T1000

AIRLINE DIVISION

T1040

MAINTENANCE MANUAL

CARD 1 OF 5

PA-31T3 T1040

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 765)

INTRODUCTION.

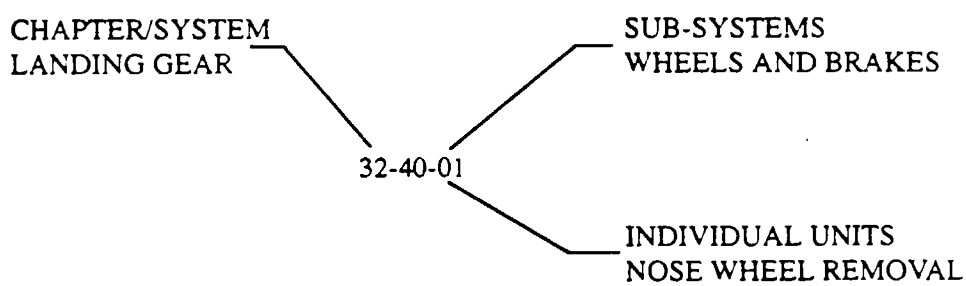
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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-31T3/T-1040 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 T-1040 Parts Catalog P/N 761 761, 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)

6. Revisions to Service Manual 761 765 issued March 26, 1982 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG820326	March 26, 1982	1, 2, 3, 4 and 5
PR820804	August 4, 1982	1, 2, 3, 4 and 5
PR821115	November 15, 1982	1, 2, 3, 4 and 5
PR830225	February 25, 1983	1, 2, 3, 4 and 5
PR840305	March 5, 1984	1, 2, 3, 4 and 5
PR840713	July 13, 1984	1, 2, 3, 4 and 5
PR860203	February 3, 1986	3
IR900313	March 13, 1990	2
IR941012	October 12, 1994	1 and 3

INTERIM REVISION

Revisions appear in Chapter 5 of card 1, and Chapter 30 or card 3. Please dispose of your current cards 1 and 3 and replace them with the revised cards. DO NOT DISPOSE OF CARDS 2, 4 and 5

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

SERIAL NUMBER INFORMATION

PA-31T T1040-1982
SERIAL NUMBERS 31T-8275001 TO 31T-8275025 INCL.
PA-31T T1040-1983
SERIAL NUMBERS 31T-8375001 TO 31T-8375005 INCL.
PA-31T T1040-1984
SERIAL NUMBERS 31T-8475001 AND UP.

—WARNING—

When servicing or inspecting vendor equipment installed in Piper aircraft, it is the user's responsibility to refer to the applicable vendor publication.

VENDOR PUBLICATIONS.

BATTERY:

Gill Lead-Acid Battery (Teledyne Battery Products) Service Manual	= P /N: GSM - 682
SAFT Nickel-Cadmium Battery Operating and Maintenance Manual	= P/N: DC 3176-5A
Marathon Nickel Cadmium Battery instruction Manual	= P/N: BA-89

DE-ICE SYSTEM (PROPELLERS):

B.F. Goodrich Electrothermal Propeller Deice Maintenance Manual	= P/N: 68-04-712 (Latest Revision)
B.F. Goodrich Electrothermal Propeller Deice Installation and Removal Procedures	= P/N: 59-728 (Latest Revision)

ENGINE:

PT6A-11/110 Maintenance Manual	= P/N: 3030442

HEATER:

Maintenance and Overhaul Manual	= P/N: 24E25-1

PROPELLER:

Hartzell Overhaul Manual	= P/N: 117-D
Hartzell Spinner Assembly and Maintenance Manual	= P/N: 127

VENDOR PUBLICATIONS (cont).

STARTER-GENERATOR

Auxilec, Inc. Maintenance and Overhaul Manual	= P/N: 8013C
Lear Siegler, Inc. Maintenance Manual (All Models)	= P/N: 23700
Lear Siegler, Inc. Overhaul Manual, Series 23048	= P/N: 23202

PIPER PUBLICATIONS.

PARTS CATALOG	= 761 761 Piper Aircraft Corporation 820 E. Bald Eagle Street Lock Haven, Pennsylvania 17745
INSPECTION MANUAL 100 HOUR	=761 774 Piper Aircraft Corporation 820 E. Bald Eagle Street Lock Haven, Pennsylvania 17745

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 Compressors	Delco Products Div. of General Motors Corp. P.O. Box 1042 Dept. 194-T Dayton, Ohio 45401 (513) 227-5000 Telex: 810-459-1788
	Sankyo Inc. 10719 Sanden Dr. Dallas, Texas 75238 (214) 349-3030 Telex: 73-0497
Air Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
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

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Marathon Battery Company 8301 Imperial Drive P.O. Box 8233 Waco, Texas 76710
	SAFT America, Incorporated 711 Industrial Boulevard Valdosta, Georgia 31601
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
Electrical Relays	Leach Corporation 5915 Avalon Boulevard Los Angeles, California 90003 (213) 232-8221
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington, Penna. 19034 (215) 643-2900
Engines	Pratt and Whitney Aircraft of Canada, Ltd. Box 10 Longueuil, Quebec, Canada JK4X9
Environmental Systems, Heater	Janitrol Aero Division 4202 Surface Road Columbus, Ohio 43228 (614) 276-3561
Fire Detection and Extinguishing Systems	HTL Industries P.O. Box 780 Pasadena, California 91006 (213) 574-7880

VENDOR-SUPPLIER INFORMATION (cont).

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
Gate Valves, Shut-off Valves and Solenoid Valves (Fuel and Hydraulic)	I.T.T. General Controls 801 Allen Avenue Glendale, California 91201 (213) 842-6131
Hoses, Fittings	Aeroquip Corporation Marmon Division 1214 Exposition Boulevard Los Angeles, California 90064 (213) 774-3230
Instruments	Aerosonic Corporation 1212 N. Hercules Avenue Clearwater, Florida 33515 (813) 461-3000
Landing Gear, Hydraulic Actuators, Hydraulic Pressure Regulator, Hydraulic Power Pack, Handpump	Ozone Aircraft Systems, Inc. 101-32 101st Street Ozone Park, New York 11416 (212) 845-5200
	Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Lighting, Tail Recognition	Devore Aviation Corporation 1-T Barstow Road Great Neck, New York 11021 (516) 487-3524
Lighting, Strobe	Whelen Engineering Company, Inc. 3 Winter Avenue Deep River, Connecticut 06417 (203) 526-9504

VENDOR-SUPPLIER INFORMATION (cont).

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	Woodward Governor Company Drake and Lemay Roads Fort Collins, Colorado 80521 (303) 482-5811
Starter-Generator	Auxilec, Incorporated One Willow Park Center Farmingdale, New York 11735 (516) 694-1441
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000
Tools, Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Voltage Regulators	Electro-Delta P.O. Box 898 Stockton, California 95201 (209) 462-8571
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

—NOTE—

Refer to Card 5, Grid 5F1 for Electrical Schematic Indexic

LIST OF CHARTS

LIST OF CHARTS (cont)

LIST OF CHARTS (cont)

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

4

AIRWORTHINESS LIMITATIONS

CHAPTER 4 - AIRWORTHINESS LIMITATIONS

TABLE OF CONTENTS / EFFECTIVITY

AIRWORTHINESS LIMITATIONS.

GENERAL.

The airworthiness limitations is FAA approved and specifies inspections and maintenance required under Parts 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/MAINTENANCE 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 may be found in the chapter covering the applicable aircraft system.

TIME LIMITS.

—NOTE—

Data to be added at later revision to this manual.

PREFLIGHT CHECK.

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

OVERLIMITS INSPECTION.

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

SCHEDULED MAINTENANCE CHECKS.

CONTINUOUS INSPECTION.

The Piper Continuous Inspection Program provides for continuous aircraft inspection and meets the FAA Continuous Inspection requirements of F.A.R. 91.217 (b) (4) for Turbo Propeller Multi-Engine Aircraft. This inspection program is also available in manual form through the Piper Airline Division under Part Number 761 774. To insure using the latest issue of this Continuous Inspection Program refer to the latest issue of the Piper Parts Price List Aerofiche and check the revision checklist on the last card in the set for the current revision date of the Continuous Inspection Manual Part Number 761 774.

INTRODUCTION

The Piper Continuous Inspection meets the F.A.A. continuous inspection requirements of F.A.R. 91.217 (b) (4) for use in the corporation's transportation and personnel; i.e., air taxi purposes, air freight, air mail, etc.

FACTS YOU SHOULD KNOW

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

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

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

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

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

An owner should periodically check with a Piper 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 Department. 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 the Piper Service Department.

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

PROCEDURE MANUAL

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

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

Owners and operators of the T-1040 are reminded that certain requirements must be met before the Piper Continuous Inspection Procedures can be utilized. These requirements are contained in the Federal Aviation Regulations Part 43, Maintenance Preventive Inspection, rebuilding and alteration and Part 91, General Operating and Flight Rules.

The inspection frequency used in the Piper Continuous Inspection is based on previous Operating experience. However, adjustments to the inspection intervals may be made by approval from your local F.A.A. Flight Standards District Office.

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

The Piper Continuous Inspection has the following basic features:

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

1. Piper Continuous Inspection

2. Event Inspections

   Each Event Inspection consists of a predetermined number of location inspections as indicated on each event sample. The Event Inspection is conducted each 100 hours and must be done in sequence, and recorded on the Event Inspection Record and Sign Off Sheet, which is the running log or current status of the aircraft inspections.

Late compliance with the Event Inspection Interval of 100 hours may be extended by not more than ten (10) flying hours (10% of Event Inspection Interval). This ten (10) percent shall only be used to return the aircraft back to the maintenance base which is performing the inspection. The excess time is included in computing the next 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 400 flying hour cycle results in a complete inspection. When the four Events are complete and recorded, an entry is made in the Event Record and Cycle Inspection Record which are the running logs or current status of the aircraft inspections .

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

EVENT #1

To be performed at the 100-500-900-1300-1700 Flying Hour Intervals

Consists of –

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

EVENT #2

To be performed at the 200-600-1000-1400-1800 Flying Hour Intervals

Consists of –

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

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

EVENT #3

To be performed at the 300-700-1100-1500-1900 Flying Hour Intervals

Consist of –

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

EVENT #4

To be performed at the 400-800-1200-1600-2000 Flying Hour Intervals

Consist of –

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

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

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

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

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

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

6. Continuous Cycle Inspection Record and Sign Off Sheet - is conducted upon completion of four (4) event inspections (400 flying hours). The cycle inspection consists of ten (10) items, which determine that the cycle paperwork and inspection records are in order before starting on the next cycle. The cycle record has the aircraft registration number, serial number, and columns for recording each cycle inspection.

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

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

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

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

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

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

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

DEFINITIONS

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

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

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

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

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

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

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

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

DEFINITIONS (cont.)

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

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

10. Maintenance - The word maintenance as defined by FAR 1 means "inspection, overhaul, repair, preservation, and the replacement of parts, but excludes preventive maintenance." However, where referenced in this inspection program the word "maintenance" means inspection and the replacement of time life limited parts as listed in FAA approved data.

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

12. Special Inspections - Involve those components, systems, or structure which by their application or intended use require an inspection peculiar to, more extensive in scope or at a time period other than and beyond that which is normally accomplished during the 400 hour cycle of events.

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

PROGRAM RESPONSIBILITY

The person responsible for scheduling the inspections required under this program must enter his or her name below and forward the original copy of this form to their local FAA (Flight Standards District 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 (Flight Standards District Office), while a duplicate copy is attached behind this page. The previous information sheet will be left in the booklet and the word "CHANGED" will be written across the deleted information.

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

REVISIONS

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

RECORD OF NORMAL REVISIONS

REV NO.	REV. APPROVAL DATE	PACE 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.

THIS SPACE INTENTIONALLY LEFT BLANK

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

EVENT #1

POWER PLANT
LEFT PROPELLER, DETAILED (See Chapter 61, Maintenance Manual)

- [ ] 1. Remove and inspect spinner and back plate for cracks and corrosion.
- [ ] 2. Inspect blades for nicks, cracks and corrosion.
- [ ] 3. Check for grease and oil leaks.
- [ ] 4. Inspect spinner bulkhead for cracks and security.
- [ ] 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.
- [ ] 8. Inspect Beta feedback ring for runout (.010 max.); inspect condition of carbon block assembly.
- [ ] 9. Inspect condition and operation of propeller deicer system.
- [ ] 10. Inspect low pitch stop rods and Beta feedback ring for freedom of movement.
- [ ] 11. Inspect condition of synchrophaser (if installed).
- [ ] 12. Lubricate.
- [ ] 13. Install spinner.

LEFT ENGINE, DETAILED (See Chapter 71, Maintenance Manual)

- [ ] 1. Remove engine cowl.
- [ ] 2. Clean and inspect cowling for cracks, distortion and loose or missing fasteners.
- [ ] 3. Inspect oil temperature sender unit for leaks and security (located on engine accessory case).
- [ ] 4. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks.
- [ ] 5. Clean and inspect oil radiator cooling fins.
- [ ] 6. Remove and inspect oil filter.
- [ ] 7. Clean exterior of engine (Pratt and Whitney Maintenance Manual).
- [ ] 8. Inspect condition of ignition plugs per Pratt and Whitney Maintenance Manual.
- [ ] 9. Inspect ignition harness and insulators for high tension leakage and continuity.
- [ ] 10. Inspect electrical connections on ignition exciter for security.
- [ ] 11. Remove air inlet screen, inspect first stage compressor blades for ingestion damage and corrosion. Inspect screen for damage and cleanliness and reinstall.
- [ ] 12. Inspect fuel pump inlet screen and outlet filter for foreign material (clean or replace as necessary) (Pratt and Whitney Maintenance Manual) (Refer to Special Inspection, 500 Hour).
- [ ] 13. Inspect gas generator case drain valves for security and leaks (to be checked during engine run) (Pratt and Whitney Maintenance Manual).
- [ ] 14. Inspect condition and operation of inlet air ducts and ice protection system.
- [ ] 15. Inspect condition of actuators for ice protection system and oil cooler door (see Special Inspection, 500 hours).
- [ ] 16. Inspect power lever, start control, propeller governor and propeller reversing linkage for travel and operation.
- [ ] 17. Inspect gas generator case for cracks, distortion and evidence of overheating (Pratt and Whitney Maintenance Manual).

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

EVENT #1 (cont.)

- ❑ 18. Inspect exit exhaust ducts and stacks for cracks and distortion (Pratt and Whitney Maintenance Manual).
- ❑ 19. Inspect propeller shaft for oil leaks.
- ❑ 20. Inspect magnetic chip detector (Pratt and Whitney Maintenance Manual).
- ❑ 21. Remove, drain, and clean fuel filter bowl and element (drain and clean at least every ninety (90) days).
- ❑ 22. Inspect flexible fuel lines for leaks, abrasion and security (Pratt and Whitney Maintenance Manual).
- ❑ 23. Inspect fuel system for leaks.
- ❑ 24. Replace hydraulic filter element (check element for contamination).
- ❑ 25. Inspect hydraulic pump and gaskets for leaks.
- ❑ 26. Inspect all engine fire seals for cracks and security.
- ❑ 27. Inspect torque pressure transmitter for security and wiring (Pratt and Whitney Maintenance Manual).
- ❑ 28. Inspect fire extinguisher pressure. (If installed.)
- ❑ 29. Inspect breather tube for obstruction and security. (Pratt and Whitney Maintenance Manual.)
- ❑ 30. Check for proper oil level and filler locking cap for security.
- ❑ 31. Inspect engine mounts for cracks and loose mount bolts.
- ❑ 32. Inspect rubber mount bushings for deterioration.
- ❑ 33. Inspect firewall for cracks and stress.
- ❑ 34. Inspect firewall seals.
- ❑ 35. Inspect condition of starter-generator (refer to Special Inspection, 300 hours).
- ❑ 36. Inspect tachometer generators security and wiring.
- ❑ 37. Lubricate Power Plant per Pratt and Whitney Maintenance Manual.
- ❑ 38. Install engine cowl.

RIGHT PROPELLER, ROUTINE (See Chapter 61, Maintenance Manual)

- ❑ 1. Remove and inspect spinner and back plate for security and corrosion.
- ❑ 2. Inspect blades for nicks, cracks and corrosion.
- ❑ 3. Check for excessive grease and oil leaks.
- ❑ 4. Check condition of propeller deicer boots.

RIGHT ENGINE, ROUTINE (See Chapter 71, Maintenance Manual)

- ❑ 1. Remove engine cowl.
- ❑ 2. Remove, drain and clean fuel filter bowl and element (drain at least every ninety (90) days).
- ❑ 3. Check for proper oil level and filler locking cap for security.
- ❑ 4. Inspect oil temperature sender unit for leaks and security (located on engine accessory case).
- ❑ 5. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks.
- ❑ 6. Inspect and clean oil radiator cooling fins.

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

EVENT #1(cont.)

- ❑ 7. Remove air inlet screen, inspect first stage compressor blades for ingestion damage and corrosion. Inspect screen for damage and cleanliness. Reinstall screen.
- ❑ 8. Inspect condition of inlet air ice protection mechanism.
- ❑ 9. Inspect power lever, start control, propeller governor and propeller reversing linkage for travel and operation.
- ❑ 10. Inspect gas generator case for cracks, distortion and evidence of overheating.
- ❑ 11. Inspect condition of flexible lines.
- ❑ 12. Inspect fuel system for leaks.
- ❑ 13. Inspect power lever, condition lever and propeller governor for travel and operating conditions.
- ❑ 14. Inspect breather tube for obstructions and security.
- ❑ 15. Inspect propeller shaft for oil leaks.
- ❑ 16. Inspect all engine fire seals.
- ❑ 17. Inspect engine rubber mount bushings for deterioration.
- ❑ 18. Inspect fire extinguisher pressure. (If installed.)
- ❑ 19. Inspect condition of starter-generator (refer to Special Inspection, 300 hours).
- ❑ 20. Inspect condition of air conditioning compressor drive belt.
- ❑ 21. Install engine cowl.

RIGHT WING, ROUTINE (See chapter 57, Maintenance Manual)

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

LANDING GEAR, DETAILED (See chapter 32, Maintenance Manual) (Refer to the latest revision of Piper Service Bulletins 822 and 841)

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.
- ❑ 6. Inspect wheel for cracks, corrosion and broken bolts.
- ❑ 7. Check tire pressure.

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

EVENT #1 (cont.)

- ☐ 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. Clean and inspect up and down lock actuator rod assemblies and rod end bearing assemblies for damage, binding, corrosion (remove boot), freedom of movement, operation and lubrication.
- ☐ 16. Inspect gear doors and attachments for security.
- ☐ 17. Check warning horn and light for operation.
- ☐ 18. Retract gear - inspect operation.
- ☐ 19. Retract gear - inspect doors for clearance and operation.
- ☐ 20. Inspect anti-retraction system operation.
- ☐ 21. Inspect actuating cylinder for leaks and security.
- ☐ 22. Inspect position indicating switches and electrical wires for condition and security.

LEFT GEAR

- ☐ 1. Check oleo struts for proper extension. (Check for proper fluid level as required.)
- ☐ 2. Inspect wheel for alignment.
- ☐ 3. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 4. Remove wheel, clean, inspect and repack bearings.
- ☐ 5. Inspect wheel for cracks, corrosion and broken bolts.
- ☐ 6. Check tire pressure.
- ☐ 7. Inspect brake lining and disc for wear.
- ☐ 8. Inspect condition and security of brake backing plates.
- ☐ 9. Inspect brake and hydraulic lines for condition, mounting, security and leaks.
- ☐ 10. Inspect gear fork for damage.
- ☐ 11. Inspect oleo struts for fluid leaks and scoring.
- ☐ 12. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.
- ☐ 13. Inspect downlock for operation and adjustment.
- ☐ 14. Clean and inspect up and down lock actuator rod assemblies and rod end bearing assemblies for damage, binding, corrosion (remove boot), freedom of movement, operation and lubrication.
- ☐ 15. Inspect gear doors and attachments for security.
- ☐ 16. Check warning horn and light for operation.

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

EVENT #1 (cont.)

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

NOSE GEAR

- ❑ 1. Check oleo strut for proper extension. (Check for proper fluid level as required.)
- ❑ 2. Inspect nose gear steering control and travel.
- ❑ 3. Inspect wheel for alignment.
- ❑ 4. Inspect tire for cuts, uneven or excessive wear and slippage.
- ❑ 5. Remove wheels clean, inspect and repack bearings
- ❑ 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 scoping.
- ❑ 11. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.
- ❑ 12. Inspect downlock for operation and adjustment.
- ❑ 13. Clean and inspect up and down lock actuator rod assemblies and rod end bearing assemblies for damage, binding, corrosion (remove boot), freedom of movement, operation and lubrication.
- ❑ 14. Inspect nose gear lock rod assembly for corrosion, freedom of movement and spring tension.
- ❑ 15. Inspect gear doors and attachments.
- ❑ 16. Check gear warning horn and light for operation.
- ❑ 17. Retract gear - inspect operation.
- ❑ 18. Retract gear - inspect doors for clearance and operation.
- ❑ 19. Inspect actuating cylinder for leaks and security.
- ❑ 20. Inspect position of indicating switches and electrical lead for security.
- ❑ 21. Remove airplane from jacks.

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

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

CABIN MAIN, ROUTINE

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

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

EVENT #1 (cont.)

ELECTRICAL, DETAILED (See Chapter 39, Maintenance Manual)

CAUTION

Do not allow the P3 heater to remain on during ground electrical check. Pull the fuel control heat circuit after verifying P3 heater operation.

FUSELAGE FORWARD, DETAILED

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

APPLY EXTERNAL POWER

CABIN, COCKPIT

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

LEFT WING

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

NOSE

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

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

EVENT #1 (cont.)

RIGHT WING

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

TAIL

- ❑ 1. Check strobe light, recognition light, and navigation light for operation.
- ❑ 2. Check tel tail light for operation. (If installed)

SIGN OFF ELECTRICAL SECTION OF CHECK.

LUBRICATION

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

RIGHT WING

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

JACK AIRCRAFT.

MAIN LANDING GEAR

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

NOSE GEAR

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

EMPENNAGE

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

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

EVENT #1 (cont.)

FUSELAGE

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

COCKPIT

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

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

WINGS

- ❑ ❑ 1. Flap tracks.

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

MAIN LANDING GEAR

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

NOSE GEAR

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

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

- ❑ ❑ MAIN WHEEL BEARINGS
- ❑ ❑ NOSE WHEEL BEARINGS

REMOVE THE AIRCRAFT FROM JACKS.

- ❑ 1. Reinstall all inspection plates and covers.
- ❑ 2. Sign off lubrication section of check form.

THIS SPACE INTENTIONALLY LEFT BLANK

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

EVENT #2

POWER PLANT

RIGHT PROPELLER, DETAILED (See Chapter 61, Maintenance Manual)

- ❑ 1. Remove and inspect spinner and back plate for cracks and corrosion.
- ❑ 2. Inspect blades for nicks and cracks.
- ❑ 3. Check for grease and oil leaks.
- ❑ 4. Inspect bulkhead for cracks, security and corrosion.
- ❑ 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.
- ❑ 8. Inspect Beta feedback ring for runout (.010 max.); inspect condition of carbon block assembly.
- ❑ 9. Inspect low pitch stop rods and Beta feedback ring for freedom of movement.
- ❑ 10. Inspect condition and operation of propeller deicer system.
- ❑ 11. Lubricate.
- ❑ 12. Inspect for condition and operation of synchrophaser (if installed).
- ❑ 13. Install spinner.

RIGHT ENGINE, DETAILED (See Chapter 71, Maintenance Manual)

- ❑ 1. Remove engine cowl.
- ❑ 2. Clean and inspect cowling for cracks, distortion and loose or missing fasteners.
- ❑ 3. Inspect oil temperature sender unit for leaks and security (located on engine accessory case).
- ❑ 4. Inspect oil lines and fillings for leaks, security, chafing, dents and cracks.
- ❑ 5. Clean and inspect oil radiator cooling fins.
- ❑ 6. Remove and inspect oil filter.
- ❑ 7. Clean exterior of engine (Pratt and Whitney Maintenance Manual).
- ❑ 8. Inspect condition of ignition plugs per Pratt and Whitney Maintenance Manual.
- ❑ 9. Inspect ignition harness and insulators for high tension leakage and continuity.
- ❑ 10. Inspect electrical connections on ignition exciter for security.
- ❑ 11. Remove air inlet screen, inspect first stage compressor blades for ingestion damage and corrosion. Inspect screen for damage and cleanliness. Reinstall screen.
- ❑ 12. Inspect fuel pump inlet screen and outlet filter for foreign material (clean or replace as necessary) (Pratt and Whitney Maintenance Manual) (Refer to Special Inspection, 500 hour).
- ❑ 13. Inspect gas generator case drain valves for security and leaks (to be checked during engine run) (Pratt and Whitney Maintenance Manual).
- ❑ 14. Inspect condition of inlet air ducts and ice protection system.
- ❑ 15. Inspect condition of actuators for ice protection system and oil cooler door (see Special Inspection, 500 hour).
- ❑ 16. Inspect power lever, start control, propeller-governor and propeller reversing linkage for travel and operation.

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

EVENT #2 (cont.)

- ☐ 17. Inspect gas generator case for cracks, distortion and evidence of overheating (Pratt and Whitney Maintenance Manual).
- ☐ 18. Inspect exit exhaust ducts and stacks for cracks and distortion (Pratt and Whitney Maintenance Manual).
- ☐ 19. Inspect propeller shaft for oil leaks.
- ☐ 20. Inspect magnetic chip detector (Pratt and Whitney Maintenance Manual).
- ☐ 21. Remove, drain and clean fuel filter bowl and element (drain and clean at least every ninety (90) days).
- ☐ 22. Inspect flexible fuel lines for leaks, abrasion and security (Pratt and Whitney Maintenance Manual).
- ☐ 23. Inspect fuel system for leaks.
- ☐ 24. Replace hydraulic filter element (check element for contamination).
- ☐ 25. Inspect hydraulic pump and gaskets for leaks.
- ☐ 26. Inspect all engine fire seals for cracks and security.
- ☐ 27. Inspect torque pressure transmitter for security and wiring (Pratt and Whitney Maintenance Manual).
- ☐ 28. Check fire extinguisher pressure. (If installed.)
- ☐ 29. Inspect breather tube for obstruction and security (Pratt and Whitney Maintenance Manual).
- ☐ 30. Check for proper oil level and filler locking cap for security.
- ☐ 31. Inspect engine mounts for cracks and loose mount bolts.
- ☐ 32. Inspect rubber mount bushings for deterioration.
- ☐ 33. Inspect firewall for cracks and stress.
- ☐ 34. Inspect firewall seals.
- ☐ 35. Inspect condition of starter-generator (Refer to Special Inspection, 300 hour).
- ☐ 36. Inspect security of air conditioner compressor mount.
- ☐ 37. Lubricate Power Plant per Maintenance Manual.
- ☐ 38. Inspect compressor drive belt condition and tension.
- ☐ 39. Inspect compressor clutch for security and wiring.
- ☐ 40. Inspect tachometer generator for security and wiring.
- ☐ 41. Install engine cowl.

LEFT PROPELLER, ROUTINE (See Chapter 61, Maintenance Manual)

- ☐ 1. Remove and inspect spinner and back plate for security.
- ☐ 2. Inspect blades for nicks and cracks.
- ☐ 3. Check for excessive grease and oil leaks.
- ☐ 4. Check condition of propeller deicer boots.

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

EVENT #2 (cont.)

LEFT ENGINE, ROUTINE (See Chapter 71, Maintenance Manual)

- ☐ 1. Remove engine cowl.
- ☐ 2. Remove, drain and clean fuel filter bowl and element (drain at least every ninety (90) days).
- ☐ 3. Check for proper oil level and filler locking cap for security.
- ☐ 4. Inspect oil temperature sender unit for leaks and security (located on engine accessory case).
- ☐ 5. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks.
- ☐ 6. Inspect and clean oil radiator cooling fins.
- ☐ 7. Remove air inlet screen, inspect first stage compressor blades for ingestion damage and corrosion. Inspect screen for damage and cleanliness. Reinstall screen.
- ☐ 8. Inspect condition of inlet air ice protection mechanism.
- ☐ 9. Inspect power lever, start control, propeller governor and propeller reversing linkage for travel and operation.
- ☐ 10. Inspect gas generator case for cracks, distortion and evidence of overheating.
- ☐ 11. Inspect condition of flexible lines.
- ☐ 12. Inspect fuel system for leaks.
- ☐ 13. Inspect power lever, condition lever and propeller governor for travel and operating conditions.
- ☐ 14. Inspect breather tube for obstructions and security.
- ☐ 15. Inspect propeller shaft for oil leaks.
- ☐ 16. Inspect all engine fire seals.
- ☐ 17. Inspect engine rubber mount bushings for deterioration.
- ☐ 18. Inspect fire extinguisher pressure (if installed).
- ☐ 19. Inspect condition of starter-generator (Refer to Special Inspection, 300 hour).
- ☐ 20. Install engine cowl.

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

- ☐ 1. Remove inspection plates and panels (refer to Index for locations).

CAUTION

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

- ☐ 2. Inspect plug connection from the Flux Detector for corrosion and tightness.
- ☐ 3. Check surfaces, skins and tips for damage and loose rivets.
- ☐ 4. Inspect aileron cables, pulleys and bellcrank for damage, full travel and proper cable tension.
- ☐ 5. Inspect all rod end bearings for freedom of ball movement. Use a 10X magnifying glass to check thread end of bearing for cracks and damage. Replace bearing if ball is frozen or hard to move.
- ☐ 6. Inspect aileron balance weight and arm for security and condition (located outboard of aileron).
- ☐ 7. Inspect flaps, actuators, limit switches, and wiring for condition, operation and full travel.
- ☐ 8. Inspect flap time delay switch operation.

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

EVENT #2 (cont.)

- ☐ 8. Inspect condition of flap track bolts and aileron hinge bolts for wear, security and corrosion.
- ☐ 9. Remove aileron and inspect area beneath inboard hinge on aileron spar for cracks. (Refer to latest revision of Piper Service Bulletin No. 974.)
- ☐ 10. Inspect all control surface exterior bearings for wear and freedom of movement.
- ☐ 11. Inspect wing attachment bolts for stripe alignment and brackets for cracks and corrosion.
- ☐ 12. Inspect engine mount attachments for security.
- ☐ 13. Inspect fuel cells and lines for leaks and water.
- ☐ 14. Check fuel tanks for marked capacity, fuel caps for proper seal and quick drains for proper operation.
- ☐ 15. Check fuel tanks marked for correct operating fuel.
- ☐ 16. Inspect fuel vents for blockage and damage.
- ☐ 17. Inspect tip tank for damage, attachment and leaks.
- ☐ 18. Remove and inspect forward and aft tip tank cone for presence of water and face of tip tank surface for presence of corrosion.
- ☐ 19. Inspect condition of pneumatic deicer boots for damage and wing ice inspection light for operation (if applicable).
- ☐ 20. Inspect wing tip navigation and strobe lights for broken lenses and operation; replace bulb or flash tube as required.
- ☐ 21. Inspect wing locker for condition and for security and operation of hinges and latches.
- ☐ 22. Lubricate.
- ☐ 23. Reinstall inspection plates and panels (see CAUTION after Step 1).

LANDING GEAR, ROUTINE (See chapter 32, Maintenance Manual) (Refer to Piper Service Bulletins 822 and 841.)

LEFT GEAR

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

RIGHT GEAR

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

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

EVENT #2 (cont.)

NOSE GEAR

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

FUSELAGE FORWARD, ROUTINE

- ☐ 1. Inspect baggage door latch and hinges for operation and security.
- ☐ 2. Inspect fluid in brake reservoir (fill as required).
- ☐ 3. Inspect battery, box and cables. (Check at least every 30 days. Flush box as required and fill per instructions on box.)
- ☐ 4. Check hydraulic power pack fluid level (fill as required).
- ☐ 5. Inspect heater for fumes and leaks.
- ☐ 6. Inspect condition of skins for visible damage.

FUSELAGE MAIN, ROUTINE

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

CABIN COCKPIT, DETAILED

- ☐ 1. Remove inspection panels and plates and floor panels.
- ☐ 2. Inspect pilot entry door. (If installed).
- ☐ 3. Inspect upholstery for tears.
- ☐ 4. Inspect pilot and copilot seats and seat belts for damage, security and operation.
- ☐ 5. Inspect trim operation and indication for full travel. (See Chapter 27, Maintenance Manual.)
- ☐ 6. Inspect rudder pedals and brake cylinders for security and operation. (See Chapter 32. Maintenance Manual.)
- ☐ 7. Inspect parking brake for operation. (See Chapter 32, Maintenance Manual.)
- ☐ 8. Inspect control wheels, column, pulleys and cables for damage, operation and full travel. (See Chapter 27, Maintenance Manual.)
- ☐ 9. Inspect instruments and attachments for security, proper markings and placards. (Refer to Pilot's Operating Handbook.)
- ☐ 10. Inspect compass correction card for correct data. Recalibrate as required.
- ☐ 11. Inspect communications systems for condition and security of switches and knobs.
- ☐ 12. Inspect pitot and static lines for condition and security.

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

EVENT #2 (cont.)

- ☐ 13. Inspect altimeter in accordance with AC 43.13-1A, and certified in accordance with FAR 23 to comply with FAR 91.170 (this applies to each altimeter installed).
- ☐ 14. Inspect condition of heater ducts.
- ☐ 15. Inspect oxygen outlets for defects and corrosion (if installed).
- ☐ 16. Inspect oxygen system operation and condition of components and masks (if installed).
- ☐ 17. Inspect condition of environmental system ducts.
- ☐ 18. Check portable fire extinguisher for proper service and service time.
- ☐ 19. Check each life preserver condition, service time, locator light attachment and operation (if applicable).
- ☐ 20. Inspect all flight control cables and pulleys for damage and tension. (See Chapter 27, Maintenance Manual.)
- ☐ 21. Inspect Autopilot roll servo for security and condition of bridle cables and wiring. (Refer to approved Autopilot Manual.)

LUBRICATION

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

LEFT WING

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

MAIN LANDING GEAR

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

NOSE GEAR

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

FUSELAGE

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

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

EVENT #2 (cont.)

COCKPIT

❑ 1. Control wheel, rollers, link and flexible joint.

❑ 2. Rudder pedals, torque tube bearings and blocks, control cable ends, and brake cylinder ends.

❑ 3. Fuel panel control levers.

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

WINGS

❑ ❑ 1. Flap tracks.

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

MAIN LANDING GEAR

❑ ❑ 1. Gear side brace link bushings and housing bushings.

❑ ❑ 2. Gear torque link fittings.

NOSE GEAR

❑ 1. Drag link assembly and idler link.

❑ 2. Upper and lower torque link.

❑ 3. Gear housing bushings.

❑ 4. Cam bearing surface (special fitting required).

❑ 5. Center steering support bearing (special fitting required).

THIS SPACE INTENTIONALLY LEFT BLANK

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

EVENT #3

POWER PLANT

LEFT PROPELLER, DETAILED (See Chapter 61, Maintenance Manual)

- ☐ 1. Remove and inspect spinner and back plate for cracks and corrosion.
- ☐ 2. Inspect blades for nicks, cracks and corrosion.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Inspect spinner mounting brackets for cracks, security and corrosion.
- ☐ 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.
- ☐ 8. Inspect Beta feedback ring for runout (.010 max.); inspect condition of carbon block assembly.
- ☐ 9. Inspect low pitch stop rods and Beta feedback ring for freedom of movement.
- ☐ 10. Inspect condition and operation of propeller deicer system.
- ☐ 11. Inspect for condition and operation of synchrophaser (if installed).
- ☐ 12. Lubricate.
- ☐ 13. Install spinner.

LEFT ENGINE, DETAILED (See Chapter 71, Maintenance Manual)

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and inspect cowling for cracks, distortion and loose or missing fasteners.
- ☐ 3. Inspect oil temperature sender unit for leaks and security (located on engine accessory case).
- ☐ 4. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks.
- ☐ 5. Clean and inspect oil radiator cooling fins.
- ☐ 6. Clean exterior of engine (Pratt and Whitney Maintenance Manual).
- ☐ 7. Inspect condition of ignition plugs per Pratt and Whitney Maintenance Manual.
- ☐ 8. Inspect ignition harness and insulators for high tension leakage and continuity.
- ☐ 9. Inspect electrical connections on ignition exciter for security.
- ☐ 10. Remove air inlet screen, inspect first stage compressor blades for ingestion damage and corrosion. Inspect screen for damage and cleanliness. Reinstall screen.
- ☐ 11. Inspect fuel pump inlet screen and outlet filter for foreign material (clean or replace as necessary) (Pratt and Whitney Maintenance Manual) (refer to Special Inspection, 500 hour).
- ☐ 12. Inspect gas generator case drain valves for security and leaks (to be checked during engine run) (Pratt and Whitney Maintenance Manual).
- ☐ 13. Inspect condition of inlet air ducts and ice protection system.
- ☐ 14. Inspect magnetic chip detector (as per Pratt and Whitney Maintenance Manual).
- ☐ 15. Inspect condition of actuators for ice protection system and oil cooler door (refer to Special Inspection, 500 hour).
- ☐ 16. Inspect power lever, start control, propeller governor and propeller reversing linkage for travel and operation.
- ☐ 17. Inspect gas generator case for cracks, distortion and evidence of overheating (Pratt and Whitney Maintenance Manual).

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

EVENT #3 (cont.)

- ☐ 18. Inspect exit exhaust ducts and stacks for cracks and distortion (Pratt and Whitney Maintenance Manual).
- ☐ 19. Check propeller shaft for oil leaks.
- ☐ 20. Remove, drain and clean fuel filter bowl and element (drain and clean at least every ninety (90) days).
- ☐ 21. Inspect flexible fuel lines for leaks, abrasion and security (Pratt and Whitney Maintenance Manual).
- ☐ 22. Inspect fuel system for leaks.
- ☐ 23. Replace hydraulic filter element (inspect element for contamination).
- ☐ 24. Inspect hydraulic pump and gaskets for leaks.
- ☐ 25. Inspect all engine fire seals for cracks and security.
- ☐ 26. Inspect torque pressure transmitter for security and wiring (Pratt and Whitney Maintenance Manual).
- ☐ 27. Inspect fire extinguisher pressure (if installed).
- ☐ 28. Inspect breather tube for obstruction and security.
- ☐ 29. Check for proper oil level and filler locking cap for security.
- ☐ 30. Inspect engine mounts for cracks and loose mount bolts.
- ☐ 31. Inspect engine rubber mount bushings for deterioration.
- ☐ 32. Inspect firewall for cracks and stress.
- ☐ 33. Inspect firewall seals.
- ☐ 34. Inspect condition of starter-generator (refer to Special Inspection, 300 hour).
- ☐ 35. Inspect tachometer generators security and wiring.
- ☐ 36. Lubricate as per Pratt and Whitney Maintenance Manual.
- ☐ 37. Install engine cowling.

RIGHT PROPELLER, ROUTINE (See Chapter 61, Maintenance Manual)

- ☐ 1. Remove and inspect spinner and back plate for security and corrosion.
- ☐ 2. Inspect blades for nicks, cracks and corrosion.
- ☐ 3. Check for excessive grease and oil leaks.
- ☐ 4. Check condition of propeller deicer boots.

RIGHT ENGINE, ROUTINE (See Chapter 71, Maintenance Manual)

- ☐ 1. Remove engine cowl.
- ☐ 2. Remove, drain and clean fuel filter bowl and element (drain at least every ninety (90) days).
- ☐ 3. Check for proper oil level and filler locking cap for security.
- ☐ 4. Inspect oil temperature sender unit for leaks and security (located on engine accessory case).
- ☐ 5. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks.
- ☐ 6. Inspect and clean oil radiator cooling fins.
- ☐ 7. Remove air inlet screen, inspect first stage compressor blades for ingestion damage and corrosion. Inspect screen for damage and cleanliness. Reinstall screen.

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

EVENT #3 (cont.)

- ☐ 8. Inspect condition of inlet air ice protection mechanism.
- ☐ 9. Inspect power lever, start control, propeller governor and propeller reversing linkage for travel and operation.
- ☐ 10. Inspect gas generator case for cracks, distortion and evidence of overheating.
- ☐ 11. Inspect condition of flexible lines.
- ☐ 12. Inspect fuel system for leaks.
- ☐ 13. Inspect power lever, condition lever and propeller governor for travel and operating conditions.
- ☐ 14. Inspect breather tube for obstructions and security.
- ☐ 15. Inspect propeller shaft for oil leaks.
- ☐ 16. Inspect all engine fire seals.
- ☐ 17. Inspect engine rubber mount bushings for deterioration.
- ☐ 18. Inspect fire extinguisher pressure (if installed).
- ☐ 19. Inspect condition of starter-generator. (Refer to Special Inspection, 300 hours.)
- ☐ 20. Inspect condition of air conditioning compressor drive belts.
- ☐ 21. Install engine cowl.

RIGHT WING, DETAILED (See Chapter 57, Maintenance Manual)

- ☐ 1. Remove inspection plates and panels.
- ☐ 2. Inspect surfaces, skins and tips for damage, loose rivets and corrosion.
- ☐ 3. Inspect trim tab hinges and attachments for wear, security and corrosion.
- ☐ 4. Inspect aileron cables, pulleys and bellcrank for damage, full travel and proper cable tension.
- ☐ 5. Inspect all rod end bearings for freedom of ball movement. Use a 10X magnifying glass to check thread end of bearing for cracks and damage. Replace bearing if ball is frozen or hard to move.
- ☐ 6 Inspect aileron balance weight and arm for security and condition (located outboard of aileron).
- ☐ 7. Inspect flaps, actuators, limit switches, and wiring for condition, operation and full travel.
- ☐ 8. Inspect flap time delay switch operation.
- ☐ 9. Inspect condition flap track bolts and aileron hinge bolts for wear and security.
- ☐ 10. Remove aileron and inspect area beneath inboard hinge on aileron spar for cracks. (Refer to latest revision of Piper Service Bulletin No. 974.)
- ☐ 11. Inspect all control surface exterior bearings for wear, freedom of movement and corrosion.
- ☐ 12. Inspect wing attachment bolts for stripe alignment and brackets for cracks and corrosion.
- ☐ 13. Inspect engine mount attachments for security.
- ☐ 14. Inspect fuel cells and lines for leaks and water.
- ☐ 15. Check fuel tanks for marked capacity, fuel caps for proper seal and quick drains for proper operation.
- ☐ 16. Check fuel tanks marked for correct operating fuel.
- ☐ 17. Inspect fuel vents for blockage and damage.
- ☐ 18. Inspect tip tank for damage, attachment and leaks.
- ☐ 19. Remove and inspect forward and aft tip tank cone for presence of water and face of tip tank surface for presence of corrosion.
- ☐ 20. Inspect condition of pneumatic deicer boots for damage and operation (if applicable).
- ☐ 21. Inspect wing tip navigation and strobe lights for broken lenses and operation; replace bulb or flash tube as required.
- ☐ 22. Inspect wing locker for condition and for security and operation of hinges and latches.
- ☐ 23. Lubricate.
- ☐ 24. Install inspection plates and panels.

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

EVENT 3 (cont.)

LANDING GEAR, DETAILED (See chapter 32, Maintenance Manual) (Refer to Piper Service Bulletins 822 and 841.)

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.
- ❑ 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. Clean and inspect up and down lock actuator rod assemblies and rod end bearing assemblies for damage, binding, corrosion (remove boot), freedom of movement, operation and lubrication.
- ❑ 16. Inspect gear doors and attachments for security.
- ❑ 17. Check warning horn and light for operation.
- ❑ 18. Retract gear - inspect operation.
- ❑ 19. Retract gear - inspect doors for clearance and operation.
- ❑ 20. Inspect anti-retraction system operation.
- ❑ 21. Inspect actuating cylinder for leaks and security.
- ❑ 22. Inspect position indicating switches and electrical wires for condition and security.

LEFT GEAR

- ❑ 1. Check oleo struts for proper extension. (Check for proper fluid level as required.)
- ❑ 2. Inspect wheel for alignment.
- ❑ 3. Inspect tire for cuts, uneven or excessive wear and slippage.
- ❑ 4. Remove wheel, clean, inspect and repack bearings.
- ❑ 5. Inspect wheel for cracks, corrosion and broken bolts.
- ❑ 6. Check tire pressure.
- ❑ 7. Inspect brake lining and disc for wear.
- ❑ 8. Inspect condition and security of brake backing plates.
- ❑ 9. Inspect brake and hydraulic lines for condition, mounting, security and leaks.
- ❑ 10. Inspect gear fork for damage.
- ❑ 11. Inspect oleo struts for fluid leaks and scoring.
- ❑ 12. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security.

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

EVENT #3 (cont.)

- ☐ 13. Inspect downlock for operation and adjustment.
- ☐ 14. Inspect main gear lock rod assemblies for corrosion, freedom of movement and spring tension.
- ☐ 15. Clean and inspect up and down lock actuator rod assemblies and rod bearing assemblies for damage, binding, corrosion (remove boot), freedom of movement, operation and lubrication.
- ☐ 16. Check warning horn and light for operation.
- ☐ 17. Retract gear- check operation.
- ☐ 18. Retract gear - inspect doors for clearance and operation.
- ☐ 19. Inspect anti-retraction system operation.
- ☐ 20. Inspect actuating cylinder for leaks and security.
- ☐ 21. Inspect position indicating switches and electrical wires for condition and security.

NOSE GEAR

- ☐ 1. Check oleo strut for proper extension. (Check for proper fluid level as required.)
- ☐ 2. Inspect nose gear steering control and travel.
- ☐ 3. Inspect wheel for alignment.
- ☐ 4. Inspect tire for cuts, uneven or excessive wear and slippage.
- ☐ 5. Remove wheel, clean, inspect and repack bearings.
- ☐ 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. Clean and inspect up and down lock actuator rod assemblies and rod bearing assemblies for damage, binding, corrosion (remove boot), freedom of movement, operation and lubrication.
- ☐ 14. Inspect nose gear lock rod assembly for corrosion, freedom of movement and spring tension.
- ☐ 15. Inspect gear doors and attachments.
- ☐ 16. Check gear warning horn and light for operation.
- ☐ 17. Retract gear- inspect operation.
- ☐ 18. Retract gear - inspect doors for clearance and operation.
- ☐ 19. Inspect actuating cylinder for leaks and security.
- ☐ 20. Inspect position of indicating switches and electrical lead for security.
- ☐ 21. Remove airplane from jacks.

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

- ☐ 1. Remove all inspection plates and panels.
- ☐ 2. Inspect condition of skin, interior bulkheads, formers, stringers for damage and condition.

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

EVENT #3 (cont.)

- ☐ 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, elevator control tube, horns and attachments for damage and operation.

—NOTE—

Each time the elevator control tube is removed/reinstalled, visually inspect it for cracks, sharp dents or nicks handle with care. See the latest revision of Piper Service Bulletin No. 715 and 715A.

- ☐ 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 all rod end bearings for freedom of ball movement. Use a 10X magnifying glass to check thread end of bearing for cracks and damage. Replace bearing if ball is frozen or hard to move.
- ☐ 19. Inspect anti-collision light for security and operation.
- ☐ 20. Inspect condition of pneumatic deicer, if installed.
- ☐ 21. Inspect antenna mounting for security.
- ☐ 22. Inspect security of autopilot servo bridle cable clamps.
- ☐ 23. Inspect electronic installations for security of mounting and operation.
- ☐ 24. Inspect emergency locator transmitter battery for replacement date or time.
- ☐ 25. Install inspection plates and panels.

CABIN MAIN, DETAILED

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

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

EVENT #3 (cont.)

LUBRICATION

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

WINGS

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

MAIN LANDING GEAR

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

NOSE GEAR

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

FUSELAGE

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

COCKPIT

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

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

WINGS

- ❑ ❑ 1. Flap tracks.

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

MAIN LANDING GEAR

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

NOSE GEAR

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

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

EVENT #4

POWER PLANT

RIGHT PROPELLER, DETAILED (See Chapter 61, Maintenance Manual)

- ☐ 1. Remove and inspect spinner and back plate for cracks and corrosion.
- ☐ 2. Inspect blades for nicks, cracks and corrosion.
- ☐ 3. Check for grease and oil leaks.
- ☐ 4. Inspect spinner mounting brackets for cracks, security and corrosion.
- ☐ 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 check for tightness.
- ☐ 8. Inspect Beta feedback ring for runout (.010 max.); inspect condition of carbon block assembly.
- ☐ 9. Inspect low pitch stop rods and Beta feedback ring for freedom of movement.
- ☐ 10. Inspect condition and operation of propeller deicer system.
- ☐ 11. Lubricate.
- ☐ 12. Inspect condition and operation synchrophaser (if installed).
- ☐ 13. Install spinner.

RIGHT ENGINE, DETAILED (See Chapter 71, Maintenance Manual)

- ☐ 1. Remove engine cowl.
- ☐ 2. Clean and inspect cowling for cracks, distortion and loose or missing fasteners.
- ☐ 3. Inspect oil temperature sender unit for leaks and security (located on engine accessory case).
- ☐ 4. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks.
- ☐ 5. Clean and inspect oil radiator cooling fins.
- ☐ 6. Clean exterior of engine (Pratt and Whitney Maintenance Manual).
- ☐ 7. Inspect condition of ignition plugs per Pratt and Whitney Maintenance Manual.
- ☐ 8. Inspect ignition harness and insulators for high tension leakage and continuity.
- ☐ 9. Inspect electrical connections on ignition exciter for security.
- ☐ 10. Remove air inlet screen, inspect first stage compressor blades for ingestion damage and corrosion. Inspect screen for damage and cleanliness. Reinstall screen.
- ☐ 11. Inspect fuel pump inlet screen and outlet filter for foreign material (clean or replace as necessary) (Pratt and Whitney Maintenance Manual) (refer to Special Inspection, 500 hour).
- ☐ 12. Inspect gas generator case drain valves for security and leaks (to be checked during engine run) (Pratt and Whitney Maintenance Manual).
- ☐ 13. Inspect condition and operation of inlet air ducts and ice protection system.
- ☐ 14. Inspect condition of actuators for ice protection system and oil cooler door (refer to Special Inspection, 500 hour).
- ☐ 15. Inspect power lever, start control, propeller governor and propeller reversing linkage for travel and operation.
- ☐ 16. Inspect gas generator case for cracks, distortion and evidence of overheating (Pratt and Whitney Maintenance Manual).

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

EVENT #4 (cont.)

- ☐ 17. Inspect exit exhaust ducts and stacks for cracks and distortion (Pratt and Whitney Maintenance Manual).
- ☐ 18. Cheek propeller shaft for oil leaks.
- ☐ 19. Inspect flexible fuel lines for leaks, abrasion and security (Pratt and Whitney Maintenance Manual).
- ☐ 20. Inspect fuel system for leaks.
- ☐ 21. Replace hydraulic filter element (check element for contamination).
- ☐ 22. Inspect hydraulic pump and gaskets for leaks.
- ☐ 23. Inspect all engine fire seals for cracks and security.
- ☐ 24. Inspect torque pressure transmitter for security and wiring (Pratt and Whitney Maintenance Manual).
- ☐ 25. Inspect breather tube for obstruction and security (Pratt and Whitney Maintenance Manual).
- ☐ 26. Cheek for proper oil level and filler locking cap for security.
- ☐ 27. Inspect engine mounts for cracks and loose mount bolts.
- ☐ 28. Inspect magnetic chip detector (as per Pratt and Whitney Maintenance Manual).
- ☐ 29. Check rubber engine mount bushings for deterioration.
- ☐ 30. Inspect firewall for cracks and stress.
- ☐ 31. Inspect firewall seals.
- ☐ 32. Inspect fire extinguisher bottle pressure.
- ☐ 33. Inspect condition of starter-generator (refer to Special Inspection, 300 hour).
- ☐ 34. Inspect tachometer generators security and wiring.
- ☐ 35. Lubricate as per Pratt and Whitney Maintenance Manual.
- ☐ 36. Install engine cowl.

LEFT PROPELLER, ROUTINE (See Chapter 61, Maintenance Manual)

- ☐ 1. Remove and inspect spinner and back plate for security and corrosion.
- ☐ 2. Inspect blades for nicks, cracks and corrosion.
- ☐ 3. Check for excessive grease and oil leaks.
- ☐ 4. Cheek condition of propeller deicer boots.

LEFT ENGINE, ROUTINE (See Chapter 71, Maintenance Manual)

- ☐ 1. Remove engine cowl.
- ☐ 2. Remove, drain and clean fuel filter bowl and element (drain and clean at least every ninety (90) days).
- ☐ 3. Check for proper oil level and filler locking cap for security.
- ☐ 4. Inspect oil temperature sender unit for leaks and security (located on engine accessory case) (Pratt and Whitney Maintenance Manual).
- ☐ 5. Inspect oil lines and fittings for leaks, security, chafing, dents and cracks.
- ☐ 6. Inspect and clean oil radiator cooling fins.
- ☐ 7. Remove air inlet screen, inspect first stage compressor blades for ingestion damage and corrosion. Inspect screen for damage and cleanliness. Reinstall screen.

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

EVENT 4 (cont.)

- ❑ 8. Inspect condition of inlet air ice protection mechanism.
- ❑ 9. Inspect power lever, start control, propeller governor and propeller reversing linkage for travel and operation.
- ❑ 10. Inspect gas generator case for cracks, distortion and evidence of overheating.
- ❑ 11. Inspect condition of flexible lines.
- ❑ 12. Inspect fuel system for leaks.
- ❑ 13. Inspect power lever, condition lever and propeller governor for travel and operating conditions.
- ❑ 14. Inspect breather tube for obstructions and security.
- ❑ 15. Inspect propeller shaft for oil leaks.
- ❑ 16. Inspect all engine fire seals.
- ❑ 17. Inspect engine rubber mount bushings for deterioration.
- ❑ 18. Inspect fire extinguisher pressure (if installed).
- ❑ 19. Inspect condition of starter-generator (refer to Special Inspection, 300 hour).
- ❑ 20. Install engine cowl.

LEFT WING, ROUTINE (See chapter 57, Maintenance Manual)

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

LANDING GEAR, ROUTINE (See chapter 32, Maintenance Manual) (Refer to Piper Service Bulletins 822 and 841.)

LEFT MAIN

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

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

EVENT #4 (cont.)

RIGHT MAIN

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

NOSE

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

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

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

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

EVENT #4 (cont.)

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

- ❑ 1. Remove inspection plates, panels and floor panels.
- ❑ 2. Inspect external skin for condition, damage and corrosion.
- ❑ 3. Inspect windshield and all windows for cracks and condition.
- ❑ 4. Inspect emergency exit latching mechanism.
- ❑ 5. Inspect windshield wiper for security of mounting, condition and operation (do not operate on dry windshield).
- ❑ 6. Inspect fuel lines and crossfeed valve for damage and operation.
- ❑ 7. Inspect all fuel and hydraulic lines for security.
- ❑ 8. Inspect all flight control cables and pulleys for damage and tension.
- ❑ 9. Inspect all electrical wiring for security.
- ❑ 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 cabin door for damage, condition of door seal and proper rig and operation.
- ❑ 13. Replace inspection plates, panels and floor panels.

COCKPIT, ROUTINE

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

LUBRICATION

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

WINGS

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

MAIN LANDING GEAR

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

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

EVENT #4 (cont.)

NOSE GEAR

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

EMPENNAGE

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

FUSELAGE

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

COCKPIT

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

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

WINGS

- ❑ ❑ 1. Flap tracks.

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

MAIN LANDING GEAR

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

NOSE GEAR

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

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

- ❑ ❑ Main wheel bearings.
- ❑ ❑ Nose wheel bearings

Remove the aircraft from jacks.

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

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

SPECIAL INSPECTIONS

NOTE - Special inspections are to be performed at each specified interval, for example; at 100 hrs. perform special 100 hr. insp., at 200 hrs. perform special 100 hr. insp. and special 200 hr. insp., etc.

50 HOUR

☐ 1. Inspect main landing gear forward side brace per Piper Service Bulletin 841.

100 HOUR

LEAD-ACID BATTERY

☐ 1. Service lead-acid battery system per the service instructions given in Chapter 24 or the Maintenance Manual.

NICAD BATTERY (OPTIONAL)

☐ 1. Initially a 100 hour deep cycle interval is recommended. After the second 100 hour deep cycle, the intervals will be determined as service experience dictates. A battery log (form) is supplied for making and maintaining the appropriate entries. In the event of a battery overtemperature indication by the annunciator panel light and verified by an ammeter rise, a special inspection should be performed in accordance with T-1040 Maintenance Manual, Chapter 24.

EMERGENCY EXIT WINDOW

☐ 1. Inspect operation of emergency exit window per Chapter 52 of Maintenance Manual.

HEATER INSPECTION

☐ 1. Conduct 100 hour inspection of affected heaters per AD 82-047-03 and in accordance with Janitrol's Maintenance and Overhaul Manual, P/N 24E25-1, dated October 1981.

WING FLAP TRANSMISSION (CALCO).

☐ 1. Inspect wing flap transmission per Chapter 27 of the Maintenance Manual.

200 HOUR

BATTERY THERMOSTAT (NICAD BATTERY ONLY)

☐ 1. Inspect thermostat operation per Piper Maintenance Manual, Chapter 24.

300 HOUR

STARTER-GENERATOR

☐ 1. Inspect brushes per Piper Maintenance Manual, Chapter 24 replace as required.

☐ 2. Remove the starter generator and check spline wear and lubricate in accordance with Lubrication Chart in Maintenance Manual. Thoroughly clean carbon dust from armature using shop air.

NICKEL-CADMIUM BATTERY SERVICE RECORD

BATTERY TYPE: SAFT 40776

SERIAL NO: ______

INSTALLATION DATE: ______

AIRCRAFT: T-1040

RATED CAPACITY (C): 36 Ah

MINIMUM ALLOWABLE CELL CAPACITY (0.85 X C.): 30.6 Ah

***ALLOWABLE WATER CONSUMPTION:** 25 Cm³

CHARGE RATES:

C/2 18 **AMPS**

C/10 3.6 **AMPS**

SERVICE IN ACCORDANCE WITH AIR FRAME SERVICE MANUAL

Removal Dates	Reason for Removal	Hours Since Serviced	Condition From Aircraft			Charge and Water Consumption Data						Cell to Case Insul	Remarks
						Cell End of Charge Voltage			Distilled Water Added to Cells, Aver.				
			Visual	Minimum Cell Capacity (C_A)	Battery Capacity (C_B)	Aver.	Max./Cell No	Min./Cell No	Aver.	Max./Cell No	Min./Cell No		

Note
Number cells by starting with the cell connected to the negative battery terminal and proceeding sequentially as the cells are connected in series to the positive battery terminal

*If the quantity of water added during maintenance is greater than that indicated it is recommended that a check be made of charge voltage with rel. to temp. & if necessary shorten interval between maintenance

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

SPECIAL INSPECTIONS (cont.)

300 HOUR (CONT.)

OXYGEN SYSTEM COMPONENTS

- ☐ 1. Inspect pressure regulator for condition and operation.
- ☐ 2. Inspect pressure gauge for condition and operation.
- ☐ 3. Inspect pressure lines (high and low) for condition.
- ☐ 4. Inspect cabin outlets for condition and operation.
- ☐ 5. Inspect external recharge valve for condition and operation.

—NOTE—

Overhaul or replace the following items every five years.

1. Regulator
2. Pressure gauge
3. Outlets (cabin)
4. External recharge valve

AIR CONDITIONER

- ☐ 1. Inspect air conditioning components and quill shaft splint wear and lubricate per Lubrication Chart.

FUEL FLOW NOZZLES

- ☐ 1. Inspect per Pratt and Whitney Maintenance Manual.

500 HOUR

HEATER INSPECTION

- ☐ 1. Operational check or replace heater fuel pump.
- ☐ 2. Replace heater fuel filter (500 hrs. heater operation).
- ☐ 3. Operational check and/or replace heater fuel solenoid valve as required.

RIGHT AND LEFT ENGINES

- ☐ 1. Inspect gas generator case for cracks, distortion and evidence of overheating.
- ☐ 2. Inspect inlet ice protection and oil cooler door linkage and transmission assemblies (refer to Lubrication Chart). Assure proper rigging, Chapter 30, T-1040 Maintenance Manual.
- ☐ 3. Inspect engine mounts for cracks and loose mounting bolts.
- ☐ 4. Inspect rubber engine mount bushings for deterioration.

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

SPECIAL INSPECTIONS (cont.)

500 HOUR (cont.)

LANDING GEAR - ALL

- ❑ 1. Inspect torque link assemblies, bolts and bushings for wear (repair as required).
- ❑ 2. Inspect drag and side brace link assemblies and bolts for wear (repair as required).

RIGHT AND LEFT WING

- ❑ 1. Inspect all exterior bearings, clean and lubricate; replace as required.
- ❑ 2. Inspect operation of inboard fuel cell baffles.

ENGINE FUEL PUMP

- ❑ 1. Install new fuel pump outlet filter (10 micron) (refer to Pratt and Whitney Maintenance Manual).

FUEL SYSTEM

- ❑ 1. Inspect fuel quantity indication system for proper calibration.

800 HOUR

OIL DRAIN PERIOD

- ❑ 1. For engines operated in high utilization commuter airline type operation, a basic oil drain period of 800 hours for 7-1/2 centistoke or 1200 hours for a 5 centistoke oil, or 9 months whichever occurs first. Extensions beyond the basic drain period may be contemplated provided that the condition of the oil is monitored and a written request is submitted to the Pratt and Whitney Service Department.
- ❑ 2. See latest Pratt and Whitney Service Bulletin No. 1001 for proper oil, lubricating (synthetic) approved listing.

1000 HOUR

HEATER

- ❑ 1. At the end of 1,000 hours of heater operation, overhaul the heater in accordance with Janitrol Maintenance and Overhaul Manual P/N 24E24-1, dated October, 1981 and AD 82-07-03.

RIGHT AND LEFT ENGINE

- ❑ 1. Operational check or replace hydraulic pumps.
- ❑ 2. Bench check or replace starter-generators.
- ❑ 3. Operational check or replace tachometer generators.
- ❑ 4. Comply with Pratt and Whitney Service Bulletin No. 1002. regarding rotor components service life.
- ❑ 5. Replace oil filter element.
- ❑ 6. Replace disposable type oil filter element; do not try to clean (refer to Piper Maintenance Manual, Chapter 79 for further information).

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

SPECIAL INSPECTIONS (cont.)

1000 HOUR (cont.)

RIGHT AND LEFT WINGS

1. Inspect condition of bolts used with flap and aileron hinges; replace as required.
2. Operational check or replace electric fuel pumps as required. (Refer to Piper Maintenance Manual, Chapter 28.)
3. Inspect and/or replace fuel shutoff valves as required.
4. Replace inboard aileron hinge. Refer to latest revision of Piper Service Bulletin No. 974.

LANDING GEAR-ALL

1. Remove each Emergency Gear Extension gas storage bottle and perform weight check. Weight is stamped on side of bottles. (Refer to Chapter 32 of Maintenance Manual.)
2. Check emergency gear extension blow down system for operation and leaks (refer to Chapter 32 of Maintenance Manual).

UPPER ENGINE MOUNT

1. Inspect every event and replace on condition (P/N 761 612 and 761 613).

1250 HOUR

HOT SECTION INSPECTION - ENGINE

1. See Pratt and Whitney Maintenance Manual for proper inspection procedure.
2. All PT6-A engines may be operated to scheduled hot section intervals or alternatively; the Hot Section Inspection may be used on engine condition trend monitoring in accordance with Pratt and Whitney Part Number FO 740001, latest revision. If trend monitoring is introduced part way through engine life, a compressor wash and hot section inspection must be accomplished to establish performance base line.

1500 HOUR

PROPELLERS

— NOTE —

Refer to latest Hartzell Service Letter No. 61.

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

SPECIAL INSPECTIONS (cont.)

2000 HOUR

RIGHT AND LEFT WINGS

- ☐ 1. Inspect fuel cells every two years or 2000 hrs., whichever comes first.
- ☐ 2. Replace elevator down spring.

EMPENNAGE TAIL

- ☐ 1. Replace elevator down spring P/N 51484.

3000 HOUR

—NOTE—

Refer to latest Hartzell Service Letter No. 61.

PROPELLERS

- ☐ 1. Bench check or replace as required.

3500 HOUR

ENGINES

- ☐ 1. Refer to latest Pratt and Whitney Service Bulletin No. 1003 for recommended time between engine overhauls.
- ☐ 2. Replace flexible fuel, oil and hydraulic lines.

5000 HOUR

FUSELAGE, FORWARD

- ☐ 1. Inspect and/or replace deice system timer contactor as recommended by International Avionics Incorporated.

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

SPECIAL INSPECTIONS AS REQUIRED, UPON CONDITION

AIR CONDITIONING COMPRESSOR OIL CHECK

❑ 1. The compressor oil level should not be checked unless a freon leak has occurred which requires an addition of freon to the system.

HARD OR OVERWEIGHT LANDING. This inspection should be performed after a known rough landing is made or when a landing is made while the aircraft is know to exceed the design landing weight. Check the following areas and items (refer to Piper Service Bulletin 841):

❑ 1. Wings - for wrinkled skins, loose or missing rivets.

❑ 2. Fuel leaks around the nacelle fuel tanks and fuel fittings throughout the wings.

❑ 3. Wing spar webs, bulkheads, nacelle skins and attachments, firewall skin and wing and fuselage stringers for any signs of overstress or damage.

❑ 4. A possible alignment check to clarify any doubt of damage.

MAIN LANDING GEAR EXTENSION IN EXCESS OF VLO (MAX. LANDING GEAR OPERATING SPEED). Refer to Piper Service Bulletin 841.

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

❑ 1. Top and bottom fuselage skins for loose or missing rivets and wrinkled skins.

❑ 2. Empennage skins and attachments.

ENGINE OVERTEMPERATURE AND OVERTORQUE LIMITS

❑ 1. Refer to Pratt and Whitney Maintenance Manual.

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

❑ 1. Refer to Pratt and Whitney Maintenance Manual.

COMPONENT OVERLIMITS INSPECTION

❑ 1. Check with the appropriate manufacturer for the necessary corrective action.

OXYGEN CYLINDER

Lightweight - must be hydrostatically tested every 3 years and replaced every 12 years or 4,380 refills (ICC Regulations).

Standard Weight - must be hydrostatically tested every 5 years (ICC Regulations).

ENGINE COMPRESSOR WASH

❑ 1. Consult P&W Agtoil #7 for frequency and instructions. Observe starter limitations.

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

OPERATIONAL INSPECTION

PRE-RUN UP

1.	Cabin door and cargo door	Secure
2.	Parking brake	Set
3.	Crossfeed	Off
4.	Fuel valves	On
5.	Power levers	Idle
6.	Prop controls	Full forward
7.	Condition levers	Stop
8.	Comfort control	Off
9.	Electrical switches	Off
10.	Circuit breakers	Checked
11.	Avionics master	Off
12.	Generator bus ties	On
13.	Battery master	On
14.	Aural warning	off
15.	Annunciator lights	Checked
16.	Fuel gauges	Checked
17.	Gear lights	3-green
18.	Lights - interior and exterior	Checked

ENGINE START

When APU is used, turn battery master switch off and monitor airplane voltmeter until reading stabilizes (27V min.; 30V max.); then turn the battery master switch on. Generator switches are to be off until engines are running and APU removed.

1.	Battery	Checked (24-28-volts)
2.	Fuel pump	On
3.	Fuel pressure	Checked
4.	Ignition	On
5.	Starter	On
6.	Turbine speed (Ng)	Stabilized (min. 12%)
7.	Condition lever	Run
8.	Ignition light	On
9.	ITT and Ng	Monitor (1090°C max. for maximum of 2 secs.)
10.	Starter	Off at stabilized idle
11.	Ignition	Off/Auto
12.	Generator	On (68%)
13.	Oil Pressure	Checked
14.	Gear handle	Down (hyd. pump check) note which engine
15.	Generator	Off (when ammeter reads 100 or less)
	Second engine	Repeat above steps
16.	Generators	On
17.	Move aircraft to run-up area	

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

OPERATIONAL INSPECTION (cont.)

RUN-UP AND OPERATIONAL CHECKS

1. Parking brake	Set
2. Ammeters and voltmeters	Checked
3. Prop sync.	Off
4. Crossfeed, fuel pump and annunciator panel check, No. 1 pumps ON both engines.	
a. Right-hand engine:	
(1) Pump	Off
(2) Fuel pressure drop	To red line
(3) Annunciator panel light ON	Right fuel pressure low
(4) Crossfeed ON	Annunciator panel light out, fuel pressure in the Green
(5) No. 2 pump ON, crossfeed OFF	Fuel pressure in Green
b. Left-hand engine:	
(1) Pump	Off
(2) Fuel pressure drop	To red line
(3) Annunciator panel light ON	Left fuel pressure low
(4) Crossfeed ON	Annunciator panel light out, fuel pressure in the Green
(5) No. 2 pump ON, crossfeed OFF	Fuel pressure in Green
5. Cabin comfort	Checked
6. Flight controls	Checked
7. Flaps	Checked
8. Pneumatic boots check:	
a. Pneumatic pressure	Indicator in Green
b. Deicer switch	ON - All boots cycle for six seconds; blue indicator light ON during inflation; system returns to OFF condition
9. Power levers	Set at 1625 RPM
10. Hydraulic topping governor (HTG) test:	
a. Propeller control	Full increase RPM
b. HTG test switches	Push up; observe drop of Np approx. 50 RPM

—NOTE—

Observe maximum ITT and Torque Limits.

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

OPERATIONAL INSPECTION (cont.)

11. Ice protection system check (ice vane, inlet heat and prop boots):
    a. Left power lever — 1800 RPM Np
    b. Left engine ice protection switch — ON
    c. ICE DEFLECTOR DOWN LIGHT — ON
    d. Observe torque drop
    e. While deice moving to position ice deflector down light goes out and no inop. light.
    f. Left engine ice protection switch — OFF
    g. Observe regain of original torque
    h. Repeat Steps (a) through (g) above for Right Engine
    i. Both engines idle

CAUTION

Engine Inlet Lip Deicers can be damaged if heated without the cooling effect of propeller slipstream. Do not press ground test button at lower than 1800 RPM Np. Perform system check only long enough to determine actual system operation. Prolonged operation could overheat the boots.

12. Secondary low pitch stop check:
    a. Power lever — Towards reverse until low pitch stop light (BETA) comes ON
    b. Secondary low pitch stop switch — Push down and hold while continuing to move power lever towards reverse. Prop should not go into reverse; light should blink
    c. Power lever towards reverse until mechanical resistance is felt

CAUTION

Do not force power lever to full reverse as this could damage the linkage.

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

OPERATIONAL INSPECTION (cont.)

d. Secondary low pitch switch

CAUTION

Do not release secondary low pitch stop switches with more than 60% Ng in reverse.

	Release when mechanical resistance is felt in power lever; prop should go towards reverse (increase in prop RPM)
e. Prop feathering	Check with power levers at idle
13. Autopilot and/or electric pitch trim - refer to Flight Manual Supplement for preflight and flight check, for intended function in all modes.	

ENGINE SHUTDOWN

1. Parking brake	Set
2. Avionics master switch	Off
3. Electrical equipment	Off
4. Battery - check charge condition:	
a. Battery master switch OFF; observe ammeters. Slight drop is normal. Battery OK; large drop would indicate battery is low.	
b. Battery master switch ON	
5. ITT	Below 610° one minute
6. Power levers	Idle
7. Props	Feather
8. Generators	off
9. One condition lever (first hyd. pump check)	Stop
10. Second hydraulic pump	Checked
11. Condition lever	Stop
12. Fuel pumps	Off (when Ng is zero)
13. Battery master switch	Off

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

OPERATIONAL INSPECTION (cont.)

EMERGENCY CHECK LIST ENGINE FIRE (GROUND)

Affected Engine:

1.	Condition lever	Stop
2.	Emergency fuel shutoff valve	Off
3.	Starter switch	On
4.	Fuel pump	Off
5.	Ignition switch	Off

NOTE

Do not attempt to restart if engine was shut down because of fire or suspicion of fire. Determine cause and correct condition.

THIS SPACE INTENTIONALLY LEFT BLANK

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

EVENT INSPECTION RECORD AND SIGN OFF SHEET

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

NOTES

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

EVENT #	INSP	A/C TIME	DATE	W.O. #	SIGNATURE - CERTIFICATE #
1	100				
2	200				
3	300				
4	400				
1	500				
2	600				
3	700				
4	800				
1	900				
2	1000				
3	1100				
4	1200				
1	1300				
2	1400				
3	1500				
4	1600				
1	1700				
2	1800				
3	1900				
4	2000				

EVENT #	INSP	A/C TIME	DATE	W.O. #	SIGNATURE - CERTIFICATE #
1	2100				
2	2200				
3	2300				
4	2400				
1	2500				
2	2600				
3	2700				
4	2800				
1	2900				
2	3000				
3	3100				
4	3200				
1	3300				
2	3400				
3	3500				
4	3600				
1	3700				
2	3800				
3	3900				
4	4000				
1	4100				
2	4200				
3	4300				
4	4400				
1	4500				
2	4600				
3	4700				
4	4800				
1	4900				
2	5000				
3	5100				
4	5200				
1	5300				
2	5400				
3	5500				
4	5600				
1	5700				
2	5800				
3	5900				
4	6000				

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

CONTINUOUS CYCLE INSPECTION RECORD AND SIGN OFF SHEET

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

CYCLE #	DATE	TACH	REMARKS	SIGNATURE - CERTIFICATE #
1 400 Hr.				
2 800 Hr.				
3 1200 Hr.				
4 1600 Hr.				
5 2000 Hr.				
6 2400 Hr.				
7 2800 Hr.				
8 3200 Hr.				
9 3600 Hr				
10 4000 Hr.				
11 4400 Hr.				
12 4800 Hr.				
13 5200 Hr.				
14 5600 Hr.				
15 6000 Hr.				

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

DISCREPANCY RECORD

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

DISCREPANCY RECORD

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

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

SERVICE PUBLICATION COMPLIANCE RECORD

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 & CERTIFICATE#

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

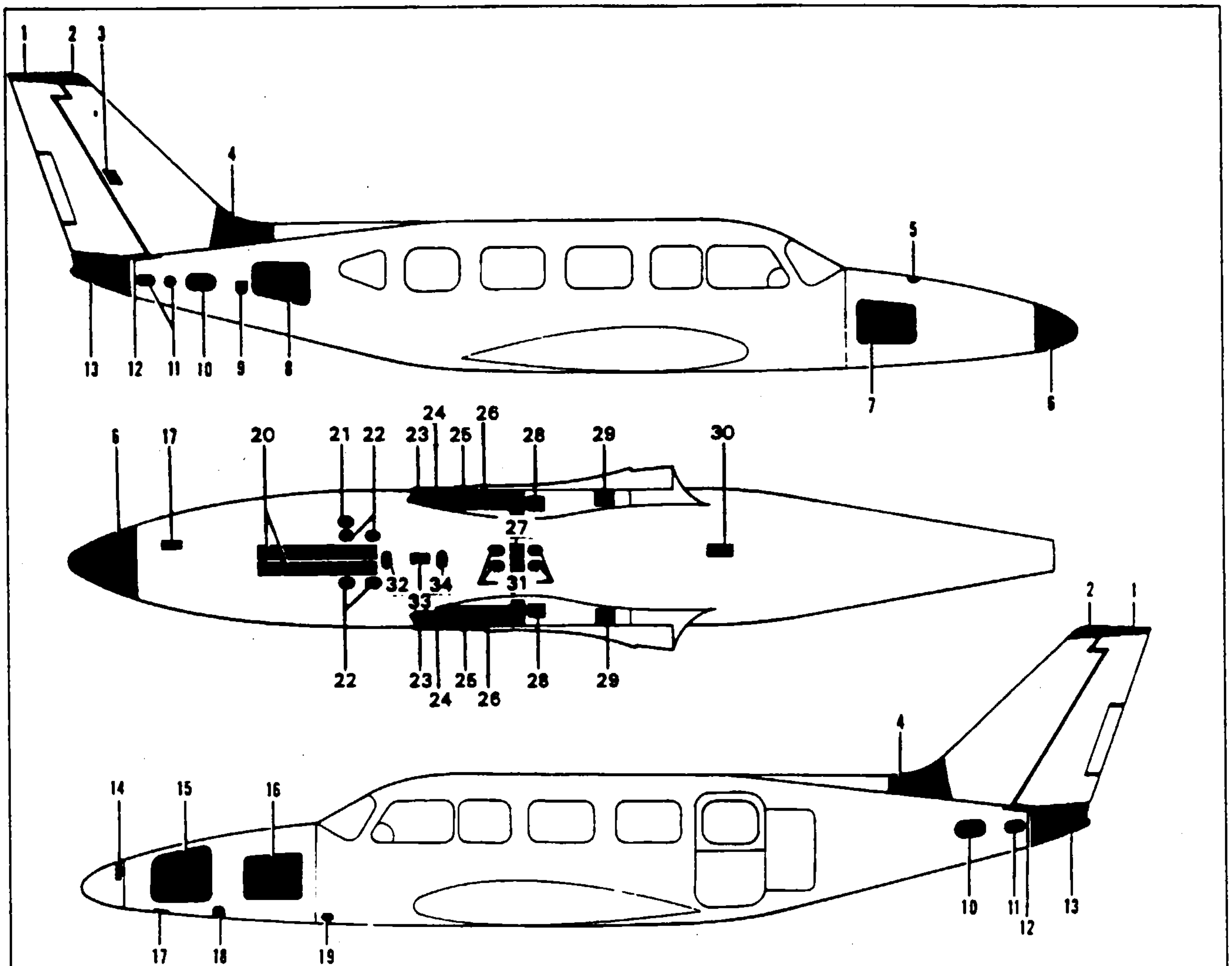
FAA AIRWORTHINESS DIRECTIVES COMPLIANCE RECORD

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

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



1. RUDDER TIP
2. VERTICAL STABILIZER TIP
3. RUDDER TRIM DRUM
4. VERTICAL FIN DEICER BOOT CONNECTION, ELT TRANSMITTER
5. HYDRAULIC RESERVOIR - BRAKE SYSTEM
6. BATTERY ACCESS, RADAR
7. HEATER - POWER PACK
8. DEICER AND INSTRUMENT STATIC AIR LINES - CONTROL CABLES
9. AFT OXYGEN RECHARGE VALVE (IF INSTALLED)
10. TRIM CABLES AND ELEVATOR BELLCRANK, ELECTRONIC GEAR
11. TRIM CABLES
12. RUDDER CONTROL HORN
13. ELEVATOR TORQUE TUBE
14. NOSE CONE LATCH RELEASE ACCESS
15. NOSE BAGGAGE DOOR
16. RADIOS - ELECTRICAL SHELF
17. AUXILIARY POWER RECEPTACLE
18. FWD OXYGEN RECHARGE VALVE (IF INSTALLED)
19. ELECTRICAL LEAD LINES
20. NOSE GEAR DOORS
21. PULLEY AND CABLE INSPECTION
22. HYDRAULIC LINES - ELECTRICAL LEADS
23. ELECTRICAL CONNECTORS - LINE CONNECTORS, FRONT SPAR ATTACHMENT
24. ELECTRICAL CONNECTORS - LINES
25. FUEL PUMP - FUEL FILTER - CROSSFEED VALVE - EMERGENCY SHUTOFF VALVE
26. FUEL FILTER BOWL
27. SPAR SPLICE - DEICER PRESSURE SWITCH
28. MAIN SPAR ATTACHMENT
29. REAR SPAR ATTACHMENT
30. CABIN EXHAUST
31. SPAR SPLICE
32. QUADRANT - CONTROL CABLES
33. CO_2 BLOWDOWN BOTTLES
34. CIRCUIT BREAKERS

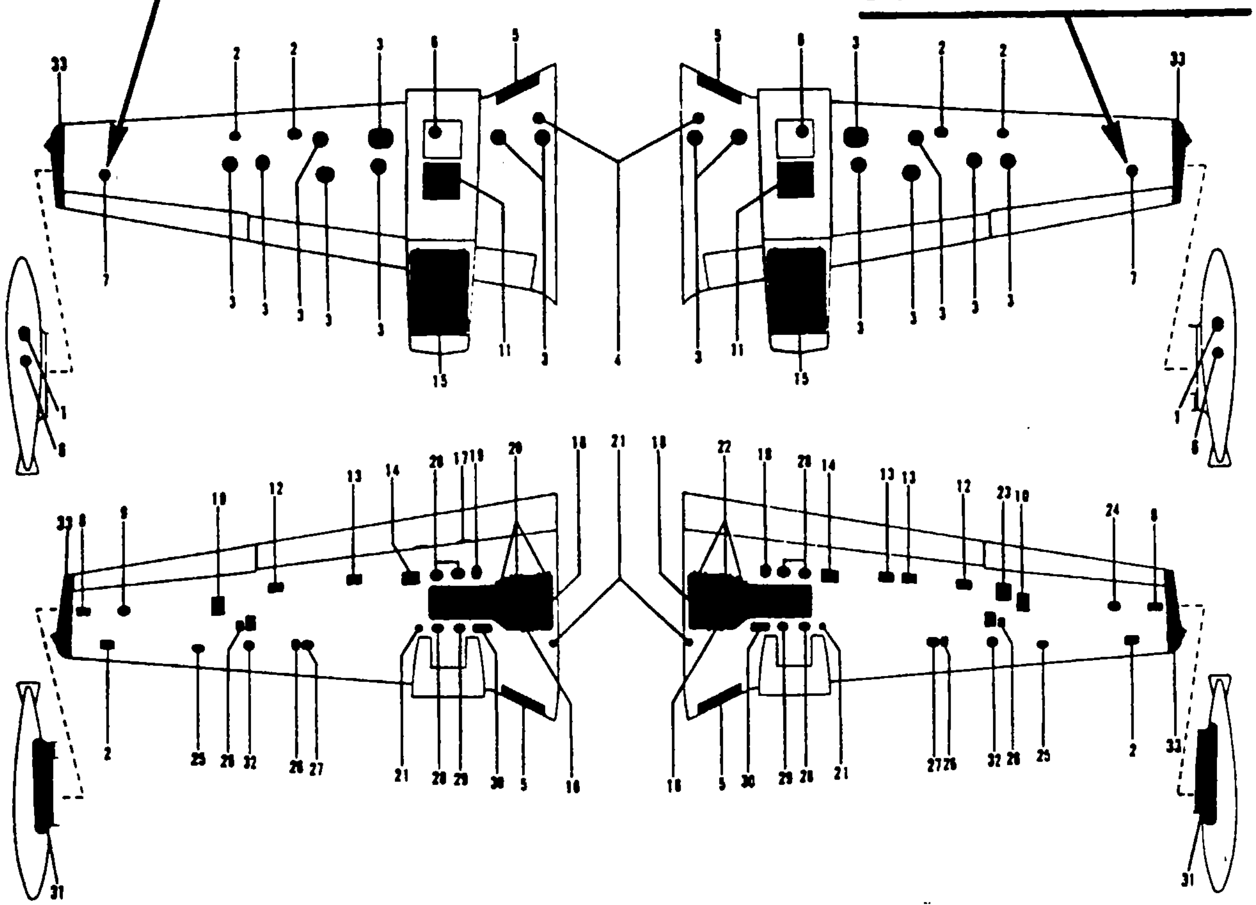
Figure 5-1. Access Plates and Panels, Fuselage and Empennage

NOTE

THIS ACCESS PANEL MUST BE INSTALLED WITH BRASS SCREWS ONLY.

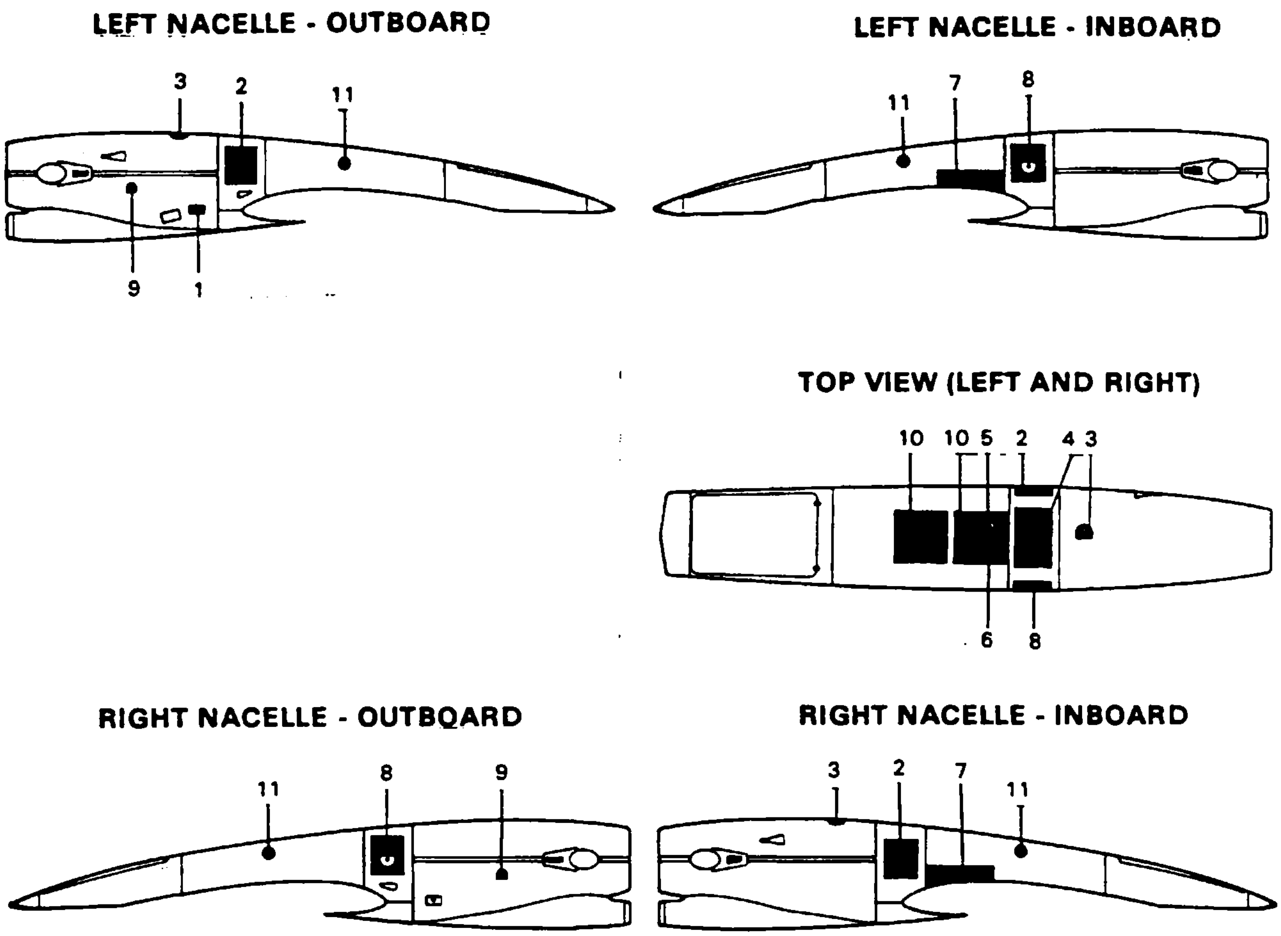
NOTE

IF FLUX DETECTOR IS INSTALLED, THIS ACCESS PANEL MUST BE INSTALLED WITH BRASS SCREWS ONLY.



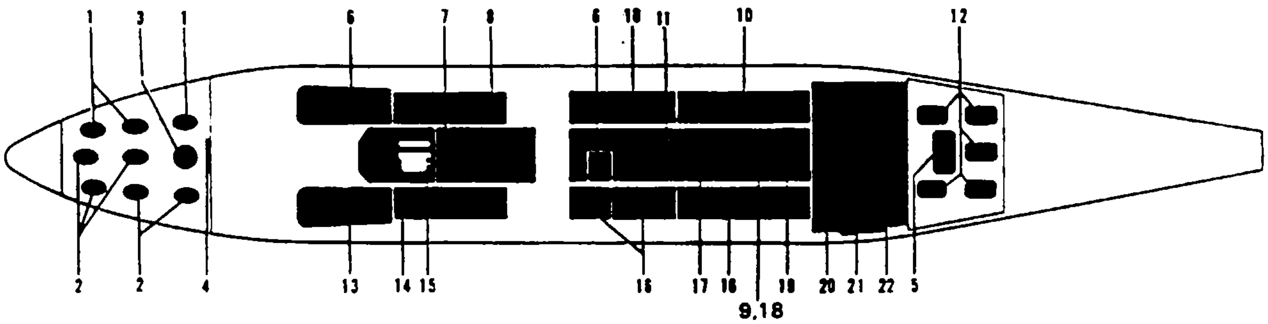
1. INSPECTION, VENT LINE - VENT FLOAT VALVE
2. INSPECTION ACCESS
3. FUEL CELL
4. FUEL SENDING UNIT
5. LINES - WIRES - CABLES
6. FUEL FILLER
7. FLUX DETECTOR (LT. WING ONLY)
8. TRANSFORMER, STROBE LIGHT
9. ELECTRONIC GEAR
10. AILERON BELLCRANK
11. DELETED
12. AILERON CABLE AND FUEL LINE
13. AILERON CONTROL CABLE
14. FLAP TRANSMISSION
15. DELETED
16. PNEUMATIC LINES
17. FLAP LIMIT SWITCHES
18. LANDING GEAR DOOR
19. CABLES AND WIRES
20. FLAP CABLE - AILERON CONTROL CABLE - ELECTRICAL LEADS
21. FUEL QUICK DRAIN
22. FLAP CABLE - AILERON CONTROL
23. AILERON TRIM DRUM
24. WING BAY ACCESS
25. INSPECTION - FUEL LINES
26. FUEL CELL VENT
27. FUEL CELL VENT LINE
28. LANDING GEAR ATTACHMENT BOLT
29. WIRES AND LINES
30. FUEL LINES
31. FUEL SENDER UNIT (WITH TIP TANKS ONLY)
32. FUEL LINES
33. WING TIP

Figure 5-2. Access Plates and Panels, Wings



1. FUEL FILTER
2. HEAT EXCHANGER AND PLUMBING
3. OIL FILLER QUANTITY DIPSTICK
4. OIL COOLER DOOR TRANSMISSION (RIGHT NACELLE ONLY: AIR CONDITIONING, CONDENSER AND FAN)
5. FUEL SENDER
6. FUEL FILLER CAP
7. JET PUMP
8. BLEED AIR AND PNEUMATIC LINES
9. WASH RING
10. NACELLE INSPECTION PANELS
11. FUEL CELL INSPECTION

Figure 5-2. Access Plates and Panels, Wings (cont.)



1. GENERATOR SUPPLY CABLE, RIGHT
2. GENERATOR SUPPLY CABLE, LEFT - BATTERY CABLE
3. ELECTRICAL LEADS
4. NOSE WHEEL STEERING
5. GROUND VENT FAN
6. HYDRAULIC LINES
7. TRIM CONTROL CABLES AND PULLEYS
8. TRIM CABLES AND PULLEYS - ENGINE CONTROL LINES, WIRES AND CABLES
9. ROLL SERVO, IF INSTALLED
10. TRIM CABLES AND PULLEYS
11. FLAP MOTOR - AILERON BALANCE CABLE
12. CONTROL AND TRIM CABLES
13. CONTROL CABLES, PULLEYS, AND TURNBUCKLES
14. CONTROL CABLES, PULLEYS, AND TURNBUCKLES - ENGINE CONTROL LINES, WIRES AND CABLES
15. HYDRAULIC HAND PUMP, PNEUMATIC BLOWDOWN
16. CONTROL CABLES AND PULLEYS
17. TRIM WARNING SYSTEM, IF INSTALLED
18. AUTOPILOT UNITS: ROLL, PITCH AND PITCH TRIM SERVOS, VOLTAGE DIVIDER AND GYRO AMPLIFIER - CONTROL CABLES - WING FLAP MOTOR
19. PITCH SERVO, IF INSTALLED
20. CABIN EXHAUST DOOR MECHANISM
21. CONTROL AND TRIM CABLES AND PULLEYS SEAT ATTACHMENTS
22. PITCH TRIM SENSOR, IF INSTALLED

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

UNSCHEDULED MAINTENANCE CHECKS.

These checks are required in addition to the normal or scheduled maintenance checks and whenever the aircraft is operated in adverse environmental conditions or subjected to unusual incidents such as:

1. Operation in high dust or industrial pollution.
2. Operation in high salt or humidity environment.
3. Operation from soft or unusual terrain.
4. Operation in extreme cold.
5. Aircraft lightning strike.
6. Engine overspeed, overtorque or sudden stoppage.
7. Severe turbulence, hard or overweight landing.

These checks are normally accomplished on a one time basis associated with each condition. Refer to the Piper Continuous Inspection Manual, Part Number 761 774 for detailed checks and record keeping forms. This manual is available through the Piper Airline Division.

—END—

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

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 data plates are located on the left rear side of the engines on the accessory case.

THIS SPACE INTENTIONALLY LEFT BLANK

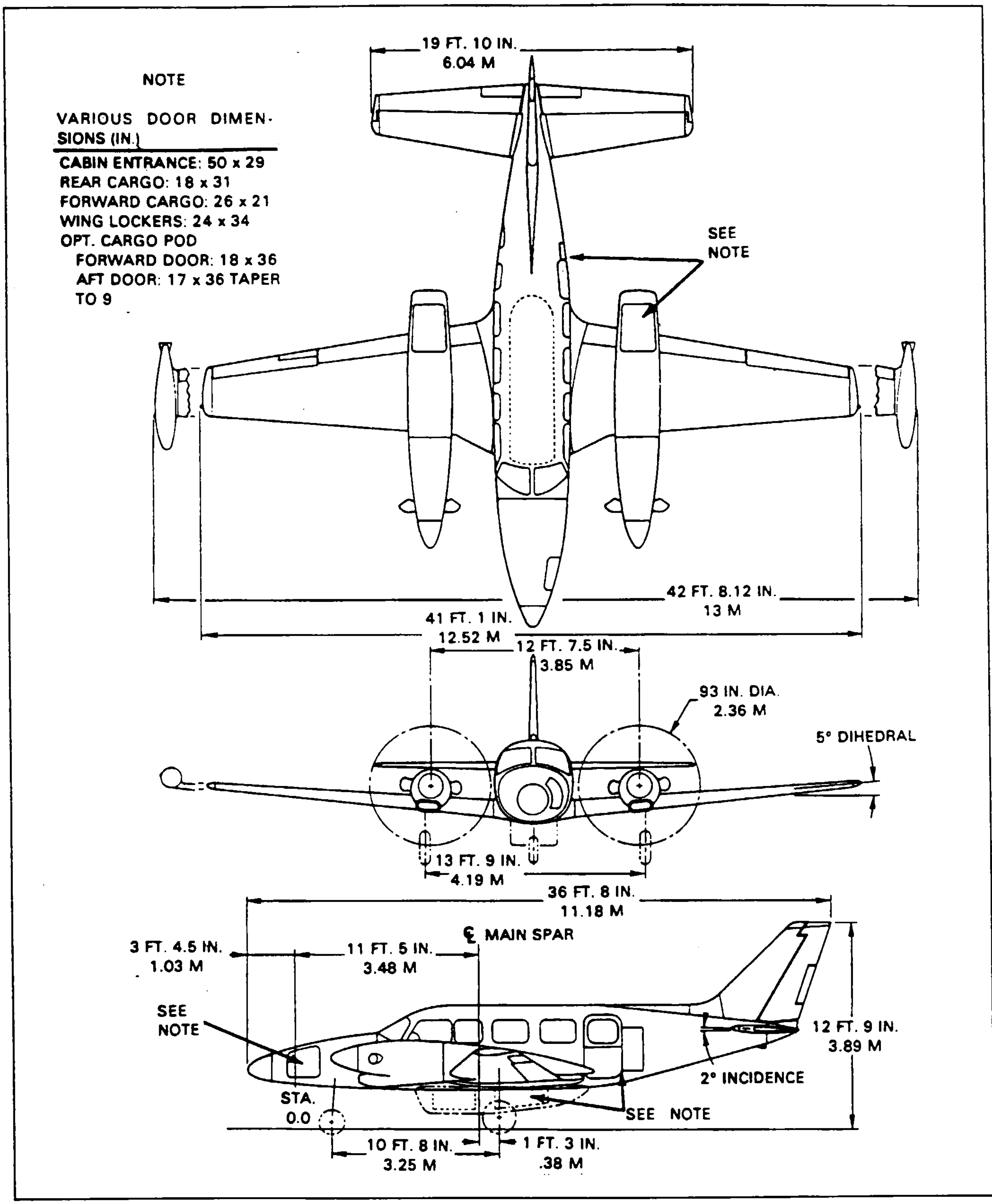


Figure 6-1. Dimensions

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	T- 1040
ENGINE	
Manufacturer	Pratt and Whitney Aircraft of Canada Limited
Model	PT6A-11
Engine Type	Free Turbine
Engine Horsepower at RPM (Propeller)	500 SHP @ 2200 RPM
Dry Weight	303 Lb. (137.5 kg)
Fuel Specification	Refer to P.&W.C. Service Bulletin No. 12044 (Latest Revision)
Oil Specification	Refer to P.&.W.C. Service Bulletin No. 12001 (Latest Revision)
Oil Tank Capacity	2.3 U.S. Gallons (8.74 Liters)
PROPELLER	
Manufacturer	Hartzell
Type	Constant Speed - Feathering and Reversing
Hub	HC-B3TN-3B
Blade	T10173K-8
Diameter	93 Inches
Overspeed Governor Model	Woodward P/N 8210-030
FUEL SYSTEM CAPACITY	
Total System Capacity	300 U.S. Gallons [1]; 366 U.S. Gallons [2]
Unusable Fuel	8 U.S. Gallons
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)	29.5 ft.
Wheel, Nose	B.F. Goodrich 3-1331, 6.00 x 6 Cleveland 40-140, 6.00 x 6 B.F. Goodrich 3-1076, 6.00 x 6

FOOTNOTES:
1 WITHOUT TIP TANKS
2 WITH TIP TANKS

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

LANDING GEAR (CONT.)

Wheel, Main	Cleveland 40-167 or 40-167A
Brake Type	Cleveland 30-142
Tire, Nose	18 x 4.4, 6 ply, Type VII, Tubeless [1]
	17.5 x 6.25 - 6, 10 ply, Tube Type [2 3]
Tire, Main	6.50 x 10, 10 ply, Tube or Tubeless Type
Tire Pressure, Nose	90 P.S.I. [1], 80 P.S.I [2 3]
Tire Pressure, Main	91 P.S.I.

FOOTNOTES:
1 B.F. GOODRICH 3-1331 WHEEL INSTALLATION
2 B.F. GOODRICH 3-1076 WHEEL INSTALLATION
3 CLEVELAND AND 40-140 WHEEL INSTALLATION

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 are 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.

THIS SPACE INTENTIONALLY LEFT BLANK

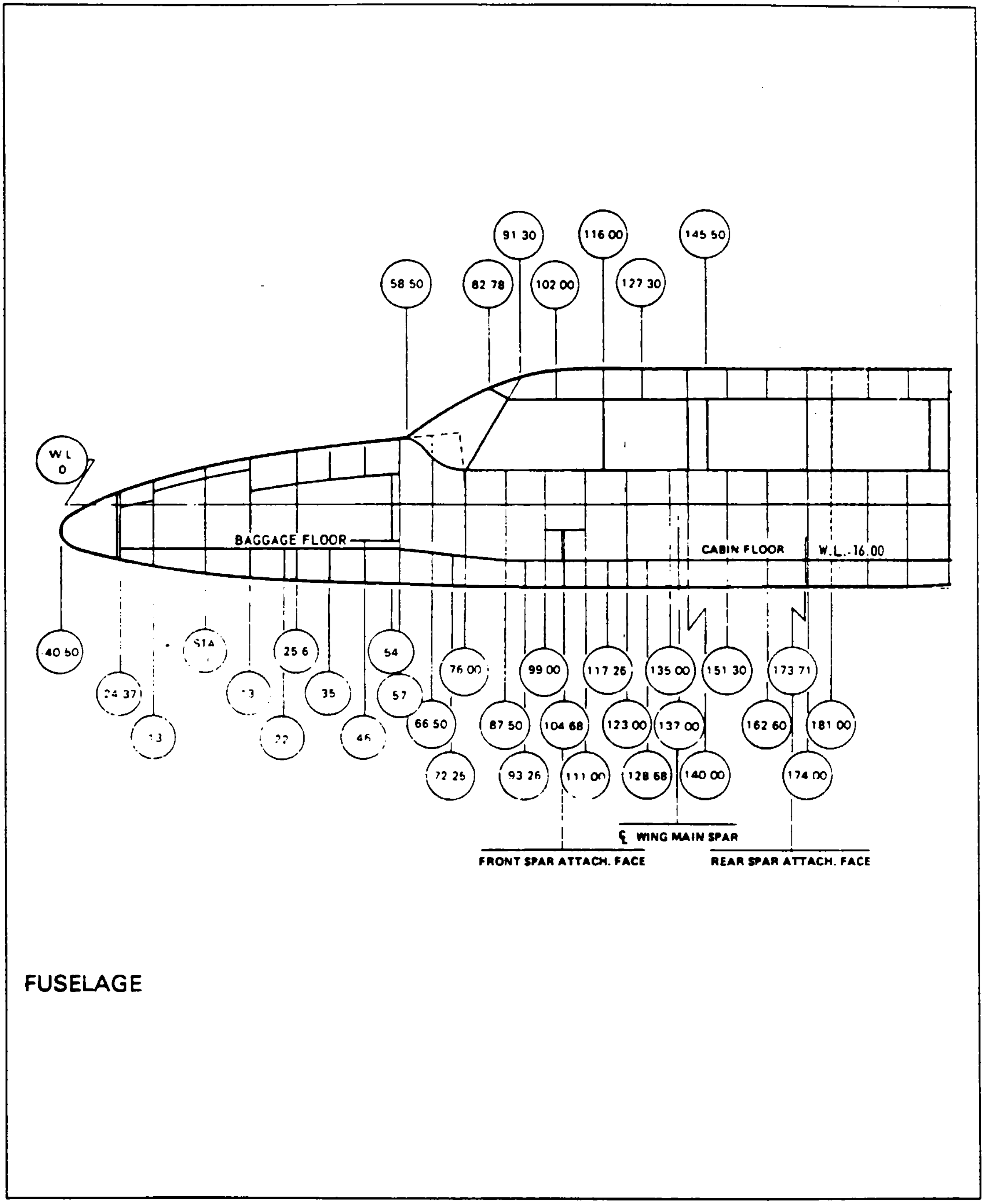


Figure 6-2. Station References

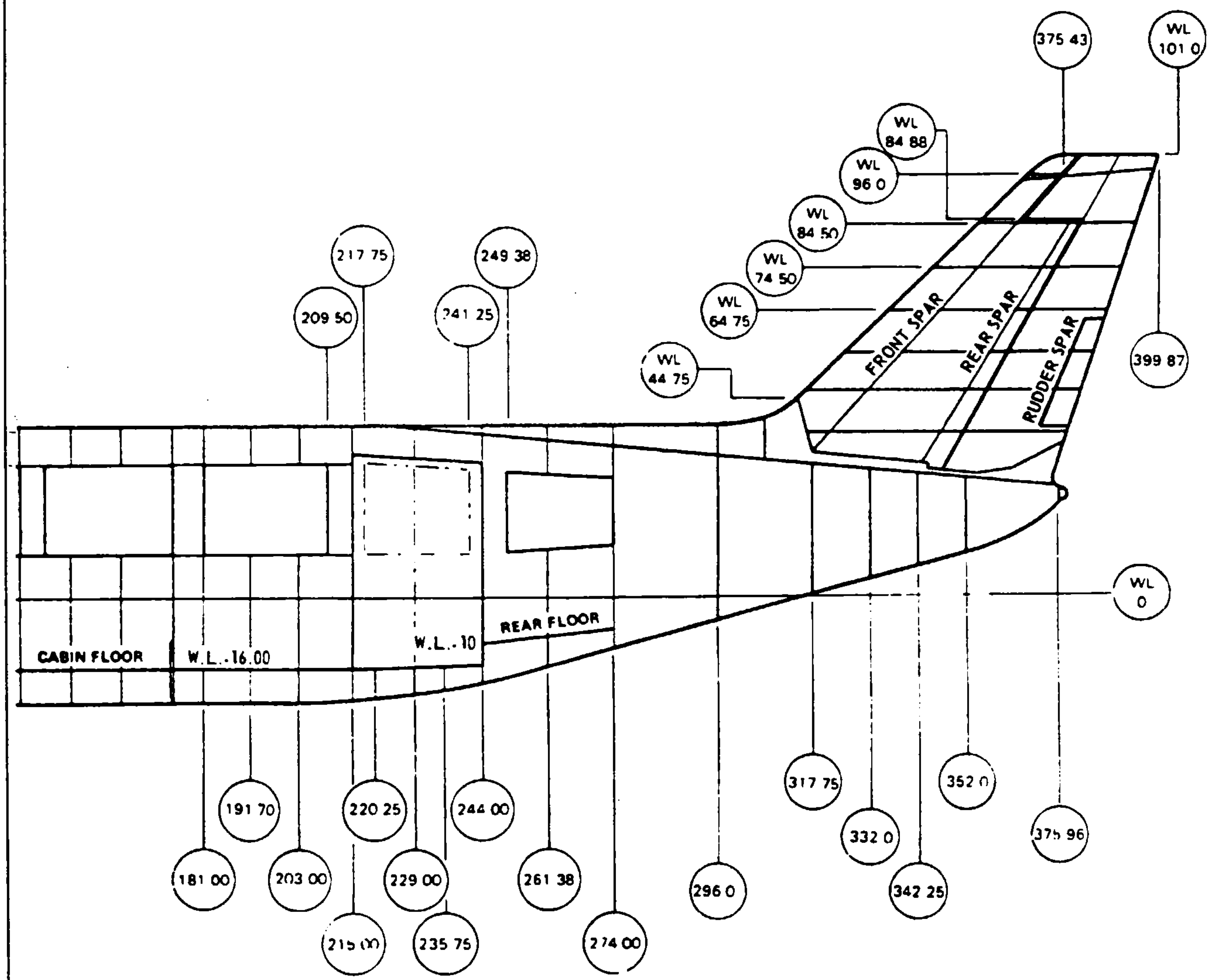
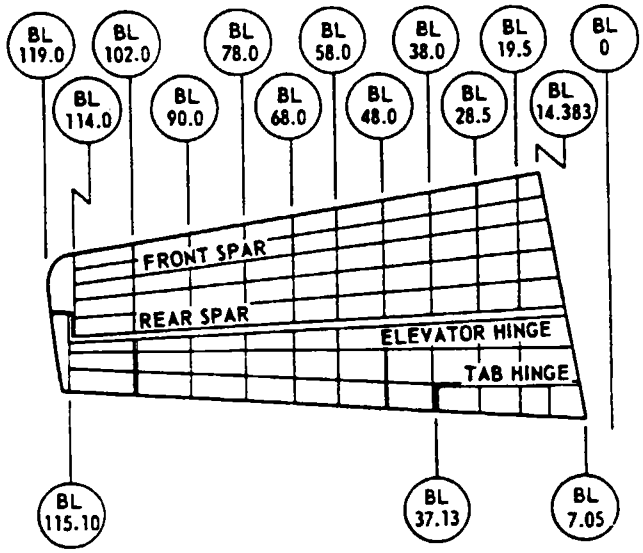
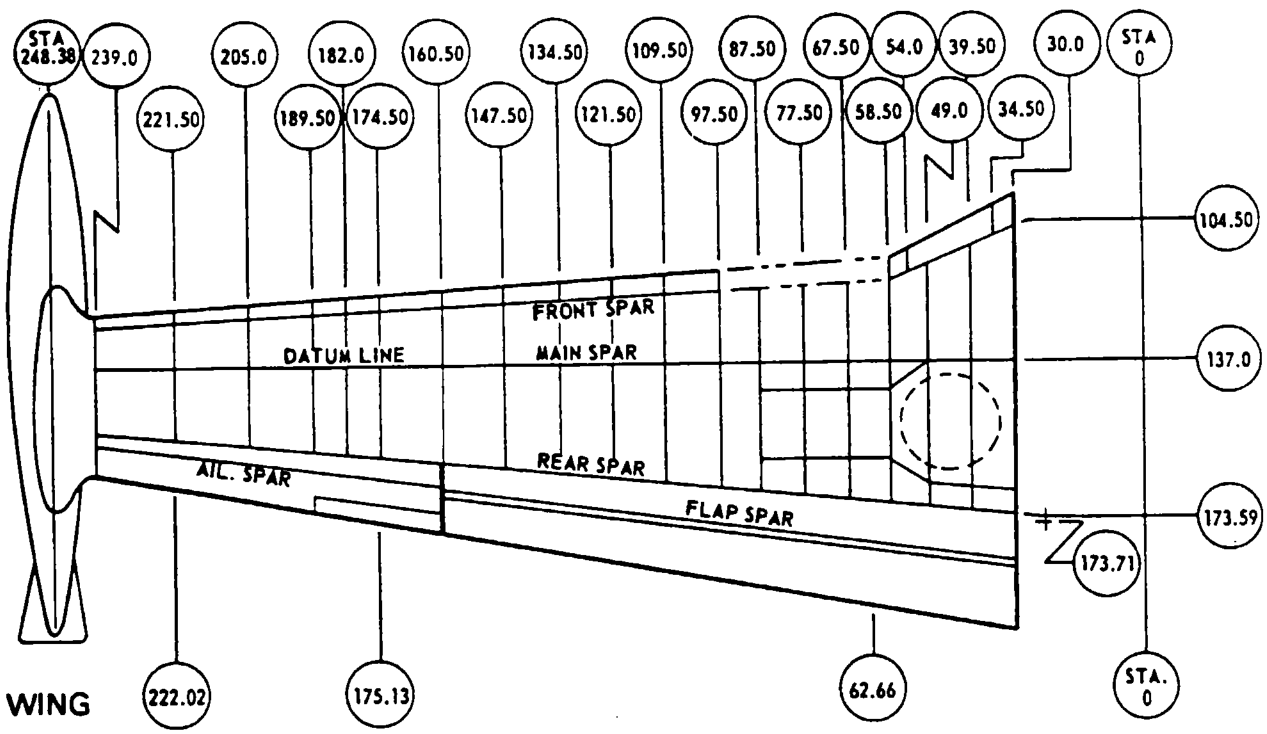


Figure 6-2 Station References (cont.)



HORIZONTAL STABILIZER



WING

Figure 6-2. Station References (cont.)

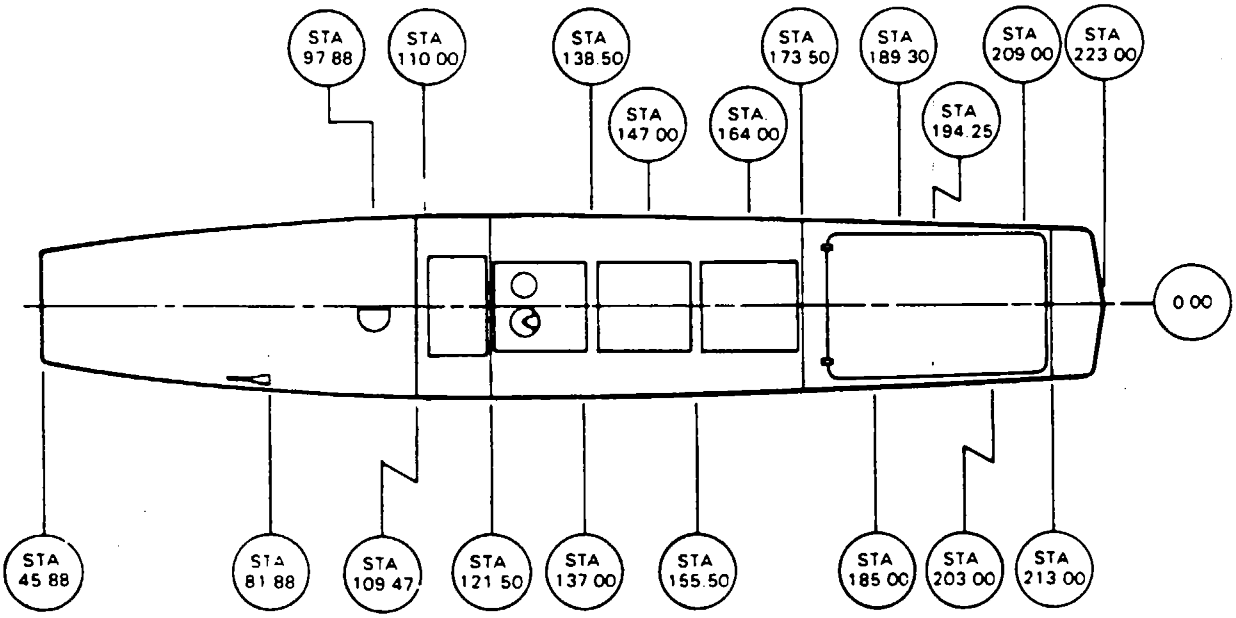
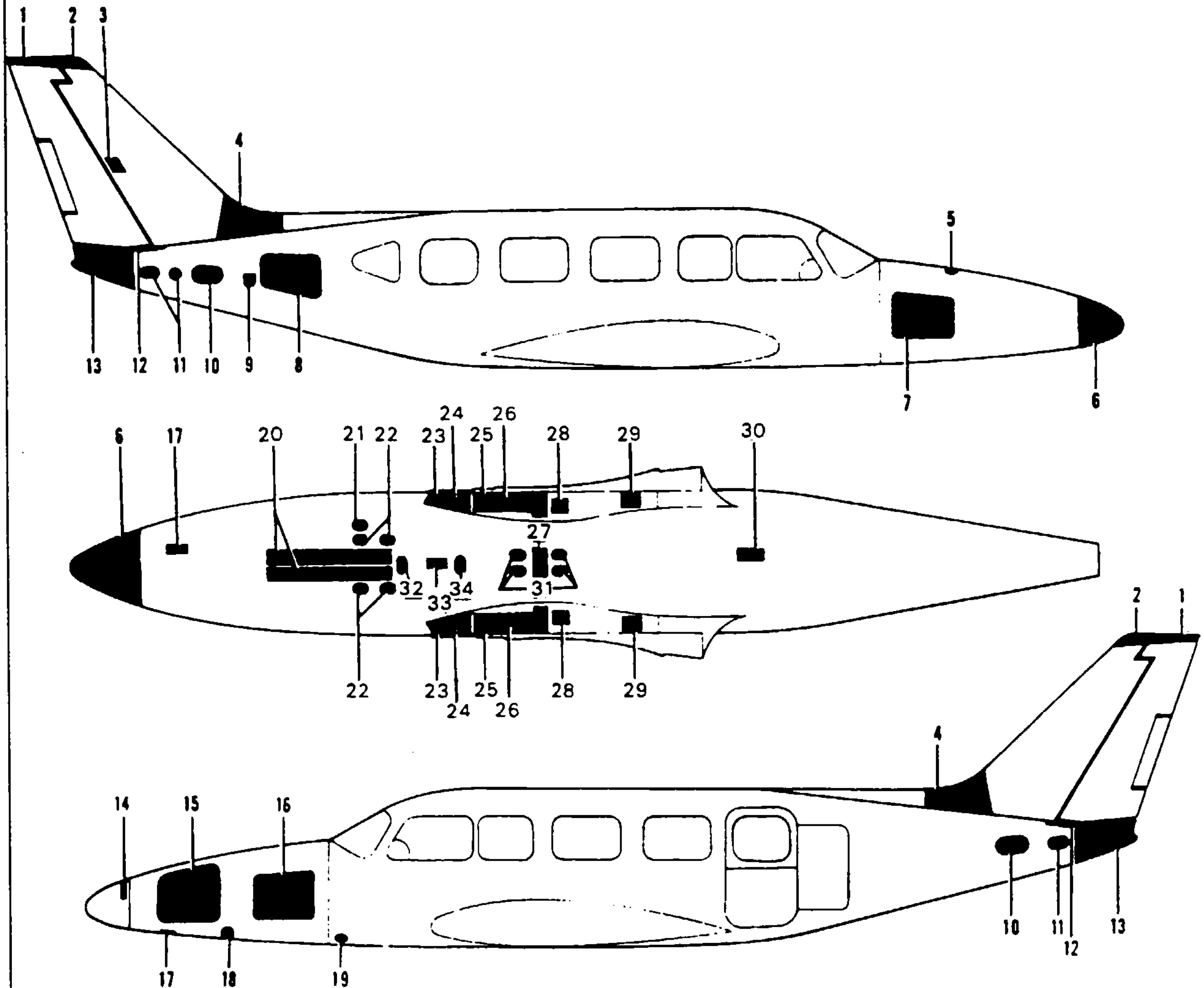


Figure 6-2. Station References (cont.)



1. RUDDER TIP
2. VERTICAL STABILIZER TIP
3. RUDDER TRIM DRUM
4. VERTICAL FIN DEICER BOOT CONNECTION, ELT TRANSMITTER
5. HYDRAULIC RESERVOIR - BRAKE SYSTEM
6. BATTERY ACCESS, RADAR
7. HEATER - POWER PACK
8. DEICER AND INSTRUMENT STATIC AIR LINES - CONTROL CABLES
9. AFT OXYGEN RECHARGE VALVE (IF INSTALLED)
10. TRIM CABLES AND ELEVATOR BELLCRANK, ELECTRONIC GEAR
11. TRIM CABLES
12. RUDDER CONTROL HORN
13. ELEVATOR TORQUE TUBE
14. NOSE CONE LATCH RELEASE ACCESS
15. NOSE BAGGAGE DOOR
16. RADIOS - ELECTRICAL SHELF
17. AUXILIARY POWER RECEPTACLE
18. FWD OXYGEN RECHARGE VALVE (IF INSTALLED)
19. ELECTRICAL LEAD LINES
20. NOSE GEAR DOORS
21. PULLEY AND CABLE INSPECTION
22. HYDRAULIC LINES - ELECTRICAL LEADS
23. ELECTRICAL CONNECTORS - LINE CONNECTORS, FRONT SPAR ATTACHMENT
24. ELECTRICAL CONNECTORS - LINES
25. FUEL PUMP - FUEL FILTER - CROSSFEED VALVE - EMERGENCY SHUTOFF VALVE
26. FUEL FILTER BOWL
27. SPAR SPLICE - DEICER PRESSURE SWITCH
28. MAIN SPAR ATTACHMENT
29. REAR SPAR ATTACHMENT
30. CABIN EXHAUST
31. SPAR SPLICE
32. QUADRANT - CONTROL CABLES
33. CO_2 BLOWDOWN BOTTLES
34. CIRCUIT BREAKERS

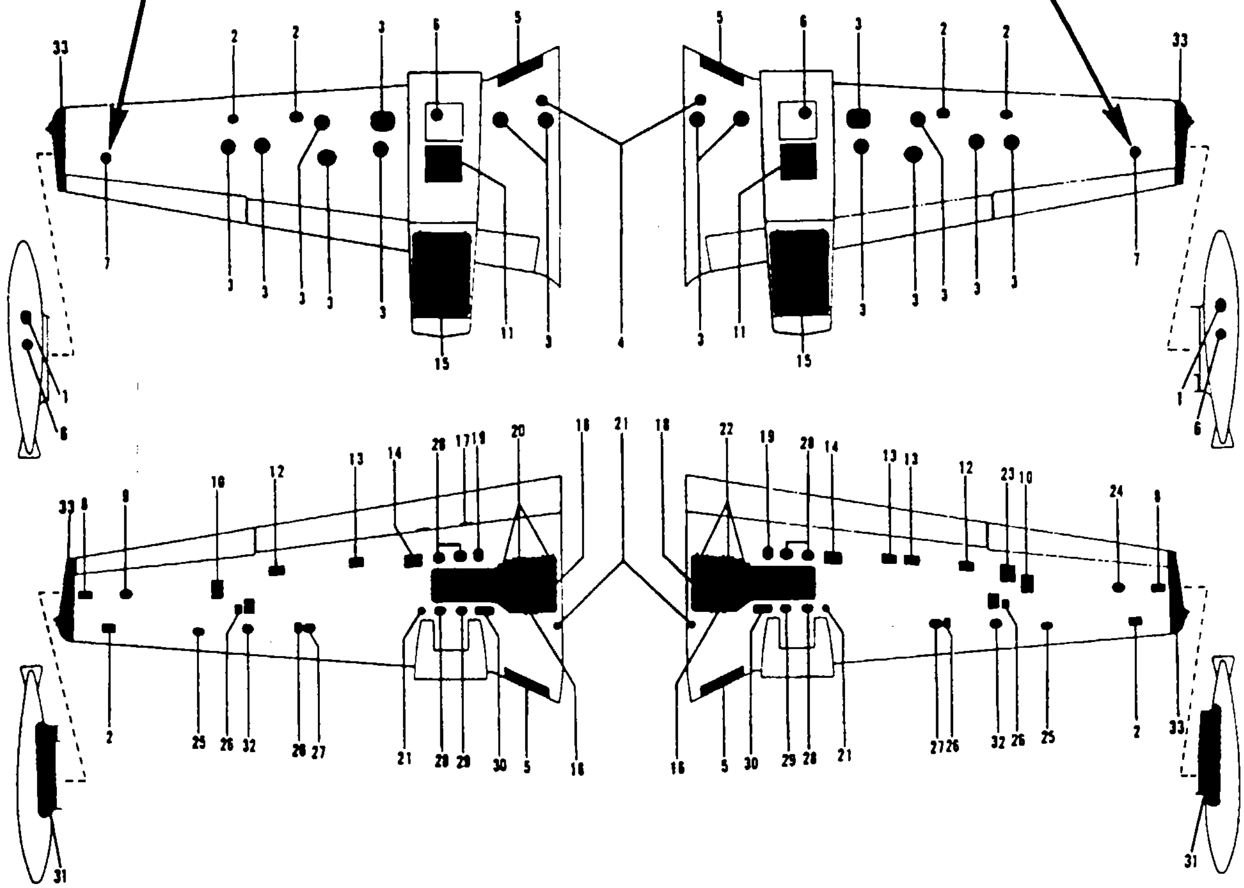
Figure 6-3. Access Plates and Panel

NOTE

THIS ACCESS PANEL MUST BE INSTALLED WITH BRASS SCREWS ONLY.

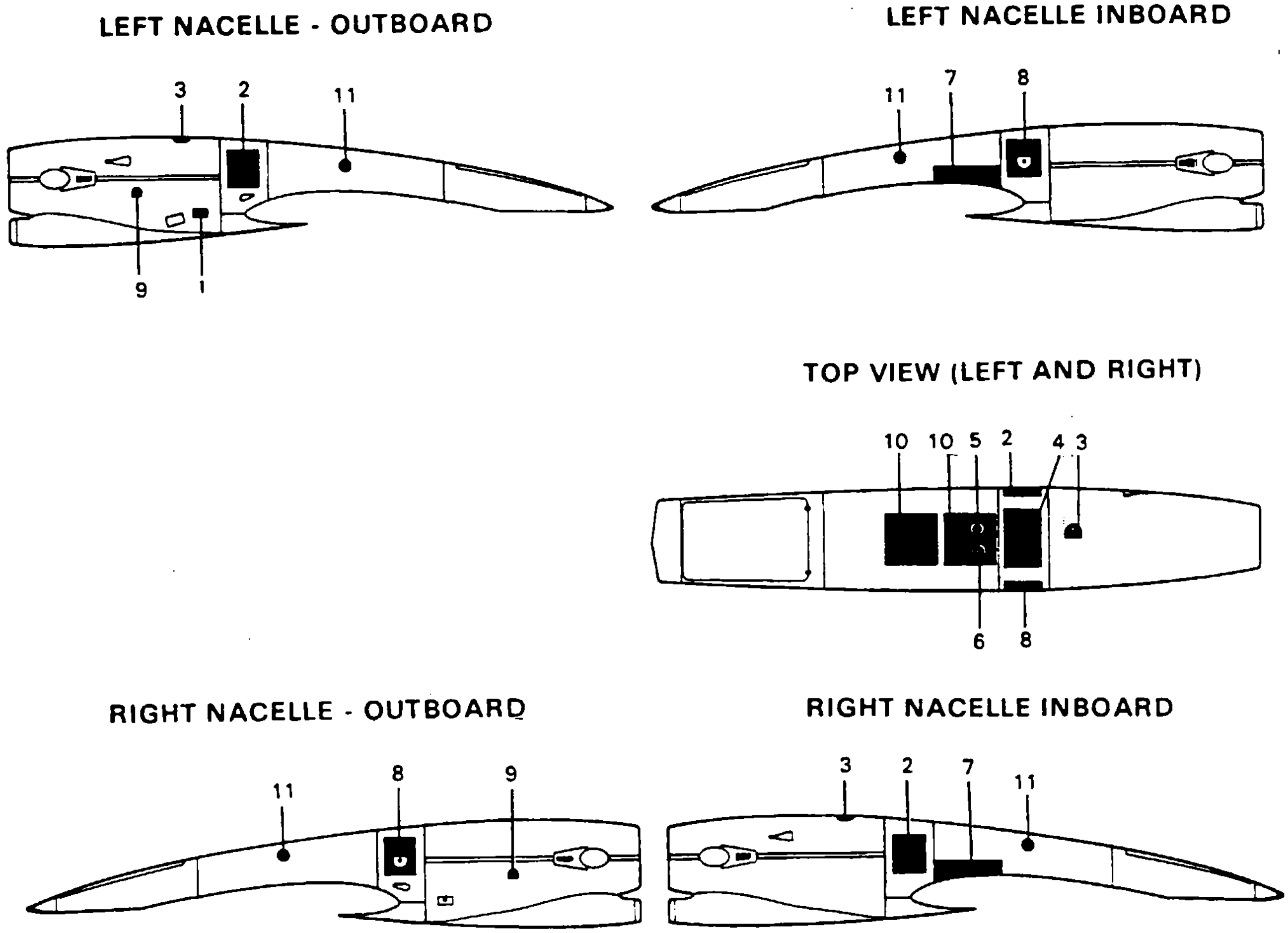
NOTE

IF FLUX DETECTOR IS INSTALLED, THIS ACCESS PANEL MUST BE INSTALLED WITH BRASS SCREWS ONLY.



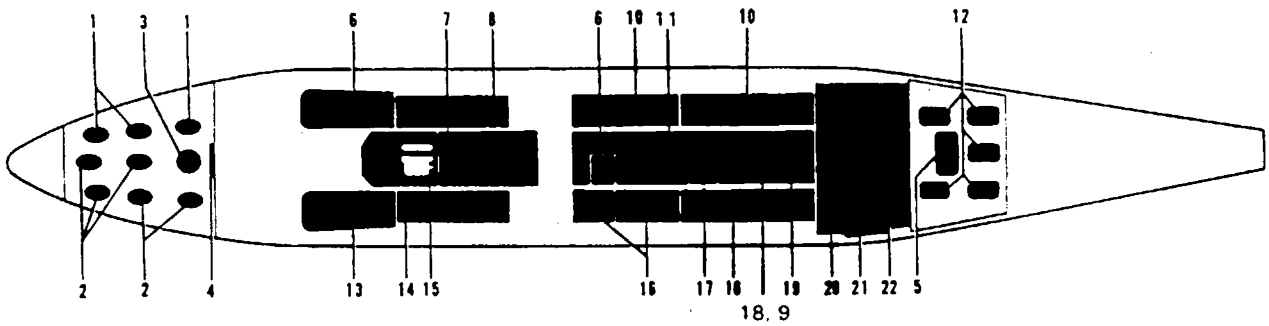
1. INSPECTION, VENT LINE - VENT FLOAT VALVE
2. INSPECTION ACCESS
3. FUEL CELL
4. FUEL SENDING UNIT
5. LINES - WIRES - CABLES
6. FUEL FILLER
7. FLUX DETECTOR (LT. WING ONLY)
8. TRANSFORMER, STROBE LIGHT
9. ELECTRONIC GEAR
10. AILERON BELLCRANK
11. DELETED
12. AILERON CABLE AND FUEL LINE
13. AILERON CONTROL CABLE
14. FLAP TRANSMISSION
15. DELETED
16. PNEUMATIC LINES
17. FLAP LIMIT SWITCHES
18. LANDING GEAR DOOR
19. CABLES AND WIRES
20. FLAP CABLE - AILERON CONTROL CABLE - ELECTRIÇAL LEADS
21. FUEL QUICK DRAIN
22. FLAP CABLE - AILERON CONTROL
23. AILERON TRIM DRUM
24. WING BAY ACCESS
25. INSPECTION - FUEL LINES
26. FUEL CELL VENT
27. FUEL CELL VENT LINE
28. LANDING GEAR ATTACHMENT BOLT
29. WIRES AND LINES
30. FUEL LINES
31. FUEL SENDER UNIT (WITH TIP TANK)
32. FUEL LINES
33. WING TIP

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



1. FUEL FILTER
2. HEAT EXCHANGER AND PLUMBING
3. OIL FILLER QUANTITY DIPSTICK
4. OIL COOLER DOOR TRANSMISSION (RIGHT NACELLE ONLY: AIR CONDITIONING, CONDENSER AND FAN)
5. FUEL SENDER
6. FUEL FILLER CAP
7. JET PUMP
8. BLEED AIR AND PNEUMATIC LINES
9. WASH RING
10. NACELLE INSPECTION PANELS
11. FUEL CELL INSPECTION

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



1. GENERATOR SUPPLY CABLE RIGHT
2. GENERATOR SUPPLY CABLE, LEFT - BATTERY CABLE
3. ELECTRICAL LEADS
4. NOSE WHEEL STEERING
5. GROUND VENT FAN
6. HYDRAULIC LINES
7. TRIM CONTROL CABLES AND PULLEYS
8. TRIM CABLES AND PULLEYS ENGINE CONTROL LINES, WIRES AND CABLES
9. ROLL SERVO, IF INSTALLED
10. TRIM CABLES AND PULLEYS
11. FLAP MOTOR - AILERON BALANCE CABLE
12. CONTROL AND TRIM CABLES
13. CONTROL CABLES, PULLEYS, AND TURNBUCKLES
14. CONTROL CABLES, PULLEYS, AND TURNBUCKLES - ENGINE CONTROL LINES, WIRES AND CABLES
15. HYDRAULIC HAND PUMP, PNEUMATIC BLOWDOWN
16. CONTROL CABLES AND PULLEYS
17. TRIM WARNING SYSTEM, IF INSTALLED
18. AUTOPILOT UNITS: ROLL, PITCH AND PITCH TRIM SERVOS, VOLTAGE DIVIDER AND GYRO AMPLIFIER - CONTROL CABLES - WING FLAP MOTOR
19. PITCH SERVO, IF INSTALLED
20. CABIN EXHAUST DOOR MECHANISM
21. CONTROL AND TRIM CABLES AND PULLEYS SEAT ATTACHMENTS
22. PITCH TRIM SENSOR, IF INSTALLED

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

THIS PAGE INTENTIONALLY LEFT BLANK

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 a support position by making use of the tail skid. To jack the airplane, proceed as follows:

1. Place the jacks (3 ton capacity or greater) under the jack pads.
2. Attach the tail support to the tail skid. Place a minimum of 500 pounds of ballast on the support to hold the tail down.

—CAUTION—

Be sure to apply sufficient tail support ballast; otherwise the airplane win tip forward and fall on the fuselage nose section.

3. Raise the jacks evenly until all three wheels clear the surface.

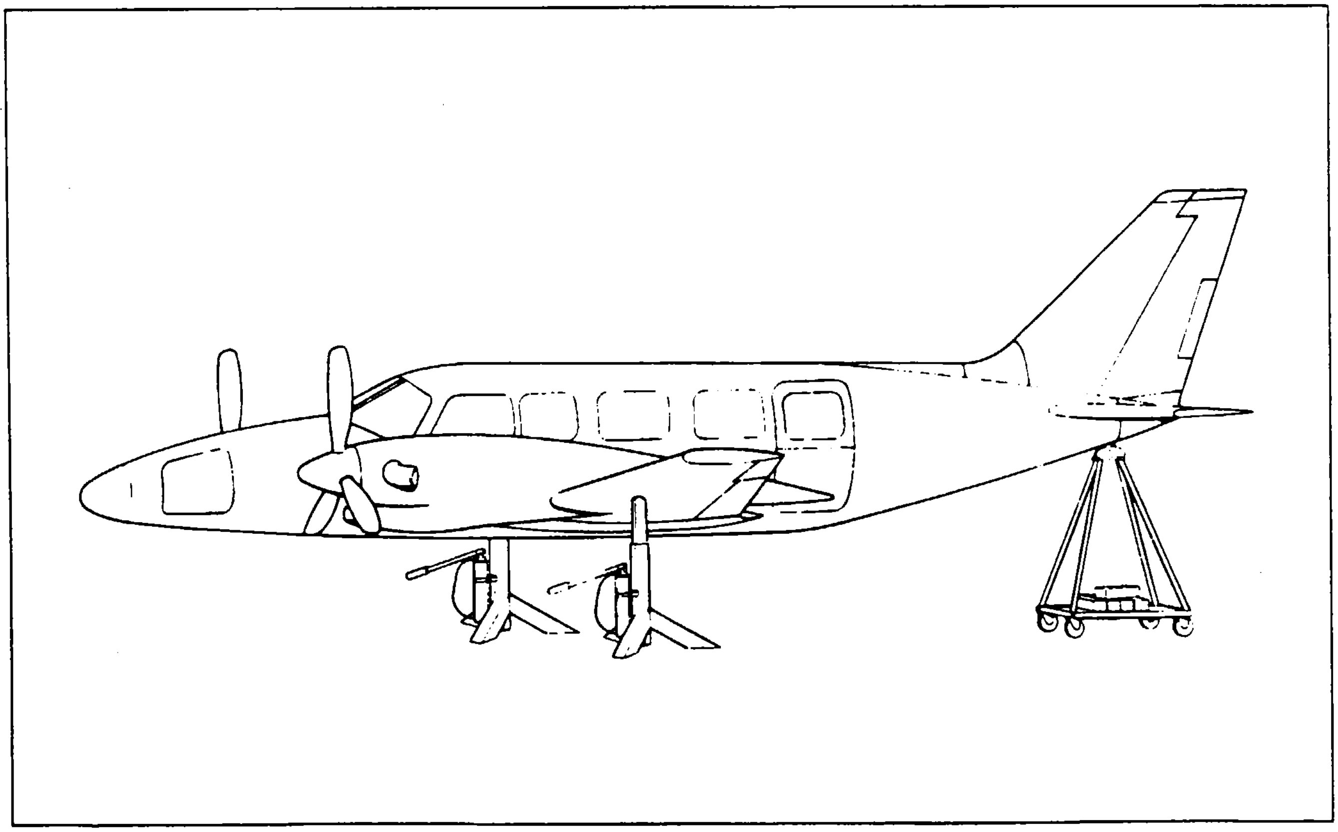


Figure 7-1. Jacking Arrangement

CHAPTER

8

LEVELING AND WEIGHING

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 25.60 and 57.00. Place a spirit level on these screw heads and deflate the nose wheel tire or adjust the jacks until the bubble of the level is centered.
2. To laterally level the airplane, place a spirit level across the two center seat rails of the cabin and deflate the tire on the high side of the airplane or adjust either jack until the bubble of the level is centered.

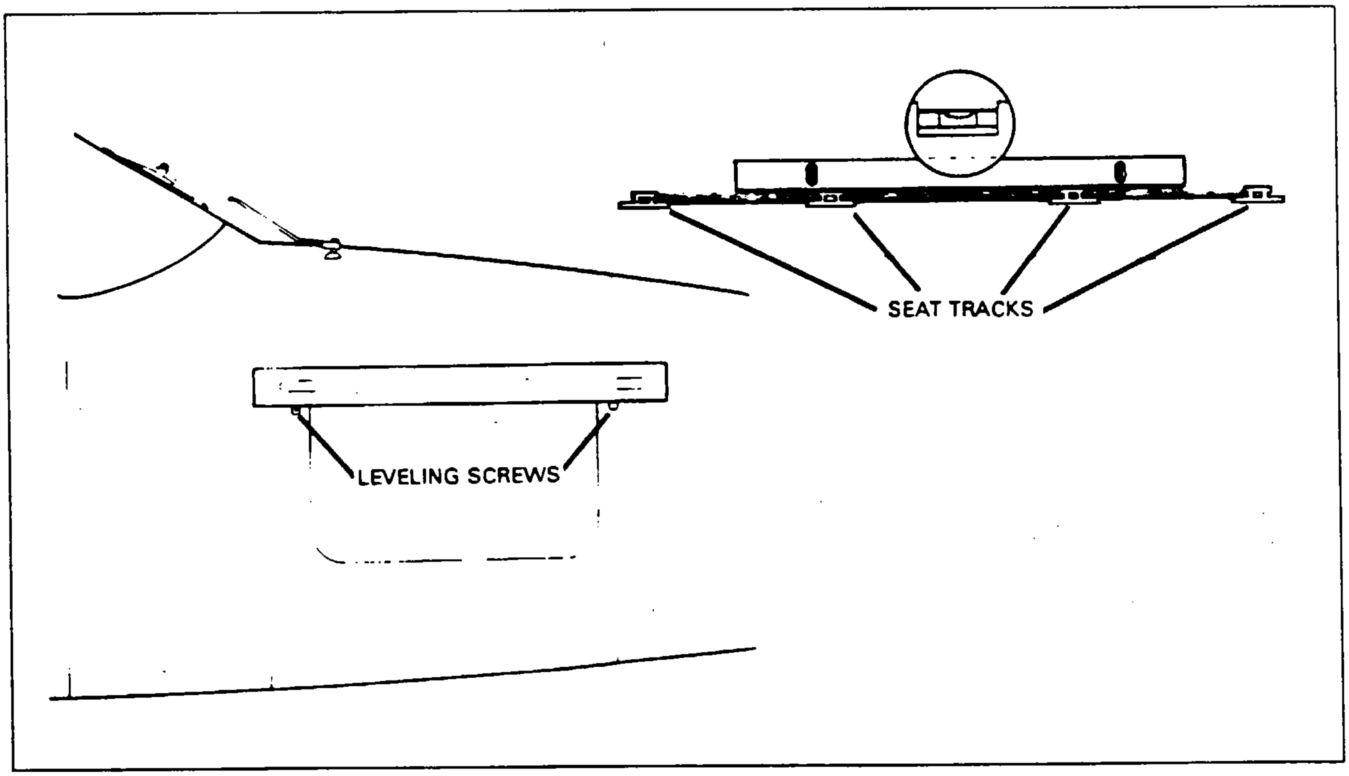


Figure 8-1. Leveling

WEIGHT AND BALANCE DATA.

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

WEIGHING. (Refer to Figure 8-2.)

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

The airplane may also be weighed with full fuel tanks, but it is not recommended, and care must be taken to verify all fuel tanks are "exactly full" and not partially under or over full (fuel topped off to bottom of filler neck with airplane in level attitude). See Chapter 6 for fuel capacities.

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

PREPARATION FOR WEIGHING.

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

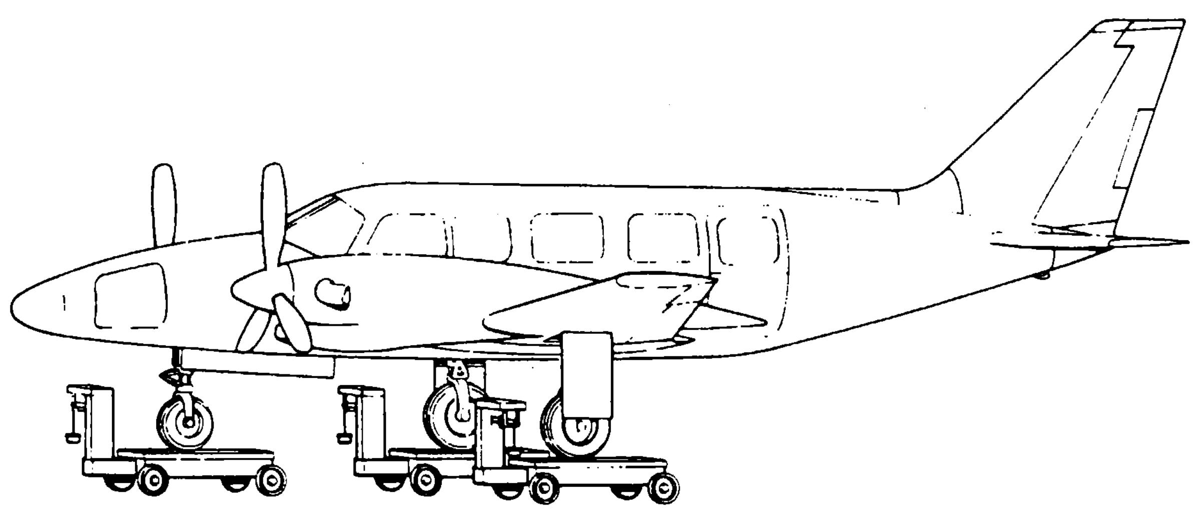


Figure 8-2. Weighing

WEIGHING THE AIRCRAFT.

1. Place a 3,000 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.

—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 others 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.)

TOWING.

The airplane may be moved by using the nose wheel steering bar that is stowed in 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 are 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.

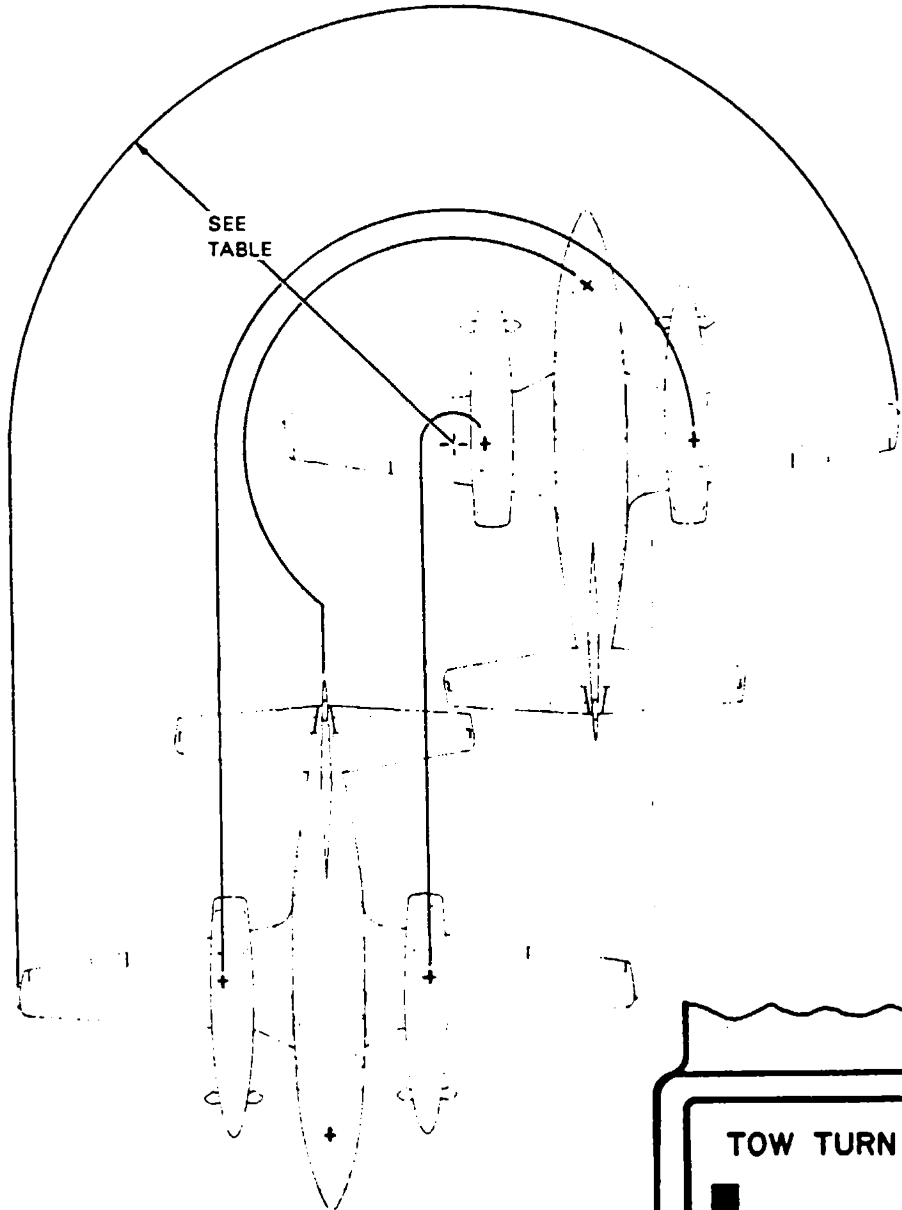
In the event towing lines are necessary, lines (rope) will be attached to both main gear struts just below the side brace link attachments. Ascertain that oil cooler doors are closed. Lines should be long enough to clear the nose and/or tail by not less than 15 feet, and a qualified person to ride in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

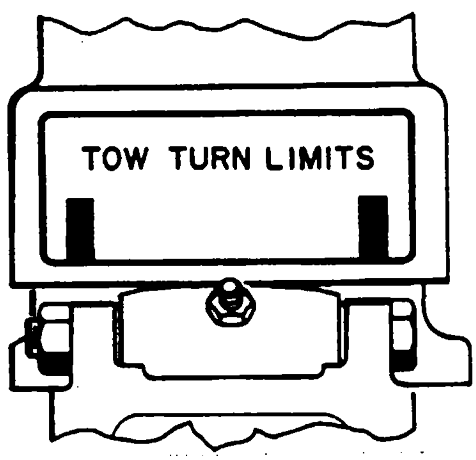
A collapsible towbar is located in the nose baggage compartment. The towbar is removed by pulling it from the friction retainers.

TAXIING.

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

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





MODEL	T-1040/WITHOUT TIP TANKS	T-1040/WITH TIP TANKS
WHEEL BASE	10 FT. 8 IN.	10 FT. 8 IN.
NOSE WHEEL TRAVEL	40°L/40°R	40°L/40°R
TURNING RADIUS WING TIP	29.5 FT.	29 FT. 9.125 IN.

Figure 9-1. Turning Radius and Limits

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 conditions and presents no danger to other aircraft. When parking the airplane for any length of time or overnight it is recommended that it be moored in accordance with sub-system section on Mooring.

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

—NOTE—

Care should be taken when setting brakes that are very hot or during cold weather, when accumulated moisture may freeze the brakes. Prior to setting the brakes, if either of the above conditions exist, it is recommended that chocks be used to block the wheels rather than setting the 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 wheel with the seat belt and/ or secure the ailerons and elevators 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 contact 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 wind milling

—END—

CHAPTER

11

REQUIRED PLACARDS

CHAPTER 11- REQUIRED PLACARDS

TABLE OF CONTENTS / EFFECTIVITY

GENERAL.

PLACARDS AND MARKINGS.

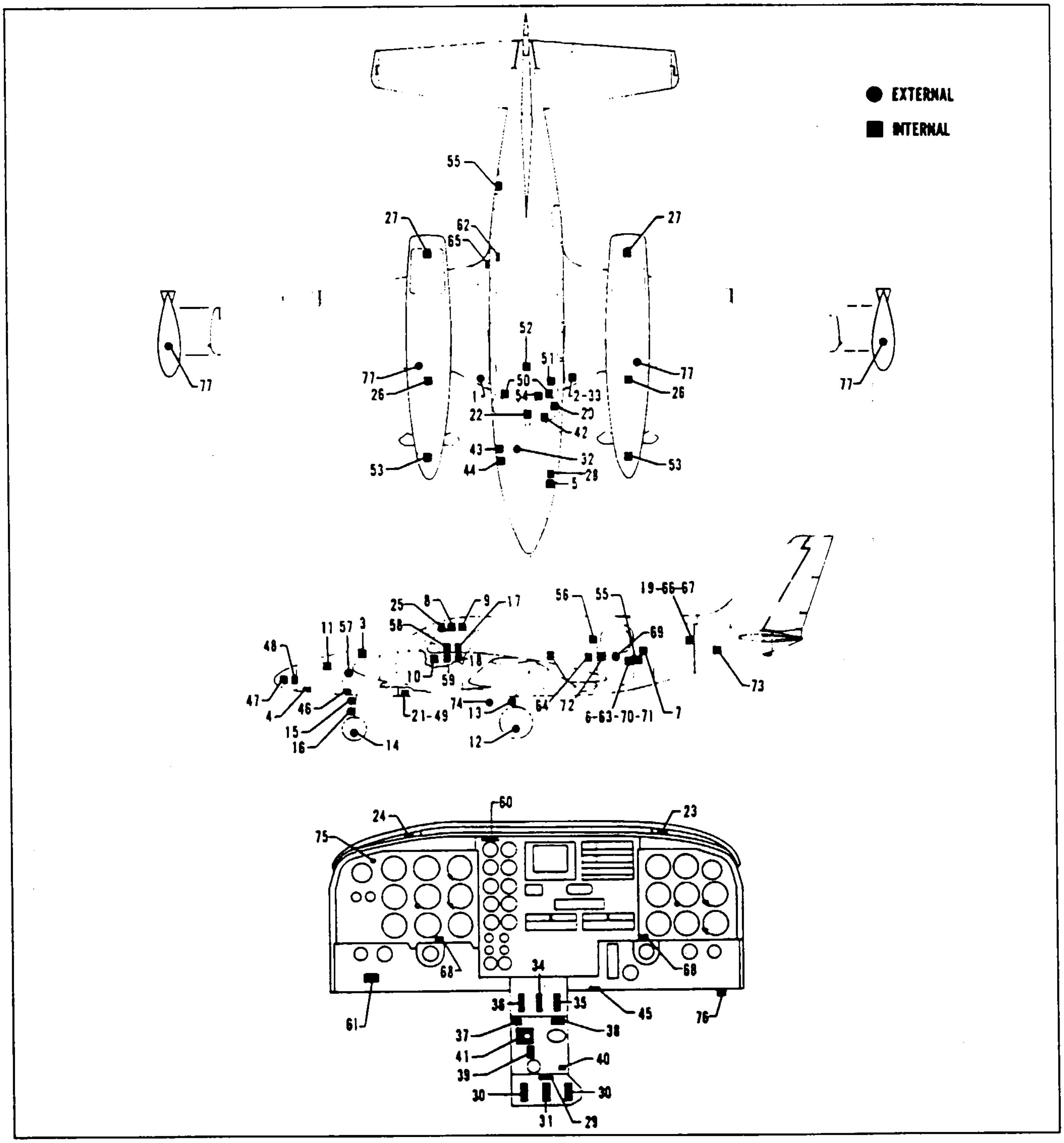


Figure 11-1. Placards and Decals

1. PLACARD - FUEL DRAIN
2. PLACARD - FUEL DRAIN INSTRUCTIONS
3. PLACARD - BRAKE RESERVOIR FILL
4. PLACARD - STARTING PROCEDURE, EXTERNAL POWER
5. PLACARD - LATCHING OPERATION
6. PLACARD - DOOR HANDLE LATCH
7. PLACARD - CARGO LOADING
8. PLACARD - PILOT DOOR (OPEN - CLOSED)
9. PLACARD - PILOT DOOR (THEFT LOCK)
10. PLACARD - LATCH
11. PLACARD - BAGGAGE CAPACITY
12. PLACARD - TIRE INFLATION, MAIN
13. PLACARD - OLEO SERVICE INSTRUCTIONS, MAIN
14. PLACARD - TIRE INFLATION, NOSE
15. PLACARD - OLEO SERVICE INSTRUCTIONS, NOSE
16. PLACARD - TOW TURN LIMITS
17. DECAL - SEAT REQUIREMENTS
18. DECAL - ANTI-COLLISION LIGHTS WARNING
19. PLACARD - AFT BAGGAGE CAPACITY
20. PLACARD - CHECK LIST
21. PLACARD - EMERGENCY GEAR EXTENSION
22. PLACARD - COMPASS
23. PLACARD - ANNUNCIATOR HI-LO
24. PLACARD - ANNUNCIATOR TEST
25. PLACARD - ARMREST STORAGE
26. PLACARD - ENGINE OIL SPECIFICATIONS
27. DECAL - NACELLE LOCKER, BAGGAGE CAPACITY
28. PLACARD - ACCESS PANEL
29. PLACARD - FUEL CONTROL
30. PLACARD - FIREWALL SHUT-OFF VALVE CONTROL
31. PLACARD - CROSSFEED CONTROL
32. DECAL - BRAKE RESERVOIR
33. DECAL - OFF
34. PLACARD - PROPELLER CONTROL
35. PLACARD - START CONTROL
36. PLACARD - POWER LEVER CONTROL
37. PLACARD - ELEVATOR TRIM
38. PLACARD - RUDDER TRIM
39. PLACARD - AILERON TRIM
40. PLACARD - CIGAR LIGHTER
41. PLACARD - WINDSHIELD WIPER
42. MEDALLION - CONTROL WHEEL
43. PLACARD - HYDRAULIC RESERVOIR
44. PLACARD - FILTER SERVICING INSTRUCTIONS
45. PLACARD - CABIN EXHAUST
46. PLACARD - OXYGEN RECHARGE
47. PLACARD - BATTERY CAUTION
48. PLACARD - FUSE FUNCTIONS
49. PLACARD - CIRCUIT PROTECTOR FUNCTIONS
50. DECAL - MAP LIGHT
51. PLACARD - COVER
52. DECAL - SEAT BELTS, DOME LIGHTS, NO SMOKING
53. PLACARD - SPINNER BULKHEAD
54. PLACARD - WARNING, E.L.T.
55. PLACARD - SEAT REQUIREMENTS
56. DECAL - PIPER LOGO
57. DECAL - ACCESS PANEL
58. DECAL - LIMITATIONS
59. DECAL - CATEGORY
60. PLACARD - TORQUE TEST
61. PLACARD - STATIC PRESSURE
62. DECAL - CUT HERE IN EMERGENCY
63. PLACARD - EMERGENCY EXIT
64. DECAL - NO SMOKING
65. DECAL- PUSH HERE
66. DECAL - BAGGAGE TIE DOWN
67. PLACARD - CARGO LOADING
68. PLACARD - CONTROLS NOT TO BE LEFT NATTENDED
69. DECAL - OPEN/LOCK
70. DECAL - PULL HERE
71. DECAL - TO OPEN PRESS HERE
72. DECAL - DOOR - OPEN
73. PLACARD - OXYGEN CYLINDER RETEST
74. DECAL - CARGO POD CAPACITY
75. DECAL - STALL SPEEDS
76. PLACARDS - HEATER BLOWER SWITCH
77. DECAL - JET FUEL ONLY

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

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

12

SERVICING

CHAPTER 12 - SERVICING

TABLE OF CONTENTS / EFFECTIVITY

CHAPTER 12 - SERVICING (cont.)

