees Fahrenheit and 50 percent relative humidity.

— *NOTE* —

Use care when mixing sealant to avoid incorporating air into the sealant.

LIST OF EQUIPMENT.

1. Mixers - Semco No. 285 Portable, or Semco No. 385 Automatic or equivalent.
2. Cartridges - SemKit No. 650 2-1/2 ounces and 6 ounces proportioned with MIL-S-7502 or MIL-S-8802 Class B sealants only.
3. Half pint kits of MIL-S-7502 or MIL-S-8802 Class A sealants only (5 fluid ounces).
4. Air powered sealant gun (Semco No. 250-6 with extra retainers for 2-1/2 ounce cartridges or equivalents).
5. Assorted nozzles for sealant gun.
6. Extension for sealant gun.
7. Solvent dispensers (polyethylene squirt bottles).
8. Clean white cotton cloths.
9. Stiff bristle brush (not nylon).
10. Solvent containers with covers for cleaning nozzles, tools, etc.
11. Fillet fairing tools. (Refer to Figure 51-20.)

The equipment listed is commercially available from the vendors as shown in the List of Consumable Materials, Chapter 91.

LIST OF MATERIALS.

Only the following materials should be used:

1. Sealants - MIL-S-7502 or MIL-S-8802 - Classes A-1/2, A-2, B-2, B-4, B-6 and B-8.
2. Leak Marker - 3M - E.C. 612.
3. Sealant material - G.E.-SS-4004 Primer.
4. Sealant material - G.E. RTV 88 with RTV 9811 catalysts.
5. Aluminum Wool - Fine.
6. Release Agent - Polyvinyl Alcohol. (P.V.A.)
7. Cleaning Solvents - Methylethylketone (MEK) or Aliphatic Naphtha.

The materials listed are commercially available from the vendors as shown in the List of Consumable Materials, Chapter 91.

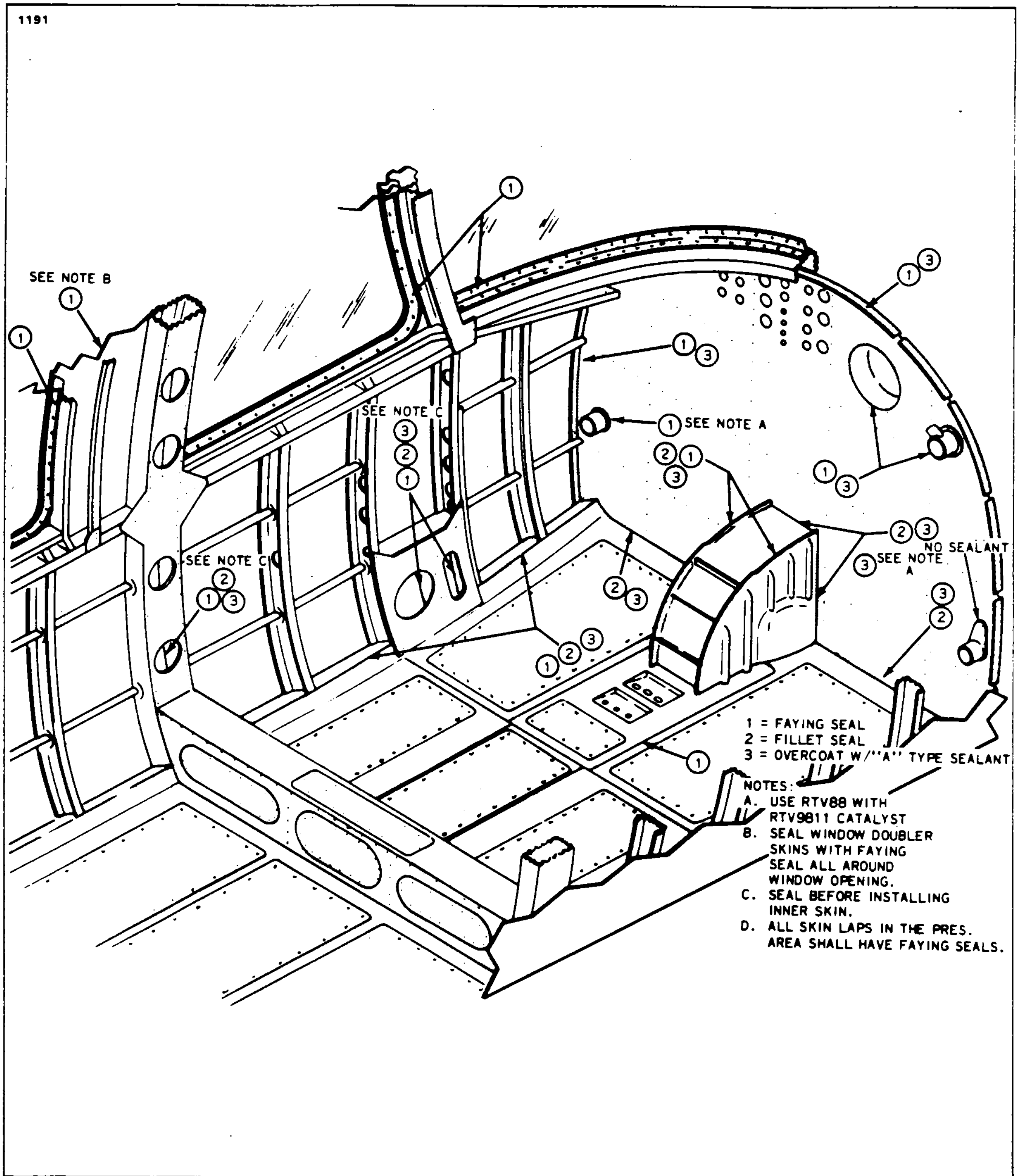

Figure 51-11. Fuselage Sealing (Forward)

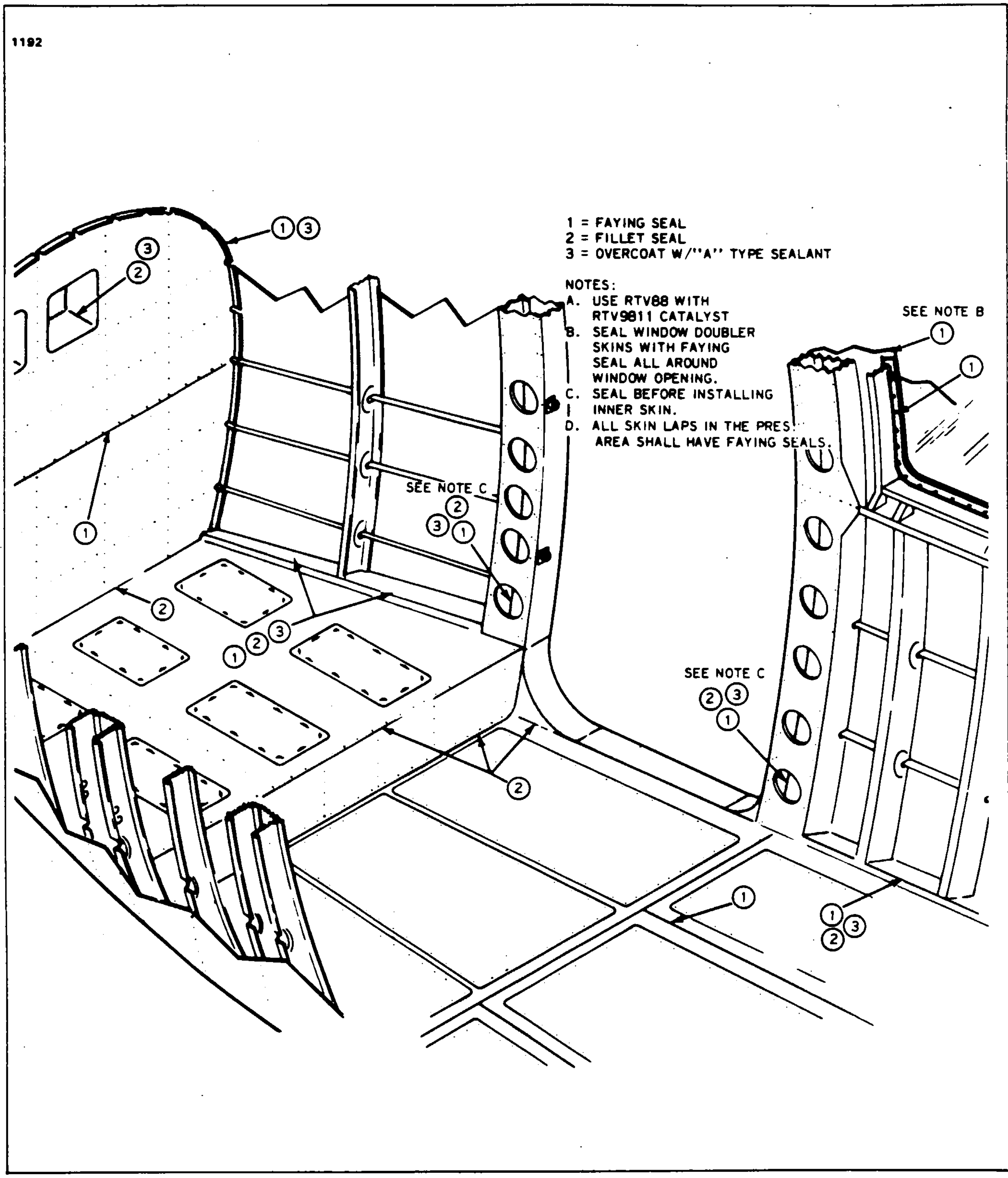

Figure 51-12. Fuselage Sealing, (Aft)

APPLICATION OF SEALANTS.

The following sequence of sealing should be observed:

1. Seal faying surfaces of assemblies and sub-assemblies prior to installation which are not accessible later.
2. Seal joggles, holes, cutout and any other gaps.
3. Seal remaining seams and joints.
4. Seal bolts, screws, nuts and other fasteners.
5. Seal electrical harness.
6. Seal formed in place gaskets.

— NOTE —

All sealing is done on the pressure side of the seal plane. This assures that the pressure will help hold the seal in place.

SEALING FAYING SURFACES. (Refer to Figure 51-13.)

Typical parts requiring sealing prior to assembly are bulkhead stations that extend beyond the seal plane between bulkhead stations 81 and 274 inclusive, 13 angles and skin joints behind box bulkheads, stringers, and windshields and windows.

Type B-2 sealant should be used. Apply a liberal amount of sealant to each mating surface of the applicable parts. Assemble and secure the components together before the sealant dries. If the specific components require riveting, the components should be riveted together while the sealant is still wet, or if permanent fastening is not possible at the time, temporary fasteners should be used in at least 50% of the holes to be riveted.

— NOTE —

Sufficient sealant should be applied to insure a continuous extrusion on both sides of the joint after assembly of the faying surface. (Refer to Figure 51-14.) Permanent fastening is required before the work life of the sealant has expired. A sand blasted bucking bar should be used to perform the riveting operation.

Allow class B-2 sealant to fully cure for 48 hours at 75°F and 50% relative humidity.

SEALING JOGGLES. (Refer to Figure 51-14.)

Joggles should be sealed by completely filling them with class B-2 sealant. The sealant should be applied by the use of a pressure applicator, forcing the sealant under the joggle from either side until it begins to extrude on the opposite side of the joggle.

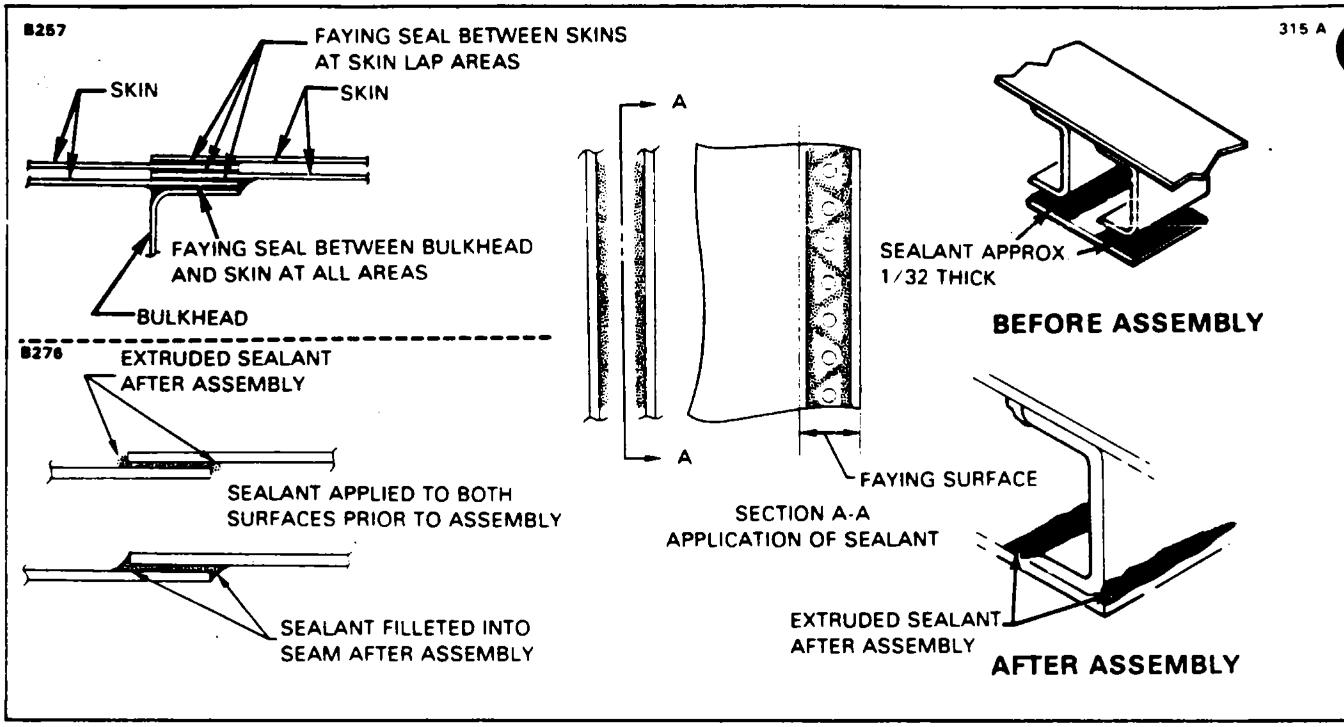

Figure 51-13. Faying Surface Seal

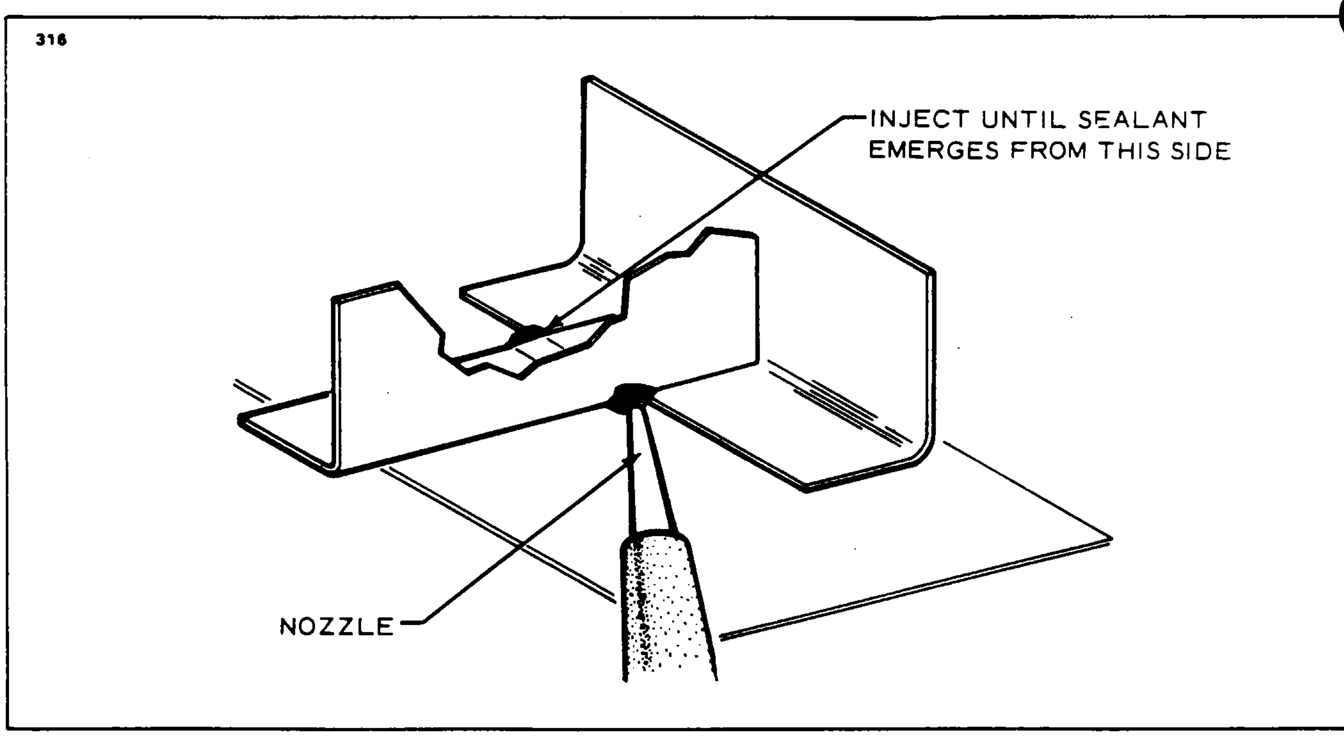

Figure 51-14. Joggle Seal

SEALING HOLES AND VOIDS. (Refer to Figure 51-15.)

Voids are defined as gaps between airframe members which present a direct opening through the pressure vessel structure. Such gaps occur at stringer cutouts in the pressure bulkheads, forming reliefs and flanges. Holes and voids which are less than .125 wide should be filled with sealant building up a bead with a minimum thickness of .062. If the gap is larger than .125 wide, it must have a mechanical closure such as a soft rivet or screw and washer. If rivets are used make sure to brush coat both sides with class A-1/2 sealant.

HOLES AND VOIDS IN (COLD) AIR DUCT WORK. (Refer to Figure 51-15.)

Sealing in this area is done to prevent air noises and eliminate undesirable, uncontrollable drafts. Apply sealant to any holes and voids less than .125 inch wide, and apply 3M 471 plastic tape on inside or outside surface of any holes and voids larger than .125 inch.

SEALING SEAMS AND JOINTS. (Refer to Figure 51-16.)

Fillet seals should be used along the edges of all structures riveted to the skin in the pressurized area, such as frames, stringers, doublers, laps, seams and joints. The sealant is applied with a pressure gun and care is taken to avoid getting any gaps or bridges along the seam joint. The final dimensions of a cross section of the bead must conform to those shown in Figure 51-16.

— CAUTION —

Be sure the pressure gun has enough sealant to make a complete seal at one injection without any break, as stopping and starting will cause air bubbles in seal and cause a poor seal job.

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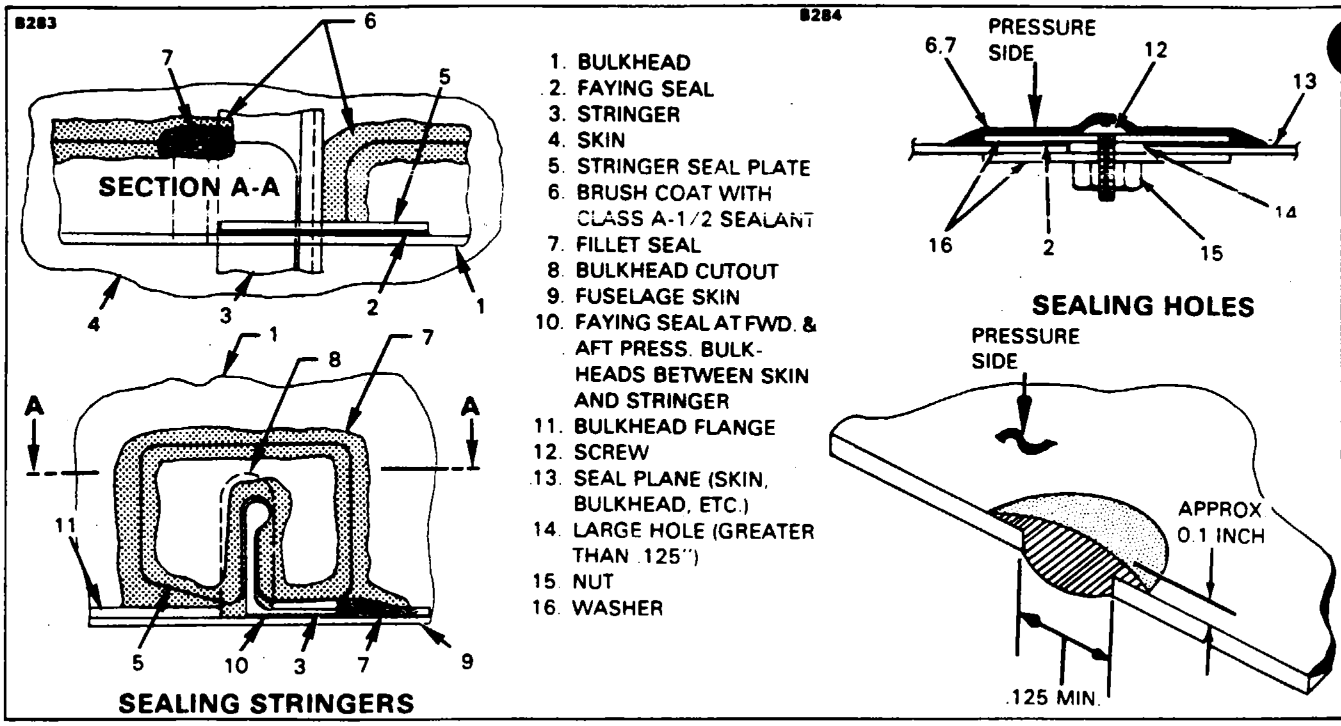

Figure 51-15. Stringers, Holes and Voids Seals

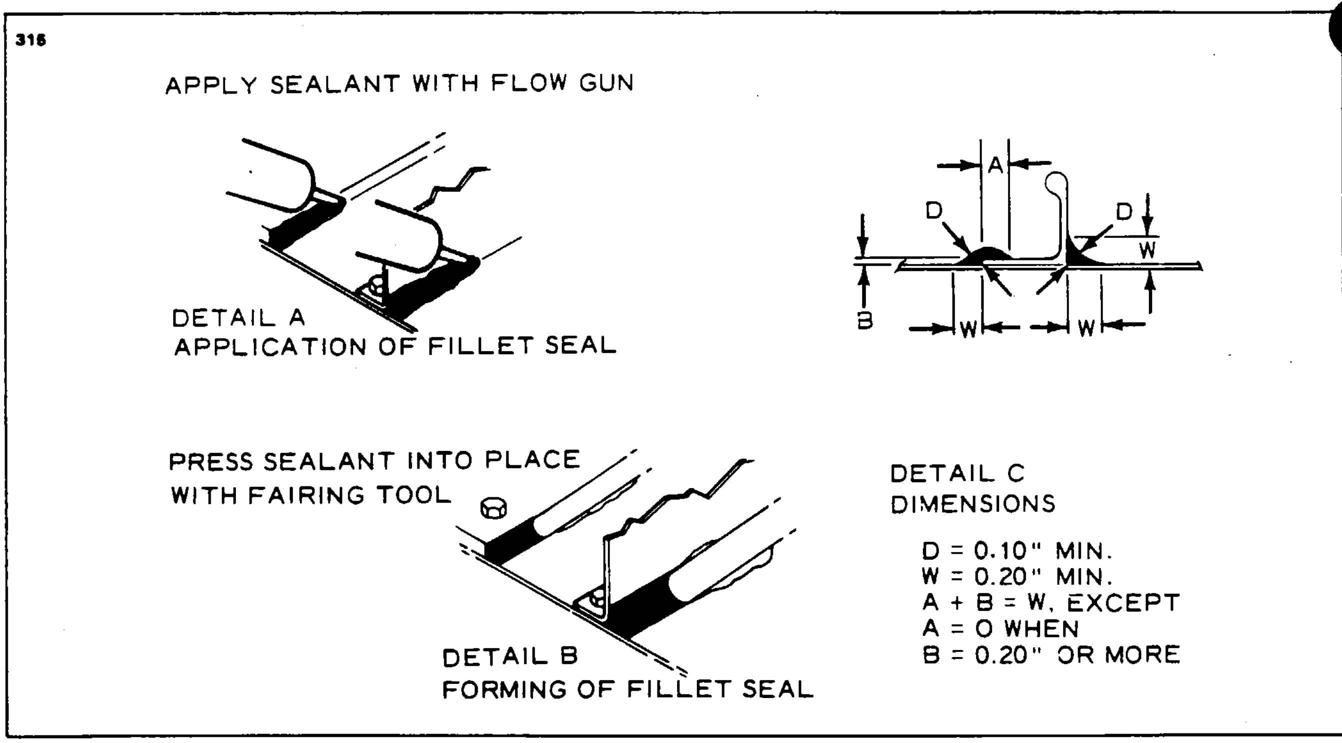

Figure 51-16. Fillet Seal

SEALING FASTENERS. (Refer to Figure 51-17.)

Seal all fasteners installed through a seal plane by filleting around the fasteners after installation with a coat of B-2 class sealant.

— NOTE —

If a bolt or nut is being sealed, it should be torqued before sealants set. Tightening after sealant sets is not recommended.

SEALING — AN — STANDARD BULKHEAD FITTINGS.

Seal AN fittings passing through the pressure plain of the bulkhead by cleaning around the seal area and applying sealant to the inside surface around the hole and installing the fitting before the sealant sets.

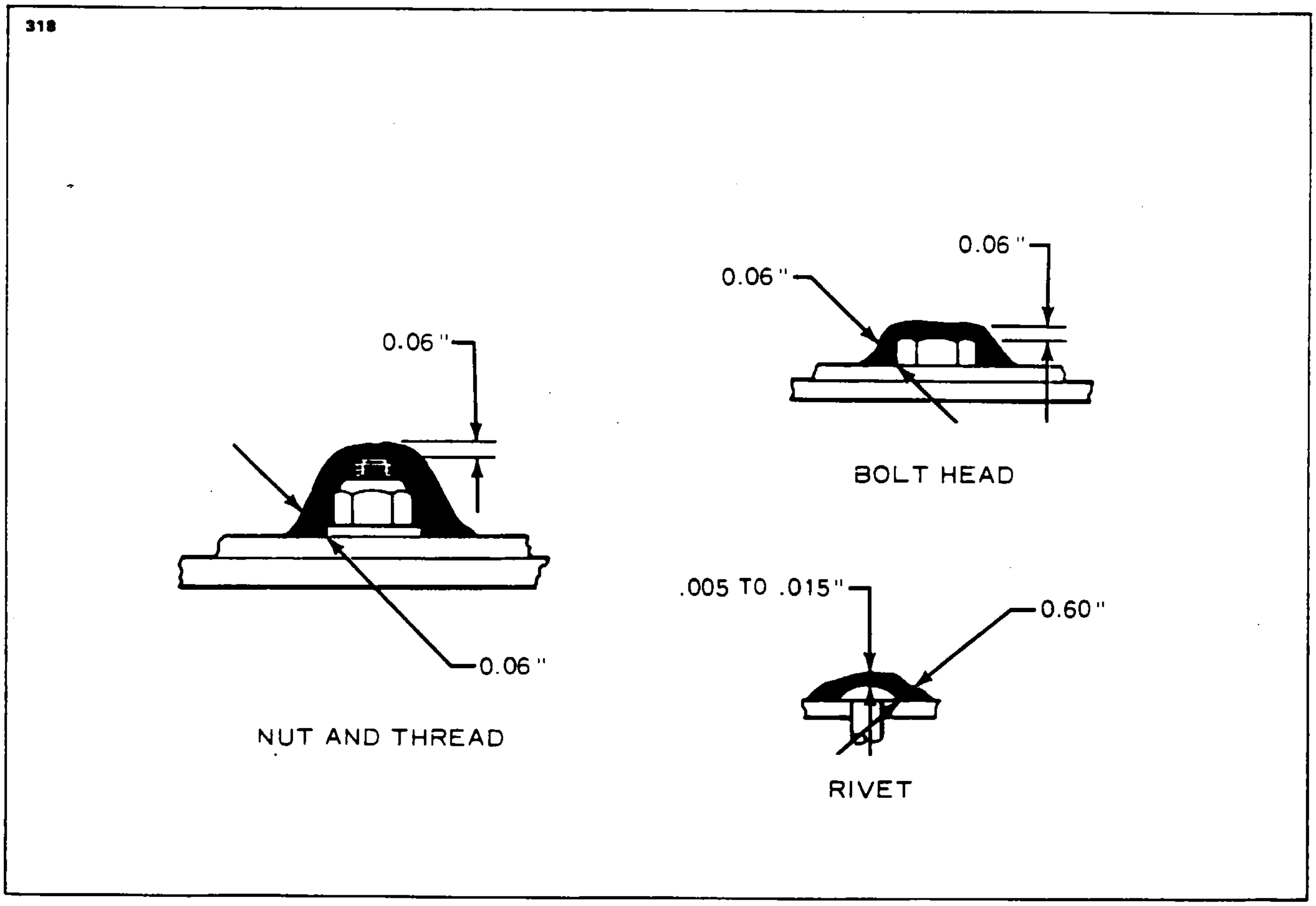

Figure 51-17. Bolts and Rivets Seals

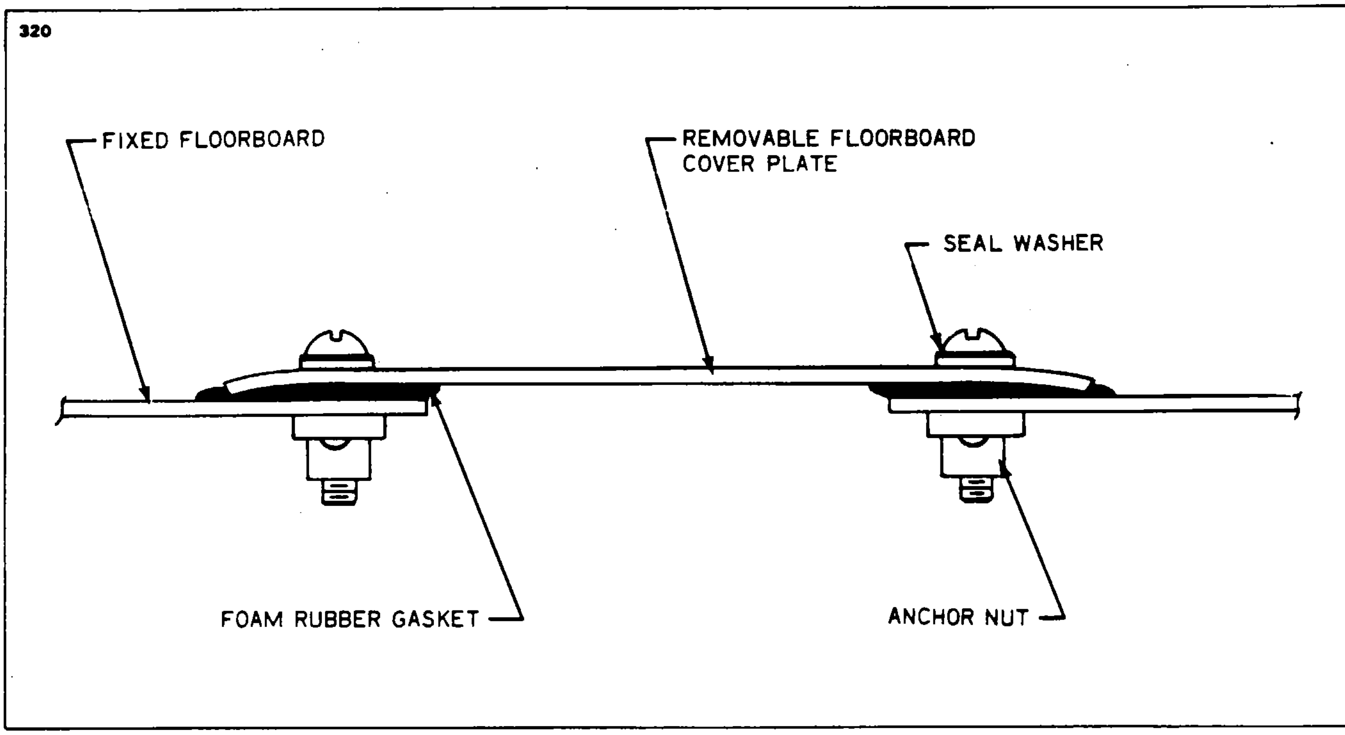

Figure 51-18. Floor Board Seals

SEALING ELECTRICAL HARNESSES. (Refer to Figure 51-19.)

These steps are for the main fuselage and wing harness only. The wire harnesses are sealed at the point where they pass through the pressure bulkhead.

1. Sealing with the use of sealing compound may be accomplished as follows:
   A. Clean the area of the bulkhead where the seal fittings will seal.
   B. Pass the wire bundle through the hole provided in the bulkhead.
   C. Place the seal fitting halves around the wire harness, on the pressure side of the bulkhead.
   D. Fill the groove in the mounting flange of the fitting halves with sealant. (Refer to detail "A" of Figure 51-19.)

— NOTE —

Use enough sealant to assure that sealant extrudes around the mounting flange after they are secured to the bulkhead.

   E. Secure the fitting to the bulkhead with fasteners.
   F. Fillet seal the extruded sealant around the sides of the mounting flange as shown in detail "B" of Figure 51-19.
   G. Put the nozzle of the sealant gun in the center of the wire harness and work sealant throughout the wires inside the seal fitting as shown in detail "C" Figure 51-19.
   H. Place a strong piece of string against the seal assembly, parallel with the wires. (Refer to detail "D" of Figure 51-19.)

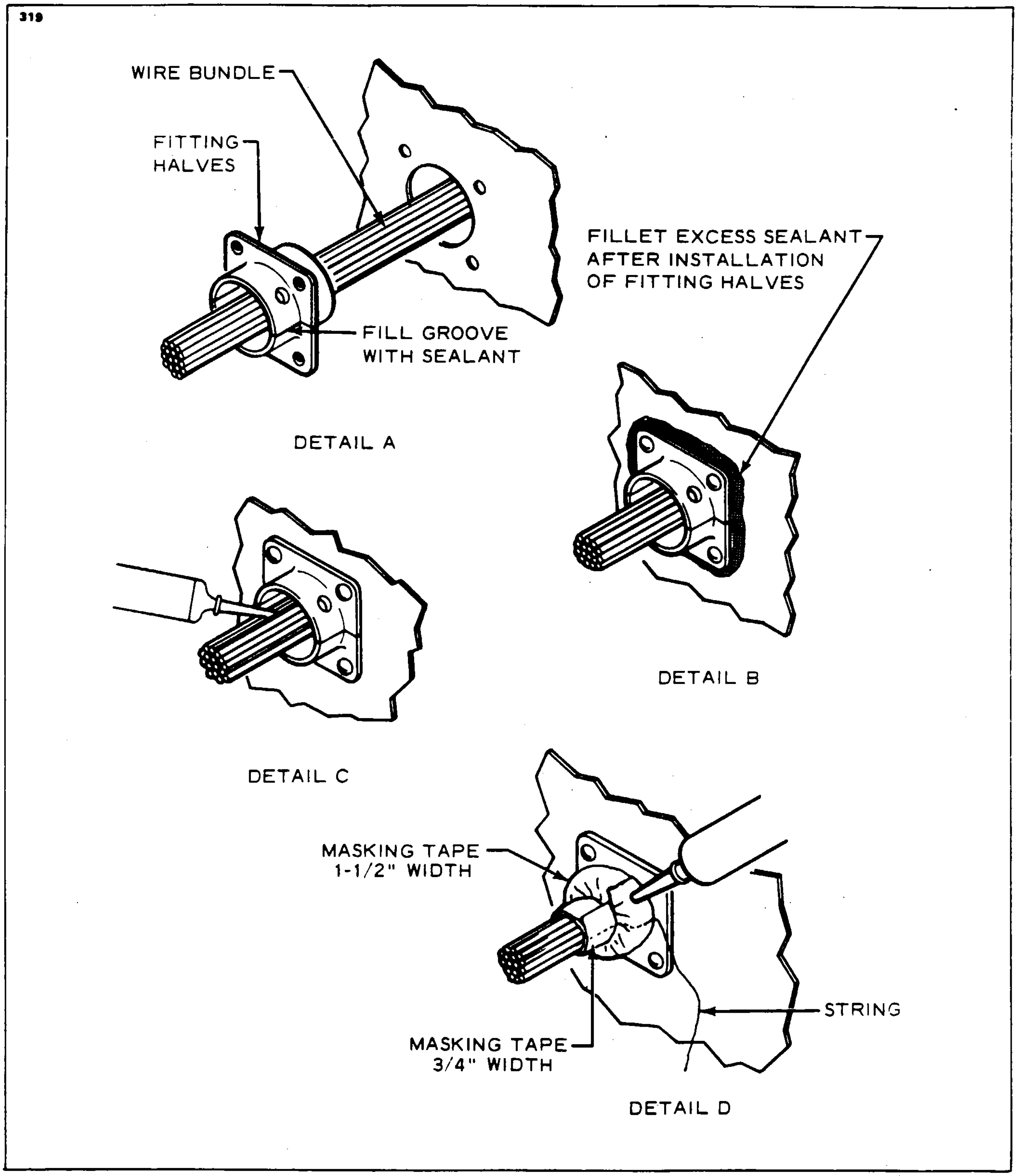

Figure 51-19. Wire Harness Seals

I. Wrap the fitting halves with three turns of 1.50 inch wide masking tape. (Refer to detail "D" of Figure 51-19.)
J. Crimp the wide masking tape around the seal assembly to center the wire harness.
K. Wrap the crimped end with three turns of .750 inch masking tape. (Refer to detail "D" of Figure 51-19.)
L. Puncture the masking tape over the most convenient injection hole in the seal fitting and inject sealant with pressure gun.
M. Apply sealant over seal fitting fasteners as explained in this section.
N. Remove tape after sealant has cured (16 to 24 hours) by pulling the rip string and unwinding the tape.
O. All other electrical harnesses and wires use o-ring type pressure seal bulkhead connectors per MIL-C-5015 or "Dura-Grom" type seals.

APPLICATION OF RELEASE AGENT.

The edges and faying surfaces of removable or hinged panels shall receive at least two coats of release agent (Polyvinyl Alcohol P.V.A.) prior to the sealant application, applied approximately .50 inch wider than the mating flange. The panel should be allowed to air dry between coats. Only removable covers requiring a formed-in-place gasket shall receive an application of a release agent. Sealant must be applied to the prepared surface within two hours after the completion of surface preparation. Surfaces not sealed within this time must be prepared again.

— CAUTION —

Do not use Polyvinyl alcohol as a release agent near acrylic (Plexiglas) windows. It will craze acrylic plastics.

SEALING FORMED-IN-PLACE GASKETS.

— NOTE —

This type of seal is used on the lock handle cover of the Radome of the airplane.

Unless otherwise specified, apply a heavy bead of class B-2 sealant to the mating surfaces not coated with a release agent and spread evenly until the coating is approximately .062 inch thick. While the sealant is still fluid, secure the access cover and smooth the excess sealant flush with the top of the cover. Allow to fully cure for 48 hours at 75° F and 50% relative humidity. After curing, trim the excess sealant from around the cover; then pry one corner of the panel open, using care not to damage the gasket, and progressively free the rest of the panel. Remove all release agent and excess sealant from the panel and mating surface.

— NOTE —

Release agents are removable with water.

— NOTE —

Do not pressure test the fuselage until the sealing compound has thoroughly cured.

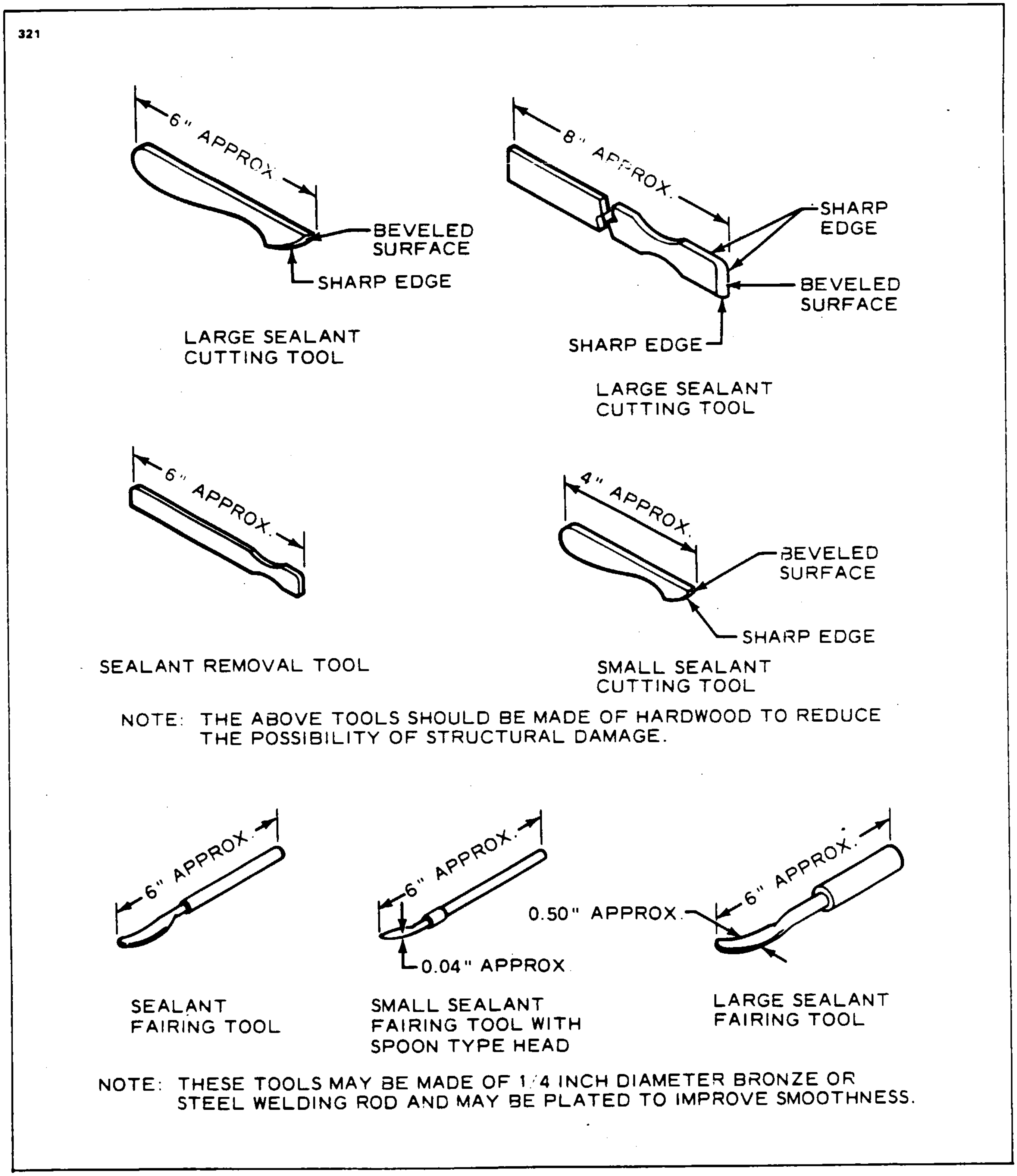

Figure 51-20. Fabricated Tools

REMOVAL OF SEALANT.

When it is necessary to remove fillets or beads of sealant because of rework or repair, scrape the sealant off with scrapers made of hardwood or plexiglas. It is necessary to remove only the major portion of the fillets or beads. After rework, the area should be cleaned, resealed and tested for leaks.

EQUIPMENT CLEAN UP.

This must be accomplished within three hours after exposure to room temperature using naptha, Methylethylketone or Toluol as a cleaning material.

— END —

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PIPER

MOJAVE

MAINTENANCE MANUAL

CARD 4 OF 5

PA-31P-350 MOJAVE

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 781)

INTRODUCTION.

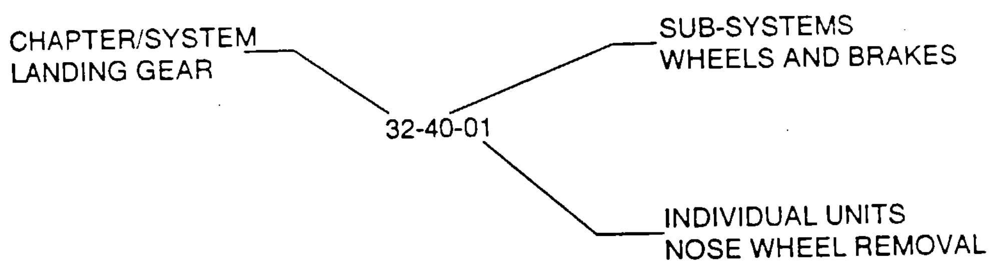
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad selection of contents (Chapters) within each group.

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-31P-350 aircraft manufactured by the Piper Aircraft Corporation of Lock Haven, Pennsylvania.

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 Parts Catalog P/N 761 776, and FAR 43 for proper utilization.

AEROFICHE EXPLANATION AND REVISION STATUS

The Maintenance Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aircraft Manufacturer's Association. (GAMA). The information compiled in this Aerofiche Maintenance Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set, Grid location J16.

To aid in locating the various chapters and related service information desired, the following is provided:

1. A complete manual System/Chapter Index Guide is for all fiche in this set.
2. A complete list of Illustrations is for all fiche in this set following System/Chapter Index.
3. A complete list of Charts is for all fiche in this set following list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:

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

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

TABLE OF CONTENTS/EFFECTIVITY CODES

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

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

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

Revisions to this Maintenance Manual 761 781 issued April 25, 1983 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG830425	April 25, 1983	1, 2, 3, 4 and 5
PR830728	July 28, 1983	1, 2, 3, 4 and 5
PR831214	December 14, 1983	1, 2, 3, 4 and 5
IR860430	April 30, 1986	1
IR860723	July 23, 1986	2
IR860925	September 25, 1986	1 and 4
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 chapter 71 of card 4. Please dispose of your current cards 2 and 4, and replace with the revised one. DO NOT DISPOSE OF CARDS 2, 3, 5.

Consult the Customer Service Information Aerofiche for current revision dates for this manual

VENDOR-SUPPLIER INFORMATION.

A partial list of companies, their address and phone numbers are provided to aid service personnel in obtaining information about components not manufactured by Piper Aircraft Corporation.

Air-Conditioning System Electronic Leak Detector	TIF Instruments 3661 N. W. 74th Street Miami, Florida 33147 (305) 696-7100
Alternator	Prestolite Company 511 Hamilton Street Toledo, Ohio (419) 255-4068
Autopilot/Avionics	Edo Corporation - Avionics Division P.O. Box 610 Municipal Airport Mineral Wells, Texas 76067 (817) 325-2517
	Bendix Avionics Division 2100 N.W. 62nd Street Fort Lauderdale, Florida 33310 (305) 776-4100
	Collins General Aviation Division Rockwell International Cedar Rapids, Iowa 52406 (319) 395-3625
	King Radio Corporation 400 N. Rogers Road P.O. Box 106 Olathe, Kansas 66061 (913) 782-0400
	Sperry Flight Systems - Avionics Division 8500 Balboa Boulevard P.O. Box 9028 Van Nuys, California 91409 (213) 894-8111
	Global Navigation 2144 Michelson Drive Irvine, California 92715 (714) 851-0119

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Gill-Teledyne P.O. Box 431 Redland, California (714) 793-3131
Deicing, Airfoil	The B.F. Goodrich Company 500 South Main Street Akron, Ohio 44318 (216) 374-3895
Deicing, Propeller	The B.F. Goodrich Company 6400 Goldsboro Road Suite 102 Bethesda. Maryland 20034 (301) 229-5000
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington, Penna. 19034 (215) 643-2900
Engines	Avco Lycoming Avco Lycoming Division Williamsport, Penna. 17701
Environmental Systems, Heater and Air Conditioner	Janitrol Aero Division 4200 Surface Road Columbus, Ohio 43228 (614) 276-3561
	Sanden International (U.S.A.). Inc. 10710 Sanden Drive Dallas, Texas 75238
Fuel Pumps	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000
Fuel System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria, Ohio 44035 (216) 323-4676

VENDOR-SUPPLIER INFORMATION (cont).

Landing Gear, Hydraulic Actuators, Hydraulic Pressure Regulator, Hydraulic Power Pack, Hand Pump	Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Magnetos	Bendix Electrical Components Division Sidney, New York 13838
Oxygen System	Scott Aviation Products 225 Erie Street Lancaster, New York 14086 (716) 683-5100
Pneumatic System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria, Ohio 44035 (216) 323-4676
Propellers	Hartzell Propeller, Incorporated 1025 Roosevelt Avenue Piqua, Ohio 45356 (513) 773-7411
Propeller Synchrophaser	Hartzell Propeller Fan Company 910 South Downing Street Piqua, Ohio 45356 (513) 773-7411
Tools, Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Turbocharger	Airesearch Industrial Division 3201 Lomita Boulevard Torrance, California 90505
Wheels and Brakes	Cleveland Wheel and Brake Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011
	B.F. Goodrich Company Transportation Products Division P.O. Box 340 Troy, Ohio 45373

PIPER PUBLICATIONS.

PA-31P-350

Parts Catalog =	761 776 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961-1328
Continuous Inspection =	761 786 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961-1328

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont.)

LIST OF ILLUSTRATIONS

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—NOTE—

Refer to Card 5, Grid No. 5C5 for Electrical Schematic Index.

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CHAPTER

52

DOORS

CHAPTER 52 - DOORS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 52 - DOORS (CONT.)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

Contained in this chapter are removal and installation procedures for the various doors and their accompanying latch assemblies.

PASSENGER/CREW.

CABIN ENTRANCE DOOR.

The cabin entrance door is located on the left side of the fuselage, aft of the wing trailing edge at stations 215.00 to 244.00. This is a one-piece door consisting of a door frame assembly constructed of angles, bulkheads and channels covered with an inner and outer skin. The door is mounted to the fuselage by means of a piano-type hinge along its bottom edge. Steps are included as an integral part of the cabin door.

INSPECTION OF CABIN ENTRANCE DOOR.

1. Perform a visual inspection of parts for excessive wear, metal fatigue and signs of improper adjustments.
2. Operate the door latch mechanism and observe for proper functioning of all locking lugs and any sign of binding or looseness.
3. Refer to Cabin Entrance Door Latch Mechanism for repair and service instructions of the latch mechanism.
4. Refer to Chapter 12 for instructions on the proper lubrication of the door and related mechanisms.

REMOVAL OF CABIN ENTRANCE DOOR.

1. Place a padded support under the door to relieve tension from the two support cables.
2. Remove the scuff cover from over the door hinge.
3. Remove the boot over the door snubber attachment point on the door, then disconnect the snubber if installed.
4. Disconnect the two support cables from the door.
5. Disconnect the pressure line to the door seal.
6. Remove lower trim panel and separate wire connector. Withdraw wire and protective rubber hose from fuselage door frame.
7. Remove the hinge pin and lift the door to separate the hinges and remove the door from the airplane.

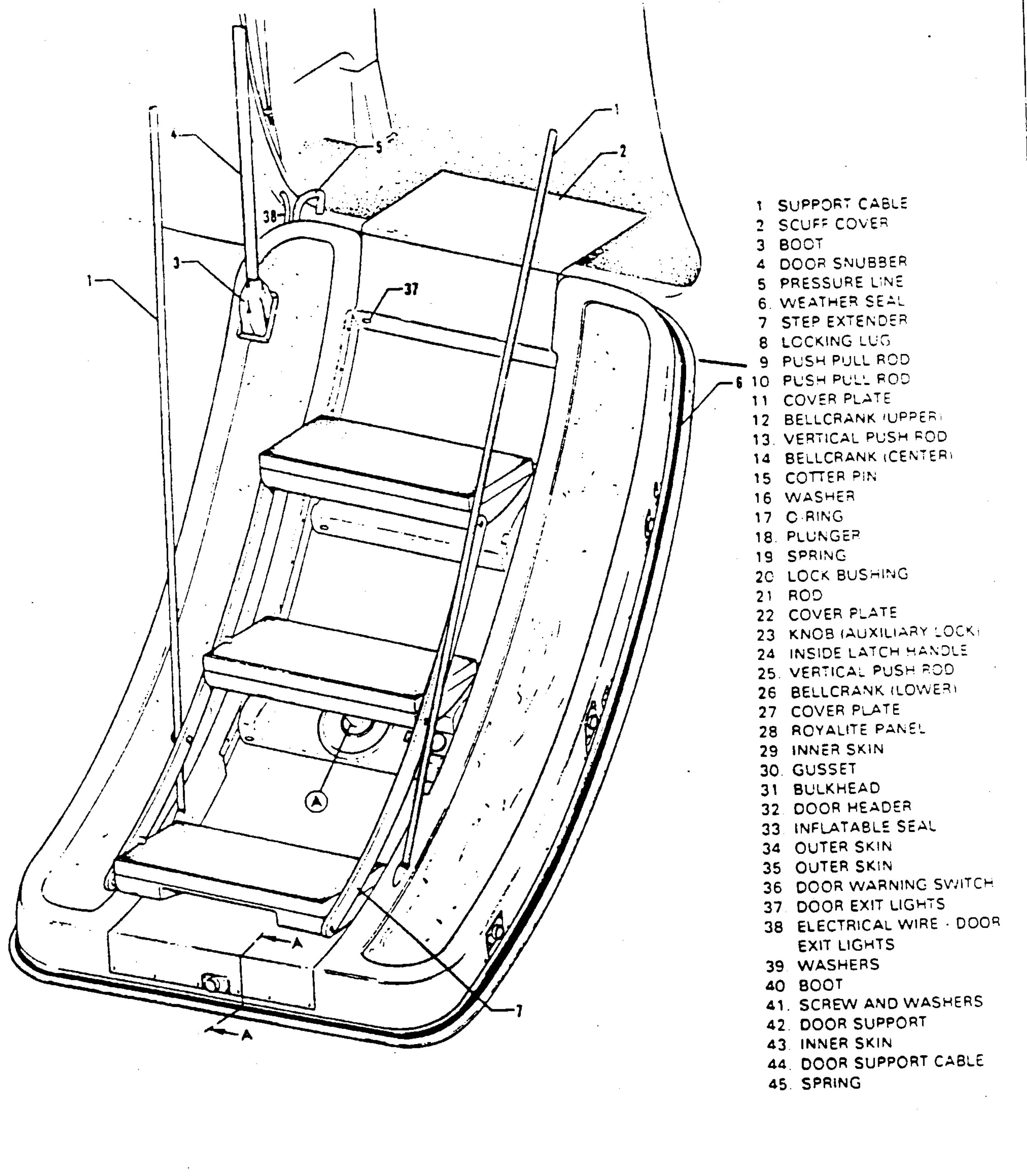


Figure 52-1. Cabin Entrance Door

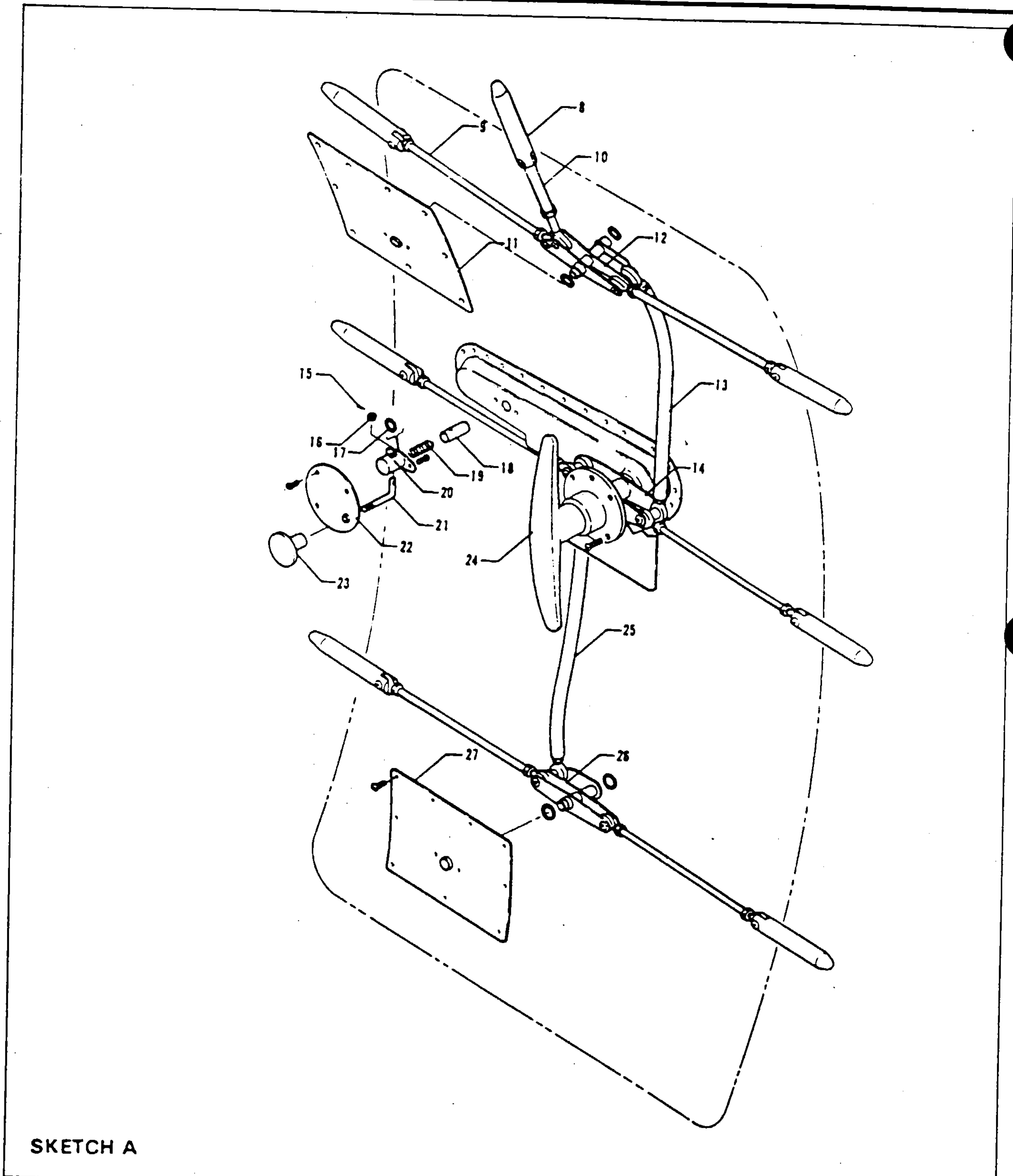
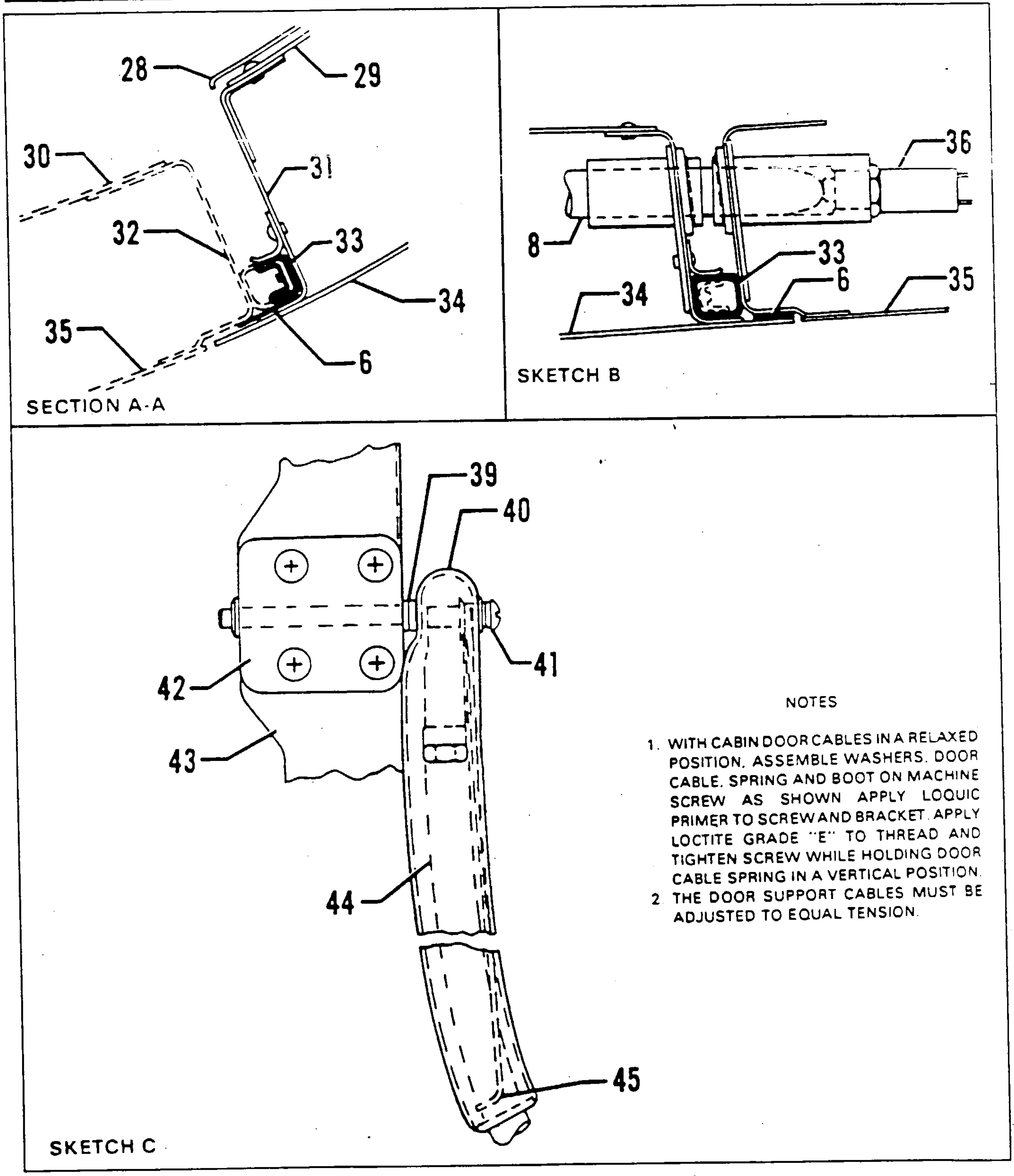


Figure 52-1. Cabin Entrance Door (cont.)



NOTES

1. WITH CABIN DOOR CABLES IN A RELAXED POSITION, ASSEMBLE WASHERS, DOOR CABLE, SPRING AND BOOT ON MACHINE SCREW AS SHOWN. APPLY LOQUIC PRIMER TO SCREW AND BRACKET. APPLY LOCTITE GRADE "E" TO THREAD AND TIGHTEN SCREW WHILE HOLDING DOOR CABLE SPRING IN A VERTICAL POSITION.
2. THE DOOR SUPPORT CABLES MUST BE ADJUSTED TO EQUAL TENSION.

Figure 52-1. Cabin Entrance Door (cont.)

INSTALLATION OF CABIN ENTRANCE DOOR.

1. Place a padded support under the door.
2. Position the hinge half on the door with the other half of the hinge on the airplane and install the hinge pin.
3. Connect the two support cables to the door. (Refer to Figure 52-1, Sketch C, Notes 1 and 2.)
4. Connect the pressure line to the door seal.
5. Insert the electrical wire and its protective rubber hose into the appropriate hole in the fuselage door
6. Connect the door snubber, if installed, and replace the boot.
7. Install the scuff cover over the door hinge.
8. Remove the padded support from under the door and check door fit.

CABIN ENTRANCE DOOR LATCH MECHANISM.

The latching mechanism consists of seven locking lugs and a series of push-pull rods and bellcranks controlled from a centrally located handle.

REMOVAL OF LATCHING MECHANISM.

1. Upper and lower latching mechanism:
   A. Remove the interior trim panels from the door.
   B. Remove the bellcrank coverplate.
   C. Remove the bolt connecting the vertical push rod to the bellcrank.
   D. Remove the bolts connecting the right or left push rod, or both if necessary, to remove complete assembly.
   E. If so desired, the bellcrank or push rod and lugs can now be removed.
2. Center latching mechanism:
   A. Remove the interior trim panels from the door, if not previously removed.
   B. Remove the inside handle and cover plate.
   C. Remove the bolts, spacers, and locknuts connecting the vertical push rods extending to the upper and lower latching mechanism bellcranks.
   D. Remove the bolts connecting the right or left push rod, or both if necessary, to remove the complete assembly.
   E. Remove the bolt and lock nut to remove the bellcrank.
   F. The outside handle is removed from the outside of the door.
   G. Remove the push rods extending to the sides of the door along with the locking lugs.

INSTALLATION OF LATCHING MECHANISM.

1. Upper and lower latching mechanism:
   A. Install the push rods and locking lugs into the door.
   B. Install the bellcranks, and position the upper bellcrank with the push-pull rod attachment point to the forward side of the door and the lower bellcrank with the push-pull rod attachment point to the aft side of the door.
   D. Connect the left push rod to the bellcrank and secure with bolt, washer and locknut.
   E. Install the lower vertical push rod to the lower bellcrank and secure along with the left push rod using bolt, washer and locknut.
   F. Install the cover plates and adjust lugs.
2. Center latching mechanism:
   A. Install the push rods and locking lugs into the door.
   B. Install the outside handle, if previously removed.
   C. Install the bellcrank and secure with bolt and locknut.
   D. Connect the push rods to the bellcrank and be sure to install the spacers between the vertical and horizontal push rods as shown in Figure 52-1. Secure with bolts and locknuts.
   E. Install the cover plate and inside handle and adjust lugs.

ADJUSTMENT OF LATCHING MECHANISM.

1. Remove the inside trim panels and access plates.
2. With the door opened, position the handle in the open position.
3. Check all seven locking lugs to ascertain that all are even with the ends of the lug guides on the door.
4. If any of the lugs are found to extend beyond the guides, or are inside the guides, loosen the locknuts on the push rod and turn the push rod to get the proper setting.
5. Position the handle in the closed position and check all seven locking lugs for proper extension of approximately 1.75 inches.
6. If any of the lugs are found out of adjustment, loosen the locknuts on the push rod and adjust the push rod to get the proper extension.
7. Ascertain that all the locknuts on the push rods are tight and all the lugs and bellcranks operate freely.
8. Replace the access plates and trim panels removed.