TABLE OF CONTENT / 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 on the firewall. Remove and clean the filters in accordance with the instructions outlined in Chapter 28. Additional service information may also be found in Chapter 28. Inspection intervals of the various fuel system components may be found in Chapter 5.

FILLING FUEL CELLS.

The fuel cells of each wing are filled through filler necks located on top of the engine nacelles.

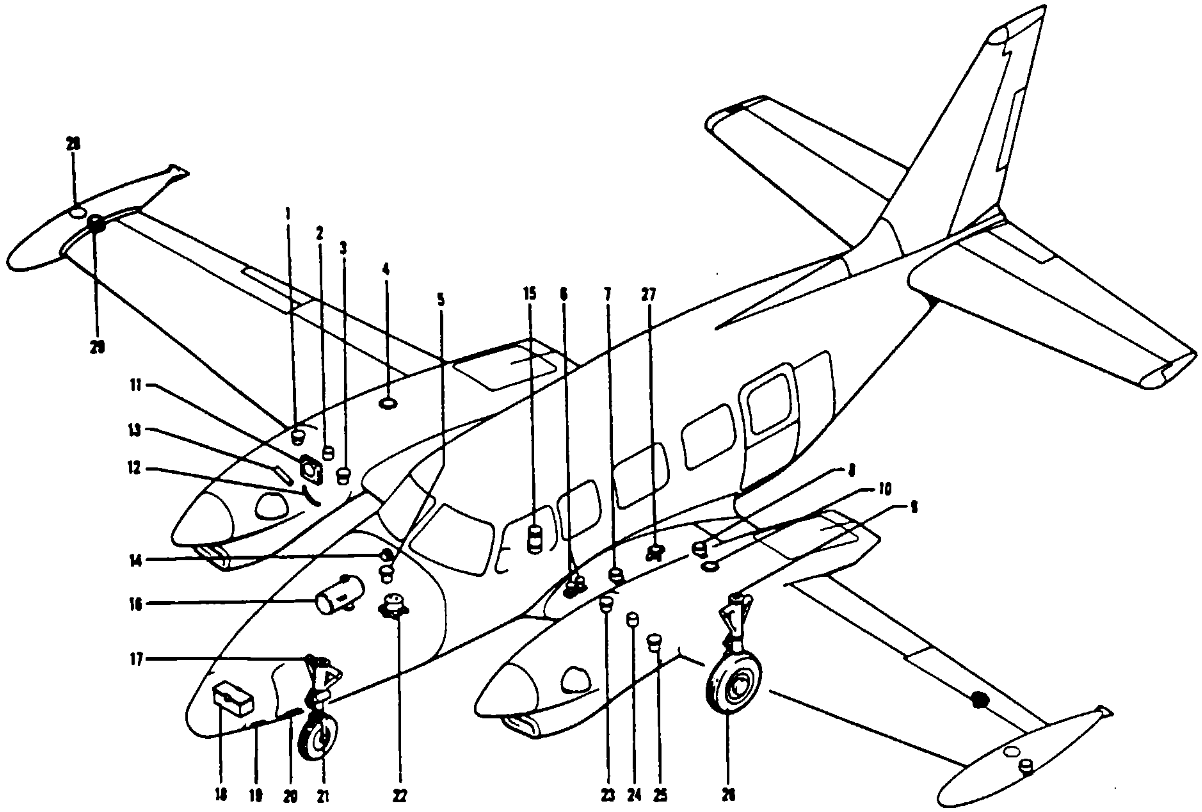
DRAINING MOISTURE FROM FUEL SYSTEM.

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

1. To flush either filter bowl, push up on the arms of the drain valve for a few seconds, then repeat the process on the opposite wing. Allow enough fuel to flow each time to clear the fuel line as well as the fuel filter bowl.
2. To flush the fuel cells, rotate the handle of each cell drain counterclockwise and allow to flow for a few seconds. Ensure the handle of the drain valve is positioned to the rear of the airplane when draining has been completed.

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. Turn the handle of the drain valve counterclockwise to hold the drain in the open position. The remaining fuel in the system may be drained through each filter bowl. An optional quick drain valve is located in the wing root. To use the drain, gain access to the valve through the access door on the bottom of the wing root fairing, place appropriate container beneath drain, remove cap from end of drain, cut safety wire on valve lever and depress lever. After using drain, insure that lever is safety wired (we) in the closed position: on Left Wing, lever should be forward; on Right Wing lever should be aft.



1. FILTER, HYDRAULIC, RIGHT ENGINE
2. OIL FILLER, RIGHT ENGINE
3. FUEL FILTER, RIGHT ENGINE
4. FUEL FILLER, RIGHT
5. HYDRAULIC BRAKE RESERVOIR
6. ELECTRIC FUEL PUMPS, RIGHT AND LEFT
7. FUEL DRAIN, MAIN INBOARD, RIGHT AND LEFT
8. FUEL DRAIN, MAIN OUTBOARD, RIGHT AND LEFT
9. FILLER, OLEO SHOCK STRUT, RIGHT AND LEFT
10. FUEL FILLER, LEFT
11. COMPRESSOR, AIR CONDITIONER
12. HOSE, ENGINE OIL DRAIN, RIGHT AND LEFT
13. FILTER ELEMENT, ENGINE OIL, RIGHT AND LEFT
14. GAUGE OXYGEN PRESSURE
15. AIR CONDITIONER, RECEIVER-DEHYDRATOR
16. HEATER
17. FILLER, OLEO SHOCK STRUT, NOSE
18. BATTERY
19. EXTERNAL POWER SUPPLY
20. FILLER, OXYGEN
21. TIRE, NOSE
22. POWER PACK
23. FILTER, HYDRAULIC, LEFT ENGINE
24. OIL FILLER, LEFT ENGINE
25. FUEL FILTER, LEFT ENGINE
26. TIRE, MAIN, RIGHT AND LEFT
27. QUICK DRAIN (OPTIONAL) RIGHT AND LEFT
28. FUEL FILLER, TIP TANK, RIGHT AND LEFT
29. FUEL DRAIN, TIP TANK, RIGHT AND LEFT

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 EC750 or equivalent) around the scupper. Particular attention should be paid to sealing the forward edge of the scupper at the hinge attaching point.
4. Install the removed items and make the appropriate logbook entry.

DRAINING BRAKE SYSTEM.

To drain the brake system, connect a hose to the bleeder fitting on the bottom of the cylinder and place the other end of the hose in a suitable container. Open the bleeder valve and slowly pump the brake pedal until fluid ceases to flow. To clean the system, flush with denatured alcohol.

SERVICING LANDING GEAR.

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

LANDING GEAR OLEO STRUTS.

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

—NOTE—

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

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

—WARNING—

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

—NOTE—

Struts may be serviced and adjusted per placard on strut.

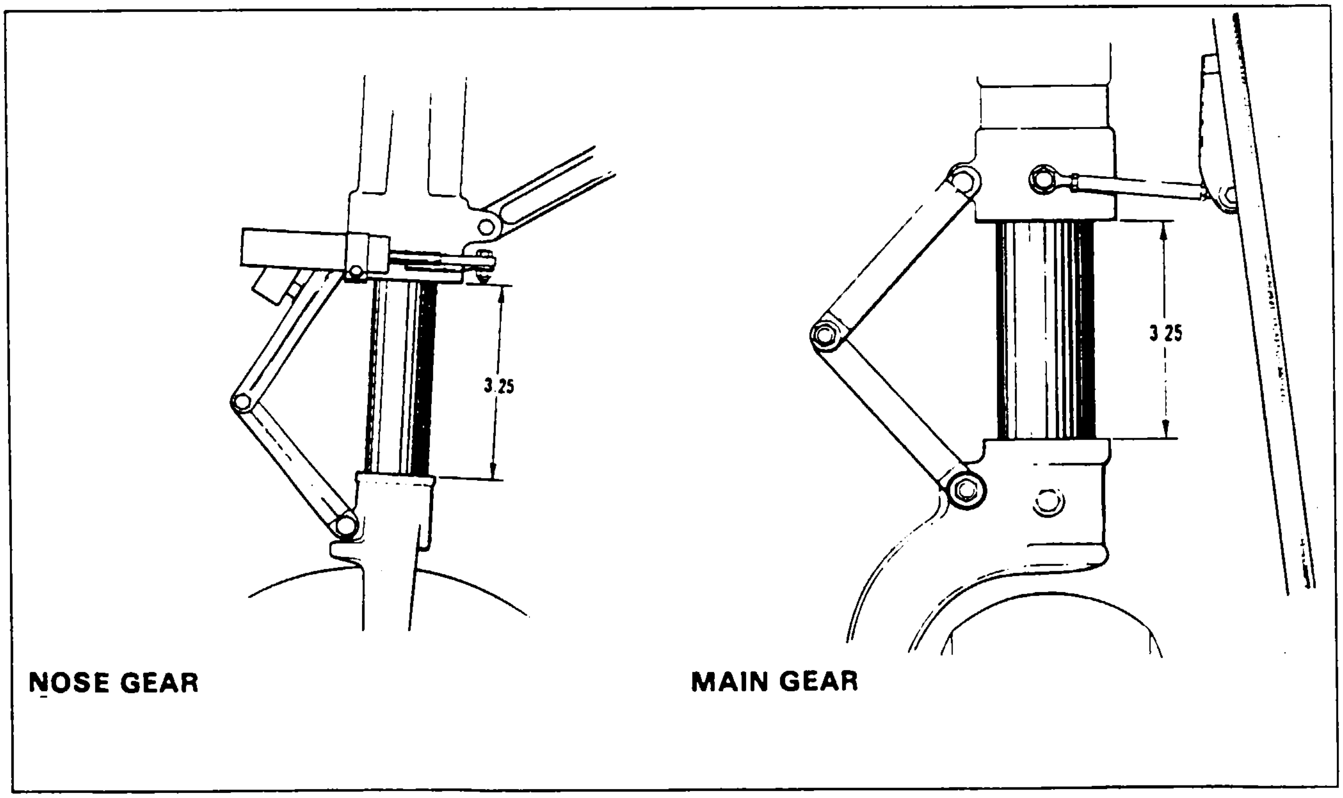


Figure 12-2. Landing Gear Strut Exposure

ADDING FLUID TO STRUTS.

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

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

FILLING OLEO STRUTS.

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

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

—NOTE—

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

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

INFLATING OLEO STRUTS.

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

TIRES.

The tires should be maintained at the pressure specified in Chart 601. When checking tire pressure, examine the tires for wear, cuts, bruises and slippage.

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

Proper balancing is critical for the life of the aircraft tires. If a new tire is balanced upon installation it will usually remain balanced for the life of the tire without having any shimmy or flat spots. 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 right side of the nose section. If the fluid level is low, it should be filled with filtered hydraulic fluid, MIL-H-5606.

FILLING HYDRAULIC SYSTEM RESERVOIR.

A special filling and draining service valve hookup is provided on this airplane to facilitate service to the hydraulic system and power pack. It is located behind the access panel on the right side of the nose section at station 27.6. 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 within ten minutes after engine shutdown. If the engine has been stationary for a period of twelve hours or more, it should be started and run at idle for minimum of two minutes; then shutdown and check oil level not more than 10 minutes later. For engines operated in corporate or utility aircraft with a typical utilization of 50 hours per month or less, it is recommended that the oil be changed every 400 hours or 9 months, whichever occurs first. For engines operated in high utilization commuter airline type operation, a basic oil change period of 1200 hours is recommended. Extensions beyond the basic oil change period may be contemplated provided that the condition of the oil is monitored such as by a spectrometric oil analysis and a written request is submitted to the United Aircraft of Canada, Limited Service Department. The total system capacity is 2.3 U.S. gallons.

—CAUTION—

Do not mix different brands of oil or specifications of oil since the chemical structures may be different, making the oils incompatible. Should oils of different brands or viscosities become intermixed, drain and flush complete oil system and refill with an approved oil.

If the brand or type of engine oil is to be changed, the lubrication system must be flushed. Refer to Draining Engine Oil for proper procedure.

ENGINE OIL LEVEL CHECK.

Approximately 10 minutes maximum after engine shutdown, unlock the filler cap located at the 11 o'clock position on the accessory gearbox housing. Check the contents of the tank against the marks on the dipstick which correspond to U.S. quarts and fill to required level.

—NOTE—

Normal oil level is one U.S. quart below maximum level. DO NOT fill oil tank more than one quart below the maximum mark.

—CAUTION—

If oil level in tank is below the bottom of the dipstick, determine the cause to assist in troubleshooting. If neither fluctuating nor low oil pressure readings have been noticed, check for external leaks and oil filter contamination. Clean oil filter and fill oil tank to recommended level. Record quantity of oil added and carry out a 15 minute engine run; then recheck the oil quantity and condition of oil filter. If both are satisfactory, no further action is necessary. Otherwise refer to the Engine Maintenance Manual.

DRAINING ENGINE OIL.

1. Place suitable containers or drip pan under engine.
2. Remove oil drain plug located at 6 o'clock position on rear face of accessory gearbox housing and discard preformed packing.
3. Remove cotterpin and oil drain plug lockpin from lugs at 6 o'clock position on compressor inlet case. Using Pratt and Whitney plug puller No. CPWA30077, withdraw drain plug. Discard preformed packing.
4. Remove chip detector located at 6 o'clock position on front case of reduction gearbox.

REPLENISHING ENGINE OIL.

1. Install new preformed packings on drain plugs and chip detector.
2. Install drain plug on accessory gearbox. Tighten plug, torque 215 to 240 inch pounds and lockwire.
3. Install preformed packing on oil tank drain plug. Press drain plug into inlet case, insert lockpin and secure with cotterpin.
4. Install chip detector on front case of reduction gearbox. Tighten detector, torque 45 to 55 inch pounds and lockwire.
5. Refill oil tank with specified oil. (Refer to Pratt and Whitney Aircraft of Canada Service Bulletin No. 12001, Latest Revision).
6. Install filler cap and dipstick assembly in filler tube. Ensure cap is correctly installed and locked securely.

FLUSHING ENGINE OIL SYSTEM.

If an engine is to be operated on a brand or type of oil which differs from that on which it previously operated, or if the oil system has been contaminated by other than metallic matter, the system must be flushed.

1. Remove the engine cowling and place a suitable container or drip pan under the engine.
2. Remove the oil drain plugs from the compressor inlet case and accessory gear box. Remove the chip detector from the reduction gearbox.

—*CAUTION*—

Limit engine rotation to minimum time required to accomplish complete draining. Do not exceed starter time limits (30 seconds ON 1 minute OFF, 30 seconds ON, 1 minute OFF, 30 seconds ON, 30 minutes OFF).

3. With drains open, place the fuel condition lever at CUT-OFF and the ignition switch OFF. Motor the engine with the starter only and allow the scavenge pumps to clear all lubricating oil.
4. Reinstall the drain plug on the accessory gearbox and torque 215 to 240 inch pounds. Press the other drain plug into the compressor inlet case, insert the lock pin and secure with cotterpin. Install chip detector on front case of reduction gearbox and torque 45 to 55 inch pounds.
5. Refill the engine oil tank.
6. Start the engine and run at IDLE speed for a minimum of two minutes.
7. Feather the propeller.
8. Shut down engine.
9. Repeat preceding Steps 1 through 3.
10. Remove and clean the main oil filter.
11. Remove and clean the reduction gearbox oil strainer.
12. Install new preformed packings on drain plugs and chip detector. Reinstall drain plugs and chip detector as described in Step 4, and lockwire.
13. Repeat preceding Steps 5 through 8.
14. Check oil level and replenish as necessary.
15. Install filler cap and dipstick assembly in filler tube. Ensure cap is correctly installed and locked securely.

SERVICING OIL FILTER ELEMENTS.

Every 100 hours the oil filter elements should be removed, inspected for foreign matter and cleaned. The service life of the filter element is 1000 hours.

—*CAUTION*—

Plug both ends of filter element before submerging in petroleum solvent. On no account must the element be ultrasonically cleaned, pressure flushed or dried with compressed air. Such cleaning and drying would cause damage to the filter media.

To clean the filter element, first plug the openings at each end of the filter element with suitable plastic or rubber plugs to prevent contamination, then gently agitate in unused petroleum solvent (AMS3160). Allow the filter element to stand in a clean environment until dry. When dry, visually inspect filter using a 10-power magnifying glass, for broken wires, dents and blocked passages. If dents and/or broken wires are found, or if more than five percent of the visible passages are found to be blocked after repeated cleaning, the filter element must be discarded.

Should the cleaning method described above prove ineffective the filter element may be cleaned electrosonically.

1. Plug the openings at each end of the filter element with suitable plastic or rubber plugs.
2. Place the filter element in an electrosonic cleaner tank.
3. Add a sufficient quantity of cleaning solvent to the tank. (Approximately 1/4 inch below the top edge of the tank.)
4. Operate the unit for 10 minutes.
5. Rotate the element (end-to-end) 180 degrees in the cleaning tank and operate the unit for an additional 10 minutes.

— NOTE —

Cleaning duration should be adjusted depending on condition of the element. For best results, the cleaning solvent should be replaced every 20 minutes.

6. Using clean, lint-free gloves remove the element from the tank and remove the plugs.
7. Place the element in a clean location and allow to dry.
8. After the element has been cleaned, inspect the element using a magnifying glass for clogged passages and broken wires. If more than five percent of the visible passages are clogged, or if dents or broken wires are found, replace the element.
9. Install new O-rings on filter element whether element has been cleaned or is new.
10. Insert filter element (perforated flange first) into filter housing in compressor inlet case.
11. Install a new O-ring on filter cover.

— NOTE —

Insure that teflon spacer is in position on studs of filter cover.

12. Install filter cover and secure with four plain washers and self-locking nuts. Tighten nuts and torque to 32 to 36 inch-pounds.

ENGINE OIL CHIP DETECTOR.

The magnetic chip detector is installed at the 6 o'clock position on the reduction gearbox. The detector is connected electrically to the annunciator panel lights. Illumination of the CHIP DETECTOR light on the annunciator is an indication of metal contamination within the oil system. If the CHIP DETECT light illuminates, the chip detector should be removed and magnetic pole pieces inspected for type of contaminates per Pratt and Whitney Maintenance Manual, Part No. 3030442, Chapter 79.

— NOTE —

Whenever the chip detector is removed for inspection, the oil filter should also be inspected

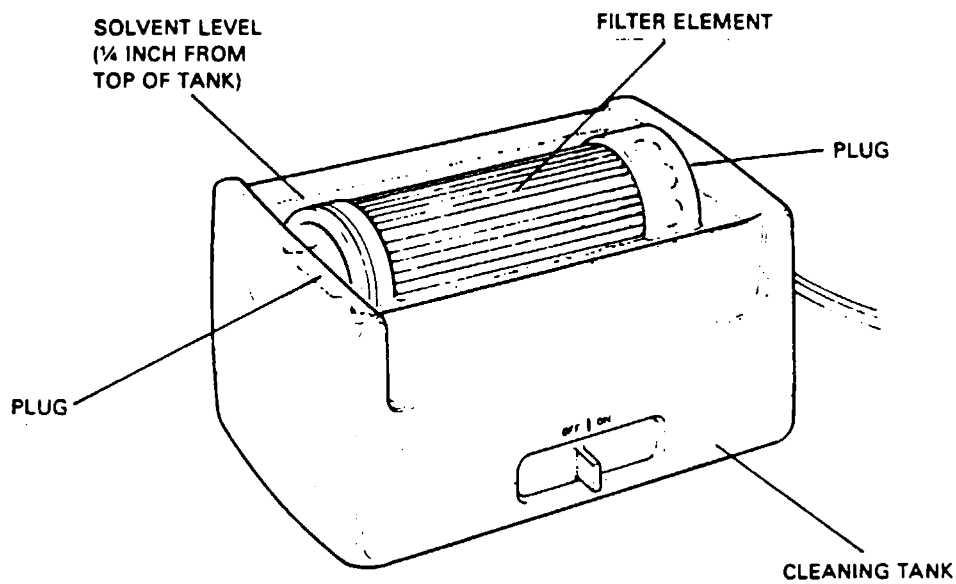


Figure 12-3. Electrosonic Cleaning Tank

REMOVAL OF CHIP DETECTOR.

1. Remove the wiring from the chip detector.
2. Place a suitable drip pan under the reduction gearbox to catch any oil spillage.
3. Remove the chip detector from the gearbox and discard the preformed packing.

INSPECTION OF CHIP DETECTOR.

1. If only a single chain of magnetic particles bridge the gap across the poles of the detector and the particles consist of small slivers, clean the chip detector by wiping with a lint-free cloth and reinstall.
2. If more than 10 pieces of small, nugget shaped magnetic material is evident on the detector, the engine should be shipped to an overhaul facility for inspection.
3. When a small amount of fuzz (powdered material) is evident, clean the detector and reinstall. Recheck for continuity after 10 hours of operation.
4. Should fuzz be found the second time, but the quantity has not increased, clean the detector, reinstall and make another continuity check after a further 10 hours of operation.
5. When fuzz is found a third time in similar or greater quantities, the engine should be shipped to an overhaul facility for inspection.

INSTALLATION OF CHIP DETECTOR.

1. Install the chip detector with a new preformed packing in the boss on the reduction gear box.
2. Tighten and torque the detector to 45 to 55 inch-pounds.
3. Connect plug and safety. (If cover is used, install new preformed packing, install cover on chip detector and torque 12 to 16 inch pounds).

RECOMMENDATIONS FOR CHANGING OIL. (Refer to United Aircraft of Canada Limited Engine Service Bulletin No. 12001, Latest Revision).

1. Major factors governing oil change periods are engine mechanical condition, spectrometer analysis of used oil, climatic conditions, dust and sand ingestion during takeoff and landing roll, engine utilization and possible shelf life limitations of synthetic lubricants.
2. Whenever the oil is changed, remove and check the oil filter element for metal particles. Clean and reinstall or replace depending on time in service. (Refer to Servicing Oil Filter Elements.)
3. No other oils are approved for commercial use other than the ones listed in UACL Service Bulletin No. 12001 (Latest Revision).

AIRFRAME LUBRICATION.

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

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

APPLICATION OF GREASE.

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

1. Where a reservoir is not provided around a bearing, apply the lubricant sparingly and wipe off any excess.
2. Remove wheel bearings from the wheel hub and clean thoroughly with a suitable solvent. When repacking with grease, be sure the lubricant enters the space between the rollers in the retainer ring. Do not pack the grease into the wheel hub.
3. Use extra care when greasing the Hartzell propeller hub to avoid blowing the clamp gaskets. Remove one grease fitting while applying grease to the other fitting. Uneven greasing will affect propeller balance.

APPLICATION OF OIL.

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

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

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.

THIS SPACE INTENTIONALLY LEFT BLANK

CHART 1201. SPECIAL INSTRUCTIONS

SPECIAL INSTRUCTIONS

1. CLEAN OR REPLACE OIL FILTER ELEMENT AT EACH OIL DRAIN PERIOD AS DESCRIBED IN CHAPTER 12 OF THE-MAINTENANCE MANUAL. IN AIRCRAFT WITH A TYPICAL UTILIZATION OF 50 HOURS/MONTH OR LESS, CHANGE ENGINE OIL EVERY 400 HOURS OR 9 MONTHS, WHICHEVER COMES FIRST. REFER TO THE LATEST REVISION OF UACL S/B NO. 1 FOR A LIST OF APPROVED OILS.
2. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY SOLVENT BEFORE RELUBRICATING.
3. OIL COOLER DOOR, ICE PROTECTION TRANSMISSION AND SCREWS, TRIM SCREWS - DISASSEMBLE AND CLEAN WITH A DRY SOLVENT. WHEN REASSEMBLING TRANSMISSIONS, LUBRICATE AND APPLY A THIN COATING TO SCREW.
4. OLEO STRUTS, POWER PACK RESERVOIR - FILL PER INSTRUCTIONS ON UNIT OR CONTAINER, OR REFER TO MAINTENANCE MANUAL, CHAPTER 12. (SEE CAUTIONS NUMBER 1).
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. PILOT AND PASSENGER SEATS - LUBRICATE TRACK ROLLERS AND STOP PINS.
8. LOOSEN BOOTS FROM LANDING GEAR LOCK ROD ASSEMBLY AND GREASE TUBE. TUBE MUST SLIDE FREE TO SLOT LIMITS .
9. WIPE EXPOSED STRUT WITH CLEAN CLOTH AND HYDRAULIC FLUID, MIL-H-5606

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.
3. CONTROL AND TRIM CABLES - WIPE CLEAN AT REGULAR INTERVALS BUT DO NO LUBRICATE.

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.

WARNING

1. JET FUELS AND LUBRICATING OILS HAVE AN INJURIOUS EFFECT ON SKIN. AVOID CONTACT AS MUCH AS POSSIBLE.

COMPONENT	LUBRICANT	FREQUENCY
1. GEAR DOOR, OUTBOARD, HINGES AND CONTROL RODS, RIGHT AND LEFT	MIL-L-7870	100 HRS
2. GEAR OLEO STRUT FILLER, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 4 AND CAUTION 1)	MIL-H-5606	AS REQUIRED
3. GEAR DOWNLOCK HOOK, CONTROL ROD ENDS AND BELLCRANK, RIGHT AND LEFT (STD. AND EMER.)	MIL-L-7870	100 HRS
4. WHEEL BEARINGS, RIGHT AND LEFT (SEE SPECIAL INSTRUCTION 2 AND NOTE 2)	MIL-G-81322 SEE NOTE 2	100 HRS
5. GEAR TORQUE LINK FITTINGS, RIGHT AND LEFT	MIL-G-23827	100 HRS
6. GEAR SIDE BRACE LINK BUSHING AND HOUSING BUSHING, RIGHT AND LEFT	MIL-G-23827	100 HRS
7. GEAR UPLOCK HOOK, CONTROL ROD ENDS, CYLINDER ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS
8. GEAR DOOR, INBOARD, HINGES AND CYLINDER ENDS, RIGHT AND LEFT	MIL-L-7870	100 HRS
9. BRAKE AND POWER PACK RESERVOIR (SEE SPECIAL INSTRUCTION 4 AND CAUTION 1)	MIL-H-5606	AS REQUIRED
10. GEAR LOCK ROD ASSEMBLY (STD. AND EMER.) (SEE SPECIAL INSTRUCTION 8)	MIL-G-3545	100 HRS
11. RETRACTION CYLINDER	MIL-H-5606	500 HRS

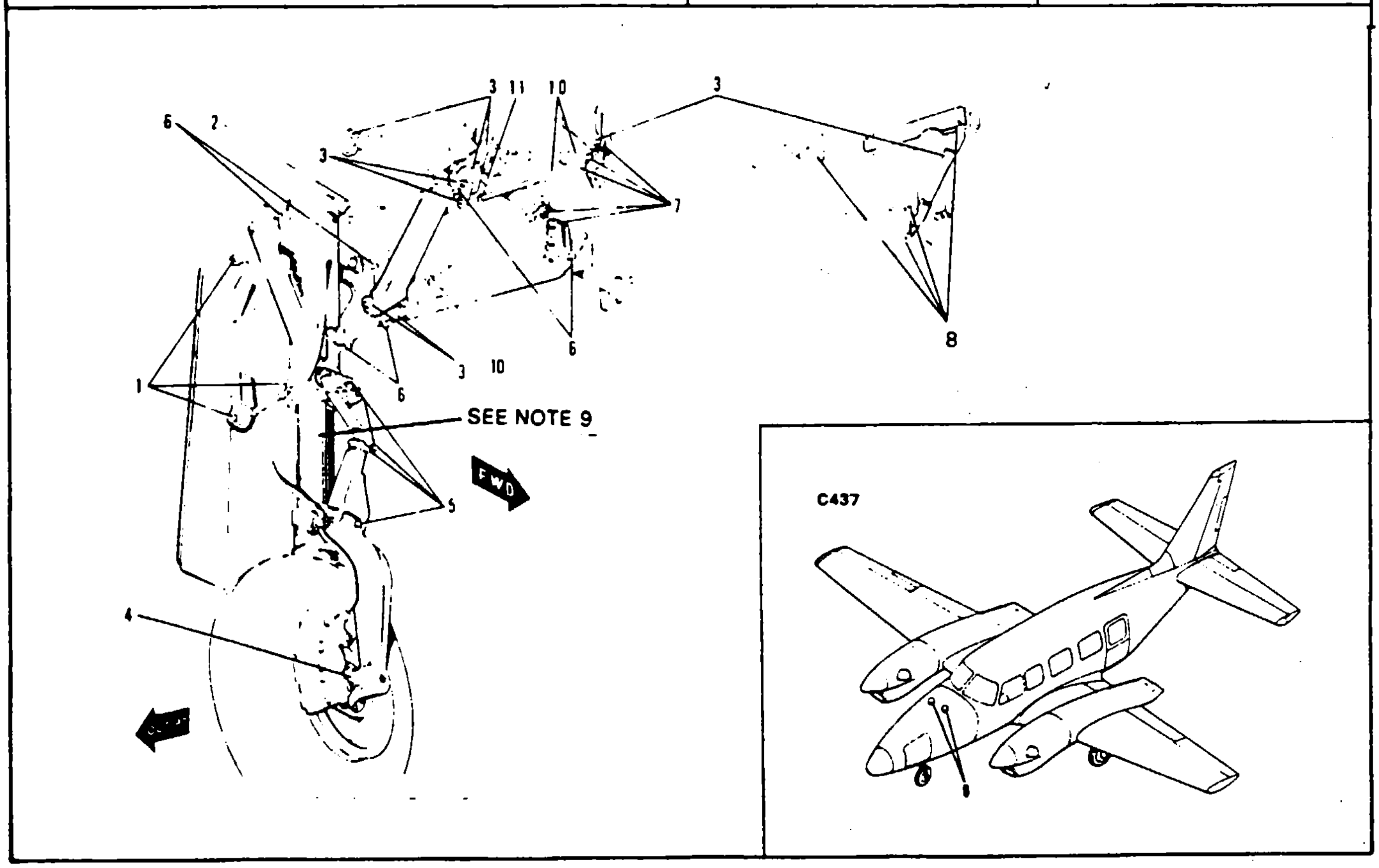
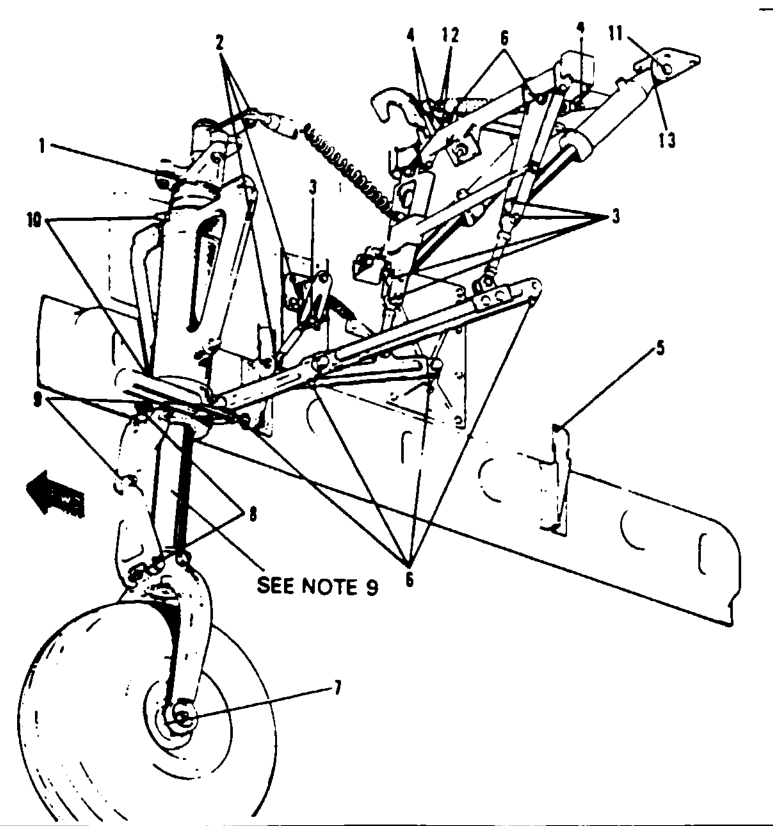
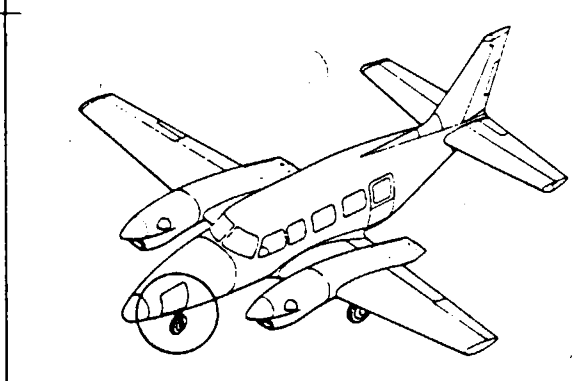


Figure 12-4. Lubrication Chart (Landing Gear, Main)

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 (STD AND EMER)	MIL-L-7870	100 HRS
4. UPLOCK HOOK AND UPLOCK ROD (STD AND EMER) SEE NOTE 8	MIL-L-7870	100 HRS
5. DOOR HINGES	MIL-L-7870	100 HRS
6. DRAG LINK ASSEMBLY AND IDLER LINK (STD AND EMER)	MIL-G-23827	100 HRS
7. WHEEL BEARINGS (SEE SPECIAL INSTRUCTION 2 AND NOTE 2)	MIL-G-3545	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-G-23827	100 HRS
10. GEAR HOUSING BUSHINGS	MIL-G-23827	100 HRS
11. RETRACTION ROD END	MIL-L-7870	100 HRS
12. UPLOCK ROD ASSEMBLY (STD AND EMER) SEE SPECIAL INSTRUCTION 8)	MIL-G-3545	100 HRS
13. RETRACTION CYLINDER (STD AND EMER)	MIL-L-5606	500 HRS





THIS SPACE INTENTIONALLY LEFT BLANK

Figure 12-5. 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. DELETED		
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 OR MIL-G-3278	500 HRS
13. FLAP TRANSMISSION SCREW	MIL-G-23827	500 HRS

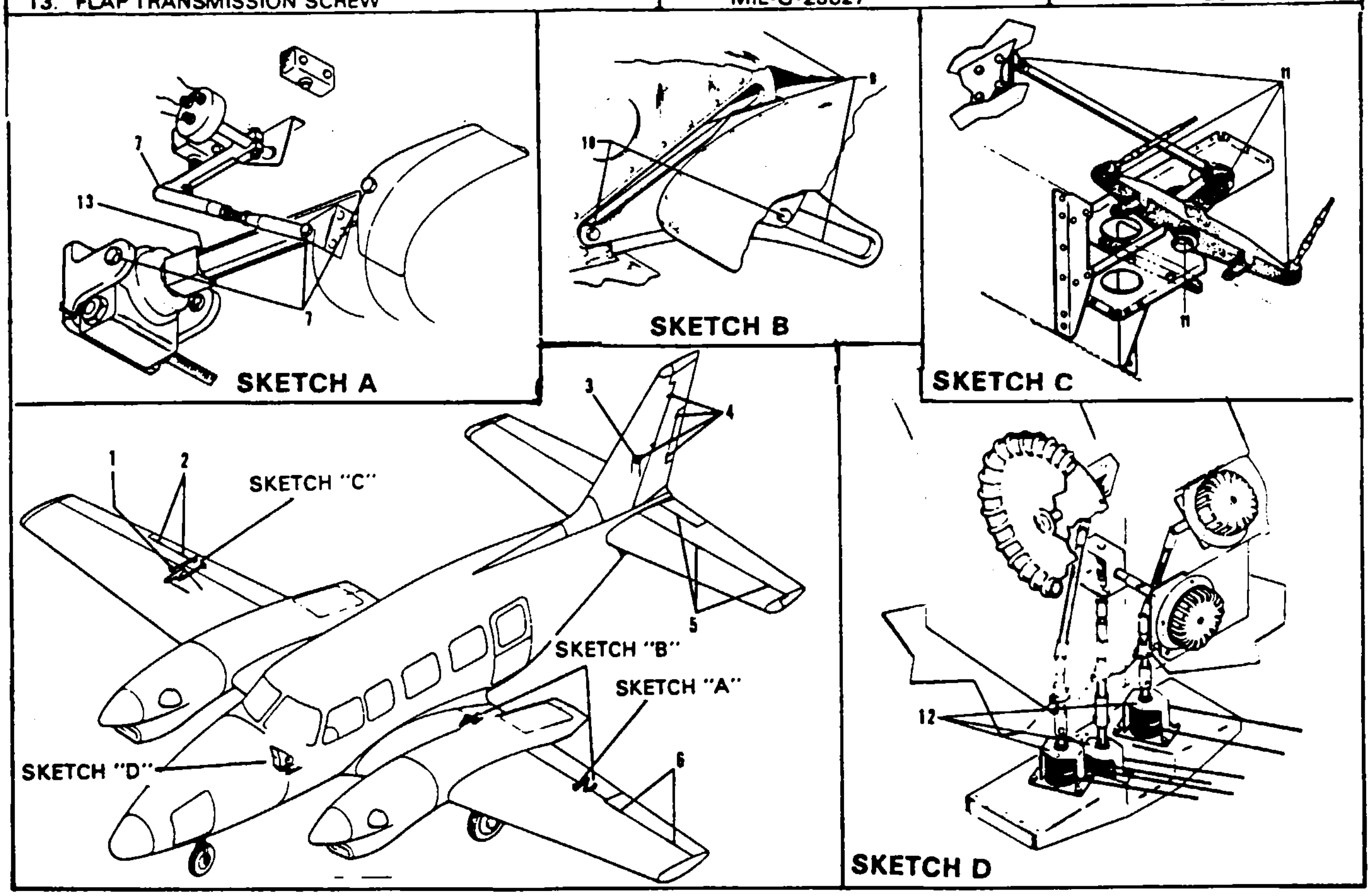


Figure 12-6. Lubrication Chart (Control System)

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, BRAKE CYLINDER ENDS AND PULLEYS	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 SCREW (SEE SPECIAL INSTRUCTION 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

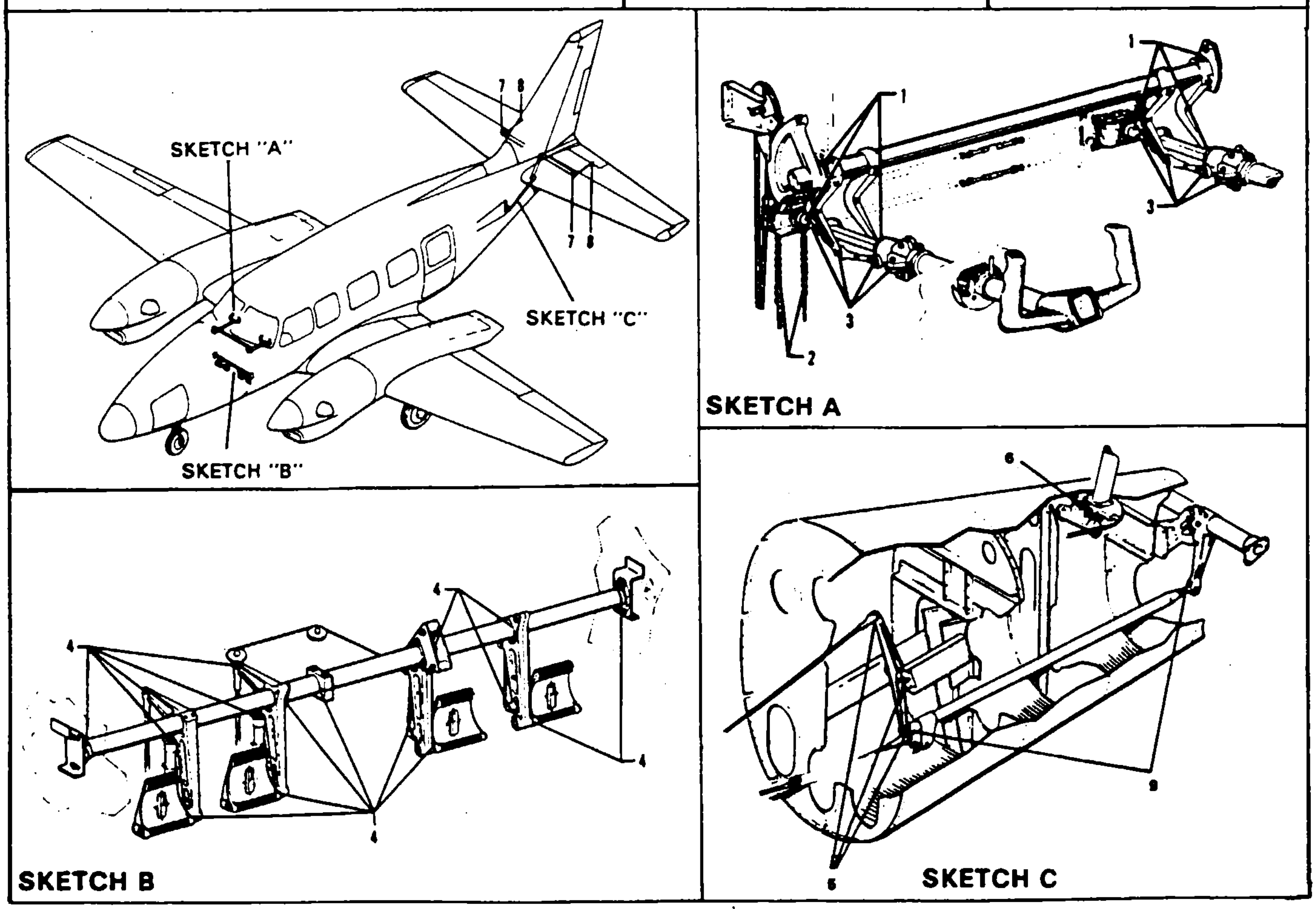


Figure 12-6. Lubrication Chart (Control System) (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. ZERK FITTINGS, BLADE HUB (2 PER BLADE)	MIL-G-23827	100 HRS
2. FUEL CONTROL UNIT INTERCONNECT ROD ENDS	MIL-G-23827	100 HRS
3. CONTROL CAM AND PINS, PIN GUIDE TRACKS	LUBRIPLATE 130A	100 HRS
4. PROPELLER CONTROL ROD ENDS	MIL-G-23827	100 HRS
5. OIL FILTER ELEMENT		REFER TO SPECIAL IN-STRUCTION NO. 1
6. OIL TANK		REFER TO SPECIAL IN-STRUCTION NO. 1
7. PUSH PULL CONTROL - WIRE ROPE	MIL-G-21164C	100 HRS

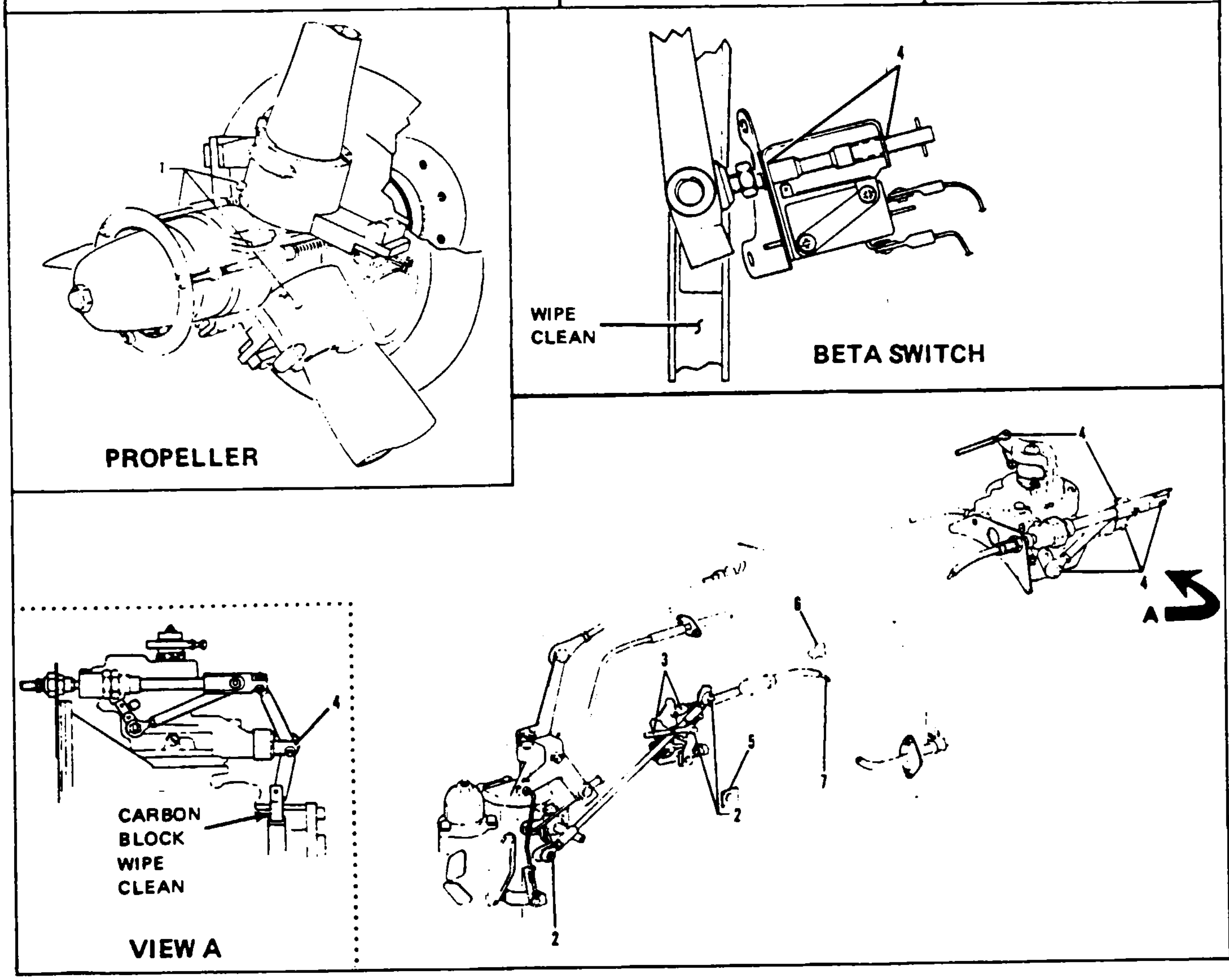


Figure 12-7. Lubrication Chart (Power Plant, Propeller and Propeller Reversing Linkage)

COMPONENT	LUBRICANT	FREQUENCY
1. TRANSMISSION ASSEMBLY (SEE SPECIAL INSTRUCTION 3)	2196-74-1 (DUKES)	500 HRS
2. TRANSMISSION SCREW (SEE SPECIAL INSTRUCION 3)	MIL-G-23827	500 HRS
3. SLEEVE AND BOLT ASSEMBLY	MIL-L-7870	100 HRS
4. OIL COOLER DOOR HINGE	MIL-L-7870	100 HRS
5. BEARING BLOCKS	MIL-G-23827	100 HRS
6. TRANSMISSION SCREW	MIL-G-21164C	500 HRS
7. TRANSMISSION MOUNTING BUSHINGS (SEE SPECIAL INSTRUCTION 2)	MIL-G-23827	500 HRS
8. CLEVIS PIN	MIL-L-7870	100 HRS
9. ICE DEFLECTOR DOOR ROD ENDS	MIL-L-7870	100 HRS

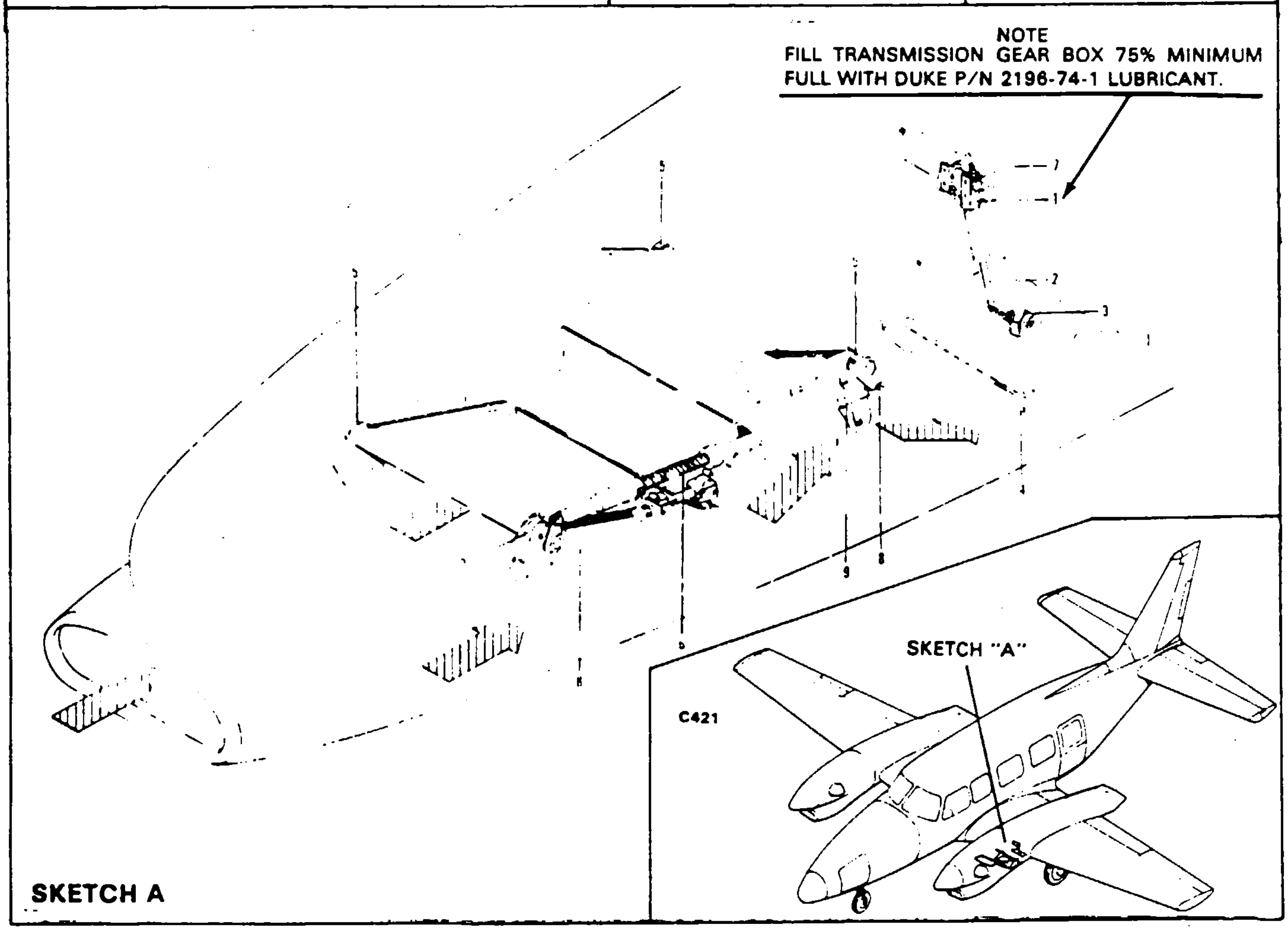


Figure 12-8. Lubrication Chart (Air Inlet Ice Protection - Oil Cooler Doors)

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

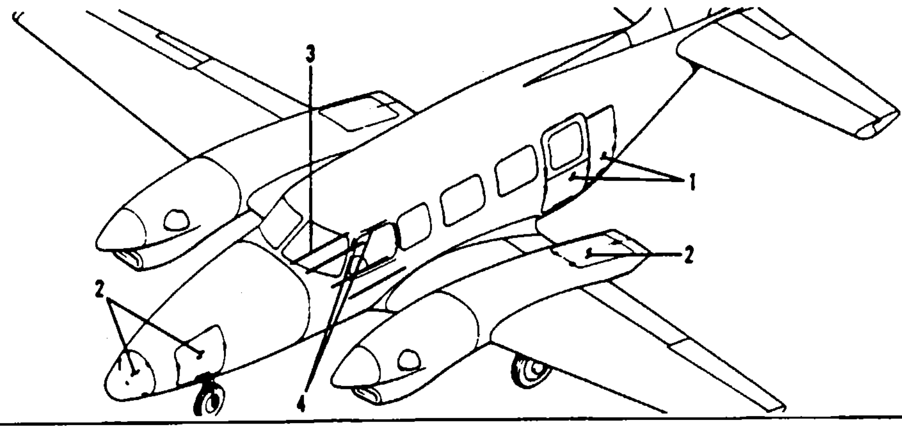
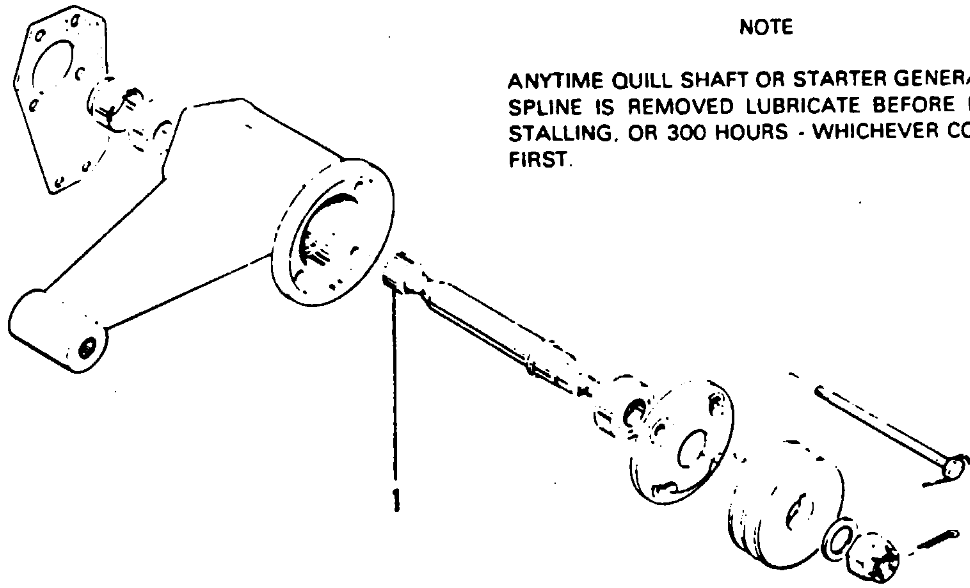


Figure 12-9. Lubrication Chart (Cabin Door, Baggage Door and Seats)

COMPONENT	LUBRICANT	FREQUENCY
1. SPLINES OF QUILL SHAFT	MIL-G-21164 PLASTIMOLY OR PLASTILUBE #3	SEE NOTE



NOTE

ANYTIME QUILL SHAFT OR STARTER GENERATOR SPLINE IS REMOVED LUBRICATE BEFORE REINSTALLING, OR 300 HOURS - WHICHEVER COMES FIRST.

Chart 12-10. Lubrication Chart (Air Conditioner Quill Shaft)

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-dehydrator. This is done by viewing the receiver-dehydrator sight gauge located immediately in front of the main spar on the right hand side beneath the spar box cover. To view the sight gauge, simply pull back the carpet on the spar box cover, remove the black plastic plug and the sight gauge will be visible. 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-dehydrator and any Borings in connections which were opened.

OXYGEN SYSTEM.

The optional oxygen system may consist of the 115 cubic foot system or the 22 cubic foot system, each of which has up to eleven outlets. The oxygen cylinder may be either forward or aft mounted. Maintenance instructions for the oxygen system may be found in Chapter 35.

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, fuel 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 in 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 for the oxygen system is accessible through an access door located on the right side of the fuselage tail section for systems having the aft mounted cylinder and on the left side of the nose section for systems having the forward mounted cylinder.

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

   —NOTE—

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

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

CHART 1202. INDICATED OXYGEN PRESSURES FOR GIVEN AMBIENT TEMPERATURES

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

ENGINE/COMPRESSOR WASHING.

As a result of accumulated environmental airborne chlorides which cause deterioration of compressor blades by a process known as sulphidation, Pratt and Whitney Aircraft recommends a compressor wash be carried out weekly regardless of the apparent atmospheric condition, and more often if significant atmospheric pollution is suspected.

The Pratt and Whitney 3030442 service manual for the PT6A-11 engine gives full, detailed instructions for the washing of the engine and compressor. For specific instructions peculiar to the Piper installation, the following additional instructions should also be used.

—CAUTION—

Before any type of cleaning make sure the cables are properly sealed to prevent water from entering the cable housings. Try not to direct any water pressure at these seals. Water could freeze and bind cables under certain conditions.

1. Allow the engine to cool for at least 40 minutes before performing a compressor wash.
2. With the top cowling removed, disconnect the bleed air line at the union, just below the "T" connection, and securely cap the lines.
3. Install the ground run cowl.
4. On the affected engine, open the access door on the side of the bottom cowl and with the cleaning mechanism attached to the wash ring fitting, perform the cleaning as directed in the P&W service manual.
5. A soaking period of about 15 minutes should be observed after wash.

—NOTE—

Motor engine with starter only. Make sure ignition is off and appropriate fuel "firewall shut-off valve" is closed.

Due to chemicals in tap water which may cause deposits on compressor blades, tap water should not be used.

—CAUTION—

Observe starter operating limits of 30 seconds on 60 seconds off, 30 seconds on 60 seconds off, 30 seconds on and then 30 minutes off. Insure that P3 heater (fuel control heat) circuit breaker is pulled.

—END—

1G17 THRU 1G20
INTENTIONALLY LEFT BLANK

CHAPTER

20

STANDARD PRACTICES/ AIRFRAME

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

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

STANDARD PRACTICES—AIRFRAME.

TORQUE WRENCHES.

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

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

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

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

EXAMPLE

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

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

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

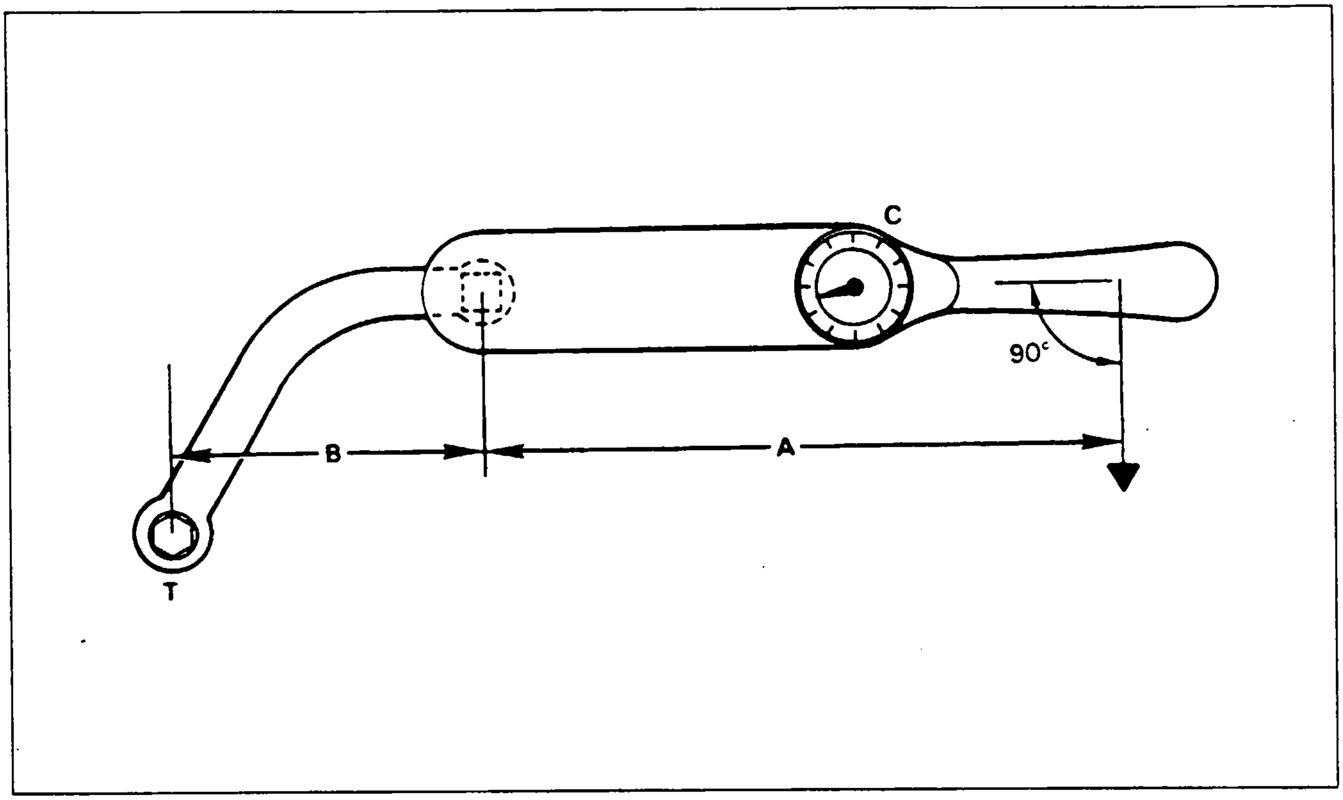


Figure 20-1. Torque Wrench Extension

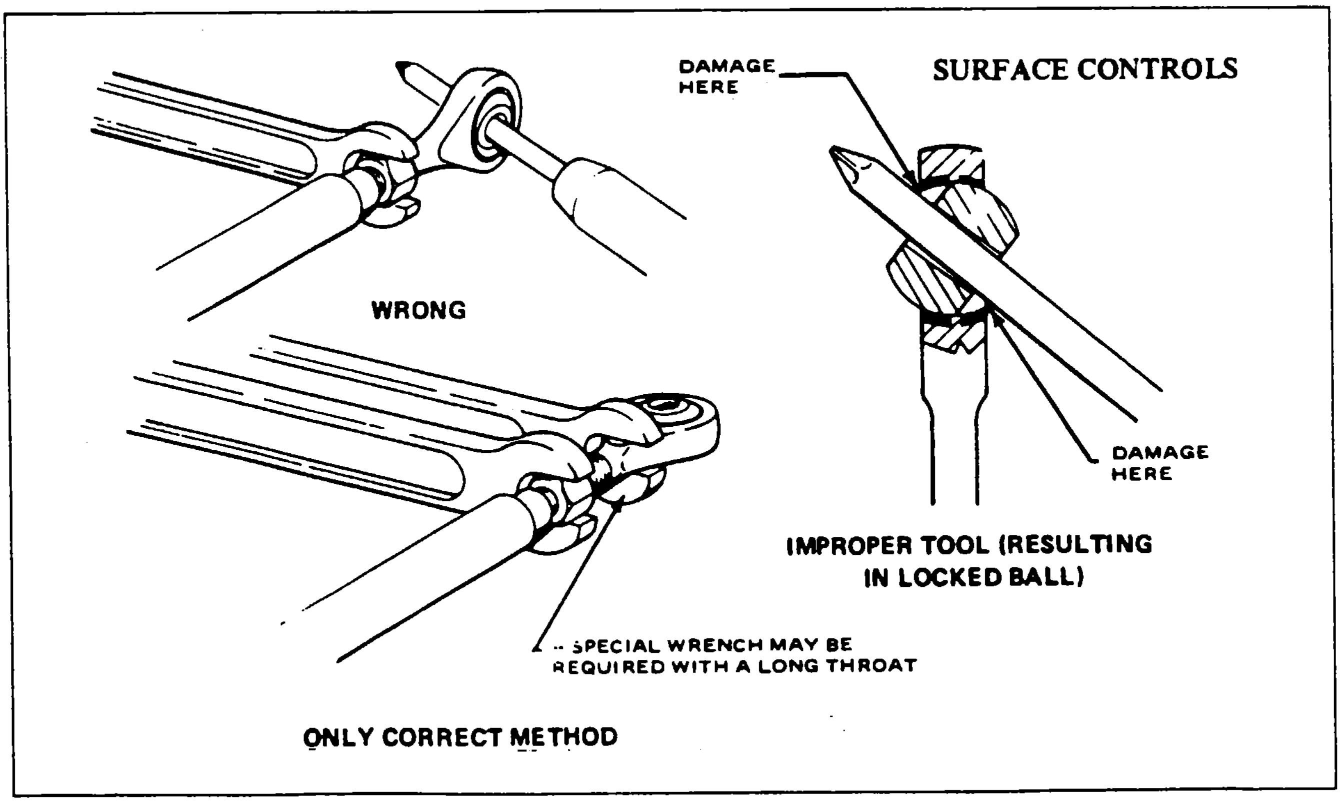


Figure 20-2. Correct Method of Installing Rod End Bearings

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

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

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

—NOTE—

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

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

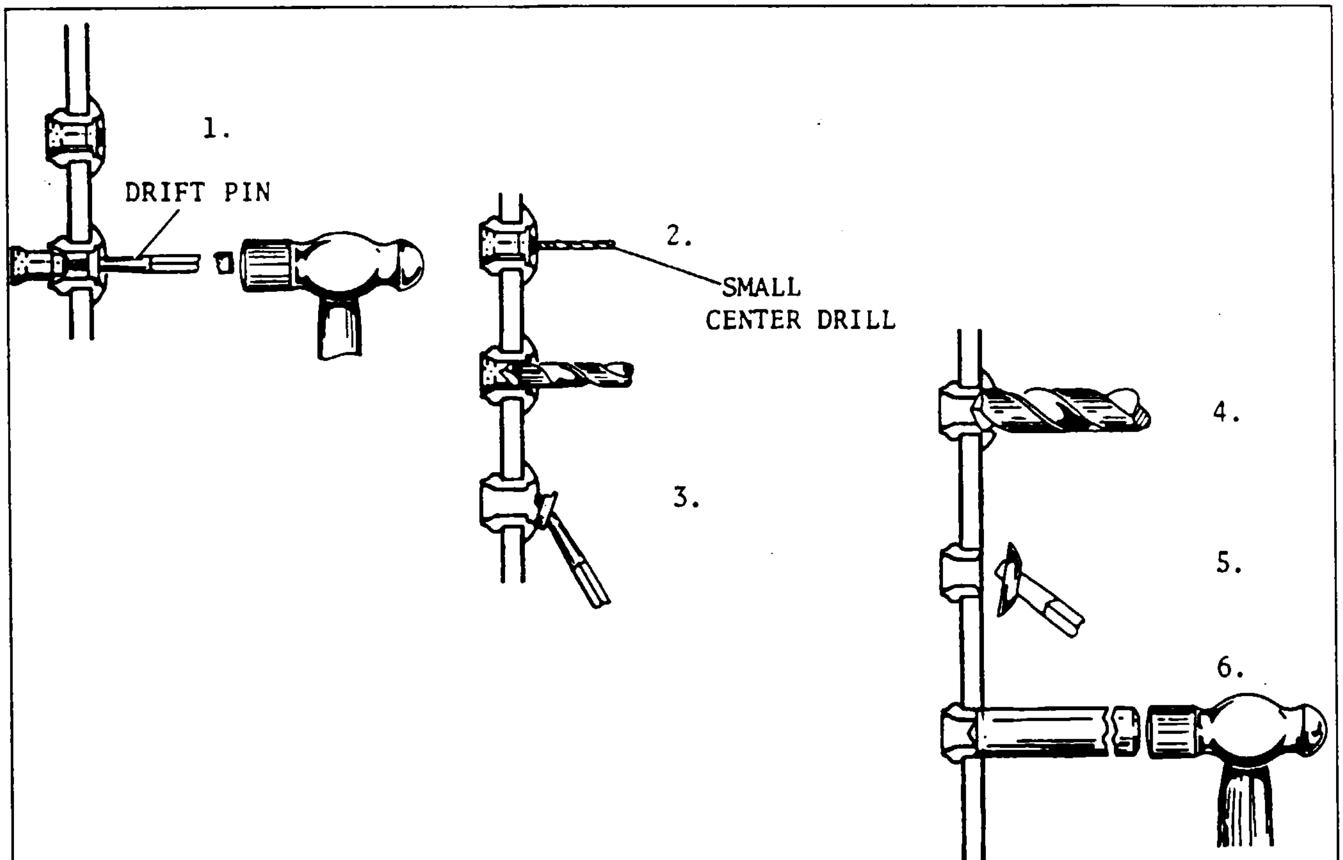


Figure 20-3. Cherrylock Rivet Removal

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

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

In most instances, fluid lines are marked with 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.

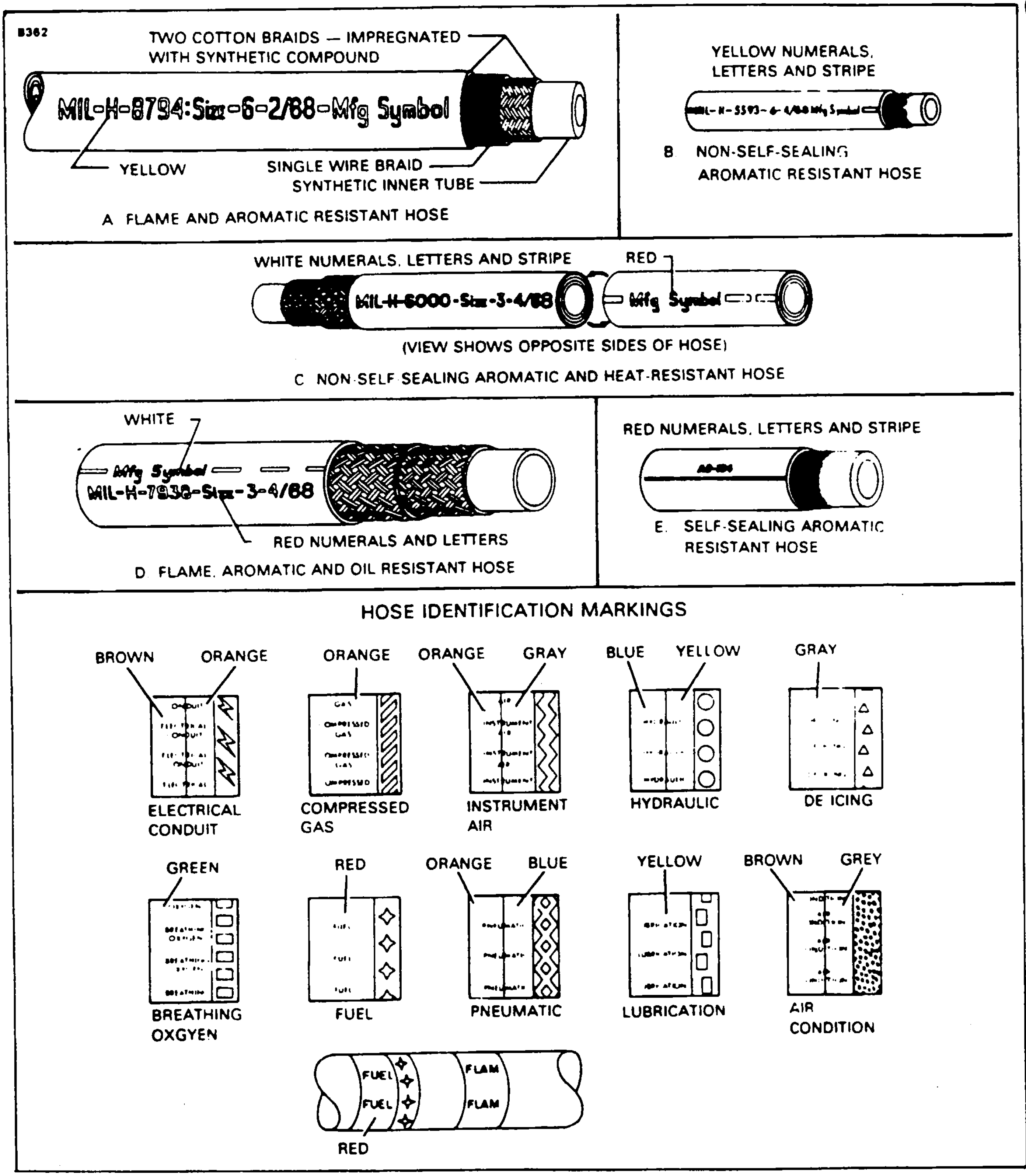
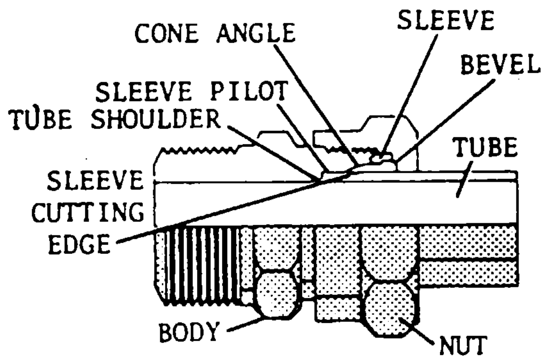


Figure 20-4. Hose/Line Markings

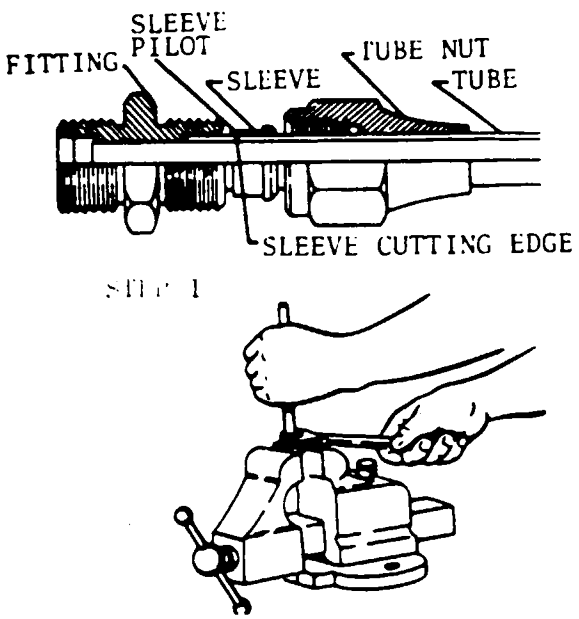
TUBING SYSTEM	LUBRICANT
HYDRAULIC	MIL-H-5606
FUEL	MIL-H-5606
OIL	System Oil
PNEUMATIC	MIL-L-4343
OXYGEN*	MIL-T-5542

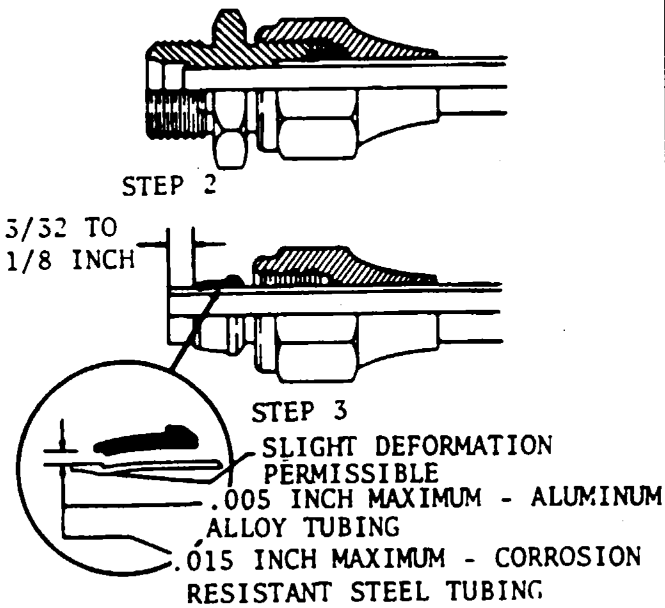
*CAUTION-DO NOT USE OIL OR GREASE

TUBING AND HOSE LUBRICANTS



FLARELESS-TUBE FITTING





PRESETTING FLARELESS-TUBE ASSEMBLY

Figure 20-5. Flareless Tube Fittings

CHART 2001. THREAD LUBRICANTS

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

—NOTE—

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

CHART 2002. MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

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

LUBRICATION OF GASKETS AND SEALS.

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

LUBRICATION OF THREADS.

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

The following steps should be followed when applying thread lubricants:

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

AIRCRAFT FINISH CARE.

CLEANING - GENERAL.

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 Titanine polyurethane enamel.

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 (not on deicer boots) 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 and Agemaster material. This is a special compound which will not harm the rubber surface of the deicer boots.

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

CLEANING INTERIOR SURFACES.

HEADLINER, SIDE PANELS AND SEATS.

1. Clean headliners and side panels with a good quality spray cleaner. such as Fantastic spray cleaner. Follow the manufacturer's instructions carefully.

—CAUTION—

Solvent cleaners require adequate ventilation.

2. Clean seats with a stiff bristle brush and vacuum where necessary.

CARPETS.

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

CLEANING EXTERIOR SURFACES.

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

1. Flush away loose dirt with water.
2. Apply cleaning solution with a rag, sponge or soft bristle brush.
3. To remove stubborn oil and grease, use a cloth dampened with naphtha.
4. Where exhaust stains exist, allow solution to remain on the surface longer. A cleaning compound may be used on the stainless steel exhaust shield.
5. Any good automotive wax may be used to preserve the painted surfaces. Soft cleaning cloths or a chamois should be used to prevent scratches when cleaning or polishing. A heavier coating of wax on the leading surfaces will reduce the abrasion problems in these areas. Do not put wax on deicer boots.

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 (side windows only) 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. The doors may be closed by turning the master switch on and actuating the emergency hand pump.

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.

FIELD CLEANING ENGINE.

Field cleaning of the engine consists of internal washing of the compressor and external washing of the engine. Refer to Pratt and Whitney Aircraft of Canada, Ltd. Maintenance Manual No. 3030442 for details and Chapter 12 of this manual for precautions.

CORROSION CONTROL.

Corrosion is the deterioration of metal by chemical or electrochemical attack. Water which is allowed to remain An 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 structural failure is by disassembly and inspection. Insulating is necessary between two contacting dissimilar surfaces (2-3 coats of zinc chromate or a coat of epoxy polyamid 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 pipe thread grease fittings, clevis pin joints and shrink fit parts.
5. Fretting Corrosion takes place when two parts rub together, constantly exposing fresh active metal to the corrosive effects of the atmosphere.
6. Filiform Corrosion is the appearance of numerous meandering threadlike filaments of corrosion on the surface of various types of metal.

CONDITIONS AFFECTING CORROSION.

Some conditions which affect the occurrence of corrosion are:

1. Heat and humidity increase corrosion.
2. Different metal and their relative sizes affect resistance or susceptibility to corrosion.
3. Frequent contributing factors to corrosion are:
   A. Soil and atmosphere dust
   B. Oil, grease and exhaust residues
   C. Salt water and salt moisture condensation
   D. Spilled battery acids and 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 a semi-acid condition should be inspected monthly. A semi-acid condition is likely to occur in industrialized areas where sulphurbearing particles in dust, smoke and smog attack painted surfaces.
3. Inspections for corrosion should be performed by personnel familiar with corrosive problems and their remedies.
   A. Daily and preflight inspections should include the engine frontal areas, all intake vents, engine compartments, gaps, seams, and faying surfaces in the exterior skins, wheel and wheel well areas, battery compartment, 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 rapid 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 scaling 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.

—NOTE—

The depth of material removed should not exceed safe limits.

—CAUTION—

Removal of "severe corrosion" may be considered a major repair. Any repair of this type must be approved by the FAA before returning the airplane to service.

CHART 2003. TYPES OF METAL CORROSION

Type of Material	Type of Corrosion	Remedy**
Steel	Rust*	Complete removal of corrosion by mechanical means
Aluminum	White to grey powdery material	Mechanical polishing or brushing 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 products 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 material (ex. steel wool on aluminum). Remove only the material required to clean up the affected area.

AREAS PRONE TO CORROSION.

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

1. Areas around steel fasteners are susceptible to corrosion. The paint on these areas cracks which allows moisture to seep in and corrode the underlying metal. Each time the fastener is removed, it should be coated with zinc chromate before reinstallation. The paint should be wet when the fastener is 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. Spot welded assemblies are particularly prone to corrosion. The only means to prevent this type of corrosion is by keeping potential moisture entry points in the spotweld filled with a sealant or preservative compound. On an aluminum spot welded assembly a chromate conversion coating before paint is applied will help prevent corrosion.
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, assemblies and fittings, maintaining a protective coverage is difficult. The especially troublesome areas are: 1. Magnesium wheels: around boltheads, lugs and wheel well areas: 2. Exposed rigid tubing, B-nuts, ferrules; under clamps and tubing identification tape; 3. Exposed position indicator switches and other electrical equipment; 4. Crevices between stiffeners, ribs and lower skin surfaces. 5. Downlock rod (Refer to the latest revision of Piper S/L 755).
6. Flaps, flight control slots and equipment installed in these areas may corrode unnoticed unless a careful surveillance is maintained.
7. Engine frontal areas, air inlet ducts and the leading edge of wings, because they are constantly exposed to abrasion by dirt, dust, gravel and rain, should be checked frequently for the beginning of corrosion.
8. Hinges (piano hinges especially) are extremely vulnerable to corrosion due to the wearing away of their protective coating and their being a natural trap for dirt, salt and moisture.
9. Control cables may have bare spots in their preservative coating which could lead to corrosion. Cables having external corrosion should be checked for internal corrosion. If internal corrosion is present, replace the cable. If only external corrosion is present, remove corrosion with a wire brush and recoat cable with preservative.
10. Any area where water may be trapped is a trouble spot for corrosion. Drain holes should be checked and cleaned regularly.
11. Battery compartment and vent openings are particularly prone to corrosion due to spilled electrolyte. Fumes from overheated battery electrolyte will spread to adjacent areas and cause rapid corrosion of unprotected surfaces. Frequent cleaning and neutralization of deposits will minimize corrosion from this cause.
12. Due to magnesium parts being prone to corrosion, special attention should be given to their surface treatment, proper insulation (due to dissimilar metal corrosion) and paint coatings.
13. Electrical components and connectors should be checked. Their inspection frequency should be based on their operational environment and past trouble with them.
14. Skin joints and lap-overs are two areas which may contain moisture. Corrosion in these areas may go unnoticed unless particular attention is paid to them during inspection.
15. Hoses having an internal wire braid which are located in a position where they are frequently water soaked need a protective treatment.
16. Drilled holes and the trimmed end of sandwich panels should be protected. An inhibitor solution and/or sealant application is recommended. Any gaps or cavities which allow dirt or moisture to enter should be filled with a sealant.

PAINTING.

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

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

PAINTING SAFETY.

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

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

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

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

—CAUTION—

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

SANDING.

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

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

If a circular motion can't be used, do not sand in a straight line with the fingers pointing in the direction of the strobes. 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 as 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 in to contact with any surfaces which are to be painted, as the lubricant is very difficult to remove completely.

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

SPRAY PATTERNS.

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

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

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

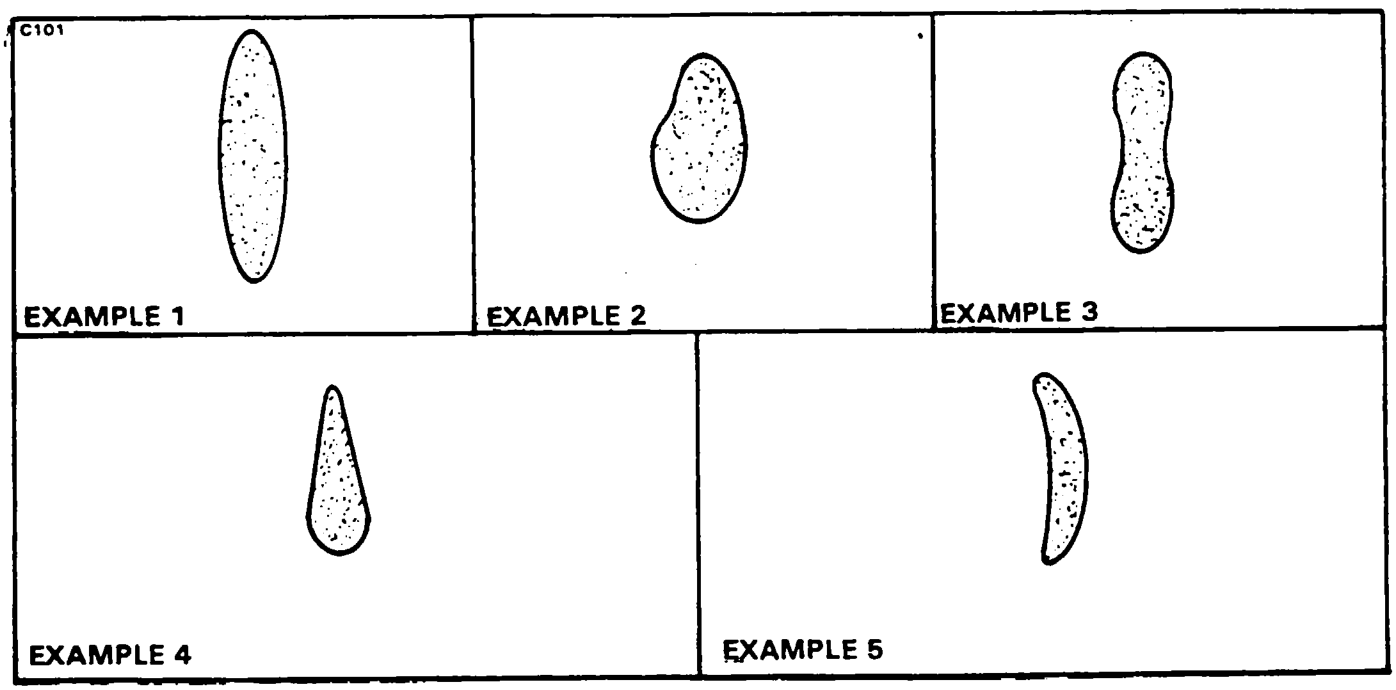


Figure 20-6. Spray Patterns

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

—CAUTION—

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

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

CLEANING SPRAY GUN.

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

—NOTE—

Remove pressure from equipment before beginning cleanup.

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

—CAUTION—

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

SPRAY TECHNIQUES.

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

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

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

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

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

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

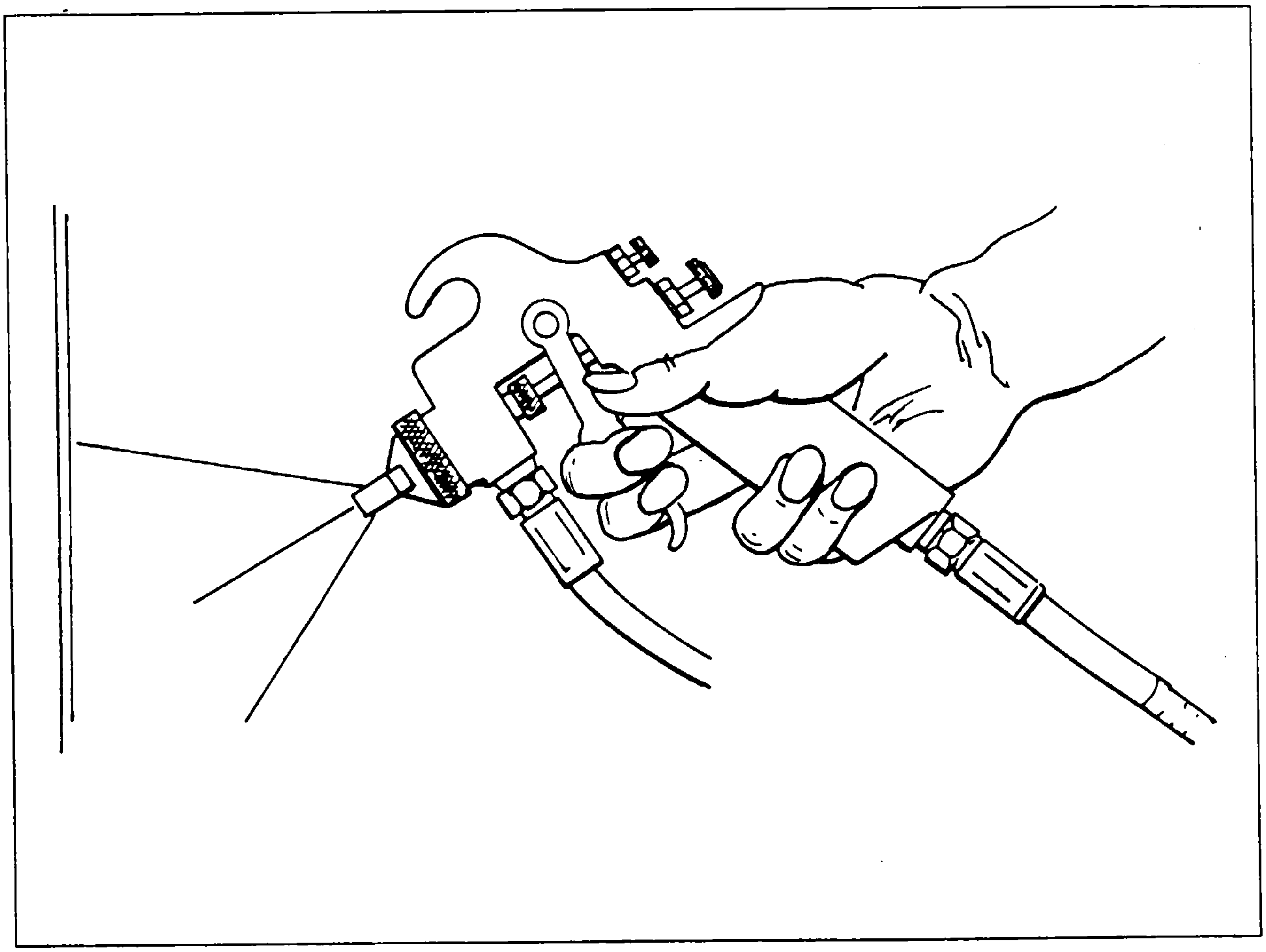


Figure 20-7. Improper Spray Technique

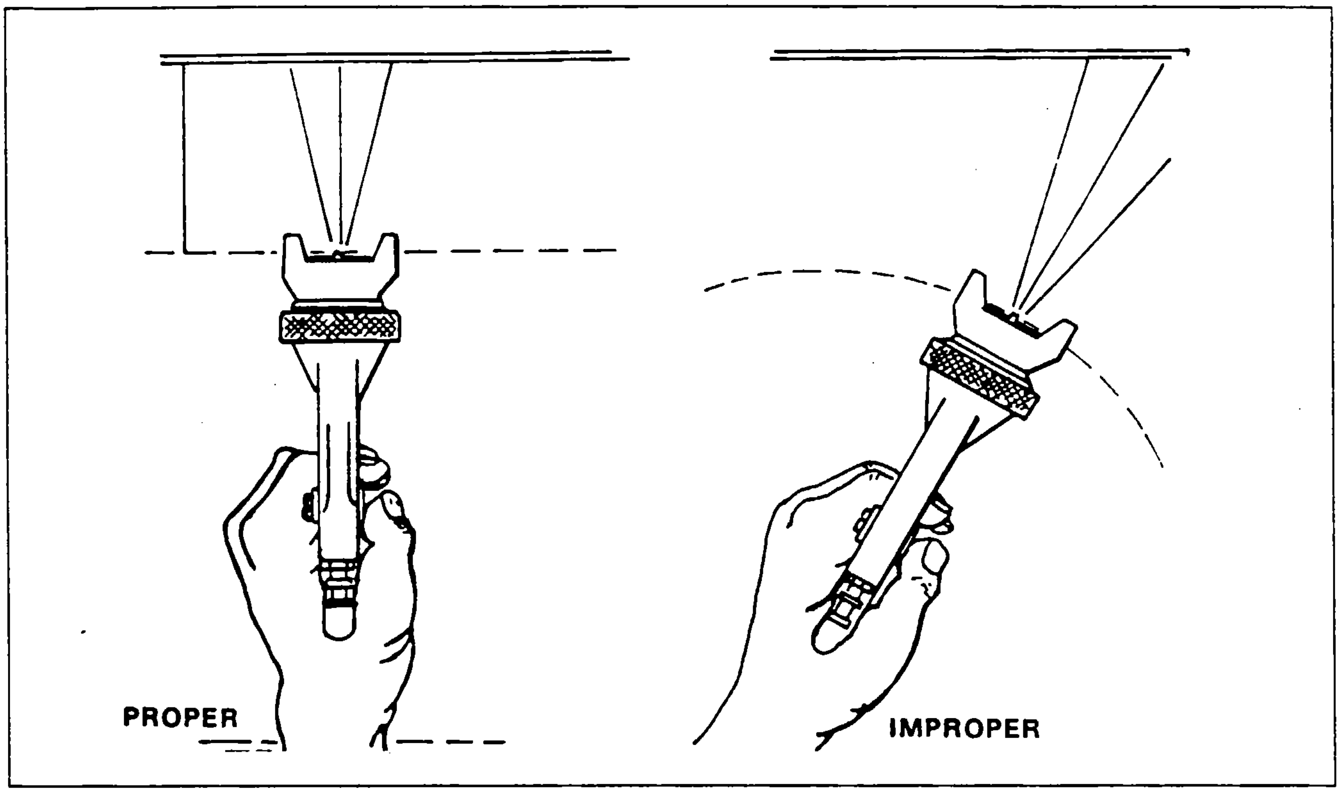


Figure 20-8. Spray Technique

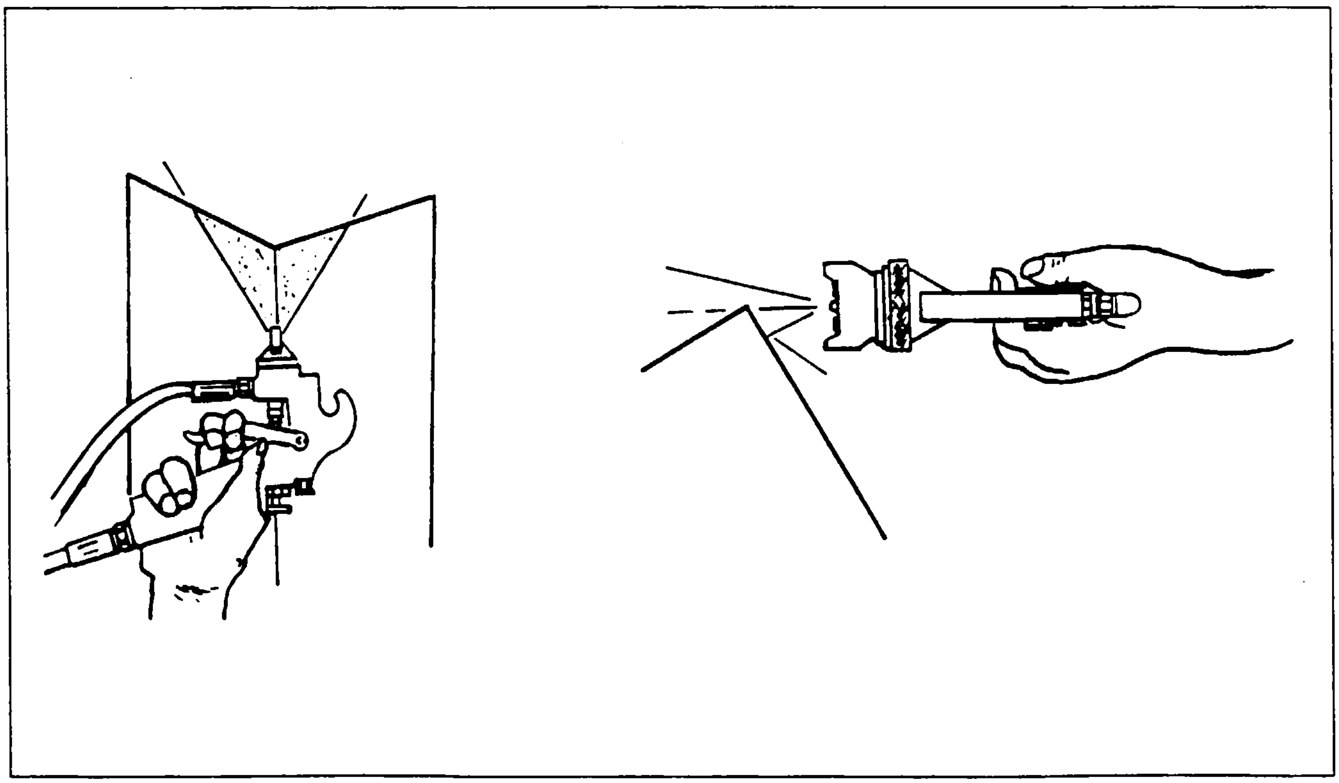


Figure 20-9. Spraying Corners

AIRCRAFT PAINTING SEQUENCE.

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

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

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

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

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

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

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

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

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

COLOR MATCHING.

—NOTE—

See aircraft logbooks for color codes.

—WARNING—

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

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

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

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

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

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

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

POLYURETHANE PAINT SAFETY.

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

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

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

DIFFICULTIES WITH POLYURETHANE.

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

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

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

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

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

APPLICATION OF POLYURETHANE.

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

—NOTE—

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

—CAUTION—

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

B. Rinse thoroughly with water (pay particular attention to rivets and seams).

C. Wipe with Methyl Ethyl Ketone.

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

D. For fiberglass parts, remove old finish by sanding followed by wiping with MEK. Proceed to step G.

E. For aluminum parts, clean and condition metal with step A, 225S cleaner, follow with step B 226S conversion coating. Proceed to step G.

F. For magnesium parts, apply step B226S conversion coating (diluted with 6 parts water). Rinse and dry.

G. Prime surface to be painted with Corlar Epoxy Primer or Multi-Purpose Primer Surfacer.

H. Allow to dry at least 4 hours before topcoating.

I. Sand; then wipe with 3812S Reducer.

J. Tack wipe surface to be painted before applying topcoat.

K. Mix enamel as per manufacturer's directions.

L. To apply solid colors, use 50 PSI at the gun for siphon equipment. Spray a medium first coat, allow to tack up and follow with a full second coat.

M. To apply metallic colors, use 65 PSI. Apply a light medium tack coat. Allow to set up for 20 minutes. Repeat for a second coat. Then reduce 15% with 8485S (17-18 seconds in a #2 Zahn cup) and apply a third light medium coat. Another light medium coat of the reduced paint may be added. After drying, this may be clear coated with 500S clear.

—NOTE—

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

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

—NOTE—

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

—CAUTION—

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

—WARNING—

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

—WARNING—

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

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

—NOTE—

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

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

—NOTE—

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

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

—NOTE—

Do not leave mixed material in spray equipment. Clean an 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 follow instructions are by volume only.

3. Alumigrip Method.

A. Zinc Chromate Wash Primer - Thoroughly mix one part each of zinc chromate wash primer and acid reducer. If blushing is encountered during application, add one part of retarder to the previous solution.

B. Urethane Primer - Thoroughly mix two parts urethane primer and one part primer catalyst. Thin as required with urethane thinner. The recommended viscosity is 18 to 20 seconds using a number 2 Zahn Cup.

—*NOTE*—

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

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

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

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

D. Surface Preparation - After removing old finish, if any, clean areas to be painted with ScotchBrite pads and water. Follow this by wiping clean with water or an appropriate solvent. Prior to application of primer wipe the areas with M.E.K. and clean rags.

E. Primer Application - Coat parts to be painted with zinc chromate wash primer solution followed by a coat of urethane primer solution. Coat fiberglass parts only with urethane primer solution.

Allow the zinc chromate wash primer to dry 30 minutes minimum before applying the urethane primer. Allow the urethane primer to dry two to four hours before applying urethane enamel.

—*NOTE*—

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

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

4. Titanine Polyurethane Method.

—*NOTE*—

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

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

—*NOTE*—

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

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

C. Polyurethane Enamel - Thoroughly mix 1 part enamel catalyst, 1/2 part enamel reducer (except when using flat black; then increase enamel reducer to 2 parts), and 4 parts urethane enamel. Allow to stand for 15 minutes then remix before use.

Thin as required with enamel reducer. Recommended viscosity is 38 to 40 seconds using a number 1 Zahn Cup.

D. Refinish - Installation of pressure - sensitive decals, placards and tapes on Titanine Polyurethane finish.

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

5. Ameron Method.

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

—*NOTE*—

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

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

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

C. Mix intermediate epoxy primer to manufacturer's directions. Thin 20-30% by volume with MX-15 thinner. Air dry 4-6 hours at 75°F or force dry 2-3 hours at 125°F before top coating with Jet-Glo.
D. Tack wipe surface before applying topcoat.
E. Mix Ameron Jet-Glo polyurethane enamel to manufacturer's directions. Reduce with 110-655 thinner to a viscosity of 17-20 seconds using a No. 2 Zahn Cup at 75°F.
F. Apply Jet-Glo to a spreading rate of approximately 300 sq. ft./gal. to attain a 2.0 mil. dry film thickness. A recommended pot pressure of 10-13 PSI and an atomizing 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 methy ethyl ketone. MEK will pick up the pigments from an acrylic finish, but not from epoxy or cured Urethane coatings. Wipe the surface, don't rub. Heavy rubbing will pick up even epoxy and Urethane pigments from coatings that aren't fully cured.

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

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

4. Meyercord Decals - A list of materials needed to install Meyercord #1505 gly solvent type decals along with suggested suppliers of the materials is given in Chart 2004.
   A. Apply a thin coat of 1698-S cement to the area to which the decal is to be applied.
   B. Allow cement to dry until tacky.
   C. Prepare solvent solution in a mixture of 8 parts water to 1 part 1505 gly and then dip transfer in solution for 4 to 5 seconds.
   D. Position decal and squeegee firmly from center to edges.
   E. Remove excess solvent with damp sponge. Droplets may spot the finish. Wait 30 seconds and peel off backing paper.
   F. Wipe over decal with water dampened sponge and wipe dry.
   G. Clean up excess cement with 1647 cleaner and wipe dry.
   H. Allow decal to dry thoroughly before handling excessively.

CHART 2004. LIST OF MATERIALS (MEYERCORD DECALS)

ITEMS	DESCRIPTIONS	SUPPLIERS
Solvent	Meyercord 1505 gly	Meyercord Corporation 365 East North Avenue Carol Stream (Wheaton) Illinois 60187 Phone (312) 682-6200
Cleaner	Meyercord 1647	
Cement	Meyercord 1698-S	
Shallow Pan or Tray. Squeegee and Sponge		Obtain from Local Suppliers

THIS SPACE INTENTIONALLY LEFT BLANK

GRIDS 1I9 THRU 1L24
INTENTIONALLY LEFT BLANK

T1000

AIRLINE DIVISION

T1040

MAINTENANCE MANUAL

CARD 2 OF 5

PA-31T3 T1040

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 765)

2A1

INTRODUCTION.

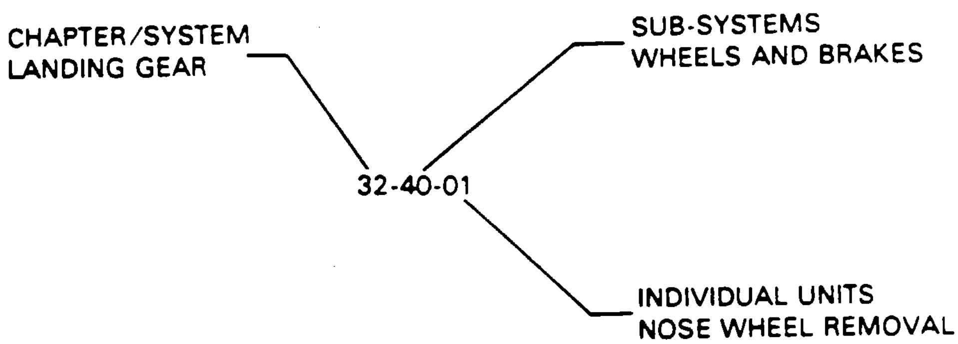
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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-31T3/T-1040 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 T-1040 Parts Catalog P/N 761 761, 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)

6. Revisions to Service Manual 761 765 issued March 26, 1982 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG820326	March 26, 1982	1, 2, 3, 4 and 5
PR820804	August 4, 1982	1, 2, 3, 4 and 5
PR821115	November 15, 1982	1, 2, 3, 4 and 5
PR830225	February 25, 1983	1, 2, 3, 4 and 5
PR840305	March 5, 1984	1, 2, 3, 4 and 5
PR840713	July 13,1984	1, 2, 3, 4 and 5
PR860203	February 3, 1986	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 it with the revised card.
DO NOT DISPOSE OF CARDS 1, 3, 4 and 5

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

SERIAL NUMBER INFORMATION

PA-31T T1040 - 1982
SERIAL NUMBERS 31T-8275001 TO 31T-8275025 INCL.
PA-31T T1040 - 1983
SERIAL NUMBERS 31T-8375001 TO 31T-8375005 INCL.
PA-31T T1040 - 1984
SERIAL NUMBERS 31T-8475001 AND UP..

- *WARNING* -

When servicing or inspecting vendor equipment installed in Piper aircraft, it is the user's responsibility to refer to the applicable vendor publication.

VENDOR PUBLICATIONS.

BATTERY:

Gill Lead-Acid Battery (Teledyne Battery Products) Service Manual	= P/N : GSM - 682
SAFT Nickel-Cadmium Battery Operating and Maintenance Manual	= P/N : DC 3176-5A
Marathon Nickel Cadmium Battery Instruction Manual	= P/N : BA-89

DE-ICE SYSTEM (PROPELLERS):

B.F. Goodrich Electrothermal Propeller Deice Maintenance Manual	= P/N : 68-04-712 (Latest Revision)
B.F. Goodrich Electrothermal Propeller Deice Installation and Removal Procedures	= P/N : 59-728 (Latest Revision)

ENGINE:

PT6A-11/110 Maintenance Manual	= P/N : 3030442

HEATER:

Maintenance and Overhaul Manual	= P/N : 24E25-1

PROPELLER:

Hartzell Overhaul Manual	= P/N : 117-D
Hartzell Spinner Assembly and Maintenance Manual	= P/N: 127

VENDOR PUBLICATIONS (cont).

STARTER-GENERATOR

Auxilec, Inc. Maintenance and Overhaul Manual	= P/N: 8013C
Lear Siegler, Inc. Maintenance Manual (All Models)	= P/N: 23700
Lear Siegler, Inc. Overhaul Manual, Series 23048	= P/N: 23202

PIPER PUBLICATIONS.

PARTS CATALOG	= 761 761 Piper Aircraft Corporation 820 E. Bald Eagle Street Lock Haven, Pennsylvania 17745
INSPECTION MANUAL 100 HOUR	= 761 774 Piper Aircraft Corporation 820 E. Bald Eagle Street Lock Haven, Pennsylvania 17745

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 Compressors	Delco Products Div. of General Motors Corp. P.O. Box 1042 Dept. 194-T Dayton, Ohio 45401 (513) 227-5000 Telex: 810-459-1788
	Sankyo Inc. 10719 Sanden Dr. Dallas, Texas 75238 (214) 349-3030 Telex: 73-0497
Air Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
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

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Marathon Battery Company 8301 Imperial Drive P.O. Box 8233 Waco, Texas 76710
	SAFT America, Incorporated 711 Industrial Boulevard Valdosta, Georgia 31601
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
Electrical Relays	Leach Corporation 5915 Avalon Boulevard Los Angeles, California 90003 (213) 232-8221
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington, Penna. 19034 (215) 643-2900
Engines	Pratt and Whitney Aircraft of Canada, Ltd. Box 10 Longueuil, Quebec, Canada JK4X9
Environmental Systems, Heater	Janitrol Aero Division 4202 Surface Road Columbus, Ohio 43228 (614) 276-3561
Fire Detection and Extinguishing Systems	HTL Industries P.O. Box 780 Pasadena, California 91006 (213) 574-7880

VENDOR-SUPPLIER INFORMATION (cont).

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
Gate Valves, Shut-off Valves and Solenoid Valves (Fuel and Hydraulic)	I.T.T. General Controls 801 Allen Avenue Glendale, California 91201 (213) 842-6131
Hoses, Fittings	Aeroquip Corporation Marmon Division 1214 Exposition Boulevard Los Angeles, California 90064 (213) 774-3230
Instruments	Aerosonic Corporation 1212 N. Hercules Avenue Clearwater, Florida 33515 (813) 461-3000
Landing Gear, Hydraulic Actuators, Hydraulic Pressure Regulator, Hydraulic Power Pack, Handpump	Ozone Aircraft Systems, Inc. 101-32 101st Street Ozone Park, New York 11416 (212) 845-5200
	Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Lighting, Tail Recognition	Devore Aviation Corporation 1-T Barstow Road Great Neck, New York 11021 (516) 487-3524
Lighting, Strobe	Whelen Engineering Company, Inc. 3 Winter Avenue Deep River, Connecticut 06417 (203) 526-9504

VENDOR-SUPPLIER INFORMATION (cont).

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	Woodward Governor Company Drake and Lemay Roads Fort Collins, Colorado 80521 (303) 482-5811
Starter-Generator	Auxilec, Incorporated One Willow Park Center Farmingdale, New York 11735 (516) 694-1441
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000
Tools, Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Voltage Regulators	Electro-Delta P.O. Box 898 Stockton, California 95201 (209) 462-8571
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000

GAMA SYSTEM/CHAPTER INDEX GUIDE

SYST CHAP	TITLE	AEROFICHE GRID NO.
4	AIRWORTHINESS LIMITATIONS	1B1
5	TIME LIMITS/MAINTENANCE CHECKS	1B4
6	DIMENSIONS AND AREAS	1E1
7	LIFTING AND SHORING	1E17
8	LEVELING AND WEIGHING	1E20
9	TOWING AND TAXIING	1F1
10	PARKING AND MOORING	1F5
11	REQUIRED PLACARDS	1F8
12	SERVICING	1F13
20	STANDARD PRACTICES/AIRFRAME	1G21
21	ENVIRONMENTAL SYSTEM	2B1
22	AUTOFLIGHT	2F1
23	COMMUNICATIONS	2F4
24	ELECTRICAL POWER	2F10
25	EQUIPMENT/FURNISHINGS	2H14
26	FIRE PROTECTION	2H22
27	FLIGHT CONTROLS	2I6
28	FUEL	3B1
29	HYDRAULIC POWER	3D9
30	ICE AND RAIN PROTECTION	3F21
32	LANDING GEAR	3I8
33	LIGHTS	4B1
34	NAVIGATION AND PITOT/STATIC	4B22
35	OXYGEN	4C17

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

— NOTE —

Refer to Card 5, Grid No. 5F1 for Electrical Schematic Index

LIST OF CHARTS

LIST OF CHARTS (cont)

LIST OF CHARTS (cont)

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

21

ENVIRONMENTAL SYSTEM

CHAPTER 21 - ENVIRONMENTAL SYSTEMS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 21 - ENVIRONMENTAL SYSTEMS (cont.)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 21 - ENVIRONMENTAL SYSTEMS (cont.)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 21 - ENVIRONMENTAL SYSTEMS (cont.)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

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

HEATING.

TROUBLESHOOTING.

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

DESCRIPTION AND PRINCIPLES OF OPERATION.

The flow of air for heating and defrosting is taken through an inlet in the lower right side of the airplane nose section and directed to a Janitrol heater located in the right side of the nose section. From the heater, air for defrosting is directed through outlets located on the instrument panel cover, while air for cabin heat and fresh air is delivered through outlets on the forward cabin bulkhead and grills located in the cabin side panel next to the floor. These functions are controlled by a heater switch and control levers along the lower right side of the instrument panel.

The heater is protected from overheating by a heat limit switch. If the heater temperature reached a predetermined setting, the limit switch opens and the heater becomes inoperative. This is indicated by the illumination of the OVER TEMP warning light located in the lower right-hand portion of the instrument panel. The OVER TEMP light will remain on until the temperature drops below a predetermined limit. The heater OVER TEMP light can be reset and the heater restarted by using the "PUSH TO RESET" button.

An additional scoop mounted on the bottom of the airplane draws fresh air into the cabin through individual vents at each seat. Each vent is adjustable for the desired air flow. A cabin exhaust outlet is located in the raised floor panel of the aft cabin area. The exhaust scoop is located in the lower, center section of the fuselage, in line with the cabin door. This exhaust scoop is controlled by a push-pull knob on the lower right side of the instrument panel. A ventilating fan for this outlet is available as optional equipment.

The 45,000 B.T.U. Janitrol heater is controlled by a three position switch located on the lower right side of the instrument panel, labeled FAN, OFF and HEAT. The FAN position will operate the vent blower only and may be used for cabin ventilation on the ground or windshield defogging when heat is not desired. When heat is desired the heater switch must be turned to the HEAT position. This will start fuel flow and ignite the burner simultaneously.

The heater uses fuel from either the right fuel tank when the fuel crossfeed is off, or from all tanks when the crossfeed is on.

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

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

CHART 2101. TROUBLESHOOTING (HEATING SYSTEM)

Trouble	Cause	Remedy
Heater fails to light.	Heater switch or circuit breaker open.	Turn on heater switch or close circuit breaker.
	Low voltage supply.	Apply external power supply. Attempt to start heater.
	Fuel cut off from tank.	Turn on manual shut off valve or master solenoid.
	Restriction in fuel nozzle orifice.	Remove the nozzle and clean or replace it.
	Fuel heater solenoid not operating.	Remove and check solenoid. Replace if faulty.
	Fuel lines clogged or broken.	Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located.
	Ignition vibrator inoperative.	Replace vibrator. Check for defective ignition unit.
	Manual reset limit (overheat) switch open.	Press reset button firmly and recheck to determine 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.
	Duct switch open.	Operate control to see if switch will come on. Replace switch if defective.
	Bad spark plug.	Replace plug.

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

Trouble	Cause	Remedy
Heater fails to light. (cont.)	Suction leak ahead of pump.	Secure all fittings.
	Insufficient fuel pressure.	Low or no current to fuel pump. Check for operation of pump and remove for repairs if not operating.
	Regulator not operating properly.	Check for low pressure or replace regulator.
	Fuel pump operating but not building up sufficient pressure.	Remove and repair or replace fuel pump.
	Fuel filter clogged.	Clean fuel filter element. Check for ice in fuel system.
Ventilating air blower fails to run. (Mounted separate from combustion heater.)	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 if necessary.
	Motor burned out.	Remove blower assembly and replace motor.
	Defective radio-noise filter.	Replace filter.
Combustion air blower fails to run.	Faulty wiring to motor.	Inspect and replace faulty wiring.
	Poor ground connection.	Tighten ground screw. Ensure all metal preservation has been removed for good ground connection.

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

Trouble	Cause	Remedy
Combustion air blower fails to run. (cont.)	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 blower for overhaul or replacement of motor.
Heater fires but burns unsteadily.	Insufficient fuel supply. Ice or water in system fuel lines.	Inspect fuel supply to heater, including shut-off valve, solenoid valve, fuel filter, fuel pump and lines. Make necessary repairs.
	Spark plug partially fouled.	Replace spark plug.

— *CAUTION* —

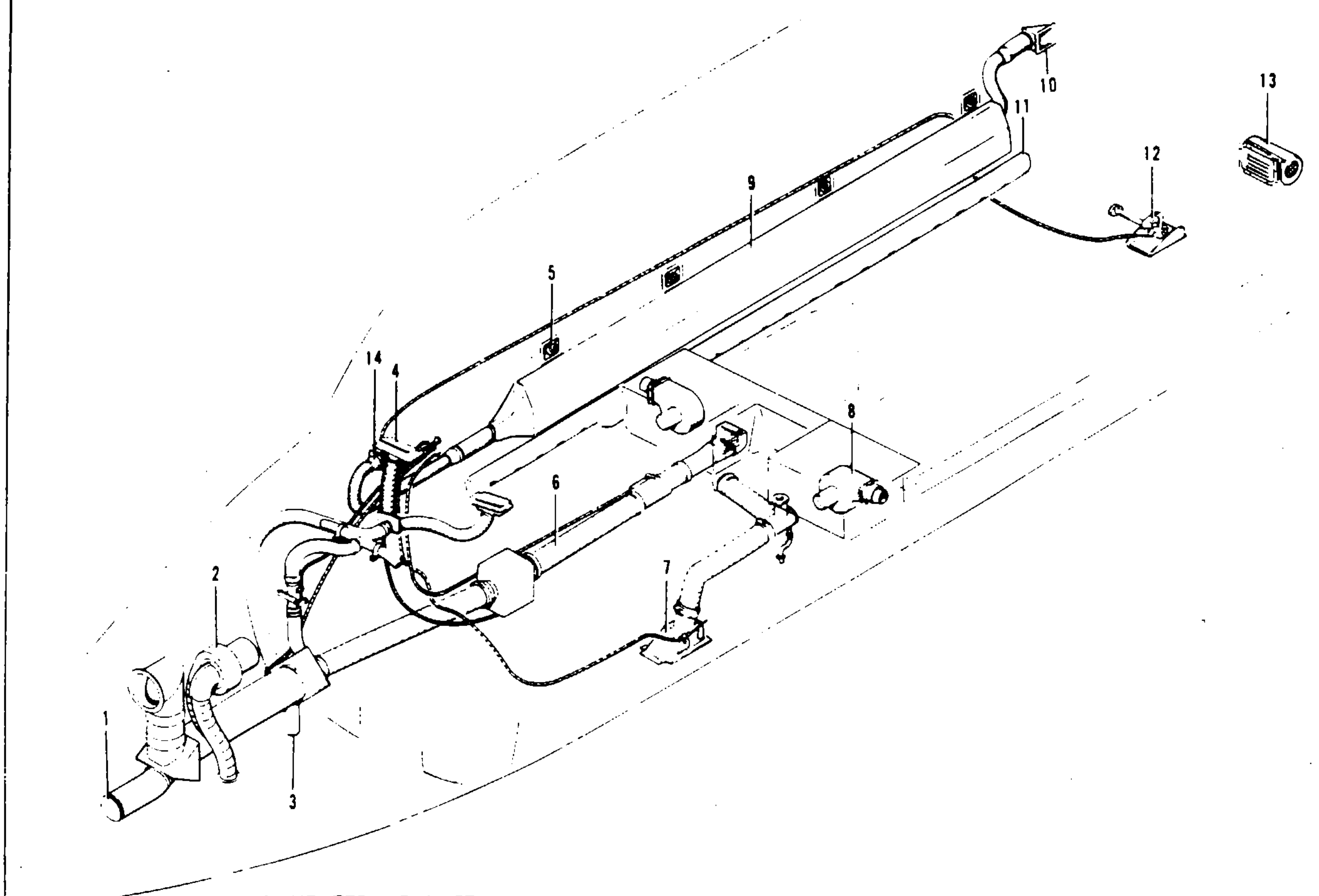
Do not create spark gap by holding lead to heater jacket. This can result in damage to lead and ignition unit and operator may receive an electrical shock.

Trouble	Cause	Remedy
	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.

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

Trouble	Cause	Remedy
Heater fires but burns unsteadily. (cont.)	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 corrections.
	Inoperative or chattering combustion air pressure switch.	Check and adjust or replace switch.
	Inoperative overheat switch.	Check or replace switch.
	Inoperative cycling switch.	Adjust or replace the switch.
	Low voltage.	Attach external power.
Heater fails to shut off.	Fuel solenoid valve in heater stuck open.	Remove and replace solenoid assembly.
	Inoperative duct and cycling switch.	Check and repair.
	Defective heater switch.	Replace the heater switch.

3219



1. HEATER AIR INLET
2. COMBUSTION BLOWER
3. HEATER INSTALLATION
4. DEFROSTER OUTLET
5. FRESH AIR OUTLET - COCKPIT
6. HEATER DUCT
7. FRESH AIR INLET SCOOP
8. VENTILATING BLOWER
9. VENTILATION DUCT
10. FRESH AIR OUTLET - CABIN
11. HEATER DUCT
12. CABIN EXHAUST
13. GROUND VENTILATION FAN (OPT.)
14. PILOT'S FRESH AIR OUTLET

C597

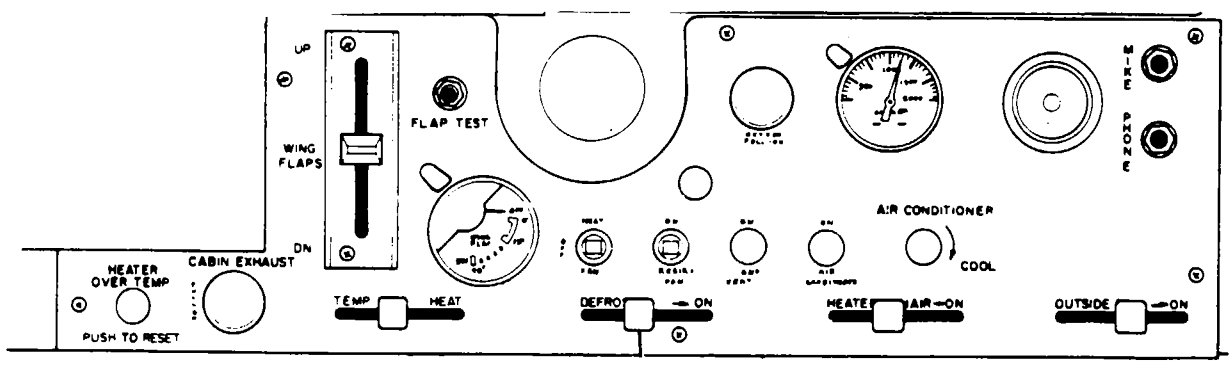
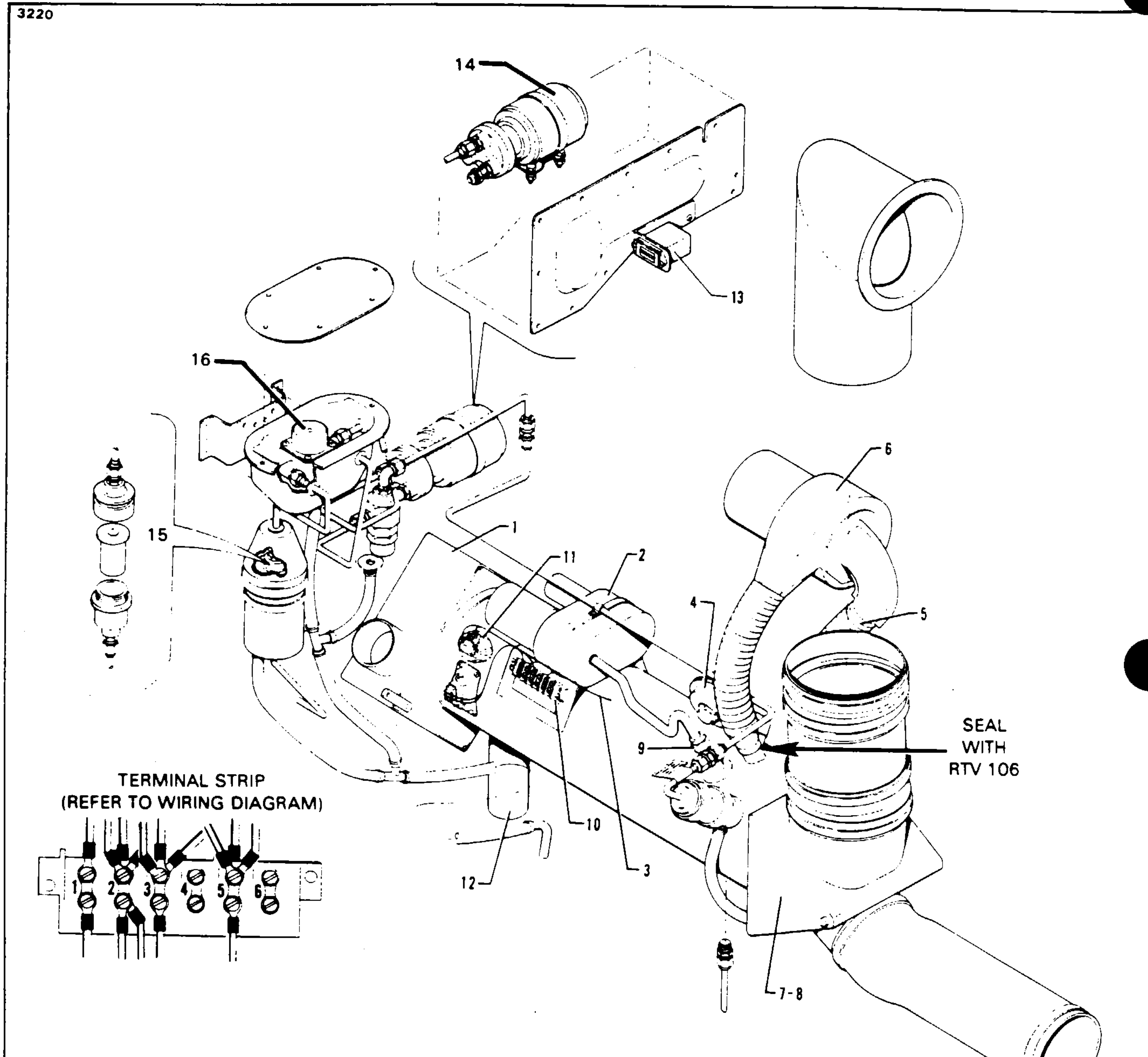


Figure 21-1. Heating and Ventilating System



1. HEAT DISTRIBUTION BOX
2. IGNITION ASSEMBLY
3. HARNESS ASSEMBLY
4. COMBUSTION AIR PRESSURE SWITCH
5. COMBUSTION AIR INTAKE TUBE
6. COMBUSTION AIR BLOWER
7. VENTILATING AIR BLOWER
8. VENTILATING AIR INTAKE VALVE
9. SPARK PLUG
10. TERMINAL STRIP
11. LIMIT STRIP
12. HEATER EXHAUST PIPE
13. HOURMETER
14. HEATER FUEL PUMP
15. HEATER FUEL FILTER ASSEMBLY
16. FUEL REGULATOR AND SHUTOFF VALVE

Figure 21-2. Heater Assembly and Combination Air Blower

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 ventilating air flow and the heater output. An override micro switch is incorporated on the duct switch to override the duct stat at the very last movement of the duct stat arm toward the high position.
4. To stop heater operation, turn off the HEATER SWITCH.
5. It is desirable to operate the fan several minutes to cool the heater after operation. To stop fan operation, turn OFF the HEATER SWITCH.

INSPECTION.

INSPECTION OF HEATER AND HEATER COMPONENTS.

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

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 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 Janitrol Maintenance and Overhaul Manual, Part No. 24E25-1.

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 21-5.)

1. Discard all rubber parts such as grommets, gaskets, etc. These items should always be replaced at overhaul. Also discard the rope gasket.
2. Inspect all wires and wiring harnesses for damage to insulation, damaged terminals, chafed or cracked insulation and broken plastic bands. Individual wires can be replaced by making up new wires from No. 16 AWG stock and 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 21-4.)
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 21-5) 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 a polyethylene bag until ready for reassembly.
10. Replace the nozzle at overhaul.

— *NOTE* —

The nozzle can be spray tested by installing it in the holder and connecting the fuel tube to a 100 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 at 24 volts and 57-65 ohms at 28.5 volts 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 commutator 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 commutator for grooved brush track, pitting or burning. The commutator surface should be smooth and medium brown in color. Replace the motor if the commutator or other parts show damage.
13. Inspect the combustion air blower motor as described in the preceding step.
14. Inspect the blower 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 and ventilating 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. The motors, except for the Howard Industries ventilation motor, should rotate at approximately 7500 RPM at rated voltage. Current draw is approximately 2.9 amperes. The Howard Industries ventilation motor should rotate at approximately 9,800 RPM at rated voltage and should have a current draw of 15-16 amps.
   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, for the combustion air motor.

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 21-3.) Use a rubber gasket under the plate and attach the plate with six screws.

B. Make up seals for all remaining openings, except the one used to connect the air pressure source. (Refer to Figure 21-3.) Use rubber stoppers as shown. The combustion air inlet tube can be sealed best with a drilled stopper and clamp. Other openings should be sealed with expansion plugs. The seal used in the exhaust tube should be formed so that it will not deform the air pressure switch tube which protrudes into the exhaust.

C. Install plugs and caps in all openings except the one to which the combustion air pressure switch is attached. (Any opening can be used to connect the air pressure source; however, the combustion air pressure switch opening is usually the most convenient. The drain opening would normally be considered a second choice.)

D. Connect a regulated air supply to the opening that has not been plugged and apply a pressure of between three and five psi to the combustion tube assembly.

— 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 21-4.)

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.

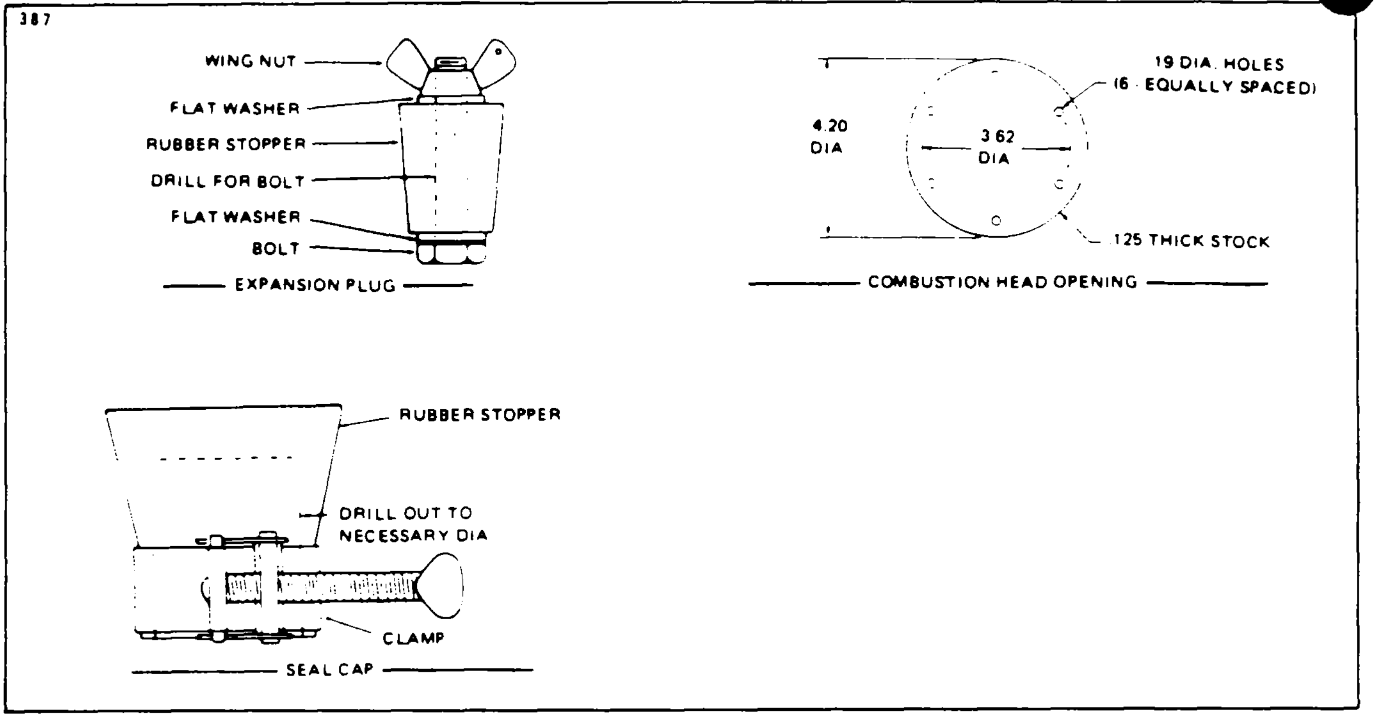


Figure 21-3. Suggested Design for Seal Plate, Plugs and Caps for Combustion Tube Leakage Test

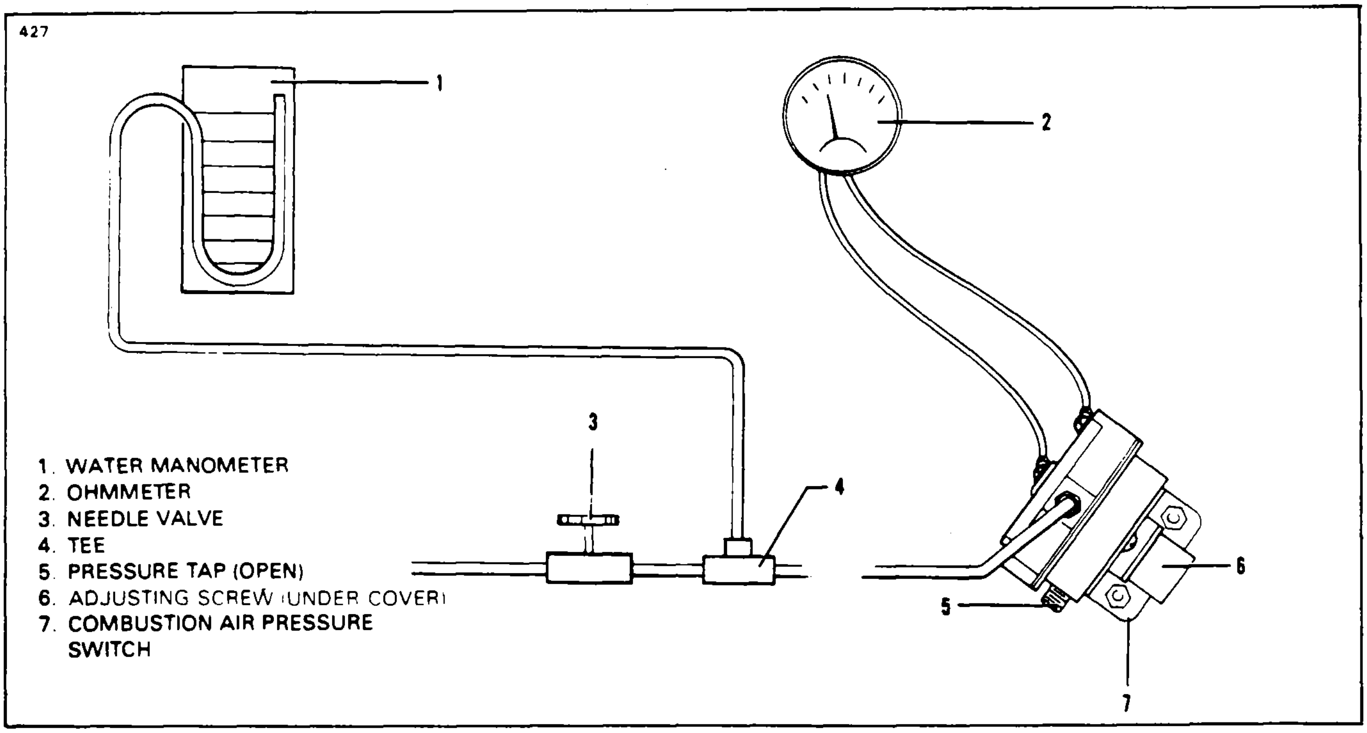


Figure 21-4. Test Set-up - Combustion Air Pressure Switch

5. Spray test the nozzle (Figure 21-5) as follows:

A. Install the nozzle in the fuel feed and nozzle holder assembly. Connect the fuel tube to a 100 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 kerosene fuel operated 24 Vdc electrically controlled unit installed in the nose section just forward of bulkhead Sta. 57.00.

REMOVAL OF HEATER.

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

INSTALLATION OF HEATER.

1. Position the heater on its mounting bracket and secure with clamp.
2. Attach the forward end of the heater to the fuselage bulkhead.
3. Connect the air inlet valve cable to the forward end of the heater.
4. Connect the fuel line to the heater and install shroud cover.
5. Connect the fuel drain to the underside of the heater.
6. Position the combustion air blower, connect tubes and secure the unit to its mounting bracket.
7. Connect the defroster and heat ducts to the air-heat distribution box.
8. Connect the heat control cable to the control arm located on the air-heat distribution box. Adjust the cable so that when the door is completely closed, approximately .062 to .125 inch springback exists between the control lever and lever stop.
9. Connect the duct switch control cable to the switch on the right side of the air-heat distribution box. Adjust the cable so that when the control lever is full against its stop the control arm aligns with the vertical line of the switch. (Do not loosen the allen set screw that secures the arm to the switch shaft.) Move the lever to the extreme right to ascertain that the control arm on the duct switch will have a $145° \pm 1°$ travel to high heat position.
10. Connect the electrical leads to the heater.
11. Operate the heater long enough to determine that the unit is operating properly.
12. Install the access panels in the baggage compartment and at the side of the fuselage.

DISASSEMBLY OF HEATER. (Refer to Figure 21-5.)

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, lockwashers and cable straps to free the ignition assembly from the heater jacket and remove the ignition assembly. The vibrator may be removed by exerting a firm pull straightaway from the ignition assembly case.
5. Remove the grommet from the jacket and remove the spark plug with a 7/8 inch deep socket. Make sure the spark plug gasket is removed.
6. Remove the two screws, lockwashers and flat washers and lift out the overheat (limit) switch and spacer gaskets.
7. Remove the two screws, lockwashers and flat washers and lift out the cycling switch.
8. Remove the two screws and lockwashers to release the terminal strip and insulator from the jacket.
9. Disconnect the tube fitting at the cover of the combustion air pressure switch. Unscrew and remove the combustion air pressure switch from the combustion air inlet tube.

NOTES

1. TORQUE 75 TO 100 INCH POUNDS.
2. COAT SCREWS AND BOTH SIDES OF GASKET WITH PERMATEX NO. 1372, FORM-A-GASKET.
3. COAT SCREWS AND BOTH SIDES OF GASKET WITH RTV NO. 732 SILICONE RUBBER SEALANT.

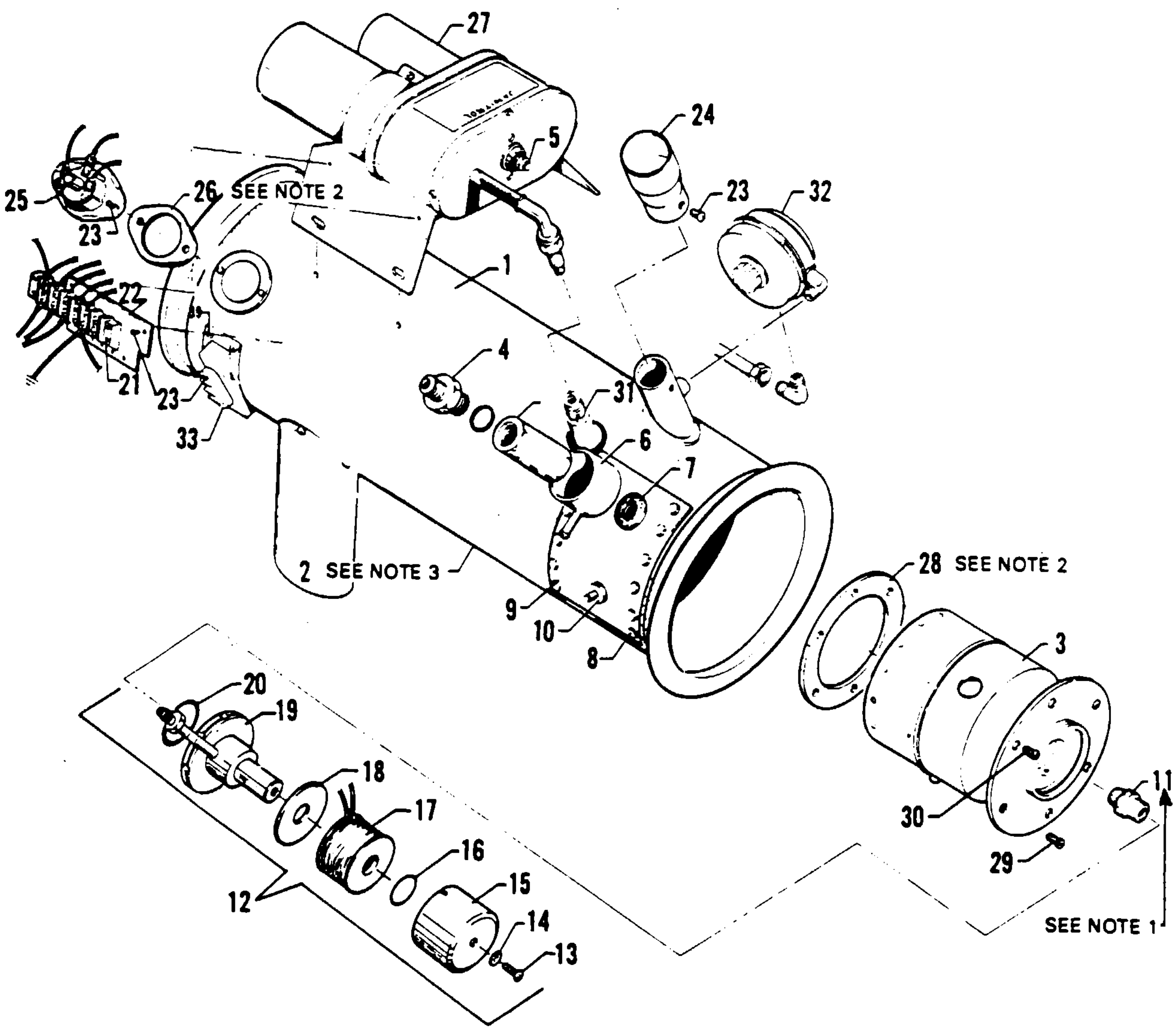


Figure 21-5. Exploded View of Heater Assembly

1. HEATER ASSEMBLY
2. COMBUSTION TUBE AND JACKET ASSEMBLY
3. COMBUSTION HEAD ASSEMBLY
4. REDUCER FITTING
5. FILTER
6. SHROUD ASSEMBLY
7. GASKET
8. CAP SCREWS
9. COVER AND GASKET
10. TERMINAL
11. SPRAY NOZZLE
12. FUELFEED, NOZZLE HOLDER AND SOLENOID VALVE ASSEMBLY
13. MACHINE SCREW
14. FLAT WASHER
15. SHELL COVER
16. O-RING
17. SOLENOID COIL
18. BASE PLATE
19. KNURLED NUT
20. O-RING
21. TERMINAL STRIP
22. INSULATOR
23. MACHINE SCREW
24. COMBUSTION AIR INLET ADAPTER
25. OVERHEAT LIMIT SWITCH
26. GASKET
27. IGNITION ASSEMBLY
28. COMBUSTION HEAD GASKET
29. MACHINE SCREW
30. MACHINE SCREW (MS24693-48) 1 EACH
31. SPARK PLUG
32. COMBUSTION AIR PRESSURE SWITCH
33. CYCLING SWITCH

Figure 21-5. Exploded View of Heater Assembly (cont.)

10. To remove the fuel shroud and gasket, it will first be necessary to remove the reducer fitting and filter assembly with a 3/4 inch deep well socket. The shroud and gasket will then be free for removal.

11. Disconnect the solenoid wire from the electrical connector on cover.

12. Remove safety wire from fuel feed-nozzle holder-solenoid assembly.

13. Loosen the knurled nut that secures the fuel feed-nozzle holder-solenoid assembly to the combustion head using a spanner wrench.

— NOTE —

Hold fuel tube assembly while loosening the nut, to prevent damage to the assembly. This assembly is indexed to the combustion head ring. Do Not Rotate.

14. Remove the screw that secures the cover, O-ring and coil to the fuel feed assembly and carefully slide the solenoid coil from the valve assembly. The base plate need not be removed unless it is warped.

15. Remove the O-ring from the face of the fuel feed assembly.

16. Remove the spray nozzle using care not to bend or distort the fuel tube.

— 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.

17. Remove the six screws that attach the combustion head assembly to the combustion tube and jacket assembly and lift out of combustion tube.

REASSEMBLY OF HEATER. (Refer to Figure 21-5.)

When reassembling the heater, use new gaskets, seals and O-rings.

1. Slide the solenoid coil onto the stem of the nozzle holder and solenoid valve assembly. Install the O-ring, cover, screw and lockwasher, then tighten the screw securely. Be careful to avoid pinching the wire leads connected to the solenoid core.

2. Place a new rope gasket in position on the exhaust outlet. Spring the jacket assembly open at the seam and insert the combustion tube assembly carefully into the jacket. Exercise care to clear the pressure switch tube in the exhaust outlet and see that the rope gasket is properly located. Close the gap on the jacket assembly and install screws and lockwashers to secure it at the seam. (Solenoid lead wire is grounded under one of these screws. See notations made during disassembly.) Make sure the seam is in good condition and a tight fit is effected.

3. Install cable straps at locations noted during disassembly.

4. Remove the spray nozzle from the polyethylene bag and install O-ring. 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", or loosening of internal body assembly of nozzle.

— *CAUTION* —

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

5. Apply High Temperature Permatex to both sides of the new head gasket. Install the head gasket and the head assembly to the combustion tube assembly with six screws.

— *NOTE* —

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

6. Install new O-ring on face of fuel feed assembly.
7. Through the heater opening, install fuel feed-nozzleholder-solenoid valve assembly. Place assembly in position with index pin in slot in combustion head ring and tighten the nut using spanner wrench.
8. Safety wire nozzleholder nut to fuel inlet fitting.
9. Connect the solenoid wire to the electrical connector on cover.
10. Install the cover, with a new gasket, to the jacket and secure with cap screws. Use a small amount of RTV No. 732 silicone rubber sealant or equivalent sealant on the threads of the cap screws and on both sides of the gasket.
11. Using a new spark plug gasket, install the spark plug and tighten to a torque of 28 foot-pounds. Install the grommet in the jacket around the spark plug.
12. Install the ignition assembly on the jacket assembly with the four screws. Connect the high voltage lead to the spark plug and tighten it to 20 foot-pounds.
13. Attach the overheat limit switch and two spacer gaskets to the jacket assembly with two screws. Tighten the screws securely. After installing overheat limit switch and cycling switch, visually check to ensure that the switch does not come into contact with the outer radiator.
14. Attach the cycling switch to the jacket assembly with the two screws.
15. Place the terminal strip insulator in position on the jacket followed by the terminal strip. Secure both parts by installing the two screws.
16. Center the fuel fitting in jacket opening. Place the fuel fitting shroud gasket and shroud on the fuel fitting. Install a new fuel filter. Tighten sufficiently to seal the gasket joint at the jacket and fuel fitting joint. Install reducer fitting, with new O-ring, into fuel filter. Carefully pull solenoid lead wires through hole in shroud and install grommet.
17. Rotate the combustion air pressure switch onto the threaded fitting on the combustion air tube and tighten it firmly.
18. Slide the grommet over the combustion air tube and connect the tube to the fitting on the combustion air pressure switch. Grommet may be split for ease of installation.
19. Install the wiring harness and connect all wire leads to their respective terminals. (Refer to the wiring diagram, Chapter 91.) Place the grommet (Figure 21-5) in position in the jacket.
20. Install the combustion air inlet adapter with the screw.

SPARK PLUG.

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

REMOVAL OF SPARK PLUG.

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

— *NOTE* —

Insure that the heater electrical circuits are de-energized.

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

INSTALLATION OF SPARK PLUG.

1. 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 21-5) 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 21-7.)

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 mixes with combustion air and is ignited by a spark from the spark plug. Electric current for ignition is supplied by an ignition unit which converts 28-volts to high-voltage, oscillating current to provide a continuous spark. 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.

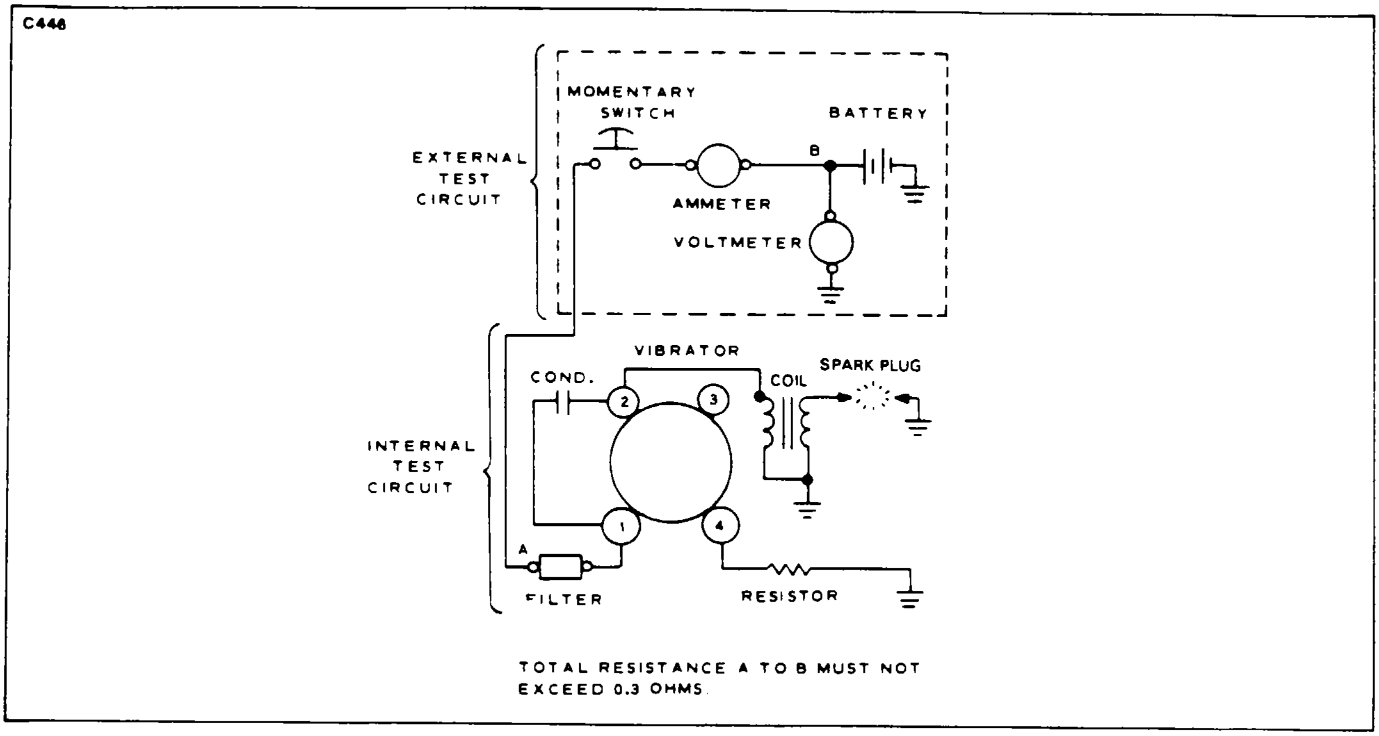


Figure 21-6. Wiring - Test Setup

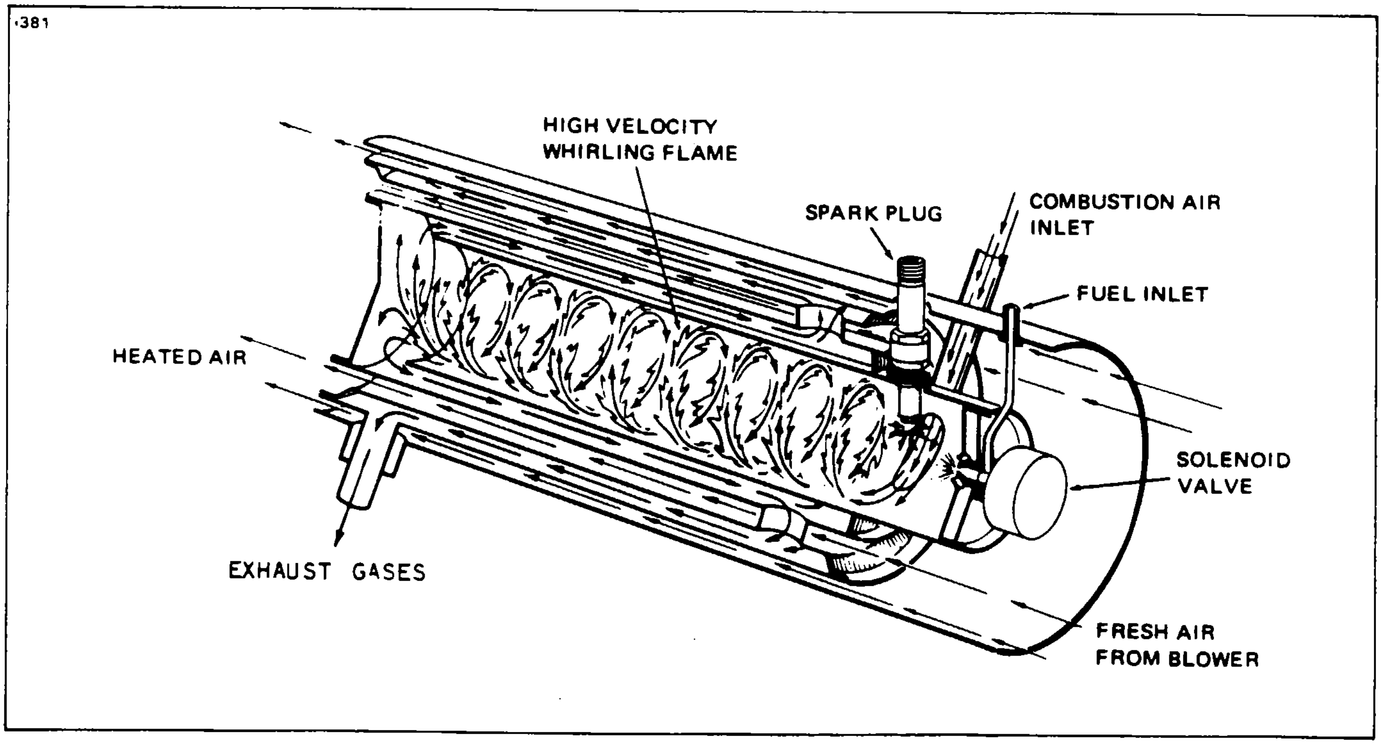


Figure 21-7. Diagramatic Cutaway of Heater to Show Whirling Flame Action

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 21-5.)