CABIN DOOR AUXILIARY LOCK.

REMOVAL OF CABIN DOOR AUXILIARY LOCK.

1. Remove the knob from the auxiliary lock rod extending through the inside surface of the entrance door next to the handle.

—NOTE—

The interior trim panels must be removed to gain access to the cover plate over the lock mechanism.

2. Remove the four screws securing the cover plate and remove.
3. Remove the cotter pin and washer from the end of the lock rod extending through the lock bushing and remove the rod.
4. To remove the lock bushing, plunger and spring from the door, loosen and remove the two machine screws and nuts securing the assembly to the door.

INSTALLATION OF CABIN DOOR AUXILIARY LOCK.

1. Install the spring into the plunger and the plunger and spring into the bushing.

—NOTE—

Ascertain that the O-ring is installed in the bushing, around the plunger.

2. Place the assembly into the access opening and secure it in place with two screws and nuts.
3. Install the lock rod into the slot in the bushing and through the hole in the plunger, and secure in place with washer and cotter pin.
4. Install the cover plate, being sure the lock rod extends out through the bushing in the cover.
5. Secure the cover to the door with four screws, and replace the trim panels on the interior of the door and the knob on the end of the lock rod.

CABIN ENTRANCE DOOR SEAL ASSEMBLY.

This is an inflatable seal having an air inlet valve which is located at the lower corner of the seal and which is connected to a control solenoid valve by rigid and flexible lines. A metal flange is installed around the seal to keep it in place. With the door closed and the cabin pressurized, the door seal expands against the door frame to completely seal the door opening.

REMOVAL OF CABIN ENTRANCE DOOR SEAL.

1. Remove the lower trim from the door and disconnect the rubber hose from the inlet valve on the seal.
2. Remove the rubber seal from around the door using MEK or white gas to cut through the cement.

—CAUTION—

When removing the inlet valve from the hole in the door, use extreme caution not to damage it.

3. Clean the door and seal with MEK or white gas to remove all traces of old cement.

INSTALLATION OF CABIN ENTRANCE DOOR SEAL.

1. Clean both the door and seal with MEK or white gas prior to applying cement.
2. Apply one even coat of 3M #EC1300L cement to the cleaned surfaces of the door and seal. Allow to dry and then apply a second coat and allow to dry.

—CAUTION—

Take care to avoid getting cement on areas not to be cemented

3. Activate the cement by wiping the cemented surfaces lightly with Toluol. Do approximately two feet at a time and immediately position and press the seal in place. Start at the air inlet on the inflatable seal.

—CAUTION—

Care must be taken to avoid stretching the inflatable seal. Mark the seal and door at ten inch intervals to gage length.

4. After positioning the seal correctly on the door, press the seal firmly in place to assure complete adhesion .
5. Clean off excess cement with a cloth dampened in MEK or white gas. Allow cement to set for four hours before using the door and inflating the seal.
6. Connect the rubber hose to the inlet valve and replace the trim panel over the door.

CABIN ENTRANCE DOOR STEP MECHANISM.

REMOVAL OF CABIN ENTRANCE DOOR STEPS.

With the door in an open position and the steps extended, proceed as follows:

1. Remove the nuts, bolts, and washers from both sides of each step which are used to connect the step support tubes linking the three steps together.
2. Remove the hinge pins which secure the step half of the hinge with the door half of the hinge and remove the steps.

INSTALLATION OF CABIN ENTRANCE DOOR STEPS.

1. Position the steps to the door and install the hinge pins.
2. Position the step support tubes along the sides of the steps, being certain to place the tube with the door support cable guide on the forward side of the door. Be sure that the step stops on the step support tubes are pointing towards the center of the entrance door.

—NOTE—

Ascertain that the door support cable is routed between the roller and bracket on the forward step support tube assembly.

3. Install the bolts through the step support tubes and install washers between the tubes and step brackets; then secure with locknuts.

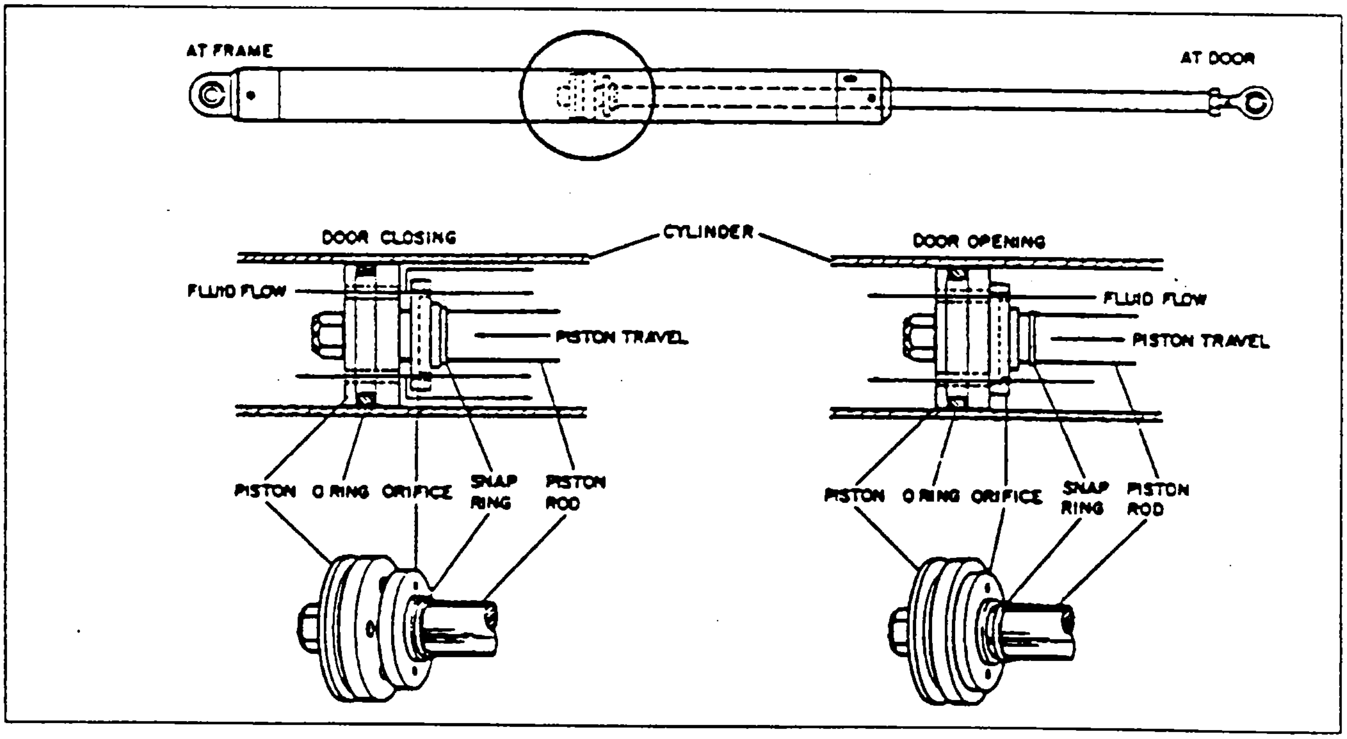


Figure 52-2. Door Snubber Assembly

CABIN DOOR SNUBBER. (Refer to Figure 52-2.)

The snubber assembly is a hydraullic cylinder with an orifice type valve on the piston which allows hydraulic fluid to pass at a predetermined rate during the door opening sequence. When the door is being closed, the piston is forced into the cylinder and the orifice valve opens to allow a faster flow rate of hydraulic fluid.

FILLING SNUBBER ASSEMBLY.

With the snubber piston collapsed into the cylinder, remove the plug on the cylinder and fill with MIL-H-5606 hydraulic fluid, insert the plug in the cylinder and extend the piston from the cylinder, work the piston in and out to help remove any trapped air within the cylinder. Collapse the piston into the cylinder and remove the plug, add more fluid as required, then reinsert the plug in the cylinder.

REMOVAL OF DOOR SNUBBER.

1. With the door extended, remove the screws which secure the boot over the lower end of the snubber.
2. Remove the bolt and locknut which secures the lower end of the snubber to the cabin door.
3. Remove the bolt which secures the snubber assembly to the bracket on the door frame.

INSTALLATION OF DOOR SNUBBER.

1. Install the snubber to the bracket on the door frame with bolt previously removed.
2. Install the lower end of the snubber into the bracket on the door and secure with bolt and nut.
3. Secure the boot over the snubber connection on the entrance door.

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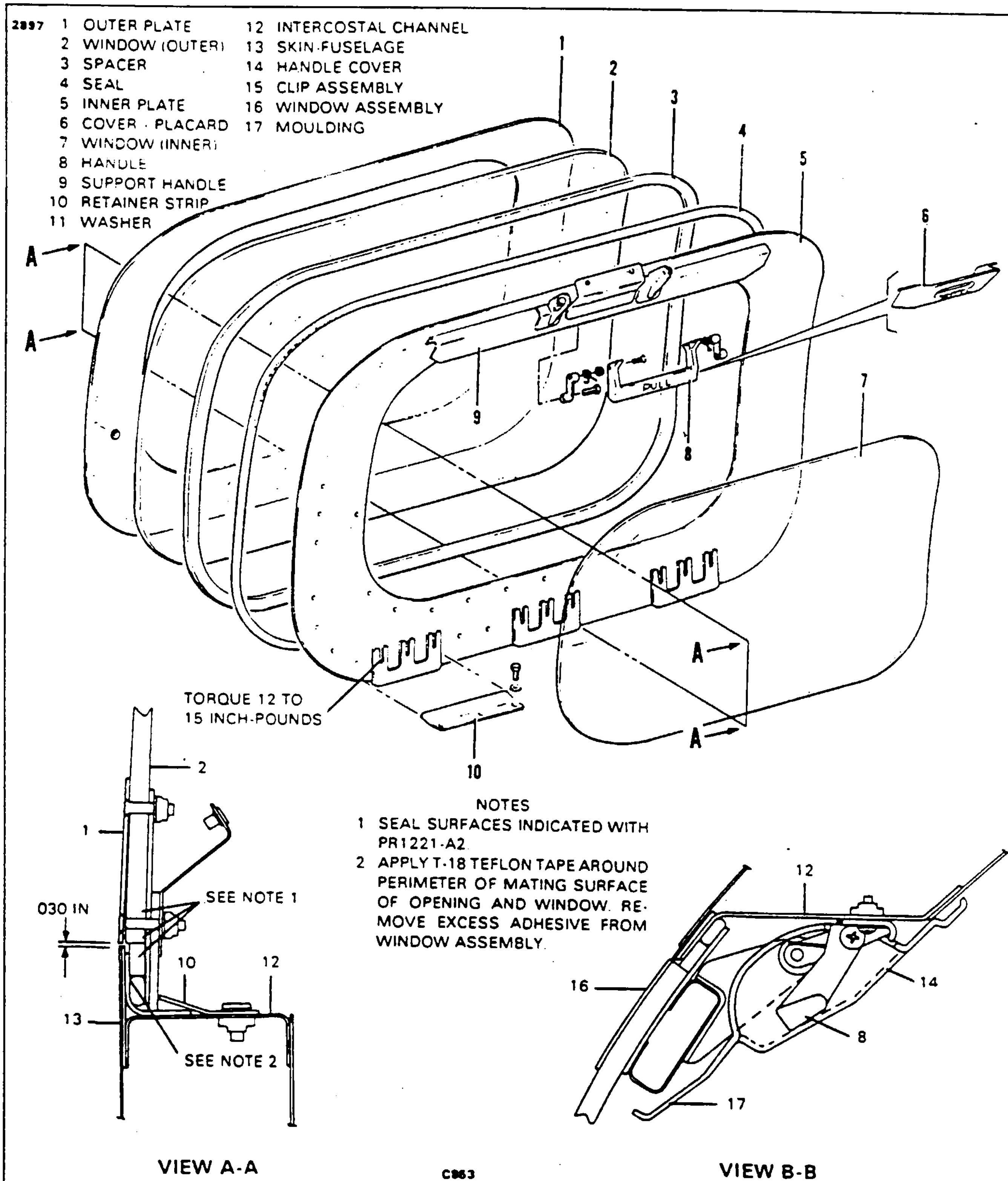


Figure 52-3. Emergency Exit Window

EMERGENCY EXIT.

An Emergency Exit window is mounted on the right side of the fuselage between fuselage station 146.00 and station 174.00. This is a 25.75 inch by 19.75 inch window designed for quick removal in an emergency situation, or when an alternate exit from the cabin is required. The window is held in place by three retainer strips at the bottom of the window frame and a release handle at the top of the window. The frame of the emergency exit window is provided with a "Rubatex" seal which provides an air-tight seal for pressurization purposes. To prevent damage to this seal, the emergency exit should be handled with care during removal and installation.

INSPECTION AND SERVICING OF EMERGENCY EXIT WINDOW.

At each one hundred hour inspection, the emergency exit window should be removed from the fuselage to ensure its operation. Should the window stick or should the window be hard to remove, perform the following:

1. Inspect the rubber seal on the window frame for serviceability.
2. Spray both the window frame and fuselage frame with silicone.
3. Inspect the fuselage frame for excess skinlap sealant and remove any that may be present.

—NOTE—

Excess sealant may cause the window seal to stick to the fuselage frame.

CARGO.

CARGO DOOR.

REMOVAL OF CARGO DOOR. (Refer to Figure52-4.)

—NOTE—

The cabin door must be open prior to removing the cargo door.

1. With the door open, disconnect the door support assembly from the door.
2. Disconnect door seal hose.
3. Remove hinge pin and remove the door from airplane.

INSTALLATION OF CARGO DOOR. (Refer to Figure 52-4.)

1. Position the door and align hinges. Insert hinge pin and bend both ends.
2. Attach door support assembly to the door.
3. Operate door latch to determine that the locking pins are engaging properly.

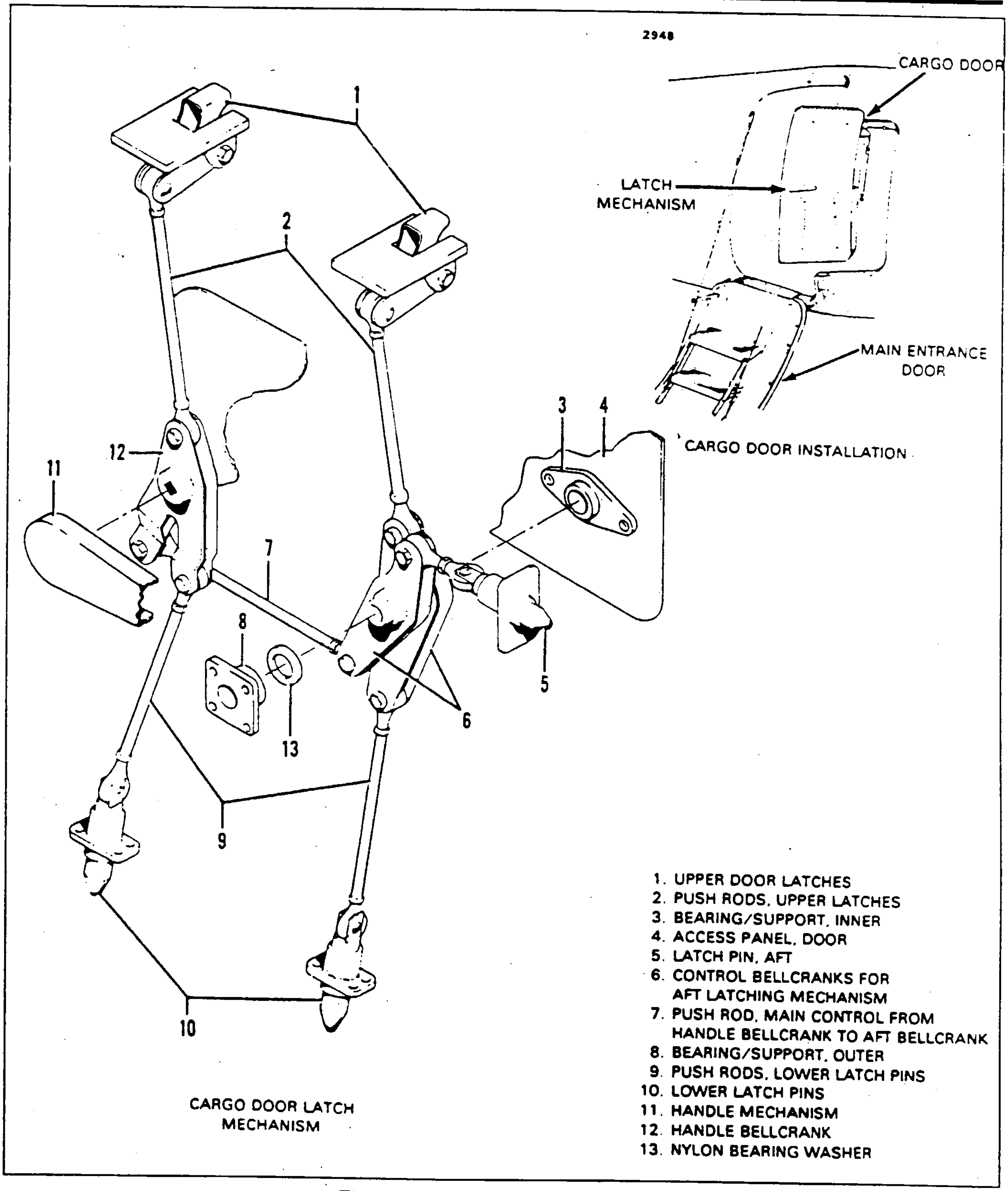


Figure 52-4. Cargo Door Installation

CARGO DOOR LATCH ASSEMBLY.

The latching mechanism consists of three locking pins, two latch assemblies and a series of push rods controlled by two bellcranks from a centrally located handle.

REMOVAL OF CARGO DOOR LATCH ASSEMBLY. (Refer to Figure 52-4.)

1. Remove the trim panels and bellcrank cover plates.

—NOTE—

Index the push rods to aid in reassembly.

2. Remove the hardware securing the push rods to bellcranks.
3. Remove the bellcrank assemblies from the door along with teflon washers used on left bellcrank only.
4. Remove the hardware securing the push rods to the upper door latch assemblies.
5. Remove the push rods from the door.
6. The remaining push rods with the locking pins attached may now be removed.

INSTALLATION OF CARGO DOOR LATCH ASSEMBLY. (Refer to Figure 52-4.)

1. Install the upper door latch assembly push rods and secure with the appropriate hardware.
2. Install the remaining push rods with locking pins attached.
3. Install the bellcrank assemblies using new teflon washers where required.
4. Secure with the push rod assemblies to the bellcrank assemblies using the appropriate hardware.
5. Install the bellcrank cover plates.
6. With the door handle in the closed position check the three locking pins for proper extension (approximately 1.75 inches).
7. Determine that all locknuts on push rods are secure and the door latch assembly operates freely.
8. Install trim panels previously removed.

SEAL ASSEMBLY- CARGO DOOR.

REMOVAL OF CARGO DOOR SEAL. (See Removal of Cabin Entrance Door Seal.)

INSTALLATION OF CARGO DOOR SEAL. (See Installation of Cabin Entrance Door Seal.)

FORWARD BAGGAGE COMPARTMENT DOOR.

A baggage compartment door provides access to the forward baggage compartment located between fuselage station 11.00 and 37.00. This door consists of a formed inner skin spotwelded to an outer skin. The door is hinged at the top and security is provided by a lockable, two-point latching mechanism.

REMOVAL OF FORWARD BAGGAGE COMPARTMENT DOOR.

1. With the door open and the hinges exposed, remove the cotter pins and washers from the hinge pins, and remove the screw which secures the baggage door holder link to the baggage compartment door frame.
2. While supporting the door, remove the hinge pins and lift the door for removal.

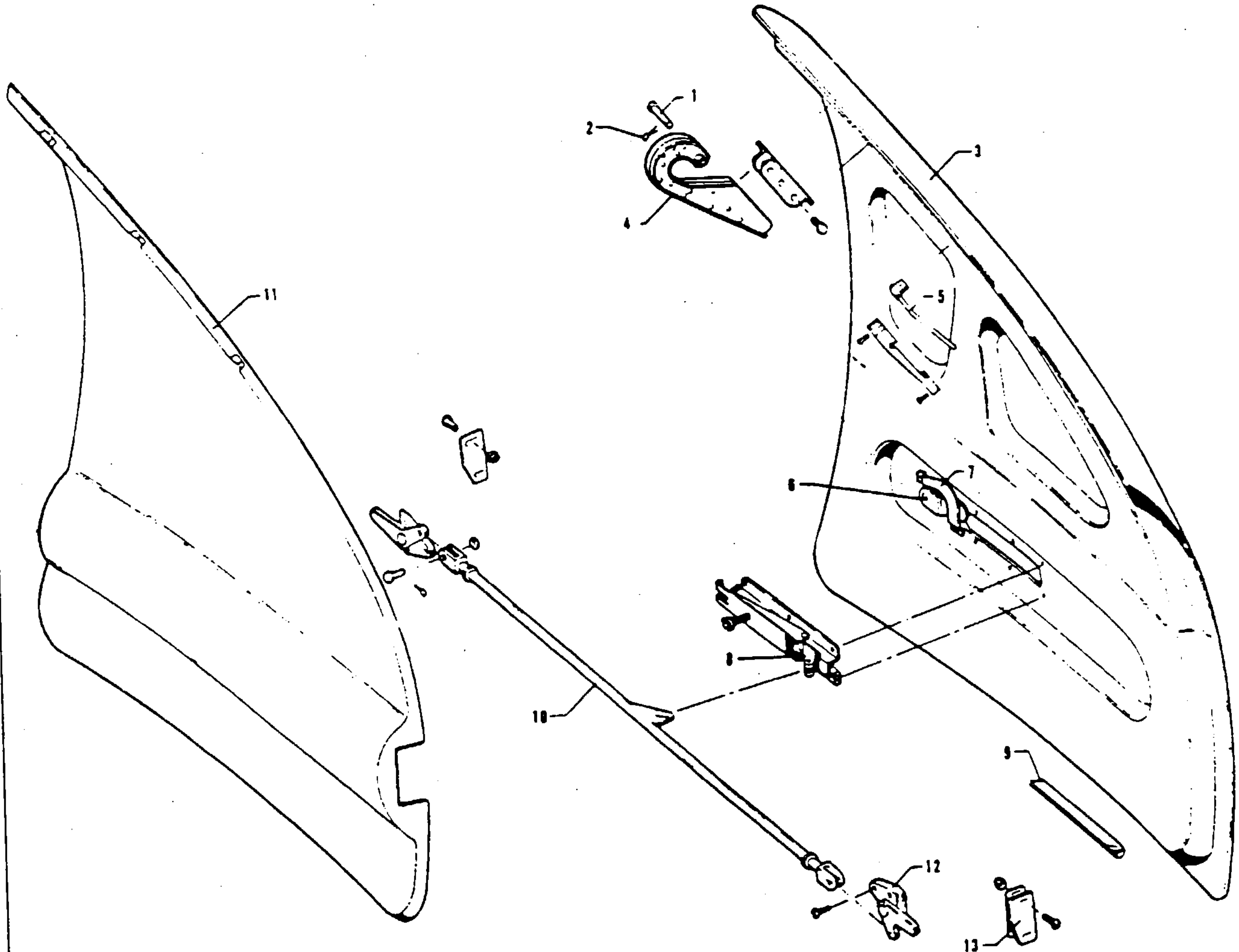
INSTALLATION OF FORWARD BAGGAGE COMPARTMENT DOOR.

1. While supporting the door, align the hinges in the bracket assemblies and insert the hinge pins.
2. Replace the washers and insert the cotter pins into the ends of the hinge pins.
3. Reinstall baggage door holder link.

FORWARD BAGGAGE COMPARTMENT DOOR LATCH ASSEMBLY.

REMOVAL OF FORWARD BAGGAGE COMPARTMENT DOOR LATCH ASSEMBLY.

1. With the door open, remove the screws holding the inside cover and remove the cover from the door assembly.
2. Remove the cotter pin and roller pin linking the tube assembly to the door handle.
3. Remove the six machine screws (three per arm assembly) which secure the arm assemblies to the door assembly and remove the tube assembly from the door.
4. Remove the six machine screws and locknuts that secure the handle assembly to the door and remove handle.
5. Remove the two screws from the outside of the door to remove the lock guide plate assembly located on the inside of the door.
6. Remove the keylock assembly by removing the retaining nut and washer from the back of the keylock assembly.



1 HINGE PIN
2. COTTER PIN
3 DOOR ASSEMBLY
4. HINGE
5 BAGGAGE DOOR
6. DOOR LOCK
7 DOOR LOCK GUIDE
8 HANDLE ASSEMBLY
9. DOOR SEAL
10 TUBE ASSEMBLY
11 INNER DOOR COVER
12 ARM ASSEMBLY
13 LOCK PLATE

Figure 52-5. Forward Baggage Door Assembly

INSTALLATION OF FORWARD BAGGAGE COMPARTMENT DOOR LATCH ASSEMBLY.

1. Insert the keylock in the door with the latching arm towards the handle cut out in the door.
2. Position the washer and retaining nut on the back of the lock and secure.
3. Position the lock guide plate and secure with two screws inserted from exterior side of door.
4. Position the handle assembly in the door cutout and secure with six screws and self-locking nuts.
5. Position the tube and arm assembly on the door and secure with three machine screws in each arm assembly.
6. Align the hole in the door handle with the slot in the tube assembly and insert roll pin. Secure with cotter pin.
7. Place door inside cover and secure with screws.

ADJUSTMENT OF FORWARD BAGGAGE DOOR LATCH.

1. Adjust the lock plates in or out as required to obtain a proper closed-door seal.
2. Adjust the door lock arms so that when the door is locked the arms are tight against the lock plate stops, by screwing them in or out of the tube assembly.

NACELLE LOCKER DOOR.

The nacelle locker is an integral part of the wing nacelle extending from a bulkhead at fuselage station 147.75 aft to a tapered fiberglass tip. The lockable nacelle locker door provides security and protection from the elements for any cargo placed within the compartment. Hinges are attached to the forward edge of the door assembly and a lock and latch assembly is fitted to the aft portion of the door.

REMOVAL OF NACELLE LOCKER DOOR.

1. With the nacelle locker door open and supported, remove the cotter pin, door support assembly hinge pin and spacer, then separate the door support assembly from the nacelle locker door.
2. Remove the cotter pins and washers from the nacelle locker door hinge pins.
3. Remove the hinge pins and remove the door from the nacelle.

INSTALLATION OF NACELLE LOCKER DOOR.

1. Position the door on the nacelle, align the hinges and insert the hinge pins.
2. With the door supported in the open position, place a washer on each hinge pin and secure with cotter pins.
3. Align the door support assembly with the door-mounted support bracket. With the spacer in position, insert pin and secure with cotter pin.

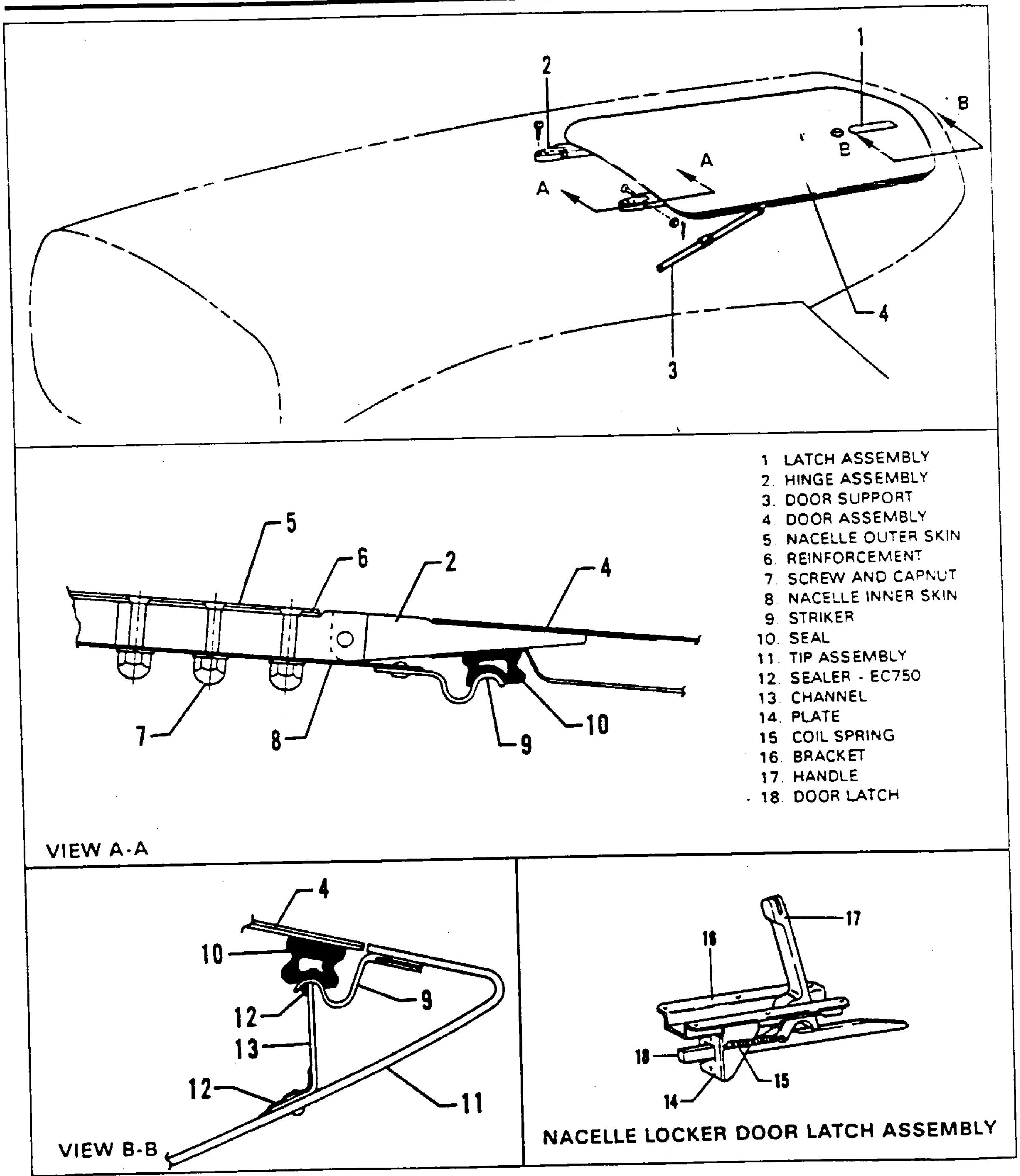


Figure 52-6. Nacelle Locker Door

NACELLE LOCKER DOOR LATCH ASSEMBLY. (Refer to Figure 52-5.)

The nacelle locker door latch assembly consists of a spring-loaded handle connected to the door latch by a pin and cotter pin. The handle and latch assemblies are mounted in a bracket which is then secured to the nacelle locker door by six machine screws, washers and self-locking nuts.

REMOVAL OF NACELLE LOCKER DOOR LATCH ASSEMBLY.

1. With the nacelle locker door in the open position. remove the fourteen machine screws and washers that secure the door latch cover to the door.
2. Remove the six machine screws, washers and self-locking nuts that secure the latch assembly to the door and remove the latch assembly.

INSTALLATION OF NACELLE LOCKER DOOR LATCH ASSEMBLY.

1. Place the latch assembly in position against the inner skin of the nacelle locker door and align the holes in the latch assembly bracket with the holes in the locker door.
2. Secure the latch assembly to the door with machine screws, washers and self-locking nuts.
3. Apply a thin bead of PRC 5000 (white) sealant around the mating surface of the door latch cover, place it in position on the locker door inner surface and secure with fourteen (14) washers and machine screws.

SERVICE.

NOSE CONE.

The nose cone provides access to the battery compartment and houses the radome when installed. The radome is constructed principally of fiberglass and has an aluminum rear bulkhead. Copper strips are imbedded in the fiberglass and a battery box air inlet is an integral part being located at the bottom rear portion of the nose cone. A hinge is provided on the right side of the nose cone, and a four-point latch assembly provides security.

REMOVAL OF NOSE CONE.

1. Gain access to the locking handle in the forward baggage compartment. Pull the handle down completely to unlock the four locking pins and swing the nose forward and to the right.
2. Disconnect any electronic cables going into the nose cone.
3. Support the nose cone from beneath, remove the hinge pin and separate the hinge halves.

INSTALLATION OF NOSE CONE.

1. Align the hinge halves and insert hinge pin.
2. Reconnect any electronic cables previously removed.
3. Close nose cone and secure by pushing locking handle up.

DOOR WARNING.

DOOR AJAR WARNING SWITCHES.

There are seven switches wired in parallel located in the cabin door channel, three on each side and one on top. These switches are adjusted to sense the insertion of the door plungers in their receptacles in the locked position. If any one of the switches is out of adjustment, and the circuit is completed, the cabin door ajar light will stay on. The lower forward switch is a two pole switch. The purpose of these switches is to independently provide ground to the warning light assembly should any one of the locking pins not engage properly.

REMOVAL OF DOOR AJAR WARNING SWITCHES.

1. Remove the interior trim panel from around the door frame.
2. Disconnect the electrical leads from the switch.

—NOTE—

Make note of the place from which each wire was removed to facilitate reinstallation.

3. Loosen the retainer nut and unscrew the switch from the receptacle.

INSTALLATION OF DOOR AJAR WARNING SWITCHES.

1. Install new switch into latch receptacle located behind the door frame.
2. With the door closed and locked, and using an ohmmeter or continuity tester to indicate switch actuation, screw the switch into the receptacle until the switch actuates (to the off position).

—NOTE—

All switches should be adjusted so that the switch actuates only when the plunger has reached full travel.

3. Secure the switch in this position with the retainer nut.
4. Connect the wires to their proper place on the switch.
5. Install the interior trim panel around the door frame.

ADJUSTMENT OF DOOR AJAR WARNING SWITCHES.

Due to the fact that there are seven switches wired in parallel, each one will have to be checked and adjusted separately. This can be accomplished by jumping the wires at the switches not being adjusted.

1. Before adjusting the switches, ascertain that all the locking pins are adjusted.
2. Remove the interior trim panel from around the door frame.
3. With the door closed and locked, screw the switch into the receptacle until the switch actuates.

—*NOTE*—

An ohmmeter or continuity tester can be used to indicate switch actuation.

4. When adjustment is satisfactory, tighten the retainer nut on the switch. If several switches are being adjusted, follow the same procedures for each switch.
5. Install the interior trim panel around the door frame.

PERIODIC CHECK OF DOOR AJAR WARNING SWITCHES.

Periodically but not less than 100 flying hour intervals, check the mechanical action of the cabin door ajar switches.

1. Insert a long blunt object small enough to fit into the door lock pin receptacle.
2. Actuate the switch by pushing against it until an audible click is heard and release it, noting another audible click.
3. Replace any malfunctioning switch in which the click action and mechanical function is doubtful.

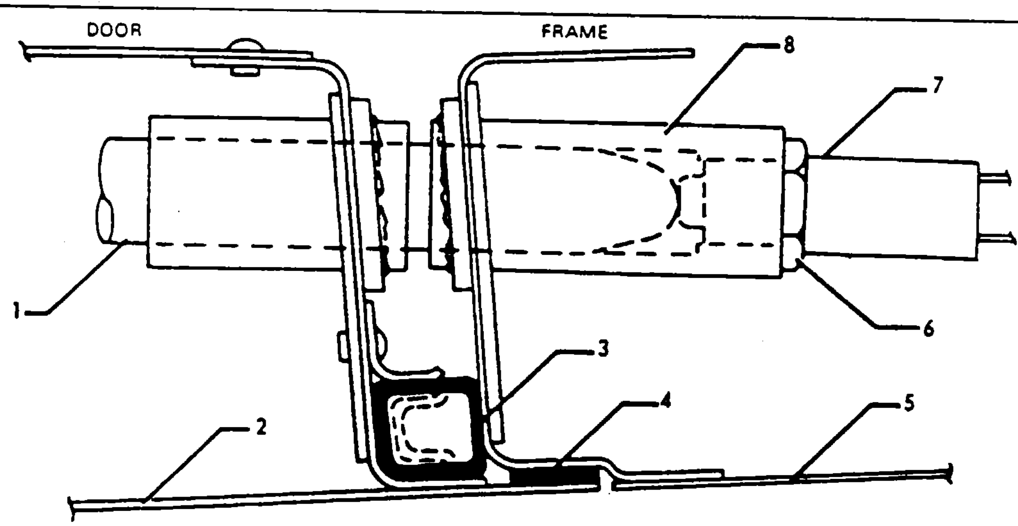


Figure 52-7. Door Ajar Switch

CHAPTER

53

FUSELAGE

CHAPTER 53 - FUSELAGE

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter contains information pertinent to the fuselage structure. The fuselage assembly contains compartments which house the nose landing gear, forward baggage, avionics and accommodations for crew and passengers. It provides attachment points for the wings, cabin door and empennage.

DESCRIPTION

The fuselage is an all metal, semi-monocoque structure which consists of bulkheads, stringers, stiffeners and longitudinal beams to which the outer skin is riveted. The fuselage is pressurized between bulkheads, 81.00 and 274.00.

Windows include a two-piece windshield, four windows along the right side and three windows along the left side of the fuselage, and a storm window for the pilot. A 25.75 by 19.75 inch emergency exit window on the right side of the fuselage is removable upon pulling the release located above the window. This window is sealed upon installation and should the window be removed, it must be reinstalled with care in order to retain the pressure seal.

The cabin entrance door is located on the left side of the fuselage just aft of the wind. This is a one piece door which swings down to open and provides cabin entrance steps.

All wiring, plumbing and control cables passing through the pressurized portion of the fuselage, are sealed to minimize air leakage. For this reason, no holes should be added on any of the reinforcement channels or the forward and aft pressure bulkheads. Any repairs, modifications or removal of floorboard cover plates for inspection which creates, a break in the pressure seal is considered the responsibility of the owner or facility performing the work. All aluminum components of the pressure envelope and exterior surfaces, are alodine treated and zinc chromate primed to resist corrosion.

— END —

CHAPTER

54

NACELLES

CHAPTER 54 - NACELLES

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The nacelle assembly is composed of three sections - the engine cowling, the nacelle fuel cell, and the baggage locker.

The engine cowling consists of upper and lower cowl assemblies of cantilever construction attached at the firewall. A hinged door on the upper cowl allows access to the oil filler neck and quantity dipstick for servicing. The lower cowl priovides mounting for the cowl flap door and intercooler air inlet.

The nacelle fuel cell is located in a compartment directly aft the engine firewall.

The baggage locker is located aft of the nacelle fuel cell compartment. The locker has a capacity of 9 cubic feet which allow 90 pounds of baggage to be carried.

The main nacelle structure, excluding the engine cowling, consists of longitudinal and lateral bulkheads riveted and sealed to the wing.

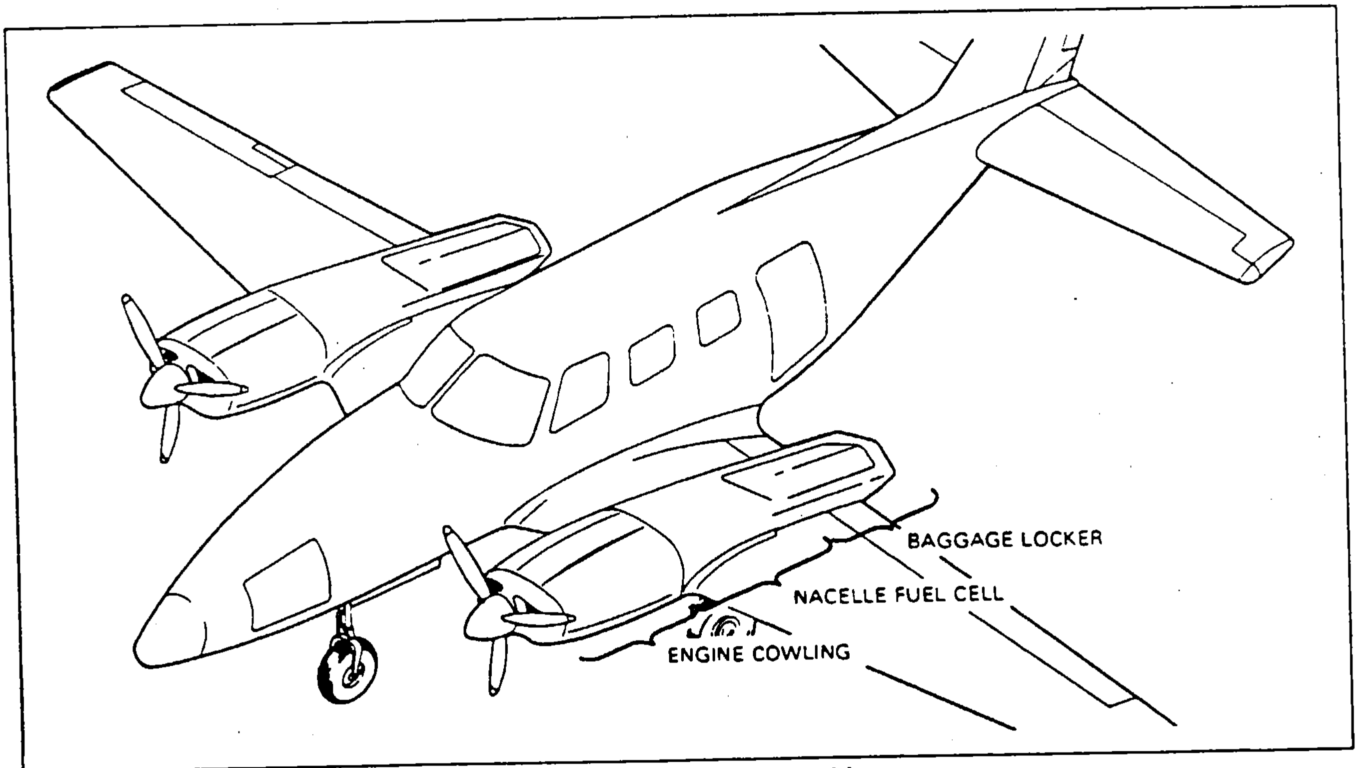


Figure 54-1. Nacelle Assembly

CHAPTER

55

STABILIZERS

CHAPTER - STABILIZERS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The stabilizers consist of the vertical stabilizer (fin), rudder, rudder trim tab, horizontal stabilizer, elevator and elevator trim tab. The control surfaces are cable controlled, and are statically balanced.

CONTROL SURFACE BALANCING.

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 as described in Removal of Elevator.
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. 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.
4. Disconnect the trim cables at the turnbuckles.
5. Through the top access hole, remove the two elevator trim cable pulleys, spacer and bolt. Draw the cables through the fuselage to this point.
6. Disconnect the elevator trim tab control tubes and deicer lines (if installed).
7. Remove the mounting bolts that attach the front spar to the fuselage bulkhead.
8. Remove the mounting bolts that attach the elevator torque tube hinge bracket and rear spar.
9. 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 the 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 tab control tubes and deicer lines (if installed).
11. Connect the trim cable ends and set cable tension. (Refer to Chapter 27.)
12. Install the elevator(s) assemblies per Installation of Elevator.
13. Check elevator trim and elevator operator. (Refer to Chapter 27 for the rigging and adjustment of elevator and elevator trim controls.)
14. Install all access plates and panels.

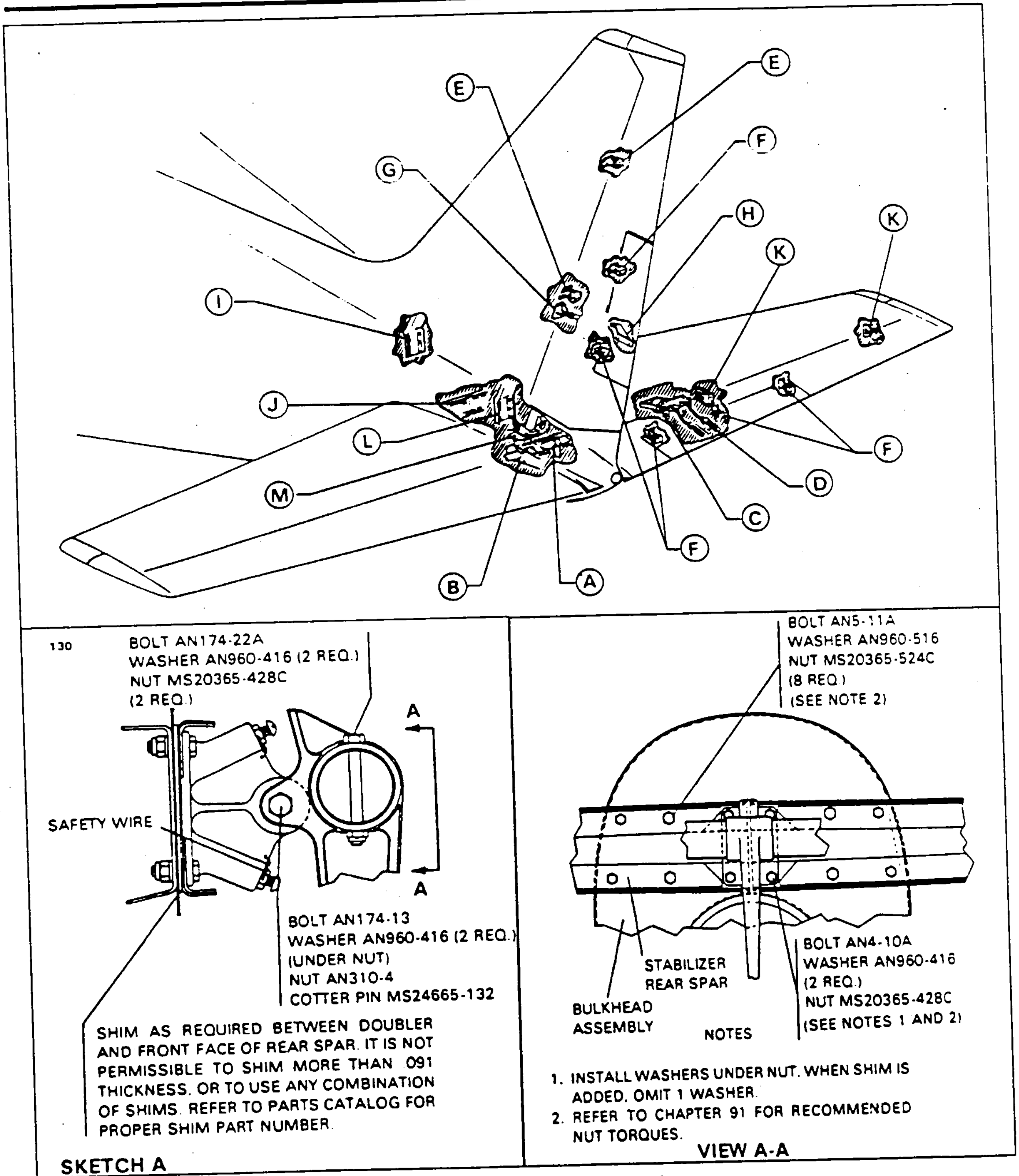


Figure 55-1. Empennage Installation

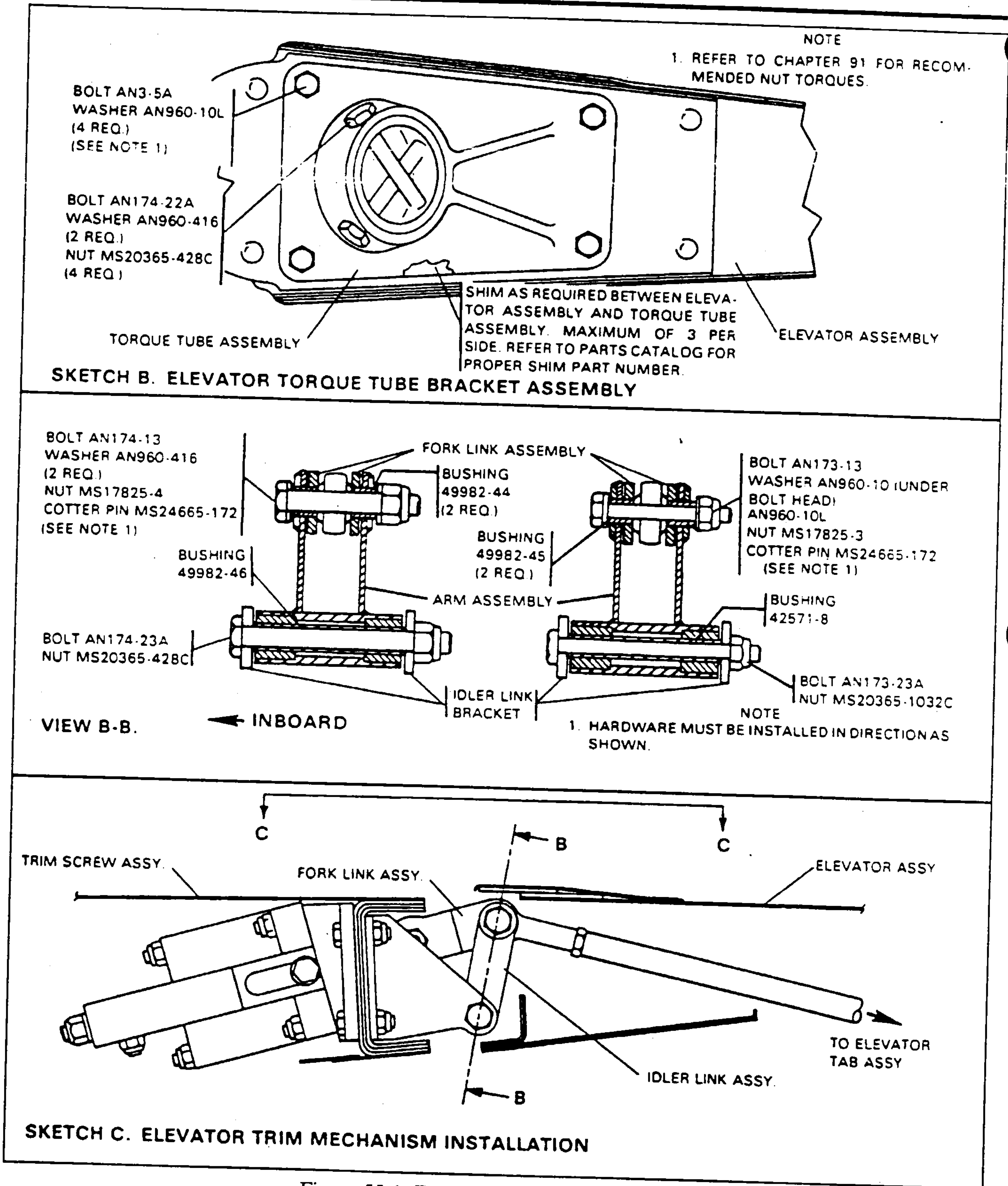


Figure 55-1: Empennage Installation (cont.)

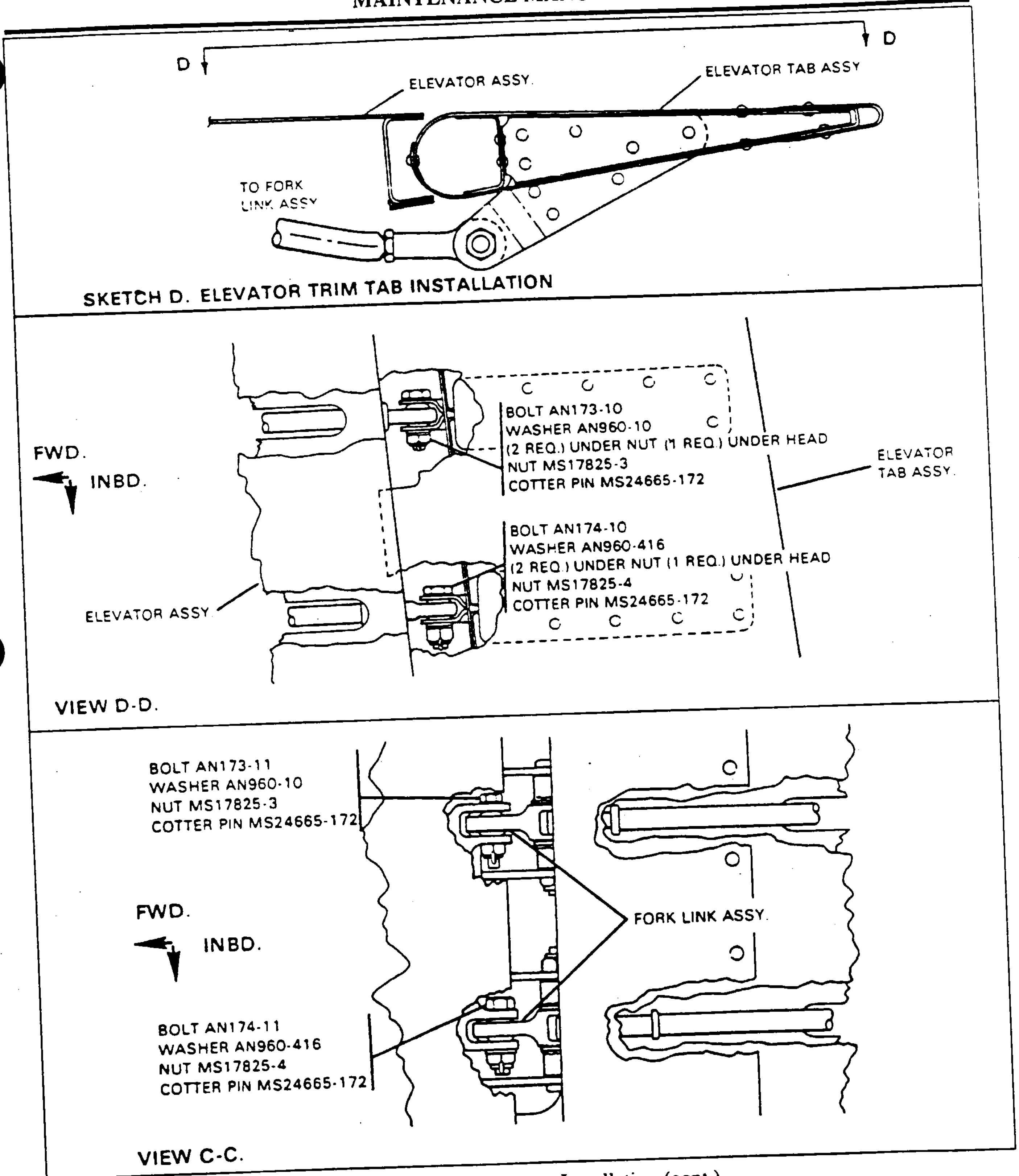
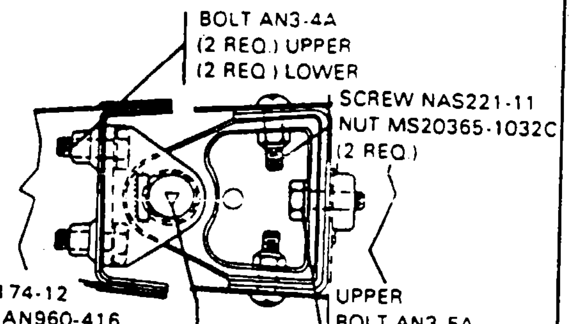
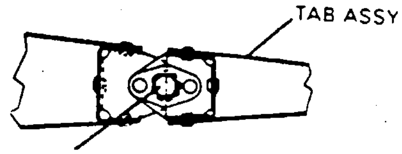


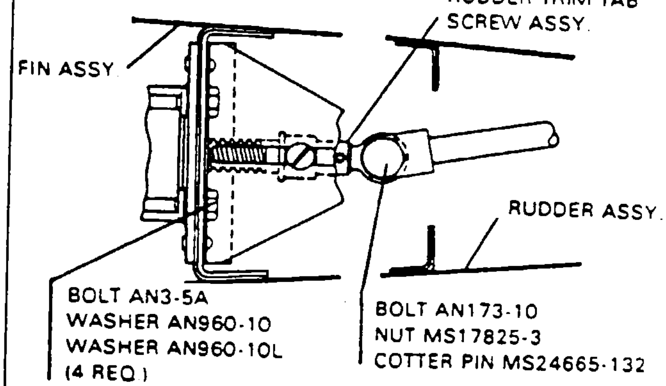
Figure 55-1. Empennage Installation (cont.)



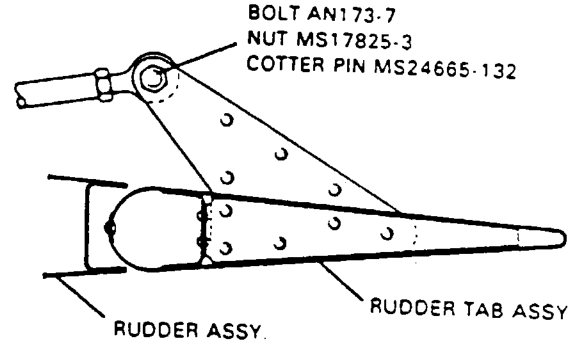
SKETCH E. RUDDER HINGE INSTALLATION



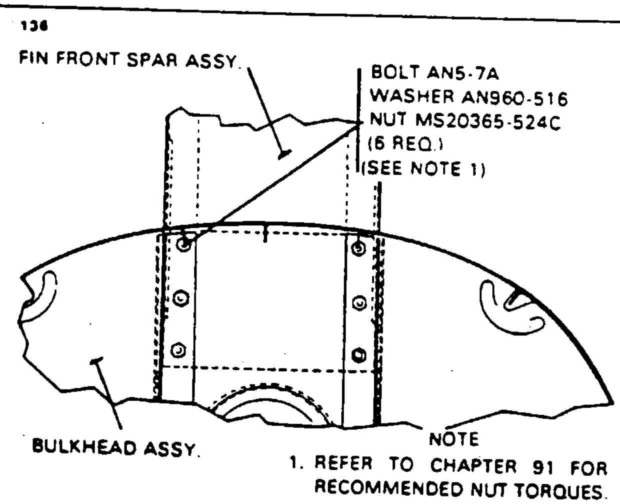
SKETCH F. RUDDER/ELEVATOR TRIM TAB HINGE



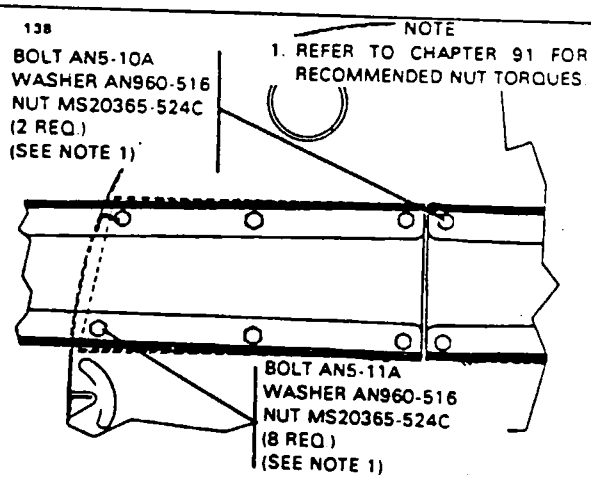
SKETCH G. RUDDER TRIM SCREW INSTALLATION



SKETCH H. RUDDER TRIM TAB INSTALLATION

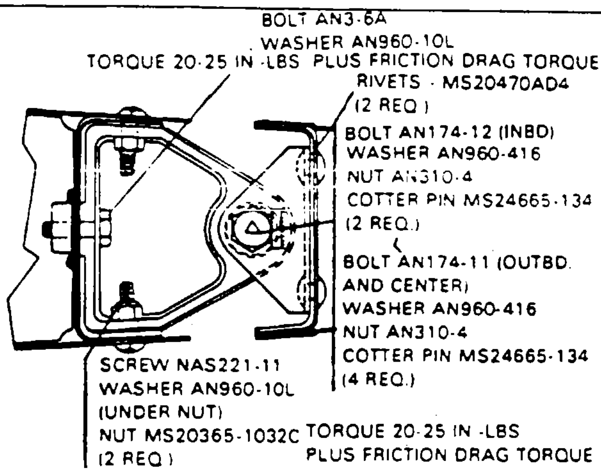


SKETCH I. FIN FRONT SPAR INSTALLATION

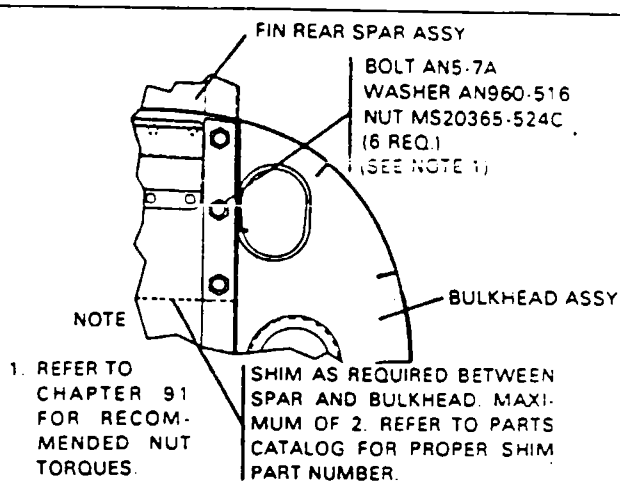


SKETCH J. STABILIZER FRONT SPAR INSTALLATION

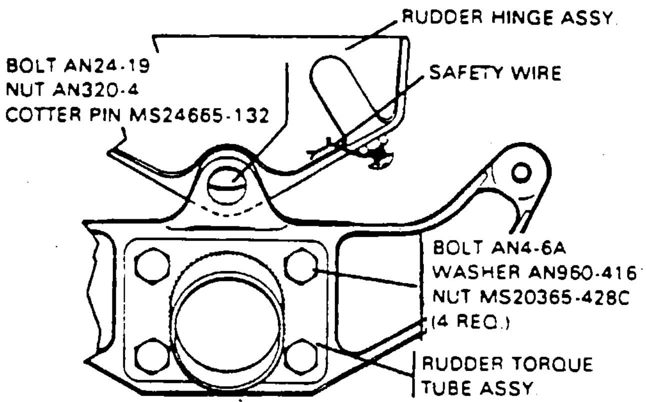
Figure 55-1. Empennage Installation (cont.)



SKETCH K. ELEVATOR HINGE INSTALLATION



SKETCH L. FIN REAR SPAR INSTALLATION



SKETCH M. RUDDER HORN INSTALLATION

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 rods.
3. Remove the bolts that attach the elevator torque tube bracket to the elevator.
4. Remove hinge bolts and remove elevator. 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 rods 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.

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 master 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, on both sides. 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.

CHART 5501. ELEVATOR BALANCE SPECIFICATIONS

Master Test Weight (Pounds)	2 @ 1.81
Master Test Weight Arm (Inches)	8.28
Static Balance Limit (Inch-Pounds Trailing Edge Heavy	40 $^{+0}_{-10}$
Weight of Lead Balance Weight (Pounds)	4.1 lbs. $^{+1.6\ oz.}_{-0\ oz.}$
Trim Weight Part Number (Left and Right)	43332
Maximum Number of Trim Weights Allowed per Side	2 per Anchor Nut
Maximum Allowable Balance Weight per Side In Pounds	4.70

NOTES:
1. This data pertains to a control surface having final base and trim paint applied.
2. Surfaces must be removed from the aircraft for balancing.

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 static balance limits. 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 in the elevator control system must not be in excess of ten pounds with 45 + - 1 pounds tension on elevator control spring with elevator in neutral position. 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.

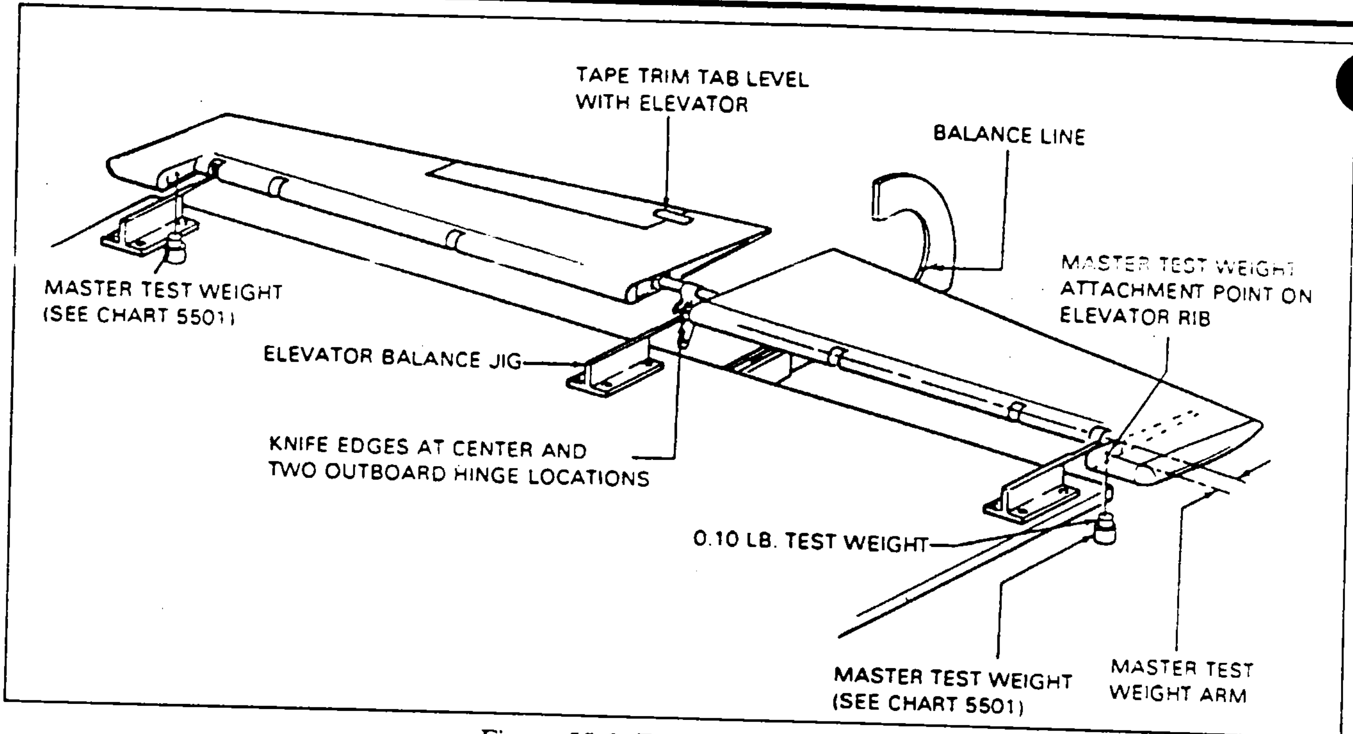


Figure 55-2. Elevator Balancing

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.*

ELEVATOR TRIM TAB.

REMOVAL OF ELEVATOR TRIM TAB. (Refer to Figure 55-1.)

1. Disconnect the control rods 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 rods, install bolts and torque.
3. For rigging and adjustment refer to Chapter 27.

ELEVATOR TRIM TAB FREE PLAY.

1. Position the trim tab so that the trailing edge of the tab is .50 inch ± .12 inch below the trailing edge of the elevator.
2. With tab positioned per Step 1, the total tab free play may not exceed .10 inch as measured between the outboard end of the tab and the training edge of the elevator.

VERTICAL STABILIZER.

REMOVAL OF VERTICAL STABILIZER. (Refer to Figure 55-1.)

1. Remove the fairing from the forward portion of the dorsal fin.
2. Disconnect the rotating beacon wire, 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 vertical stabilizer directly up from the fuselage.

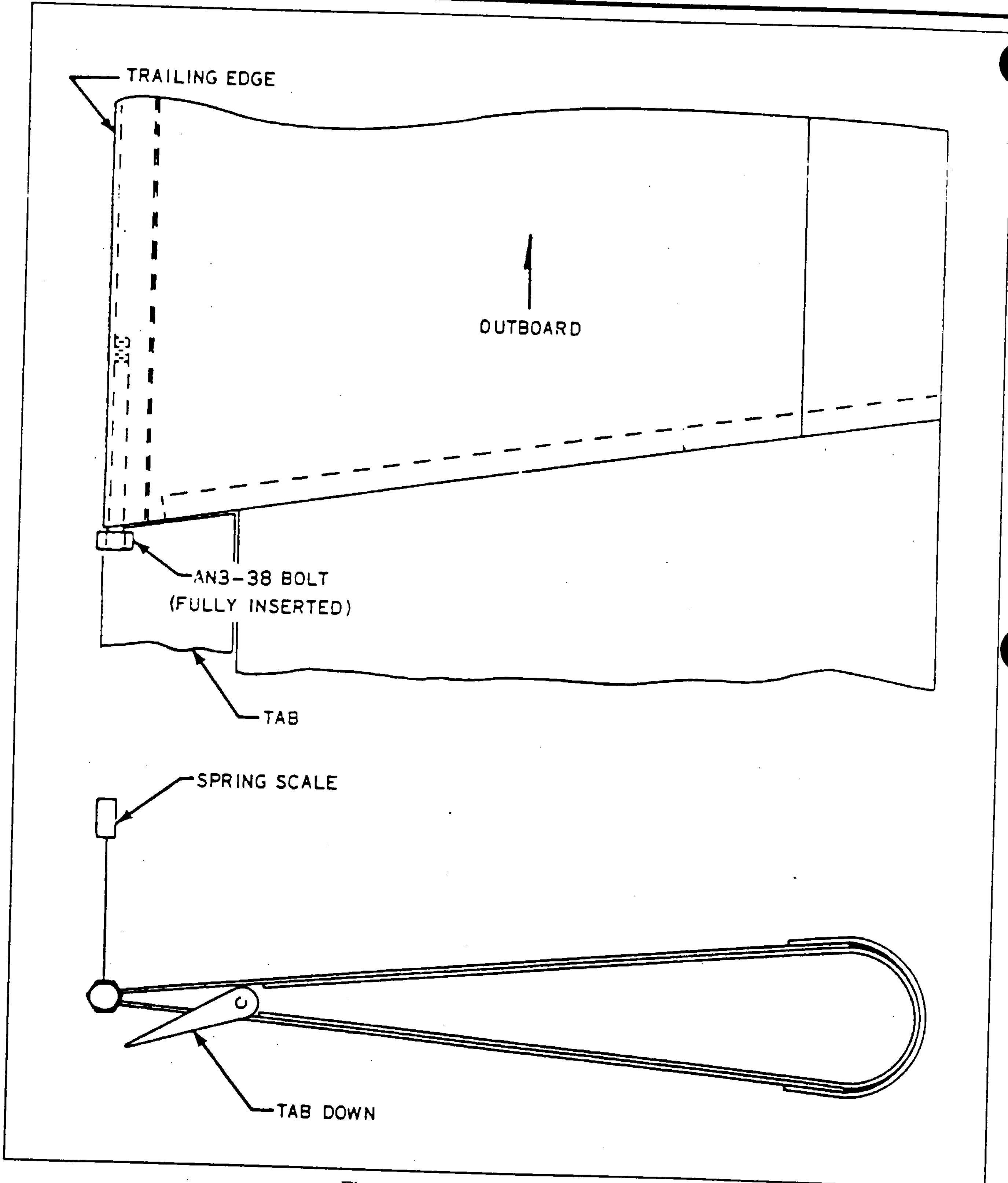


Figure 55-3. Friction Measurement

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 cable ends, remove cable blocks and set cable tension. (Refer to Chapter 27.)
13. Install the rudder.
14. Check rudder trim and rudder operation. (Refer to Chapter 27 for the rigging and adjustment of rudder and rudder trim controls.)
15. Install all access plates and panels.

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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.

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 tip support channel. 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 weight installed, 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.

CHART 5502. RUDDER BALANCE SPECIFICATIONS

Master Test Weight (Pounds)	7.76
Master Test Weight Arm (Inches)	5.03 In.
Static Balance Limit (Inch-Pounds Trailing Edge Heavy	44 $^{+0}_{-5}$ In lbs.
Weight of Lead Balance Weight (Pounds)	Not Removable
Trim Weight Part Number	53892-2
Maximum Number of Trim Weights Allowed	2
Maximum Allowable Balance Weights and Trim Weights (Pounds)	7.75

NOTES:
1. This data pertains to a control surface having final base and trim paint applied.
2. Control surface must be removed from the aircraft for balancing.

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.

9. For the rudder assembly, the trim weights are mounted below the rudder support channel. (Refer to Figure 55-5.)
10. With rudder completely reassembled, recheck the balance to insure that it is now within the proper limits.
11. Reinstall the rudder.

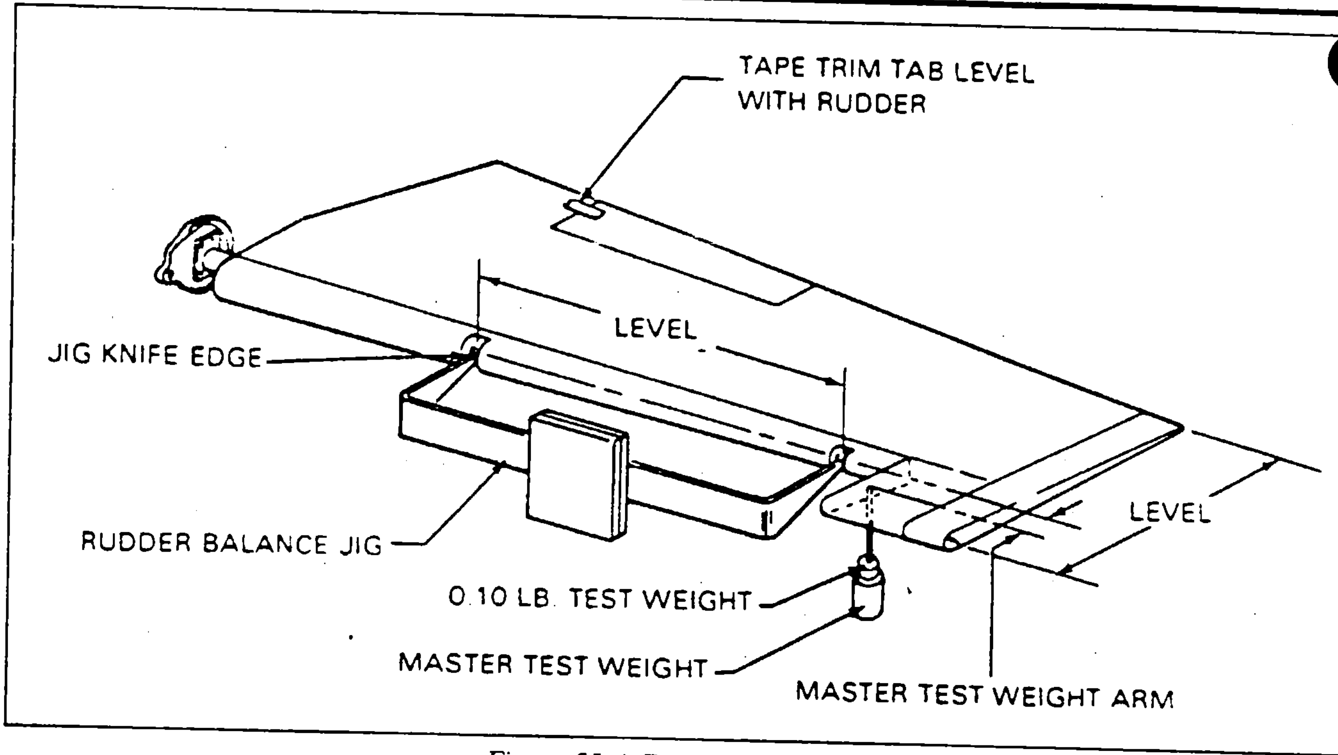

Figure 55-4. Rudder Balancing

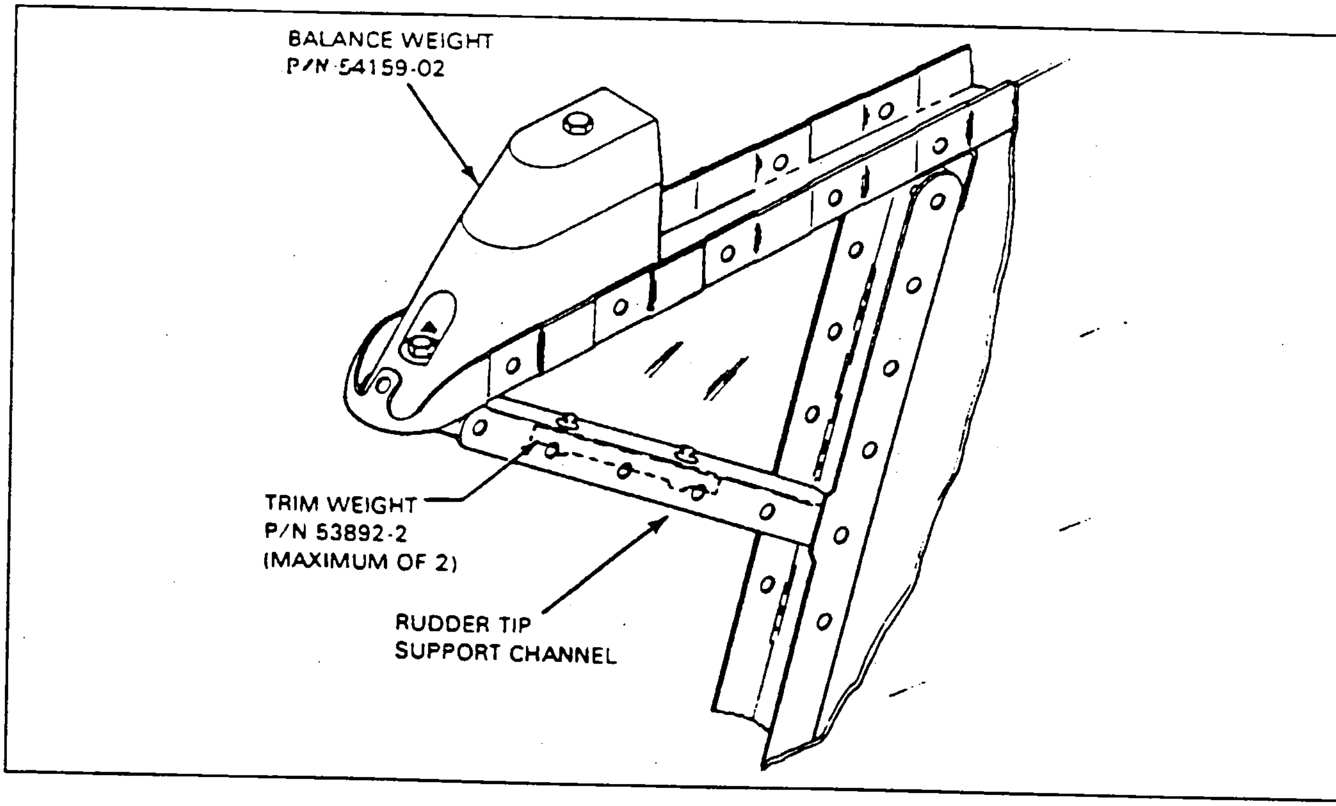

Figure 55-5. Rudder Balance Weight Location

RUDDER TRIM TAB

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.

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CHAPTER

56

WINDOWS

CHAPTER 56 - WINDOWS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter contains general information on damage limits and repair procedures for the windshields and removal installation procedures for the windshields and side windows.
The windows on this aircraft consist of a two-piece windshield, four windows along the right side and three windows along the left. A storm window is provided for the pilot.

WINDSHIELD DAMAGE LIMITS.

WINDSHIELD DELAMINATION.

Delamination is the condition which occurs when the interlayer separates from the glass. This condition may be caused by moisture penetration into the interlayer as the result of the absence, or lack of maintenance of the weather sealant around the windshield periphery.

The strength of an aircraft windshield in bending or in tension is not affected by a moderate amount of delamination. Generally, the first safety consideration in cases of delamination is reduced visibility and, in the case of a heated windshield, electrical failure. If either of these conditions exist, the windshield should be replaced .

A cloudy or "milky" appearance in the delamination indicates the presence of moisture or solvent. This type of delamination tends to be "progressive" so the windshield should be replaced at the earliest opportunity.

Delamination along the windshield periphery in the parting medium area is considered normal. A low degree of adhesion is intended in this area.

A delamination area which is characterized by an irregular or jagged boundary indicates the separation of the vinyl and glass is not uniform. Such a condition can cause the vinyl to pull chips from the inner glass surface which could lead to failure of the glass ply. If this situation occurs, it is recommended that a periodic inspection be performed to determine whether the delamination is progressive or if chipping of the inner glass surface is present. The existence of either condition would require replacement of the windshield.

Generally, a delamination which is characterized by a clear (not cloudy) smooth-edge boundary, is not progressive as the stresses causing the delamination are relieved when the delamination occurs.

WINDSHIELD/WINDOW REPAIRS.

TERMINAL BLOCK REPAIR (HEATED WINDSHIELD).

Normally terminal blocks do not require maintenance. However, if the terminal block should become separated from the windshield surface, repair as follows:

1. Clean base of terminal and glass surface with methylethylketone.
2. Apply a thin coat of PR-1221-B1/2, to the base of the terminal.
3. Place the terminal on the glass in the proper location and secure to prevent movement and to maintain intimate contact with the glass. Masking tape may be used to hold terminal block in position.
4. Remove excess PR-1221-B1/2, from edges of terminal block.
5. Allow PR-1221-B1/2 to cure for 24 hours before removing masking tape.

REPAIR OF WINDSHIELD/WINDOW SEALANT.

Although the material used in sealing the windshield is of a high quality, exposure to the natural elements, aircraft cleaning solutions, etc., over an extended period of time will cause the sealant to erode to various degrees. Although it is very difficult to repair sealants, it can be done if care is exercised.

1. The repair of a polysulfide sealant (MIL-S-7502 or MIL-S-8802) may be completed as follows:
   A. Mask the windshield and surrounding metal surfaces.
   B. Remove a layer of material to expose a fresh surface of sealant. (It is extremely important that all of the degraded outer layer be removed.)
   C. Mix sealant components per manufacturer's directions.

   — NOTE —

   Use a similar type sealant as that on the windshield

   D. Apply fresh sealant up to the original sealant level.
   E. Remove masking after the sealant starts to cure.
   F. Allow the sealant to cure completely.
2. It is very difficult to effect a good repair on silicone sealants. Therefore, repairs should be made with extreme care.

   — NOTE —

   All silicone bumpers should be of the two component type. Single component silicones that depend upon moisture for their cure, cannot be cured effectively in thick sections.

Repair silicone sealant as follows:
   A. Mark the windshield and surrounding metal surfaces.
   B. Remove all old sealant
   C. Clean the exposed surfaces to be sealed with a 50 50 solution of isopropanol and water.
   D. Prime the cavity with material recommended by the sealant manufacturer.
   E. Apply fresh sealant to fill up the original sealant level.

   — NOTE —

   Use the same sealant as originally applied.

   F. Remove masking after sealant starts to cure.
   G. Allow the sealant to cure completely before using aircraft.

FLIGHT COMPARTMENT.

WINDSHIELD.

The windshield is a three layer, tempered plexiglass assembly having Aircon NESA coating on the exterior surface. This NESA film is basically a tin oxide and provides for static electricity protection. The windshield installation consists of left and right windshield halves secured to the fuselage by a one-piece windshield collar.

REMOVAL OF WINDSHIELD (STANDARD AND HEATED).

1. Remove the windshield wiper blade and arm from the airplane by removing the safety wire from the bolt holding the arm to the wiper motor and the cotter pin from the pivot bolt.
2. Remove the magnetic compass from the inside center post of the windshield.
3. Remove the cover panel on top of the instrument panel.
4. Remove the inside windshield molding. On heated windshields, disconnect electrical leads.
5. Remove the existing sealant from around the locknuts on the windshield.
6. Remove the machine screws from around the collar moldings. This will require the assistance of another person.

— NOTE —

The machine screws which hold the windshield in position are installed in a particular order of sizes, and when removed, a note of their location should be made to insure the proper installation of the various sizes.

7. Remove the collar molding and the windshield.
8. With the windshield removed, the eyebrow bulkhead should be cleaned to remove all traces of old sealant before reinstalling the windshield.

INSTALLATION OF WINDSHIELD (STANDARD AND HEATED).

1. Surface preparation of the windshield collar, support channel and eyebrow bulkhead shall be accomplished as follows:
   A. All parts to be sealed should be thoroughly cleaned with Methylethylketone (MEK) or Aliphatic Naphtha.

— NOTE —

Aliphatic Naphtha is preferred as it will not damage painted surfaces or acrylic (Plexiglass) windows.

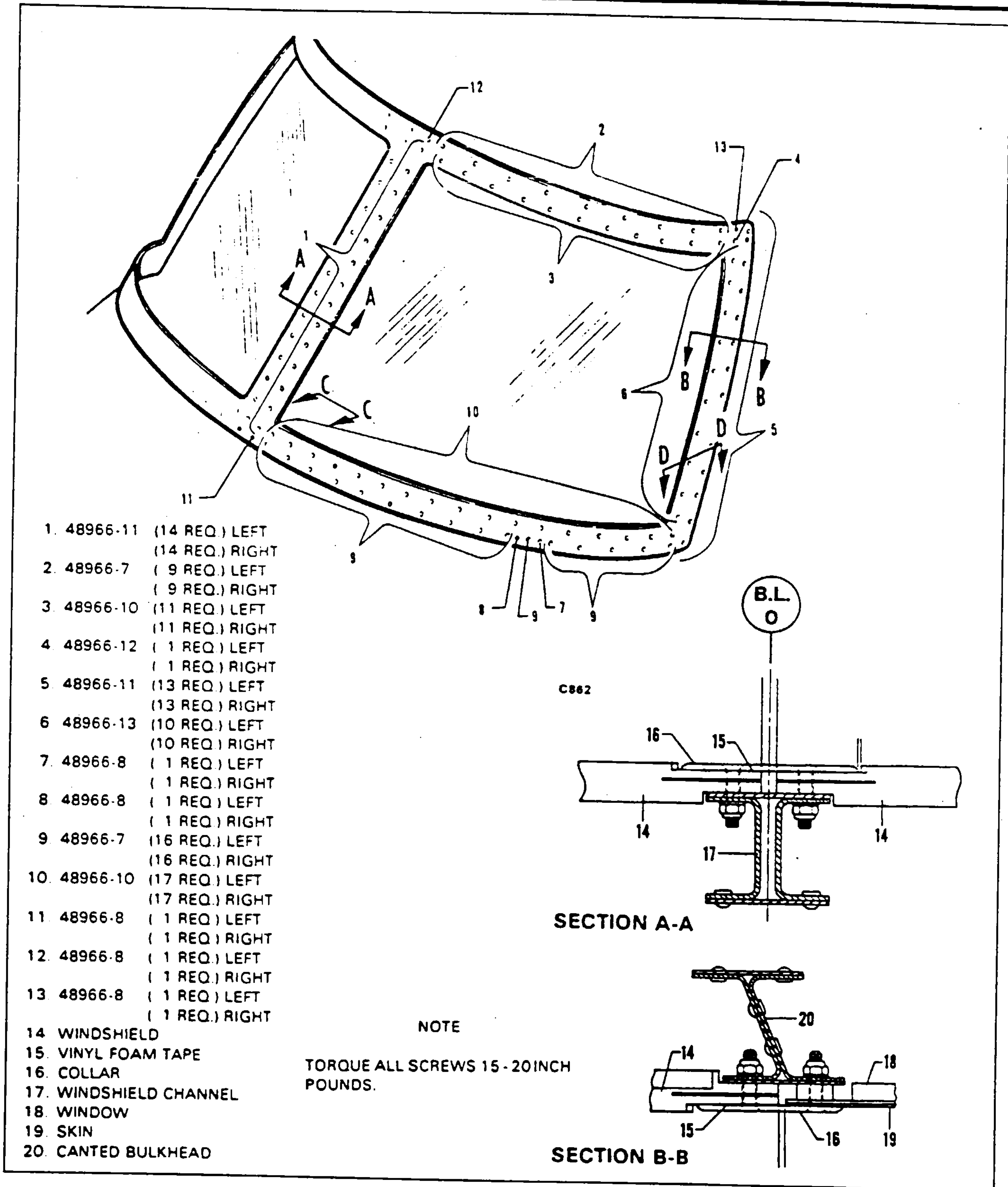
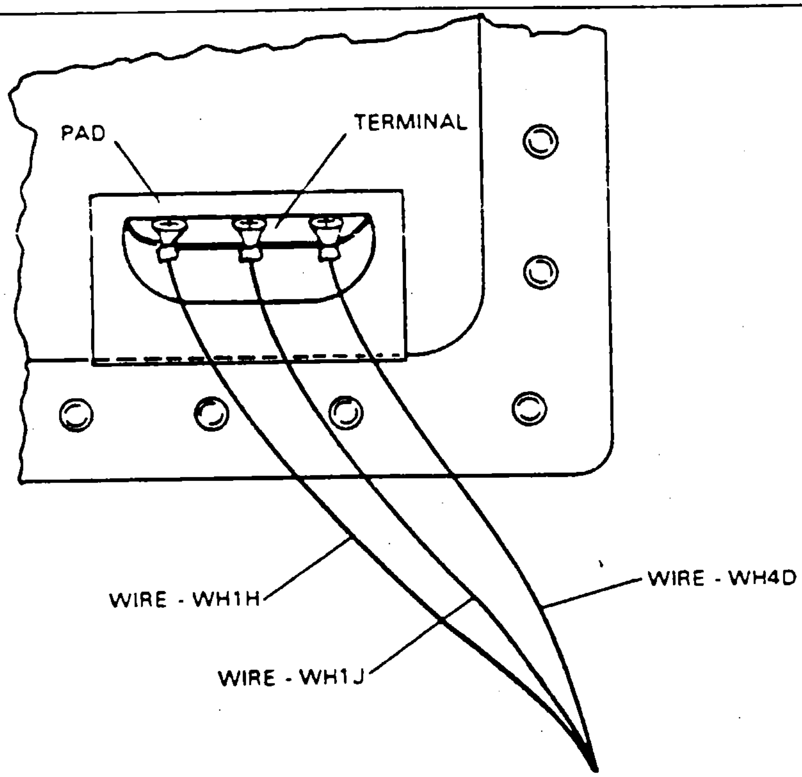
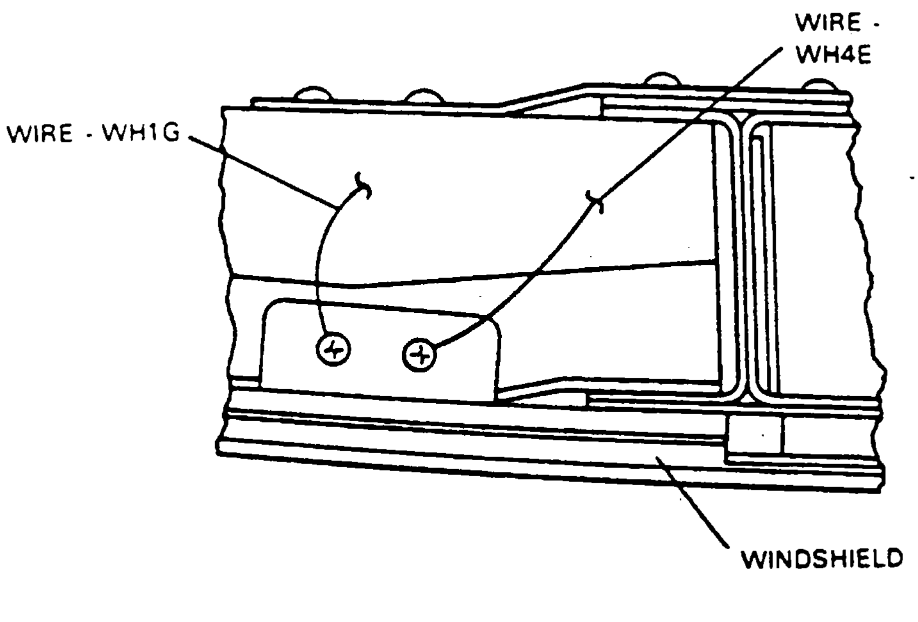


Figure 56-1. Windshield Installation



VIEW C-C. HEATED PILOT'S WINDSHIELD WIRE TERMINAL



VIEW D-D. HEATED PILOT'S WINDSHIELD WIRE TERMINAL

Figure 56-1. Windshield Installation (cont.)

B. All parts, sub-assemblies, and assemblies to be sealed shall be alodined and primed with zinc chromate, except pressurized air duct work, airboxes, etc., which shall be alodined only.
C. Remove all filings, chips, loose dirt, and other foreign objects on the surfaces to be sealed by forced air or vacuum cleaning and brush.
D. Clean all surfaces or voids to be sealed, to remove all fingerprints, oil or grease. To clean, wipe the affected areas with naphtha, using a clean cotton cloth. The cleaned surfaces should be wiped dry immediately and not allowed to dry.

— CAUTION —

When using these cleaning solvents in a closed area, forced ventilation must be used to protect personnel from toxic fumes.

E. It is essential that clean cloths be used for cleaning. When a cloth becomes soiled, it should be discarded. To avoid contamination of the cleaning solvent, it should be poured on the cloth. Repeat the cleaning procedures above until it is certain no contaminates are left on the surfaces to be sealed.

— NOTE —

The important of proper cleaning prior to applying sealant cannot be overemphasized. Sealant will not adhere properly to a dirty, oily surface. The entire purpose of the sealant is defeated if it lifts from the structure after it has been applied.

2. Mask the windshield optical surface and fuselage skin around the windshield collar area to minimize cleanup.
3. Apply one inch wide, 1/16 inch thick vinyl foam tape (Norton Co., Tape No. V542, Piper No. 924 441) to the outer surface of the windshield, even with the edge and covering the holes.
4. Position the windshield into the eyebrow bulkhead from the outside.
5. Apply a bead of sealant to the frame on each side of the outer collar attachment holes.
6. Seal between the left and right windshields.
7. Position the windshield collar over the windshield and cleco in place using 50% of the holes to attach the collar to the fuselage and 5 or 10 clecos to hold each windshield haft to the collar.
8. Secure with screws, washers and locknuts, beginning at the center top corner moving downward, then outboard both at top and bottom. Torque 15-20 inch-pounds and clean excess sealant.

— NOTE —

Refer to Figure 56-1, for proper screw location.

9. Apply a bead of sealant around the inner collar chamfer and windshield. Remove excess sealant with the appropriate sealant removal tool. (Refer to Figure 56-2.)
10. On heated windshield installations, connect the electrical leads.
11. Install the inside windshield moulding and the top cover over the instrument panel.
12. Install the magnetic compass to the windshield center post.

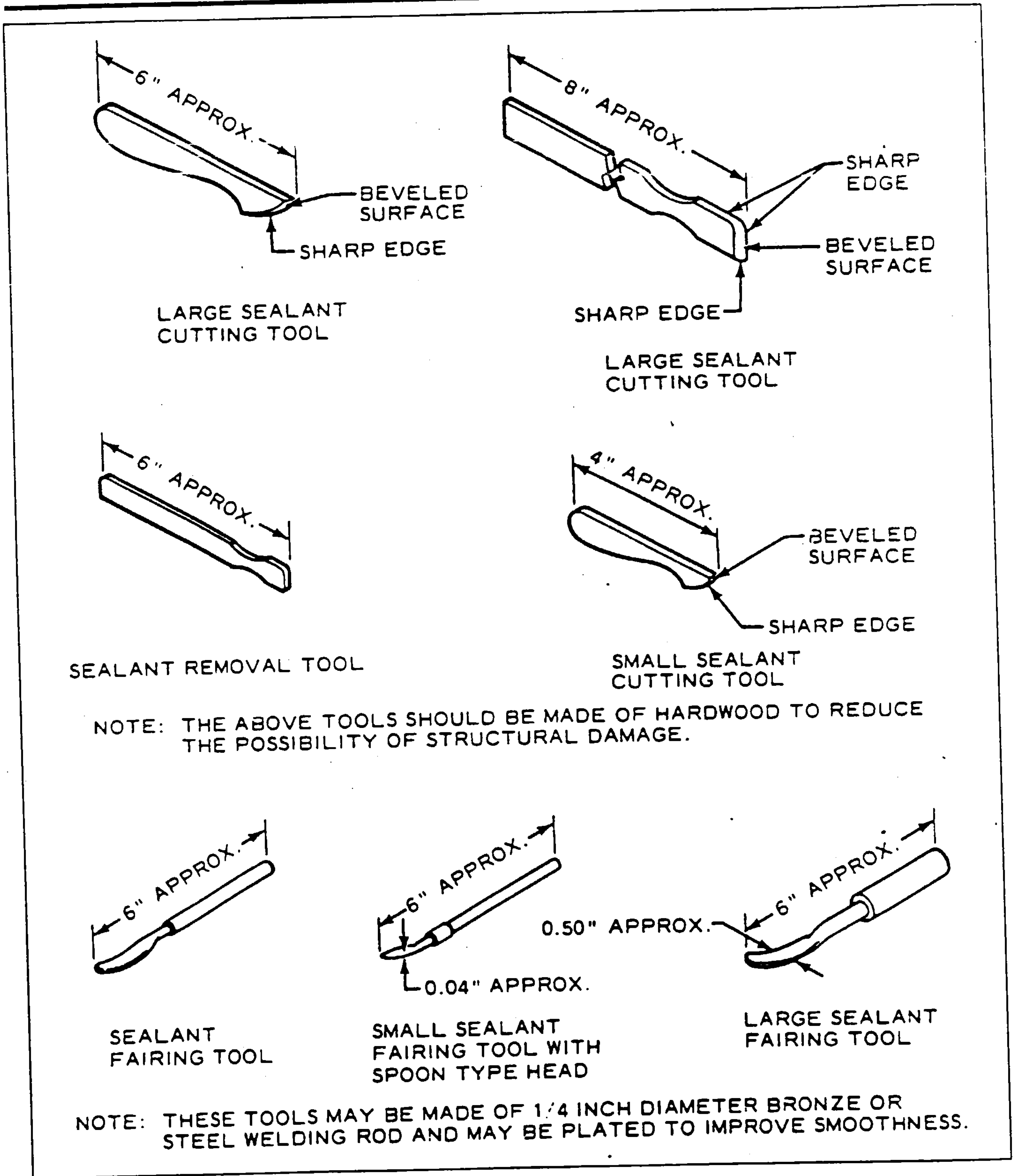


Figure 56-2. Fabricated Sealant Tools

13. Install the windshield wiper blade and arm and safety wire arm to converter with MS20995-C4 lockwire.

— *NOTE* —

In order to ensure adequate time for the sealant around the windshield to cure, do not pressurize the cabin for at least 48 hours.

HEATED WINDSHIELD FUNCTIONAL CHECK.

1. Connect a 24-volt test light to the positive and negative terminals of the windshield.
2. Set the switch marked "Windshield Heat" to the ON position. The test light should light indicating current is being delivered to the windshield.
3. Place your hand against the windshield to determine that the windshield heating element is operating.
4. The test light should go out before the windshield becomes too hot to hold your hand against it. This indicates that the temperature sensing element is operating properly and has passed through its thermostatic ON-OFF cycle.

— *CAUTION* —

Exercise caution during ground operation to prevent overheat and possible damage to the windshield.

5. When check is completed, set the "Windshield Heat" to the OFF position and remove the test light.

PILOT'S STORM WINDOW.

A storm window is provided in the pilot's side window. This storm window consists of a circular. "stretched" plexiglass window installed in a stainless steel (Type 321) window frame with a push-button latch.

REMOVAL OF PILOT'S STORM WINDOW.

1. With the storm window open remove the six (6) equally spaced screws which secure the storm window inner ring and trim ring to the side window assembly.
2. Remove the storm window assembly from inside the cabin.

NOTES

1. SEAL BETWEEN INNER RING AND TRIM RING WITH SEALANT MIL-S-7502B. REMOVE EXCESS OR VISIBLE SEALANT.
2. SEAL BETWEEN WINDOW AND TRIM RING WITH SEALANT MIL-S-7502B. REMOVE EXCESS OR VISIBLE SEALANT.
3. SPLICE IN SEAL MUST BE AT TRAILING EDGE OF WINDOW. CUT SEAL .75 IN. LENGTH AT SPLICE AND CEMENT ENDS TOGETHER WITH 3M #EC-847 CEMENT.
4. CEMENT SEAL TO RETAINER WITH 3M #EC-847 CEMENT.

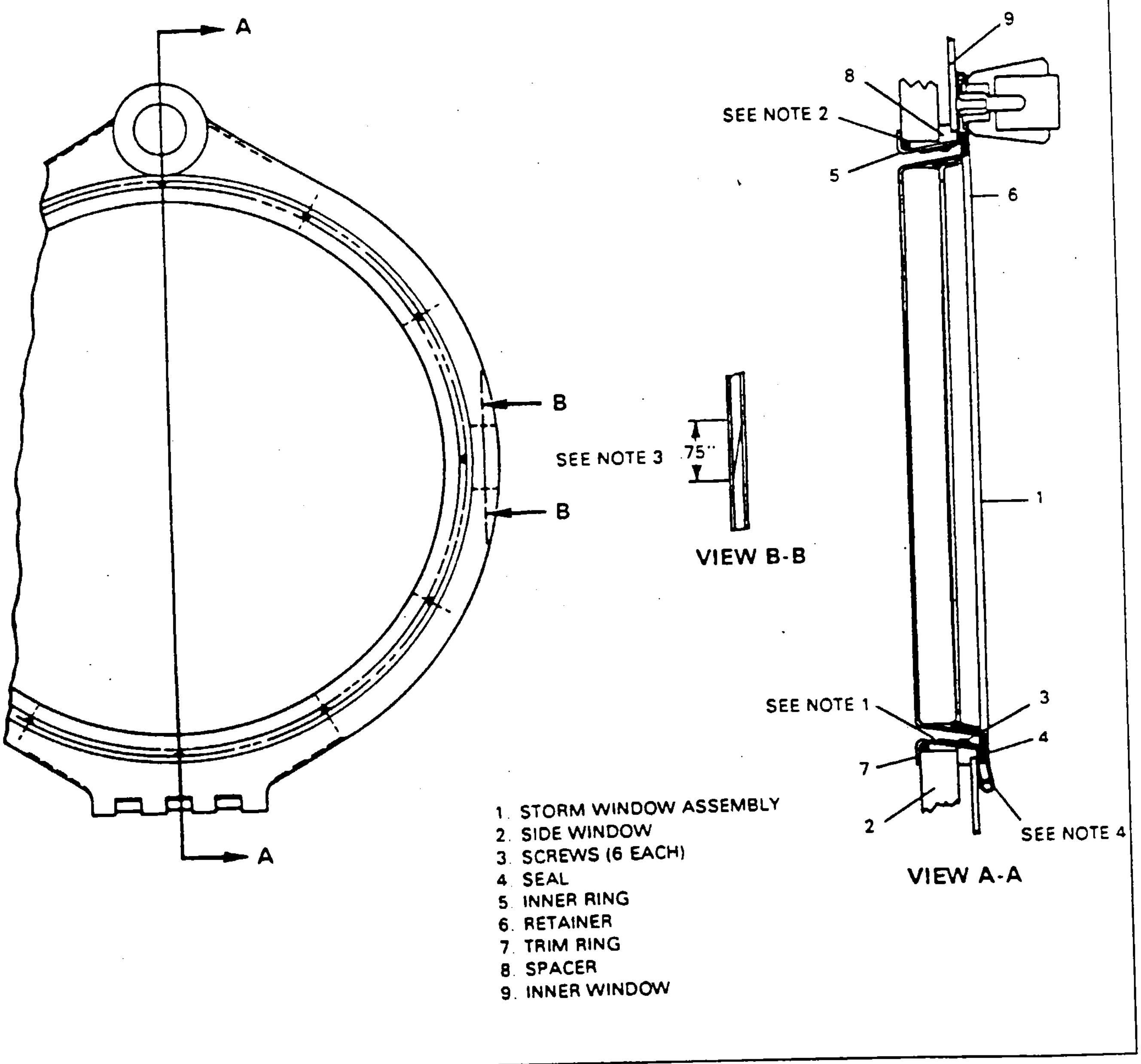


Figure 56-3. Storm Window Installation

INSTALLATION OF PILOT'S STORM WINDOW.

1. Position spacer (Piper P / N 51225) as shown in Figure 56-3. It is permissible to use EC-1357 cement as an aid in securing the gasket to the window prior to installation.
2. Apply sealant (MIL-S-7502B) to the trim ring as shown in Figure 56-3, and position the trim ring in the storm window opening.
3. Apply sealant (MIL-S-7502B) to the outer rim of the inner ring on the storm window assembly and place the window assembly into position in the opening.
4. Align holes in storm window inner ring with holes in trim ring and secure with six retaining screws.

CABIN.

CABIN SIDE WINDOWS.

The cabin side windows consist of 0.31 inch "stretched" plexiglass panes having equidistant mounting holes drilled around its periphery. The window pane is then mounted to the fuselage skin with machine screws, washers and self-locking nuts.

REMOVAL OF CABIN SIDE WINDOWS.

1. Remove the trim moulding and inner window assembly from around the inside of the window.
2. Remove the sealant from around the locknuts securing the window to the fuselage.
3. Remove the locknuts and washers from the screws and remove the screws.
4. Remove the window by pushing it into the cabin.
5. Remove all traces of old sealant from around the window frame.

INSTALLATION OF CABIN SIDE WINDOWS.

1. Apply a bead of sealant (MIL-S-7502B) around the inside of the window frame.
2. Install the window from inside the cabin.
3. Install machine screws and secure with washers and locknuts. Torque to 15 to 20 inch-pounds.
4. Install the trim moulding and inner window assembly around the inside of the window.

—NOTE—

Allow the sealant to cure thoroughly before pressurizing the fuselage.

—END—

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CHAPTER

57

WINGS

CHAPTER 57 - WINGS

TABLE OF CONTENTS/EFFECTIVITY

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 fiberglass 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.

The wing tip is constructed of fiberglass and provides mounting for the Recognition and Position Lights. Attachment to the wing is provided by means of phillips head screws.

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 5 l .

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.

WING ATTACH FITTINGS.

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 72.)
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.

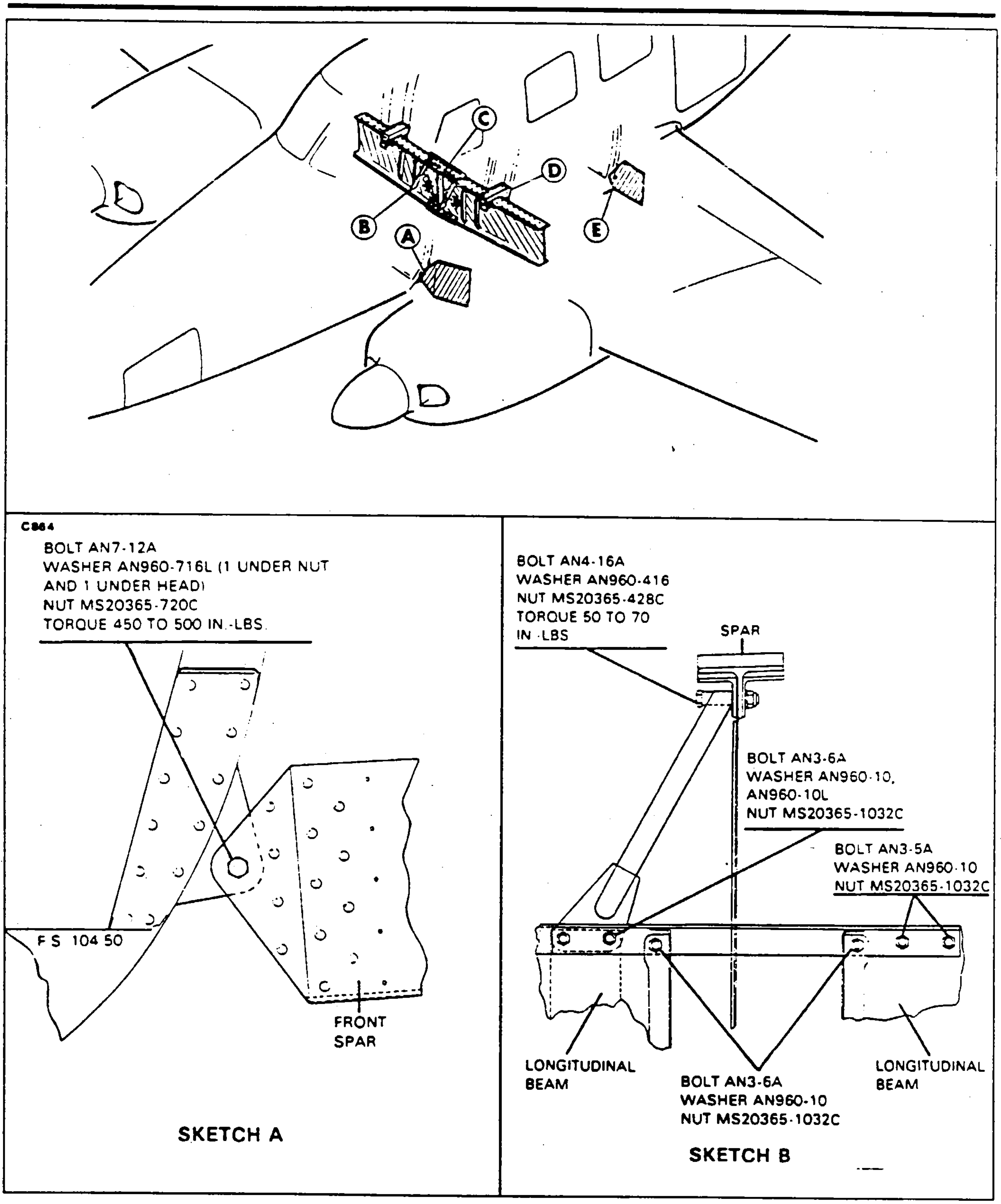

Figure 57-1. Wing Installation

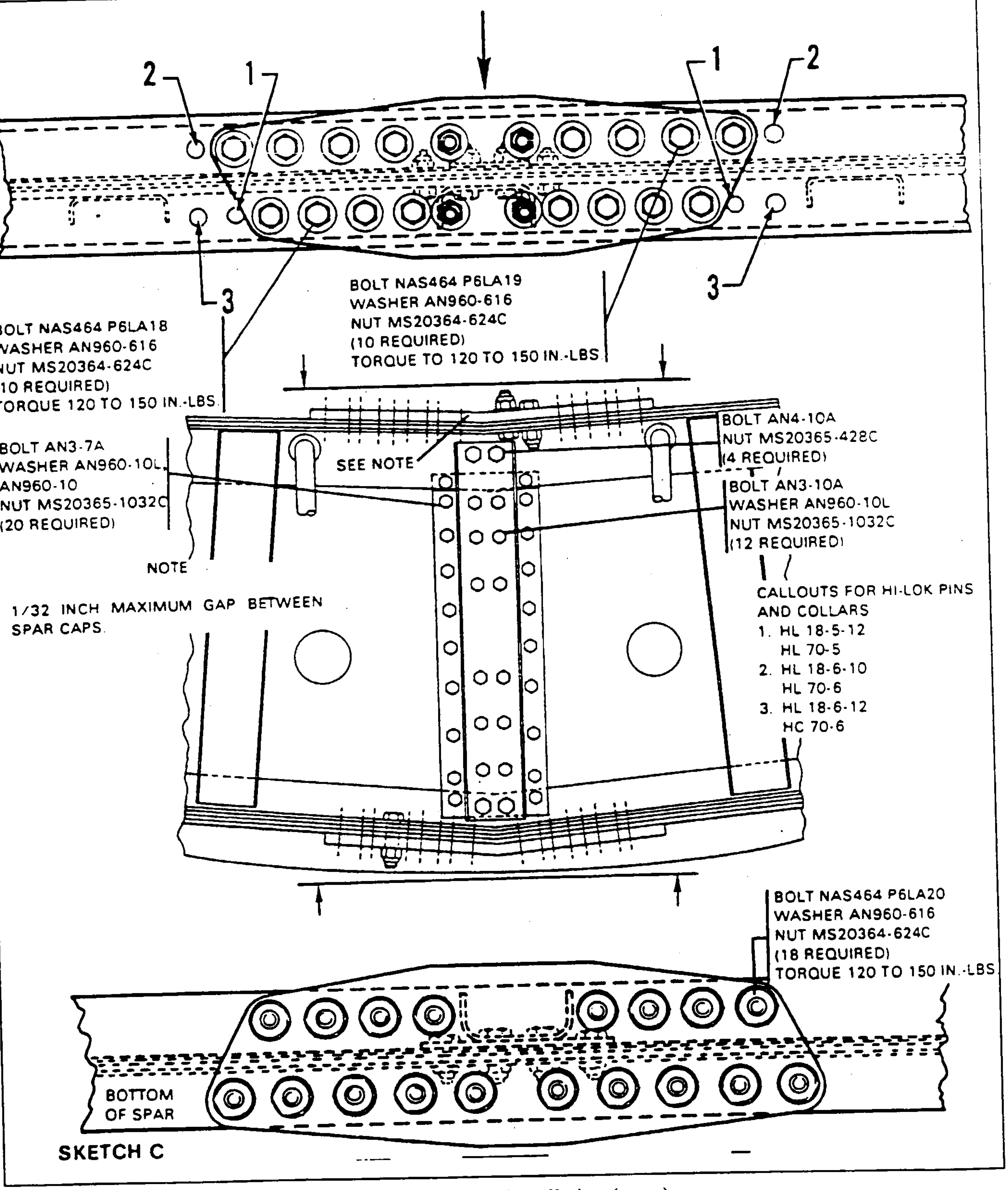

Figure 57-1. Wing Installation (cont.)

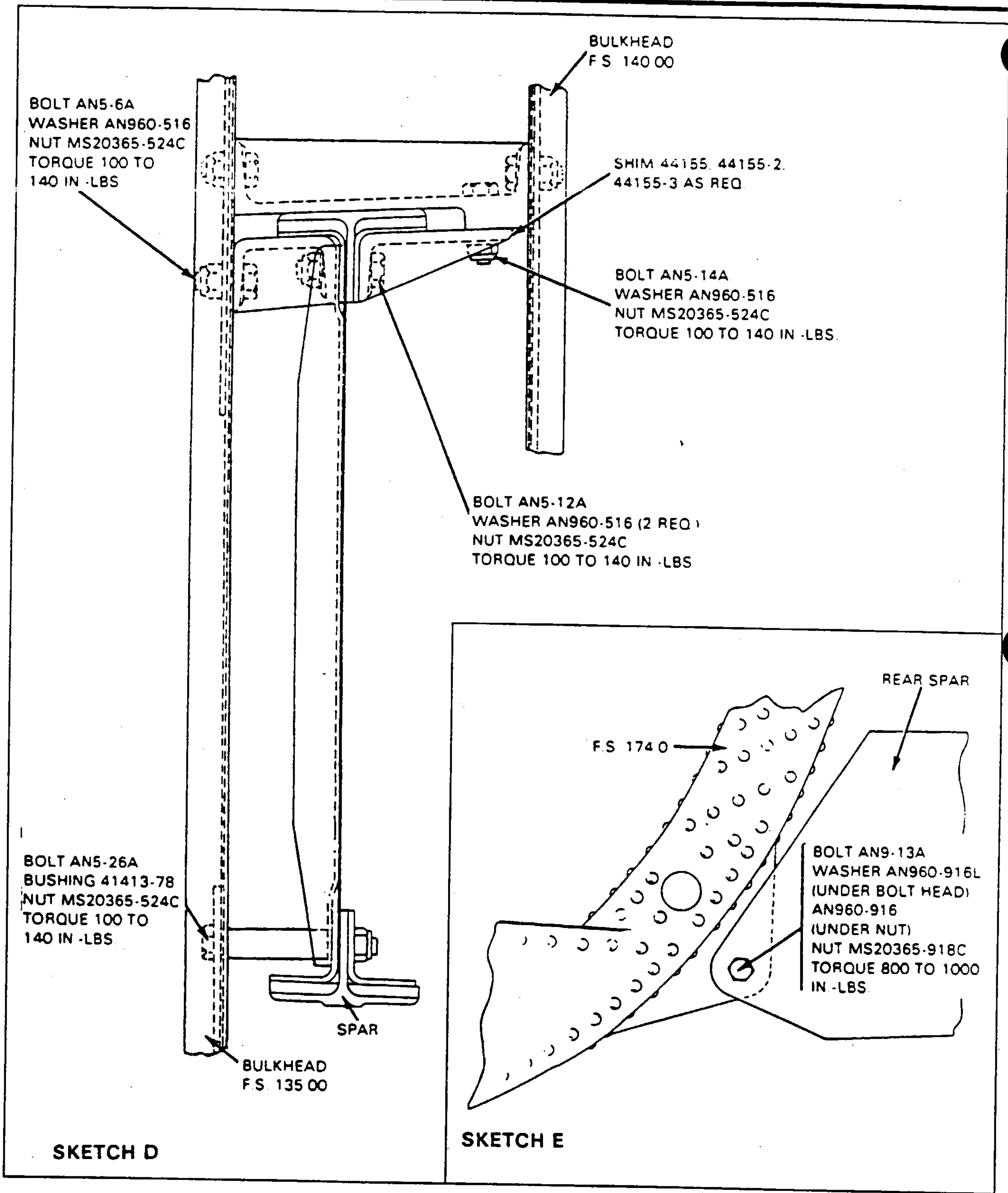

Figure 57-1. Wing Installation (cont.)

5. Remove the access plates from the fairing located between the underside of the wing butt and fuselage and the access plate to the spar splice located on the underside of the fuselage.
6. Within the fuselage, remove the fuel control panel and 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.

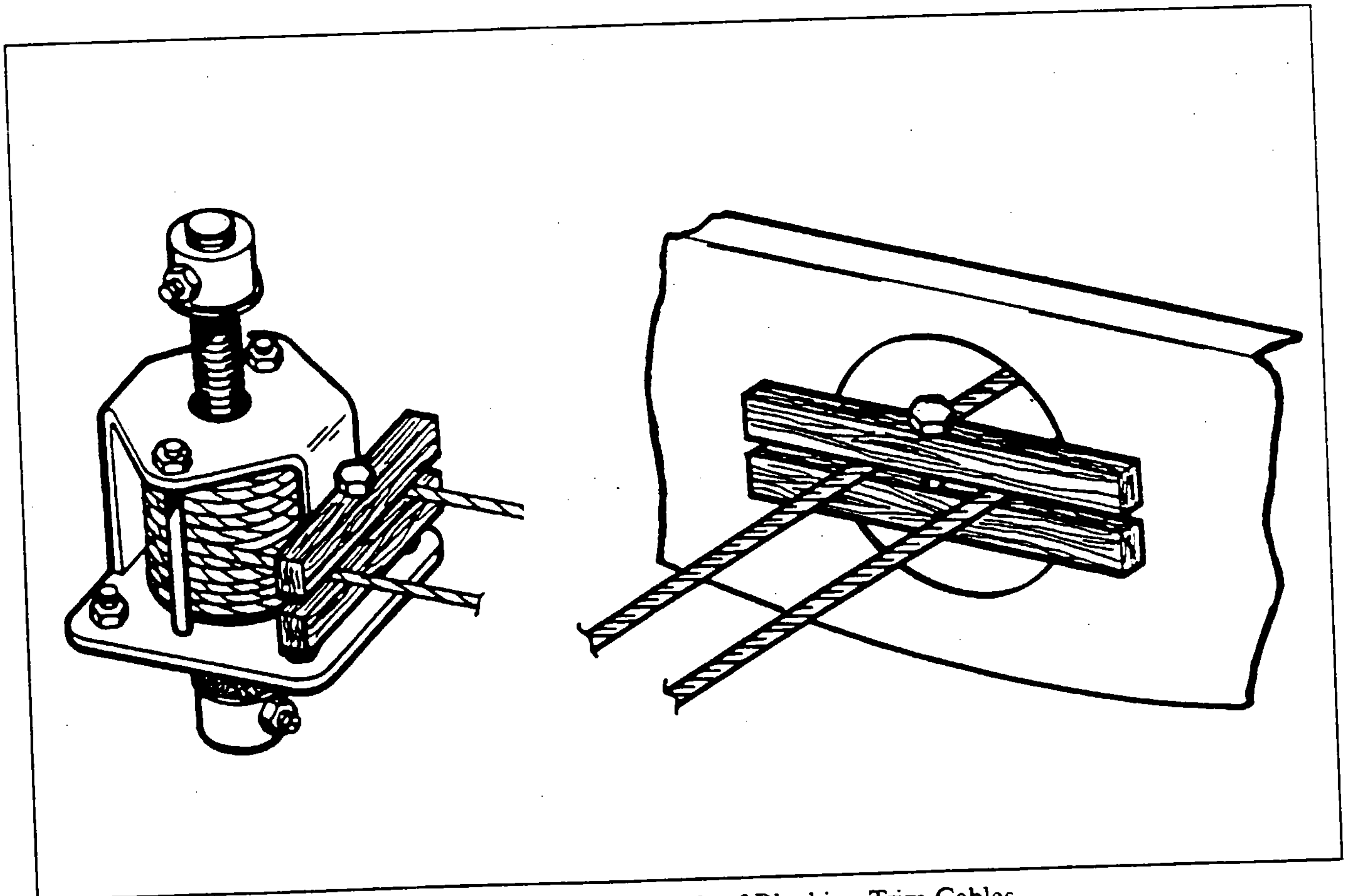

Figure 57-2. Typical Methods of Blocking Trim Cables

A. Disconnect the primary control cables at the turnbuckles located at stations 100 and 110.5 between the left forward side trim panel and control pedestal. Drawing the cables back through the spar. Remove the elevator cable guard pin at station 121.38 to allow the cable ends to pass through.
B. Remove the left aileron cable guard pin at station 164.51.
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 rib 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 removal of the cable.
C. Remove the access panels at 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 at stations 308.75 and 287.50. Draw the cables forward through the main spar, to allow the cables to be drawn through the fuselage. Remove the cable guard pins from stations 243.25 and 262, also remove the rub blocks from stations 137, 162.60, 174 and 215.
D. Block the aileron trim cable at the side of the 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 the cable guard at the butt end of the wing and tape the cables out of the way at the fuselage.
E. Disconnect the hydraulic lines at stations 100 and 140.
F. Disconnect the bleed air and freon lines.

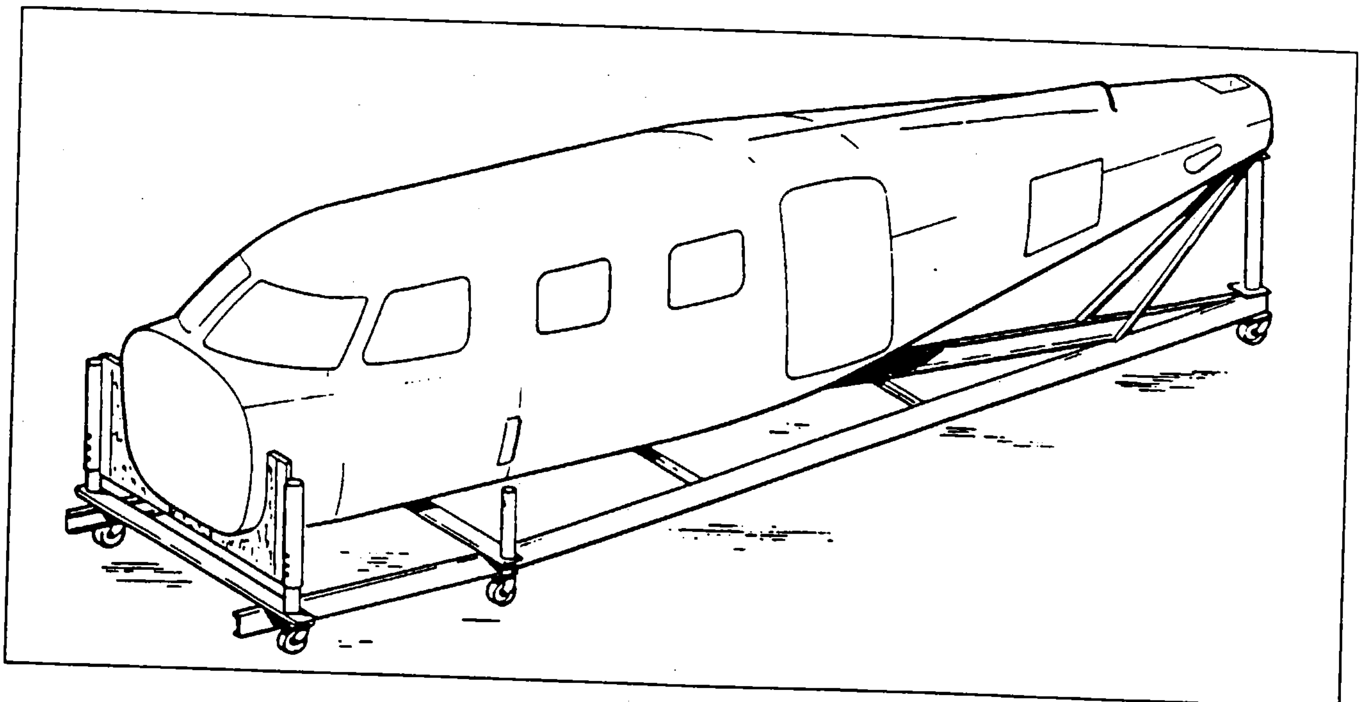

Figure 57-3. Fuselage Cradle (Typical)

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 underside 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 fire wall, engine nacelle and wing.
15. Arrange a suitable fuselage cradle and supports for both wings.
16. Remove the fuel control panel cover, bracket, lever assembly, and unbolt and remove the angle support that extends 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. (Refer to Figure 57-1.)
13. Install the fuel control panel.
14. Draw the engine control cables into place.
15. 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.

16. Connect electrical wire connectors.
17. Through the wing fairing access openings at the underside of the fuselage, connect the fuel and hydraulic lines and fuel valves control cables.
18. Draw flap control cable into position, ascertain rigging is set (refer to Rigging and Adjustment of Flap Controls. Chapter 27) and secure cable.
19. Connect the air pressurization and deicer lines.
20. If the right wing is being installed, the following items pertain to the installation of the right wing only:
    A. Connect the freon lines and evacuate and recharge the system. (See Chapter 21.)
    B. Route the hydraulic lines through the main spar and connect to their respective fittings at stations 140 and 100.
    C. Draw the aileron trim cables into the wing, connect turnbuckles 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.
21. 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 100 and 110.50. Install the cable guard pins for the left aileron cable at station 164.51 and the elevator cables at station 121.38. Check rigging and adjustment, cable tension (refer to Rigging and Adjustment of Aileron, Elevator and Rudder, Chapter 27) and safety turnbuckles.
22. Install engine (refer to Installation of Engine, Chapter 72).
23. 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.
24. Check brake fluid level, bleed brakes (refer to Bleeding Brakes. Chapter 12) and ascertain that there are no fluid leaks.
25. Check fuel system for leaks and flow.
26. 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.
27 At the fairing between the underside of the fuselage and wing, insert the retaining screws that draw the fairing against the underside of the wing butt and fuselage.
28. Reinstall access plates and panel at the underside of fuselage and wing and leading edge of wing.
29 Install the floor panels and spar covers.

HI-LOK PIN INSTALLATION AND REMOVAL. (Refer to Figure 57-4.)

— *NOTE* —

Refer to Hi Shear Catalog for further information and a complete list of power and hand tools to aid in the removal and installation of Hi-Lok fasteners.

1. Install Hi-Lok pins and collars as follows:
   A. If a new hole was drilled, deburr and insert Hi-Lok pin in hole.
   B. Manually turn the Hi-Lok collar onto pin.
   C. If using Hi-Lok power tools, insert the hex wrench tip of the power driver into the pin hex recess, and the socket over collar hex. Press the power driver against the collar and operate until the collar's wrenching device has been torqued off.
   D. Check the protrusion of the threaded end for the limits given in Figure 57-4. Hi-Lok protrusion Gauge, part number 2-1522 offers a convenient method for checking pin protrusion limits.
2. Remove Hi-Lok pins and collars as follows:
   A. Grasp collar with pliers.
   B. Insert Allen hex wrench in hex end of pin.
   C. Turn collar with pliers
   D. Remove collar and pin.

— *NOTE* —

Hi-Lok pins can be reused if not damaged during removal.

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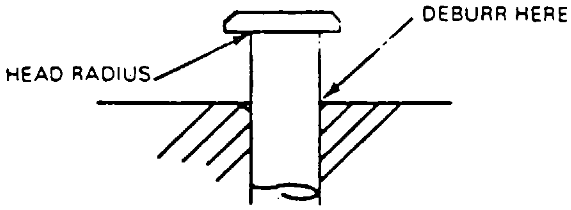
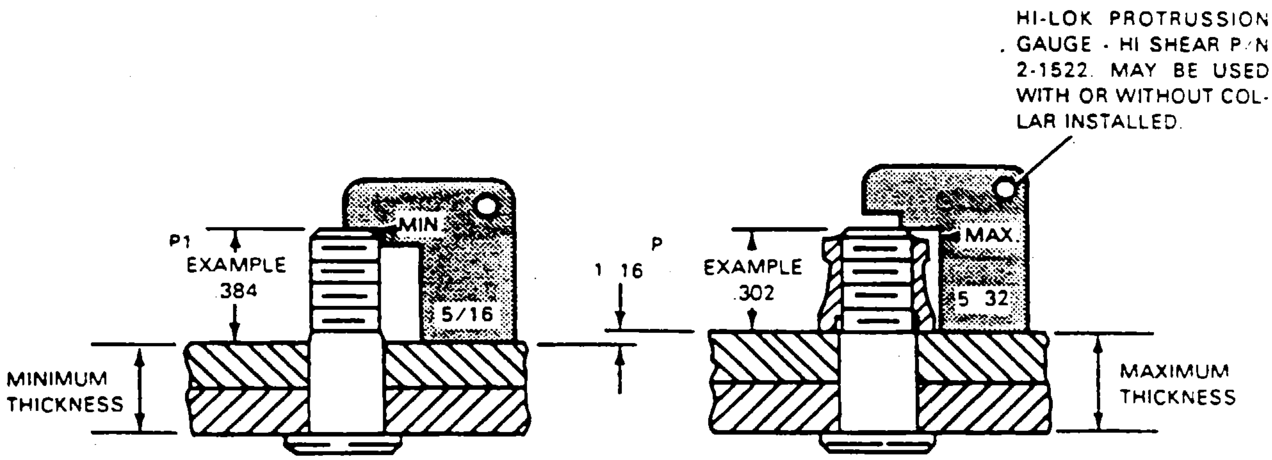


NOTE

THE HI-LOK PIN HAS A SLIGHT RADIUS UNDER ITS HEAD AFTER DRILLING. DEBURR THE EDGE OF THE HOLE. THIS PERMITS THE HEAD TO FULLY SEAT FOR EXAMPLE. THE HL-18-6 SERIES HAS A 015 025 RADIUS

TYPE OF HI-LOK PIN	(R)
HL-18-5 (SERIES)	015 025
HL-18-6 (SERIES)	



MINIMUM GRIP
(Maximum Protrusion)

MAXIMUM GRIP
(Minimum Protrusion)

MAXIMUM GRIP LENGTH OF PIN IN 16ths

EXAMPLE HL-18-5-19

STANDARD HI-LOK PIN		MINIMUM PROTRUSION	MAXIMUM PROTRUSION
FIRST DASH NUMBER	NOMINAL DIAMETER	P	P1
-5	5 32	302	384
-6	3/16	315	397

Figure 57-4. Hi-Lok Fastener Installation

FLIGHT SURFACES.

AILERON.

REMOVAL OF AILERON. (Refer to Figure 57-5.)

1. Remove the access plate to uncover the aileron weight.
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 57-5.)

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. Install the wing tip access plate removed.
5. Check aileron for proper operation. Refer to Chapter 27 for rigging and adjustment procedure.

AILERON BALANCING PROCEDURE. (Refer to Figure 57-6 and Chart 5701.)