— *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 21-5.)

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 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.
6. Arrange the test equipment as shown in Figure 21-6.

OPERATIONAL TEST OF IGNITION UNIT.

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

VIBRATOR.

The 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.

VENTILATING AIR BLOWER. (Refer to "Blower and Motor Assembly" in this chapter.

COMBUSTION AIR BLOWER.

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

REMOVAL OF COMBUSTION AIR BLOWER. (Refer to Figure 21-8.)

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 21-8.)

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

INSTALLATION OF COMBUSTION AIR BLOWER. (Refer to Figure 21-8.)

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

DISASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 21-8.)

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 commutatoı is badly worn or if the motor is defective in any respect, it must be replaced.

CLEANING. (Refer to Figure 21-5.)

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

— CAUTION —

Do not attempt to 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 21-5.)

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.

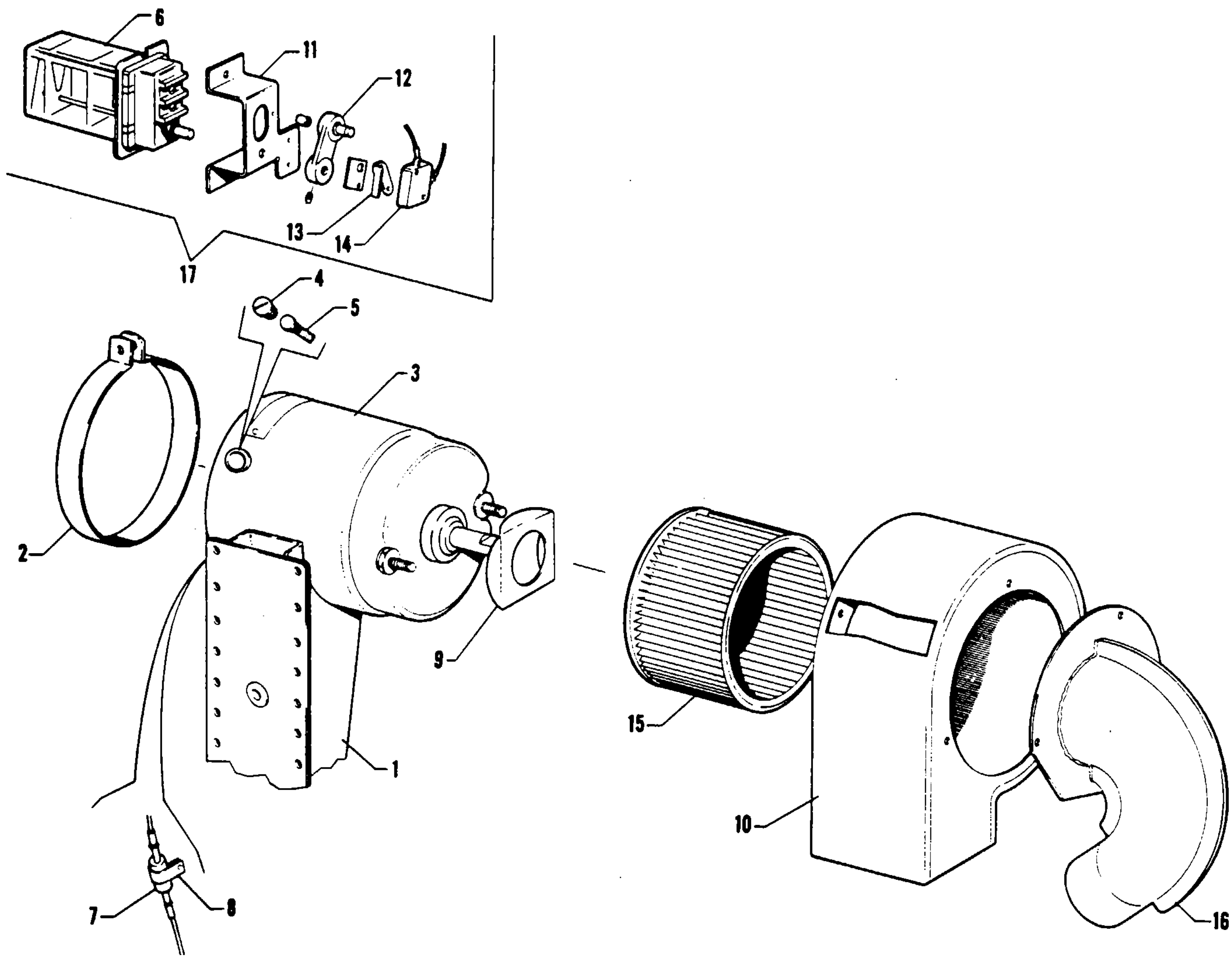
B. A second method of cleaning is what is commonly known as hand "tumbling." Insert shot or glass beads through the exhaust outlet opening, then close all openings and shake the combustion tube assembly vigorously, while rotating it and changing from end-to-end frequently. Be sure to pour out all of 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 21-8.)

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. BRACKET ASSEMBLY
2. CLAMP
3. MOTOR, COMBUSTION AIR BLOWER
4. SCREW
5. BRUSH
6. SWITCH
7. CAPACITOR
8. BRACKET
9. SPACER
10. HOUSING
11. BRACKET ASSEMBLY
12. LEVER SWITCH
13. PLATE, SWITCH ACTUATOR
14. MICRO SWITCH
15. BLOWER WHEEL
16. BLOWER INLET ADAPTER
17. DUCT SWITCH

Figure 21-8. Exploded View of Combustion Air Blower and Motor Assembly

COMBUSTION AIR PRESSURE SWITCH.

This differential pressure switch cuts off the heater operation whenever the fuel-air mixture is not appropriate for efficient heater operation. This switch is set to activate at 0.5 inches of water ± .03 inches.

REMOVAL OF COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 21-5.)

1. Disconnect the electrical leads from the terminals of the combustion air pressure switch item. (Identify leads to facilitate reinstallation.)
2. Disconnect the tube assemblies from the switch. (Identify tube connections to facilitate reinstallation.)

— *CAUTION* —

Exercise caution not to exert excessive bending of the tubes during removal and installation procedure.

3. Unscrew and remove the combustion air pressure switch from the fitting on the combustion air inlet tube.

INSTALLATION OF COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 21-5.)

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 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 control 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 SWITCH.

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

DUCT SWITCH. (Refer to Figure 21-9.)

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 ± 6°. The switch has differential of 10°F ± 5° at any given setting. An override switch has been added to the duct system switch to override the duct switch at the last portion of its travel to the high heat position and cancel the duct stat control only at the maximum heat position.

REMOVAL OF DUCT SWITCH. (Refer to Figure 21-8.)

1. Place the control lever arm in high position and loosen the allen-head set screw that secures the arm to the temperature selector shaft. Slide the lever and arm off the shaft.
2. Disconnect the two electrical leads from the terminals on the exposed face of the switch.
3. Remove the two wires from the duct switch to the micro switch. (Identify wires to facilitate reinstallation.)
4. Remove the two attaching screws and washers from the duct.
5. Carefully lift out the switch and gasket (if gasket is used).

CLEANING AND INSPECTION OF DUCT SWITCH.

1. Brush off any dust or lint from the switch operating mechanism (exposed inside the duct) and wipe external surfaces with a clean cloth.

INSTALLATION OF DUCT SWITCH. (Refer to Figure 21-8.)

1. Insert the switch carefully, with gasket (if used), into the ventilating duct opening and install the two attaching screws and washers.
2. Connect the two electrical leads to their respective terminals, as marked during removal. Connect the two wires from the micro switch to the duct switch terminals.
3. Set the temperature selector shaft at the high stop. Then carefully place the control lever arm on the shaft at the high position and lock the lever by tightening the allen-head set screw. (Do not over tighten.) Rotate the lever arm to make sure it clears the electrical terminal screws and support bracket when it is moved to the high position.
4. Set the micro switch to activate at the very last movement of the control lever arm in the high heat position.
5. Operate the heater with the duct switch set above ambient temperature to check operation.

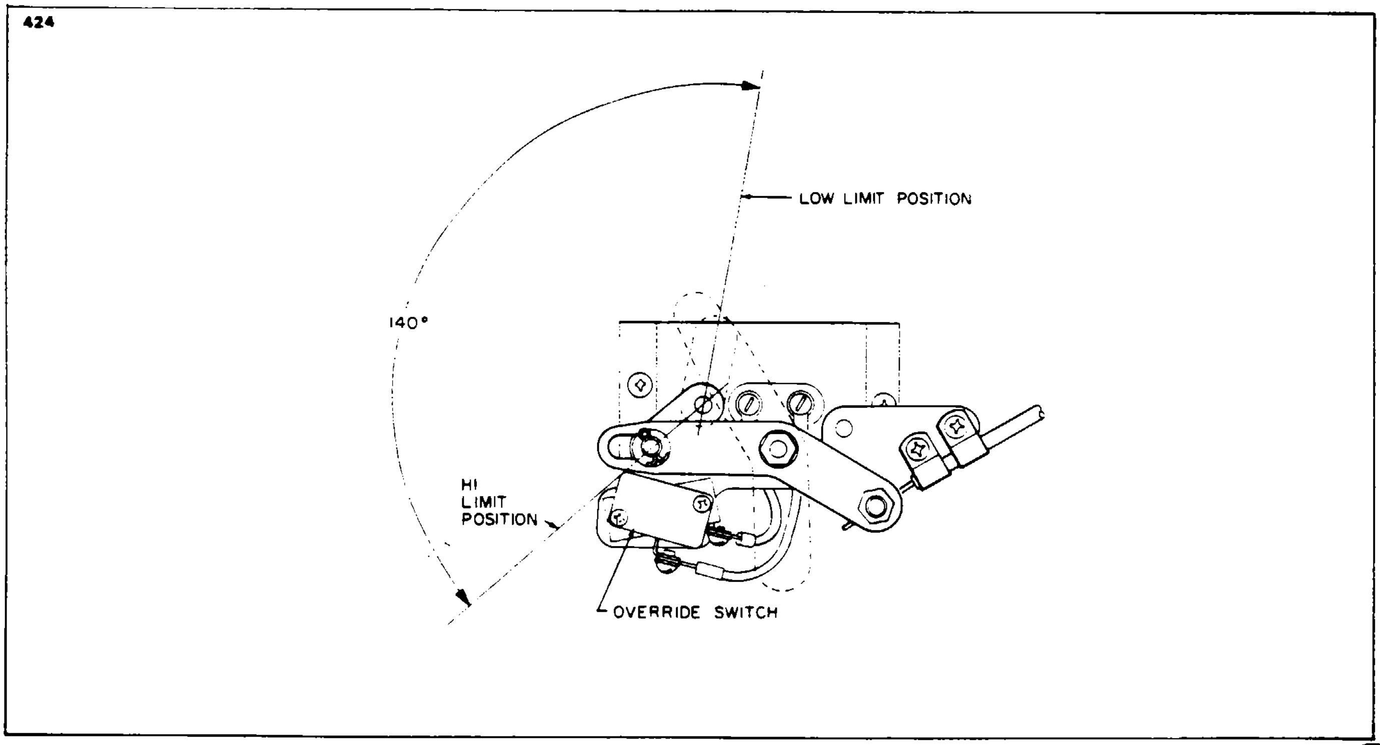


Figure 21-9. Left Side View - Duct Switch

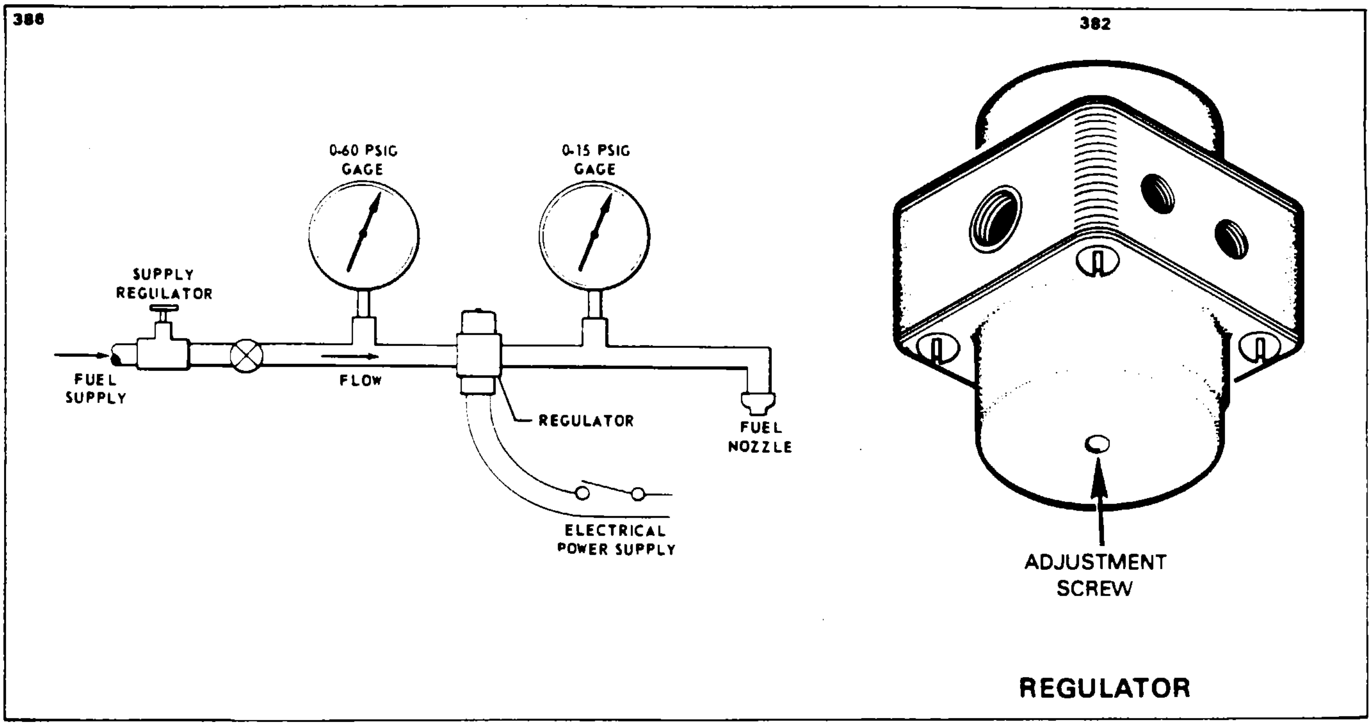


Figure 21-10. Test Setup for Fuel Regulator and Shutoff Valve

FUEL REGULATOR AND SHUTOFF VALVE.

This unit provides preset, regulated fuel pressure as well as remote shutoff to the heater. It is set for 7.5 psi. The shutoff valve is operated by a solenoid.

REMOVAL OF FUEL REGULATOR AND SHUTOFF VALVE.

1. Disconnect the electrical leads from the valve.
2. Disconnect the fuel lines from the inlet and outlet openings. Take note of these connections for correct installation.
3. Disconnect 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 is 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 21-10.
2. Install a 2.5 gph nozzle (Janitrol Part No. D08D09). Stoddard solvent should be used for testing.
3. Apply a fluid pressure of 20 to 50 psi and energize the solenoid.
4. Using a screwdriver, break the adjustment seal and adjust the regulated outlet pressure as close to 7.5 psi as possible. (Turn clockwise to increase pressure; counterclockwise to decrease pressure.)

5. Slowly vary the inlet pressure from 10 to 50 psi. The outlet pressure should remain between 7.0 and 8.0 psi.
6. With the inlet pressure of 50 ± 3 psi, de-energize and energize the solenoid at least twice. The outlet pressure should be 7.0 to 8.0 psi with the solenoid energized. When the solenoid is de-energized, the pressure should drop to zero and the fuel flow from the nozzle should stop.
7. With the solenoid energized, slowly reduce the inlet pressure from 50 to 10 psi. Outlet pressure should remain between 7.0 and 8.0 psi.
8. During the above test, observe for signs of external leakage. Any leakage is cause for rejection of the regulator. After satisfactory adjustment has been made, apply Glyptol around the threads of the adjustment screw and in the slot.

INSTALLATION OF FUEL REGULATOR AND SHUTOFF VALVE.

1. Install the fuel regulator and shutoff valve on its mounting with the attaching screws.
2. Connect the fuel lines to the inlet and outlet openings and secure.
3. Connect the electrical lead. Be sure to slide an insulating sleeve (or tape) over the connection to avoid a short circuit and tie the sleeve in place.

TEST PROCEDURE.

GENERAL.

A test of all components should have been made after overhaul to insure proper operation. Some shops may not have complete testing facilities for measuring air flows, pressure drops, and other factors which would be accomplished in a laboratory-type test. If such a test cannot be made, install the heater and check operation on the ground and in the air to determine if operation is normal. In shops where complete test equipment is available and a complete functional test can be performed, the test routine described in subsequent paragraphs should be made.

EQUIPMENT REQUIRED. (Refer to Figure 21-11.)

1. An improvised stand to hold the heater during test. The heater should be located far enough away from any combustible material or atmosphere to avoid hazard. A location should be chosen where exhaust can be dispelled. Do not add an excessive extension to the heater exhaust.
2. A source of fuel capable of being regulated at 100 ± 2.0 psi.
3. The combustion air blower to be used with the heater should be used for the test.
4. A 28 volt current supply, which may be a DC generator with a rheostat, ammeter and voltmeter in the line to control and indicate the current draw and voltage output.
5. Two water manometers (zero to 5.0 inch water column) for measuring the pressure in the ventilating air duct and in the combustion air stream.
6. A piece of duct to be attached to the downstream end of the heater. It should have a minimum length of 24 inches and the same diameter as the heater being tested. A 2.25 inch diameter orifice should be centrally located at the outlet end. An aperature should be provided for the thermometer and duct switch and a static tap should be attached as shown in Figure 21-11.

7. A thermometer with 500° F scale.
8. A fuel-pressure gauge.
9. A controlled source of compressed air for final leakage test.
10. Vent air source.

OPERATIONAL TEST. (Refer to Figures 21-11 or 21-12.)

1. Connect the heater to the test setup as shown in Figure 21-11. Make sure the combustion air blower is mounted securely and that the heater is clamped to its supporting stand.
2. Insert the duct switch in the sheet metal extension tube at the location shown in Figure 21-11.
3. Connect components and heater as outlined in the wiring connection diagram, Figure 21-12. The power supply switch should be open.
4. Connect the power source to the heater.
5. Disconnect wire lead from terminal "3" on the heater side of heater terminal strip to prevent the heater from lighting and close the power source switch to check operation of blowers. The combustion air blower should operate at full speed with no blower wheel interference. If the blower fails to run, locate and correct the trouble before proceeding with the test.
6. Connect a voltmeter from open side of combustion air pressure switch terminal to ground to determine if the switch is closed, which would be indicated by a full voltage reading on the meter. If a full voltage reading is not obtained, either the combustion air supply is inadequate or the switch is defective or improperly adjusted. Make necessary corrections.
7. Observe the manometer connected to the ventilating air pressure tap, which should show a reading of 1.1 inches of water (minimum) at rated voltage.
8. Observe the manometer connected to the combustion air tube tap, which should show a reading of 1.5 inches of water (minimum) at rated voltage.
9. Open the power supply switch and reconnect the terminal lead disconnected in preceding step 5.
10. Close the power supply switch and turn on the fuel supply. The heater should light within five seconds (may require slightly longer for air to be purged from fuel lines on the first trial).
11. Observe operation of duct switch, which should control heater operation acording to the switch setting.
12. If the duct switch fails to control the temperature according to the setting, place the control lever in High "H" position and notice the control variation. A high reading of 250° F ± 10° should be obtained (reading will vary in different applications).
13. Connect a jumper across the terminals of the duct switch to make it inoperative and observe action of the cycling switch. The cycling switch should cycle to control the outlet air temperature at approximately 250° F (nominal). This is a function of ambient temperature and air flow conditions. If operation is within a range of 190° F to 290° F, the switch is operating normally. If the switch is out of range it can be reset in the same manner as described for the duct switch, except that no control lever or indicator stop are used. If adjustment fails to restore proper temperature range, replace the switch.
14. With duct switch still jumped, place a jumper across the cycling switch terminals to check operation of the overheat switch. Block the ventilating air inlet and notice if the overheat switch shuts off the heater. It should open at between 300° F and 400° F. (This is also a function of ambient temperature and air flow.) After the switch shuts off, remove ventilating air restriction and push the switch reset button until it clicks. The heater should light and operate.
15. Shut down the heater and check all components visually to make sure no damage has occurred to any of them.
16. Remove heater and other components from the test setup and install it in the airplane.

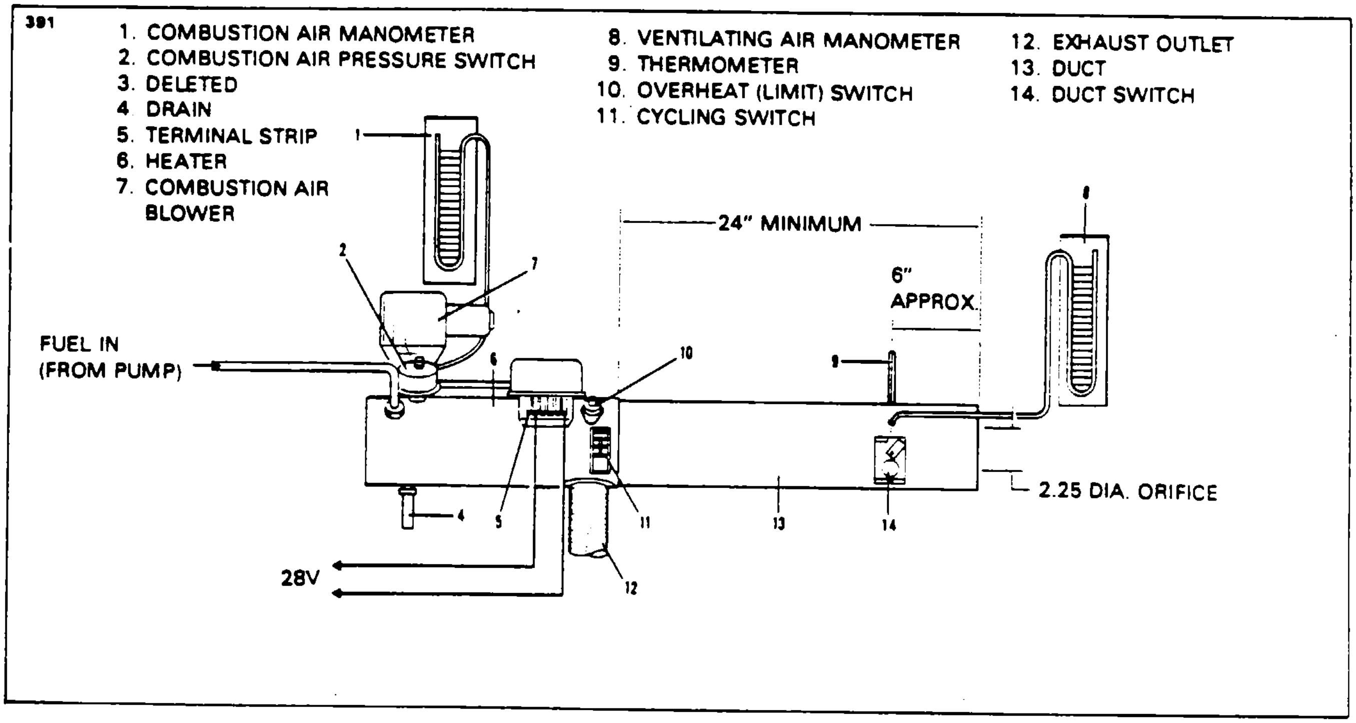


Figure 21-11. Suggested Setup for Heater Operation Test

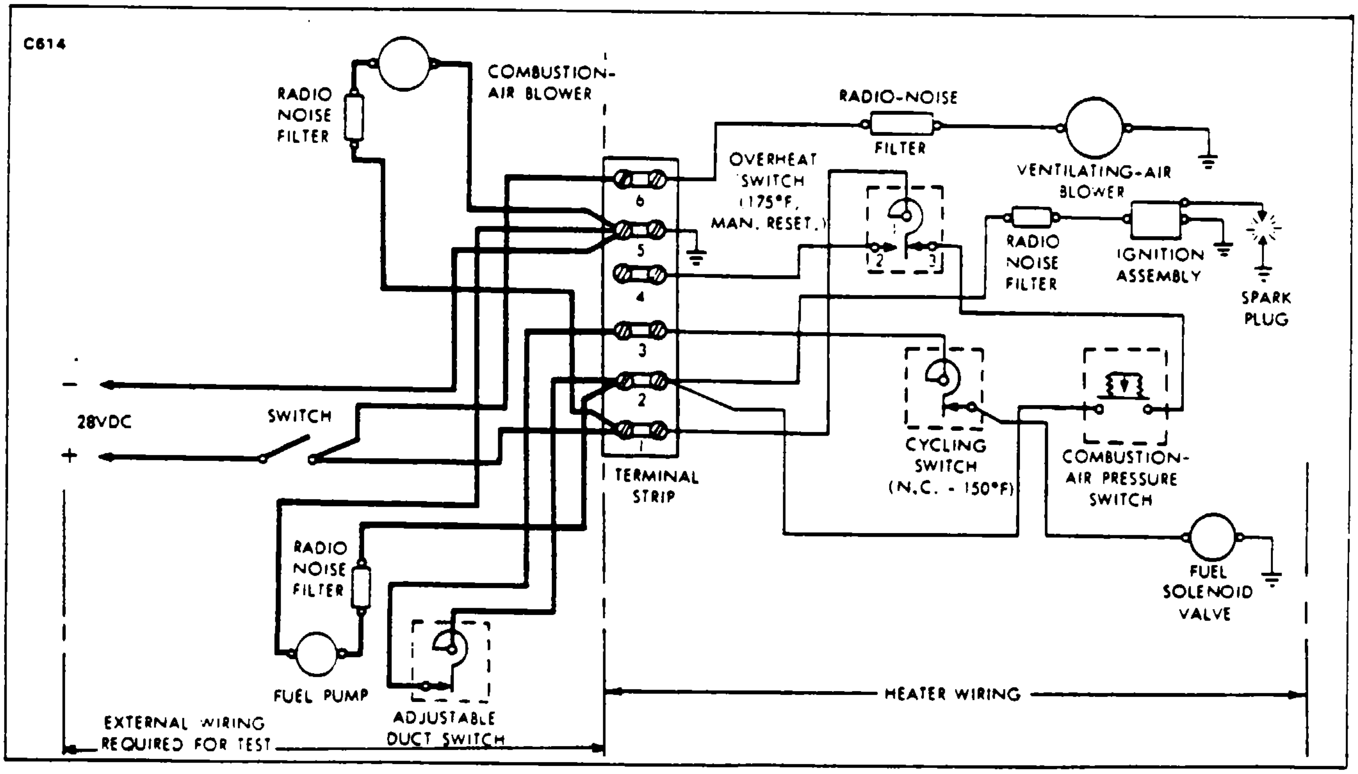


Figure 21-12. Wiring Connections for Heater Operation Test (Typical)

REMOVAL AND INSTALLATION OF HEATER FUEL FILTER.

1. Ascertain heater fuel switch is in the OFF position.
2. Remove access panel on right side of aircraft.
3. Remove clamp which secures filter to bulkhead.
4. Separate halves of fuel filter shroud to gain access to filter.
5. Disconnect the filter at the line connector fittings and remove the filter.
6. Disassemble filter and inspect filter element for contamination; then reassemble filter.

— NOTE —

Inspect filter first 100 hours of operation and then every detailed inspection. Change filter at least every 500 hours.

7. Install filter assembly and secure connector fittings.
8. Rejoin shroud halves and secure with SAE-TYF-40 clamp.
9. Install clamp which secures filter assembly to firewall.
10. Check heater for operation.
11. Install access panel.

THIS SPACE INTENTIONALLY LEFT BLANK

GRIDS 2C18 THRU 2C20
INTENTIONALLY LEFT BLANK

COOLING.

DESCRIPTION AND PRINCIPLES OF OPERATION.

The vapor cycle air conditioning system consists of a variety of parts which make up the complete system. The compressor is an engine mounted, belt driven, two cylinder, reciprocating compressor. It is driven from the compressor drive of the right engine through an electric clutch mounted to the compressor. This clutch is used to engage the compressor. The condenser is a fin and tube heat exchanger mounted behind the right engine fire wall. The condenser is cooled by air taken from the propeller slipstream, through two condenser air inlets on the lower forward portion of the nacelle. The condenser provides the heat sink to condense the high pressure freon vapor. The receiver-dehydrator acts as a reservoir to ensure that only liquid refrigerant is supplied to the expansion valve. It also functions as a trap for any air or moisture that was left in the system during the initial charging of the system. The system has two evaporator modules mounted in the cabin on the forward side of the main spar. The evaporator is a fin and tube heat exchanger which cools and dehumidifies the air. Each evaporator is equipped with an expansion valve. These valves control the flow of freon into the evaporator cores. A capillary coil mounted to the suction lines at the evaporators regulates the operation of the valves. The refrigerant is carried to and from the air conditioning module from the compressor through flexible hoses and aluminum tubing routed from the compressor at the left rear of the right engine, to a point on the left side of the fire wall. From there, the refrigerant passes through the condenser to the spar box and into the cabin evaporator modules. The pressure and suction lines run approximately parallel. The suction line is the larger of the two.

The air conditioner is an independent unit which dehumidifies, cools, and recirculates the cabin air. The temperature is selected by the temperature control mounted in the instrument panel. Under all normal operations, the temperature control switch will control the operation of the air conditioner. The system uses R-12 refrigerant which is drawn into the compressor and pumped to the condenser under high pressure. The freon vapor is heated as a result of the compression process. As it flows through the condenser, the vapor is cooled by ram air which causes the vapor to condense into a liquid state. This liquid refrigerant then passes from the condenser to the receiver-dehydrator assembly, which acts as a reservoir and also functions as a filter to remove any trapped air or moisture that was in the system during the initial charging. High pressure liquid freon is supplied from the receiver, to an expansion valve. This valve meters the refrigerant into the evaporator core at a rate which allows the liquid refrigerant to evaporate. Heat from the evaporator core surface is lost to the boiling and vaporizing refrigerant, which is cooler than the core, thereby cooling the core and the air passing through it. As this process is taking place, moisture in the air condenses on the outside surface of the evaporator core and is drained off as water. By the time the refrigerant leaves the evaporator, it has completely vaporized. The refrigerant vapor then returns to the compressor where the cycle is repeated.

TROUBLESHOOTING.

Troubles peculiar to the air conditioning system are listed in Chart 2102, along with their probable cause and suggested remedies.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER)

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

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Gauge Indication	Probable Causes	Remedy
Low suction pressure. (Accompanied by icing evaporator.)	Low air supply through evaporator.	Repair blower or blower motor. Clean stoppage in air ducts.
	Very dirty evaporator fins and coils.	Clean and flush with water.
Low suction pressure. (evaporator not cold enough) suction gauge may read a vacuum 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 charge, replace expansion valve.
	Restriction anywhere in liquid line. Restriction will show frost.	Locate restriction and repair.
High suction pressure.	Capillary bulb clamp loose on suction line. Suction line shows frost.	Clean contact surfaces of suction line and cap bulb. Tighten clamp.
	Expansion valve not closing. Evaporator flooded. Suction line frosted to compressor.	Replace expansion valve.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Gauge Indication	Probable Causes	Remedy
High suction pressure (cont.)	Compressor drive belt slipping.	Adjust belt tension.
	Magnetic clutch slipping.	Check electrical circuit for correct voltage to clutch coil. Clean clutch surfaces of oil.
	Strainer at suction service valve clogged.	Clean with solvent and replace.
	Leaking or broken compressor valves.	Replace valves with valve kit.
System produces no cooling.	<u>Electrical</u>	
	Open circuit breaker.	Reset circuit breaker.
	Broken or disconnected electrical wire.	Check all terminals for loose connections; check wiring for hidden breaks.
	Broken or disconnected ground wire.	Check ground wire to see if loose, broken, or disconnected.
	Clutch coil or solenoid burned out or disconnected.	Check current flow to clutch or solenoid-replace if inoperative.
	Thermostat sensing element defective.	If system works in manual mode, check thermostat and cabin comfort control panel.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
System produces no cooling. (cont.)	<u>Electrical</u>	
	Circulating fan motor disconnected or burned out.	Check current flow to blower motor-repair or replace if inoperative.
	<u>Mechanical</u>	
	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.
	<u>Refrigeration</u>	
	Broken refrigerant line.	Examine all lines for evidence of breakage by external stress or rubbing wear.
	Leak in system.	Evacuate system, apply static charge, leak test system, and repair leak as necessary.
	Compressor shaft seal leaking.	Replace compressor shaft seal.
	Clogged screen or screens in receiver dehydrator or expansion valve; plugged hose or coil.	Repair as necessary.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
— NOTE — *After completing repairs of any above causes, the system must have the 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.
	Insufficient air circulation over condenser coils; fins clogged with dirt or bugs.	Clean condenser. coils.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

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

CHART 2102. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
Excessively noisy system. (cont.)	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.

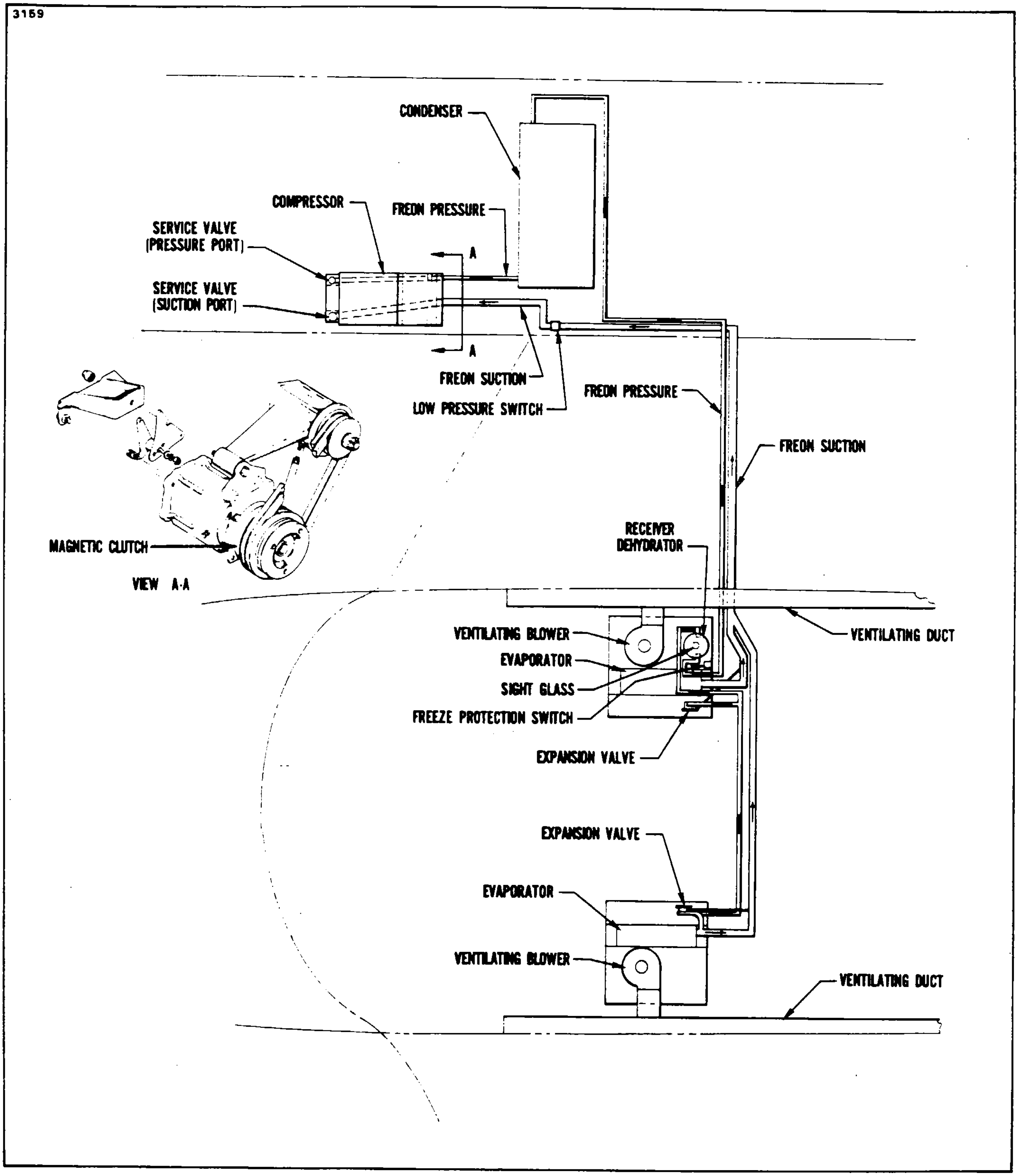
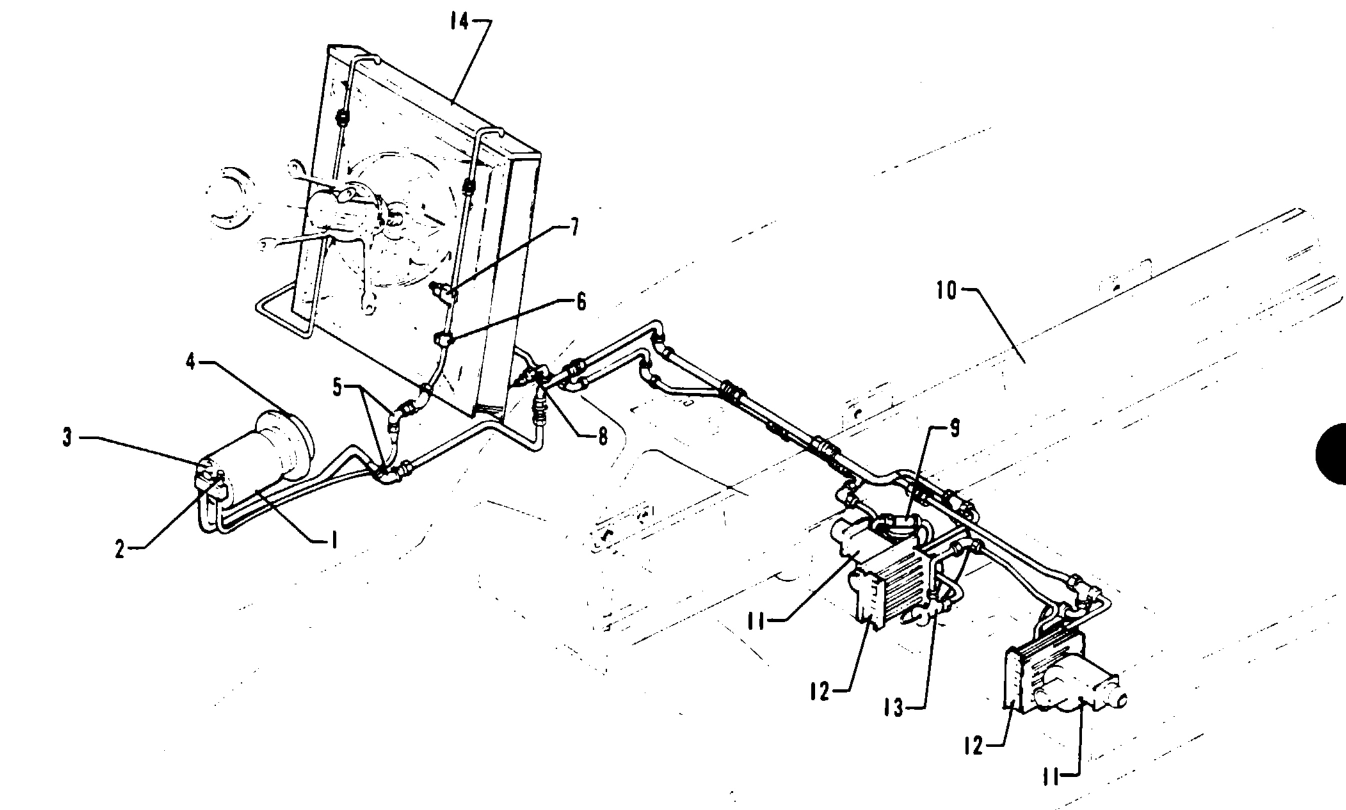


Figure 21-13. Air Conditioning Schematic Diagram



1. COMPRESSOR
2. SERVICE VALVE, SUCTION PORT
3. SERVICE VALVE, PRESSURE PORT
4. MAGNETIC CLUTCH
5. FIREWALL FITTINGS
6. THERMAL SWITCH
7. FREON PRESSURE SWITCH
8. LOW FREON PRESSURE SWITCH
9. RECEIVER-DEHYDRATOR
10. VENTILATING DUCT
11. BLOWER
12. EVAPORATOR
13. EXPANSION VALVE
14. FREON CONDENSER

81780

Figure 21-14. Air Conditioning Installation

CHART 2103. TEMPERATURE/PRESSURE CHART

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

MALFUNCTION DETECTION.

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

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

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

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

— *NOTE* —

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

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

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

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

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

PERFORMANCE TEST.

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

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

PERFORMANCE TEST IN COLD CLIMATES.

To run a performance test on the T-1040 air conditioning in cold climate, below 70° F, the following procedures will have to be used:

1. Obtain an air blower with the following requirements:

   A. 300 cfm at 3.00" H^2O static pressure with standard air density of .0765 lbs/cu ft., or a Piper recirculating air blower from the PA-31P, Piper Part No. 460 003.

2. Take the air blower and connect the exhaust side to an appropriate hose.
3. Insert the hose into the T-1040 nose inlet opening. Using the T-1040 heater with the air blower, the necessary cabin heat load will be supplied.

— CAUTION —

Since the nose inlet opening on the T-1040 is on the lower right-hand side of the nose, and the air conditioning unit operates off the right engine, be sure the air blower and hose are secure and all personnel clear.

4. Start the air conditioning for the performance test.
5. With the heater and air blower operating, the air conditioner should be allowed to operate until the freeze protection shuts it down.
6. With the freeze protection checked, remove the right air conditioning module access plate.
7. Place a jumper wire (No. 18 or larger) across the freeze protection pressure switch, wires H3R-22 and H3P-22.
8. This will allow further operation to check the thermostat operation and the freon level.

SPECIAL SERVICING PROCEDURES.

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

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

— *WARNING* —

The air conditioner MUST NOT be operated with the right engine uncowled. Dangerously high compressor discharge pressures result from the low condenser cooling air flow, caused by the disturbed air flow over the uncowled engine.

1. The most accurate way to check the condition of the system is by attaching gauges to the system as shown in Figure 21-18.
2. Always wear safety goggles when handling refrigerant.

— *WARNING* —

One of the most important precautions is protection of the eyes when handling refrigerant. Any liquid refrigerant which may accidentally escape is approximately 21.7° F below zero. Serious injury could result if refrigerant comes in contact with the eyes. If refrigerant comes in contact with the eyes:

1. DO NOT rub the eyes. Rinse the eyes with cool water to gradually raise temperature.

2. Apply a protective film of antiseptic oil over the eyeball to reduce the possibility of infection.

3. Consult a physician immediately. Should refrigerant come in contact with skin, it should be treated as though the skin had been frostbitten or frozen.

3. Large quantities of R-12 refrigerant should not be discharged into a closed room. It may displace the oxygen in the air.
4. Large quantities of Refrigerant 12 which come in contact with live flame will produce poisonous phosgene gas.
5. Keep lines capped to prevent foreign material and moisture from entering the system.
6. This is a high pressure system and the pressure should be released slowly before disconnecting any lines.

Figure 21-15. Intentionally left blank

7. Use clean, dry refrigerant oil which should be contained in a capped container to reduce the possibility of the oil absorbing moisture and dirt.

8. Replace O-rings when a connection has been broken. Dip new O-rings in refrigeration oil before using. Do not over torque connections. Refer to Chart 2104.

9. To insure a consistent seal on all flared and pipe fittings used on the air conditioning system, seal the fittings with Loctite refrigerant sealant. Sealant should be applied only to the flare surfaces of the flare fittings.

10. Torque all flare fittings in accordance with Chart 2104.

CHART 2104. ALUMINUM TUBING TORQUE

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

SERVICE VALVES.

Discharge and suction valves are service valves mounted on each side of the compressor cylinder head. The suction side of the compressor is identified by the "S" or word "SUCTION" cast in the cylinder head. The discharge side is identified by the letter "D" or word "DISCHARGE."

TEST GAUGE AND MANIFOLD SET.

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

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

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

Cracking the hand valve, in the counterclockwise direction, opens the system to the middle service port of the manifold set. This is desirable only when it is necessary to let refrigerant out or into the system. (Refer to Figures 21-16, 21-18 and 21-19.)

CHECKING THE SYSTEM FOR LEAKS.

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

LEAK CHECK - METHOD I.

Leak tests may be accomplished by using an electronic leak detector. These are compact electronic type units which sense freon. They may be purchased from TIF Instruments or the Kent-Moore Corporation. (Refer to Vendor-Supplier Information at the beginning of this card.)

1. Connect the manifold gauge set into the system and determine if there is any refrigerant in the system. Do not overtighten the knurled fitting on the service hose. Tighten only finger tight. A minimum of 50 psi refrigerant pressure in the system is needed for leak detection. (Refer to Figure 21-16.)
2. Purge the hoses of air by allowing some refrigerant to escape from the connections at the service valves. Then tighten connections at the service valve.
3. Close the low side manifold valve and open the high side manifold valve. (Refer to Figure 21-18.)

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 fuel vapors in the engine nacelle.

7. If any leaks are found, purge the system of refrigerant, make the necessary repairs and check the compressor oil.

8. Add oil, if required, (refer to Compressor Oil Level Check) then repeat Steps 1 thru 5.

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

LEAK CHECK - METHOD II.

1. Remove the protective cap on the Schrader valve fitting on the suction line valve (on the compressor), and connect a charging hose with a shutoff valve arrangement to the fitting. The charging hose must have Schrader fitting or adapter to fit the valve. Do not overtighten the knurled fitting on the service hose. Tighten only finger tight.

2. Connect the other end of the charging hose to a small cylinder of refrigerant and purge the hose by allowing a slight amount of refrigerant gas to escape from the Schrader valve fitting.

3. The cylinder of refrigerant should be placed upright in a container of warm (125° F max.) water on a small scale.

5. Allow approximately 1/2 pound of refrigerant to enter the system by opening the valve on the charging hose and observing the weight change on the scale.

5. Using an electronic leak detector, check all joints and repair any leaks.

6. After completion of repair of any leaks, proceed to check the system in accordance with one of the methods outlined for any other leaks.

7. If no further repair is required on the system, it is now ready to evacuate in accordance with the following paragraph.

EVACUATING THE SYSTEM.

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

CHART 2105. SYSTEM VACUUM CHART

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

— *NOTE* —

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

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

1. Remove the cowling from the right engine. (Refer to Chapter 71.)

— *CAUTION* —

Ascertain that all system pressure is released before attempting the evacuation. (Refer to Malfunction Detection.)

2. Connect the manifold gauge set to the Schrader valves on the compressor. (Refer to Figure 21-19.)
3. The high and low manifold hand valves should be in the closed position. (Refer to Figure 21-16.)
4. Connect the center manifold hose to the inlet of the vacuum pump.

— *NOTE* —

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

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

— *NOTE* —

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

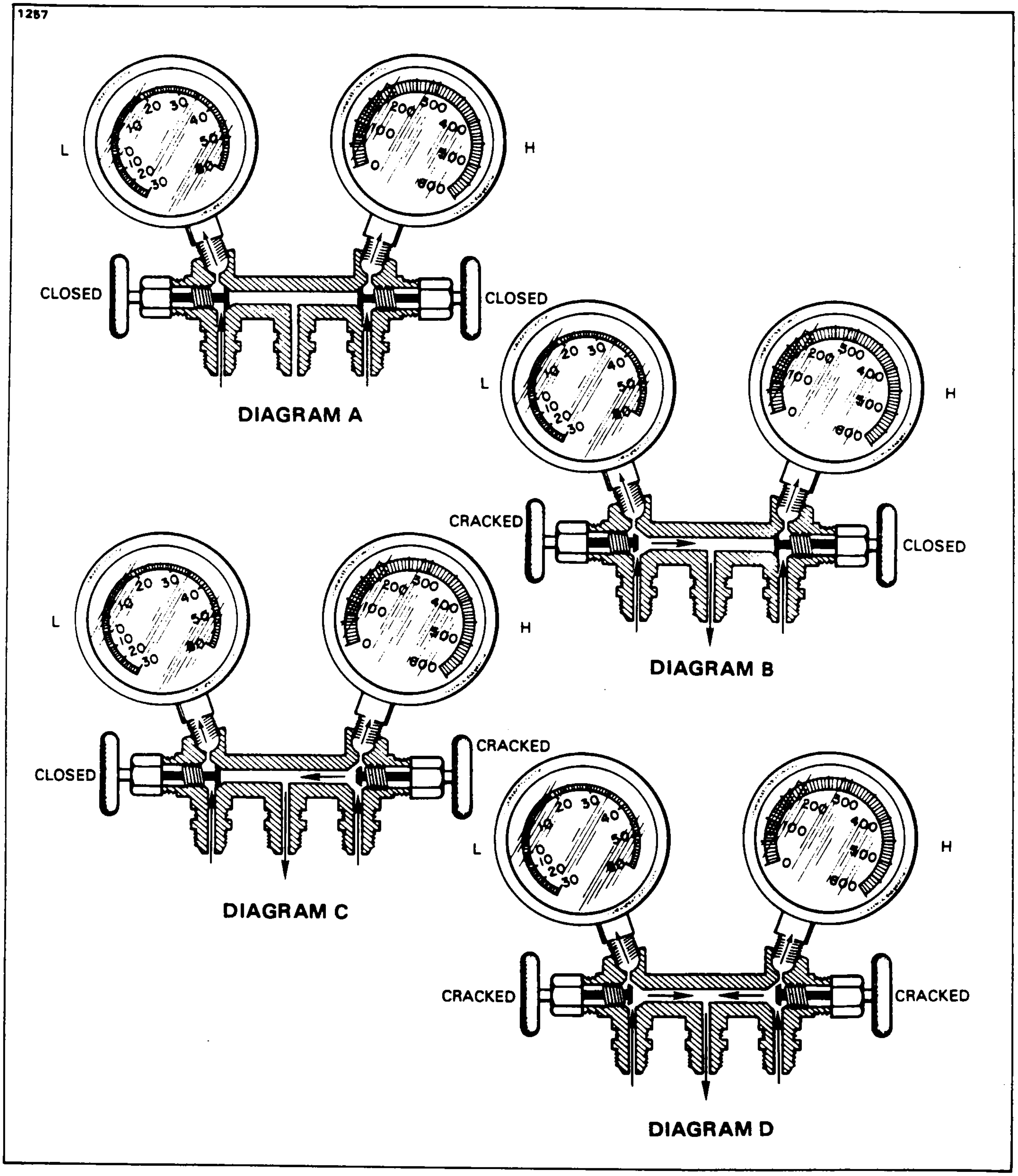


Figure 21-16. Manifold Set Operation

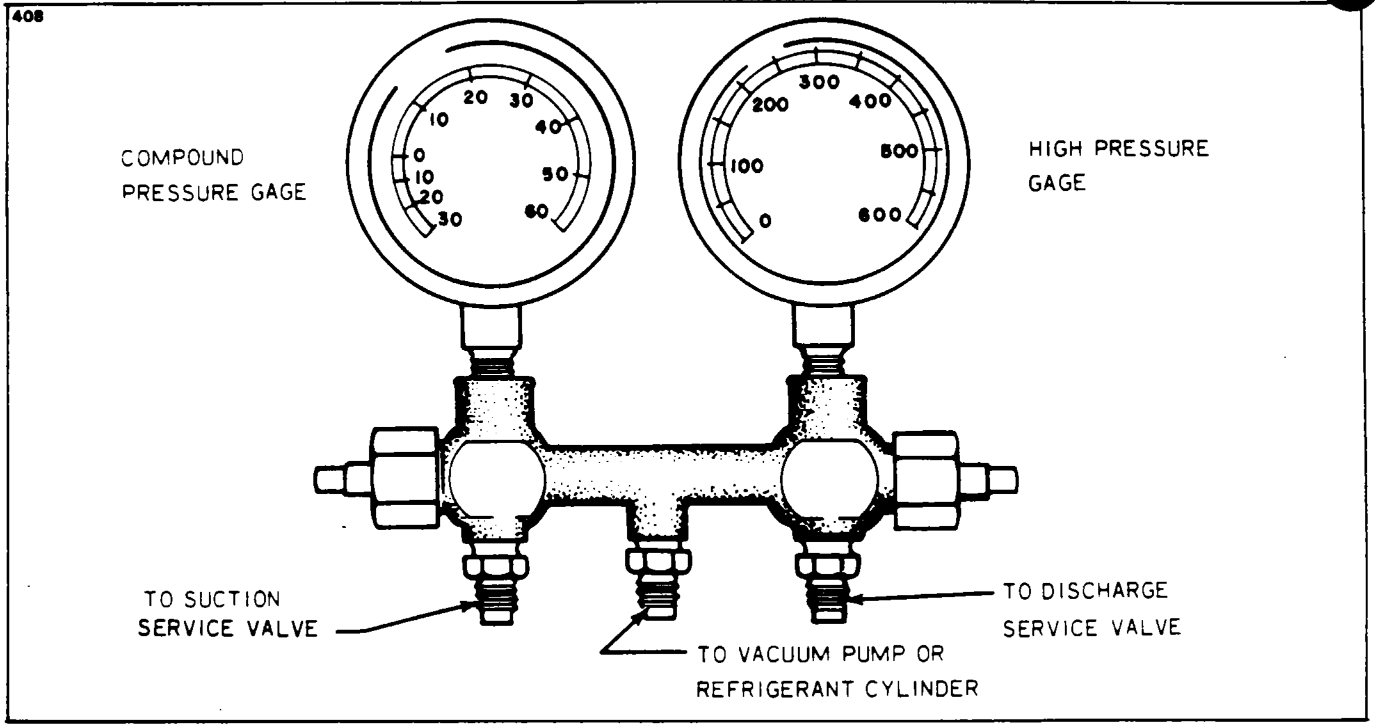


Figure 21-17. Test Gauge and Manifold Set

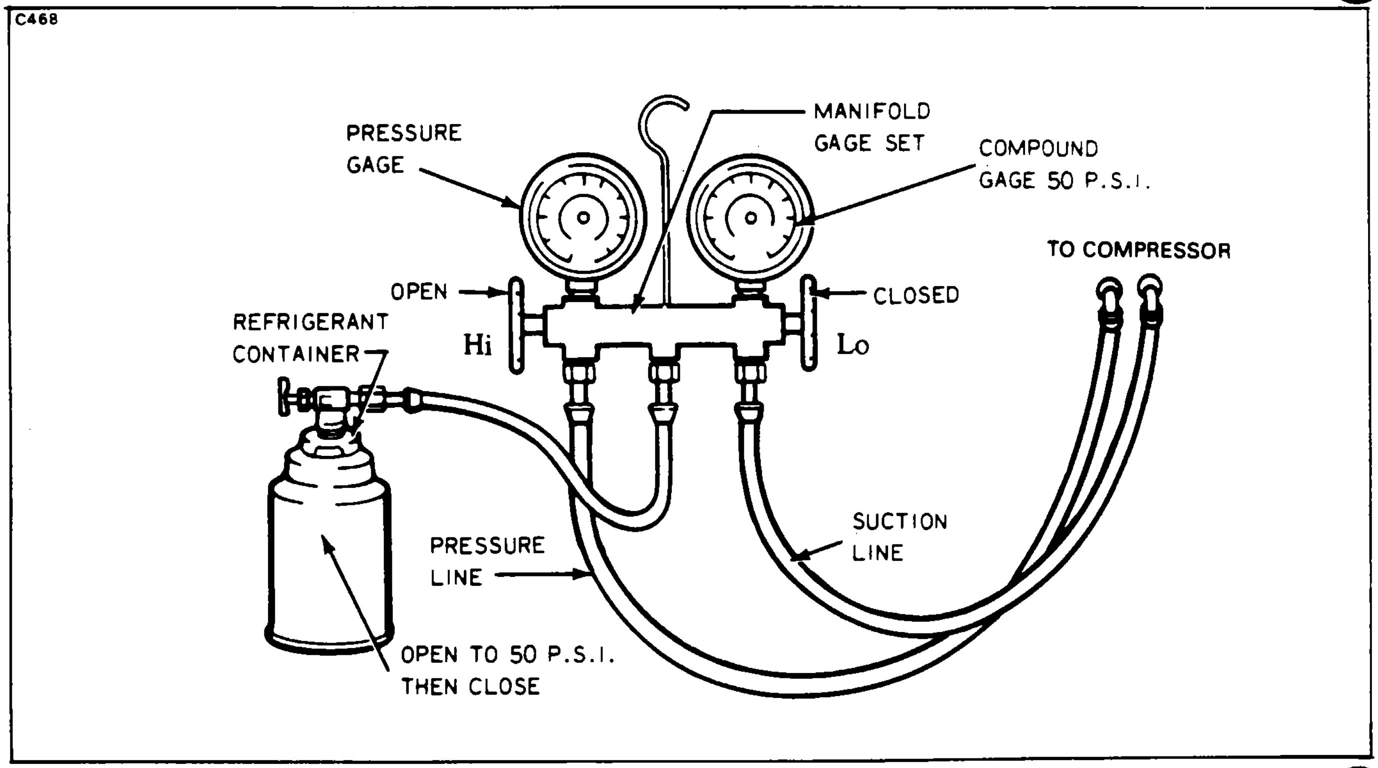
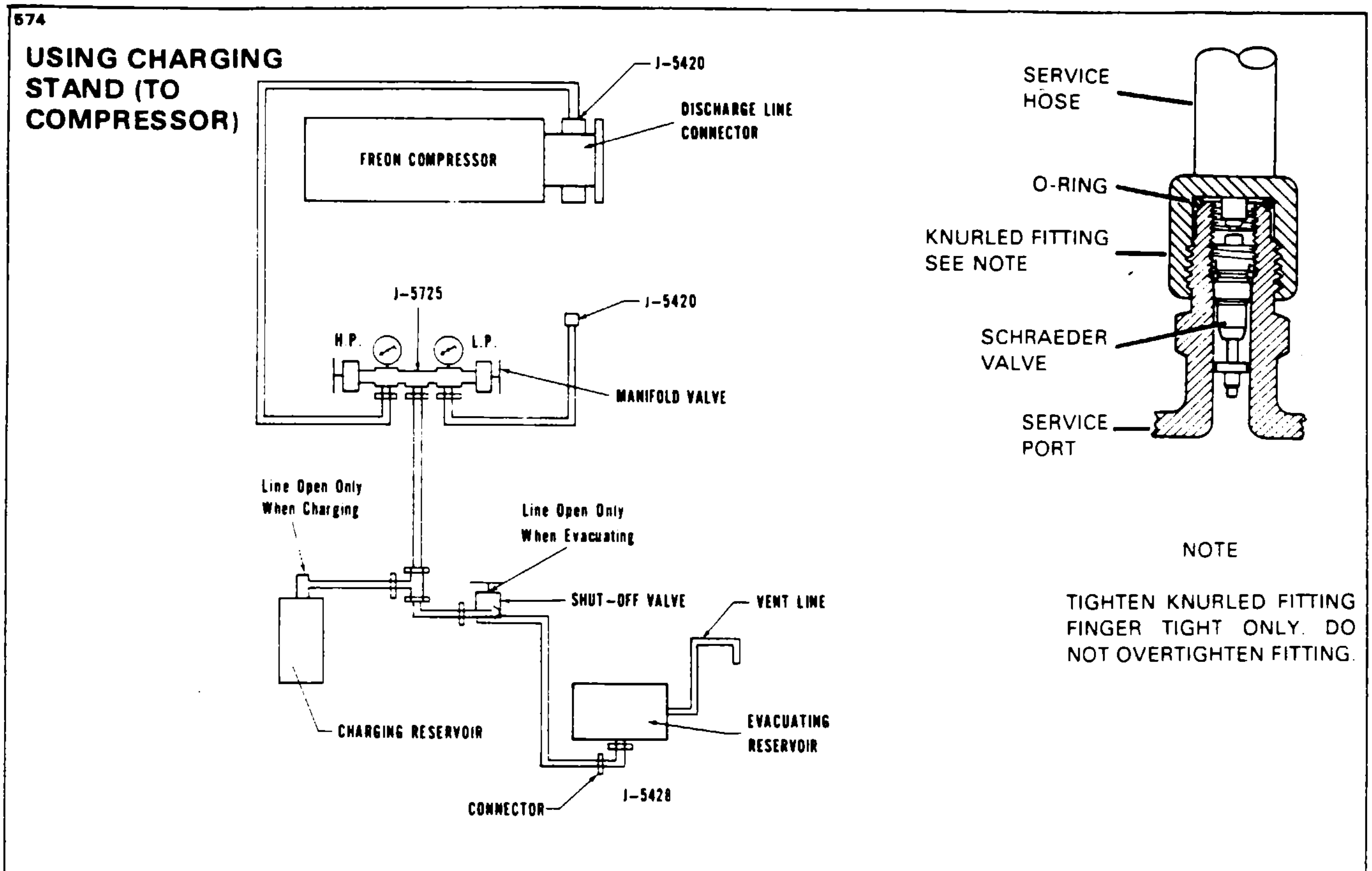


Figure 21-18. Leak Test Hookup



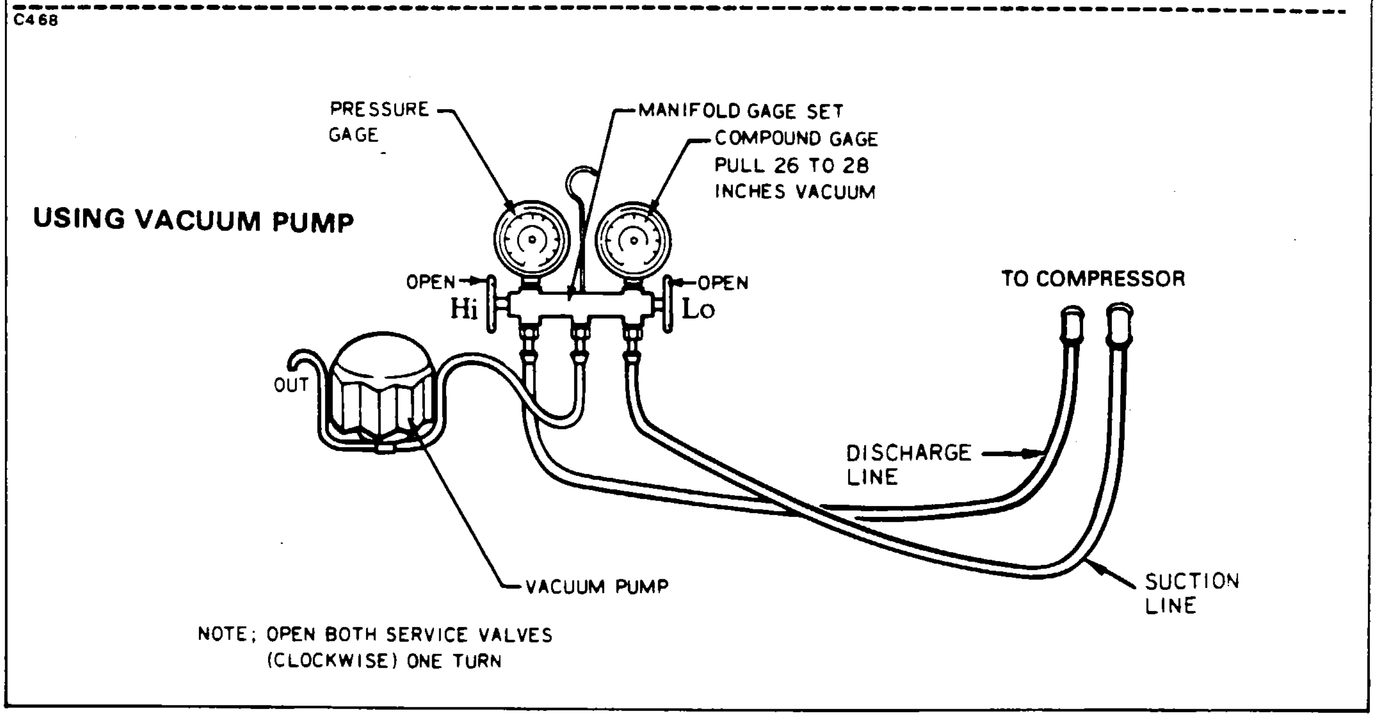


Figure 21-19. Evacuation Hookups

CHARGING THE SYSTEM.

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

CHARGING STATION METHOD.

— NOTE —

Applies to Kent Moore J8393-02 or similar charging station. Use Refrigerant 12. (Refer to Figure 21-20.)

1. DEPRESSURIZING (required only if system contains refrigerant).
   A. Close all valves on charging station.
   B. Connect red high pressure charging line to high pressure Schrader valve on the compressor. (Refer to Figure 21-25.)
   C. Open valve 2 (high pressure control) on charging station one turn.
   D. Hold end of blue low pressure charging line in a shop rag and slowly open valve 1 (low pressure control) on charging station allowing refrigerant to exhaust from system into shop rag.

— CAUTION —

REFRIGERANT CAN CAUSE FREEZING OF SKIN. BE PARTICULARLY CAREFUL NOT TO ALLOW CONTACT WITH EYES. Do not allow refrigerant to escape too rapidly as excessive oil may be carried out of system. When hissing stops, pressure should read zero, indicating the system is empty and service valves should be closed if no further work is planned.

   E. Open refrigerant drum valve and valve at base of charging cylinder and allow approximately 1/2 pound of refrigerant to enter cylinder.
   F. Open valve 4 on charging station (refrigerant control) and flush out high and low pressure lines by opening valves 1 and 2 momentarily until a white stream of refrigerant is observed. Close all valves.
2. EVACUATING SYSTEM.

— NOTE —

Be certain system has been depressurized before attempting to evacuate.

   A. Connect red high pressure hose to the high pressure Schrader valve (on the compressor) and the blue low pressure hose to the low-pressure Schrader valve (on the compressor). (Refer to Figure 21-25.)
   B. Connect vacuum pump power cord to 110-volt outlet.
   C. Remove exhaust port cap and open valve on pump. Turn on pump and open the low and high pressure and vacuum control valves on the charging station. (Refer to Figure 21-20.)

D. Operate pump until 26 to 28 inches vacuum is attained. Continue to operate pump for 25 minutes after 26 to 28 inches vacuum is reached.

— *NOTE* —

Reduce vacuum reading one inch for each 1000 feet altitude above sea level.

E. While system is evacuating, fill charging cylinder as outlined in Step 3.
F. If 28 inches of vacuum cannot be attained, close valve 3 (vacuum control), stop pump and check system for leaks per Step 4.
G. After evacuation, close valve 3 (vacuum control) stop pump. Check system for leaks per Step 4.
H. When no leaks are evident, proceed with charging per Step 5.

3. FILLING THE CHARGING CYLINDER.
A. Be sure refrigerant drum valve is open.
B. Open valve at base of charging cylinder and fill cylinder with required amount of refrigerant to charge system (4.0 lbs. for full charge). Liquid refrigerant can be seen rising in sight glass.
C. As refrigerant stops filling the cylinder, open valve at top of cylinder behind control panel intermittently to relieve pressure and allow refrigerant to continue filling cylinder.
D. When refrigerant reaches desired level in the sight glass, close both the valve at the base of the charging cylinder and the valve at the refrigerant tank. Be certain that the top cylinder valve is fully closed.

— *NOTE* —

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

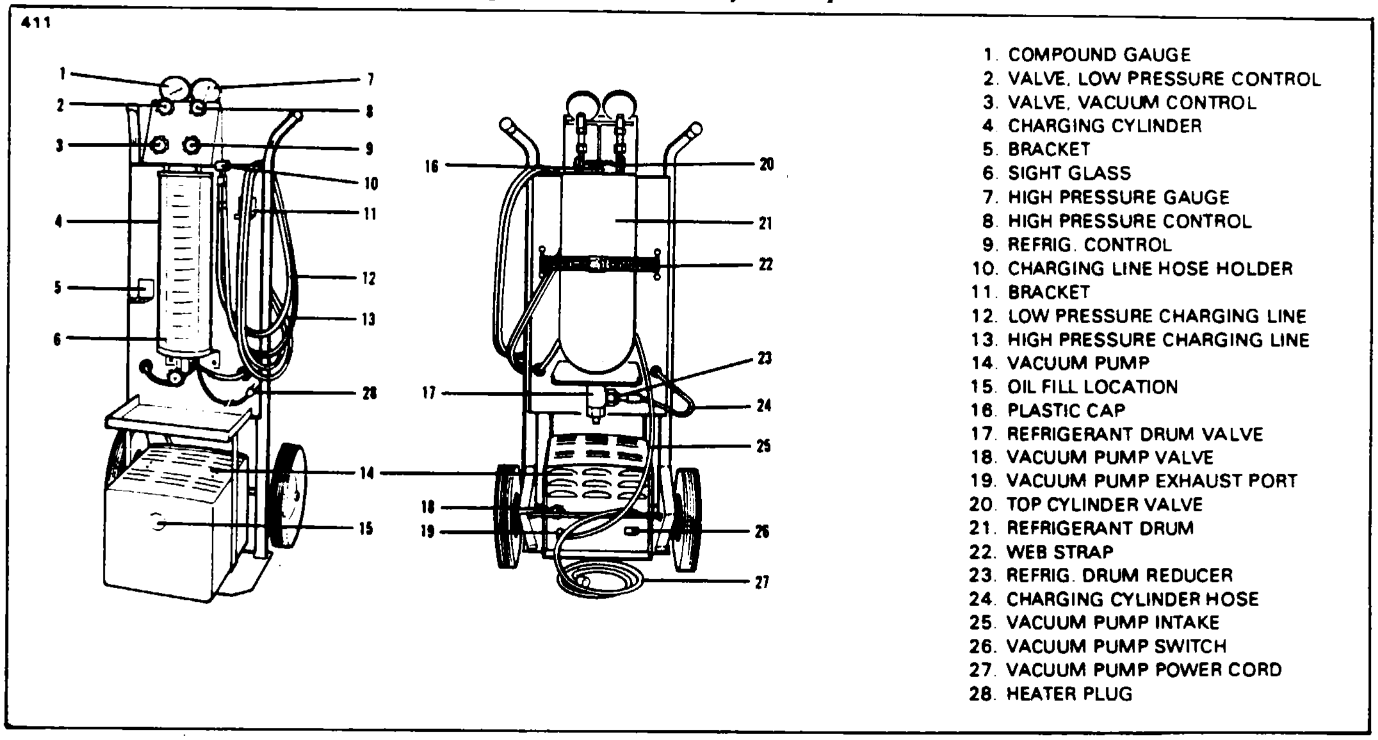


Figure 21-20. Charging Stand

4. CHECKING SYSTEM FOR LEAKS.

A. Open valve at bottom of charging cylinder and allow two pounds of refrigerant to enter cylinder.

B. With system evacuated per Step 2, close all charging station valves. Open valve 4 (refrigerant control) and valve 2 (high pressure control) and allow one pound of refrigerant to enter system.

C. Using the electronic leak detector, check all joints and repair any leaks.

D. Evacuate again for 15 minutes and add another one pound of refrigerant to system.

E. Release the one pound of refrigerant from the system and re-evacuate for 5 minutes to be certain as much contamination is removed from the system as possible. The system is now ready for charging per Step 5.

5. CHARGING SYSTEM - FULL CHARGE.

A. With 4 pounds of refrigerant in the cylinder per Step 3, valve 2 (high pressure control) fully open, and valve 1 (low pressure control) closed, open valve 4 (refrigerant control) and allow as much liquid refrigerant to enter the high side of the system as possible. It will be necessary to slightly warm the base of the charging cylinder. (If charging station does not have a cylinder heater use heat from a 75 to 100 watt bulb and watch that system pressure does not exceed 150 psig) in order to drive the last portion of charge into the system. Do not use open flame or other high heat source for warming cylinder.

B. After completion of charging, close all valves on charging station. Close refrigerant drum valve and recap the compressor exhaust. Remove charging lines from compressor using care due to the small amount of refrigerant remaining in the lines. (Cover Schrader fittings with a shop rag during removal of lines to catch escaping refrigerant.) Replace lines on holder and open valve on top of charging cylinder to release remaining pressure.

6. ADDITION OF PARTIAL CHARGE.

— NOTE —

Ambient air temperature should be 70°F or higher during this operation.

A. Connect a charging hose from the low pressure Schrader valve to the refrigerant container valve. Place the container upright in a safe area free from the propeller blast. Have an assistant watch the sight glass on the receiver-dehydrator.

B. Operate the right engine at 900 - 1000 rpm with the air conditioner ON.

C. Observe the receiver-dehydrator sight glass for bubbles. (Plastic plug will have to be removed and should be replaced to keep the sight glass clean following charging.) Bubbles or foam indicate the system needs refrigerant.

D. With the right engine and air conditioner operating, open the valve on the refrigerant container keeping the valve up to add only gaseous refrigerant.

— CAUTION —

Tipping the container and allowing liquid refrigerant to enter the system can damage the compressor. Continue to add refrigerant until the sight glass clears of all bubbles. Close the container valve after the sight glass clears.

E. If means are available to weigh the container, an additional 1/2 pound of refrigerant can be added to increase the time between system charges.

F. Turn off the air conditioner and stop the engine after charging. Remove the charging hose from the Schrader valve using a cloth to direct the escaping refrigerant. Recap Schrader valve.

REFRIGERANT DRUM METHOD.

1. DISCHARGING THE SYSTEM.

A. Close both valves on a standard gauge set. Connect the red high pressure hose from the gauge set to the high pressure Schrader valve on the compressor. Connect the blue low pressure hose from the gauge set to the low pressure Schrader valve on the compressor. (Refer to Figure 21-25.)

B. Crack both valves on the gauge set and allow the system to slowly discharge. Regulate flow to prevent oil loss from the compressor during discharging.

C. Close valves on gauge set after system is discharged.

2. EVACUATING THE SYSTEM USING EXTERNAL VACUUM PUMP.

A. With gauge set connected per Step 1 and gauge valves open, connect the suction line of the vacuum pump to the center outlet of the gauge set.

B. Start vacuum pump and pull a vacuum of 26 to 28 inches mercury. Continue to operate pump for 25 minutes.

C. If 26 to 28 inches vacuum cannot be attained, check system for leaks per Step 3.

— NOTE —

Reduce vacuum reading one inch for each 1000 feet altitude above sea level.

D. After evacuating, check for leaks per Step 4.

E. When no leaks are evident, close service valves on compressor, remove gauge set and proceed with charging per Step 4.

3. EVACUATING SYSTEM USING SYSTEM COMPRESSOR.

— NOTE —

This method is the least desirable due to the requirement of working near the running engine.

A. Using lines long enough to extend from the rear of the wing, connect the gauge set to the compressor Schrader valves. Connect the low pressure gauge to the suction side and the high pressure gauge to the discharge side. (Refer to Figure 21-25.) Secure the gauge set to prevent movement and aircraft damage from prop blast.

B. Fully open the high pressure gauge valve. Close the low pressure gauge valve.

C. Start the right engine and run at 900 - 1000 prop rpm. Turn air conditioner on in manual mode.

D. Evacuate to 26 to 28 inches vacuum. Continue to evacuate system for approximately 10 minutes. Close the high pressure gauge valve. Turn off the air conditioner and stop the right engine. Check the system for leaks per Step 4.

E. If you cannot pull 26 to 28 inches (at sea level) vacuum on the system, turn off air conditioner and engine. Check for leaks per Step 4.

— NOTE —

Decrease vacuum reading one inch for each 1000 feet of elevation above sea level.

F. When no leaks are evident, charge per Step 5.

4. CHECKING SYSTEM FOR LEAKS.

A. With the gauge set hoses connected per Step 1 and system evacuated, connect a charging hose between the gauge set manifold and a refrigerant container.

B. The refrigerant container should be placed in a container of warm (150° F max.) water. The container should be in the upright position with the valve on top.

C. Open the refrigerant container valve with the gauge set high pressure valve open and allow refrigerant gas to enter the system until the system pressure stops rising. Close the container valve.

D. Using the electronic leak detector, check all joints and repair any leaks.

E. Release the refrigerant, evacuate the system again for approximately 15 minutes and then add another refrigerant gas charge per Step C above.

F. Release the refrigerant and again evacuate the system for 5 minutes to be sure all contamination is removed. The system is now ready for charging.

5. CHARGING THE SYSTEM - FULL CHARGE.

A. Determine the weight of the refrigerant container and its heating water and container on a suitable scale. The refrigerant container and scale should be located at the rear of the wing or on the left side of the fuselage well clear of the right prop.

B. Loosely connect a suitable charging line to the gauge set which should be connected to the evacuated system. Connect the other end of the charging line to the refrigerant container valve and purge the line by opening the valve and allowing refrigerant gas to flow through the hoses. Tighten the hose at the gauge set, open the low pressure gauge valve.

C. With the right engine operating at 900 - 1000 rpm and the air conditioner ON, allow 4 pounds of refrigerant gas to flow into the system by opening the container valve. Close the container valve when the proper charge is reached and stop.

D. Carefully remove the gauge set hoses from the Schrader valves. Use a cloth to divert any escaping refrigerant. Recap the Schrader valves.

6. ADDITION OF PARTIAL CHARGE. (See Step 6 under Charging Station Method.)

COMPONENT MAINTENANCE.

COMPRESSOR SERVICE.

Two types of freon compressors are used on the T-1040. Earlier models used the Delco compressor and later models use the Sankyo compressor.

Maintenance to the compressors is limited to replacement of the drive belts or magnetic clutch and checking the compressor oil level.

For additional information, refer to the list of Vendor Supplier Information at the front of this card.

*DELCO COMPRESSOR.

***COMPRESSOR REMOVAL.** (Refer to Figure 21-25.)

To remove and install the compressor from the air conditioning system without discharging the refrigerant in the system, the following procedures should be used:

1. Insure that the circuit protector is off for the air conditioning system.
2. Remove the cowling from the right engine.
3. Disconnect the electrical leads to the magnetic clutch on the compressor.
4. Fully close both service valves (clockwise) on the compressor.

5. Remove both service valves from the compressor with the related pressure and suction lines attached.

— *CAUTION* —

Compressor pressure will bleed off at the flanges of these valves, when the bolts are loosened.

6. Loosen the jam nut on the adjustment rod; then loosen the mounting bolts on top and remove the bottom bolts.
7. Run the adjustment up to relieve tension on the adjustment rod.
8. Remove the top clevis pin to disconnect the adjustment rod.
9. Move the compressor IN to relieve tension on the belts.
10. Slip the belts off the compressor pulley.
11. Support the compressor, remove the mounting bolts and remove the compressor from the nacelle.

— *NOTE* —

A normally running compressor will retain approximately 10 ounces of refrigerant oil during operation. If it becomes necessary to replace an old compressor, it is important that the new compressor contain the same amount of refrigerant oil as that contained in the compressor being replaced. This checking procedure should not be confused with that given under Checking and Adding Oil (which is for checking total oil in the air conditioning system).

12. While working over a draining tray and, with the clutch end up, completely drain the sump and remove the protective plate from the end of the compressor. Rotate the compressor shaft with a socket wrench several revolutions to force the oil from the piston tops.

— *NOTE* —

Measure the amount of oil drained from the old compressor. The new compressor to be installed should contain an equal amount of oil as that removed from the old compressor (approx. 10 oz.).

BELT INSPECTION (DELCO AND SANKYO COMPRESSOR INSTALLATIONS). (Refer to Figure 21-22.)

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 the matched set of belts.

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

The dual belts must always be replaced as a matching set.

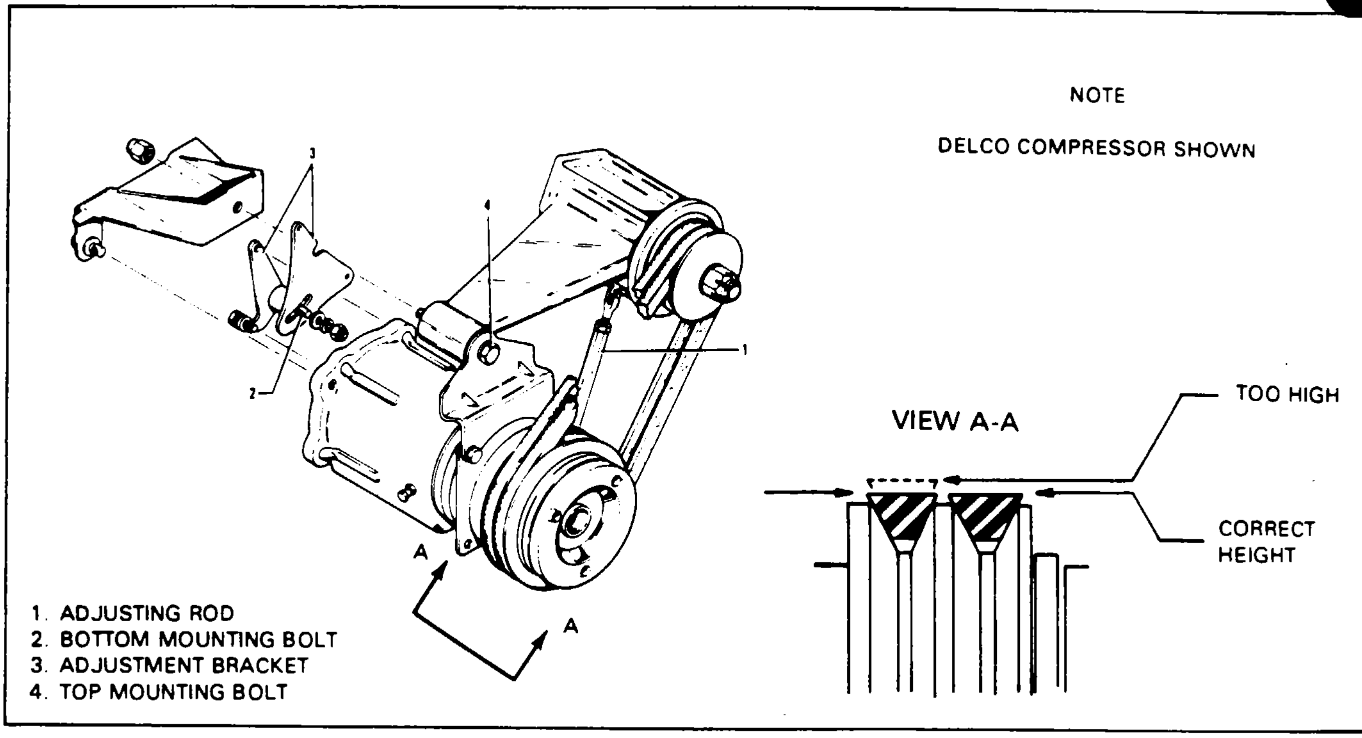


Figure 21-21. Compressor and Drive Assembly

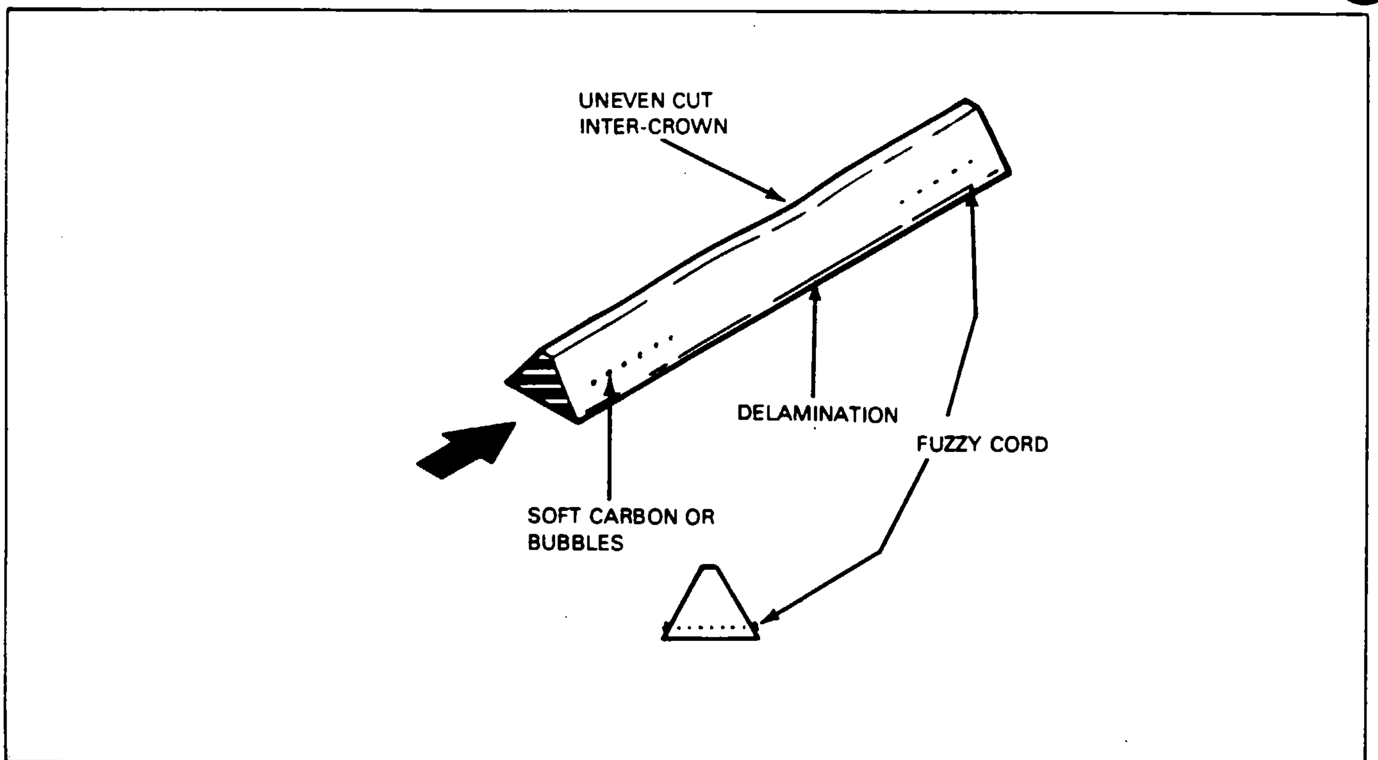


Figure 21-22. Belt Inspection

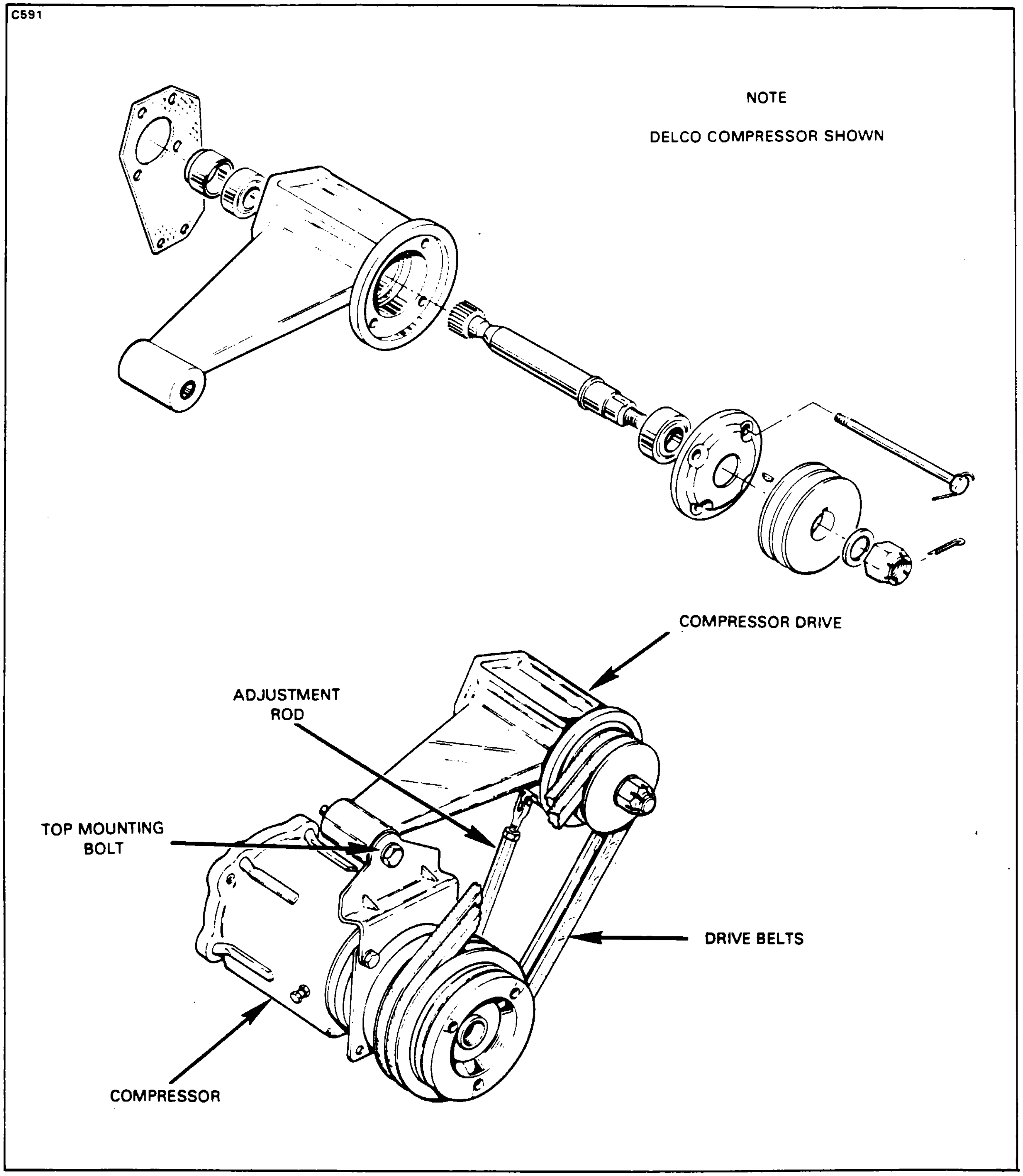


Figure 21-23. Drive Housing and Drive Assembly

INSTALLATION OF COMPRESSOR. (Refer to Figure 21-21.)

1. Drain the oil from the new compressor per instructions in Step 12 of Compressor Removal. Refill the unit with the same amount of oil as removed from the old unit. It should be approximately 10 ounces. The oil from the new compressor can be reused if it is drained into a clean container and filtered before being reused.
2. Place the compressor in the nacelle and attach with the mounting bolts.
3. Slip the belts on the compressor pulley.
4. Attach the compressor adjustment rod.
5. Adjust the rod and tighten the mounting bolts. Tension the belts as follows:
   A. Use a Gates Rubber Co. No. 150 tensionmeter when checking belt tension.
   B. On the initial installation of the belts, adjust the tension to 100 ± 5 pounds.
   C. After initial compressor operation of up to (1) hour, recheck the tension. If the recheck is made immediately after the engine is shutdown (hot) and tension is below 50 lbs., readjust the tension to 50 lbs. If the recheck is made cold and tension is below 90 lbs., readjust the tension to 90 ± 5 lbs.
6. Connect the lines to the compressor and ascertain that the compressor rotates freely through two complete revolutions. Do not exceed 8 foot-pounds rotating torque.
7. Evacuate and charge the system.
8. Connect the electrical leads to the magnetic clutch.
9. Install cowling on the right engine.
10. Reset the air conditioning circuit breaker.
11. Check operation of the air conditioning system.

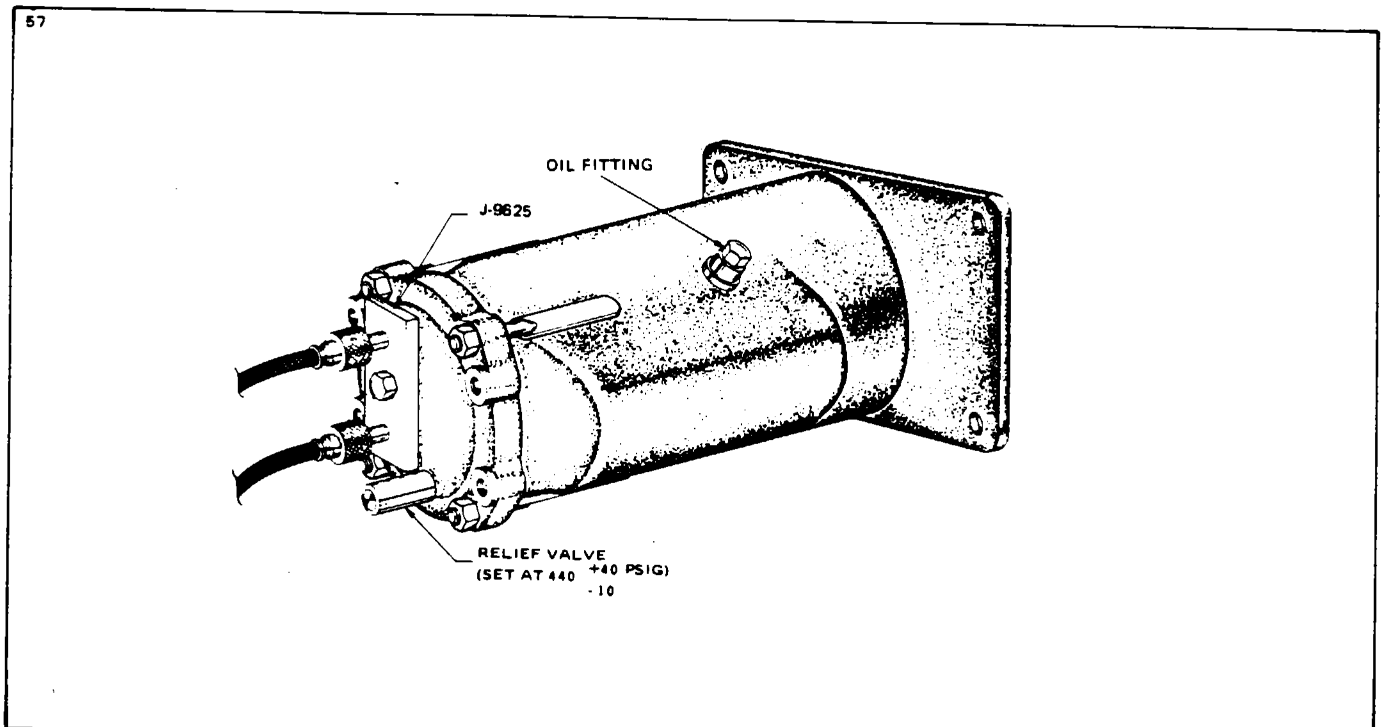


Figure 21-24. Leak Test

LEAK TESTING THE COMPRESSOR.

With Tool J-9625 installed on compressor (refer to Figure 21-24) leak test the compressor as follows:

1. Using the J-23575 gauge set, connect the center hose to the refrigerant drum and the high and low pressure Schrader valves.
2. With the high pressure valve and the low pressure valve open, allow refrigerant to flow to the compressor.
3. Open the oil plug fitting in the compressor housing and allow the air to exhaust until refrigerant starts to flow from the fitting.
4. Close the oil plug fitting and allow the drum pressure to stabilize in the compressor.
5. Check and correct any leaks that may exist.
6. Remove gauge set and cap fittings on Tool J-9625; then add oil as outlined under Checking and Adding Oil.

CHECKING AND ADDING OIL.

Compressor oil will not be lost unless a freon leak has occurred; therefore, the oil level is not to be checked unless a freon leak has occurred. However, it is possible to lose freon from the system without loss of compressor oil. It is then a matter of good judgment as to whether the oil level is to be checked. If any major loss of oil has occurred, proceed as follows after making the necessary repairs. (Refer to Figure 21-21.)

1. Remove belts.
2. Support the compressor and remove the top mounting bolt.
3. Rotate the compressor 30 degrees from horizontal.
4. If the engine has not been operated within the last hour, it will be necessary to warm the compressor case for 15 minutes by a light source or heat gun. The compressor must be slightly warmer than the rest of the air conditioning system to drive out all liquid freon, otherwise a diluted oil reading will be obtained. Do not overheat the compressor.
5. Loosen the oil drain screw and allow oil to drain from the compressor.
6. If the system is under pressure, the oil will come out of the drain with considerable force and care must be exercised not to lose an excessive amount of oil. If the system is not under pressure, the drain screw may have to be removed to allow the oil to drain. If only oil comes out of the compressor, the oil level is sufficient. If gas escapes from the drain screw, the oil level must be re-established by the alternate procedure given in Step 7.

— NOTE —

The following alternate procedure must be used if a major freon loss has occurred. Example: Large oil loss visible at leak location.

7. If an excessive amount of oil is lost during the oil level check, the following alternate procedure must be used:
   - A. Rotate the compressor until the oil drain is vertical and drain all the oil from the compressor. Allow the freon charge to slowly discharge through the oil drain.
   - B. Rotate compressor back and attach to engine.
   - C. Add 10 ounces of refrigerant oil (Frigidaire 525 Viscosity Oil, Suniso No. 5 or Texaco Capella "E") to compressor through oil drain.
   - D. Replace oil drain screw.
   - E. Refer to Installation of Compressor for compressor installation.
   - F. Check system for leaks and recharge.

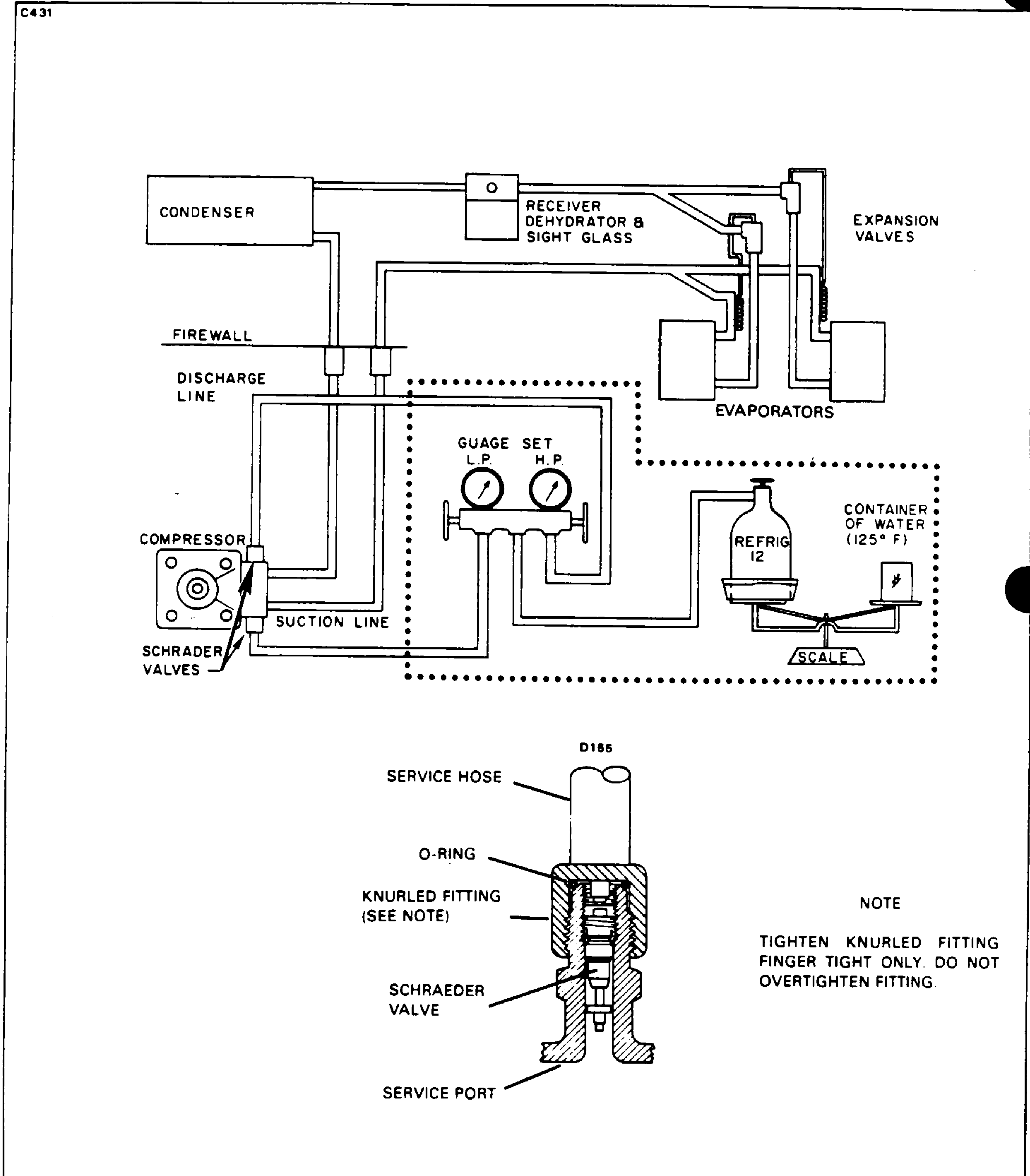


Figure 21-25. Charging Hookup

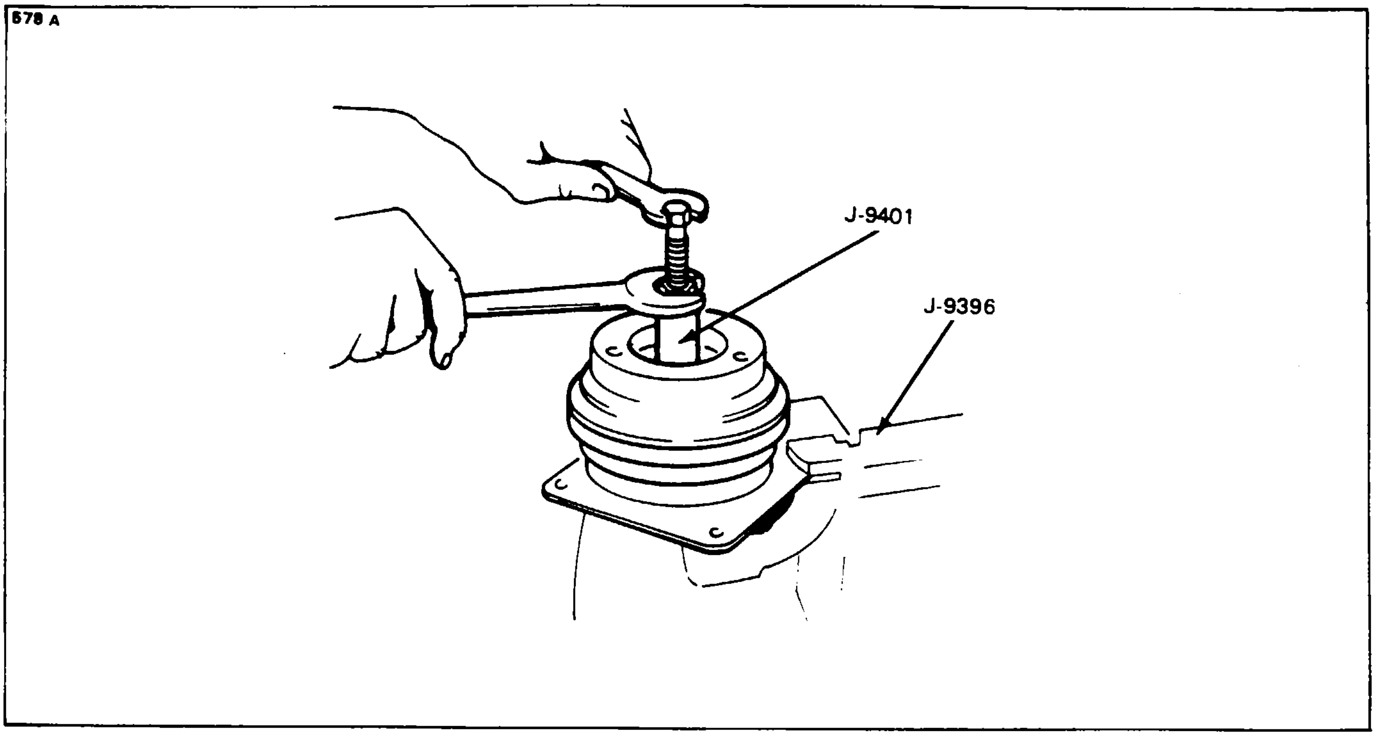


Figure 21-26. Removing Driven Plate

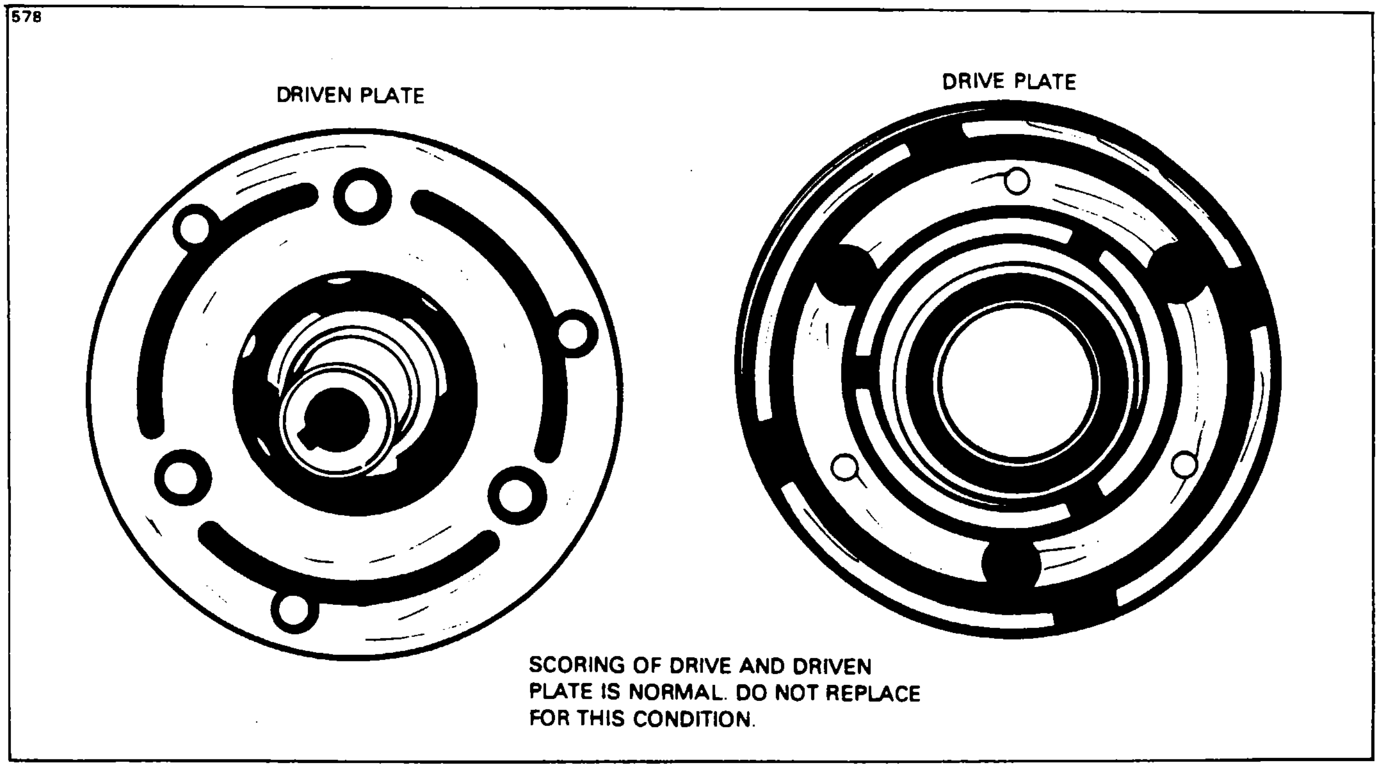


Figure 21-27. Drive and Driven Plates

579

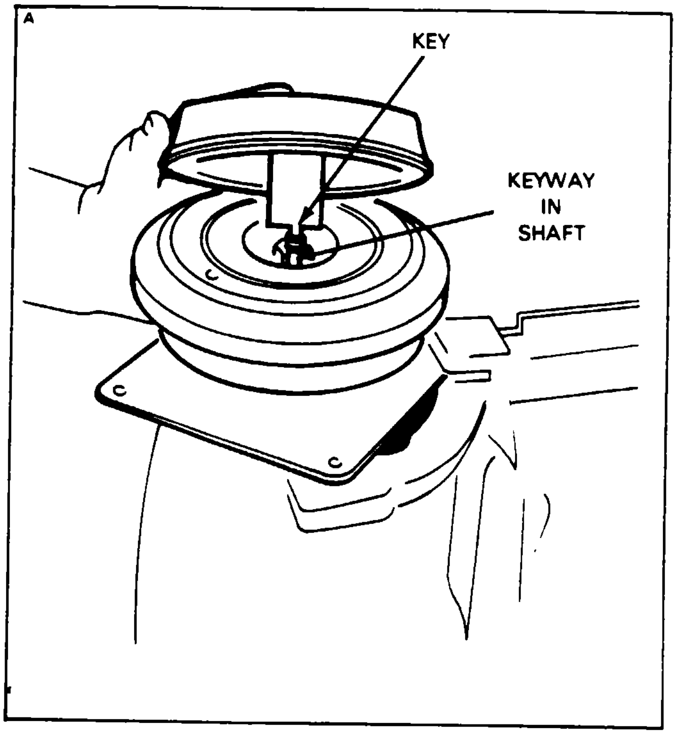


Figure 21-28. Aligning Driven Plate Key

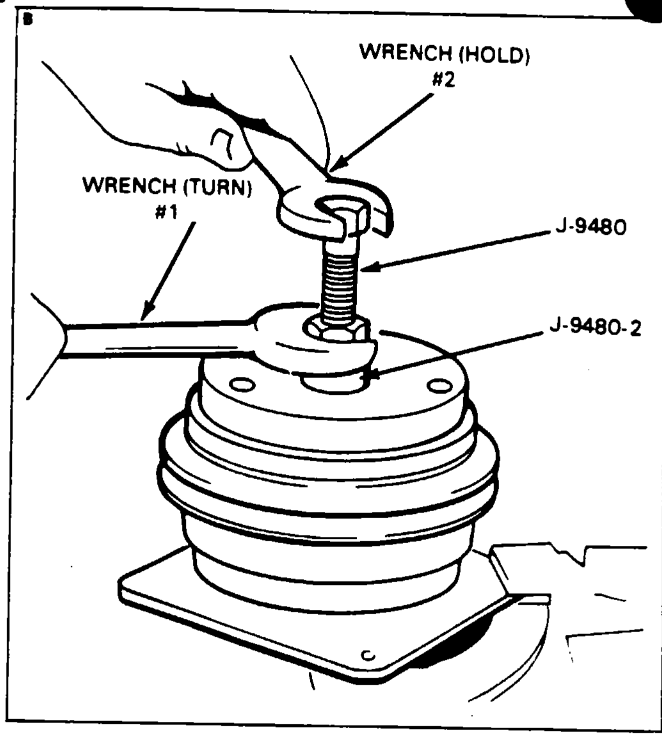


Figure 21-29. Installing Driven Plate

580

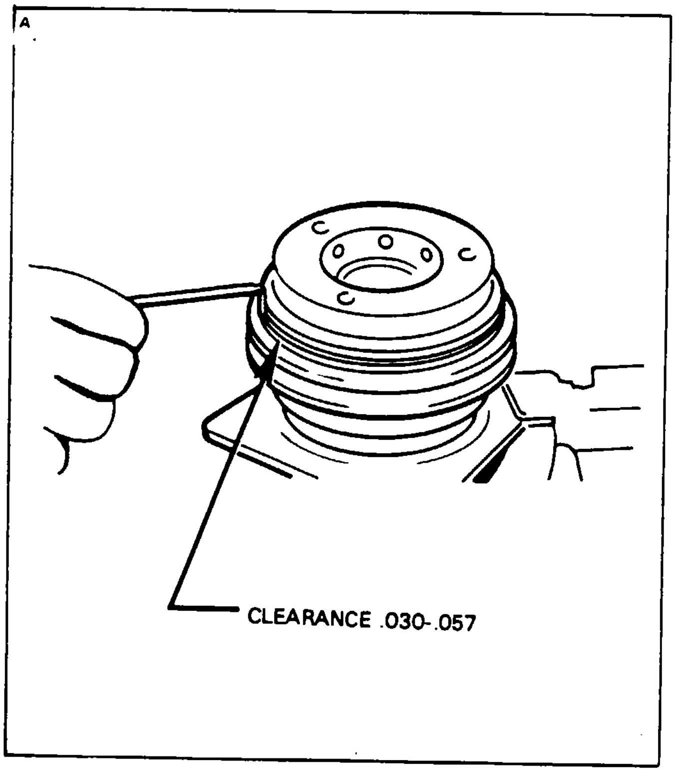


Figure 21-30. Checking Air Gap

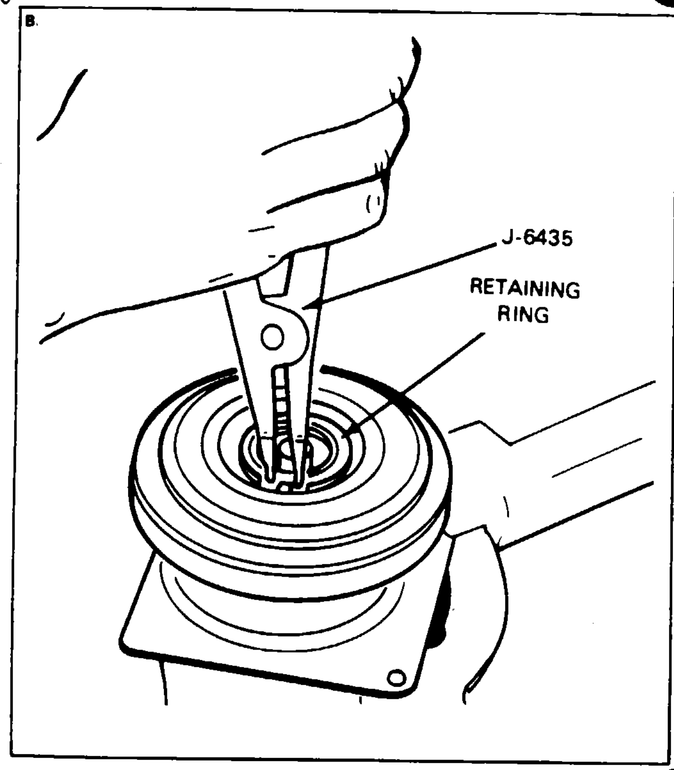


Figure 21-31. Removing Pulley Retaining Ring

MAGNETIC CLUTCH, PULLEY AND COIL. (Refer to Figures 21-26 thru 21-36.)

REMOVAL OF DRIVEN PLATE AND PULLEY ASSEMBLY.

1. Using a thin wall socket, remove the locknut from the compressor shaft. Use tool J-972-A to hold driven plate.
2. Install puller J-9401 into hub of driven plate. Hold main body of tool and turn forcing screw clockwise to remove driven plate. (Refer to Figure 21-26.)
3. Remove the pulley retaining ring from inside driven plate using tool J-6435. (Refer to Figure 21-31.)
4. Remove key from either the compressor shaft or the driven plate.
5. Remove pulley with puller J-8433. (Refer to Figure 21-32.)
6. Inspect driven plate for cracks or stresses in the resilient drive. Do not replace driven plate for a scoring condition. (Refer to Figure 21-27.)
7. If necessary to remove the pulley bearing, proceed as follows:
   A. Remove the bearing retaining ring.
   B. Drive out bearing with brass drift.
   C. Install new bearing; then install retaining ring.

INSTALLATION OF DRIVEN PLATE AND PULLEY ASSEMBLY.

1. Install the pulley and bearing assembly on the end of the compressor, with tool J-9481. (Refer to Figure 21-34.) The pulley should rotate freely.
2. Install the pulley retaining ring, with tool J-6435.
3. Insert the square drive key into the shaft of the compressor.

— NOTE —

The small snap ring and spacer washer must be removed from the driven plate assembly before continuing next step.

4. Line up the key in the shaft with the keyway in the hub. (Refer to Figure 21-28.)
5. Position the driven plate installing tool J-9480-1 on the threaded end of the shaft. The "Free" washer, J-9480-2, should be in place under the hexnut on the tool. This tool has a left-hand thread on the body. (Refer to Figure 21-19.)
6. Press the driven plate onto the shaft until there is approximately 1/8 inch space between the frictional faces of the clutch plates.
7. Remove installing tools.
8. Replace the snap ring and spacer washer in the driven plate assembly.
9. Replace the installing tools and adjust the air gap by carefully turning the wrench. (Refer to Figure 21-29.)
10. Remove installing tools.
11. Install the locknut, using a thin wall socket. Tighten to 15 foot-pounds torque. The air gap between the friction faces should now be between .030 to .057 inch clearance. (Refer to Figure 21-30.)

592

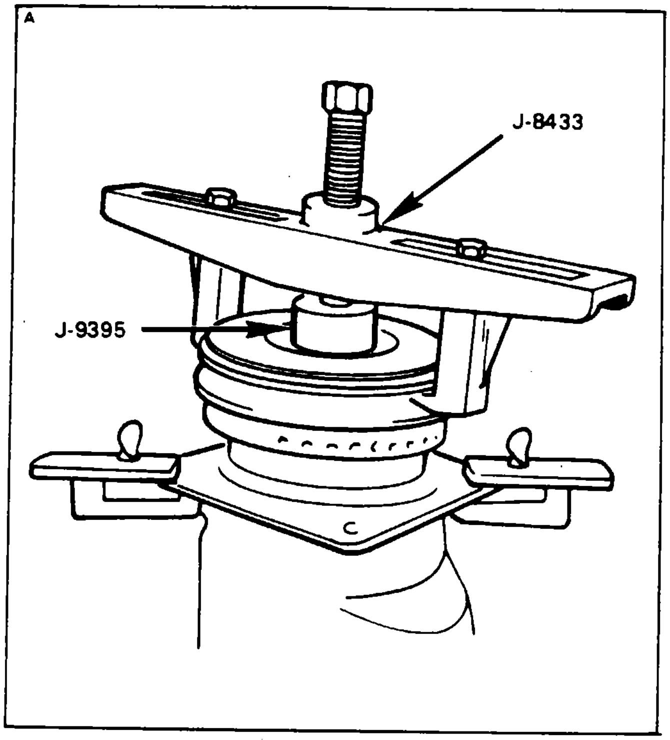


Figure 21-32. Removing Pulley and Drive Plate

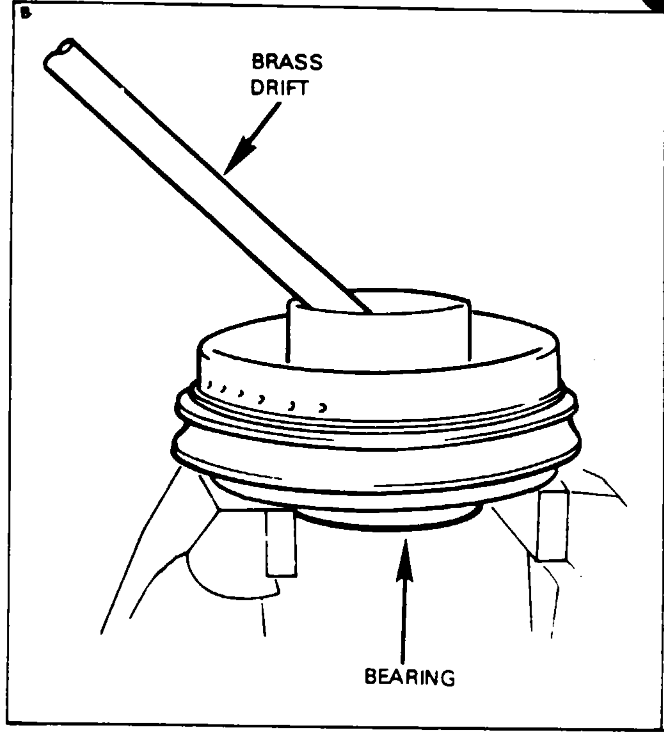


Figure 21-33. Removing Bearing

581

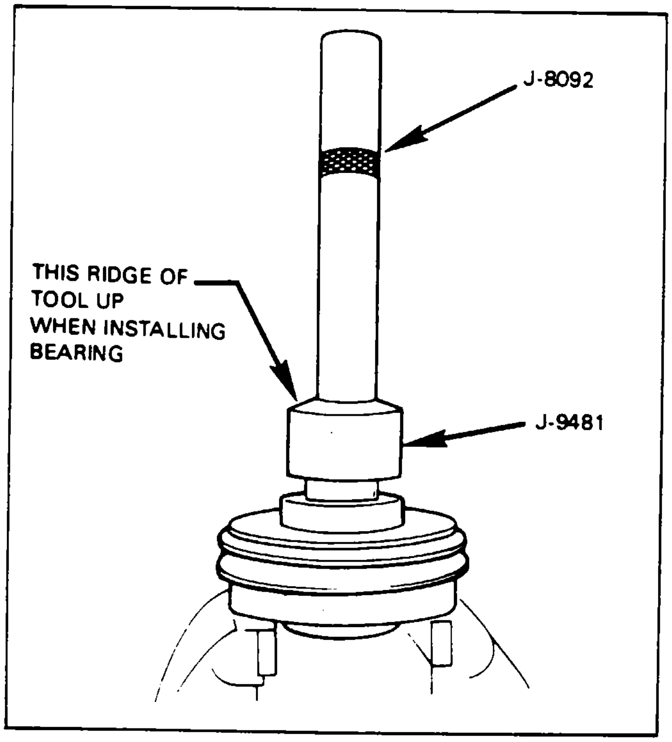


Figure 21-34. Installing Pulley and Drive Plate Bearing

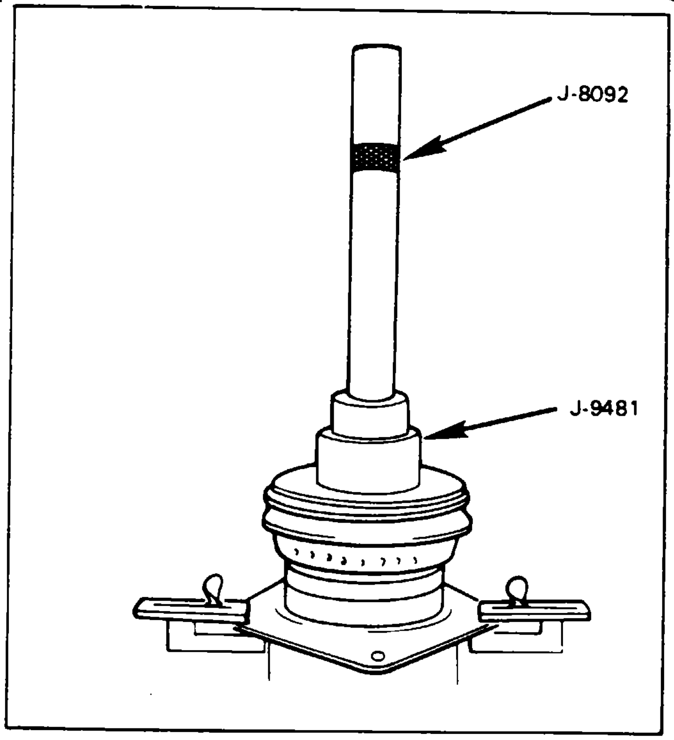


Figure 21-35. Installing Pulley and Drive Plate

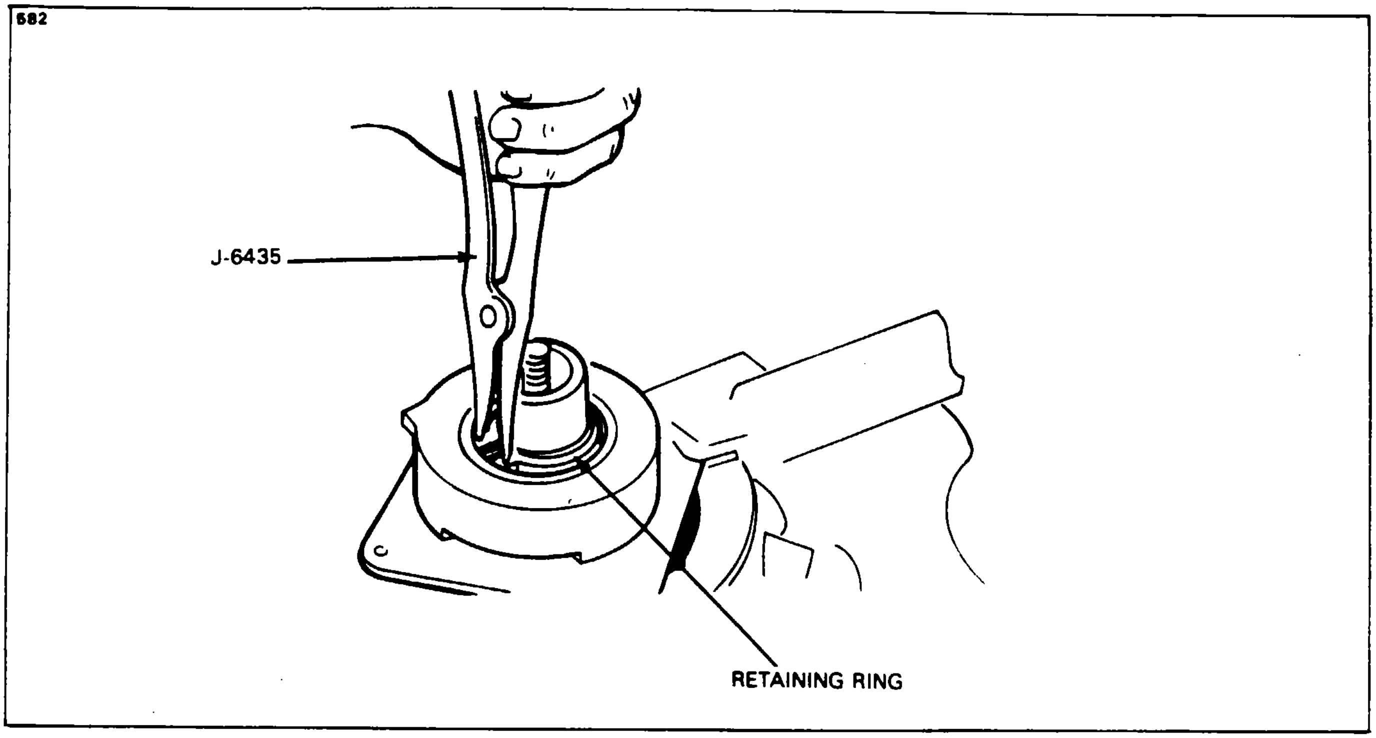


Figure 21-36. Removing Coil Housing Retaining Ring

REMOVAL OF CLUTCH COIL AND HOUSING.

1. With the driven and drive plates removed, scribe the clutch coil housing retaining ring with tool J-6435.
2. Remove the clutch coil housing retaining ring with tool J-6435.
3. Remove coil housing assembly.

INSTALLATION OF CLUTCH COIL AND HOUSING.

1. With the scribe marks aligned, locate the extrusions on the coil housing with the holes in the front head.
2. Install the coil retainer ring with tool J-6435.

SANKYO COMPRESSOR.

REMOVAL OF COMPRESSOR.

1. Discharge the system in accordance with instructions given in this chapter under Refrigerant Drum Method.
2. Turn the air conditioning system circuit breaker OFF.
3. Remove the cowling from the right engine.
4. Disconnect the electrical leads from the magnetic clutch on the compressor.
5. Loosen the jam nut on the adjustment rod and run the adjustment turnbuckle up to loosen the adjustment then loosen the mounting bolt on top of the compressor. Remove the bottom and top compressor mounting bolts. Note the location of any washers that may have been installed on the upper bolt.
6. Slip the belts off of the pulleys and remove the compressor.

INSTALLATION OF COMPRESSOR.

1. Position compressor on mounting bracket. Install mounting bolts. Do not torque at this time.
2. Adjust the adjustment rod and tighten the mounting bolts. Tension the belts as follows:
   A. Use a Gates Rubber Co. No. 150 tensionmeter when checking belt tension.
   B. On the initial installation of the belts, adjust the tension on one belt to 100 + - 5 lbs.
   C. After initial compressor operation of up to one hour, recheck the tension. If the recheck is made immediately after the engine is shut down (hot) and belt tension is below 50 lbs., readjust the tension to 50 lbs. If the recheck is made when the engine is cold and tension is below 90 lbs. Readjust the tension to 90 + - 5 lbs.
3. Reconnect the freon lines to the compressor.
4. Evacuate and charge the system per instructions in this chapter.
5. Connect the electrical leads to the magnetic clutch.
6. Reinstall the cowling on the right engine.
7. Reset the air conditioning circuit breaker.
8. Check operation of the air conditioning system.

CHECKING COMPRESSOR OIL LEVEL.

Whenever a system component has been replaced or there is an obvious leak, use the following procedure to check the compressor oil level (after making necessary repairs):

1. Determine the compressor mounting angle by positioning an angle protractor across the flat surfaces of the two front mounting ears.
2. Center the bubble and read the mounting angle to the closest degree.
3. Discharge the freon from the air conditioning system slowly until the low side gauge reads 0 psi. (Refer to Connecting the Manifold and Hose and Discharging the System.)
4. Remove the oil filler plug.

C645

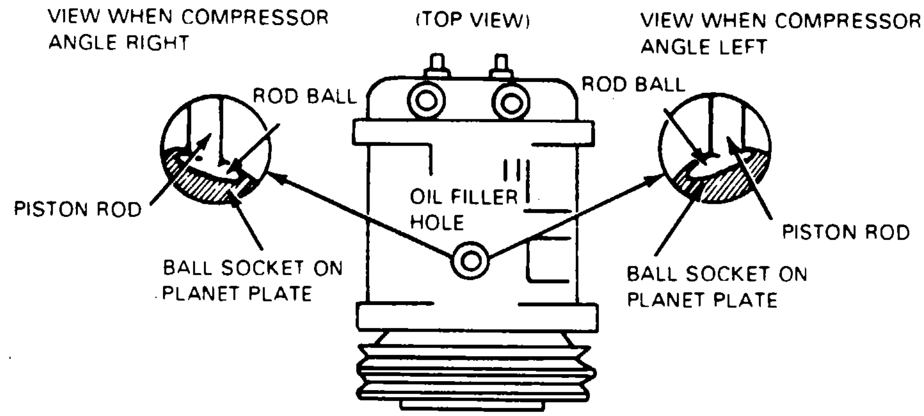


Figure 21-36a. Positioning Sankyo Compressor Internal Parts

5. Look through the oil filler plug hole and rotate the clutch front plate to position the internal parts as shown in Figure 21-36a.

A. If the compressor is mounted to the right (facing the pulley and clutch) (refer to Figure 21-36a), center the parts as they are moving to the rear of the compressor (discharge stroke).

B. If the compressor is mounted to the left (facing the pulley and clutch) (refer to Figure 21-36a), center the parts as they are moving to the front of the compressor (suction stroke).

— *NOTE* —

This step is necessary to clear the dipstick of internal parts and to allow its insertion to full depth.

6. Insert the dipstick to its stop position. (Refer to Figure 21-36c.) The stop is the angle near the top of the dipstick.

A. The point of the angle must be to the left if the mounting angle is to the right.

B. The point of the angle must be to the right if the mounting angle is to the left.

C. The bottom surface of the angle, in either case, must be flush with the surface of the oil filler hole.

7. Remove the dipstick and count the increments of oil.
8. Use Chart 2105a to determine the correct oil level for the mounting angle of the compressor.
9. If the increments read on the dipstick do not match the table, add or subtract oil to the mid-range value.

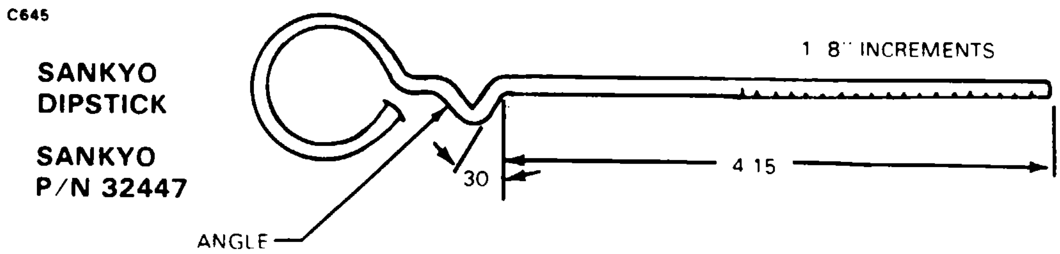


Figure 21-36b. Fabricated Dipsticks for Compressor Oil Check

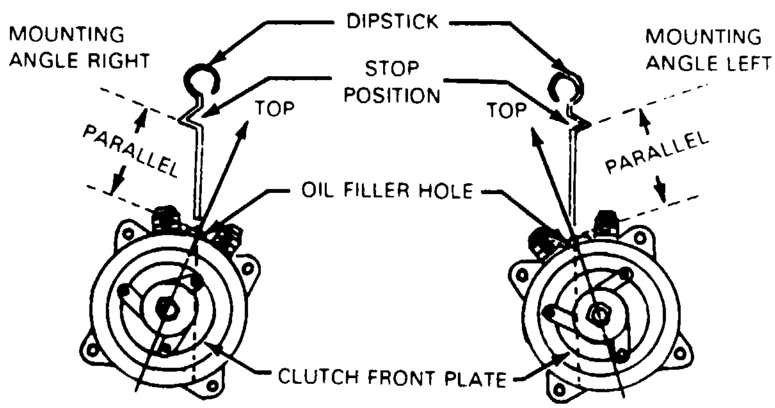
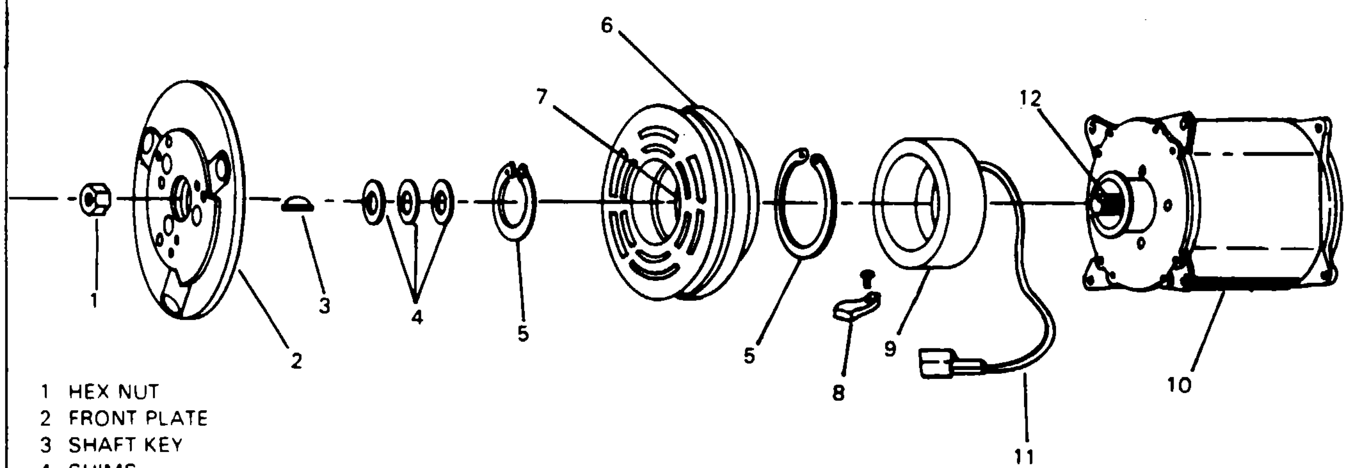


Figure 21-36c. Sankyo Compressor Mounting Angle

CHART 2105a. SANKYO COMPRESSOR MOUNTING ANGLE/OIL LEVEL

Mounting Angle Degree	Acceptable Oil Level In Increments
0	4-6
10	6-8
20	8-10
30	10-11
40	11-12
50	12-13
60	12-13
90	15-16

C745



1 HEX NUT
2 FRONT PLATE
3 SHAFT KEY
4 SHIMS
5 SNAP RINGS
6 ROTOR PULLEY
7 BEARING
8 CLIP
9 COIL
10 COMPRESSOR
11 COIL LEAD WIRE
12 KEYWAY

Figure 31-36d. Magnetic Clutch Assembly (Sankyo Compressor)

MAGNETIC CLUTCH, PULLEY AND COIL.

REMOVAL OF MAGNETIC CLUTCH PULLEY AND COIL. (Refer to Figure 21-36d.)

1. Insert the two pins of the 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. Remove clutch front plate using Sankyo puller 32416.
   A. Align puller center bolts to compressor shaft and thumb tighten the three puller bolts into the threaded holes.
   B. Turn center bolt clockwise to remove front plate.
3. Remove shaft key by lightly tapping it loose with a slot screwdriver and hammer. Also, remove shims.
4. Remove the external and internal snap rings by the bearing inner and outer races, respectively, with snap ring pliers.
5. Remove rotor pulley assembly.
   A. Insert the lip of the jaws into the snap ring groove.
   B. Place rotor puller shaft protector over the exposed shaft.
   C. Align thumb head bolt to puller jaws. Finger tighten.
   D. Turn puller center bolt clockwise until rotor pulley is free.
6. Remove field coil.
   A. Loosen coil lead wire from clip on top of compressor front housing.
   B. Remove snap ring and field coil.

INSTALLATION OF MAGNETIC CLUTCH, PULLEY AND COIL.

1. Install field coil. Coil flange protrusion must match hole in front housing to prevent coil movement and correctly locate lead wire.
   A. Install snap ring.
   B. Position coil lead wire and secure it with clip on top of compressor front housing.
2. Replace rotor pulley:
   A. Using a vise, clamp the compressor rear mounting ears, never the compressor body.
   B. Align rotor assembly squarely on the front housing hub.
   C. Using rotor installation set, place the ring part of the set into the bearing cavity. Make certain the outer edge rests firmly on the rotor bearing outer race.
   D. Place the tool set drive into the ring.
   E. With a hammer, tap the end of the driver while guiding the rotor to prevent binding. Tap until the rotor bottoms against the compressor front housing hub. Listen for a distinct change of sound during the tapping process.
3. Install external and internal snap ring.
4. Replace front plate assembly.
   A. Check that original clutch shims are in place on compressor shaft.
   B. Replace compressor shaft key.
   C. Align front plate keyway to compressor shaft key.
   D. Using shaft protector, tap front plate to shaft until it has bottomed to the clutch shims. Note distinct sound change.
5. Replace shaft hex nut and torque from 25 to 30 foot-pounds.

6. Check air gap with feeler gauge (.016" to .031"). If air gap is not consistent around the circumference, lightly pry up at the minimum variations. Lightly tap down at points of maximum variation.

— NOTE —

The air gap is determined by the spacer shims. When reinstalling or installing a new clutch assembly, try the original shims first.

7. If the air gap does not meet the specifications in Step 6, add or subtract shims by repeating steps 4 and 5.

REMOVAL OF FAN AND CONDENSER. (Refer to Figure 21-37.)

1. Remove cowling and access panels on each side and on top of the nacelle.
2. Ascertain that the air conditioning system circuit breaker is pulled.
3. Discharge the system.
4. Disconnect the freon lines at the condenser.
5. Disconnect the electrical leads from the fan.
6. Remove the clamp from the fan motor.
7. Loosen the set screw on the fan; slide the fan aft and off of the shaft.
8. Disconnect the bracket from the firewall and remove the fan motor and fan blades from the nacelle.
9. Disconnect the hardware holding the condenser.
10. Remove the condenser from the nacelle.

— NOTE —

If new condenser is being installed, add 2.0 ounces of refrigerant oil to the condenser and add an identifying mark (red dot) to indicate that oil has been added.

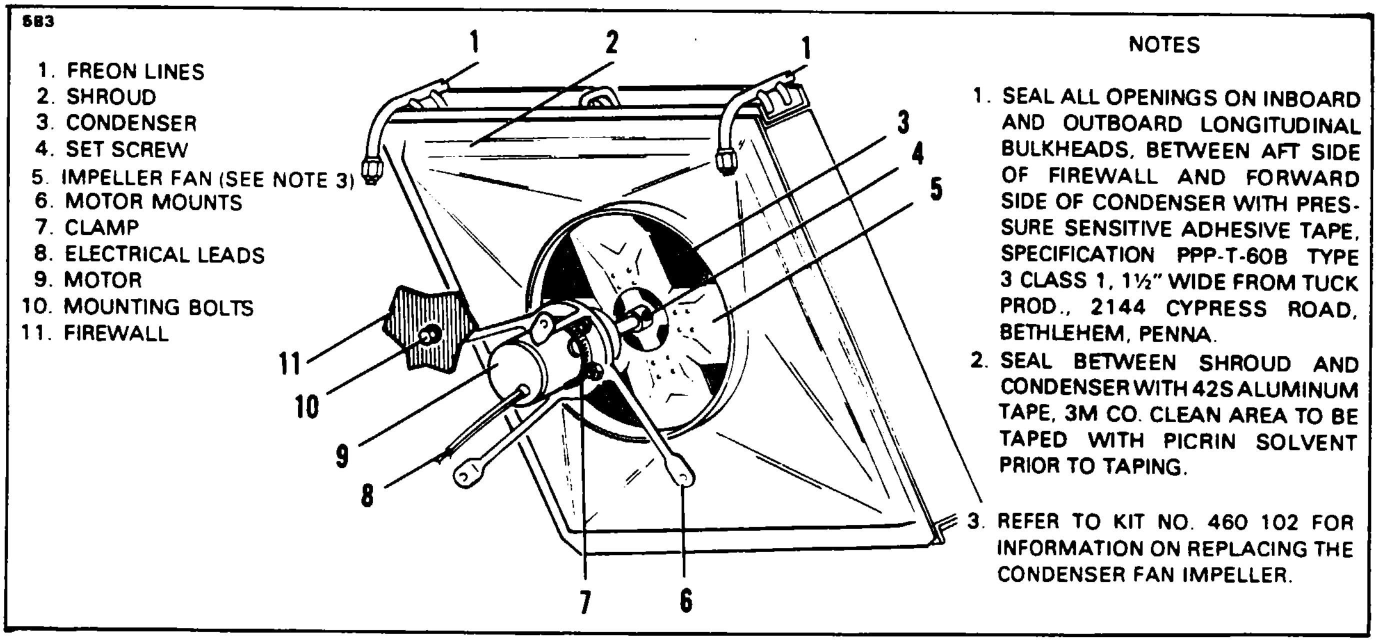


Figure 21-37. Fan and Condenser

INSTALLATION OF FAN AND CONDENSER. (Refer to Figure 21-37.)

1. Install condenser and secure.
2. Connect the fan motor and bracket to the firewall.
3. Slide the fan on the shaft and position the aft "face" of the fan hub 1.88 inches from the condenser and secure with the set screw.
4. Install the clamp on the fan motor. Insure that wires are located at the top of the motor.
5. Connect the electrical leads.
6. Connect the freon lines at the condenser.
7. Evacuate and charge the system and check for leaks.
8. Engage the air conditioning circuit breaker.
9. Install the cowling and access panels.

RECEIVER-DEHYDRATOR REMOVAL.

This unit is mounted in front of the main spar underneath the first passenger's seat on the right-hand side.

1. Discharge the system of all refrigerant.
2. Disconnect the refrigerant lines at the receiver-dehydrator. Cap the end of the lines to prevent contamination of the system.
3. Loosen the clamps and remove the receiver-dehydrator from its mounting bracket.

— NOTE —

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

RECEIVER-DEHYDRATOR INSTALLATION.

1. Mount the new receiver in the mounting bracket with the sight glass up. Position the clamps so that the wormgear housings are in line with the aft fitting of the receiver.
2. Lubricate new O-rings with refrigerant oil and install them on the line fittings.
3. Connect the refrigerant lines to the dehydrator.

— CAUTION —

Torque the fittings. (Refer to Chart 2104.)

4. Evacuate and recharge the system per instructions in this Chapter.

C366

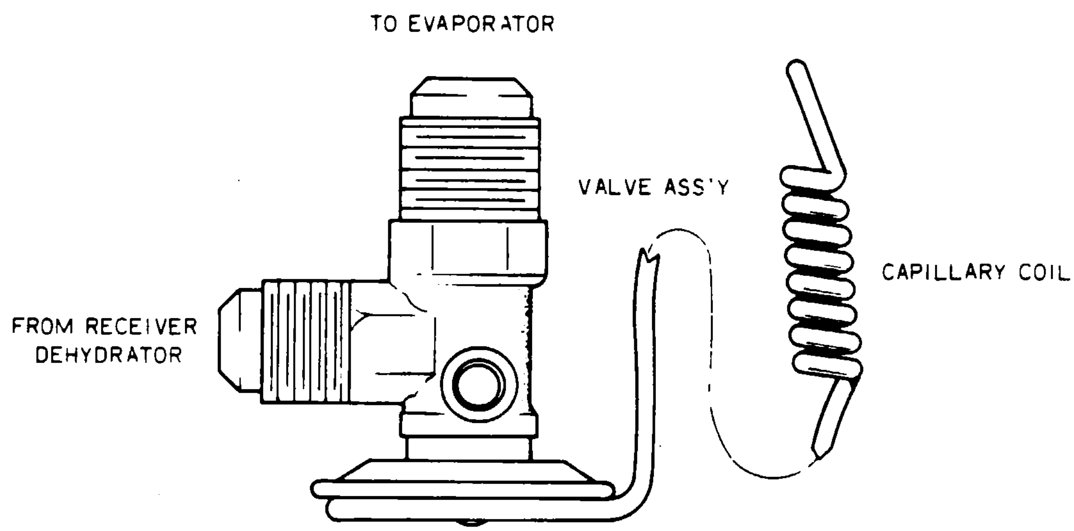


Figure 21-38. Expansion Valve (Typical)

EXPANSION VALVE REMOVAL. (Refer to Figure 21-38.)

This air conditioning system is equipped with two evaporator units; each unit has an expansion valve mounted on the inboard side of the module. The evaporator units are located in front of the main spar in the spar box.

1. Remove the appropriate seat(s) from the airplane.
2. Remove the seat tracks and carpet from the floorboard panel.
3. Remove the screws securing the floorboard panel over the unit and remove the panel.
4. Discharge the system prior to loosening any fittings.
5. Remove the tape covering the pressure line, capillary tube and clamp. Remove the clamp. (Do not kink the capillary tube.)
6. Loosen and separate related tube fittings (heat fittings to approximately 400 degrees to loosen). Cap all tube ends to prevent contamination of the system.

— NOTE —

This part is not serviceable.

EXPANSION VALVE INSTALLATION. (Refer to Figure 21-38.)

1. Install the expansion valve to the evaporator core, seal all tube connections with Loctite refrigerant sealant (applied to tube flanges only). Couple the fitting and torque in accordance with Chart 2104.
2. Secure the capillary tube to the evaporator outlet line (with the clamp provided). Cover capillary tube, clamp and outlet line with Presstite insulating tape (or equivalent).
3. Evacuate and charge the system. Check system for leaks.
4. Install floorboards, carpet, seat tracks, and seats previously removed and secure.

EVAPORATOR REMOVAL.

The evaporators are located in the spar box forward of the main spar. To remove the evaporator core, it is necessary to remove, as an assembly, the module which is located forward of the main spar.

1. Remove the appropriate seat(s) from the airplane.
2. Remove the appropriate cabin divider panel (if installed).
3. Remove the seat tracks and carpet from the floorboard panel.
4. Remove the screws securing the floorboard panel over the unit and remove the panel.
5. The air conditioning system must be completely discharged before disassembly.
6. Remove the inboard end panels of the modules.
7. Loosen and separate tube fittings (the tube flanges are sealed and may require heat to separate).

— NOTE —

When Loctite refrigerant sealant has been used on a joint it must be heated to 400°F prior to disassembly.

8. Remove the bolts and sheet metal screws attaching the evaporator mounting bracket to the spar cover. Lift assembly away. (Cap tubing ends.)
9. Remove expansion valve. (Refer to Expansion Valve Removal.)
10. Remove the bolts attaching the evaporator core to the mounting flanges. (On the right evaporator remove the temperature control switch capillary tube which is attached to the outboard side of the evaporator core with retainer clips.)

— NOTE —

Protect the evaporator core fins during assembly and disassembly. (A piece of cardboard taped to each side.) Insure that the fins are not bent or crumpled. This would cause a low efficiency in the cooling action. If fins are bent, comb the fins with an air conditioning comb. These can be purchased locally at any air conditioning dealer.

EVAPORATOR INSTALLATION.

1. With the shroud removed, place the evaporator core in the respective mounting brackets. Secure with bolts. (In the right module, attach the temperature control switch capillary tube to the second tube from the forward side of the evaporator core, with the special clips, placed approximately 6 inches apart - Part No. 44843.)
2. Install the evaporator assembly on the spar cover and mating air duct and secure to this spar cover.
3. Apply Loctite refrigerant sealant to all tube flanges. Couple the fittings and torque in accordance with Chart 2104.
4. Secure the expansion valve capillary. (Refer to Expansion Valve Installation.)
5. Evacuate and charge the system and check for leaks.
6. Install divider panels and inboard end panels (on right panel connect electrical connections).
7. Install floorboards, carpet, seat tracks, and seats previously removed and secure.

BLOWER AND MOTOR ASSEMBLY.

The blower and motor assemblies are located in the spar box on the outboard side of the evaporator assemblies.

BLOWER AND MOTOR ASSEMBLY REMOVAL.

1. Remove the divider panel.
2. Disconnect the related electrical wires.
3. Remove the two screws attaching the air duct bracket to end panel and disengage the locking lip.
4. Remove the clamp attaching the blower motor to the mounting bracket and remove assembly.

— NOTE —

The blower motor assembly is not a serviceable unit, it should be replaced with a new assembly.

— NOTE —

Protect the evaporator fins.

BLOWER AND MOTOR ASSEMBLY INSTALLATION.

1. Place the blower motor assembly in the mounting bracket and tighten the clamp enough to hold the unit. Engage the locking lip on the duct bracket and the forward edge of the duct opening in the end panel of the module. Secure with attaching screws.
2. Realign blower motor assembly with air duct and secure clamp.
3. Make related electrical connections.
4. Check electrical circuits; install divider panel and secure.

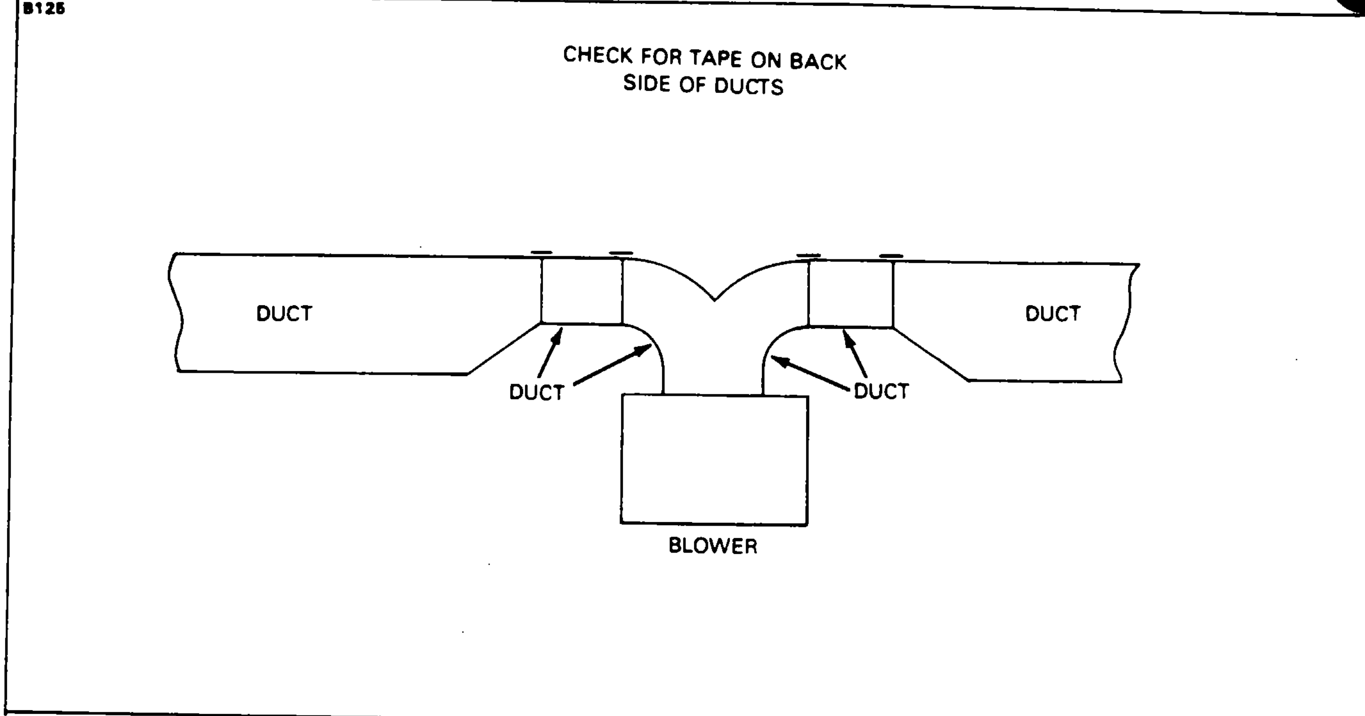
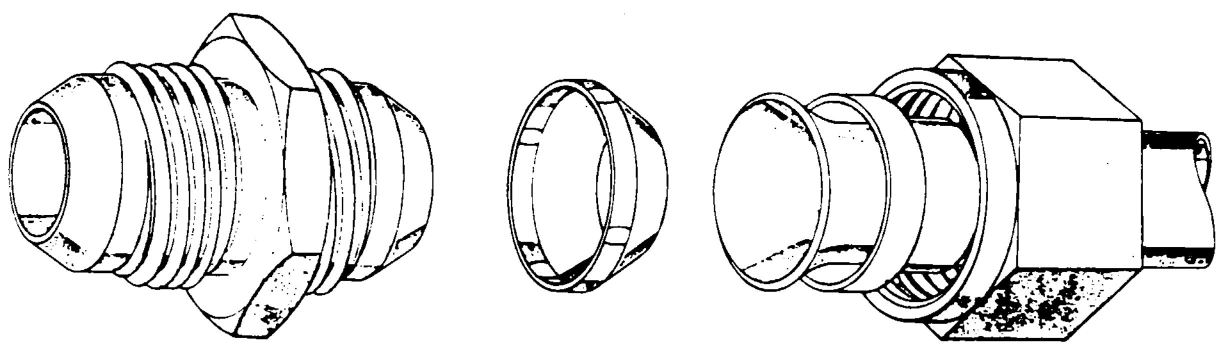


Figure 21-39. Sealing of Ducts



NOTE:
USE V01-SHAN SEALS VSF1015A6BX (PIPER CODE 486 476) FOR ⅜" DIA. TUBE, VSF1015A8BX (PIPER CODE 486 479) FOR ½" DIA. TUBES, VSF1015A12BX (PIPER CODE 486 478) FOR ¾" DIA. TUBES

Figure 21-40. Installation of VOI-SHAN Seals

FREON SYSTEM CHECKS.