1. Remove the aileron from the airplane.
2. Place the aileron on a balancing jib as illustrated in Figure 57-6. Establish a horizontal reference mark which aligns with the training 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. Fabricate a master test weight. (Refer to Chart 5701.)
5. Hang the master test weight on the forward attachment bolt of the balance weight.
6. If the aileron balances with the master test weight installed, it is at the minimum static balance limit and is satisfactory.
7. If the aileron is leading edge heavy with the master test weight installed, material must be removed from the surface balance weight until a balanced condition is obtained. This would also result in the lower static balance limit.
8. If the aileron is trailing edge heavy with the master test weight installed, it must be determined that the aileron does not exceed the upper static limits. (Refer to Chart 5701.) The following instructions should be used to determine the extent of unbalance:
   A. Add individual 0.1 pound test weights to the master test weight until the aileron balances.
   B. If the number of 0.1 pound test weights does not exceed the maximum allowable, the aileron is within the static limits and is satisfactory. (Refer to Chart 5701.)
   C. If the number of 0.1 pound test weights added to the master test weight to balance the aileron exceeds the maximum allowable per Chart 5701, the aileron balance exceeds the static limits allowable. The reason for the excessive unbalance must be determined: the unbalance must be corrected and the aileron re-checked.
9. With the balance check complete, install the assembly on the aircraft

CHART 5701. AILERON; BALANCE SPECIFICATIONS

Master Test Weight (Pounds)	0.0 to 0.50 lbs..	
Master Test Weight Arm (Inches)	6.00 in.	
Static Balance Limit (Inch-Pounds) Trailing Edge Heavy	0+0 –3 in.-lbs..	
Weight of Lead Balance Weight (Pounds)	Right Left	4.75 lbs. 3.9 lbs.
Trim Weight Part Number	54395-3	
Maximum Number of Trim Weights Allowed Per Side	2	
Maximum Allowable Balance Weights and Trim Weights (Pounds) Per Side	Right Left	7.75 lbs. 7.75 lbs.

NOTES:
1. This data pertains to a control surface having final base and trim paint applied.
2. Control surface must be removed from the aircraft for balancing.

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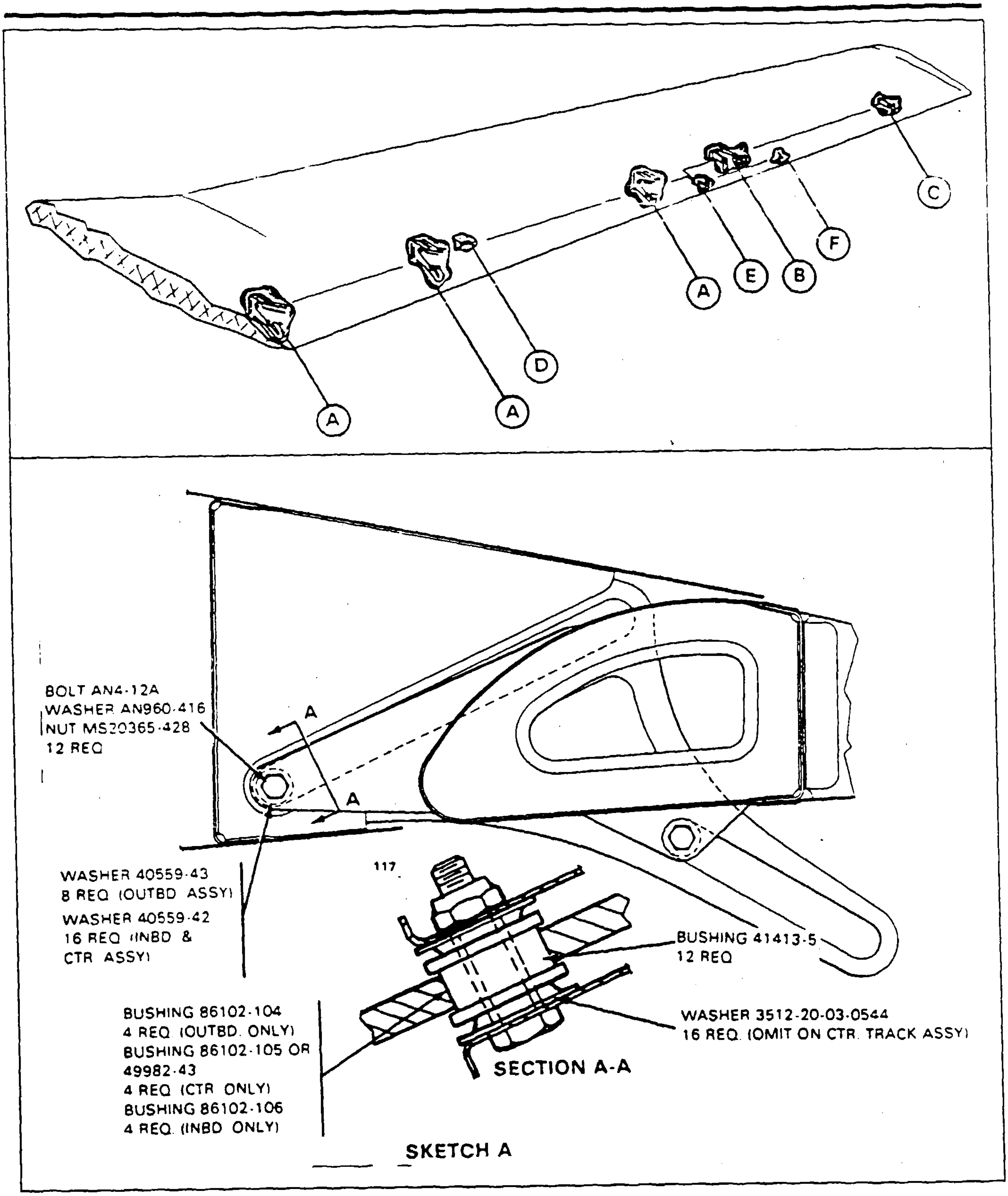


Figure 57-5. Aileron and Flap Installation

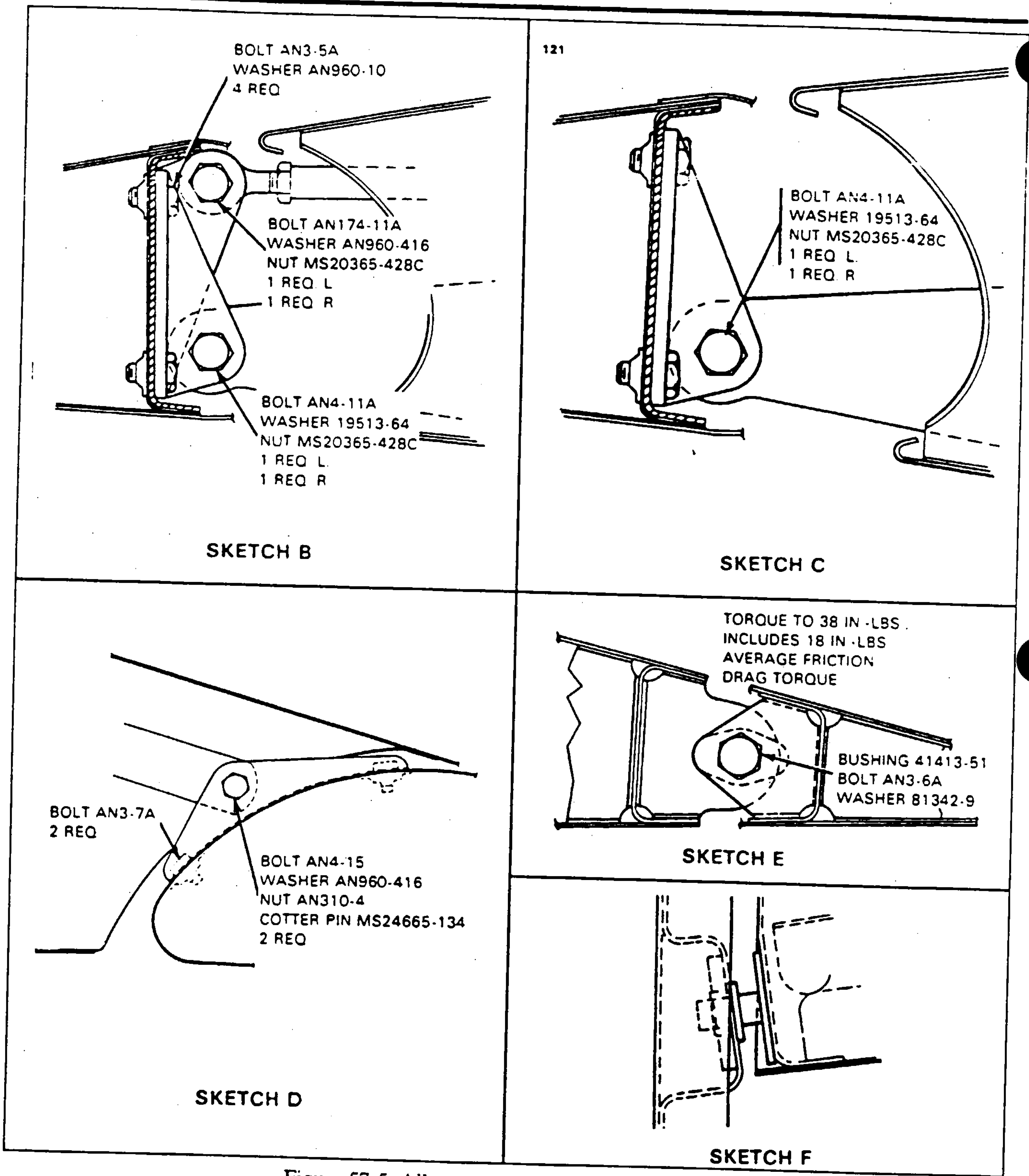


Figure 57-5. Aileron and Flap Installation (cont.)

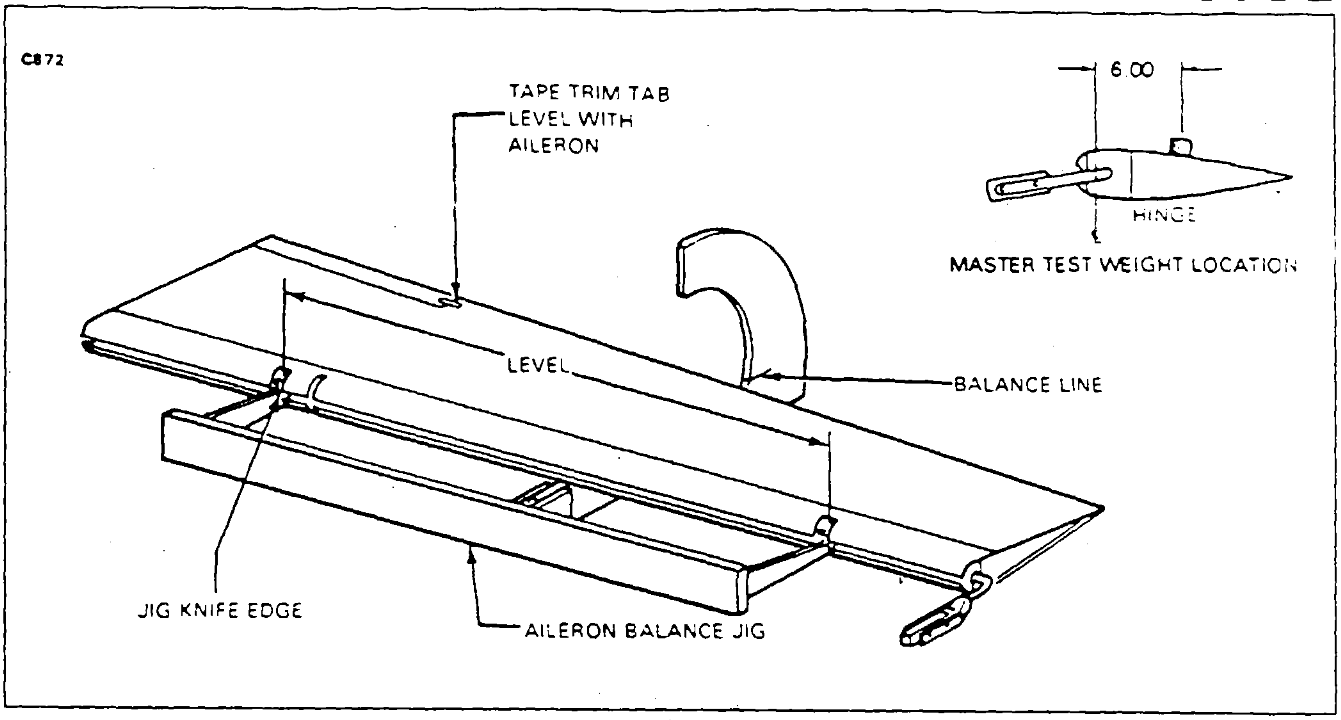


Figure 57-6. Aileron Balancing

AILERON TRIM TAB.

REMOVAL OF AILERON TRIM TAB. (Refer to Figure 57-5.)

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 57-5.)

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 inch-pounds: includes .18 inch-pounds average friction drag torque
3. Connect the tab control rod.
4. Check tab for proper operation. (Refer to Chapter 27 for rigging and adjustment procedures.)

FLAP.

REMOVAL I. OF FLAP. (Refer to Figure 57-5.)

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 57-5.)

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 —

CHAPTER

61

PROPELLER

CHAPTER 61 - PROPELLER

TABLE OF CONTENTS/EFFECTIVITY

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 moue the blades into low pitch. Opposing these two forces are blade counterweights, and the force produced by compressed gas between the cylinder head and the piston in the propeller dome, which tends to moue the blades into high pitch and feather in the absence of governor oil pressure.

PROPELLER ASSEMBLY.

MAINTENANCE.

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.

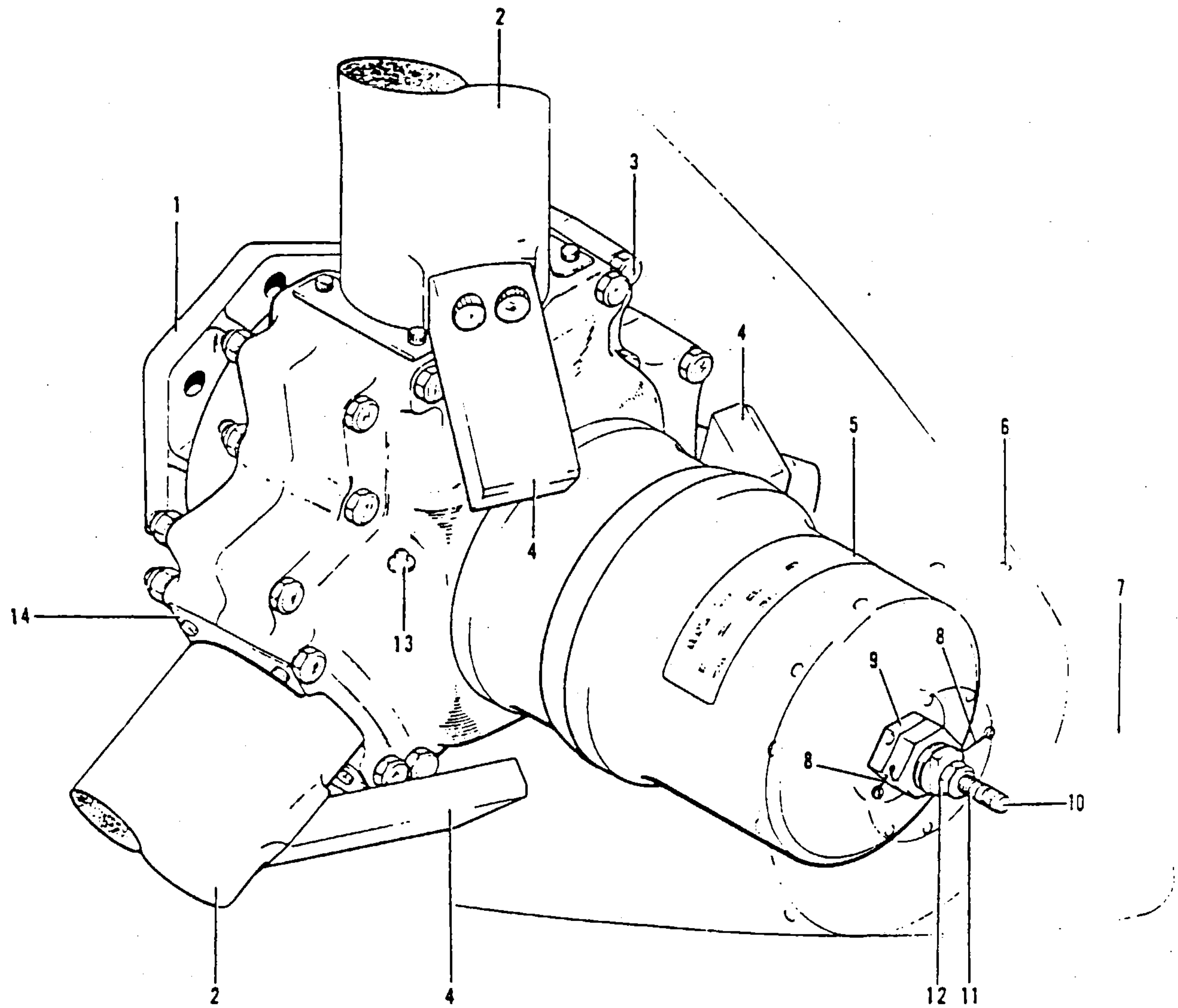
4. If the airplane is equipped with a propeller deicer system, disconnect electrical leads.
5. Place a drip pan under the propeller to catch oil spillage.
6. Cut the safety wire around the propeller mounting studs and remove the studs from the engine flange. The nuts are frozen and pinned to the studs, 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 6l-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 (refer to the latest revision of Hartzell instructions No. 130) 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.



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 (30" Sta.) (3 Blades)	Low Pitch (High RPM) High Pitch (Low RPM) Feather	9.4° ± 0.1° 14.0° ± 16.0° 80.0° ± 0.5°
Propeller RPM Setting	Engine Static High RPM	2600 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 Stop Jamb Nut	27-33 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.

6. Charge the cylinder through 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 high pressure core #5230 in the cylinder dome assembly requires replacement, DO NOT USE low pressure automotive type valve core. Schrader air valve #645A 6 is optional on this propeller assembly.***
2. ***Do not check pressure or charge with propeller in feathered position.***

7. Test for leaking by using a soap solution or equivalent and applying it around the valve 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.

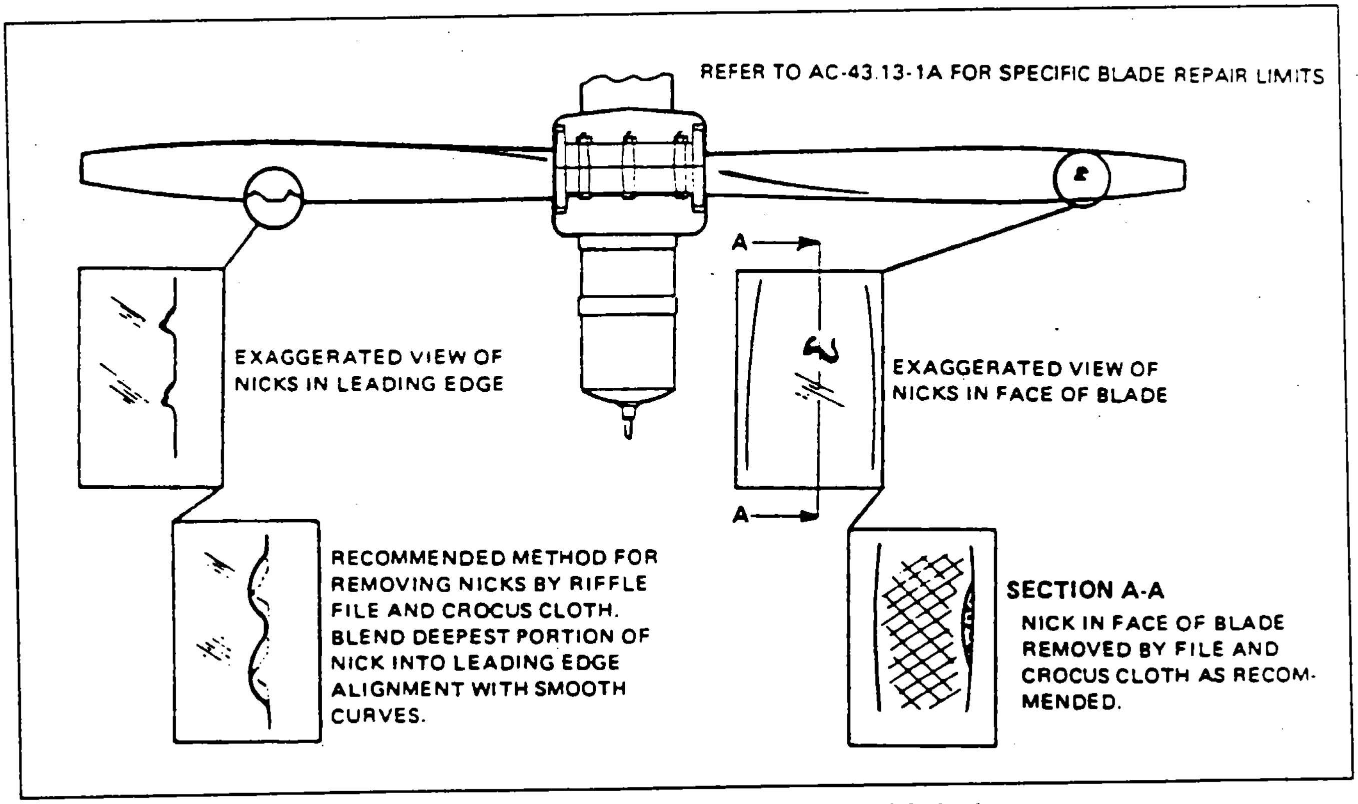


Figure 61-2. Typical Nicks and Removal Method

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 rod end from the governor control arm.
3. Remove the governor mounting stud nuts, washers and lock washers.
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.
3. Align the splines on the governor shaft with the engine drive and slide the governor into position.
4. With the governor in position, install washers and start mounting nuts. Torque nuts evenly.
5. Connect the control rod end to the governor control arm. The control rod end is installed in the outer hole of the control arm.
6. Adjust governor control.
7. Install engine cowl.

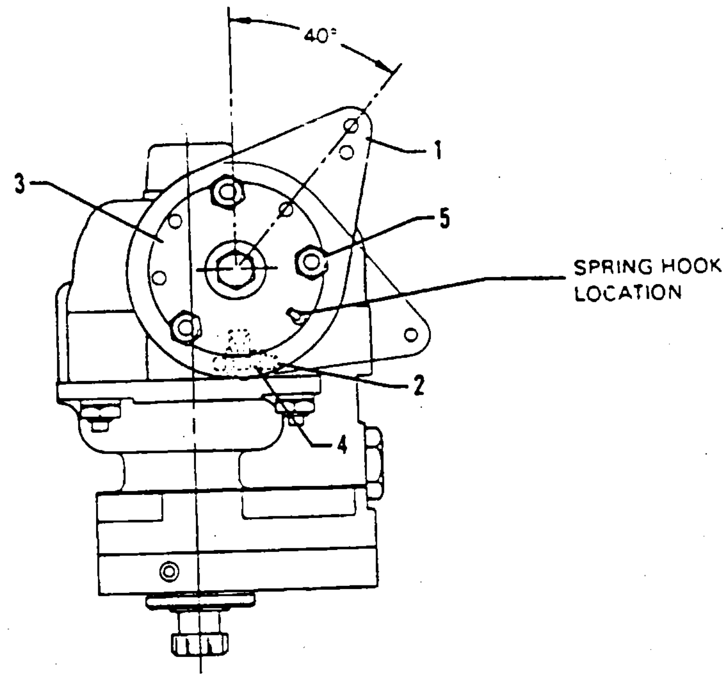


Figure 61-3. Propeller Governor

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 2600 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 2600 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 rod end from the control arm, loosen the rod end jam nut and rotate the end to obtain the desired lever clearance. Reconnect the rod 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 (right) 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, ON and OFF. In the OFF position, engines and propellers are operated and controlled in the conventional manner. After manually synchronizing engines, the selector switch can be set to the ON position. This permits the synchrophaser to hold engines in RPM agreement and also in the preselected phase relationship.

FLIGHT OPERATING INSTRUCTIONS.

1. Leave the switch in the OFF position until the first power reduction after takeoff.
2. Synchronize the engines manually until any audible out of synch beat is eliminated, then move the switch to the ON position.
3. At this point an audible out of synch beat may be noticed for a few seconds as the system brings the engines into the phase relationship.
4. The engines should now remain in synch and phase for the duration of the flight.
5. It is recommended that the switch be moved to the OFF position during power changes and Step 2 repeated.
6. If an out of synch condition arises during flight that the synchrophaser does not correct, it could be that its effective range has been exceeded. Return the switch to the OFF position for about 30 seconds and repeat Step 2. Normal synchrophaser operation should resume.

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 ON OFF switch in the OFF position. The Manual light should come on and the Phase light should go out on the test box. When the switch is placed in the ON position the opposite should occur.

E. It 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.

PULSE GENERATOR.

TIMING THE PULSE GENERATOR (LEFT ENGINE AND RIGHT ENGINE).

— *CAUTION* —

Be sure that the magneto switches are off.

1. Loosen the hex nut securing the pulse generator to the tach generator.
2. Turn the 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.)

— *NOTE* —

If this point is missed do not turn engine backwards; start over.

3. Turn the pulse generator counterclockwise to align the timing mark with the center of the keyway. (Refer to Figure 61-5.)
4. Secure the hex nut.
5. Pull the prop through (in the direction of rotation) two complete revolutions and stop at the phase position.
6. Check the timing mark alignment (of the pulse generator). Reset it if necessary.

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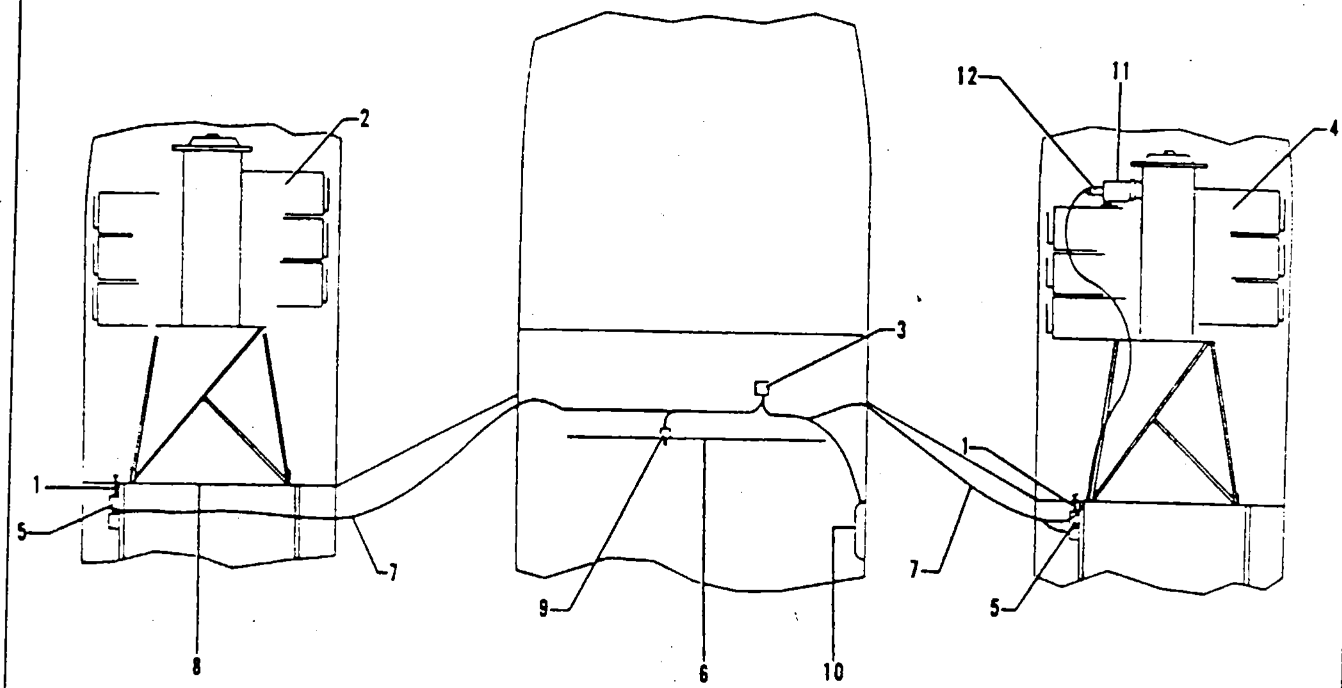
CHART 6102. TROUBLESHOOTING CHART (ENGINE SYNCHROPHASER)

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 of 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. SLAVED ENGINE (RIGHT)
5. PULSE GENERATOR
6. INSTRUMENT PANEL
7. WIRE HARNESS
8. FIRE WALL
9. COCKPIT CONTROL SWITCH
10. CIRCUIT PROTECTOR
11. GOVERNOR
12. 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.

2. Time the pulse generator per instructions in Timing the Pulse Generator.
3. Connect the electrical plug connector to the pulse generator and install the access panel on top of the nacelle.

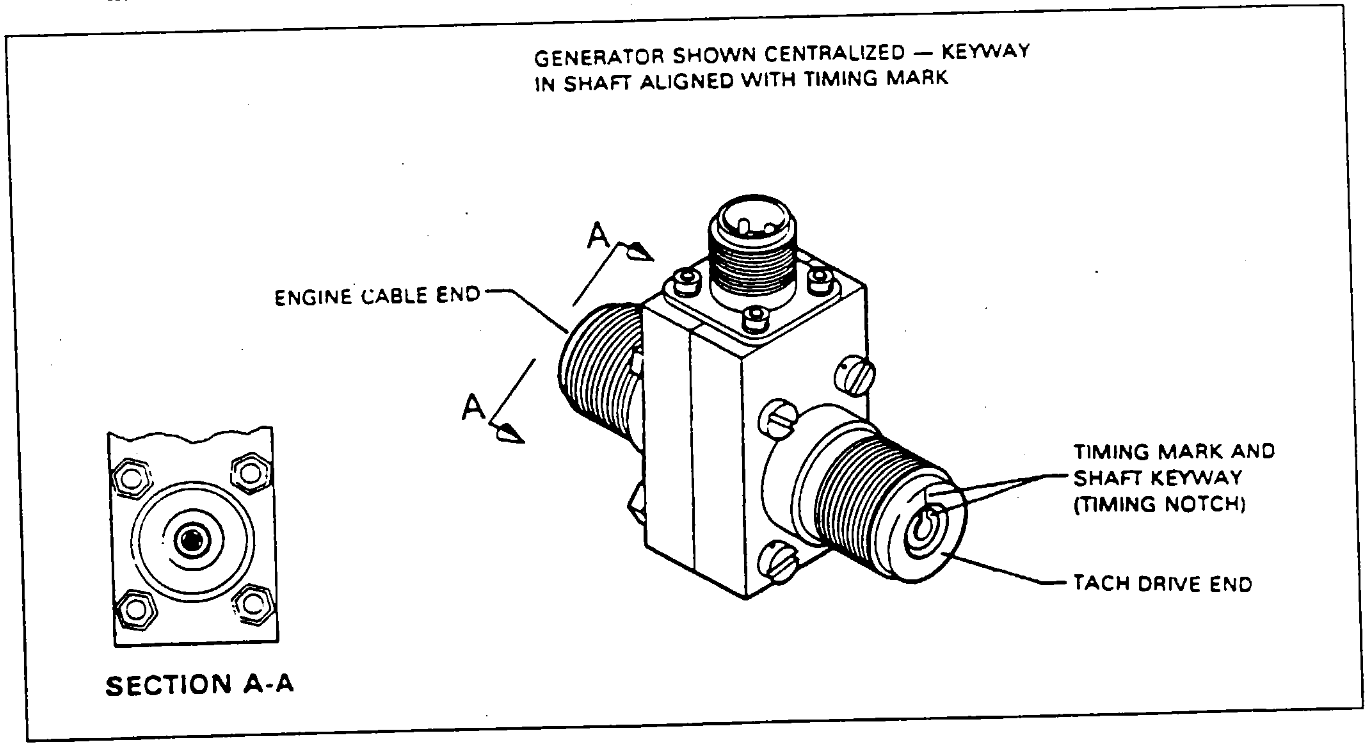


Figure 61-5. Pulse Generator

COMPUTER ASSEMBLY.

REMOVAL OF COMPUTER ASSEMBLY.

This unit is mounted on brackets in between the instrument panel support channel and the brake fitting support channel (above the copilot's pedals). (Refer to Figure 61-4.)

1. Disconnect the electrical plug that is connected to the computer unit.
2. Remove the machine screws, on the mounting flanges, that hold the computer unit to the, angle assemblies. Remove the computer.

INSTALLATION OF COMPUTER ASSEMBLY. (Refer to Figure 61-4.)

1. Position the computer unit on the mounting angles.
2. Secure the unit in place with the machine screws in the mounting flanges of the unit.
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).

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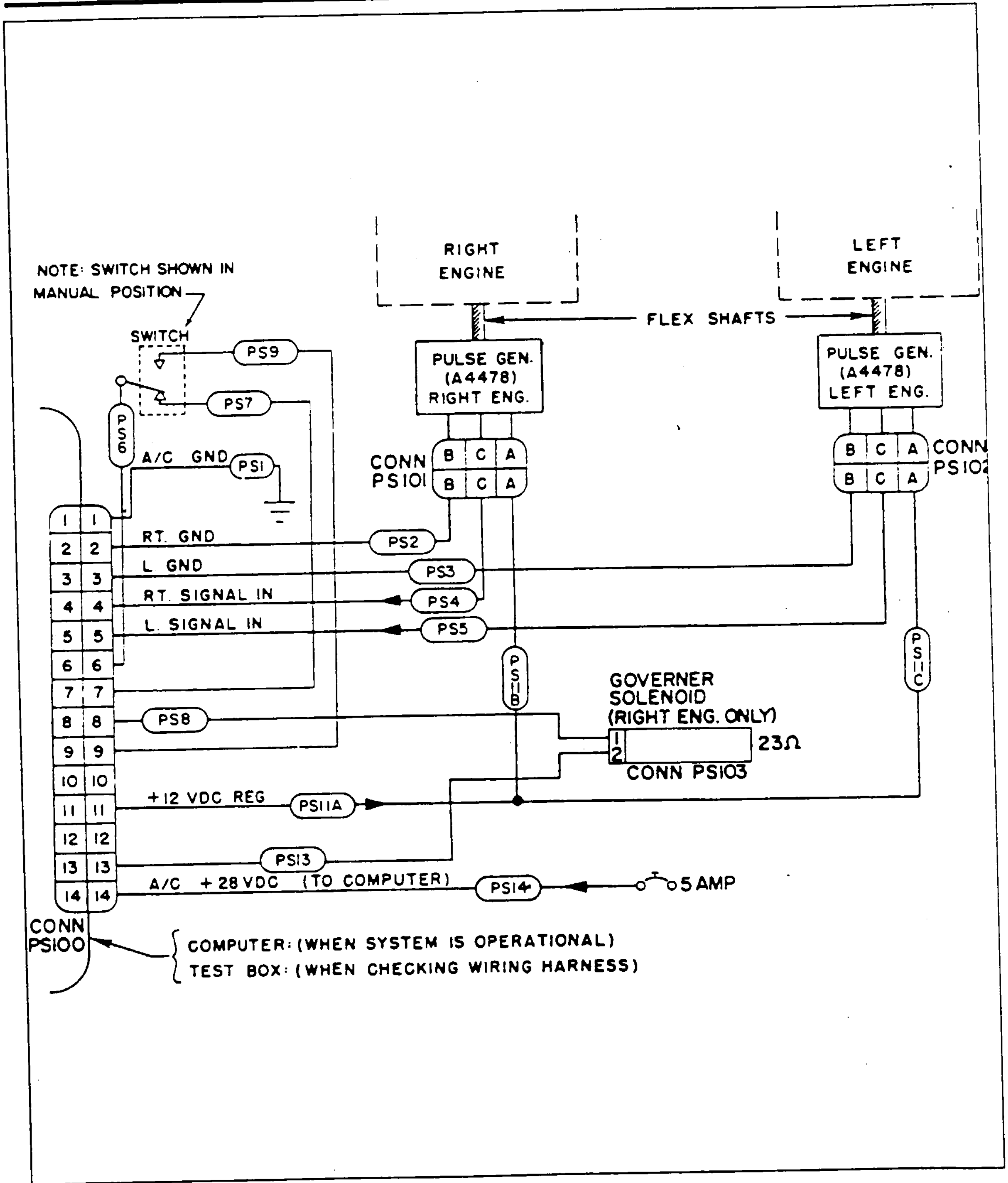

Figure 61-6. Synchrophaser Schematic

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CHAPTER

70

STANDARD PRACTICES
ENGINES

CHAPTER 70-STANDARD PRACTICES ENGINES

TABLE OF CONTENTS/EFFECTIVITY

STANDARD PRACTICES - ENGINE.

The following suggestions should be applied wherever they are needed, when working on the power plant:

1. To insure proper reinstallation and or assembly, tag and mark all parts, clips, and brackets as to their location prior to their removal and or disassembly.
2. During removal of various tubes or engine parts, inspect them for 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, washers, nuts, dirt, dust, etc. This precaution applies whenever work is done on the engine, either on or off the aircraft. Suitable protective caps, plugs and covers must be used to protect all openings as they are exposed.

— NOTE —

Dust caps used to protect open lines must always be installed OVER the tube ends and NOT IN the tube ends. Flow through the lines may be blocked off if lines are inadvertently installed with dust 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, lock washers, 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 powered 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-POWER PLANT

TABLE OF CONTENTS/EFFECTIVITY

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.

This airplane is powered by two Avco Lycoming TIO-540-V2AD 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 2600 RPM and designed to operate on 100 or 100LL (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 louvers. 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 an AN type fuel supply pump as an integral part of the fuel injector system. An AiResearch model TH08A69 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.

This engine is equipped with a single pressurized Bendix type D6LN-3200 magneto. This magneto has a retard breaker providing fixed retard, long duration boosted spark for starting. A source of DC power and a starting vibrator are required to complete the installation. The spark advance is 20° BTC.

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 through 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 returned 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.	Leave ignition OFF and mixture control in "idle cut-off." open throttle and "unload" engine by cranking for a few seconds. Turn ignition switch on and proceed to start in a normal manner.
	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 .
	Improper operation of magneto breaker.	Clean points. Check internal timing of magnetos.
	Lack of sufficient fuel flow.	Disconnect fuel line at fuel injector and check fuel flow.
	Water in fuel injector.	Drain fuel injector or fuel lines.
	Internal failure.	Check oil screens for metal particles. If found. com plete overhaul of engine may be indicated.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
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
Failure of engine to idle properly. (cont.)	Leak in air bleed nozzle balance line.	Check connection and replace if necessary.
	Plugged fuel injector nozzle .	Clean or replace nozzle
	Flow divider fitting plugged.	Clean fitting.
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. Readjustment of fuel injector by authorized personnel is indicated.
	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 internal 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.
	Fuel injector nozzles clogged .	Clean or replace nozzle.

CHART 7101 TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
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.
	Plugged fuel injector nozzle.	Clean or replace nozzle.
	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.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Rough engine. (cont.)	Magneto check out-of-limits.	Check magneto-to-engine timing. Inspect contact assemblies for proper opening.
	Blocked fuel injector nozzles.	Clean or replace nozzles.
Low oil pressure.	Insufficient oil.	Fill sump to proper level 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.
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.

CHART 7101 . TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
High oil temperature. (cont.)	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 sump 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.
	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.
High fuel flow indicated on fuel gauge.	Plugged fuel injector nozzle.	Clean or replace nozzle.

ENGINE.

REMOVAL OF ENGINE. (Refer to Figure 71-1 .)

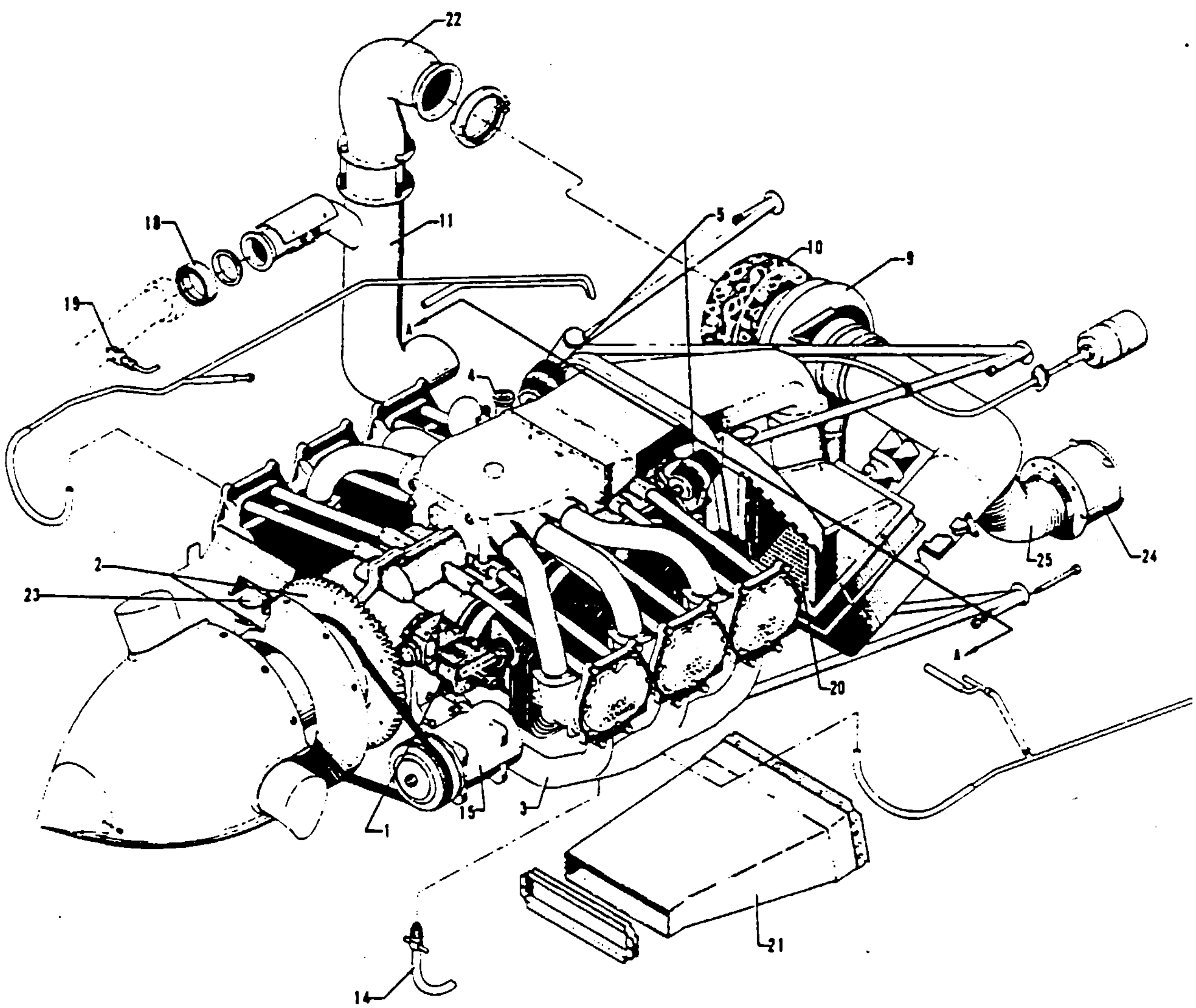
The removal of either engine is basically the same procedure. though the routing of some wires, cables. lines. etc.. does vary betveeen engines. Each line should be identified to facilitate reinstallation and covered. where disconnected, to prevent contamination.

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 firewall.
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. Disconnect the field wire.
9. Disconnect the electrical leads to the oil temperature sender at the accessory housing, the cylinder head temperature probe and the exhaust temperature sender.
10. Disconnect the magneto ground leads and the retard spark lead at the magneto.
11. Disconnect the propeller deicer electrical wires (optional equipment).
12. Disconnect the pressure pump hose.
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 duct at the fire wall. 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 firewall.
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.

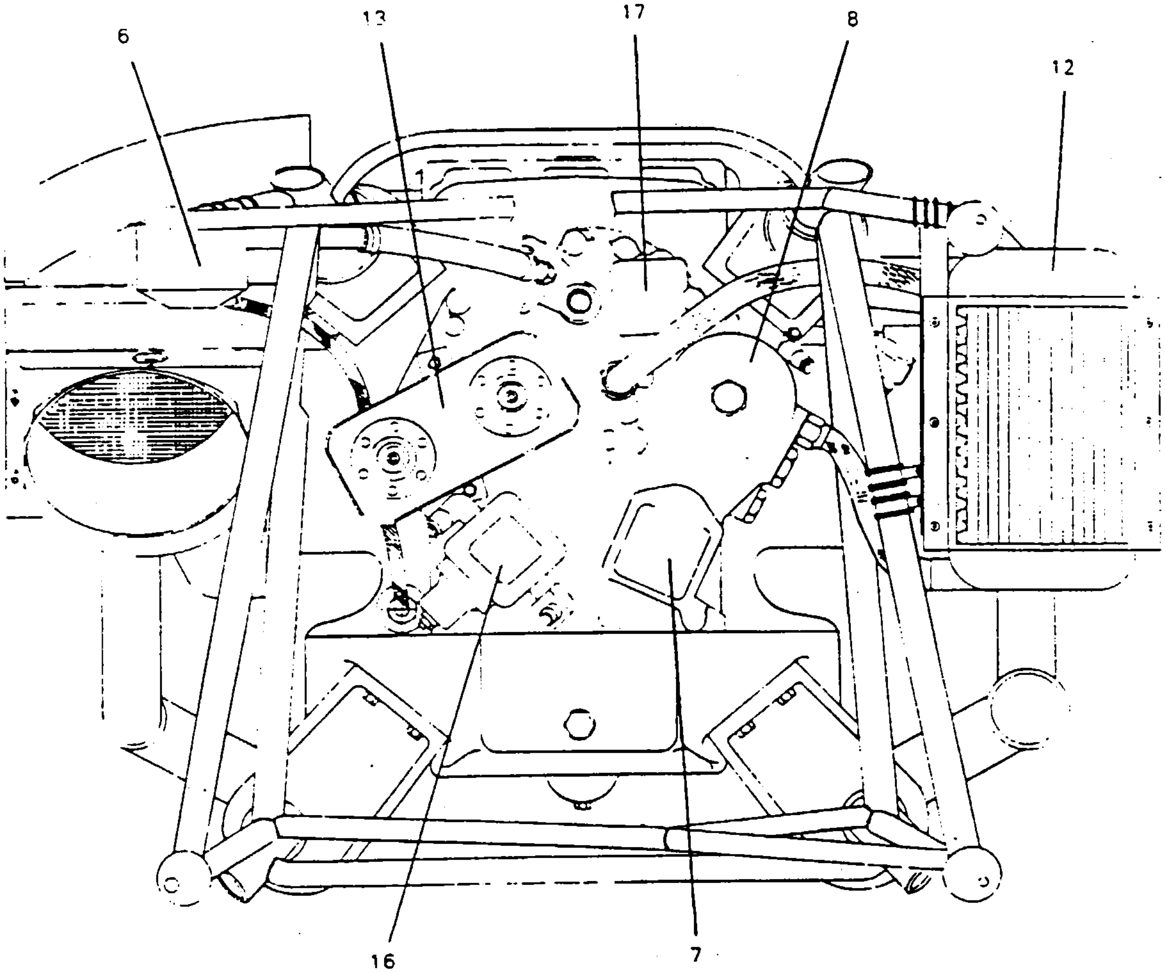
The installation of either engine is basically the same procedure, though the routing of some wires, cables, lines, etc., does vary between engines. Before starting, ascertain that all components of the engine mount, turbocharger unit, exhaust stacks, etc., are installed.

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. Torque nuts from 17-20 ft-lbs.



1 GOVERNOR, PROPELLER
2 RING GEAR, STARTER
3 EXHAUST LEFT
4 OIL FILLER
5. ENGINE MOUNT ASSEMBLY
6. OIL SEPARATOR
7. PNEUMATIC PUMP
8. OIL FILTER
9. TURBINE ASSEMBLY
10. COMPRESSOR
11. TAIL PIPE, BOTTOM
12. OIL COOLER
13. MAGNETO
14. DRAIN, ENGINE SUMP
15. FREON COMPRESSOR
16. FUEL PUMP
17. HYDRAULIC PUMP
18. WASTE GATE
19. EGT PROBE
20. AIR FILTER
21. TUNNEL ASSEMBLY
22. TAIL PIPE, UPPER
23. ALTERNATOR COOLING AIR INLET
24. ALTERNATE AIR BOX
25. ALTERNATE AIR DUCT

Figure 71-1. Engine Installation



NOTE
VIEW OF TURBOCHARGER, INTERCOOLER, BREATHER TUBE, AIR INDUCTION SYSTEM, TAILPIPE AND ENGINE CONTROL LINKAGE OMITTED FOR CLARITY.

Figure 71-1. Engine Installation (cont.)

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. Check rigging.
7. Connect the alternate air door duct to the fire wall.
8. Connect the tachometer drive cable to the drive on the accessory housing.
9. Connect the pressure pump hose to the fitting on 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 magneto.
12. Connect the electrical leads to the oil temperature sender at the accessory housing, the cylinder head temperature at the probe and the exhaust temperature probe.
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. Pre-oil the engine per the latest revision of Lycoming Service Instructions 1241.
20. Install the access plates on the engine nacelle and the cowling.
21. Perform an engine operational check.

COWLING.

The engine cowling consists of upper and lower cowl assemblies of cantilever construction joined together by rotary latches and screw fasteners and attached to the nacelle at the fire wall.

COWLING MAINTENANCE.

REMOVAL OF COWLING.

—NOTE—

The procedure for removing the cowling is the same for either engine.

1. Release the screw fasteners and rotary latches which join the upper and lower cowl assemblies.
2. Release the screw fasteners which secure the upper cowl to the nacelle and remove the upper cowl.
3. Disconnect cowl flap control rods from cowl flap.
4. Release the screw fasteners which secure the intercooler air inlet scoop to the lower cowl.
5. Support the lower cowl, release the screw fasteners which secure the cowl to the nacelle and remove.

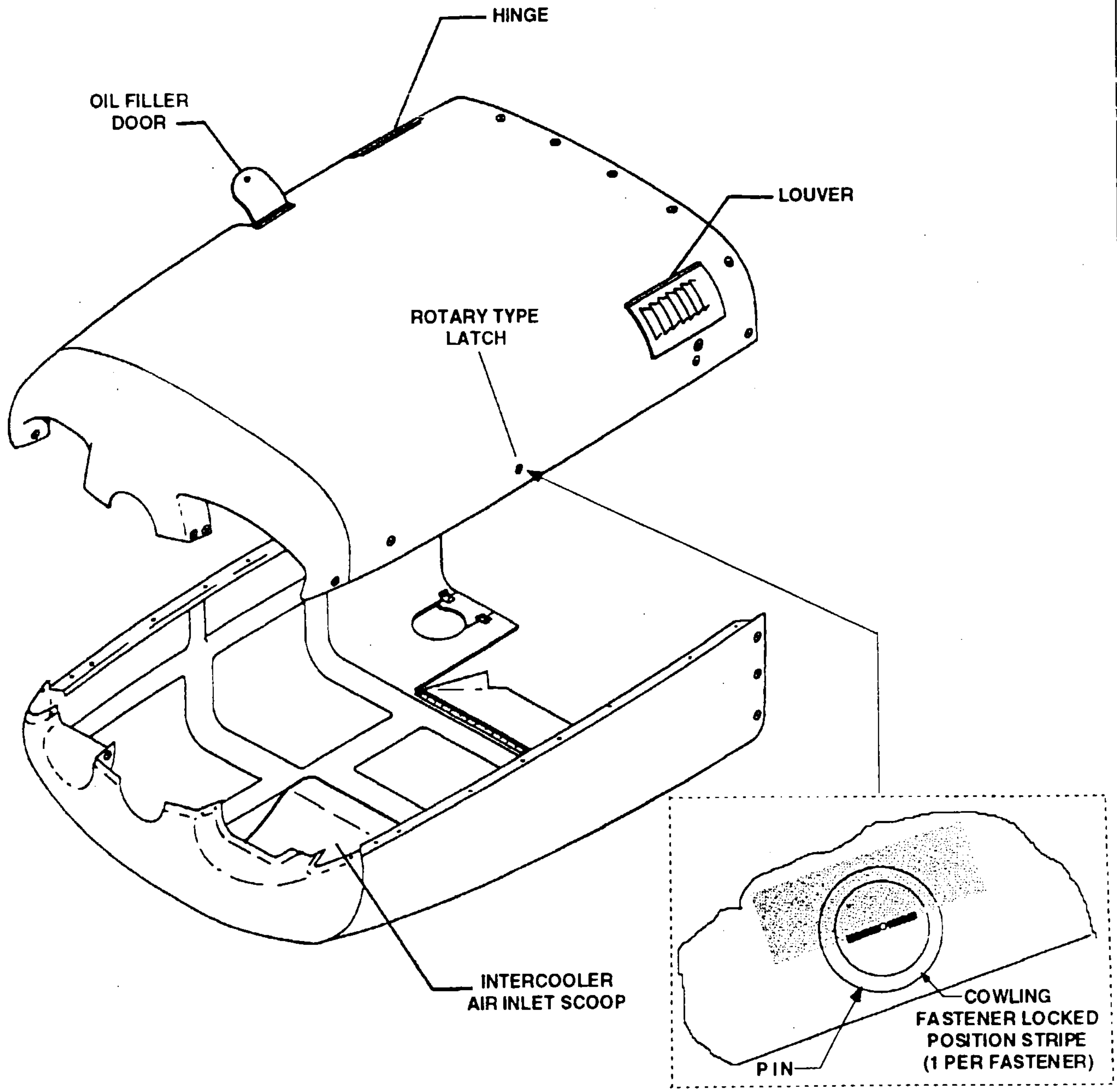


Figure 71-2. Cowling

CLEANING, INSPECTION AND REPAIR OF COWLING.

1. The cowling should be cleaned with a suitable solvent and 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 completed in accordance with Fiberglass Repairs, Chapter 51.

INSTALLATION OF COWLING.

— NOTE —

The cowl installation procedure is the same for either engine.

1. Position the lower cowl and secure to nacelle utilizing the screw fasteners along the aft section of the cowl.
2. Position the cowl flap control rods on the cowl flap and secure.
3. Position the intercooler air inlet scoop on the opening in the lower cowl and secure with screw fasteners.

— WARNING —

The rotary latches have a dark line painted along the top half of the fastener and cowling to provide a visual check of fastener security. This stripe must be refurbished or replaced id faded or missing, or cowling is repainted.

4. Position the upper cowl onto the lower cowl utilizing the four alignment pins on the upper cowl and secure with screw fasteners and rotary latches. The rotary latches a 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.

The engine cowl flap consists of an inner skin of .032 2024-0 aluminum secured to an outer skin of .025 2024-T3 aluminum connected by a piano-type hinge to the lower engine cowl with an .089 diameter hinge pin. Operation of the cowl flap is by means of an electrical motor assembly mounted on the aft side of the engine fire wall (F.S. 111.50) working through a torque tube and control rod linkage.

RIGGING AND ADJUSTMENT OF COWL FLAP. (Refer to Figure 71-3.)

1. With the cowl flap actuator in the full open position, loosen the jam nuts on the stop pads and turn the pads in so that they will not contact the cowl flap in its closed position.
2. Place the cowl flap in the closed (up) position and adjust the cowl flap control rods so that the trailing edge of the cowl flap is 0.10 to 0.13 inch above the level of the cowl.
3. Adjust the cowl flap stop pads so that the trailing edge of the cowl flap is level with the exterior surface of the cowl under preload.
4. Secure all jam nuts upon completion of adjustments.

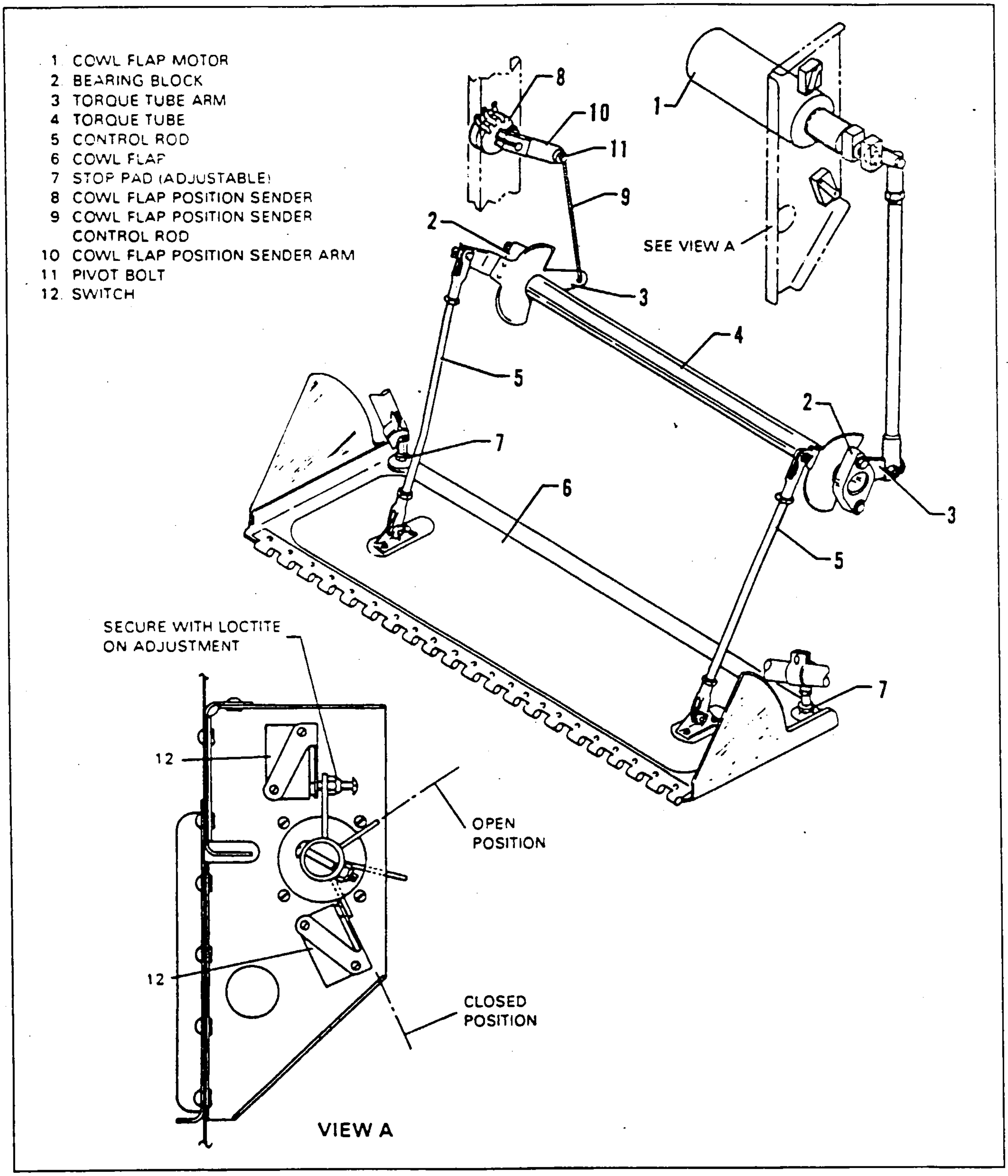


Figure 71-3. Cowl Flap Installation

COWL FLAP POSITION SENDER.

REMOVAL 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. Disconnect the electrical leads from the sender unit.
3. Loosen the bolt assembly which secures the sender arm on the sender shaft and slide the arm off of the shaft.
4. Loosen the locknut which secures the sender unit and remove the nut. The sender unit may now be removed.

INSTALLATION OF COWL FLAP POSITION SENDER. (Refer to Figure 71-3)

1. Start the sender unit through the mounting hole far enough to start the locknut onto the threaded shaft.
2. Position the sender by placing the index tab on the sender into the index slot in the mounting bracket. Tighten locknut.
3. Place the sender ;arm on the sender shaft but do not secure.
4. Connect the electrical leads to the sender.
5. Rig the sender beginning with Step 2 of Rigging and Adjustment of Cowl Flap Position Sender.

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 nap 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.
4. 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.

RIGGING COWL FLAP LIMIT SWITCHES.

1. Preset aft control rod assembly to 12.81 in. (from center of upper bolt hole to center of lower bolt hole).
2. Adjust switches to provide 2.20 inch of vertical travel after adjustment is completed.
3. Secure the adjusting screw by adding Loctite and tightening locknut.

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.
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, toward shock mounts, washers and nuts, start nuts only a few threads.

—NOTE—

Rotate the heat shields (on the lower inboard mount on the left engine and the lower outboard mount on the right engine) to provide the greatest protection against exhaust heat.

8. Remove the upper mount attachment bolts, nuts, washers 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, mounting bolts, washers and nuts.
11. Tighten attachment bolts 34 to 42 foot-pounds (torque bolt head).

AIR INTAKES.

The induction air system consists of two induction ducts with an induction air filter installed between them, an alternate air hose leading from the aft duct, an alternate air box and alternate air controls.

Air is taken from the left-hand side of the engine into the forward air duct through the air filter into the aft duct where it is directed into the turbocharger. The turbocharger compresses the air and directs it through duct to the intercooler where the hot compressed air from the turbocharger is mixed with ram air taken from beneath the engine cowling. This air is then directed through the fuel injector to the individual engine cylinders.

When alternate air is selected, air is drawn from the area behind the left-hand side of the fire wall.

AIR INDUCTION FILTER.

REMOVAL OF AIR INDUCTION FILTER.

1. Remove the upper cowling.
2. Remove the four screws that secure the air filter between the forward and aft induction ducts.
3. Move the aft duct slightly down to gain enough clearance to slide the filter out from between the ducts.
4. Remove the filter.

INSTALLATION OF AIR INDUCTION FILTER.

1. Position the filter between the forward and aft induction ducts. Insure that arrows for air flow direction on side of filter are pointing in the proper direction.
2. Secure the filter in place with the four screws.

—NOTE—

Air filter is serviced per the placard on the side of the filter.

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ALTERNATE AIR BOX.

REMOVAL OF ALTERNATE AIR BOX.

1. Disconnect the alternate air nose from the forward end of the air box.
2. Remove the screws that attach the air box to the fire wall.
3. Slide the air box forward through the fire wall.

INSTALLATION OF ALTERNATE AIR BOX.

1. Slide the air box aft into its hole in the fire wall.
2. Rotate the air box until its magnetic catch is at its lowest position.
3. Attach airbox to the fire wall with the screws.
4. Connect the alternate air hose to the forward end of the air box.

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CHAPTER

73

ENGINE FUEL AND CONTROL

CHAPTER 73- ENGINE FUEL AND CONTROLS

TABLE OF CONTENTS/EFFECTIVITY

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, cause 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.

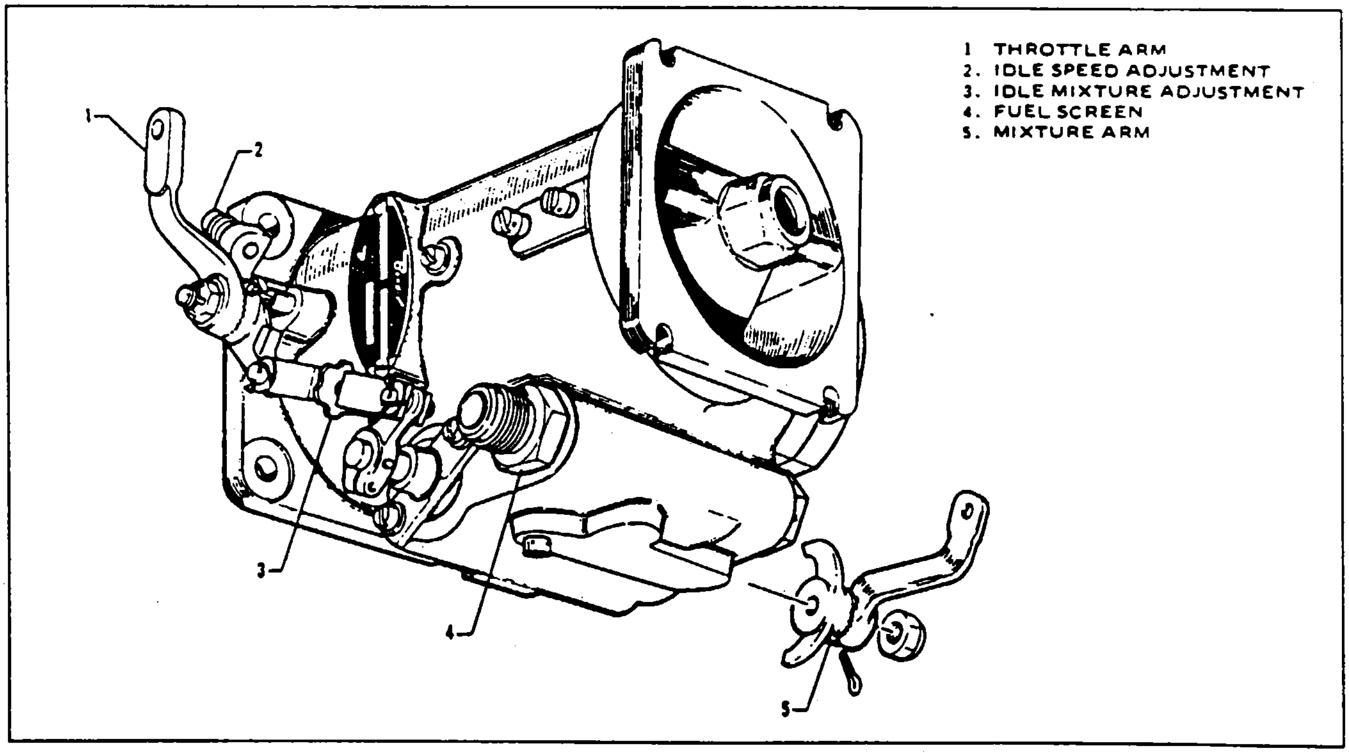

Figure 73-1. Fuel Injector

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. Disconnect the control rod that comes from the absolute pressure controller.
3. Disconnect the fuel inlet, flow, pressure and discharge lines at the injector.
4. Remove the bolts securing the injector to the air box and induction duct.
5. Remove the fuel injector.

PREPARATION FOR STORAGE.

Any unit taken out of service, or units being returned for overhaul, must be flushed with preserving oil (Specification MIL-0-6081. 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 air 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. Attach the injector to the air box and induction duct.
2. Connect the fuel inlet, flow, pressure and discharger lines to the injector.
3. Connect the throttle and mixture control cables to the injector. Attach the control rod that comes from the absolute pressure controller to the fuel injector. Rig controls.
4. Pressure check for leaks.
5. Adjust idle speed and mixture.
6. Replace cowling.

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 nozzle 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 74-2.)
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.

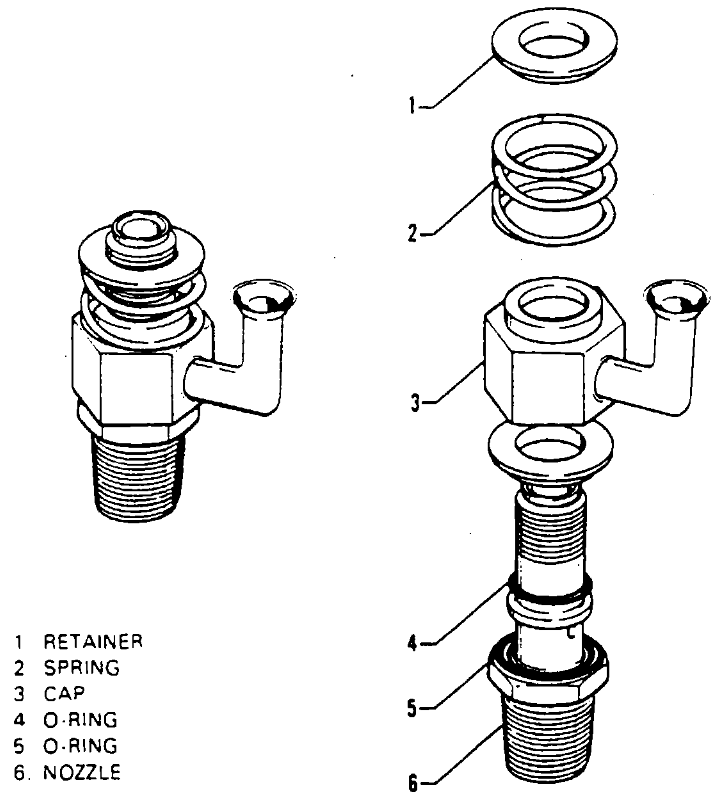

Figure 73-2. Fuel Air Bleed Nozzle

INDICATING.

FUEL PRESSURE GAUGE.

The fuel pressure gauge is electrically operated and mounted on the right hand side of the instrument panel. This gauge is connected to its transducers located behind the firewall at wing stations 58.50 for right engine and 89.31 for left engine. The tranducers are connected to the fuel pressure lines at the injectors and the instrument air deck pressure at the intercoolers of each engine.

TROUBLESHOOTING.

CHART 7301. TROUBLESHOOTING (FUEL PRESSURE GAUGE)

Trouble	Cause	Remedy
No fuel pressure indication.	Fuel valve stuck.	Check valve.
	Fuel valve off.	Check valve.
	No fuel in tanks.	Check fuel. fill.
	Defective fuel pump.	Check pump for pres sure build-up. Check diaphragm and relief valves in engine pump. Check for obstruction in electric pump. Check bypass valve. Air leak in intake lines.
	Detective 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.

CHART 7301. TROUBLESHOOTING (FUEL PRESSURE GAUGE) (cont.)

Trouble	Cause	Remedy
Slight fuel pressure fluctuates.	Heater in operation.	Normal.

REMOVAL AND INSTALLATION OF FUEL PRESSURE GAUGE.

1. Remove the electrical connection 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 mounted to the right of center in the upper section of the instrument panel, and is electrically operated by the flow transducers located in the fuel lines at wing station 49.00, under the leading edge access covers of each wing.

TROUBLESHOOTING.

CHART 7302. TROUBLESHOOTING (FUEL FLOW GAUGE)

Trouble	Cause	Remedy
Pointer oscillates	Air in fuel line.	Purge line.

REMOVAL OF FUEL FLOW GAUGE.

1. At the back of the instrument panel disconnect the electrical connection 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. Connect the electrical connector to the gauge.

FUEL PRESSURE LOW WARNING LIGHT.

Illumination of the warning lights located in the annunciator panel indicator impending fuel starvation due to insufficient fuel pressure to the engines.

—END—

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CHAPTER

74

IGNITION

CHAPTER 74- IGNITION

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION AND OPERATION.

The D3200 series magnetos feature two electrically independent ignition circuits in one housing. A single four pole rotor provides the magnetic energy for both circuits. This magneto is designed to be used with a starting vibrator unit. The magneto has two separate breaker cams. The lower cam operates the main breakers for both magneto circuits. The upper cam operates the left magneto retard breaker. Suppression of radio interference is accomplished by feed-thru capacitors, which are mounted in the magneto cover and forms a part of the magneto harness assembly.

With the magneto switches ON, and the starter switch depressed the right side of the magneto is grounded 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 re-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 side are simultaneously firing in full advance.

Pressurized air for the magnetos is supplied via a hose from the intercooler.

TROUBLESHOOTING.

The following chart lists some of the more common troubles which may be encountered. their probable causes and suggested remedies.

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CHART 7401. TROUBLESHOOTING (MAGNETO)

Trouble	Cause	Remedy
Failure of engine to start.	Detective spark plugs.	Clean and adjust or replace spark plugs.
	Defective ignition wire.	Check with electric tester and replace defective wires.
	Defective battery.	Replace with charged battery.
	Improper operation of magneto breaker.	Check points. Check internal timing of magnetos.
Failure of engine to idle properly.	Faulty ignition system.	Check entire ignition system.
Low power and uneven running.	Detective spark plugs.	Clean and gap, or replace spark plugs.
	Magneto breaker points not working properly.	Clean points. Check internal 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.
Failure of engine to develop full power.	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.

ELECTRICAL POWER SUPPLY.

MAGNETO.

INSPECTION OF MAGNETO.

After the first 50 hour period and every 100 hours thereafter, the magneto ignition system should be checked. If engine operating troubles develop which are caused by the ignition system, it is advisable to check the spark plugs and wiring first before working on the magneto. Should trouble appear definitely associated with the magneto, install a replacement magneto known to be in satisfactory condition and send the suspected magneto to the overhaul shop for test and repair. Should this not be possible, a visual inspection of the following items may disclose the source of trouble:

—NOTE—

Refer to VSP 69 before completing inspection of the magneto ignition system.

1. Check lead terminals for definite contact with spring contacts in outlets.
2. Remove harness outlet cover from the magneto and inspect for presence of moisture and carbon tracking due to moisture.
3. Check contact springs in distributor block for evidence of spark erosion.
4. Check height of contact springs (0.422 maximum from top of block tower to spring) (refer to figure 741).
5. Check contact assemblies with cover and harness separated from the magneto housing to ensure that cam follower is securely riveted to its spring.
6. Examine the contact points for excessive wear or burning (see figure 74-2 for visual reference).

—CAUTION—

Do not open point contacts more than 0.0625 (1/16) inch for examination of contact surfaces. Excessive spreading of breaker points will overstress and damage the contact spring.

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. Minor irregularities or roughness of point surfaces are not harmful (refer to figure 74-2, center). Neither are small pits or mounds, if not too pronounced. If there is a possibility of the pit becoming deep enough to penetrate pad (refer to 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 condition of cam follower felts for proper lubrication. If oil has migrated from one follower felt to another, it may be necessary to remove the lubrication from one felt strip while oiling another. If felt is over lubricated, remove oil by using a clean, lintless cloth. If dry, apply one or two drops of Bendix Breaker Felt Lubricant 10-86527.

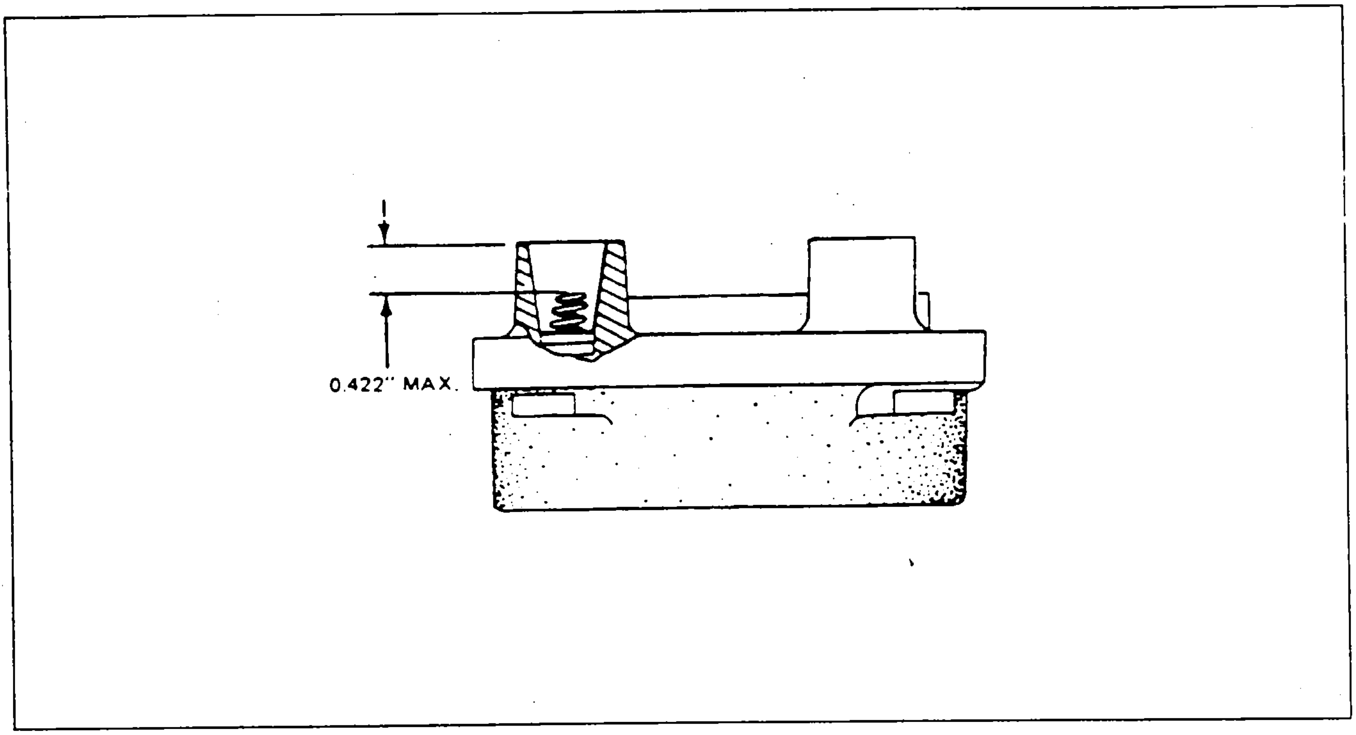

Figure 74-1. Height of Spring in Distributor block Tower

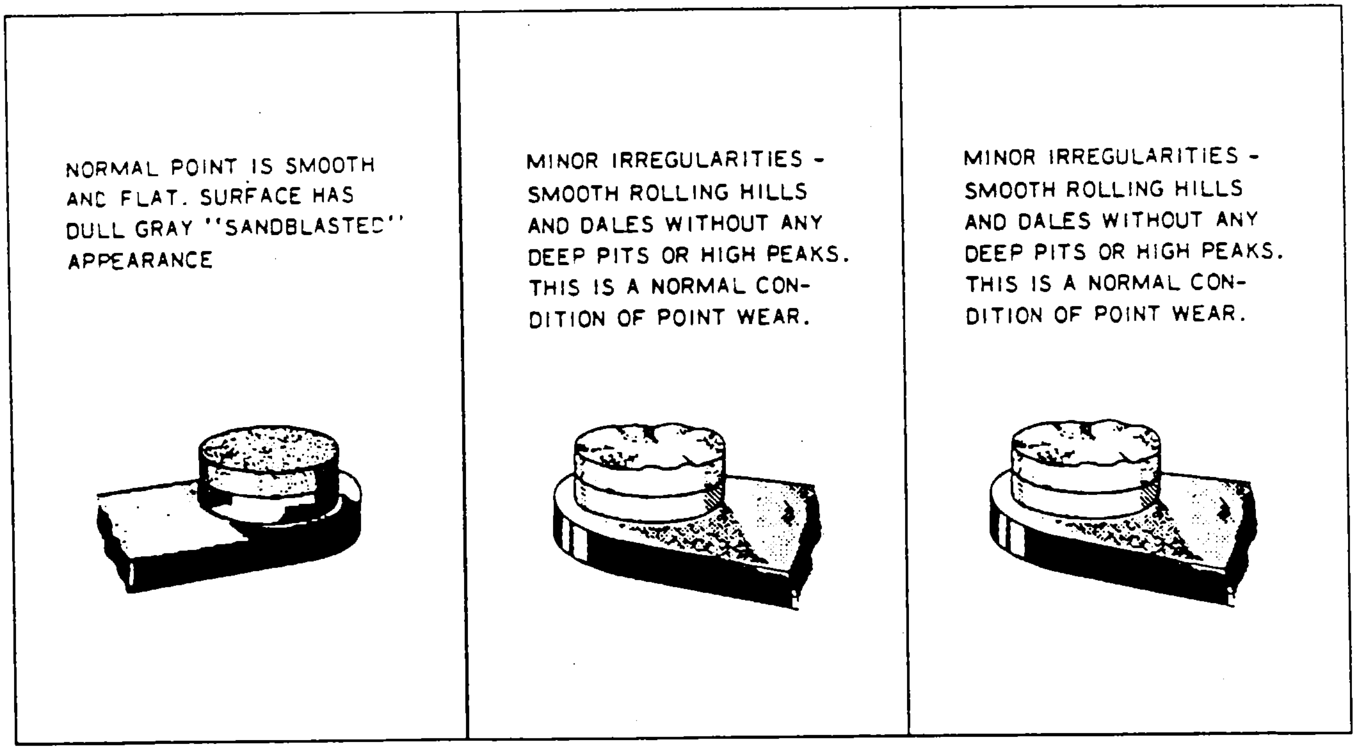

Figure 74-2. Contact Points

8. Check the capacitors for looseness in the magneto cover of the harness assembly and for any physical damage. Using a Bendix 11-1767-1, -2 or -3 condenser tester or equivalent, check capacitors for capacitance series resistance and leakage. Capacitance shall be 0.34 to 0.41 microfarads.
9. Check magneto to engine timing.

INSTALLATION AND TIMING (MAGNETO TO ENGINE).

1. Installation of the magneto to the engine may be accomplished without removal of the cover from the magneto. Also, the magneto cover has switch terminal outlets for the right and left sides of the magneto located in the center of the harness lead outlet sections of the cover.
2. The magneto incorporates a built-in pointer and a degree wheel with sufficient reference to assist the mechanic in magneto timing procedures. Printed upon the rotating magnet are marks to indicate magneto neutral and magneto 'E" gap (8°). (Refer to Figure 74-5.) Also included are retard angle references of 15.20 and 25 degrees. These marks are set up for either clockwise (R) or counter-clockwise (L) rotation of the magneto as viewed from the magneto drive end. The timing tooth of the large distributor gear is marked with red paint. (Refer to Figure 74-6.)
3. When correctly timed internally, a magneto will have the timing teeth of the large distributor gears approximately centered in the timing windows. the R or L ("E" gap) mark on the rotor in alignment with the pointer, and both main breaker points opening, all at the same time. These three references, 'E" gap, painted teeth and point opening, are all used when timing the magneto to the engine.
4. Remove the spark plug from the No. 1 cylinder and turn the crankshaft in the direction of normal rotation until the compression stroke is reached.
5. 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 74-3.)
6. Install the magneto-to-engine gasket on the magneto flange.

—WARNING—

Do not attach harness spark plug ends to the spark plugs until all magneto-to-engine timing procedures and magneto-to-switch connections are entirely completed.

—NOTE—

The use of a timing light unit Part No. 11-9110 or 11-9110-1 will simplify the timing procedure. This unit is available from the Bendix Corporation at Sidney, New York 13838.

It is recommended that short adapter leads be fabricated to facilitate connecting the timing light unit to the switch outlet terminals of the cover. (Refer to Figure 74-4.)

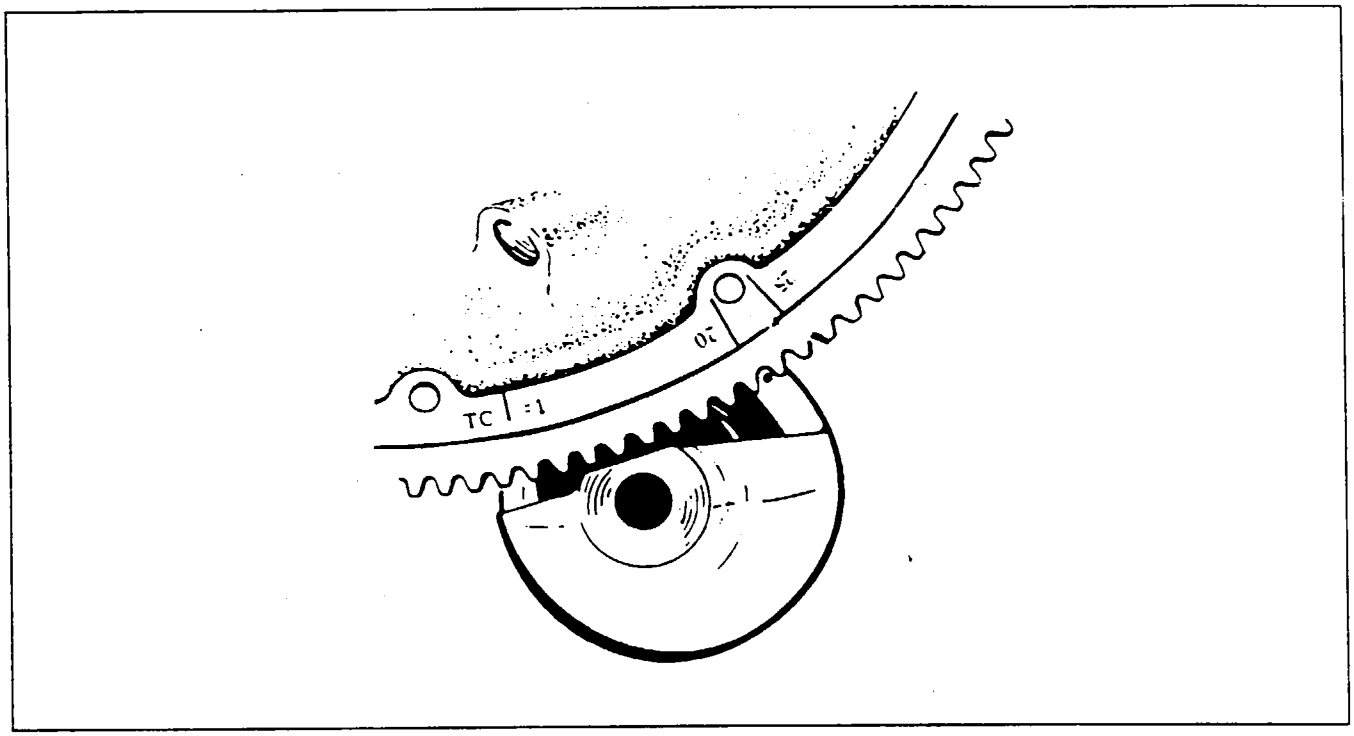

Figure 74-3. Engine Timing Marks

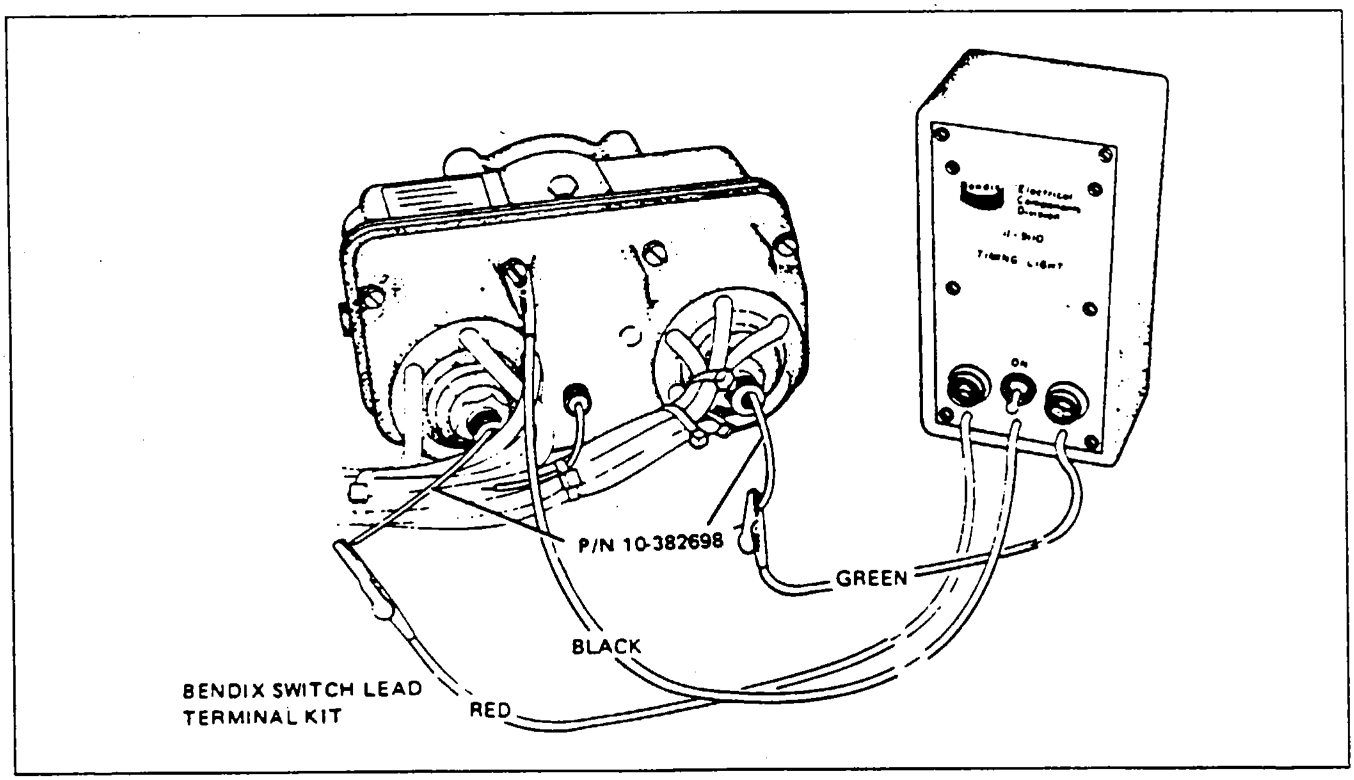

Figure 74-4. Timing Light connected to Magneto

7. Remove the magneto drive gear backlash by turning the propeller opposite to normal rotation approximately 40° past No. 1 firing position: then turn propeller in direction of normal rotation up to No. 1 firing position of 20° BTC.
8. Remove the timing window plug from the most convenient side of the magneto housing. Also, remove the plug from the rotor viewing window in the center of the housing.
9 Turn the rotating magnet drive shaft in the normal direction of magneto rotation until the red distributor tooth is centered in the timing hole. Also, check to ensure that the built-in pointer just ahead of the rotor viewing window aligns with the R or L mark on the rotor depending on whether the magneto is for right or left-hand rotation as specified by the magneto data plate.
10. While holding the magneto in its No. 1 firing position (tooth in window center and pointer ower R or L mark on rotor). install the magneto to the engine and loosely clamp in position.

—NOTE—

Engine should be in No. 1 cylinder firing position of 20° BTDC.

11. Attach red lead from the 11-9110 timing light to the left switch adapter lead, the green timing light lead to the right switch adapter lead and the black timing light lead, to the magneto housing. (Refer to Figure 74-4)

—NOTE—

An internal timing tolerance is allowed when adjusting the two main breakers. Therefore, one of the main breakers may open slightly before the other. Magneto-to-engine timing should be accomplished using the first main breaker to open as a reference point when the engine is in the firing position for No. 1 cylinder. This will ensure that ignition created by either spark plug will not occur prior to the desired engine firing point.

12. If both timing lights are ON, indicating breaker contacts are closed, proceed to Step 13. If either or both are OFF, proceed as follows:
    A. Turn the entire magneto to the right (if it is a right-hand rotating magneto) or to the left (if it is a left-hand rotating magneto) until both timing lights are ON.
    B. Ensure that the red painted distributor gear tooth is still visible in the timing hole.
13. Rotate the entire magneto in the direction of rotor rotation until one of the timing lights just goes OFF. Then, evenly tighten the magneto mounting clamps.
14. Back the engine up approximately 10° then carefully "bump" the engine forward while observing the timing lights.
15. At the No. 1 cylinder firing position, the same timing light mentioned in Step 13 should go OFF. Continue turning the engine in its normal direction of rotation until the other timing light goes OFF. This should not be more than 3 engine degrees later than the first light.
16. Repeat Steps 12, 13 and 14 until the condition described in Step 15 is obtained.
17. Complete tightening of the magneto securing clamps by torquing to 150 inch-pounds.
18. Recheck timing once more and if satisfactory, disconnect timing light. Remove adapter leads.
19. Reinstall plugs in timing inspection holes and torque from 12 to 15 inch-pounds.
20. Loosely install the harness with clamps and or brackets.

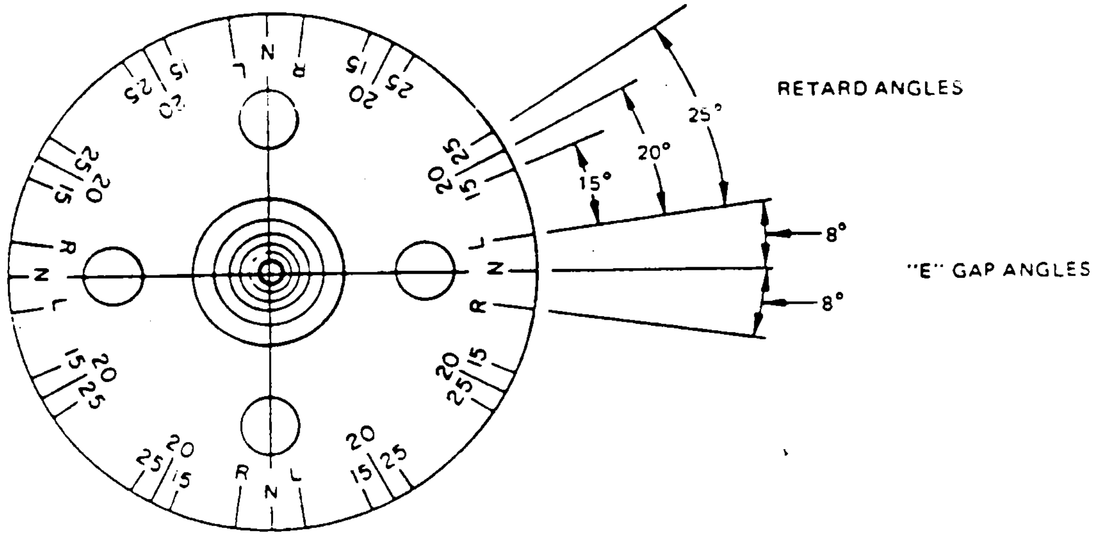

Figure 74-5. Timing Marks on Magneto Rotor

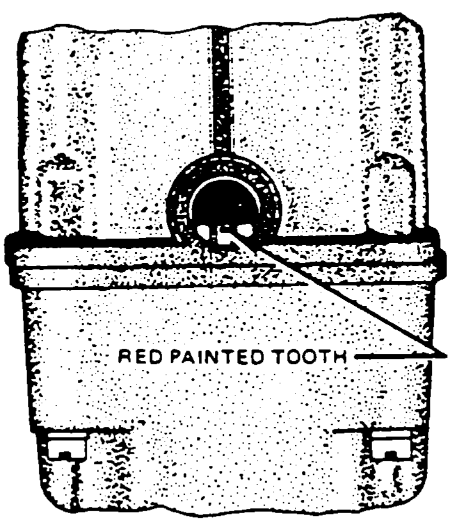

Figure 74-6. Painted Tooth Centered in Timing Window

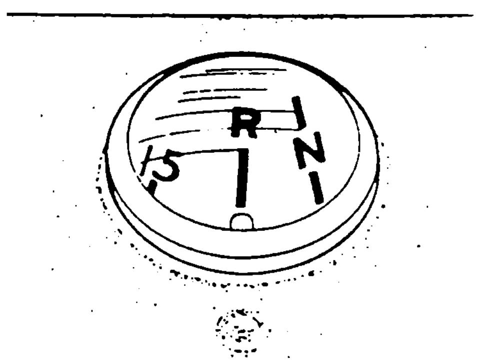

Figure 74-7. Timing Mark on Rotor Aligned with Pointer

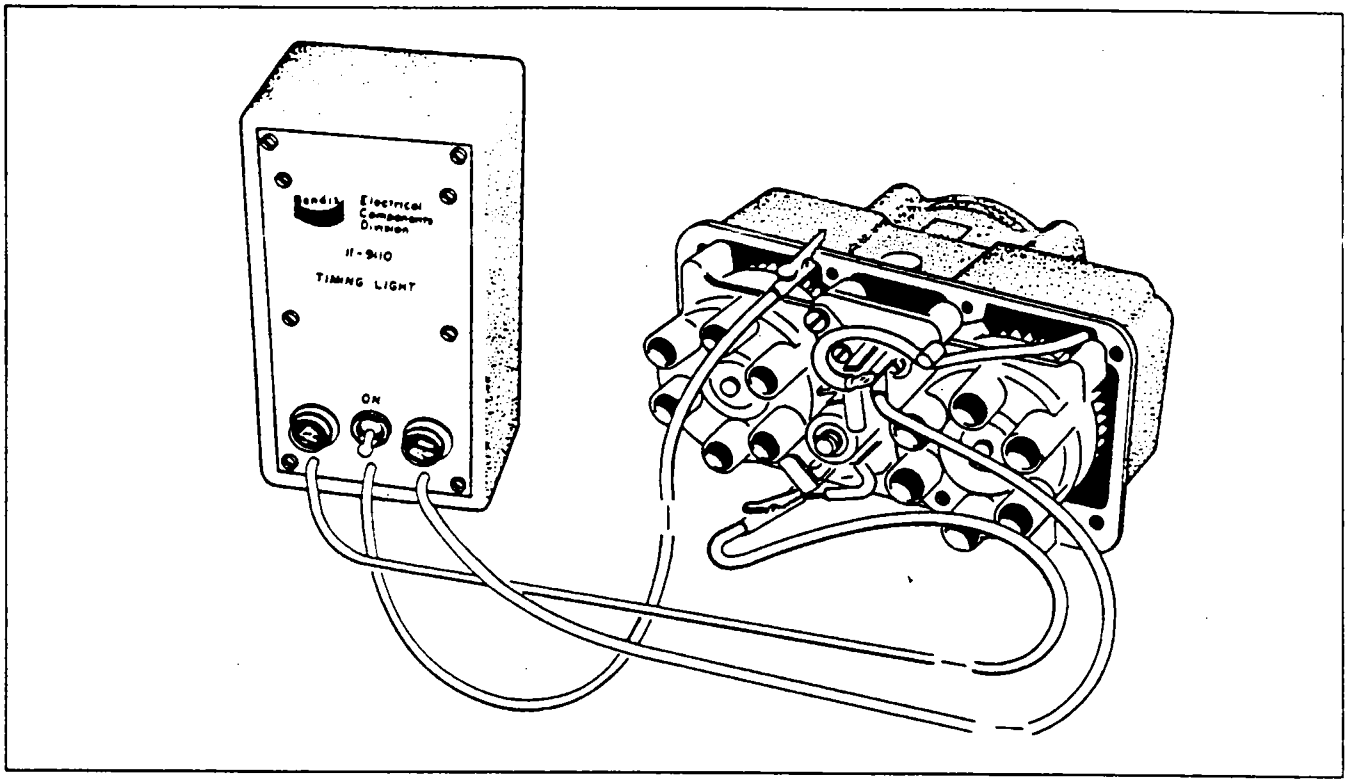

Figure 74-8. Timing Light Connected to Magneto and Breakers

INTERNAL TIMING OF MAGNETO.

1. Remove magneto cover.
2. Loosen flange clamps and remove magneto from engine.
3. Check condition of points: replace if necessary.
4. Rotate the magneto drive shaft until a main cam lobe touches the follower of the left main breaker assembly and adjust the breaker points to an initial opening of .016 inch. Wire feeler gauge is recommended.
5. Adjust right main breaker contact assembly to an initial point opening of .016 inch just as in Step 4.
6. Figure contact support may be bent to adjust clearance. If support is bent, main breaker contact must be rechecked. Torque breaker securing screws to 20-25 inch-pounds.

—NOTE—

Bend bracket carefully. Do not correct by bending back if bent too much; this weakens the bracket.

7. Position rotor so keyway is at 12 o'clock position and red painted distributor teeth are visible in timing windows.
8. Loosen drive shaft nut and position the Rotor Holding Tool (Bendix part number 11-8465) under washer or bushing on drive end of rotor shaft with clamp at 4 o'clock position so any shaft deflection caused by clamping action will be in a plane parallel to breaker contacts. Tighten nut to secure holding tool to shaft. Check to insure proper location of keyway and tighten adjusting screw of holding tool to lock rotor in position.

9. Loosen rotor holding tool and turn magnet in direction of rotation until adjacent "R" or "L" ("E" gap) mark is aligned with pointer and lock in position. Both red painted teeth should be approximately centered in timing windows.

—NOTE—

The use of the timing light unit, part number 11-9110-1 available from Bendix will simplify the internal timing procedure and breaker synchronization.

10. Connect the timing light black lead to any unpainted surface of the magneto.
11. Connect the red timing light lead to the left breaker terminal and the green lead to the right main breaker terminal. (Refer to Figure 74-8.)
12. Loosen rotor holding tool and move the rotor back a few degrees; then move it forward. Both lights should go out to indicate opening of the main breakers when the timing pointer is indicating within the width of the "R" mark and the red painted teeth are centered in timing windows.

—NOTE—

A self-locking cam retaining screw is utilized on this magneto. Torque the screw from 21 to 25 inch-pounds. If this self-locking screw is removed at any time, it should be replaced with a new screw.

13. If breaker timing is not correct, loosen cam securing screw (refer to Figure 74-9) and unseat main breaker cam from taper. Using 11-3071 Retaining Ring Pliers inserted in holes in cam, rotate main breaker cam in direction of rotation until left main breaker points just open and press cam onto taper. Install retard cam washer and screw. Tighten screw to seat main breaker cam.
14. Loosen rotor holding tool to turn rotating magnet back a few degrees; then turn rotating magnet in normal direction of rotation. Timing light should go out when timing pointer is aligned with "R" or "L" ('E" gap) mark. Lock rotating magnet in position where points just open.
15. Loosen right main breaker securing screws and position breaker so cam follower is pressed against cam with points closed. Tighten contact assembly securing screws to prevent contact assembly from bouncing back when moved. Using a small mallet and drift, tap right breaker in until points just open.
16. Turn rotating magnet back a few degrees; then turn rotating magnet in normal direction of rotation. Both timing lights should go out within one degree or half the width of "R" or "L" mark on rotor. If breakers are not properly synchronized, reset right breaker.
17. Check right main breaker contact for .016 ± .004 inch point opening and torque right breaker contact securing screws to 20-25 inch-pounds. If point opening is out of limits, repeat timing procedure setting left main breaker opening at .016 ± .002 inch. If right contacts open beyond .020 inch. set left contacts closer to .018 inch. If right contacts open less than .012 inch, set left contacts closer to .014 inch.
18. Connect the timing light to the retard terminal on the left contact assembly. Turn the rotating magnet in the normal direction of rotation to 11° retard for the D6LN-3200 magneto or 19° retard for the D6RN-3200 magneto and lock in position. Carefully loosen the cam securing screw enough to allow the retard cam to turn. Turn the cam in the normal direction of rotation until the retard breaker points just open. Torque the cam securing screw to 16-20 inch-pounds.

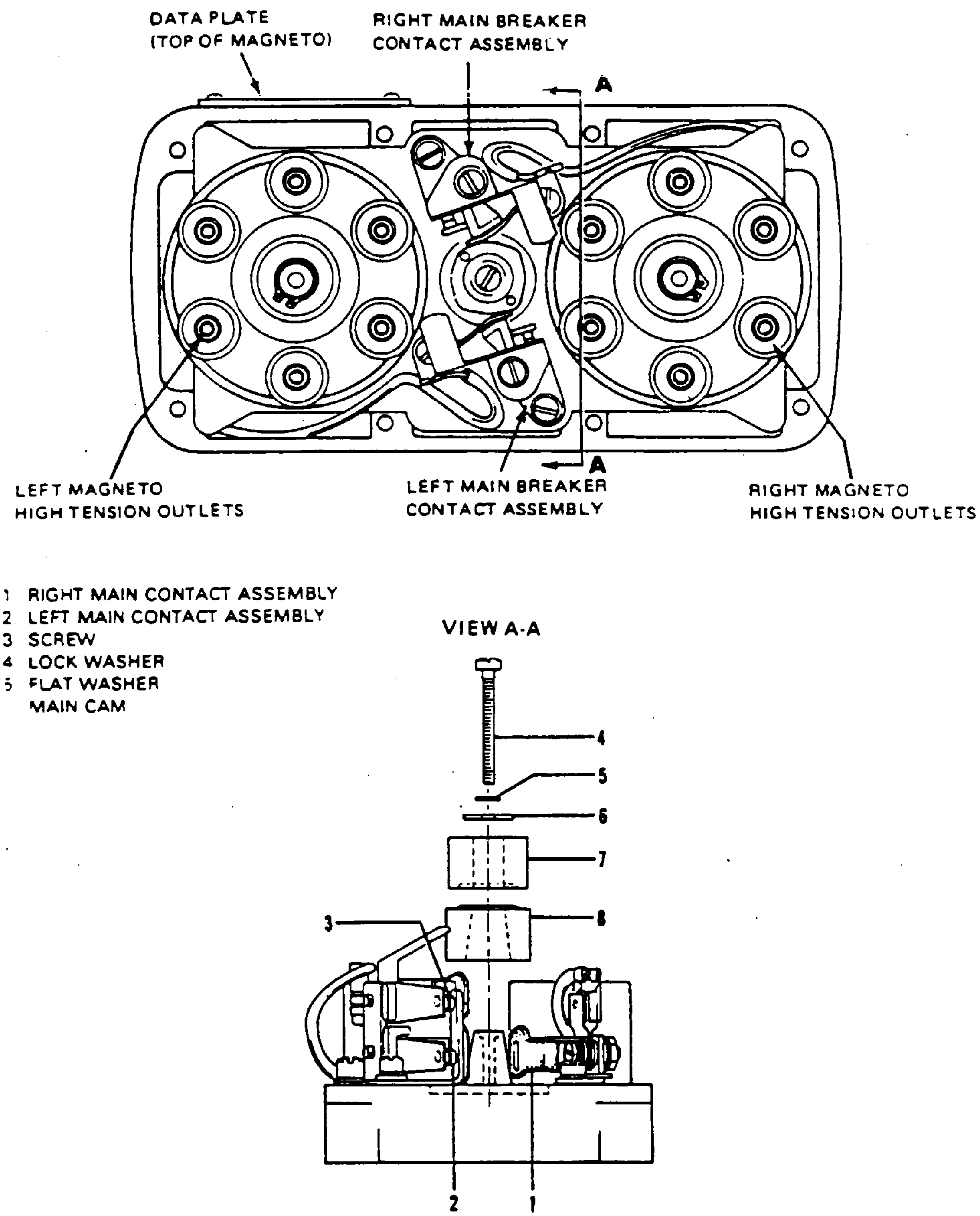

Figure 74-9. Cam End View of Magneto

19. Using timing light, recheck timing to insure main breakers open within one-half the width of "R" mark and that retard breaker opens at correct degree setting. Using a wire feeler gauge, check left main breaker for .016 ± .002 inch point opening and right main breaker and retard breaker for .016 ± .004 inch point opening.

—NOTE—

If correct breaker timing cannot be achieved, remove magneto and have it overhauled

OVERHAUL.

—NOTE—

For overhaul instructions refer to the latest revision of Bendix Overhaul Instructions for the 3000/3200 series magnetos.

DISTRIBUTION .

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 per instructions given in Paragraph titled Maintenance of Harness.

5. Test continuity of each harness lead using a High Tension Lead Tester, part number 11-8888 or 11-8888-1 from Bendix as follows:
   A. Connect black test lead to contact spring and red lead to eyelet of the same lead. (Refer to Figure 74-10.)
   B. Observe that the continuity lamp illuminates.

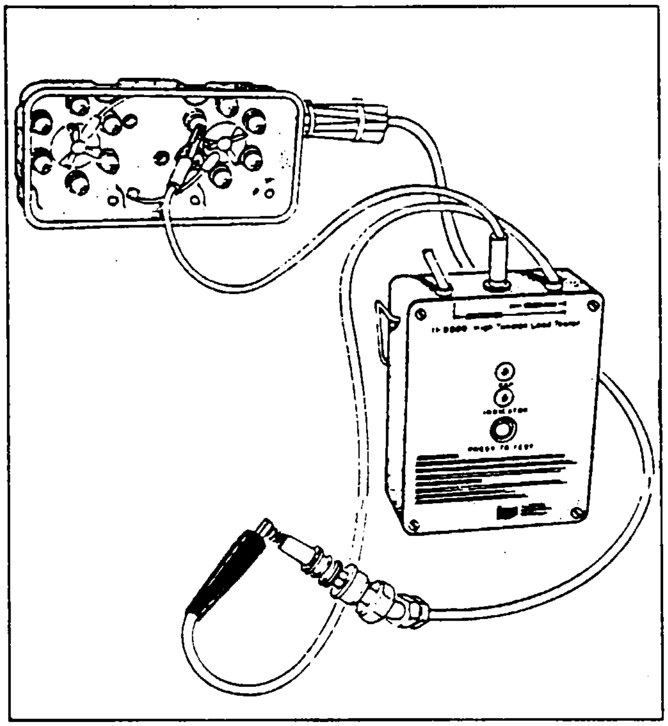

Figure 74-10. Checking Harness Lead Continuity

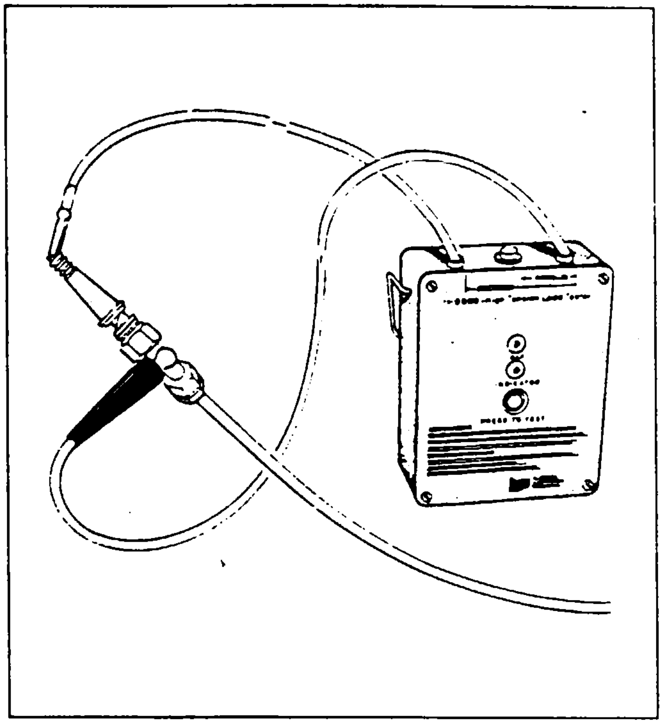

Figure 74-11. Checking Harness Lead Insulation Resistance

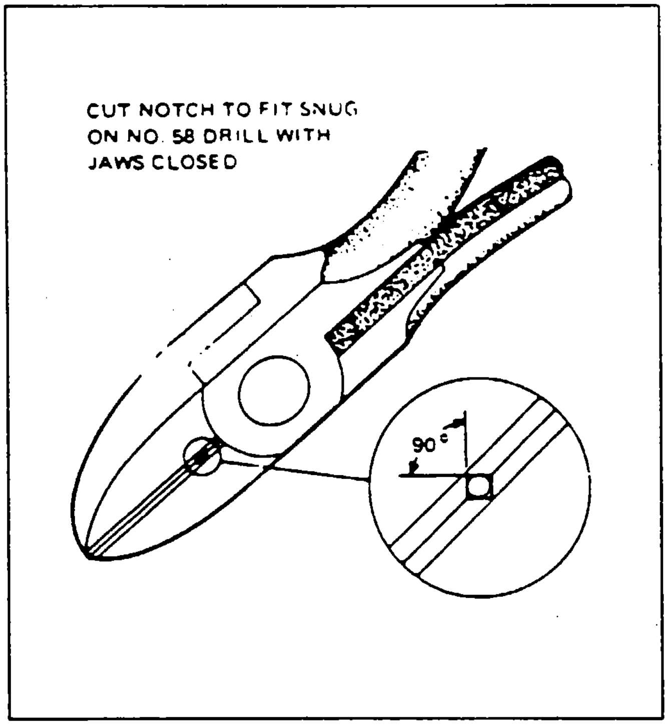

Figure 74-12. Modified Pliers

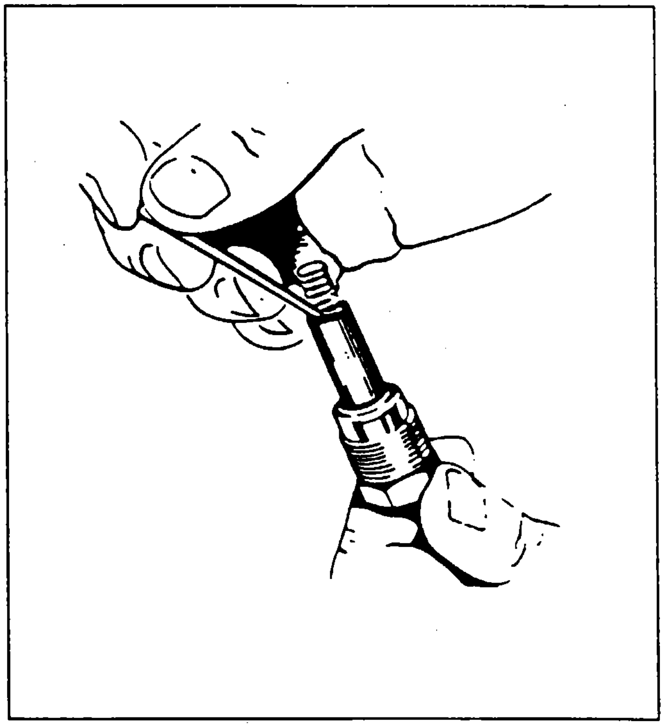

Figure 74-13. Removing Spring From Lead Assembly

6. Test insulation resistance of each harness lead by using the 11-8888 or 11-8888-1 tester as follows:
   A. Attach the red high voltage test lead to contact spring of harness lead. (Refer to Figure 74--11.)
   B. Attach the black test lead to the ferrule of the same harness lead. (Refer to Figure 74-11.)
   C. Depress PRESS-TO-TEST pushbutton 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 74-12. 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 74-13.
2. Using the needle or pencil, unscrew the spring.
3. Slide insulating sleeve and spring retainer assembly off end of lead assembly.
4. Replace defective component and reassemble as follows:
   A. Fabricate a tool as shown in Figure 74-14 for installing the insulating sleeves over 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 74-15. Screw the cable terminal into the tool.
   D. Work insulating sleeve and spring 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.

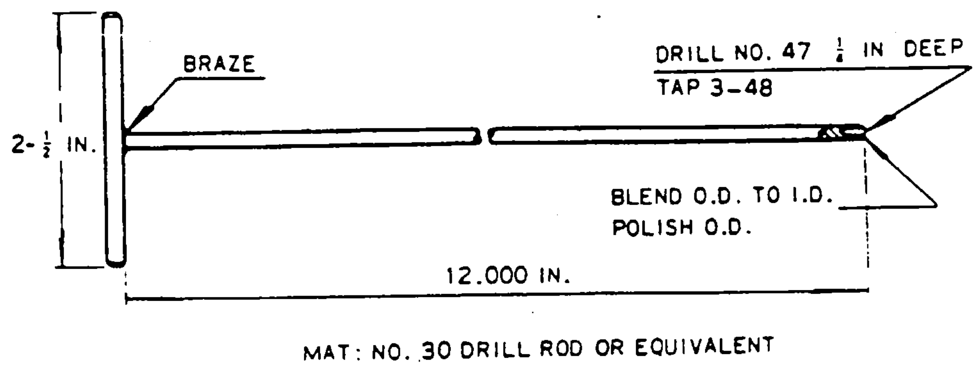

Figure 74-14. Assembly Tool

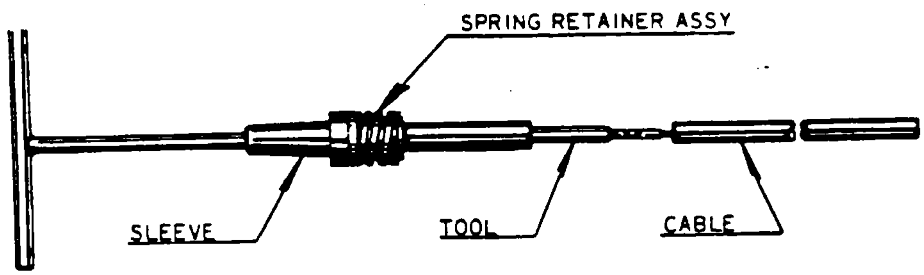

Figure 74-15. Using Assembly Tool

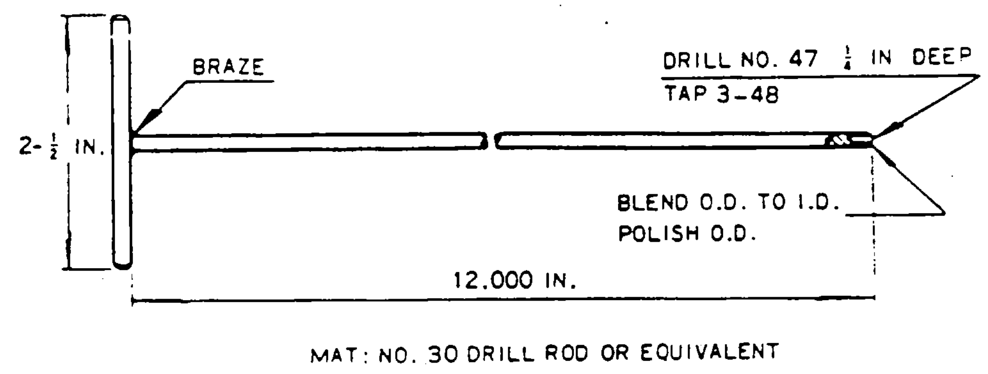

Figure 74-16. Ferrule Positioned Under Braid

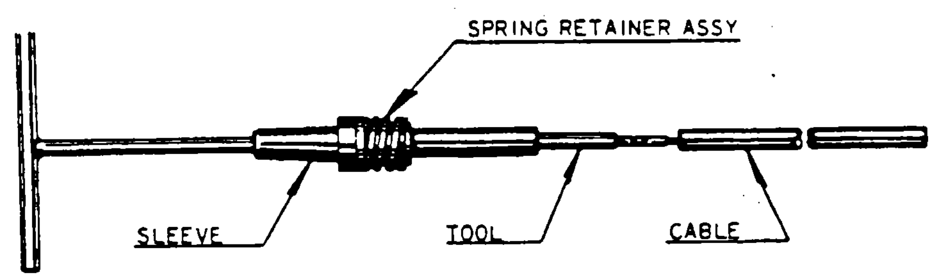

Figure 74-17. Ferrule Seating Tool

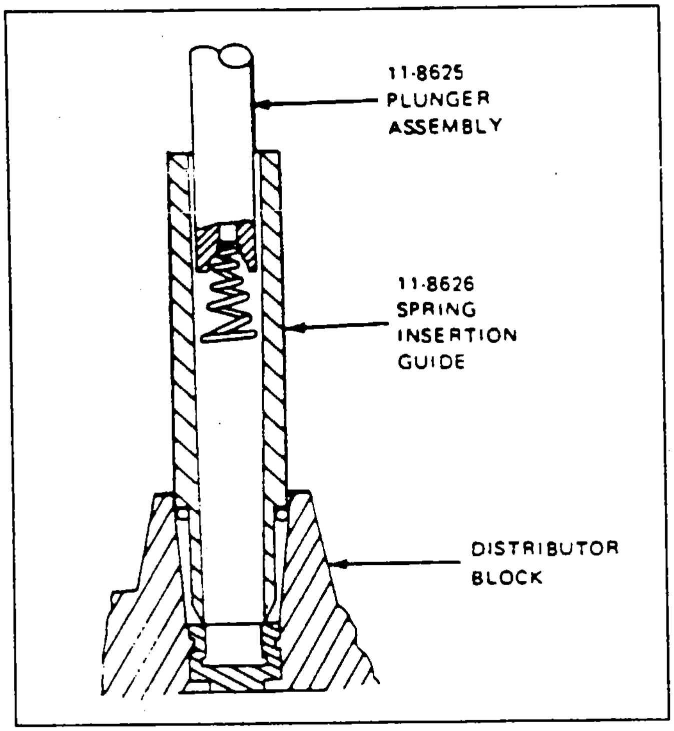

Figure 74-18. Position of 11-8627 Kit and Contact Spring at Start of Installation

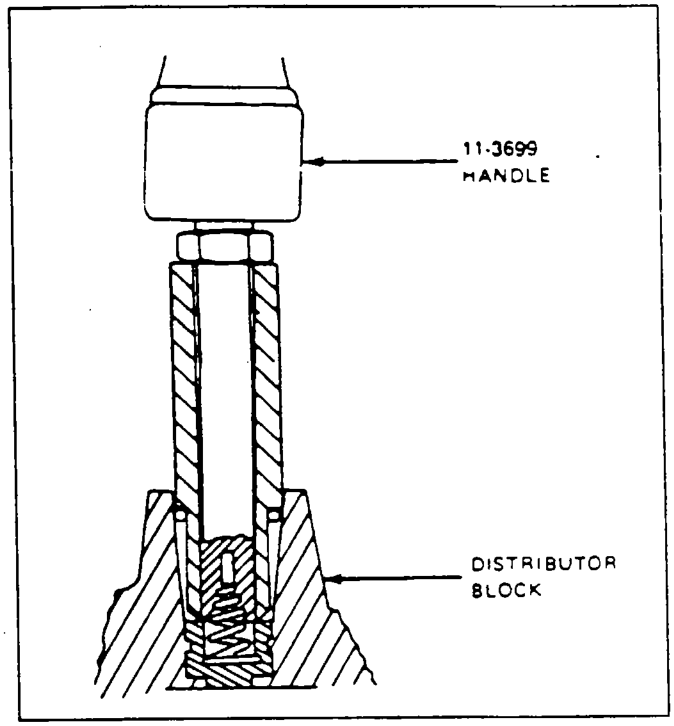

Figure 74-19. Position of 11-8627 Kit and Contact Spring After Installation

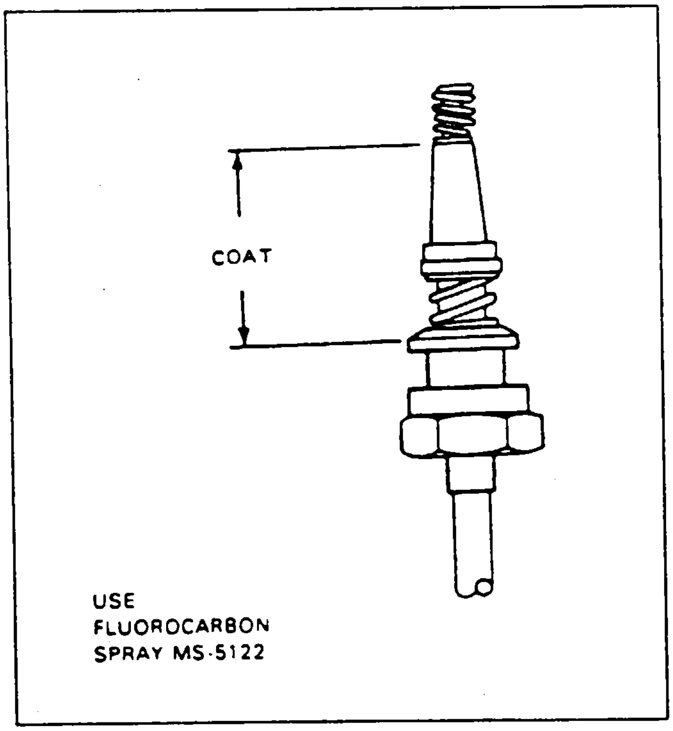

Figure 74-20. Lubricating Sleeve

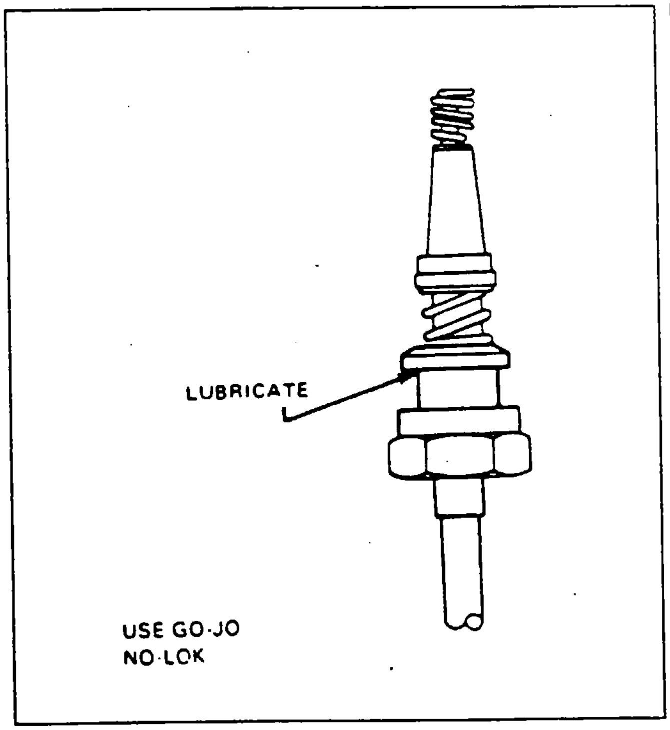

Figure 74-21. Lubricating Ferrule Shoulder

5. To replace one of the lead assemblies, proceed as follows:
   A Remove clamps and brackets from defective lead assembly. Cut cable 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.

—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 74-16.)

—CAUTION—

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 11-7071 Ferrule Seating Tool (refer to Figure 71-17) and a mallet. Ferrule must be driven straight into the cover and fully seated.
   I. Thread the pre-stripped end of 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 74-18 and 74-19) 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 74-20) to prevent heat from sticking sleeve to spark plug barrel. Lightly lubricate the shoulder of ferrule to minimize twisting of ferrule. (Refer to Figure 74-2 1 .) Use GO-JO NO LOK manufactured by Go-Jo Inc., Akron, Ohio 44309.
10. Check cam securing screw. Screw must be torqued to 16-20 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.

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 or 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 74-02. Do not allow ferrules to turn while torquing nuts.

CHART 7402. COUPLING TORQUES

Spark Plug Coupling Threads	Torque (lb.-in.)
5/8-24	90-95
3/4-20	110-120

SPARK PLUGS.

Refer to the latest revision of Avco-Lycoming Service Instruction No. 1042 for a list of approved spark plugs.

REMVOAL 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. A void undue distortion of the collar and possible side loading of the barrel insulator.

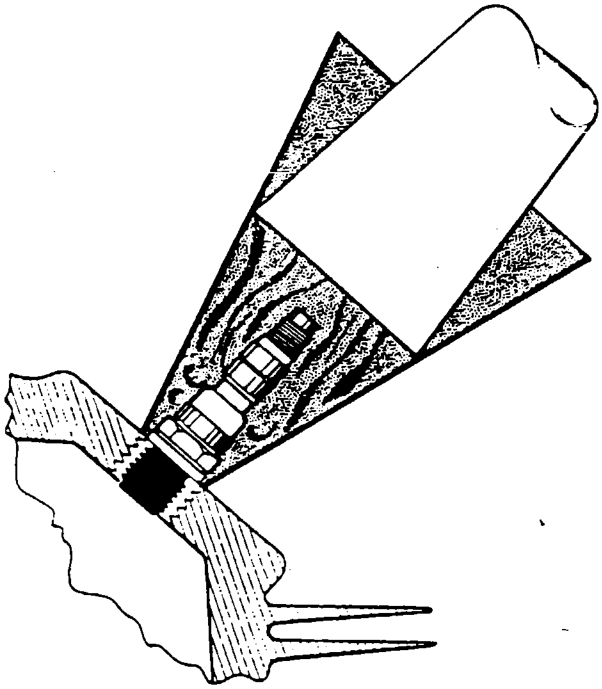

Figure 74-22. Removing Spark Plug Frozen to Bushing

2. Remove the spark plug from the engine. In the course of engine operation, carbon and other combustion products will be deposited on the end of the spark plug and will penetrate the lower threads to some degree. As a result, greater torque is frequently required for removing a plug than for its installation. Accordingly, the torque limitations given do not apply to plug removal and sufficient torque must be used to unscrew the plug. The higher torque in removal is not as detrimental as in installation, since it cannot stretch the threaded section. It does, however, impose a shearing load on this section and may, if sufficiently severe, produce a failure in this location.

—NOTE—

A torque indicating handle should not be used for spark plug removal because of the greater torque requirement.

3. Place spark plugs in a tray that will identify their position in the engine as soon as they are removed.

—NOTE—

Spark plugs should not be used if they have been dropped.

4. Removal of seized spark; plugs in the cylinder may be accomplished by application of fluid carbon dioxide by a conical metal funnel adapter with a hole in 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 PLUGS.

1. Visually inspect each spark plug for the following non-repairable defects:
   A. Severely damaged shell or shield threads nicked up, stripped or cross-threaded.
   B. Badly battered or rounded shell hexagons.
   C. Out-of-round or damaged shielding barrel.
   D. Chipped, cracked or broken ceramic insulator portions.
   E. Badly eroded electrodes worn to approximately 50% of original size.
2. Clean the spark plugs as required, removing carbon and foreign deposits.
3. Test the spark plug both electrically and for resistance.
4. Set the electrode gap at 0.017 to 0.021 inches.

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.

SWITCHING.

IGNITION SWITCH.

Refer to Chapter 39.

—END—

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CHAPTER

76

ENGINE CONTROLS

CHAPTER 76- ENGINE CONTROLS

TABLE OF CONTENTS/EFFECTIVITY

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 600-650 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. on all cases, allowance should be made for the effect of weather conditions and field altitude upon idling adjustment.

RIGGING ALTERNATE AIR CONTROLS.

1. Disconnect alternate air control clevis from alternate air actuating arm (on aft induction duct).
2. Pull alternate air control knob .12 to .25 inch from its full in position on the instrument panel.
3. Place alternate air actuating arm all the way forward against its stop on the aft induction duct.
4. Adjust the clevis on the end of the alternate air control cable to fit on the arm. Tighten clevis jam nut.

—END—

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CHAPTER

77

ENGINE INDICATING

CHAPTER 77- ENGINE INDICATING

TABLE OF CONTENTS/EFFECTIVITY

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.

The tachometer used in this system is electric and makes use of two tach generators (one for each engine). and one dual tachometer indicator. Each generator is mounted aft of the firewall on the upper left longitudinal bulkhead for its respective engine (Sta. 116.88) and is connected to the engine by a flexible tach cable to the engine accessory case. The generators are electrically interconnected with the tachometer secured to the instrument panel.

The system functions through the reaction of each engine operating its own tach generator. As the generator is activated by the engine, a pulse pattern is sent to the tachometer which reacts to the incoming signals to indicate the engine RPM.

TROUBLESHOOTING. (Refer to Chart 7702.)

CHART 7702. TROUBLESHOOTING (TACHOMETER)

Trouble	Cause	Remedy
Both pointers inop.	Circuit breaker tripped.	Reset
One pointer inop.	Defective generator.	Replace generator.
One pointer inaccurate.	Defective indicator.	Replace tach. indicator.

—NOTE—

The adjustments within the tachometer indicator must be made only by a qualified instrument repair facility.

With a tach. generator removed from the engine, and electrical power applied, spinning the shaft with fingers should cause the pointer to deflect. This generally proves out the wiring. The tach. generators receive an excitation voltage from the indicator.

The generators can be exchanged from one engine to the other for troubleshooting.

CHART 7702. TROUBLESHOOTING (TACHOMETER) (cont.)

Trouble	Cause	Remedy
Each generator cable breaks.	Cable bent too sharply.	Reroute cable, replace shaft.

—NOTE—

Ascertain that the drive cable from the engine to the tach generator will rotate properly.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

TEMPERATURE.

CYLINDER HEAD TEMPERATURE GAUGE.

The cylinder head temperature gauge is one of the functions of the oil temp. oil press. CHT gauges, located on the right-hand instrument panel. These instruments measure the cylinder head temperature using senders located in a cylinder head in each engine. These gauges are electrical instruments and are 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 and determining the proper fuel mixture setting at altitudes above 5,000 feet. 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.

Attempts to lean the engine with a faulty EGT can result in excessive cylinder head temperature or burned exhaust valves.

CLEANING AND INSPECTION.

Unless there is 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.

C. Clean the probe with solvent and check for broken weld (at tip end) or burnt off end.
D. Repalce 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 probe cables for the following:

Probe Resistance (Probe 54353)	0.98 + 20% ohms
Probe Resistance (Probe 55841)	1.00 + .020 ohms

INSTALLATION OF EGT PROBE. (Refer to Figure 77-1.)

The EGT probe is mounted in the exhaust manifold downstream from 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 High Temperature 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 7701.)

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.)