Freon, because of its chemistry, is difficult to confine with rubber hoses and seals. For this reason an acceptable leak rate has been established, and due to temperature and system operation the leak rate will vary. Following are some areas of the system which should be inspected to prevent freon leaks:

1. Improper tightening of "B" nuts is a source of freon leaks. An alternate method of tightening "B" nuts in lieu of torque values is as follows:

   A. Hand tighten "B" nut; move the tube from side to side while tightening the nut to aid seating the nut and flare to the nipple.

   B. With the proper wrench, tighten the nut 1/4 turn.

   C. Loosen the "B" nut and repeat Steps A and B.

2. Flared fittings are sometimes difficult to seal. On the hard-to-get-at fittings, it may be necessary to install Voi-Shan seals. (Refer to Figure 21-40.) To install the seal, place seal over the nipple end and place tube flare over seal and nipple. Tighten per the procedure given in paragraph 1 except tighten only once.

— CAUTION —

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

3. Leaks are most frequently found in the nacelle area or around the evaporators.

   A. In the nacelle, the fittings at the condenser and at the aft side of the firewall and the fittings in the immediate area.

   B. In the evaporator area the fittings at and around the expansion valve.

   C. Although the above areas seem to be most susceptible to leaks, all fittings are subject to leaks and should be checked.

   D. Because of the planned leaks at the compressor shaft seal and the freon loss of the rubber hoses, Piper Aircraft Corporation has discontinued the use of Freon 12 with Dytel. The red dye also shows up the planned leaks as well as other leaks.

CABIN TEMPERATURE.

Air temperature should be measured at the six individual outlets and recorded to check efficiency of the system. A temperature differential should range from 24° F to 29° F between the outlet temperature and outside temperature.

If the temperatures don't fall within these figures the system should be checked for leaks. Refer to Chart 2102 for possible causes.

— END —

GRIDS 2E22 THRU 2E24
INTENTIONALLY LEFT BLANK

CHAPTER

22

AUTO FLIGHT

CHAPTER 22 - AUTOFLIGHT

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

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

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

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

Bendix Avionics Division
2100 N.W. 62nd Street
Fort 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
(714) 851-0119

CHAPTER 23

COMMUNICATIONS

CHAPTER 23 - COMMUNICATIONS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter 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.

DATA TRANSMISSION AND AUTOMATIC CALLING.

EMERGENCY LOCATOR TRANSMITTER.

DESCRIPTION.

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

BATTERY REMOVAL AND INSTALLATION. (Refer to Figures 23-1 and 23-2.)

The ELT is located under the dorsal fin.

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 and contact separator 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 23-1.)
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. 23-2.)
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. (Refer to Pilot's Operating Handbook.)

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 aircraft 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.

THIS SPACE INTENTIONALLY LEFT BLANK

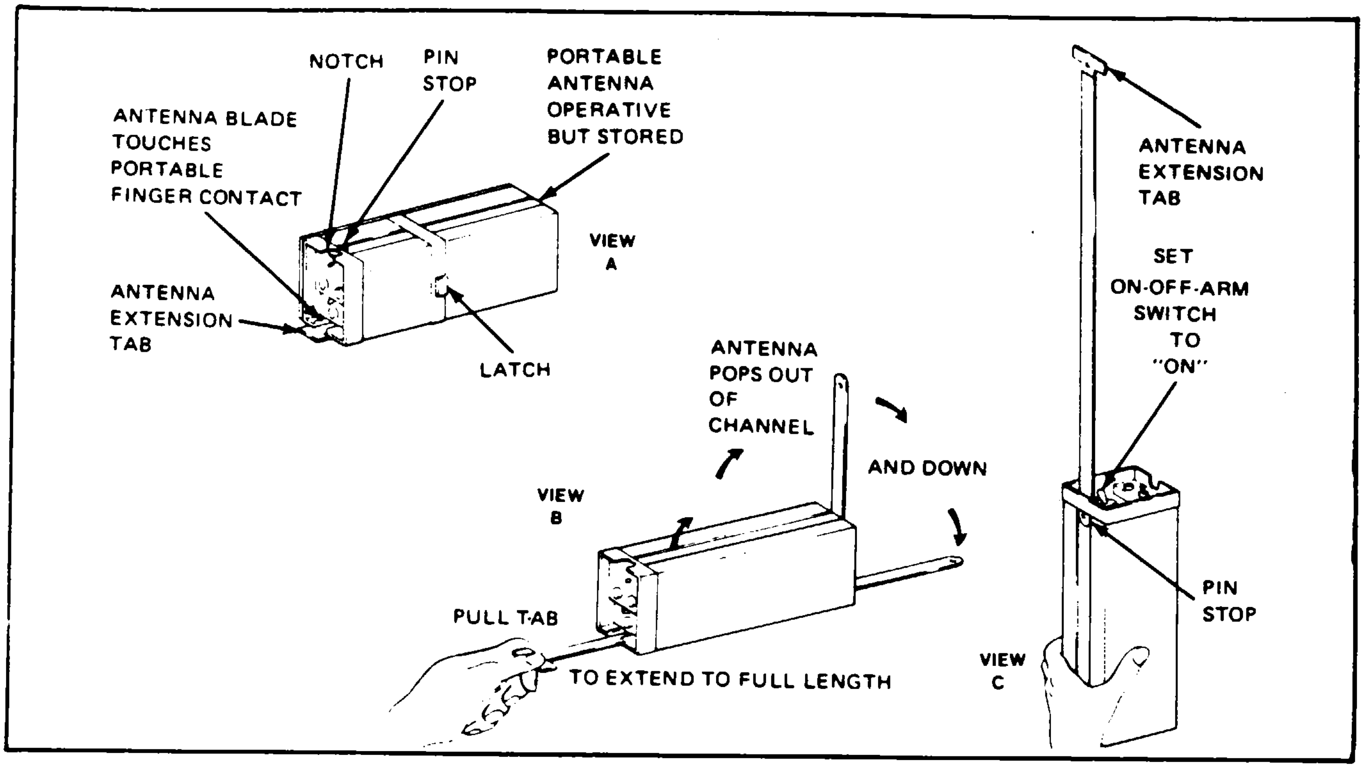


Figure 23-1. Portable Folding Antenna (Narco)

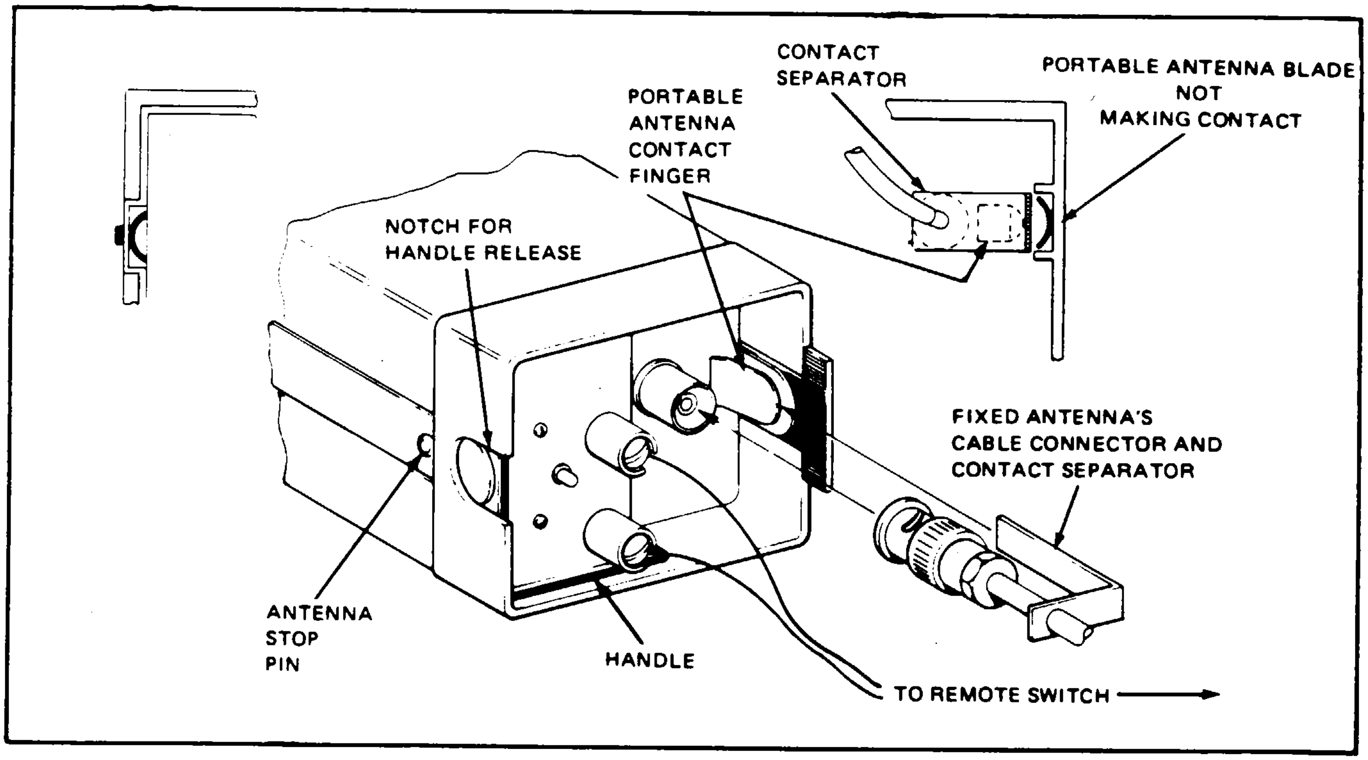


Figure 23-2. ELT Using Fixed Aircraft Antenna (Narco)

CHAPTER

24

ELECTRICAL POWER

CHAPTER 24 - ELECTRICAL POWER

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 24 - ELECTRICAL POWER (cont.)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This section contains general service instructions including a general description and function of each part of the system along with test and adjustments of the various components. This does not include any electronics installation such as Autopilot or radios. For electronics information, refer to Chapter 23 of this manual.

DESCRIPTION.

Electrical power is supplied by a 28-volt, direct current, negative ground electrical system. A 24 volt Lead-Acid (Nickel-Cadmium optional) battery is incorporated in the system to furnish power for starting, and as a reserve power source in case of generator failure. An external power receptacle is also provided in the nose of the airplane for use during cold weather operation and when operating equipment for test purposes.

The electrical system of the aircraft is controlled by three switches, which are: Battery Master Switch, Right Starter-Generator Switch and Left Starter-Generator Switch. The Battery Master Switch controls a master contactor which connects the battery to the tie bus of the aircraft. The five basic electrical system buses are also connected to the tie bus. The mode of operation of the DC Starter-Generator is selected by utilizing the Left and or Right Starter-Generator switches. There are two, three position switches which function as follows: UP position, GEN., CENTER position OFF, and DOWN position START. Each switch has a placard which indicates its selected function.

The electrical generating system contains two 200 amp DC Starter-Generators in parallel. Also incorporated into the system are overvoltage and overload protection. The electrical switches are located in an overhead panel just above the windshield and in a panel on the left and right side of the cockpit. There are two circuit breaker panels on the right and left side panels of the cockpit.

TROUBLESHOOTING.

Troubles peculiar to the electrical system are listed in Chart 2401 along with their probable causes and suggested remedies. The wiring diagrams included in the manual will give a physical breakdown of the different electrical circuits used in the airplane. (Refer to Chapter 91 for Electrical System Schematics.)

After the trouble has been corrected, check entire electrical system for security and operation of its components.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM)

Trouble	Cause	Remedy
STARTER-GENERATOR		
Unit fails to operate or does not attain normal speed.	Low voltage power source.	Check the power source to make certain that full voltage is being applied to starter terminals.
	Defective switch in power supply line.	Replace switch.
	Defective starter solenoid.	Replace solenoid.
	Damaged armature.	Replace the armature assembly.
	Short circuited or open stator windings.	Replace the stator and housing assembly.
	Improperly seated brushes.	Check brush seats and increase brush run-in time.
	Eccentric commutator.	Refinish commutator.
Excessive sparking at brushes.	Short circuited or grounded field windings.	Replace stator and housing assembly.
	Excessive clearance in bearings or rough bearing races.	Replace bearings.
	Eccentric commutator.	Refinish commutator.
	Short circuit in armature windings.	Replace armature assembly.
	Brushes incorrectly installed with top bevel reversed.	Reverse and reseat brushes.
	Armature out of balance.	Balance or replace armature.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont)

Trouble	Cause	Remedy
STARTER-GENERATOR (cont)		
Excessive sparking at brushes. (cont)	Insufficient brush run-in; improper seating.	Run in brushes until seated.
	Severe overload or short circuit in aircraft electrical system.	Locate and correct fault.
	Brushes sticking in holders.	Free-up brushes.
	Weak brush springs.	Replace brush holders.
	Brushes loose in holder.	Replace brushes. If still loose, replace brush holder assemblies.
Noisy operation.	Rough bearings.	Replace bearings.
	Scored or worn drive splines.	Replace drive shaft.
	Armature rubbing in stator.	Repair or replace defective parts.
	Fan blades bent and rubbing.	Straighten or replace fan.
Unit vibrates.	Unbalanced armature assembly.	Balance or replace armature assembly.
	Excessive run-out of armature bearings.	Replace armature bearings.
	Fan damaged or out of balance.	Rebalance or replace fan.
Generator produces full voltage - but with reversed polarity.	Voltmeter leads reversed.	Connect voltmeter correctly.
	Residual magnetism in field poles creates wrong polarity.	Flash the field.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont)

Trouble	Cause	Remedy
	STARTER-GENERATOR (cont)	
Generator overheats.	Continuous overload or restricted air inlet.	Check aircraft electrical system for grounds, etc. Make correction as necessary.
D to E paralleling voltage not within limits.	Insufficient cooling air.	Check for air inlet temperature.
	Air flow obstruction: dirt accumulation in generator ducting.	Check ducting and generator air inlet.
	Wrong load applied during testing.	Check testing procedure and correct condition.
Starter-generator fails starting test.	Short circuited or open stator winding.	Replace stator and housing assembly.
	Open circuit in armature.	Replace armature.
	BATTERY-DISCONNECT SOLENOID	
Does not operate.	Open circuit.	Repair wiring.
	Dirty contacts on connector plug.	Clean contacts.
	Open-circuited solenoid coil.	Replace unit.
	Plunger binding.	Remove and wash plunger and housing thoroughly with stoddard solution. Change spring compression only as a last resort.

CHART 2401. TROUBLESHOOTING (ELECTRICAL SYSTEM) (cont)

Trouble	Cause	Remedy
BATTERY-DISCONNECT SOLENOID (cont)		
Intermittent operation.	Short-circuited coil. Loose electrical connection.	Replace coil. Clean and tighten electrical connections.
	Plunger binding.	See remedy pertaining to "Plunger binding" under "Does not operate."
	Badly burned points.	If points cannot be dressed down, replace the unit.

STARTER GENERATOR SYSTEM.

DESCRIPTION AND OPERATION.

The Starter Generators are located on the aft top side of the engines. The purpose of this unit is to provide torque for engine starting and to generate DC electrical power. When the unit is being utilized as a starter, it may be energized by the aircraft battery or through the use of an external power source.

— NOTE —

The following information is taken from Lear Siegler, Inc. and Auxilec, Inc. Maintenance Manuals. For the most current information, refer to these manuals. Refer to Vendor-Supplier information at the front of this manual for vendor information.

— CAUTION —

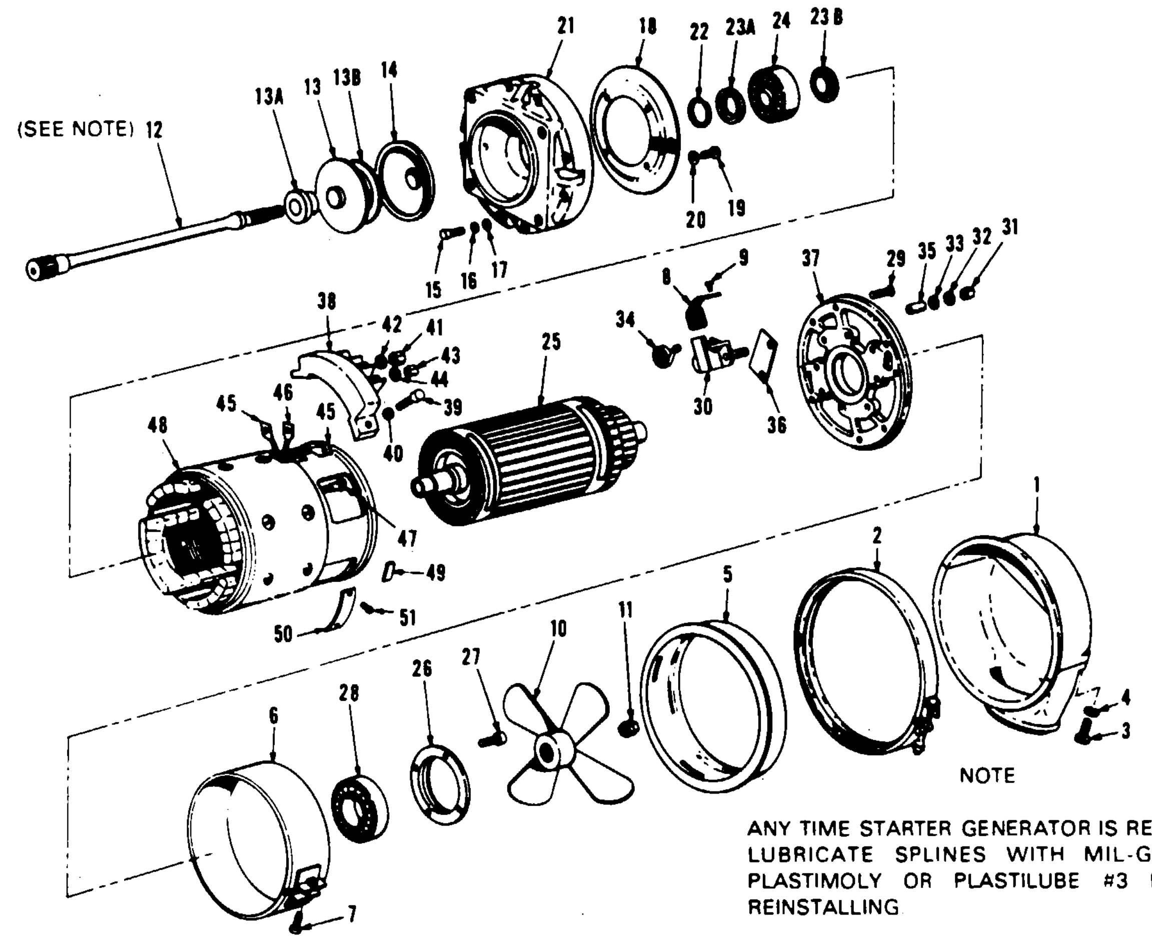
The selector switch should not be left in the START position any longer than the time required for a normal engine start; otherwise the unit may be damaged by excessive temperature caused by the large starting currents.

When the unit is being utilized as a generator, it will provide its rated DC output when operated at its rated speeds. This generated electrical power is then utilized as required to operate the various electrical systems of the aircraft.

This unit incorporates its own cooling system which consists of an air inlet duct, a pressure sensitive check valve in the air inlet duct which regulates direct airflow, and a four bladed fan which is part of the unit. Cooling is obtained by routing the outside ram air through the air inlet duct which is then driven through the unit by the four bladed fan.

Each unit is controlled by its own independent three position switch which operates as follows: DN for START, UP for GEN with the center position being the OFF position. The switches are located on the overhead switch panel. With the Battery Master Switch ON, placing the Right and/or Left Starter-Generator Switch in the START position, closes the appropriate starter solenoid for that particular engine. Power is then supplied through the master contactor to the field windings of the starter unit creating a strong magnetic field. At the same time, current flows through the brushes to the commutator and continues through the armature windings to ground. The magnetic field now existing in the armature combines with that existing in the field windings of the starter unit driving the armature as required to start the engine.

When the switch is placed in the GEN position, the unit provides rated DC output to the aircraft electrical system through the voltage control panel and the overvoltage control. Placing the switch in the center or OFF position disconnects the unit from the electrical system of the aircraft.

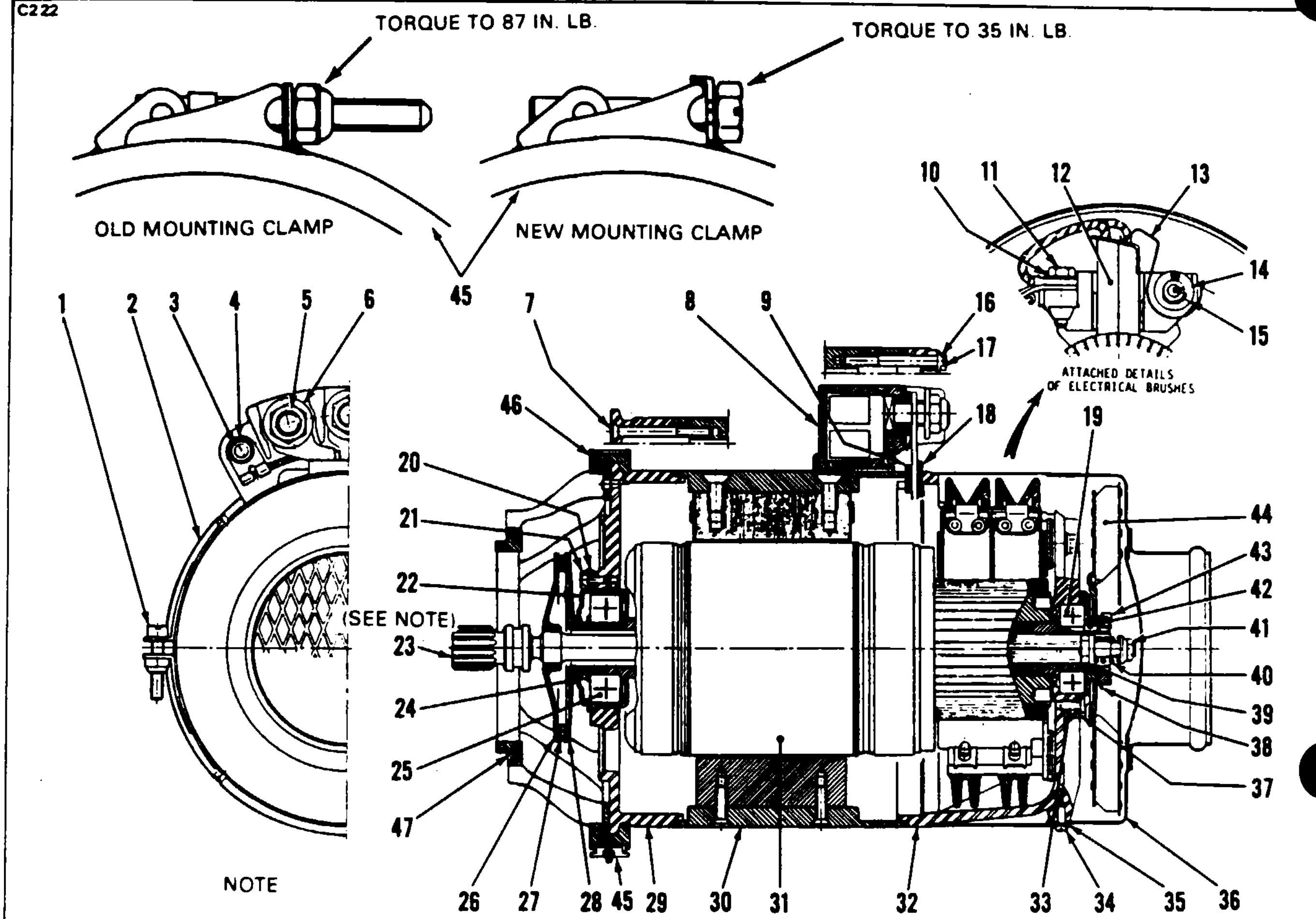


NOTE

ANY TIME STARTER GENERATOR IS REMOVED LUBRICATE SPLINES WITH MIL-G-21164 PLASTIMOLY OR PLASTILUBE #3 BEFORE REINSTALLING

1. INLET ASSEMBLY
2. CLAMP
3. SCREW
4. WASHER
5. COVER (FAN)
6. COVER (BRUSH)
7. SCREW
8. BRUSH
9. SCREW
10. FAN
11. LOCKNUT
12. DRIVE SHAFT
13. PLATE (DAMPENER)
13A. HUB (DAMPENER)
13B. RING
14. BACK PLATE
15. SCREW
16. LOCK WASHER
17. WASHER
18. SCREEN
19. SCREW
20. WASHER
21. END BELL
22. RETAINING RING
23. DISC
24. BEARING
25. ARMATURE
26. BEARING RETAINER
27. SCREW
28. BEARING
29. SCREW
30. BRUSH HOLDER
31. NUT
32. WASHER
33. WASHER
34. SPRING
35. SLEEVE
36. INSULATION
37. SUPPORT
38. TERMINAL BLOCK
39. SCREW
40. WASHER
41. NUT
42. WASHER
43. NUT
44. WASHER
45. TERMINAL LUG
46. TERMINAL LUG
47. TERMINAL LUG
48. STATOR
49. INSTRUCTION DECAL
50. IDENTIFICATION PLATE
51. SCREW

Figure 24-1. DC Starter-Generator (Lear-Siegler, Inc.)



NOTE

ANY TIME STARTER GENERATOR IS REMOVED LUBRICATE SPLINES WITH MIL-G-21164 PLASTIMOLY OR PLASTILUBE #3 BEFORE REINSTALLING.

1. SCREW
2. BRUSH BAND
3. NUT
4. FLAT WASHER
5. NUT
6. FLAT WASHER
7. SCREW
8. TERMINAL BOARD
9. INSULATOR
10. FLAT WASHER
11. SCREW
12. BRUSH
13. SPRING
14. WASHER
15. PIN
16. WASHER KEY
17. SCREW
18. GASKET
19. BALL BEARING
20. WASHER KEY
21. SCREW
22. CLAMP
23. DRIVE SHAFT
24. CIRCLIPS
25. BALL BEARING
26. DISK, DAMPER
27. FIBROUS DISK, DAMPER
28. DISK, DAMPER
29. MOUNTING FLANGE
30. STATOR, GENERATOR
31. ARMATURE, GENERATOR
32. COMMUTATOR BEARING
33. SCREW
34. SCREW
35. FLAT WASHER
36. COVER
37. CLAMP
38. WASHER
39. WASHER
40. SPRING
41. NUT
42. KEY
43. NUT
44. FAN
45. MOUNTING CLAMP
46. SECTURE
47. MOUNTING PAD

Figure 24-2. Starter-Generator (Auxilec, Inc.)

SERVICE OF STARTER-GENERATOR SYSTEM.

CHECKING STARTER-GENERATOR SYSTEM.

The system incorporates two ammeters which provide an independent output check of each generator and a voltmeter which monitors the electrical bus voltage. Should either ammeter fail to indicate an output from its associated generator, check the appropriate circuit breaker. If the circuit breakers are in their normal operating position, a further check of the system should be accomplished.

1. Ascertain that the ammeters are operating properly.
2. Ascertain that all electrical units are off and battery is fully charged.
3. Disconnect electrical lead at terminal stud C+ on Starter-Generator being tested, (L or R).
4. Turn on battery master switch and turn selector switch (L or R) for the unit being tested to the START position.
5. Using a voltmeter, attach positive lead to the electrical lead removed from terminal stud C+ on Starter-Generator and the other voltmeter lead to airframe ground. Voltmeter should read the battery voltage of 24-volts.
6. Turn battery master switch off.
7. Disconnect the voltmeter positive lead from wire removed from Starter-Generator terminal stud C+.
8. Remove the voltmeter from the airplane.
9. Connect electrical lead previously removed to C+ terminal stud on Starter-Generator.

ADJUSTMENTS.

The only adjustment necessary to maintain the generator system is the adjustment of the voltage control on the voltage regulator. A voltage of 28.5 volts must be maintained. All other control adjustments are made at time of installation and need not be reset.

— NOTE —

Since the Starter-Generator and Regulator units are designed for use on a single polarity type electrical system, the following listed precautions must be observed when servicing the charging circuits. Failure to observe these precautions could 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 Starter-Generator 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 Starter-Generator on an open circuit. Make absolutely certain all connections in the circuit are secure.***
5. ***Do not short across or ground any of the terminals on the Starter-Generator or voltage regulator.***

STARTER-GENERATOR SERVICE TEST SPECIFICATIONS.

Specifications for the 28 volt Starter-Generator are as follows:

CHART 2402. STARTER-GENERATOR TEST SPECIFICATIONS

Manufacturer	Auxilec, Inc.	Lear-Siegler, Inc.
DC Starter-Generator Model	8013C	23046-520 and 23048-006
Rating (kw)	6	6
Continuous load within speed range (amp)	200	200
Voltage (gen. output)	30	30
Speed range (rpm)	7000 to 12150 tr/mn	5800 to 12,000
Direction of rotation when viewing shaft end	CCW	CCW
Operating altitude (max.-ft.)	20,000[1], 35,000[2]	35,000
Voltage (starter, max.)	36	28
Positive terminal designation	B+	B+
Negative terminal designation	E-	E-
Positive field-terminal designation	A+	A+
Equalizer terminal designation	D	D
Starting terminal designation	C+	C+

1. Self-cooled.
2. Blast-cooled.

OVERHAUL.

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

LEAR-SIEGLER.

DISASSEMBLY. (Refer to Figure 24-1.)

1. Loosen the clamp holding the air inlet assembly enough so that the air inlet assembly may be removed. Remove the fan cover by twisting to unlock it. If necessary to separate air inlet castings, remove the necessary screws and washers.
2. Loosen the screw and take the brush cover out of the slot. Remove brush cover.
3. To remove the brushes, remove screws securing the brush and field leads and remove the brushes from the holders.

4. Remove the locknut from the drive shaft and remove fan.
5. Tap out drive shaft using a plastic hammer; then remove hub dampener, plate dampener, friction ring, and dampener back plate.
6. Remove the screws, lock washers and washers; then remove drive end bell assembly. Remove screws, washers, and screen from end bell only if necessary for repair.

— NOTE —

Items 16 and 17 of Figure 24-1 not used on quick-disconnect model (23048-006).

7. Remove the screws securing the bearing support assembly with the armature assembled.
8. To disassemble the support assembly, put the support end bell in a suitable arbor press; then press armature assembly out of the support bearing. To disassemble the armature, remove the retaining ring and disc baffle from the armature shaft. Remove the bearing from armature by using a suitable bearing puller; then remove the disc baffle from the armature.
9. Remove the screws securing the bearing retainer and remove bearing retainer. Press bearing out of support.
10. Do not disassemble brush holders and springs unless inspection reveals that replacement of parts is required.
11. Disassembly of the stator assembly is not required. If inspection reveals the stator to be defective, replace it.

CLEANING.

Clean all parts except the armature, bearings, brushes, and stator by washing in a dry cleaning solvent. Federal Specifications P-D-680 (Stoddard Solvent). Clean armature by wiping with a cloth moistened in the solvent. Clean bearings and brushes with a dry cloth. Blow dust and other foreign matter from inside the stator; then wipe with a clean cloth moistened in solvent.

— CAUTION —

Do not use carbontetrachloride for cleaning.

REMOVING CARBON DUST FROM AUXILEC 8013C STARTER GENERATOR. (Refer to Figure 24-2a.)

Carbon dust from the starter generator carbon brushes may be removed by using Auxilec Tool P/N 506280 and a source of compressed air.

This carbon dust, under cooling air pressure is pushed inside the generator and accumulates in any cavity or recess in the yoke as well as in the armature one area particularly likely to retain the carbon dust is located just under the conductor end winding where the holed disc used to pre-balance the armature is mounted.

The carbon dust may be blown out using one of the following methods:

1. If the starter generator has been rmeoved and disassembled.

— NOTE —

Cleaning of contaminated parts should be performed in a well ventilated room.
The air pressure used should be as high as possible, but within the maximum limits of the local safety codes. Also, the air should be dry and filtered.

A. Insert the nozzle of the tool between the radial leads connecting the bars of the commutator to the conductors up to the black band (on the tool nozzle) as shown in Figure 24-2a.

B. When the tool has been inserted correctly, blow out the armature until carbon dust ceases to come out. The cleaning should be down around 360° of the armature with the tool inserted every 2 or 3 gaps.

C. When the commutator end has been cleaned, use the nozzle to remove carbon from the drive end of the windings.

D. Also blow out any accumulated carbon inside the yoke and field assembly.

2. If the starter-generator is removed, but not disassembled:

A. Remove the brush band.

B. Insert the nozzle of the tool as described in a 1. Accomplish this by passing the nozzle first through the spaces between the brush holders.

C. Repeat step A 2 by rotating the rotor by hand.

D. Although not as accessible as if the starter-generator was disassembled, the drive end of the rotor and the yoke and field assembly should be blown out whenever possible.

3. If the starter-generator is still mounted on the engine, repeat the procedure in step B as far as possible.

1. AUXILE TOOL 506280
2. BRUSHES
3. STRAP
4. BEARING
5. COMMUTATOR BEARING HOUSING
6. ARMATURE
7. DRIVE SHAFT
8. STATOR AND HOUSING ASSY

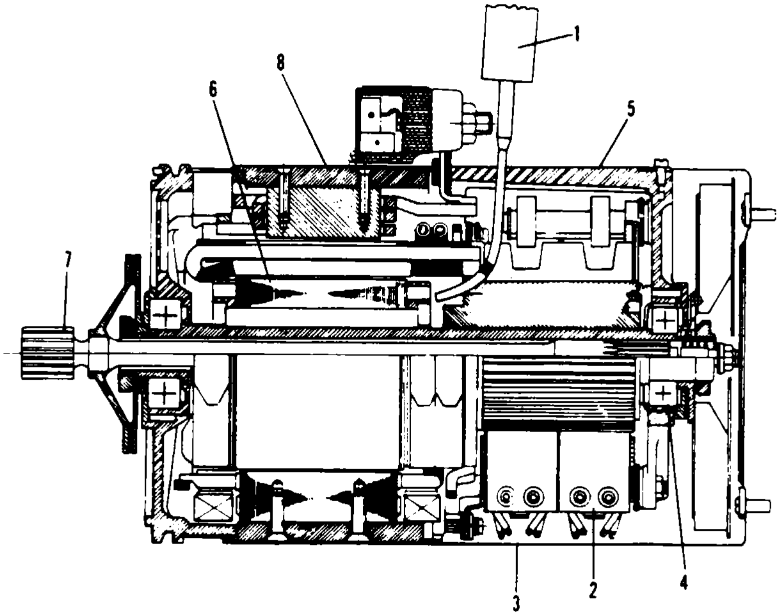


Figure 24-2a. Position of Auxilec Tool for Blowing out Carbon Dust from Auxilec 8013C Starter-Generator

THIS SPACE INTENTIONALLY LEFT BLANK

INSPECTION.

The following table will give the name of the parts, their index number, and the type for inspection required for that part:

CHART 2403. INSPECTION OF COMPONENTS - LEAR-SIEGLER

NOMENCLATURE AND FIGURE 24-1 REFERENCE NO.	INSPECTION TIME AND REPLACEMENT
Covers (5, 6)	Check for dents or broken spot welds. Replace if damaged.
Brush (8)	Check for cracks, chips, frayed leads and loose rivets on shunt connections. Replace if defective. Replace brushes if remaining allowable wear will be exceeded before the next inspection. Inspect every 300 hours and replace as required. Brush length new 1.30 inches.
Fan (10)	Inspect for looseness of blade on hub or a bent or cracked condition. Forward edge of blade shall not measure less than 0.100 inch from locating shoulder of hub and the back edge of blade shall not measure more than 0.830 inch. Replace if beyond repair.
Drive Shaft (12)	Magnaflux inspect per MIL-I-6868 for cracks. Visually inspect for broken or damaged splines and spline wear. To measure spline wear on the large splines, use two 0.096 inch diameter pins. Dimension across the pins should not be less than 0.7262 inch. Replace shaft if dimensions are less than indicated. Inspect the inter-spline of the engine drive gear for wear tolerance.
Plate, Dampener (13)	Inspect for cracks and warpage. Replace if defective or if Belleville spring shows signs of wear.
Hub, Dampener (13A)	Magnaflux inspect per MIL-I-6868 for cracks. Replace if defective.
Ring, Friction (13B)	Inspect for cracks and warpage. Replace ring if thickness is not .063 minimum.
Dampener Back Plate (14)	Magnaflux inspect per MIL-I-6868 for cracks. Replace if defective.
Drive-End End-Bell (21)	Inspect for cracks or warpage. Replace if defective. Repair or replace if liner I.D. is not within 1.8501/1.8504 inch.
Ball Bearings (24,28)	Replace at each overhaul.

CHART 2403. INSPECTION OF COMPONENTS - LEAR-SIEGLER (cont.)

NOMENCLATURE AND FIGURE 24-1 REFERENCE NO.	INSPECTION TIME AND REPLACEMENT
Armature (25)	Inspect for worn, pitted or burned commutator bars; damage to windings, retainer band or shaft; shaft concentricity and bar to bar concentricity. Refinish commutator, if necessary, and perform electrical test. Bar to bar concentricity must be within 0.0001 inch and concentricity with shaft must be within 0.005 inch total indicator reading. Minimum commutator diameter is 2.055 inches.
Brush Holder and Spring (30)	Inspect for cracks, warpage or weak spring.
Support Assembly (37)	Inspect for cracks or warpage. Replace if defective. Perform electrical test. Repair or replace if liner I.D. is not within 1.8501/1.8504 inch.
Terminal Block (38)	Inspect for cracks and loose or damaged terminals. Check for shorts between terminals, but do not hi-pot to avoid damaging embedded capacitors. Replace if defective.
Stator Assembly (48)	Visually inspect for cracks, burned or damaged insulation, loose pole shoes and damaged coils. Replace stator assembly if defective. Perform electrical test.

REPAIR AND/OR REPLACEMENT.

1. If inspection reveals that the commutator is rough, pitted, scored or burned, refinish in a lathe that is accurately set up and adjusted. Remove only enough material to clean and true up the commutator surface. Replace the armature if it has to be turned to less than a diameter of 2.055 inches. Hold commutator diameter concentric with the bearing journals within 0.0005 inch Total Indicator Reading.
2. To undercut the mica turn the commutator in a lathe. If the depth of undercut remaining is less than .032 inch, the mica between the bars should be re-undercut to .032 inch. Use a triangular scraper to remove all excess mica, sharp edges, and burrs from between the bars. Use a bristle brush to remove metal chips and mica particles from the slots between the commutator bars. Check tolerances as outlined in Step 1.
3. To polish the commutator, mount the armature in a lathe and operate at a speed of 500 to 600 RPM. Polish commutator by using sandpaper (5/0) with an accuately cut block of wood over its entire length and at least one-third of its perimeter. Remove any dust or particles from between the commutator bars with a bristle brush.
4. After refinishing the commutator, the armature should be checked for proper balance, which should be within 5 grain-inches. If balance correction is required, mill the stainless steel retaining bands at each end of the lamination stack until the proper balance is obtained. Only two .25 inch wide and .031 inch deep millings are permitted in each band to maintain adequate strength.

5. To measure brush spring tension, use the following procedure:
   A. Using a new brush, cut a groove down the center of both edges and across the bottom. The brush will have a continuous groove around three sides.
   B. Place a thin wire around the brush in the groove; then insert the brush in one of the brush holders. Tie the two ends of the wire together and attach to a spring scale.
   C. Raise the brush with the spring scale until the lower end of the brush is even with the bottom edge of the holder. The tension should be between 40 and 55 ounces. Use an average of several readings. If tension is not within this range, replace the spring.
   D. Utilize the same procedure for the remaining brush holders.
6. When replacing brushes, no brush run in is required.
7. A unit with reversed polarity in the output voltage may be corrected by flashing the field as in the procedure below:

— CAUTION —

Do not flash the field while unit is in operation.

A. Disconnect the leads to the external voltage regulator.
B. Connect the negative terminal of battery to terminal "E".
C. Connect the positive terminal of battery to terminal "A" through a knife switch.
D. Close the switch for 5 seconds; then open switch and disconnect from battery.

— NOTE —

If flashing the field fails to correct generator polarity, check for incorrect connections or defective field circuit.

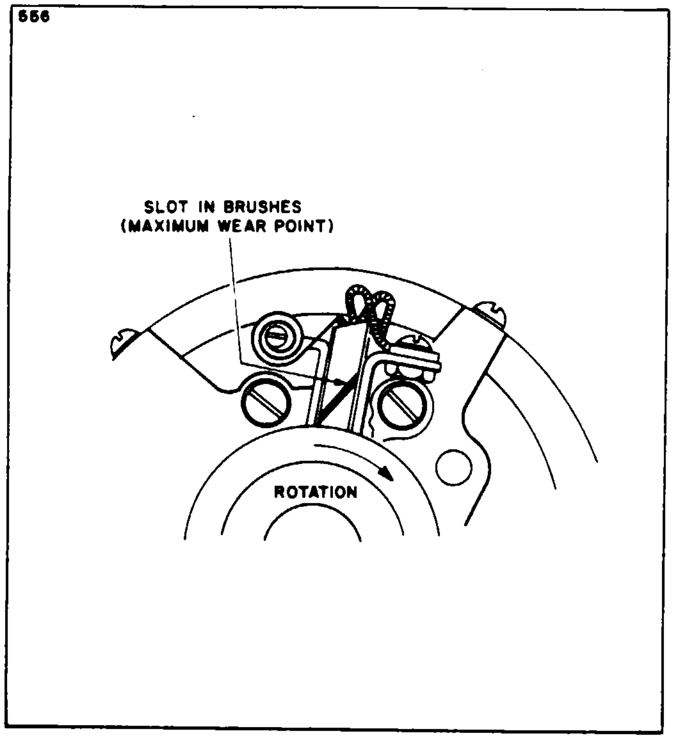


Figure 24-3. Correct Position of Brushes and Springs

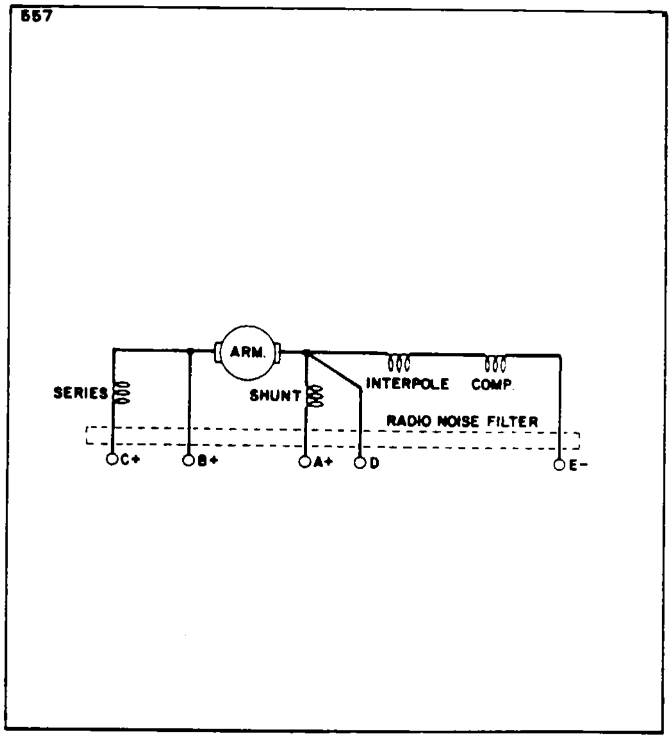


Figure 24-4. Electrical Connections of Starter-Generator

REASSEMBLY. (See Figure 24-1.)

1. If the identification plate was removed, reinstall with the appropriate screws. Coat surface lightly with a moisture and fungus resistant varnish per MIL-V-173 or PED P/N 05-651260.
2. Press a ball bearing into the support and secure with bearing retainer and screws. Apply anti-seize compound, JAN-A-669, or PED P/N 05-648227 to screw.
3. Install disc-baffle on drive end of armature with recessed area facing armature. Support armature in an arbor press; then press new ball bearing on armature shaft pressing on bearing inner race. Install the other disc-baffle over armature shaft with recessed area facing away from armature. Install retaining ring and make certain that ring engages the groove fully.
4. Support armature in an arbor press; then position support, with bearing assembled, over commutator end of armature shaft and press bearing on armature shaft end. Press on inner race of bearing only.
5. Position support, with armature assembled, over end of stator and secure with screws.
6. Install drive end bell assembly against stator; secure with washers, lock washers and screws. Make certain end bell is fully seated on bearing.

— NOTE —

Items (16) and (17) of Figure 24-1 not used on quick-disconnect model (20348-006).

7. Install dampener back plate on armature and make certain back plate taper is fully seated on drive shaft taper.
8. Install hub dampener, plate dampener, and friction ring over small spline end of drive shaft, and make certain dampener taper is fully seated on drive shaft taper.
9. Lubricate the drive shaft splines with Molybdenum Disulfide Type "G", paste form type lubricant.
10. Install the drive shaft through armature, making certain splines of drive shaft are fully engaged with splines of armature.
11. Install fan and secure with nut. Tighten nut to 100 to 120 inch-pounds.
12. Install brushes and secure brush and field leads with appropriate screws. Make electrical connections per Figure 24-4.
13. Install brush cover and secure with appropriate screw. Cover may be assembled in any angular position.
14. Install fan cover; then position so that grooves will accomplish a locking effect. Turn clockwise or counterclockwise to lock.

— NOTE —

Do not assemble air inlet until unit is installed in the aircraft.

15. After installing air inlet, secure with clamp. Torque nut to 25 inch-pounds.

AUXILEC.

DISASSEMBLY. (Refer to Figure 24-2.)

— NOTE —

Disassembly should only be done during complete overhauls. At each disassembly reject all locking devices. If it is a complete overhaul, reject also brushes, bearings and fibrous damper disk. Mark the position of the parts, and for the bearings, mark the position of internal and external cages.

1. To remove the brushes unsafety and remove screw securing brush band in position. Mark brushes and shunts positioning. Remove screws, washer and lift brush springs. The brushes are now free to be removed.
2. Remove screws and washers securing fan cover in position.
3. Lock the drive shaft in rotation maintained by damper disk. Remove and discard nut. Also remove spring and washer.
4. Remove drive shaft, with damper disk and fibrous damper disk.

— NOTE —

To remove damper disk from drive shaft, tool P/N E3370 should be used. (Refer to Chapter 95, Special Purpose Equipment).

5. Remove damper disk using the extractor P/N A1003, fitted with end piece P/N 4B09378 and pull disk out. (Refer to Chapter 95, Special Purpose Equipment.)
6. To remove the fan, unsafety nut then stop the armature in rotation with key P/N E3392 and remove nut using key P/N 405394. Remove and discard washer. The fan is now free to be removed and key. (Refer to Chapter 95, Special Purpose Equipment.)
7. To remove the commutator bearing assembly, unsafety and remove screws, washers and clamp. Discard washers.
8. Remove circlips and then unsafety and remove screws, washers. Discard washers.
9. Remove bearing assembly and armature from the stator.

— NOTE —

Hold armature of the assembly and not the commutator bearing assembly. DO NOT touch the commutator bars.

10. Remove gasket then remove the commutator bearing assembly from armature being careful not to damage the commutator bars.
11. Remove screws and clamp then extract bearing.
12. Remove pins, washers, spacers, then brush springs.
13. Remove screws, flange mounting, then extract bearing.

14. To disassemble the stator remove terminal board by removing nuts (3), washers (4) and then nuts (5) and washers (6). (Refer to Figure 24-2.)

— NOTE —

To prevent deterioration to the terminal board fences use box wrenches.

15. Unsafety and remove screws, washers and then remove terminal board being careful not to damage connecting wires. Discard washers.
16. Carefully push aside the cables from the set of coils, then remove insulator.

CLEANING.

1. Mechanical Parts:
   A. Clean the mechanical parts with Aliphatic Naphtha, Grade F, and blow dry with dry compressed air.

— NOTE —

The brushes and bearings should not come in contact with the cleaning agent.

2. Windings:
   A. Clean the windings with a brush in a container of Aliphatic Naphtha, Grade F.

— NOTE —

Particular attention should be given to the winding base.

   B. Blow dry the washed windings with a jet of dry compressed air.
   C. Dry in an oven at 120°C for approximately 1 hour.

INSPECTION CHECKS.

1. Stator Assembly:
   A. Visually inspect for cracks, burned or damaged insulation and shunt indicator resistance between terminals A and D. The resistance value must be 1.95 ohms +/-5% at 20°C+ if not, replace stator assembly.
   B. Check for continuity of series inductor between terminals C and B. If no continuity, (2.5 milliohms), replace stator assembly.
   C. Check for continuity of commutating poles and compensation windings between terminals D and E. If no continuity, (10 milliohms) replace stator assembly.
2. Armature:

— NOTE —

DO NOT touch commutator bars.

A. Inspect for worn, pitted or burned commutator bars; damage to windings, retainer band or shaft.

B. Check insulation between commutator bars and armature ground.

3. Brushes:

A. Check to ensure there are no cracks, chips, frayed leads, grease, burnt or unsoldered wires and that brush insulating sheathes are in good condition. Replace if defective.

B. Replace brushes if remaining allowable wear will be exceeded before the next inspection. See Figure 24-5 for brush wear limits.

C. If one brush is defective, discard the whole set of brushes.

4. Bearings:

A. Check that the bearings turn freely, without friction and without play and that their seals are in correct condition. If not, replace defective bearing.

5. Commutator Bearing Assembly:

A. Inspect brush guides for any damage and distortion, their inner surface should be smooth. If not, replace commutator bearing assembly.

6. Fan:

A. Inspect for looseness of blade on hub, or a bent or cracked condition.

7. Brush Holder and Spring:

A. Inspect for cracks, warpage or weak spring.

8. Terminal Block:

A. Inspect for cracks, and loose or damaged terminals.

B. Check for shorts between terminals.

C. Replace if defective.

REASSEMBLY. (Refer to Figure 24-2.)

1. To reassemble the stator carefully release the stator connections then install insulator.
2. Install terminal board and secure in position with screws and new washers.
3. Fold nut retainer lugs over the screws to safety them.
4. Install nuts with washers to terminal board. Do not tighten nuts at this time.
5. Reassemble the commutator bearing assembly by first installing the brush springs, spacers, washers and then secure them to their shaft with pins.
6. Install ball bearing according to the markings made during removal.

— NOTE —

Apply a light coat of Normaly compound 201 to the internal and external bearing cages.

7. Install clamp and secure it with screws. Torque screws to 0.150 m. daN. (13 inch pounds).
8. Install ball bearing according to the markings made during removal.
9. Before installing drive shaft first insert damper disk and locate it by means of tool P/N E3990. (Refer to Chapter 95, Special Purpose Equipment.)
10. Position commutator bearing assembly into the bearing internal cage on armature shaft, aligning the marks made during disassembly.

— NOTE —

DO NOT touch commutator bars.

11. Install flange mounting on stator according to the marks made during disassembly, and secure in this position with screws.

— *NOTE* —

Coat the threads of screws with Loctite 932 and then torque to 0.200 m, daN. (18 inch pounds).

12. Install gasket.
13. Install the commutator bearing assembly with armature in the stator with its flange mounting and position the forward end of the armature into the bearing and internal cage.

— *NOTE* —

Align the marks made during disassembly on the bearing internal cage and the forward part of the armature shaft and also on the stator and the commutator bearing assembly.

14. Secure commutator bearing assembly by means of screws fitted with washers. Torque screws to 0.200m. daN. (18 inch pounds).
15. Fold washer lugs over screws in order to safety them.
16. Insert circlips in armature groove.
17. Install clamp and secure it with screws fitted in washers. Torque screws to 0.05 m. daN. (4 inch-pounds).
18. Fold washer lugs over screws in order to safety them.
19. To install the fan fit the key P/N E3392 through machine nose section in armature splines to keep it from rotating. (Refer to Chapter 95, Special Purpose Equipment).
20. Position key then install fan.
21. Install washer then block nut by means of key P/N 405394. (Refer to Chapter 95, Special Purpose Equipment.)
22. Torque nut to 1.6 m. daN. to 2 m. daN. (142 to 177 inch-pounds).
23. Safety nut by folding washer lugs in nut recesses to safety it.
24. Install disk on the armature shaft and position it by means of tool P/N E3487. (Refer to Chapter 95, Special Purpose Equipment.)
25. Manually rotate the armature and check that there is no friction.
26. To install the brushes lift brush springs and carefully install the brushes in contact with the commutator bars then install brush springs on the top of brushes.

— *NOTE* —

Position brushes according to the marks made during disassembly and also position brush shunts as shown in Figure 24-5.

At each brush replacement it will be necessary to perform a brush preliminary seating and running in operation.

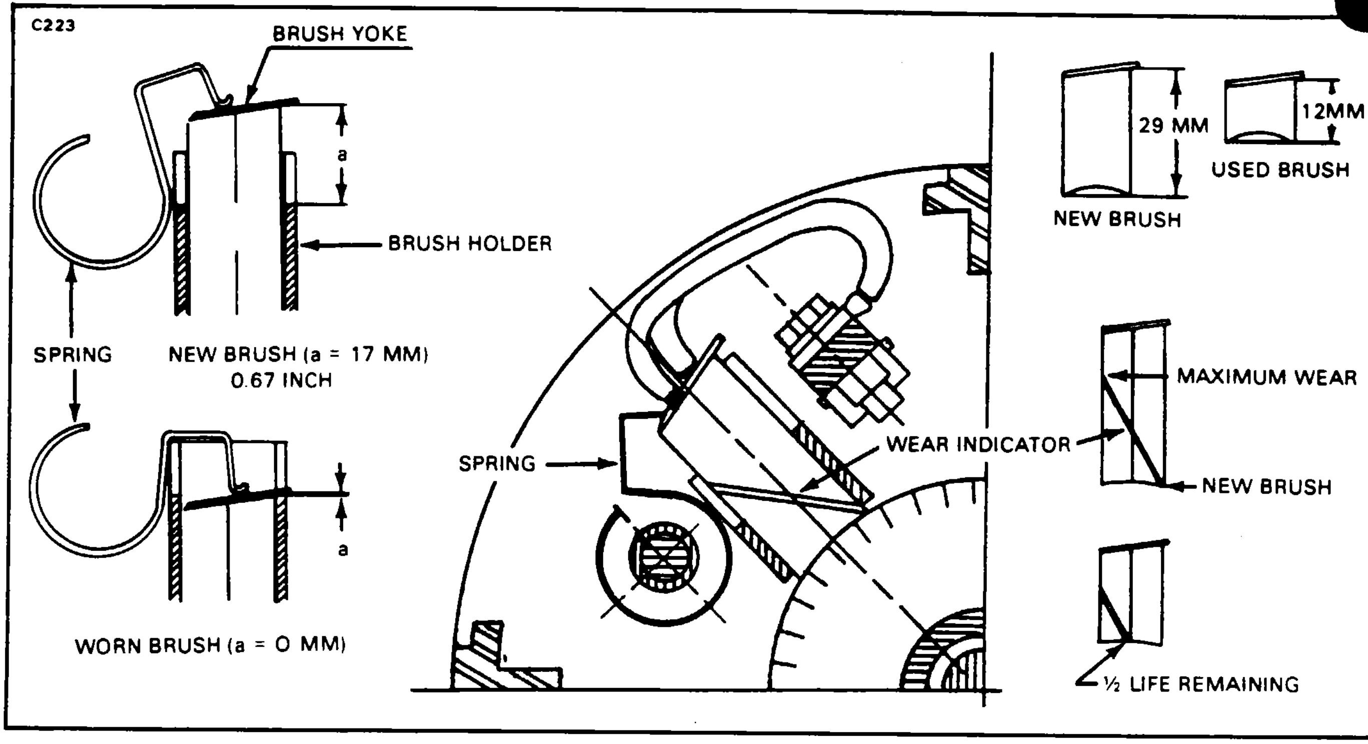


Figure 24-5. Brush Shunts Positioning and Brush Wear Checks

27. Connect the connections from the stator to those of the brush shunts and secure them by means of screws fitted with washers. Torque screws to 0.150 m. daN. (13 inch-pounds).

28. Install drive shaft fitted with damper disk into stator, flange mounting side, then engage its splines on those of the armature.

— *NOTE* —

Damper disk must be mating on damper disk.

29. Check that the end of the spline of the drive shaft is not engaged inside of spring recess. (See length A, Figure 24-6.

— *NOTE* —

If the drive shaft is not located as shown on Figure 24-6, check damper disks, to see that they are not distorted and that they are properly fitting on their own support.

30. Remove the drive shaft fitted with damper disk.
31. Fit the washer and check the dimension B as indicated on Figure 24-7.
32. Fit the fibrous damper disk into the damper disk recess.
33. Fit the drive shaft fitted with damper disk after coating its splines with Normaly compound 201.
34. Fit washer (39) , spring (40) and begin to screw nut (41) a few threads. (Refer to Figure 24-2.)
35. Block drive shaft in order to prevent its rotation by maintaining it with damper disk, then tighten nut to obtain the dimension C as shown in Figure 24-6.

— *NOTE* —

When tightening nut ascertain that the fibrous damper disk remains inside the damper disk recess.

36. Ascertain that damper disk is not off center with damper disk.
37. Manually rotate armature and check for no friction.
38. Install cover and secure it with screws and washers. Torque screws to 0.05 m. daN. (4 inch pounds).

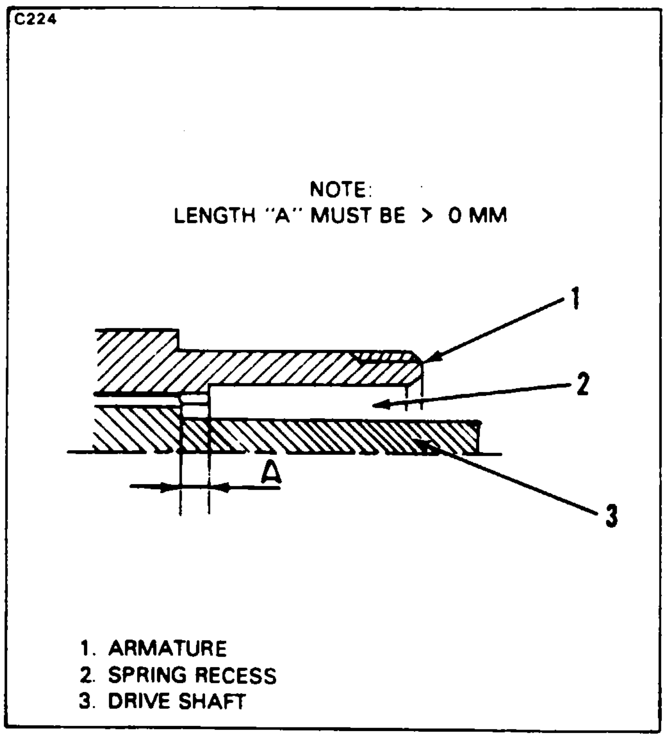


Figure 24-6. Dimension Check of Shaft Drive Sinking

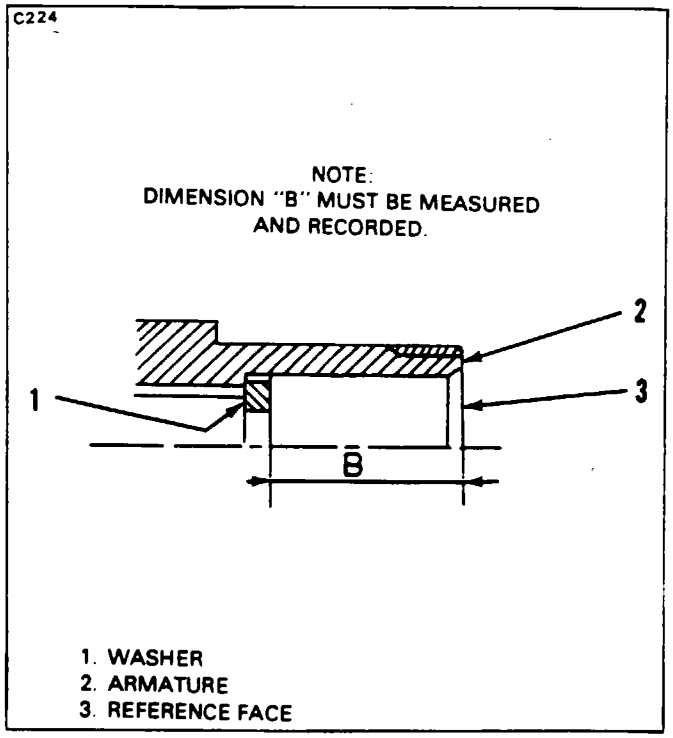


Figure 24-7. Locating Washer

C224

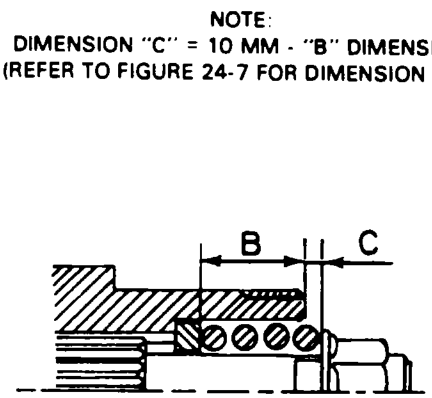


Figure 24-8. Location of Drive Shaft

39. Install brush band and secure with screw. Torque screw to 0.200m. daN. (18 inch pounds.)
40. Lockwire screws (34) two by two and brush band screw with 0.6 mm diameter annealed stainless steel. (Refer to Figure 24-2.)

— NOTE —

The electrical connections torque values for terminals A and D are 0.30 m. daN. (26.5 inch pounds) and for terminals B, C, and E torque to 1.9 m daN. (168 inch pounds).

NOTE

To prevent deterioration to the terminal board fences use box wrenches.

COMMON OVERHAUL PROCEDURES.

The following information is common to both the Lear-Siegler and Auxilec Starter-Generator installations. Refer to Vendor Publications list for available vendor information.

BRUSH RUNNING IN (Refer to Figure 24-9).

— CAUTION —

This operation must be carried out at each brush replacement.

1. Brush Preliminary Seating:
   A. Cut a 45 mm (1.77 inches) wide strip of abrasive paper of a length corresponding to a 172 mm (6.771 inches) new commutator bar.
   B. Keep brushes in a raised position by means of brush springs.
   C. Stick double face adhesive tape on commutator bars width.
   D. Position abrasive paper strip on the commutator bars and stick the end together on the double face adhesive tape.

— NOTE —

The abrasive face of the tape is on the outside.

   E. Lower the brushes, apply them on the abrasive face and position the brush springs.
   F. Manually drive the armature with key P/N E3392 in a counterclockwise direction (seen from driving side). (Refer to Chapter 95, Special Purpose Equipment.)

— NOTE —

Turn the rotor regularly and evenly until brush contact surface is 100%. (Check by lifting brushes.)

   G. Set the brushes in a raised position and hold them by means of brush springs.
   h. Discard the abrasive paper and also the adhesive tape.
   I. With a blast of dry, compressed air, blow the carbon dust out of the starter generator.
   J. Install the brushes in contact with the commutator bars and install the brush springs.
2. Brush Running In:
   A. Install cover and secure it with screws fitted with washers. Torque screws to 0.05 m daN. (4 inch pounds).
   B. Install brush band then secure it with screw. Torque screw to 0.200 m. daN. (18 inch pounds).
   C. Connect the starter generator according to Figure 24-9.
   D. Set energization rheostat (Rh 1) to the minimum resistance.
   E. Set I-2" "ON" to short circuit (A1) when instrument starts.
   F. Set I-1 to "ON" and increase gradually resistance (Rh1) to obtain a rotation speed of 5000 rpm.
   G. Set I-2 "OFF" and read current consumption on (A1).

— NOTE —

Consumption must not exceed 30 amperes.

H. Operate the generator like this for 3 hours.
I. Set (Rh1) to its minimum and set (I-1) to "OFF".
J. Remove screw then brush band.
K. Remove screws, washers and then cover.
L. Inspect every brush and check its running in; the contact surface must be 100% in the circumference direction and 100% minimum in the axial direction. If not, pursue the brush running in operation until these values are reached.
M. Disconnect the instrument.
N. Blow carbon dust out of the starter generator.

— NOTE —

After brush running in, it is recommended to operate the starter generator for 30 minutes.

FITS AND CLEARANCES.

No special fits or clearances are required; however, fan dimensions must be maintained.

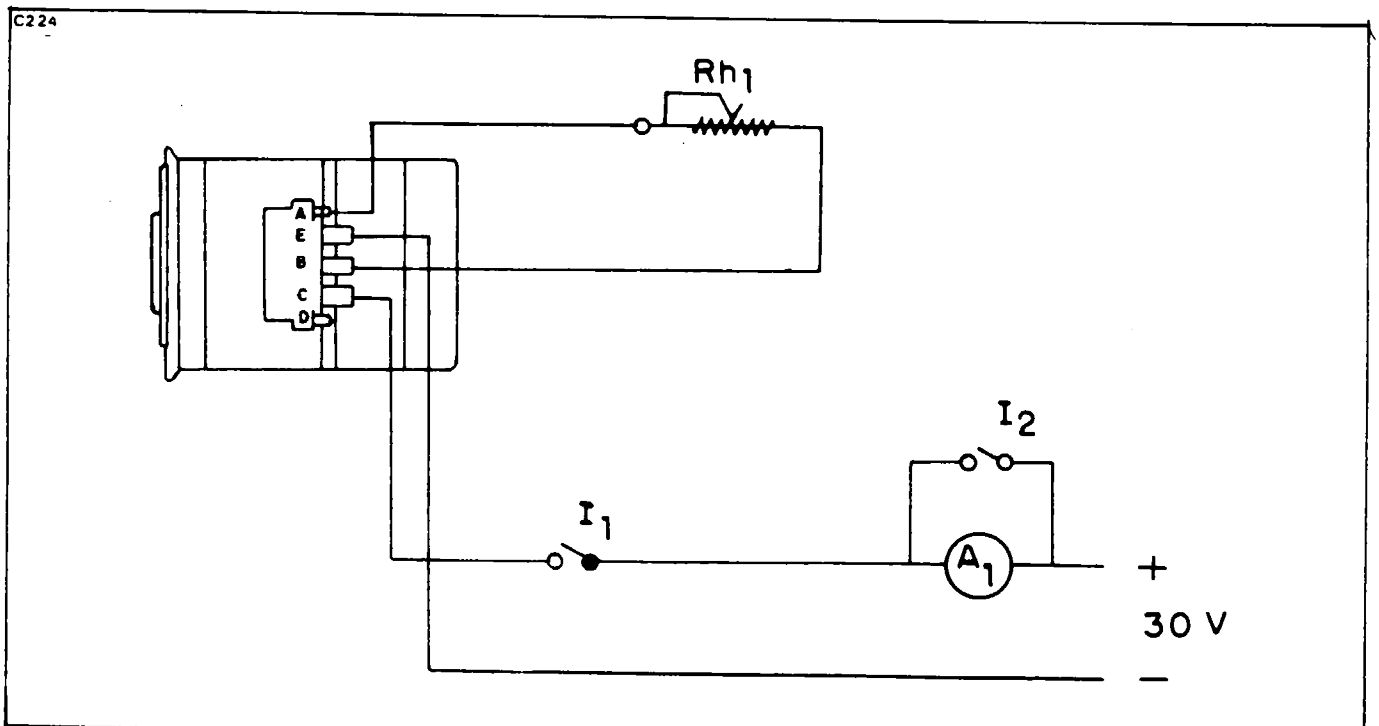


Figure 24-9. Brush Running in Diagram

INSPECTION AND TESTING OF COMPONENTS.

The following test equipment will be needed: a variable speed test stand capable of driving the unit at speeds from 5,500 to 12,000 RPM at full load and to 14,000 RPM no load. The test stand should have suitable instruments to measure torque, speed, voltage, current and temperature. Also needed is adequate circuitry to load the unit in five steps: 0 amps, no load, 50 amps, 100 amps, 150 amps, 200 amps. The following conditions will also be needed to perform the tests: cool air from a shop air source must be injected into the blast cover.

1. Test requirements before assembly of the unit.

A. Check the brush holders and support for shorts to ground by using 110-volt AC source and a 7-1/2 watt test light connected in series. Touch one lead to the brush holder and one to the support for one second. If lamp lights, support must be repaired.

B. To test the armature, use a 110-volt source and a 7 1/2 watt light connected in series. Touch one lead to the armature shaft and the other lead to the commutator risers. Also check between each of the two commutator bands and commutator risers. If lamp lights, the armature is grounded and must be replaced.

C. To test the stator assembly, use the same circuit as before, and touch one lead to the frame and the other to terminal "A". If lamp lights, stator is grounded and must be replaced. Use an ohmmeter and check for continuity by touching one lead of the meter to the negative field lead and the other to terminal "A". The terminal block must be removed for this test.

2. Test requirements after assembly of the unit. (After overhaul.)

A. Without operational warm-up and regulator connected to the unit, operate as a generator at 13,000 RPM, 30 volts and no load. Record field current, commutation and frame temperature. Shunt field current shall not be less than .81 amperes. Commutation must be black.

B. With the voltage regulator connected to the unit, operate at 12,000 RPM 30-volts, 200 amps until the frame temperature shows no more than 2° F rise in five minutes. Record the voltage between D and E, air blast inlet temperature, commutation, field current and frame temperature. Commutation should not be worse than pinpoints along the edges of the brushes. The paralleling voltage must be within the limits shown on Figure 24-10. Frame temperature must not exceed air temperature by more than 175° F.

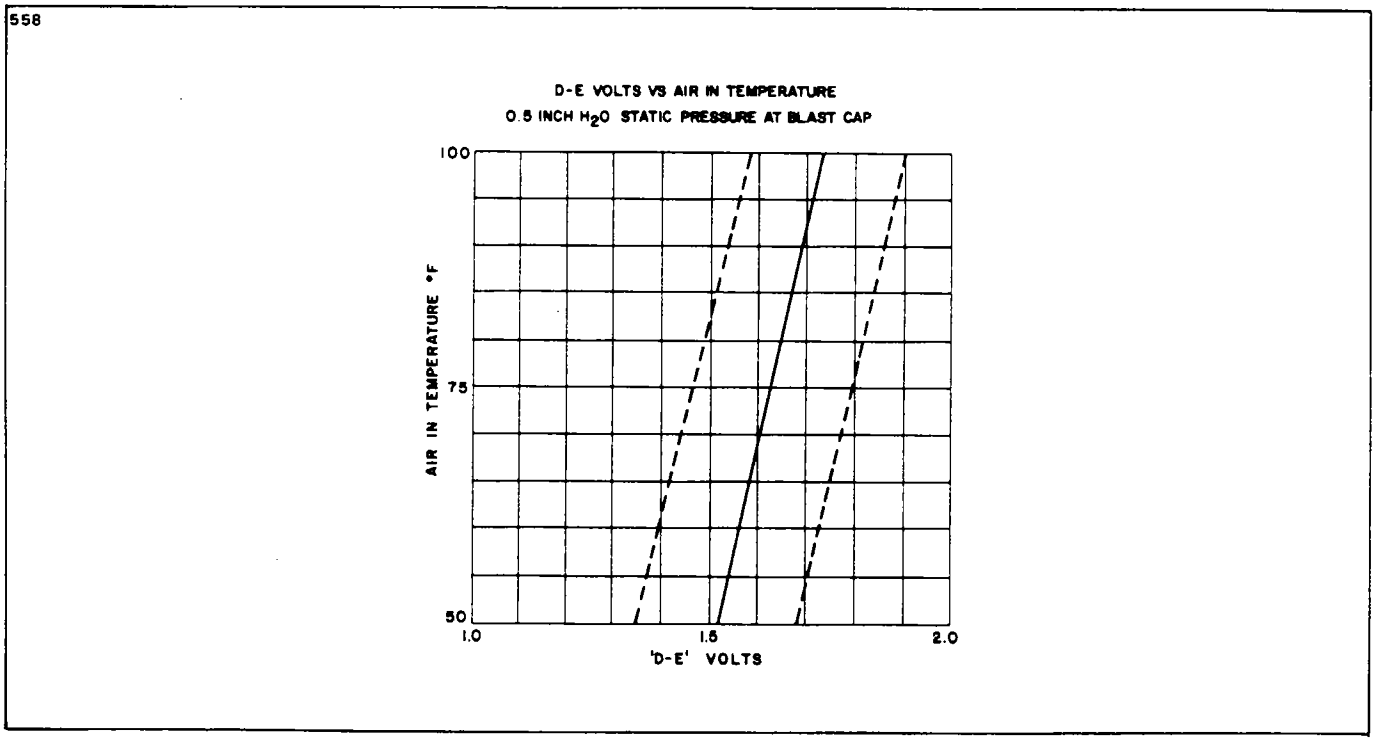


Figure 24-10. Paralleling Voltage Chart.

C. Operate the unit at 12,000 RPM, 30-volts. Compound the current at 0, 50, 100, 150 and 2[illegible] amps. Field current must increase with load and commutation must not exceed pinpoints.

D. Operate the unit at 6500 RPM, 30 volts and 200 amps, to check regulation at the minimum speed. Record field current, frame temperature and commutation. Shunt field current shall not exceed 8.0 amps. Commutation should not be worse than pinpoints.

E. Reduce the speed to approximately 5800 RPM. Operate at no load and open field until the frame temperature is 120°F or less. Substitute 1.25 ohms for the regulator in the field circuit and adjust speed to produce 26 volts and 200 amps. Operate until stabilized as in Step B. Record field current, speed, frame temperature and commutation. Speed shall not be greater than 5800 RPM.

F. Reconnect voltage regulator and observe commutation at 30 volts, 0, 100 and 200 amps at speeds of 6500, 10,000 and 12,000 RPM. Record field current, frame temperature and commutation. Commutation must not exceed pinpoints for all conditions.

G. With the unit hot, operate for five minutes at 14,000 RPM with field circuit open. Then operate at 12,000 RPM. 30 volts and 200 amps. Record field current temperature and commutation. Commutation must not exceed pinpoints.

H. To conduct a dielectric test, remove unit from test stand and while still hot as a result of testing, conduct a test using 110 volts AC, 60 Hz. Put one lead on the frame and the other to the leads removed from terminal block. The leads from the terminal block must be removed from studs due to the embedded capacitors connected to ground. The unit shall not be shorted, grounded in any circuit.

I. To conducts tests on the unit as a starter, connect a 50 ohm resistor between terminals "A" and "B".

J. With the unit rigidly mounted in a horizontal position by use of a mounting flange, operate at no load with 23-volts applied to terminals "C" and "E". The no load speed shall not be less than 5200 RPM.

K. Lock the rotor; apply voltage between terminals "C" and "E". Increase the voltage until the output torque is 23 foot-pounds. Do not energize the unit for more than two seconds. Record current and voltage. Current shall not be greater than 500 amps and the voltage shall not exceed 13 volts.

L. Make commutator run out checks while rotating the armature on its own bearings. Record the total indicated run-out and the maximum bar-to-bar difference. Maximum total indicated run-out is to be .0005 inch, and the bar-to-bar difference must not be more than .0002 inch.

BUS FEEDER CHECKS.

Operational check of the crossfeed power diodes, checking for shorted or open diodes, on the split bus electrical power distribution system. To ensure power distribution is not interrupted due to single generator operation.

TESTING FOR OPEN DIODES.

1. With both engines running (approximately 68% N^1) turn battery master switch and both generator switches on.
2. Open left generator bus tie circuit breaker (200 amp) and turn off generator switch.
3. No power should be lost from any sub-bus (left main, right main or avionics bus).

4. If power is lost on any of these buses: a bus feeder diode from the right side has failed open and must be replaced. -- if not proceed to step 5.
5. Reset left generator bus tie circuit breaker (200 amp) and turn on left generator switch.
6. Open right generator bus tie circuit breaker (200 amp) and turn off right generator switch.
7. Same result as step 3.
8. Same as step 4. a bus feeder diode from the left side has failed open and must be replaced.
9. This completes "open diode test".
10. Shut right engine down. turn off right generator switch and proceed to "shorted diode test".

TEST FOR SHORTED DIODE.

1. Left engine running at (approximately 68% N[1]).
2. Battery master switch on. left generator switch on.
3. Right generator bus tie circuit breaker pulled.
4. Open right main and number 1 avionics circuit breaker on left generator feed bus.
5. Right main bus and avionics buses should be dead (no electrical power). If either bus is powered. the bus feed diode from the right side (left main) is shorted and must be replaced. If not. proceed to step 6.
6. Reset right main bus circuit breaker open in step 5.
7. Avionics bus should be dead (no electrical power) if the avionics bus is powered. the bus feed diode from the right side (right main) is shorted and must be replaced. if not proceed to step 8.
8. Open the right main circuit breaker that was reset in step 6 (ascertain that avionics bus tie circuit breaker is in).
9. Reset the avionics No. 1 circuit breaker that was open in step 4.
10. Right main bus should be dead (no electrical power) if right main bus is powered. the bus feeder diode from the right side (avionics No. 2 bus) is shorted and must be replaced. If not proceed to step 11.
11. Reset all circuit breakers.
12. Start right engine.
13. Shut left engine down.
14. Repeat above procedure for right side.

BATTERY.

SERVICING THE LEAD ACID BATTERY SYSTEM. (Refer to Figure 24-10a.)

Service includes the entire battery system consisting of: The battery. acid recovery jar. vents. and battery box environment.

The battery and acid recovery jar should be removed from the aircraft and all surfaces cleaned thoroughly and inspected every 50 hours or 30 days. whichever occurs first. The following service procedures are to be performed at every 100 hour inspection.

REMOVAL OF BATTERY AND ACID RECOVERY JAR.

1. Open the forward baggage door and unlatch the nose cone locking handle, to the left, just inside the door opening, swing open the nose cone.
2. Cut the safety wire and remove the elcon connector from the battery.
3. Remove the positive vent hose from the front of the battery.
4. Release fasteners at bottom front of battery so battery can be pulled forward out of the nose section.

— *CAUTION* —

Battery is very heavy, pull out only part way exercising caution.

5. Disconnect the negative vent hose from the left rear of battery.
6. Remove battery from aircraft.
7. Remove acid recovery jar negative vent hose and remove jar assembly with remaining short vent hose still attached.

INSTALLATION OF BATTERY AND ACID RECOVERY JAR.

1. Install all components reverse of removal instructions.

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.)
2. Wipe all exposed surface of the battery with a cloth saturated with a solution of bicarbonate of soda: mix one part soda to twenty parts of water. (Check cell plugs are tight: do not allow any soda solution to enter any cells.)
3. Wash entire battery with clear water and dry thoroughly.
4. Wash down with soda solution, followed by clear water, the floor area, battery support angle, connector cable ends, and dry entire area and component parts.

CLEANING VENT HOSES AND VENTS.

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

1. Visually inspect the condition of vent hoses for kinks, deterioration and loose connections.

— *CAUTION* —

Do not replace vent hoses with ordinary hose. Replace only with special acid proof from the parts manual.

2. At the disconnected ends, in the battery compartment, slowly pour the soda solution into the vent hoses using 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 hoses with low pressure air.

— *NOTE* —

This procedure provides verification the vent lines 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. After drying, apply a high quality aircraft wax to the entire area.

CLEANING AND RECHARGING ACID RECOVERY JAR.

1. Unscrew the bottom and separate from the top of the jar.
2. Remove jar pad and empty contents into a suitable container for safe disposal.
3. Thoroughly wash and neutralize jar, pad, and jar top (including short length of vent hose inside and out) with the soda solution and rinse with clear water and dry thoroughly.
4. Inspect short length of vent hose as was done on aircraft vent hoses. (See caution note on replacement.)
5. Recharge the acid jar with .75" of bicarbonate of soda, (baking soda) and replace dry jar pad in jar on top of soda charge.
6. Screw jar back together and keep in upright position.
7. Reinstall in aircraft.

THIS SPACE INTENTIONALLY LEFT BLANK

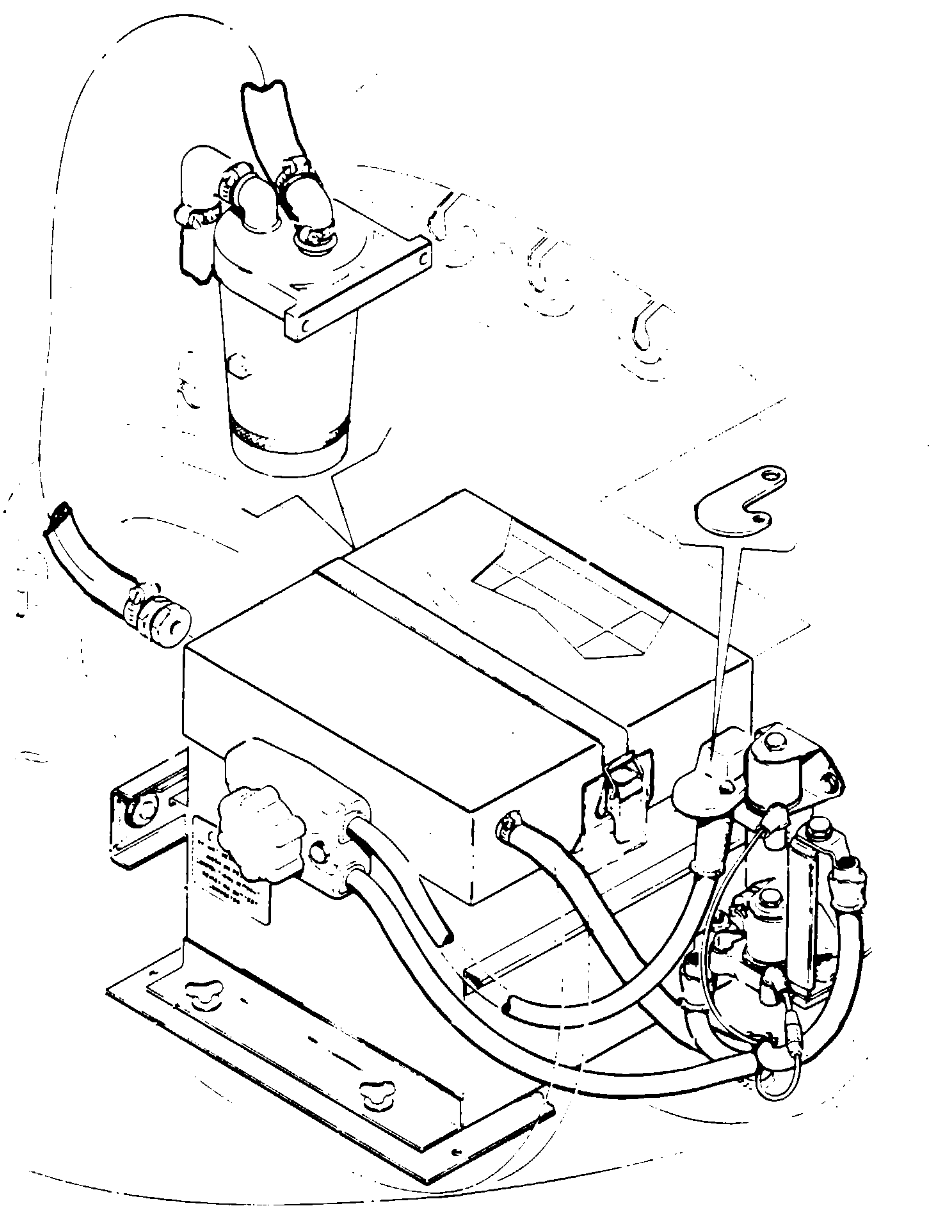


Figure 24-10a. Lead Acid Battery Installation

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 a maximum of 3/8 of an inch above the baffle plates. 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 2405 for the temperature corrections.

CHART 2404. SPECIFIC GRAVITY OF ELECTROLYTE FOR TEMPERATURE INDICATED

Electrolyte Temperature[2]	Specific Gravity[1]
47°F 77°F 107°F	1.280 to 1.300 1.280 to 1.290 1.260 to 1.280
1. Cell fully charged. 2. 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.

CHARGING BATTERY.

Remove the battery from the airplane before charging.

1. Remove caps and check fluid level.
2. The battery may be charged at any rate in amperes that will not produce gassing or bubbling of the electrolyte or a cell temperature in excess of 115°F as soon as gassing starts, or before. If the temperature reaches this limit, the rate should be reduced and the charge completed at 3 amperes or lower; do not charge at higher rate while cells are gassing. If charging at constant current is more convenient, the entire charge may begin at or below 6 amperes and finished at or below 3 amperes.
3. If the cells flood or sputter electrolyte, the level is too high and should be lowered by withdrawing electrolyte until the specified level is reached. Clean exterior of battery as described in Cleaning Battery.

CHART 2405. SPECIFIC GRAVITY TEMPERATURE CORRECTION

ELECTROLYTE TEMPERATURE		SPECIFIC GRAVITY CORRECTION TO 80°F (27°C)
°C	°F	
60	140	+1.024
55	130	+1.020
49	120	+1.016
43	110	+1.012
38	100	+0.008
33	90	---
27	80	---
23	70	---
15	60	-0.008
10	50	-0.012
5	40	-0.016
-2	30	-0.020
-7	20	-0.024
-13	10	-0.028
-18	0	-0.032
-23	-10	-0.036
-28	-20	-0.040
-35	-30	-0.044

— 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 compartment when charging to dispose of the gas generated by the battery.

4. Reinstall the battery when completely charged.

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.

CHART 2406. CAPACITY RATINGS AT DISCHARGE RATES

BATTERY TYPE	VOLTS	CAPACITY RATINGS				
		1 HOUR (AMP HOURS)	5 HOURS (AMP HOURS)	EMERGENCY CAPACITY (AMP)	COLD TEMP CRANKING (AMP @ 0°F)	HIGH TEMP CRANKING (AMP @ 120°F)
BB638/T1	24	48	53	93.6	525	725

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 HOUR (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.
HIGH TEMP. CRANKING (AMP @ 120°F:	The amperes shown is discharge current used to crank an engine for 30 seconds at 120°F to 1.2 volts per cell.

CHART 2407. 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

NICKEL-CADMIUM BATTERY (OPTIONAL).

The 24-volt vented nickel-cadmium battery requires little service. That service which is required is limited to checking electrolyte level during each periodic inspection, cleaning the battery box and components as necessary, equalizing the cells when required and occasionally recharging the battery. A battery temperature sensor is connected to the battery to indicate an over temperature condition on the annunciator panel in the cockpit.

A periodic maintenance program is required to prevent battery failures. The condition of the battery should be determined every 50 to 100 hours initially. Periodic battery check intervals may be varied as service experience dictates by referring to the Battery Service Record which should be maintained for each battery.

For information on the battery maintenance, refer to the battery manufacturers maintenance manual. This provides detailed instruction of charging, discharging, cleaning, handling and general troubleshooting and maintenance of the battery. The manuals for each manufacturer are as follows: Saft America Inc., Operating and Maintenance Manual (P/N DC 3-01-78-3176-5 latest revision) and Marathon Battery, Marathon battery instruction manual (P/N BA-89). Refer to front of this maintanenance manual for a list of addresses on these vendors.

— CAUTIONS —

Do not use tools, hydrometers, or water that have been contaminated by contact with lead-acid batteries or acid of any kind.
Electrolyte (potassium hydroxide) is very caustic and will burn the eyes, fabric, skin, etc. Neutralize with 3% boric acid and wash with water.
Be very careful when working with uninsulated tools around the battery terminals. This battery can deliver very high currents when shorted. It is advisable to remove finger rings, watches, bracelets, etc. when working on the battery, since they may fuse to the intercell straps and cause serious injury. When cleaning the battery, Do Not use petroleum spirits, trichloroethylene or other solvents. Do Not use a wire brush.
This battery must be connected to the air cooling source at all times.

— NOTE —

Keep vent plugs in place during charging and discharging procedures, and at all other times except when inspecting and adjusting electrolyte level. Carbon dioxide absorbed from the air forms potassium carbonate in the cell, which reduces the cell efficiency.

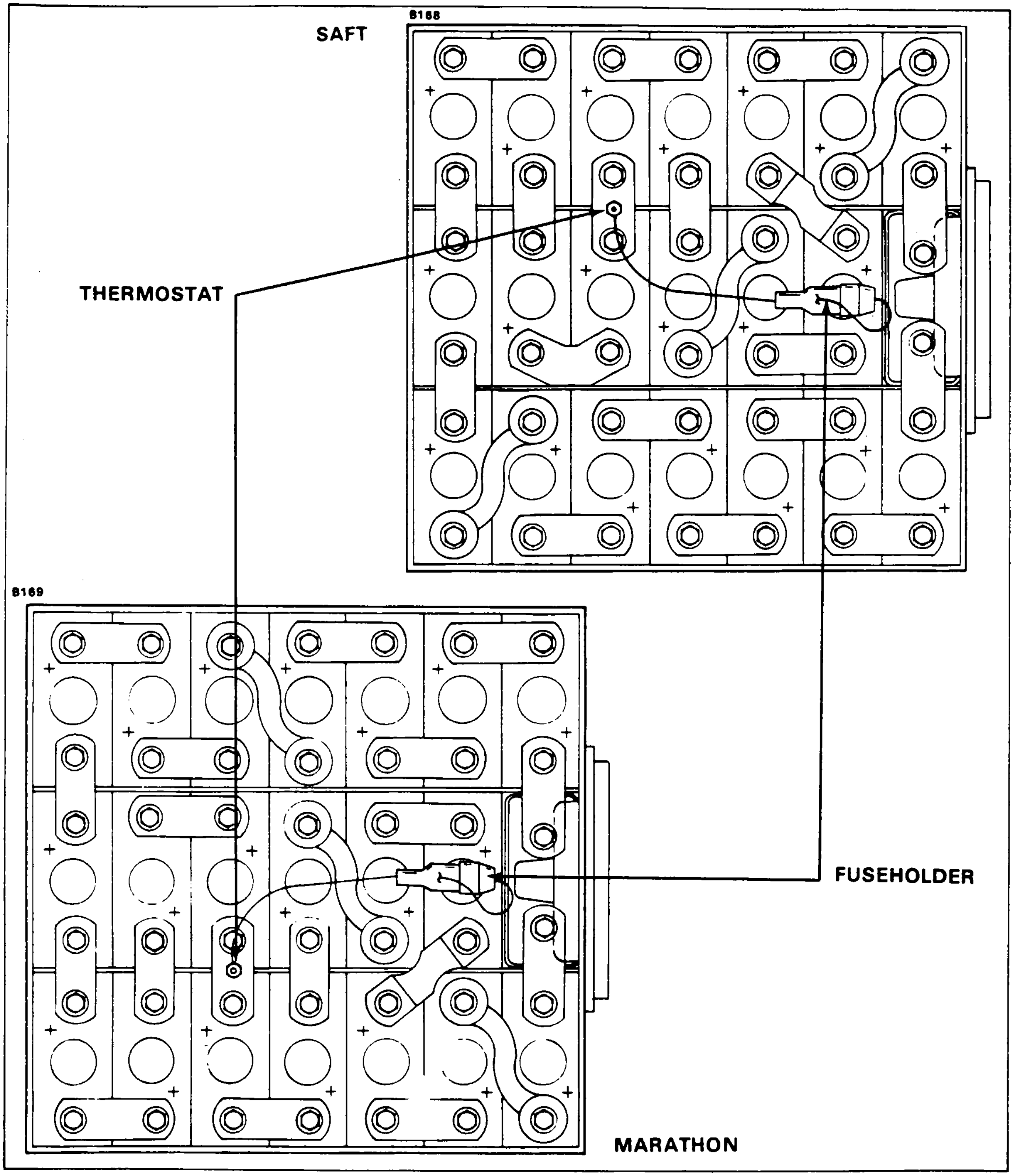


Figure 24-11. Cell Layout - Nickel-Cadmium Battery

REMOVAL OF BATTERY.

The battery is located just behind the nose cone of the airplane.

1. Gain access to the nose cone latching mechanism and unlatch and swing open the nose cone.
2. Cut the two safety wires from the Elcon electrical connector.
3. Loosen Elcon connector and remove from battery.
4. Loosen two camlocks on the bottom front of battery and slide battery forward.
5. Disconnect battery temperature probe wire from the top of battery at inline connector.
6. Disconnect air lines and remove battery from airplane.
7. To gain access to the battery cells, unsnap the four hinge snap locks on the battery cover, lift lid and disconnect fuseholder to remove cover.

INSTALLATION OF BATTERY.

1. Place battery on mounting bracket and reconnect air lines previously removed.
2. Slide battery back into place and secure with the two camlocks on the bottom front of the battery.
3. Connect battery temperature probe wire from the top of the battery at the inline connector.
4. Put electrical connector on battery with the + symbols on the connector on top, and the - symbols on the connector on the bottom. Secure by tightening knob on connector.
5. Secure knob by safety wire through the two holes on the knob to the two nuts one each side of the knob.
6. Close nose cone and secure in place by pushing the locking handle up.

TESTING BATTERY TEMPERATURE SENSOR.

The following information should be used to check the temperature sensor operation.

1. Set up a hot oil bath at 130°F. and obtain an ohmmeter.
2. Remove the temperature sensor unit from the battery and disconnect the wire at the fuseholder.
3. Connect the probes of the ohmmeter to the temperature sensor; reading should be approximately zero ohms (short).
4. Submerge the temperature sensor into the hot oil and observe the ohmmeter; an infinite meter reading should be indicated (open). The sensor should reset when removed from the hot oil, after being allowed to cool down to 110°F.
5. With the test completed, reinstall the temperature sensor to the battery and connect the fuseholder. Ascertain that the fuse is installed and in good condition.

EXTERNAL POWER.

EMERGENCY STARTING THROUGH EXTERNAL POWER RECEPTACLE.

— CAUTION —

The use of an external battery is not recommended due to the high starting currents involved. A discharged or run-down battery must be removed from the aircraft for recharging. In any case do not connect an external power unit to the external power receptacle unless the battery master switch is turned off.

1. Locate the ground power unit on the pilot's side of the aircraft, in full view of the pilot's window.

— NOTE —

Upon inserting the external power plug into the external power receptacle, the aircraft's external power contactor will automatically energize, immediately applying power to all aircraft busses.

2. Turn "OFF" battery master switch.
3. Turn "OFF" all electrical loads as in a normal start.
4. Connect a A.P.U. unit to the external power receptacle located on the underside of the forward nose section.
5. Observe aircraft voltmeter reads 28 to 30-volts, and external power is indicated on the annunciator panel.
6. Turn "ON" the battery master switch and observe that the battery bus voltmeter remains stable at 28 to 30-volts.
7. Start the right engine, monitoring annunciator panel for normal starting indications.
8. With the right engine running, disconnect the A.P.U. from the external power receptacle.

— CAUTION —

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

9. Move the A.P.U. well away from the aircraft.
10. Observe the right ammeter, verifying that the right generator is on-line with a normal battery charge rate.

— *CAUTION* —

If the battery charge rate is excessive, this indicates a discharged battery which is unsafe for flight, abort the start, shut down engine and replace battery. If battery is to be charged, it must be removed from the aircraft.

11. If normal charge rate is indicated, proceed with left engine start.
12. With both engines running and both generators on line, proceed with normal aircraft operation. In any case do not take off unless charge rate is below 20 amps for the lead-acid battery.

ELECTRICAL LOAD DISTRIBUTION.

OVERLOAD SENSOR.

DESCRIPTION.

The overload sensor is designed for remote sensing of overloads in the aircraft electrical system. If an overload should occur in the electrical system, the overload sensor, through a slaved mechanical switch, would open the generator field control circuit breaker. There is one overload sensor for each starter-generator.

REMOVAL OF OVERLOAD SENSOR.

The overload sensor is located aft of the engine (L or R) in the engine nacelle.

1. Gain access to the overload sensor by removing the access plate, which contains the air conditioning condenser vent, secured with screws.
2. The overload sensor is on the top left hand corner of the aft fire wall.
3. Remove the 6 electrical leads from the overload sensor.

— *NOTE* —

Make note of the place from which each electrical lead was removed to facilitate reinstallation.

4. Remove the two screws securing overload sensor to aft fire wall. Remove overload sensor.

INSTALLATION OF OVERLOAD SENSOR.

1. Position the overload sensor in place on the left hand corner of the aft fire wall and secure with the two screws previously removed.
2. Connect in their correct position the 6 electrical leads previously removed.
3. Replace and secure access cover with appropriate screws.

ELECTRO DELTA-VR-1528-3, D.C. CONTROL UNIT.

DESCRIPTION.

The Electro Delta D.C. Controller is a modern, light weight solid state unit, automatically providing voltage regulation, generator paralleling control (or load sharing), and overvoltage protection.

ADJUSTMENT OF ELECTRO DELTA D.C. CONTROL UNIT.

The only adjusment is for 28.5 V.D.C. system voltage, inside the "snap-plug" on the unit.

BENCH TEST OF DC CONTROL PANEL (ELECTRO DELTA).

— *NOTE* —

It is necessary to fabricate test equipment per the following schematic provided by Electro Delta Inc. (Figure 24-12).

1. A digital voltmeter and regulated D.C. power supply are required for the following tests.
2. With external regulated power supply set at -0 V.D.C. and digital voltmeter set to read 0-33 V.D.C. actuate "MONITOR" switch to "BUS" position.
3. Plug unit under test into test equipment plug PL-1.

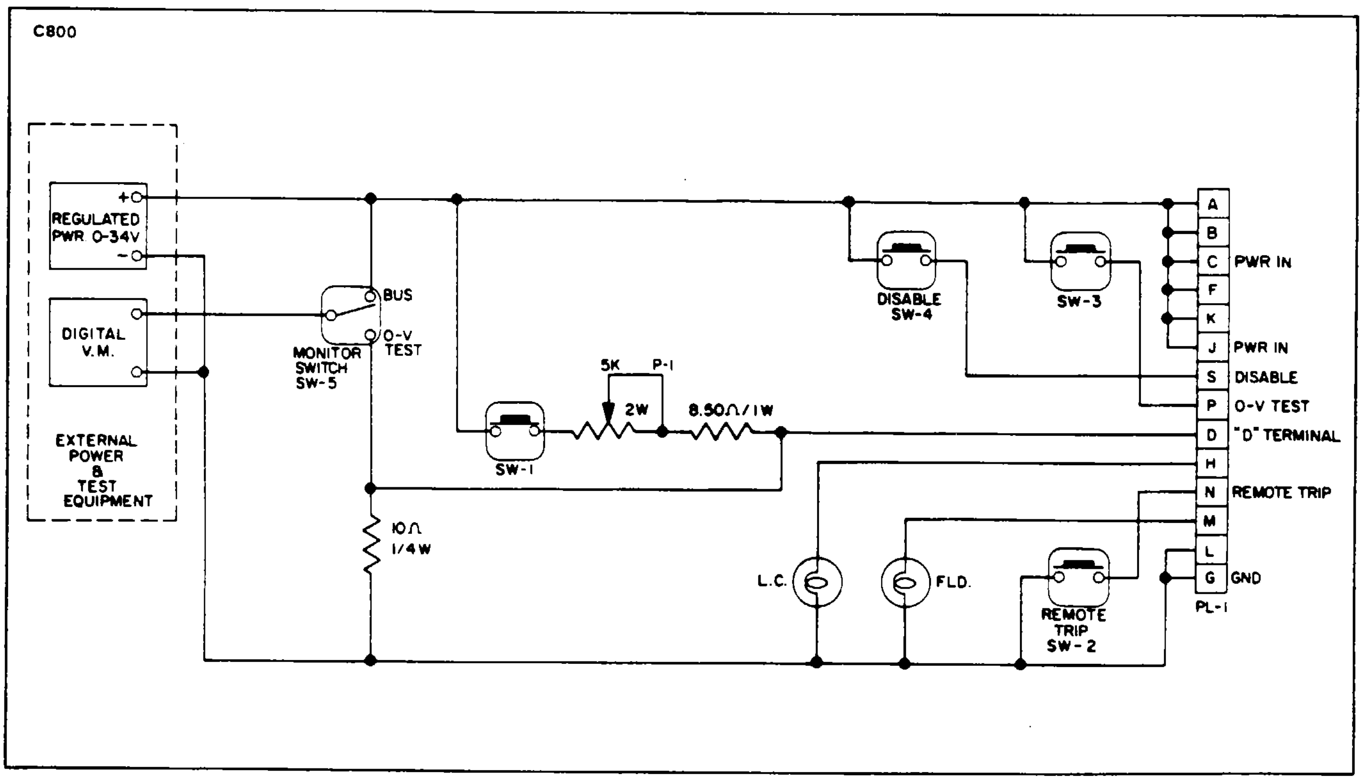


Figure 24-12. Electro Delta Wiring Diagram, Model VR-1528-3 D.C.

4. Increase power supply output to 28.0 V.D.C. and note both "L.C." and "FIELD" light filament glow.

— NOTE —

To properly interpret light bulb indications, it must be realized that full brightness is not required on the "FIELD" light. This bulbs filament will just barely glow red at point of adjustment.

5. Increase power supply voltage slowly until "FIELD" light filament just stops glowing. At this point, the D.C. voltage shall indicate 28.7 to 28.9 V.D.C.
6. Continue increasing power supply output slowly to 31.5 V.D.C. and then increase at an even slower rate, verifying the "L.C." light goes out at 32 + 0.3 V.D.C. indicating an overvoltage trip has occured.
7. Decrease power supply output to 10 V.D.C., both "L.C." and "FIELD" lights must stay "OUT".
8. Decrease power supply to -0 V.D.C., and then return to 28.0 V.D.C. Verify the "L.C.", and "FIELD" again glow, indicating regulation has returned.
9. Depress "0" voltage test switch (SW-3) and verify both "L.C.", and "FIELD" lights extinguish and release "0" voltage test switch.
10. Repeat steps 7 and 8.
11. Depress "REMOTE TRIP" switch (SW-2), and again verify both "L.C." and "FIELD" lights extinguish.
12. Repeat steps 7 and 8.
13. Depress "DISABLE" switch (SW-4), and observe ONLY THE "FIELD" LIGHT FILAMENT GOES OUT - HOLD DISABLE SWITCH DEPRESSED, and reduce power supply to 13 + 0 V.D.C. "FIELD" light must remain out.
14. Release "DISABLE" switch, and readjust power supply to -0 V.D.C. and and back up again to 2 V.D.C.
15. Actuate "MONITOR" switch (SW-5) to "D" terminal position.
16. Set D.C. voltmeter range for 0-2 V.D.C. and DEPRESS AND HOLD SW-1 switch and set potentiometer P-1 for a reading of 0.18 + 0 V.D.C.
17. Release switch SW-1 for 2-3 SECONDS, and re-activate swith SW-1, "L.C." light should extinguish AFTER A SLIGHT DELAY.
18. This completes the bench test. If unit fails tests, it must be replaced with a new unit.

REMOVAL/INSTALLATION ELECTRO DELTA D.C. CONTROL UNIT.

1. The control unit mounts on the electrical accessory shelf with four screws.
2. Simply unplug/plug the harness connector and removal/install the four screws.

CHART 2408. 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	5	RELAY CLUTCH	INT. INT.	2	.50 2.10
AIR CONDITIONING CONDENSER BLOWER	15	MOTOR	INT.	1	11.60
RECIRCULATING FANS (2)	15 15	MOTOR MOTOR	INT. INT.	2	13.60 13.60
GROUND VENT FAN	5	MOTOR	INT.	1	4.60
HEATER	10	RELAY MOTOR SOLENOID SOLENOID PUMP HOURMETER	INT. INT. INT. INT. INT. INT.	6	.25 4.00 .51 .32 1.0 .01
HEATER BLOWER FAN	15	MOTOR	INT.	1	15.0 MAX.
SURFACE DEICE	5	TIMER INDICATOR SOLENOID	INT. INT. INT.	3	.01 .04 1.20
LEFT LIP DEICE INTAKE-1 INTAKE-2 INTAKE-3	 30 30 30	 RESISTIVE TYPE ELEMENT RESISTIVE TYPE ELEMENT RESISTIVE TYPE ELEMENT	 INT. INT. INT.	 2	 26.9* 21.2* 19.9*
RIGHT LIP DEICE INTAKE-1 INTAKE-2 INTAKE-3	 30 30 30	 RESISTIVE TYPE ELEMENT RESISTIVE TYPE ELEMENT RESISTIVE TYPE ELEMENT	 INT. INT. INT.	 2	 26.9* 21.2* 19.9*
DEICE SOLENOID (2) & DEICE TIMER (2)	5	SOLENOIDS TIMERS (SOLID STATE)	INT. INT.	4	1.00 1.00
LEFT PROP. DEICE	15	RESISTIVE TYPE ELEMENT	INT.	1	12.00
RIGHT PROP. DEICE	15	RESISTIVE TYPE ELEMENT	INT.	1	12.00
WINDSHIELD HEAT CONTROL	5	TIMER	INT.	1	.05
LEFT WINDSHIELD HEAT	25	RESISTIVE TYPE ELEMENT SOLENOID	INT. INT.	2	23.00 .62
WINDSHIELD WIPER	10	MOTOR	INT.	1	4.60
LEFT PITOT HEAT	10	RESISTIVE TYPE ELEMENT	INT.	1	3.70
RIGHT PITOT HEAT	10	RESISTIVE TYPE ELEMENT	INT.	1	3.70
LEFT VOLTAGE REGULATOR	10	REGULATOR (SOLID STATE) GEN. LINE CONTACTOR SOLENOID	CONT. CONT.	2	8.00 .60 *@26 VDC

CHART 2408. 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.
RIGHT VOLTAGE REGULATOR	10	REGULATOR (SOLID STATE) GEN. LINE CONTACTOR SOLENOID	CONT. CONT.	2	8.00 .60
LEFT STARTER CONTROL - START CYCLE	5	STARTER CONTACTOR SOLENOID GEN. FIELD SHUNT RELAY FUEL RECOVERY SUMP SOLENOID STARTER ENERGIZE INDICATOR AUTO IGNITION RELAY	INT. INT. INT. INT. INT.	5	.60 .40 .50 .04 .25
RIGHT STARTER CONTROL - START CYCLE	5	STARTER CONTACTOR SOLENOID GEN. FIELD SHUNT RELAY FUEL RECOVERY SUMP SOLENOID STARTER ENERGIZE INDICATOR AUTO IGNITION RELAY	INT. INT. INT. INT. INT.	5	.60 .40 .50 .04 .25
LEFT IGNITION	5	SOLID STATE	INT.	1	3.50
RIGHT IGNITION	5	SOLID STATE	INT.	1	3.50
LEFT FUEL PRESSURE	3	INDICATOR TRANSDUCER	CONT.	2	.40
RIGHT FUEL PRESSURE	3	INDICATOR TRANSDUCER	CONT.	2	.40
LEFT FUEL FLOW	3	INDICATOR TRANSDUCER	CONT.	2	.62
RIGHT FUEL FLOW	3	INDICATOR TRANSDUCER	CONT.	2	.62
LEFT FUEL HEAT	10	RESISTIVE TYPE ELEMENT	CONT.	1	4.90
RIGHT FUEL HEAT	10	RESISTIVE TYPE ELEMENT	CONT.	1	4.90
FUEL TOTALIZER	3	SOLID STATE	CONT.	1	.10
FUEL QUANTITY	3	INDICATOR TRANSDUCER	CONT.	2	.90
LEFT MAIN FUEL PUMP	10	MOTOR	CONT.	1	9.00
RIGHT MAIN FUEL PUMP	10	MOTOR	CONT.	1	9.00
LEFT AUXILIARY FUEL PUMP	10	MOTOR	INT.	1	9.00
RIGHT AUXILIARY FUEL PUMP	10	MOTOR	INT.	1	9.00
LEFT OIL PRESSURE	3	INDICATOR TRANSDUCER	CONT.	2	.40
RIGHT OIL PRESSURE	3	INDICATOR TRANSDUCER	CONT.	2	.40
LEFT OIL TEMPERATURE	3	INDICATOR TRANSDUCER	CONT.	2	.64
RIGHT OIL TEMPERATURE	3	INDICATOR TRANSDUCER	CONT.	2	.64

CHART 2408. 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.
LEFT OIL COOLER	5	MOTOR INDICATOR SOLENOID	INT. CONT. INT.	3	4.1 .04 .50
RIGHT OIL COOLER	5	MOTOR INDICATOR SOLENOID	INT. CONT. INT.	3	4.1 .04 .50
WING FLAP MOTOR	35	MOTOR	INT.	1	.22
WING FLAP CONTROL	3	SOLENOID AMPLIFIER METER RHEOSTATS (3)	INT. CONT. CONT. CONT.	4	.86 1.20 .01 .03
GEAR POSITION IND.	5	LAMPS	INT.	4	.12
GEAR WARNING SOLENOID		DOOR SOLENOID L L SOLENOID (GEAR DOWN) LOCK SOLENOID (FLIGHT) RELAY (GROUND ONLY) LAMP (IN TRANSIT)	INT. INT. INT. INT. INT.	5	1.60 .50 1.10 .20 .04
PROP SYNC	3	SOLID STATE	CONT.	1	1.00
LEFT H.T.G. & BETA	5	LOCK PITCH SOLENOID H.T.G. SOLENOID INDICATOR	CONT. CONT. CONT.	3	1.10 .90 .04
RIGHT H.T.G. & BETA	5	LOCK PITCH SOLENOID H.T.G. SOLENOID INDICATOR	CONT. CONT. CONT.	3	1.10 .90 .04
LEFT TORQUE METER	3	INDICATOR TRANSDUCER	CONT.	2	.40
RIGHT TORQUE METER	3	INDICATOR TRANSDUCER	CONT.	2	.40
ANNUNCIATOR MASTER CAUTION INDIVIDUAL INDICATORS	5	SOLID STATE LAMPS (FAULT ONLY) LAMPS (4-8)	CONT. INT. INT.	VARIES	.50 MAX. .28 MAX. 3.84 MAX.
RIGHT GYRO HORIZ.	2	INDUCTIVE	CONT.	1	1.00
RIGHT DIRECTIONAL GYRO	2	INDUCTIVE	CONT.	1	1.00
LEFT GYRO HORIZ.	2	INDUCTIVE	CONT.	1	1.00
LEFT DIRECTIONAL GYRO	2	INDUCTIVE	CONT.	1	1.00

CHART 2408. 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.
LEFT TURN & BANK	2	INDUCTIVE	CONT.	1	1.00
GYRO-INVERTER #1	15	SOLID STATE	CONT.	1	1.00
GYRO-INVERTER #2	15	SOLID STATE	CONT.	1	1.00
STALL WARNING	5	TIME DELAY HORN	INT. INT.	2	.01 .20
STALL WARNING HEAT	7.5	RESISTIVE	INT.	1	6.10
ANTI-COLLISION STROBES, LEFT ANTI-COLLISION STROBES, RIGHT	5	STROBES AND PWR. SUPPLY STROBES AND PWR. SUPPLY	CONT. CONT.	2	1.60 1.60
LANDING LIGHT	10	LAMP SOLENOID	INT. INT.	2	8.90 .50
POSITION LIGHTS	7.5	LEFT LAMP RIGHT LAMP TAIL LAMP	CONT. CONT. CONT.	3	1.80 1.80 1.00
TAXI LIGHT	10	LAMP SOLENOID	INT. INT.	2	8.90 .50
WING INSPECTION LIGHT	5	LAMP	INT.	1	1.81
RECOGNITION LIGHT	10	LAMP SOLENOID	INT. INT.	2	1.81 .50
LEFT PANEL LIGHTING	5	ELECTRO LUMINESCENT	CONT.	1	1.32
RIGHT PANEL LIGHTING	5	ELECTRO LUMINESCENT	CONT.	1	.84
RADIO PANEL LIGHTING	5	ELECTRO LUMINESCENT	CONT.	1	.04
PLACARD LIGHTING	5	ELECTRO LUMINESCENT	CONT.	1	1.86

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

25

EQUIPMENT/FURNISHINGS

CHAPTER 25 - EQUIPMENT/FURNISHINGS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The T-1040 flight and passenger compartments are equipped with the following standard equipment and/or furnishings. The flight compartment is equipped with two adjustable crew seats. A divider between the crew and passenger compartments consists of a pull-curtain installation on the standard commuter.

The passenger compartment is equipped with nine forward facing seats.

FLIGHT AND PASSENGER COMPARTMENT.

DIVIDER CURTAINS AND CURTAIN TRACK.

REMOVAL.

1. Remove one of the two stop screws located at either end of the forward or aft curtain tracks and slide the curtains off the curtain tracks.
2. The forward and aft divider curtain tracks can be removed by releasing the remaining three and five attachment screws respectively.

INSTALLATION.

1. Install the curtain tracks by means of attachment screws.
2. Slide the curtain on the tracks and secure with the stop screws on the end of the track.

PASSENGER SEATS.

REMOVAL.

1. Lift up on seat latch and slide the seat all the way aft until forward slide meets slot, then remove forward slide.
2. Slide seat forward until the aft slide meets the slot, then remove the seat.

INSTALLATION.

1. Position the seat so that the aft slide meets the slot. Move seat aft until forward slide meets slot.
2. Lift seat latch up and position seat as required.

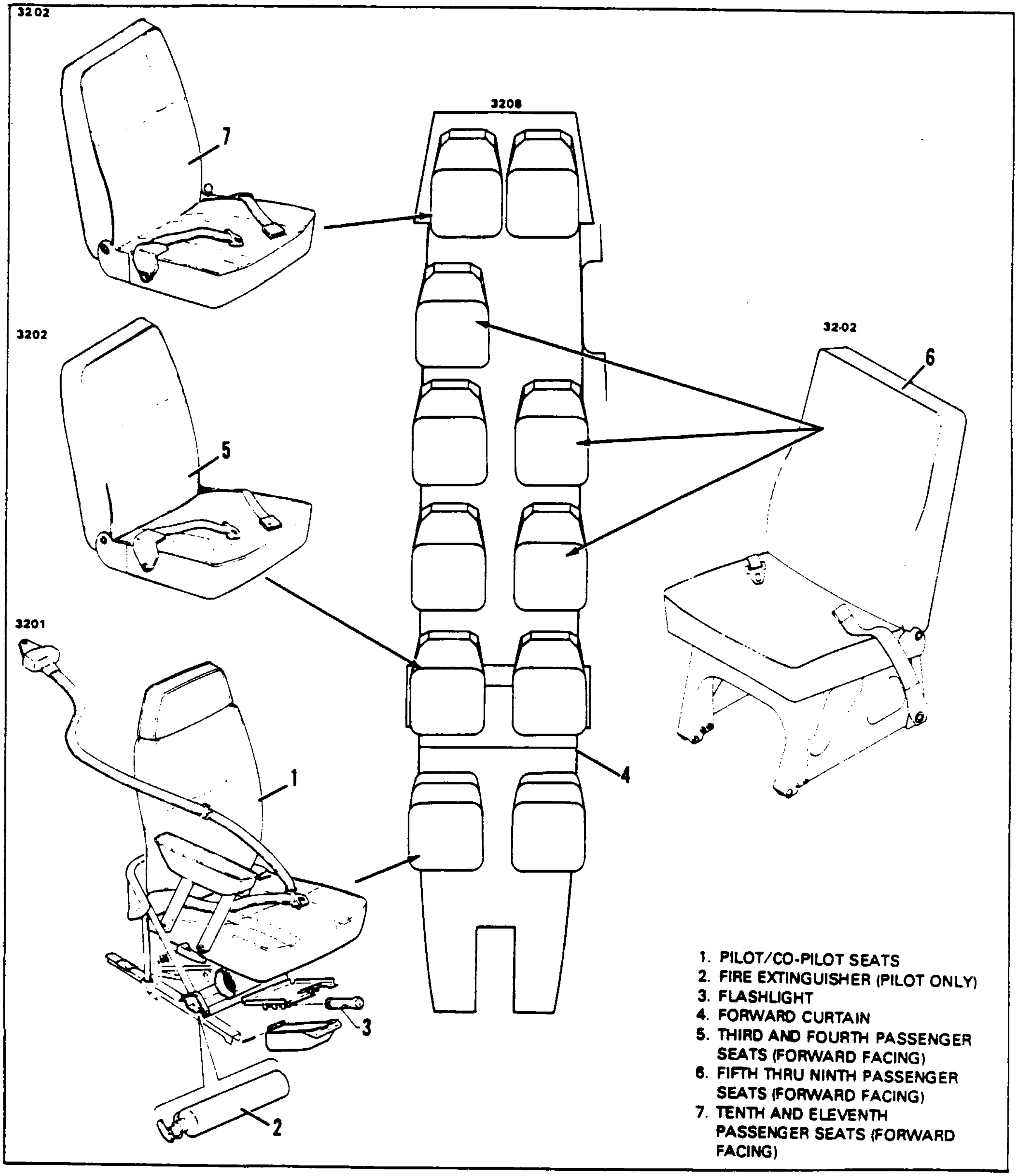


Figure 25-1. Interior Arrangement

SHOULDER HARNESS INERTIAL REEL ADJUSTMENT.

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

CARGO.

The cargo configuration provides special cargo barriers consisting of four tubular structures, two aft of the pilot's seat and two aft of the copilot's seat. These structures are fabricated to plug-into holes in the seat tracks and the top of the fuselage structure. A cargo net and tie-down straps anchored to the barriers and tie down rings positioned on the seat tracks facilitate securing cargo of various bulks for appropriate weight distribution.

Roller assemblies are available which fit on the seat tracks to aid in the handling of bulky items. The pilot's door and cargo door also contribute to the complete utilization of the aircraft during cargo operation.

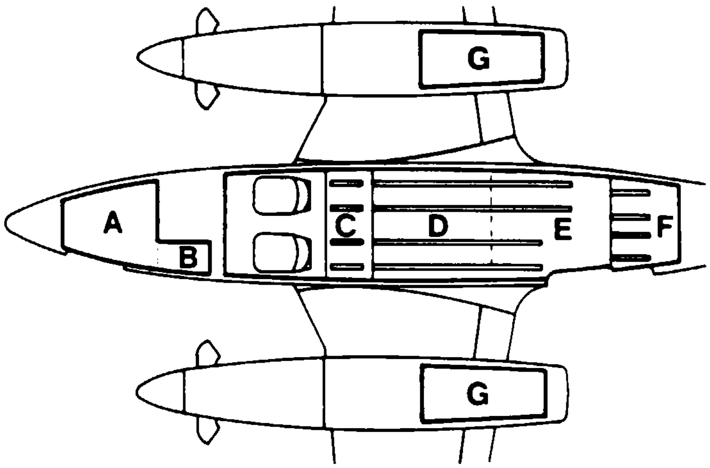
LOADING LIMITATIONS.

There are specific limitations which must be observed when loading the aircraft. A cargo loading placard is mounted on the aft bulkhead as an aid in the loading of the aircraft (Refer to Figure 25-3.)

INSTALLATION OF CARGO FURNISHINGS. (Refer to Figure 25-2.)

1. Remove all cabin dividers refreshment centers, tables, etc. and all seats except pilot and copilot.
2. Install the cargo barriers as follows:
   A. Position the base of the outboard barriers in the seat tracks and secure with spring-loaded pins. Then secure the top of the barrier at the cargo barrier trim cover with bolt (AN4-14A).
   B. Install the inboard barriers by placing pin through the hole in cargo barrier trim cover and attach bottom to seat tracks with spring-loaded pins.
3. Secure the equipment storage container to the forward side of the right hand cargo barrier.
4. Install the tie-down rings in the desired positions and lock in place by turning the threaded ring into the seat track lock holes.
5. Install tie-down rings in wedjit holes if desired.
6. Install cargo rollers in desired positions.

C547



MAXIMUM CAPACITY

AREA	FLOOR LOAD LBS/SQ FT	ALLOWABLE LBS	
A	100	300	
B	30		
C	200	400	2000 TOTAL
D	200	1800	
E	200	900	
F	100	440	
G	30	150 EACH	

MAXIMUM TIEDOWN CAPACITY

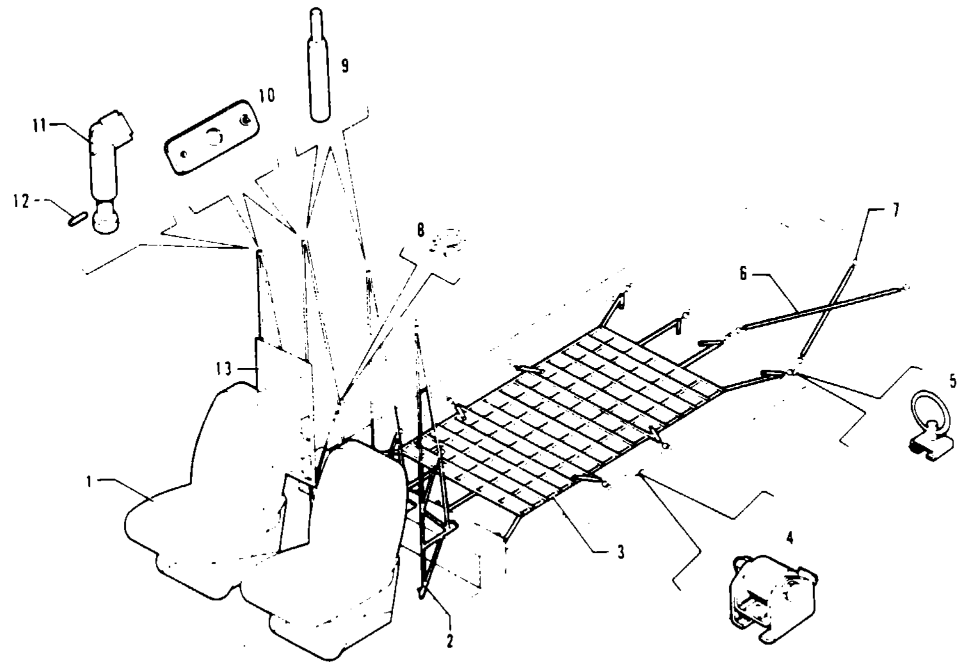
PER FOOT OF TRACK	200 LBS
PER TRACK	900 LBS
PER TIEDOWN RING	200 LBS

CARGO MUST BE LOADED WITHIN THE WEIGHT AND BALANCE LIMITS OF THIS AIRCRAFT

Figure 25-3. Cargo Loading Placard

3200

CARGO



1. SEAT
2. CARGO BARRIER
3. CARGO NET
4. CARGO ROLLER
5. BAGGAGE TIE-DOWN RING
6. CARGO STRAP
7. CARGO STRAP TIE-DOWN RING
8. CARGO STRAP-ATTACHMENT RING
9. CARGO BARRIER PIN
10. CARGO BARRIER TRIM COVER
11. CARGO BARRIER ATTACHMENT FITTING
12. ROLL PIN
13. CARGO EQUIPMENT STORAGE CONTAINER

Figure 25-2. Cargo Furnishing Installation

CARGO POD (OPTIONAL).

The optional cargo pod assembly is an external baggage compartment that is secured beneath the aircraft with screws. The pod is equipped with a fore and an aft cargo door. A barrier net is affixed to the inside of the pod between the two doors. The barrier net should not be lowered long articles are to be loaded in the pod.

Micro switches are mounted on the door frame. They will activate the NOS/BAG DOOR AJAR annunciator light to warn the pilot if one of the doors is open. Each door has a gas spring door snubber attached to it. For information on the doors and door warning system, refer to Chapter 52, Doors.

The pod is provided with internal lighting and an exterior ramp light (on the lower left wing root) for night operations. The ramp light is controlled by a switch near the cabin door or by a switch on the overhead panel. Refer to Chapter 33, Lights for information on the cargo pod lighting.

REMOVAL OF CARGO POD.

1. Place suitable supports beneath the cargo pod to prevent it from dropping while the attachment screws are being removed.
2. Remove the attachment screws and washers from the lip on the cargo pod.
3. Disconnect the cargo pod internal light wiring connector. It is sandwiched between the top of the cargo pod and the belly of the fuselage.
4. Move the cargo pod from beneath the belly of the aircraft.

INSTALLATION OF CARGO POD.

1. Position the cargo pod beneath the belly of the aircraft.
2. Connect the cargo pod internal light wiring connector.
3. Lift the cargo pod up to the belly and align the attachment screw holes in the lip of the cargo pod with the screw holes in the belly of the aircraft.

— NOTE —

Insure that the cargo pod internal light wiring connector is placed in the drainage channel on top of the pod prior before securing the cargo pod to the belly of the aircraft.

4. Secure the cargo pod to the belly of the aircraft with the attachment screws and washers.

— END —

CHAPTER

26

FIRE PROTECTION

CHAPTER 26 - FIRE PROTECTION

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter contains description and maintenance procedures for the fire extinguishing and detection system of the T-1040.

DETECTION.

GENERAL.

A fire detection system is provided for each engine. In the event of an engine compartment fire, thermal detector units installed in the nacelle actuate and complete an electrical circuit illuminating the master caution warning light, sounding a warning horn and illuminating the appropriate engine fire warning light on the annunciator display.

DESCRIPTION AND OPERATION.

Each engine fire detection system consists of three fire detecting thermal units and their interconnecting harness. Two of these units are located on each side of the front fire seal in the hot section, and one is located at the bottom of the rear fire seal in the accessory section. The thermal units actuate at a temperature of 450° F. Whenever the contacts in any one of the thermal units are actuated (due to a fire condition) the circuit is completed, causing the master caution light to blink, a horn to blow, and the engine fire warning light to show on the annunciator display. The horn and flashing light may be deactivated by pressing on the master caution light.

The TEST switch, when pressed, connects the interconnecting harnesses of each engine system in series and completes a circuit through the annunciator display to ground thus checking the continuity of the system and the operation of the left and right engine fire warning lights on the annunciator.

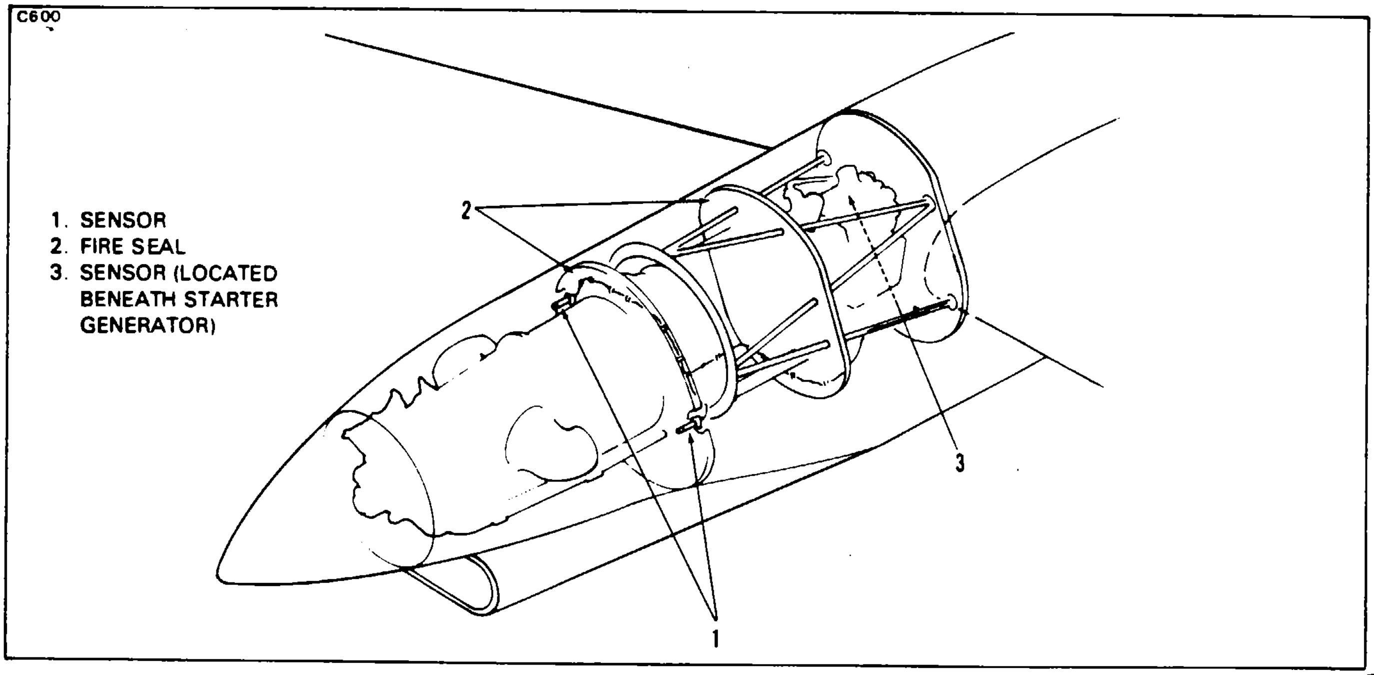


Figure 26-1. Engine Fire Detectors

EXTINGUISHING.

GENERAL.

The optional engine compartment fire extinguishing system consists of an independent system for each engine. Each system has a switch located on the left side of the overhead panel, which when actuated, electrically discharges the fire extinguisher bottle for that system. The extinguishing agent is directed by a tube into the appropriate engine compartment.

The standard equipment halon filled fire extinguisher is located under the pilot's seat.

DESCRIPTION AND OPERATION.

Each engine fire extinguishing system consists of a spherical container (bottle) that stores the fire extinguishing agent (Halon 1301) charged to 360 + 25 -0 psig at 70° F with dry nitrogen. A pressure gauge mounted on the side of the bottle indicates the internal (charged) pressure. Each bottle is mounted on the right side of each rear fire seal in the accessory section of the engine nacelles. A main discharge pipe extends from a valve on the bottom of the bottle, forward, through the rear and front fire seals to the "hot section" of the engine. An additional tube extends from the main discharge pipe and passes aft through the rear fire seal and terminates at the top of the engine accessory section.

An electrically operated cartridge (firing squib), screwed into the discharge valve at the base of the bottle, provides the means of releasing the extinguishing agent. When the switch in the cockpit is actuated, the firing squib in the discharge valve is detonated, which in turn punctures the seal in the discharge valve allowing the release of the extinguishing agent through the pipes. The container (bottle) also has a combination fill fitting and safety relief valve assembly. If ambient temperature should rise abnormally (215° F to 226° F), a fusible check valve within the fill fitting melts, thus relieving the contents of the container (bottle) and avoiding any possible bursting of the container.

TESTING EXTINGUISHING SYSTEM.

1. A quick check may be made of the system electrical circuit by turning the aircraft master switch ON and pressing the annunciator display test switch. Verify that the left and right engine fire extinguisher inoperative indicator lights are operating. A more thorough check is found in the following steps:
2. Assure all aircraft electrical power is off and that all circuit breakers are disengaged.
3. Disconnect the electrical wiring harness from the fire extinguisher squib in one engine compartment and connect a test lamp across the disconnected wires of the harness.
4. Reset circuit breakers: turn master switch ON.
5. Engage the appropriate engine fire extinguisher switch in the cockpit and verify that the test lamp illuminates.
6. Reset fire extinguisher switch: turn master switch OFF; disengage circuit breakers and disconnect the test lamp.
7. Connect a squib tester (Model 115 squib test, American Standard, Monrovia, California) to the squib terminals and check for a nominal resistance of 1.15 ± 0.25 ohms. Disconnect the squib tester.

— *WARNING* —

Do not use a volt-ohmmeter, battery powered continuity light, or any similar device in an attempt to test the squib assembly. Use of test devices which pass more than 30 MA may detonate the squib.

8. Assure aircraft electrical system is deactivated: then reconnect system wiring to squib assembly terminals, insuring ground wire is connected to ground terminal.
9. Repeat Steps 1 through 9 for opposite engine.
10. A pressure check of the fire extinguisher containers should be made periodically to determine that the pressure is between the minimum and maximum limits prescribed by the manufacturer. Refer to the Pressure-Temperature Correction Table on the container (bottle) or refer to Chart 2601.

— *NOTE* —

Changes of pressure with ambient pressure must fall within the prescribed limits. If pressures do not fall within the prescribed limits, the extinguisher container should be replaced.

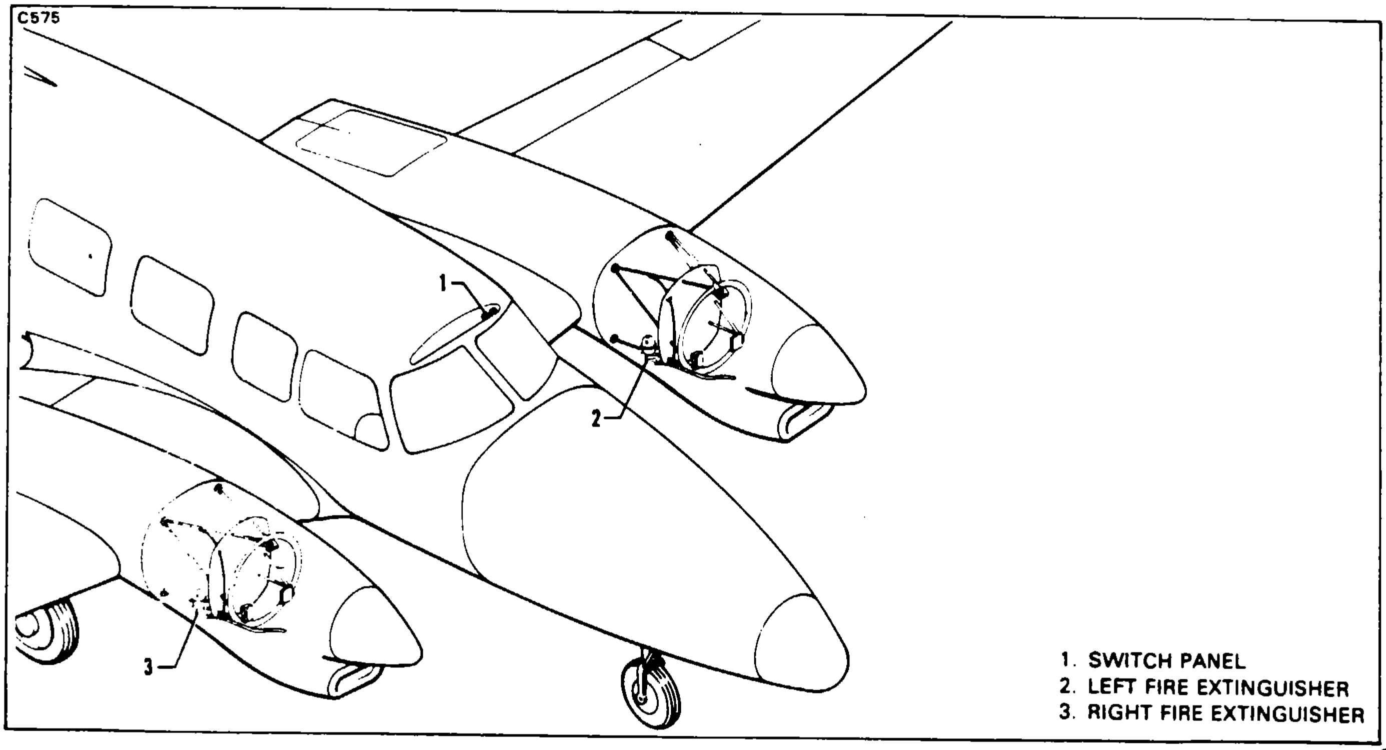


Figure 26-2. Engine Fire Control System

FIRE EXTINGUISHER BOTTLE.

REMOVAL OF FIRE EXTINGUISHER BOTTLE.

— *CAUTION* —

Frostbite or low temperature burns will result if Halon 1301 (Bromotrifluoromethane CBrF3) comes in contact with skin.

1. Assure aircraft master switch is OFF, and fire extinguisher circuit breaker is disengaged.
2. Remove upper and lower engine cowling.
3. Disconnect the three wires that connect the squib unit with the aircraft harness.

— *CAUTION* —

Charged bottles must be handled with care to avoid damaging the seal. Do not bring any electrical current in contact with the terminals on the squib assembly of a loaded unit or accidental detonation could result.

4. Disconnect the discharge pipe at the fire seal fitting and also remove the nut and washer from the fitting on the forward side of the fire seal.
5. Support the bottle: loosen the mounting clamp and remove the bottle. The fitting may then be removed from the discharge port of the squib housing.

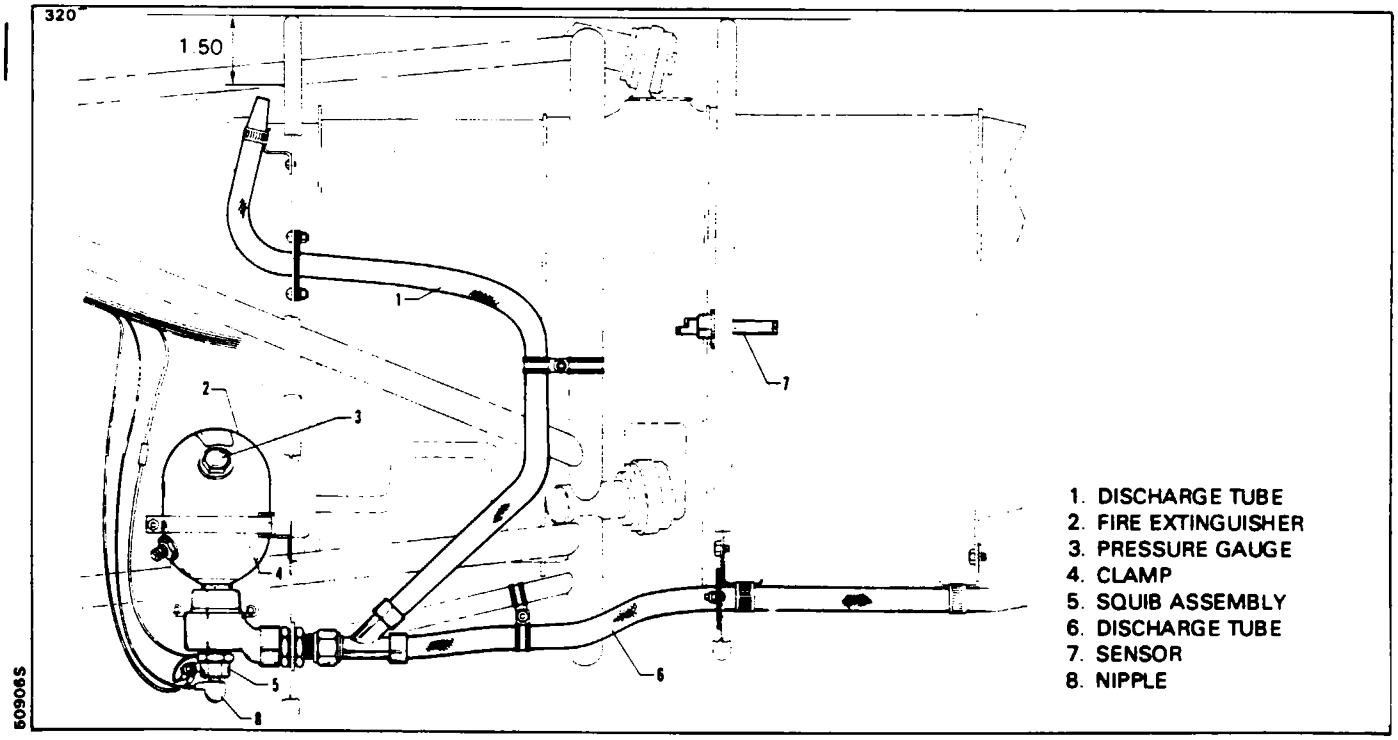


Figure 26-3. Engine Fire Extinguisher

SERVICING FIRE EXTINGUISHER BOTTLE.

1. Check for evidence of leakage or damage to the container.
2. If the bottle is not being removed for the purpose of replacement, it should be weighed and must fall within 0.25 pounds of total weight stamped on the data plate.
3. If the bottle is found underweight or damaged, it must be replaced with a serviceable unit.
4. Check the indicated pressure reading on the fire extinguisher bottle. The pressure of a serviceable unit should be within the specifications given in Chart 2601.

CHART 2601. PRESSURE-TEMPERATURE CORRECTION

Temperature	-60	-40	-20	0	+20	+40	+60	+80	+100	+120
Ind. Pressure	110 134	127 155	148 180	174 212	207 251	249 299	304 354	367 417	442 492	532 582

INSTALLATION OF FIRE EXTINGUISHER BOTTLE.

1. Install the connector fitting into the squib housing and tighten.
2. Locate the bottle into its proper position with the discharge tube connector fitting protruding through the hole in the fire seal.
3. Secure the bottle in place by tightening the clamp and installing nut and washer on the fitting that protrudes through the fire seal.
4. Connect and secure the discharge pipe to the fire seal fitting.
5. Ascertain the placement of the discharge nozzles per the dimension shown in Figure 26-3. It is important that the nozzles be positioned as shown to obtain proper dispersal of the extinguishing agent.
6. Check and make sure that all aircraft electrical power is OFF; then connect the wires to their proper terminals on the squib assembly.
7. Install engine cowling.
8. Turn aircraft electrical system ON and press annunciator test switch and verify that the left and right engine fire extinguisher inoperative indicator lights are operating.

FIRE EXTINGUISHER, HAND HELD.

A portable fire extinguisher is mounted to the seat frame beneath the pilot's seat. The extinguisher is suitable for use on liquid or electrical fires. It is operated by aiming the nozzle at the base of the fire and squeezing the trigger grip. Releasing the trigger automatically stops further discharge of the extinguishing agent. Read the instructions on the nameplate and become familiar with the unit before an emergency situation. The Halon 1211 extinguisher is fully discharge in 15 to 20 seconds.

— WARNING —

The concentrated agent from extinguishers using Halon 1211 or the by-products when applied to a fire are toxic when inhaled. Ventilate the cabin as soon as possible after fire is extinguish to remove smoke or fumes.

PORTABLE FIRE EXTINGUISHER, INSPECTION AND MAINTENANCE.

1. It is recommended that the fire extinguisher be inspected monthly or in accordance with the manufacturer's instructions on the label attached to the fire extinguisher.
2. When inspecting the fire extinguisher, check the following items:
   A. Check that the inspection tag is present and has been updated.
   B. Check that the locking ring is firmly in place and has not been tampered with.
   C. Check for cleanliness, dents, scratches, damage and corrosion. If found, take extinguisher to a qualified dealer or distributor for testing and/or repair.
   D. Check the discharge nozzle for cleanliness and clogging.
   E. Check for a full charge. Check the charge weight noted on the nameplate with an appropriate scale.
   F. Check that the gauge indicator is in the green service pressure section.

— END —

CHAPTER

27

FLIGHT CONTROLS

CHAPTER 27 - FLIGHT CONTROLS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 27 - FLIGHT CONTROLS (cont.)

TABLE OF CONTENTS/EFFECTIVITY

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 streamlined.	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 con-nection.
	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.

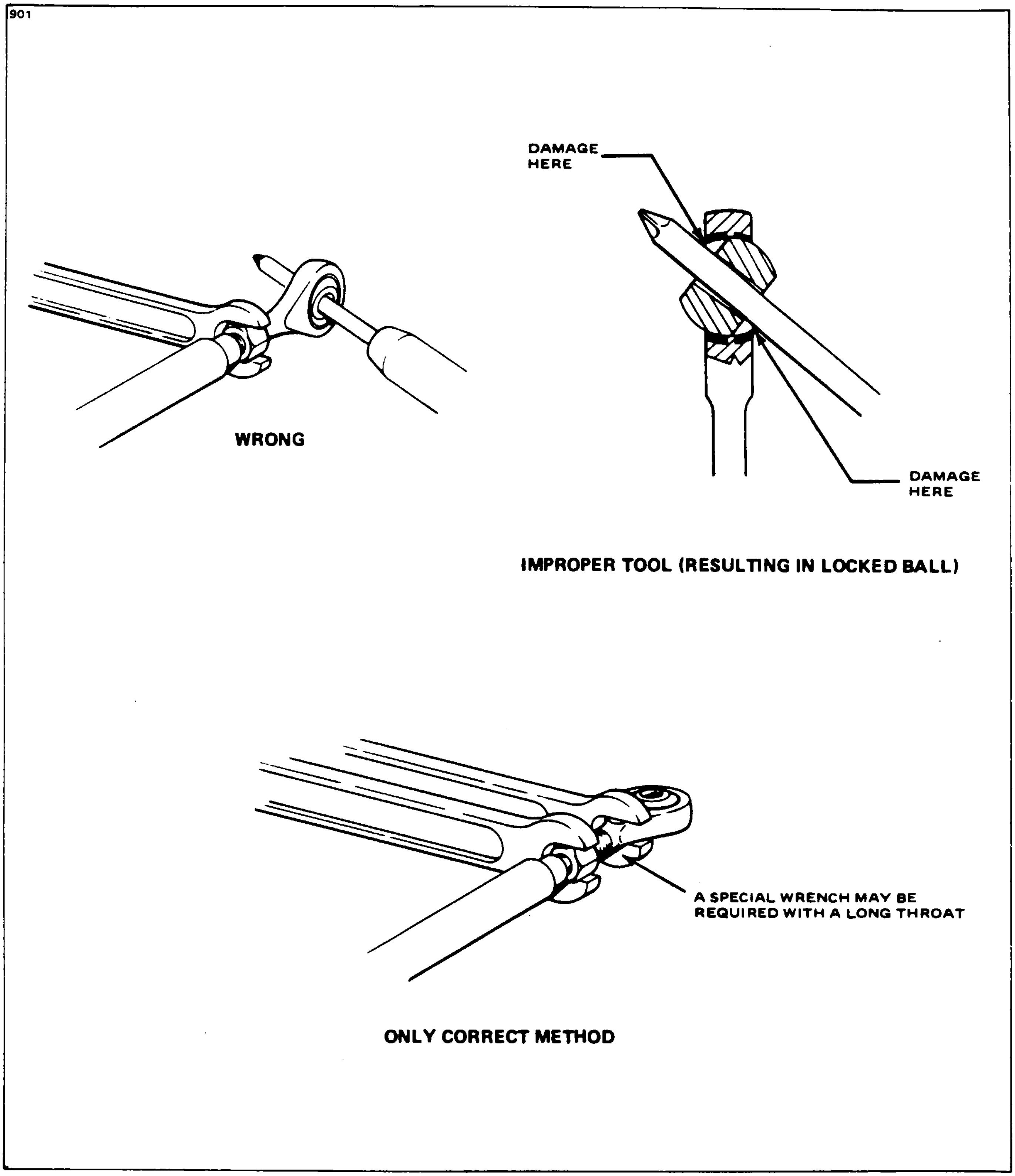


Figure 27-1. Correct Method of Installing Rod End Bearings

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.

Kaynar Mfg. Co. Inc.
800 S. State College Blvd.
Fullerton, California

E. Remove nut and slide stud from sprocket housing.

4. To remove the torque tube assembly, use the following procedure:

A. With the floor panel removed from between the control pedestal and the left fuselage side panel and the links disconnected from between the control tube housing and the torque tube arms, loosen one of the elevator control cable turnbuckles at fuselage station 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.

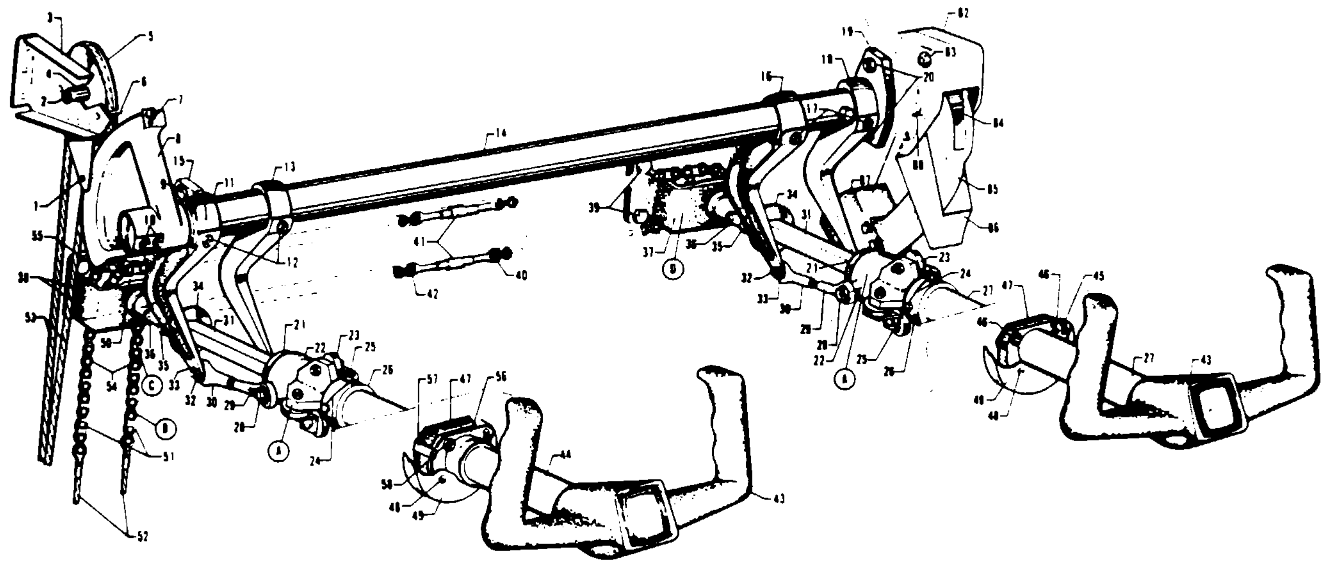
Kaynar Mfg. Co. Inc.
800 S. State College Blvd.
Fullerton, California

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.

1193



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

Figure 27-3. Control Column Installation

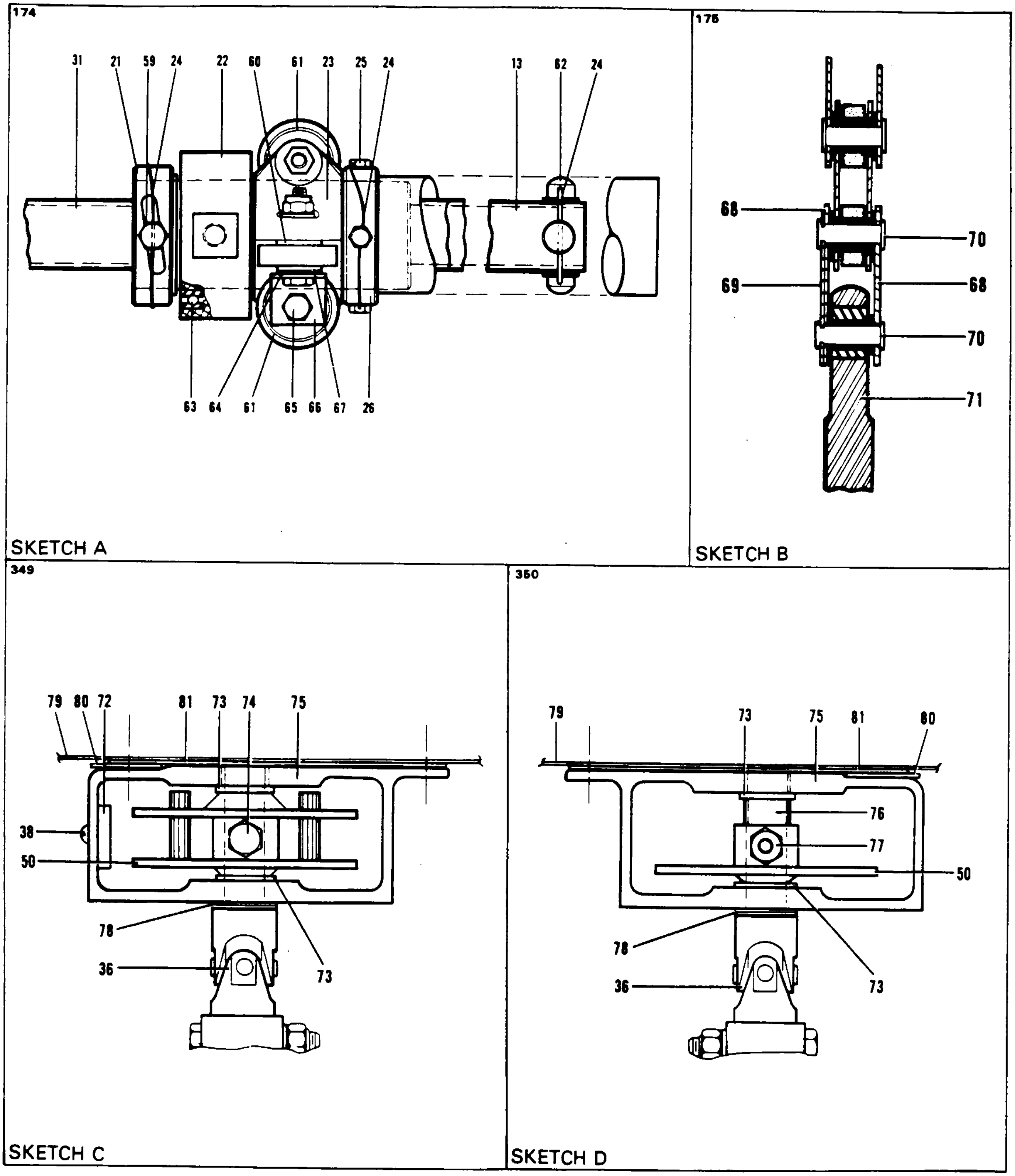


Figure 27-3. Control Column Installation (cont.)

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.

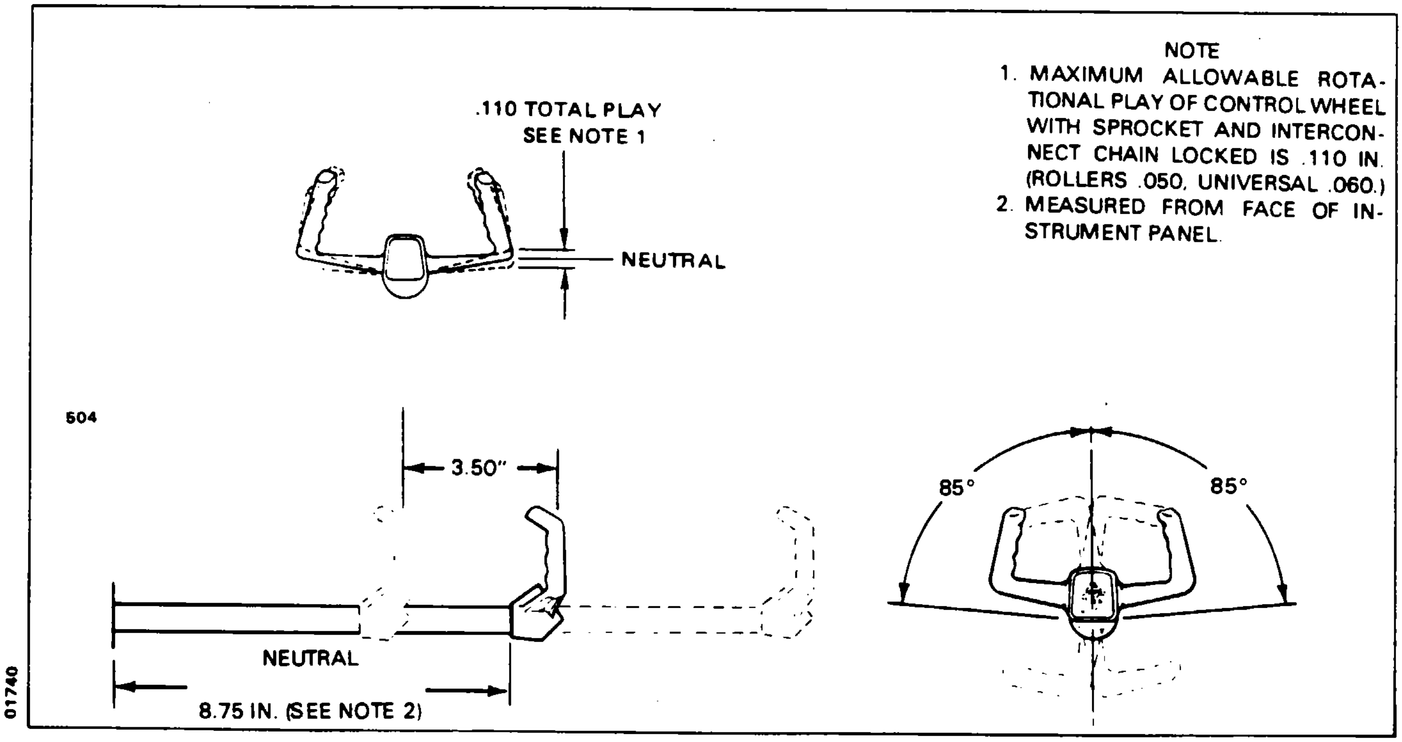


Figure 27-4. Control Wheel Travel

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.

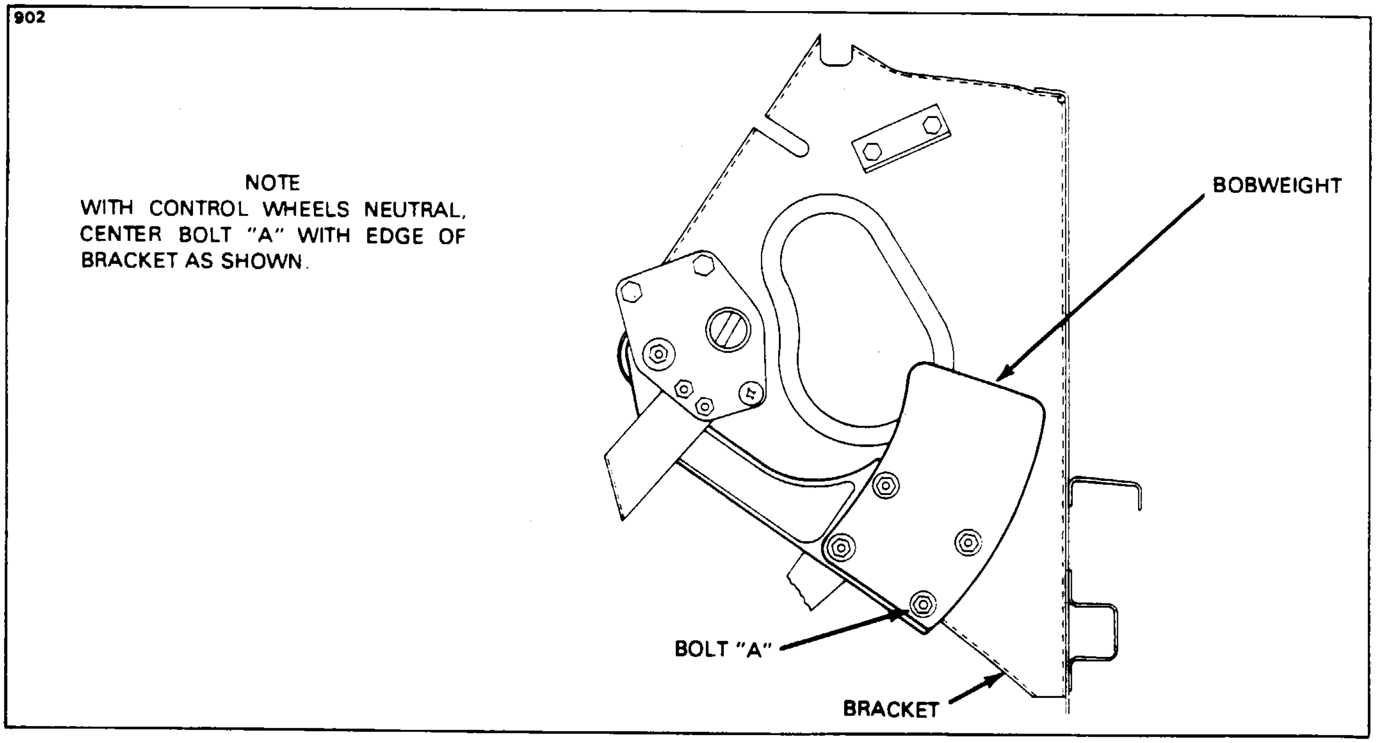


Figure 27-5. Rigging Bobweight

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 178.00 and aft plate located on the fillet fairing between the fuselage and wing.
4. To remove the right or left primary control cables, the following procedure may be used:
   A. Mark one set of cable ends to facilitate installation, and separate the aileron control cables at the turnbuckle within the fuselage at station 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 171.00.
   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.

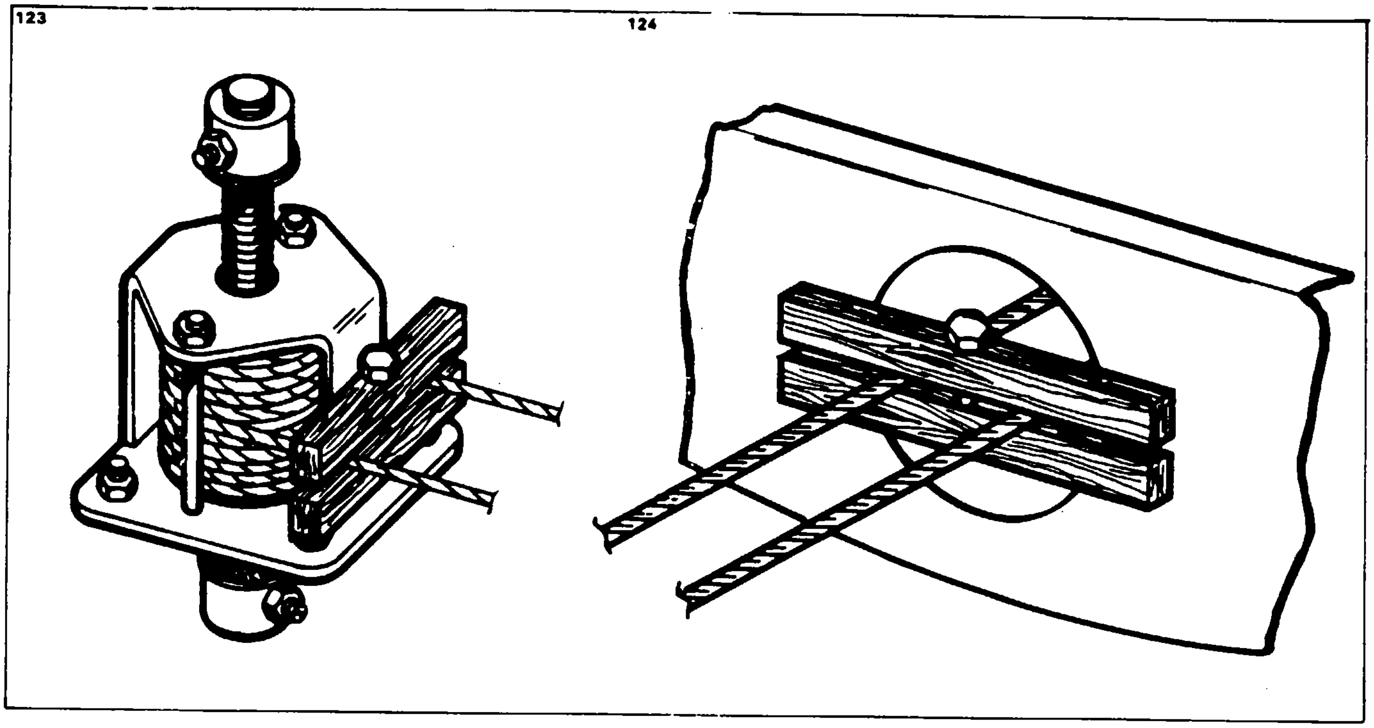
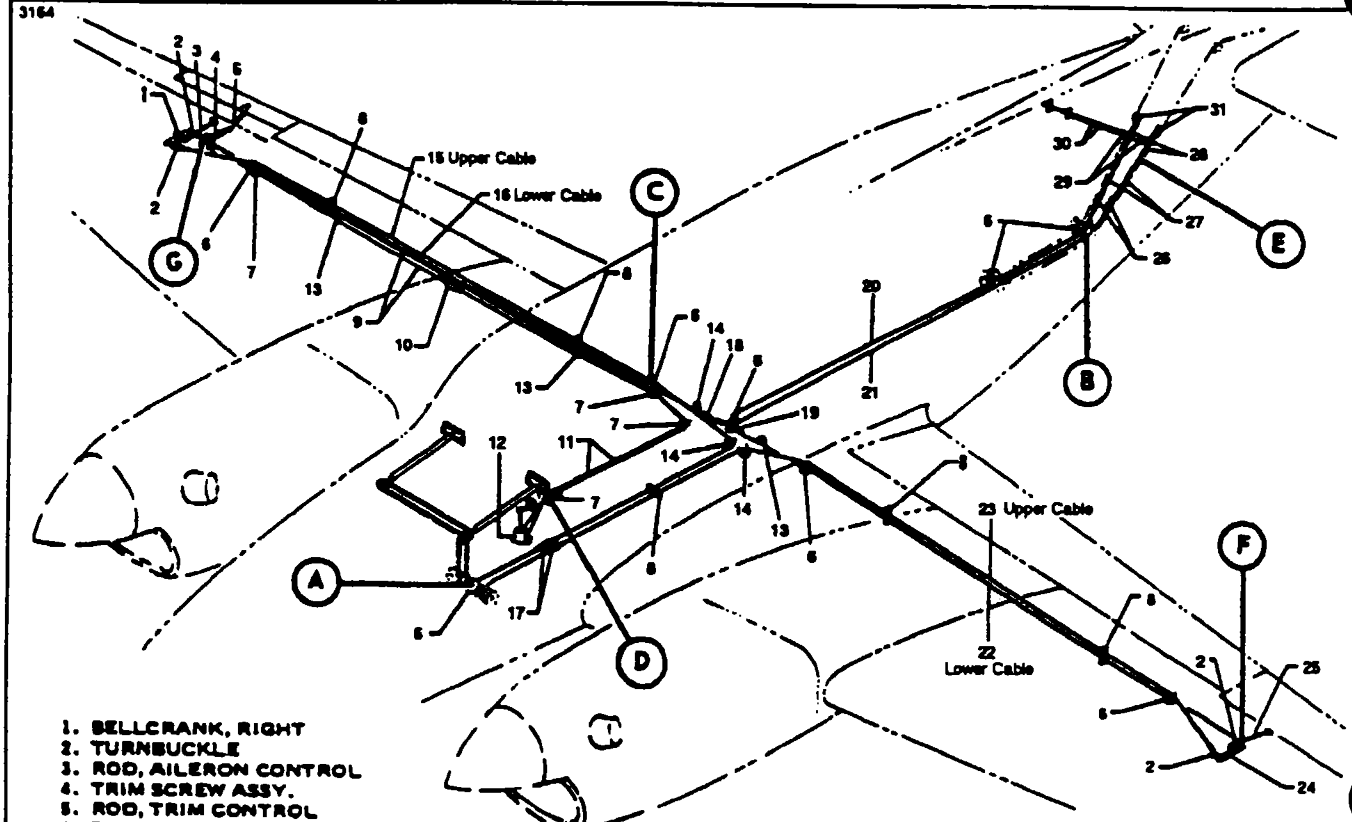


Figure 27-6. Methods of Blocking Trim Cables

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

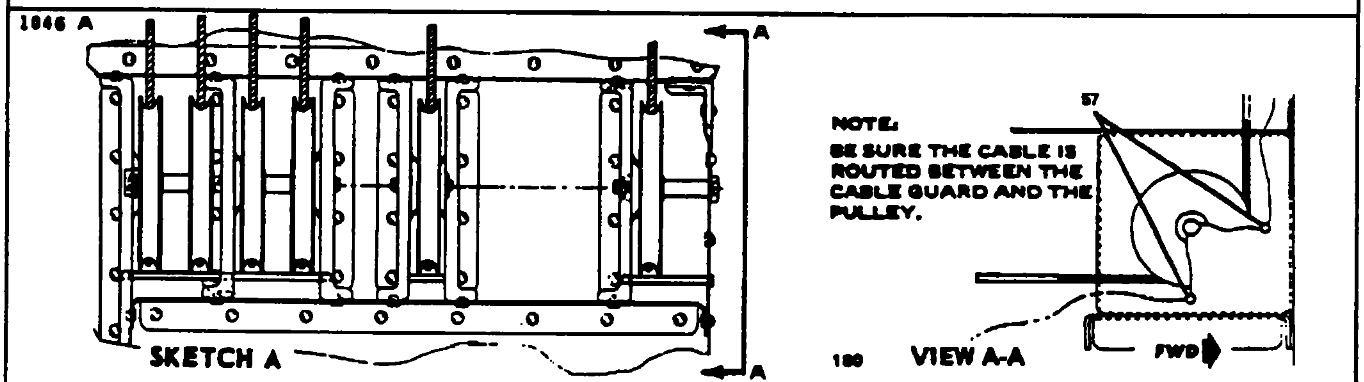


Figure 27-7. Aileron and Aileron Trim Controls

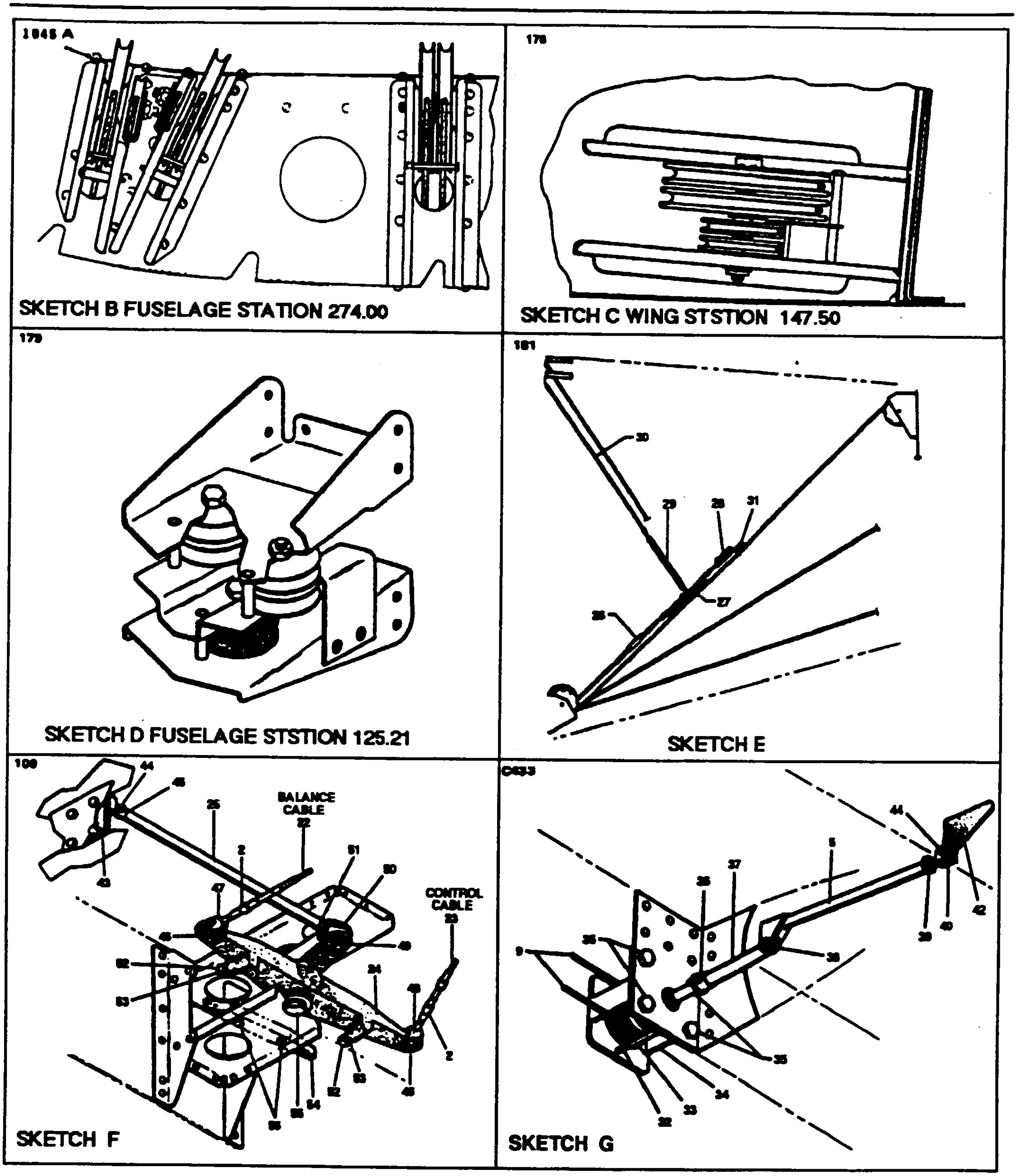


Figure 27-7. Aileron and Aileron Trim Controls (cont.)

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 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.

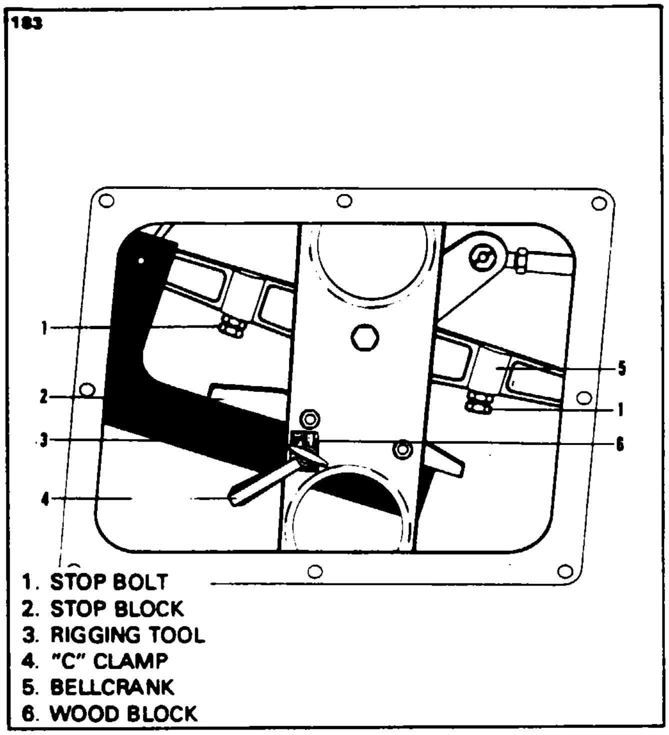


Figure 27-8. Installation of Bellcrank Rigging Tool

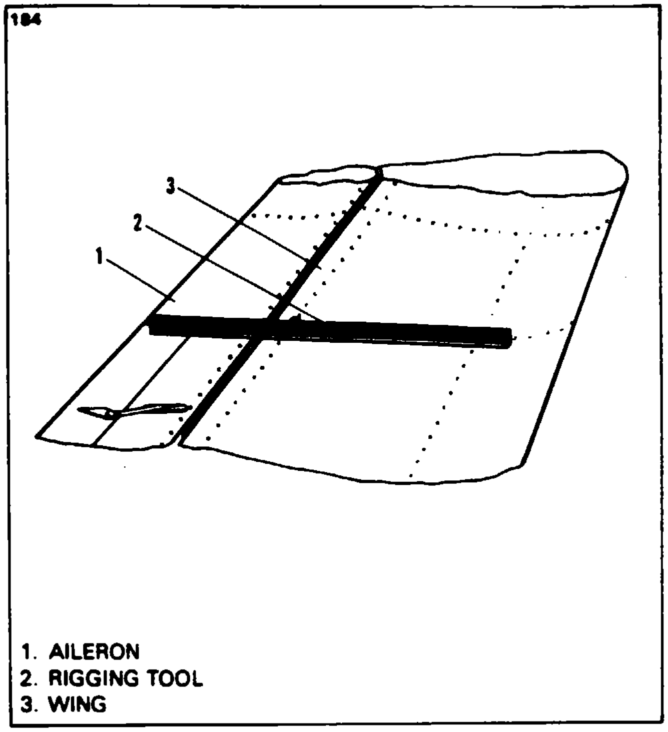


Figure 27-9. Installation of Aileron Rigging Tool

RIGGING AND ADJUSTMENT OF AILERON CONTROLS. (Refer to Figure 27-6.)

1. To rig the aileron controls, set the right and left aileron bellcranks in neutral position by attaching an aligning tool within both wings as shown in Figure 27-8. (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 178.00.
   B. Remove the cotter pin and nut that secures the forward turnbuckle fork end to the bellcrank. The bolt should not be removed.
   C. Insert the tool between the bellcrank mounting brackets and over the end of the bolt from which the nut was removed. (It may be necessary to loosen one of the primary control cables or the balance cable.)
   D. Position the tool so that it fits tight against the outboard side of the bellcrank stop block.
   E. Clamp the tool to the lower support bracket with a small "C" clamp. Place a small block of wood or 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 102.00 and the cable guard pins at stations 124.00 and 163.50.

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.

WRAPPING CONTROL PEDESTAL AILERON TRIM DRUM. (Refer to Figure 27-9a.)

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 shaft from the trim screw assembly. 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 aileron trim cable on the forward trim drums (located beneath the control pedestal).

   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.

8. Insert the drum in the housing bracket, position the drum and route the cables from the assemby as shown in Figure 27-9a.

9. Install the drum shaft and secure with the roll pin (if used).

10. Block the trim cables (refer to Figure 27-6) to keep them from loosening.

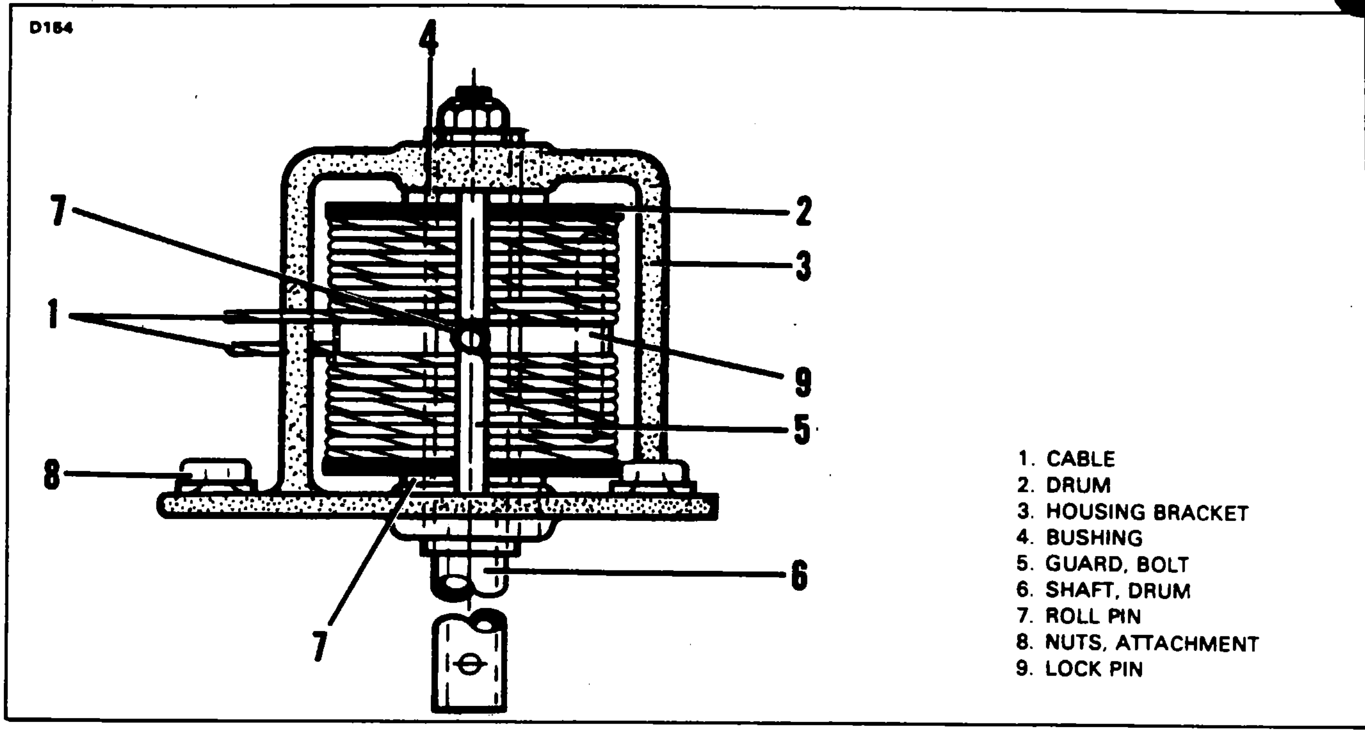
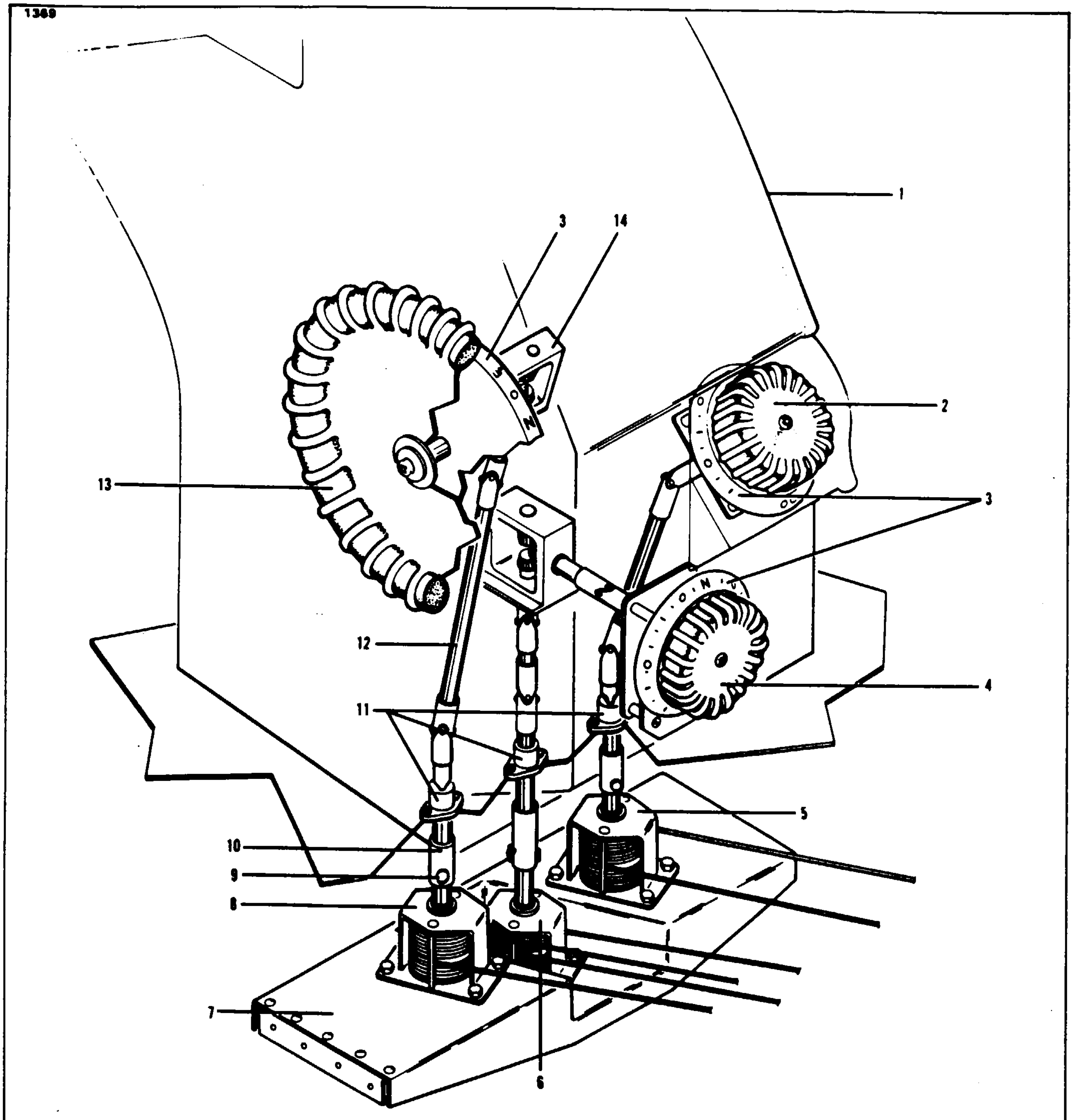


Figure 27-9a. Wrapping Control Pedestal Aileron Trim Drum

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 Control Pedestal Aileron Trim Drum.)
2. Lubricate the screw assembly shaft bearing on the face of the control pedestal.
3. Position the screw assembly in the pedestal on its mounting bracket and secure.
4. Draw the cables from the pedestal through the fuselage and into the wing.
5. Install the cable pulleys in the fuselage at station 102.00 and secure.
6. Install the aileron and aileron trim pulleys in the wing at station 29.00.
7. Set the aileron cable tension per Figure 27-11 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 124.00 and 163.50.
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

Figure 27-10. Trim Controls Installation

604

Cable Tensions

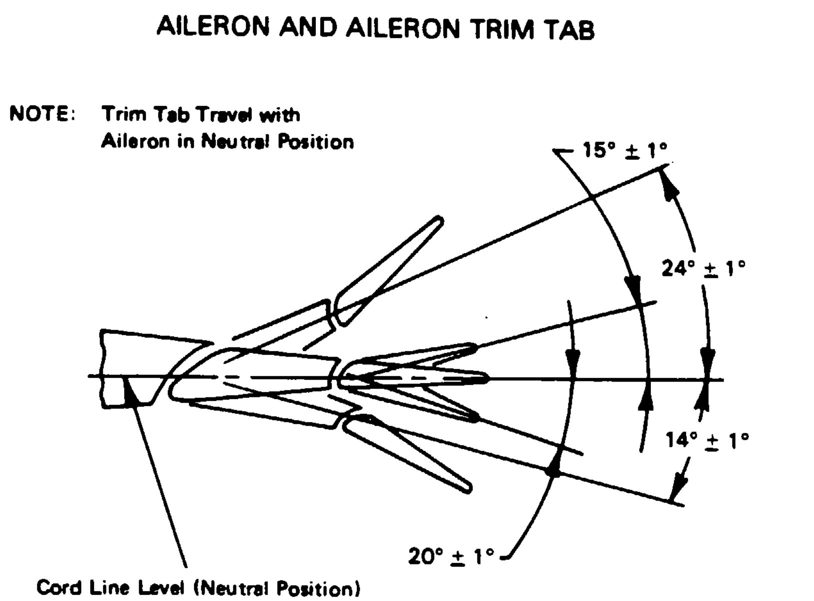
Aileron	35 lbs. ± 2 lbs.
Aileron Trim Tab	14 lbs. ± 2 lbs.

NOTE

WITH AILERON IN NEUTRAL POSITION, TOTAL AILERON "FREE PLAY" MAY NOT EXCEED .10 INCH AS MEASURED BETWEEN THE INBOARD END OF THE AILERON AND THE TRAILING EDGE OF THE FLAP.
THE AILERON TAB "FREE PLAY" SHALL BE CHECKED AS FOLLOWS: POSITION AILERON AND AILERON TAB IN NEUTRAL POSITION. THE TOTAL TAB "FREE PLAY" MAY NOT EXCEED .045 INCH AS MEASURED BETWEEN THE INBOARD END OF THE TAB AND THE TRAILING EDGE OF FLAP.

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.



01740

Figure 27-11. Aileron Control Travels and Cable Tension

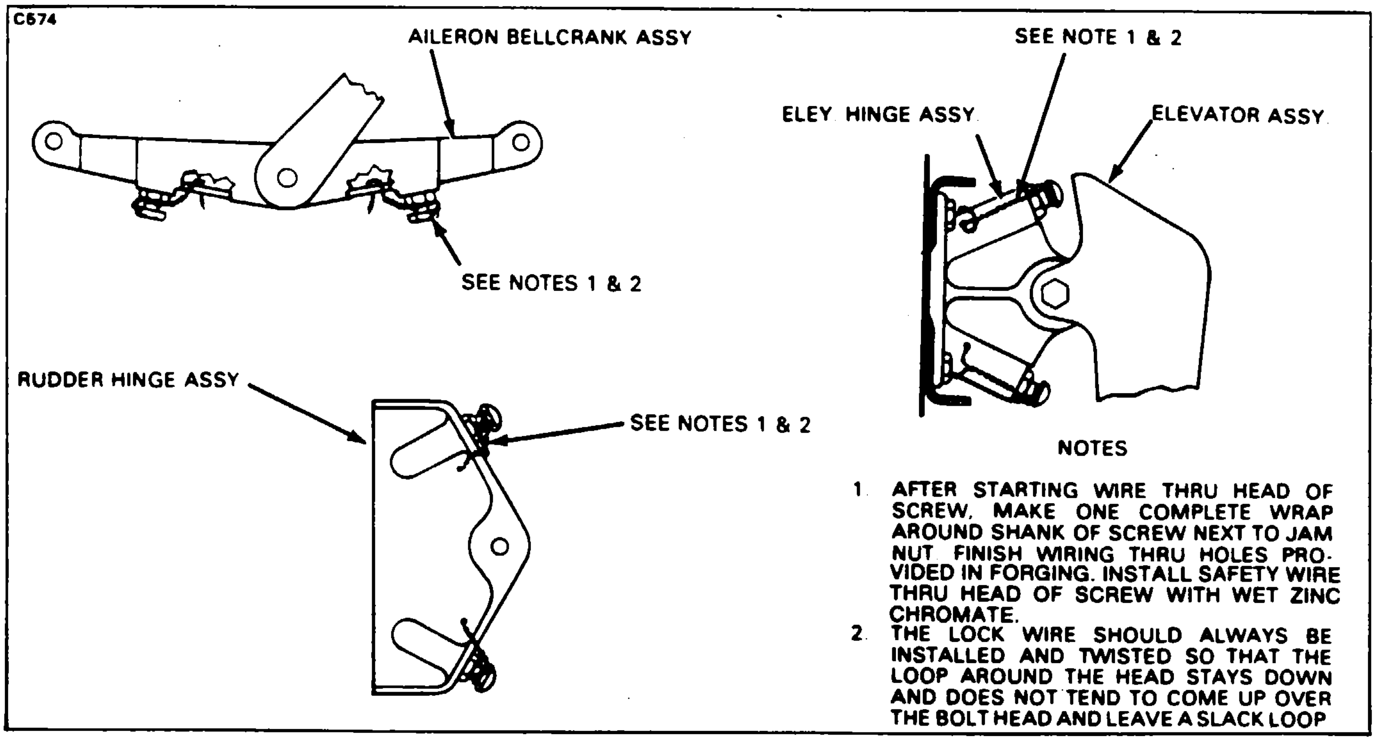


Figure 27-12. Safety Wiring Control Surface Stops

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, 117.50, 128.00, 151.50 and 171.00.
2. Disconnect the trim control rod located between the trim screw and tab at the screw.
3. Block the trim cables to prevent them from unwrapping from their drums at the screw assembly and within the wing at station 87.50 by one of the methods shown in Figure 27-6. (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 at wing station 128.00 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.

WRAPPING AILERON TRIM DRUM (WING). (Refre to Figure 27-12a.)

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 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.
4. Remove the drum from the housing.

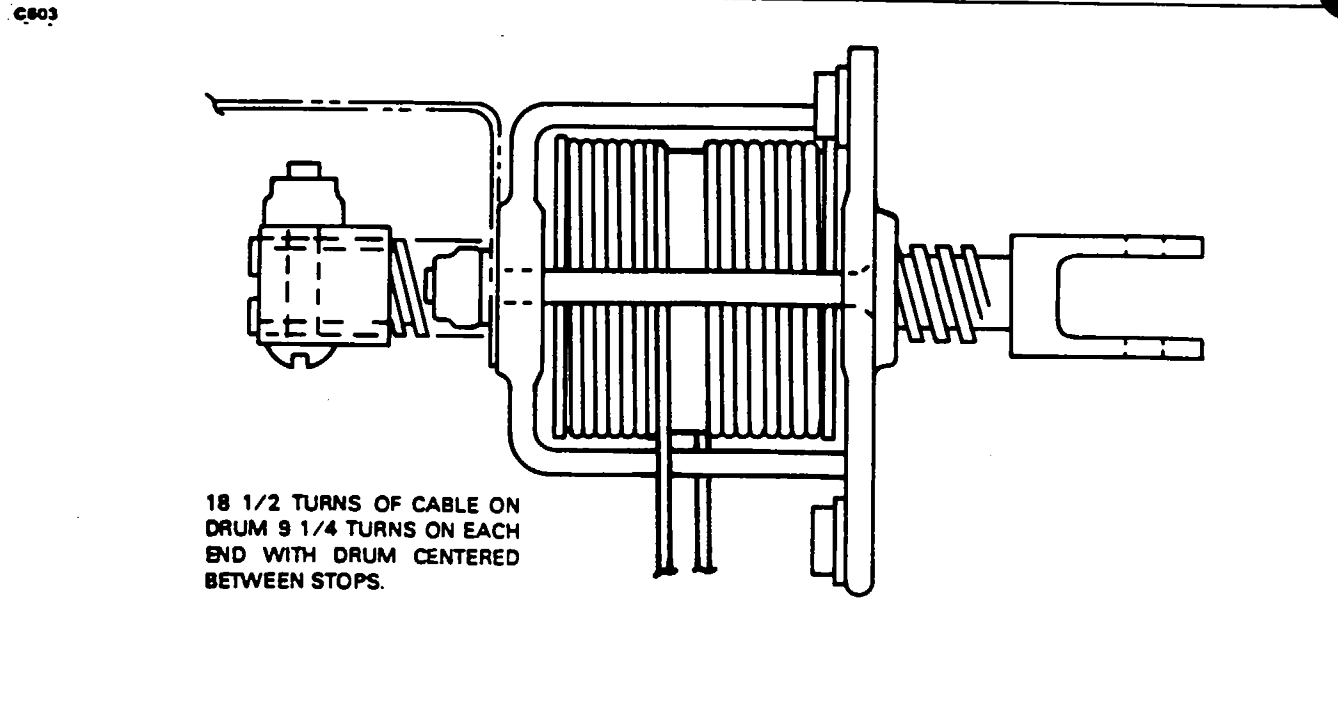


Figure 27-12a. Wrapping Aileron Trim Drum (Wing)

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 faciliate 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 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.
8. Insert the drum in the housing bracket, position the drum and route the cables from the assembly as shown in Figure 27-12a.
9. Install the screw and screw stop.
10. Block the trim cables (refer to Figure 27-6) to keep them from loosening.
11. Center the drum between the stops on the screw by rotating the screw.

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 171.00.
3. With the trim screw held from rotating, turn the trim drum until .560 of an inch exists between the forward screw stop and the drum housing, as measured along the screw. Do not measure from sender mounting bracket. (Neutral position of the screw is at this measurement.)
4. With the trim screw in neutral position, the trailing edges of the tab and aileron should align. Should they not, remove the bolt from the aft end of the trim control rod and adjust the rod end until the trailing edges align. Reinstall bolt and tighten it so that bushing will not rotate and secure.
5. Turn the trim in each direction to screw stops to check tab angle as given in Figure 27-11 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 286.00 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 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, 275.00, 315.00 and 345.00. In addition, when removing the left cable, remove pins at stations 142.00 and 160.60.
9. Draw the cables aft through the fuselage and remove.

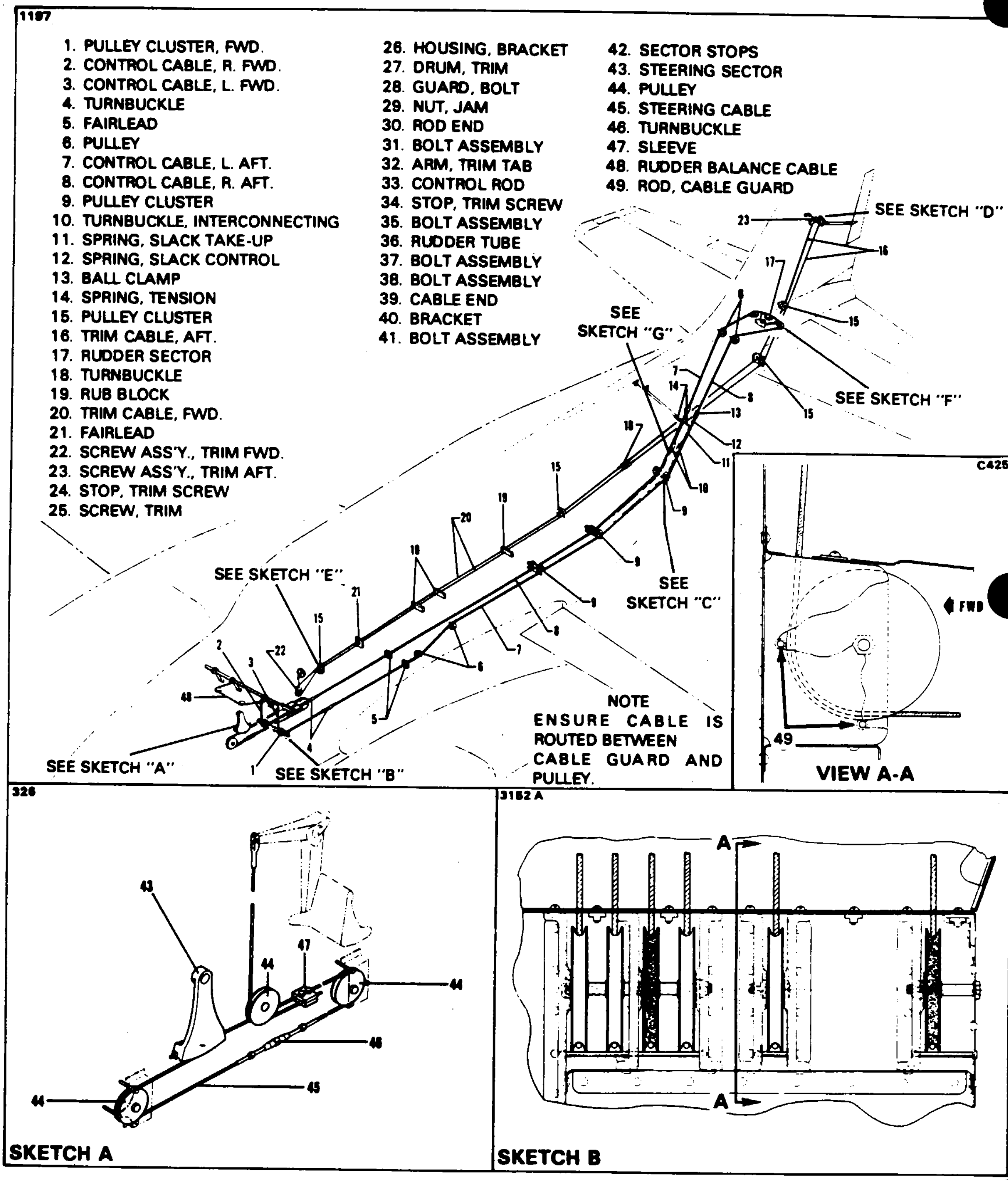


Figure 27-13. Rudder and Rudder Trim Controls

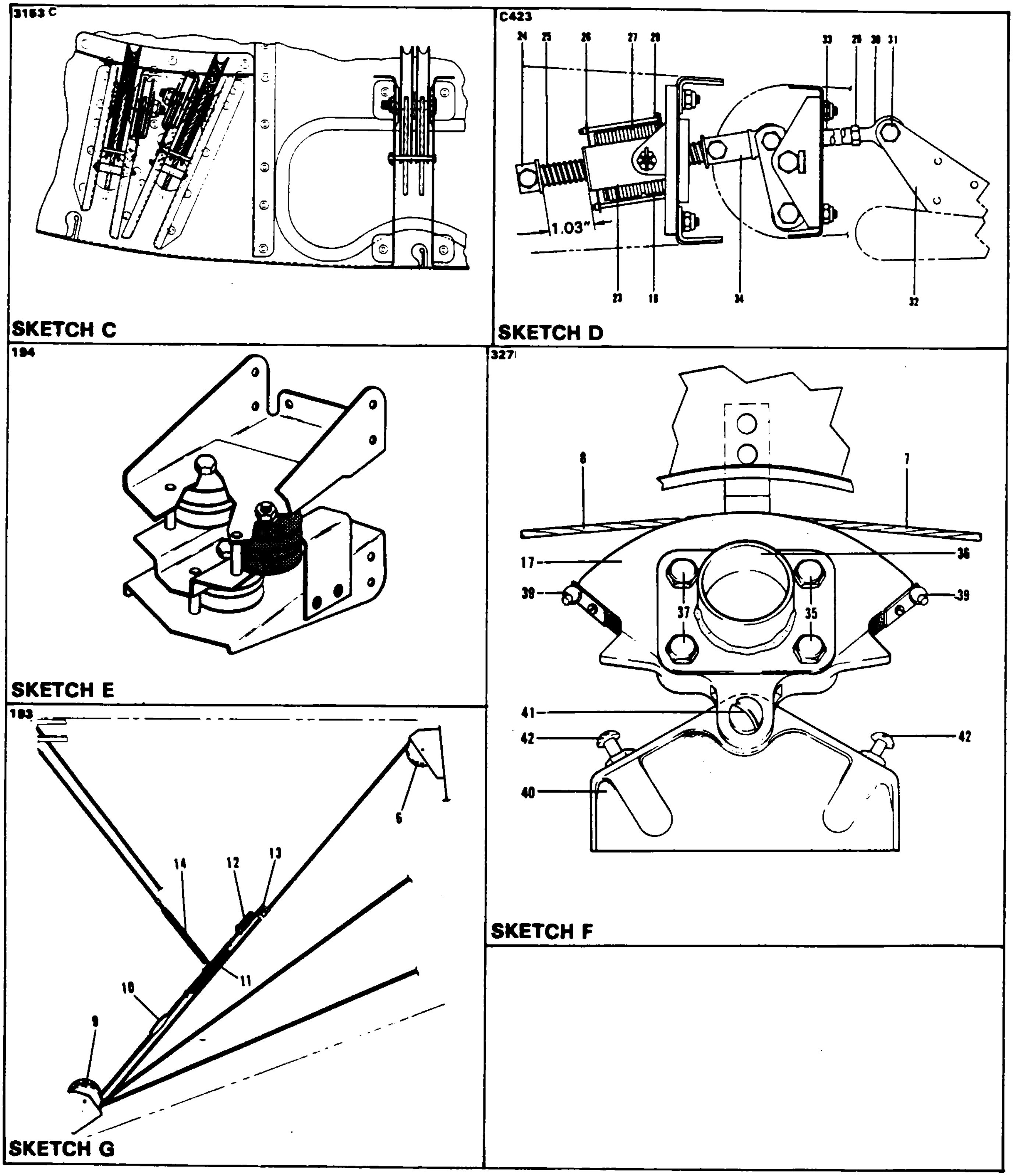


Figure 27-13. Rudder and Rudder Trim Controls (cont.)

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, 275.00, 315.00 and 345.00. If the left cable was removed, install pins at stations 142.00 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.

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.

CABLE TENSIONS	
RUDDER	26 lbs. ± 2 lbs.
RUDDER TRIM TAB	14 lbs. ± 2 lbs.

NOTE

THE RUDDER TAB "FREE PLAY" SHALL BE CHECKED AS FOLLOWS: POSITION RUDDER AND RUDDER TAB IN NEUTRAL POSITION. THE TOTAL TAB "FREE PLAY" MAY NOT EXCEED .07 INCH AS MEASURED BETWEEN THE BOTTOM END OF THE TAB AND THE TRAILING EDGE OF THE RUDDER.

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.

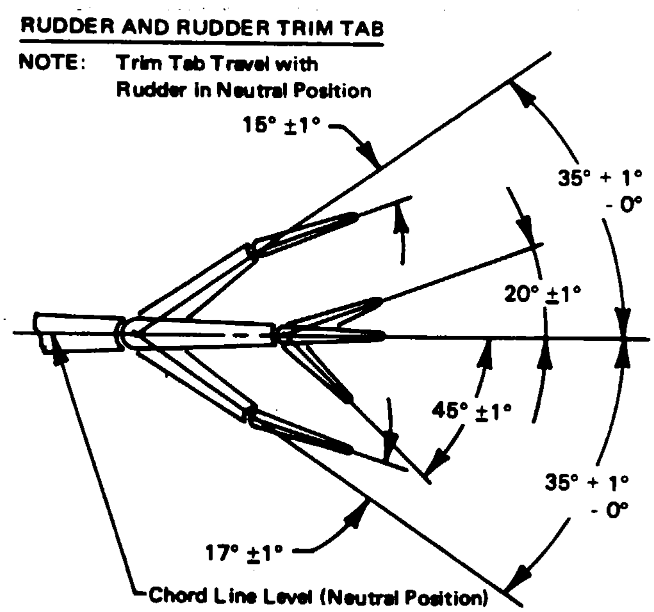


Figure 27-14. Rudder and Trim Tab Control Travels and Cable Tensions

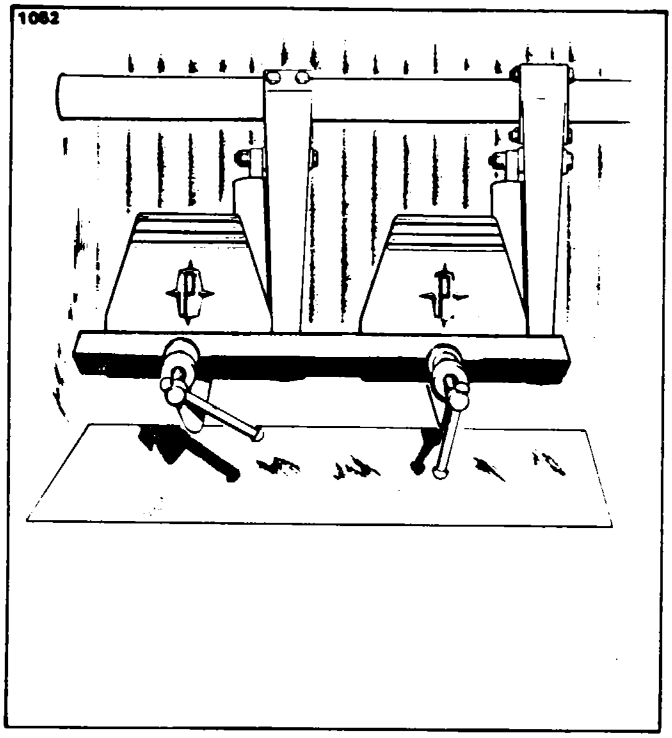


Figure 27-15. Clamping Rudder Pedals in Neutral Position

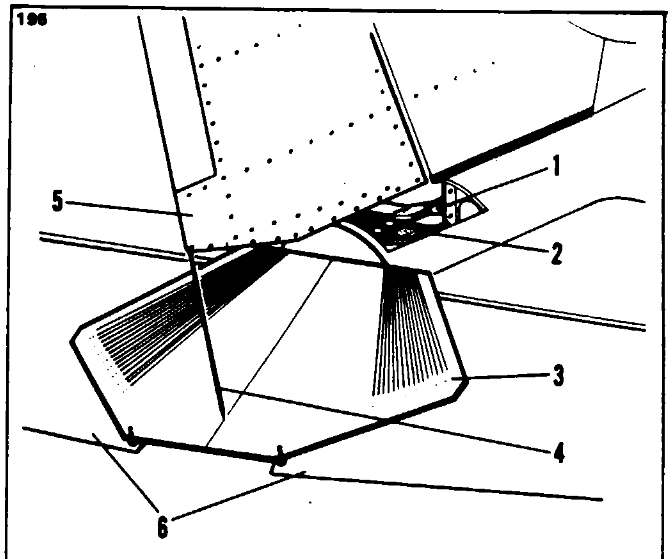


Figure 27-16. Installation of Rudder Rigging Tool

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 check rigging and adjustment.
4. Install access plate, panel and seat.

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 slide 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.

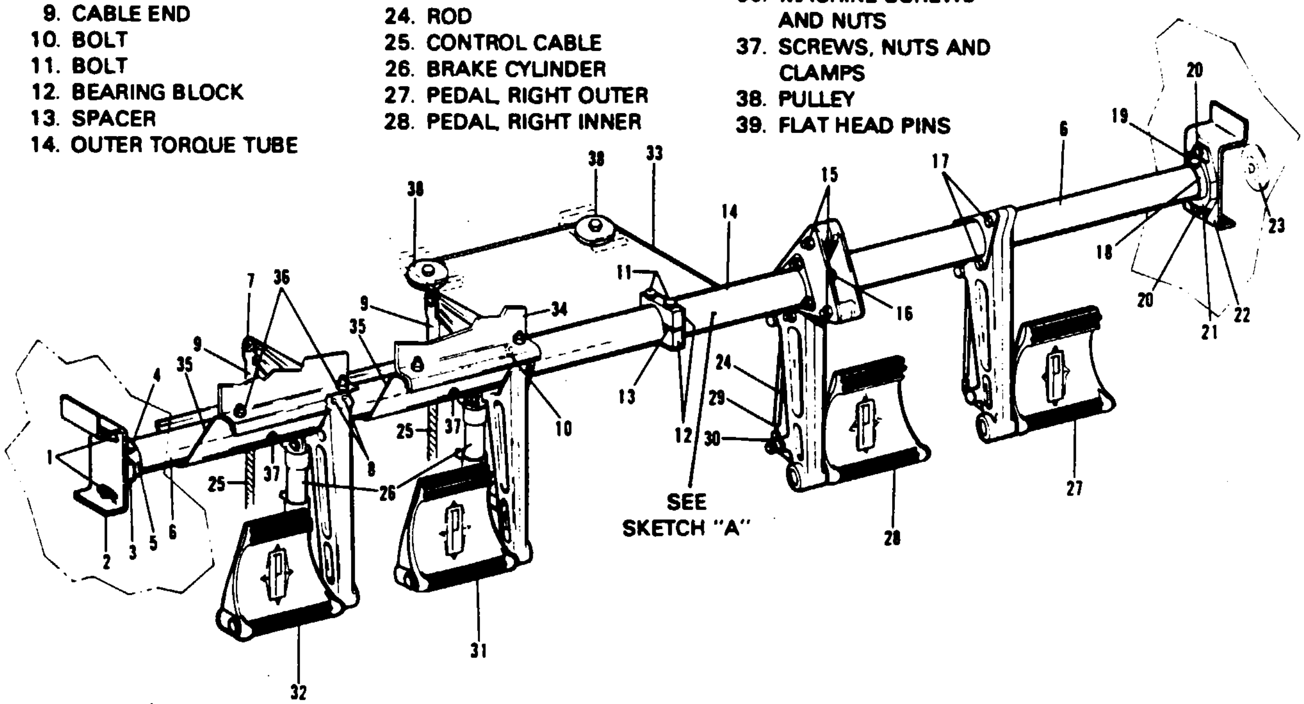
11. Connect the balance cable to the rudder pedals.

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.

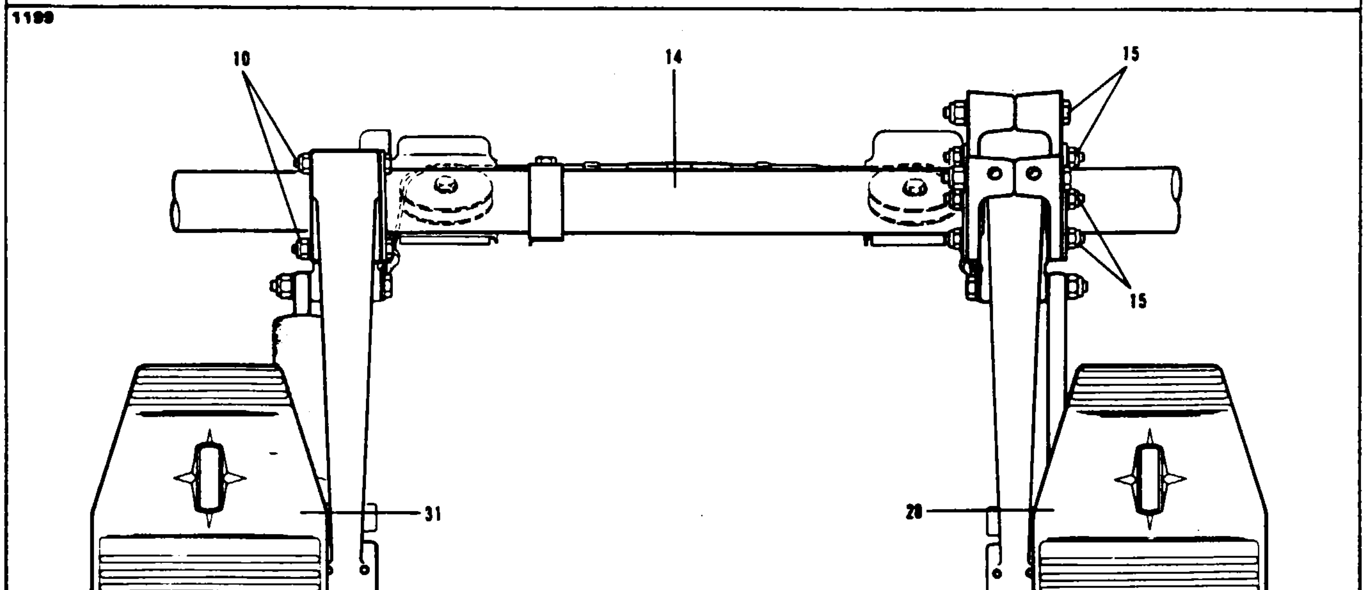
13. Install access plates, panels and seats.

1198

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



1199



SKETCH A

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 286.00 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.

WRAPPING RUDDER TRIM DRUM (CONTROL PEDESTAL).

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 shaft from the trim screw assembly. 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 rudder trim cable on the forward trim drums (located beneath the control pedestal).
   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 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.
8. Insert the drum in the housing bracket, position the drum and route the cables from the assembly as shown in Figure 27-17a.
9. Install the drum shaft.
10. Block the trim cables (refer to Figure 27-6) to keep them from loosening.

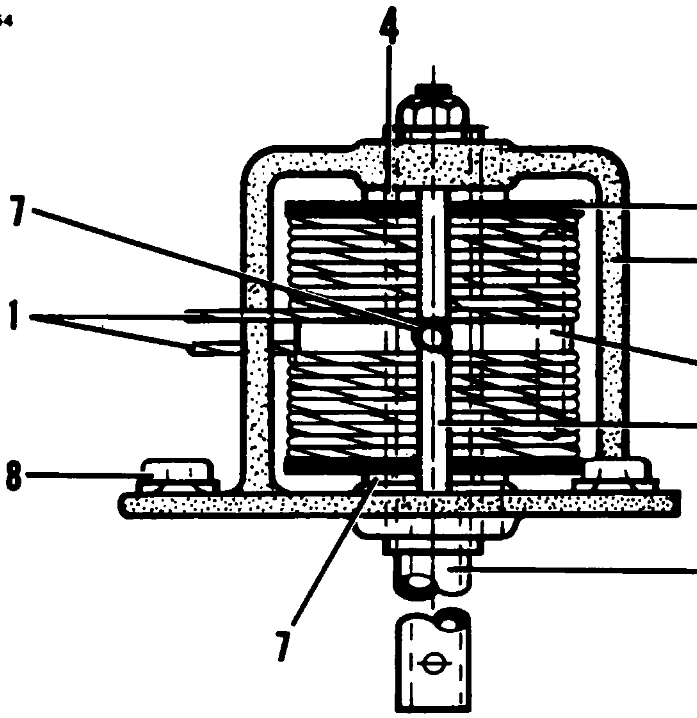


Figure 27-17a. Wrapping Rudder Trim Drum (Control Pedestal)

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 342.00.
6. Disconnect the trim control rod from the trim screw.
7. Remove the anti-rotation guide bushing and bolt assembly from the aft end of the screw.
8. Remove the 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 332.50 and 342.00.
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.

WRAPPING RUDDER TRIM DRUM. (Refer to Figure 27-17b.)

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.

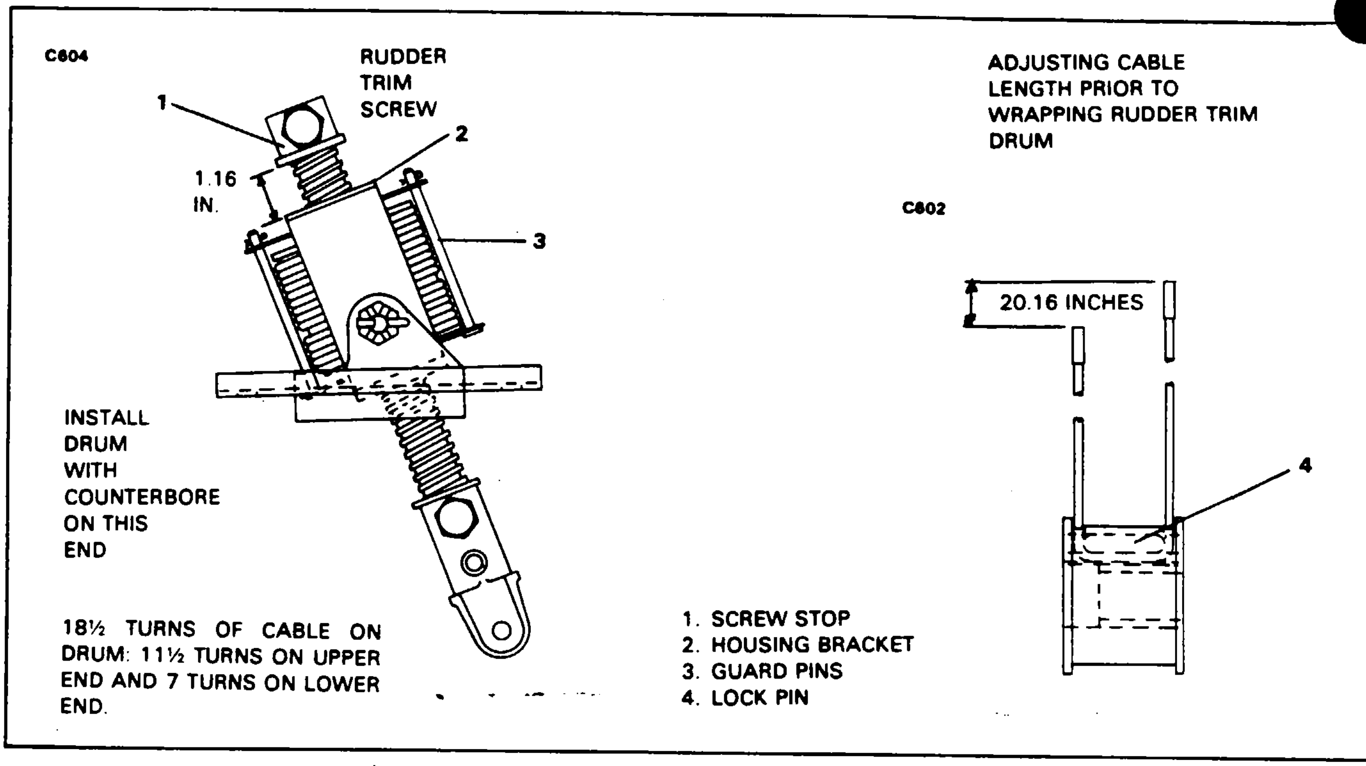


Figure 27-17b. Wrapping Rudder Trim Drum

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 rudder trim drum:
   A. Insert the cable to the slot in the trim drum. There should be a 20.16 inch difference in the length of the unwrapped cable as it comes out of the trim drum. The shorter end of the cable should be that end which comes out of the lower end of the drum (the counterbored end). Refer to Figure 27-17b.)
   B. Insert the cable lock pin.
   C. Hold the drum with the counterbored end down. Wrap the shorter cable in a counterclockwise direction seven turns up towards the center of the drum. Wrap the longer cable in a clockwide direction eleven and one-half turns 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 27-17b.
9. Install the screw and screw stop.
10. Insert the two guard pins into the drum and secure them with cotter pins.
11. Block the trim cables (refer to Figure 27-6) to keep them from loosening.
12. Insure that there is 1.16 in. between the upper surface of the bracket and the screw stop.

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.)

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 faciliate 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.

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, 192.00, 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, 203.00, 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.)

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, 192.00, 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, 203.00, 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.)

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)
2. CONTROL CABLE (FWD. L)
3. TURNBUCKLE
4. PULLEY CLUSTER
5. PULLEY CLUSTER
6. TRIM CABLE
7. FAIRLEAD
8. PULLEY
9. RUB BLOCK
10. CONTROL CABLE
11. CONTROL CABLE
12. TURNBUCKLE
13. TRIM CABLE
14. BELLCRANK
15. ROD, CONTROL, (SEE CAUTION IN SKETCH B)
16. DOWN SPRING (SEE NOTE)
17. CABLE
18. ARM, ELEVATOR
19. TRIM SCREW ASSY. LEFT
20. BOLT ASSEMBLY
21. CABLE END
22. BOLT ASSEMBLY
23. BOLT ASSEMBLY
24. BOLT, PIVOT
25. PULLEY
26. ROD END
27. BOLT ASSEMBLY
28. JAM NUT
29. TRIM SCREW ASSY.
30. ELEVATOR TORQUE TUBE
31. PULLEY CLUSTER
32. TRIM CABLE
33. GUIDE BRACKET
34. TRIM SCREW CLEVIS
35. BUSHING
36. TRIM TAB ROD
37. BOLT ASSEMBLY
38. ROD END
39. ROD, CABLE GUARD
40. CENTER CABLE
41. TURNBUCKLE
42. SPRING
43. CABLE, ELEVATOR DOWN
44. CABLE, ELEVATOR UP
45. LINK, ELEVATOR

NOTE

ELEVATOR DOWN SPRING MUST BE REPLACED EVERY 2000 HOURS. LOAD RATE IS 7.5 +/- .5 LBS. PER IN.

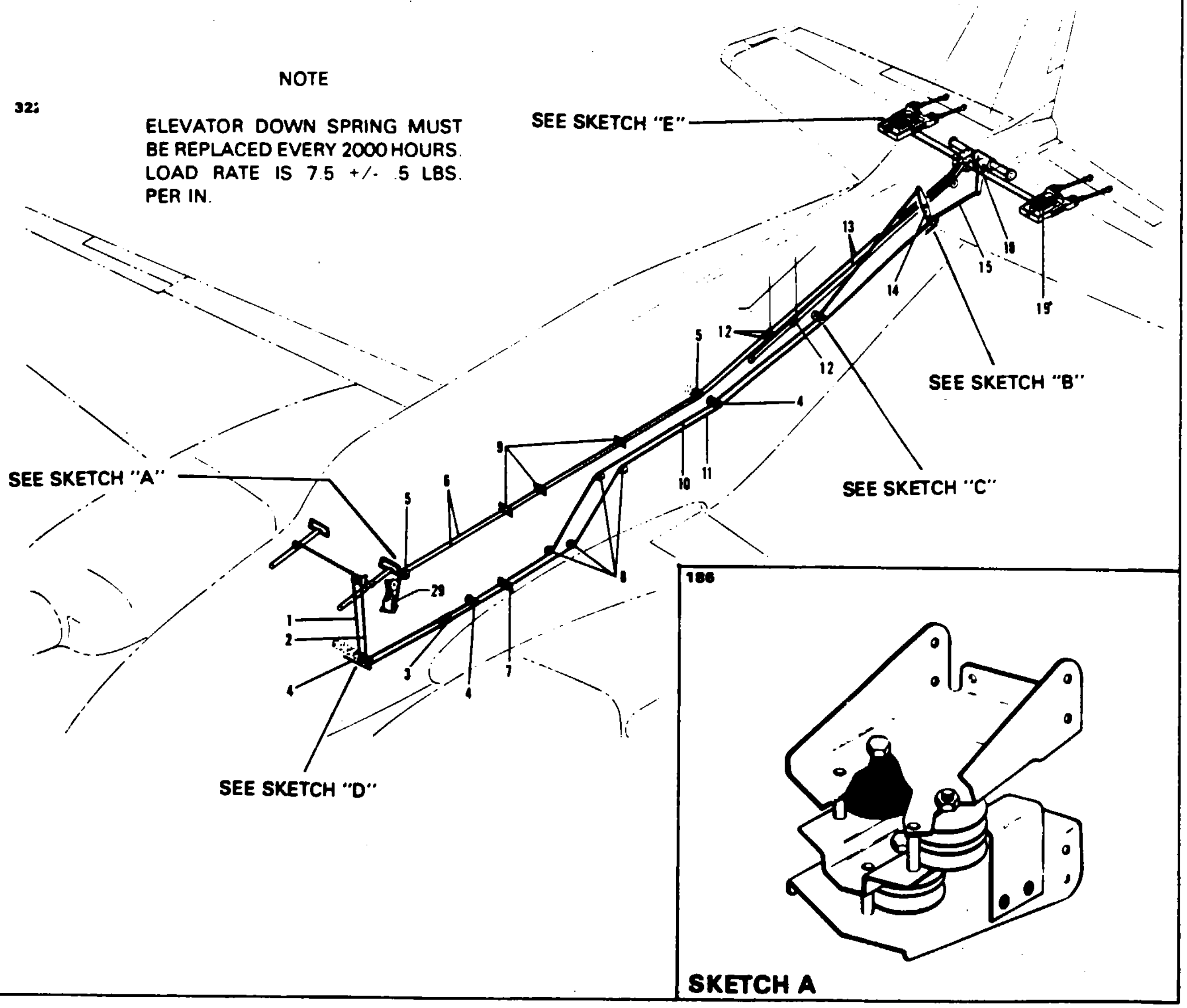


Figure 27-18. Elevator and Elevator Trim Controls

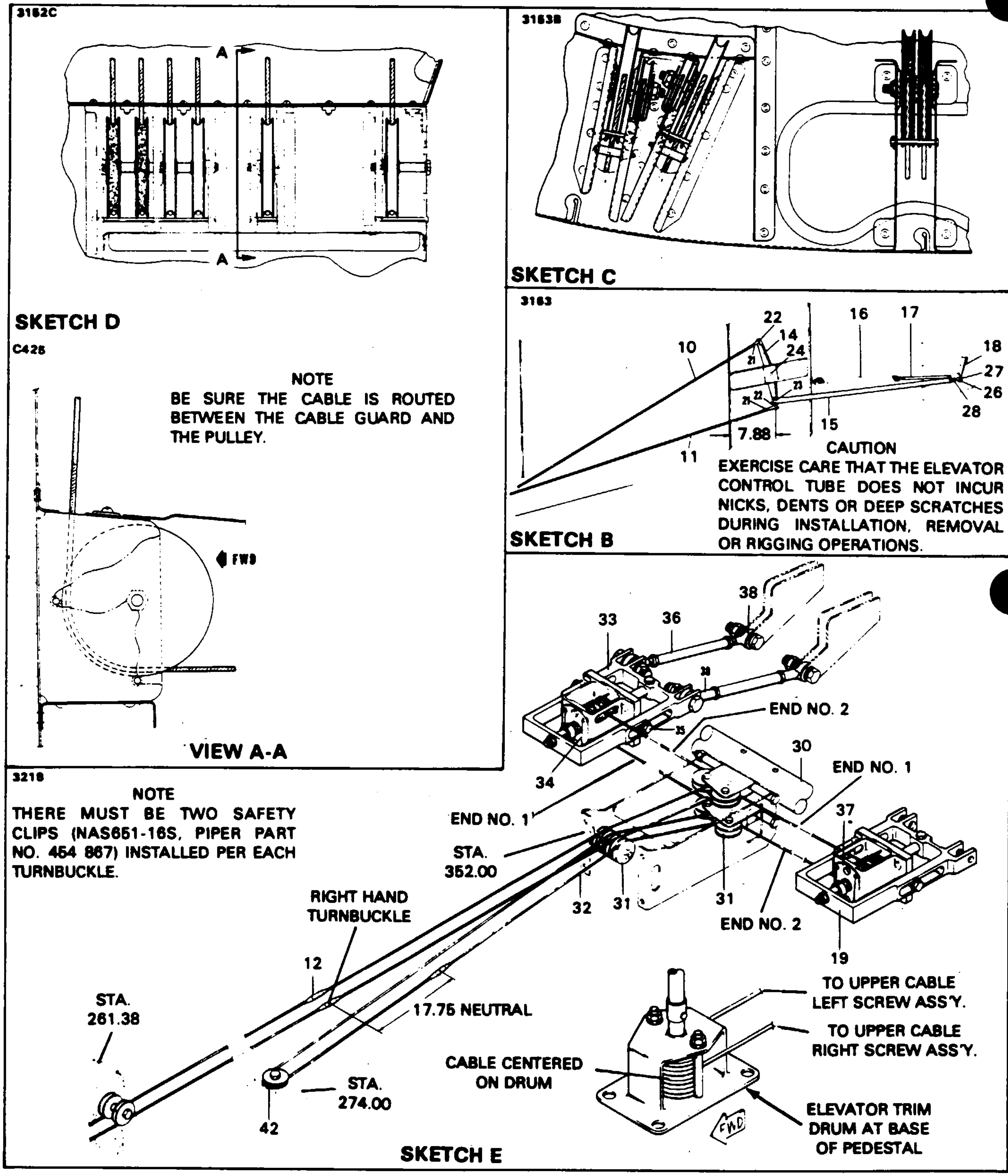


Figure 27-18. Elevator and Elevator Trim Controls (cont.)

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

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.

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 at 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.

— NOTES —

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.

The elevator down spring (item 16 of Figure 27-18, Sketch B) must be replaced after 2000 hours of operation. Load rate is 7.5 +/- .5 Lbs. per In.

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. Check control operation and direction of travel, bolts and turnbuckles for safety and installation of cable guards.

7. Check the complete elevator control system (including autopilot, if installed) to determine the friction in the system.

8. 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.

CABLE TENSIONS

ELEVATOR	21 lbs ± 2 lbs.
ELEVATOR TRIM TAB	14 lbs ± 2 lbs.

NOTE

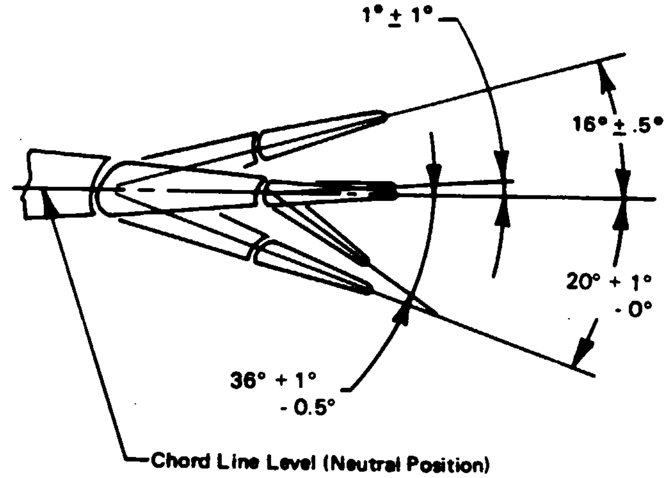
THE ELEVATOR TRIM TAB "FREE PLAY" SHALL BE CHECKED AS FOLLOWS: POSITION THE TRIM TAB SO THAT THE TRAILING EDGE OF THE TAB IS .50 INCH +/- .12 INCH BELOW THE TRAILING EDGE OF THE ELEVATOR. THE TOTAL TAB "FREE PLAY" MAY NOT EXCEED .06 INCH, AS MEASURED BETWEEN THE OUTBOARD END OF THE TAB AND THE TRAILING EDGE OF THE ELEVATOR.

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.

ELEVATOR AND ELEVATOR TRIM TAB

NOTE: Trim Tab Travel with Elevator in Neutral Position



01740

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

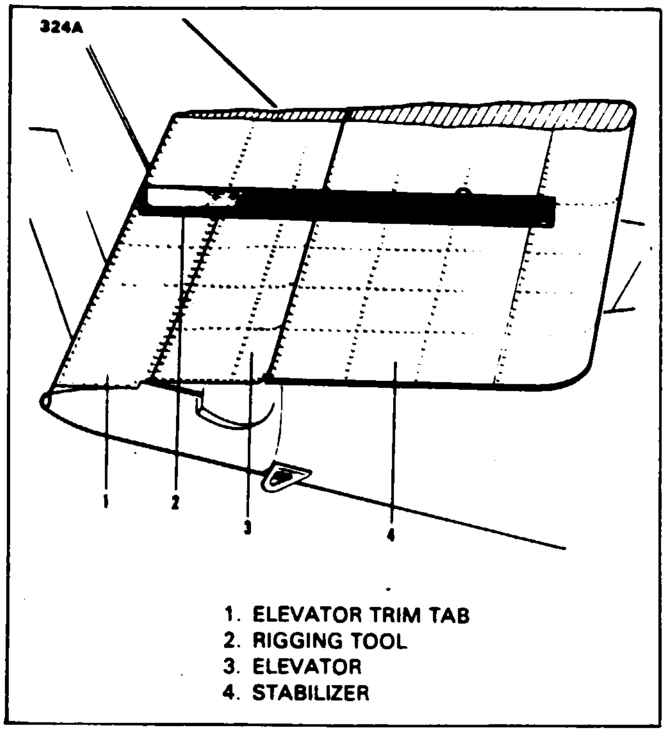


Figure 27-20. Installation of Elevator Rigging Tool

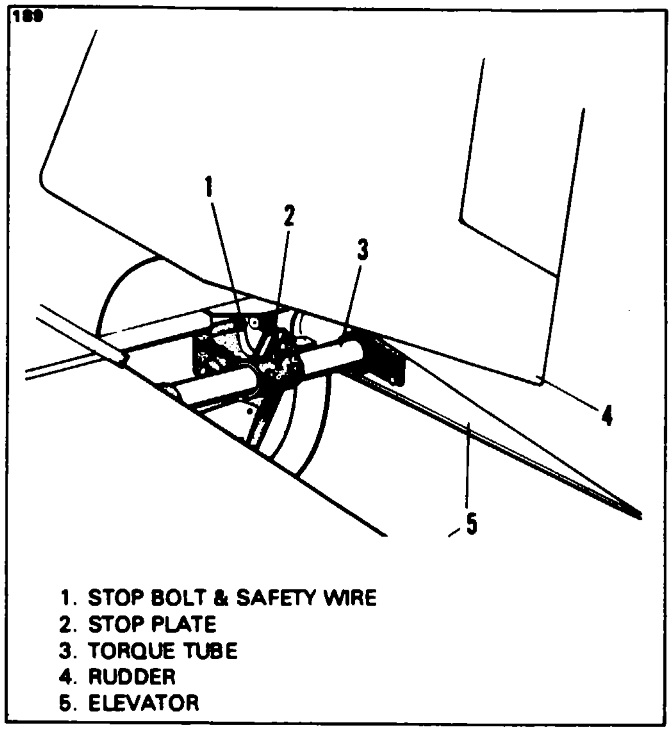


Figure 27-21. Elevator Travel Stops

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 and 308.75 to facilitate installation and disconnect the cables at the turnbuckles.
8. Remove the cable guard pins at fuselage stations 125.91, 243.25 and 262.00.
9. 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.
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.

WRAPPING ELEVATOR TRIM DRUM (CONTROL PEDESTAL). (Refer to Figure 27-21a.)

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 shaft from the trim screw assembly. 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 elevator trim cable on the forward trim drum (located beneath the control pedestal).
   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.
8. Insert the drum in the housing bracket, position the drum and route the cables from the assembly as shown in Figure 27-21a.
9. Install the drum shaft and secure with the roll pin (if used).
10. Block the trim cables (refer to Figure 27-6) to keep them from loosening.

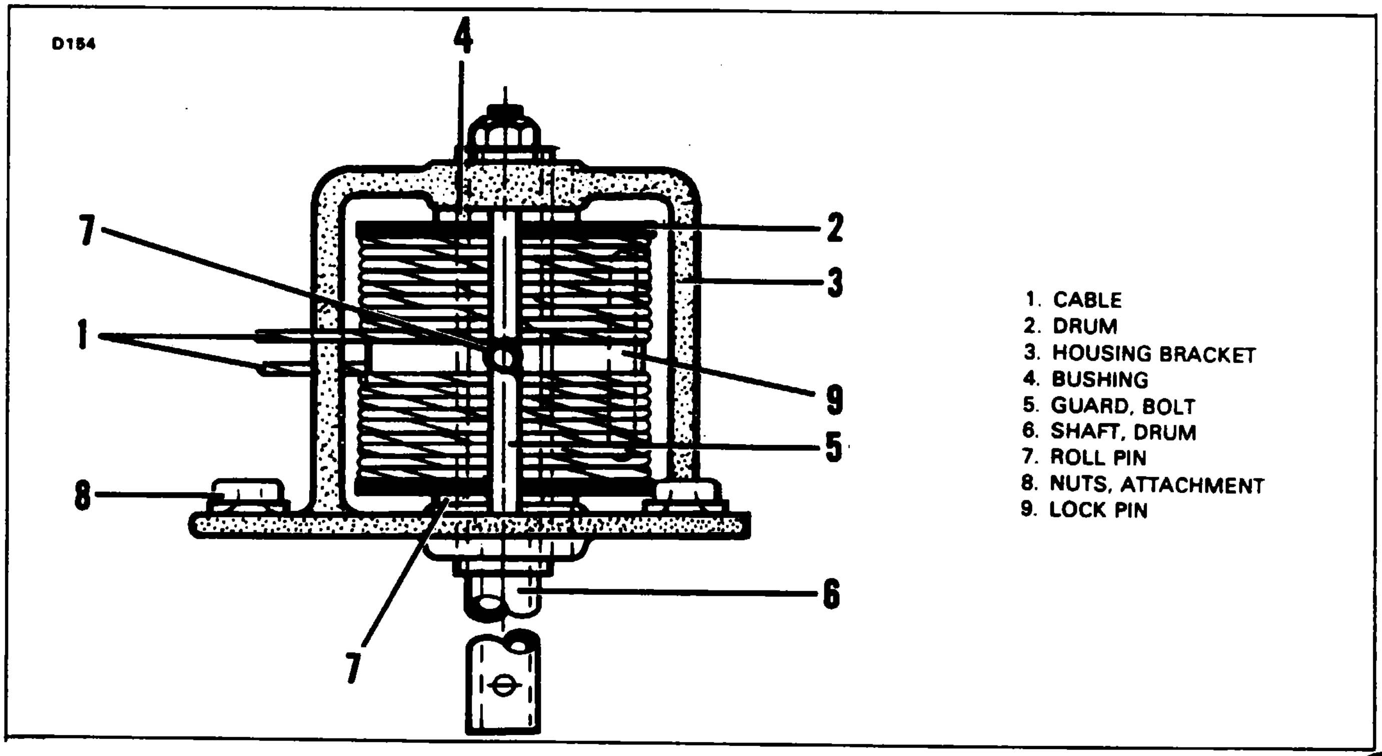


Figure 27-21a. Wrapping Elevator Trim Drum (Control Pedestal)

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, 243.25 and 262.00, and close and secure the rub blocks at stations 137.00, 162.60, 174.00 and 215.00.
6. Remove the cable blocks.
7. Install the trim control wheel on the trim screw shaft at the side of the pedestal and secure with screw.
8. Set cable tension with the turnbuckles at station 291.00 per Figure 27-19 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 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 and 308.75 to facilitate installation. Disconnect the cables at the turnbuckles.
4. Remove the cable guard pins from the pulleys located at stations 274.00 and 352.00 and the pulleys mounted on the stabilizer rear spar.
5. Disconnect the trim tab rods from the trim screw clevis by removing the attachment hardware and bushings.
6. The right and left trim screws and guide brackets are removed in the same manner. 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.

WRAPPING ELEVATOR TRIM DRUM (ELEVATOR). (Refer to Figure 27-21b.)

1. To install and wrap the trim cable on the trim drum:
   A. Insert the cable into the slot in the trim drum. On the left hand drum, cable end 1 should be 164.75 inches long prior to wrapping on the right hand trim drum, cable end 1 should be 125.5 inches long prior to wrapping.
   B. Install the cable lock pin in the slot in the drum.
   C. Wrap end 1 six and one-half turns counterclockwise towards the center of the drum.
   D. Wrap end 2 twelve turns clockwise towards the center of the drum.
   E. After wrapping, check the cable end positions:
      (1) On the left hand trim drum, cable end 1 should be approximately 18.0 inches longer than cable end 2.
      (2) On the right hand trim drum, cable end 1 should be approximately 44.6 inches longer than cable end 2.
2. Insert the drum in the housing bracket, position the drum and route the cables from the assembly as shown in Figure 27-21b.
3. Install the screw and screw stop.
4. Block the trim cables to keep them from loosening. (Refer to Figure 27-6.)
5. Insure there is 1.34 inches between the lower surface of the plate and the boss on the bracket. Insure there is .07 inch between the upper surface of the retainer and the lower surface of the bushing. (Refer to Figure 27-21b.)

CHART 2703. ELEVATOR TRIM DRUM AND CABLE SPECIFICATIONS

Drum Part No. and Location	Cable Part No. and Length	Length of Cable End 1 at start of wrapping	Cable end positions on drum after wrapping
82190-2 Left hand	80420-2 260.00 inches	125.5 inches	End 1 = 18.0 inches longer than End 2. (See Note)
82190-3 Right hand	41734-46 312.25 inches	164.75 inches	End 1 = 44.6 inches longer than End 2. NOTE: End 1 has the right hand turnbuckle terminal.

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

1. Check to be certain the trim cables are properly wrapped on the trim drums. If a new cable is installed, the cable must be wrapped with the drum removed from the bracket per the previous instructions.
2. The right and left trim screws are installed in the same manner. 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, which would cause bearing preload.

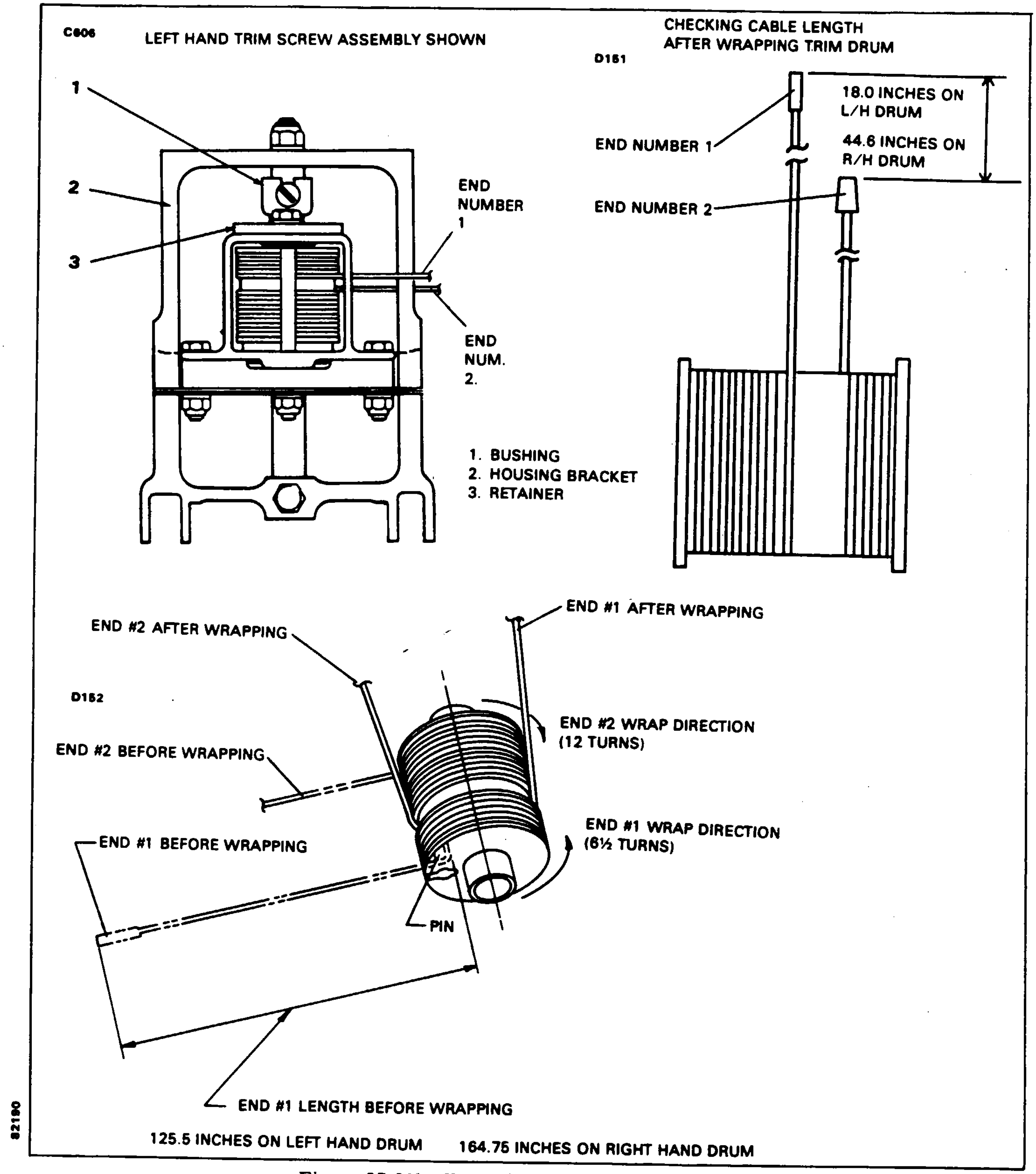


Figure 27-21b. Wrapping Elevator Trim Drums

3. Draw the trim cables through the elevator, around the pulleys mounted on the stabilizer rear spar and over the pulleys at station 352.00 into the fuselage. Route the longest cable from the right hand trim screw around the pulley at station 274.00 and connect it to the shorter cable of the left hand trim screw assembly.
4. Connect the remaining trim cable from the left rear trim screw to the forward trim cable from the left side of the control drum in the pedestal, and the right rear cable to the forward cable from the right side of the control drum in the pedestal. (Refer to Figure 27-18, Sketch E.)
5. If the forward trim cables are not installed, draw the rear cables tight and block the cables at bulkhead station 296.00. Install the forward trim assembly.
6. Install the cable guard pins in the pulleys at stations 274.00 and 352.00 and in the pulleys mounted on the elevator torque tube.
7. 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.
8. With the trim control completely installed, set the cable tension with turnbuckle per specifications given in Figure 27-19. Check to be certain the trim screws move freely in both directions and check the rigging and adjustments per Rigging and Adjustment of Elevator Trim.
9. Install the access plates and tail cone assembly.

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 at station 274.00 and also the access panels on the bottom of the elevators. 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 screws are 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 screws are at their stops, disconnect the trim tab rods and rotate the screws in the drums until screws are at stops 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 tabs are 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 the 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. 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 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.
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.

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 27-23 and 27-24.)

LH-2091

The wing flap control system provides continuous control and monitoring of flap position and condition over its full range. In addition, to the limiting of both up and down overtravel, the system will shut the driving mechanism off in the event of a 5° or more differential between right and left flap position and it will self-monitor and automatically react appropriately in the event of critical component failure in the control circuitry.

Preselection of any desired flap position from full up (0°) to full down (40°) is possible thru the positioning of the selector control which has an 80° stroke analog lever. (That is, 2° of lever movement represents 1° of wing flap movement.) The selector incorporates a friction type drag brake to hold the lever to any desired intermediate position as well as ball lock detents at 0°, 15°, and 40° of flap extension. Flaps are deployed mechanically by a single motor driven thru two flexible shafts connected to individual ball screw actuators.

Selection of the desired flap position moves the control rheostat wiper relative to the left wing flap rheostat wiper with a resultant amplifier output which will operate the flap motor through contactors K1 and K2 to move the left and right flaps to the desired position. If at any time the amplifier sees a differential voltage in excess of 0.55 VDC between the left wing flap rheostat wiper and the right wing flap rheostat wiper, the amplifier will shut the system off. This condition corresponds to a maximum differential of 5° of flap position.

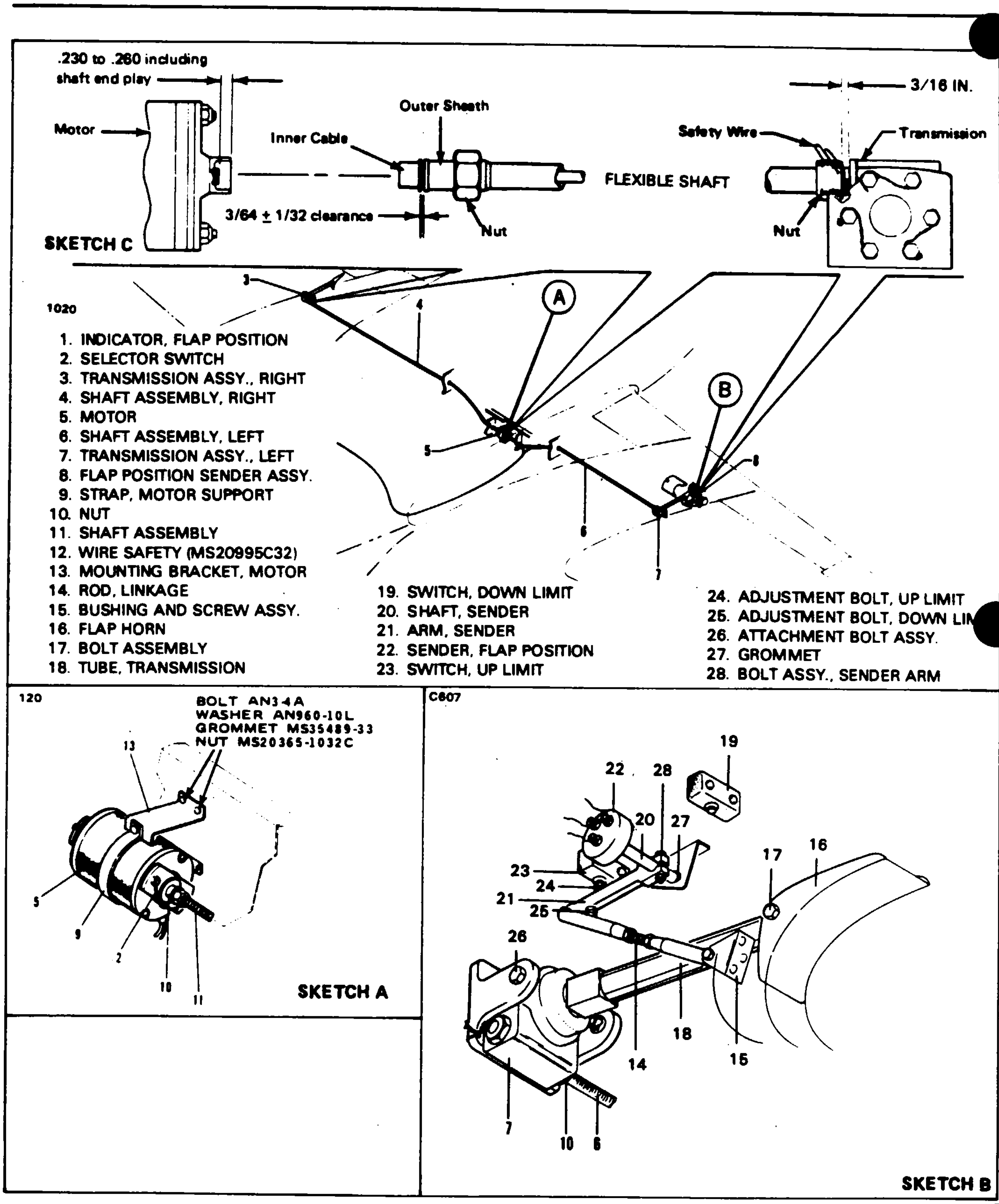


Figure 27-23. Flap Installation

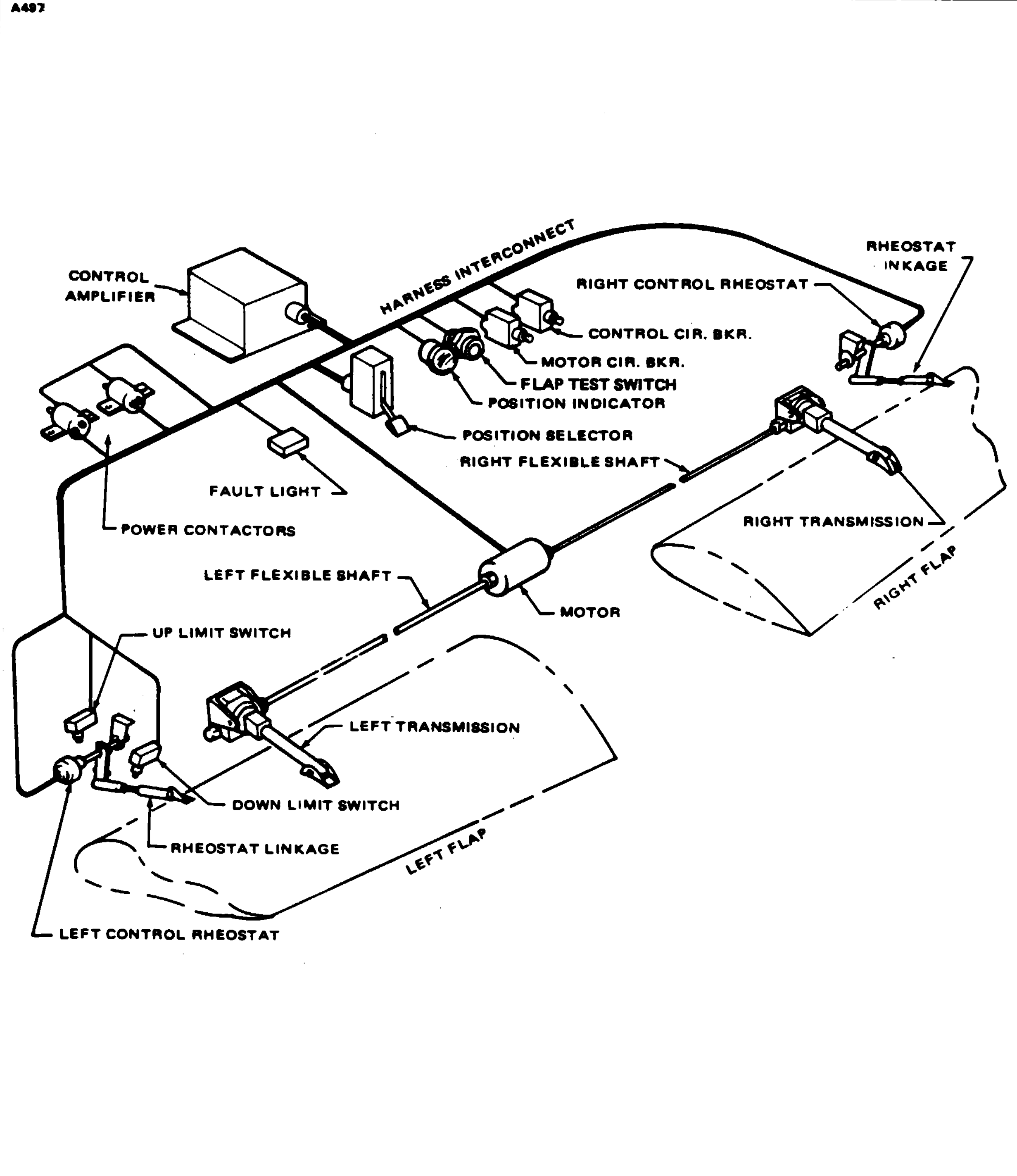


Figure 27-24. Flap System Diagram

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 27-23.)

1. Remove the center floor panel located in the main cabin area. The flap actuator is located on 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 bracket may be removed together by removing the bracket mounting bolts at the bulkhead.

DISASSEMBLY OF FLAP ACTUATOR MOTOR. (Refer to Figure 27-25.)

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.

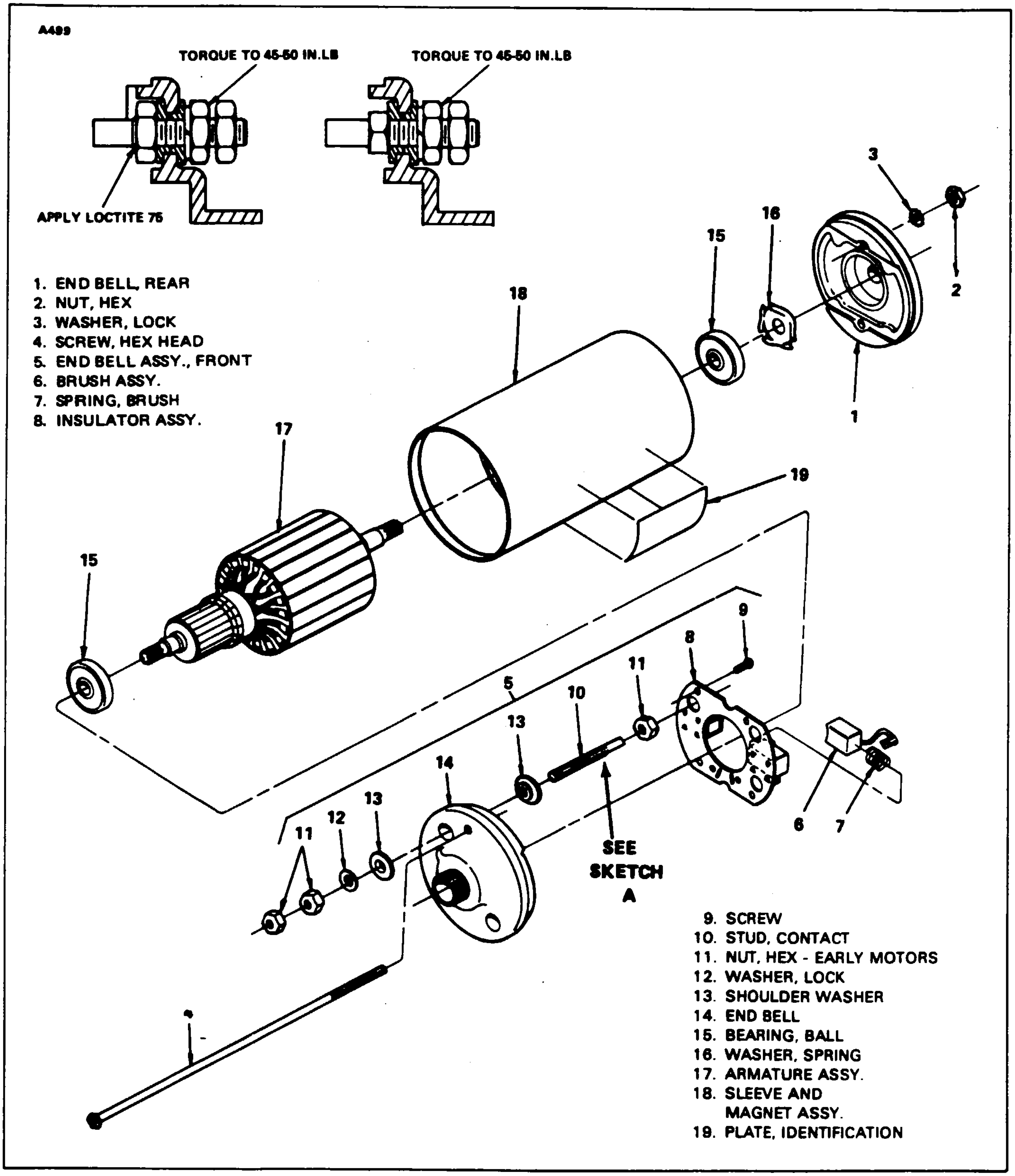


Figure 27-25. Motor Assembly, Exploded View

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 27-25.)

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. On early models, apply Loctite 75 adhesive to inner nut and torque outer nut to 30-35 inch pounds. (See Sketch A.)
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 27-23.)

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-C32 safety wire.
4. Connect electrical leads.
5. Check flap rigging and adjustments.
6. Install access plates and panels.

FLEXIBLE ACTUATOR SHAFT. (Refer to Figure 27-23.)

REMOVAL OF FLEXIBLE ACTUATOR SHAFT. (Refer to Figure 27-23.)

1. Remove the center floor panel located in the main cabin area.
2. Remove the right and/or left row of seats and floor panels aft of the main spar.
3. Remove the aft access plate on the fairing located on the underside between the fuselage and wing.
4. Remove the access plates at the aft side of the wheel well at stations 34.50, 44.50 and 54, and on the underside of the wing at stations 65, 82.75 and 92.50.
5. Cut the safety wire and disconnect the shaft from the actuator motor and flap transmission.
6. Remove the support clamp on the fuselage bulkhead and the support grommets within the wing and fuselage.
7. Remove the actuator shaft.

INSTALLATION OF FLEXIBLE ACTUATOR SHAFT. (Refer to Figure 27-23.)

1. Draw the shaft through the wing into the fuselage.
2. Align and insert the tang on shaft assembly into slot in transmission. Tighten nut finger tight and wrench not over 1/16 turn from finger tight. When properly installed, the nut on flexible shaft will bottom or be within 3/16 of an inch of bottoming against transmission, thus insuring that the end of shaft housing is firmly seated against transmission. Safety nut with .032 wire.

3. After the transmission end of shaft has been connected, observe the clearance between the outer sheath and inner cable. Twist outer sheath in proper direction; bring clearance to 3/64 +/- 1/32 of an inch. It may be necessary to loosen clamp on fuselage bulkhead in order to twist outer sheath if cable has not been removed from aircraft. Holding outer sheath in this position, insert spline into flap motor and tighten nut. Safety nut with .032 wire. The clearance check noted above must be conducted on every occasion that the flexible shaft is disconnected from the motor or transmission.
4. Check the flap rigging and adjustments per instructions given in this section.
5. Install the access plates, panels, clamps, grommets and seats.

FLAP TRANSMISSION.

REMOVAL OF FLAP TRANSMISSION. (Refer to Figure 27-23.)

1. Lower the flap and remove the access plate on the aft underside of the wing and at the false spar area, both of which are at station 92.50.
2. Disconnect the transmission tube from the flap horn bracket.
3. Remove the safety wire and disconnect the flexible actuator shaft.
4. Remove the spreader bushing and washers from between the transmission attachment brackets.
5. Remove the transmission from its mounting brackets and draw the unit through the access opening in the wing false spar.

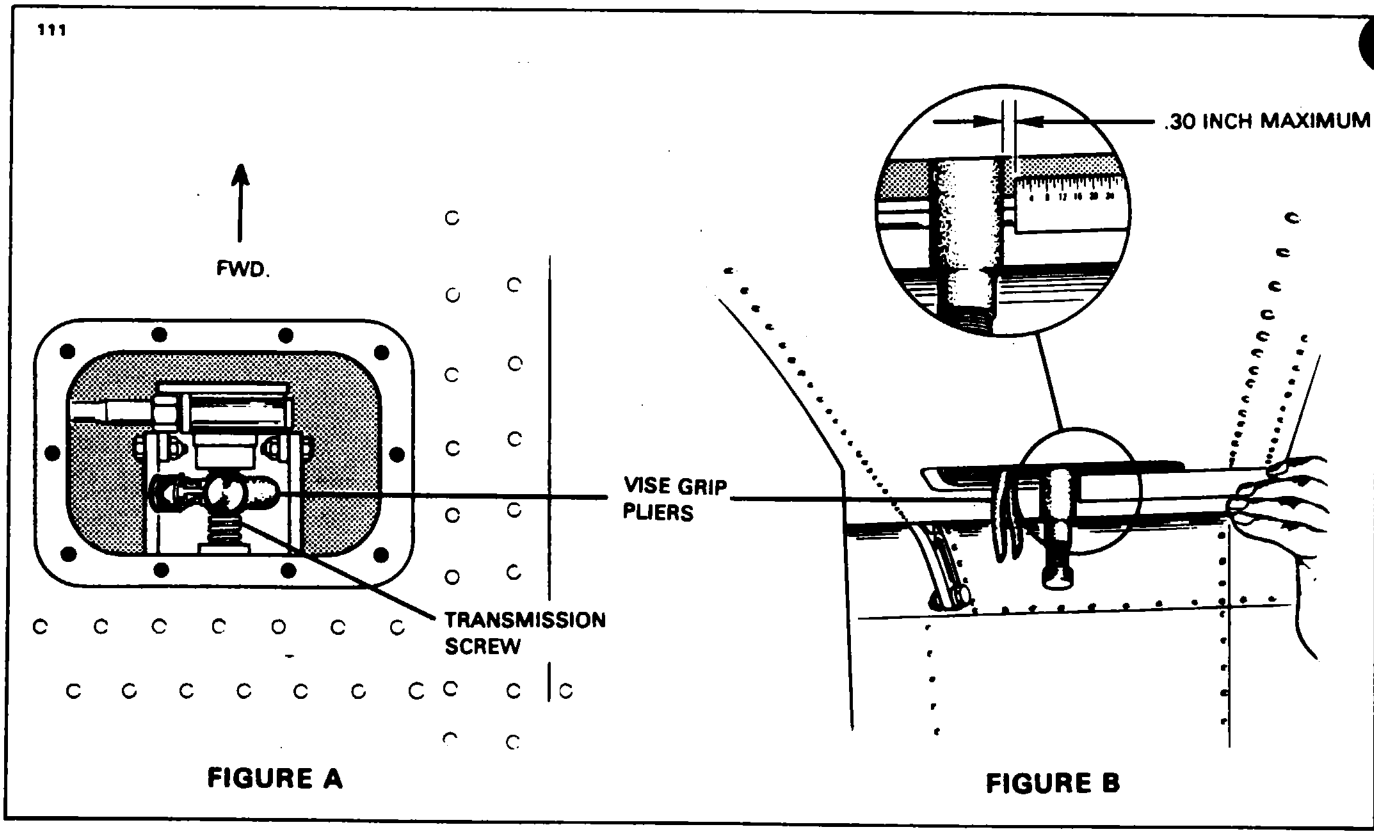


Figure 27-26. Wing Flap Transmission Inspection

INSPECTION OF WING FLAP TRANSMISSION. (Refer to Figure 27-26.)

The flap transmissions are inspected at the first 500 hour inspection cycle of the aircraft and at each 100 hours thereafter. This is accomplished without removal of the transmission's, by the following procedure:

1. Position the flaps in the extended position (Down).
2. Remove the access covers on the lower wing surface to gain access to the flap transmissions.
3. With the use of vise grip pliers and exerting light pressure, grasp the exposed portion of the screw close to the transmission as shown. (Refer to Views A and B.)
4. With the pliers secured to the screw, a light pressure will move the pliers and screw as free play in the transmission gear set is taken up in either direction. Do not force the pliers.
5. Place a six inch ruler along the skin surface as shown in View B, and measure the overall distance the pliers move.
6. Should this dimension exceed .30 of an inch, replace the transmission assembly.
7. Reinstall the access panels amd make appropriate logbook entry.
8. Continue inspection at 100 hour intervals.

SERVICE OF FLAP TRANSMISSION.

1. Wash all parts in a suitable dry cleaning solvent.
2. Examine all parts for cracks, burrs and corrosion.
3. Parts are not available to repair the transmission, therefore it should be replaced (if defective).

FUNCTIONAL TEST OF FLAP TRANSMISSION.

1. Tet 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 (MS20995C20) all bolts and screws.
4. Install protective cap. Do not lockwire.

INSTALLATION OF FLAP TRANSMISSION. (Refer to Figure 27-23.)

Ascertain that the correct flap transmission assemblies are being installed by checking the part numbers on the assemblies with information in the latest T-1040 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-C32 safety wire. Attach the right flexible shaft during rigging and adjustment.
5. Check the flap rigging and adjustment.
6. Install access plates.

RIGGING AND ADJUSTMENT OF FLAPS.

LH-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 volt. 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 27-27, 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 .03 inch maximum gap between the rollers and the end of the flap track slots. (See Figure 27-27, Sketch B.)

— NOTE —

It is the intent here that the electrical limit 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 inch diameter rod between the rollers and end of the flap track slots, turn the transmission sleeves out from their forward stops approximately 32 turns, align the attachment hole in the sleeves with the holes in their respective flap horns and temporarily install the attachment bolts. The difference in the number of turns between the right and left transmissions should not exceed 1/2 turn.

H. Check for proper alignment of 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.

I. With the sleeve and the horn properly aligned, connect the sleeve to the horn with bolt and castellated nut. Tighten nut so as to allow .03 inches thrust play of the bolt. Install cotter pin.

J. 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 MS20995C32 wire.

K. Remove the covers from RT2 and RT3 on flap control amplifier and ascertain that both trimmers are in their full clockwise position (maximum resistance).

L. Apply external power to the aircraft and establish bus voltage at 28 ± .5 volts.

M. Place the flap selector in the DOWN position.

N. Engage flap control circuit breaker — DO NOT engage flap motor circuit breaker at this time. Allow five minute warm-up time.

O. 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.)

P. 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.

Q. Move flap selector to the UP position. Listen for audible click of motor solenoid. If solenoid does not actuate check wiring for proper interconnect.

R. Move flap selector back to full DOWN position.

S. Engage 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

T. The values at the DOWN position have already been established for VC, VL and VR in Step O 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 O 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.

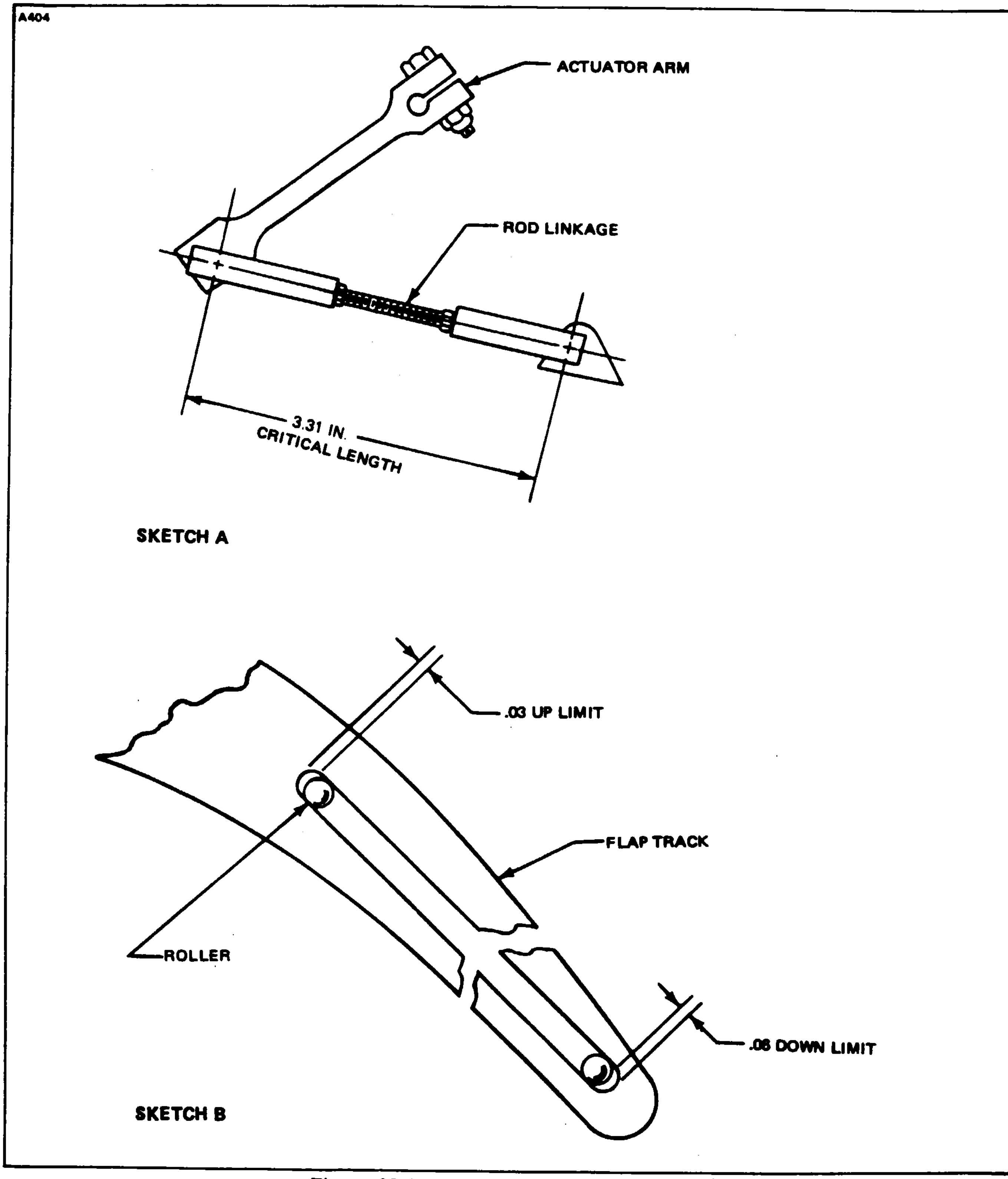


Figure 27-27. Flap Rigging Adjustments

A. VL at the UP position should be equal to VC plus .1 volt $^{+0.0}_{-0.05}$ volts. From the example in Step T preceding; it can be seen that VL is too high in relation to VC by .36 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 .36 = 8.95-.72 = 8.23]).

(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 S 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 27-23.)

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 27-23.)

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 27-23, Sketch D. 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.

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.
4. Reinstall floor panel.

ELECTRICAL SYSTEM FUNCTIONAL TEST PROCEDURE.

— NOTE —

The serviceman should refer Figure 27-28 for Amplifier Schematic and 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 jumber 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. If this voltage exceeds 0.5 volts the shut down is due to flap asymmetry. Correct cause of asymmetry and rerig flap system.
17. Connect the voltmeter between test jacks RR and GND on the amplifier. Voltage should equal RC voltage within 0.3 volts.
18. Connect the voltmeter between test RL and GND on the amplifier. Voltage should equal RC voltage within 0.3 volts.

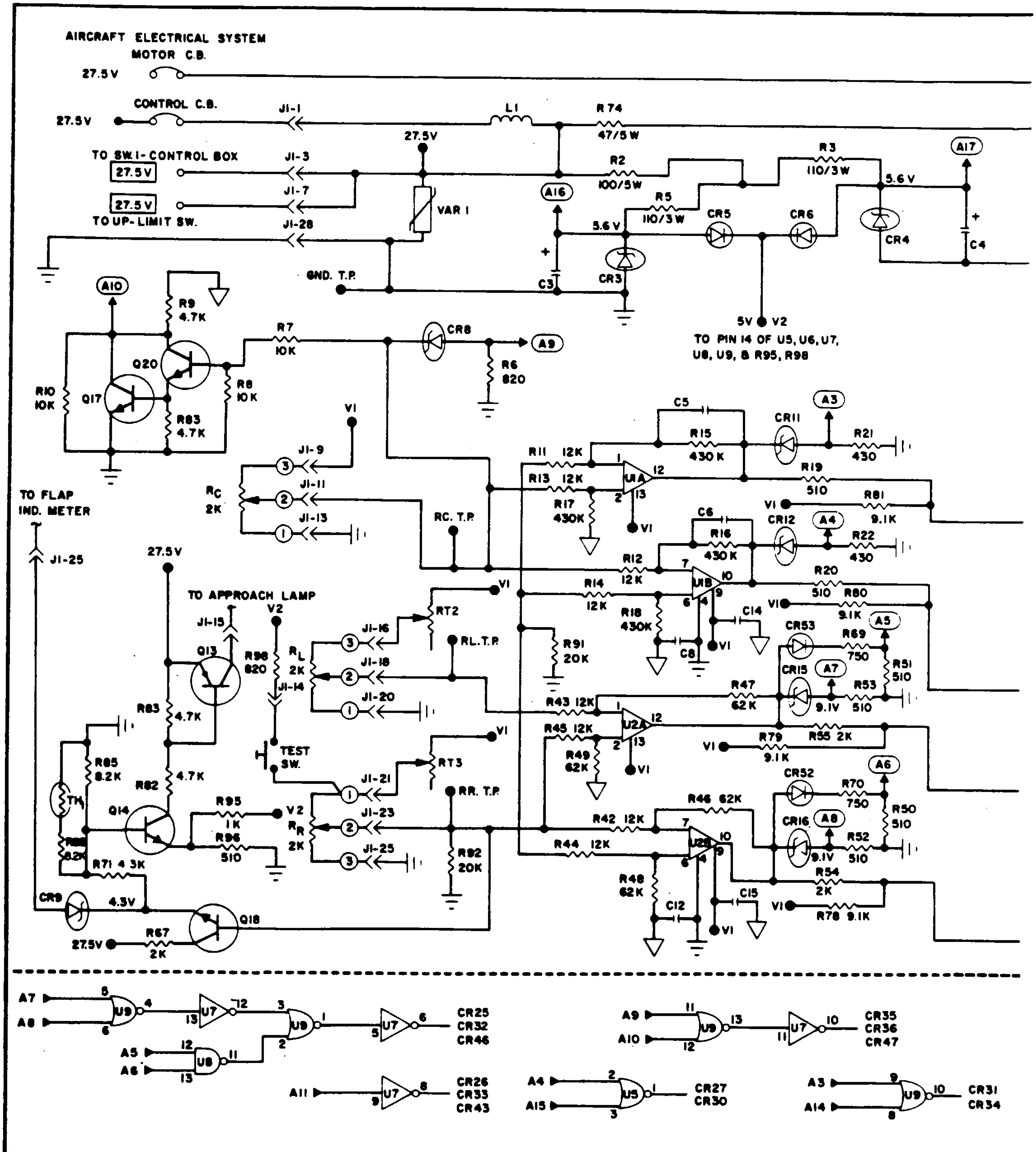


Figure 27-28. Amplifier - Electrical Schematic (Calco) P/N 8482

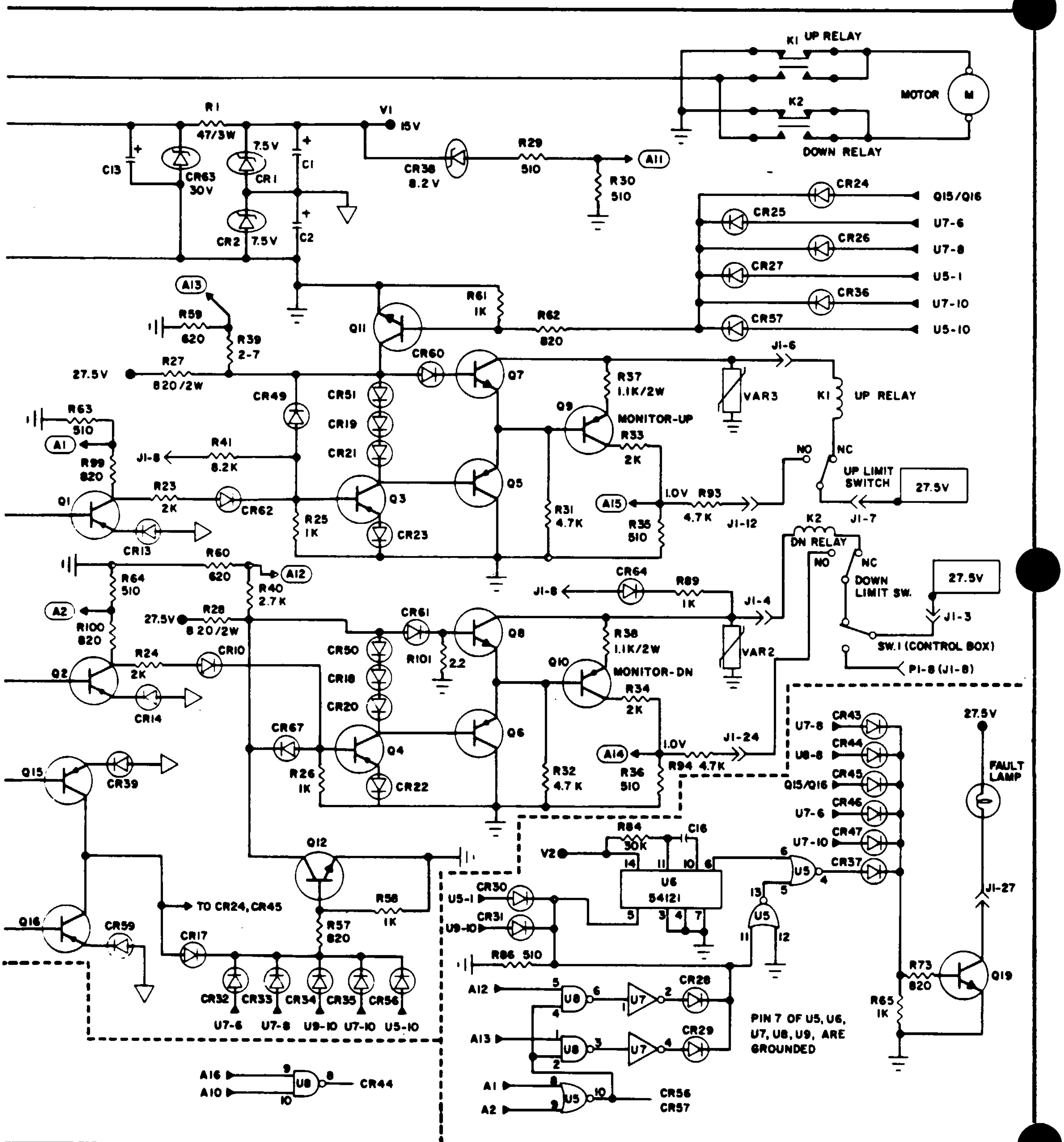


Figure 27-28. Amplifier - Electrical Schematic (Calco) P/N 8482 (cont.)

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 —

GRIDS 2L17 THRU 2L24
INTENTIONALLY LEFT BLANK

T1000

AIRLINE DIVISION

T1040

MAINTENANCE MANUAL

CARD 3 OF 5

PA-31T3 T1040

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 765)

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:

CHAPTER/SYSTEM
LANDING GEAR

SUB-SYSTEMS
WHEELS AND BRAKES

32-40-01

INDIVIDUAL UNITS
NOSE WHEEL REMOVAL

This Maintenance Manual is provided to support and maintain the Piper Model PA-31T3/T-1040 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 T-1040 Parts Catalog P/N 761 761, 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)

6. Revisions to Service Manual 761 765 issued March 26, 1982 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG820326	March 26, 1982	1, 2, 3, 4 and 5
PR820804	August 4, 1982	1, 2, 3, 4 and 5
PR821115	November 15, 1982	1, 2, 3, 4 and 5
PR830225	February 25, 1983	1, 2, 3, 4 and 5
PR840305	March 5, 1984	1, 2, 3, 4 and 5
PR840713	July 13, 1984	1, 2, 3, 4 and 5
PR860203	February 3, 1986	3
IR900313	March 13, 1990	2
IR941012	October 12, 1994	1 and 3

INTERIM REVISION

Revisions appear in Chapter 5 of card 1, and Chapter 30 or card 3. Please dispose of your current cards 1 and 3 and replace them with the revised cards. DO NOT DISPOSE OF CARDS 2, 4 and 5

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

SERIAL NUMBER INFORMATION

PA-31T T1040-1982
SERIAL NUMBERS 31T-8275001 TO 31T-8275025 INCL.
PA-31T T1040-1983
SERIAL NUMBERS 31T-8375001 TO 31T-8375005 INCL.
PA-31T T1040-1984
SERIAL NUMBERS 31T-8475001 AND UP.

—*WARNING*—

When servicing or inspecting vendor equipment installed in Piper aircraft, it is the user's responsibility to refer to the applicable vendor publication.

VENDOR PUBLICATIONS.

BATTERY:

Gill Lead-Acid Battery (Teledyne Battery Products) Service Manual	= P /N: GSM - 682
SAFT Nickel-Cadmium Battery Operating and Maintenance Manual	= P/N: DC 3176-5A
Marathon Nickel Cadmium Battery instruction Manual	= P/N: BA-89

DE-ICE SYSTEM (PROPELLERS):

B.F. Goodrich Electrothermal Propeller Deice Maintenance Manual	= P/N: 68-04-712 (Latest Revision)
B.F. Goodrich Electrothermal Propeller Deice Installation and Removal Procedures	= P/N: 59-728 (Latest Revision)

ENGINE:

PT6A-11/110 Maintenance Manual	= P/N: 3030442

HEATER:

Maintenance and Overhaul Manual	= P/N: 24E25-1

PROPELLER:

Hartzell Overhaul Manual	= P/N: 117-D
Hartzell Spinner Assembly and Maintenance Manual	= P/N: 127

VENDOR PUBLICATIONS (cont).

STARTER-GENERATOR

Auxilec, Inc. Maintenance and Overhaul Manual	= P/N: 8013C
Lear Siegler, Inc. Maintenance Manual (All Models)	= P/N: 23700
Lear Siegler, Inc. Overhaul Manual, Series 23048	= P/N: 23202

PIPER PUBLICATIONS.

PARTS CATALOG	= 761 761 Piper Aircraft Corporation 820 E. Bald Eagle Street Lock Haven, Pennsylvania 17745
INSPECTION MANUAL 100 HOUR	=761 774 Piper Aircraft Corporation 820 E. Bald Eagle Street Lock Haven, Pennsylvania 17745

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 Compressors	Delco Products Div. of General Motors Corp. P.O. Box 1042 Dept. 194-T Dayton, Ohio 45401 (513) 227-5000 Telex: 810-459-1788
	Sankyo Inc. 10719 Sanden Dr. Dallas, Texas 75238 (214) 349-3030 Telex: 73-0497
Air Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
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

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Marathon Battery Company 8301 Imperial Drive P.O. Box 8233 Waco, Texas 76710 SAFT America, Incorporated 711 Industrial Boulevard Valdosta, Georgia 31601
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
Electrical Relays	Leach Corporation 5915 Avalon Boulevard Los Angeles, California 90003 (213) 232-8221
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington, Penna. 19034 (215) 643-2900
Engines	Pratt and Whitney Aircraft of Canada, Ltd. Box 10 Longueuil, Quebec, Canada JK4X9
Environmental Systems, Heater	Janitrol Aero Division 4202 Surface Road Columbus, Ohio 43228 (614) 276-3561
Fire Detection and Extinguishing Systems	HTL Industries P.O. Box 780 Pasadena, California 91006 (213) 574-7880

VENDOR-SUPPLIER INFORMATION (cont).

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
Gate Valves, Shut-off Valves and Solenoid Valves (Fuel and Hydraulic)	I.T.T. General Controls 801 Allen Avenue Glendale, California 91201 (213) 842-6131
Hoses, Fittings	Aeroquip Corporation Marmon Division 1214 Exposition Boulevard Los Angeles, California 90064 (213) 774-3230
Instruments	Aerosonic Corporation 1212 N. Hercules Avenue Clearwater, Florida 33515 (813) 461-3000
Landing Gear, Hydraulic Actuators, Hydraulic Pressure Regulator, Hydraulic Power Pack, Handpump	Ozone Aircraft Systems, Inc. 101-32 101st Street Ozone Park, New York 11416 (212) 845-5200
	Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Lighting, Tail Recognition	Devore Aviation Corporation 1-T Barstow Road Great Neck, New York 11021 (516) 487-3524
Lighting, Strobe	Whelen Engineering Company, Inc. 3 Winter Avenue Deep River, Connecticut 06417 (203) 526-9504

VENDOR-SUPPLIER INFORMATION (cont).

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	Woodward Governor Company Drake and Lemay Roads Fort Collins, Colorado 80521 (303) 482-5811
Starter-Generator	Auxilec, Incorporated One Willow Park Center Farmingdale, New York 11735 (516) 694-1441
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000
Tools, Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Voltage Regulators	Electro-Delta P.O. Box 898 Stockton, California 95201 (209) 462-8571
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000

GAMA SYSTEM / CHAPTER INDEX GUIDE

GAMA SYSTEM / CHAPTER INDEX GUIDE (cont)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

—NOTE—

Refer to Card 5, Grid No. 5F1 for Electrical Schematic Index

LIST OF CHARTS

LIST OF CHARTS (cont)

LIST OF CHARTS (cont)

THIS PAGE INTENTIONALLY LEFT BLANK

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. Fuel is supplied to the engine by one of two submerged fuel pumps located in the inboard main tank. One of these boost pumps must be operating any time the engine is in operation so the fuel under pressure is supplied to the engine driven fuel pump. 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. The only other valve in the system is the crossfeed which is also 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.

Fuel tank drains arc provided at the low point of each fuel tank while the optional fuel drain is located just aft of the submerged fuel pumps at wing station 23.00 and fuselage station 131.00. This drain (when installed) provides a more rapid means of draining the aircraft of fuel.

A main duct filter is located forward of each engine firewall. The filter is provided with a drain which is accessible through an access door in the engine cowling.

The aircraft is equipped with capacitance probe fuel quantity indicating system with four probes located in each wing. All fuel cells in each wing are interconnected.

TROUBLESHOOTING.

Troubles peculiar to the fuel system arc listed in Chart 2801 and 2802 along with their probable causes and suggested remedies. When troubleshooting. check from the power supply to the items affected. If no trouble is found by this method the trouble probably exists inside individual pieces of equipment: they may be removed from the airplane and an identical unit or units, tested and known to be good, installed in their place.

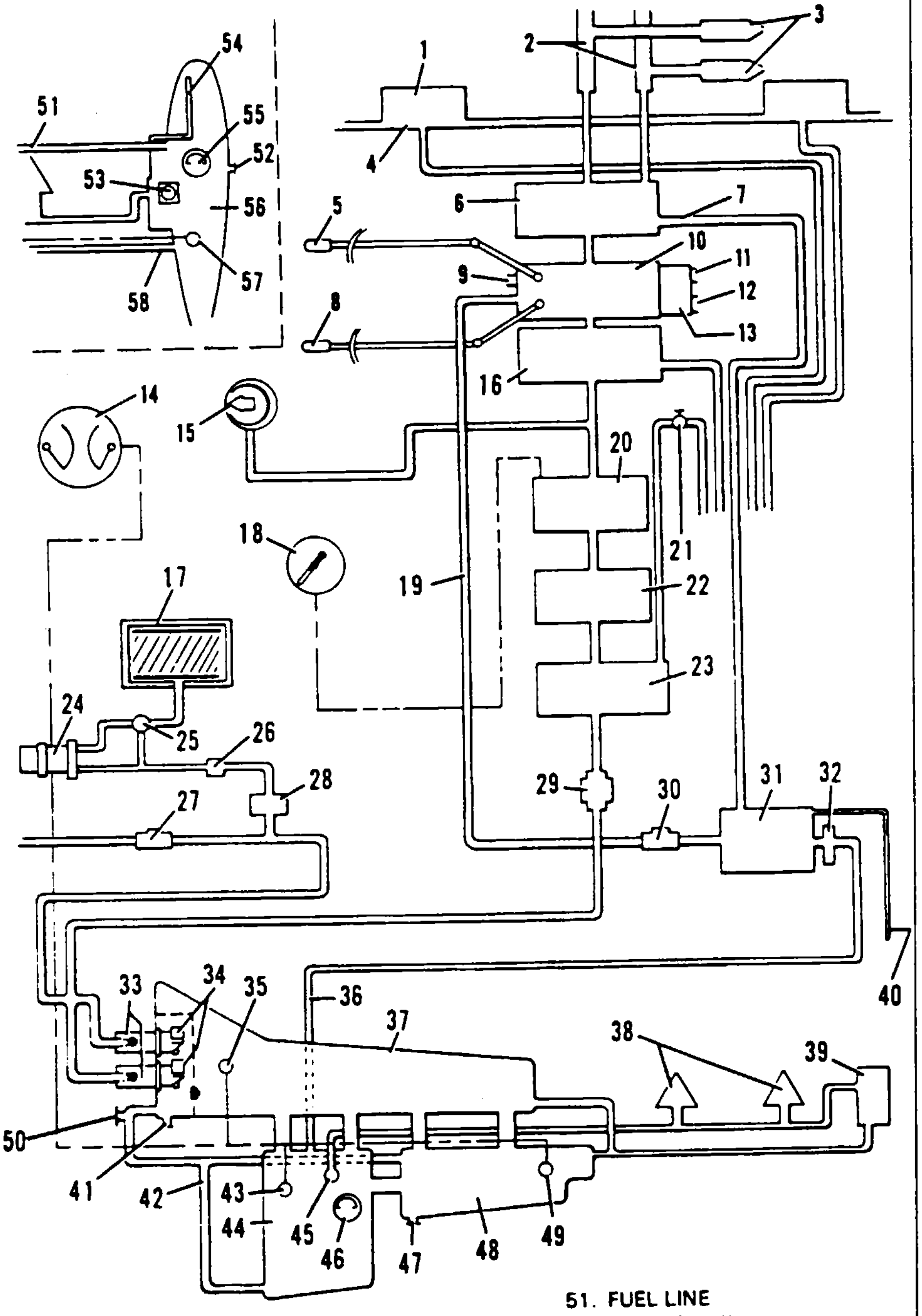
CHART 2801. TROUBLESHOOTING (FUEL SYSTEM)

Trouble	Cause	Remedy
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.
	Relief valve in nacelle or float valve in tip tank sticking open or leaking.	Defuel aircraft and inspect valves for condition.

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

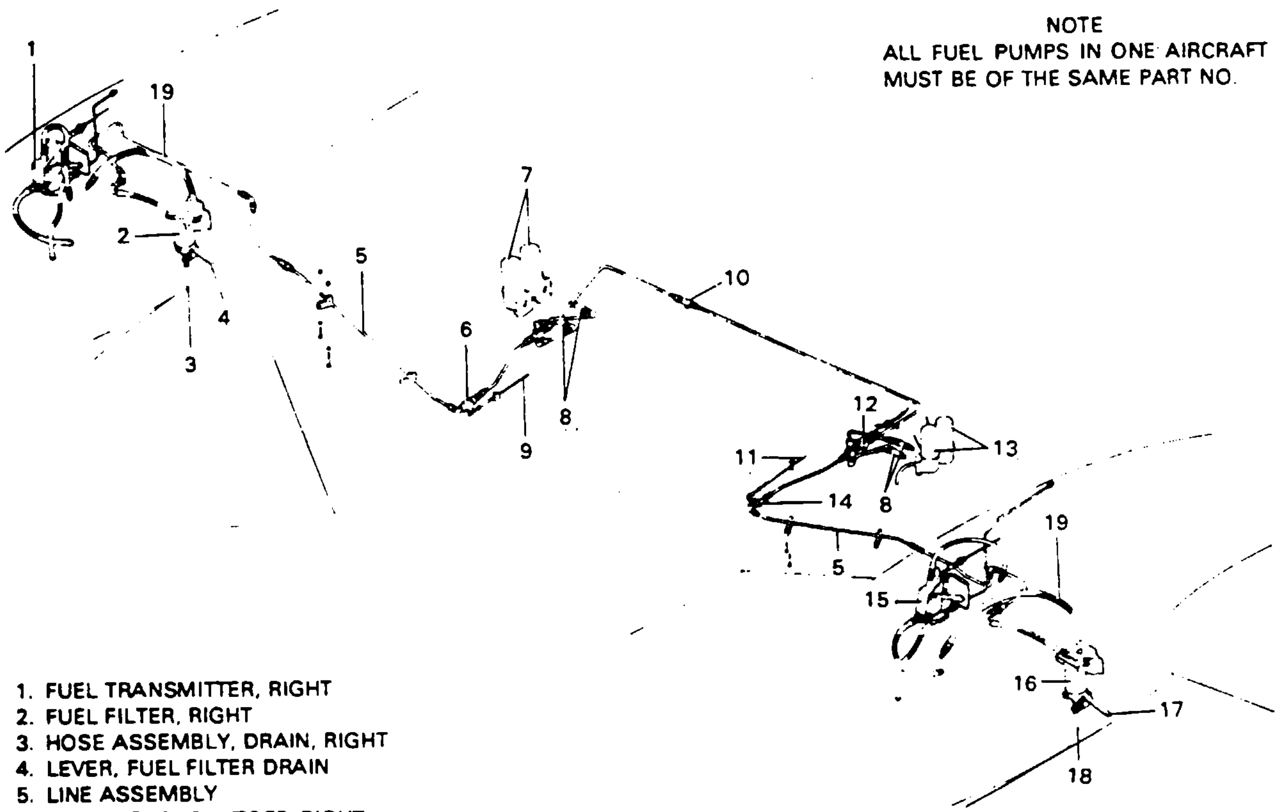
Trouble	Cause	Remedy
Fuel leaking from filler caps.	Filler caps improperly adjusted and not sealing properly.	Adjust filler caps to obtain tight seal.
Fuel gauge indicating approximately 1/2 tank when tank is full but will function normally on other tank.	Inboard fuel transmitter assembly grounded.	Check 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.

1. DRAIN VALVE
2. FUEL MANIFOLD
3. FUEL NOZZLE
4. GAS GENERATOR CASE
5. START CONTROL LEVER
6. FLOW DIVIDER AND DUMP VALVE
7. FUEL DUMP
8. POWER CONTROL LEVER
9. NF SENSE
10. FUEL CONTROL AND SHUTOFF VALVE
11. INLET TEMPERATURE SENSE
12. P3 SENSE
13. TEMPERATURE COMPENSATOR
14. DUAL FUEL QUANTITY GAUGE
15. FUEL PRESSURE GAUGE
16. FUEL PUMP
17. HEATER
18. FUEL FLOW GAUGE
19. FUEL VENT LINE
20. FUEL FLOW METER
21. FILTER DRAIN VALVE
22. FUEL HEATER
23. FILTER
24. PUMP
25. PRESSURE RELIEF VALVE
26. FILTER
27. CROSSFEED VALVE
28. SOLENOID VALVE
29. FIREWALL SHUTOFF VALVE
30. SOLENOID VALVE
31. CANISTER
32. CHECK VALVE
33. CHECK VALVE
34. SUBMERGED FUEL PUMP
35. FUEL QUANTITY SENDER UNIT
36. VAPOR BLEED LINE
37. MAIN FUEL CELL (INBD)
38. VENT (NACA) NON-ICING
39. VENT FLOAT VALVE
40. FUEL DUMP
41. SUMP DRAIN VALVE
42. DRAIN LINE
43. FUEL QUANTITY SENDER UNIT
44. NACELLE FUEL TANK
45. VENT VALVE
46. FILLER CAP
47. SUMP DRAIN VALVE
48. MAIN FUEL CELL (OUTBD)
49. FUEL QUANTITY SENDER UNIT
50. FUEL DRAIN (OPTIONAL)



51. FUEL LINE
52. SUMP DRAIN
53. VENT FLOAT VALVE
54. TIP RELIEF LINE
55. FILLER CAP
56. TIP TANK
57. FUEL QUANTITY SENDER UNIT
58. TIP TANK VENT LINE

Figure 28-1. Fuel System Schematic



1. FUEL TRANSMITTER, RIGHT
2. FUEL FILTER, RIGHT
3. HOSE ASSEMBLY, DRAIN, RIGHT
4. LEVER, FUEL FILTER DRAIN
5. LINE ASSEMBLY
6. VALVE, FUEL SHUTOFF, RIGHT
7. SUBMERGED FUEL PUMPS, RIGHT (SEE NOTE)
8. CHECK VALVE
9. CONTROL CABLE
10. HEATER FUEL LINE FITTING
11. CONTROL CABLE
12. VALVE ASSEMBLY, FUEL CROSSFEED
13. SUBMERGED FUEL PUMPS, LEFT (SEE NOTE)
14. VALVE, FUEL SHUTOFF, LEFT
15. FUEL TRANSMITTER, LEFT
16. FUEL FILTER
17. LEVER, FUEL FILTER DRAIN
18. HOSE ASSEMBLY, DRAIN, LEFT
19. HOSE ASSEMBLY

Figure 28-2. Fuel System Installation

STORAGE.

WING FUEL CELLS AND TANKS.

REMOVAL OF WING TIP TANKS. (Refer to Figure 28-4.)

1. Drain the tank.
2. Remove the fairing between wing tip and tip tank.
3. Remove the sender unit.
4. Disconnect the electrical wires to the navigation lights and strobes.
5. Disconnect all plumbing from the tip tank and cover the ends to prevent contamination of fuel.
6. Support the tank and remove the six bolts holding the tank to the wing thus removing the tank.

INSTALLATION OF WING TIP TANKS. (Refer to Figure 28-4.)

1. Connect the tank to the wing by installing the six bolts. Refer to Figure 28-4 for bolt torque values.
2. Connect all the plumbing to the tank.
3. Install the sender unit and connect electrical leads to navigation lights and strobes.
4. Install the fairing between the wing tip and tip tank.

REMOVAL OF WING FUEL CELLS. (Refer to Figures 28-5 and 28-6).

1. Drain either entire system or make sure crossfeed valve is closed 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 access panel aft of the one containing the filler cap on the nacelle top.
3. Remove the fuel cell and fuel sender access plates from the top of the wing.
4. Remove the lower wing root fairing and fuel cell drain fitting plates from the underside of the wing.
5. By reaching through the nacelle opening, remove the bolts from the three flange connections on the nacelle floor that connect the main inboard and outboard fuel cells to the nacelle tank.
6. 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.
7. By reaching into each fuel cell, remove the clamps from the two nipples in each tank that connect the two crossover tubes between the two 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.
8. Loosen the clamps and disconnect the fuel lines that attach to the outboard ends of both cells and also the one line that attaches to the inboard end of the main outboard fuel cell.
9. On the underside of the wing, draw the two fuel cell drains down enough to release the clamps and remove the drain.
10. Disconnect the electrical connections and fuel lines to the submerged fuel pumps; remove the check valves, and disconnect the fuel line that connects to the cell just aft of the pump by loosening the clamp.

—NOTE—

Use a wrench to backup the electrical connection on the submerged fuel pumps to prevent the nylon fitting from turning, which could cause the internal wire connection to break and render the pump inoperative.

11. Loosen the eight mounting bolts that attach the two submerged fuel pumps to the wing rib; reach through the access hole just above the pumps and remove them.
12. Reach through the proper access holes for each fuel cell and untie the nylon cords that secure the cell.
13. 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.
14. 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.
15. Place tape or another protective material around the cell access opening to prevent damage to the cell when removing.
16. 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 locations.

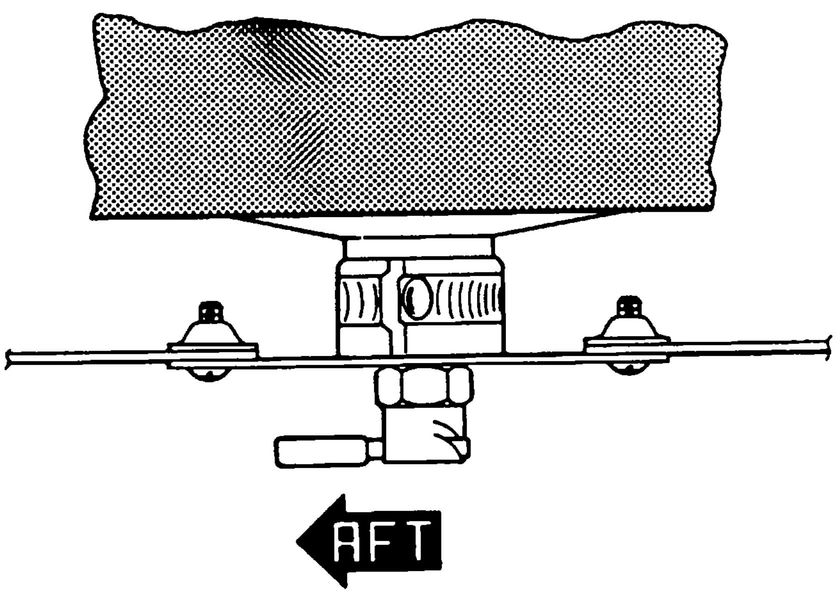


Figure 28-3. Fuel Valve Drain Plate

INSTALLATION OF WING FUEL CELLS. (Refer to Figures 28-5 and 28-6).

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 cell.
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 28-5 and 28-6.

—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.

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 28-3.) 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 pumps, through the access opening in the wing top, and secure to the inboard rib with the four bolts that attach each of the pumps.
11. Connect the electrical wires to the submerged fuel pumps and install the check valves into the fuel pumps and connect the fuel lines to the check valves.
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 two 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 inchpounds. (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 nylon screws to 5 +2, -0 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.