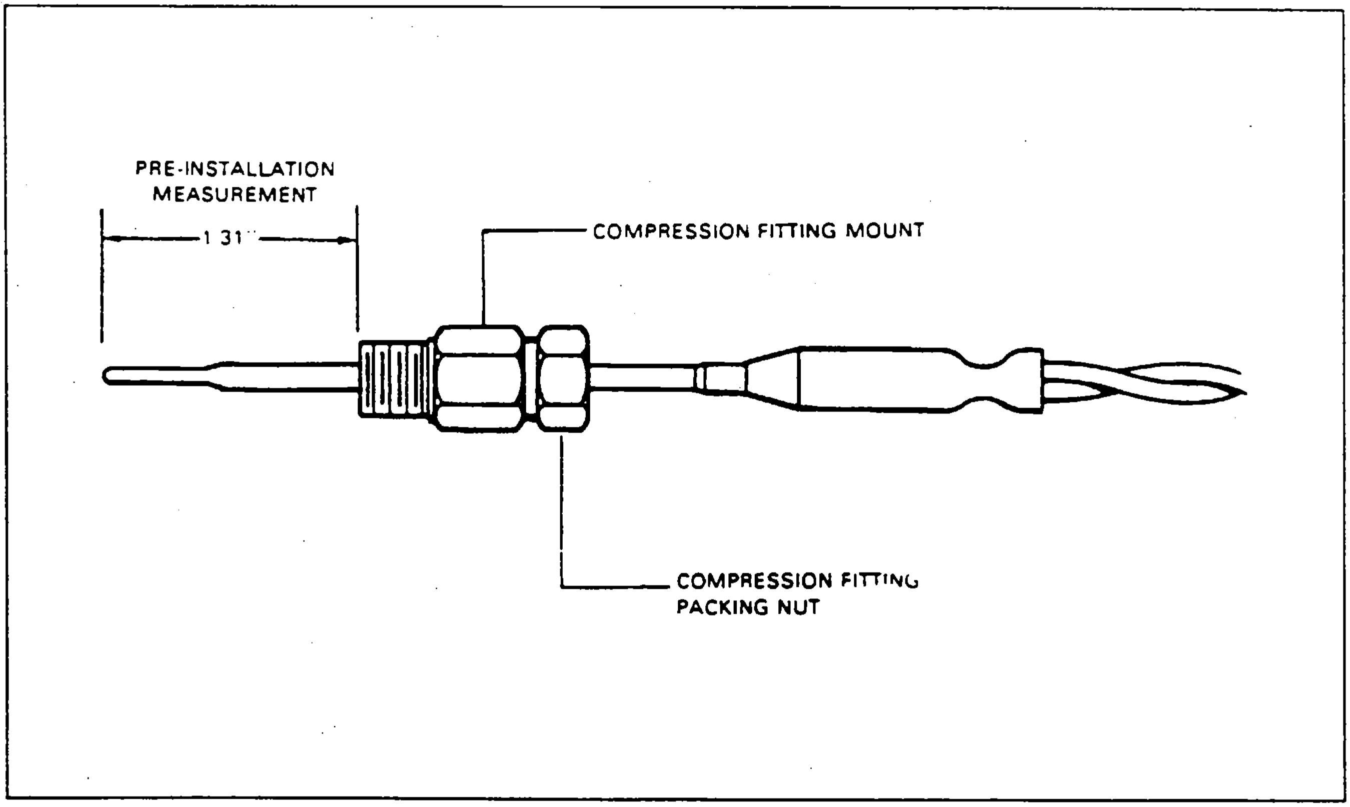

Figure 77-1. EGT Probe (Adjustable)

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CHAPTER

79

OIL SYSTEM

CHAPTER 79- OIL SYSTEM

TABLE OF CONTENTS/EFFECTIVITY

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 thermostatic 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.

—NOTE—

Refer to Chapter 81, for information concerning the turbocharger lubrication system.

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 t~ 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, over haul 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 bearing.	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 (55 to 95 psi). The valve is located above and to the rear of No. 5 cylinder. If the pressure under normal operating conditions should consistently exceed 95 psi or run less than 55 psi adjust valve as follows:

1. With the engine thoroughly warmed up and running at approximately 2000 RPM, observe the reading on the oil pressure gauge. If the pressure is above 90 psi. stop engine and back off the adjusting screw to decrease pressure.
2. If pressure is too low, stop engine and 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 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 throwaway filter, remove the element for inspection by using Champion cutter tool CT-470. Available from Champion Spark Plug Co., Toledo, Ohio 43601. It will cut open any spin-on type filter for inspection. Examine the material trapped in the filter for evidence of internal engine damage such as chips or particles from bearings. In new or newly overhauled engines, some small particles of metallic shavings might be found; these are generally of no consequence and should not be confused with particles produced by impacting, abrasion or pressure. Evidence of internal engine damage found in the oil filters justifies further examination to determine the cause.
3. After the filter has been replaced, tighten the attaching bolt within 15 to 18 foot-pounds of torque. Lockwire the bolt through the loops on the side of the housing to the drilled head of the thermostatic valve. Be sure the lockwire is replaced at both the attaching bolt head and the thermostatic oil cooler bypass valve.

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. 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 gauges are one of the functions of the oil temp./oil press./CHT gauges on the right-hand instrument panel. These gauges 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 indicators are one of the functions of the oil temp./oil press./CHT gauges on the right-hand 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 engine accessory section.

TROUBLESHOOTING.

CHART ?903. 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.

This chapter provides general maintenance information on the PA-31P-350 starter motors. Prestolite Models: MHB-4016R (Left Engine) and MHB-4014R (Right Engine). For overhaul and repair procedures, and repair stations contact:

THE PRESTOLITE COMPANY
511 HAMILTON STREET
TOLEDO, OHIO 43694
TEL: (419) 255-4068

DESCRIPTION.

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 also flows, through the brushes and commutator, and finally through the armature to ground. The result is a high cranking torque, for a limited period of time, with a high current flow at a minimum loss of voltage.

The drive end gear of the armature mates with the reduction gear which drives the Bendix shaft. The Bendix drive is held in position on the shaft by a "spirol" pin. As the armature turns the reduction gear, the Bendix drive pinion meshes with the starter drive gear by inertia and action of the "spirol" grooves within the Bendix unit. A detent pin engages in a notch in the screw threads which prevents de-meshing if the engine fails to start. When the engine does start and reaches a predetermined speed, centrifugal action forces the detent pin to release and allows the pinion to demesh from the starter drive gear.

CRANKING TESTS.

The starting circuit should be inspected at regular intervals (100 Hour Inspections). The frequency should be determined by the type of starting conditions and the amount of starter usage. In any case, it is recommended the following tests be completed at least twice a year.

1. Check the battery with a hydrometer to make sure it is fully charged and filled to the proper level. A load test should be accomplished to verify the condition of the battery before proceeding.
2. Check all starter circuit wiring making sure all connections, including battery terminals, are clean and tight and that all insulation is sound and complete.
3. A voltage loss test should be made to locate any high resistance connections that would impair starting motor electrical efficiency. Measure the following voltage drops while cranking the engine, or at approximately 100 amps of current flow.
   A. Voltage drop across the positive battery post to the starter motor terminal -0.3 volt maximum.
   B. Voltage drop across the battery negative terminal to the starter motor frame - 0.1 volt maximum.
4. If voltage loss exceeds the above limits, thoroughly clean all connections. If still too high, measure voltage across each connection point to discover the source of the unwanted resistance. Proceed to next step when these limits are met.
5. Crank the engine for several seconds with the ignition "OFF". The starter motor engagement and response should be prompt and the motor should drive at a uniform speed, without binding or producing unusual sounds.
6. Re-engage the starter two or three times, listening for prompt engagement, without gear clash.

REMOVAL OF STARTER MOTOR

1. Disconnect the negative (ground) cable from the battery first to prevent accidental electrical shorts.
2. Disconnect starter cable from starter terminal.
3. Remove mounting bolts and lift off starter motor.

INSTALLATION OF STARTER MOTOR.

1. Clean all traces of rust, corrosion, and dirt from all mounting surfaces and hardware. All grounding points shall be clean and tight.
2. Place starting motor in position, with no stressing or binding forces present, and reinstall mounting hardware.
3. Reinstall starter cable to starter terminal post.
4. Reconnect battery ground cable.
5. Perform cranking tests.

—END—

CHAPTER

81

TURBINES

CHAPTER 81 - TURBINES

TABLE OF CONTENTS/EFFECTLVLTY

GENERAL.

This chapter contains information pertinent to the maintenance, troubleshooting .and repair of the turbochargers installed on this airplane.

DESCRIPTION AND OPERATION.

The Turbocharger System consists of 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 Troublèshooting 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 turbo charger.
	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. 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. R~ lines or hoses. Increase oil pressure to desired pressure.
	Inlet orifices to actuator clogged.	Remove inlet line at actuator and clean orifices.
	Restriction in return lines from actuator to waste gate controller.	Remove and clean lines.
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 or rerig.

CHART 8101. TROUBLSHOOTING (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 lull 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 tuator, check condition of piston and packing or replace actuator assembly.
Oil in induction housing.	Oil leaking past seal in controllers. Engine idles too slow - turbo doesn't turn allowing oil to leak from compressor seal.	Replace faulty controller. 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). Engine idles too slow - turbo not turning.	Clean drain passages. It is sometimes necessary to overhaul or replace turbo. Increase engine idle speed to a maximum of 700 RPM, if turbo still smokes, it must be overhauled or replaced.

CHART 810L. 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 adjsut 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 adjsut 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 bearing.	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.

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TURBOCHARGER.

TURBOCHARGER NOMECLATURE.

Many unfamiliar terms may appear on the following pages of this manual. An understanding of these be helpful in performing maintenance and troubleshooting. The following is a list of commonly used terms and names as applied to turbocharging and 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 turbocharger that takes in ambient air and compresses it before discharging it to the engine.
Turbine	The exhaust driven and 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.
Absolute Pressure Controller	The absolute pressure controller senses deck pressure on an absolute scale and tries to maintain constant absolute deck pressure to provide sea level horse power at varying altitudes. The controller aneroid bellows assembly is mechanically linked to a hydraulic poppet valve. The bellows are enclosed in an airtight cower with an inlet port for the deck pressure sensing line. Deck pressure in excess of a preset level squeezes the bellows enough to move the spring-loaded, normally-closed poppet and open the controller oil outlet. Consequently, compressor speed is quickly reduced and the deck pressure is brought back down to the acceptable level.
Ground Boosted or Ground Turbocharged	These phrases indicate that the engine depends on a certain amount of turbo-charging at sea level to produce the advertised horsepower. An engine that is so designed w ill usually include a lower compression ratio to avoid detonation n.
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 throttlevalve is almost directly proportioned to the engine power output.
Normalizing	If a turbocharged system is used only to regain power losses caused by decreased air pressure of high 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. Overshopt 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 owershoot due to turbocharger inertia.
Bootstrapping	This is a term used in conjunction wvith 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 tester, etc. A turbocharged engine above critical altitude (waste gate closed) is similiar 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 parially 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 tull closed position. the preselected manifold pressure will start to drop and this is considered critical altitude.

TURBOCHARGER MAINTENANCE.

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 connecting the turbo and engine.
   D. Loosen the upper clamp of the hose that connects the turbo compressor and intercooler inlet duct.
   E. Remove the voltage that attach the turbo to the mounting pad on the exhaust plenum and remove the turbo from the airplane.
3. The waste gate may be removed as follows:
   A. Remove the lower cowling.
   B. Disconnect the waste gate actuating mechanism from the waste gate actuating arm.
   C. Remove the two clamp that secure the waste gate between the right-hand exhaust manifold pipe and the extension on the tail pipe. Do not spread the clamps any more than is necessary to remove the waste gate.
4. For service maintenance and overhaul of the turbocharger refer to Airesearch Overhaul Manual for Aircraft turbochargers, Valves and Controllers.

TURBOCHARGER LUBRICATION SYSTEM PRIMING.

1. After reassembly, and if the turbocharger is not to be installed immediately on an engine, perform the prelubrication procedure described below:
   A. Fill the oil inlet port with clean engine oil.
   B. Manually turn the compressor wheel for several revolutions to coat all journal and bearing surfaces with oil.
   C. Drain excess oil from the turbocharger through both the oil inlet and outlet ports.
   D. Install protective cowering on all openings to prevent dirt and moisture from entering the turbocharger.

2. After isntalling the turbocharger on the engine or following the engine oil and filter or following any prolonged period of non-operation, prelubricated the (already installed) turbocharger as follows:
   A. Temporarily disconnect the engine oil supply line from the turbocharger oil inlet port, and the engine ail duct from the compressor housing inlet.
   B. Fill the turbocharger oil inlet port with clean engine oil and manually turn the compressor wheel several revolutions to coat all journal and bearing surfaces with oil. Reconnect the air duct.
   C. Place a suitable container under the disconnected engine oil supply line to avoid spilling oil on the engine. Crank the engine not allowing it to start. When a steady flow of oil is obtained from the supply line to show that air has been purged from the system, stop cranking. Reconnect the oil supply line.
   D. If the turbocharger is installed on a new or newly overhauled engine, with the initial run-in period not yet complete, take the following precauions to protect the turbocharger during engine initial run in:
      (1) TEMPORARILY install a screen of 100 mesh or finer in the oil supply line to the turbocharger to trap metal particles from the engine during the initial run in.

—*CAUTION*—

Since cleaning of the screen is not provided for in periodic maintenance procedures for the engine, the screen must not be left in place after the initial run-in period. Operation of the turbocharger with a clogged screen will cause turbocharger failure due to lack of lubrication.

      (2) Remove the extra screen from the oil supply line after the initial run-in period.

—*WARNING*—

Operation of the turbocharger without all normally installed inlet ducts and filters connected can result in injury to personnel and damage to equipment from foreign objects entering the turbocharger.

—*CAUTION*—

Operation of the engine at any speed faster than idle immediately after start-up can result in "oil log" failure of turbocharger bearings, especially in cold weather or after a prolonged non-operative period.

   E. Verify that all air and exhaust inlet ducts and filters are properly installed. Then, start the engine and operate for three or four minutes at idle speed to allow engine oil pressure and flow to stabilize.
   F. Check all oil connections for leakage, and tighten or repair as needed.

INSTALLATION OF TURBOCHARGER.

1. Attach the turbocharger to the mounting pad on the exhaust plenum.
2. Attach the turbo charger to its support.
3. Attach the intercooler inlet duct to the turbocharger compressor.
4. Attach the upper tail pipe to the turbocharger turbine. Torque the coupling to the valve specified on the coupling.
5. Attach the induction air duct to the turbocharger compressor.
6. The waste gate maw be installed as follows:
   A. Position the waste gate between the right-hand exhaust manifold pipe and the extension on the tail pipe. Secure the waste gate in place with the two clamps.
   B. Reconnect the waste gate actuating mechanism to the waste gate actuating arm.
7. Pre-oil the turbocharger per turbocharger Lubrication System Priming.

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. 11187.

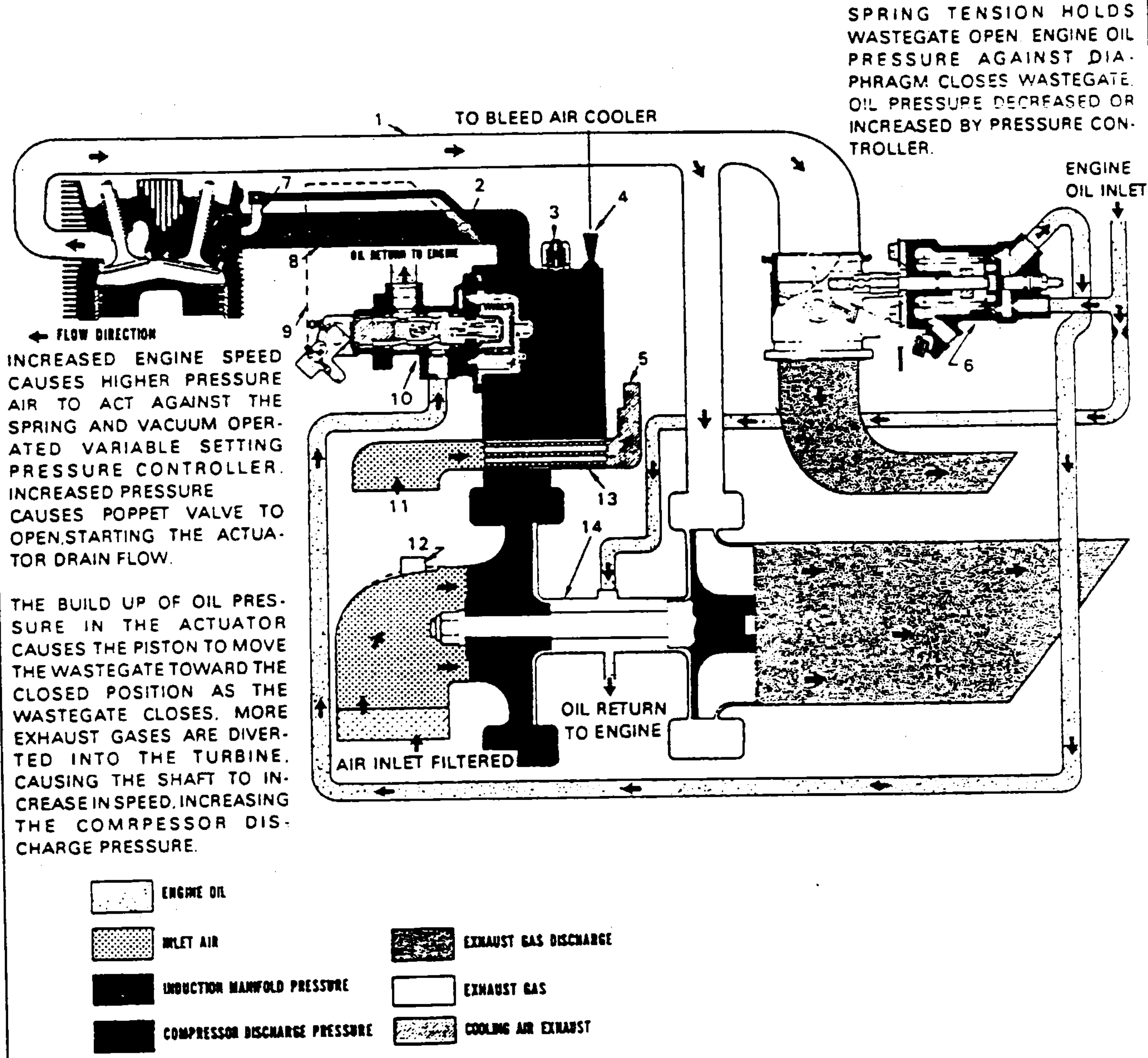
RIGGING OF ABSOLUTE PRESSURE CONTROLLER. (Refer to Figure 81-2.)

1. Disconnect controller link rod at injector throttle arm.
2. Rotate throttle arm full open with throttle lever in cockpit, and with .020 feeler gauge located between the throttle arm stop pin and the throttle arm, hold the throttle in the full open position.
3. Move the controller arm to the full boost (counterclockwise) position until contacting its stop.
4. If necessary, adjust the rod end bearing on the forward end of the controller link rod so that the attachment bolt will fit freely through the hole in the throttle arm and the link rod.
5. Reconnect and safety all attachments that were disconnected for the previous procedure.
6. The above clearance is required when the full throttle M.P. is 42 in. Hg.

EXHAUST WASTE GATE ASSEMBLY.

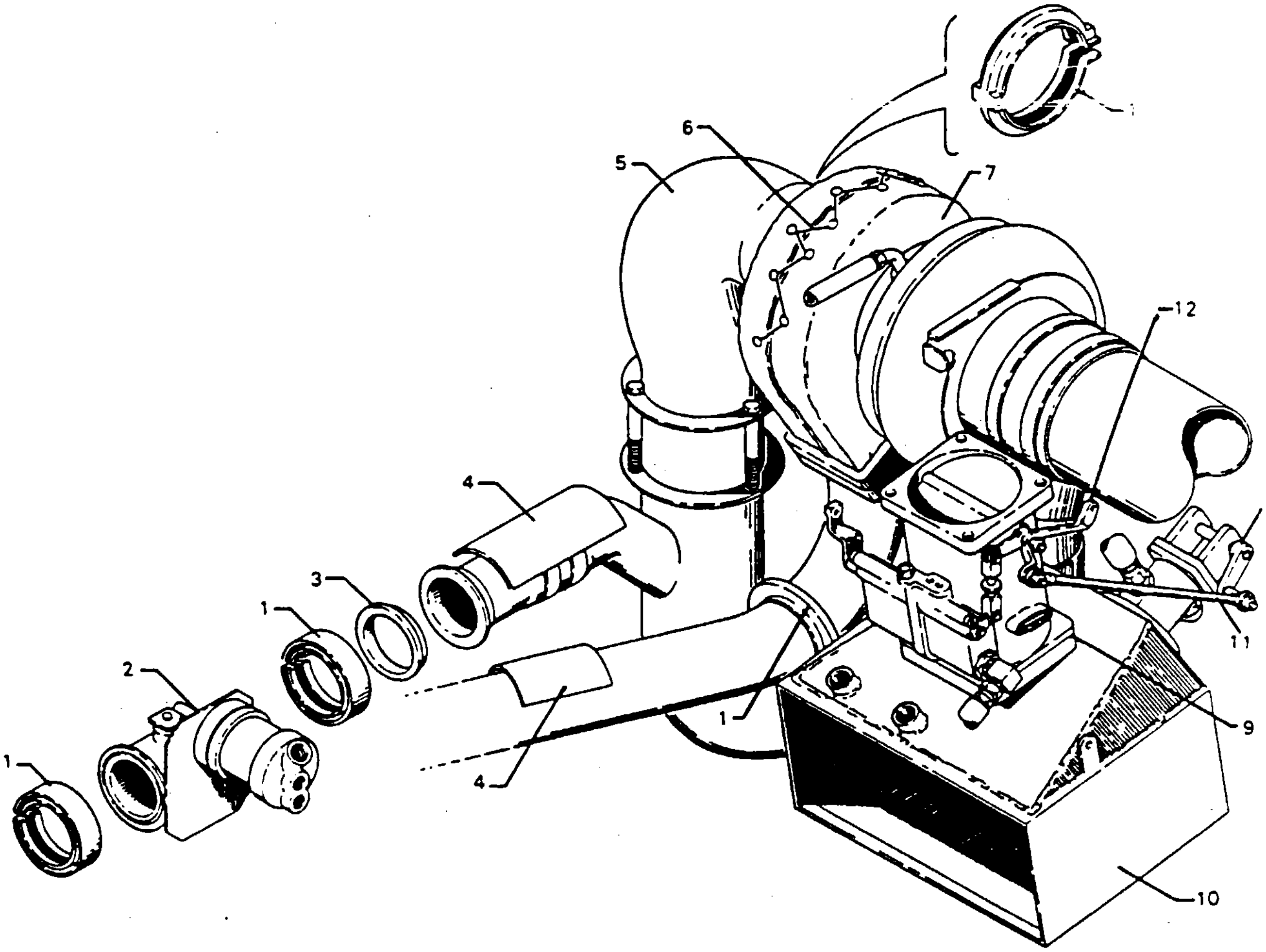
REMOVAL OF EXHAUST WASTE GATE ASSEMBLY.

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.



1. EXHAUST MANIFOLD
2. THROTTLE
3. ABSOLUTE PRESSURE RELIEF VALVE
4. SONIC NOZZLE
5. RAM AIR OUTLET
6. EXHAUST BYPASS VALVE ASSEMBLY
7. FUEL
8. INDUCTION MANIFOLD
9. THROTTLE LINKAGE
10. VARIABLE ABSOLUTE PRESSURE
11. RAM AIR INLET
12. ALTERNATE AIR
13. INTERCOOLER
14. TURBOCHARGER

Figure 81-1. Schematic Diagram of Turbocharger System



NOTE: TORQUE TO VALUE ON COUPLINGS.

1 COUPLING
2 WASTE GATE
3 GASKET
4 GUARD ASSEMBLY
5 TAIL PIPE ASSEMBLY
6 SAFETY WIRE
7 BLANKET
8. ABSOLUTE PRESSURE CONTROLLER
9 FUEL INJECTOR
10. INTERCOOLER
11. CONTROLLER LINK ROD
12. THROTTLE ARM

Figure 81-2. Turbocharger Installation

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 clearance. A table of this clearance as given in Figure 81-3. With 50-60 psi pressure in the waste gate cylinder, adjust the closed position of the valve so that the waste gate valve firmly contacts the bore in the closed position. After adjusting the closed position and with no pressure in the waste gate cylinder, adjust the full open (A) 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—

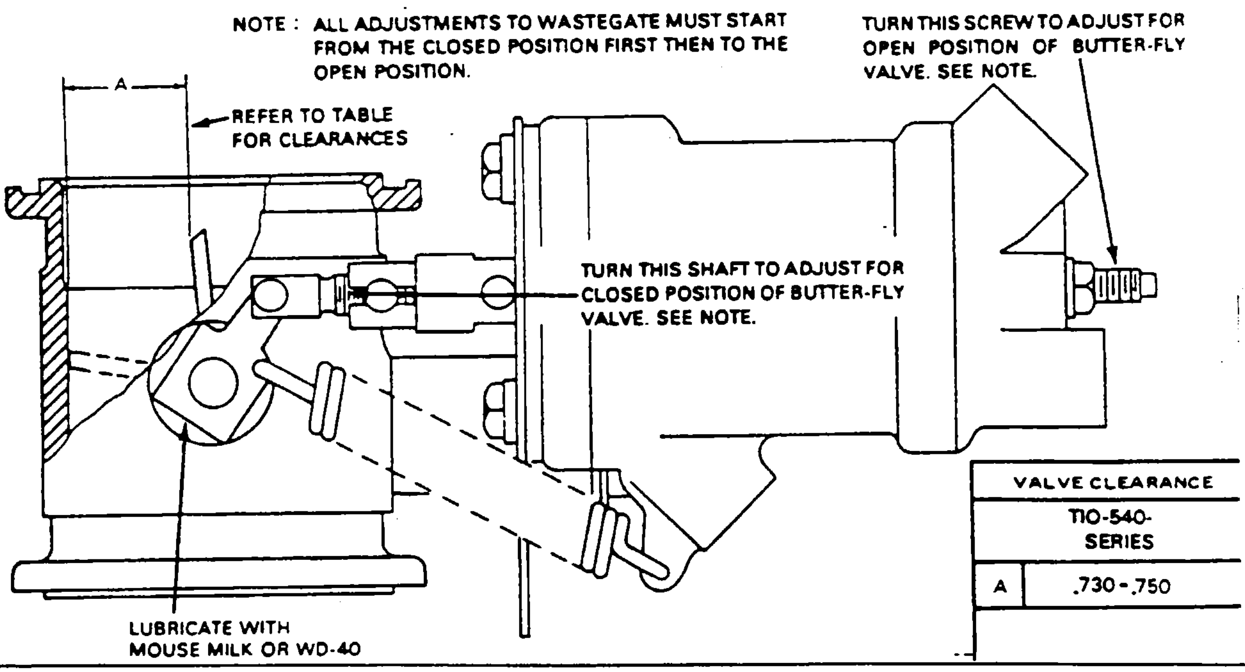
All adjustments to the waste gate valve must start from the closed position first and then to the open position.

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.
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.)



VALVE CLEARANCE	
	TIO-540-SERIES
A	.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 driving.
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 flash the unit with engine oil.
5. Prime the turbocharger.

—END—

GRIDS 4J19 THRU 4L24
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PIPER

MOJAVE
MAINTENANCE MANUAL

CARD 5 OF 5

PA-31P-350 MOJAVE

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 781)

INTRODUCTION.

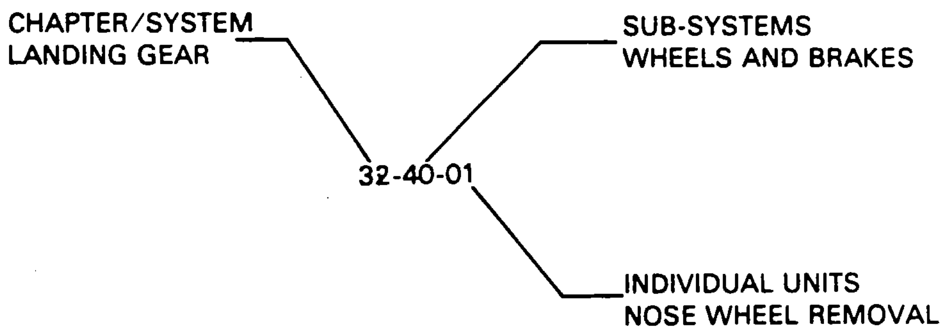
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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-31P-350 aircraft manufactured by the Piper Aircraft Corporation of Lock Haven, Pennsylvania.

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 Parts Catalog P/N 761 776, and FAR 43 for proper utilization.

AEROFICHE EXPLANATION AND REVISION STATUS

The Maintenance Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aircraft Manufacturer's Association, (GAMA). The information compiled in this Aerofiche Maintenance Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set, Grid location J16.

To aid in locating the various chapters and related service information desired, the following is provided:

1. A complete manual System/Chapter Index Guide is for all fiche in this set.
2. A complete list of Illustrations is for all fiche in this set following System/Chapter Index.
3. A complete list of Charts is for all fiche in this set following list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:
   Revised text and illustrations are indicated by a black vertical line along the left-hand margin of the frame, opposite revised, added or deleted material. Revision lines indicate only current revisions with changes and additions to or deletions of existing text and illustrations. Changes in capitalization, spelling, punctuation, indexing, the physical location of the material or complete page additions are not identified by revision lines.
   A reference and record of the material revised is included in each chapter's Table of Contents/Effectivity. The codes used in the effectivity columns of each chapter are defined as follows:

TABLE OF CONTENTS/EFFECTIVITY CODES

Original Issue: None
First Revision: Revision Identification, (1R Month-Year)
Second Revision: Revision Identification, (2R Month-Year)
All subsequent revisions will follow with consecutive revision numbers such as 3R, 4R, etc., along with the appropriate month-year.
Added Subject: Revision Identification, (A Month-Year)
Deleted Subject: Revision Identification, (D Month-Year)

Revisions to this Maintenance Manual 761 781 issued April 25, 1983 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG830425	April 25, 1983	1, 2, 3, 4 and 5
PR830728	July 28, 1983	1, 2, 3, 4 and 5
PR831214	December 14, 1983	1, 2, 3, 4 and 5
IR860430	April 30, 1986	1
IR860723	July 23, 1986	2
IR860925	September 25, 1986	1 and 4
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.

Consult the Customer Service Information Aerofiche for current revision dates for this manual

VENDOR-SUPPLIER INFORMATION.

A partial list of companies, their address and phone numbers are provided to aid service personnel in obtaining information about components not manufactured by Piper Aircraft Corporation.

Air-Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
Alternator	Prestolite Company 511 Hamilton Street Toledo, Ohio (419) 255-4068
Autopilot/Avionics	Edo Corporation - Avionics Division P.O. Box 610 Municipal Airport Mineral Wells, Texas 76067 (817) 325-2517
	Bendix Avionics Division 2100 N.W. 62nd Street Fort Lauderdale, Florida 33310 (305) 776-4100
	Collins General Aviation Division Rockwell International Cedar Rapids, Iowa 52406 (319) 395-3625
	King Radio Corporation 400 N. Rogers Road P.O. Box 106 Olathe, Kansas 66061 (913) 782-0400
	Sperry Flight Systems - Avionics Division 8500 Balboa Boulevard P.O. Box 9028 Van Nuys, California 91409 (213) 894-8111
	Global Navigation 2144 Michelson Drive Irvine, California 92715 (714) 851-0119

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Gill-Teledyne P.O. Box 431 Redland, California (714) 793-3131
Deicing, Airfoil	The B.F. Goodrich Company 500 South Main Street Akron, Ohio 44318 (216) 374-3895
Deicing, Propeller	The B.F. Goodrich Company 6400 Goldsboro Road Suite 102 Bethesda, Maryland 20034 (301) 229-5000
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington, Penna. 19034 (215) 643-2900
Engines	Avco Lycoming Avco Lycoming Division Williamsport, Penna. 17701
Environmental Systems, Heater and Air Conditioner	Janitrol Aero Division 4200 Surface Road Columbus, Ohio 43228 (614) 276-3561
	Sanden International (U.S.A.), Inc. 10710 Sanden Drive Dallas, Texas 75238
Fuel Pumps	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000
Fuel System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria, Ohio 44035 (216) 323-4676

VENDOR-SUPPLIER INFORMATION (cont).

Landing Gear, Hydraulic Actuators, Hydraulic Pressure Regulator, Hydraulic Power Pack, Hand Pump	Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Magnetos	Bendix Electrical Components Division Sidney, New York 13838
Oxygen System	Scott Aviation Products 225 Erie Street Lancaster, New York 14086 (716) 683-5100
Pneumatic System Components	Airborne Manufacturing Company 711-T Taylor Street Elyria, Ohio 44035 (216) 323-4676
Propellers	Hartzell Propeller, Incorporated 1025 Roosevelt Avenue Piqua, Ohio 45356 (513) 773-7411
Propeller Synchrophaser	Hartzell Propeller Fan Company 910 South Downing Street Piqua, Ohio 45356 (513) 773-7411
Tools, Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Turbocharger	Airesearch Industrial Division 3201 Lomita Boulevard Torrance, California 90505
Wheels and Brakes	Cleveland Wheel and Brake Aircraft Wheel and Brake Division 1160 Center Road Avon, Ohio 44011
	B.F. Goodrich Company Transportation Products Division P.O. Box 340 Troy, Ohio 45373

PIPER PUBLICATIONS.

PA-31P-350

Parts Catalog =	761 776 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961-1328
Continuous Inspection =	761 786 Piper Aircraft Corporation P.O. Box 1328 Vero Beach, FL 32961-1328

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont.)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont.)

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— NOTE —

Refer to Card 5, Grid No. 5C5 for Electrical Schematic Index.

LIST OF ILLUSTRATIONS (cont.)

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CHAPTER

91

CHARTS AND WIRING DIAGRAMS

CHAPTER 91 - CHARTS AND WIRING DIAGRAMS

TABLE OF CONTENTS/EFFECTIVITY

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	PRODUCT	VENDOR
ABS-Solvent Cements		Solarite, #11 Series	Solar Compounds Corp.
Adhesive		EC 801 EC 807 EC 1357 Scotch Grip 210 (Rubber Adhesive)	Minnesota Mining and Manufacturing Adhesive Coating and Sealers Division
Anti-Galling Solution	MIL-A-907	Ease-Off	Taxacone Company
Anti-Seize Compound (Graphite Petrolatum)	MIL-T-5544	Armite Product	Armite Laboratories
		Anti-Seize Compound	Exxon Oil Company
		Royco 44	Royal Lubricants Co.
Anti-Seize Compound (White Lead Base)	TT-A-580 (JAN-A-669)	Armite Product	Armite Laboratories
Anti-Seize Thread Compound "HIGH TEMPERATURE"		Fel-Pro C5-A	Fel-Pro Incorporated
Buffing and Rubbing Compounds		Automotive Type DuPont #7	DuPont Company
		Ram Chemical #69	Ram Chemicals
Compound for Polishing		Mirror Glaze	Mirror Bright Polish Co., Incorporated
Cleaners		Fantastic Spray Perchlorethylene VM&P Naphtha (Lighter Fluid)	Local Supplier
Dry Lubricant, Fluorocarbon Release Agent	MIL-L-60326	MS-122-6075	Local Supplier

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Epoxy Patching Compound		Solarite #400	Solar Compounds Corp.
Gasket Cement		Permatex No. 2	Permatex Company, inc.
Grease, Aircraft Instrumentation, Gear and Actuator Screw Temp. Range = -100° F (-73° C) to +250° F (121° C) and for short periods at +300° F (149° C)	MIL-G-23827A (See Note 1)	Supermil Grease No. A72832	Amoco
		Royco 27A	Royal Lubricants Co.
		Shell 6249 Grease	Shell Oil Company
		RR-28	Socony Mobil Oil Co.
		Castrolease A1	Burmah-Castrol LTD.
		Low-Temp. Grease E.P.	Texaco Incorp.
		5114 E.P. Grease AV55	Standard Oil of Calif.
		Aeroshell Grease 7 Braycote 627S	Shell Oil Company
		Mobil Grease 27	Mobil Oil Corporation
		B.P. Aero Grease 31B	B.P. Trading Limited
Grease, Aircraft Instrument, Gear and Actuator Screw Temp. Range = -65° F to +250° F and for short periods at +300° F	MIL-G-3278	Unitemp E.P.	Texaco Incorporated
		RPM Aviation Grease 5, Supermil Grease No. 8723	Standard Oil of Calif.
		Aeroshell Grease 7A	Shell Oil Corporation
		Royco 78	Royal Lubricants Company
		L-1212	Sinclair Refining Co.
		1916 Uni-Temp. Grease	California Texas Oil Corporation

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, Ball and Roller Bearing	MIL-G-18709	Regal ASB-2 Formula TG-10293	Texaco Incorporated
		Andok B	Exxon Company, U.S.A.
		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 Company
Grease, General Purpose Wide Temperature	MIL-G-81322	Marfax All Purpose	Texaco Incorporated
		Aeroshell No. 6	Shell Oil Company
		Mobil Grease 77 or Mobilux EP2	Mobil Oil Corporation
		Shell Alvania EP2	Shell Oil Company
		Royco 22	Royal Lubricants Company
		Mobil Grease 28	Mobil Oil Corporation
		Aeroshell No. 22	Shell Oil Company
Grease, High Temperature	MIL-G-3545	High Temp. Grease, Marfax All Purpose	Texaco Incorporated
		Shellaire Grease HT Alvania E.P. Grease 2 Aeroshell Grease 5	Shell Oil Company

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, High Temperature (cont.)		Grease 77, Mobilux EP2	Mobil Oil Corporation
		Royco 45A	Royal Lubricants Co.
		L-1231	Sinclair Refining Company
Grease, Aircraft General Purpose	MIL-G-7711	Regal AFB2 Regal Starfak Premium	Texaco Incorporated
		PED 3040	Standard Oil of Calif.
		Aeroshell Grease 6	Shell Oil Company
		Royco 11	Royal Lubricants Company
Grease, Lubricating, Molybdenum Disulfide, Low and High Temperature	MIL-G-21164	Aeroshell Grease No. 17	Shell Oil Company
		Royco 64C	Royal Lubricants Co.
		Castrolease MSA (c)	Burmah Castrol LTD.
Grease, Lubricating, Plug Valve, Gasoline and Oil Resistant	MIL-G-6032	Royco 32	Royal Lubricant Company
		Castrolease PV	Burmah Castrol LTD.
		Parker Fuel Lube 44	Parker Seal Company
		B. P. Aero Grease 32	B.P. Trading Limited
	MIL-G-6032	L-237	Lehigh Tenneco Chemicals Co., Inc.
		Rockwell 950	Rockwell International

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, Waterproof, High and Low Temperature		Aero Lubriplate	Fiske Brothers Refining Company
"Hot Melt" Adhesive Polyamids, and "Hot Melt" Gun	Stick Form 1 2 in. diameter, 3 in. long		Sears, Roebuck and Company or most hardware stores
Hydraulic Fluid	MIL-H-5606 (Univis 40)	Brayco 756D	Bray Oil Company
		TL-5874	Texaco Incorporated
		PED 3565	Standard Oil Company of California
		Aircraft Hydraulic Oil AA	Texaco Incorporated
		RPM Aviation Oil No. 2 Code PED 2585 PED 3337	Standard Oil Company of California
		3126 Hydraulic Oil (Univis 40)	Exxon Company U.S.A.
		Aeroshell Fluid 4, SL-7694	Shell Oil Company
		Aero HF	Mobil Oil Corporation
		Royco 756, 756A and 756B	Royal Lubricants Co.

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Isopropyl Alcohol	Fed. Spec. TT-I-735		Local Supplier
Leak Detector Solution for Oxygen Systems	MIL-L-25567	ALPHA 73 Oxygen Leak Detector Type I	U.S. Gulf Corporation
		Leak Tec #16-OX	American Gas and Chemical Co. LTD.
Loctite	MIL-S-22473 Grade AA	Loctite 290	Loctite Corporation
	MIL-S-22473 Grade H and HV	Loctite 222	
Methylethylketone	Fed. Spec. TT-M-261		Local Supplier
Molybdenum Disulfide	MIL-M-7866	Molykote-Type G (Paste)	Dow Corning Corp.
		Molykote - Type 2 (Powder)	
Oil, Air Conditioner		Frigidaire #525	Virginia Chemical
		Suniso #5	Sun Oil Company of Pennsylvania
		Texaco Capilla "E"	Texaco Incorporated
Oil, Lubricating, General Purpose, Low Temperature	MIL-L-7870	Caltex Low Temp. Oil	Caltex Oil Products Company
		Sinclair Aircraft Orbit Lube	Sinclair Refining Company
		1692 Low Temp. Oil	Texaco Incorporated
		Aviation Instrument Oil	Standard Oil Company of California
		Royco 363	Royal Lubricants Co.

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Rain Repellent	FSCM 50159	Repcon	Unelco Corporation
Safety Walk Pressure Sensitive		Flextred 300	Wooster Products, Incorporated
Sealant	MIL-S-11031B	PRC 5000 PRC 383	Products Research Company
Sealant, Fuel Tank Sealing		RS-36b, Stripper (thin)	CEE BEE Chemical Co.
		RS-24b, Stripper (thick)	
		PR 1422 A-2 Sealant (Brushing Consistency)	Products Research Company
		PR 1422 B-2 Sealant (Trowling Consistency)	
		PR 1431G, Faying Surface Seal, Type 1	
		PR 1321-B 1 2, Access Panel Sealant	
		PA 1560 MK, Primer (Anti-Bacteriological Coating)	Products Research Company
		BJO-0930, Phenolic Balloons	Union Carbide Plastics Division
		ERL-2795, Epoxy Resin	
		22LA-0340 Polyamid Hardener	

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Sealing Compound, Gasket and Joint		Tite-Seal	Radiator Specialty Co.
Sealer		PR 1321 B½	Products Research Company
Silicone Compound	MIL-S-8660 (MIL-C-21567)	DC-4, DC-6 Compound	Dow Corning
		G-624	General Electric Co. Silicone Products Department
Solvents		Methylethylketone Methylene Chloride Acetone	Local Suppliers
		Y2900	Union Carbide, Plastic Division
	Fed. Spec. PD 680 Type I - Stoddard Solvent		Local Supplier
	Type II - High Temperature		Local Supplier
Propeller Slip Ring Cleaning Solvent		CRC-2-26	Corrosion Reaction Consultants, Inc.
Toluol	TT-M-261		Local Supplier
Trichlorethylene	MIL-T-7003	Perm-A-Clor	Dextrex Chemical Industries, Inc.
		Turco 4217	Turco Products, Inc.

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Teflon Tape	.003" x .5" wide -1		Minnesota Mining and Manufacturing Company Shamban W.S. and Co.
	.003" x .25" wide -2		Johnson & Johnson, Inc. Permacel Division
Thread Sealant for High Pressure Oxygen System	MIL-T-27730	Permacel 412	Johnson & Johnson, Inc. Permacel Division
Vinyl Foam	1 in. x 1/8 in.	530 Series, Type I	Norton Tape Division
Vinyl, Foam Tape	1/8 in. x 1 in.	501 Series, Type II	Norton Tape Division
Vinyl, Black Plastic	2 in. x 9 mil. and or 1½ in. x 9 mil.		

NOTE 1: Take precautions when using MIL-G-23827 and engine oil. These lubricants contain chemicals harmful to painted surfaces.

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

VENDOR INFORMATION

A

American Gas and
Chemical Co. LTD.
220 Pegasus Avenue
Northvale, New Jersey 07647
201-767-7300

Amoco
200 E. Randolph Drive
Chicago, Illinois 60601
312-856-5111

Armite Laboratories
1845-49 Randolph Street
Los Angeles, California
90001
213-587-7744

B

BP Trading Limited
Moore Lane
Brittanic House
London E.C. 2
England

Bray Oil Company
1925 Marianna Avenue
Los Angeles, California 98103
213-268-6171

Burmah - Castrol LTD.
30 Executive Avenue
Edison, New Jersey 08817
201-287-5640

C

California Texas Oil
Corp., 380 Madison Avenue
New York, New York 10017

Caltex Oil Products Co.
New York, New York 10020

CEE BEE Chemical Co.
9520 E. CEE BEE Drive
Box 400
Downey, California 92041

Corrosion Reaction
Consultants, Inc.
Limekin Pike
Dresher, PA 19025

D

Dextrex Chemical
P.O. Box 501
Detroit, Michigan 48232

Dow Corning Corporation
Alpha Molykote Plant
64 Harvard Avenue
Stanford, Conn. 06902

Dukes Astronautics Co.
7866 Deering Avenue
Canoga Park, California
91304

DuPont Company
Finishes Div.
Dupont Bldg.
Wilmington, Delaware 19898
302-774-1000

E

Exxon Oil Company
1251 Avenue of the Americas
New York, New York 10019
212-757-1200

F

Fel-Pro Incorporated
7450 N. McCormick Blvd.
Box C1103
Skokie, Illinois 60076
312-761-4500

Fiske Brothers
Refining Company
129 Lockwood Street
Newark, New Jersey 07105
201-589-9150

G

General Electric Co.
Silicone Products Dept.
Waterford, New York 12188
518-237-3330

H

H. S. Bancroft Corp.
One Rockhill
Industrial Park
Cherry Hill, New Jersey 08003
609-854-8000

J

Johnson & Johnson Inc.
Permacel Division
501 George Street
New Brunswick, N.J. 08901
201-524-0400

K

Kevlar Special Products
E.I. DuPont de
Nemours & Co., (Inc.)
Textile Fibers
Department
Centre Road Building
Wilmington, Delaware 19898
(302) 999-3156

L

Lehigh - Tenneco Chemicals
Co., Inc.
Chestertown, Maryland 21620
301-778-1991

Loctite Corporation
705 N. Mountain Road
Newmington, Conn. 06111
203-278-1280

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

VENDOR INFORMATION

M

Minnesota Mining and MFG.
3M Center
St. Paul, Minn. 55101
612-733-1110

Mirror Bright Polish Co., Inc.
Irvine Industrial Complex
P.O. Box 17177
Irvin, California 92713
714-557-9200

Mobil Oil Corporation
150 E. 42ND Street
New York, N.Y. 10017
212-883-4242

N

Norton Tape Division
Department 6610
Troy, New York 12181
518-273-0100

P

Parker Seal Company
17325 Euclid Avenue
Cleveland, Ohio 44112
216-531-3000

Permatex Co., Inc.
P. O. Box 11915
Newington, CT 06111
203-527-5211

Products Research Co.
2919 Empire Avenue
Burbank, Cal. 91504
213-849-3992

R

Radiator Specialty Co.
P.O. Box 34689
Charlotte, N. C. 28234
707-377-6555

Ram Chemicals
210 E. Alondra Blvd.
Gardena, California 90248
213-321-0710

Rockwell Internat
400 N. Lexington Avenue
Pittsburgh, PA 15208
412-247-3000

Royal Lubricants Company
River Road
Hanover, New Jersey 07936
201-887-3100

S

Shamban W.S. and Co.
11543 W. Olympic Blvd.
Los Angeles, CA 90064
213-879-2270

Shell Oil Company
One Shell Plaza
Houston, Texas 77002
713-220-6697

Sinclair Refining Co.
600 Fifth Avenue
New York, N.Y. 10020

Socony Mobil Oil Co.
Washington 5, D.C. 20005

Solar Compounds Corp.
1201 W. Blancke Street
P.O. Box 227
Linden, N.J. 07036
201-862-2813

Standard Oil of California
225 Bush Street
San Francisco, Calif. 94120
415-434-7700

Sun Oil Company of Penna.
5 Penn Center Plaza
Philadelphia, PA 19103
215-972-2000

T

Taxacone Company
P.O. Box 10823 TR
Dallas, Texas 75208

Texaco, Inc.
2000 Westchester Avenue
White Plaines, N. Y. 10650
914-253-4000

Turco Products Inc.
24600 S. Main Street
Box 6200
Carson, California 90749
213-835-8211

U

U. S. Gulf Corp.
P.O. Box 233
Stoneybrook, N.Y. 11790
(212) 683 9221

Unelko Corporation
727 E. 110th Street
Chicago Ill. 60628

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

VENDOR INFORMATION		
Union Carbide, Plastic Div. 270 Park Avenue New York, N.Y. 10017 212-551-3763		
V		
Virginia Chemical 3340 W. Norfolk Rd. Portsmouth, Va. 23703 804-484-5000		
W		
Wooster Products, Inc. 30 Spruce Street Wooster, Ohio 44691 216-262-8065		

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 can not 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. Ascertain that the bolt and nut threads are clean and dry (unless otherwise specified by the manufacturer).
3. Run nut down to near contact with the washer or bearing surface and check "friction drag torque" required to turn the nut.
4. Add the friction drag torque to the desired torque recommended by the manufacturer, or obtain desired torque as shown in **Chart 9103**. This is referred to as final torque which should register on the indicator or the setting for a snapover type wrench.

NOTE

For more details on torquing, refer to FAA Manual AC 43.13-1.

FRICTION DRAG TORQUES
COARSE AND FINE

BOLT SIZE	FRICTION DRAG TORQUE (IN.-LBS.)
10	18
1/4	30
5/16	60
3/8	80
7/16	100

	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

COARSE THREAD SERIES

Nut-bolt size	Torque Limits in-lbs Min.	Torque Limits in-lbs Max.	Torque Limits in-lbs Min.	Torque Limits in-lbs Max.
8 -32	12	15	7	9
10 -24	20	25	12	15
1/4-20	40	50	25	30
5/16-18	80	90	48	55
3/8-16	160	185	95	110
7/16-14	235	255	140	155
1/2-13	400	480	240	290
9/16-12	500	700	300	420
5/8-11	700	900	420	540
3/4-10	1,150	1,600	700	950
7/8- 9	2,200	3,000	1,300	1,800
1 -8	3,700	5,000	2,200	3,000
1-1/8-8	5,500	6,500	3,300	4,000
1-1/4-8	6,500	8,000	4,000	5,000

PPS 20018E

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.
8 −36	12	15	7	9					5	10	3	6
10 −32	20	25	12	15	25	30	15	20	10	15	5	10
1/4−28	50	70	30	40	80	100	50	60	30	45	15	30
5/16−24	100	140	60	85	120	145	70	90	40	65	25	40
3/8−24	160	190	95	110	200	250	120	150	75	110	45	70
7/16−20	450	500	270	300	520	630	300	400	180	280	110	170
1/2−20	480	690	290	410	770	950	450	550	280	410	160	260
9/16−18	800	1,000	480	600	1,100	1,300	650	800	380	580	230	360
5/8−18	1,100	1,300	660	780	1,250	1,550	750	950	550	670	270	420
3/4−16	2,300	2,500	1,300	1,500	2,650	3,200	1,600	1,900	950	1,250	560	880
7/8−14	2,500	3,000	1,500	1,800	3,550	4,350	2,100	2,690	1,250	1,900	750	1,200
1 −14	3,700	4,500	2,200	3,300	4,500	5,500	2,700	3,300	1,600	2,400	950	1,500
1-1/8−12	5,000	7,000	3,000	4,200	6,000	7,300	3,600	4,400	2,100	3,200	1,250	2,000
1-1/4−12	9,000	11,000	5,400	6,600	11,000	13,400	6,600	8,000	3,900	5,600	2,300	3,650

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	Teflon Tape
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
				53/54	.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.

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. FIT.	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	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	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	0.1447	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	5.558	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

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

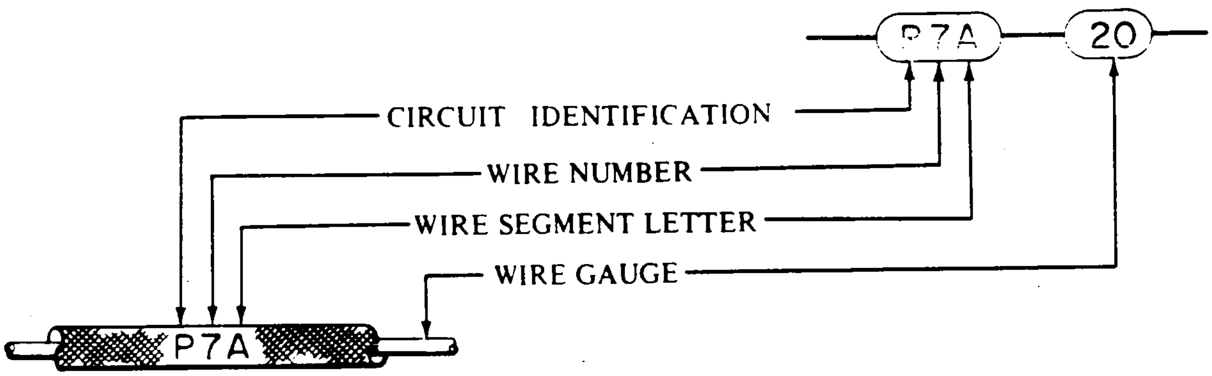
Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.
1/2	0.500	12.7000	G	0.261	6.6294	5/32	0.1562	3.9687	51	0.067	1.7018
31/64	0.4843	12.3031	F	0.257	6.5278	23	0.154	3.9116	52	0.0635	1.6129
15/32	0.4687	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.

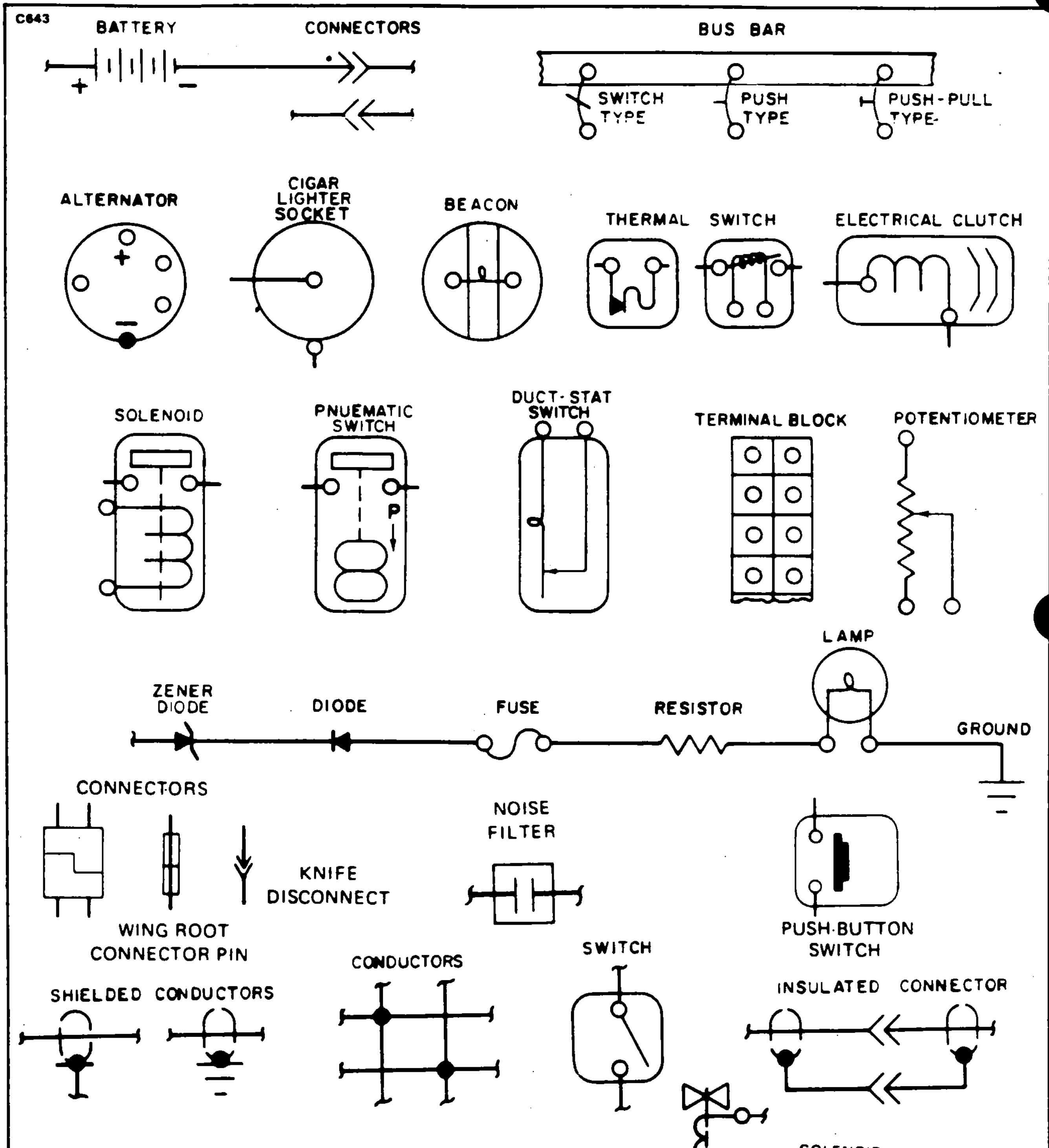
ELECTRICAL WIRE CODING AND SYMBOLS.

CHART 9109. ELECTRICAL WIRING 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 = From Fuselage Station 57.0 Aft.
G	LANDING GEAR	E 400 Series = On Fuselage Station 57.0 and Forward.
H	HEATER - VENTILATING & DEICING	
L	LIGHTING	
P	POWER	
Q	FUEL. OIL & ENGINE INSTRUMENT	
RP	RADIO POWER	
RZ	RADIO AUDIO	
J	IGNITION	

CHART 9110. ELECTRICAL SYMBOLS



*CONDUCTORS CROSSINGS AND JUNCTIONS OF CONDUCTORS. THE DOT AT THE INTERSECTION INDICATES A JOINING OF CONDUCTORS.

ELECTRICAL SCHEMATIC INDEX

SHEET NO.	SCHEMATIC	GRID NO.
	ANNUNCIATOR	
13	Master Caution Channels	5D9
13	Advisory Channels	5D9
	COMFORT SYSTEMS	
9	Cabin Aft Refreshment Center (Optional)	5D1
9	Cabin Divider Forward (Optional)	5D1
1	Cigar Lighter	5C9
1	Heated Thermos	5C9
1	Razor Inverter	5C9
9	Toilet (Optional)	5D1
	DEICE SYSTEMS	
3	Alternator - 100 Amp Required	5C13
5	Pitot Heat - Left/Right	5C17
14	Propeller Blade Deice - Left/Right	5D11
5	Stall Warning - Heated Lift Detector	5C17
5	Surface Deice/Pneumatic Pressure Switches	5C17
5	Windshield Heat - Left/Right	5C17
	ELECTRICAL POWER SYSTEMS	
3	Alternators - 70 Amp - Left/Right	5C13
3	Alternators - 100 Amp - Left/Right (Optional)	5C13
2	Bus - Main Power Distribution/Battery - 70 Amp/100 Amp	5C11
2	External Power	5C11
6	Electronic Locator Transmitter (E.L.T.)	5C19
	ENGINE SYSTEMS	
11	Cylinder Head Temperature - Left/Right	5D5
2	Magnetos - Left/Right	5C11
11	Oil Temperature - Left/Right	5D5
2	Starters - Left/Right	5C11
11	Tachometers - Left/Right	5D5

ELECTRICAL SCHEMATIC INDEX (cont.)

SHEET NO.	SCHEMATIC	GRID NO.
	ENVIRONMENTAL	
16	Air Conditioning	5D15
1	Cabin Instruments Display Computer	5C9
11	Cabin Pressurization System	5D5
16	Ground Vent and Recirculation Fans	5D15
16	Heater	5D15
	FLAP SYSTEMS	
14	Cowl Flap	5D11
12	Wing Flaps/Amplifier Computer	5D7
	FUEL SYSTEMS	
4	Boost Pumps - Left/Right	5C15
4	Fuel Flow - Left/Right	5C15
4	Fuel Pressure - Left/Right	5C15
4	Fuel Pumps - Left/Right	5C15
4	Fuel Transducers - Left/Right	5C15
4	Fuel Totalizer	5C15
4	Fuel Quantity	5C15
	INDICATORS	
10	Ammeter	5D3
1	Cabin Instruments Display Computer	5C9
11	Cylinder Head Temperature - Left/Right	5D5
9	Fasten Seat Belts/No Smoking	5D1
6	Gyro - Attitude	5C19
6	Gyro - Directional	5C19
6	Gyro - Pictorial Rate (Turn & Bank Optional)	5C19
11	Hour Recorder - Flight	5D5
16	Hour Recorder - Heater	5D15
11	Oil Pressure - Left/Right	5D5
11	Oil Temperature - Left/Right	5D5
11	Outside Air Temperature - Electronic	5D5
11	Tachometer - Left/Right	5D5
10	Voltmeter	5D3
	LANDING GEAR	
15	Gear Motor - Solenoid	5D13
15	Warning Lights and Horn	5D13

ELECTRICAL SCHEMATIC INDEX (cont.)