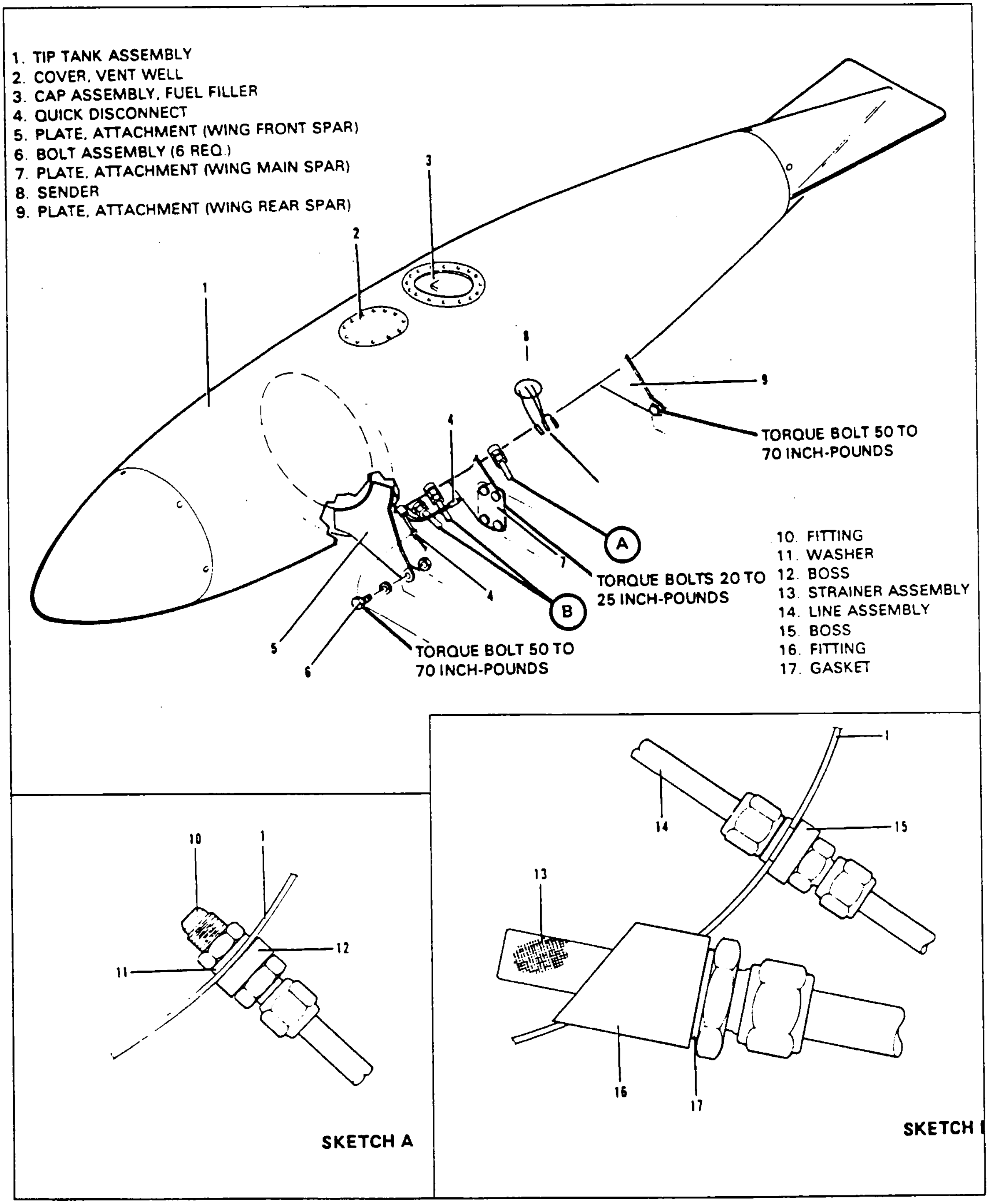
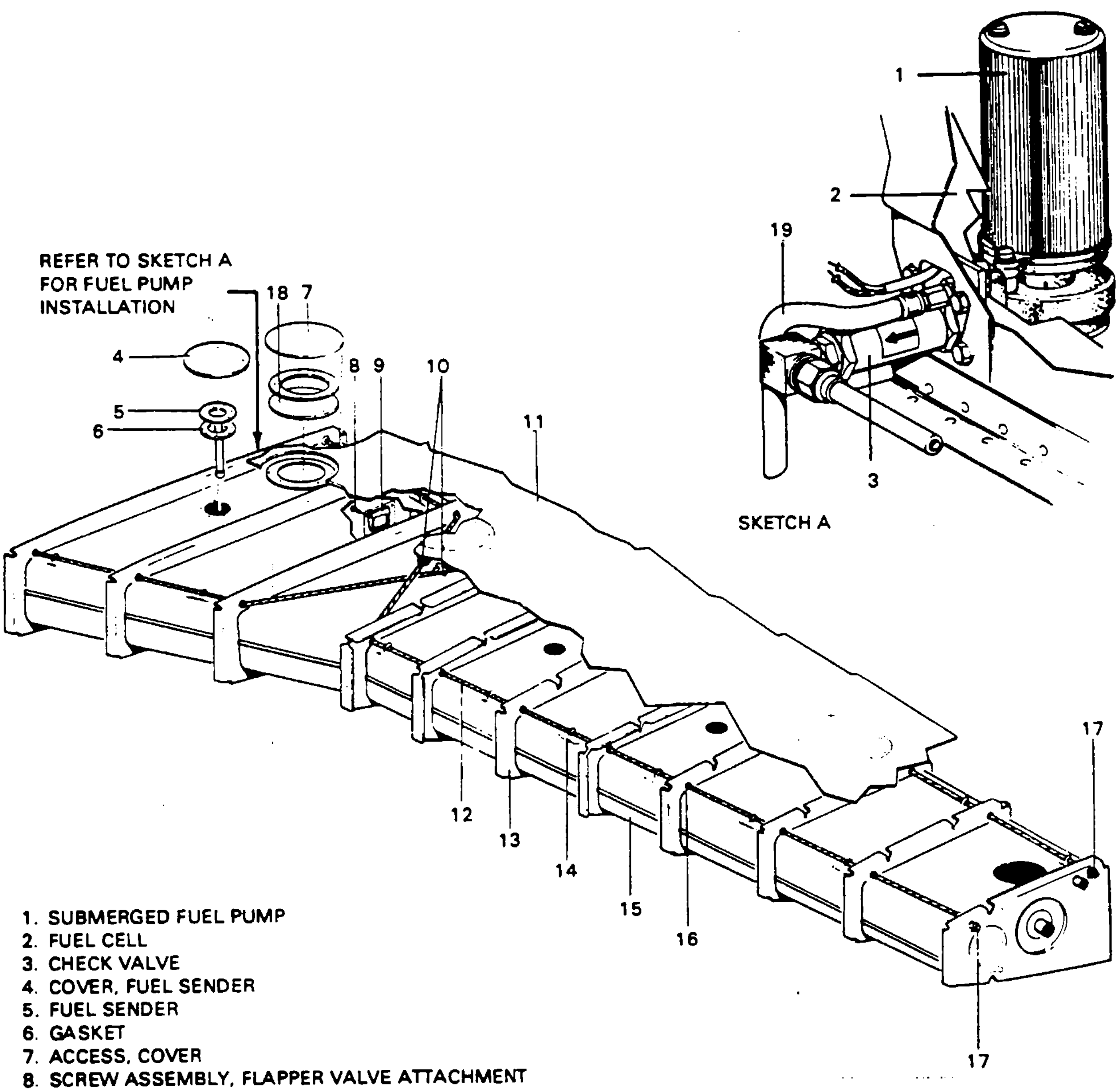
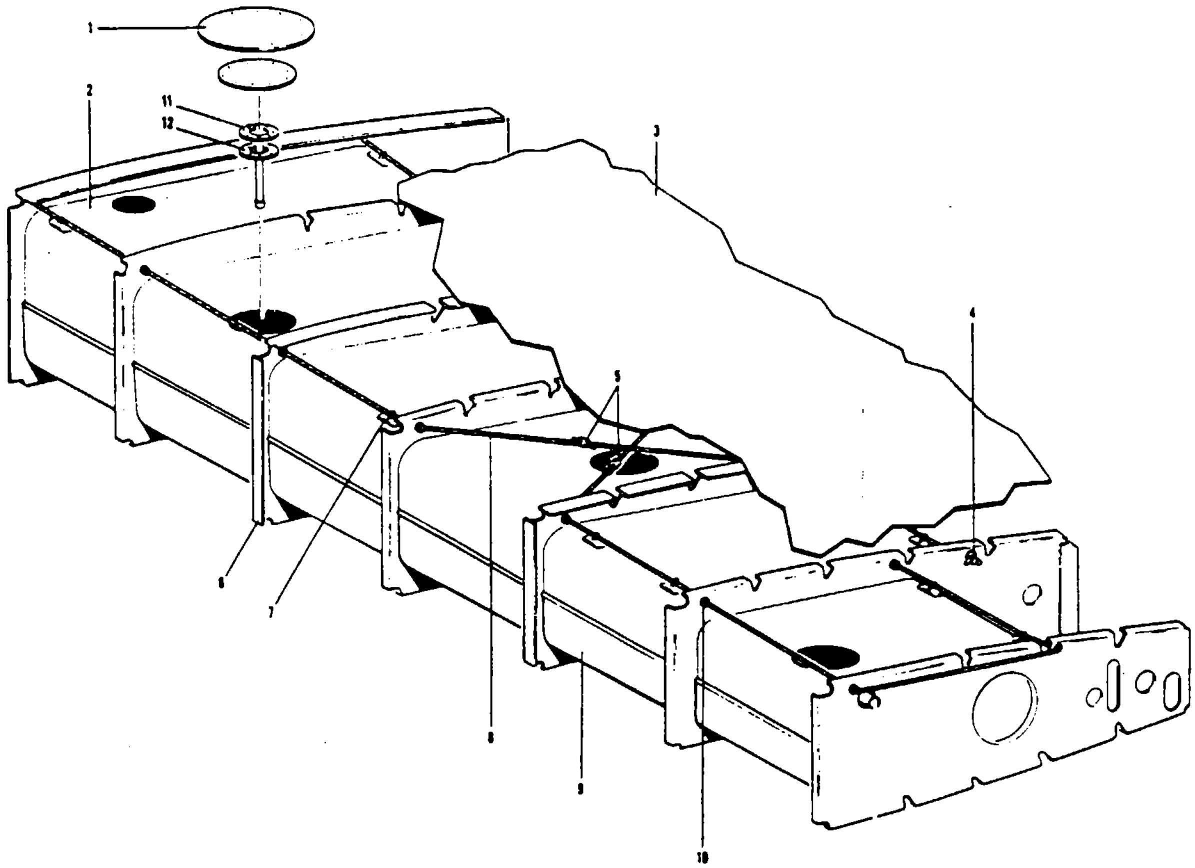


Figure 28-4. Tip Tank Installation



1. SUBMERGED FUEL PUMP
2. FUEL CELL
3. CHECK VALVE
4. COVER, FUEL SENDER
5. FUEL SENDER
6. GASKET
7. ACCESS, COVER
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, FUEL CELL
16. BUSHING, SNAP
17. KNOT AND WASHER
18. COVER, FUEL CELL
19. DRAIN LINE

Figure 28-5. Fuel Cell Installation (Inboard)



1. COVER ASSEMBLY, ACCESS
2. FUEL CELL
3. WING SKIN
4. KNOT AND WASHER
5. TIE KNOTS
6. RIB ASSEMBLY
7. LOOP ATTACHMENT
8. CORD
9. LINER ASSEMBLY
10. SNAP BUSHING
11. FUEL SENDER
12. GASKET

Figure 28-6. Fuel Cell Installation (Outboard)

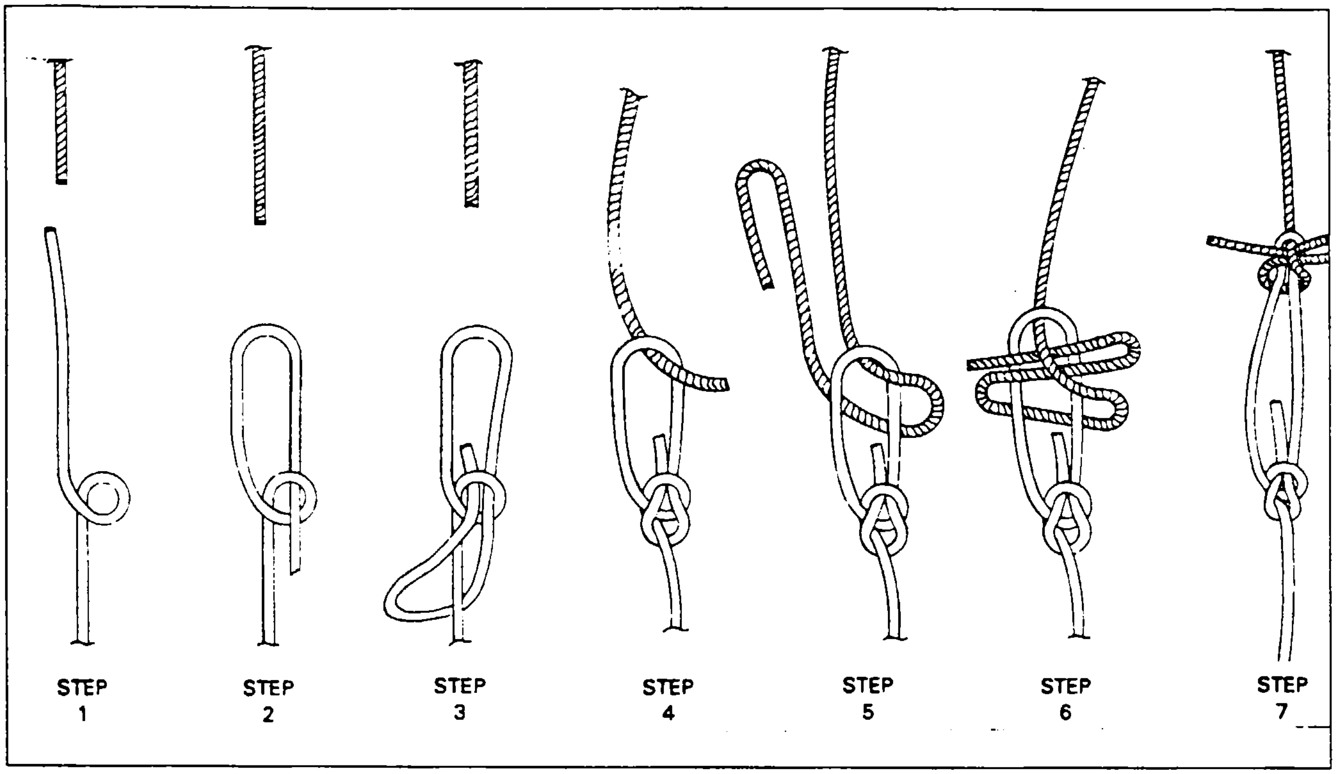


Figure 28-7. Fuel Cell Tie Detail

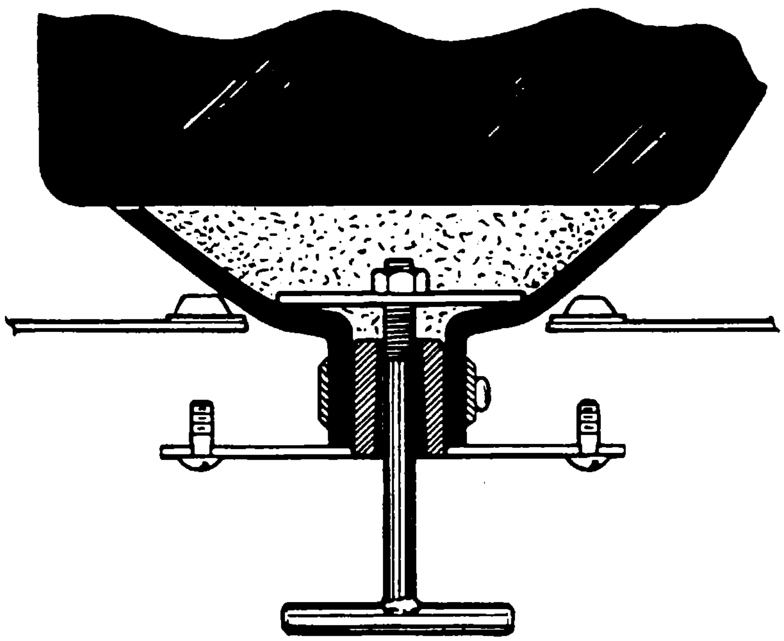


Figure 28-8. Installation of Fuel Valve Drain Plate

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 28-7.
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.

—NOTE—

The nacelle tank is not removable; it is a wet type tank coated with an anti-corrosive primer.

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 which ever 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.

—NOTE—

If replacement fuel cell does not include alternate fuel sender location opening at station 137.50, it will be necessary to tape over the bottom of fuel sender support bracket. Use a pressure sensitive adhesive waterproof type tape.

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.

THIS SPACE INTENTIONALLY LEFT BLANK

REPAIR OF FUEL CELLS.

GENERAL.

The following is the repair procedure recommended for field repair of fuel cells constructed of Goodyear BTC-54A 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.

THIS SPACE INTENTIONALLY LEFT BLANK

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 an outside and inside patch.
8. External abraded or scuffed areas without fabric damage require an outside patch only.
9. A loose edge may be trimmed provided that a .50 inch minimum lap or seam is maintained.
10. Air cure repair patches are to remain clamped and undisturbed for 72 hours at room temperature of approximately 75°F.

—CAUTION—

For each 10° drop in temperature from 75°F, add 20 hours cure time. For example, at 65°F, cure for 92 hours.

11. All heat cured patches are ready for use when cool.
12. Fitting repairs are confined to loose flange edges, seal surface rework and coat stock.
13. The maximum number of heat cure repairs in the same area is four.

—NOTE—

Any damage not covered by the above should be returned to The Goodyear Tire & Rubber Company, Rockmart, Georgia, 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 Methyl Ethyl Ketone solvent.
3. Abrade cell wall surface about injury and contact side of patch with fine emery cloth to remove shine.
4. Repeat Methyl Ethyl Ketone washings two more times. A total of three washings each surface.
5. Tape an 8" x 8" piece of cellophane inside cell over injury.
6. When all the above preparatory work has been done and cell has been positioned for patch application on repair table, mix the 80C27 cement (320 gms) with the cross-linker 80C28 (81 cc) and stir mixture thoroughly for five minutes.

—NOTE—

Cement must be at a minimum of 70°F before mixing. Keep away from water and excessive heat.

7. Brush one even coat of mixed repair cement on the cell wall around injury and on the contact side of repair patch. Allow to dry for 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 centered 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 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.

CHART 2802. FUEL CELL REPAIR EQUIPMENT LISTS

Repair Kit, Goodyear Drawing No. 2F1-3-37813

Group I Materials

80C27 Repair Cement	8	pint cans, 320 gms in each
80C28 Cross-Linker	8	4 oz. bottles, 81 cc in each
Methyl Ethyl Ketone	2	1 pint cans
FT-192 Repair Fabric	2	Sheet 12" x 12"
AP368 Manual	1	

Group II Materials

The following equipment is necessary to perform the repair.

Group II equipment will be furnished at additional cost, if ordered by customer.

Foam Rubber Cloth Back Sheet, 1/4" x 12" x 12"	2
Paint Brush, 1 inch wide	2
Aluminum plates, 1/4" x 6" x 6"	4
Measuring cup (250 ml)	1
Cellophane (Sheet 12" x 24")	2

NOTES

Accessories - order per individual cell requirements.

Phenol plates, phenol plate assemblies and phenol test equipment can be ordered as required from cell manufacturer.

Cure Iron (Set 240°F) Optional.

Alodine 1200 - to be ordered as required from cell manufacturer

12. Center a repair iron 2F1-3-2572-1 on the plate over the repair patch. Secure the assembly with "C" clamp. Tighten by hand. Check cement flow to determine pressure.

—CAUTION—

Make sure that cell fold is not clamped between plates This would cause a hard permanent crease. Also make sure that patch does not move when clamp is tightened.

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.

METAL FITTING - SEALING SURFACES.

1. Rub off roughness of affected area with a fine file or fine emery cloth. Treat reworked area.
2. Clean metal surface using a clean cloth dipped in Methyl Ethyl Ketone. Moisten cleaned surface with clean cloth dipped in water. Apply alodine 1200 solution, undiluted, to the affected area with a small nylon brush. Allow solution to dry until a light golden color appears. When coating has been formed, remove excess solution by wiping with a clean water-moistened cloth. Allow coating to dry.

—WARNING—

Do not allow solution to come in contact with hands, eyes or clothing.

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 wig 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 Methyl Ethyl Ketone. Apply 80C27 mixed cement; two coats as with repair patch. Clamp and cure. Either method may be used. See Repair Patch. Loose seams may be trimmed if minimum lap remains.
4. Loose Fitting Flange - Inside: Buff edge of flange and contact surface under flange. Apply 80C27 mixed repair cement, cellophane, padded plates and clamp. Follow procedure as outlined for repair patch, except for patch itself.
5. Looseness Against Metal: Prepare metal as per metal fitting - sealing surfaces. Apply 80C27 mixed cement and cure.

TESTING FUEL CELLS.

Either of the following test procedures may be used to detect leaks in the bladder cells.

1. Soap Suds Test.
   A. Attach test plates to all fittings.
   B. Inflate the cell with air to a pressure of 1/4 psi maximum.
   C. Apply a soap and water solution to all repaired areas and any areas suspected of leakage. Bubbles will appear at any point where leakage occurs.
   D. After test, remove all plates and wipe soap residue from the exterior of the cell.
2. Chemical Test.
   A. Attach test plates to all fitting openings except one.
   B. Make up a phenolphthalein solution as follows: Add 40 grams phenolphthalein crystals in 1/2 gallon 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.

REPAIR OF LEAKING NACELLE FUEL TANK.

The following procedure should be used for repairing leaks in the nacelle fuel tank. The use of the specified material will allow the least amount of aircraft down time to make the repair.

LIST OF MATERIALS

Sealant Material - PR-1435 (Products Research and Chemical Corp.)
PRC Coating and Sealants Division
2919 Empire Avenue
Burbank, California 91505
Solvent - Methylethylketone (M.E.K.)
Alodine Solution 1200
Small nylon brush
Clean white gauze pads (4 inch squares)
Fillet fairing tools (Refer to Chapter 95)

PR-1435 is a two-part polysulfide sealant which when mixed has a short application life (15 minutes at 70°F and 50% relative humidity); for every 10°F rise in temperature the time is reduced by half, and for every 10°F drop in temperature the time is doubled. High humidity at time of mixing also shortens the application life.

This sealant will cure to an acceptable hardness in approximately 24 hours at 75°F and 50% relative humidity. Cure may be hastened by applying heat up to 130°F.

—NOTE—

Nacelle fuel tanks may be filled with fuel one hour after application of the sealant. The cure does not depend upon exposure to air or elevated temperatures, and therefore, win take place even under fuel, without affecting the sealing efficiency.

1. In areas where the original sealant has been scratched, gouged or otherwise damaged, remove the damaged section of fillet with a sharp plexiglas scraper. Taper all cuts in the old sealant at a 45° angle.
2. The original sealant in the fuel tank will be fuel soaked and should be dried in the area of any repair. Use a vapor-proof heat lamp or hot air blower.
3. Thoroughly clean all areas to be repaired with solvent such as Methylethylketone (M.E.K.). A progressive cleaning procedure should be used. Wash one small area at a time; then dry with a clean cloth before the solvent evaporates, to prevent redeposition of the oil, fuel, etc., on the surface. Always pour solvent on the washing cloth to maintain a clean solvent supply. Reclaimed solvents should not be used.
4. Check the damaged area for any other repairs which may have to be made before applying the new sealant. Re-alodine any aluminum surfaces which have the original alodine coating removed. Apply alodine 1200 solution (undiluted) to the affected area with a small nylon brush. Allow the solution to dry until a light golden color appears. When a coating has been formed, remove the excess solution by wiping with a clean, water moistened cloth and wipe dry.

—WARNING—

Do not allow alodine solution to come in contact with hands, eyes or clothing.

5. Lust prior to application of PR-1435 sealant the affected area must be recleaned with M.E.K., per instruction given in Step 3.
6. Mix the two-part sealant per instruction supplied with it. Proper mixing and correct proportions are extremely important if optimum results are to be obtained.
7. Apply the sealant .125 to .187 of an inch thick to the repair area with a paddle shape tool. Firmly press sealant in place and form into the desired shape. Lap new sealant over old existing sealant .125 to .25 of an inch.

—WARNING—

This sealant contains flammable and volatile solvents. Keep it away from heat, sparks and flame. Proper precautions must be used when applying this sealant.

Avoid an contact of this sealant with your body, especially contact with open breaks in the skin. Polyethylene mitts should be used and hands washed before eating or smoking.

NACELLE AND TIP TANK ACCESS PLATE RESEALING.

The sealant material to be used for sealing the access plates should be PR-1321B manufactured by:

Products Research and Chemical Corp.
PRC Coating and Sealants Division
2919 Empire Avenue
Burbank, California 91505

Proceed as follows:

1. Clean all mating surfaces as described in step 3 of previous paragraph.
2. Apply a film of sealant 1/32" to 1/16" thick to the surface to be sealed.
3. Install part immediately. Tighten screws to obtain as nearly as possible, a metal-to-metal contact. This squeezes out excess sealant, leaving only enough to fill remaining gaps.

—NOTE—

After sealing and securing access panels, the nacelle and/or tip tank can be filled with fuel 45 minutes after application of the sealant.

QUICK-DRAIN VALVE.

An optional quick drain valve is located in the wing root fairing. It would take approximately 40 minutes to (gravity) drain a full tank containing 150 gallons of fuel at an average flow rate of 3.8 to 4 g.p.m. Access to the valve is by way of an access door located on the underside of the fairing. Refer to Chapter 12, Draining the Fuel System, when utilizing the drain.

REMOVAL OF QUICK DRAIN VALVE.

1. Drain the appropriate fuel system. (Refer to Chapter 12).
2. Unscrew the two tubing nuts which secure the fuel lines to the quick drain valve and separate the lines from the valve.
3. Remove the bolts which secure the valve to the mounting bracket and remove the valve from the aircraft.

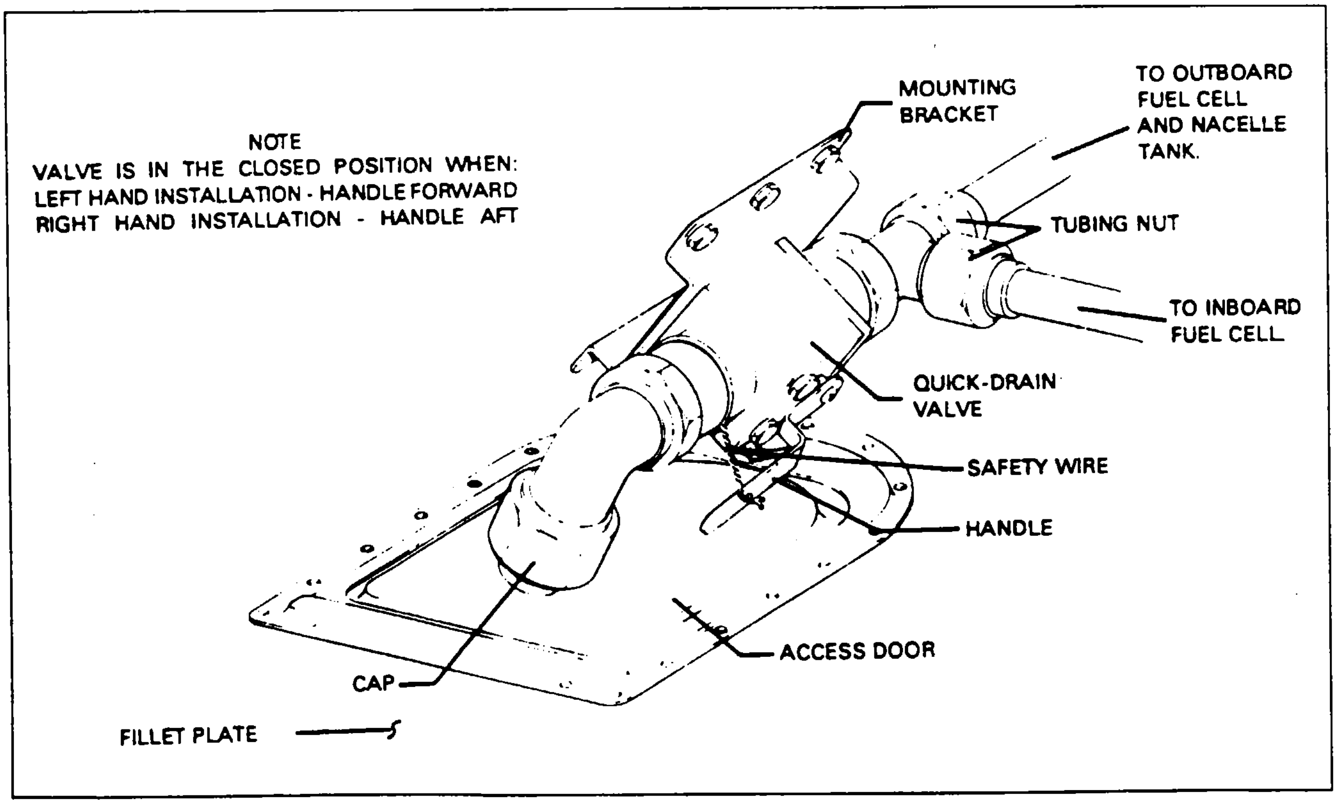


Figure 28-9. Quick Drain Valve (Optional)

INSTALLATION OF QUICK DRAIN VALVE.

1. Position quick drain valve against mounting bracket and secure with bolts.
2. Position the fuel lines to the valve and secure with tubing nuts.
3. Ensure that valve handle is in the closed position and that the handle is safetied with MS20995-C32 safety wire before filling fuel system.

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 or tip tank. A float valve is installed on the end of the vent line in the nacelle tank 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. The tip tank (if installed) has a vent well assembly which has a float valve, tip relief tube and the main vent line connected to it. This vent well is sealed from the fuel storage area in the tip tank, except for the float valve and relief tube which extends to the forward top portion of the tank. The float valve installed in the tip tank vent well prevents fuel from escaping through the vent line. The relief tube allows the fuel system to vent during climb attitude with full fuel aboard, and may allow fuel to escape when the tanks are full and fuel expansion takes place due to heat, such as the aircraft being parked on the ramp and being exposed to high ramp temperatures.

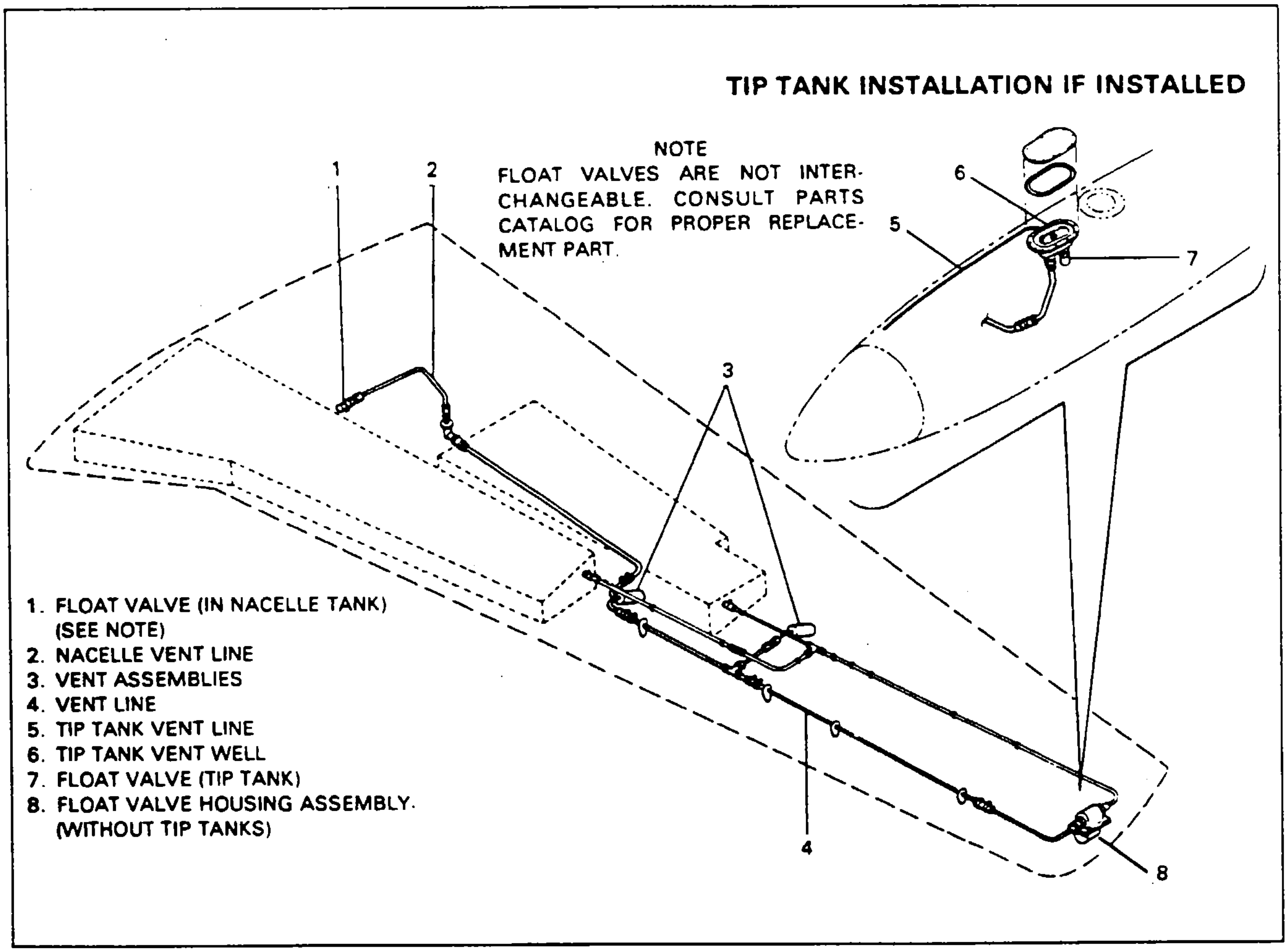


Figure 28-10. Fuel Vent System

DISTRIBUTION.

FUEL VALVES. (Refer to Figures 28-11 and 28-12).

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 that all fuel needs to be drained.
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 28-11 and 28-12).

1. Crossfeed Valve:
   A. Remove the clamp on top of the valve.
   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.
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.

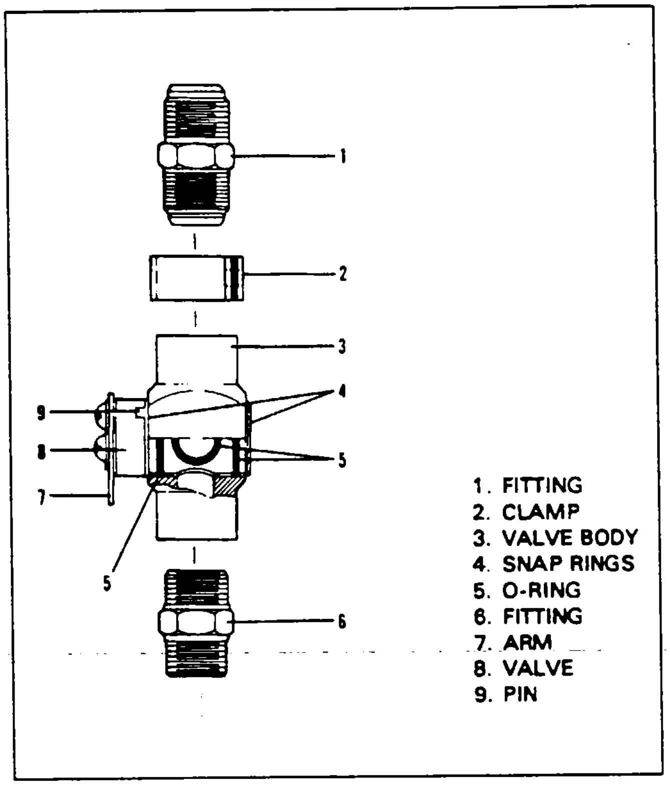


Figure 28-11. Crossfeed Valve.

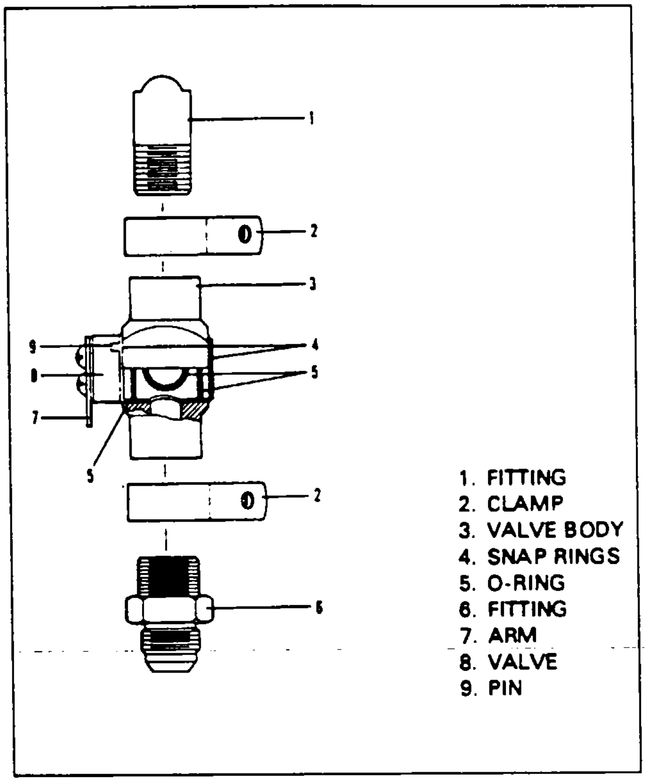


Figure 28-12. Fuel Shutoff Valve

ASSEMBLY OF FUEL SHUTOFF AND CROSSFEED VALVE. (Refer to Figures 28-11 and 28-12).

1. Ascertain that the snap ring is installed on the upper portion of the valve.
2. Place new O-rings on the valve.
3. Lubricate the O-rings with DC-55 (MIL-G-4343) and insert the valve in the valve body. Place the valve in the valve body so that the valve is allowed only 90° travel between stops.
4. Lock the valve in the valve body by installing the snap ring on the valve.
5. For the fuel shutoff valve, install the two clamps. For the crossfeed valve, install one clamp.

LEAK TEST OF FUEL SHUTOFF AND CROSSFEED VALVE.

1. Connect the inlet port of the valve to a 50 psi air source.
2. 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.
3. There should be no evidence of leakage through the valve port or around the seat.
4. Disconnect the air source and wipe fluid from the exterior of the valve.

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. Remove the lower wing root fairing on the particular side that the valve adjustment is to be made.
2. Disconnect the control cable at the actuator arm on the particular valve and loosen the jam nut at the clevis fitting.
3. 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.
4. 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.
5. 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.

FUEL FILTER. (Refer to Figure 28-13).

—NOTE—

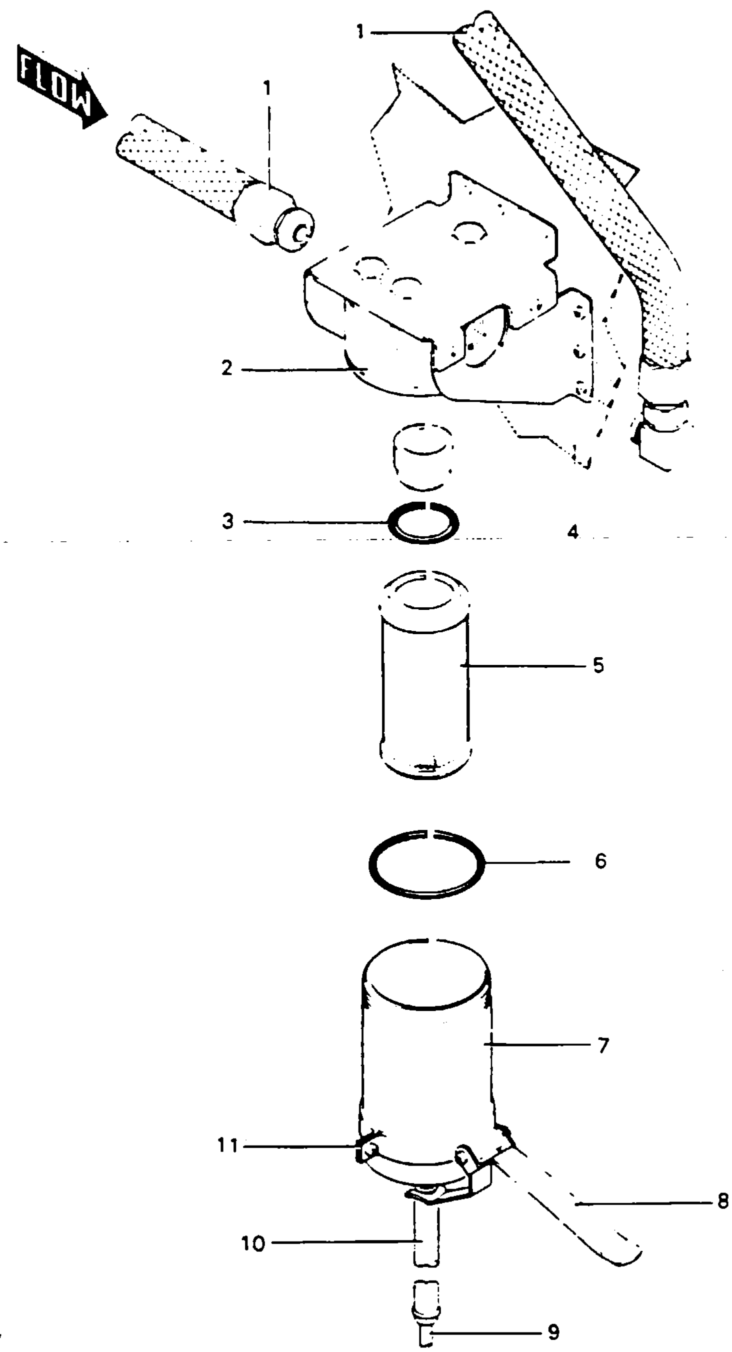
Refer to List of Vendor Publications for appropriate Pratt and Whitney Engine Maintenance Manual for information regarding engine-driven rotary fuel pump filter and screen replacement.

REMOVAL OF FUEL FILTER.

1. Close the fuel shutoff valve.
2. Remove top engine cowl.
3. Disconnect the two main fuel lines from the top of the filter unit along with the elbow fitting in the outlet port of the unit. Disconnect the drain line from the bottom of the filter unit.
4. Remove the fuel bowl drain valve actuator handle from the clamp on the bowl assembly by removing the attachment screw and nut.
5. Remove the safety wire from the three mounting bolts that attach the filter unit to the bracket; remove the bolts; then remove the filter unit.

DISASSEMBLY OF FUEL FILTER.

1. Unscrew the bowl assembly from the head assembly by use of a strap wrench and remove the O-ring.
2. Pull the filter element from the head assembly.



1. FUEL LINE
2. HEAD ASSEMBLY
3. O-RING
4. FIREWALL
5. FILTER ELEMENT
6. O-RING
7. BOWL ASSEMBLY
8. FUEL DRAIN LEVER
9. DRAIN TUBE
10. DRAIN, FILTER
11. CLAMP

Figure 28-13. Fuel Filter

CLEANING, INSPECTION AND REPAIR OF FUEL FILTER.

1. Clean the element with an oil solvent.
2. Inspect the filter element for damage.
3. Check condition of O-rings.
4. Normal repairs necessary for the filter are: replacement of O-rings and the filter element.

ASSEMBLY OF FUEL FILTER.

1. Install O-ring on element; then install element on head assembly.
2. Install O-ring in head assembly; then screw the bowl assembly into the head and torque to 13 ± 3 foot-pounds.

INSTALLATION OF FUEL FILTER.

1. Position the filter housing in its proper location with respect to its mounting bracket and secure with the three cap bolts and safety.
2. Install the elbow fitting in the outlet port of the filter housing; then connect the two main fuel lines to their respective fittings.
3. If the fuel bowl quick drain actuator handle was removed, attach it to the mounting clamp on the filter bowl with screw, washer and nut.
4. Connect the filter bowl drain hose to the fitting on the bottom of the bowl.
5. Turn the fire wall fuel valve ON and depress the fuel filter bowl drain valve until a steady flow of fuel is noted. Release handle and check for leaks where the filter bowl assembly screws into the head assembly and also where the two main fuel lines and the filter bowl drain line attach to the filter housing.

—NOTE—

Fuel cells must be 90% full to get fuel flow from filter.

6. Install top engine cowl.

FUEL PUMPS.

REMOVAL OF SUBMERGED FUEL PUMPS. (Refer to Figure 28-14).

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 under side of the wing of which the pump or pumps are 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 pumps. (Refer to Figure 28-5).
4. In the wing root cavity disconnect the electrical connections, fuel and drain lines from the pump or pumps. Drain line on Lear Siegler fuel pump only.

—*CAUTION*—

The use of a wrench to backup the electrical connection on the airborne fuel pump is recommended to prevent the nylon connector assembly from turning at the pump and destroying the electrical connection within. Care should also be used when removing the fuel line from the check valve and check valve from the pump, so as not to disassemble the check 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 28-14.)

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 rib with the four mounting bolts.
2. Reconnect the electrical connections, fuel and drain lines and check valves to their respective positions.
3. Install the fuel cell cover plate and access plate on top of the wing. Fill fuel cell through nacelle filler just enough to check for leaks by observing all connections in the wing root cavity.
4. Install the lower wing root fairing.

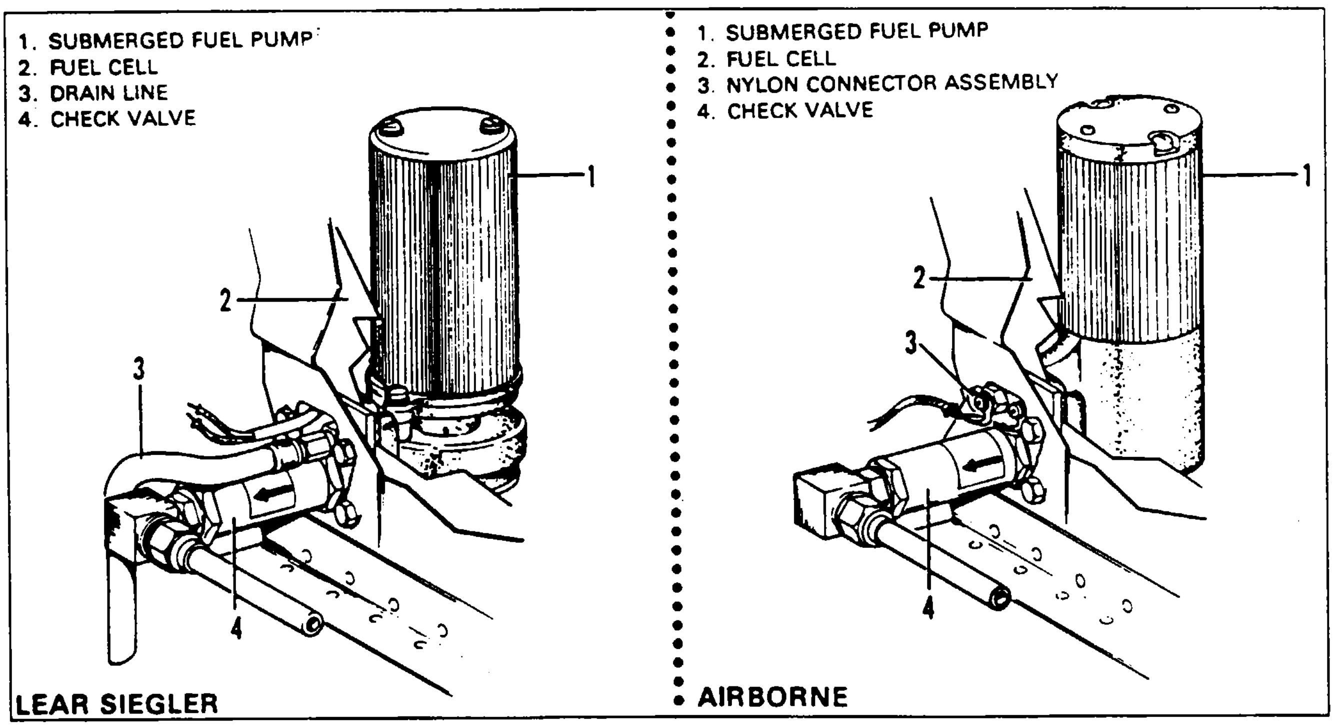


Figure 28-14. Submerged Fuel Boost Pump

INDICATING.

DESCRIPTION AND OPERATION.

The aircraft is equipped with a capacitance type gauging system. As fuel rises inside each sensor, the sensor's measurable capacitance increases. Capacitance varies with weight and temperature of fuel. The sensor capacitance approximately doubles when it is completely immersed in fuel. The fuel quantity indicator measures the total sensor capacitance increase and indicates how many pounds of fuel were required to produce that much capacitance increase.

The indicator contains a square wave generator which puts out voltage pulses on the "LO Z" wires. The indicator also has two square wave receivers, connected to the LEFT and RIGHT "HI Z" wires. These receivers drive the fuel quantity pointers higher, when higher square wave voltages comes back from the tank sensor units because of an increase in sensor capacitance coupling from "LO Z" to a "HI Z" wire.

The electrical power for the entire system is supplied from the 28-volt DC aircraft power supply. (Refer to Chapter 91 for electrical schematics of the fuel gauging system.)

SENSOR UNITS.

—CAUTION—

Sensor units must be handled very carefully as damage to the tubes will destroy the accuracy of the unity

There is a fuel sensor unit located in each fuel cell and tank. Each installation will be covered separately. Install in reverse order of removal.

1. TIP TANK: The sensor unit is mounted on the bottom of each tip tank.
   A. Remove the fairing between the tip tank and wing.
   B. Disconnect the electrical leads at the connectors next to the sensor unit.
   C. Check that the tip tank is completely drained of fuel. (Refer to Chapter 12, Draining Fuel System.
   D. Remove the five screws securing the sensor to the tip tank. Carefully remove the unit and gasket.
2. NACELLE TANK: The sensor unit is mounted in the upper portion of the nacelle tank, inboard of the filler cap.
   A. Remove the access cover next to the filler cap.
   B. Disconnect the electrical leads from the sensor unit. Mark leads for later reconnection.
   C. Check that enough fuel has been drained from the system to prevent spillage. (Refer to Chapter 12, Draining Fuel System.)
   D. Remove the five screws securing the sensor to the nacelle tank. Carefully remove the unit and gasket.
3. MAIN OUTBOARD FUEL CELL: The sensor is mounted in the fuel cell at wing station 104.50.
   A. Remove the outboard wing access panel.
   B. Disconnect the electrical leads from the sensor unit. Mark leads for later reconnection.
   C. Check that enough fuel has been drained from the system to prevent spillage. (Refer to Chapter 12, Draining Fuel System.)
   D. Remove the five screws securing the sensor to the fuel cell. Carefully remove the unit and gasket.
4. MAIN INBOARD FUEL CELL: The sensor is mounted in the fuel cell at wing station 36.00.
   A. Remove the inboard wing access panel.
   B. Disconnect the electrical leads from the sensor unit. Mark leads for later reconnections.
   C. Check that enough fuel has been drained from the system to prevent spillage. (Refer to Chapter 12, Draining Fuel System.)
   D. Remove the five screws securing the sensor to the fuel cell. Carefully remove the unit and gasket.

REPAIR OF INDICATING SYSTEM.

FUEL QUANTITY INDICATOR.

Periodic overhaul of the indicator is not recommended.

TANK SENSOR UNITS (ALL).

Periodic overhaul of all tank units is not recommended.

CLEANING OF TANK UNITS.

All the tank sensor units used in this system can be cleaned with trichloroethylene or similar degreasing agent. This may restore units found unserviceable due to high electrical leakage (under 10 megohms).

—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—

Handy 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.

—WARNING—

Use of a hand cranked "megger" 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 2803 is sold (compete with operation instruction manuals) to be used for proper calibration of the fuel quantity indication system components.

The test equipment listed in Chart 2803 can be conveniently inserted 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. Refer to Chart 2804 for Indicator Calibration and Chart 2805 for Tank Sensor Unit Calibration capacitance values. See Figure 28-15 Test Equipment Hookup.

CHART 2803. TEST EQUIPMENT

Nomenclature	Model No.	Manufacturer	Use
Test Set	2548-H	Barfield Instrument Corp. 4101 N.W. 29th Street P.O. Box 4-20537 Miami, FL 33242-0537 Phone: 305-871-3900 Telex: 51-8808	Test Sensor Units or Gauge in aircraft or on bench for electrical leakage, or capacitance, and calibration.
Adapter	101-00448		
Lead Package	101-00431 or- 2 coax/BNC jumper cables		
		or	
Test Set	89-108-2	Ragan Data Systems 3 Oval Drive P.O. Box 417 Central Islip, NY 11722 Phone: 516-234-3800 TWX: 685-2305	(See above)
System Harness	78-125-1		
Probe Harness	Comes with test set		
		or	
Test Set	GTF-12	Gull Airborne 395 Oser Avenue P.O. Box 9400 Smithtown, NY 11787 Phone: 516-231-3737 TWX: 968-1518	(See above)
Test Harness	Field fabricated		

CHART 2804. INDICATOR SCALE SPAN CALIBRATION

	Capacitance Tester Settings (pF)	
Dial (lbs.)	Standard System	With Tip Tanks
1200	——	138.8
1000	——	127.6
980	115.8	——
800	105.8	116.5
600	94.7	105.4
400	83.6	94.3
200	72.4	83.1
0	61.3	72.0
	+/- 3pF	+/- 3pF

CHART 2805. TANK UNIT CAPACITANCE, DRY

Unit Location	Piper Part No.	Tank Unit Model	Capacitance (pF)	Tolerance(+/-pF)
Main Inboards	50946-04 550 578	PBA1020-1	12.46	+/-0.75
Main Outboards	50946-05 550 579	PBA1020-2	23.60	+/-0.75
Nacelles	50946-02 550 576	PBA1020-3	21.88	+/-0.75
Tip Tank	50946-03	PBA1021	10.75	+/-0.75

NOTE: Electrical leakage resistance between "H" and "L" or between "H" or "L" and the Tank Sensor Unit mounting flange must measure 10 or more megohms.

TESTING TANK SENSOR UNITS.

Sensor units can be most accurately tested for correct capacitance (calibration) when installed in a metal container grounded to both the sensor mounting flange and the test harness shield ground. See Figure 28-15A. Less accurate readings come from a unit standing or lying on a bench, where nearby metals or insulators other than free air come close to the sensor ends. Figure 28-16A shows the appropriate harness for bench testing tank sensor units with any accurate capacitance bridge. See capacitance values on Chart 2805. Test harness ends may be chosen from the list of aircraft Harness Connectors noted below.

HARNESS CONNECTORS:

1/4" x .032 Spade (Flag) Receptacle is AMP 60290-2 (P/N 588 364) in fold over plastic housing AMP. 1-480306-1 (P/N 484 227), for WING or NACELLE TANK SENSORS.

Indicator Connector is MS3106E-18-1S (P/N 555 647).

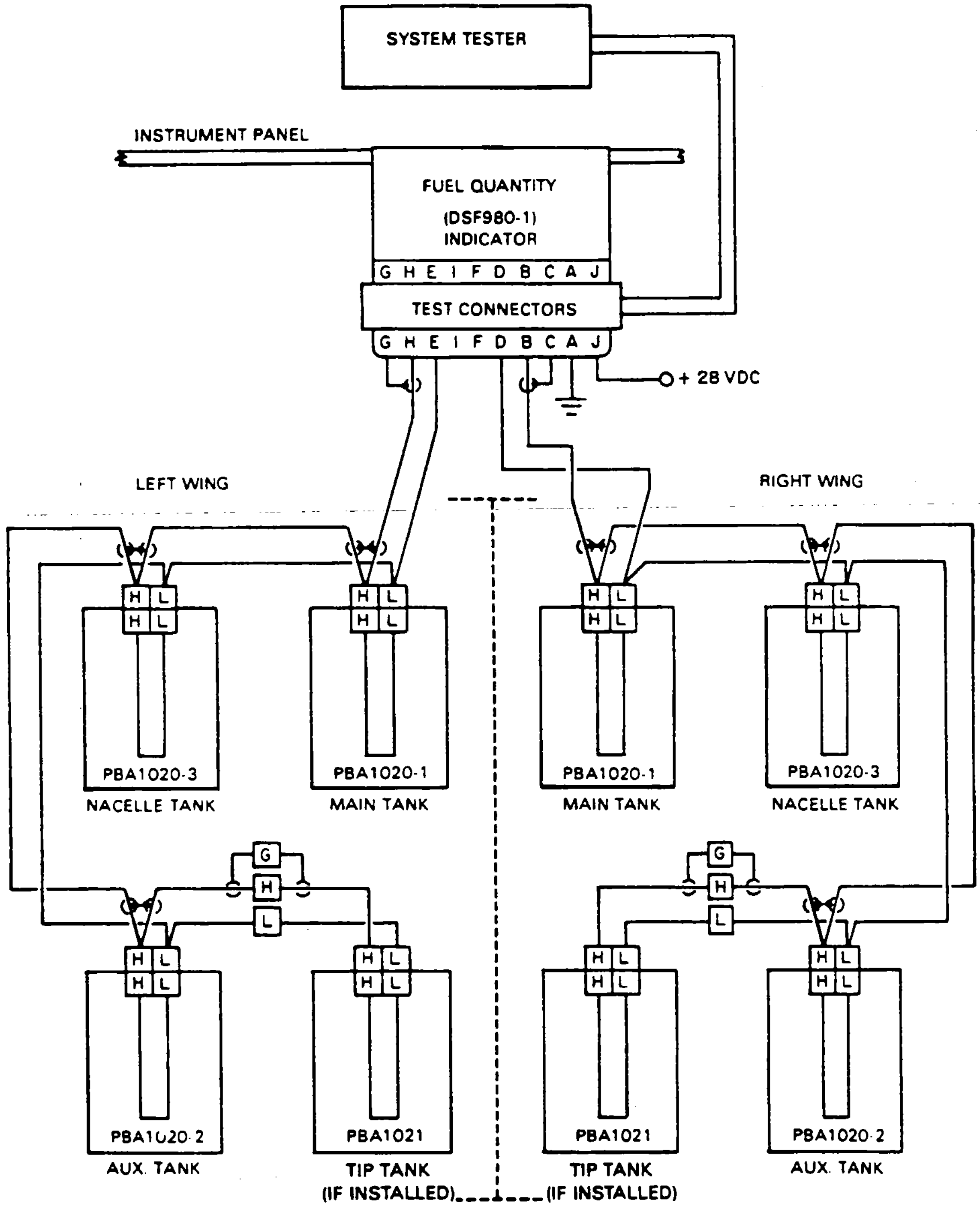
TESTING FUEL QUANTITY INDICATOR.

When testing one side of a fuel quantity indicator, the meter for the opposite side should be activated to approximately mid-scale, with a fixed capacitor of about 100 pF. (See Figure 28-16.) Use the capacitance test equipment (see Chart 2803) to determine that both sides of the Fuel Quantity Indicator read within the limits shown in Chart 2804.

—CAUTION—

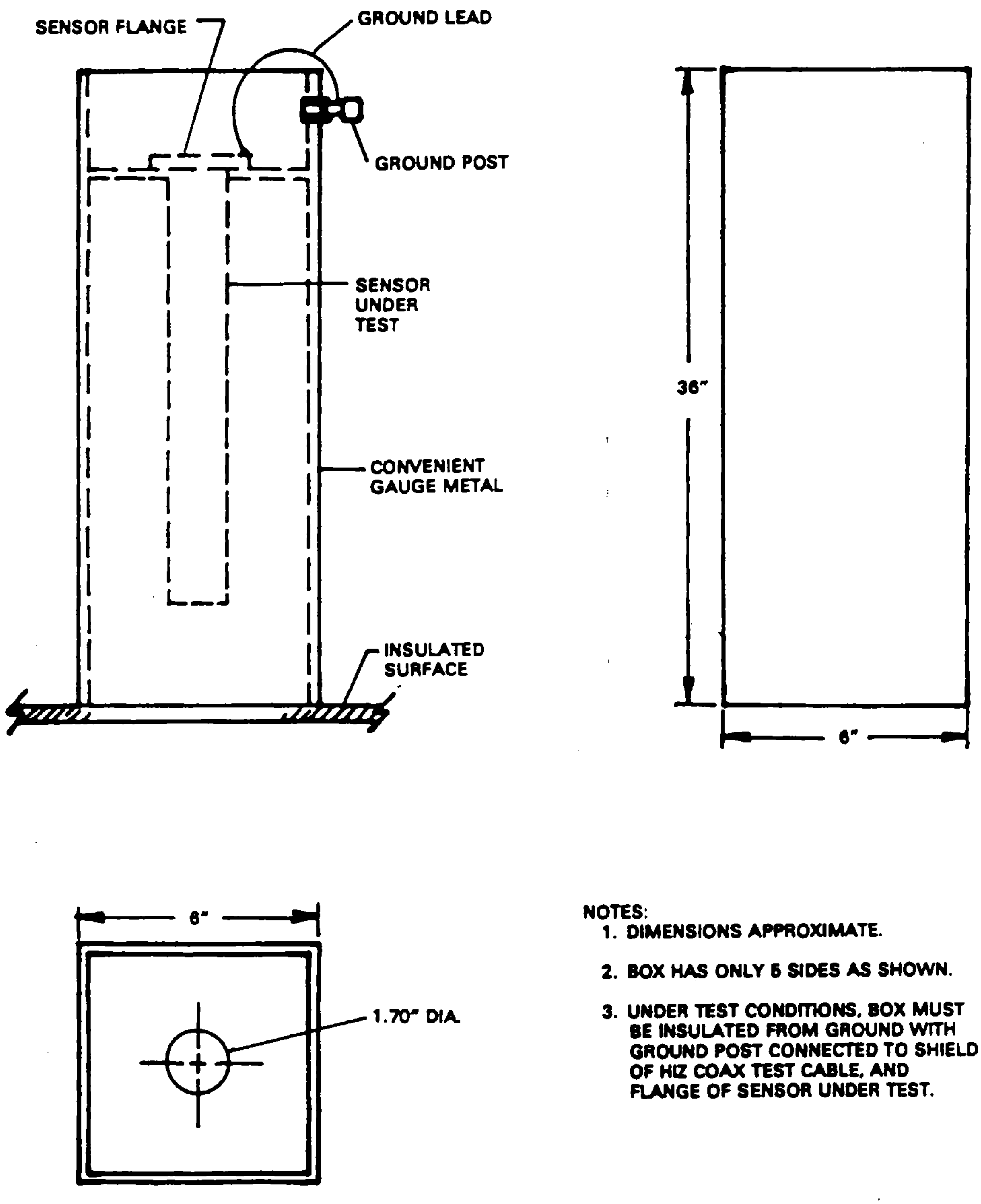
Keep dc instruments or other apparatus containing magnets at least two feet away from the indicator under test, during an testing procedures

1. OHMMETER TEST: Using a VOM set at R x 1, check for jumper continuity between connector pins D and E; and grounding between Pins A, C, G, and case of indicator under test. Resistance must not measure more than 0.2 ohms.
2. TEST SETUP:
   A. Adjust the regulated dc power supply for +28 + 0.5 volts and shut off power.
   B. Connect indicator to test set and harness as shown on Figure 28-16, View A.
3. LINE CURRENT TEST:
   A. Readjust power supply to +28 volts dc, +0.5 volts as necessary in the remaining tests.
   B. The indicator should draw between 66 and 86 milliampere



NOTES
1. CONTINUITY OF HIGH IMPEDANCE SHIELD MUST BE MAINTAINED THROUGHOUT SYSTEM WIRING. SHIELD MUST NEVER TERMINATE AT AIRFRAME STRUCTURE.
2. ALL WIRE NO. 20 AWG UNLESS OTHERWISE INDICATED.

Figure 28-15. Test Equipment Hookup



NOTES:
1. DIMENSIONS APPROXIMATE.
2. BOX HAS ONLY 5 SIDES AS SHOWN.
3. UNDER TEST CONDITIONS, BOX MUST BE INSULATED FROM GROUND WITH GROUND POST CONNECTED TO SHIELD OF HIZ COAX TEST CABLE, AND FLANGE OF SENSOR UNDER TEST.

Figure 28-15A. Fabrication Of Test Fixture For Tank Unit Testing

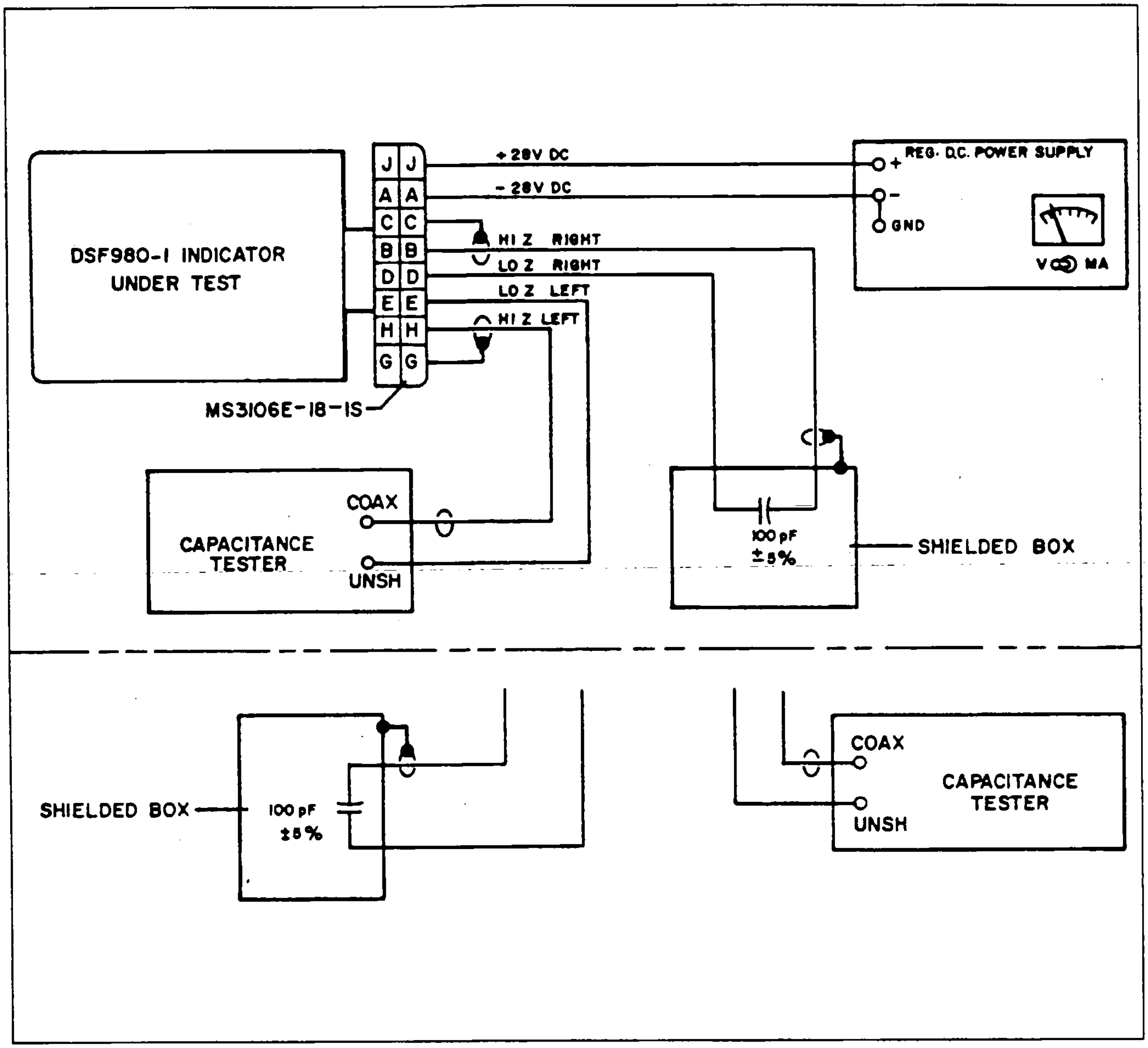


Figure 28-16. Alternate Indicator Bench Test Hookup

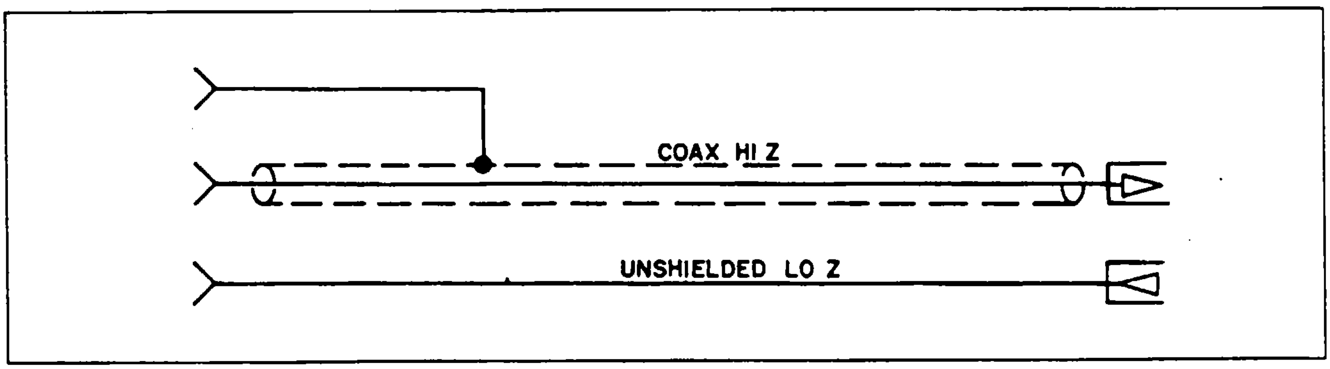


Figure 28-16A. Test Cables For Tank Unit Testing

4. SCALE ERROR TEST:

—NOTE—

The indicator being tested should be tapped lightly (3 times per minute) before a test point reading is taken.

A. Connect the test equipment as shown in View A of Figure 28-16.
B. See Figure 28-17 for location of indicator EMPTY and FULL calibration screws. Any calibration screw should have sufficient range to compensate for +/- 5 pF different capacitance at zero or 1200 pounds.
C. Slowly vary the capacitance tester for left tank simulation to obtain pointer readings in Chart 2804 in the down scale direction only. Readings obtained must fall within the tolerance specified in Chart 2804.
D. Connect the test equipment as shown in View B of Figure 28-16 and repeat test for the right tank simulation.

5. POSITION ERROR TEST:

A. With the indicator being tested in the normal upright position, obtain down scale readings for both left and right tank simulation on the capacitance tester. When the dial on the indicator reads 700 pounds, note these readings.
B. Rotate the indicator 90 degrees clockwise and repeat Step A above; again note readings obtained.
C. Rotate the indicator 90 degrees counterclockwise from the normal upright position and repeat Step A above.
D. The four readings obtained in Steps B and C must fall within +/- 2.0 pF of the normal upright position reading obtained in Step A.

6. POINTER OVERSHOOT AND RESPONSE TIME:

A. Disconnect the 28 volt power supply from the indicator being tested. Set the capacitance tester for both the left and right tank simulation to value equivalent to full fuel.
B. Apply the +28 volt dc power to the indicator being tested and observe both pointers on the dial indicator. There should be no overshoot of the pointers, and the time required for pointers to reach final position (1200 lbs.) should exceed minimum of two seconds.

7. FAILURE INDICATION TEST:

A. Disconnect the 28 volt power supply to the indicator being tested. Both pointers on the indicator must go off scale and come to rest below the zero mark.

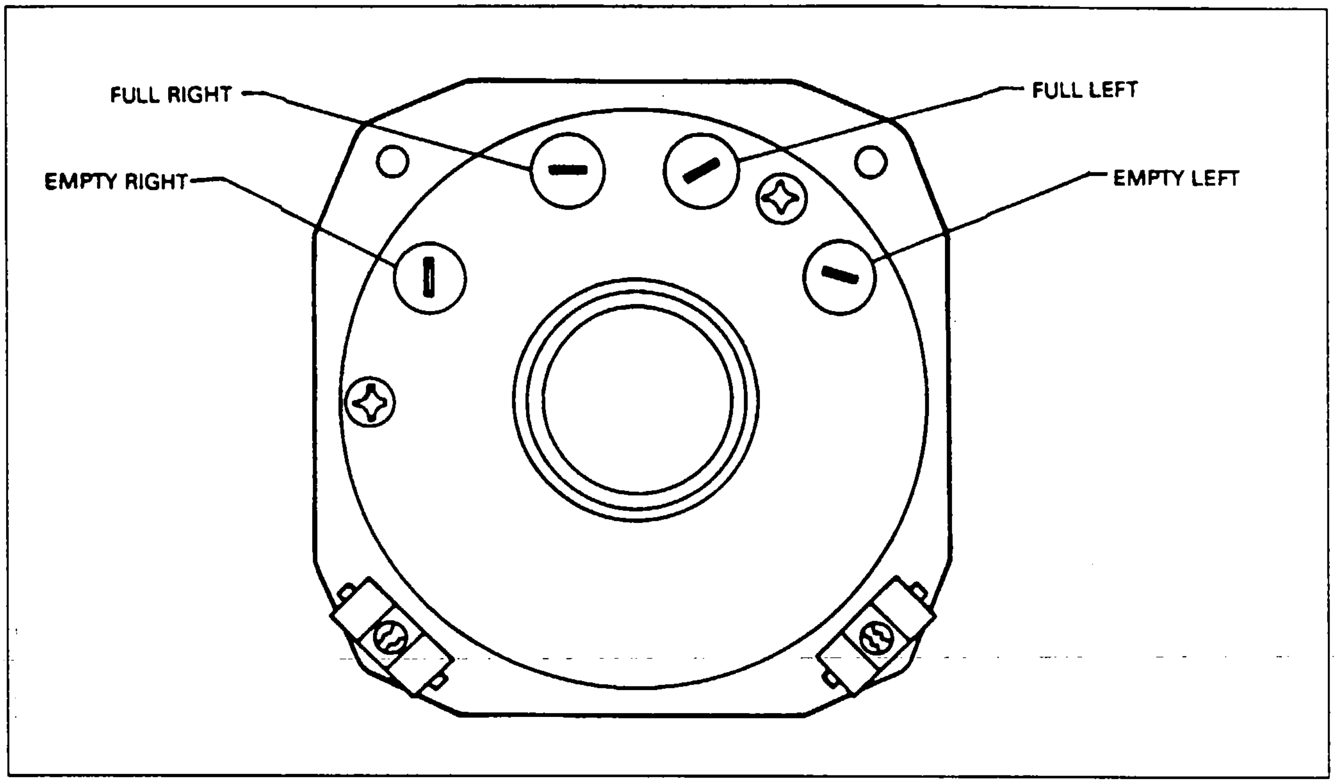


Figure 28-17. Fuel Gauge Adjustment

CHECKS AND ADJUSTMENTS OF FUEL QUANTITY GAUGE.

1. Completely drain the fuel system. (Refer to Draining Fuel Cells, Chapter 12).
2. Level the airplane longitudinally and laterally. (Refer to Leveling, Chapter 8).
3. Determine that the crossfeed and firewall shutoff valves are closed.
4. Add unusable fuel to the tank. (4 gal. per side).

—NOTE—

The electrical system must supply power to the gauge to make these checks. The gauge must read zero with unusable fuel in the tank, and below zero, when turned off.

5. With the master switch ON, observe the fuel quantity gauges, both should read zero. If not, adjust the particular gauge to read zero by turning the proper set screw, located on the rear of the gauge, marked "Empty - Right and Left" to obtain the zero reading.
6. Add fuel to each wing in increments as indicated in Chart 2804. Fuel quantity gauge indication must be within +/- 50 pounds.

—*CAUTIONS*—

Adjust the fuel quantity gauge, if required, at zero fuel and full fuel only; do not make adjustments anywhere in the mid range.

It is extremely important that the weight of the fuel be accurate, before readjusting the quantity gauge. A particular batch of Jet A that weighs 1200 lbs per 180 U.S. gallons at +70°F will probably take 183 U.S. gallons of +100°F fuel to weigh 1200 pounds

If greater than 50 pound adjustment is made to the FULL setting, in step 6, it is important that the EMPTY setting be reverified, according to steps 4 and 5.

CHART 2806. 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 2803, to run a 10 or more megohm test of the tank sensor system in each wing.

—*WARNING*—

DO NOT USE A HIGH VOLTAGE "MEGGER". DANGER OF EXPLOSION. See warning under paragraph titled Cleaning of Tank Units.

Trouble	Cause	Remedy
Dead-gauge does not come up to zero pounds.	No dc power to gauge.	Correct loss of +24V dc 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 24V dc, 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 2805.
Gauge appears to work properly but is not properly calibrated.	Tanks are partly or completely filled with other than jet fuel.	Test Fuel Quantity Indicator per Chart 2804 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.

FUEL CONSUMED TOTALIZER (OPTIONAL).

Refer to Chapter 73, Indicating.

—END—

3C23 THRU 3D8
INTENTIONALLY LEFT BLANK

CHAPTER

29

HYDRAULIC POWER

CHAPTER 29 - HYDRAULIC POWER

TABLE OF CONTENTS / EFFECTIVITY

CHAPTER 29 - HYDRAULIC POWER (cont.)

TABLE OF CONTENTS / EFFECTIVITY

CHAPTER 29 - HYDRAULIC POWER (cont.)

TABLE OF CONTENTS / EFFECTIVITY

THIS PAGE INTENTIONALLY LEFT BLANK

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 hydraulic power pack is located in the fuselage nose section just aft of the nose baggage compartment, and is operated by a selector lever in the shape of a wheel mounted to the right of the left control column. The power pack contains the system reservoir and assorted valves which control the system operation. The power pack works in conjunction with various electrical switches and solenoid valves to perform the desired sequence of operation as selected by the control lever in the cockpit. Movement of the selector lever operates a control arm on the power pack through a flexible cable assembly and connecting arms. A solenoid operated lock is located behind the instrument panel as part of the selector assembly to prevent the lever from being moved to the up position while the airplane is on the ground. (Weight of the airplane on the landing gear.) This solenoid is spring-loaded to the locked position and is activated by an anti-retraction (squat) switch mounted on the left main gear, upper torque link. The anti-retraction switch will also sound a warning horn if the selector lever is moved to the gear up position while the aircraft is on the ground and the master switch is ON. If the selector handle can be moved to the up position while the airplane is on the ground, it is an indication of an improperly adjusted selector mechanism or the anti-retraction system is inoperative. The anti-retraction switch is actuated by the last .250 of an inch of oleo extension. When the selector is moved to either the up or down position, it is locked in place by the action of the handle release valve at the power pack, acting against the release mechanism detent. The handle will remain in this position until it is manually released or until fluid pressure in the actuator and lock release reaches a preset pressure. At this time, the pressure forces the plunger in the lock release down, allowing the lever to return to either the up or down neutral position. (Depending on what the selector lever was set to.) An electrically operated door solenoid valve located in the power pack will position itself in the door (main inboard gear doors) open position when the selector lever is placed in the up or down position with the master switch on; this valve is spring-loaded in the open position and requires electrical current to remain in the closed position. In the event of an electrical failure, the valve will position itself in the open position and allow the doors to open when the selector lever is actuated and hydraulic pressure is routed through the system.

The engine driven hydraulic pumps draw fluid from the power pack reservoir and pump it through the system filters, mounted on the engine side of the fire wall, and check valves back to the pressure port of the power pack. Within the power pack, fluid travels into the gear door solenoid valve and landing gear selector pressure chamber. When the selector valve is in the neutral position, the fluid travels through the landing gear selector valve back to the reservoir.

When the selector valve is moved either to the up or down position, it electrically actuates the door solenoid valve to the open position, thus allowing fluid to flow through the door solenoid valve and into the hydraulic cylinders thus opening the doors. During the time the doors open, the gear priority valve remains closed as less pressure is required to operate the door cylinders. After the gear doors have opened, pressure continues to build up enough to allow the priority valve to open and permit fluid to flow through the gear selector valve to the gear actuating cylinders, thus allowing the gear to move to the selected up or down position.

After the gear has moved to the full up or down position, limit switches are actuated which cause the electrically operated door solenoid valve to move to the door closed position, allowing the door actuating cylinders to close the gear doors. When the doors have fully closed, pressure builds up in the time delay valve, operated by pressure in the closed door cylinders. The valve opens and allows fluid to flow to the handle release valve, thus returning the selector lever to neutral. With the selector in neutral, fluid is allowed to circulate back to the reservoir.

The main relief valve functions as a safety between the pump and selector valves. When the main relief valve opens, fluid is directed back to the reservoir. The hand pump relief valve also serves as a secondary relief valve. Valve operating pressures can be found in Chart 2902.

The thermal relief vent valve functions as a safety to relieve pressure due to thermal expansion in the gear door actuating cylinders.

The hand pump serves as an emergency pump, should the engine driven pumps fail. The system check valves prevent the fluid from backing up through the engine driven pumps into the reservoir. In the event of severe leakage of the hydraulic fluid, the standpipe in the reservoir prevents the fluid level from dropping below the emergency quantity required for the operation of the system by means of the hand pump. The engine driven pumps are supplied with fluid through the standpipe, so that when the fluid level goes below the top of the standpipe, no fluid will flow. Thus, even though the system may develop a break, and the engine driven pumps continue to operate, devoiding the system of fluid, the standpipe retains sufficient fluid in the reservoir for hand pump operation.

In case of an electrical failure, the door solenoid valve 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.

—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.

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 can not 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.
	If gear completes cycle (red light out) but doors do not close battery output may be low.	Check voltage.
	Time delay valve and/or piston release lock out of adjustment.	Check operation.

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont.)

Trouble	Cause	Remedy
Selector handle returns to neutral before cycle is complete. (cont.)	Time delay valve air locked.	Bleed air out by holding selector down for 30 seconds, then make three or four rapid movements to neutral and back to down.
Gear retracts or extends before doors open.	Priority valve leaks in power pack.	Check valve cracking pressure.
	Solenoid valve stuck in closed position.	Turn off power and hand pump doors open. (Note: With power off sole noid 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 locking mechanism.	Check actuator operation.
Doors fail to close.	Faulty limit switch.	Check all indicator light.
	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. Disconnect the hydraulic lines at the engine driven pumps.
3. Drain the hydraulic fluid from the power pack reservoir.
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.

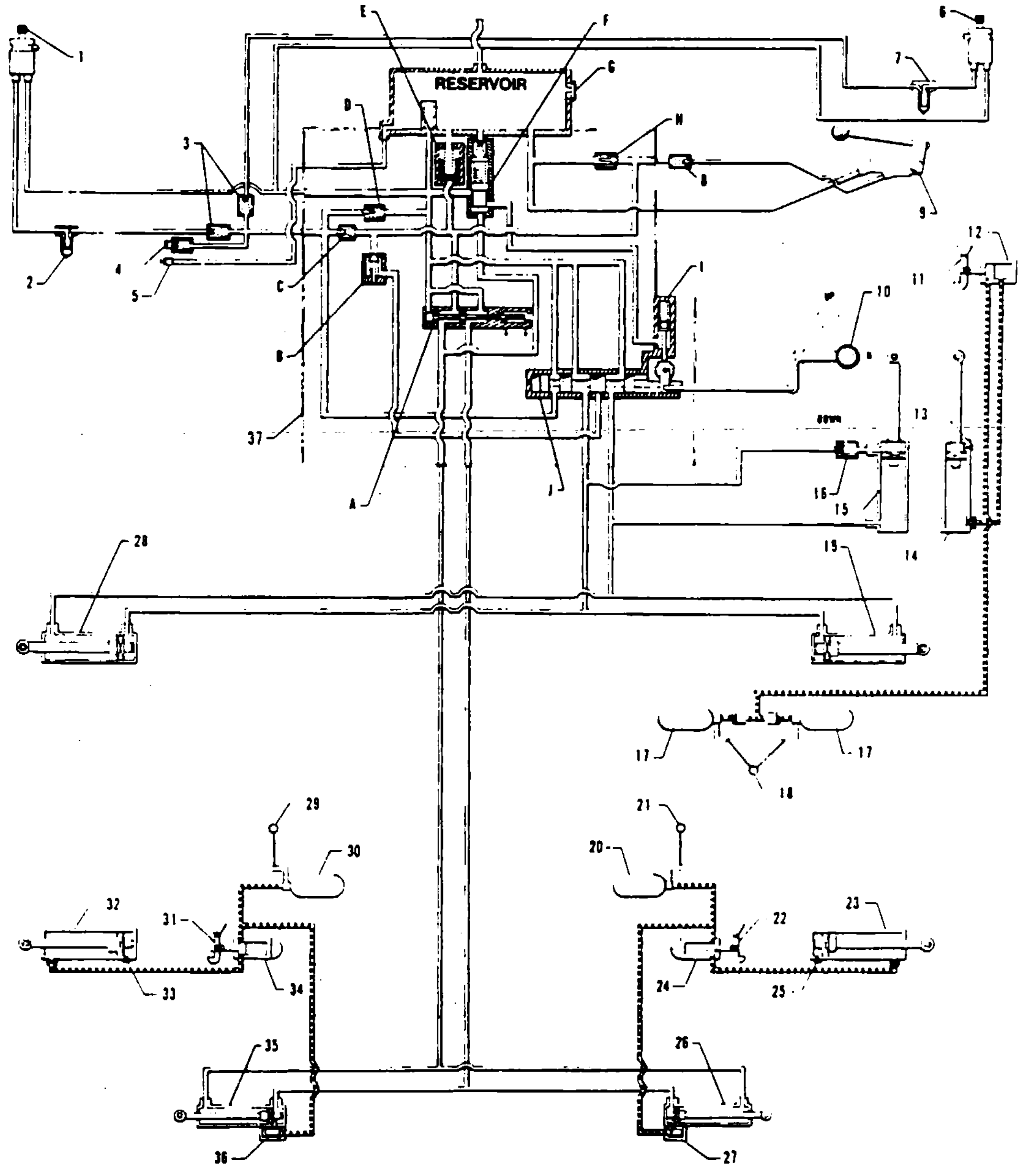


Figure 29-1. Schematic Diagram, Hydraulic System

1. HYDRAULIC PUMP - LEFT ENGINE
2. HYDRAULIC FILTER - LEFT ENGINE
3. CHECK VALVES FOR LEFT AND RIGHT PUMPS
4. PRESSURE PORT
5. SUCTION - FILL
6. HYDRAULIC PUMP - RIGHT ENGINE
7. HYDRAULIC FILTER - RIGHT ENGINE
8. HAND PUMP CHECK VALVE
9. HAND PUMP
10. GEAR SELECTOR (REMOTE)
11. UPLOCK HOOK - PNEUMATIC SYSTEM
12. PNEUMATIC ACTUATOR FOR RELEASING UPLOCK HOOK
13. FILTER/VENT
14. PNEUMATIC ACTUATOR - NOSE GEAR
15. HYDRAULIC ACTUATOR - NOSE GEAR
16. RESTRICTOR VALVE
17. NITROGEN BOTTLES - NOSE GEAR PNEUMATIC SYSTEM
18. OPERATING LANYARD - NOSE GEAR PNEUMATIC SYSTEM
19. HYDRAULIC ACTUATOR - RIGHT MAIN GEAR
20. NITROGEN BOTTLE - RIGHT MAIN GEAR PNEUMATIC SYSTEM
21. OPERATING LANYARD - RIGHT MAIN GEAR PNEUMATIC SYSTEM
22. UPLOCK HOOK - RIGHT MAIN PNEUMATIC
23. PNEUMATIC ACTUATING CYLINDER - RIGHT MAIN GEAR
24. PNEUMATIC ACTUATOR FOR RELEASING UPLOCK HOOK
25. FILTER/VENT
26. GEAR DOOR ACTUATING CYLINDER - RIGHT MAIN
27. SHUTTLE VALVE
28. HYDRAULIC ACTUATOR - LEFT MAIN GEAR
29. OPERATING LANYARD - LEFT MAIN PNEUMATIC SYSTEM
30. NITROGEN BOTTLE - LEFT GEAR PNEUMATIC SYSTEM
31. UPLOCK HOOK - LEFT GEAR PNEUMATIC SYSTEM
32. PNEUMATIC ACTUATING CYLINDER - LEFT MAIN GEAR
33. FILTER/VENT
34. PNEUMATIC ACTUATOR FOR RELEASING UPLOCK HOOK
35. GEAR DOOR ACTUATING CYLINDER - LEFT MAIN
36. SHUTTLE VALVE
37. POWER PACK

A. DOOR SOLENOID VALVE
B. PRIORITY VALVE
C. ENGINE PUMP CHECK VALVE
D. MAIN RELIEF VALVE
E. LOW PRESSURE THERMAL RELIEF VENT VALVE
F. TIME DELAY VALVE
G. SIGHT GAUGE
H. HAND PUMP RELIEF VALVE
I. PISTON RELEASE (LOCK)
J. LANDING GEAR SELECTOR VALVE

Figure 29-1. Schematic Diagram, Hydraulic System (cont.)

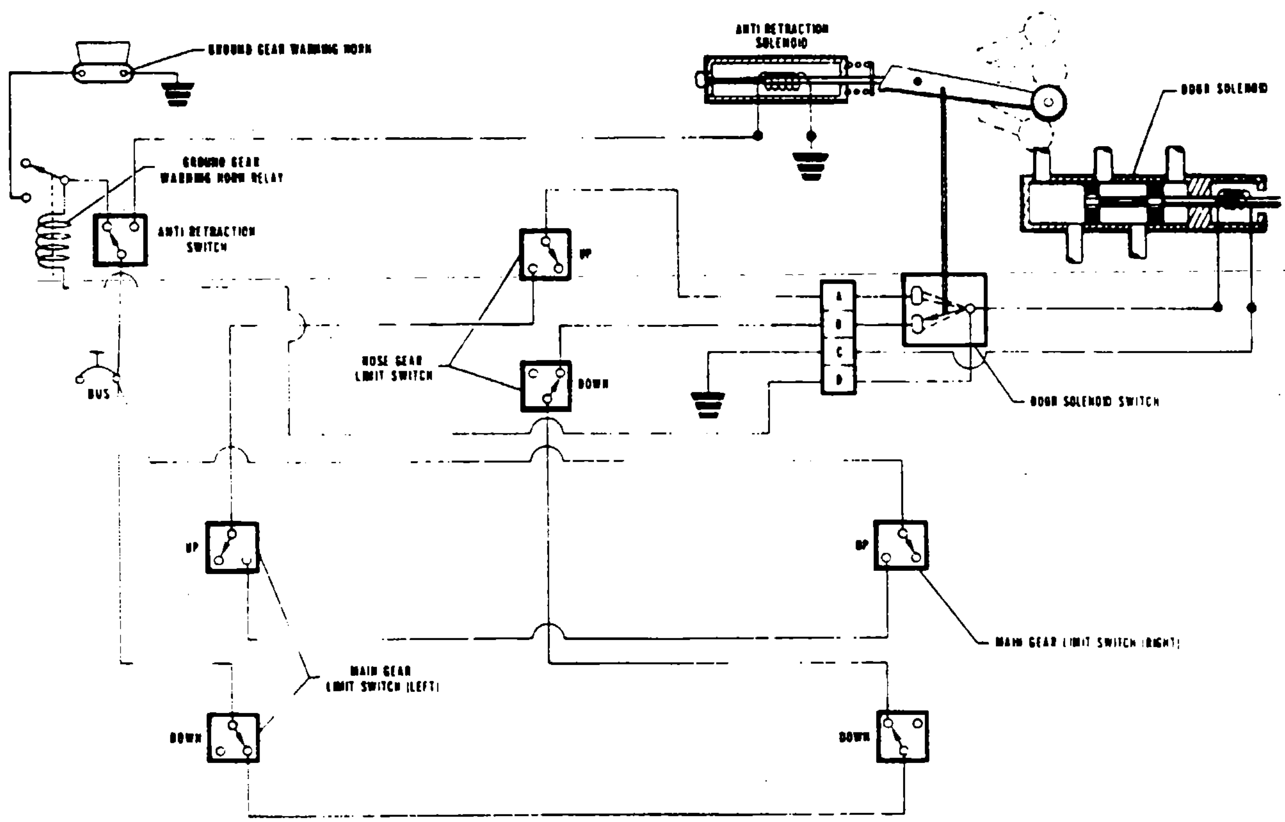


Figure 29-2. Schematic of Power Pack Electrical System

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 neutral 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*—

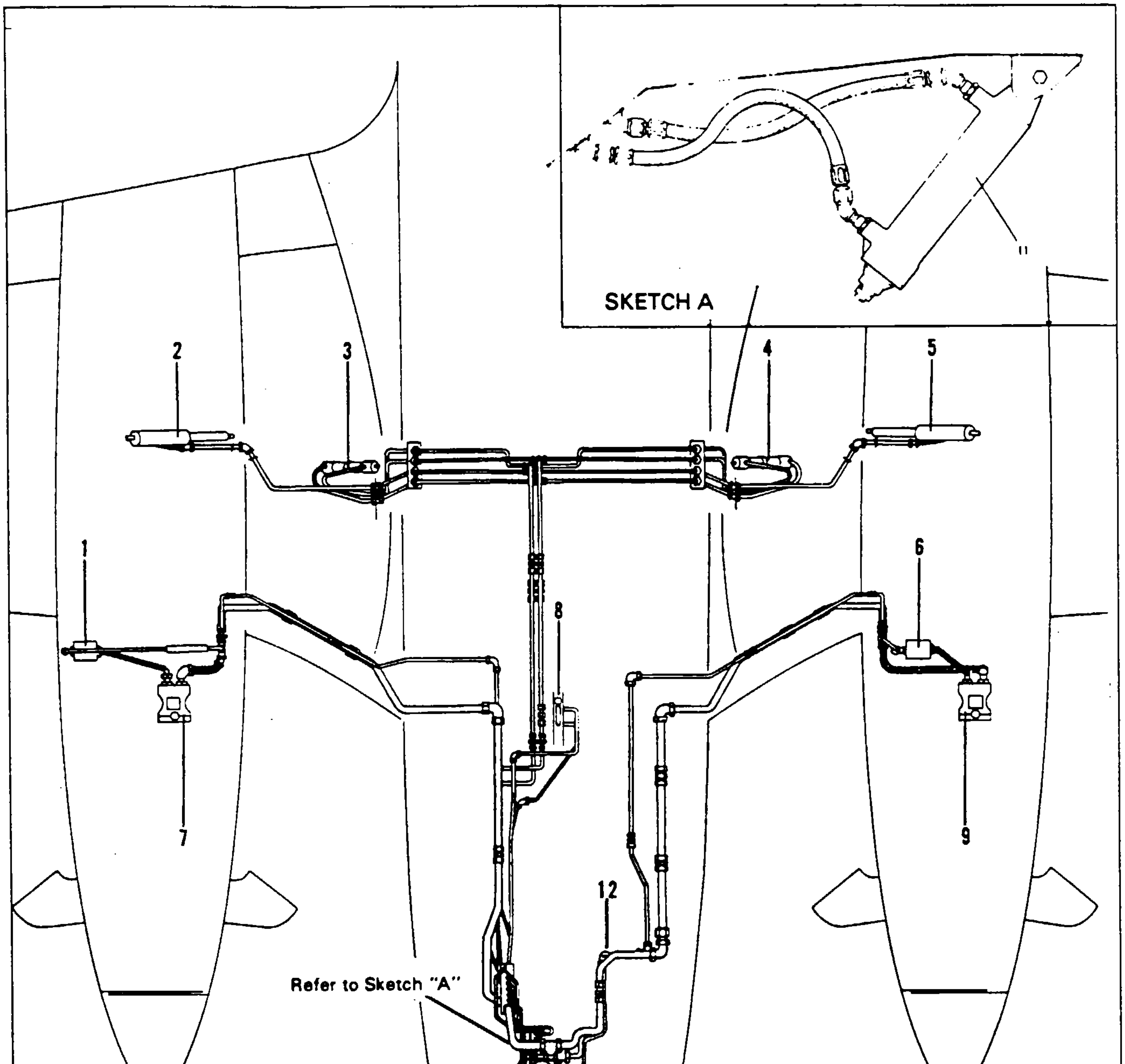
Gear cycling time can be prolonged by slowly opening the test unit bypass valve part way. This will bleed off part of the pump flow.

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).



1. FILTER, RIGHT PUMP
2. GEAR ACTUATING CYLINDER, RIGHT
3. DOOR ACTUATING CYLINDER, RIGHT
4. DOOR ACTUATING CYLINDER, LEFT
5. GEAR ACTUATING CYLINDER, LEFT
6. FILTER, LEFT PUMP
7. HYDRAULIC PUMP, RIGHT
8. EMERGENCY HAND PUMP
9. HYDRAULIC PUMP, LEFT
10. POWER PACK ASSEMBLY
11. GEAR ACTUATING CYLINDER, NOSE
12. DRAIN TUBE

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 8 seconds ± .5 seconds plus the time required for the time delay valve to operate. (Refer to Chart 2902 for hydraulic fluid flow rate).

—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 fire wall 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 3 to 9 seconds at room temperature. Colder temperature will cause a longer delay.

4. If the time delay fails specification given ascertain that valve is not air locked. Bleed air out by holding selector down for 30 seconds, then make three or four rapid movements to neutral and back to down.
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 the doors closed.
4. Set the hydraulic test unit bypass valve full open.
5. Place the landing gear selector handle in the full down position.
6. Very slowly close the bypass valve until the handle trips back to neutral. Read the gauge at the point of the handle trip. The pressure should be as indicated in Chart 2902. Be sure to allow time for the time delay valve to open.

—NOTE—

One release valve serves to release the handle from both the gear down and gear up positions. If the handle return springs are adjusted correctly, the release valve should release the handle from both positions at the same pressure. The preceding procedure checks the release pressure from the gear down position, and the following procedure checks the release pressure from the gear up position. This is performed only to assure satisfactory operation of other equipment relative to handle release operations.

7. Set hydraulic test unit bypass valve full open.
8. Place landing gear selector handle in the full up position.
9. Very slowly close the bypass valve until the handle trips back to neutral. Read the gauge at the point of handle trip. The pressure should be as indicated in Chart 2902. Be sure to allow time for the time delay valve to open.
10. Refer to handle release adjustment, should it be required.
11. Ascertain that the landing gear selector handle is in the down neutral position, and that the landing gear is down and locked.
12. Disconnect test unit, and remove airplane from jacks.

CHECKING PRIORITY VALVE.

1. Connect hydraulic test unit, and place airplane on jacks in accordance with Jacking, Chapter 7.
2. Cycle landing gear through two complete cycles.
3. With gear down and locked and test unit operating, turn the master switch off, move the gear handle to the down position. This will cause the doors to open and the handle will return to neutral position. Leave the switch off to permit the doors to remain open, thereby making it easier and faster to complete this check.
4. Open hydraulic test unit bypass valve.
5. Place landing gear selector handle full up. Very slowly close bypass valve, observing pressure gauge of the test unit and noting pressure at which priority valve opens. Priority valve should open at 600-650 psi as indicated in Chart 2902.

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	1220 - 1250 P.S.I.
Time Delay Valve	5 to 9 seconds
Hydraulic Fluid Required	MIL-H-5606
Weight Dry - Power Pack	10.00 pounds
Hydraulic Fluid Flow Rate (Both Pumps Operating)	1.6 G.P.M.
Reservoir Operating Fluid Level (Engine Pump) (Minimum - Maximum)	1.82 - 2.1 pints
Reservoir Fluid Level (Emergency) (Stand Pipe Level)	1.22 pints

—*NOTE*—

As the priority valve opens, the nose gear down lock starts to release. Read the pressure gauge at this point.

6. Make any priority valve adjustments as required.
7. Ascertain that the landing gear selector handle is in the down neutral position, and that the landing gear is down and locked.
8. Disconnect the test unit and remove the airplane from jacks.

CHECKING MAIN RELIEF VALVE.

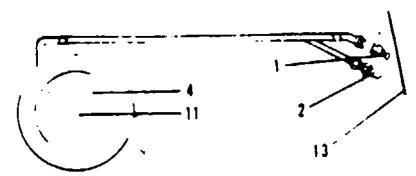
1. Connect test unit.
2. Open test unit bypass valve.
3. Hold the landing gear selector handle in the full down position.
4. Slowly close bypass valve, observing pressure build-up and point at which pressure stabilizes on test unit gauge. Stabilization indicates relief valve setting. The relief valve pressure and flow rate are 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.

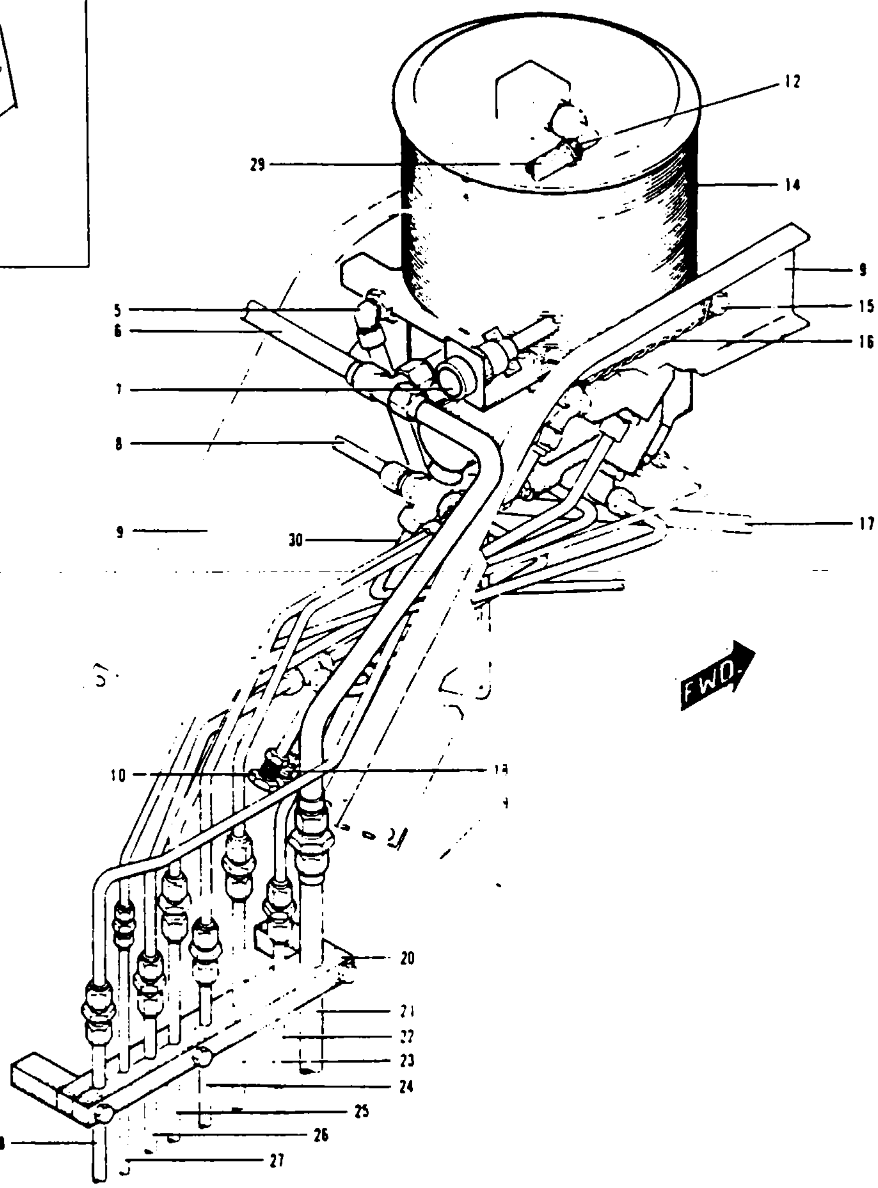
1. Place landing gear selector handle in the full down position. With master switch off, extend the handle located to the right of the pilot's seat under the floor, and operate emergency hand pump to open landing gear doors.
2. Disconnect door open line (upper fitting) from main gear door cylinder and 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, 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.



SKETCH A



1. SUCTION, FILL, AND DRAIN PORT
2. PRESSURE PORT
3. TRANSPARENT RESERVOIR (WIEBEL UNITS)
4. POWER PACK
5. FITTING, ELBOW
6. LINE, RETURN L. ENGINE
7. CONNECTOR, ELECTRICAL
8. LINE, PRESSURE L. ENGINE
9. BRACKET, MOUNTING
10. LINE, GEAR DOWN
11. FITTING, VENT
12. HOSE, VENT
13. ACCESS OPENING
14. POWER PACK
15. BOLT
16. SAFETY WIRE
17. DRAIN
18. LINE, GEAR UP
19. PANEL, WHEEL WELL
20. BLOCK
21. LINE, RETURN R. ENGINE
22. LINE, PRESSURE R. ENGINE
23. LINE, DOOR CLOSE
24. LINE, GEAR UP
25. LINE, DOOR OPEN
26. LINE, GEAR DOWN
27. LINE, HAND PUMP PRESSURE
28. LINE, HAND PUMP SUCTION
29. TO DRAIN TUBE
30. SUCTION, FILL AND DRAIN LINE

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—

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 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. Reach through the nose baggage compartment upper, aft access panel, and position the Power Pack within the mounting brackets. Install the bolts to secure it in place. Safety wire the bolts.
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 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 and in the nose baggage compartment.
8. Check the system operation.

DISASSEMBLY, CLEANING, INSPECTION AND REPAIR OF HYDRAULIC POWER PACK AND COMPONENTS.

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 reinstalled, 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.)

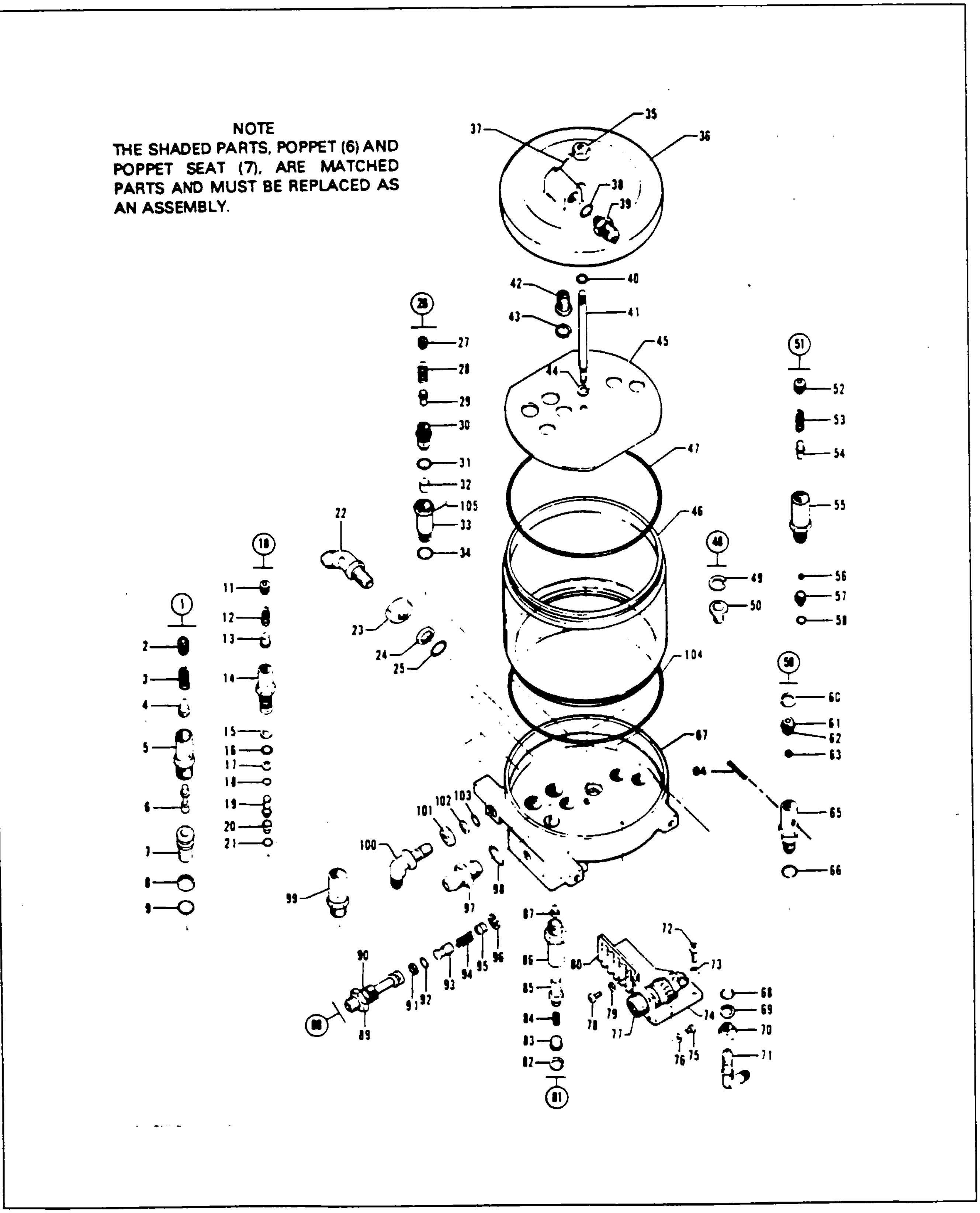
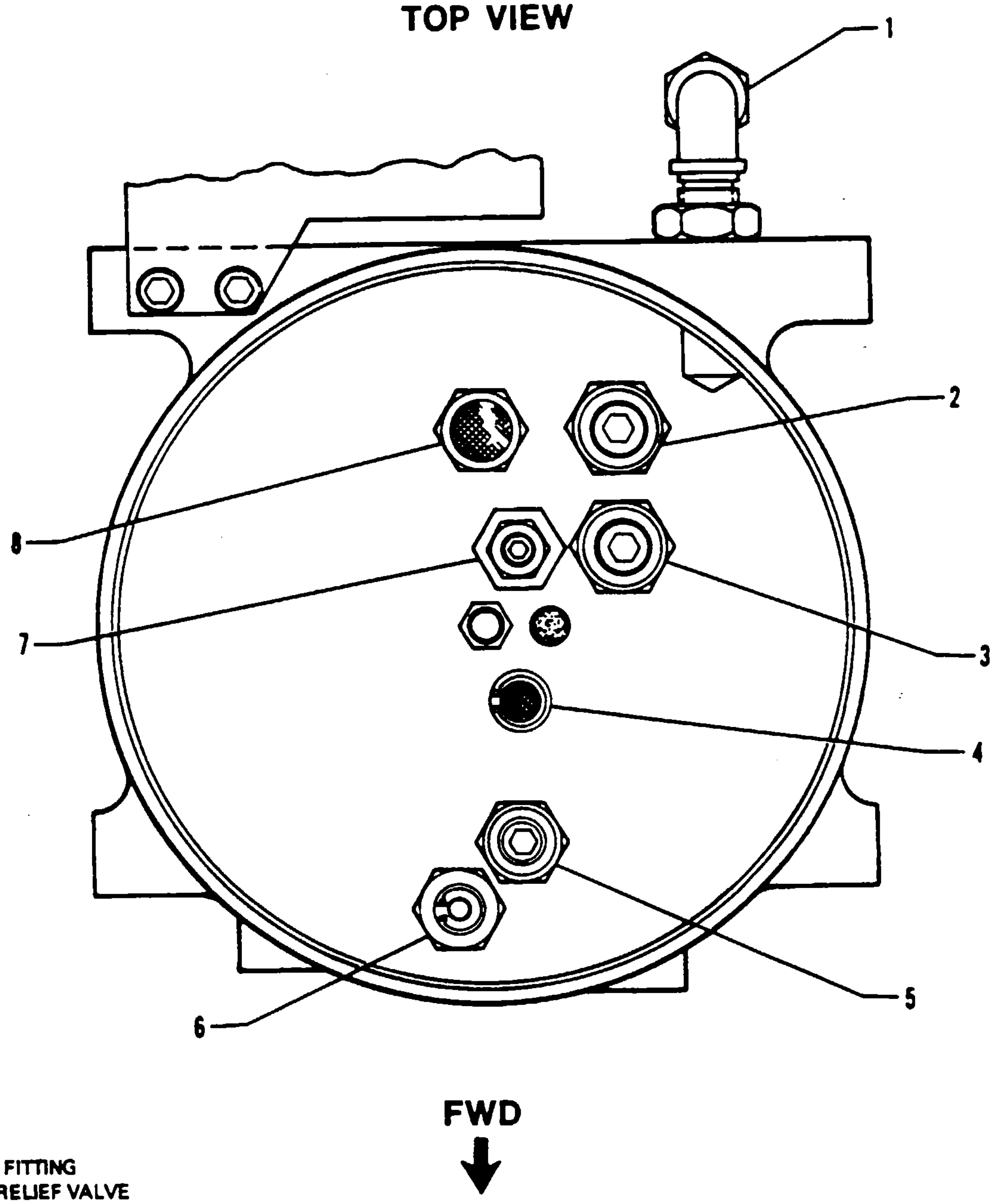


Figure 29-5. Hydraulic Power Pack

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 (±.06 inch) with the manifold body at the end opposite the selector spool teeth. 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 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.

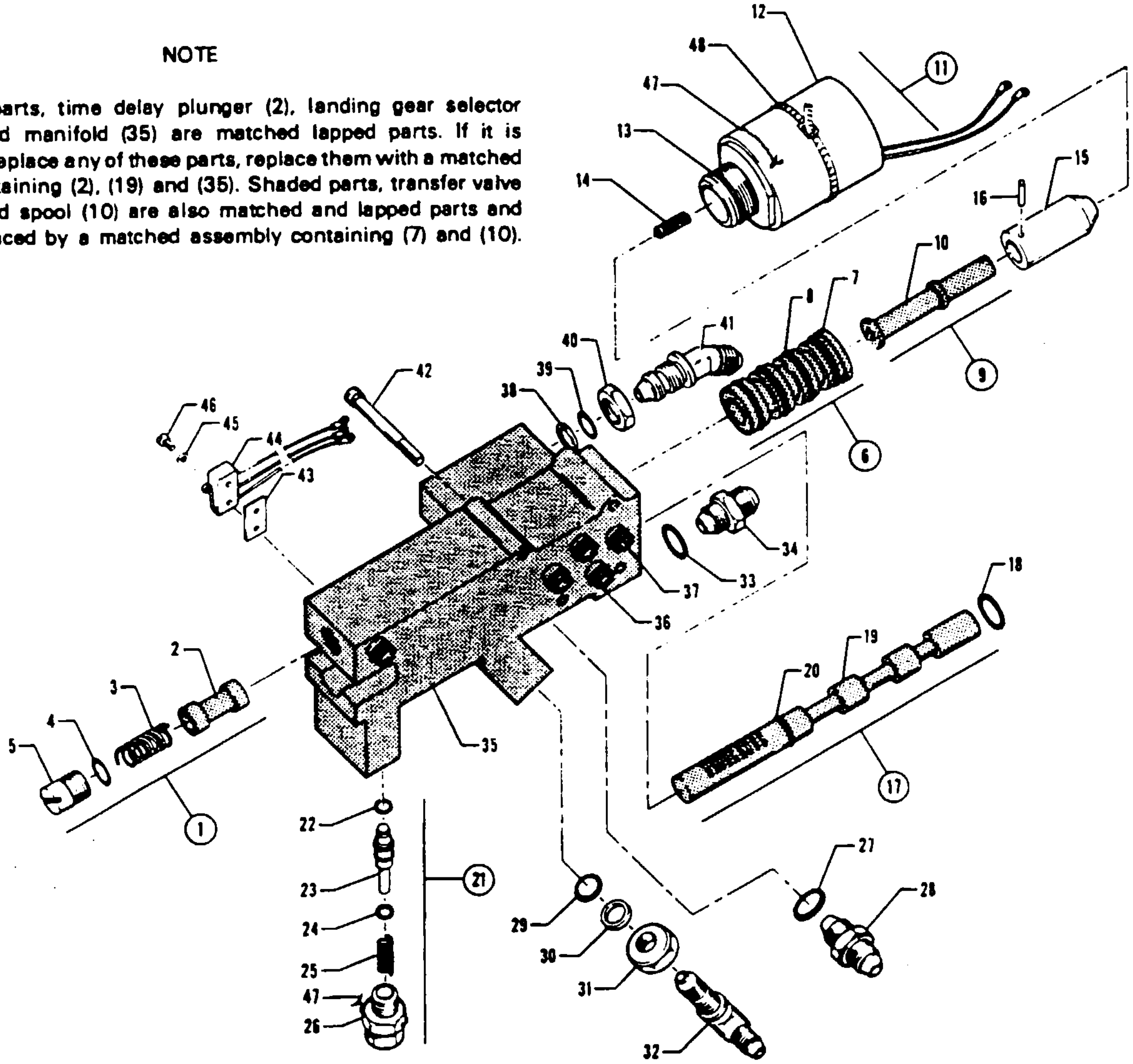
—NOTE—

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.

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 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—

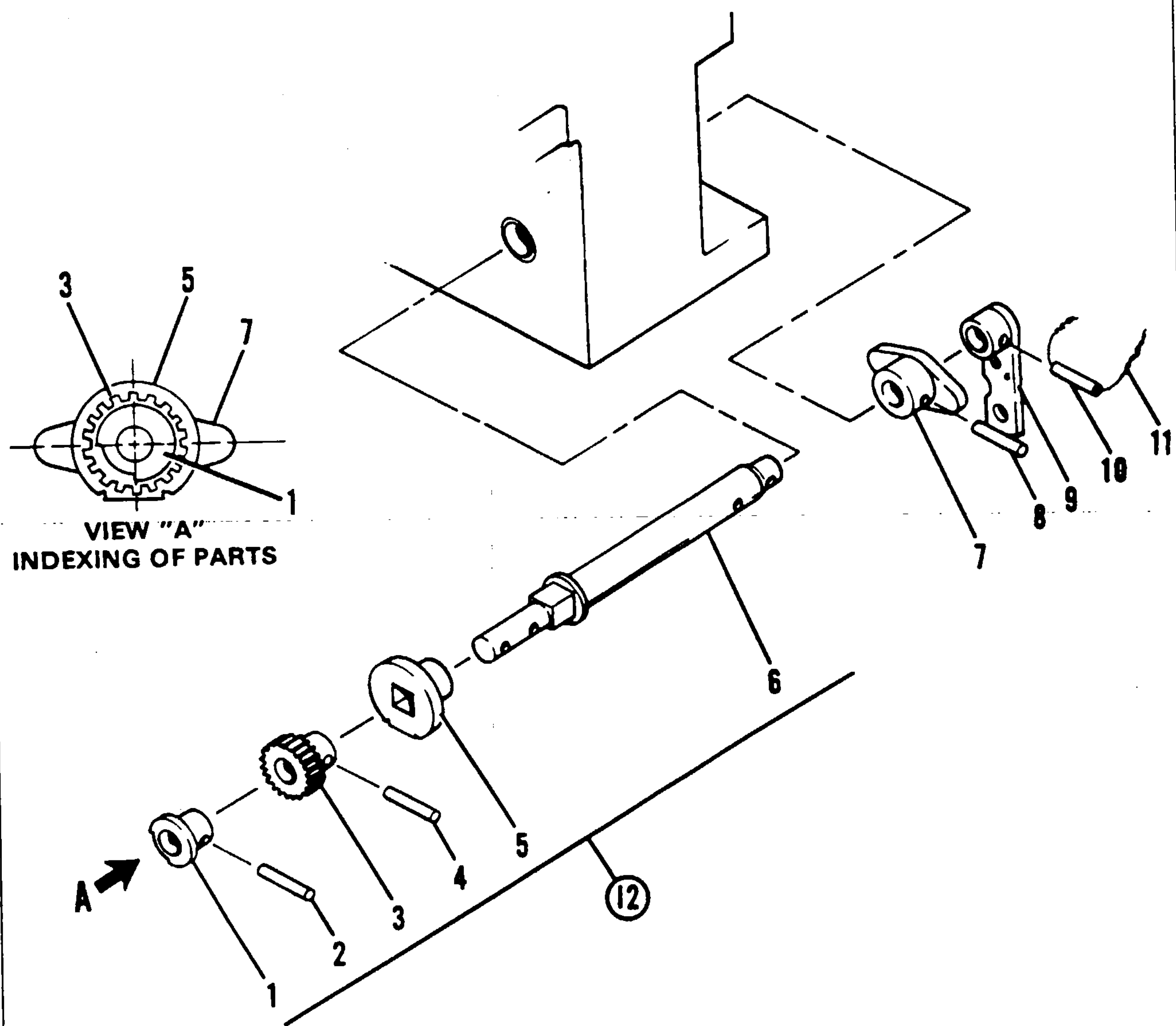
Take care when removing snap rings, cartridges are spring loaded.

LANDING GEAR 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.



1. SWITCH CAM
2. PIN
3. GEAR
4. PIN
5. DETENT CAM
6. INPUT SHAFT
7. RETURN CAM
8. PIN
9. ARM
10. PIN
11. LOCKWIRE
12. INPUT ASSEMBLY SHAFT

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 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 clean, 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.
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 only.

2. Insert the selector spool into the manifold from the landing gear handle end of the manifold. Insert only until the taper of the selector spool is protruding out the manifold end, approximately .06 inches.

—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 win 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 tooth space 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 DOORS SWITCH.

1. Install switch assembly with insulating plate between 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 29-5) using safety wire.

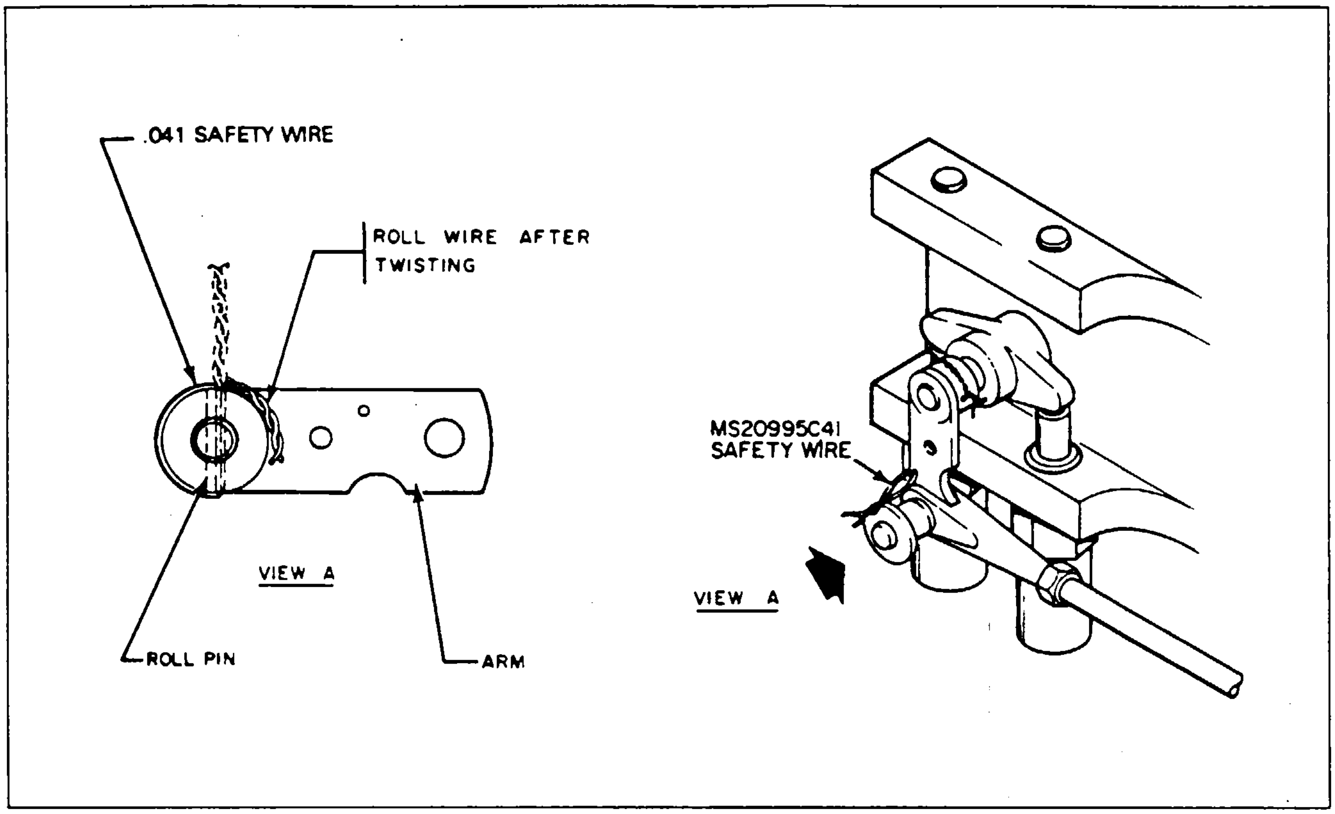


Figure 29-9. Safetying Control Arm - Wiebel

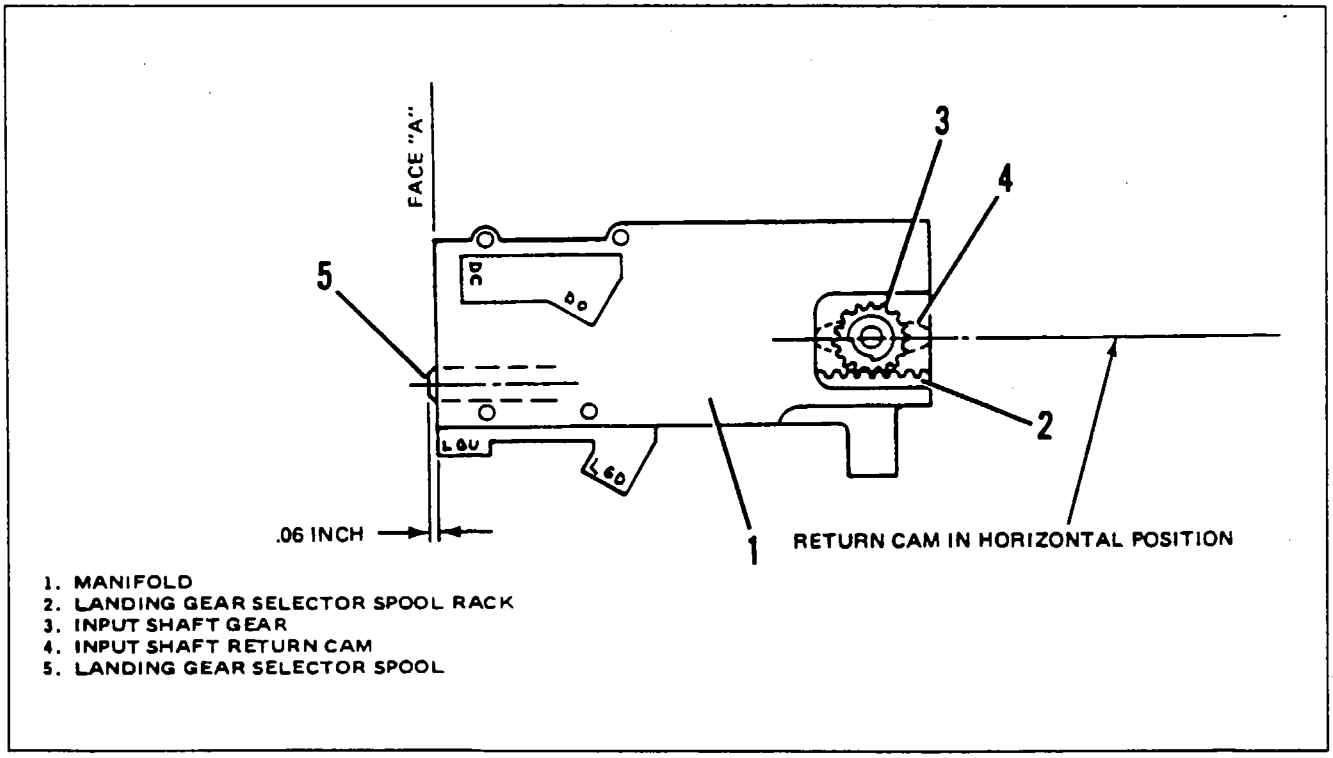


Figure 29-10. Indexing of Selector Spool - Wiebel

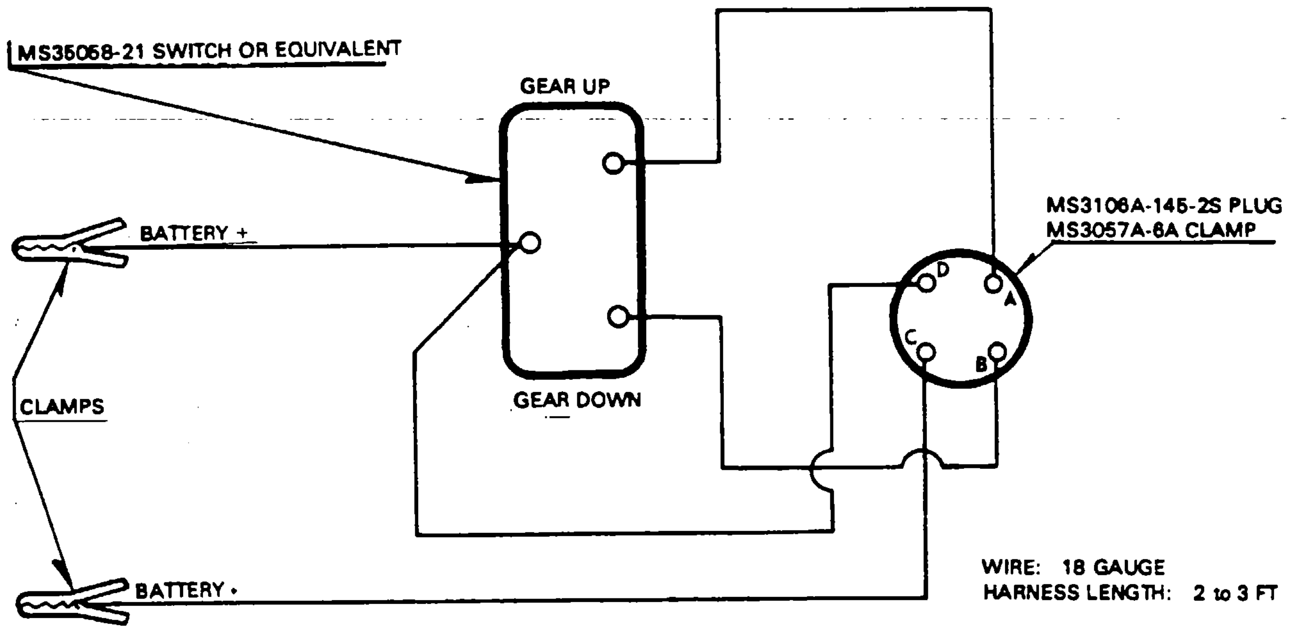


Figure 29-11. Power Pack Test Harness Schematic

4. Connect the electrical wires from 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.

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 pressure gauge of 200 psi capacity.
3. Connect the test pressure hose to the pressure inlet port of the Power Pack. The 2500 psi gauge is to operate off the pressure line.
4. Connect the suction hose to the suction port of the Power Pack.
5. If a vent hose is part of the test unit, connect it to the vent port at the top of the reservoir cover. DO NOT plug vent port.
6. Cap all other fittings with high pressure caps.

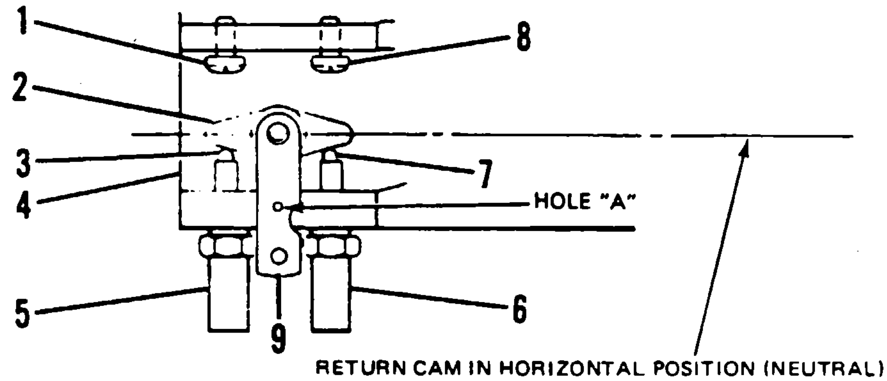
—NOTE—

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 stop screw to allow a slight overtravel past the detent position.
2. Rotate the input shaft into the "gear down" detent position and adjust 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.



1. STOP SCREW
2. INPUT SHAFT RETURN CAM
3. RETURN PLUNGER BALL
4. POWER PACK BODY
5. HANDLE RETURN CARTRIDGE
6. HANDLE RETURN CARTRIDGE
7. RETURN PLUNGER BALL
8. STOP SCREW
9. ARM

Figure 29-12. Handle-Release Adjustment

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 cap on "door open" fitting.
4. Disconnect the test unit and cap all open fittings.

ADJUSTMENT OF DOOR SOLENOID VALVE. (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 (also 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.

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 the fittings.
7. The hydraulic Power Pack is now ready to be installed in the airplane.

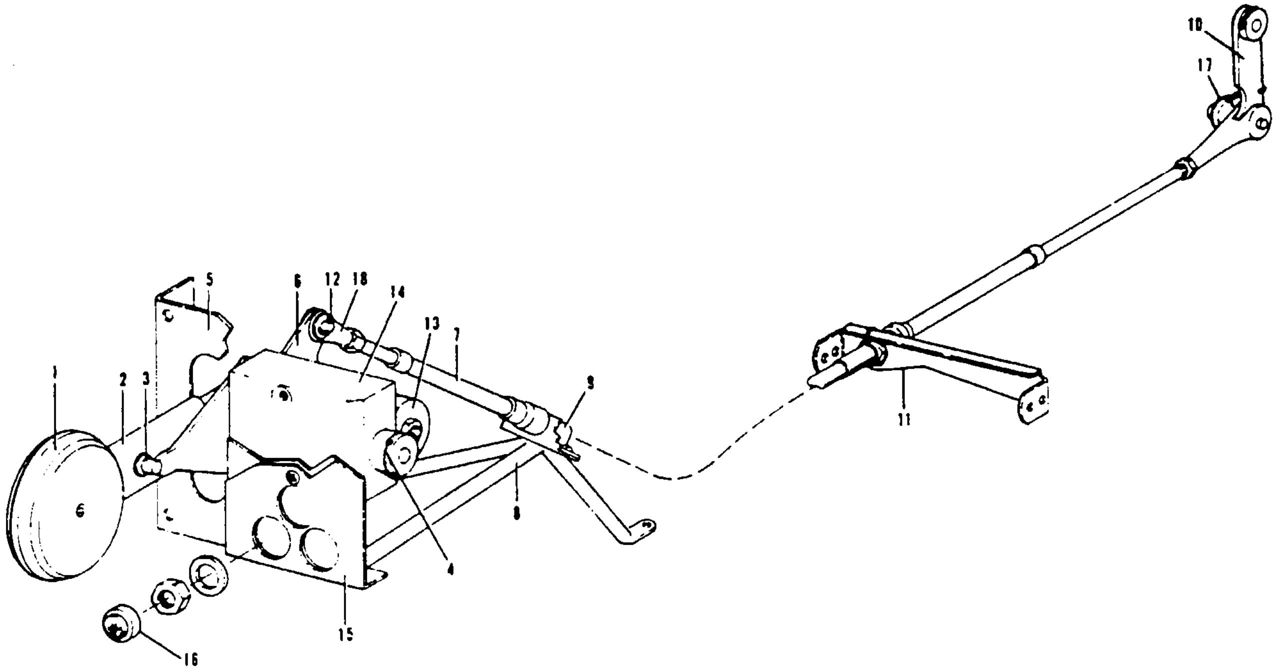
HYDRAULIC SYSTEM COMPONENT SERVICING.

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 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.



1. CONTROL KNOB
2. SLEEVE
3. STOP PIN
4. SAFETY WIRE
5. PLATE ASSY.
6. LEVER ASSY.
7. CABLE ASSY.
8. BRACKET ASSY.
9. CLAMP
10. CONTROL ARM
11. BRACKET ASSY.
12. PIN, WASHER AND COTTER PIN
13. SOLENOID
14. MOUNTING BLOCK
15. PANEL ASSY.
16. LIGHT ASSY.
17. CABLE ATTACHMENT PIN
18. TERMINAL

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.

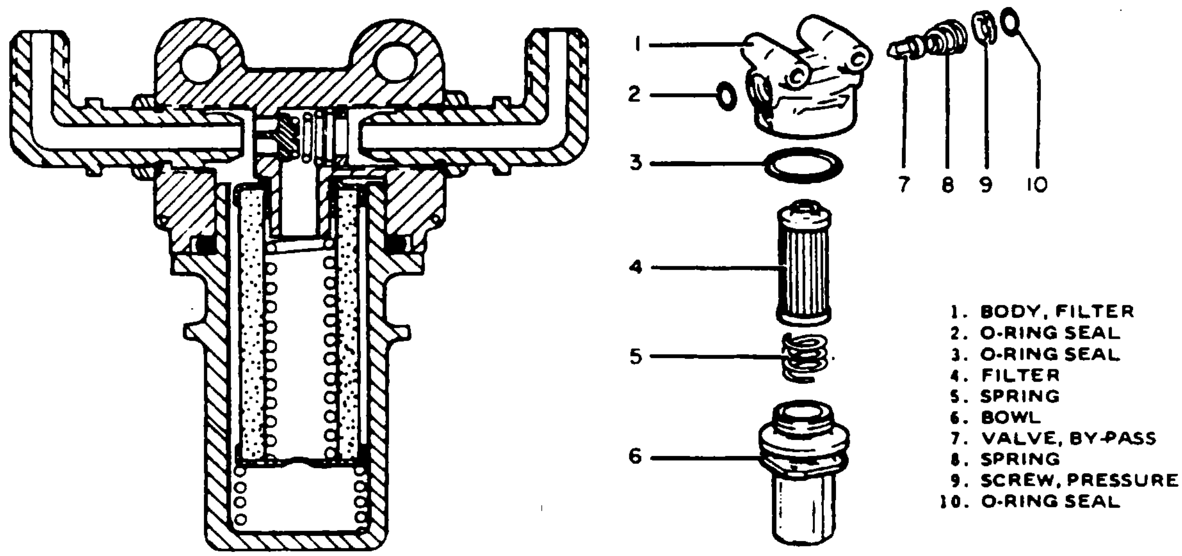


Figure 29-14. Hydraulic Filter

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 52% gas generator 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.

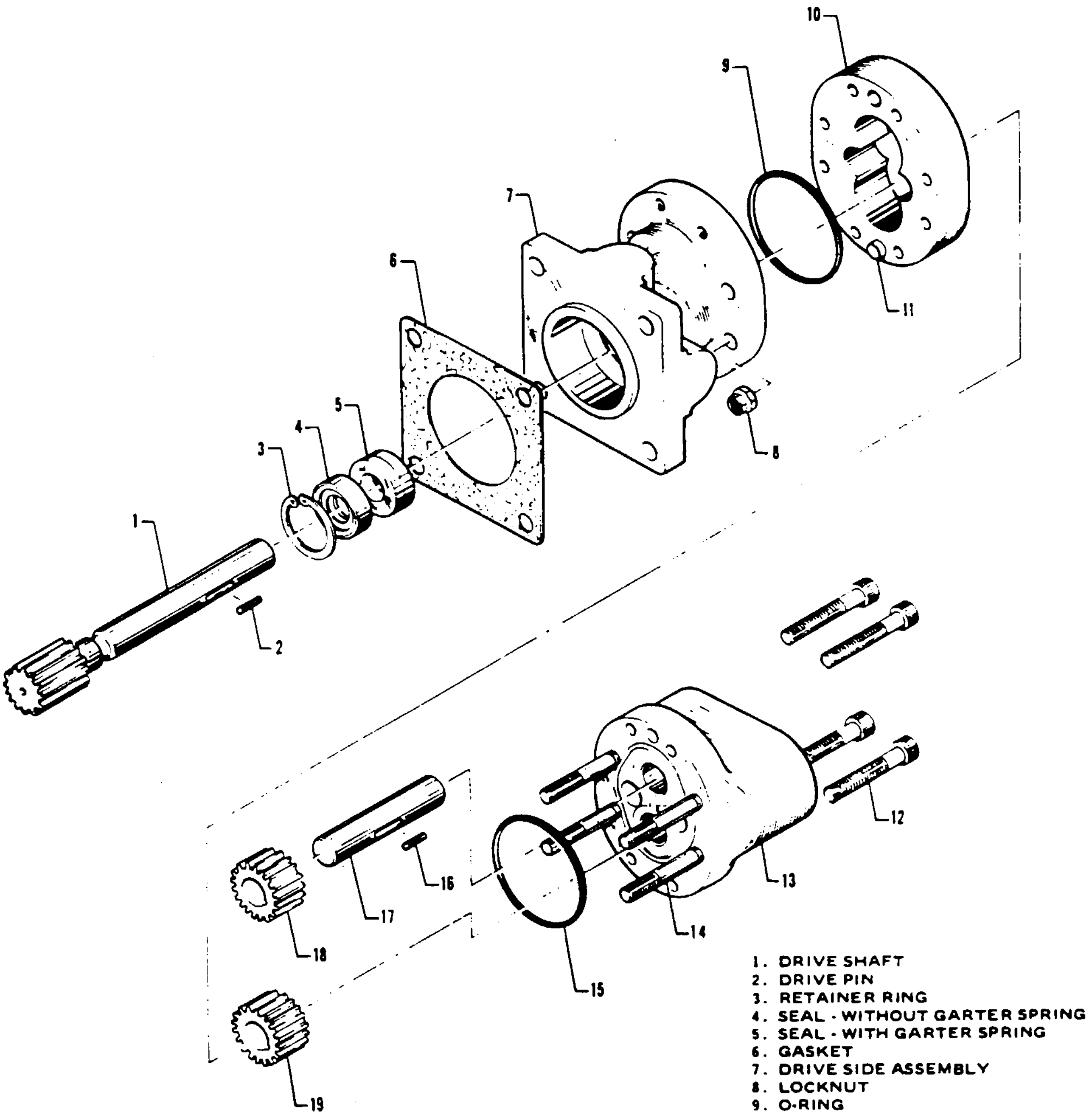
DISASSEMBLY OF HYDRAULIC PUMP. (Refer to Figure 29-7.)

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.



1. DRIVE SHAFT
2. DRIVE PIN
3. RETAINER RING
4. SEAL - WITHOUT GARTER SPRING
5. SEAL - WITH GARTER SPRING
6. GASKET
7. DRIVE SIDE ASSEMBLY
8. LOCKNUT
9. O-RING
10. CENTER PLATE ASSEMBLY
11. DOWELS (4)
12. SCREW, SQC. HD. CAP.
13. REAR SIDE ASSEMBLY
14. STUD
15. O-RING
16. DRIVE PIN
17. SECONDARY SHAFT
18. SECONDARY GEAR
19. DRIVE GEAR

Figure 29-15. Hydraulic Pump

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 2902. 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.

THIS SPACE INTENTIONALLY LEFT BLANK

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 position before the gear door closing cycle is complete. If this occurs, manual override of the time delay cycle must be used to close the gear doors.

During gear extension, if the selector returns to neutral at the same time the gears are locked down, and before the gear doors have had time to close, again select the gear down position and hold the handle down for an additional 3 to 4 seconds. This allows completion of the door closing cycle.

During gear retraction, if the selector returns to neutral and the gear unsafe light remains lit, again select the gear up position and hold the handle up for 4 seconds after the gear unsafe light extinguishes. Be sure that the light has extinguished before exceeding the maximum gear extended speed.

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.

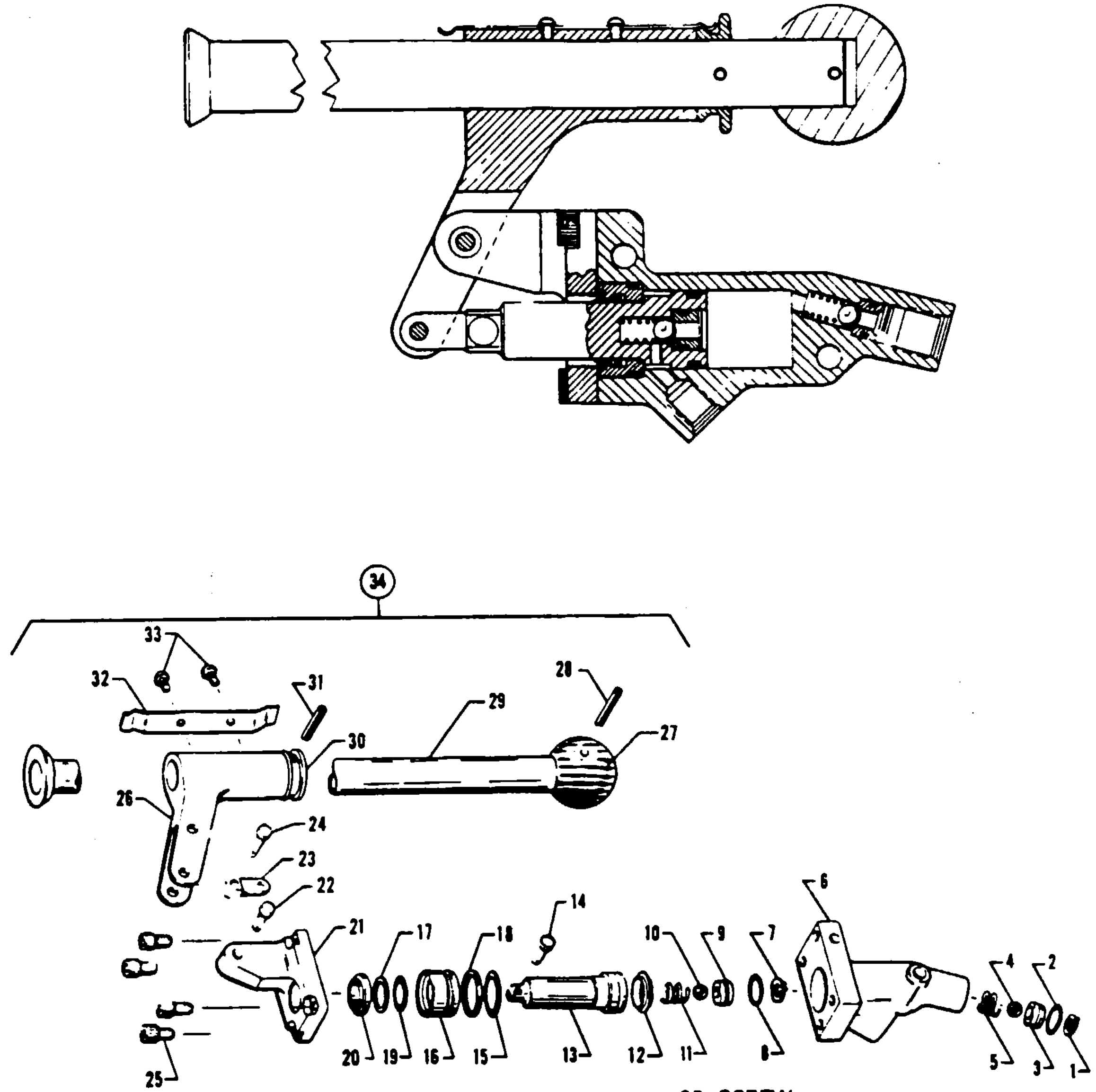
DISASSEMBLY OF HAND PUMP. (Refer to Figure 29-16.)

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

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 enlarged pinhole, surface area for scratches, burrs, etc., that could damage O-rings.
4. Inspect check balls and seats for damaged seating areas and corrosion.
5. Check general condition of remaining parts.
6. Repairs to the pump are limited to polishing out small scratches, burrs, etc., replacing O-rings and worn or damaged parts.

ASSEMBLY OF HAND PUMP. (Refer to Figure 29-16.)

Lubricate all parts with oil per MIL-H-5606 prior to assembly.

1. Lubricate O-ring and install on seat.
2. Install the spring, ball and lubricated seat into the plunger and retain with snap ring.
3. Install GT-ring on the plunger.
4. Install O-ring and back up into inside groove of gland.
5. Install O-ring and back up onto outside groove of gland.
6. Lubricate the complete gland and slide it onto the plunger with the recessed end on the outside.
7. Lubricate the bore of the pump body and slide the plunger with the gland into the pump body.
8. Install the scraper 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. Access 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—

3F16 THRU 3F20
INTENTIONALLY LEFT BLANK

CHAPTER

30

ICE AND RAIN PROTECTION

CHAPTER 30 - ICE AND RAIN PROTECTION

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 30 - ICE AND RAIN PROTECTION (cont.)

TABLE OF CONTENTS/EFFECTIVITY

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 means of cement to the leading edge of the surfaces to be protected.

The deicers are installed along the leading edges of each wing and the tail surfaces. All sections operate simultaneously. 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 controlled by the deicer system control switch. When the system control switch is actuated, the timer energizes the deicer solenoid engage valve for 6 seconds. This valve shuts off the vacuum to the system and directs pressurized air to the system causing the deicers to inflate. The deicer pressure, normally 20 psig is regulated bleed air from the compressor turbine section of each engine. The bleed air leaves the bleed port on both engines at a temperature of 600°F and a pressure of 90 psi. and travels to the intercoolers where the heat exchange process is taking place. As the air is cooled it is routed to a tee in the line where a water separator (accumulator) is mounted. This separator removes any moisture from the air before it enters the pressure regulator. The regulator decreases the pressure from 90 psi, down to 18 psi +1, -3 psi for deicer operation. This pressure regulator is backed up by a pressure relief valve which cracks open at 21 psi and becomes full open at 26 psi should the regulator fail to open. This regulated air is then routed to a three way valve which directs the pressurized air to the deicer system. Upon automatic de-energization of the ejector solenoid valve by the timer, system pressure is bled to ambient. This process of bleeding air overboard creates the system vacuum which is then reapplied to the deicers to hold them close to the surface skin. Pneumatic system pressure can be monitored during deicer inflation through the pneumatic pressure gauge located on the instrument panel.

A thin coating of conductive cement is provided over the neoprene ply to dissipate static electric charges. These charges, if allowed to accumulate, would eventually discharge through the boot to the metal skin beneath, causing static interference with the radio equipment and possible punctures in the rubber. Also, such static charges would constitute a temporary fire hazard after each flight.

TROUBLESHOOTING.

In the utilization of the troubleshooting charts, it must be assumed that the engine 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. Both engines operating at minimum cruise RPM or either engine at 1600 propeller RPM.	Open circuit breaker.	Push circuit breaker to reset.
	System connection loose or wire broken.	Tighten or repair as required.
	Timer not functioning.	Test or replace as required.
	Control valves not functioning.	Make electrical test. Replace as required.
	Piping lines blocked or not connected.	Blow out lines and inspect connections. Make air leakage test.
Deicers inflate slowly. (Inflation time - 6 seconds.)	Lines partially blocked or not connected securely.	Blow out lines and inspect connections. Make air leakage test.
	Deicer pump valve not functioning.	Check fitting in deicer port for proper installation.
	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.

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. Timer: Activate the deicer system switch. The timer should begin to operate immediately and complete one full cycle of the system. If the timer does not function:
   A. Reset circuit breaker and recheck.
   B. Check circuit from power source, through circuit breaker, to switch, to timer, to ground.
   C. Replace timer if found to be defective.
2. Solenoid Valve: Check solenoid valve. Activate system switch to ON position. Solenoid valve should be actuated immediately for 6 seconds, as evidenced by an audible "click". It may also be possible to feel the solenoid actuate by placing a hand on the solenoid. If solenoid valve does not function:
   A. Disconnect wires at solenoid. Attach test light or other suitable test equipment to connector and reactuate system switch. If test equipment does not indicate complete circuit:
      (1) Check circuit from timer, to solenoid connector, to ground.
      (2) Replace timer.
   B. Use ohmmeter to check solenoid for open circuit. If solenoid circuit is open, replace solenoid 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. Observe 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.

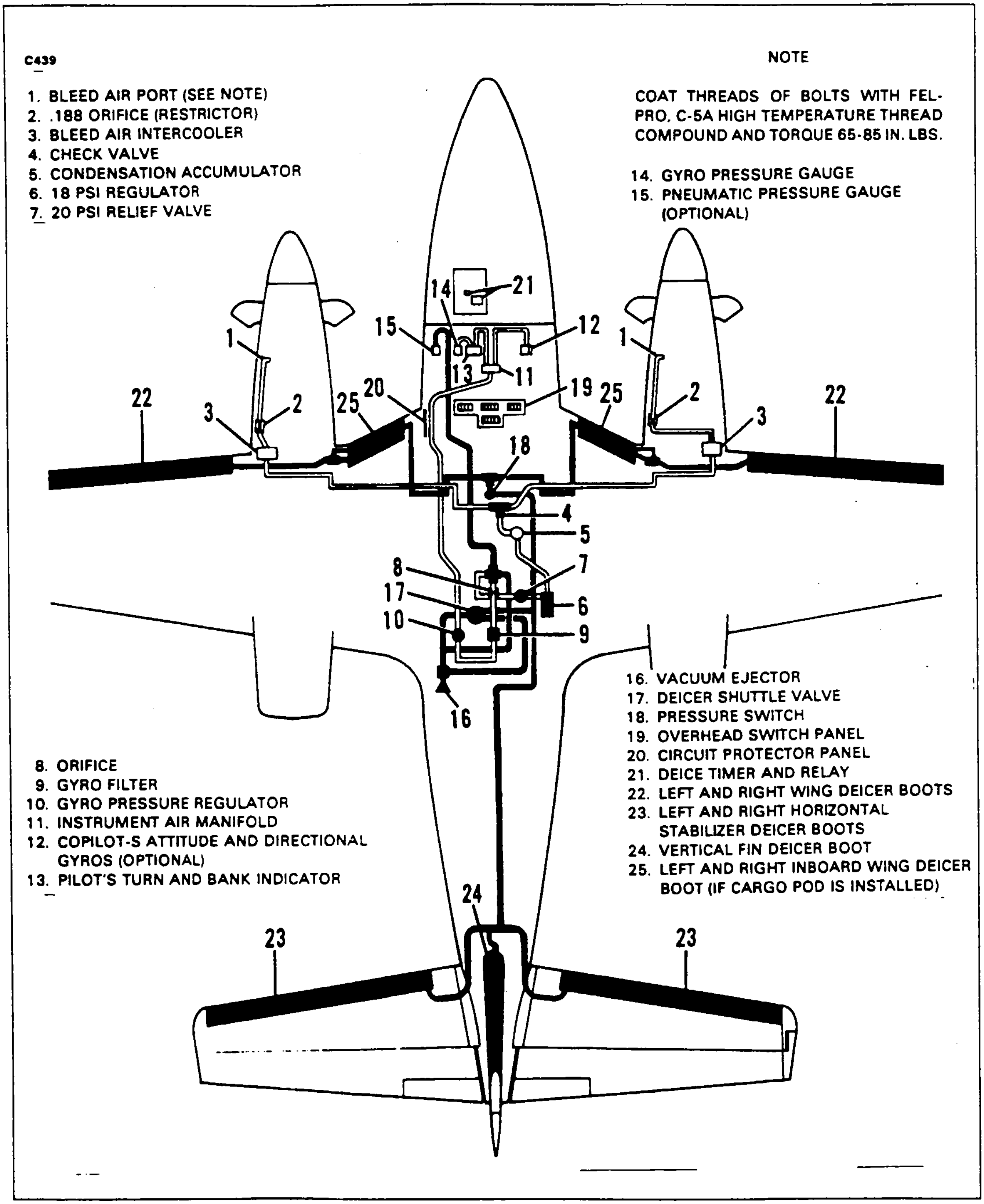


Figure 30-1. Pneumatic Deice Installation (Typical)

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 operating pressure and the inflation time allotted to the deicers.

CHART 3002. OPERATING PRESSURES

Recommended Operating Pressure PSIG	Test Pressure in PSIG	
	MIN.	MAX.
15	13	17
18	16	20

GROUND TEST PROCEDURE.

After the test pressure range is established, connect an external source of air providing this pressure to the test plug. 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 seconds.

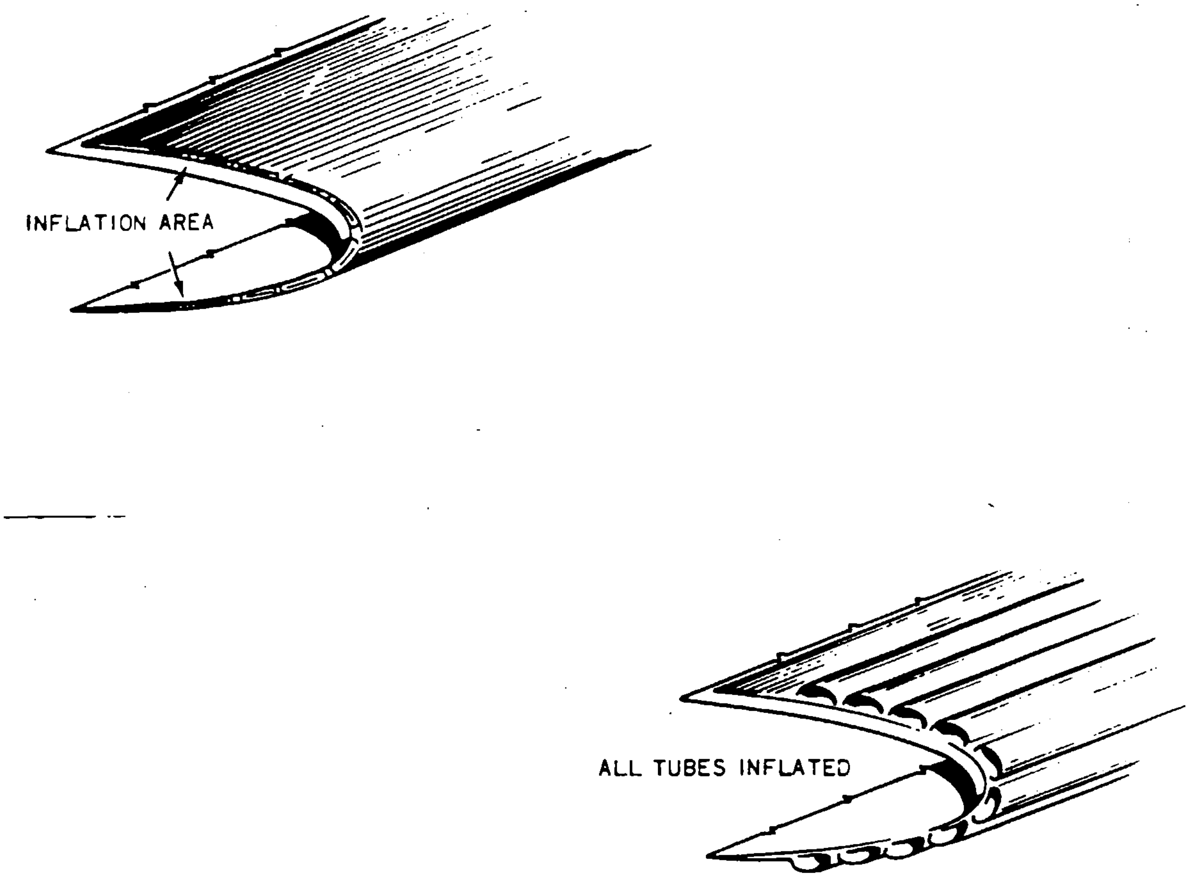


Figure 30-2. Pneumatic Deicer Boots Operation

100 HOUR INSPECTION.

At each 100 hour inspection of the airplane, inspect and operate the deicer boots. Make checks as follows:

1. Carefully inspect the deicers for evidence of damage or deterioration and repair or replace damaged boots.
2. Resurface boots which show signs of considerable wear or deterioration.
3. Inspect all hose connections which form a part of the pneumatic deicing system. Replace deteriorated sections of non-kink hose.
4. Check the operation of the boots and the operating pressure of the system.
5. If new or replacement boots have been installed, check the tube inflation to make sure that the air connection stems have been properly connected.
6. Disconnect all drain lines in the system and check for proper drainage.
7. Check the on-off control switch for freedom of action. Check associated electric wiring.

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. Proceed as follows:
   A. Clean the area around the damage with a cloth dampened slightly with solvent. Buff the area around the damage with 74-451-75 emery buffing stick so that it is moderately but completely roughened. Wipe the buffed area with a clean cloth slightly dampened with solvent to remove all loose particles.
   B. Select a patch of ample size to cover the area. Apply one even thorough coat of cement, Part No. 74-451-20, to the patch and the corresponding damaged area. Allow cement to set a couple of minutes until tacky.
   C. Apply the patch to the deicer with an edge, or the center, adhering first. Work down the remainder of the patch carefully to avoid trapping air pockets. Thoroughly roll the patch with stitcher-roller, Part No. 74-451-73, and allow to set for ten to fifteen minutes.
   D. Wipe the patch and surrounding area from the center outward with a cloth slightly dampened with solvent. Apply one light coat of A-56-B conductive cement, Part No. 74-451-11, to the patched area.
   E. Satisfactory adhesion of patch to deicer will be reached in four hours. Deicer may be inflated for checking repair in a minimum of 20 minutes.
2. TUBE AREA DAMAGE. Repair cuts, tears or ruptures to the tube area with fabric reinforced patches, Part No. 74-451-16, -17, -18 or -19 depending on size of damaged area.
   A. Select a patch of ample size to cover the damage and to extend to at least 5/8 inch beyond the ends and edges of the cut or tear. If none of the patches is of proper size, cut one to the size desired from one of the larger patches. If this is done, bevel the edges by cutting with the shears at an angle.

   —NOTE—

   These patches are manufactured so that they will stretch in one direction only. Be sure to cut and apply the patch selected so that stretch is in the widthwise direction of the inflatable tubes.

   B. Buff the area around the damage with buffing stick, Part No. 74-451-75, so that the surface is thoroughly roughened.
   C. Apply the patch to the deicer with the stretch in the widthwise direction of the inflatable tubes, sticking edge of patch in place, working remainder down with slight 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	320 grit emery cloth
	As required	Hypodermic needles (22 gauge or smaller)
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. 74-451-11, to damaged area and one coat to patch. Allow cement to set until tacky. Roll the surface ply to the deicer with 2 inch rubber roller, Part No. 74-451-74. Roll edges with stitcher-roller, Part No. 74-451-73. Apply just enough tension on the surface ply when rolling to prevent wrinkling, and be careful to prevent trapping air. If air blisters appear after surface ply is applied, remove them with a hypodermic needle.
   D. Clean excess cement from deicer with solvent.
4. LOOSE SURFACE PLY IN TUBE AREA. Loose surface ply in tube area is usually an indication of the deicer starting to flex fail. This type of failure is more easily detected in the form of a blister under the surface ply when deicer is pressurized. If this type of damage (or void) is detected while still a small blister (about 1/4 or 3/8 inch diameter) and patched immediately, the service life of the deicer will be appreciably extended. Apply repair patch as outlined in paragraph 1.
5. DAMAGE TO FABRIC BACK PLY OF DEICER DURING REMOVAL. If cement has pulled loose from the wing skin and adhered to the back surface of the deicer, remove it with clean rags and MEK. In those spots where the coating has pulled off the fabric, leaving bare fabric exposed, apply at least two additional coats of cement, Part No. 74-451-24. Allow each coat to dry thoroughly.

VULCANIZED REPAIR.

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	Quantity
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 2-3/4 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	1/2 pt.
74-451-12	*NEOPRENE PUTTY	1/2 pt.

*These cements have an extended shelf line 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	Quantity
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 2-1/2 x 8	1
74-451-41	PADS, Sponge rubber, 3-1/2 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, 1/2 in.	2
74-451-71	BRUSH, Cement (Artist)	2
74-451-72	SHEARS, 10 in.	1
74-451-73	STITCHER, 1/8 in. Steel	1
74-451-74	ROLL, Sponge rubber 2-1/2 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, solvents, 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 (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 Isopropyl 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.

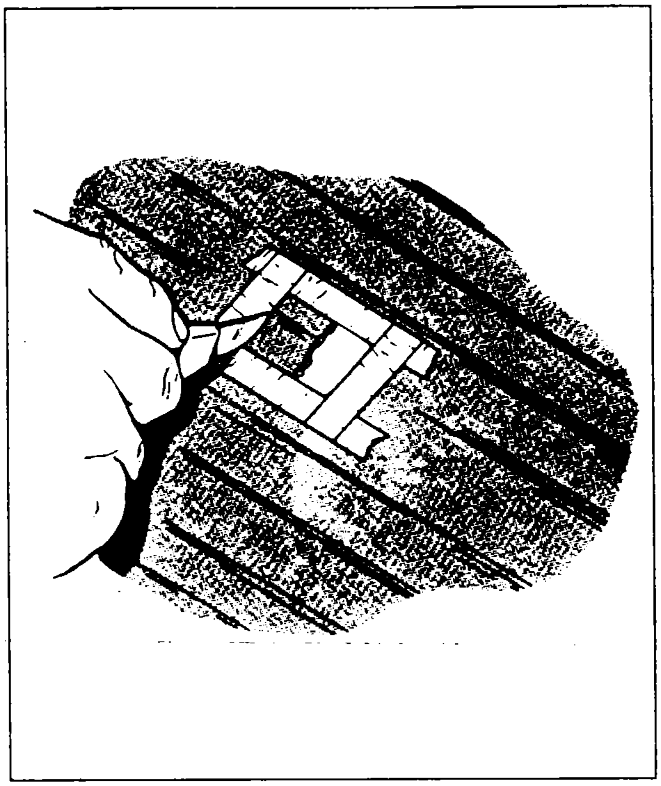


Figure 30-3. Marking and Cutting Scuff

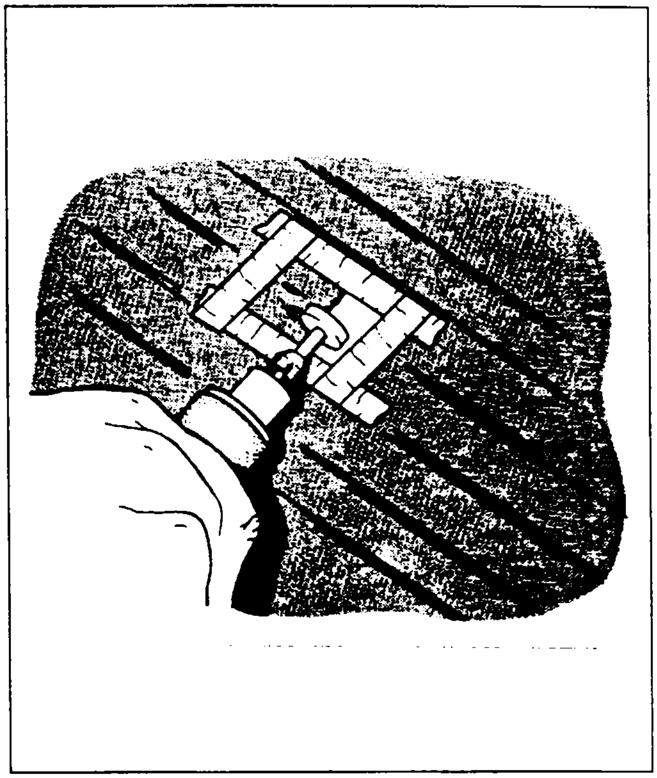


Figure 30-4. Routing Scuff

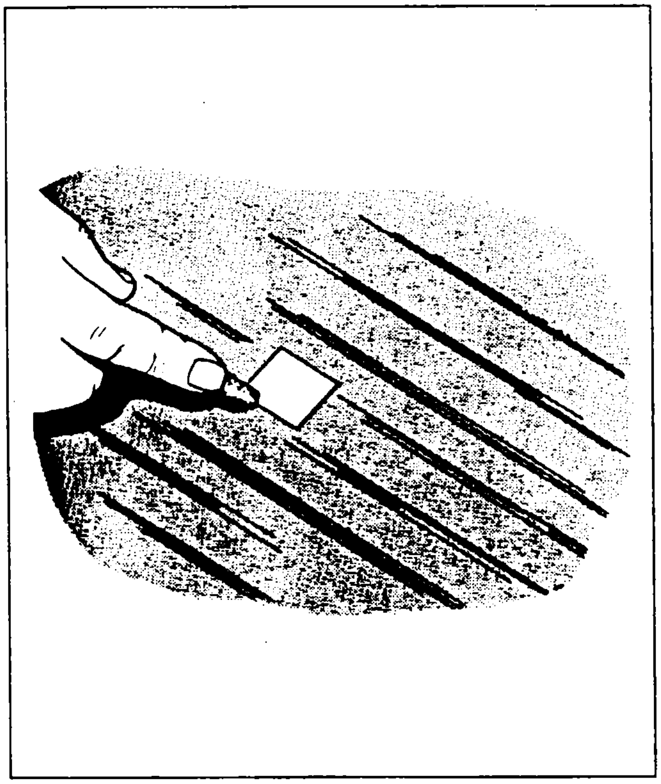


Figure 30-5. Buffing Edge of Repair

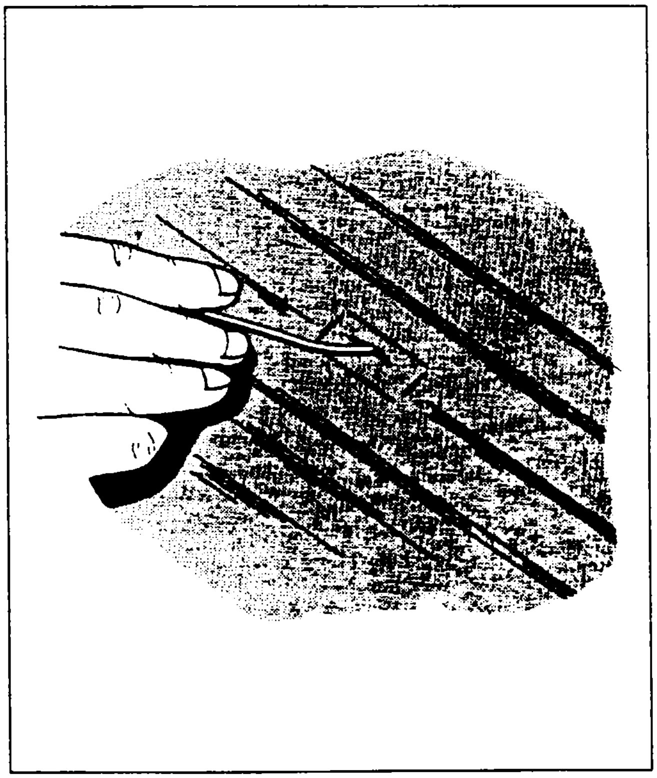


Figure 30-6. Hole through Surface of Tube

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 Paragraphs 4 and 5.
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

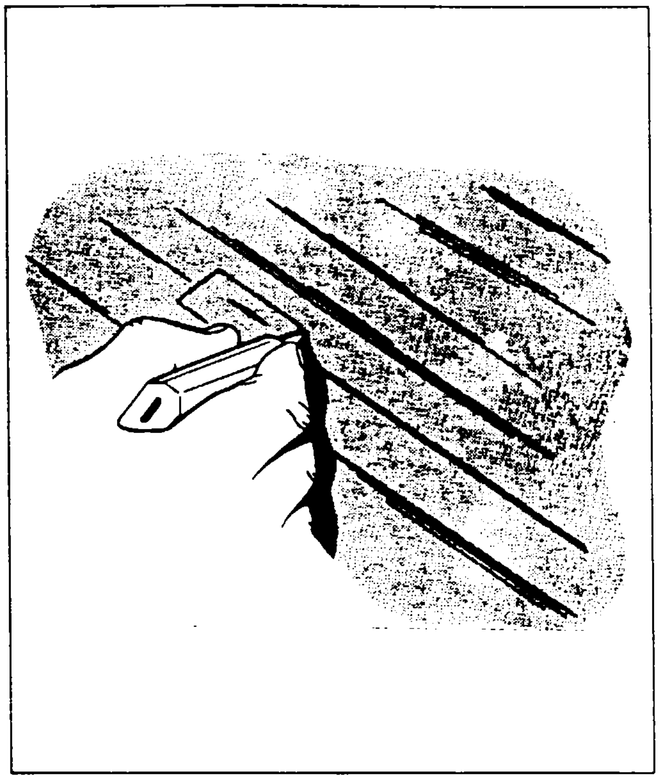


Figure 30-8. Cutting Surface of Tube

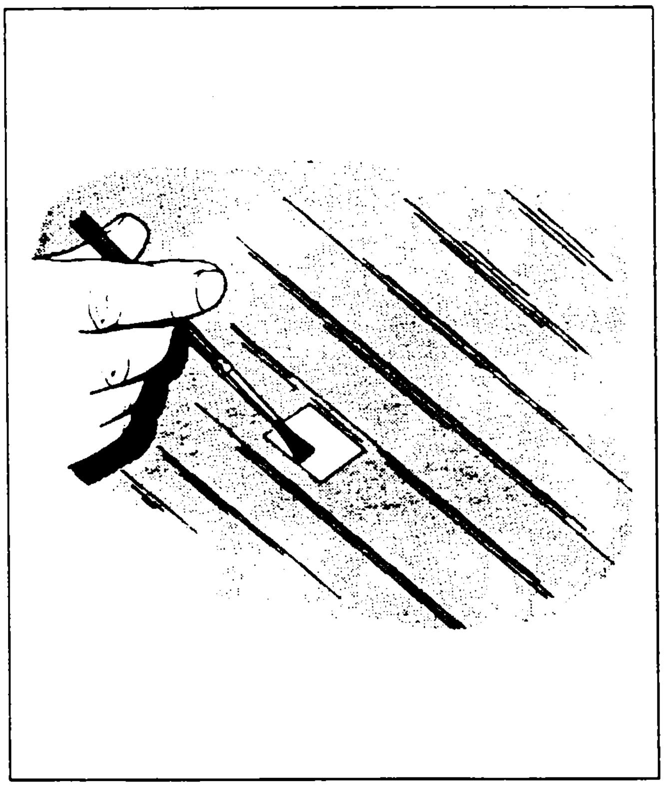


Figure 30-9. Cementing Buffed Area and Patch

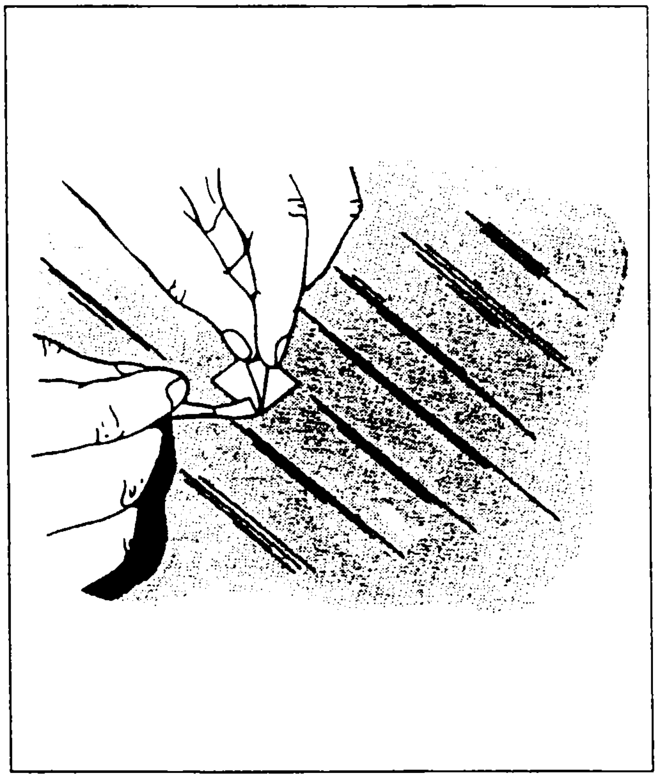


Figure 30-10. Applying and Stitching Fabric

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.

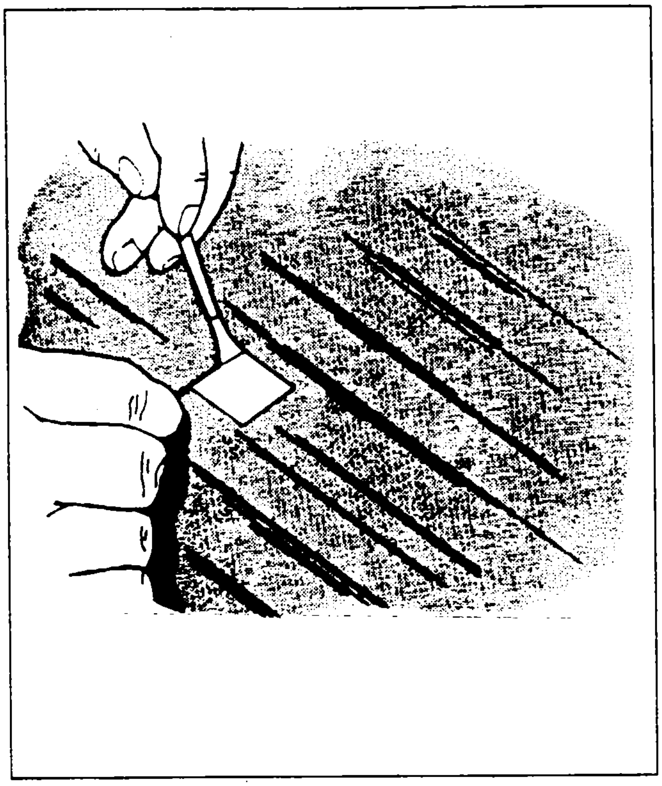


Figure 30-11. Placing and Stitching Gum

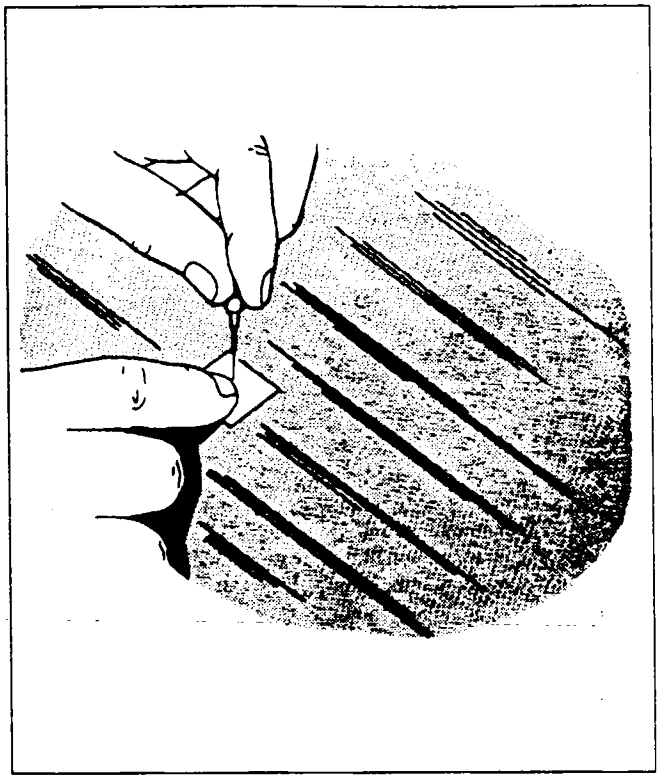


Figure 30-12. Removing Trapped Air

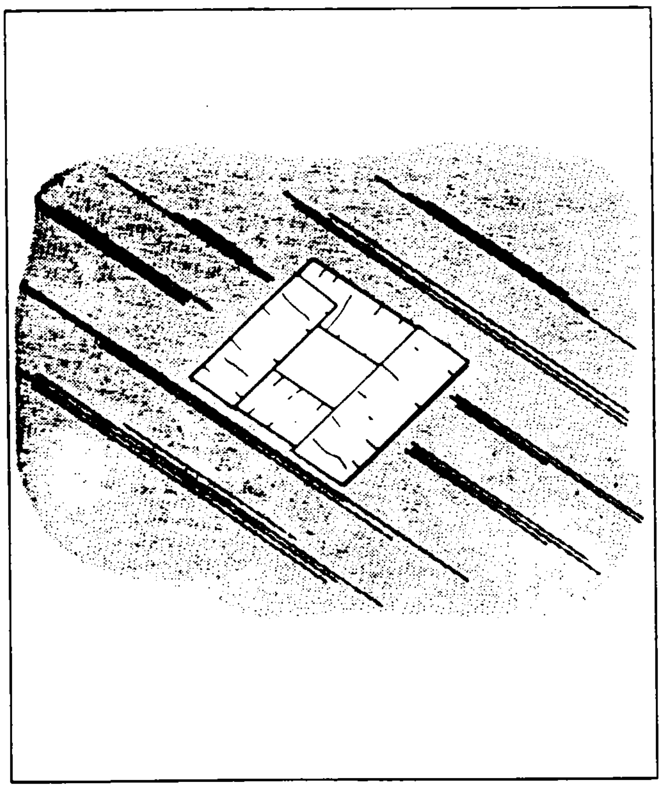


Figure 30-13. Masking Repair

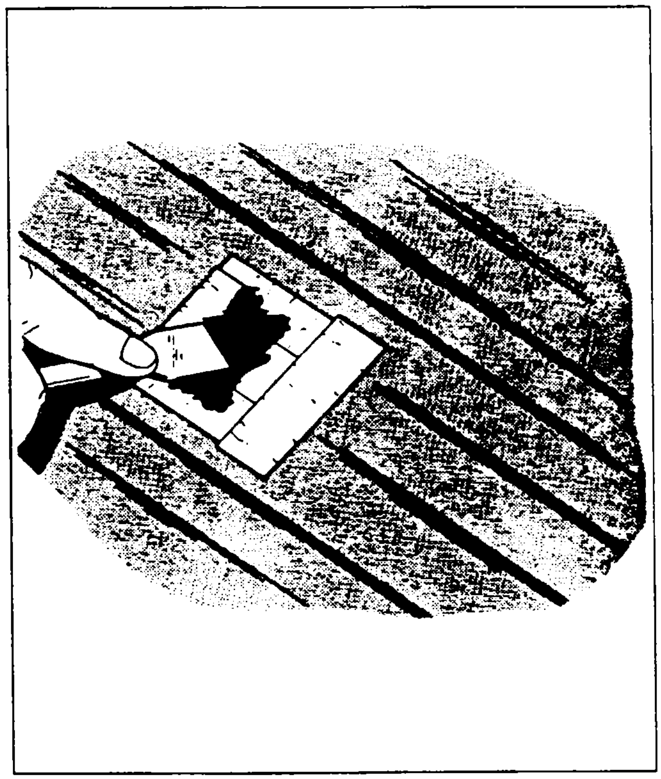


Figure 30-14. Applying Neoprene Putty

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 acceptability of the boot adhesion shall be based on the following tests:

1. Carefully lift one corner of boot in question sufficiently to attach a spring clamp.
2. Attach a spring scale to this clamp and pull with force 180° to the surface and in such a direction that the boot tends to be removed on the diagonal.
3. If a force of five pounds per inch of width can be exerted under these conditions, the installation shall be considered satisfactory. Remember, the width increases as the corner peels back.
4. Re-cement corner following previous procedure.
5. Failure to meet this requirement shall result in reinstallation of the boot.

—NOTE—

Possible reasons for failure are: dirty surfaces, cement not reactivated properly, cement not mixed thoroughly. Corrosion of the metal skin may occur if good adhesion is not attained, especially around rivet heads and metal skin splices.

If these adhesion requirements are met, the airplane may be flown immediately. Do not inflate deicers within 12 hours of installation or until adhesion strength of 8 to 10 pounds is obtained.

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.

ICEX APPLICATION.

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.

1. Icex is applied as follows:
   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 500 square feet, or 46 square meters.)

—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-720, 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 in line 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.

AIR INTAKES.

The air inlet deice system consists of an air inlet lip deicer, and forward and aft ice protection doors.

Ice protection systems for each engine are activated by engine ice protection switches on the overhead switch panel. Each system is composed of heated air inlet boots, propeller boots, and two ice deflector vanes (doors) located in the inlet duct and controlled by inertial mechanisms.

Optional propeller ice shields, designed to protect the fuselage during ice shedding procedures, may be installed in each side of the aircraft, adjacent to the propeller operational arc.

Each air inlet boot contains three separate heating elements; the parting strip, located on the foremost area of the lip, and two shedding areas, located within the throat. Each propeller boot also contains a heating element. Selection of a control switch to the ON position activates the respective engine's entire system. Ice deflector doors deploy in 15 seconds. The parting strip is provided with continuous heat while the other elements are provided with heat in the following controlled, timed and repeated sequence: propeller - 90 seconds; shedding area I-45 seconds; shedding area II-45 seconds.

—NOTE—

A drop in torque win be indicated when the ice deflector doors are extended. This process will reverse when the system is turned OFF and the doors are retracted.

Annunciator displays monitor the positioning of the ice deflector doors and the energy supplied to the boots. When the doors are extended, corresponding lights indicate R. DEICE DOOR and L. DEICE DOOR. The light remains illuminated until the system is turned OFF and the doors are retracted. If energy flow to a heated element is interrupted, corresponding lights indicate DEICE OFF for the respective engine. If an element should fail during normal system operations, the annunciator will illuminate during that element's intended time of operation. For example, failure of one shedding area on the left engine is indicated by illumination of L. DEICE OFF for 45 seconds of every cycle. Illumination of the L. DEICE OFF annunciator for 90 seconds indicates an inoperative propeller deicing system. Failure of the inlet parting strip is indicated by continuous illumination.

A thermostat on each parting strip will limit lip temperature to 49°C (120°F). If lip temperatures exceed this limit, energy is automatically removed until the temperature falls below 32°C (90°F).

—NOTE—

Inlet lip temperature may reach 49° C (120°F) whenever operation is conducted in ambient temperatures above -23°F with the engine deicing system ON. It is recognized by random brief periods of annunciator illumination.

During ground operations with the system turned ON, energy normally supplied to boot elements is locked out by a landing gear squat switch. This prevents overheating due to insufficient airflow. Activation of the ground test switch on the instrument panel overrides the lockout feature. To verify proper operation, select the left engine deicing system to ON. The L. DEICE OFF light should immediately illuminate followed by the illumination of the L. DEICE DOOR light. A drop in the left engine torque should be noted. Depress the ground test switch and hold for 10 seconds.

—CAUTION—

Engine inlet lip deicers can be damaged if heated without the cooling effect of propeller slipstream. Do not press ground test button for periods longer than 10 seconds with propeller speed below 1800 RPM.

The L. DEICE OFF light should remain illuminated approximately two seconds, flash one time, and extinguish. It should re-illuminate only upon release of the test switch. Re-illumination prior to switch release indicates an element malfunction. Upon completion of this procedure turn the left engine deicing system OFF and note a corresponding regain of torque. Repeat the test procedure for the right engine.

AIR INLET LIP DEICER.

OPERATIONAL CHECK.

(Refer to Propeller Deicer System Operational Check.)

REMOVAL OF AIR INLET LIP DEICER BOOT FROM LIP.

Refer to Removal of Propeller Deicer Boot.

REMOVAL AND INSTALLATION OF AIR INLET LIP ASSEMBLY.

1. Disconnect the electrical connector in the lower cowl which supplies power to the lip deicer if installed.
2. Remove the screws which secure the lip assembly to the lower cowl. Discard all these screws and replace with new MS24693-C29 (P/N 414 740) screws upon reinstallation of lip assembly.
3. Gently pry the lip from the intake scoop.

4. Prior to replacing the lip assembly onto the intake scoop inspect the anchor nuts for their locking ability by trying to screw the new attachment screws into the anchor nuts by hand pressure only. Replace any anchor nut NAS686A06 (P/N 406 824) which will allow screw engagement by hand pressure only.
5. Prior to installing the lip assembly, coat all new attachment screws with No. 222 Loctite. Make sure the thread bearing surface is completely coated.
6. Install the lip assembly and secure with the new loctite coated screws. Wipe off any excess loctite from around the lip and screw heads.
7. Reconnect the electrical connection of the lip deicer if installed.

PREPARATION OF SURFACE PRIOR TO INSTALLATION.

1. Clean the surface thoroughly with MEK or toluol. For the final cleaning, wipe the solvent film off quickly with a clean dry cloth before it has time to dry.
2. Place a strip of 1 inch wide masking tape around the inside and outside of the air inlet scoop so the leading edge of the tape is along the edge of the recess in the fiberglass.
3. Fill any seams or pockets in the fiberglass with EC-801 sealing compound; then scuff sand the entire area lightly. Remove the sanding dust with a compressed air gun.

APPLICATION OF CEMENT.

1. Moisten a clean cloth with acetone or MEK and clean the unglazed surface of the deicer, changing cloth frequently to avoid contamination of the clean area.

—NOTE—

For best results, the cementing and installation should be made at normal room temperature.

2. Thoroughly mix the EC1300L cement (Piper Code No. 915 005). Apply one even brush coat of cement to the entire area within the masking tape. Allow to air dry for at least one-half hour.
3. Apply an even coat of EC 1300L cement to the unglazed back surface of the deicer. Allow to air dry for at least one half hour.
4. When the cement dries on both the air inlet and deicer, brush on another coat of cement on both the inlet and deicer cemented surfaces. Allow ample drying time of the cement, a minimum of one half hour.

—NOTE—

Of curling of the edges is a problem, apply masking tape to the edges of the glazed side before applying cement to the unglazed side. Remove the tape before starting to install the deicer.

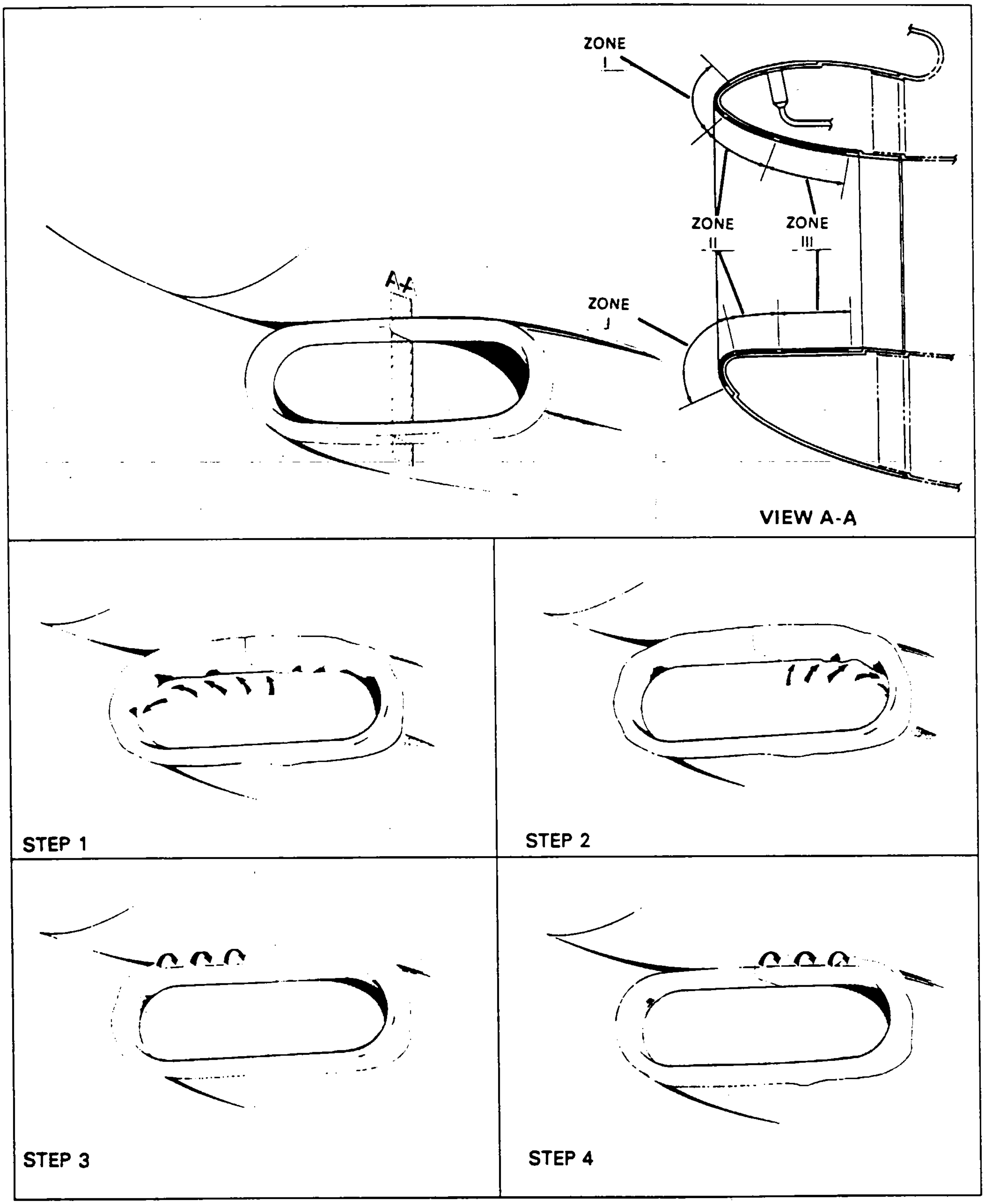


Figure 30-15. Engine Air Inlet Lip Deicer Installation

PREPARATION OF BOOTS PRIOR TO INSTALLATION.

1. Ascertain that the boot is the proper length by laying it out flat on a smooth level surface. The proper length is 36.75 inches +/- .50 of an inch, measured .75 of an inch in from the electrical lead edge of the boot.

—NOTE—

Do not install boots which are not the proper length.

2. With the boot laying flat, check the electrical resistance of the heating elements in the following manner.

—NOTE—

Establish the resistance of the test instrument leads on a Wheatstone or Kelvin Bridge. Zero this resistance out of the equipment or subtract it from the test readings In no way should it be included in the test readings. See Chart 3006 for test values.

3. Do not install a boot assembly that does not conform to the required resistance values given in Chart 3006.

INSTALLATION OF DEICER AND REQUIRED MATERIALS. (Refer to Figure 30-15.)

1. After dimensional and resistance test are properly completed, lay the boot on a clean, flat dry surface with the wire leads side up. Clean this surface with Methylethyl Ketone (MEK) or toluol and allow to dry.
2. Clean the fiberglass lip of the air inlet with MEK or toluol and allow to dry.
3. Using a yellow marker, mark the inner surface of the boot at increments of .25, .50 and .75 of full length. Also make corresponding marks on the fiberglass lip assembly.
4. Apply one coat of Scotch grip rubber adhesive (#1300L), Piper Code No. 915 005 to both the boot assembly and the fiberglass lip.
5. Allow both to dry for 45 minutes and then apply a second coat of adhesive to each part. Again allow to dry for 45 minutes.

—NOTE—

The next step win require the use of an oven which is capable of maintaining 170°F for five minutes, and have sufficient volume to allow the boot assembly to be laid out flat. (Approx. 37 inches.)

6. After the second drying cycle, place the boot assembly (cement side up) into the oven and heat soak at 175°F for five (5) minutes.
7. Remove the boot from the oven. Place on a dry flat surface, grip the boot assembly at each end and gently stretch approximately one inch and hold for two (2) minutes.

8. Put the wire leads through the hole in the fiberglass lip assembly. While doing this, align the .50 length mark on the boot assembly and lip assembly.

—*NOTE*—

To bond the deicer boot to the air inlet, it may be necessary to tackify the cement. Use a clean lint free cloth dampened (not saturated) with Toluol. Tackify only the cemented surfaces that you intend to work on immediately.

9. When satisfied that the alignment of the deicer on the inlet is satisfactory, hold the deicer in this position and fold back the lead wire end and tackify around the lead wire and the mating surface on the inlet. Using hand pressure only press the boot in place at the wire leads and at the .50 length marks tackifying the cement as required.
10. Continue to work the boot into place, making sure to align all marks at the .25, .50 and .75 points.
11. Roll the external surface with a hard rubber rolling tool to assure no air bubbles remain between the rubber boot and the fiberglass surface.
12. Apply masking tape around the edges of the inlet where the boot meets the fiberglass edges. (See Figure 30-15, View A-A.) to prevent sealer from contacting any areas beyond the deicer boot edges.
13. Apply one even coat of sealer around the edge of the installed deicer, both outside and inside of the intake scoop and in the seam at the top of the scoop where the ends of the deicer meet.
14. Seal the area around the wire leads where they pass through the lower cowl with EC-801B-Class A2 Compound (MIL-S-7502B).
15. Remove the masking tape from around the edges of the deicer immediately after applying the sealer. Cleanup excessive cement with MEK.
16. When the boot has cooled to room temperature (70°F) repeat the resistance test prior to installation to assembly to the engine cowling.
17. The deicers should not be operated before the cement has dried for a minimum of eight hours. Avoid handling the deicer when removing the bottom cowling or for any other purpose to prevent damage to the heating elements.

PREPARATION AND APPLICATION OF SEALER.

Refer to Propeller Preparation and Application of Sealer.

WRINKLED DEICER.

Refer to Propeller Wrinkled Deicer.

ELECTRICAL CHECK OF AIR INLET DEICER.

1. The deicer may be checked simply by disconnecting the harness plug and the ground connection inside the lower engine cowl. The upper cowl will have to be removed to do this.
2. Cheek the electrical resistance of each of the elements by checking between each pin in the plug and the ground lead. Pin 1 is the Parting Strip element; Pin 2 is the Shedding Area I element and Pin 3 is the Shedding Area II Element. Refer to Figure 30-15 and Chart 3006.
3. System power may be checked, and cycle time and sequence can be checked by using a voltmeter and checking the pins in the connector on the aircraft harness with the system power on. (Aircraft on jacks.)
4. Reconnect the circuit and install the engine cowl.

CHART 3006. ELECTRICAL RESISTANCE - LIP DEICER

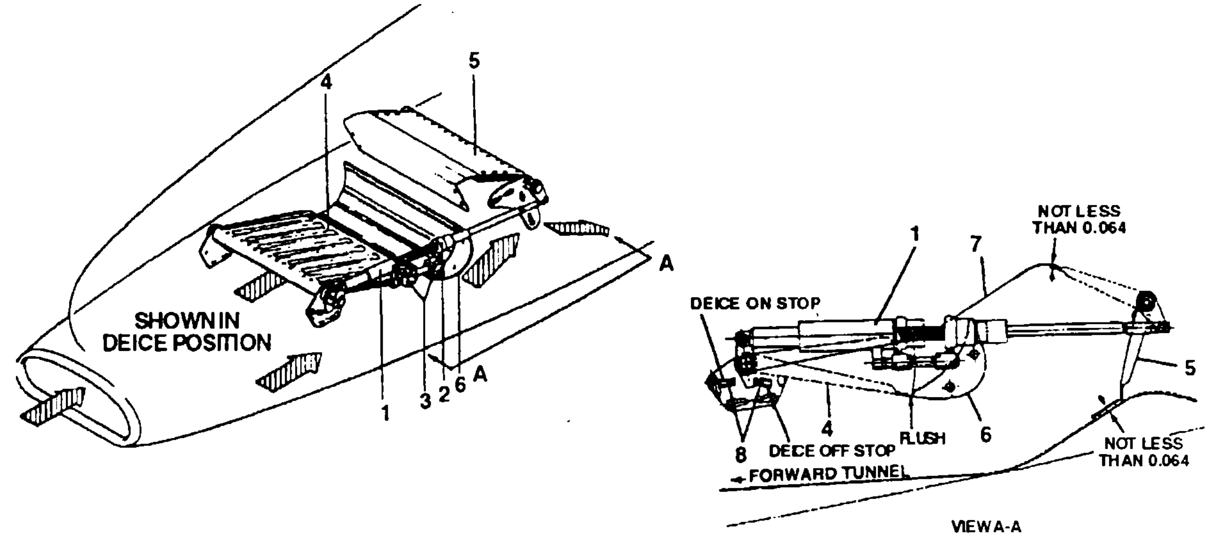
LEAD WIRES	ZONE	RESISTANCE = OHMS
1	I	.966 +/- .05
2	II	1.224 +/- .06
3	III	1.305 +/- .06
NOTE: ALL ABOVE OBTAINED WITH BOOT AT 70°F +/- 5°F.		

ADJUSTMENT OF AIR INLET ICE PROTECTION SYSTEM. (S/N 31T-8275001 AND UP)

1. To insure that the ice protection system actuator is correctly rigged, perform the following steps:
   A. Fabricate a "Length Rigging Gauge" per information given in Figure 30-16a, and a "Test Harness and Connector" per Figure 30-16a.
   B. With the lower cowl removed from the airplane, remove the actuator assembly from the lower cowl and set it aside for adjustment.
   C. Manually position the inertial doors in the non-icing or normal flight position (Front door up, Rear door down).
   D. Utilizing the fabricated rigging tool, ascertain the distance between the holes of the actuator horns by inserting the pins through the rigging tool and into the horns. Adjust the tool to fit without moving either horn. Tighten the tool wing nuts to retain this position and remove the tool from the cowl assembly.
   E. With the actuator assembly on the work bench and the fabricated test switch assembly connected, electrically activate the actuator to its full length, allowing the limit switch to stop the movement.
   F. Adjust the overall length of the actuator to match the rigging tool length by adjusting the clevis bolt length on the end of the actuator. Do not adjust the limit switch unless it is absolutely necessary.

—NOTE—

If the limit switch must be adjusted, take care not to exceed the stop pin on the thread of the actuator assembly. Resafety wire the jam nut on the clevis bolt after rigging.



1. ACTUATING ASSEMBLY
2. BALL TUBE
3. MICRO SWITCHES
4. FORWARD DEICE DOOR
5. AFT DEICE DOOR
6. TURNING VANE
7. UPPER STOP ANGLE
8. MECHANICAL STOPS
9. VANE RESTRAINT TUBE ASSEMBLY

WHEN KIT 765 156 INSTALLED

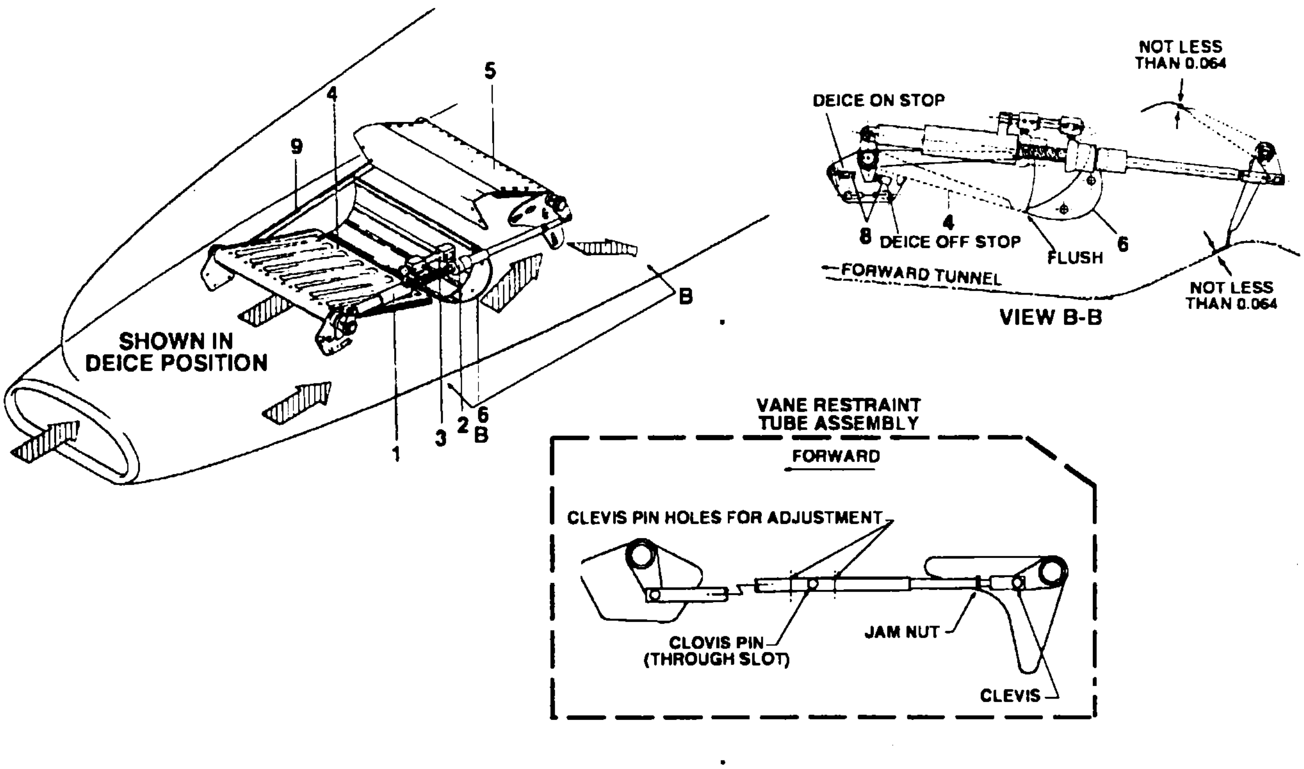


Figure 30-16. Air Inlet Ice Protection System

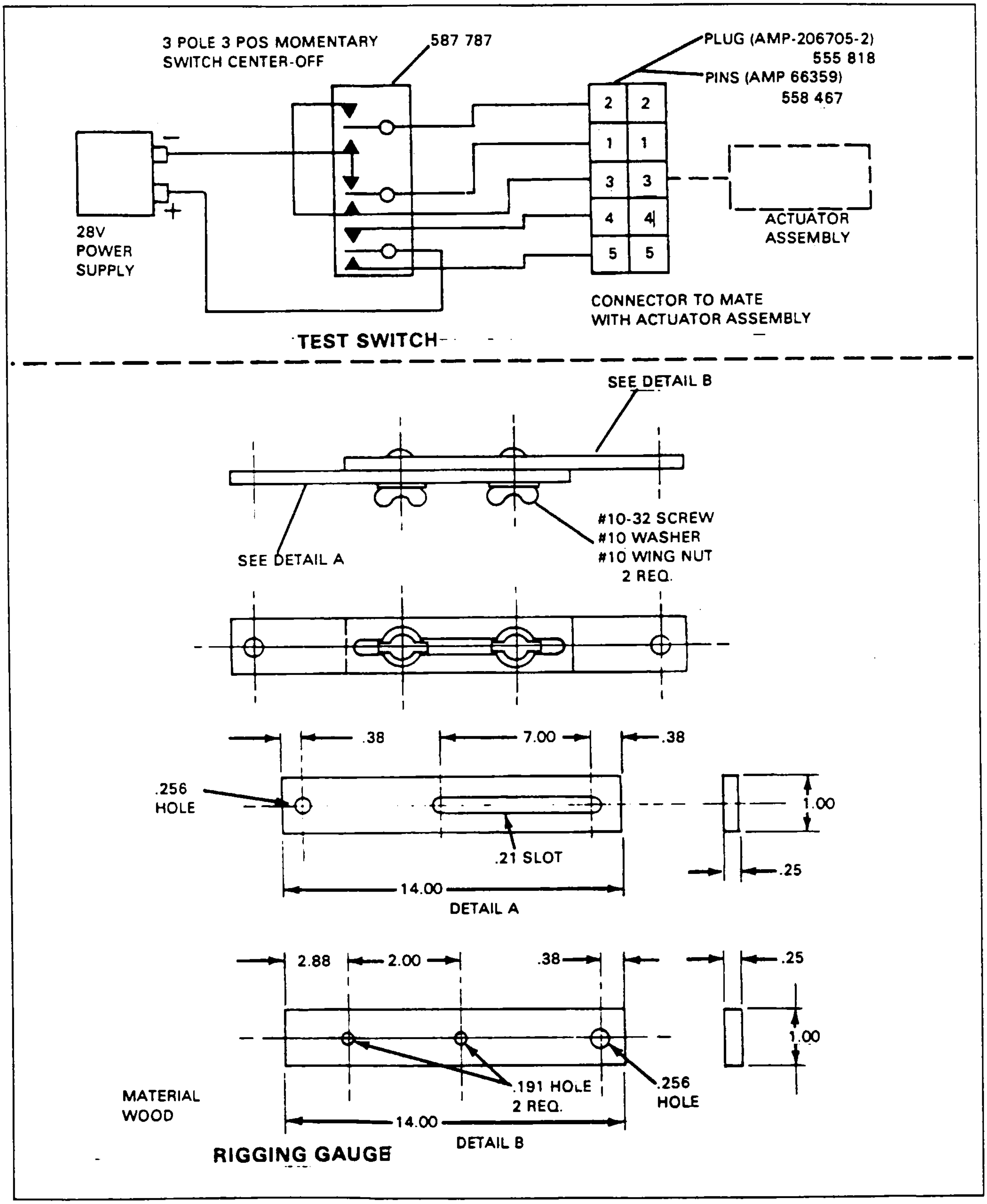


Figure 30-16a. Special Equipment for Rigging Inertial Separator Doors

G. Electrically operate the actuator to its fully retracted position. Allow the limit switch to stop the travel.

—*CAUTION*—

Do not allow the ball nut to rotate on the threaded shaft during installation and rigging.

H. Manually position the inertial separator doors to the icing position (Front door down, rear door up) insure that the front door trailing edge is flush with the fixed turning vane. See Figure 30-16 for this position.

I. Establish the distance between the actuator horn holes with the rigging tool as done previously in step D. Lock the tool length and remove from the cowl.

J. After removing the rigging tool, further shorten the overall length of the tool by an additional .125 of an inch.

K. Adjust the actuator length to match the rigging tool by adjusting the forward limit switch.

—*NOTE*—

Do not adjust the length of the clevis bolt at this time. It may be necessary to lengthen the slot in which the limit switch is mounted to accomplish this adjustment. If this is necessary, remove the switch mounting hardware and file out the slot to the required length.

L. Install the actuator assembly into the lower cowling and connect the assembly to the actuator horns. Activate the system to the open and closed positions to assure its proper operation.

M. In the DEICE OFF position, ascertain that both doors stop electrically before the mechanical stop is contacted. Also insure that the rear door has no less than 0.064 of an inch gap between its trailing edge and the lower surface of the tunnel.

N. In the DEICE ON position, ascertain that the forward door does not extend below the fixed turning vane, and the rear door has no less than 0.064 of an inch gap between its trailing edge and the upper stop angle. (See Figure 30-16.)

O. Rigging of vane restraint tube assembly. **(Applicable only to airplanes with kit 765 156 installed.)**:

(1) In the closed icing position, locate the ***forward*** vane restraint tube assembly with the clevis toward the aft end of the cowl and the tube assembly on the side opposite the actuator. (See Figure 30-16.)

(2) Move the clevis pin, through the, slot to one of the three adjustment holes provided; then adjust the clevis end, as required, to align the rod assembly attach holes with the holes in the ***forward*** and ***aft*** arm assemblies. The torque tube must be fully compressed. (See Figure 30-16.)

(3) Turn clevis out 1/4 to 1 turn; then lock.

(4) Install tube assembly using appropriate hardware. Activate the system through several cycles to ensure no binding.

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 30-17.)

1. Remove the access panel on 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 fro m 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 30-17.)

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.

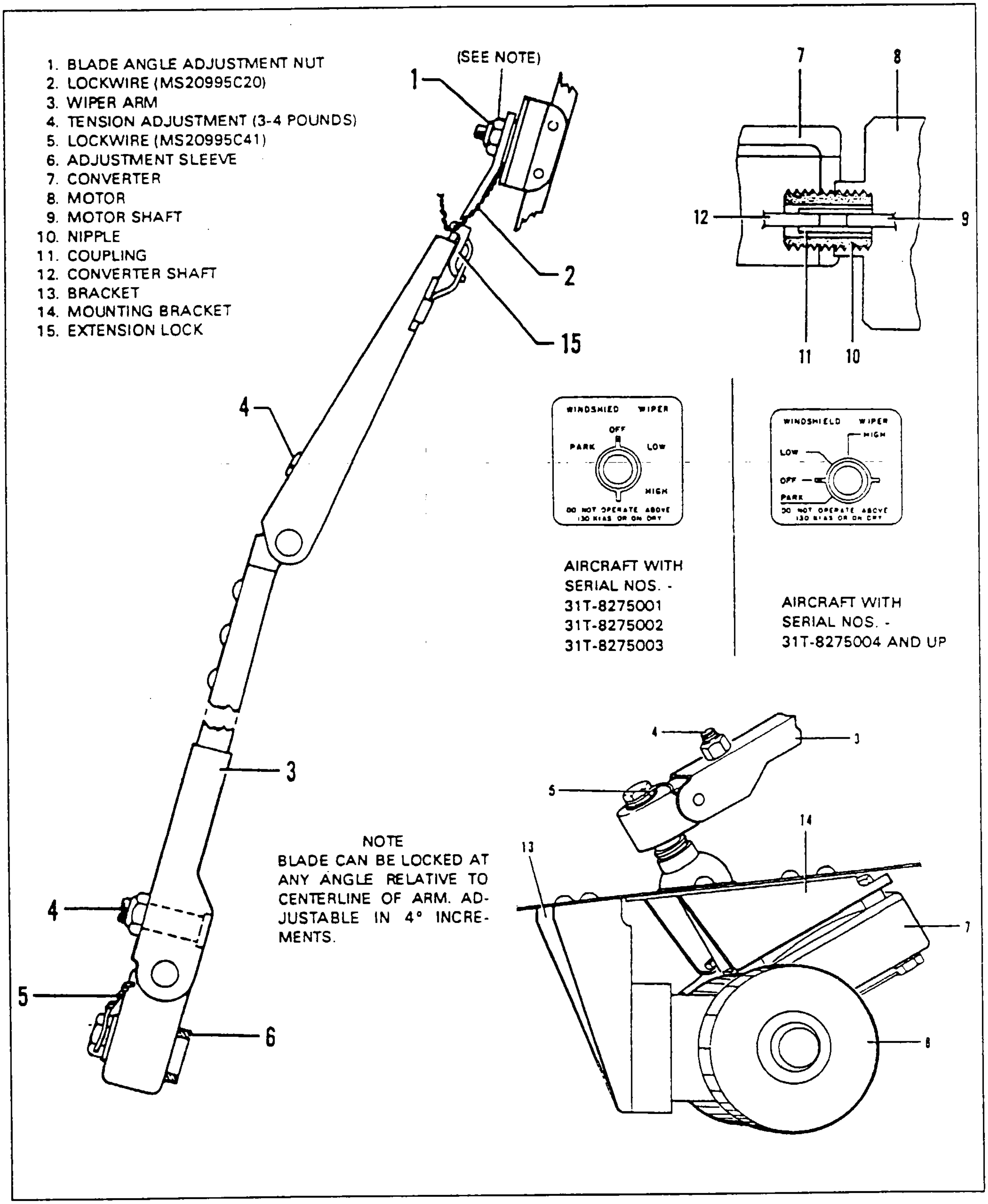


Figure 30-17. Windshield Wiper

WIPER BLADE AND ARM INSTALLATION. (Refer to Figure 30-17.)

1. Install the wiper blade to the arm assembly and ascertain that the blade is locked to the arm and safety with MS20995-C20 lockwire.
2. Turn the wiper switch on momentarily to the PARK position, then position the arm assembly and adjustment sleeve on the serrated converter shaft so the wiper blade is clearing the windshield centerpost by approximately 2.25 to 3.00 inches during operation.
3. If the arm is not in the proper position, remove the arm and sleeve and rotate it in the direction required to get the proper setting.

—NOTE—

The outside teeth on the adjustment sleeve will not locate the arm in the desired position.

4. Install the bolt through the wiper arm into the converter shaft. Tighten and safety with MS20995-C41 lockwire.

WIPER BLADE AND ARM ADJUSTMENT. (Refer to Figure 30-17.)

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 five 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. (Refer to Figure 30-18.)

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 for each propeller deice system (right and left); L DEICE OFF and R DEICE OFF annunciator lights; 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.

—NOTE—

Since the propeller deice system and the air inlet lip deicer utilize the same timer, the description of system operation which follows also contains information on the lip deicer.

The engine deice system installation consists of an engine inlet lip deicer having three separate deicing heaters and single element propeller deice boots. A heater at the forward apex of the inlet strip (Parting Strip) is required to be powered continuously. A second heater inside the inlet (Shedding Area I) and a third heater around the exterior of the inlet (Shedding Area II) are each powered for 45 seconds sequentially while the propeller heater is required to be powered for a period of 90 seconds in turn with the two shedding area heaters. Internal circuits sense the temperature of a representative location of the parting strip, removing power to the parting strip if the temperature rises above a predetermined value. Power is restored to the parting strip automatically when the sensed temperature falls below a predetermined lower value. Provision is made to prevent the shutdown of the parting strip heater in the event a temperature sensor lead becomes broken.

A system interlock is provided by means of a safety switch on the right and left main landing gear to prevent the system from being energized while the aircraft is on the ground. However, an Engine Deice Ground Test switch does provide for functional testing of the system.

The test circuit will functionally test all aspects of the timer and accomplish this test within a short period of time. It will detect failures such as shorted relay contacts, shorted transistors and open or shorted components that will not allow the timer to function as designed.

TROUBLESHOOTING.

Refer to Chart 3007 for troubleshooting procedures.

CHART 3007. TROUBLESHOOTING (PROPELLER AND ENGINE INLET 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.

CHART 3007. TROUBLESHOOTING (PROPELLER AND ENGINE INLET DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
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 AND ENGINE INLET DEICE SYSTEM OPERATIONAL CHECK.

The engine heated air inlet boot and propeller deicer system are locked out through a landing gear squat switch while the aircraft is on the ground. The inertia separator doors will function normally on the ground. The system should be tested prior to flight as follows:

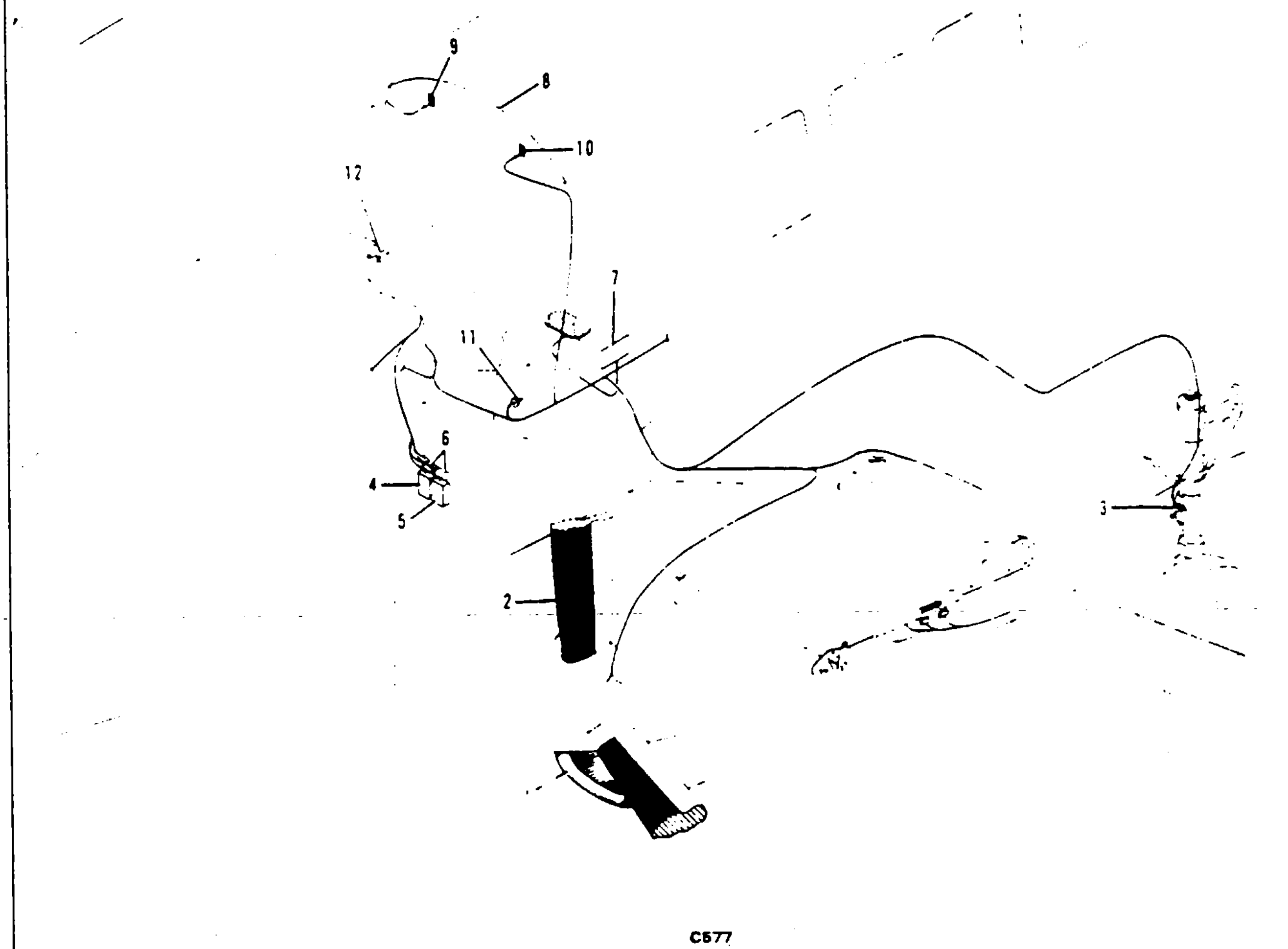
1. Ground Test: Select the engine deice system to ON. Observe that the annunciator DEICE DOOR DOWN light illuminates after approximately 10 seconds. The annunciator DEICE OFF light should illuminate immediately. Depress the ground test switch for approximately 10 seconds. The DEICE OFF light should extinguish within two seconds and should remain off for the remainder of the time that the test switch is depressed. If the deice light illuminates momentarily after it has once extinguished (while the test switch is depressed) one or more heating elements is faulty.
2. 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.
3. Flight Test: Testing of the system in flight is similar to the ground test procedure.

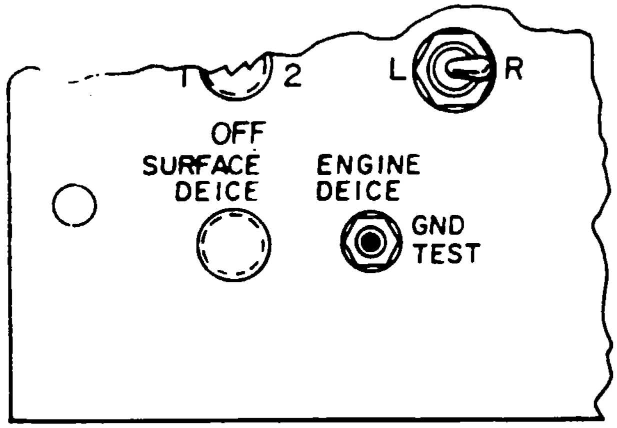
—*NOTE*—

On the older 456 654 (International Avionics Inc. 950D0123) timer when operating the system at temperatures above -25°F, the DEICE OFF indicator lights may illuminate for short time periods at random intervals. This is not an indication of a malfunction. The heated air inlet lip incorporates a thermostat on the leading edge parting strip which prevents that area from exceeding 120°F. When the lip temperature exceeds this limit, the thermostat control shuts this area OFF until the temperature falls below the control limit of 90°F. The malfunction annunciator win 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.





1. AIR INLET LIP DEICER
2. PROP DEICER
3. SAFETY SWITCH
4. LEFT DEICE TIMER
5. RIGHT DEICE TIMER
6. DEICE POWER CONTROL RELAYS
7. CIRCUIT BREAKER PANEL
8. ENGINE CONTROL PANEL
9. RIGHT ENGINE DEICE SWITCH
10. LEFT ENGINE DEICE SWITCH
11. ENGINE DEICE GROUND TEST SWITCH (SEE SKETCH A)
12. LEFT AND RIGHT DEICE ANNUNCIATOR LIGHTS

LOWER LEFT HAND CORNER OF INSTRUMENT PANEL

SKETCH A

Figure 30-18. Electric Propeller Deicer System Installation

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 o 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 solvents (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 30-19 to check alignment of slip rings to propeller shaft.
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 30-20 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 30-23. If not correct, loosen mounting screws and move in elongated holes to correct block position before tightening securely.
   C. Check brush block for wear limitation. Refer to Checking for Brush Wear and Figure 30-22.
   D. Visually check brush block for approximately 2° angle of attack. (Refer to Figure 30-23.) If not, loosen mounting screws and twist block, but be sure to hold clearance limits shown when tightening.

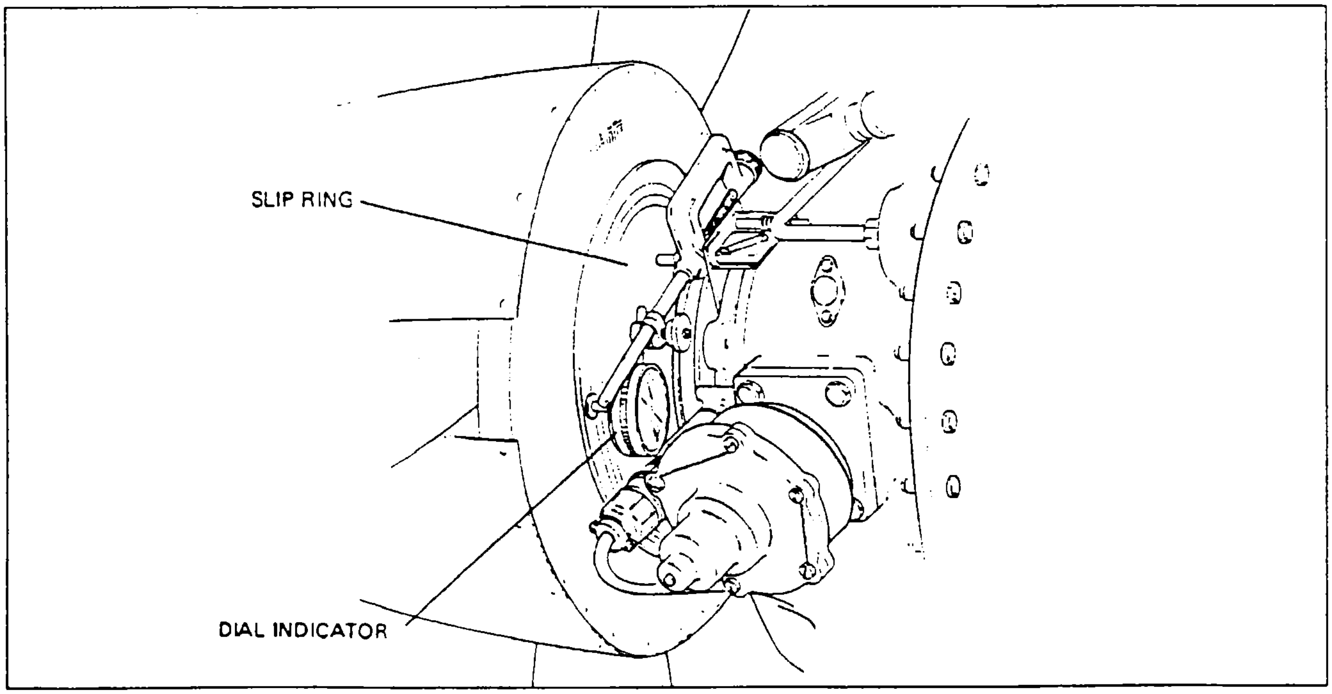


Figure 30-19. Typical Use of Dial Indicator

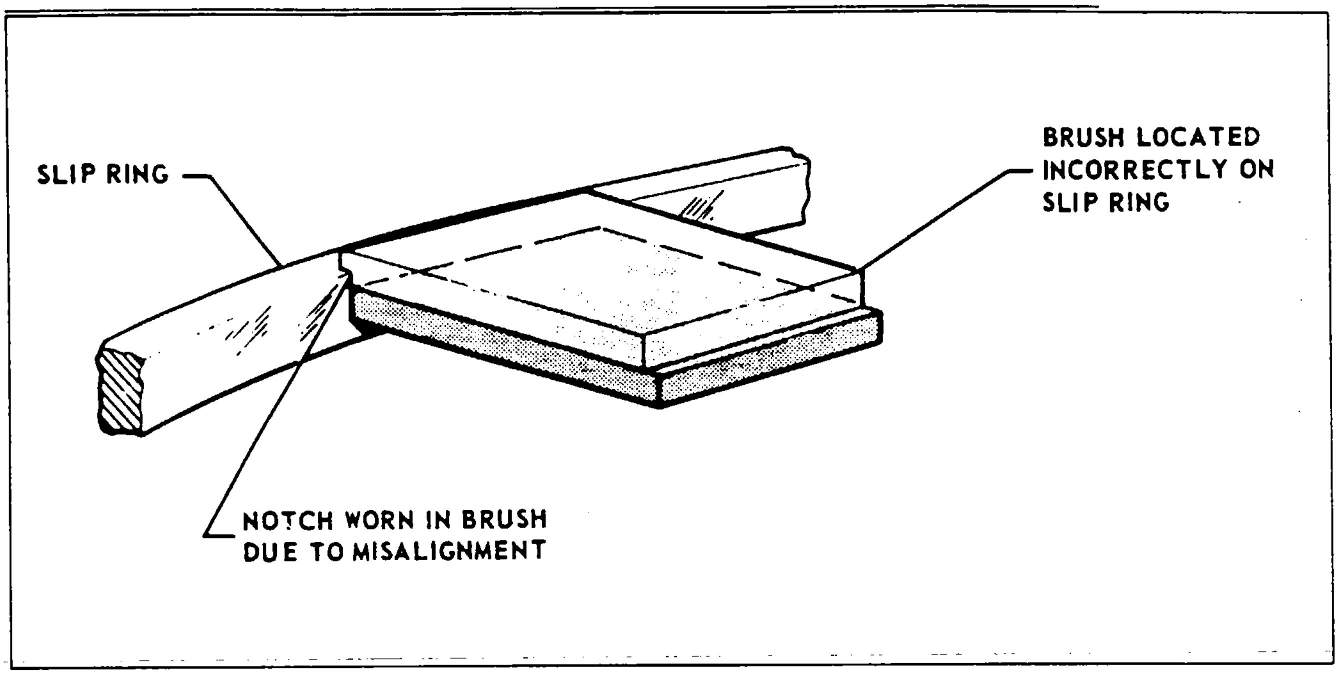


Figure 39-20. Centering of Brushes on Slip Rings

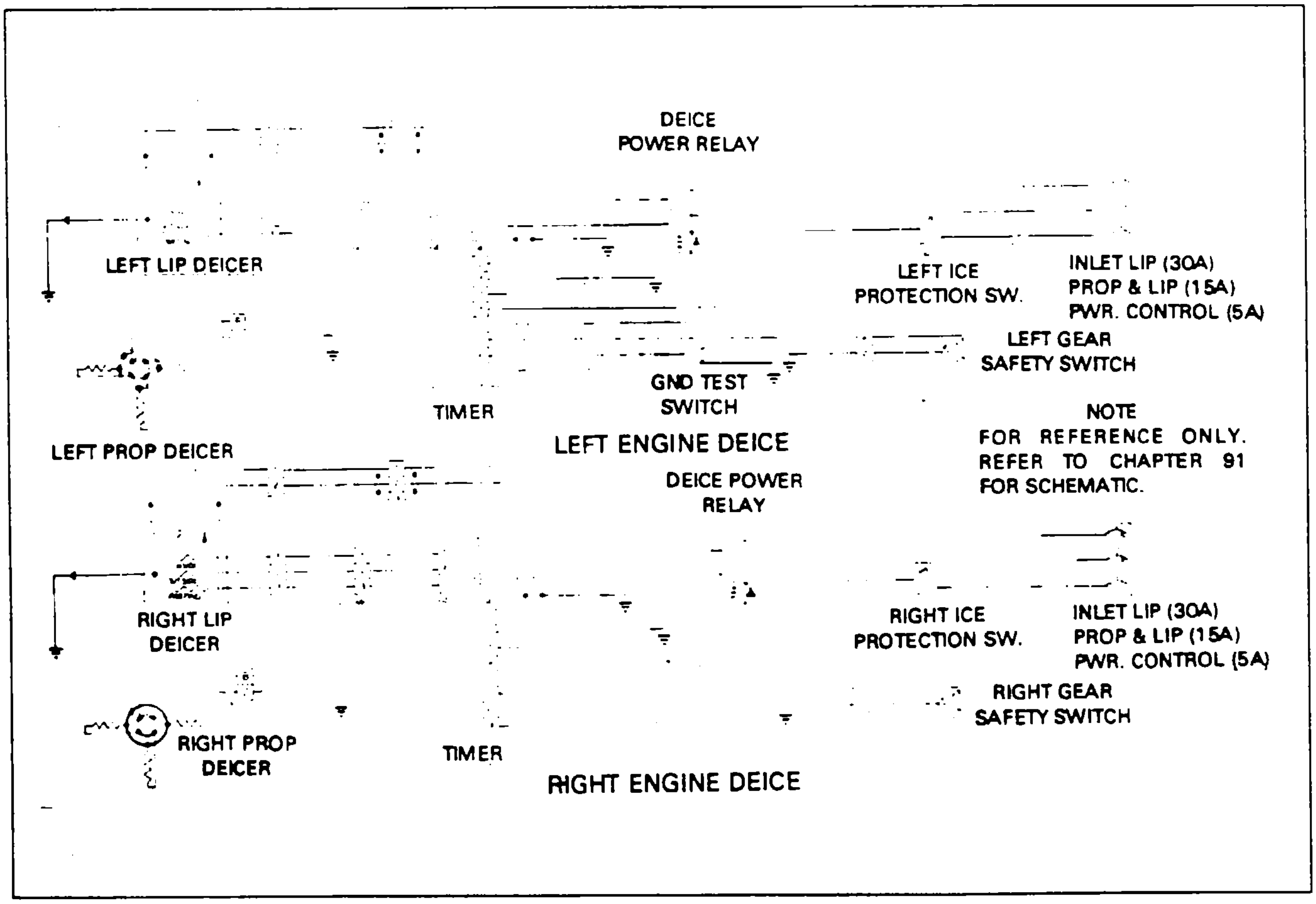


Figure 30-21. Wiring Schematic, Electric Propeller Deicing System

BRUSH MODULES/MODULAR BRUSH ASSEMBLIES.

Each 3E2090-1 modular brush assembly consists of one 3E2011-2 brush module, one 3E2011-3 brush module and a 4E2218-4 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 30-25.)

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 30-22 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 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 30-25.

—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 30-23.)

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 parallel within 0.005 inch and flat within 0.005 finch 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 30-26.)

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.

MODULAR BRUSH ASSEMBLY	X-DIMENSION (INCHES) MUST REPLACE
BRUSHES WITH RODS	17/64
BRUSHES WITHOUT RODS	1 7/64

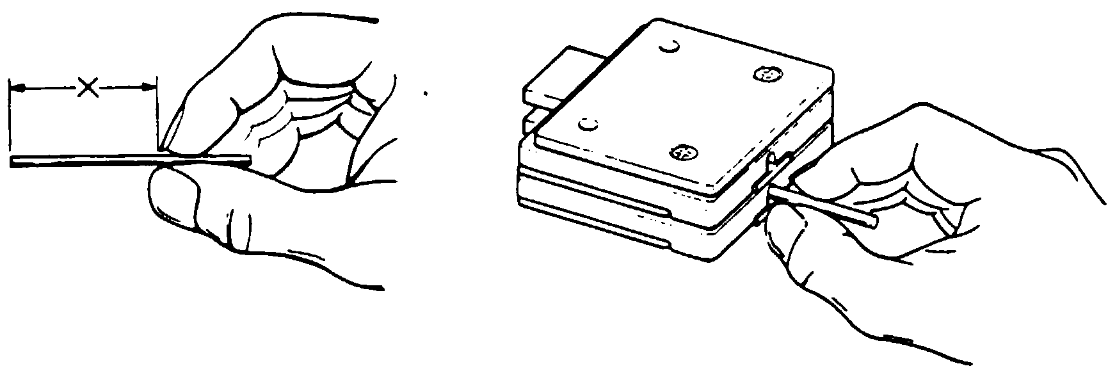


Figure 30-22. Modular Brush Assembly Wear Check

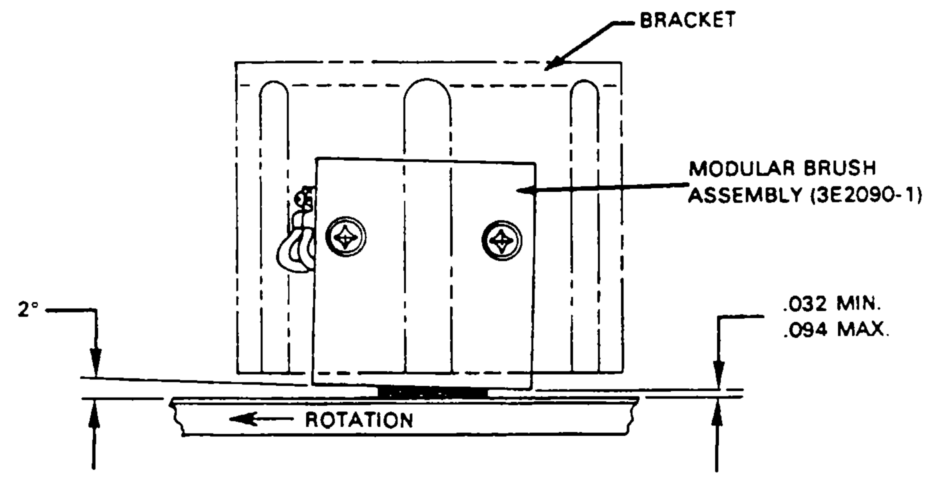
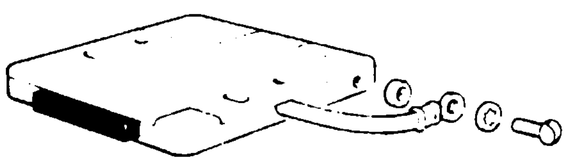
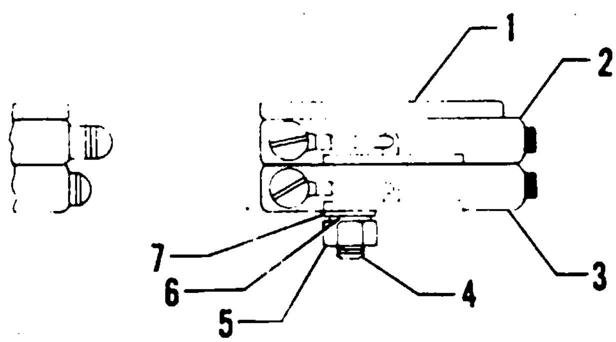


Figure 30-23. Angle of Contact Brushes to Slip Rings



1. BRUSH MODULE ASSEMBLY
2. NYLON SPACER (P/N 2E1260, ON -2 ONLY)
3. WIRE MARKER:
   "B" -2 ASSEMBLY
   "C" -3 ASSEMBLY

Figure 30-24. Brush Module Assembly (3E2011)



1. SPACER
2. BRUSH MODULE ASSEMBLY (3E2011-2)
3. BRUSH MODULE ASSEMBLY (3E2011-3)
4. SCREW (MS24693-532)
5. NUT (MS35649-262)
6. LOCKWASHER (MS35333-37)
7. WASHER (AN960C6)

Figure 30-25. Modular Brush Assembly 3E2090-1

—*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.

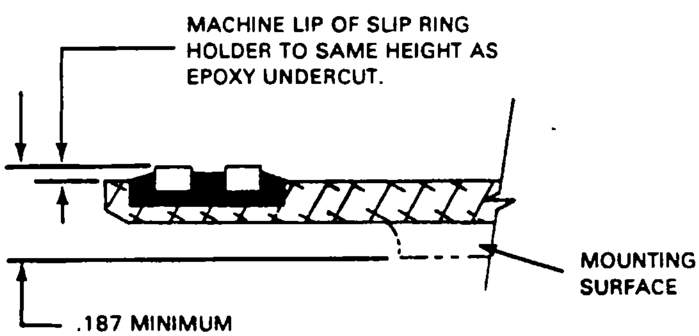


Figure 30-26. Machining of Slip Rings

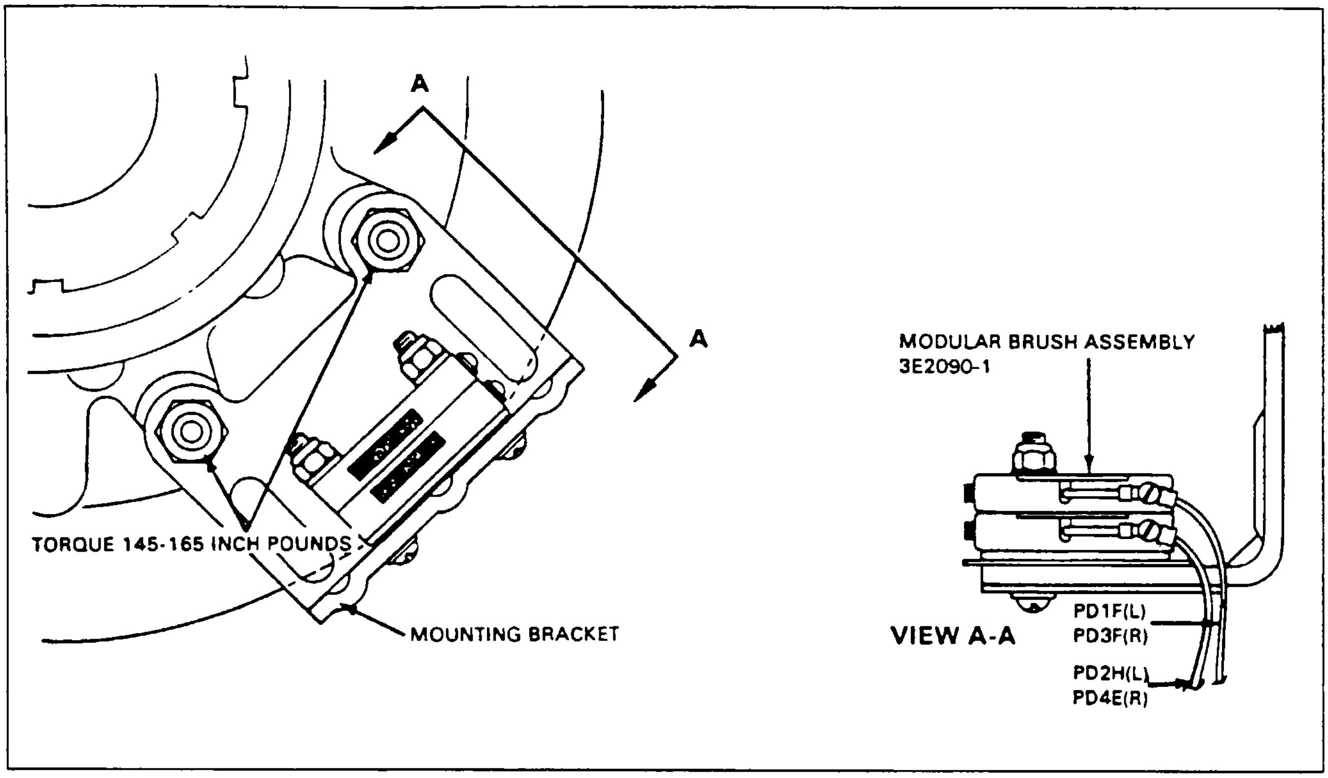


Figure 30-27. Modular Brush Assembly Installation

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.

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 30-28.)
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—

An 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 win 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.

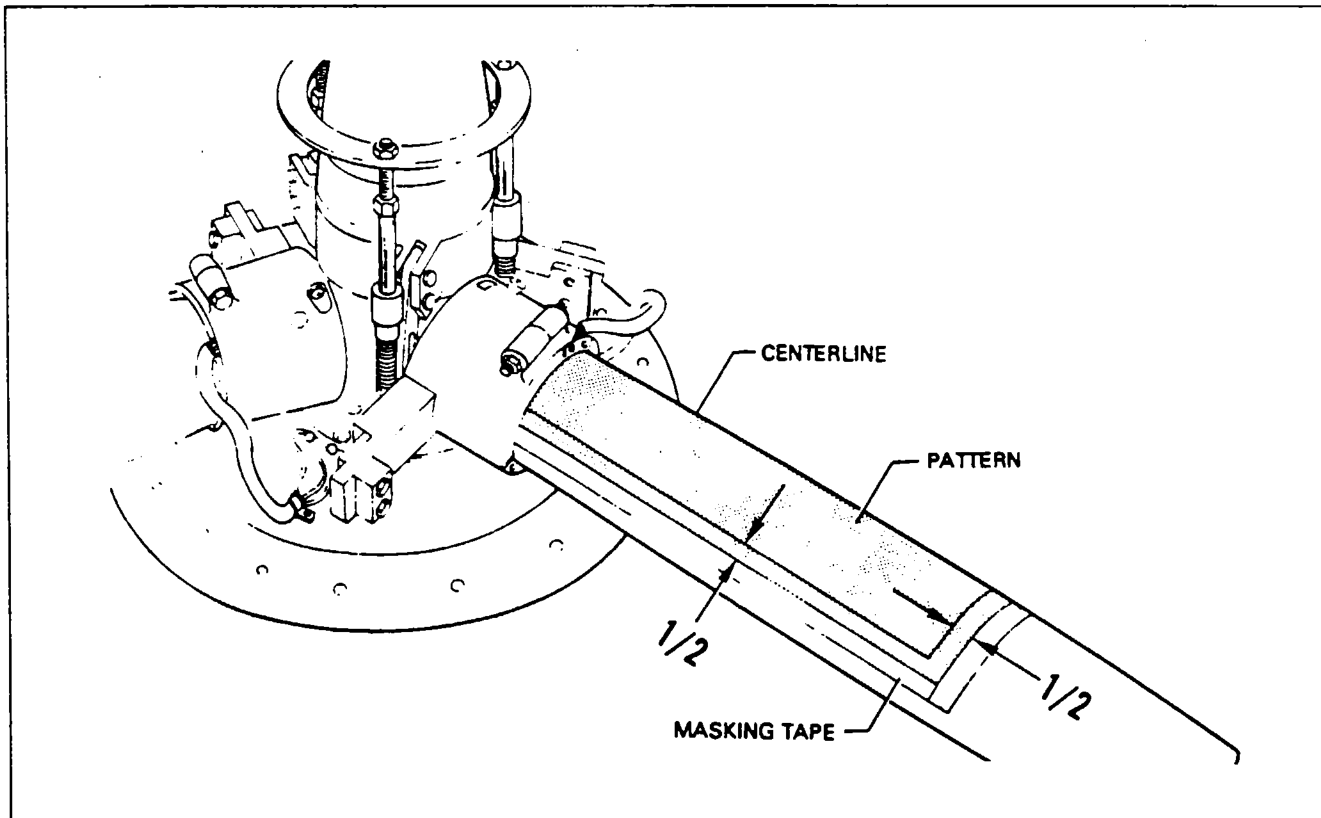


Figure 30-28. Installation of Deicer Boots (Typical)Figure 30-29. Wrinkled Deicers

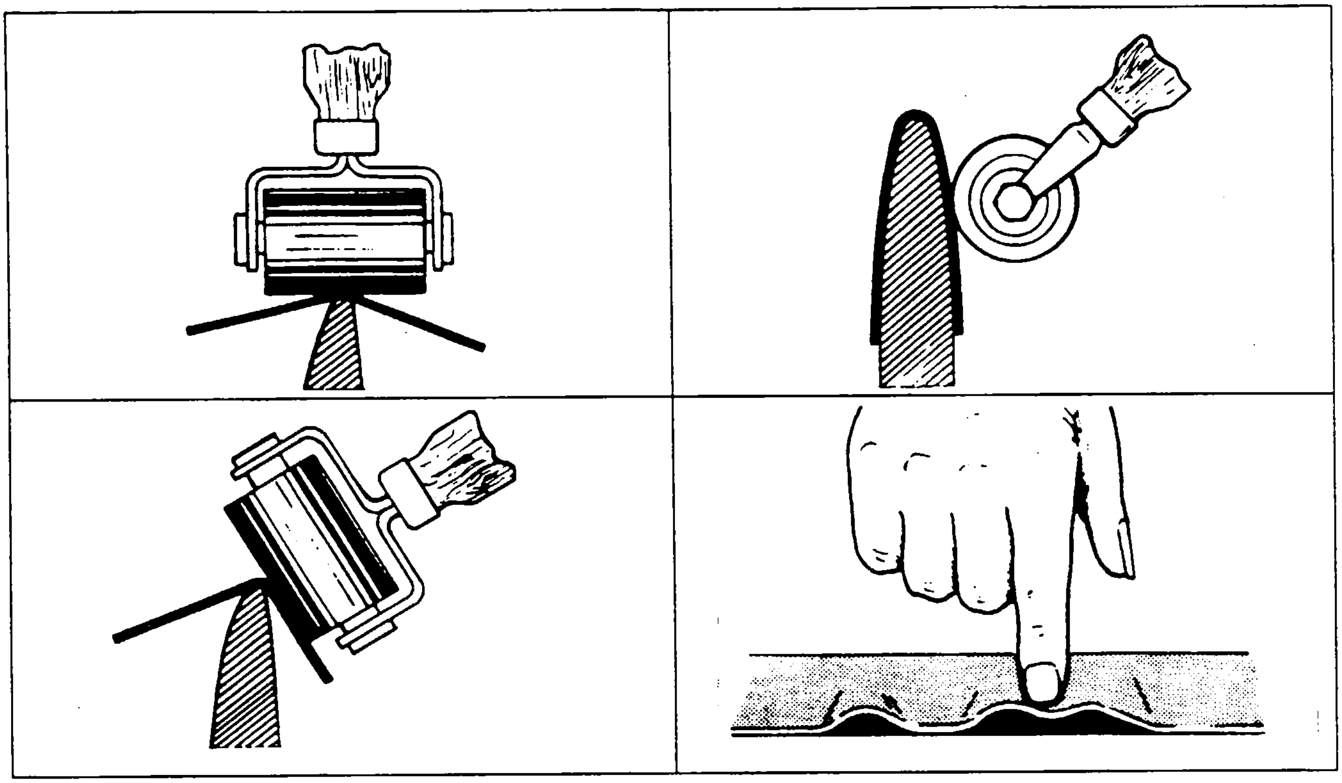


Figure 30-29. Wrinkled Deicers

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 40° or above, when the relative humidity is less than 75%. If the humidity is 75% to 90%, allow two hours drying time. Do not apply cement if the relative humidity is higher than 90%. After allowing the proper amount of drying time, apply a second even brush coat of 1300L cement.

—*NOTE*—

If curling of the deicer edges is a problem, apply masking tape to the edges of the glazed side before apply cement to the unglazed side. Remove the tape before starting to install the deicer.

4. Apply an even brush coat of 1300L cement on the cleaned surface of the propeller blade, immediately after the second coat of cement has been applied to the deicer. This timing is important for the cement on both surfaces to reach the tack stage at the same time.

INSTALLATION OF DEICERS AND REQUIRED MATERIALS.

It is imperative that the following instructions be followed exactly to insure maximum adhesion to the propeller blades.

1. When the cement coats are tacky dry on both propeller surface and deicer surface, proceed as follows:
   A. Position in the deicer on the propeller leading edge, using centerlines starting from the hub. (Refer to Figure 30-28.) 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 30-28.
   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 part 801.
   D. C-19861/C-21871/C-16176 - one part 19861/seven parts 21871/two and two thirds parts 16176.

CHART 3008. 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. Place masking tape along the edge of the recess on the outside of the engine air inlet scoop to allow application of filler directly into gap between the deicer boot and the edge of the recess. 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. For the lip deicer, simply fill the gap evenly and smoothly.
6. Immediately remove masking tape from propeller and/ or engine inlet lip and allow filler to dry for six 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 30-31.)
8. Insure that sealer completely covers area between deicer and blade on propeller. (See Figure 30-31.) Sealer must also completely cover the area between the deicer and edge of recess on the outside of the engine air inlet lip. Immediately remove masking tape and allow sealer to dry for 24 hours before starting engine.

WRINKLED DEICERS. (Refer to Figure 30-29.)

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 1 300L cement to the deicer and propeller bonding surfaces and allow to air dry for one hour. Then apply a second coat of 1300L cement to both the deicer and bonding surface. Allow to dry. Retackify with MEK or Acetone and press with fingers to work out wrinkles or to secure loose edges. If material has stretched and will not cement flat, replace the deicer.

ELECTRICAL CHECK.

1. Check the electrical resistance of each deicer. Refer to Schematic, Figure 30-21 and Resistance Readings. Refer to Chart 3009.
2. Check for intermittent open circuits by tensioning the deicer strap slightly while measuring the resistance. Also, press lightly on the deicer surface in the area adjacent to the strap retainer. Resistance must not vary.
3. Identification of the circuits within the element may be confirmed by referring to the resistance values and schematic diagram, Figure 30-21. 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 3009. 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. A test should be conducted on each propeller deicing system to insure that deicer leads are installed in such a manner that the propeller can be moved from full low pitch through the feathering position without placing the leads in tension.
4. If damage occurs to slip ring, wire harness or tie straps, replace damaged parts.

BALANCING.

To assure balance of the propeller assembly, the original balancing weights or their equivalents must be reinstalled. The weights must be left in their original position on the propeller hub. The restrainer and weights should not interfere with any part of the propeller assembly under any condition. If for any reason balance weights were removed, reinstall safety wire on screws.

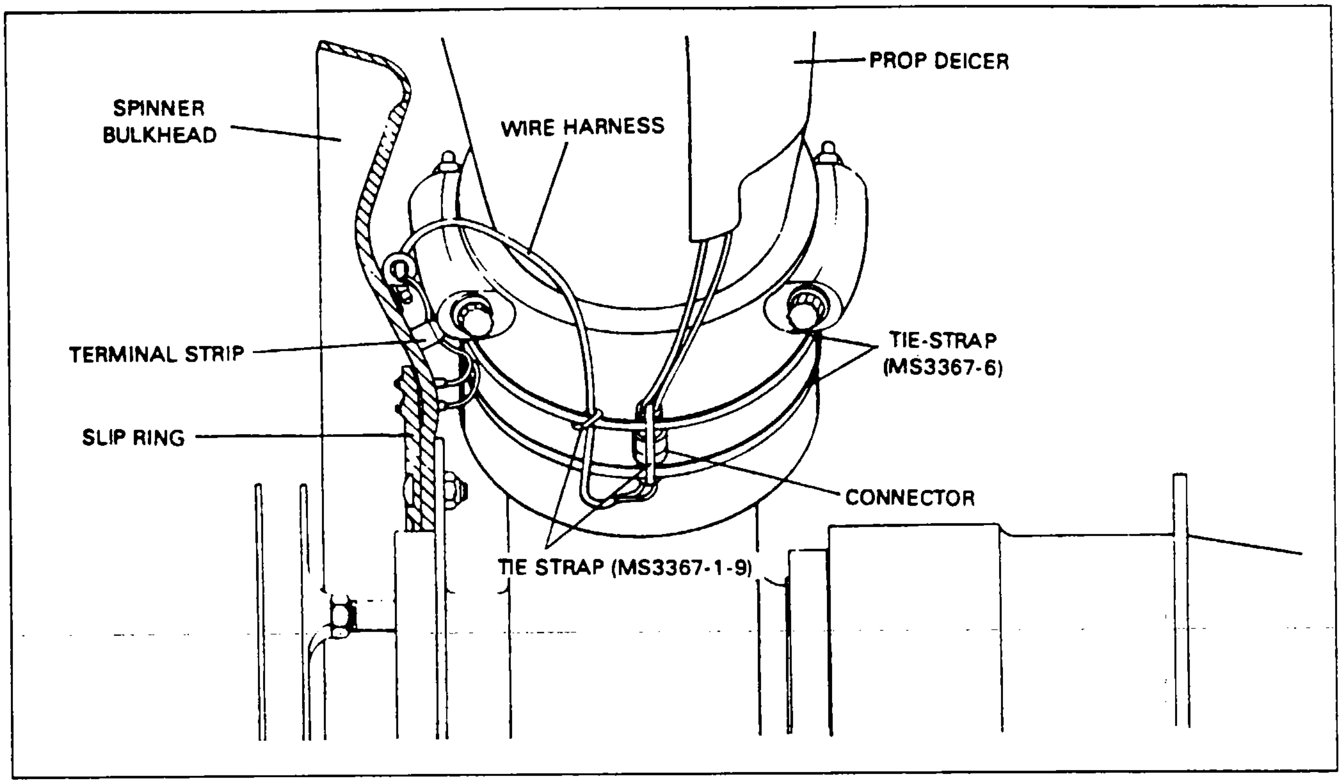


Figure 30-30. Prop Deicer Wiring Harness Attachment

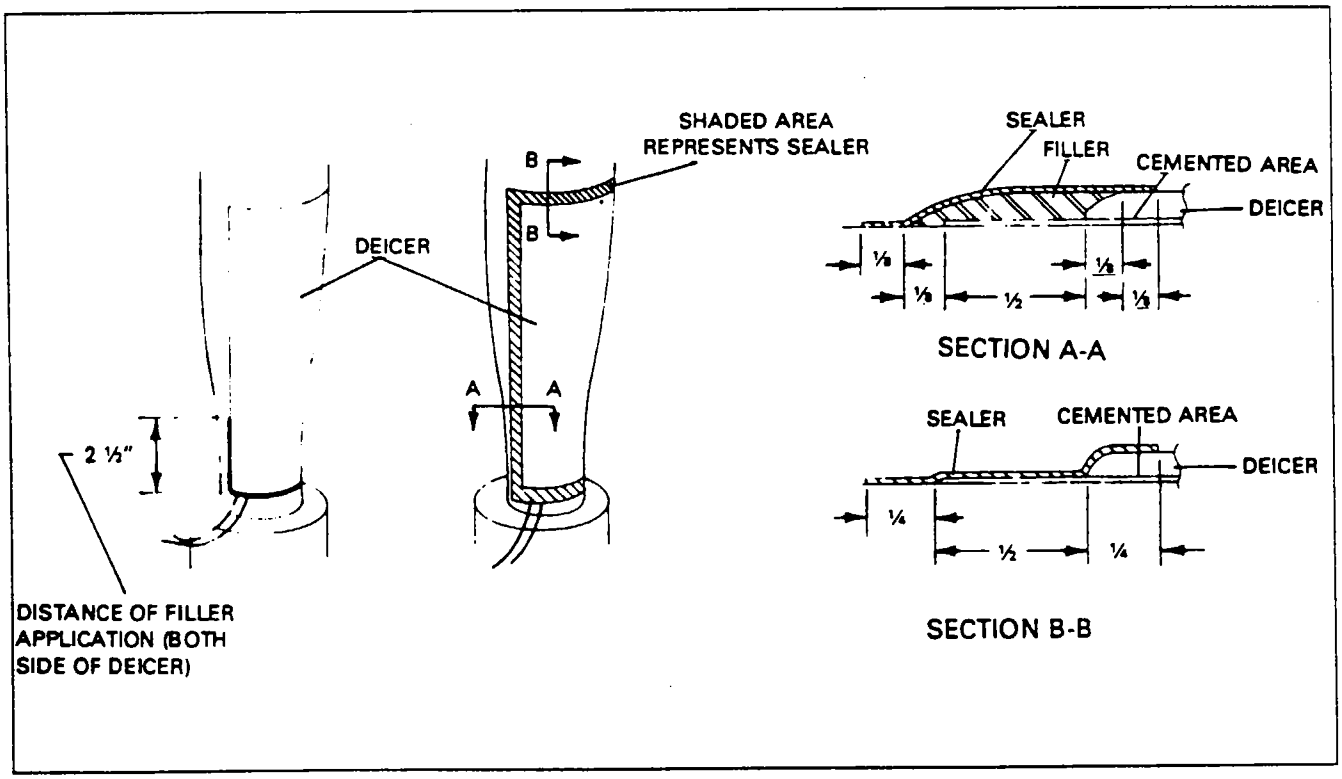


Figure 30-31. Typical Deicer Boot Sealer Application

ICE DETECTION.

WING INSPECTION LIGHT.

The wing inspection light is used in conjunction with the pneumatic deicing system to aid the pilot in detecting the formation of ice on the left wing leading edge during night flying operations. For removal and installation procedures, refer to Chapter 33, Lights.

—END—

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

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 closing again when the gear has fully extended. To prevent the gear from retracting while the airplane is on the ground, an anti-retraction safety switch is located on the left gear upper torque link, which will not allow the gear actuator lever to move to the gear up position until weight is off the landing gear allowing the strut to extend to within one-quarter of an inch of full extension.

The nose gear is steerable through an 40 degree arc by the use of the rudder pedals with an additional 40 degrees available for towing. 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 150 ft. lbs. of engine torque 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.

Located in the cockpit between the pilot seats, under the floor access panel, is a hand pump and emergency blow down system to be used should the primary hydraulic system fail. The "blow-down" system is a mechanically actuated pneumatic emergency extension system which provides pressure for emergency extension of the landing gear. This pressure is provided by four sealed, disposable gas storage cylinders (One for each main gear, and two for the nose gear).

The brakes are hydraulically actuated by individual master cylinders mounted on the left (optional on right) set of rudder pedals. A reservoir, accessible through the access door on the upper right portion of the nose section, supplies fluid to each master cylinder. From these cylinders, hydraulic fluid is routed through lines and hoses to a parking brake valve located on the left aft side of the forward cabin bulkhead, through the cabin and wings, to the brake assemblies on each main landing gear. To operate the brakes, apply toe pressure against the top of the rudder pedal. The parking brake may be actuated by applying toe pressure and at the same time pulling out on the brake handle. To relieve parking brake pressure, apply toe pressure on the pedals and at the same time push in on the parking brake handle.

Servicing of the hydraulic and brake system is found in Chapter 12.

TROUBLESHOOTING.

Mechanical and electrical switch troubles peculiar to the landing gear system are listed in the Troubleshooting Chart. When troubleshooting, first eliminate hydraulic malfunctions as listed in Chapter 29. Then proceed to switch malfunctions and last to the mechanical operation of the gear itself, both of which are listed in this section. Always place the airplane on jacks before attempting any troubleshooting of the gear.

CHART 3201. TROUBLESHOOTING (LANDING GEAR SYSTEM)

Trouble	Cause	Remedy
Landing gear selector handle fails to operate to gear up position.	Selector lever cannot be moved to the gear up position while the LEFT main gear strut is compressed or with the power off.	Ascertain that the LEFT main gear strut is extended and that the power is on.
	Faulty safety switch on left main gear.	Adjust or replace safety switch.
Gear retracts or extends before the doors open.	Priority valve leaks in power pack.	Check priority valve cracking pressure.
	Solenoid valve stuck in closed position.	Turn off power and hand pump doors open.
	Micro switch on power pack out of adjustment.	Check for bent bracket or loose mounting or wire and adjust.
—NOTE— *With power off, solenoid valve shuttles to door open and the doors may be opened without selecting gear up or down.*		
Doors come open in flight.	Doors are rigged too tight.	Adjust rigging of doors.
	Micro switch on power pack out of adjustment.	Adjust micro switch.

CHART 3201. TROUBLESHOOTING (LANDING GEAR SYSTEM) (cont.)

Trouble	Cause	Remedy
Doors fail to close.	Circuit breaker out.	Check circuit breaker.
	Limit switch out of adjustment.	Adjust limit switch.
	Gear not fully retracted.	Check adjustment.
	Cannon plug on power pack loose.	Tighten plug.
	Solenoid valve stuck in door open position.	Check wiring to solenoid valve.
	Powerpak microswitch out of adjustment or faulty.	Adjust or replace switch.
Nose gear fails to lock up when handle returns to neutral.	Not enough actuator stroke.	Increase the actuator stroke.
	Gear doors pinching.	Relieve door pinch by lengthening door operating rods.
Main gear fails to lock up.	Uplock rod out of adjustment.	Adjust rod.
	Actuator out of adjustment.	Adjust actuator.
No red light on panel when gear are in transit.	Circuit breaker out.	Check circuit breaker.
	Indicator light burned out.	Replace indicator light.
	Circuit wire broken.	Check wiring.
No green light on panel when gear are down.	Circuit breaker out.	Check circuit breaker.
	Indicator light burned out.	Replace indicator light.
	Lock switch defective or out of adjustment.	Replace and/or adjust lock switch.
	Gear not locked in down position.	Adjust the gear.

CHART 3201. TROUBLESHOOTING (LANDING GEAR SYSTEM) (cont.)

Trouble	Cause	Remedy
Flashing red indicator light or warning horn sounding when power from one or both engines is above 150 foot pounds of torque.	Power lever switches are faulty.	Replace switches.
	Power lever switches out of adjustment.	Adjust throttle switches.
Red indicator light stays on with gear up and locked.	Doors could be open.	Adjust doors.
	Switch defective.	Replace defective switch.
Flashing red light and warning horn fail to operate when power from both engines is reduced below 150 foot pounds of torque.	Power lever switches out of adjustment.	Adjust throttle switches.
	Power lever switches are defective.	Replace switch.
	Horn or light defective.	Replace defective part.
	Defective wiring.	Check wiring.
Nose gear shimmies during fast taxi, take-off and landing.	Internal wear in shimmy dampener.	Replace shimmy dampener.
	Shimmy dampener or bracket loose at mounting.	Replace necessary parts and bolts.
	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/or bushings.	Replace bolts and/or bushings.
Main landing gear shimmies during fast taxi, take-off and landing.	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/ or bushings.	Replace bolts and/or bushings.

CHART 3201. TROUBLESHOOTING (LANDING GEAR SYSTEM) (cont.)

Trouble	Cause	Remedy
Strut bottoms on normal landing or when taxiing over rough ground.	Insufficient air and/or fluid in strut.	Service strut with air and/or fluid.
	Defective internal parts in strut.	Replace defective parts.
Excessive or uneven wear on main tires.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wheel out of alignment (toe-in or toe-out).	Check wheel alignment.
Nose gear fails to steer properly.	Oleo cylinder binding in strut housing.	Lubricate strut housing.
	One brake dragging.	Determine cause and correct.
	Steering arm roller sheared at top of strut.	Replace defective roller.

REPLACEMENT OF WIPER STRIP ON LANDING GEAR STRUTS.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Jack the airplane only high enough to take weight off the gear.
3. Release the air pressure from the strut by depressing the valve core pin until the pressure has diminished.
4. Using snap ring pliers, disengage the snap ring from the annular slot in the oleo housing and allow it to lay at the lower end of the piston tube along with the wiper strip retainer washer.
5. Remove the old wiper strip from the housing, and clean and inspect the housing to determine that no pieces remain in it.
6. Wipe the piston tube and check it for any abrasions which may damage the new wiper. Polish the tube to remove any abrasions found.
7. A new wiper strip should be cut with a 30 degree bevel, a little longer than needed, to circle the piston tube.
8. Insert the new wiper strip up into the oleo housing with the tapered edge down. Slide the retainer washer and snap ring up the piston tube and insert them into the oleo housing. Using snap ring pliers to compress the snap ring, install it into the annular slot in the oleo housing.
9. Inflate the oleo strut in accordance with instructions given in Oleo Struts, Chapter 12, and remove the airplane from the jacks.

REPLACEMENT OF T-RINGS ON LOWER BEARINGS. (Refer to Figure 32-6.)

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.

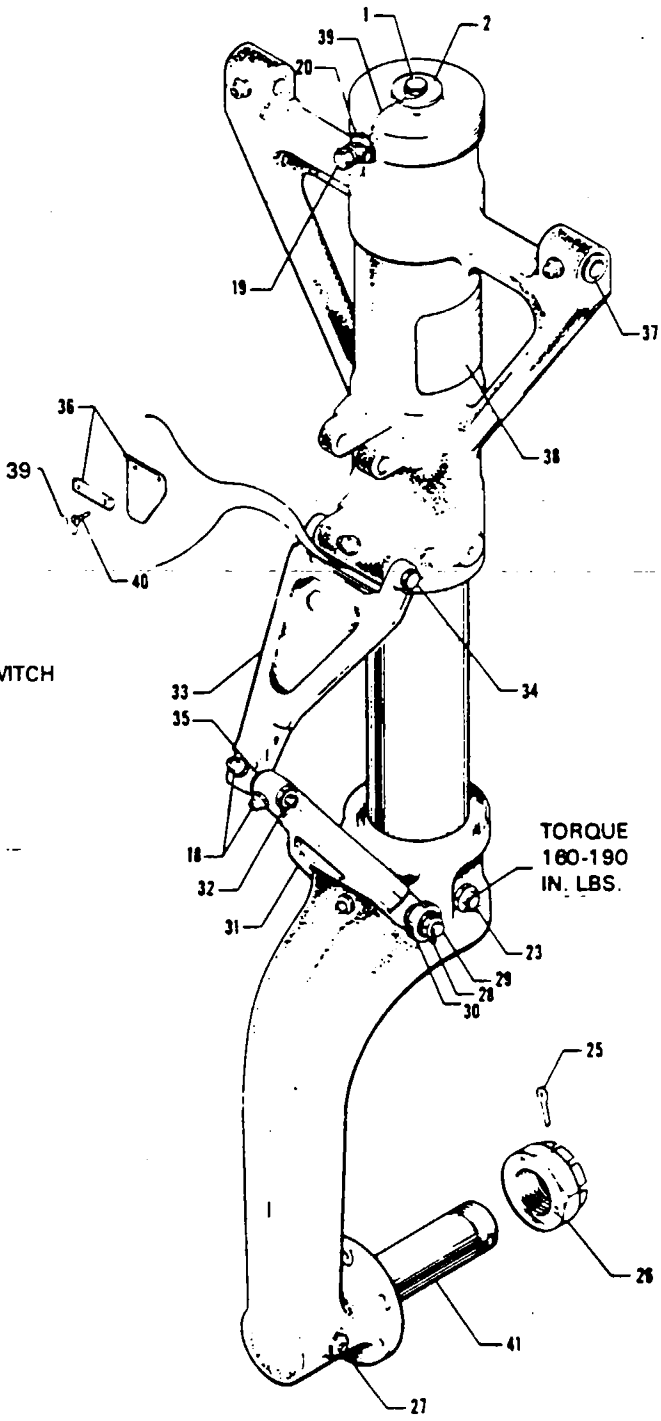
MAIN GEAR OLEO STRUT.

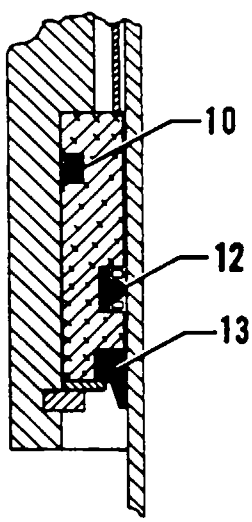
DISASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 32-1.)

The main gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed on the airplane.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Place a drip pan under the main gear to catch spillage.
3. Remove the air and fluid from the oleo. (Refer to Oleo Struts, Chapter 12.)

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. "T" RING
11. BEARING, LOWER
12. "T" RING
13. WIPER STRIP
14. WASHER
15. RING, RETAINER
16. O-RING, PACKING
17. PLUG
18. GREASE FITTING
19. VALVE, AIR
20. PLUG, FILLER
21. HOUSING, OLEO
22. TUBE, PISTON
23. BOLT ASSEMBLY
24. FORK
25. PIN, COTTER
26. NUT, AXLE
27. BOLT ASSEMBLY
28. PIN, COTTER
29. BOLT ASSEMBLY
30. BEARING, UPLOCK
31. TORQUE LINK, LOWER
32. BOLT ASSEMBLY
33. TORQUE LINK, UPPER
34. BOLT ASSEMBLY
35. WASHER, SPACER
36. CONTACT, SAFETY SWITCH
37. BUSHING
38. PLACARD, SERVICE
39. SAFETY WIRE
40. SCREW
41. AXLE





VIEW A A
(Refer to following page)

Figure 32-1. Main Gear Oleo Strut Assembly

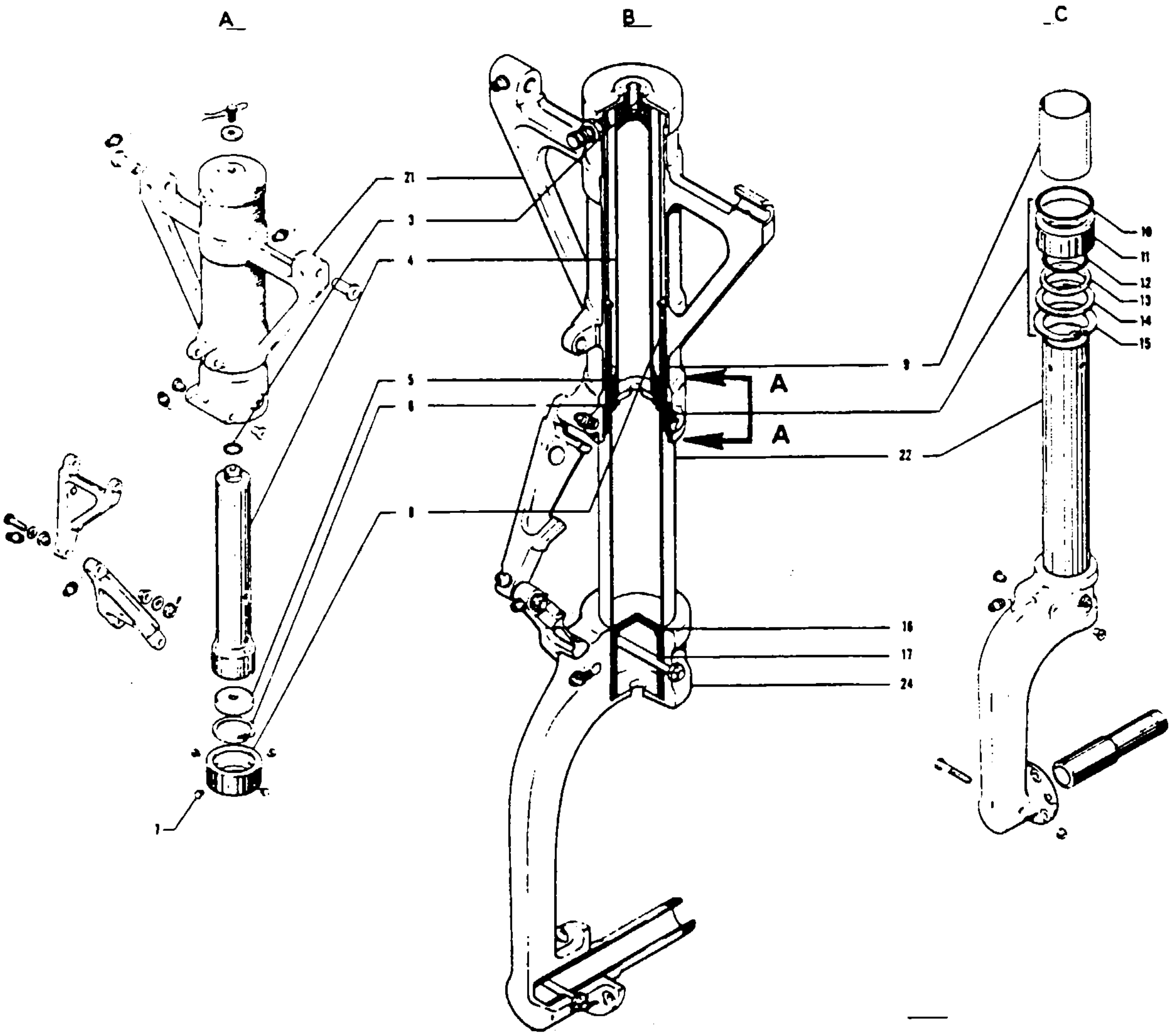


Figure 32-1. Main Gear Oleo Strut Assembly (cont.)

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 T-rings, wiper, washer and retainer ring.
8. To remove the orifice tube from the oleo housing, cut safety wire and remove cap bolt and washer from top of the housing.
9. The orifice plate is removed from the orifice tube by releasing the retainer ring that holds the plate in position.

—NOTE—

Do not remove piston plug from piston tube, or piston tube from fork.

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR OLEO.

The instructions for cleaning, inspection and repair of the main gear oleo are the same as those given for the nose gear oleo.

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

1. Ascertain that all parts are cleaned and inspected.
2. To assemble and install the orifice tube insert the orifice plate into the bottom of the tube, with the countersunk side of the orifice hole exposed. Secure the plate with retainer ring. Lubricate and install the O-ring on the upper end of the tube. Insert the tube up through the bottom oleo housing. With the tube exposed through the top of the housing, install washer and tighten cap bolt finger tight.
3. The piston tube assembly may be assembled to the oleo housing by first installing the tube components on the tube. In order, slide onto the tube the retainer ring, washer, lower bearing with inner and outer T-rings, spacer and upper bearing. Align reference marks on the upper bearing and piston tube to insure proper indexing of the lock pin holes of the upper bearing and tube and install retainer pins.
4. Carefully insert the piston tube assembly into the oleo housing, guiding the orifice tube into the piston tube until the retainer ring can be installed in the annular slot at the lower end of the housing. Install wiper strip, slide washer into position and secure assembly with retainer ring. At the top of the housing, tighten the cap bolt.
5. Install the upper and lower torque links. (Use same thickness spacer washers between the two links as those removed to maintain correct wheel alignment.)
6. Lubricate the gear assembly. (Refer to Lubrication Chart, Chapter 12.)

7. Service the oleo strut with fluid and air (refer to Oleo Struts, Chapter 12) and safety with MS20995-C40 wire between the filler plug and cap bolt.
8. Check the gear alignment and gear operation.

MAIN LANDING GEAR.

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

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Remove the two access plates forward and two access plates aft of the outboard wheel door.
3. With the hand pump, retract the main gear slightly to relieve the gear from its downlocked position and to lower the inboard gear door out of the way.
4. Disconnect brake line.
5. To remove side brace link assembly, the following procedure may be used:
   A. Disconnect the actuating cylinder and downlock rod from the upper side brace link arm by removing clevis bolt. Disconnect the other end of the downlock rod at the downlock hook. Disconnect the emergency actuating cylinder from the upper side brace link arm by removing the clevis bolt.
   B. Remove downlock hook and spring by removing pivot bolt.
   C. Remove the downlock switch bracket with switch by removing the four screws that attach the bracket between the forward and aft side brace links. Remove the clamps that secure the electrical wiring to the side brace link.
   D. Disconnect the lower side brace link from the gear oleo housing and let the link assembly swing down.
   E. Remove the bolt that connects the upper and lower side brace links.
   F. Disconnect the aft link from its attachment plate.
   G. To remove the forward link, remove the nut with washers that is holding the link on its pivot shaft. Slide the link from the pivot shaft.
   H. The pivot shaft may be removed by reaching through the pivot shaft bracket access hole, removing the bolt securing the shaft to the shaft fitting. Slide the tube through the attachment bracket. The shaft fitting is attached with cap bolts, washers and anchor nuts.
6. Disconnect the outboard gear door retraction rods at the gear housing. With the lower side brace link disconnected from the housing, the gear may be removed by removing the attachment bolt assemblies at the attachment plates on each side of the gear housing. Note, if any, the number and location of spacer washers between the gear housing and attachment plates.
7. The uplock hook and spring may be removed by disconnecting the uplock rod from the hook and then the hook pivot bolt. Disconnect the emergency actuator rod from the uplock hook.
8. The uplock rod 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, with a wrench, remove 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—

For serial numbers 31T-8275001 through 31T-5575001, ensure that the latest revision of Service Bulletin No. 841 instructions for Inspection/Replacement of Main Landing Gear Forward Side Braces has been complied with. Piper considers compliance with service bulletins 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 of 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 downlock hook spring is 7 pounds. These checks are performed by fastening a fish type scale to the particular hook and spring and pulling against the hook and spring to get a reading on the scale.
6. Inspect the uplock roller for freedom of movement and minimum wobble.
7. Inspect lock rod end bearings and sliding surfaces for corrosion, damage and freedom of movement.
8. Inspect the general condition of limit switches and wiring for fraying, poor connection 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 .223 to .253 inch through center. (Refer to Figure 32-2.) Should this distance exceed the required through center travel and all bolts and bushings are tight, replace one or both side brace links.
10. Repair of the landing gear is limited to reconditioning of parts such as replacing bearings and bushings, smoothing out minor nicks and scratches, repainting of areas where paint has chipped or peeled and replacement of parts.

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

—NOTE—

When assembling any units, lubricate bearings and friction surfaces with proper Lubricant as described in Chapter 12.

1. Position the attachment plates of the landing gear housing and upper drag links and bolt in place.
2. The uplock hook may be installed by the following procedure:
   A. Place the "U" end of the uplock spring over the back of the hook with the loops also toward the back.
   B. Spread the spring and fit the loops over the bushing that extends through the hook.
   C. Slide the hook inboard through the bracket until the bracket hole aligns with the bolt hole in the hook.
   D. Install the pivot bolt and tighten so the hook will rotate freely, yet without side play.
3. Attach the uplock rod with the sliding end attached to the hook and the other end to the crank fitting. Attach the emergency actuator rod to the hook also.
4. To install the main gear housing assembly, position the gear so that the attachment points on the housing align with the attachment plates. If needed, install spacer washers between attachments to allow a minimum amount of end play. Tighten nut on each pivot bolt to a snug fit, allowing the gear to swing freely, 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 the nut.
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 rod may be installed by bolting the sliding end of the rod to the downlock hook and the other end to the upper drag link arm, at the same time attaching the landing gear actuating cylinder. Ascertain lubrication of sliding end of downlock rod. Attach the emergency actuating cylinder to the upper side brace link arm.
9. Lubricate the landing gear assembly. (Refer to Lubrication, Chapter 12.)
10. Check the main gear adjustment, operation and alignment.

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

1. With the airplane on jacks and the gear extended, disconnect the inboard and outboard gear door operating rods and secure the doors in the open position.
2. Disconnect emergency actuator cylinder. Locate clear of the primary gear extension components.
3. Disconnect the downlock operating rod from the downlock hook.
4. Adjust sidebrace links so that stops are touching and links are .223 to .253 inches through center (Refer to Figure 32-2).

—NOTE—

A fabricated tool may be constructed to check through center travel of the side brace link assembly while the links are installed. (Refer to Chapter 95.)

5. Use the fabricated tool in the following procedure:
   A. The gear is down and locked with no hydraulic pressure on the system.

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.

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 0.223 to 0.253 of an inch below the centerline on the plate.
F. Remove the tool and reinstall the cotter pins.

6. Operate the downlock hook by hand to determine that it engages freely and then open and close the joint several times to assure that the hook is operating properly.
7. If the hook operates properly, determine proper clearance between the hook and pin by engaging the hook and pushing up on the side brace link assembly, where the upper and lower links hinge, until the hook is tight against the pin. This will allow the link stops to separate. Clearance between the stops should not exceed 0.020 of an inch. If clearance exceeds 0.020 of an inch and pin is not worn and the link through travel is within limits; then hook must be replaced.
8. If hook will not clear pin, file inside surface of hook until minimum clearance is reached between the link stops as indicated in Step 7. Be careful to maintain the new surface parallel with the original surface. Replace pin if worn.

—CAUTION—

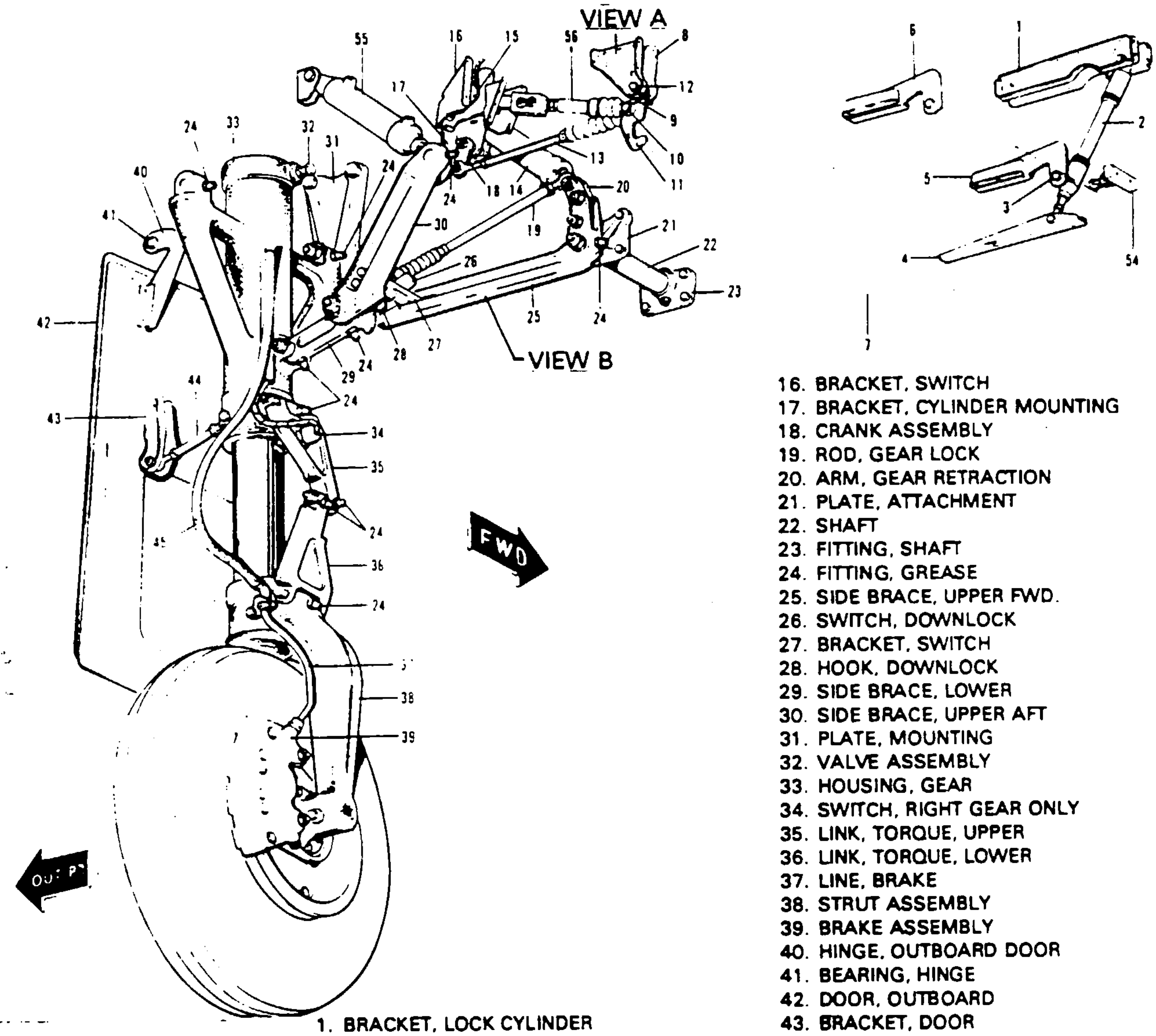
Do not file pin.

9. To replace pin, cut the pin, file off any burrs left by the cut and drive the pin out from each side. Do not try to drill the pin out as this may damage the link. Install new pin and flange.
10. With the downlock hook engaged, pull the retraction arm located at the top of the forward side brace towards the downlock hook to the limits of its travel. Also pull the downlock operating rod out to its full length and adjust the rod end until the hook bolt can be freely inserted through the hook lugs.
11. Remove the bolt and turn the rod end out one full turn, tighten the locknut and install the attaching bolt.
12. Partially retract and extend the gear several times to see that the downlock is operating properly.

—NOTE—

Refer to Position and Warning Section of this chapter for adjustment of the landing gear light switches.

13. Pull the retraction arm outboard in its slot as far as possible and position the crank assembly, along with the actuator, inboard in its slot.



1. BRACKET, LOCK CYLINDER
2. ACTUATOR, DOOR
3. BEARING, HINGE
4. BRACKET, INBOARD DOOR
5. HINGE, INBOARD DOOR
6. BEARING, HINGE
7. DOOR, INBOARD
8. BRACKET, UPLOCK HOOK
9. SPRING, UPLOCK
10. BOLT ASSY AND BUSHING
11. HOOK, UPLOCK
12. BOLT ASSY AND BUSHING
13. ROD, UPLOCK
14. CYLINDER
15. SWITCH, UPLOCK
16. BRACKET, SWITCH
17. BRACKET, CYLINDER MOUNTING
18. CRANK ASSEMBLY
19. ROD, GEAR LOCK
20. ARM, GEAR RETRACTION
21. PLATE, ATTACHMENT
22. SHAFT
23. FITTING, SHAFT
24. FITTING, GREASE
25. SIDE BRACE, UPPER FWD.
26. SWITCH, DOWNLOCK
27. BRACKET, SWITCH
28. HOOK, DOWNLOCK
29. SIDE BRACE, LOWER
30. SIDE BRACE, UPPER AFT
31. PLATE, MOUNTING
32. VALVE ASSEMBLY
33. HOUSING, GEAR
34. SWITCH, RIGHT GEAR ONLY
35. LINK, TORQUE, UPPER
36. LINK, TORQUE, LOWER
37. LINE, BRAKE
38. STRUT ASSEMBLY
39. BRAKE ASSEMBLY
40. HINGE, OUTBOARD DOOR
41. BEARING, HINGE
42. DOOR, OUTBOARD
43. BRACKET, DOOR
44. ROD, RETRACTION
45. HOSE, BRAKE
46. PIN, DOWNLOCK
47. CLEVIS BOLT
48. BUSHING
49. WASHER
50. BOLT, HOOK PIVOT
51. BOLT, NAS1309-44D
52. SPRING, DOWNLOCK
53. DUST BOOT
54. DOOR AJAR SWITCH
55. ACTUATING CYLINDER EMERGENCY EXTENSION
56. ACTUATOR ROD, EMERGENCY EXTENSION

Figure 32-2. Main Landing Gear Installation (Left)

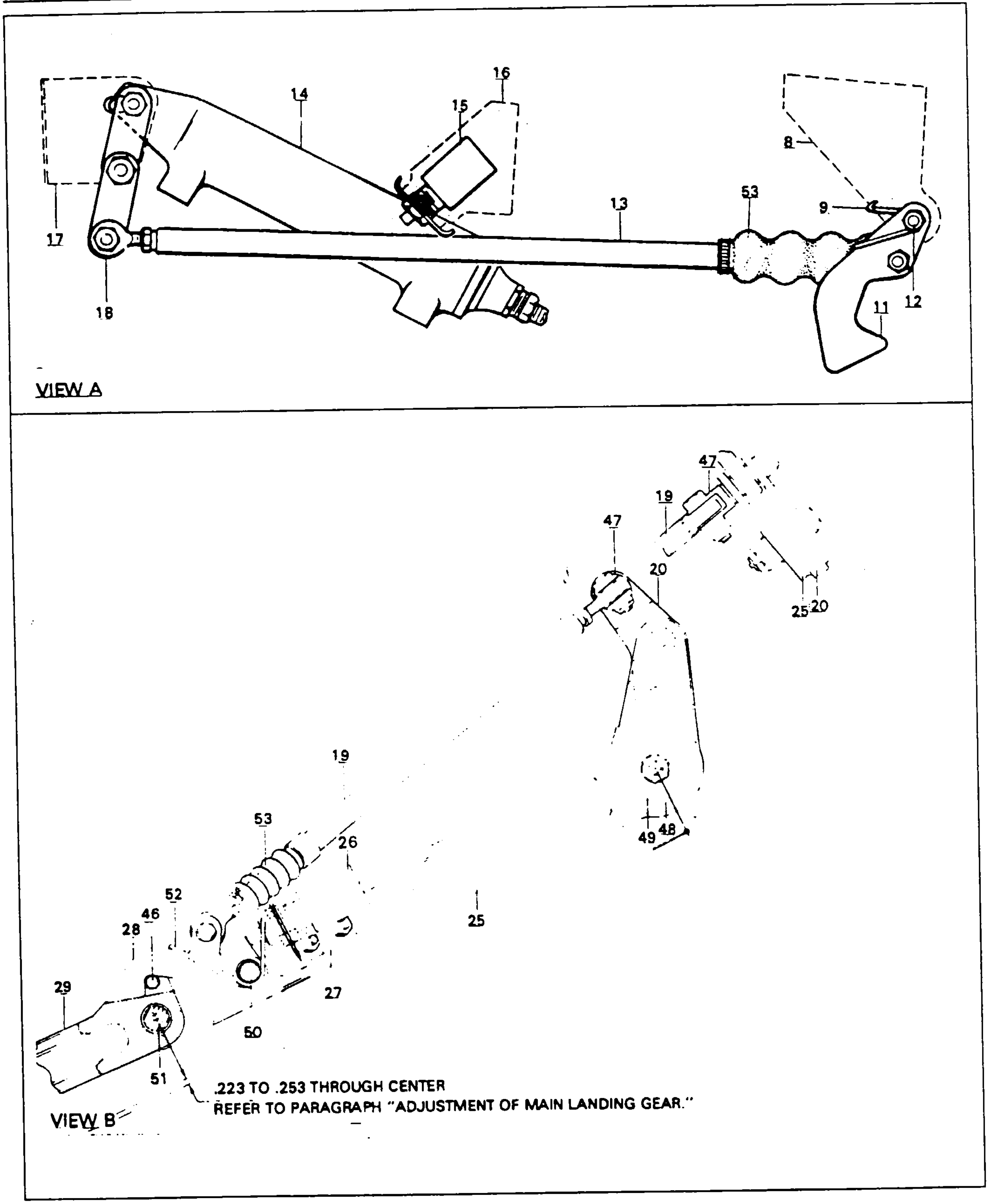


Figure 32-2. Main Landing Gear Installation (Left) (cont.)

14. With the actuator retracted under pressure, adjust the actuator rod end until the fork bolt slips in easily. Turn the actuator rod end in one turn and install the fork bolt.

—NOTE—

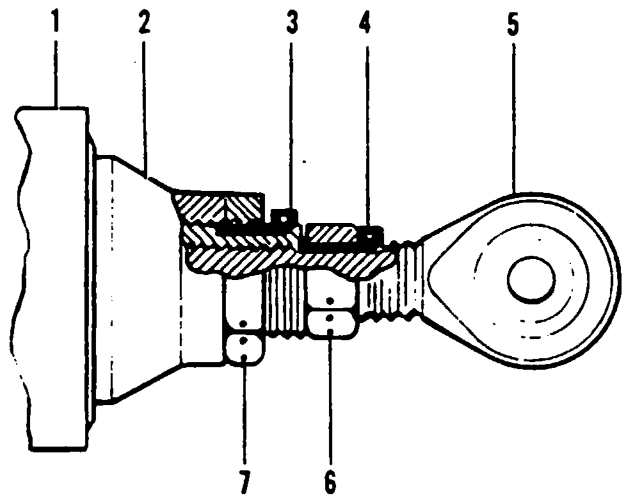
When installing the fork bolt in the actuator rod end, be sure that the forked end is properly aligned with the downlock operating rod.

15. Partially retract the gear; then extend the gear. As the side braces approach the locked position. exert a side force inboard on the wheel so that the hydraulic actuator must force the linkage into the locked position. If the gear fails to lock, adjust the actuator rod end inward in half turn increments until the gear locks down against the side load.
16. To adjust the uplock hook, use the following procedure:
    A. Disconnect the uplock operating rod from the hook.
    B. Retract the gear, being careful to keep the rod clear of moving parts.
    C. As the uplock roller approaches the hook, operate the hook by hand until the roller is engaged.

—NOTE—

This may also be obtained with the actuator attached to the retraction arm and pressure maintained on the actuator.

    D. Maintain pressure on the actuator to assure that the uplock crank is in its proper position. Pull the uplock rod out to its full length and adjust the rod end until the attaching bolt can be freely inserted. Remove the bolt and turn the rod end out one to three full turns and install bolt and spacer bushing. Tighten the locknut on the rod end.



1. CYLINDER
2. STROKE STOP
3. KEY, ROD END LOCK
4. KEY, STROKE STOP LOCK
5. ROD END
6. LOCKNUT, ROD END
7. LOCKNUT, STROKE STOP

Figure 32-3. Actuator Cylinder

E. Adjust the gear actuator rod end until the uplock roller clears inner hook surface by .03 to .06 inch when the piston is bottomed.

—NOTE—

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.

F. Increase the hydraulic pressure until the landing gear selector handle returns to its neutral position. This will indicate that the gear is hanging on the uplock hook.

—NOTE—

It will be necessary in order to extinguish the red light, to actuate the opposite main gear and nose gear up limit switches together with the inboard gear door closed switches.

G. Operate the gear through several cycles to assure that all parts are operating satisfactorily.

17. Adjust inboard and outboard main landing gear doors.
18. Adjust landing gear safety switch.

—CAUTION—

Be sure that all rod ends have sufficient gripping thread by determining that a wire will not go through the check hole in the rod.

ALIGNMENT OF MAIN LANDING GEAR.

The following steps should be completed prior to checking and/or adjusting main wheel alignment:

1. Ascertain that the airplane is parked on a level surface.
2. The full weight of the airplane must be on the landing gear.
3. Roll the airplane a minimum of two main wheel revolutions by the use of the tow bar. Move the airplane in a straight line. This will stabilize the landing gear position.

The following steps cover alignment procedures:

1. Place a straightedge no less than fifteen feet long across the front of both main landing gear wheels. Butt the straightedge against the tires at the hub level of the landing gear. Ascertain that the straightedge is the same distance from the forward side of the axle hubs. Devise a support to hold the straightedge in position.
2. Place a spacer block against the wheel rim at the hub line, with the wide end toward the front of the wheel to check and/or adjust the landing gear for proper toe-in of .5 degree. (Refer to Figure 32-4.) Set a square against the straightedge and spacer block and check to see if its outstanding leg bears against the spacer block.

—*NOTE*—

A carpenter's square, because of its especially long legs, is recommended for checking main landing gear wheel alignment.

3. If a gap appears at the rear, between the block and square, the wheel is toed-out and must be realigned. If a gap appears at the forward end between the block and square, the wheel has too much toe-in and must be realigned to get .5 degree toe-in.
4. To rectify toe-in or toe-out condition, remove bolt connecting upper and lower torque links and remove or add spacer washers to move the wheel in desired direction.
5. Recheck the wheel alignment. If the wheel alignment is correct, safety the castellated nut with a new cotter pin. If the misalignment still exists, separate the torque links and add or remove a spacer washer. Limit the number of spacers installed to allow for installation of the cotter pin in the bolt.

MAIN GEAR DOOR ASSEMBLY.

REMOVAL OF MAIN GEAR DOOR ASSEMBLY.

1. To remove the outboard gear door, disconnect the retraction rods from the door and remove the hinge bolts.
2. To remove the inboard gear door, place the airplane on jacks and retract the gear enough to allow the door to open. Disconnect the actuating cylinder rod and remove hinge bolts.

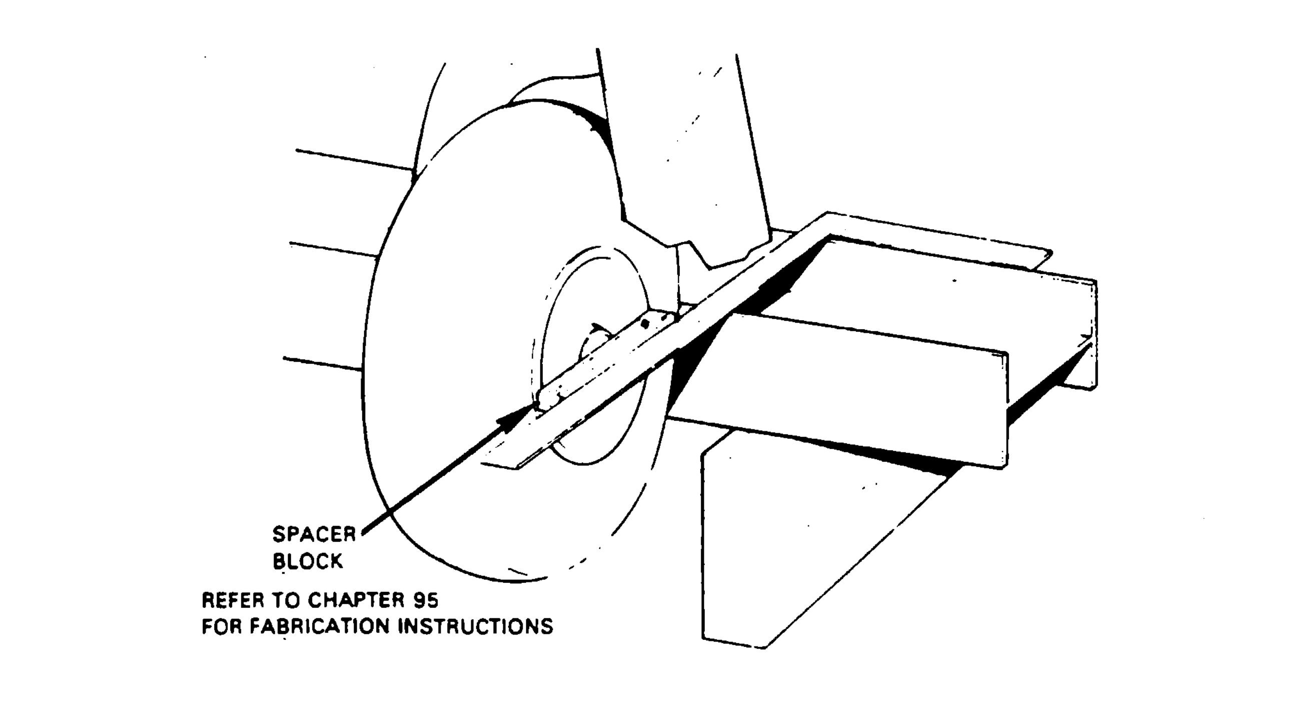


Figure 32-4. Aligning Main Gear

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR DOOR ASSEMBLY.

1. Clean all parts with a suitable cleaning solvent.
2. Inspect the outboard or inboard doors for cracks or bent skin, loose hinge brackets and worn or corroded bearings.
3. Repair to the door assemblies is limited to replacing hinge bearing, brackets or rivets, minor skin repairs and painting.

INSTALLATION OF MAIN GEAR DOOR ASSEMBLY.

1. The inboard gear door is installed by aligning the hinge bracket holes with the bearings, installing bolt assembly and securing. Install the actuating cylinder rod to the door.
2. The outboard gear door is installed by aligning the hinge bracket holes with the bearings, installing bolt assemblies and securing. Attach the actuating rods between the door and landing gear housing.

ADJUSTMENT OF MAIN GEAR DOORS.

1. Ascertain that the main landing gear has been properly adjusted.
2. Adjust outboard door rods to their maximum length and bolt 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 approximated .062 of an inch, except at the hinge side, between the door and the skin surface of the wing. A gap of approximated .093 of an inch should be maintained at the hinge side of the door.

NOSE GEAR AND DOORS.

NOSE GEAR OLEO STRUT.

This portion of the chapter pertains to the removal, disassembly, cleaning, inspection, repair, reassembly and installation of the nose gear oleo strut.

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

The nose gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed on the airplane.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Place a drip pan under the nose gear to catch spillage.
3. Remove air and fluid from the oleo. (Refer to Oleo Struts, Chapter 12.)
4. To remove the complete cylinder and fork assembly from the oleo housing as shown in Figure 32-6, cut safety wire and remove 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 retainer 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 T-rings, wiper strip, washer and retainer ring.
11. To remove the orifice tube, remove bolt and washer of the orifice tube from the top of the cylinder. Pull the tube from the cylinder.
12. The orifice plate is removed from the bottom of the orifice tube by releasing the retainer ring that holds the plate in position.

—NOTE—

Do not remove piston tube plug from piston tube or piston tube from fork.

CLEANING, INSPECTION AND REPAIR OF NOSE GEAR OLEO.

1. Clean all parts with a suitable dry type cleaning solvent.
2. Inspect the landing gear oleo assembly component for the following:
   A. Bearings and bushings for excess wear, corrosion, scratches and overall damage.
   B. Retaining pins for wear and damage.
   C. Lock rings for cracks, burrs, etc.
   D. Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.

1. PIN, RETAINER
2. BEARING, UPPER
3. SPACER
4. "T" RING
5. BEARING, LOWER
6. "T" RING
7. WIPER STRIP
8. WASHER
9. RING, RETAINER
10. RING, RETAINER
11. BUSHING, HOUSING TOP
12. CYLINDER, OLEO
13. BUSHING, HOUSING BOTTOM
14. "O" RING PACKING
15. TUBE, ORIFICE
16. PLATE, ORIFICE
17. RING, RETAINER
18. GREASE FITTING
19. FORK
20. BOLT ASSEMBLY
21. BOLT ASSEMBLY
22. TORQUE LINK, LOWER
23. WASHER, SPACER
24. BOLT ASSEMBLY
25. TORQUE LINK, UPPER
26. TUBE, PISTON
27. SHIMMY DAMPENER
28. BOLT ASSEMBLY
29. BOLT ASSEMBLY
30. BOLTS AND SAFETY WIRE
31. BRACKET
32. BUSHING
33. STUD, DOOR UPLOCK
34. PLACARD, SERVICE
35. HOUSING, OLEO
36. BUSHING
37. 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. BUSHING, STEERING
47. "O" RING, PACKING
48. PLUG, PISTON TUBE
49. DELETED
50. BUSHING

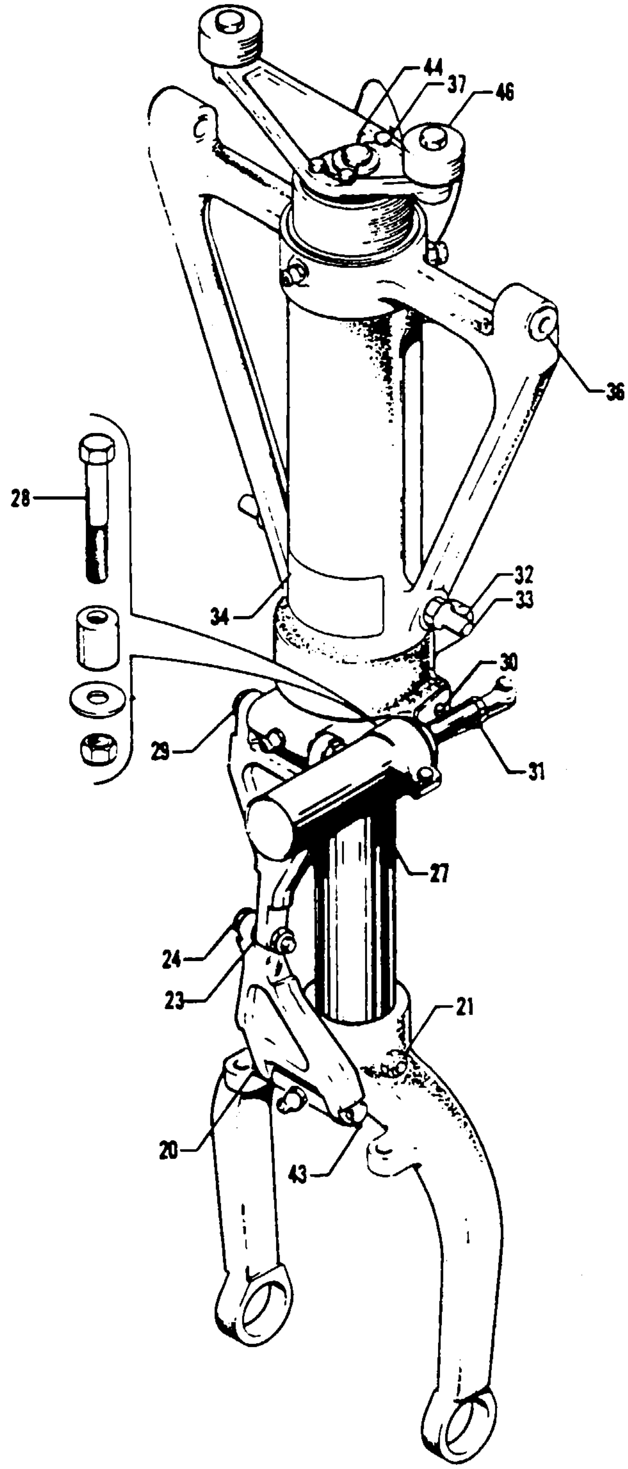


Figure 32-5. Nose Gear Oleo Strut Assembly

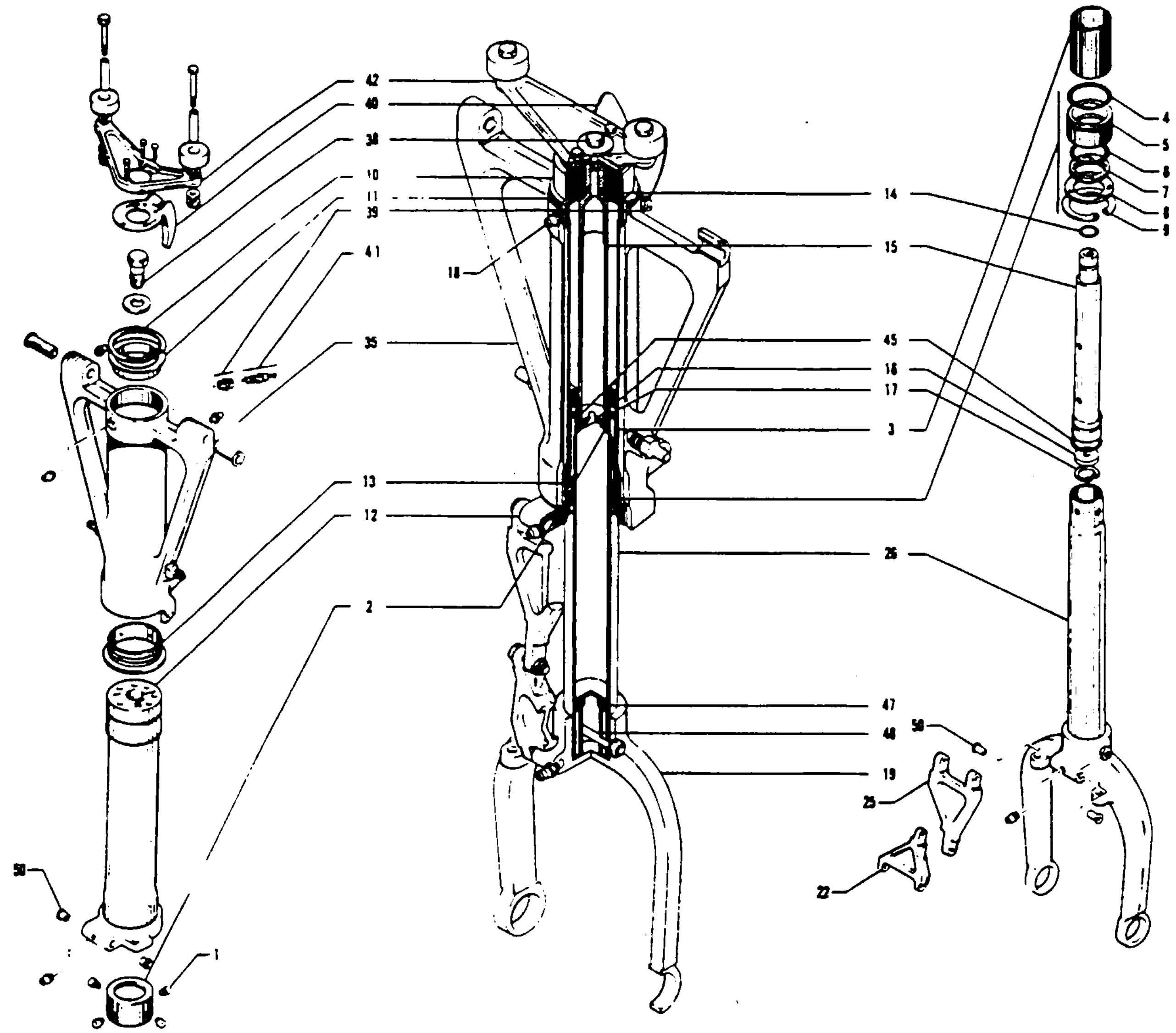
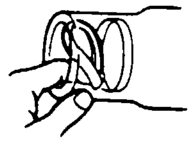
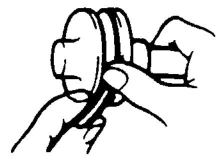


Figure 32-5. Nose Gear Oleo Strut Assembly (cont.)