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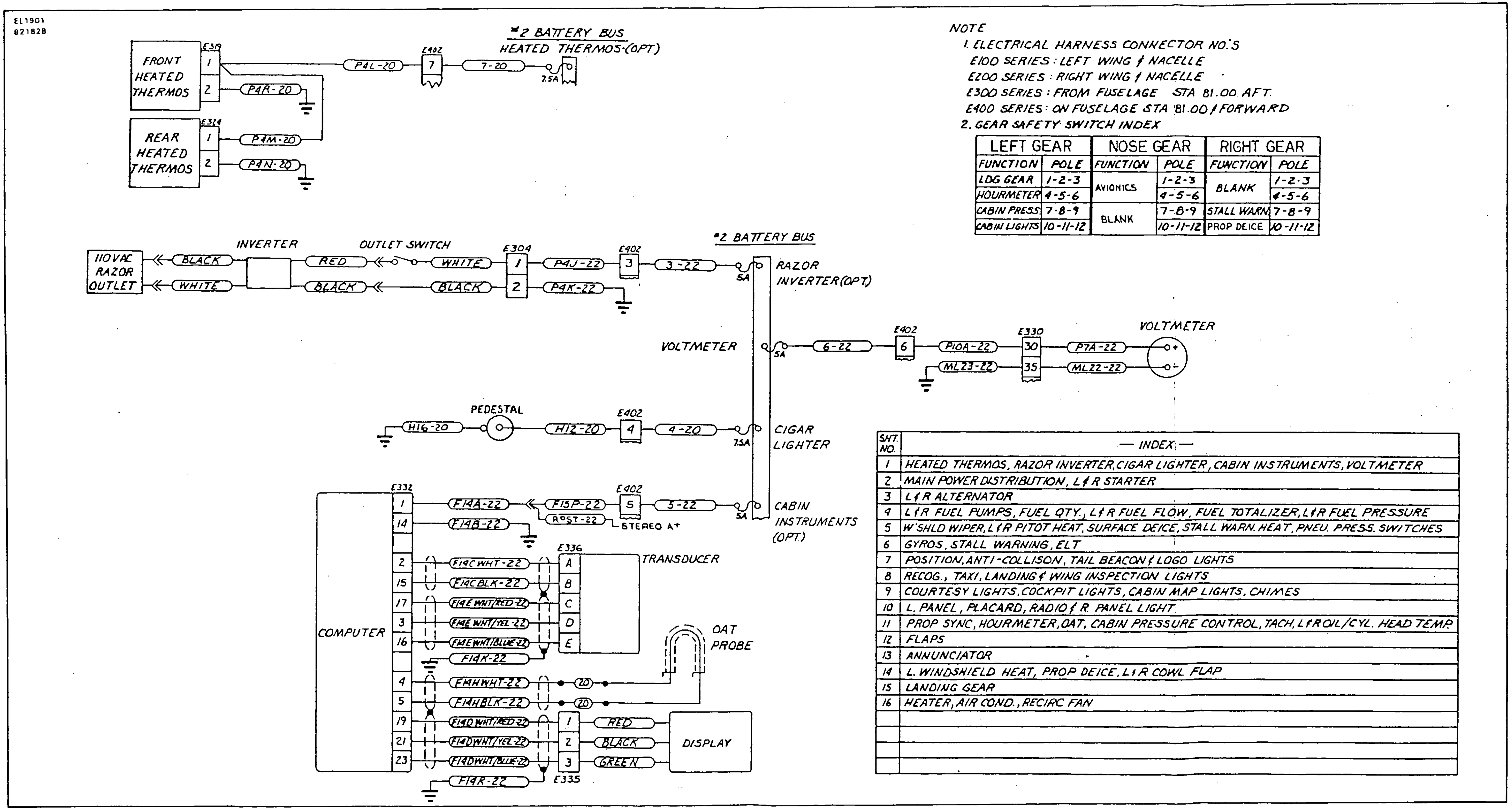
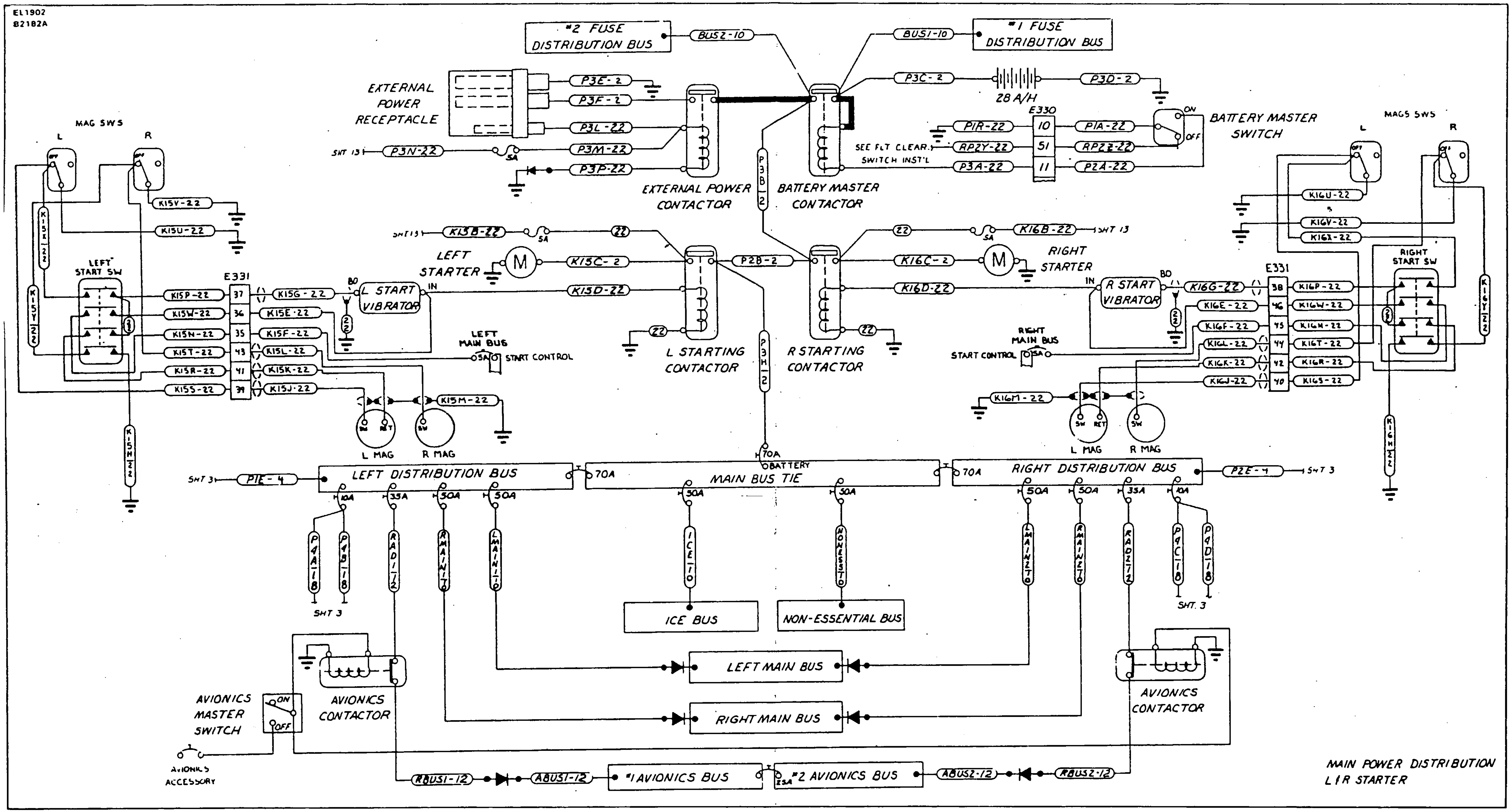


NOTE
1. ELECTRICAL HARNESS CONNECTOR NO.'S
E100 SERIES : LEFT WING & NACELLE
E200 SERIES : RIGHT WING & NACELLE
E300 SERIES : FROM FUSELAGE STA 81.00 AFT.
E400 SERIES : ON FUSELAGE STA 81.00 & FORWARD
2. GEAR SAFETY SWITCH INDEX

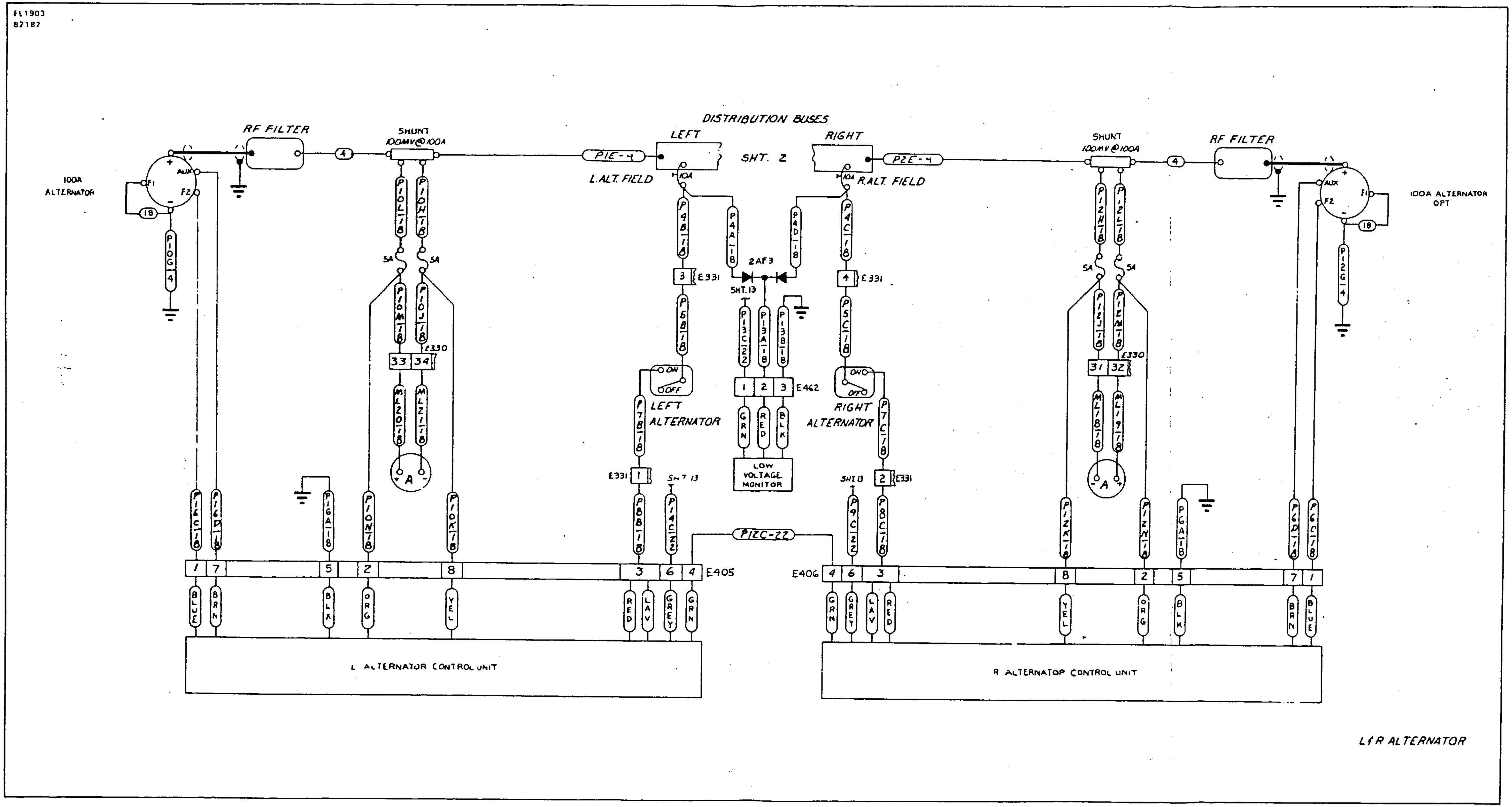
LEFT GEAR		NOSE GEAR		RIGHT GEAR	
FUNCTION	POLE	FUNCTION	POLE	FUNCTION	POLE
LDG GEAR	1-2-3	AVIONICS	1-2-3	BLANK	1-2-3
HOURMETER	4-5-6		4-5-6		4-5-6
CABIN PRESS.	7-8-9	BLANK	7-8-9	STALL WARN.	7-8-9
CABIN LIGHTS	10-11-12		10-11-12	PROP DEICE	10-11-12

SHT. NO.	— INDEX —
1	HEATED THERMOS, RAZOR INVERTER, CIGAR LIGHTER, CABIN INSTRUMENTS, VOLTMETER
2	MAIN POWER DISTRIBUTION, L & R STARTER
3	L & R ALTERNATOR
4	L & R FUEL PUMPS, FUEL QTY., L & R FUEL FLOW, FUEL TOTALIZER, L & R FUEL PRESSURE
5	W'SHLD WIPER, L & R PITOT HEAT, SURFACE DEICE, STALL WARN. HEAT, PNEU. PRESS. SWITCHES
6	GYROS, STALL WARNING, ELT
7	POSITION, ANTI-COLLISON, TAIL BEACON & LOGO LIGHTS
8	RECOG., TAXI, LANDING & WING INSPECTION LIGHTS
9	COURTESY LIGHTS, COCKPIT LIGHTS, CABIN MAP LIGHTS, CHIMES
10	L. PANEL, PLACARD, RADIO & R. PANEL LIGHT
11	PROP SYNC, HOURMETER, OAT, CABIN PRESSURE CONTROL, TACH, L & R OIL/CYL. HEAD TEMP.
12	FLAPS
13	ANNUNCIATOR
14	L. WINDSHIELD HEAT, PROP DEICE, L & R COWL FLAP
15	LANDING GEAR
16	HEATER, AIR COND., RECIRC FAN

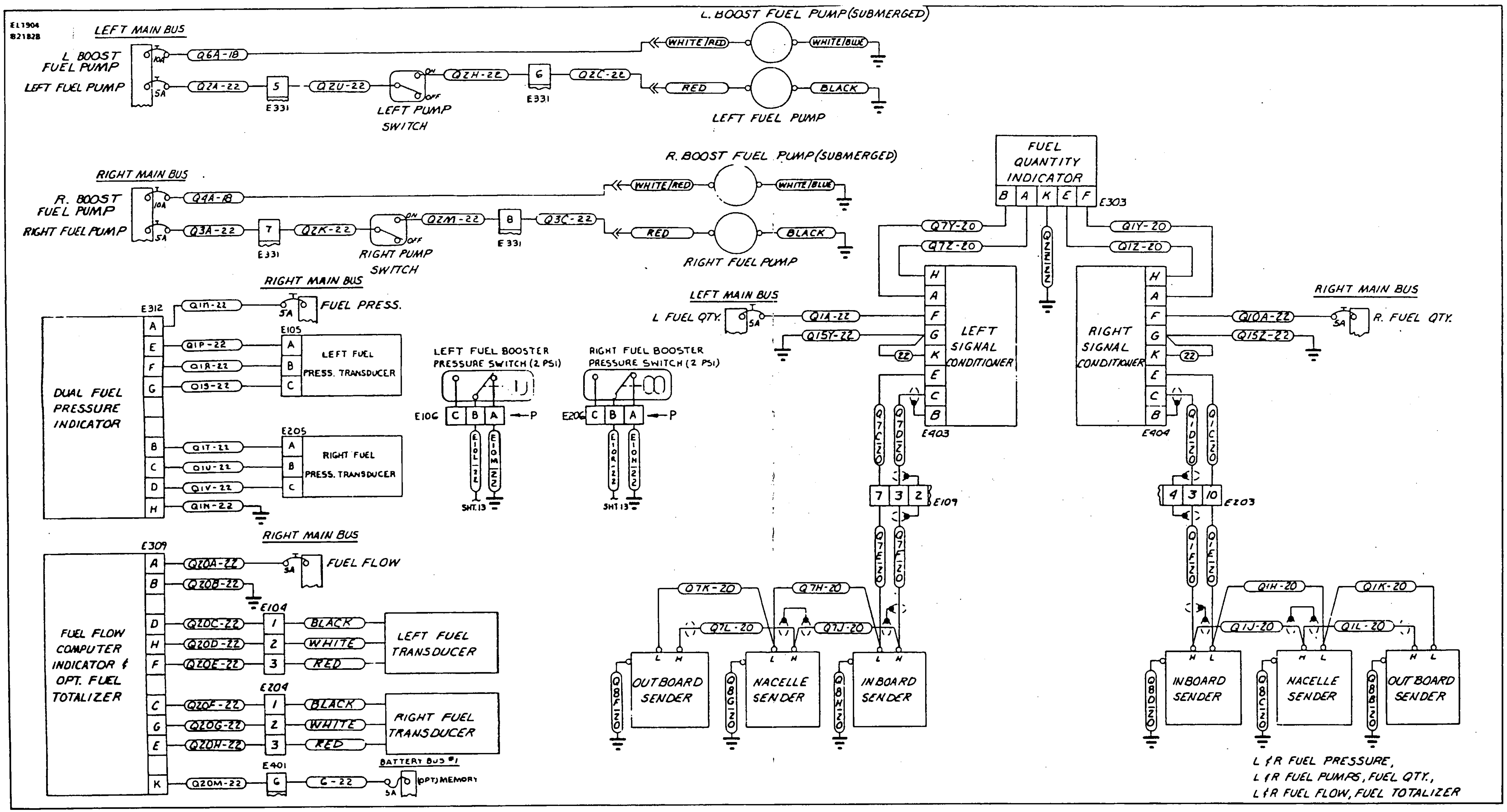
Sheet 1. Thermos, Razor, Digital Cabin Display



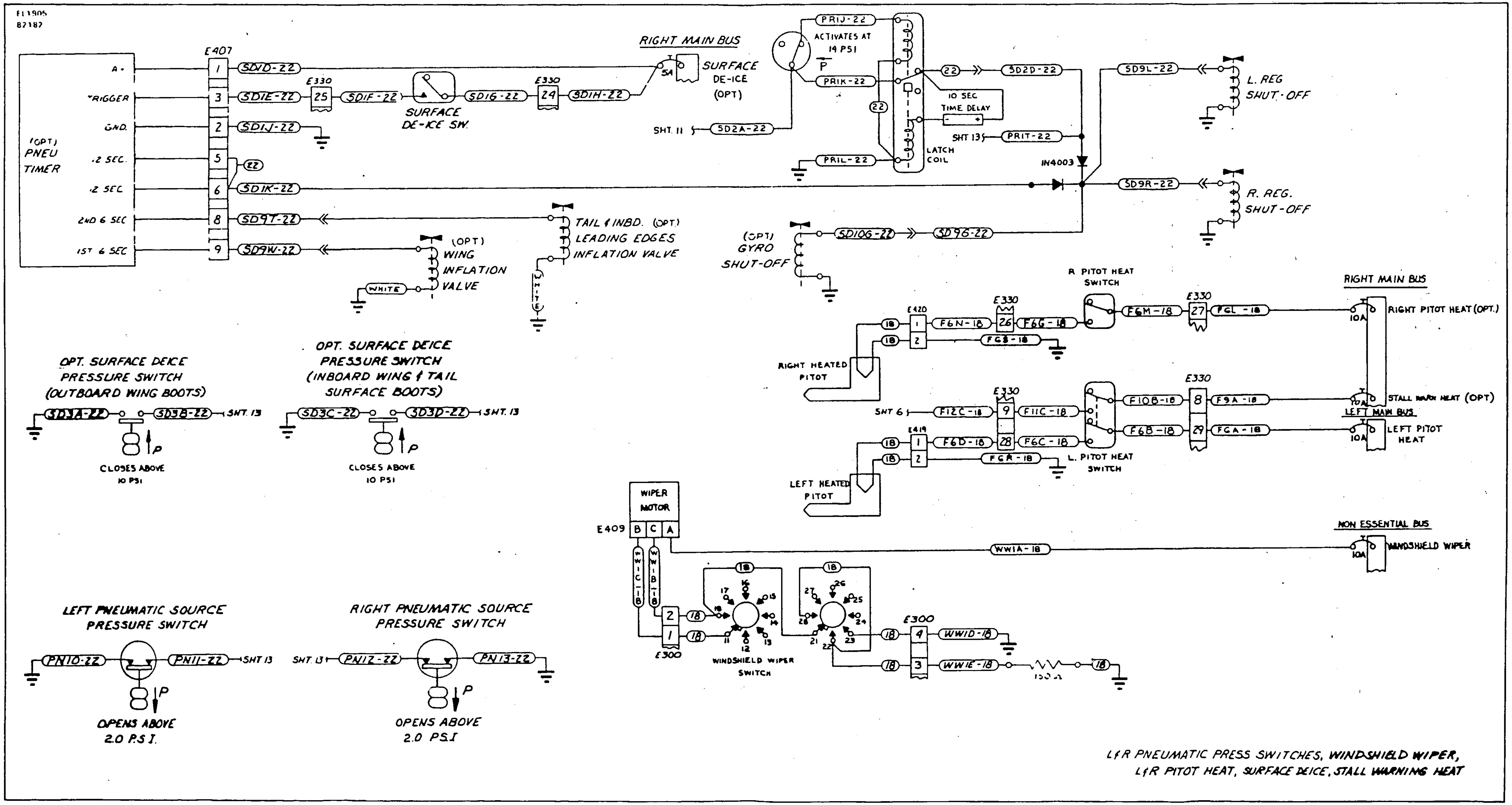
Sheet 2. Main Power Distribution, Starters - Left/Right



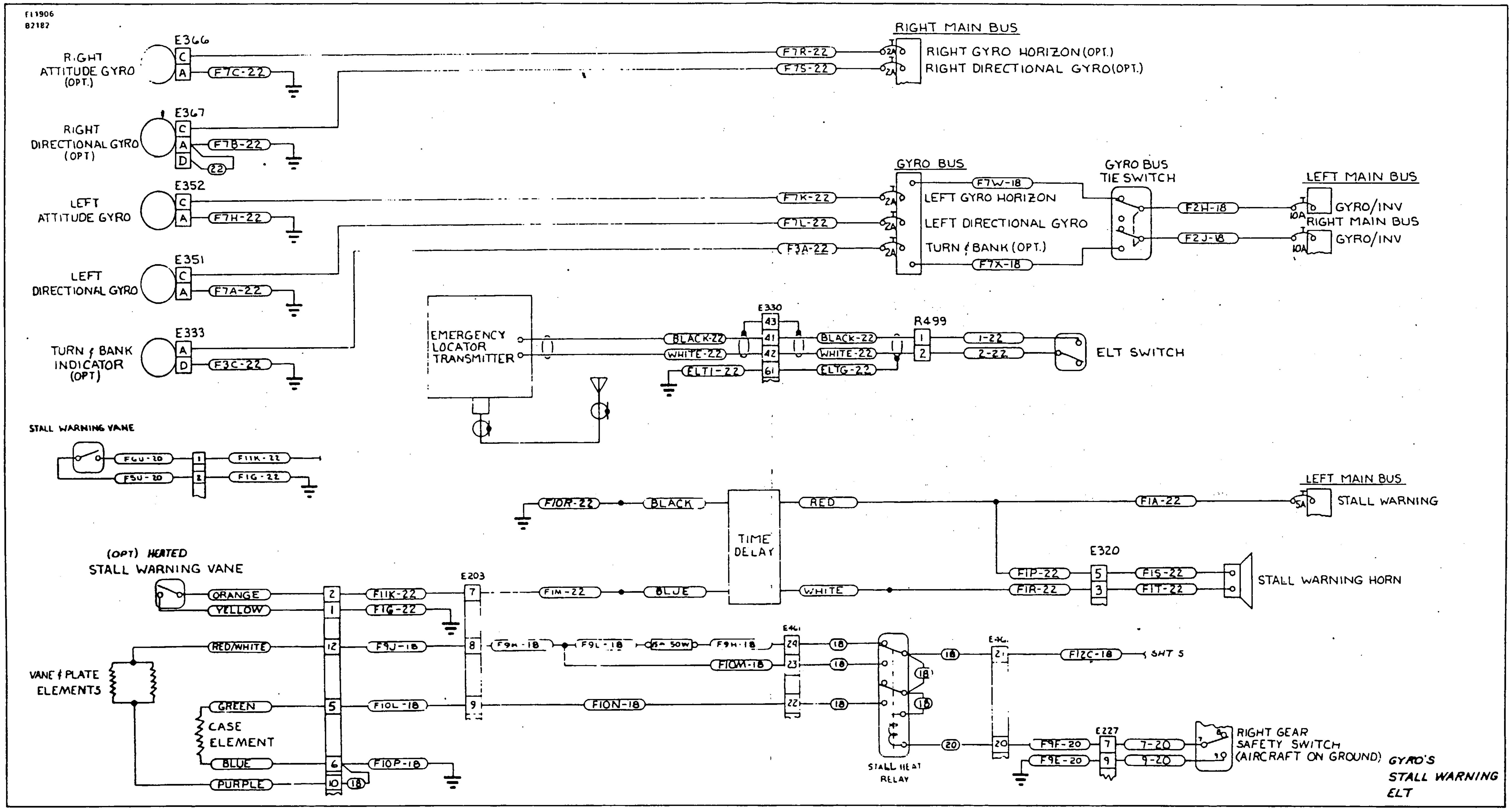
Sheet 3. Alternators - Left/Right



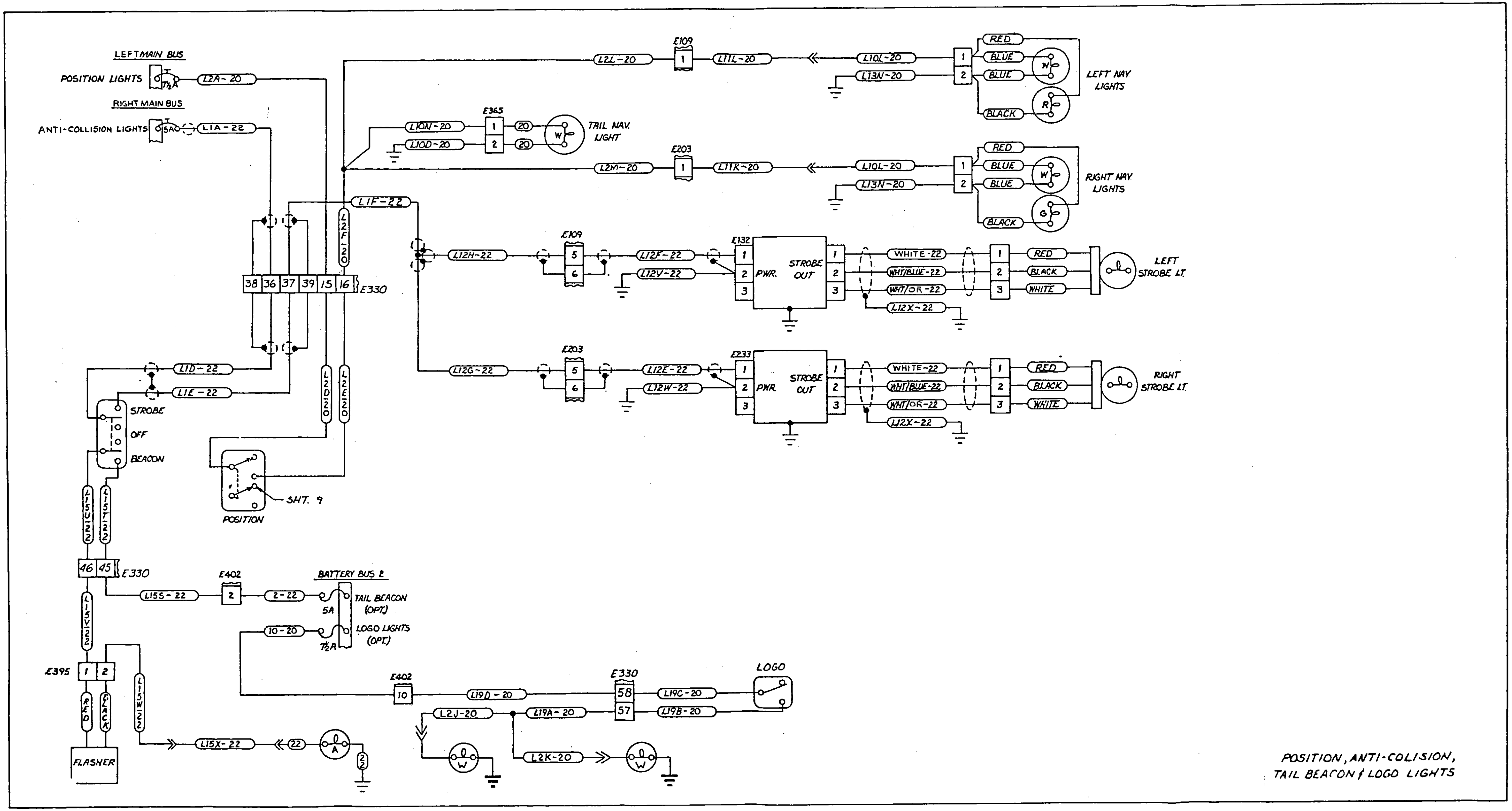
Sheet 4. Fuel Systems - Left/Right



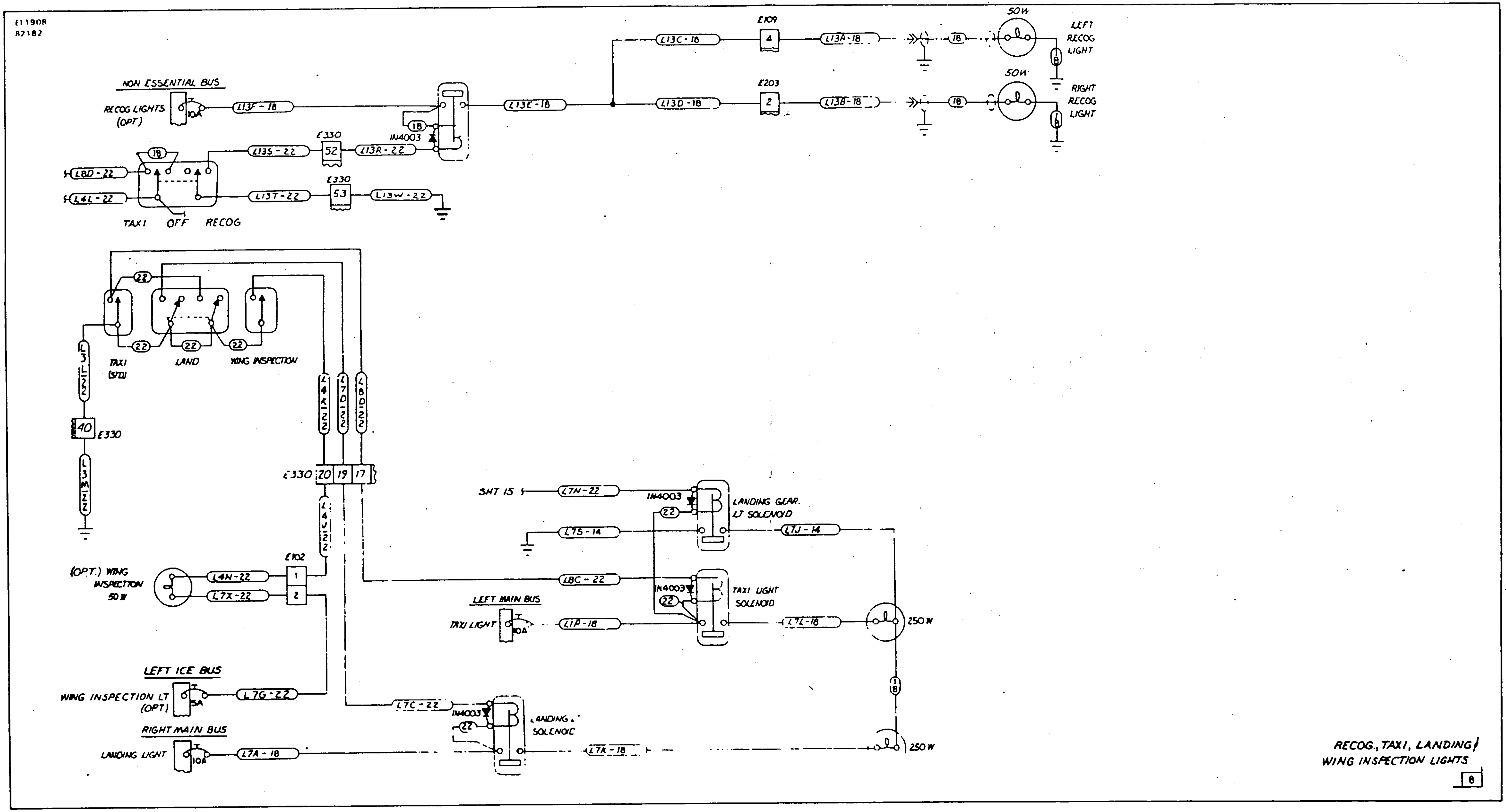
Sheet 5. Deice Systems - Left/Right



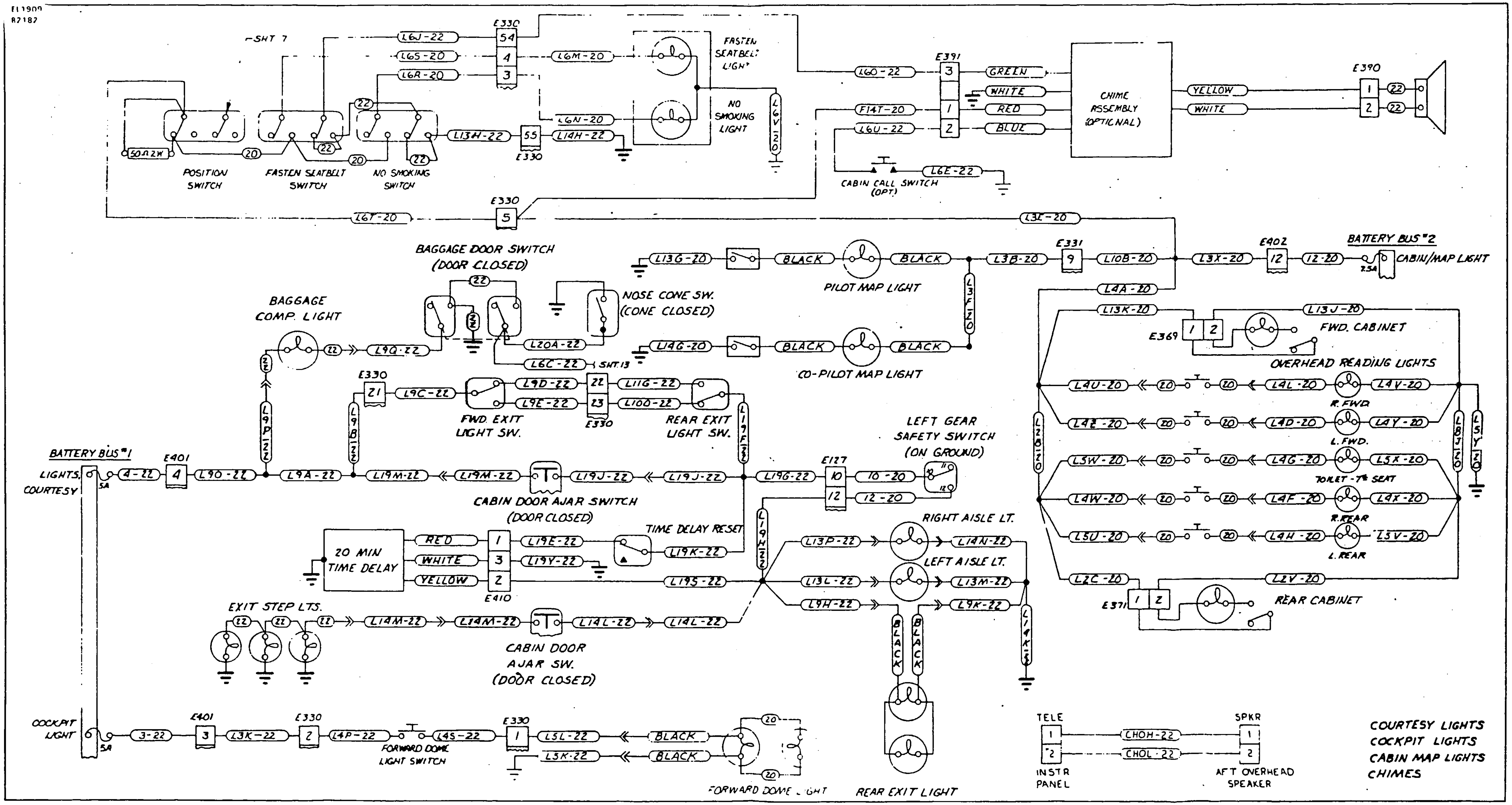
Sheet 6. Gyro's, Stall Warning, E.L.T.



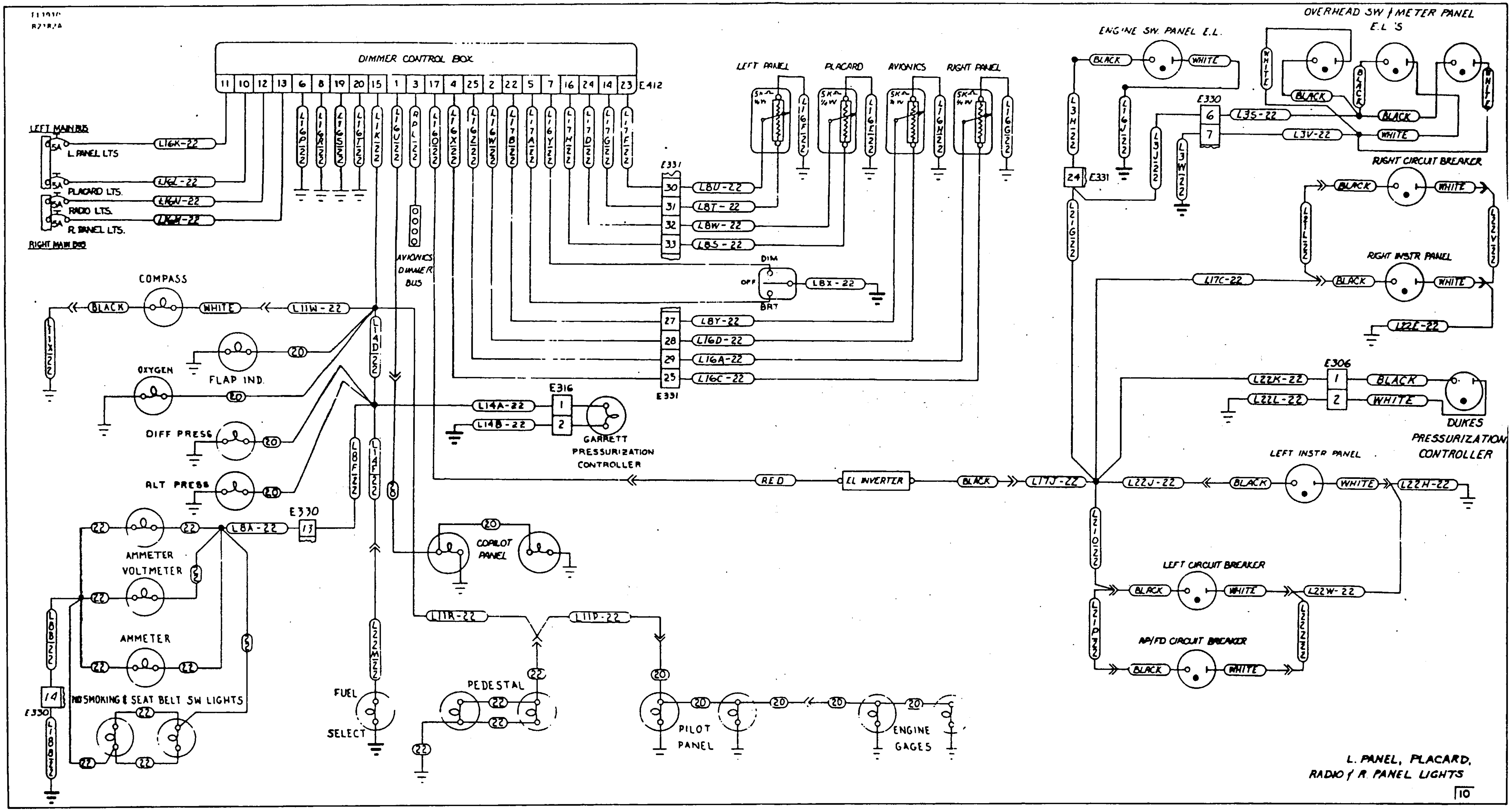
Sheet 7. Anti-Collision, Position, Logo Lights



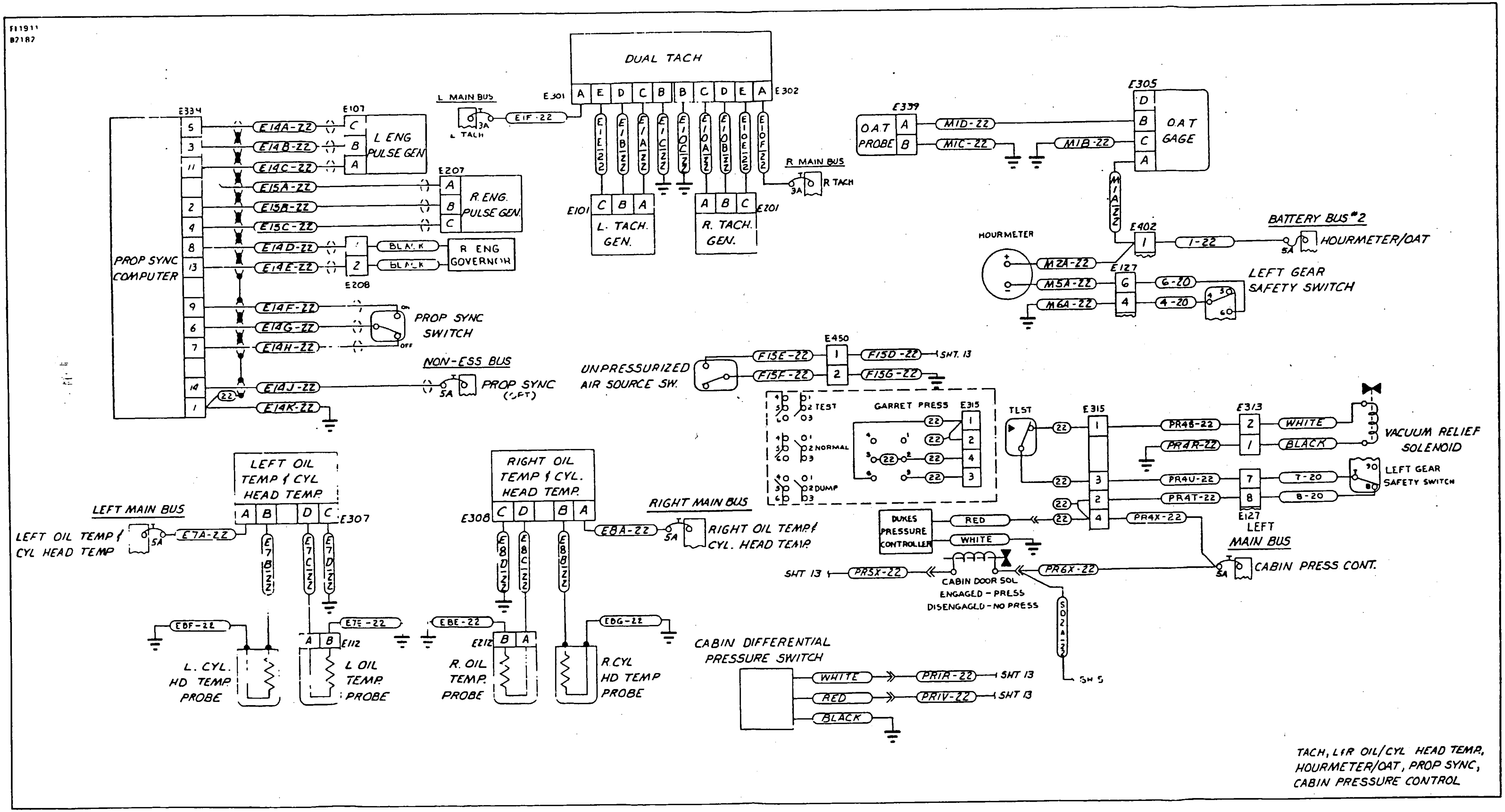
Sheet 8. Recog., Taxi, Landing, Wing Insp. Lights



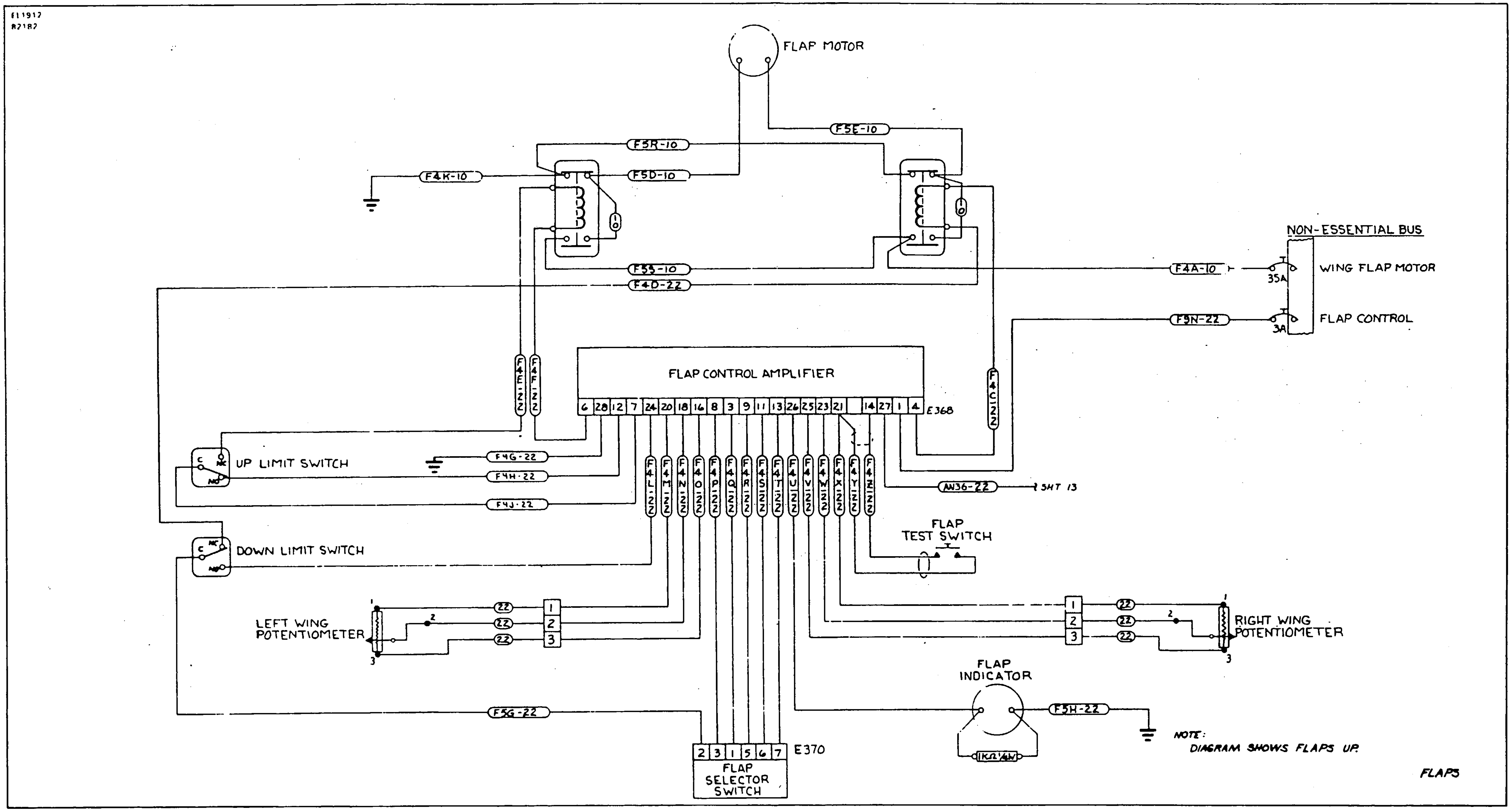
Sheet 9. Chimes, Map, Cockpit, Courtesy Lights



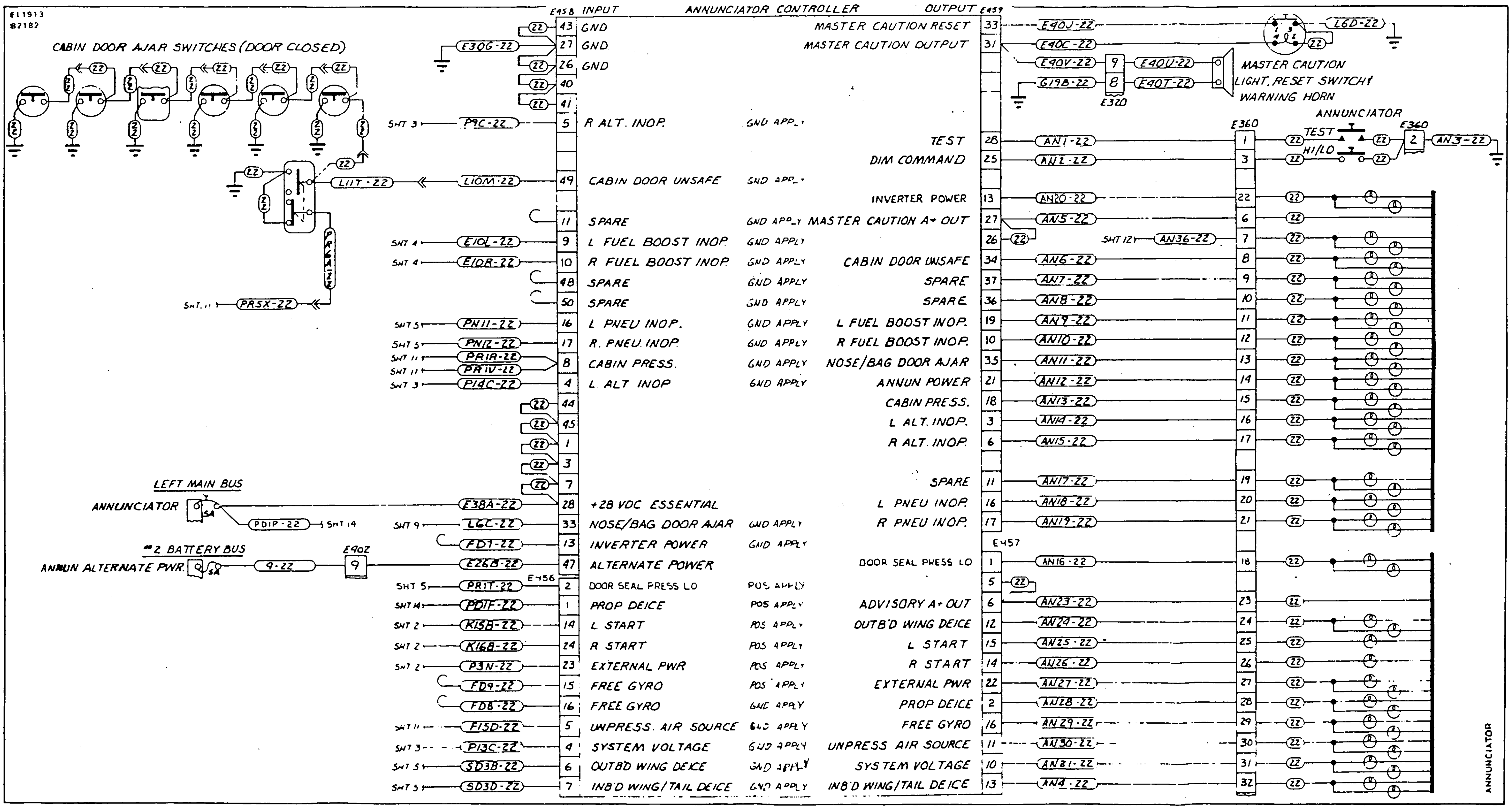
Sheet 10. Placard, Panel, Radio Lighting



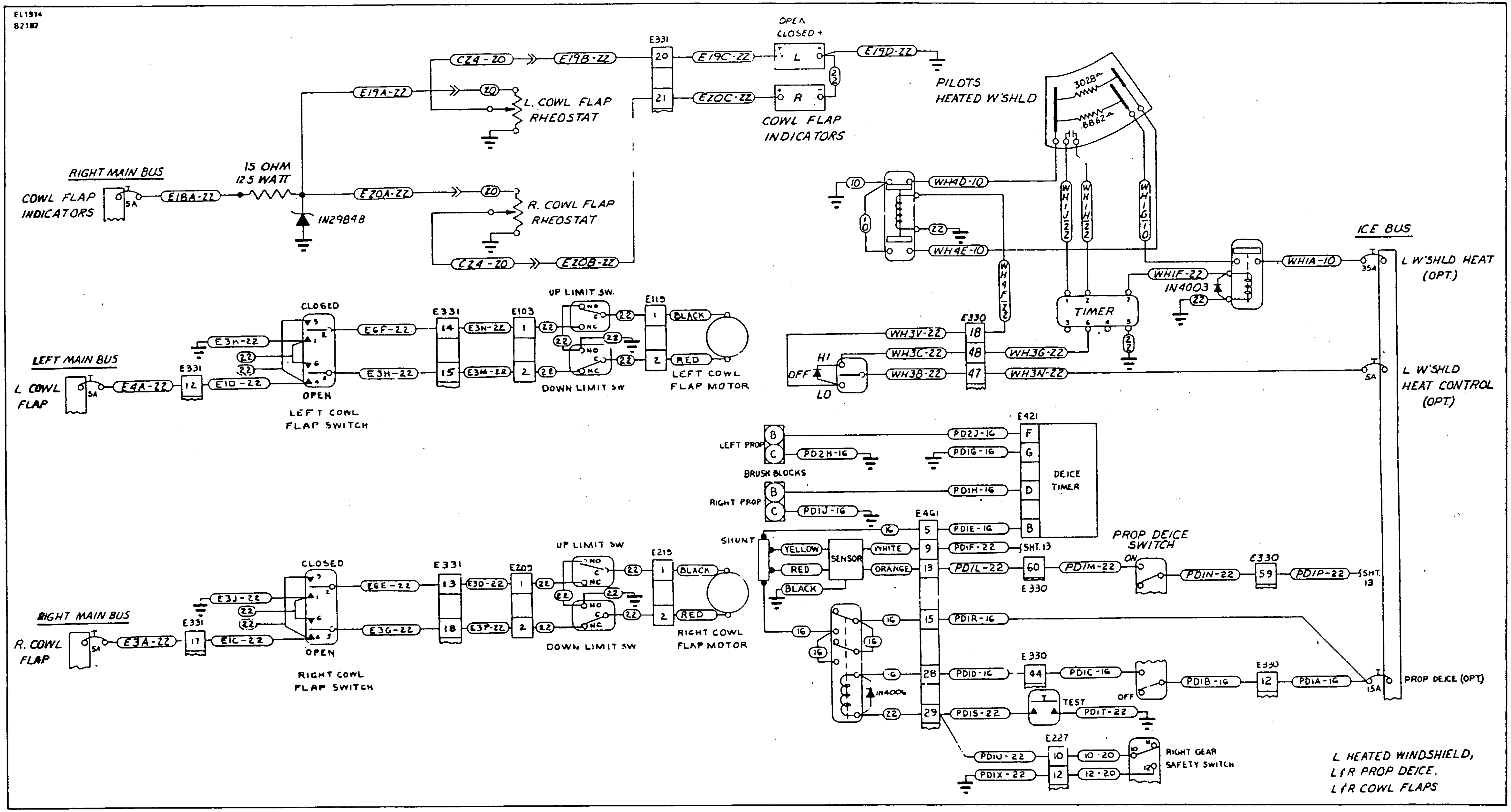
Sheet 11. Tach., Hour Meter, Cabin Press. Cont'l., Oil Cyl. Head Temp.



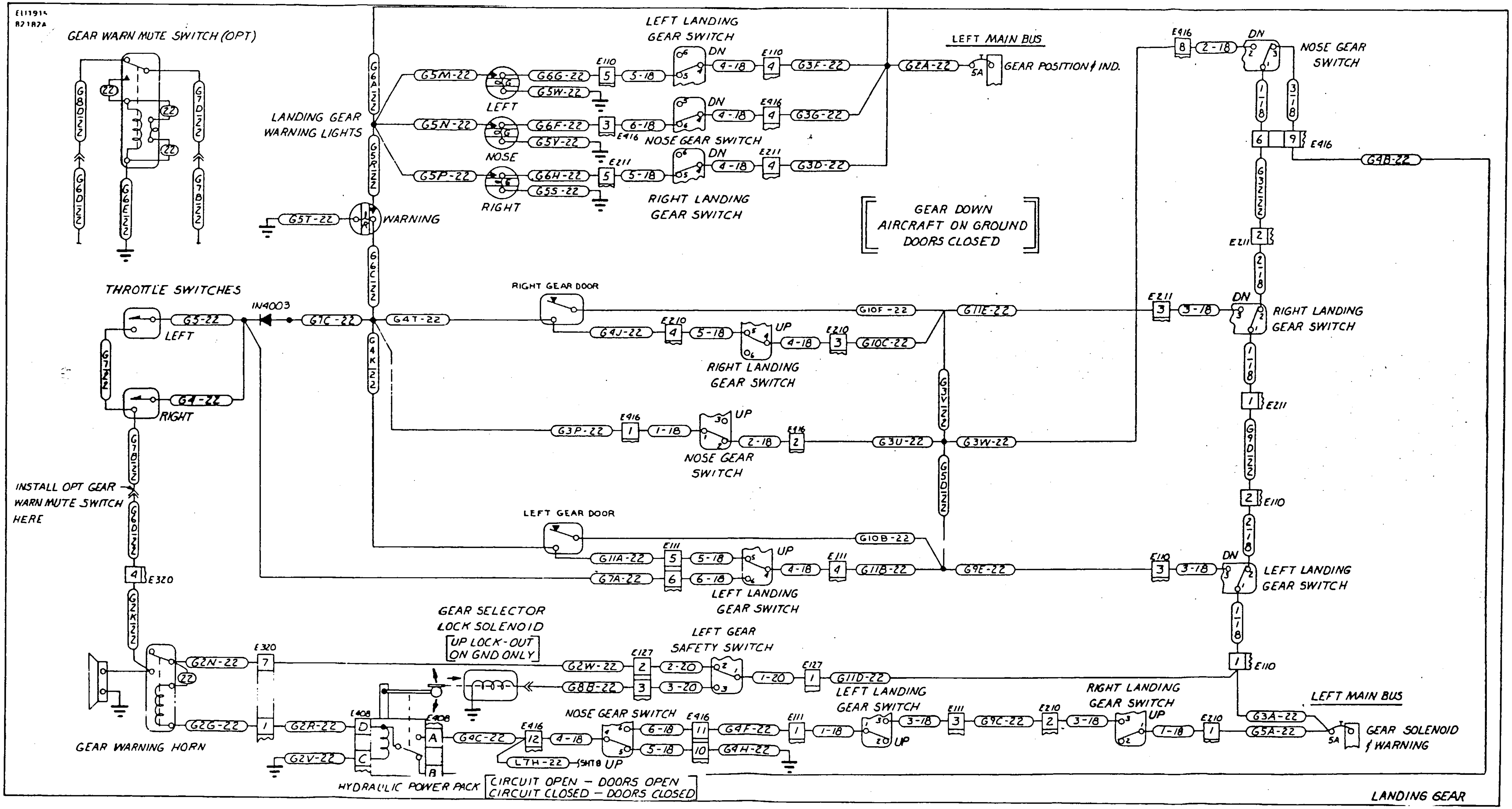
Sheet 12. Wing Flaps



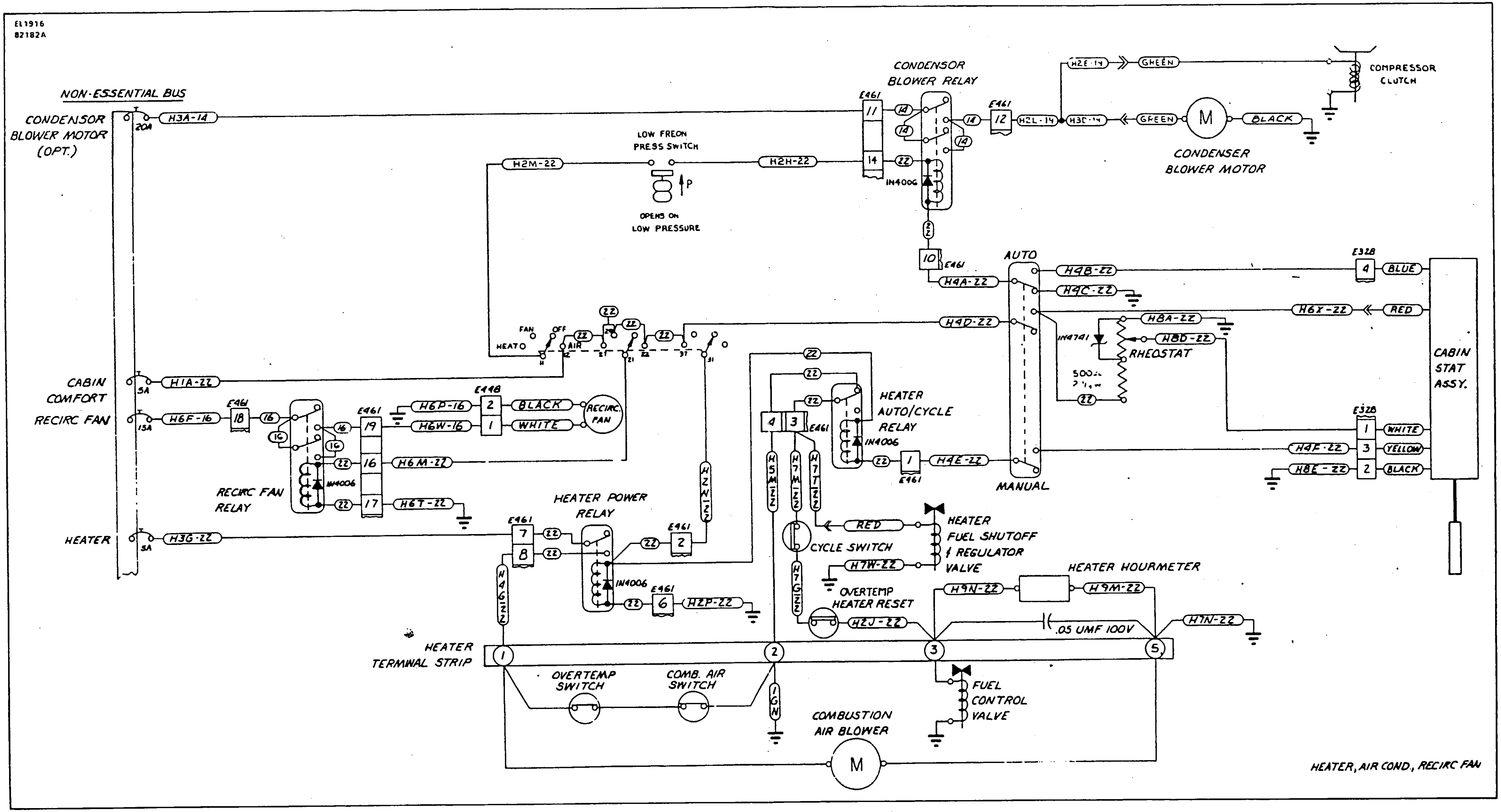
Sheet 13. Annunciator Panel



Sheet 14. Heated Windshield, Prop. Deice - Left/Right, Cowl Flaps - Left/Right



Sheet 15. Landing Gear



Sheet 16. Heater, Air Conditioner, Recirc. Fan

GRIDS 5D17 THRU 5D24
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CHAPTER

95

SPECIAL PURPOSE EQUIPMENT

CHAPTER 95 - SPECIAL PURPOSE EQUIPMENT

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter contains illustrations of the various fabricated and purchased special tools which may be required when performing various forms of maintenance on the PA-31P-350.

TOOLS AND TEST EQUIPMENT.

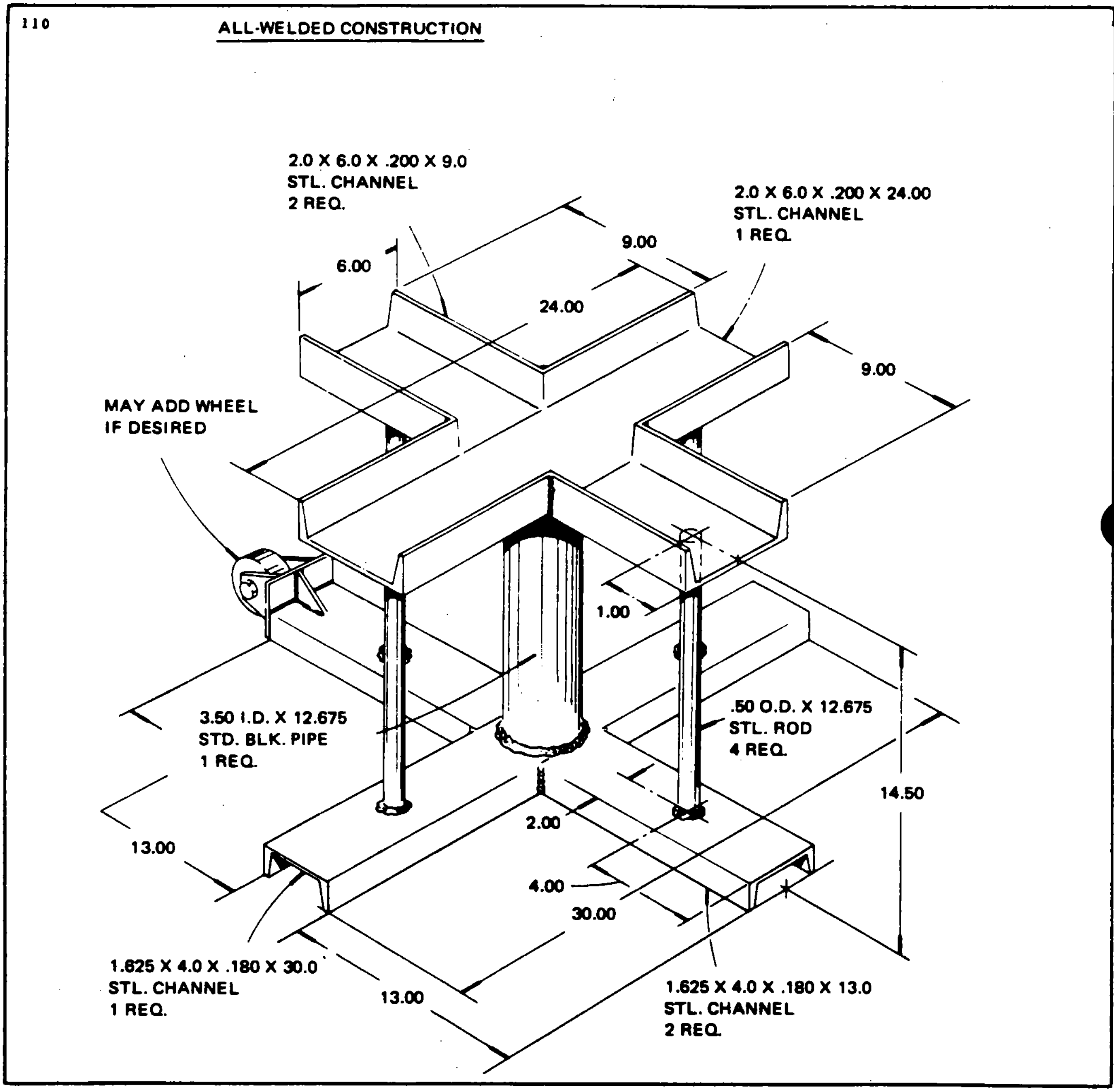


Figure 95-1. Fabricated Jack Stand for Piper Jack, Part No. 18338-00

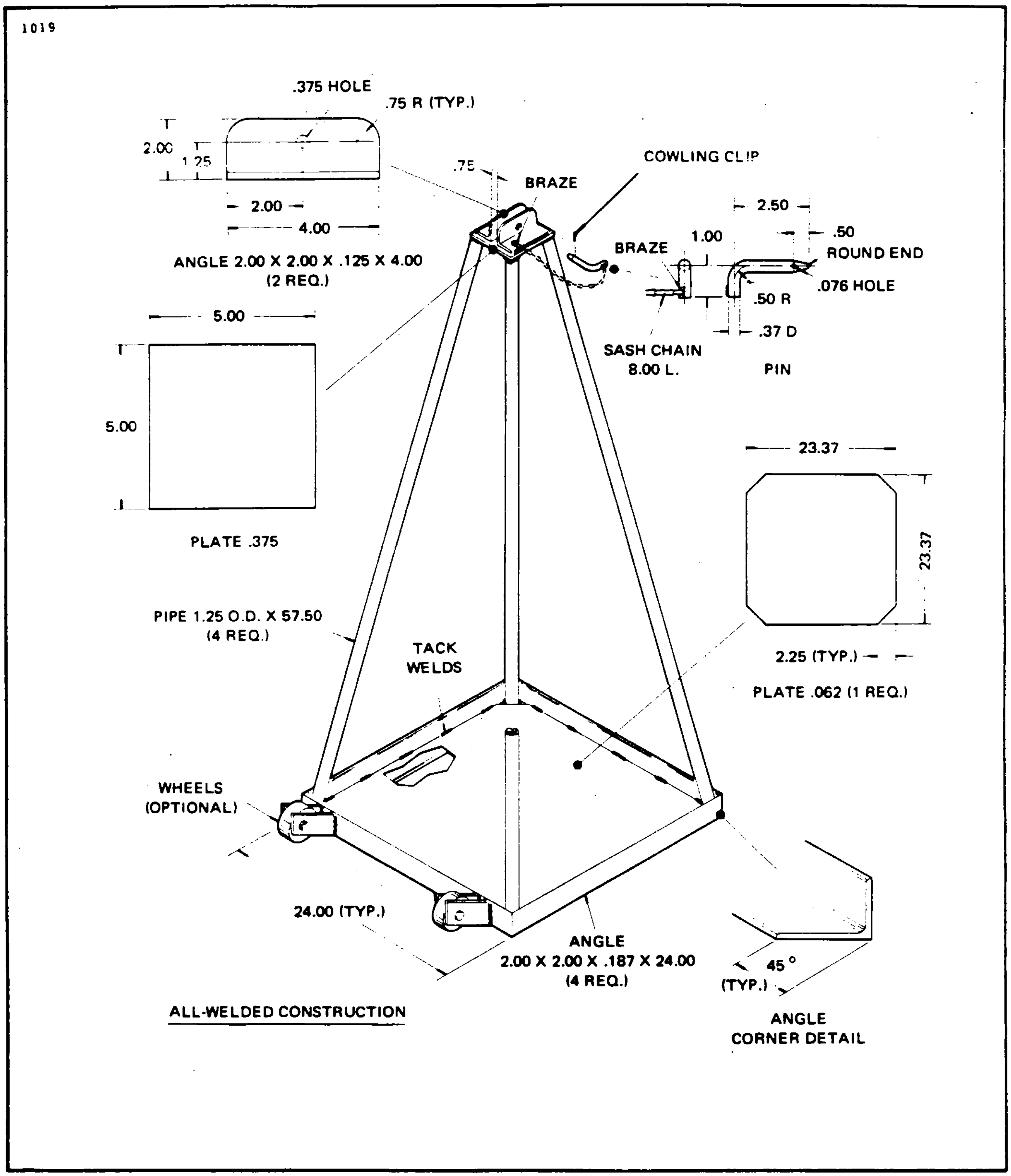


Figure 95-2. Fabricated Tail Stand

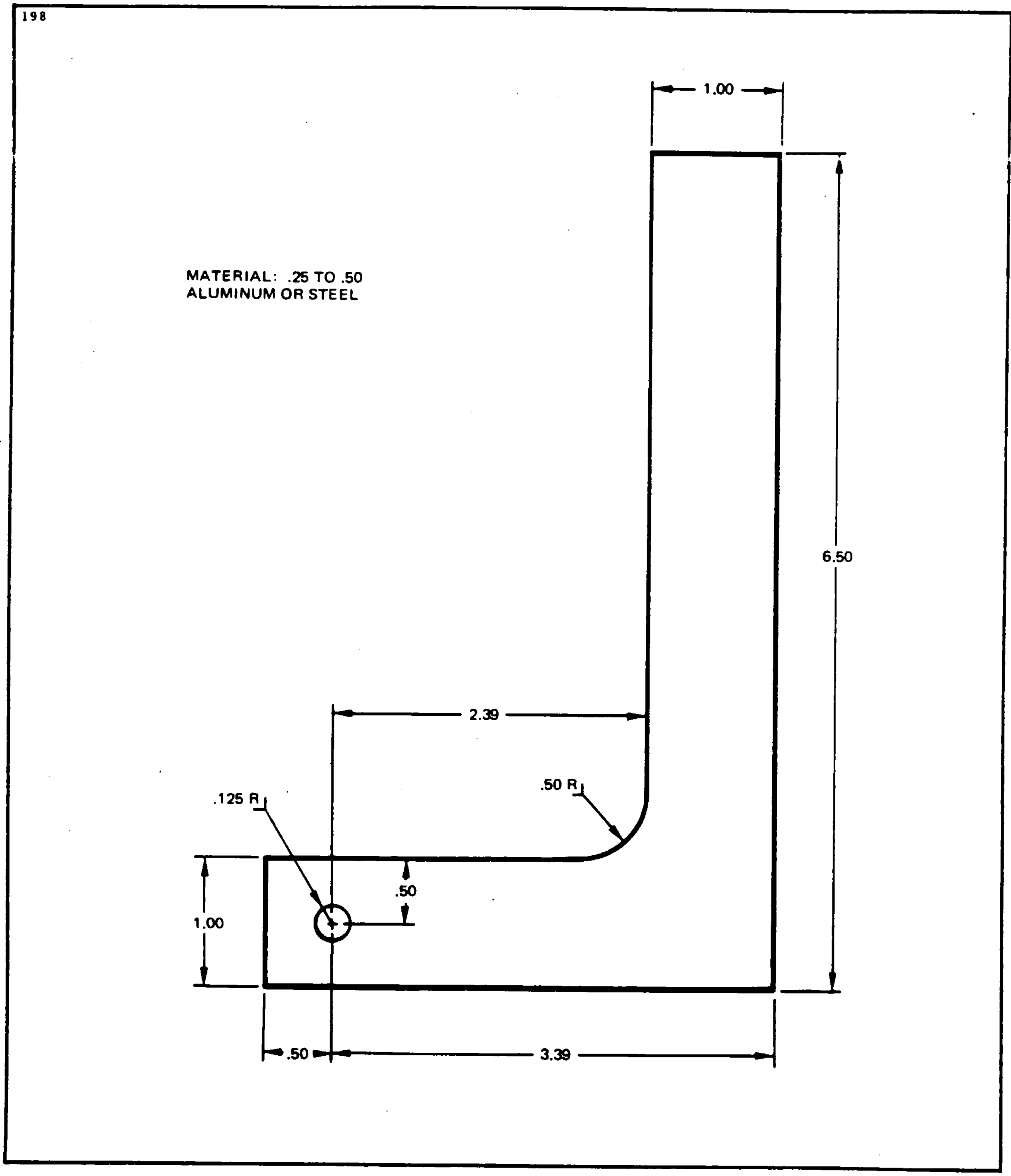


Figure 95-3. Fabricated Bellcrank Rigging Tool

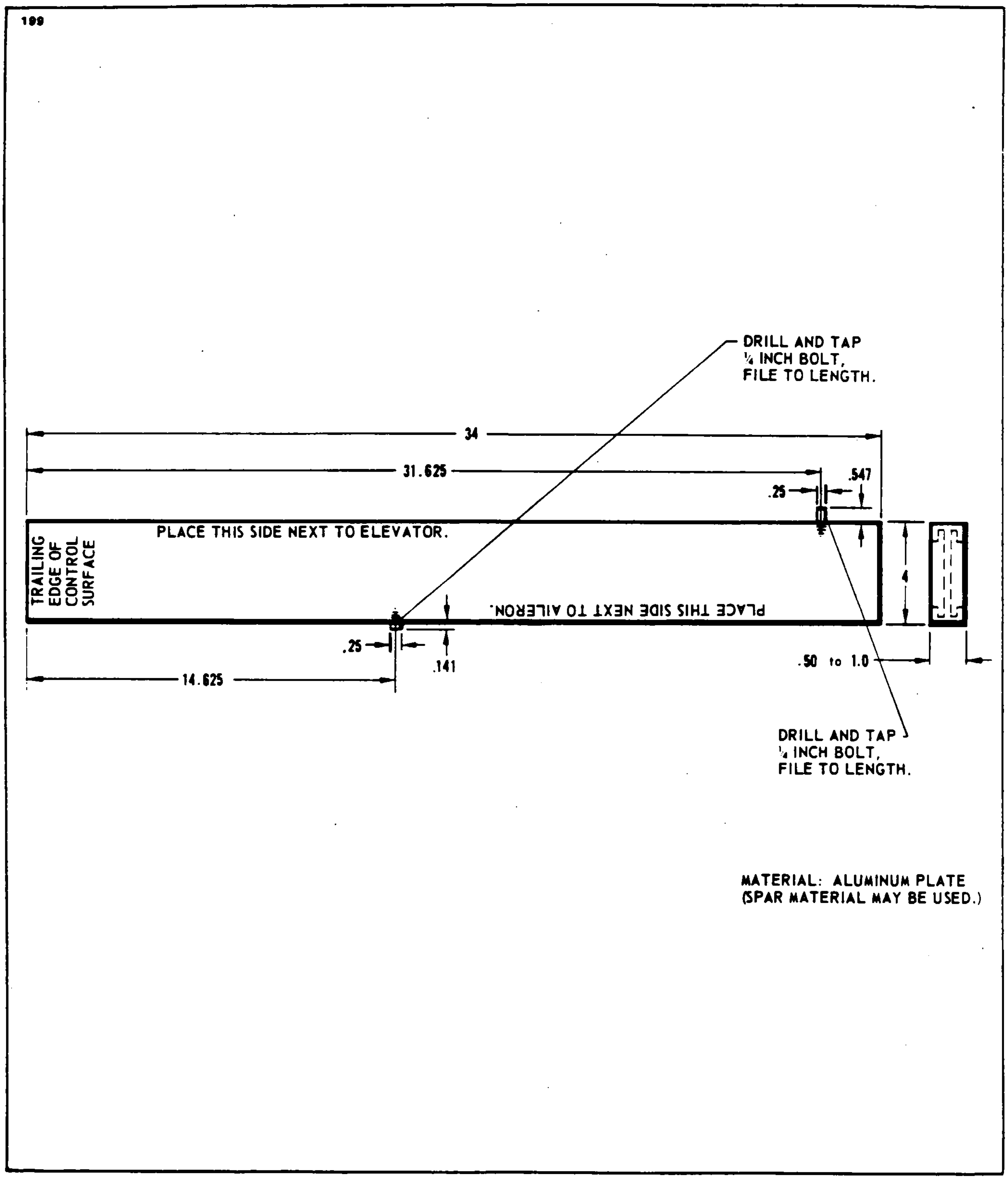


Figure 95-4. Fabricated Aileron and Elevator Rigging Tool

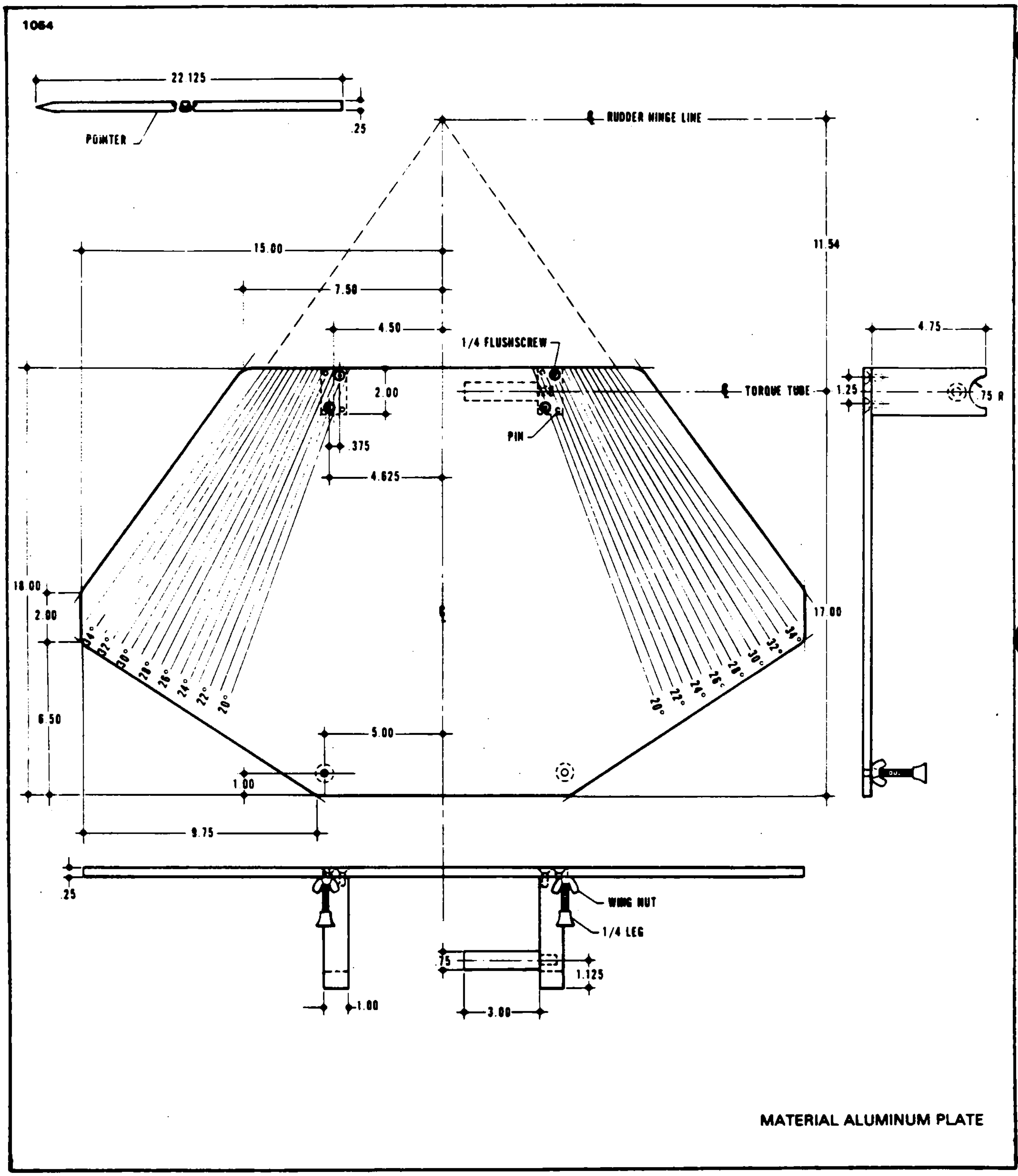


Figure 95-5. Fabricated Rudder Rigging Tool

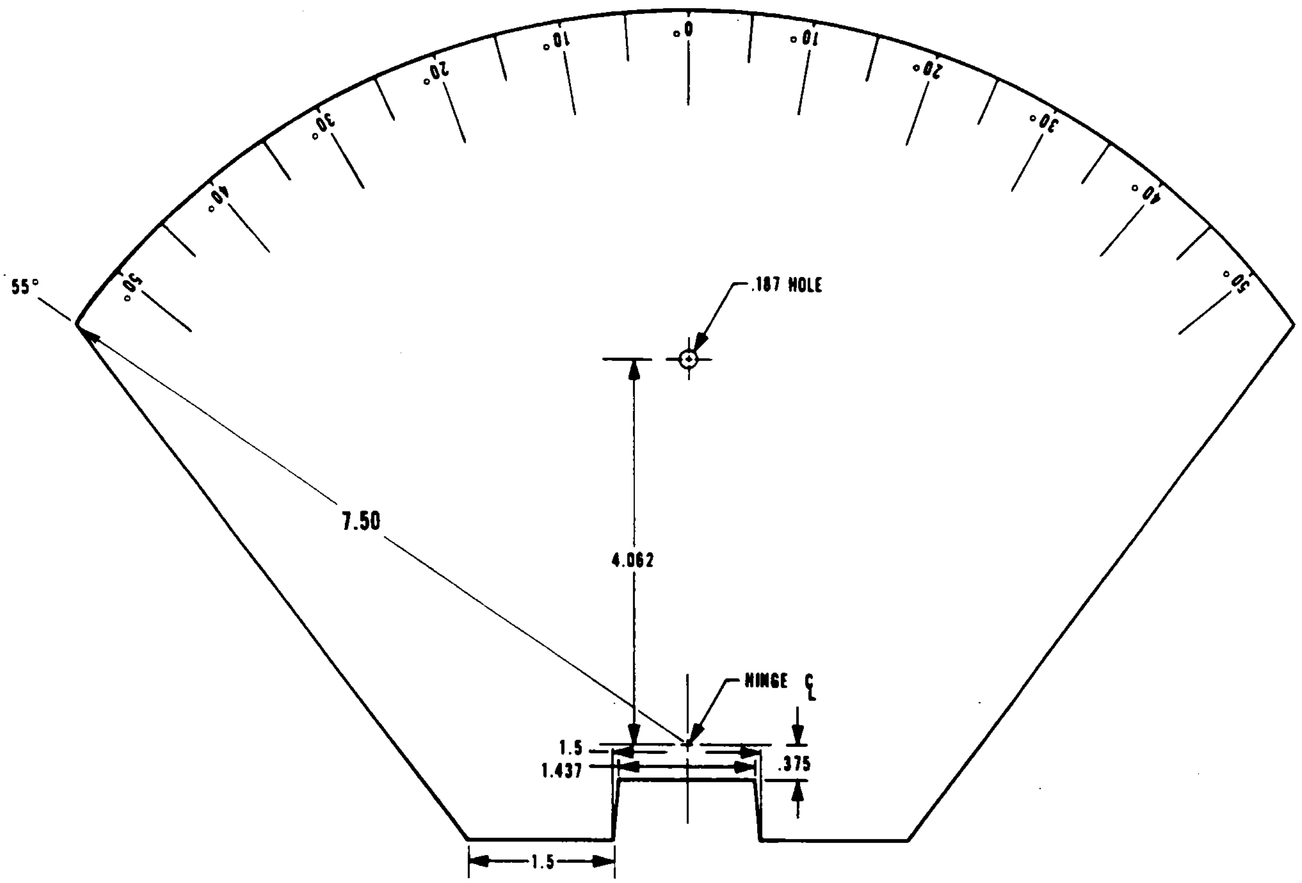


Figure 95-6. Fabricated Rudder Trim Tab Rigging Tool

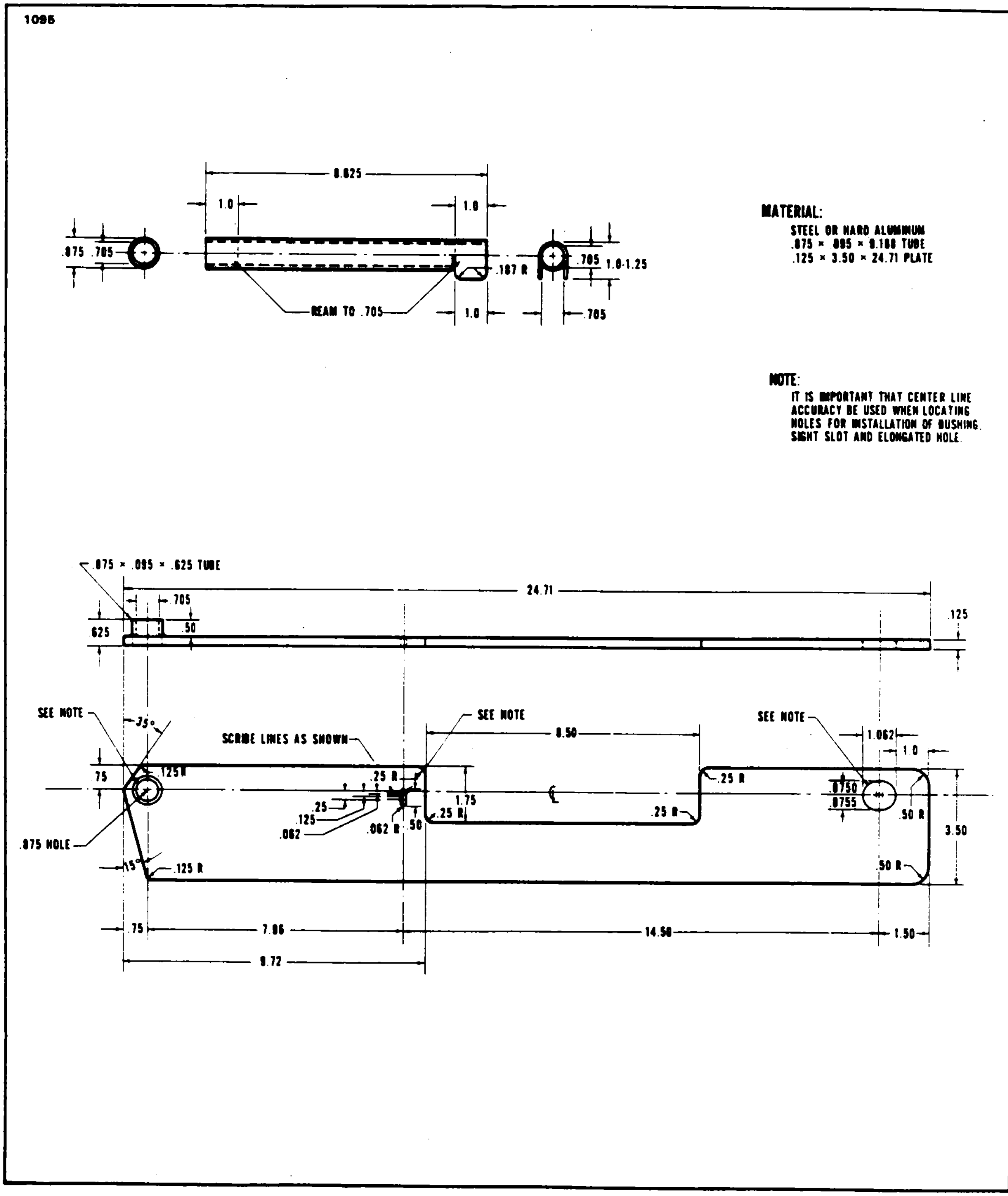


Figure 95-7. Fabricated Tool, Checking Nose Gear Link Travel

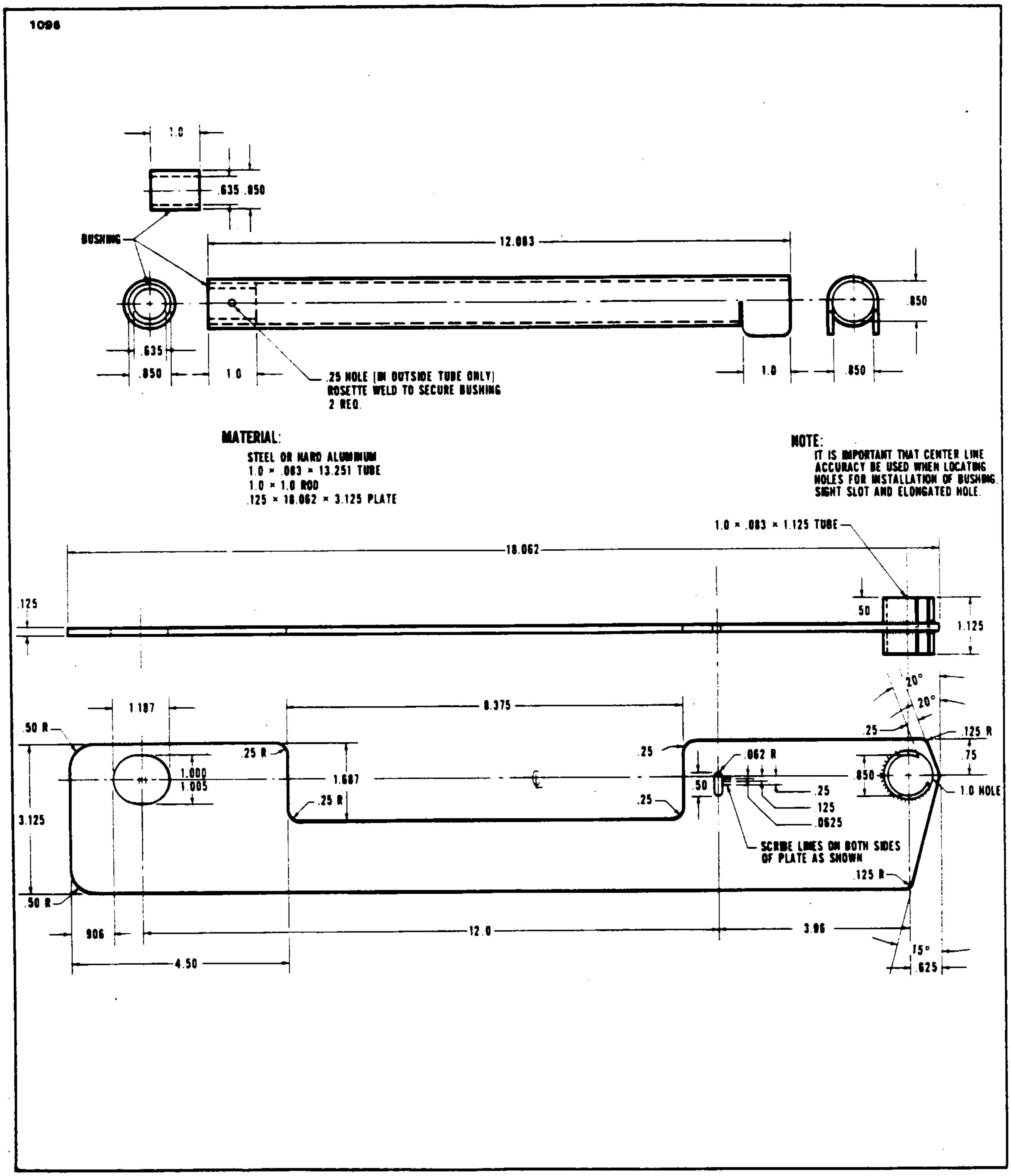


Figure 95-8. Fabricated Tool, Checking Main Gear Side Brace Link Travel

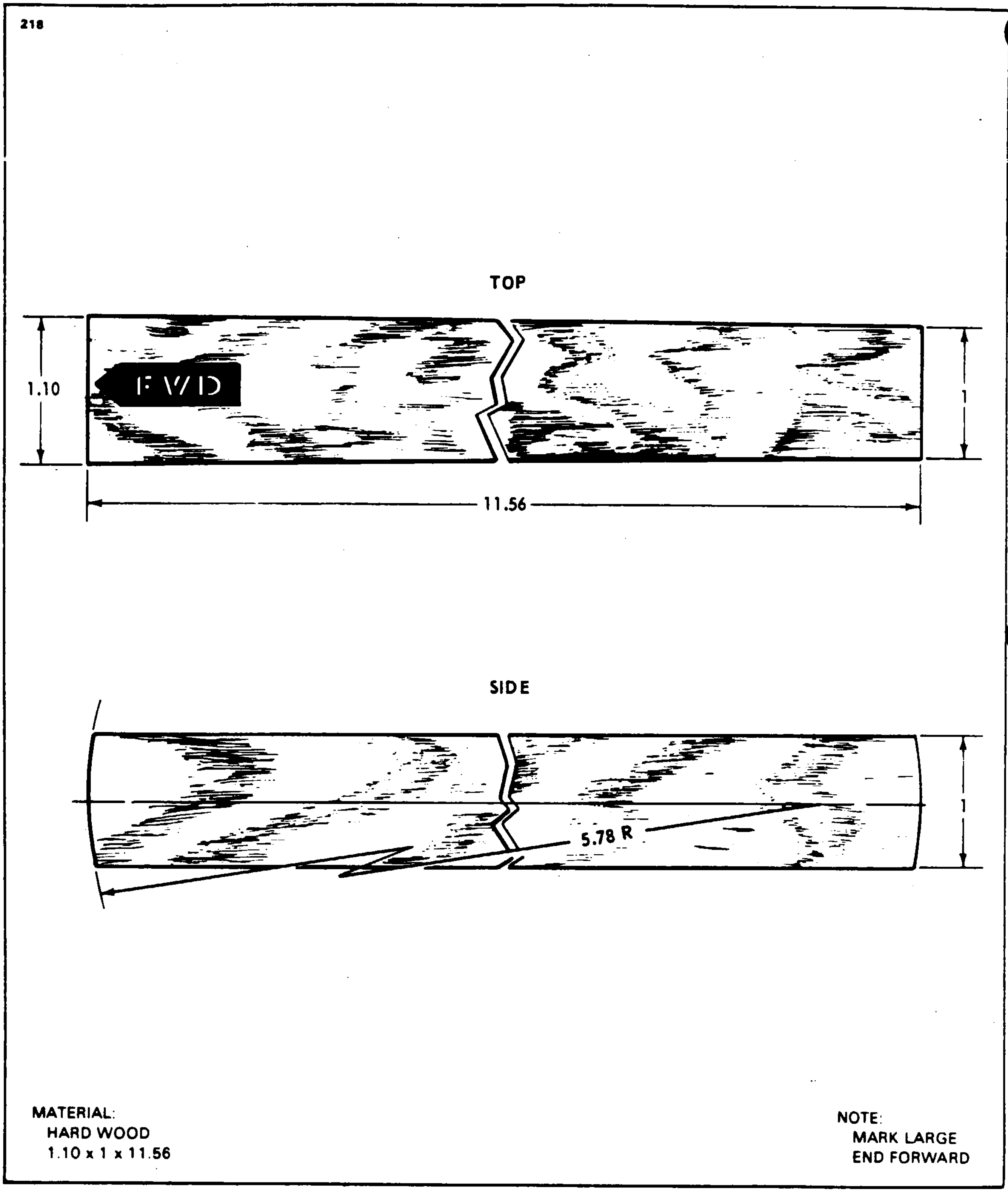
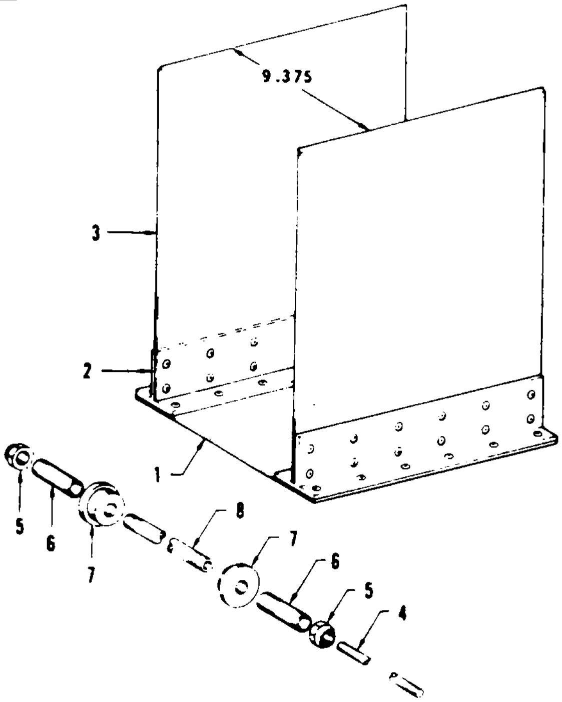


Figure 95-9. Fabricated Tool, Checking Main Gear Toe-In Adjustment



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 95-10. Tire Balancer

CONSTRUCTION OF TIRE BALANCER. (Refer to Figure 95-10.)

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 benchmade from one inch phenolic or aluminum using a 1½ inch hole saw to cut out the smaller bushing and 1¾ inch hole saw to cut out the larger. By inserting a ¼ 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 ⅛ inch black pipe and threaded with a ⅛-27 pipe die. Thread 3 inches in from each end of the pipe.

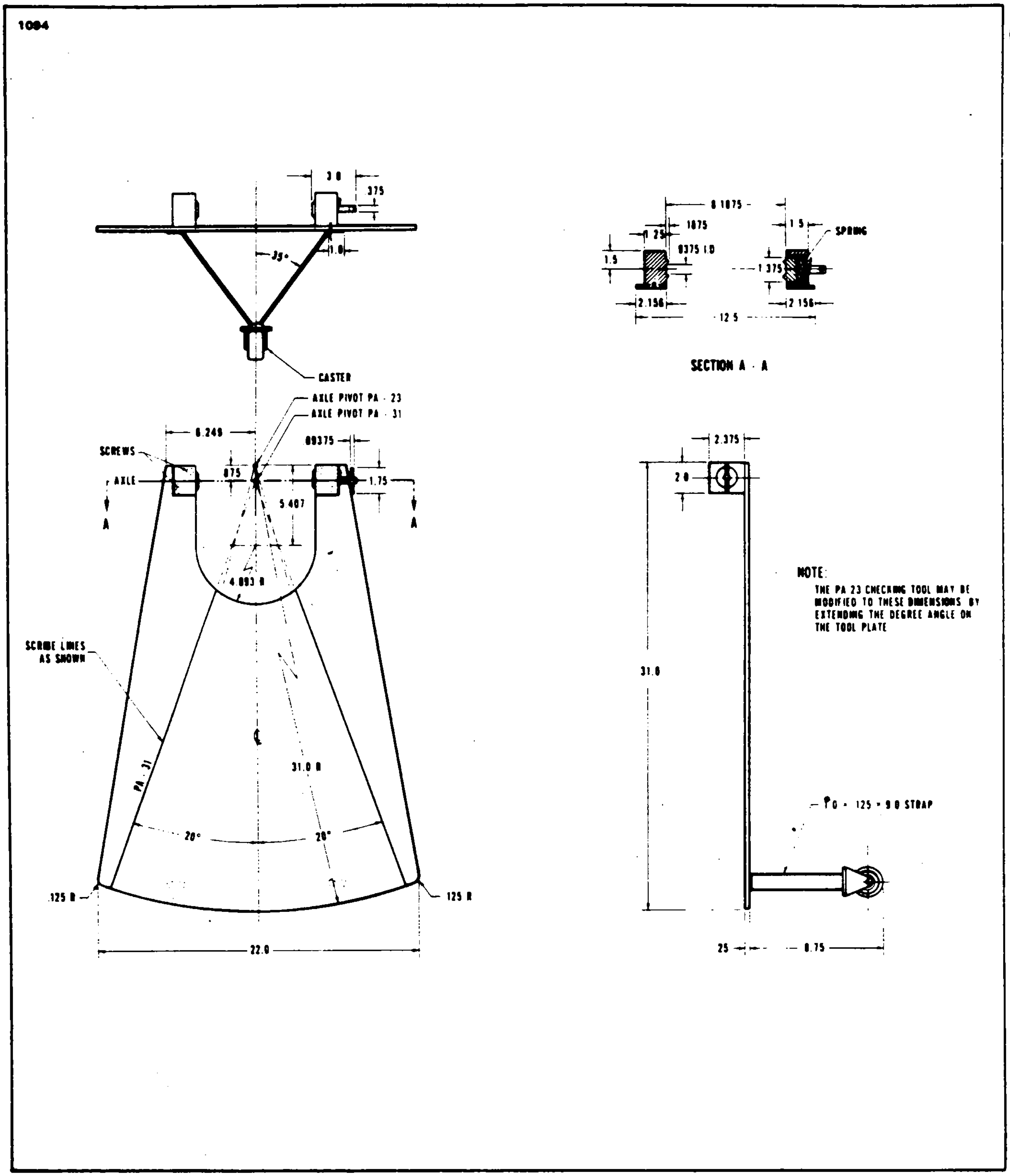


Figure 95-11. Fabricated Tool, Checking Nose Wheel Alignment

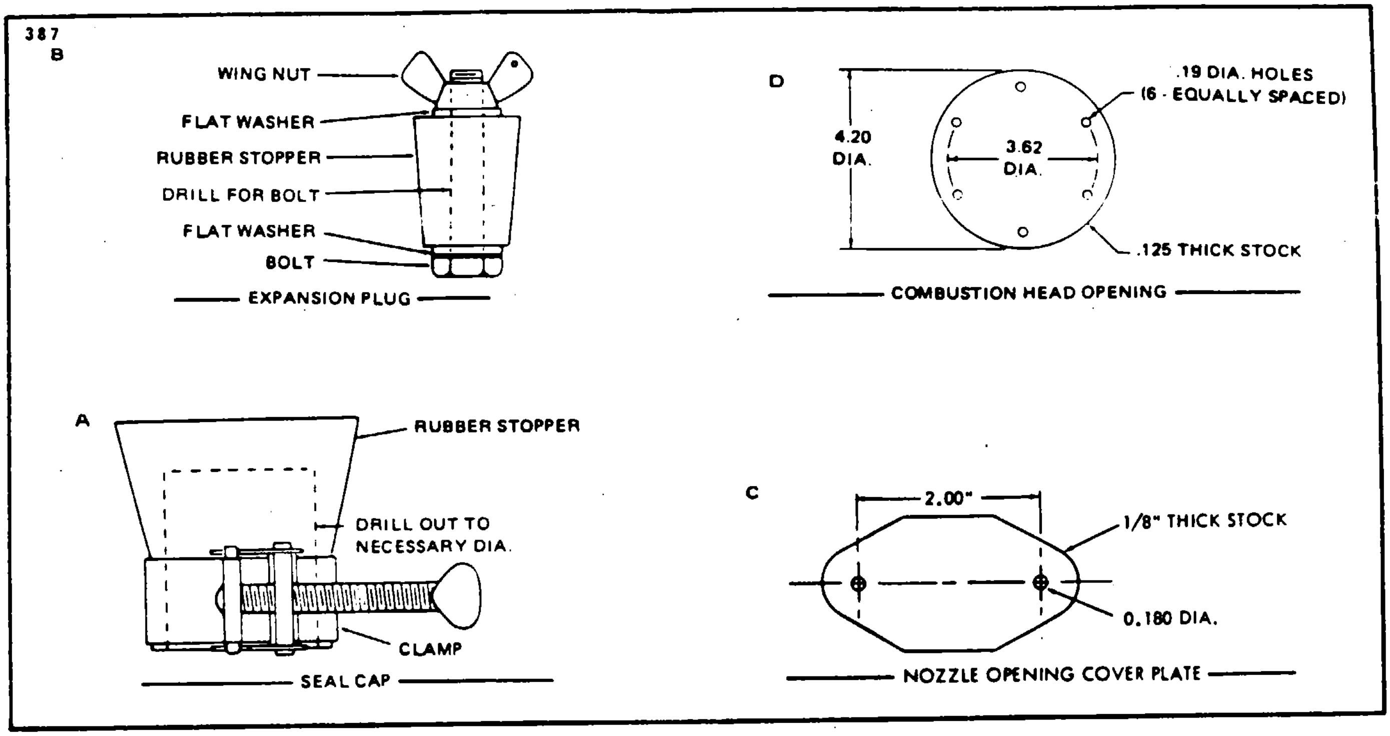


Figure 95-12. Suggested Design for Seal Plate, Plugs and Caps for Combustion Leakage Test

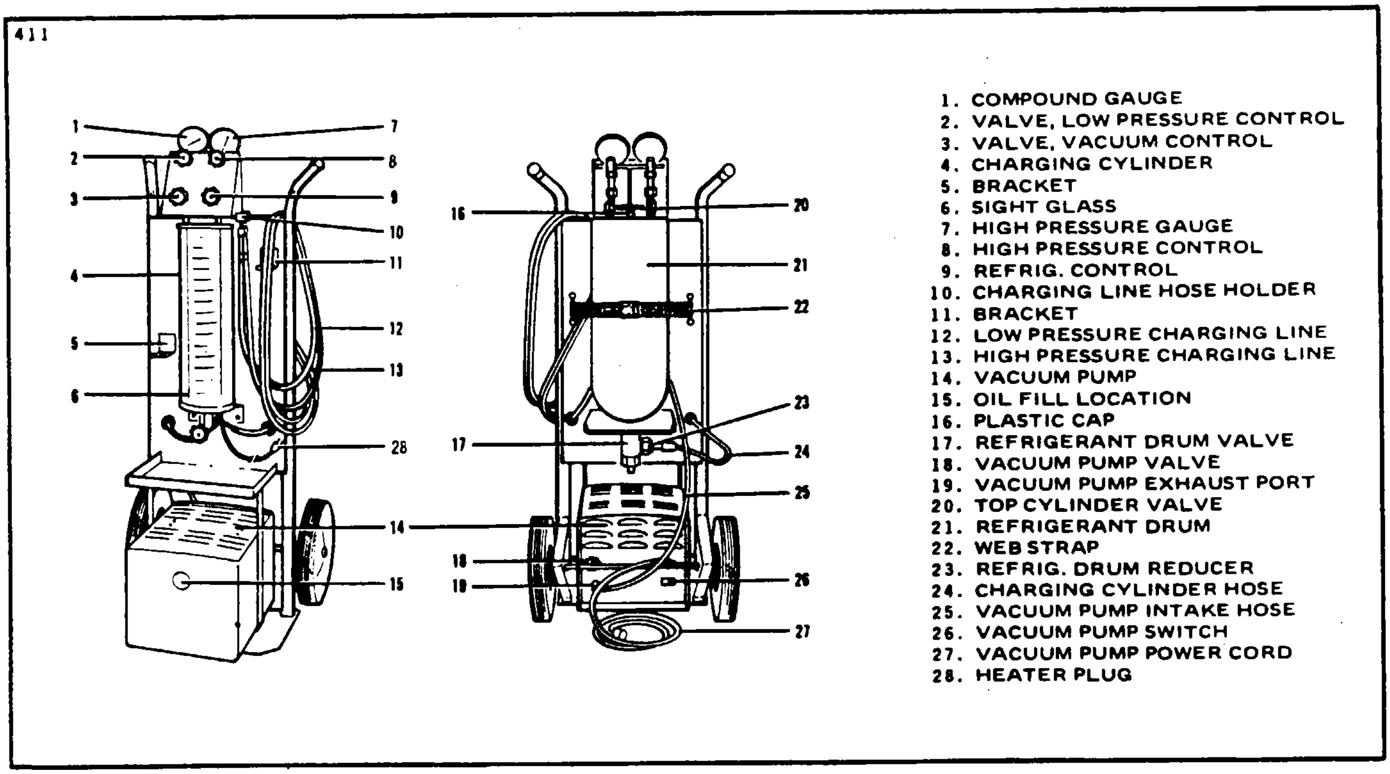


Figure 95-13. Charging Stand

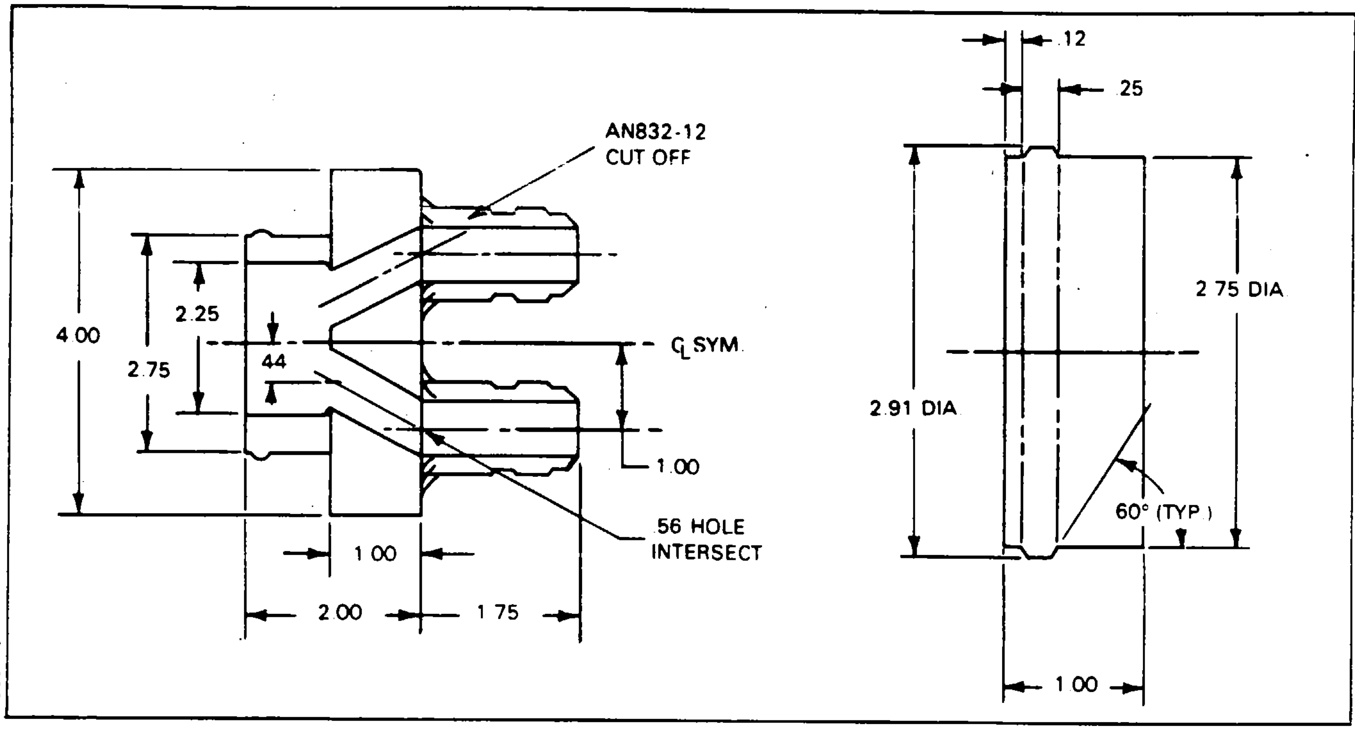


Figure 95-14. Fabricated Pressure Test Adapter

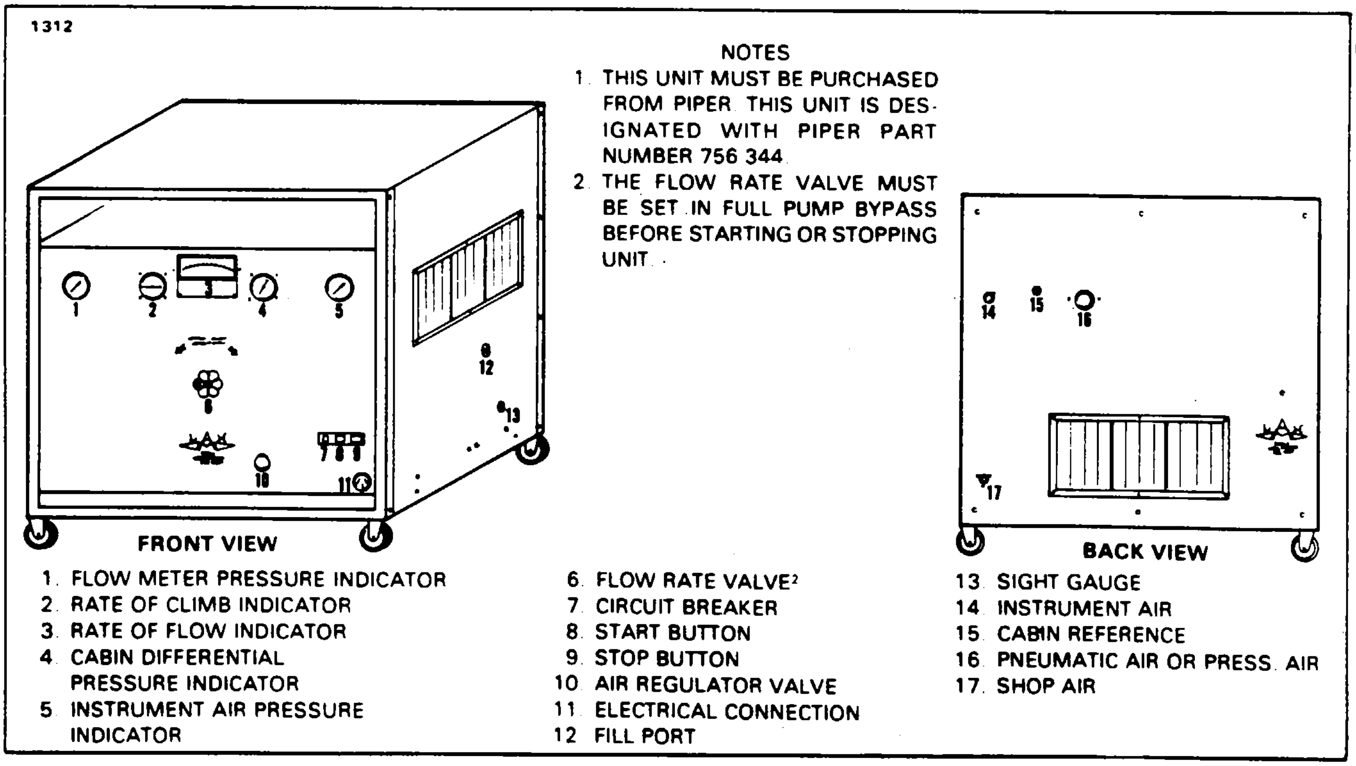


Figure 95-15. Cabin Pressure Test Unit (Typical)

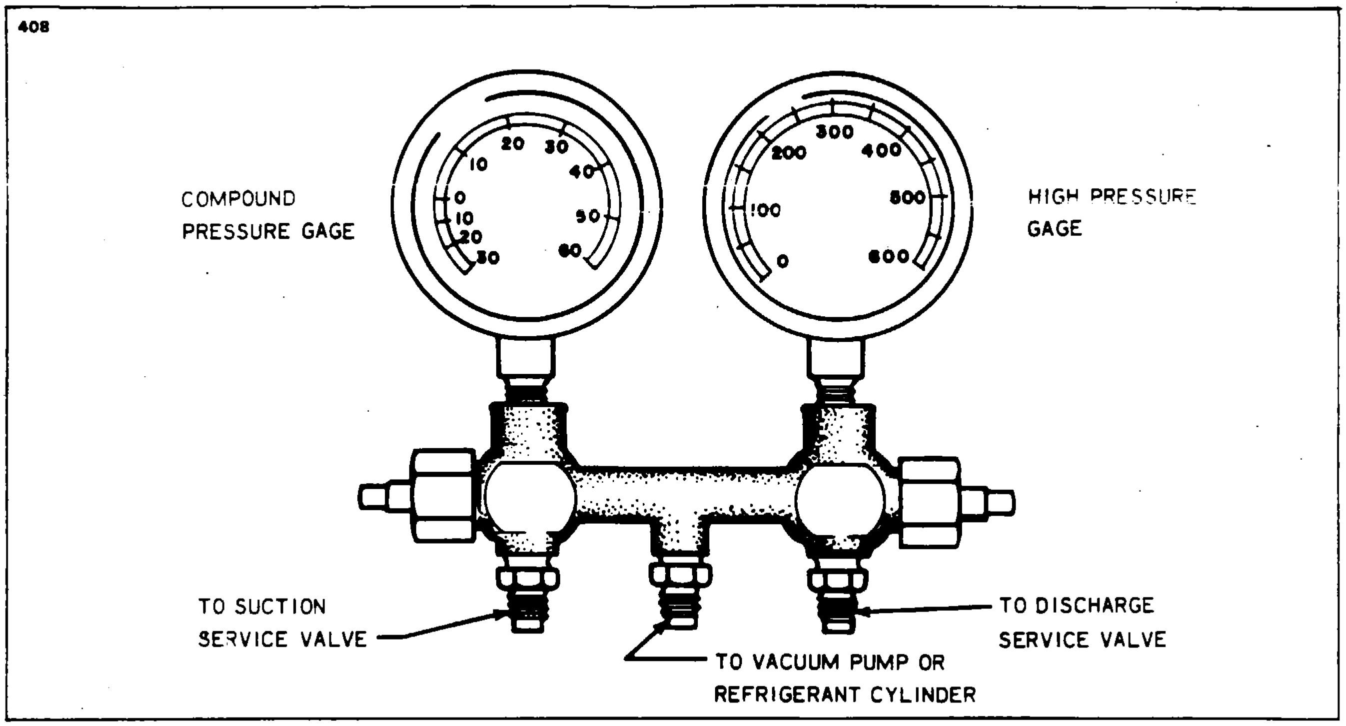


Figure 95-16. Test Gauge and Manifold Set

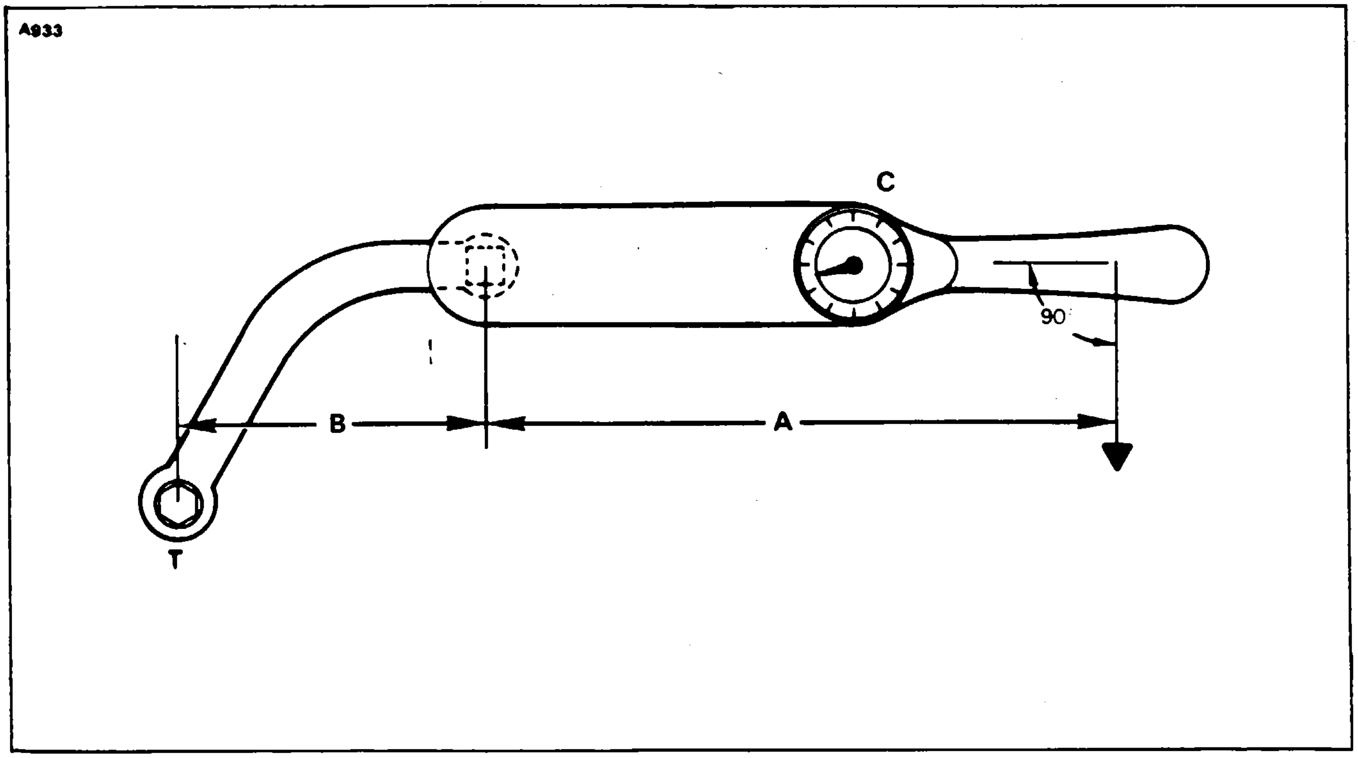


Figure 95-17. Torque Wrench Extension

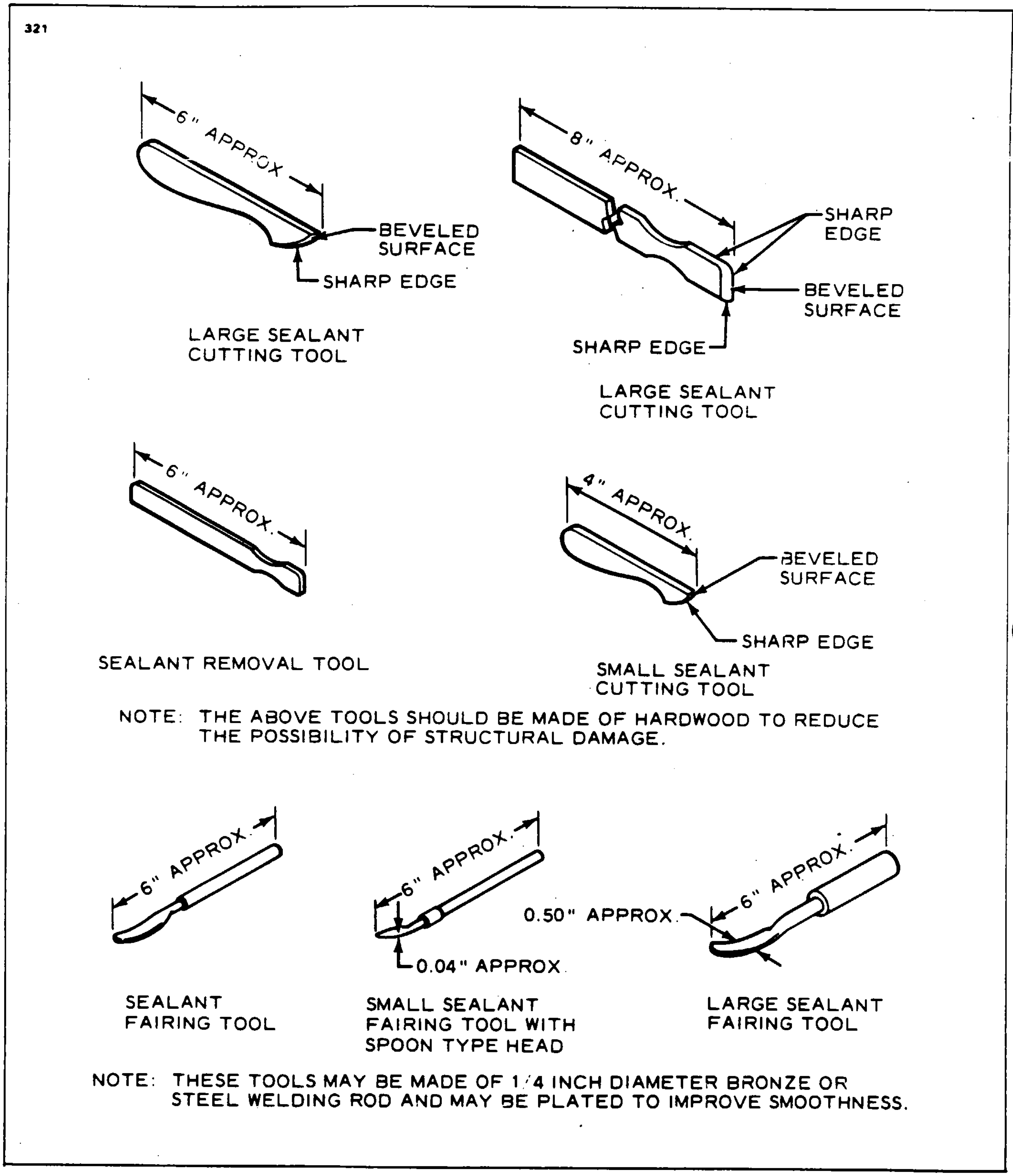


Figure 95-18. Sealant Tools

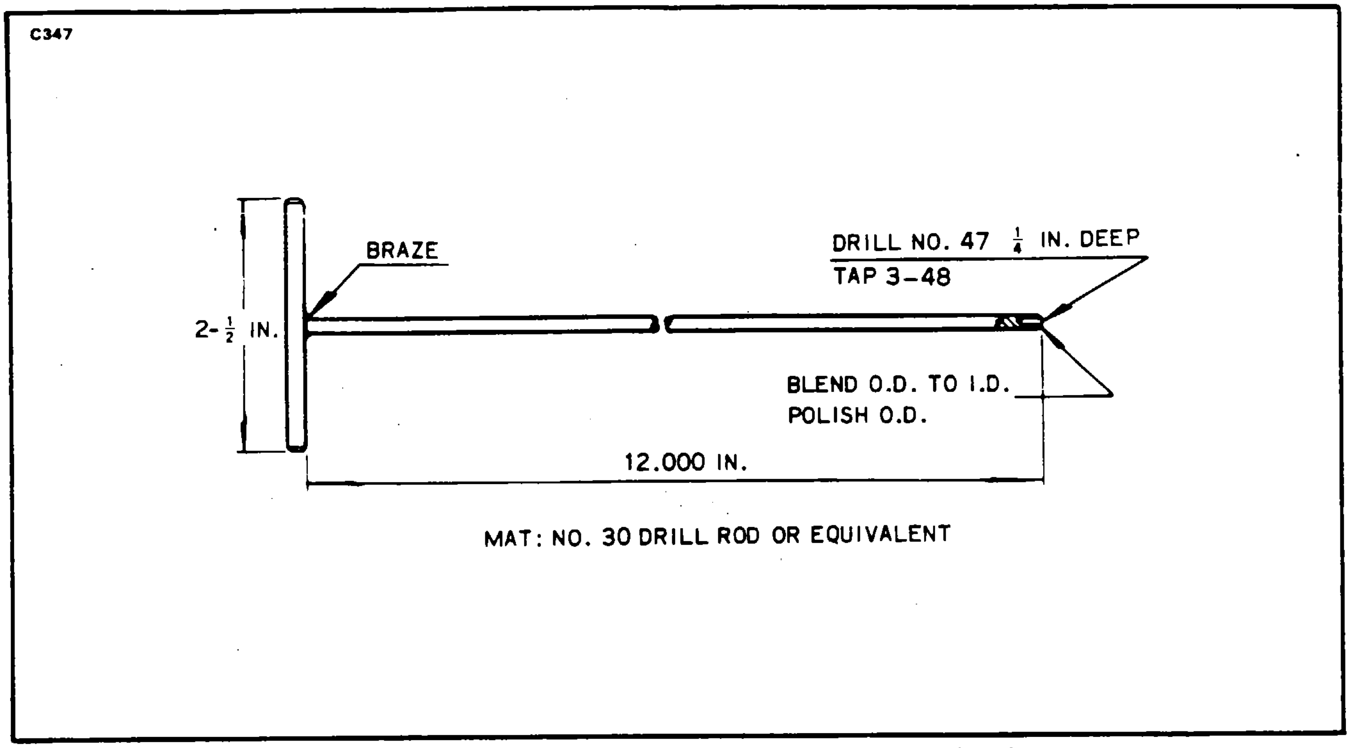
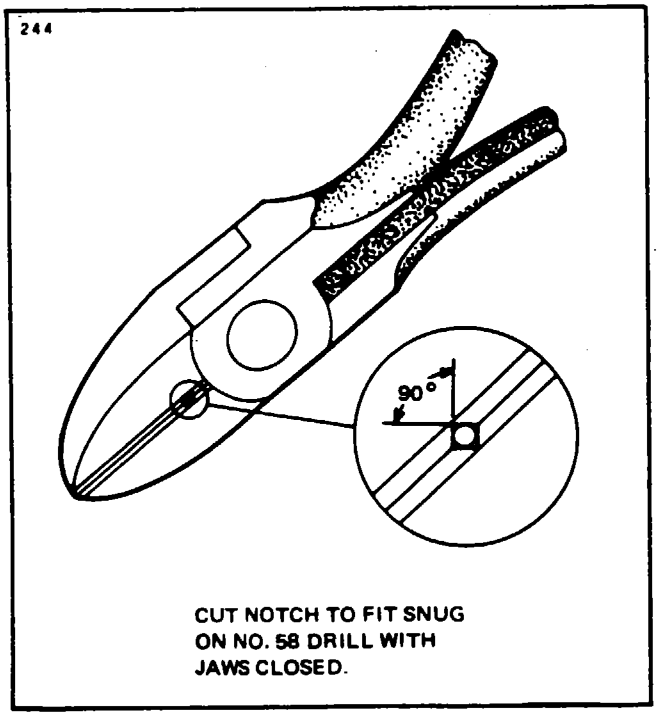


Figure 95-19. Assembly Tool - Ignition Harness Insulating Sleeves



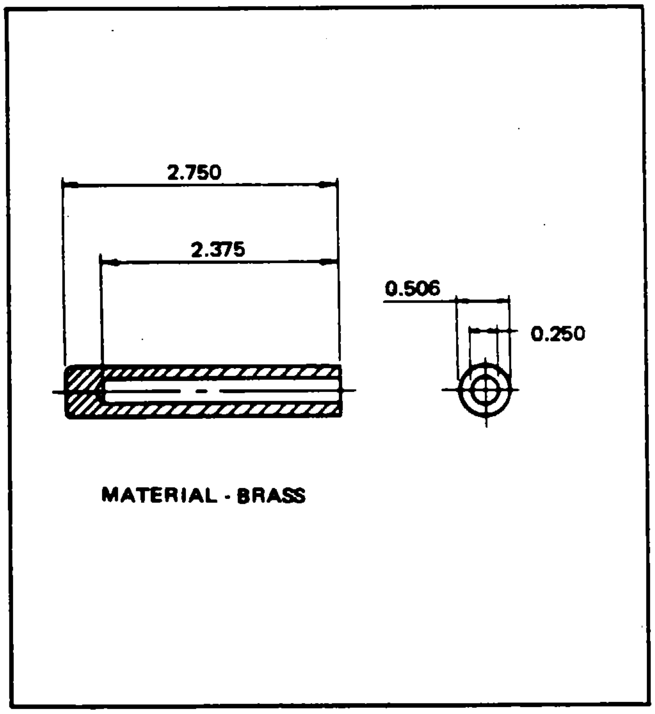
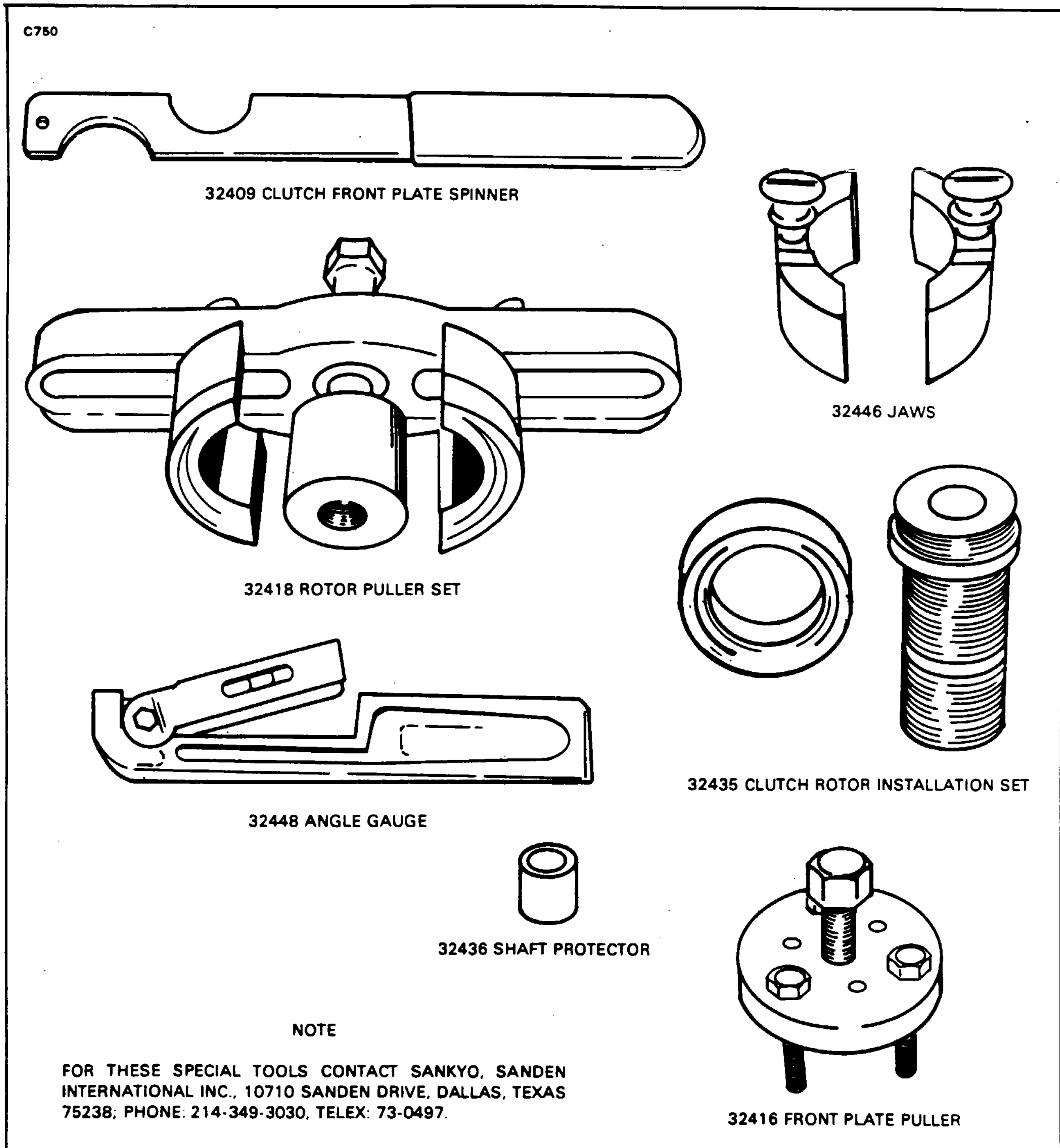


Figure 95-20. Modified Pliers for Igntion Harness

Figure 95-21. Ferrule Seating Tool-Ignition Harness



NOTE

FOR THESE SPECIAL TOOLS CONTACT SANKYO, SANDEN INTERNATIONAL INC., 10710 SANDEN DRIVE, DALLAS, TEXAS 75238; PHONE: 214-349-3030, TELEX: 73-0497.

Figure 95-22. Air Conditioning Compressor Tools

GRIDS 5E20 THRU 5L24
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