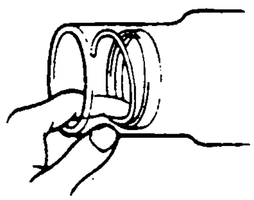
INSTALLATION OF SEALING RING IN ROD END

SKETCH A



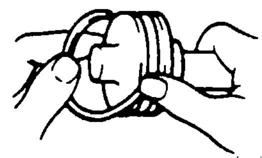
INSTALLATION OF SEALING RING ON PISTON

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 32-6. Installation of T-Rings

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 32-5.)

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. Install the bolt finger tight at this time at the top of the cylinder.
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 T-rings, spacer and upper bearing. Align reference marks on upper bearing and piston tube to insure proper indexing of 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 the right and left access panels to the aft interior portion of the nose section. Remove the access plates located on the nose baggage compartment floor panel to gain access to the landing gear attachment bolts. (Refer to Access Plates and Panels, Chapter 6.)
2. Remove lower radios and radio shelf.
3. Remove the oxygen bottle (if installed).
4. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
5. With the hand pump, retract the nose gear slightly to relieve the gear from its downlocked position.
6. To remove the drag link assembly, the following procedure may be used:
   A. Disconnect gear retraction rod from the upper right drag link.
   B. Disconnect the lower drag link from the gear oleo housing.
   C. The upper and lower link assemblies may be removed as one unit by removing the upper drag links attachment bolts at their attachment plates.

7. 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.
8. 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.
9. The uplock rod may be removed by removing the nut from the actuating cylinder support bolt and sliding the rod off the bolt. Retain the bolt in place to support the cylinder.
10. The uplock hook may be removed after the removal of the uplock rod and the hook pivot bolt. Remove the hook with the uplock spring.

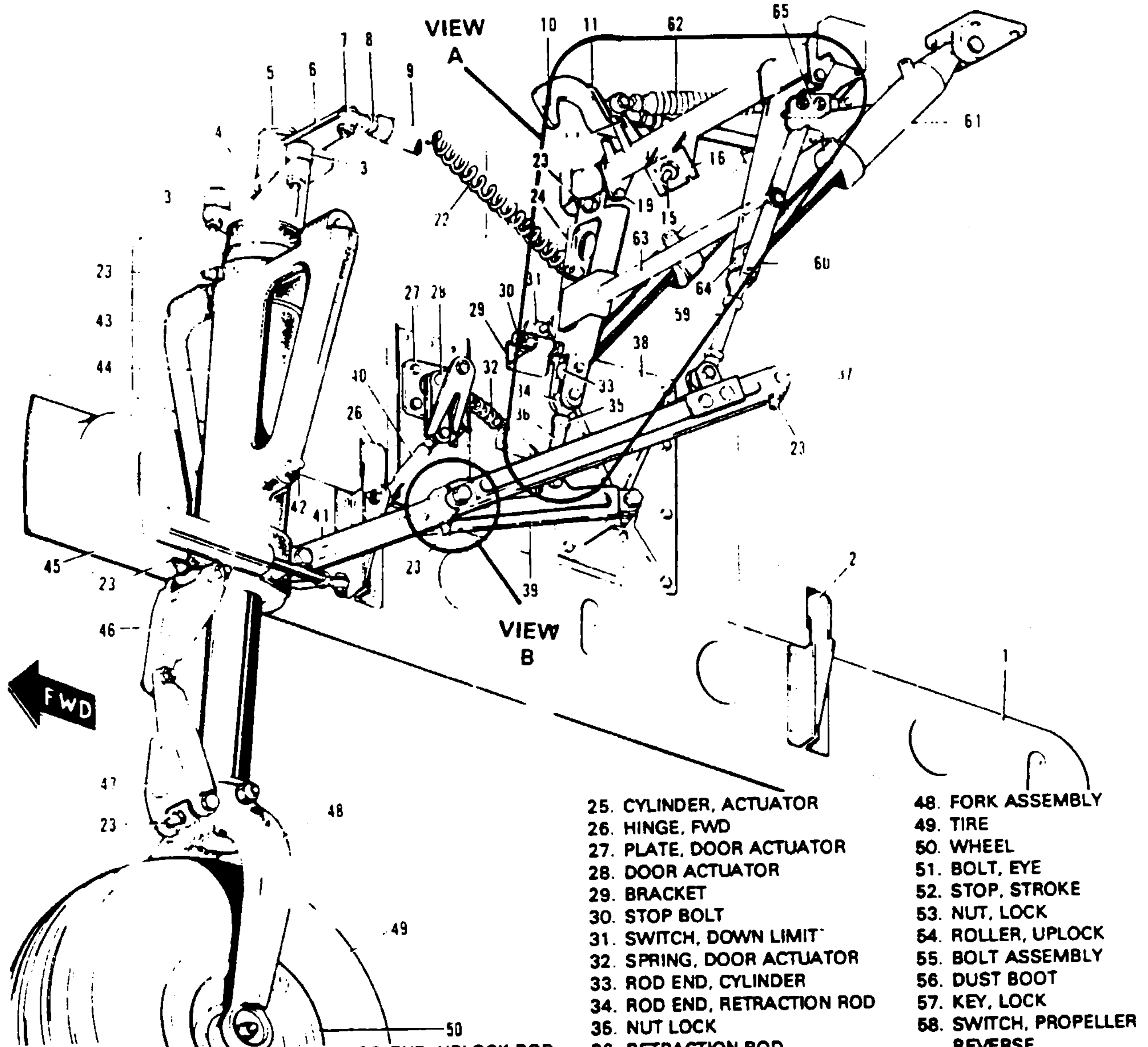
—NOTE—

The idler link, uplock rod and uplock hook may also be removed with support tube as one unit.

11. To remove the support tube first remove the up limit switch and wire support clamps. Hold the support nuts within the nose section, loosen the support bolts and remove tube.
12. The gear housing attachment plates may be removed by grinding the rivet heads flush with the plate and removing the rivets.
13. The upper drag links attachment plates may be removed by holding the attachment nuts within the nose section and loosening the support bolts.

CLEANING, INSPECTION AND REPAIR OF NOSE LANDING GEAR.

1. Clean all parts with a suitable cleaning solvent.
2. Inspect the landing gear assembly components for the following unfavorable conditions:
   A. Bolts, bearings, bushings and ball joints for excessive wear, corrosion and damage.
   B. Gear housing, drag links, idler link, rods and attachment plates for cracks, bends or misalignment.
   C. Downlock spring for wear, corrosion and not returning to complete compression. Reject the spring if corrosion or wear exceeds one-quarter the diameter of the spring.
   D. 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.
   E. Right and left gear door actuator springs for load tensions below the minimum allowable tolerances. The minimum tension for the actuator springs is 10 lbs. at a 3-inch extension. If one spring is rejected, replace both springs.
   F. Uplock spring at the uplock hook for load tension. 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.
   G. Uplock hook for wear and oversized bearing surfaces.
   H. Uplock roller for freedom of movement and minimum wobble.
   I. Uplock rod sliding surface for corrosion and freedom of movement.
   J. General condition of limit switches.
   K. Wiring for fraying, poor connections or conditions that may lead to failures.
   L. Inspect lock rod end bearings for corrosion, damage and freedom of movement.



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 ROD
14. NUT, LOCK
15. SWITCH, UP LIMIT
16. BRACKET, SWITCH
17. TUBE, SUPPORT
18. ROD, 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. ROLLER, UPLOCK
55. BOLT ASSEMBLY
56. DUST BOOT
57. KEY, LOCK
58. SWITCH, PROPELLER REVERSE
59. RETRACTION ROD
60. IDLER LINK
61. ACTUATING CYLINDER EMERGENCY GEAR EXTENSION
62. ROD UNLOCK
63. TUBE
64. ROD END CYLINDER
65. UNLOCK ACTUATOR

Figure 32-7. Nose Landing Gear Installation

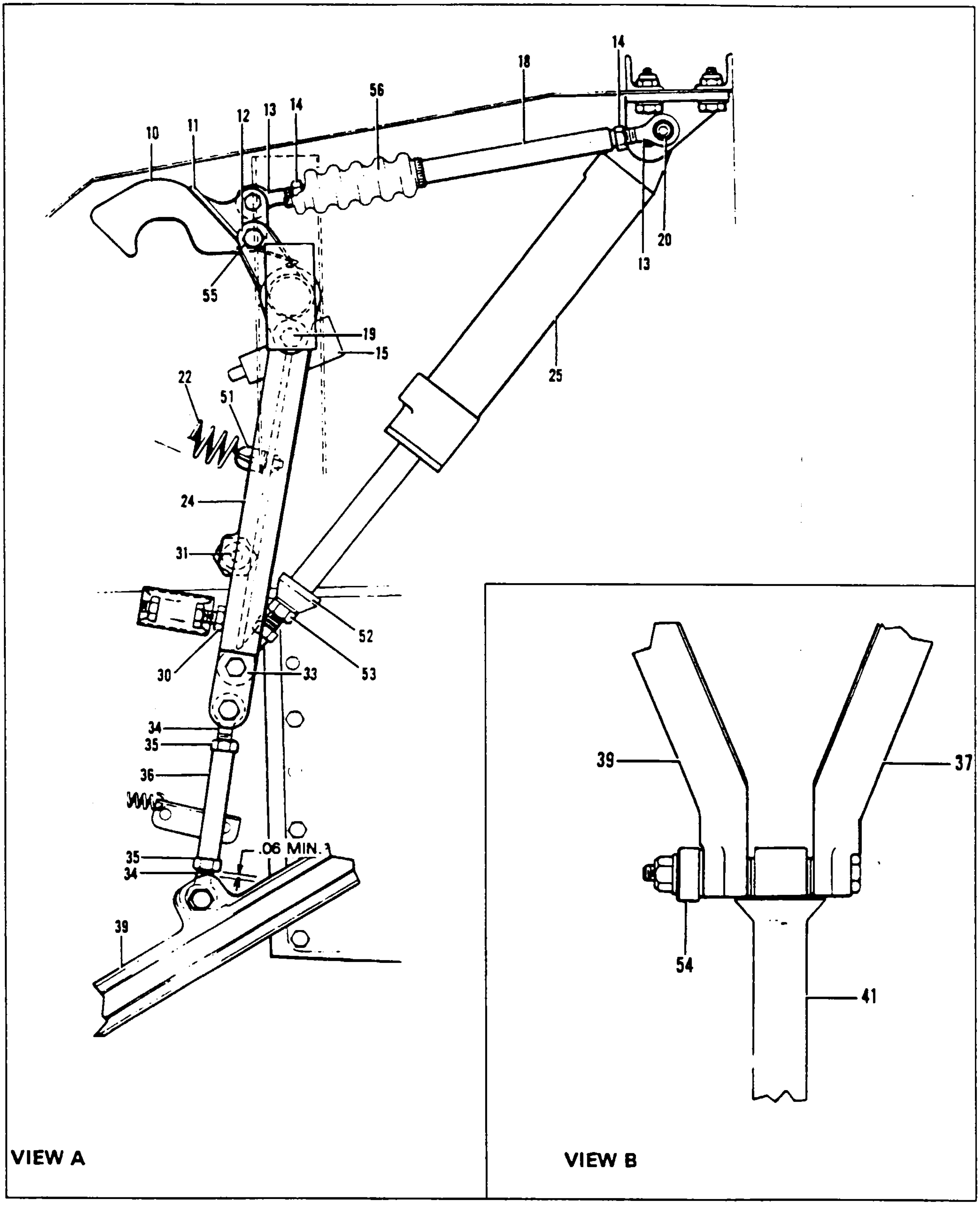


Figure 32-7. Nose Landing Gear Installation (cont.)

3. Attach the upper and lower drag links and check that when stop surfaces touch, linkage is .063 to .156 inch through center. Should this distance exceed the required through center travel and bolt and bushings are tight, replace one or all drag links.
4. The shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, the dampener should be replaced rather than repaired.
5. Repair to the landing gear is limited to reconditioning of parts such as replacing bearings and bushings, smoothing out minor nicks and scratches, repainting of areas where paint has chipped or peeled and replacement of parts.

INSTALLATION OF NOSE LANDING GEAR. (Refer to Figure 32-7.)

—NOTE—

When assembling any units of the landing gear, lubricate bearings and friction surfaces with proper lubricant as described in Chapter 12.

1. Position the right and left upper drag link plates and bolt in place.
2. Position the right and left gear housing attachment plates and rivet them in place.
3. Install the support tube and secure. Connect the up limit switch and secure electrical wiring to the tube.

—NOTE—

The uplock hook, uplock rod, idler link and retraction rod may be assembled on the support tube as a unit and then installed on the airplane, or each component installed individually after the support tube has been installed.

4. The uplock hook with uplock spring may be installed as follows:
   A. Place the "U" end of the uplock spring over the back of the hook with the loops toward the back.
   B. Spread the spring and snap the loops over the bushing that extends through the hook.
   C. Hook the ears of the spring over the aft side of the hook bracket and push the hook forward until the bolt holes in the bracket align with the holes in the hook.
   D. Bolt the hook in position and ascertain that it rotates freely with no side play, then safety it.
5. Install the uplock rod by attaching and securing the sliding end to the uplock hook and the other end on the gear actuating cylinder support bolt. Lubricate sliding end of rod per lube chart.
6. The idler links may be installed by the following procedure:
   A. Align the bolt hole in the links 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 retraction rod and actuating cylinders rod ends to the links. Do not connect retraction rods to links until gear adjustment has been completed.
   D. The downlock spring may be attached after gear check and adjustment have been completed.

7. To install the gear housing assembly, position the gear so that the attachment points on the housing align with the attachment plates. If needed, install spacer washers between attachments to allow a minimum amount of side play. Tighten the pivot bolt nuts to a snug fit, allowing the gear to swing free, then safety pivot bolt nuts.
8. The drag links may be installed as follows:
   A. Align upper and lower drag link bolt holes. Install bolt, uplock bearing and secure.
   B. Ascertain that the linkage through center travel is within tolerance.
   C. Attach the upper drag links to the attachment plates, tighten nuts to a snug fit, allowing the links to swing free, and safety wire the nuts.
   D. Attach the lower drag link to the landing gear housing and temporarily install bolt. Secure and safety 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 rods to the upper right and left drag link and adjust the rods to obtain approximately .06 of an inch clearance between the lower locknut and links.

—CAUTION—

Ascertain that the locknuts are tightened against the retraction rod.

9. Grasp the gear fork and rotate to determine that there are no gaps existing between the steering arm travel bushings and steering bellcrank which could cause the nose wheel to shimmy. Bushings are available in several different diameters to establish the proper clearance. (Refer to Parts Catalog.)
10. Lubricate the landing gear assembly. (Refer to Lubrication Chart, Chapter 12.)
11. Check the nose gear for alignment and operation.

ADJUSTMENT OF NOSE LANDING GEAR. (Refer to Figure 32-7.)

—NOTE—

Use the hydraulic test unit to supply hydraulic pressure for adjustment operations.

1. With the airplane on jacks and gear extended, disconnect both gear door retraction rods and secure the doors in the open position.
2. To facilitate adjustment of the uplock, disconnect the lower drag link from the landing gear oleo housing.
3. Disconnect the actuating cylinder rod end from the idler link.
4. Ascertain that one end of the downlock spring is disconnected.
5. Disconnect the emergency actuator, emergency idler link and idler link rod; locate them clear of the primary gear extension components.
6. Pull the actuating cylinder barrel down and forward until the actuator attaching bolt is at the bottom of the slots in the attachment bracket.
7. Rotate the drag links by hand until the uplock hook engages the uplock roller.

8. With the uplock rod fully extended and the hook resting on the uplock roller. adjust the rod end until the attaching bolt can be freely inserted. Remove bolt, extend rod end one full turn and lock rod end. Reinstall bolt and secure.

—NOTE—

Actuator cylinder attaching bolt must remain in the bottom of the attachment bracket slots during this adjustment.

9. Return drag links to the down position and bolt to gear housing. Ensure that both stop surfaces touch and that the linkage is .063 to .156 inches through center. If one side is too high, file it down until both sides touch.

—NOTE—

The linkage must not exceed .156 inches through center. A fabricated tool may be constructed to check through center travel of the drag link assembly while the links are installed on the airplane. (Refer to Chapter 95.)

A. To use the fabricated tool to check through travel of the drag link assembly, ascertain that the gear is in the downlocked position with no hydraulic pressure on the system.
B. Remove the cotter pins that safety the nuts that secure both upper drag links to their attachment plates and the lower link to the gear housing.
C. Place the tool tube through the elongated hole in the tool plate and place the tube over and between the upper link attachment nuts.
D. Swing the plate up and against the head of the bolt that connects the upper and lower links. The plate sleeve slides over the nut of the bolt that connects the lower link to the gear housing.
E. Look through the sight hole in the plate to ascertain that the center of the bolt is .063 to .156 inch below the centerline on the plate.
F. Remove the tool and reinstall the cotter pins.

10. Adjust the idler rod to provide a distinct snap-through action as the idler linkage passes through center.
11. Adjust the idler link stop bolt on the right side of the wheel well so that the idler linkage travels .220 to .280 inches through center. A straightedge laid from the attachment bolt heads of the idler link and retraction rod will give the through travel measurement.
12. Connect the downlock spring.
13. Extend the actuator cylinder with hydraulic pressure and adjust the rod end until the attachment bolt can be freely inserted. Release pressure and extend the rod end one full turn.

—NOTE—

Actuator cylinder attachment bolt must remain at full aft in its attachment fitting slot during adjustment.

14. Reinstall attachment bolt and secure. Tighten rod end locknut. Figure 32-3 shows the piston rod end with installation of locknut and lock.

—*NOTE*—

It may be necessary to partially retract gear to tighten locknut.

15. Adjust "Gear Down" Limit Switch until green indicator light comes on. Check switch operation by partially retracting and extending gear several times.
16. Retract gear and adjust stroke control stop on actuator until the uplock roller clears the inside of the uplock hook surface by .030 to .060 of an inch. Adjust the Gear Up Limit Switch until the red cockpit light goes out. Tighten locknut on stroke control stop. (Refer to Figure 32-3.)

—*NOTE*—

Main gear up limit and inboard gear door switches must be actuated also to extinguish red light.

17. Connect landing gear doors and ascertain doors are properly adjusted.

—*CAUTION*—

Ascertain that all rod ends have sufficient thread engagement by inserting a wire in the check hole of the rod.

18. Retract gear slowly and observe that all parts are operating satisfactorily.
19. 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 lengthening the door operating rods.
    C. Delay the actuating of up limit switches.
20. Adjust the prop reverse switch located on nose gear torque link so that propeller control may not be moved into its reverse position until the oleo strut is within .25 inches ± .12 inch of its fully extended position.

ALIGNMENT OF NOSE LANDING GEAR.

1. With no load on the nose wheel, make sure no gap exists at the points where the steering arm bushings contact the steering bellcrank, but will allow the bushings to rotate with a slight drag. Install bushings (.438 dia., P/N 14976-12; .625 dia., P/N 14976-23; .687 dia., P/N 14976-21; .812 dia., P/N 14976-102; .750 dia., P/N 14976-13; 1.00 dia., P/N 14175-113) to obtain proper adjustment.
2. To align the nose gear:
    A. Place the airplane on a smooth level floor that will accommodate the striking of a chalk line.
    B. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
    C. Level the airplane laterally and longitudinally. (Refer to Leveling, Chapter 8.)

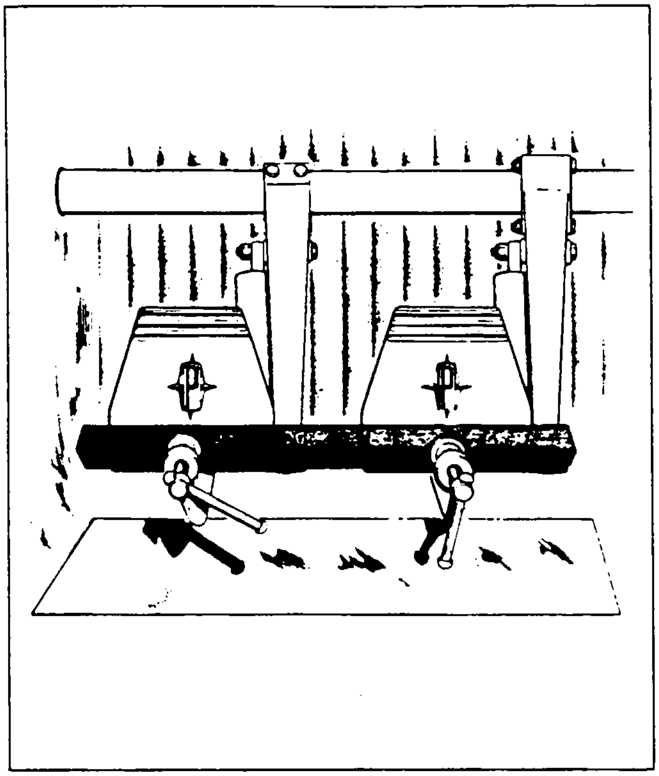


Figure 32-8. Clamping Rudder Pedals in Neutral Position

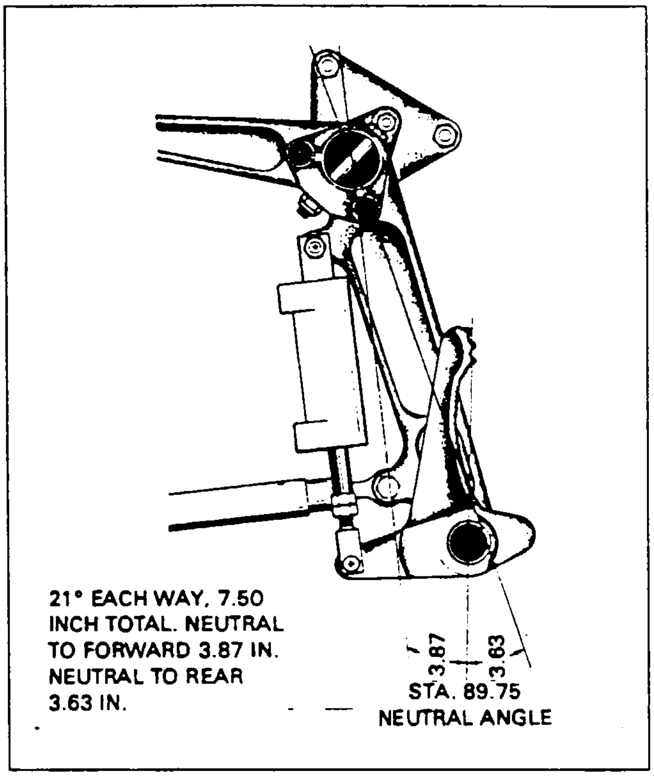


Figure 32-9. Rudder Pedals Neutral Angle

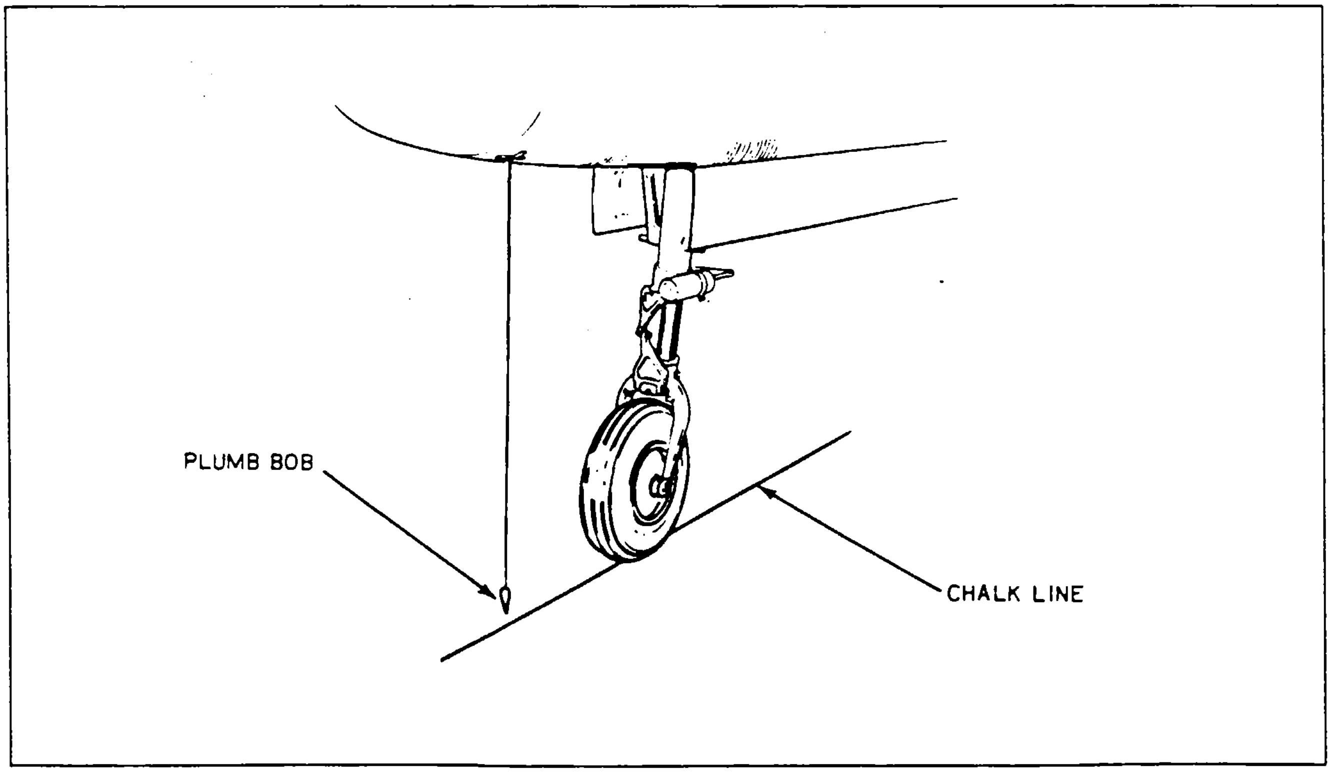


Figure 32-10. Aligning Nose Gear

D. From the center of the tail skid, extend a plumb bob and mark the contact point on the floor.
E. Extend and attach a plumb from a point that is approximately 24 inches forward along the bottom center row of rivets as measured from the wheel well opening. Mark the point of contact on the floor.
F. Using the two plumb bob marks as a guide, snap a chalk line, extending several feet beyond each mark.
G. Clamp rudder pedals in neutral position. (Refer to Figure 32-8.)
H. Adjust the rod end bearings of each steering rod to align the nose wheel with the chalk line and to bring the rudder pedals into neutral angle forward and aft. To align the nose wheel straight forward, stand in front of the nose gear and align the center rib of the tire with the chalk line or lay a straightedge along the side of the tire and parallel the straightedge with the chalk line. The neutral angle of the rudder pedals is at station 65.75 and center of the rudder pedal tube. (Refer to Figure 32-9.) One end of each rod must be disconnected and jam nuts loosened to make this adjustment. Do not attempt to make the adjustment by means of one bearing, but divide the adjustment between the bearings at each end of each rod. Check that rod ends have sufficient thread engagement, reinstall rods and secure jam nuts.
I. To check nose gear steering for its 40° ± 1° right and left travel, mark on each side of the nose wheel a 40 degree angle line from centerline and wheel pivot point. Turn wheel to maximum travel in both directions to check for allowable travel. Should travel be exceeded in one direction and not enough in the other direction, check for possible damage to the gear fork torque links or steering torque tube.

NOSE GEAR DOOR ASSEMBLY.

REMOVAL OF NOSE GEAR DOOR ASSEMBLY.

1. To remove the gear door, disconnect the retraction rod at the door and remove the hinge bolts at each side of the wheel well.
2. To remove the door retraction mechanism, ascertain that the retraction rod is disconnected, disconnect the downlock spring and remove the snap ring that holds the retraction mechanism on its support shaft. Pull the retraction mechanism from the shaft.

CLEANING, INSPECTION AND REPAIR OF NOSE GEAR DOOR ASSEMBLY.

1. Clean all parts with a suitable cleaning solvent.
2. Inspect the door for cracks or bent skin, loose hinge brackets and worn or corroded bearings.
3. Check the retraction mechanism for worn downlock spring and worn or damaged surfaces.
4. Repair to the door assembly is limited to replacing hinge bearings or rivets and mechanism parts, minor skin repairs and repainting.

INSTALLATION OF NOSE GEAR DOOR ASSEMBLY.

1. To install the door retraction mechanism, position and bolt the unit in place and connect the downlock spring.
2. The gear door is installed by aligning the bracket bolt hole with the hinge, installing bolt assembly and securing. Attach and secure retraction rod.

ADJUSTMENT OF NOSE GEAR DOOR.

1. Ascertain that the nose landing gear has been properly adjusted.
2. With gear up and locked, close one door at a time and adjust door operating rods until bolts can be freely inserted. Shorten rods one full turn of rod end bearings. Do not install bolts.
3. Extend gear and install door operating rod bolts. Adjust "door open" stop bolts to allow door linkage to pass .06 to .12 inches through center.
4. Retract gear slowly and observe that all parts are operating satisfactorily.
5. If gear fails to remain retracted after cockpit handle returns to neutral, it will be necessary to readjust either or all 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.

EMERGENCY EXTENSION SYSTEM.

A mechanically actuated pneumatic emergency extension system is incorporated into the landing gear system of the T-1040.

Pressure for emergency extension of the gears is provided by four sealed, disposable gas storage cylinders (one for each main gear and two for the nose gear). These cylinders are located beneath an access cover on the cabin floor between the pilot's and copilot's seats.

GAS STORAGE BOTTLES.

REMOVAL OF GAS STORAGE BOTTLES.

1. To remove the gas storage bottles, gain access to the extender installation cover plate (beneath the access plate between the pilot's and copilot's seats).
2. Remove the screws which retain the gas storage bottle to the cover plate.
3. Remove gas storage bottle.

TESTING/INSPECTION OF GAS STORAGE BOTTLE.

The bottles should be weighed every 1000 hours to determine if they have developed any leakage. The satisfactory weight of one bottle is stamped on the side of the bottle. If the bottle should fall below the minimum acceptable weight, it should be replaced.

TESTING EMERGENCY GEAR EXTENSION SYSTEM FOR OPERATION AND LEAKS.

This test procedure should be used whenever the system has been opened for any service and at each 1000 hour inspection, to insure system operation and integrity. To perform this test a special fitting must be fabricated and installed in place of the gas storage bottles. (Refer to Chapter 95 for details.) Also needed is a source of nitrogen gas such as an industrial 3000 psig. cylinder along with regulator, pressure gauge, control valves and lines. (Refer to Figure 32-10a for suggested hookup and equipment.)

1. Place the airplane on jacks. (Refer to Chapter 7.)
2. Remove one of the nose gear emergency extension gas storage bottles.
3. Remove both of the main gear emergency extension gas storage bottles.
4. Install the fabricated test fitting into one of the open discharger assemblies. Insure that the test valves shown in figure 32-10a are closed.
5. Cycle the landing gear up hydraulically and insure the landing gear selector handle is in the up neutral position.
6. With the 3000 psig nitrogen cylinder attached to the test fitting, adjust the cylinder regulator to 1000 psig.
7. Open the discharge valve on the test rig and insure that the particular landing gear extends properly and that there is no mechanical interference during the extension cycle.

—NOTE—

The main gear will contact the inboard gear doors during the extension cycle, however these doors should not significantly impede the main gear extension. The main gear must not "hang-up" on the main gear doors. Should interference be evident, the inboard gear door unlocking mechanism is improperly rigged. (Refer to Chapter 32 for rigging instructions.)

8. Close the discharge valve on the test rig and note the pressure on the test gauge.
9. After two minutes the pressure trapped in the system must not decrease by more than 50 psig (950 psig min.). Should pressure decrease below this limit check entire system for leaks. Make repairs and retest.
10. Perform steps 4 thru 9 on the other two remaining landing gear emergency extension system.
11. Upon successful completion of this test, open the vent valve then remove all test equipment and reinstall the gas storage bottles and secure in place.

—CAUTION—

Exercise care not to accidentally fire the bottles when installing them.

12. Ascertain that the landing gear is down and locked and the selector handle is in the down neutral position prior to removing the airplane from jacks. (Refer to Chapter 7.)

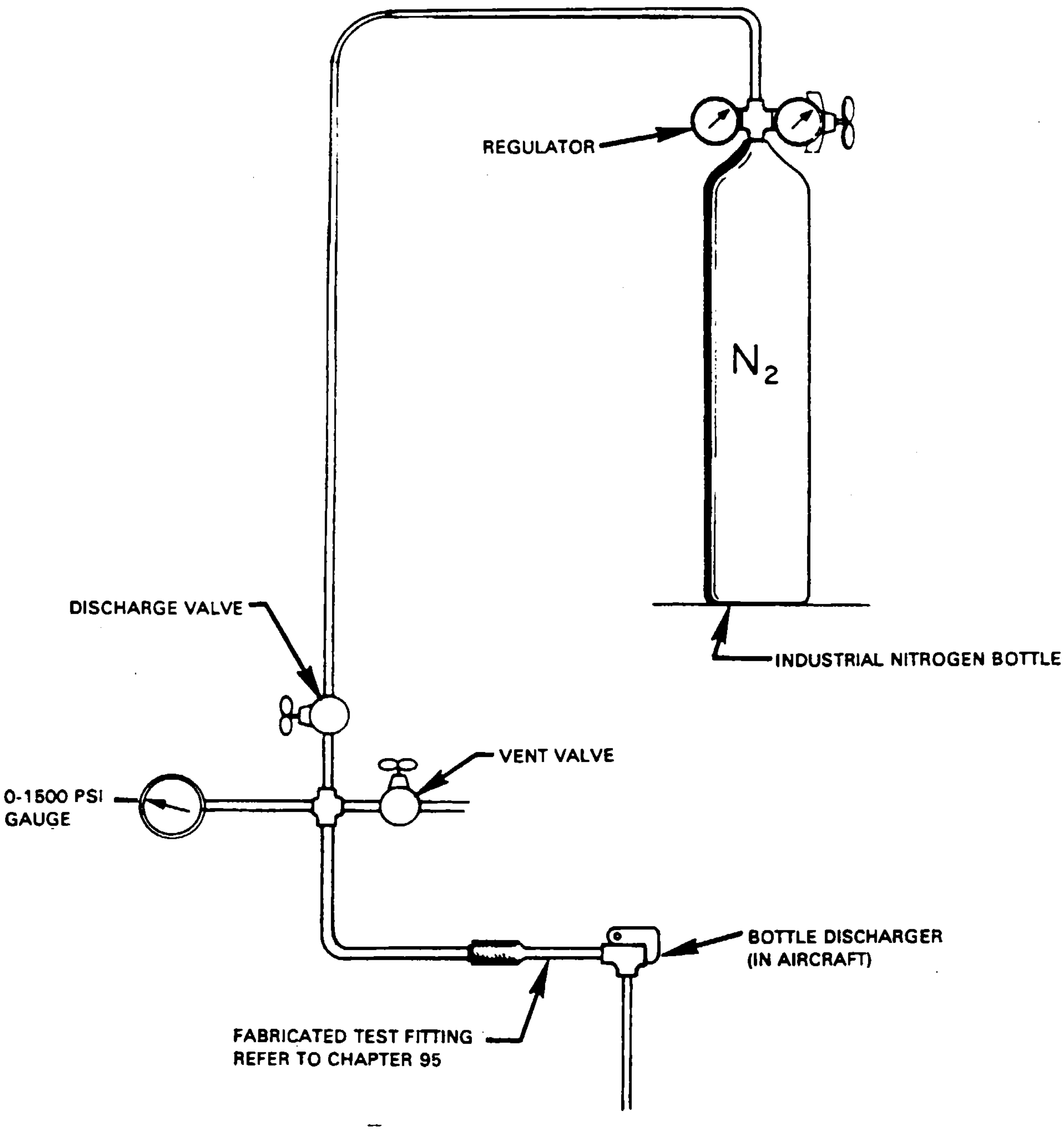


Figure 32-10a. Test Equipment Installation, Emergency Gear Extension System

INSTALLATION OF GAS STORAGE BOTTLE.

—NOTE—

If the nose gear emergency extension system has been utilized, both nose gear gas storage bottles must be replaced.

1. Insert gas storage bottles in gear extender installation.
2. Secure bottles in place with screws.

—CAUTION—

Exercise care not to accidentally fire bottles when installing them.

REMOVING PRESSURE FROM LINES AFTER ACTIVATION OF SYSTEM.

After activation of one of the gear emergency extension systems, pressure must be removed from the line. This may be accomplished by cracking any appropriate fitting of the system.

RIGGING EMERGENCY EXTENSION SYSTEM.

1. Rigging the emergency main gear extension system can be accomplished as follows:

—NOTE—

Before rigging the emergency landing gear extension system, insure that the primary gear extension system is properly rigged in accordance with instructions given in Adjustment of Main Landing Gear. Use the hydraulic test unit to supply hydraulic pressure during rigging operations.

A. With the airplane on jacks and gear extended, disconnect door operation rods and secure the doors in the open position.
B. Extend the emergency actuator to the end of its stroke and adjust the rod end until the fork bolt can be freely inserted in the upper aft side brace. Install the bolt and secure. Tighten the rod end locknut.
C. Raise the gear until it is up and locked.
D. Disconnect the emergency unlock actuator from the uplock hook and fully extend it. Adjust the rod end so the bolt can be freely inserted into the unlocking assembly. Remove the bolt and extend the rod end one full turn. Reinstall the bolt and secure.

—NOTE—

Be certain that the emergency unlock actuator piston is not moved at any time during normal cycling. Such movement would indicate improper rigging.

E. Retract and extend the gear slowly using the primary gear extension system and observe that all parts are operating satisfactorily.

F. Connect the inboard and outboard door operating rods.

2. Rigging the emergency nose gear extension system can be accomplished as follows:

A. With the airplane on jacks and gear extended disconnect door retraction rods and secure the doors in the open position.

B. Connect the emergency idler link and idler rod to the upper left drag link.

C. Adjust the idler rod to provide a distinct snap through action as the idler linkage passes through center.

D. Adjust the idler link stop bolt on the left side of the wheel well so that the emergency idler linkage is .22 to .28 inches through center.

E. Extend the emergency actuator to the end of its stroke and adjust the rod end until the attaching bolt can be freely inserted in the idler link. Install the bolt and secure. Tighten the rod end locknut.

—NOTE—

It may be necessary to partially retract the gear to tighten the locknuts.

F. Raise the gear until it is up and locked.

G. Disconnect the emergency unlock actuator from the uplock hook and fully extend it. Adjust the rod end until the attaching bolt can be freely inserted into the uplock hook assembly. Extend the rod end one full turn. Reinstall the bolt and secure.

—NOTE—

Ensure that the emergency unlock actuator piston is not moved at any time during normal gear cycling. Such movement would indicate improper rigging.

H. Retract and extend the gear slowly using the primary gear extension system and observe that all parts are operating satisfactorily.

I. Reinstall gear door retraction rods.

NOSE GEAR ACTUATING CYLINDER.

REMOVAL OF NOSE 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 rod.
5. Remove the cylinder from the wheel well.

DISASSEMBLY OF NOSE 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.

DISASSEMBLY OF NOSE GEAR ACTUATING CYLINDER. (WTC-2225-1)

Disassembly procedure is the same as Disassembly of Main Gear Actuating Cylinders.

CLEANING, INSPECTION AND REPAIR OF NOSE 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 NOSE GEAR ACTUATING CYLINDER. (WTC-2115-1) (Refer to Figure 32-11.)

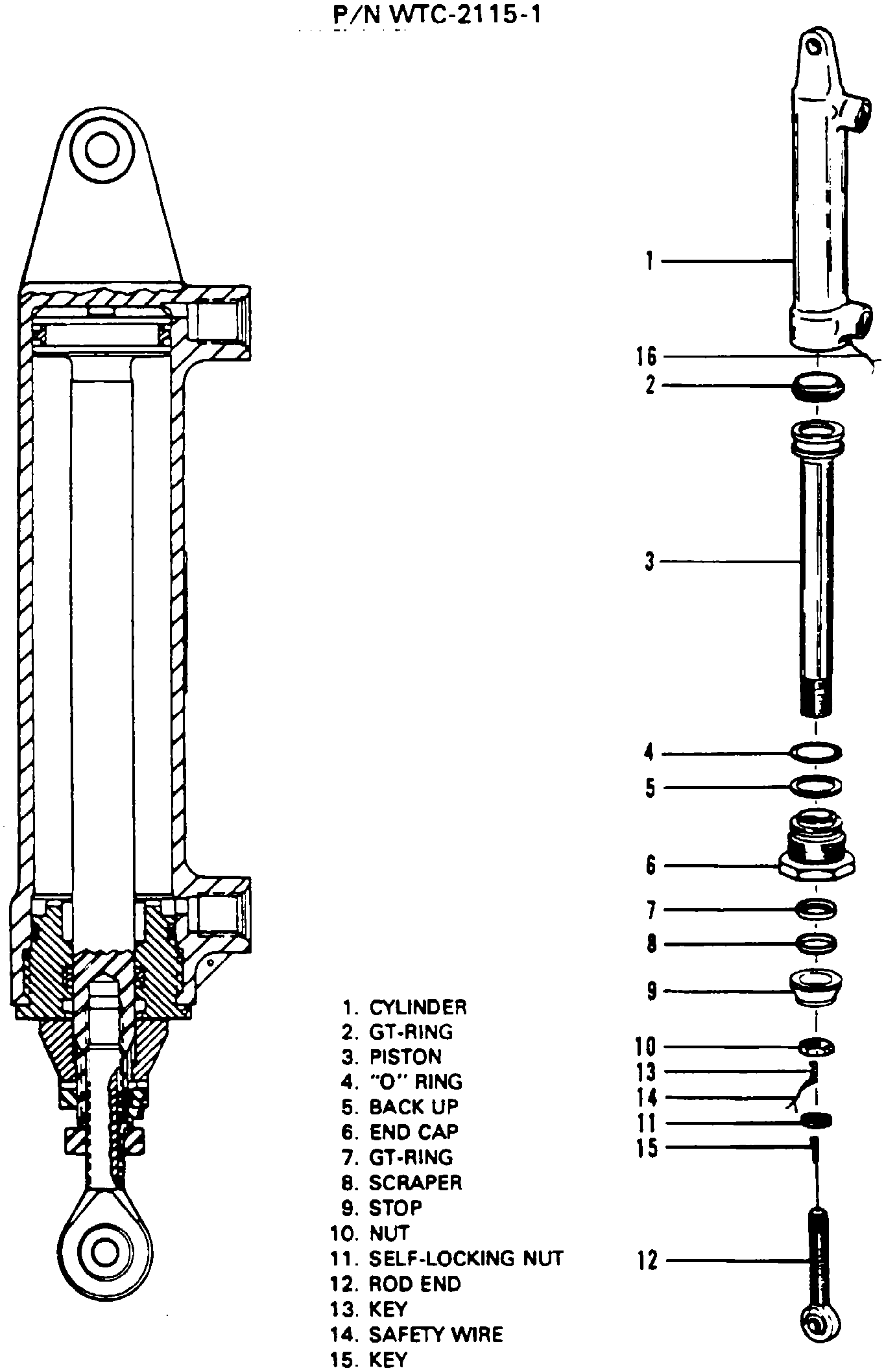
Lubricate all parts with hydraulic fluid per MIL-H-5606 prior to assembly.

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 rod end.
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 Nose Landing Gear for final adjustments. Engage key and tighten nut to a torque of 85 inch-pounds.

ASSEMBLY OF NOSE GEAR ACTUATING CYLINDER. (WTC-2225-1).

Assembly procedure is the same as Assembly of Main Gear Actuating Cylinders.

WIEBEL TOOL COMPANY
P/N WTC-2115-1



1. CYLINDER
2. GT-RING
3. PISTON
4. "O" RING
5. BACK UP
6. END CAP
7. GT-RING
8. SCRAPER
9. STOP
10. NUT
11. SELF-LOCKING NUT
12. ROD END
13. KEY
14. SAFETY WIRE
15. KEY
16. SAFETY WIRE

Figure 32-11. Nose Gear Actuating Cylinder

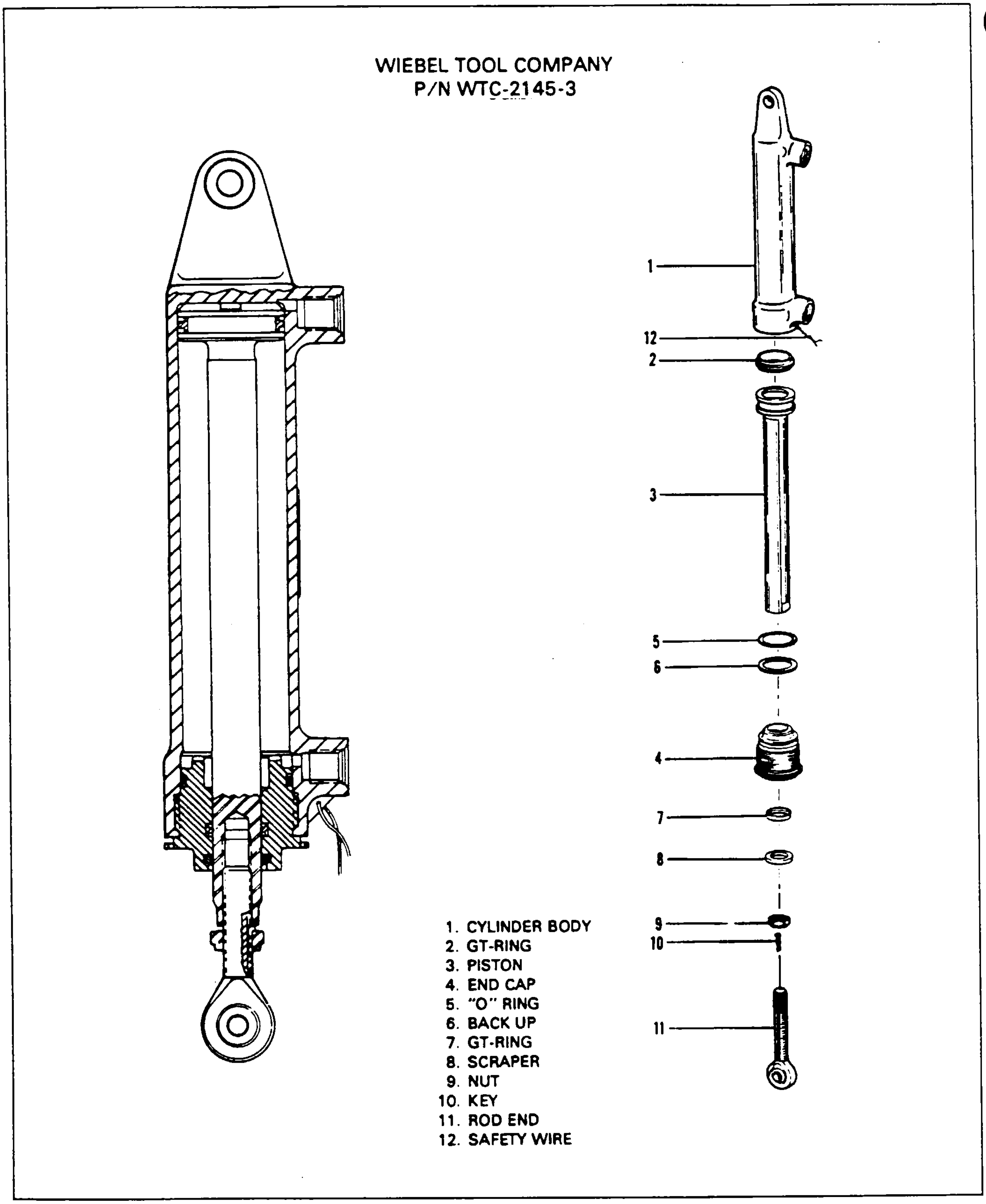
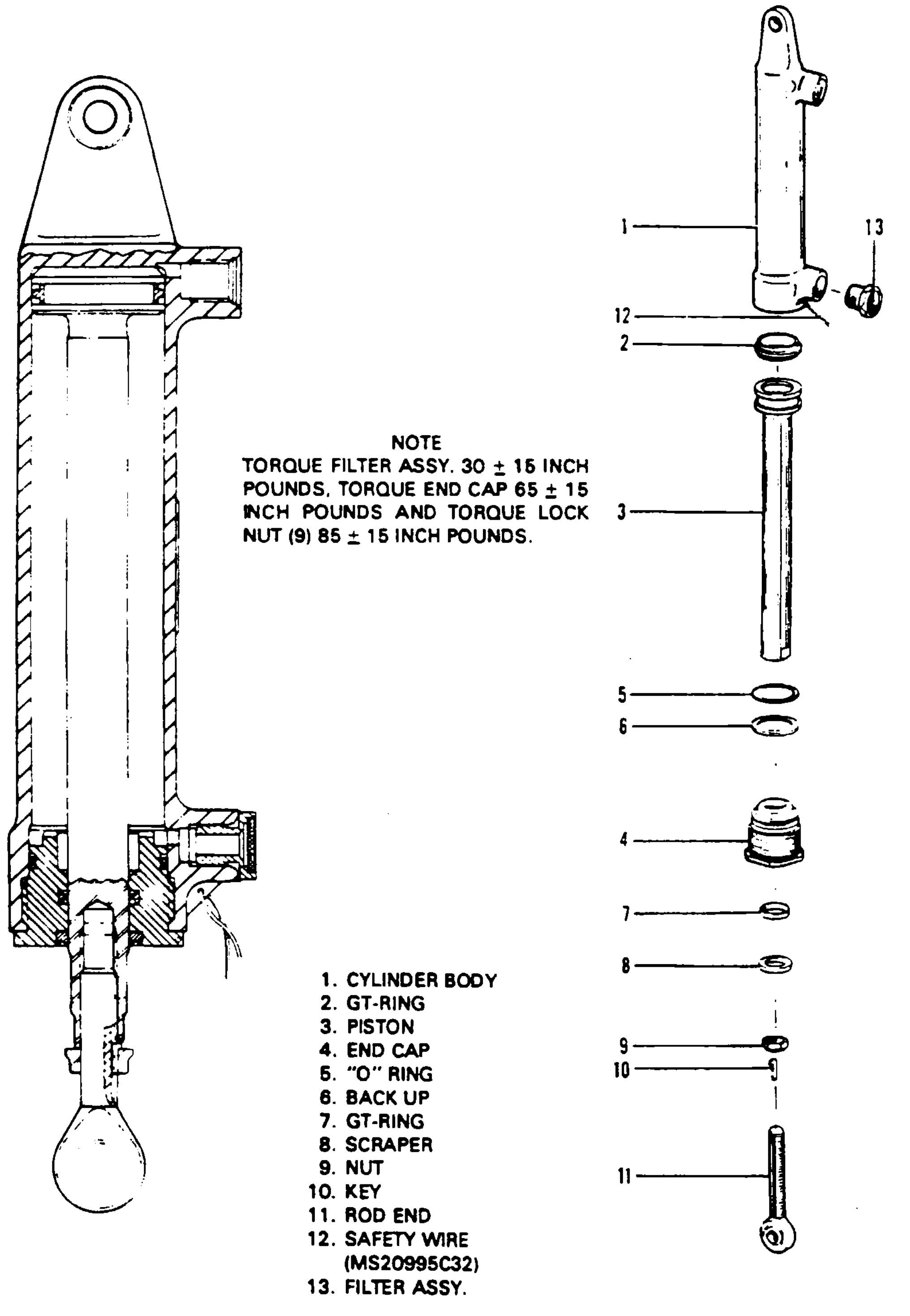


Figure 32-12. Main Gear Actuating Cylinder

WIEBEL TOOL COMPANY
P/N WTC-2225-1



NOTE
TORQUE FILTER ASSY. 30 ± 15 INCH POUNDS, TORQUE END CAP 65 ± 15 INCH POUNDS AND TORQUE LOCK NUT (9) 85 ± 15 INCH POUNDS.

1. CYLINDER BODY
2. GT-RING
3. PISTON
4. END CAP
5. "O" RING
6. BACK UP
7. GT-RING
8. SCRAPER
9. NUT
10. KEY
11. ROD END
12. SAFETY WIRE (MS20995C32)
13. FILTER ASSY.

Figure 32-12. Emergency Gear Extension, Main Gear Actuating Cylinder (cont.)

INSTALLATION OF NOSE GEAR ACTUATING CYLINDER.

1. Position the attachment end of the cylinder and the uplock rod end of the nose gear on 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 as given in this chapter.
5. Remove the airplane from jacks.

MAIN GEAR ACTUATING CYLINDERS.

REMOVAL OF MAIN GEAR ACTUATING CYLINDERS.

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 the main gear uplock crank assembly.
5. Remove the cylinder from wheel well.

DISASSEMBLY OF MAIN GEAR ACTUATING CYLINDERS. (WTC-2145-3 and WTC-2225-1) (Refer to Figure 32-12.)

1. Before disassembly establish rod end engagement distance to aid in preliminary assembly of the actuating cylinder.
2. With the cylinder removed from the airplane, remove the safety wire attached to the end cap and cylinder body.
3. Loosen rod end lock nut and remove key and rod end.
4. Unscrew end cap from cylinder body.
5. Draw the piston from cylinder body.

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR ACTUATING CYLINDERS.

Same as Cleaning, Inspection and Repair of Nose Gear Actuating Cylinder.

ASSEMBLY OF MAIN GEAR ACTUATING CYLINDERS. (WTC-2145-3 and WTC-2225-1) (Refer to Figure 32-12.)

Lubricate all parts with hydraulic fluid per MIL-H-5606 prior to assembly.

1. Install GT-ring on piston.
2. Install "O" ring and back up on exterior of end cap.
3. Install GT-ring and scraper on interior of end cap.

4. Slide end cap on piston and screw end cap into cylinder body. Torque end cap to 65 ± 15 inch-pounds and safety with wire (MS20995C32)
5. Install nut and key on rod end and screw into piston.
6. Adjust rod end to preliminary length obtained before disassembly. Refer to Adjustment of Main Landing Gear for final adjustments. Tighten nut to a torque of 85 ± 15 inch-pounds.

INSTALLATION OF MAIN GEAR ACTUATING CYLINDERS.

1. Position the attachment end of the cylinder and the uplock crank assembly on 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 as given in this chapter.
5. Remove airplane from jacks.

GEAR DOOR ACTUATING CYLINDERS.

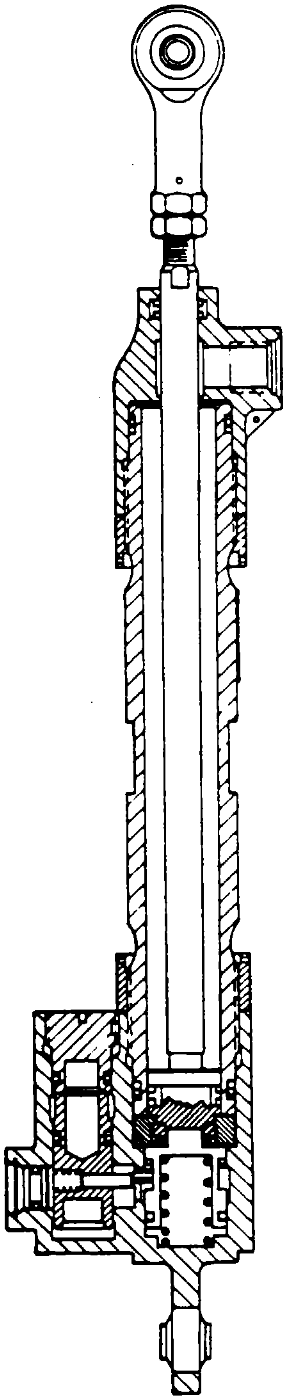
REMOVAL OF GEAR DOOR ACTUATING CYLINDERS.

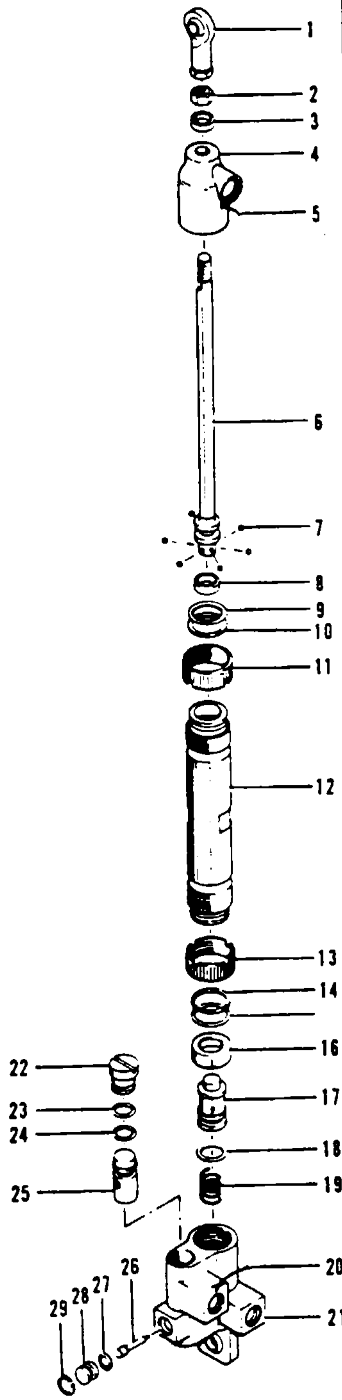
1. With master switch off, actuate the hand pump handle to bring the gear down.
2. Disconnect the hydraulic lines from the actuating cylinder and cap the open line ends to prevent contamination.
3. Disconnect the cylinder from the door and its mounting bracket.
4. Remove the cylinder from the wheel well.

DISASSEMBLY OF GEAR DOOR ACTUATING CYLINDER. (WTC-2218-1) (Refer to Figure 32-13.)

1. Unlock the cylinder by applying hydraulic pressure to the hydraulic port of the fitting assembly. Extend the piston all the way.
2. Remove safety-wire from end cap and fitting assembly.
3. Loosen locknut and remove rod end from piston. Remove locknut from piston.
4. Loosen both knurled nuts.
5. Remove end cap from barrel but leave end cap on piston.
6. Remove fitting assembly from barrel. Pull piston with end cap from barrel. Use care to prevent the loss of the six balls which are nested in the head end of the piston.
7. Remove end cap from piston.
8. Remove retainer and pull out plug using a threaded rod or bolt having a #6-40 thread.
9. Remove pin assembly with alien wrench.
10. Remove retainer assembly and piston.
11. Pull race, plunger and spring out of fitting assembly.
12. Remove GT ring from end cap.
13. Remove GT ring from piston.
14. Remove "O" ring with back-up rings from barrel.
15. Remove "O" ring from plunger.

WIEBEL TOOL COMPANY
P/N WTC-2218-1





1. ROD END
2. LOCK NUT
3. GT-RING
4. END CAP
5. SAFETY WIRE (MS20995C20)
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. PLUNGER
18. "O" RING
19. SPRING
20. SAFETY WIRE (MS20995C20)
21. FITTING ASSY.
22. RETAINER ASSY.
23. "O" RING
24. "O" RING
25. PISTON
26. PIN ASSY.
27. "O" RING
28. PLUG
29. RETAINER

Figure 32-13. Gear Door Actuating Cylinder

16. Remove "O" ring from retainer assembly.
17. Remove "O" ring from piston.
18. Remove "O" ring from plug.

CLEANING, INSPECTION AND REPAIR OF GEAR DOOR ACTUATING CYLINDERS. (WTC-2218-1)

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 effect 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 Specification 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 CYLINDERS. (WTC-2218-1) (Refer to Figure 32-13).

Lubricate all parts with oil per MIL-H-5606 prior to assembly.

1. Install "O" ring into groove of plunger.
2. Install knurled nuts on barrel.
3. Install back-up rings and "O" rings into grooves of barrel.
4. Install spring, plunger and race into fitting assembly and secure by screwing barrel into fitting assembly. Tighten barrel down against the race and torque 120 to 140 inch pounds. Then tighten knurled nut against fitting assembly and torque 120 to 140 inch pounds.
5. Install GT-ring into groove of piston.
6. Install GT-ring into inside groove of end cap.
7. Slide piston into end cap, install six balls into holes in piston head and insert assembly into bore of barrel. Screw end cap onto barrel and align port in end cap with hydraulic port in fitting assembly. Tighten knurled nut against end cap and torque 120 to 140 inch pounds.
8. Secure knurled nut to end cap using safety wire.
9. Secure knurled nut to fitting assembly using safety wire.
10. Install locknut and rod end on piston.
11. Install "O" ring into groove of piston.
12. Install "O" ring into groove of retainer assembly.
13. Install "O" ring into groove of plug.
14. Install piston into fitting assembly. Cross hole in piston to be in line with hole below the "air" port in the fitting assembly.
15. Install pin assembly into piston using alien wrench.

—NOTE—

Screw pin assembly all the way in until its tip touches the plunger and then "back up" half a turn.

16. Install plug into fitting assembly and secure with retainer.
17. Install retainer assembly into fitting assembly.

—*NOTE*—

Screw retainer assembly in until face of retainer assembly is flush with face of fitting assembly.

18. Adjust rod end to achieve proper length of actuator assembly and lock with locknut.

INSTALLATION OF GEAR DOOR ACTUATING CYLINDER.

1. Position the cylinder on its mounting bracket and secure with attachment bolt.
2. Extend the cylinder control rod enough to attach the rod end to the door and secure with attachment bolt.

—*NOTE*—

Inspect the hydraulic hoses for signs of external wear from contact with the tire. Replace if necessary.

3. Inspect the hydraulic fittings on both inboard gear door actuating cylinders. Assure their position is 15° forward to the actuating cylinder center line.
4. Connect the hydraulic line to the cylinder. Torque nut to 95 to 100 inch pounds.
5. Connect the pneumatic line to the cylinder and torque 95 to 100 inch pounds (WTC-2218-1 only).
6. Perform a retraction test to assure the tire does not rub the hoses. (Rotate the tire to check for possible "High Spots" on the tread).
7. 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.

GEAR SELECTOR HANDLE MECHANISM.

REMOVAL OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 32-14.)

Removal of the gear selector mechanism can be divided into three individual assemblies. The Solenoid Assembly; The Selector Handle Assembly; and The Flexible Cable Assembly.

1. Removal of Solenoid Assembly.
   A. Disconnect the two wires leading from the solenoid.
   B. Remove two locknuts securing the solenoid to the mounting block and remove the solenoid.
2. Removal of Selector Handle Assembly.
   A. Remove stop pin and pull the control knob and sleeve from the lever assembly.
   B. Disconnect the wires leading from the panel assembly. Remove four light assemblies securing the panel assembly to the plate assembly.
   C. Remove pin, washer and cotter pin securing the terminal to the lever assembly.
   D. Remove the selector assembly from the instrument panel.
3. Removal of Flexible Cable Assembly.
   A. Remove screws and clamp securing cable assembly to bracket assembly.

B. Push cable assembly through grommet adjacent to the bracket assembly.
C. Remove pin securing the terminal to the control arm of the power pack. Remove the lock nut and terminal from the end of the cable assembly.
D. Cut safety wire and remove lock nut nearest the end of the cable assembly. Carefully pull the cable assembly through the hole in bracket assembly.
E. Disassemble the firewall plates and grommets and pull cable assembly through the hole in the bulkhead at station 57.0.

INSTALLATION OF GEAR SELECTOR HANDLE MECHANISM. (Refer to Figure 32-14.)

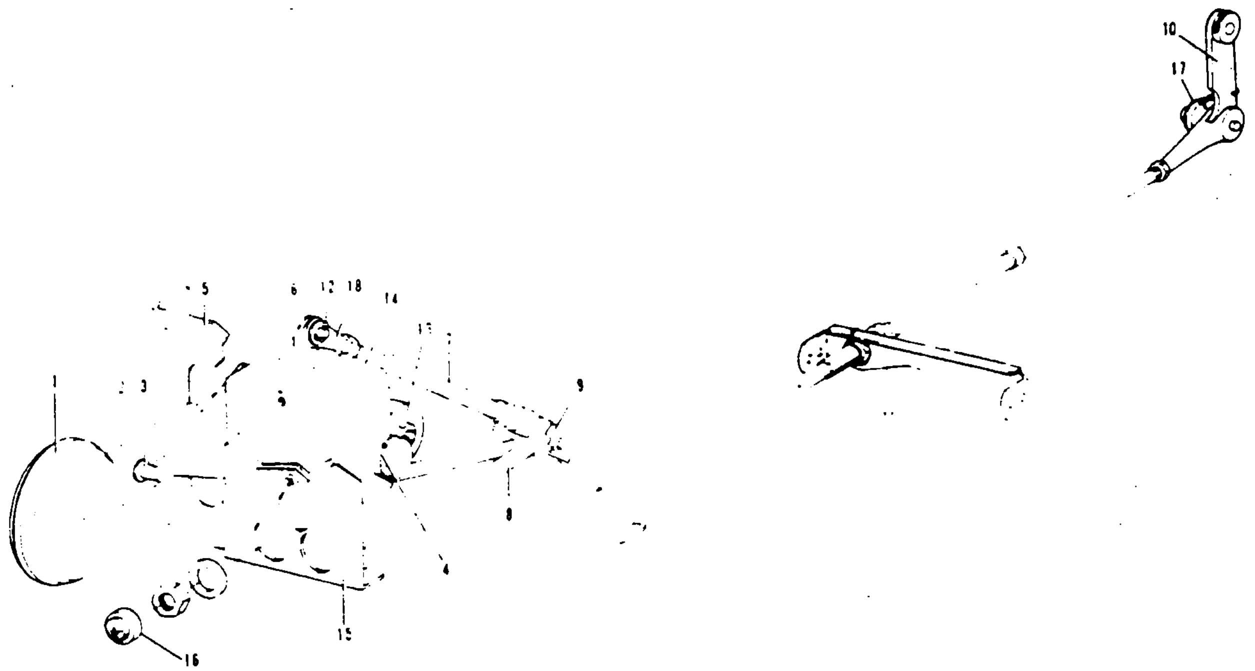
1. Installation of Flexible Cable Assembly.
   A. Insert the end of the cable assembly with lock nuts through the hole in the bulkhead at station 57.0.
   B. Insert the cable assembly through bracket assembly. An equal number of threads should appear on each side of the plate in the bracket assembly. 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 locknut, and light cap. Connect wires to their appropriate terminals.
   D. Insert the sleeve on the lever and install the control knob and stop pin.
3. Installation of Solenoid Assembly.
   A. Position the solenoid on mounting block and secure in position with two locknuts.
   B. Connect the solenoid wires to their appropriate terminals.

HIGH ALTITUDE GEAR OPERATION.

Should it be necessary to operate the landing gear above 15,000 feet, the landing gear selector may return to its neutral position before the gear door closing cycle is complete. If this occurs, manual override of the time delay cycle must be used to close the gear doors.

During gear extension, if the selector returns to neutral at the same time the gears are locked down, and before the gear doors have had time to close, again select the gear down position and hold the handle down for an additional 3 to 4 seconds. This allows completion of the door closing cycle.

During gear retraction, if the selector returns to neutral and the gear unsafe light remains lit, again select the gear up position and hold the handle up for 4 seconds after the gear unsafe light extinguishes. Be sure that the light has extinguished before exceeding the maximum gear extended speed.



1. CONTROL KNOB
2. SLEEVE
3. STOP PIN
4. SAFETY WIRE
5. PLATE ASSY.
6. LEVER ASSY.
7. CABLE ASSY.
8. BRACKET ASSY.
9. CLAMP
10. CONTROL ARM
11. BRACKET ASSY.
12. PIN, WASHER AND COTTER PIN
13. SOLENOID
14. MOUNTING BLOCK
15. PANEL ASSY.
16. LIGHT ASSY.
17. CABLE ATTACHMENT PIN
18. TERMINAL

Figure 32-14. Landing Gear Selector Mechanism

WHEELS AND BRAKES.

MAIN WHEEL ASSEMBLY.

REMOVAL AND DISASSEMBLY OF MAIN WHEEL. (Refer to Figure 32-15.)

1. Place the airplane on jacks (Refer to Jacking, Chapter 7) and fully deflate the tire.

—NOTE—

To remove the main wheel without disturbing the brake assembly, proceed to Step A. To remove the main wheel and brake disc as an assembly proceed to Step B.

2. To remove the main wheel proceed as follows:
   A. To remove the main wheel without disturbing the brake assembly, loosen and remove the eight bolts which attach the brake disc. As the last two bolts are rotated to an accessible position, set the parking brake to assure disc alignment for reassembly. Proceed to Step C.
   B. To remove the main wheel and brake disc as an assembly, it will be necessary to first remove the brake assembly (Refer to Removal and Disassembly of Wheel Brake Assembly).
   C. Remove the snap ring that secures the axle hub cap.
   D. Remove the cotter pin and axle nut.
   E. Slide the wheel from the axle.
3. Before disassembling the wheel, ensure that the tire is completely deflated.
4. Use a non-metallic mallet to break the tire bead from the wheel flange (Do not use tire irons).
5. Remove the eight tie bolts and washers from the outboard wheel half.
6. Separate the wheel halves by removing the wheel half opposite the valve stem first.

—CAUTION—

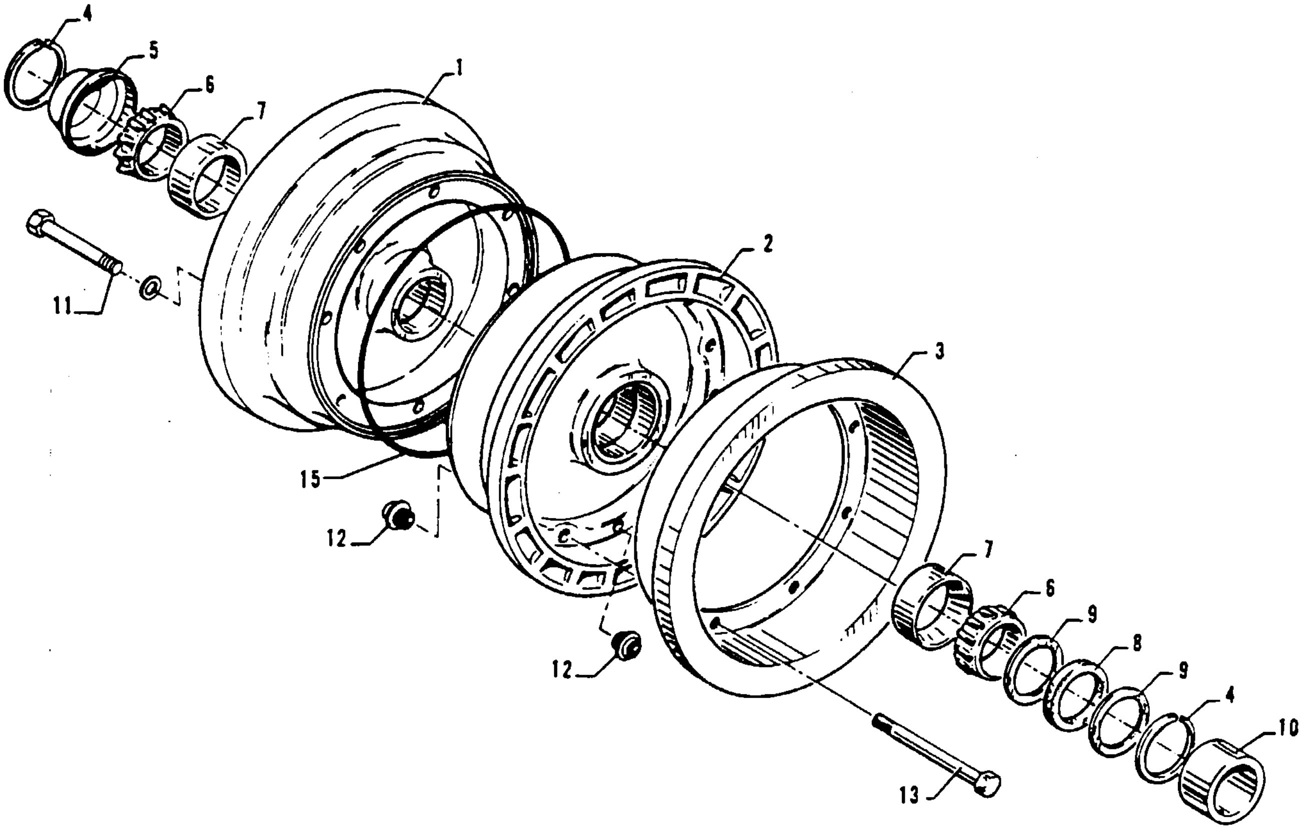
To reduce the possibility of damage to the wheel halves, do not pry between the wheel flange and the tire bead with sharp tools.

7. Remove the snap ring grease seal felts and washers.

—NOTE—

The bearing cup should only be removed when it is to be replaced.

CLEVELAND 40-167 AND 40-167A



1. WHEEL HALF (OUTB'D)
2. WHEEL HALF (INB'D)
3. BRAKE DISC
4. SNAP RING
5. HUB CAP
6. BEARING CONE
7. BEARING CUP
8. GREASE SEAL FELT
9. WASHER
10. AXLE SPACER
11. BOLT AND WASHER
12. SPLINED NUT
13. BOLT
14. VALVE ASSEMBLY (USED IF TUBELESS TIRES ARE INSTALLED)
15. O-RING (USED IF TUBELESS TIRES ARE INSTALLED)

Figure 32-15. Main Wheel Assembly

INSPECTION AND REPAIR OF MAIN WHEEL ASSEMBLY.

1. Prior to inspecting the main wheel assembly, degrease all metallic parts and dry thoroughly.
2. Visually inspect bearing cups and cones for damage or wear. Do not remove the cups from the wheel half unless replacement is necessary.

—NOTE—

If a bearing cup is to be replaced, the wheel half must be heated either in boiling water for 30 minutes, or in an oven not exceeding 149°C (300°F), before attempting to remove or install the cup. If the cup does not drop out, tap the cup evenly from the axle bore using a fiber drift pin or a suitable arbor press.

3. Inspect bearing cones for grease contamination and/or solidification at every periodic inspection. Repack wheel bearings with Mobilgrease 77, Mobilux EP2, or equivalent.

—NOTE—

Parker Hannifin Corporation recommends a "Never Exceed" period of 500 wheel miles between repacking intervals.

4. Inspect wheel halves for cracks or damage.
   A. If casting is cracked or shows excessive corrosion, it should be replaced.
   B. Small nicks or gouges in the castings should be blended out and polished with 400 grit sandpaper.
   C. Areas from which the protective coating has been removed or that show slight corrosion, should be thoroughly cleaned and repainted with one coat of zinc chromate primer and one coat of aluminum color polyurethane.

—NOTE—

NEVER paint working surfaces of the bearing cups.

5. Inspect snap rings and grease seals for distortion. Replace grease seal felts if badly worn or contaminated. Lightly saturate new or reused grease seal felts with SAE 10 oil before installation (Do Not Soak).
6. Inspect wheel bolts for corrosion and cracks. Cracked bolts are to be replaced with a new bolt of corresponding part number.

INSPECTION AND/OR REPLACEMENT OF BRAKE DISC.

1. Place the airplane on jacks (Refer to Chapter 7).
2. Remove the bolts (four per caliper) and washers that retain the back plates to the cylinder.
3. Remove the snap ring which secures the axle hub cap and remove the hub cap.
4. Remove the cotter pin and axle nut and slide the wheel assembly from the axle.
5. Remove the eight bolts and washers that retain the brake disc to the inner wheel half. Remove the brake disc.

—NOTE—

It is not necessary to deflate the tire in order to replace the brake disc.

6. Inspect the brake disc for cracks, corrosion, excessive wear, scoring, or warpage. Remove rust by hand wire brushing and finishing with a medium grit sandpaper or emery. For brake disc wear limits, refer to Figure 32-16.
7. Inspect the inner wheel half surfaces in proximity of the brake disc cavity for cracks, corrosion, or damage (Refer to Inspection and Repair of Main Wheel Assembly).
8. Inspect the brake disc attachment bolts for cracks, corrosion and thread damage. Replace if necessary.
9. To reassemble, mount the brake disc in place, install washers and bolts and torque to 150 inchpounds.

ASSEMBLY AND INSTALLATION OF MAIN WHEEL (Refer to Figure 32-15).

1. Ascertain that the bearing cup in each wheel half is fully seated in the wheel housing.
2. Lubricate the bearing cones per lubrication chart in Chapter 12.
3. Install bearing cone, washer, grease, seal felt, washer and snap ring and axle spacer in inner wheel half.

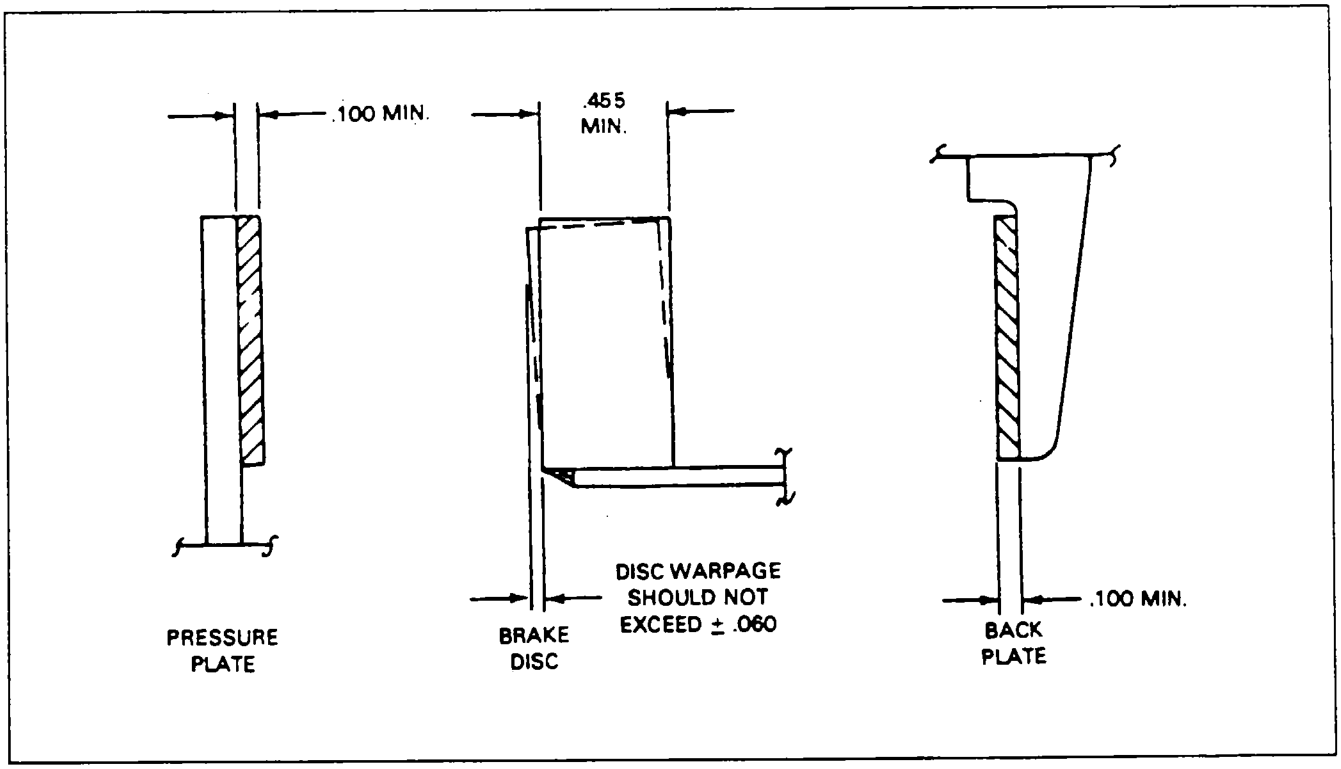


Figure 32-16. Maximum Brake Wear Limits

4. Place inner wheel half (with attached brake disc if wheel and disc were removed as an assembly) on a flat surface with the register portion of the wheel up.
5. Inflate inner tube sufficiently to round it out and install the tube into the tire so that the balance mark (yellow or white band) is radially aligned with the tire balance mark (red dot).
6. Place the outer wheel half into tire and pull tube valve stem through valve hole.
7. Place the tire and outer wheel half over inner wheel half making sure to properly align male and female registers.
8. Install bolts and washers and torque to 300 ± 5 inch pounds. When all bolts have been torqued, torque a second time to ensure that the required torque value has been achieved.
9. Inflate the tire to the recommended operating pressure as found on the main wheel assembly tire inflation placard.
10. Place the bearing cone in the outer wheel half and place the wheel on the axle.
11. If the wheel and brake disc were removed as a unit, proceed to step 15. Otherwise proceed as follows.
12. Align the wheel assembly with the brake disc and install two bolts and washers finger tight.
13. Install the axle nut and release the parking brake.
14. Install the remaining six brake disc attachment bolts and washers, and torque to 150 ± 5 inch-pounds.
15. Install the axle nut, if not already accomplished, and tighten to allow the wheel to turn freely, yet not fit loosely on the axle.
16. Install cotter pin and hub cap. Secure hub cap with snap ring.
17. Install the brake assembly to the torque plate by aligning the anchor bolts with the torque plate holes and sliding the brake assembly onto the torque plate. Install washers, cylinder tie-bolts and insulator shim. Install the back plate assemblies between the brake disc and wheel flange and align with tie-bolts. Torque the bolts to 150 ± 5 inch-pounds. If the brake line was disconnected, reconnect and bleed brakes.

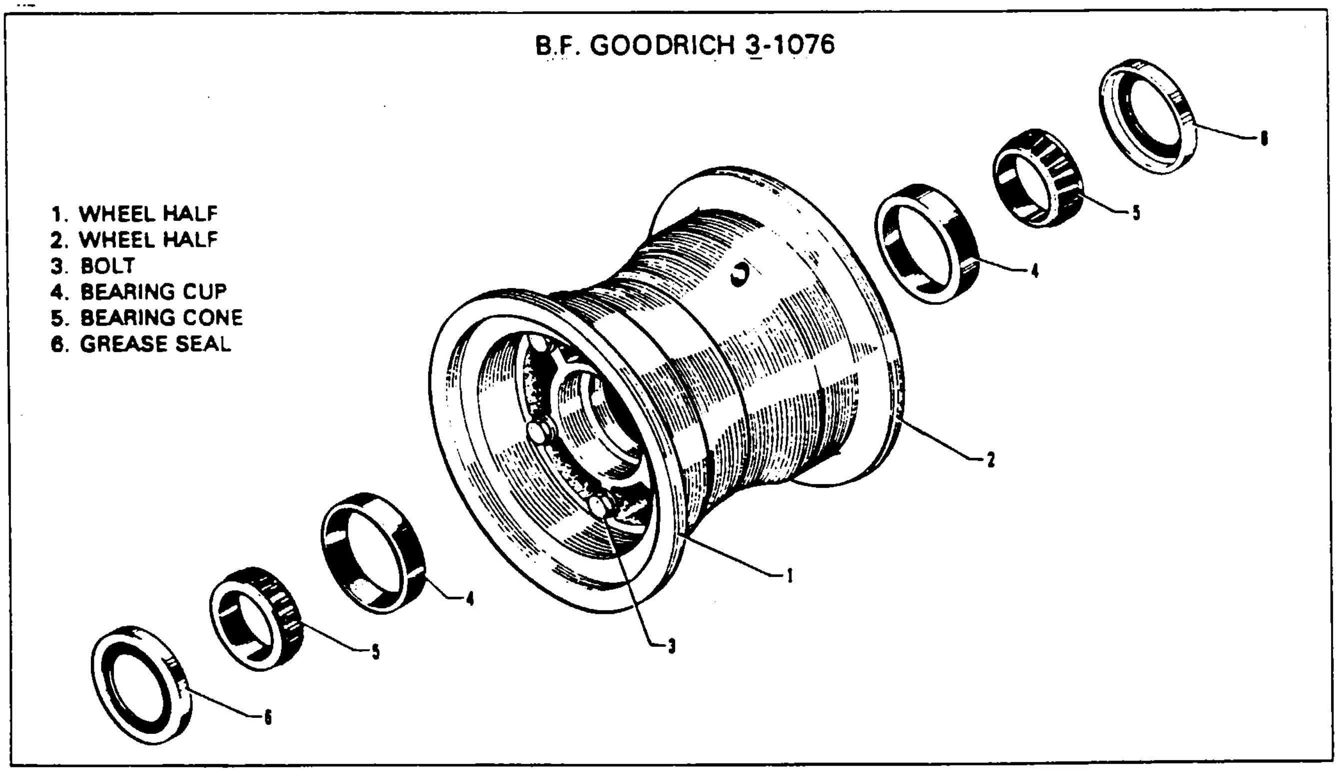
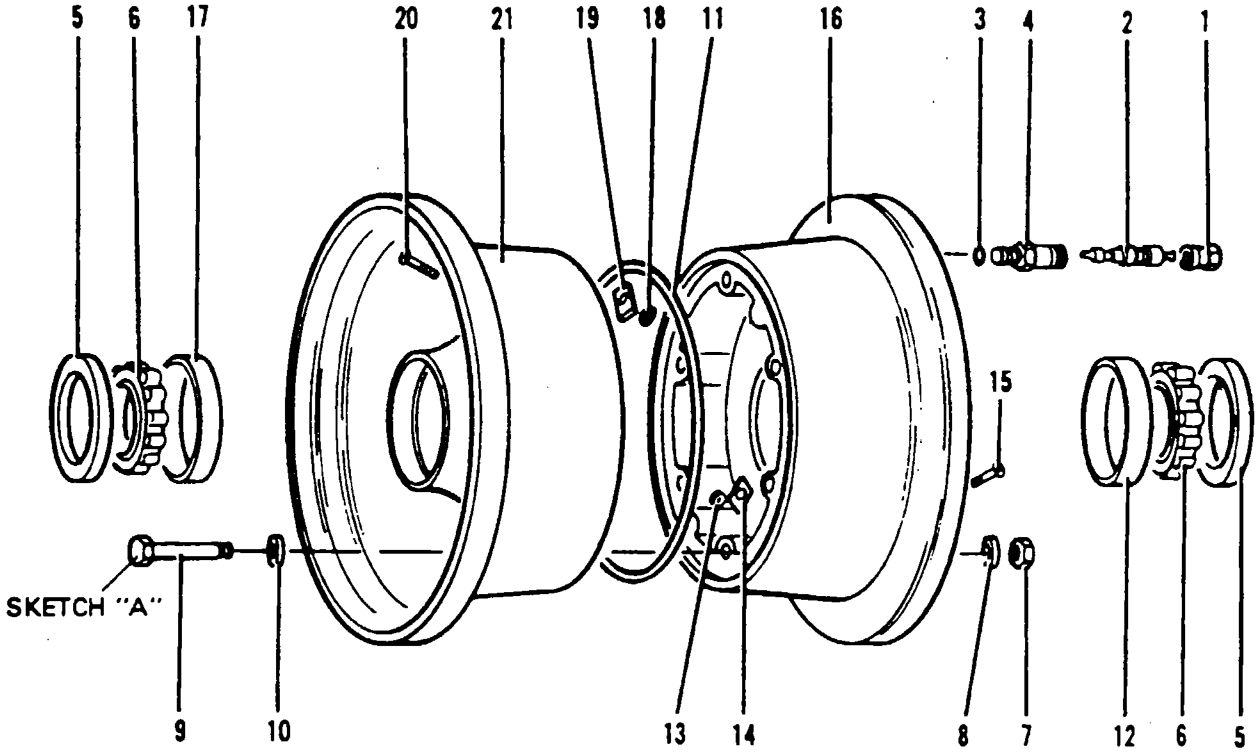
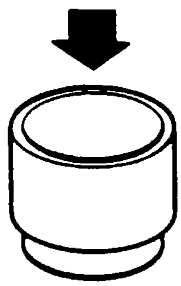
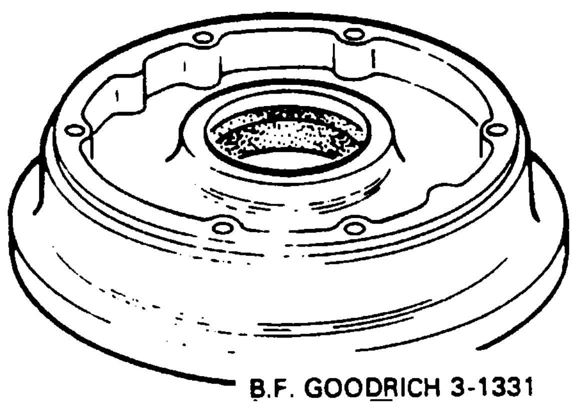


Figure 32-17. Nose Wheel Assembly





1. CAP, VALVE
2. VALVE
3. GROMMET, RUBBER
4. STEM, VALVE
5. GREASE SEAL
6. CONE, BEARING
7. NUT
8. WASHER
9. BOLT
10. WASHER, FLAT
11. PACKING, PREFORMED
12. CUP, BEARING
13. NUT, SELF LOCKING
14. WEIGHT, WHEEL BALANCING
15. SCREW
16. WHEEL HALF, OUTER
17. CUP, BEARING
18. NUT, SELF LOCKING
19. WEIGHT, WHEEL BALANCING
20. SCREW
21. WHEEL HALF, INNER



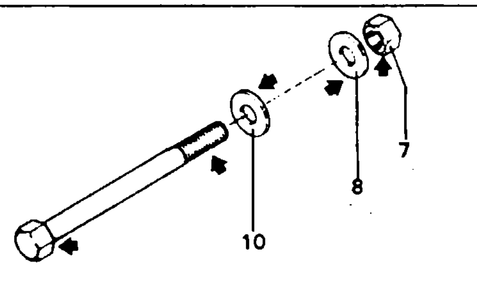


Figure 32-17. Nose Wheel Assembly (Cont.)

NOSE WHEEL ASSEMBLY.

REMOVAL AND DISASSEMBLY OF NOSE WHEEL (B.F. GOODRICH). (Refer to Figure 32-17.)

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 are 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, tube well 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 32-17.)

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. Tighten 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.

REMOVAL AND DISASSEMBLY OF NOSE WHEEL (CLEVELAND). (Refer to Figure 32-18.)

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.

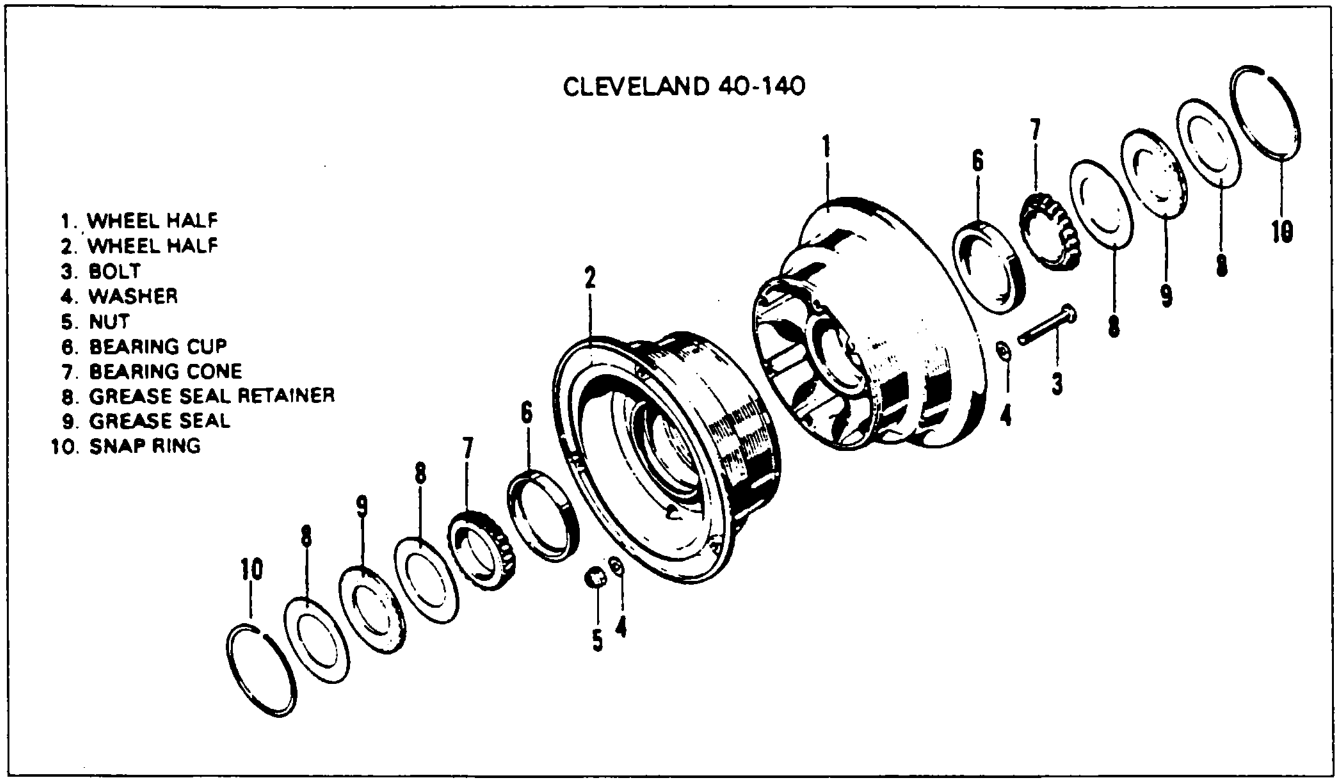


Figure 32-18. Nose Wheel Assembly (Cleveland)

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

ASSEMBLY AND INSTALLATION OF NOSE WHEEL (CLEVELAND). (Refer to Figure 32-18)

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 loose on the axle.

BRAKE ASSEMBLY.

REMOVAL AND DISASSEMBLY OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-19.)

—NOTE—

It is not necessary to remove the wheel from the aircraft to disassemble and service brake.

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 cylinder tie-bolts and remove the back plate assembly.
3. Remove the brake cylinder assembly from the torque plate (the torque plate remains mounted to the axle).
4. Remove the pressure plate assembly, inlet fitting and bleeder fitting.
5. Remove the pistons by applying a slight amount of air pressure to the inlet or outlet ports of the cylinder thus forcing the pistons from the housing.
6. Remove the "O"-rings from the cylinder.
7. If it becomes necessary to remove the anchor bolts, proceed as follows:
   A. Position the cylinder assembly on a holding fixture (Refer to Figure 32-20).

   —CAUTION—

   Cylinder must be square with arbor so that the anchor bolts do not cock.

   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 all metal parts in denatured alcohol or other suitable solvent and dry thoroughly.
2. Clean all "O"-rings in denatured alcohol and dry thoroughly.
3. Inspect "O"-rings for cuts, nicks, distortion or excessive wear. If necessary to replace an "O"-ring, use only "O"-rings of a corresponding part number.
4. Inspect brake cylinder for cracks, especially in the lug area around the anchor bolts. Cracks in this area necessitate cylinder replacement.

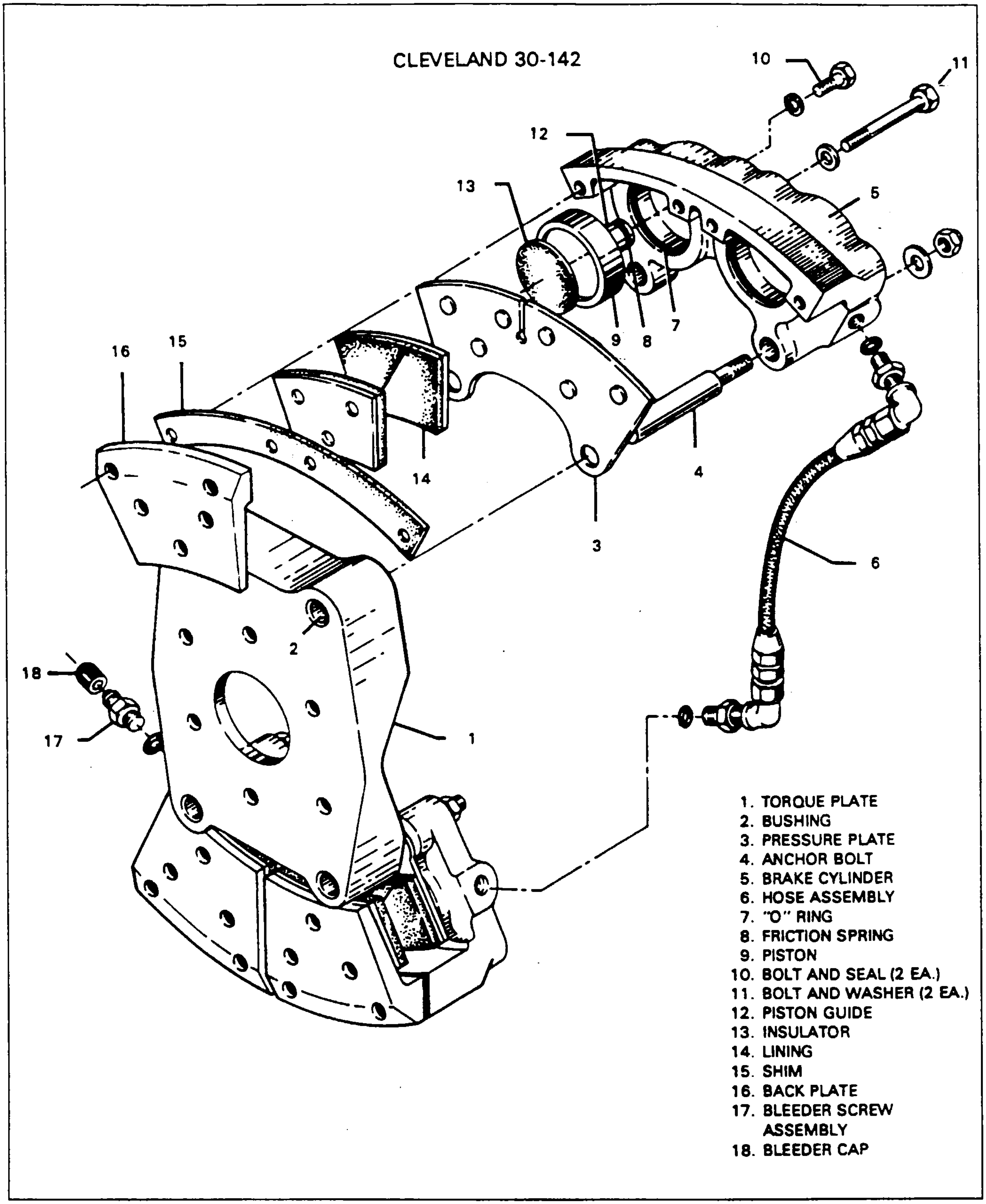


Figure 32-19. Wheel Brake Assembly

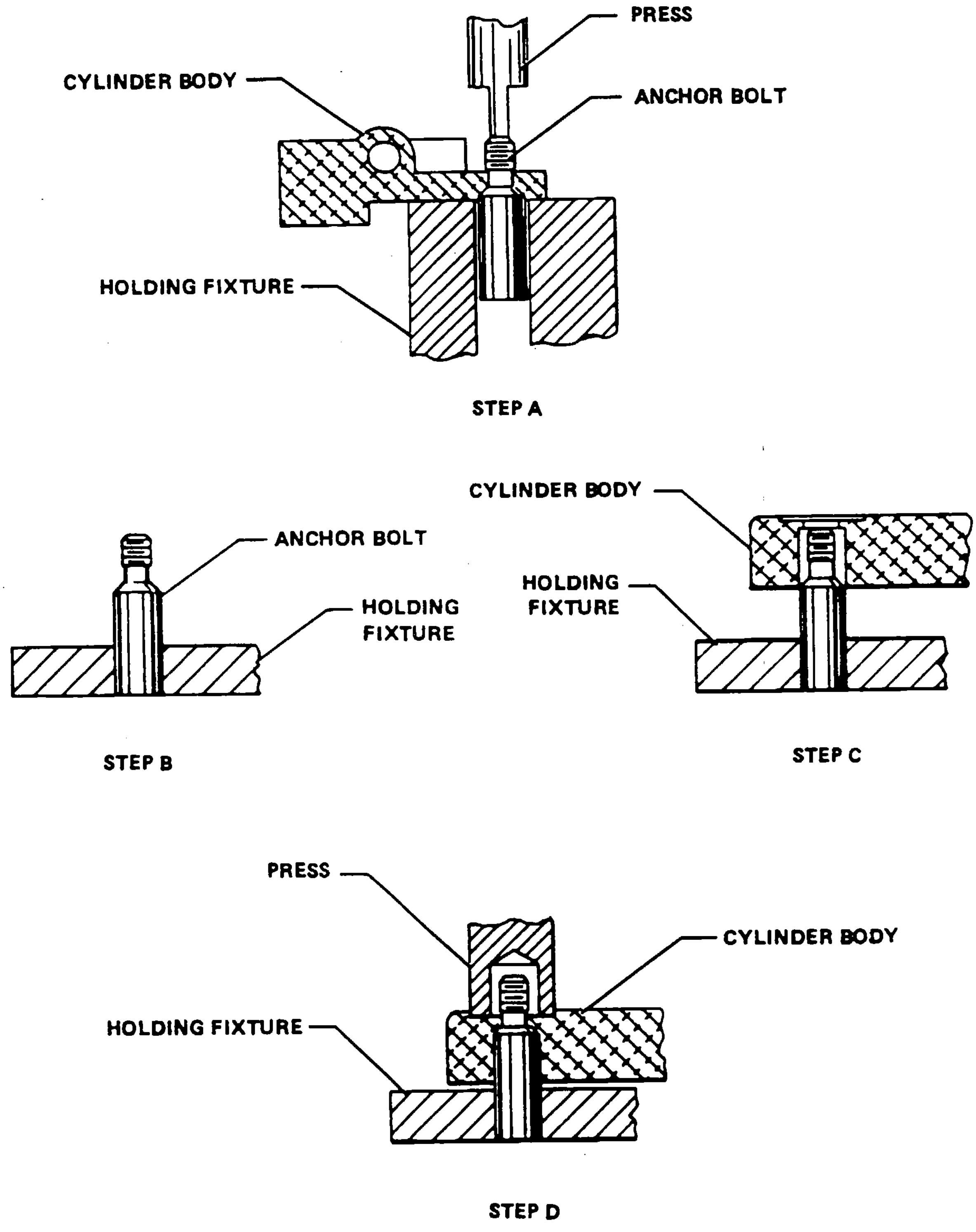


Figure 32-20. Removal and Installation of Anchor Bolts

5. Small nicks and light corrosion may be blended and removed with emery cloth or 400 grit sandpaper. Areas from which the protective coating has been removed should be thoroughly cleaned and repainted with one coat of zinc chromate primer and one coat of aluminum color polyurethene.

—NOTE—

Nicks and burrs in the pilot bore area can prevent the pistons from properly retracting resulting in brake drag.

6. Inspect the fitting ports and piston bores for contamination. Light scratches or nicks in the piston bores, pilot bores or on the chamfered surfaces within these bores may be polished out with 600 grit emery.

—NOTE—

Do not paint internal surfaces of piston bores

7. Thoroughly clean out any residue upon completion of step 6. Any external surfaces around the piston bores from which the protective coating has been removed should be cleaned and painted with one coat of zinc chromate primer and one coat of aluminum color polyurethane.
8. Inspect pistons for nicks, or burrs. Remove nicks or burrs by polishing with 600 grit emery. Thoroughly clean before reinstallation.
9. Inspect brake lining, for edge chipping and surface deterioration.
10. Replace brake linings which exceed the limits as shown in Figure 32-16, as follows:

—NOTE—

If linings are changed, but the pistons are not removed from the cylinder, clean the exposed surfaces of the pistons before displacing the pistons back into the cylinder.

A. Pry the old brake lining segments off of the carrier with a screwdriver.
B. Apply a light film of glue to the backing material of the new pad and snap the pad onto the carrier pins. The glue will retain the pads in the correct position when reassembling the brake.

11. Inspect pressure plate and back plates for cracks or warpage.

—NOTE—

Slightly warped pressure plates with relief slots can be fixtured in a vise and straightened when laid on a flat surface. Flatness should be within .015 to .020 T.I.R. Warped pressure plates can cause brake drag.

Replace if cracked or severely deformed. Inspect pins for looseness. If loose, tighten with rivet set and anvil (Parker-Hannifin P/N 199-1A and 199-1B) or replace back plate and pressure plate assembly.

12. Inspect anchor bolt holes in torque plate for internal corrosion or contamination. If present, clean with emery and apply a light coat of dry lube.

—*NOTE*—

For best service life, the cylinders must slide freely in the torque plate.

Check the anchor bolt hole and mounting bolt hole areas for elongation or cracks. Badly elongated or cracked parts should be replaced with new parts of corresponding part numbers. Minor corrosion on the torque plates may be removed with 600 grit emery.

13. Inspect bolt holes for cracks, thread damage or corrosion and replace if necessary.

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.

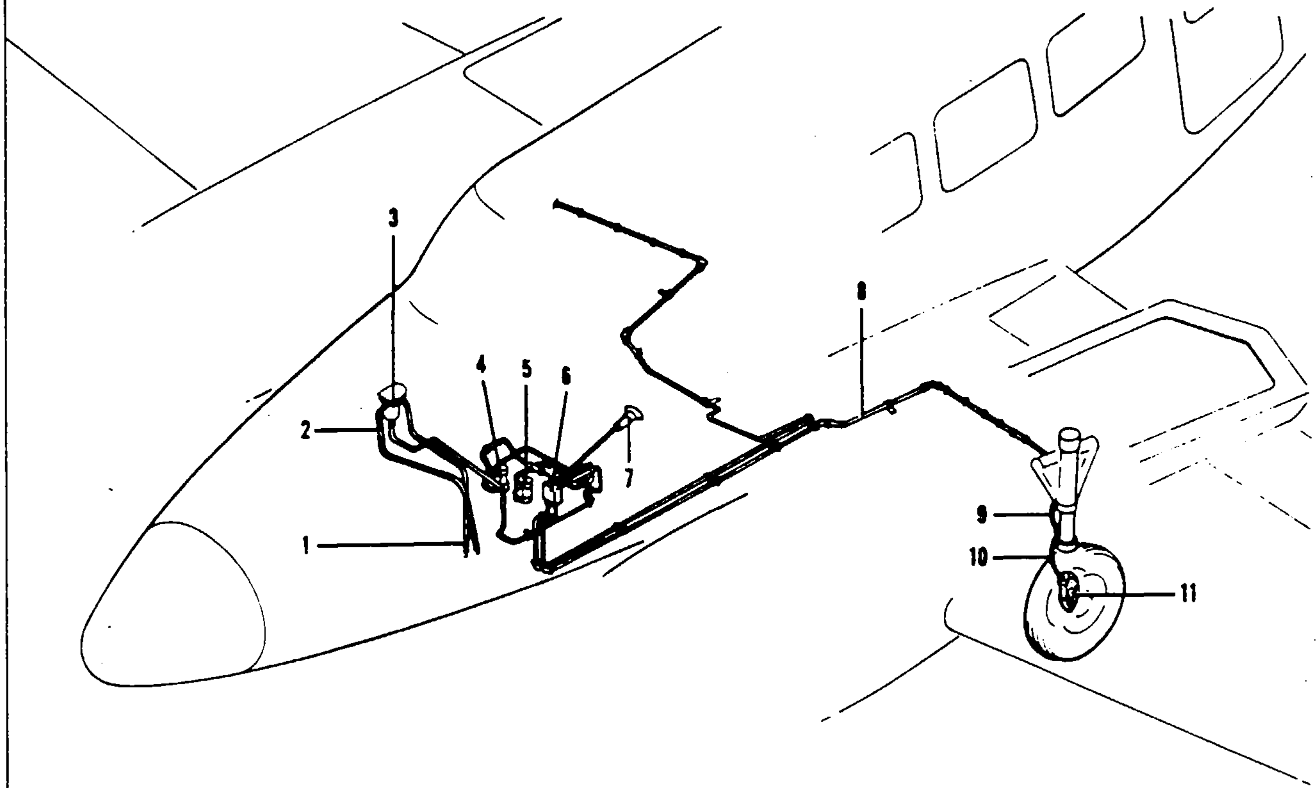
ASSEMBLY AND INSTALLATION OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-19.)

1. If removed, press anchor bolts into brake and install washers and nuts. Torque nuts to 90 inchpounds.
2. Install inlet and bleeder fittings.
3. Install the pistons as follows:
   A. Lubricate the piston, "O"-ring and piston bore with a small amount of MIL-H-5606 hydraulic fluid.
   B. Place piston in bore and rotate to seat drag ring and insure that piston and seal are in proper alignment.
   C. Tap the piston with a wooden or plastic mallet while alternately rotating. If considerable effort is required, remove piston and inspect bore and pilot bore area for damage. If the bore is damaged, check the corresponding area of the piston for damage. Repair, if necessary, and repeat the above procedure.
4. Install the pressure plate assembly by aligning the anchor bolt holes with the anchor bolts and sliding onto cylinder. The pressure plate must float freely on the anchor bolts.
5. Install the brake assembly to the torque plate aligning the anchor bolts with torque plate holes and sliding brake assembly onto torque plate. Torque plate must slide freely.
6. Install washers, cylinder tie-bolts and insulator shim. Install back plate assemblies between brake disc and wheel flange and align with tie-bolts. Torque bolts to 150 inch pounds.
7. Reconnect hydraulic lines and bleed brake system.

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.



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 32-21. Brake Installation (Typical)

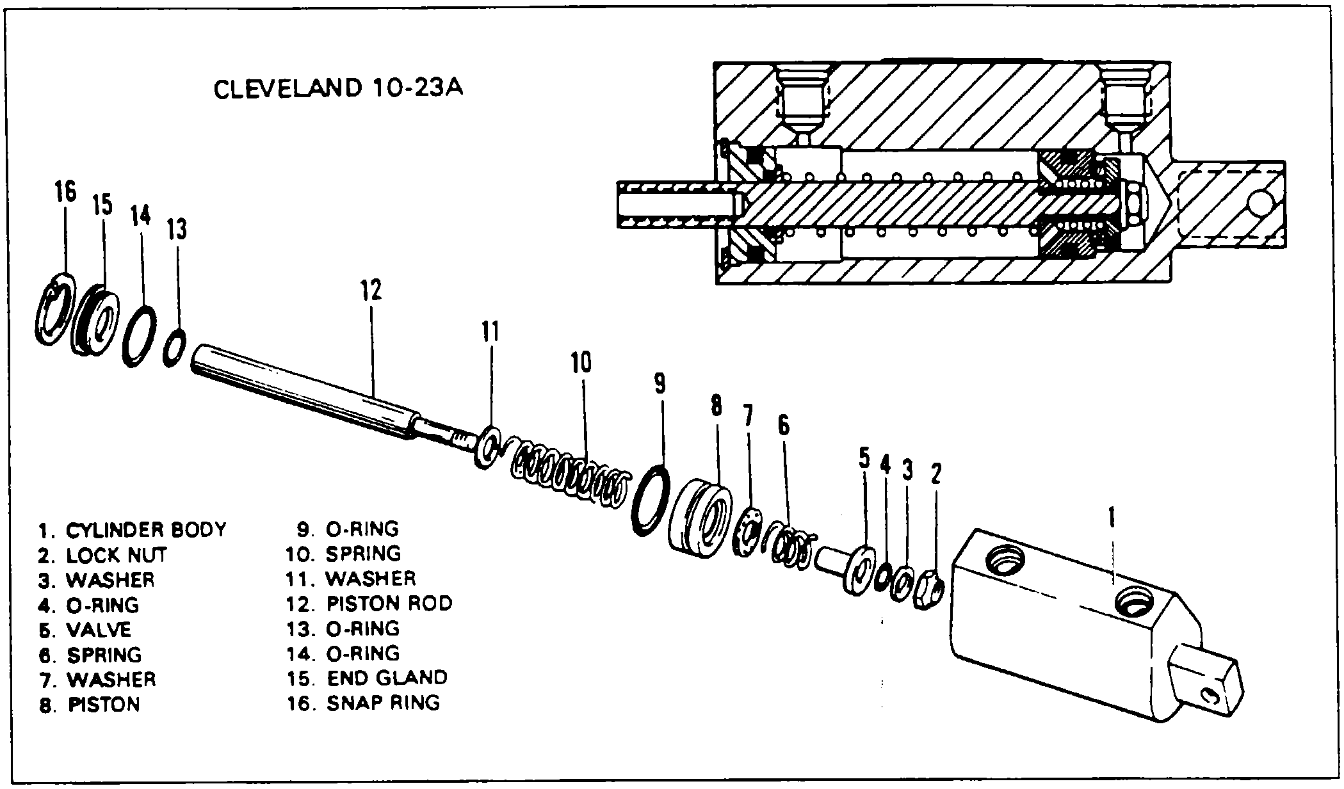


Figure 32-22. Brake Master Cylinder Assembly

DISASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 32-22.)

1. The internal parts of the brake master cylinder may be removed by removing the snap ring from the annular slot at the lower end of the cylinder. Pull the complete piston assembly from the cylinder.
2. Slide the packing gland, O-ring, washer and spring from the piston rod.
3. The piston valve assembly may be removed by first removing the self-locking nut from the piston rod. This will allow the piston with component parts to be removed.

CLEANING, INSPECTION AND REPAIR OF BRAKE MASTER CYLINDER.

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

ASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 32-22.)

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 32-23.)

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 limited to smoothing burred or scratched surfaces and replacing O-rings.

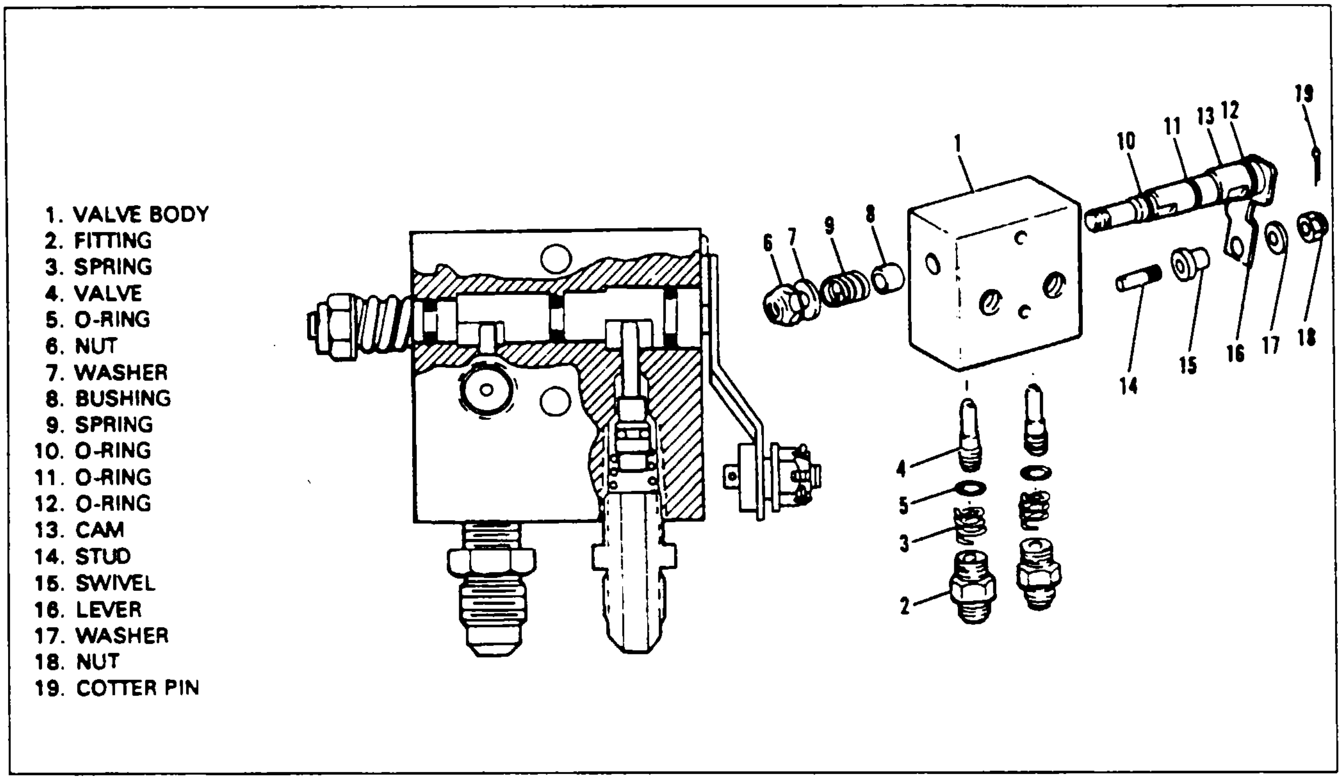


Figure 32-23. Parking Brake Valve Assembly

ASSEMBLY OF PARKING BRAKE VALVE. (Refer to Figure 32-23.)

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 the out port, install valve spring and secure with outlet fitting.

INSTALLATION OF PARKING BRAKE VALVE.

1. Attach the valve to the bulkhead mounting bracket with screws.
2. Connect the fluid lines to the valve.
3. Connect the control cable to valve lever and determine that when valve lever fits in the closed detent, parking brake handle is .062 to .125 inch of being full in against stop.
4. Bleed the Brake System.

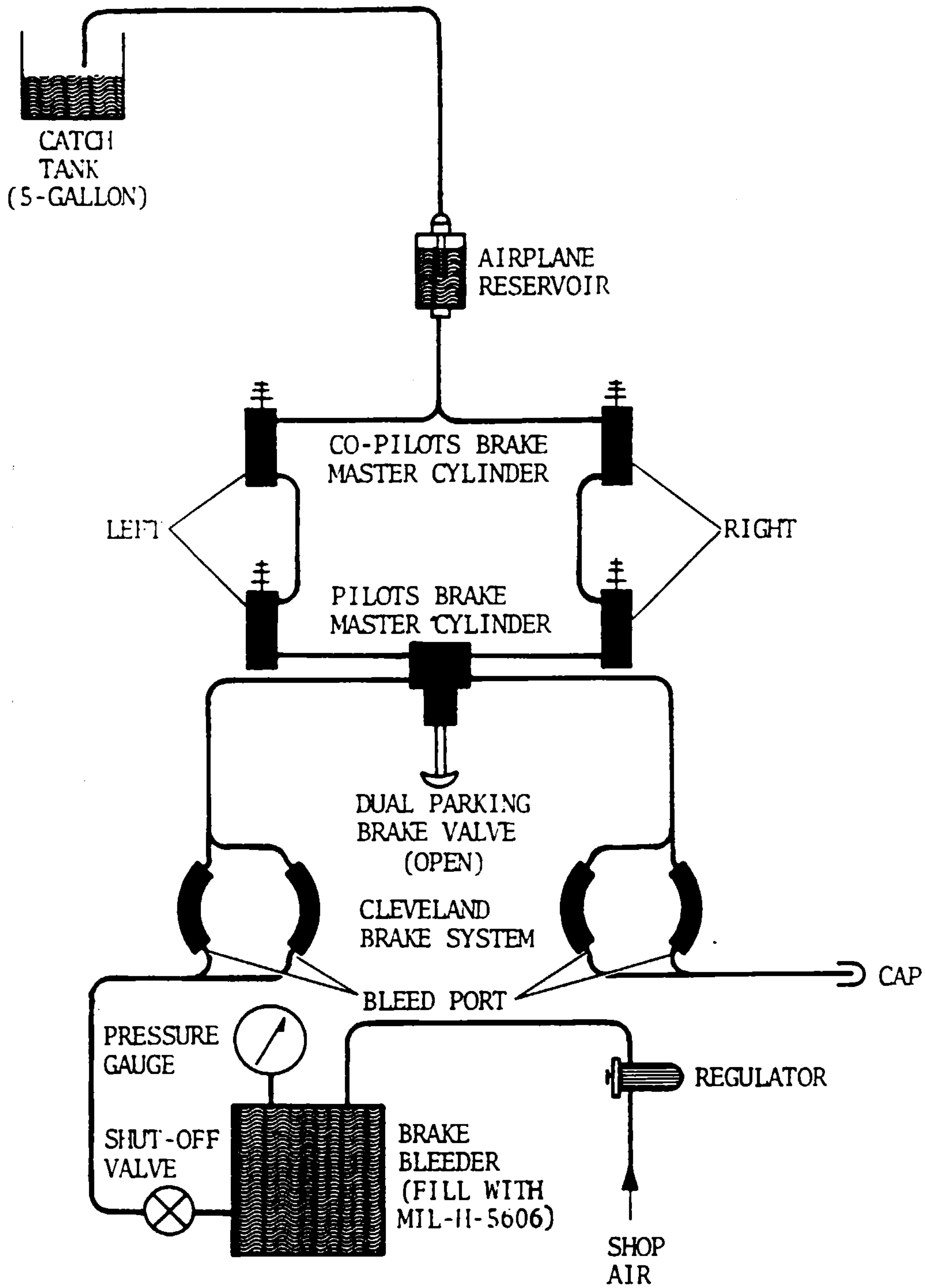


Figure 32-24. Bleeding Brake (Pressure Pot)

BLEEDING PROCEDURE.

If the brake line has been disconnected for any reason, it will be necessary to bleed the brake system as described below:

1. Place a suitable container at the brake reservoir to collect fluid overflow.
2. Remove the rubber bleeder fitting cap located on the bottom of the brake unit housing on the landing gear.
3. Slide a hose over the bleeder fitting, loosen the fitting one turn and pressure fill the brake system with MIL-H-5606 fluid. (Refer to Figure 32-24.)

—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 32-25.)

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 PEDAL ASSEMBLY. (Refer to Figure 32-25.)

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—

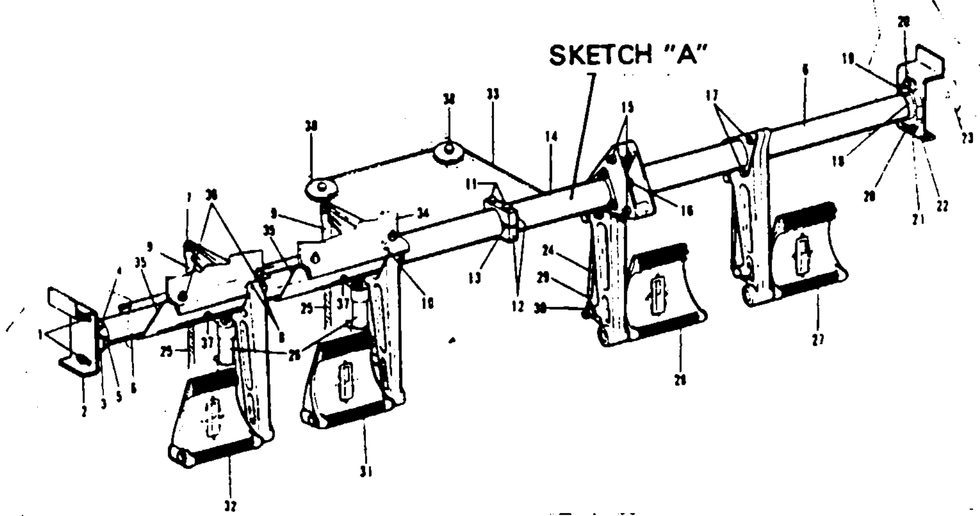
The clamps around the torque tube must not be deformed or permitted to interfere with the rotation of the torque tube.

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 section.
13. Install and seal access plates, panels and seats.

POSITION AND WARNING.

POSITION.

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



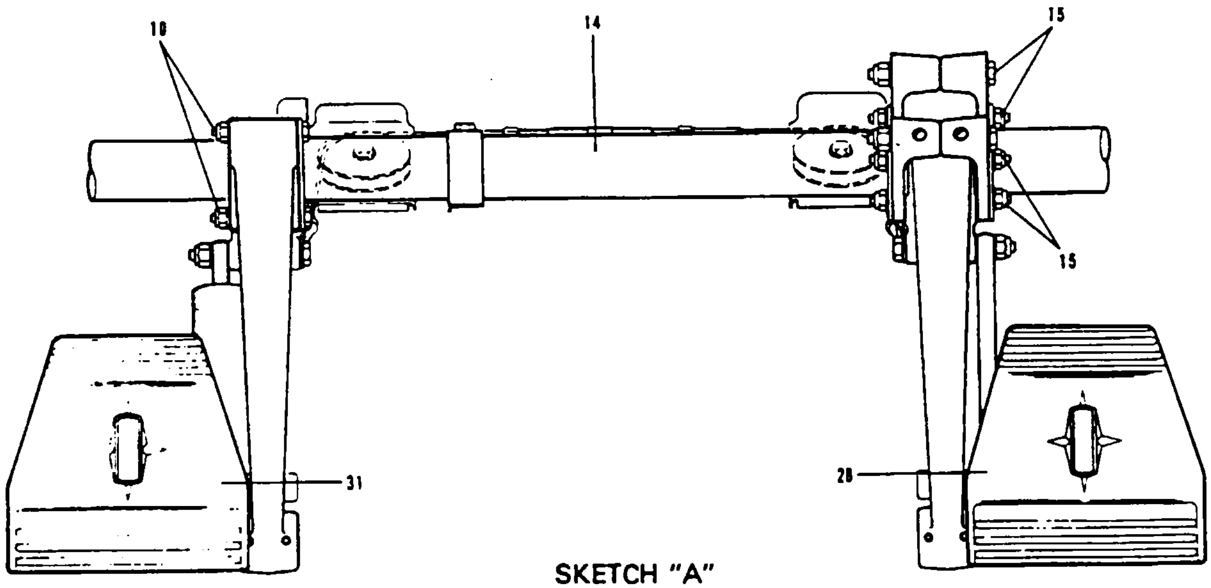


Figure 32-25. Rudder Pedal Installation

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 red light.

4. Extend and retract gear to ascertain proper adjustment.

ADJUSTMENT OF MAIN GEAR DOWN LIMIT SWITCH. (Refer to Figure 32-26.)

1. Ascertain that the main landing gear downlock is properly adjusted.
2. Adjust so that the green indicator light in the cockpit comes on when the downlock hook is between 030 to .069 of an inch above the fully locked position. To check the adjustment proceed as follows:
   A. By hand, raise the downlock hook until the green light in the cockpit goes out.

B. With hook raised, place a .070 of an inch wire feeler gauge between the hook and bottom surface of the slot in the side brace link. (Refer to Figure 32-26.)
C. Lower the hook, allowing it to rest on the feeler gauge. (The end of the gauge should be even with the lock pin.) The green light in the cockpit should remain off.
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 and right main gear torque links. Adjust so that the switches actuate 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.

ADJUSTMENT OF NOSE LANDING GEAR SAFETY (PROPELLER REVERSE) SWITCH.

The propeller reverse switch is located on the nose gear torque link.

1. Adjust the switch to activate when the oleo strut is within .25 inches ± .12 inches of its fully extended position.
2. Extend and then compress the strut to be certain the switch actuates properly. Connect an ohmmeter to the electrical leads of the switch. Measure the strut extension at the point where the switch closes. This distance should be within the range given in Step 1.
3. Check to be sure that the propellers move into their reverse position during taxi test.

—CAUTION—

Do not attempt to move the power levers into reverse with the engines static as damage will result to the linkage.

WARNING.

REMOVAL OF GEAR WARNING SWITCHES. (Refer to Figure 32-27.)

The gear warning switches are located within the control pedestal, directly under the throttle controls. Each switch will actuate the warning horn.

1. The switches may be removed from their mounting brackets by the following procedure:
   A. Remove the top cover plates of the pedestal, one of which is forward of the control levers, the other surrounds the levers, by removing their attachment screws.
   B. Remove the switch from its mounting bracket by removing the two screws that secure either switch and spacer block. First remove the nut from each screw, and allow the bracket of the other switch and spacer block to swing full forward by turning the adjustment screw counterclockwise. Pull aft on the switch bracket to be removed and push out the attachment screws.
   C. Disconnect the necessary electrical leads.
2. The switch mounting brackets may be removed by removing the control lever assembly as follows:
   A. Disconnect the engine control cables from the control levers by removing the connecting clevis pins.
   B. Remove the flush head screw at each side of the pedestal housing.
   C. Remove the friction knob with washer from the right side of the pedestal.
   D. Remove the cap bolts that secure the frame.
   E. Pull the assembly from the pedestal housing.
   F. Remove the control keeper tube that holds the switch brackets in the control frame by removing the tube attachment screws from each side of the frame.

INSTALLATION OF GEAR WARNING SWITCHES. (Refer to Figure 32-27.)

1. The switch mounting brackets, as part of the control lever assembly, may be installed as follows:
   A. Assemble the mounting brackets (switches and spacer blocks may be installed with mounting brackets), tension springs and spacer washers in the control frame and secure with keeper tube. Secure keeper tube in frame.
   B. Install control lever assembly in the pedestal housing and secure with cap bolts and screws.
   C. Install the friction knob with washer on the end of the lever shaft at the right side of the pedestal.

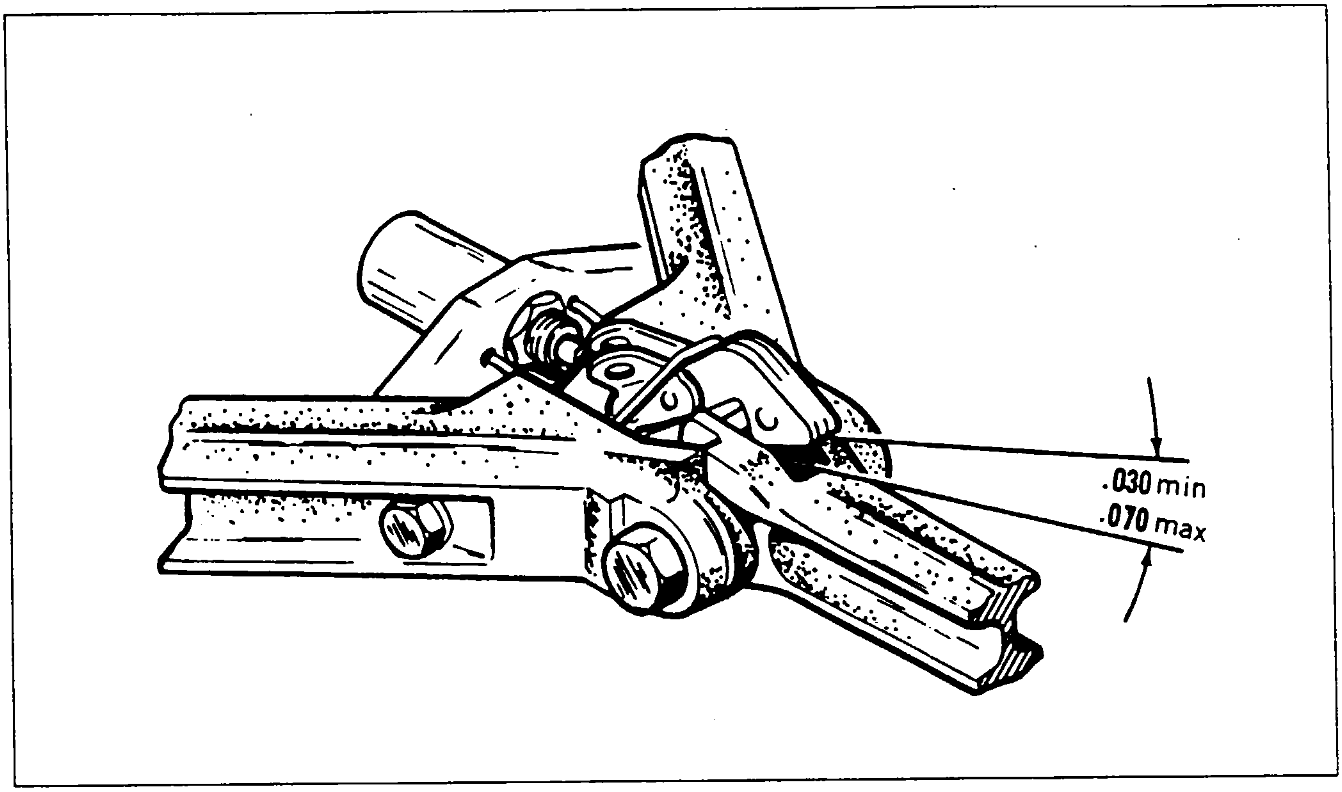


Figure 32-26. Adjusting Main Gear Down Limit Switch

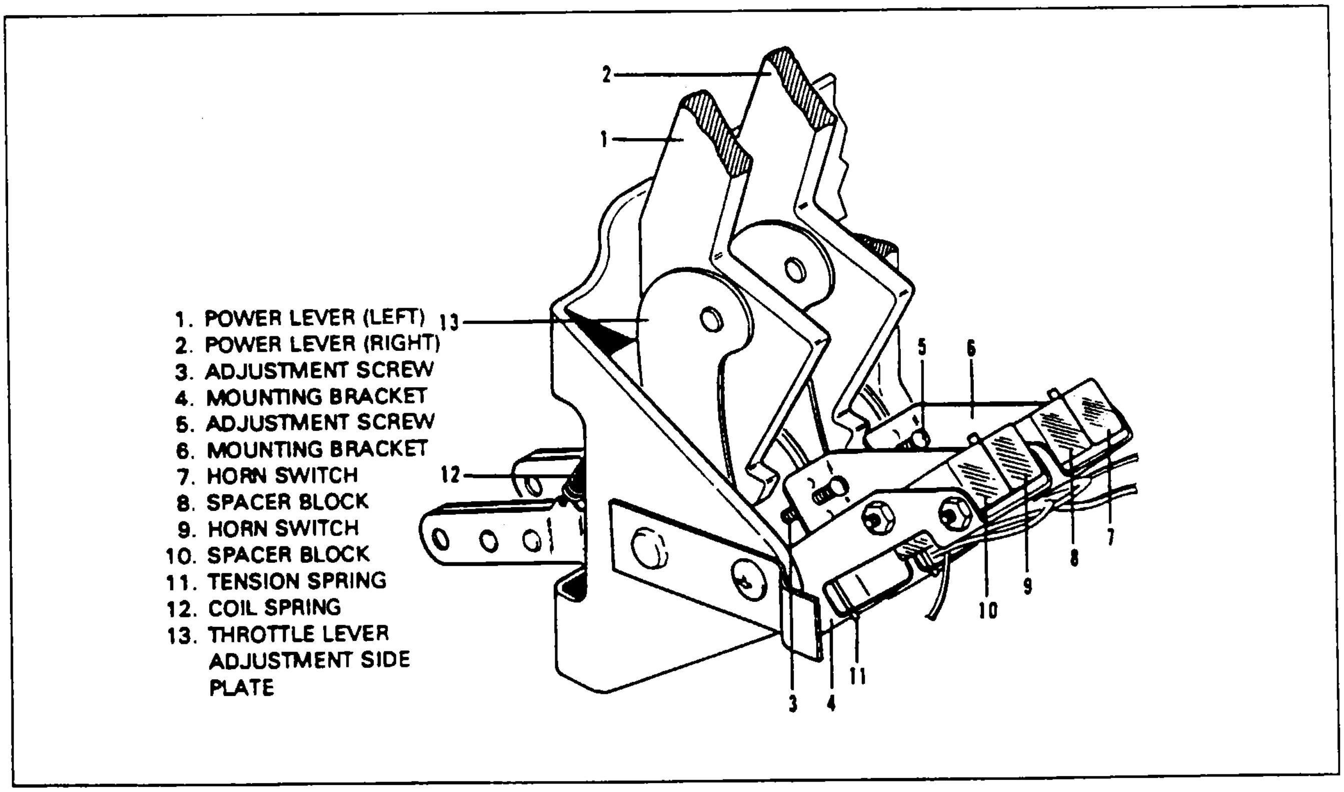


Figure 32-27. Gear Warning Switches Installation

D. Connect the engine control cables to their respective levers using clevis pins. Place washer on ends of clevis pins and secure cotter pins.

2. The switches may be installed on their mounting brackets by the following procedure:
   A. Connect the electrical leads to their respective switch terminals. (Refer to Electrical System Schematic, Chapter 91, for wire installation.)
   B. Place the switch and spacer block in its mounting bracket and install attachment screws. It will be necessary to swing the bracket of the other switch and spacer block forward to install the attachment screws Install nuts on the screws and secure.
   C. Position the pedestal cover plates on the pedestal, install screws and secure.
   D. Adjust the switches.

ADJUSTMENT OF GEAR WARNING SWITCHES.

The gear warning horn switches are installed in the control pedestal, with each controlled by a throttle lever. Each switch actuates the warning horn when either or both power levers are reduced below 150 ft. lbs. of engine torque. 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 power lever switches to actuate at a desired power lever setting. retard the power levers until the engine torque gauges read 150 ft. lbs. of torque. Mark the power lever cover in some manner in relation to the power levers for the adjustment of the gear up warning horn switches.
   C. Shut down the engines.
   D. Set the power lever 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 power 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 power lever until the gear up indicator horn sounds. Check the location of the power lever to the adjusting mark. The warning horn will operate when either or both power levers 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 engine torque.
   B. If the horn fails to operate at the desired settings, mark the throttles at the proper engine torque 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.

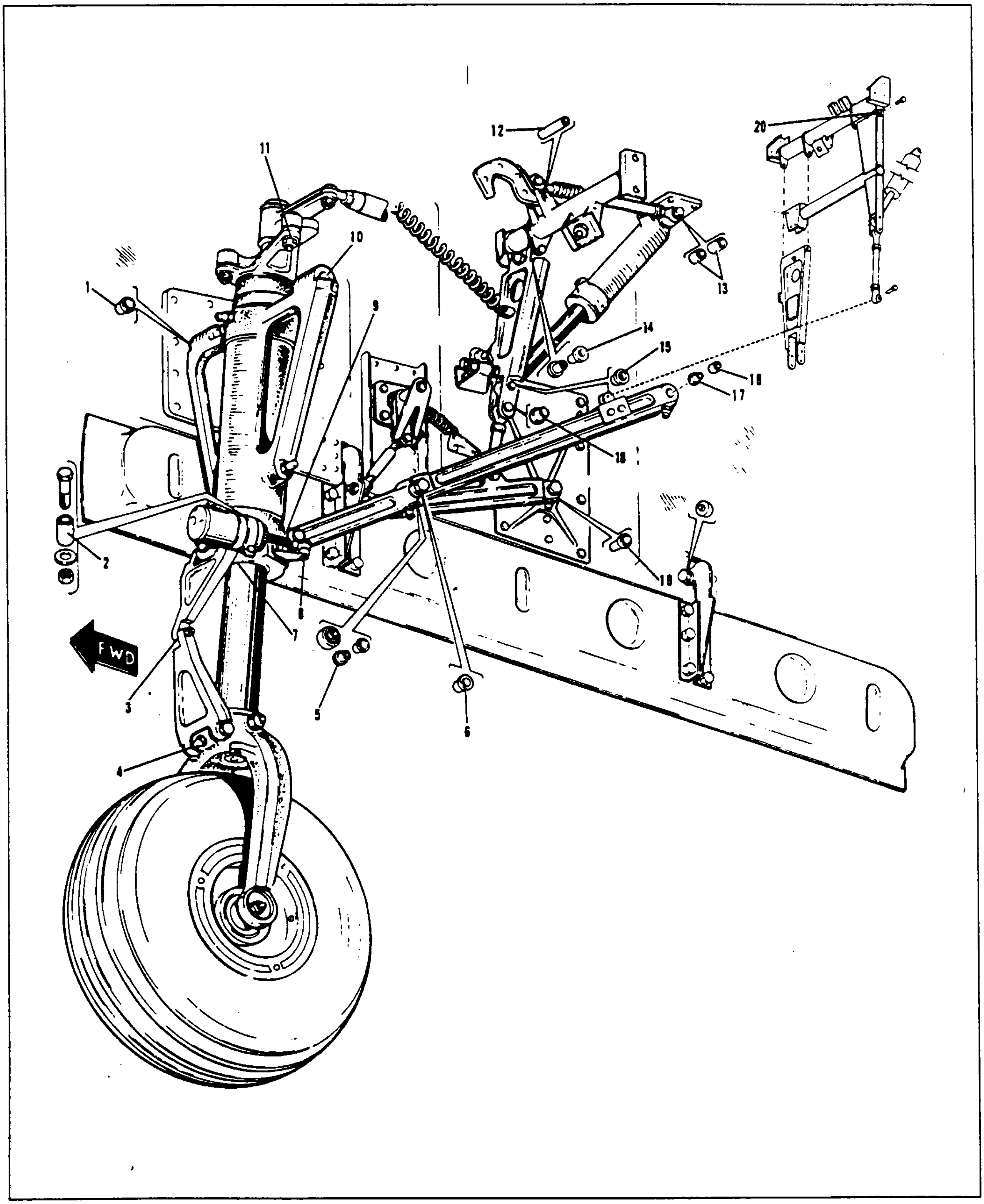


Figure 32-28. Nose Gear Wear Limits

Chart 3202. Nose Gear Service Tolerances

No.	Part No.	Nomenclature	Manufacturer's Dimension	Tolerances	Remarks
1	NAS77-9-36	Trunnion Plate Bushing	+ .0015 .5625 - .0000	.0020	
2	14843- 116	Strut Bushing	+ .002 .249 - .000	.0020	
3	NAS77-4-42	Link Bushing	+ .0010 .3745- .0000	.0035	Ream Press Fit
4	31785	Fork Bushing	+ .0020 .3130 - .0000	.0030	
5	NAS77-7-38	Lower Drag Brace Link Bushing	+ .0015 .4375 - .0000	.0035	Press Fit Ream If Required
6	NAS77-7-68	Upper Drag Brace Link Bushing	+ .0015 .4375 - .0000	.0035	Press Fit Ream If Required
7	NAS75-5-011	Upper Torque Link Bushing	+ .0010 .4370 - .0000	.0035	Press Fit Line Ream
8	21831-04	Strut Cylinder Flange Bushing	+ .002 .249 - .000	.0020	Press Fit
9	43256-7 OR NAS75-7-016	Housing Bushing	+ .0015 .4375 - .0000	.0035	Press Fit Line Ream If Required
10	43262 OR 31766-2	Housing Bushing	+ .0015 .5625 - .0000	.0025	Press Fit Line Ream If Required
11	29999-5	Steering Arm Bushing	+ .002 .313 - .000	.0020	
12	42129-04	Bushing	+ .002 .249 - .000	.0020	
13	42129-03	Hydraulic Actu- tor Uplock Rod Bushing	+ .002 .312 - .000	.0020	
14	NAS77-4-50	Idler Link Bushing	+ .0015 .250 - .0000	.0020	

Chart 3202. Nose Gear Service Tolerances (cont.)

No.	Part No.	Nomenclature	Manufacturer's Dimension	Tolerances	Remarks
15	20737-30	Idler Bushing	+ .0015 .2495 - .0000	.0020	
16	NAS75-7-014	Upper Drag Brace Link Bushing	+ .0015 .4375 - .0000	.0035	Line Ream Press Fit
17	NAS77-7-38	Upper Drag Brace Link Bushing	+ .0015 .4375 - .0000	.0035	Line Ream Press Fit
18	20737-32	Idler Link Bushing	+ .0015 .2495 - .0000	.0020	
19	NAS77-7-40	Drag Link Bracket Attachment Bushing	+ .0015 .4375 - .0000	.0035	
20	NAS77-7-40	Idler Link Bushing	+ .0015 .2500 - .0000	.0020	

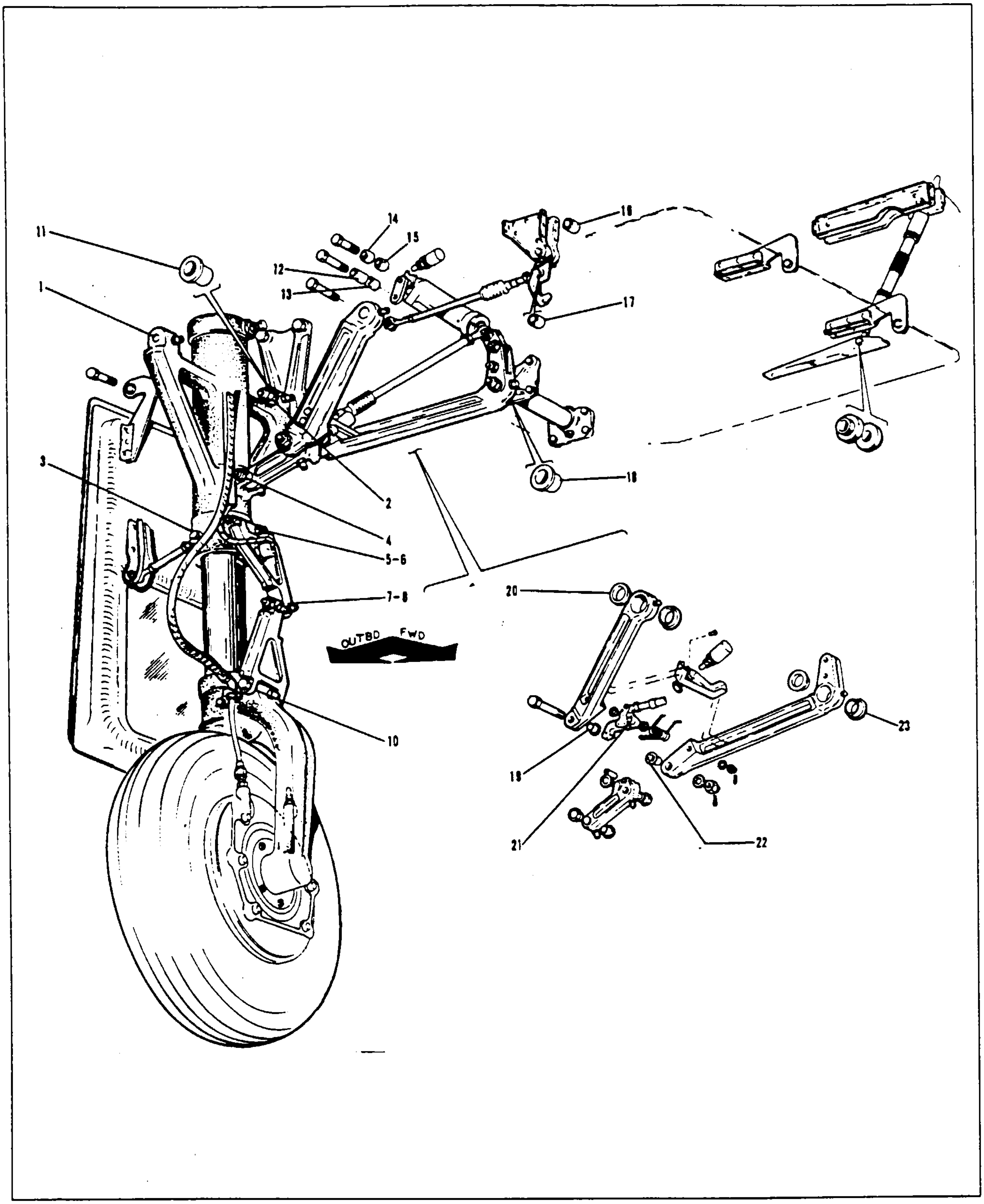


Figure 32-29. Main Gear Wear Limits

Chart 3203. Main Gear Service Tolerances

No.	Part No.	Nomenclature	Manufacturer's Dimension	Tolerances	Remarks
1	43256-4 OR 20737-23	Housing Bushing	+ .0015 .6245 - .0000	.0025	Press Fit Ream If Required
2	43256-5 OR 61402-99	Housing Bushing	+ .0015 .6245 - .0000	.0025	Press Fit Ream If Required
3	14175- 106	Retraction Bearing Spacer Bushing	+ .0015 .3745 - .0000	.0035	
4	29999-28	Housing Bushing	+ .0100 .5607 - .0000	.0025	Press Fit Line Ream If Required
5	NAS75-6-11	Link Bushing	+ .0015 .4375 - .0000	.0025	Press Fit Ream If Required
6	43256-2 OR 20737-40	Housing Bushing	+ .0015 .3745 - .0000	.0035	Press Fit Line Ream
7	NAS75-7011	Link Bushing	+ .0015 .4375 - .0000	.0025	Press Fit Line Ream If Required
8	NAS77-7-35	Link Bushing	+ .0015 .4375- .0000	.0025	Press Fit Line Ream If Required
9	NOT USED				
10	43256-2 OR 20737-40	Gear Fork Bushing	.374/.375	.0035	
11	NAS77-10-94	Trunnion Bushing	+ .0015 .6250- .0000	.0020	
12	42129-06	Bushing	.384	.0020	
13	42129-08	Bushing	.384	.0020	
14	42129-10	Bushing	.312/.314	.0020	Grease At Installation
15	42129-09	Bushing	.312/.314	.0020	Grease At Installation
16	42129-4	Bushing			

Chart 3203. Main Gear Service Tolerances (cont.)

No.	Part No.	Nomenclature	Manufacturer's Dimension	Tolerances	Remarks
17	42129-07	Bushing	+ .002 .249 - .000	.0020	
18	NAS77-9-84	Fitting Assembly	+ .0015 .565 - .0000	.0025	Aft
	NAS77- 18-88	Bushing	+ .0015 1.1250 - .0000	.0030	Forward
19	NAS77-9-72	Bushing	+ 0015 .5625 - .0000	.0025	Press Fit
20	NAS77-9-38	Bushing	+ 0010 .6870- .0000	.0025	Press Fit
21	42129- 13	Bushing	.312/.314	.0020	Ream
22	NAS77-9-72	Bushing	+ 0010 .6853 - .0000	.0025	Press Fit
23	NAS77- 18-50	Bushing	+ .0020 1.1250 - .0000	.0030	Press Fit Ream If Required

THIS PAGE INTENTIONALLY LEFT BLANK

T1000

AIRLINE DIVISION

T1040

MAINTENANCE MANUAL

CARD 4 OF 5

PA-31T3 T1040

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 765)

INTRODUCTION.

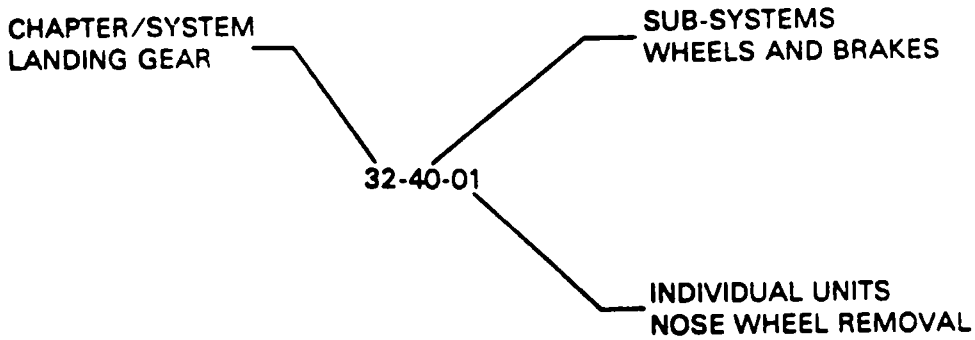
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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-31T3/T-1040 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 T-1040 Parts Catalog P/N 761 761, and FAR 43 for proper utilization.

SERIAL NUMBER INFORMATION

PA-31T T1040-1982
SERIAL NUMBERS 31T-8275001 TO 31T-8275025 INCL.
PA-31T T1040-1983
SERIAL NUMBERS 31T-8375001 TO 31T-8375005 INCL.
PA-31T T1040-1984
SERIAL NUMBERS 31T-8475001 AND UP.

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)

6. Revisions to this Maintenance Manual 761 765 issued March 26, 1982 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG820326	March 26, 1982	1, 2, 3, 4 and 5
PR820804	August 4, 1982	1, 2, 3, 4 and 5
PR821115	November 15, 1982	1, 2, 3, 4 and 5
PR830225	February 25, 1983	1, 2, 3, 4 and 5
PR840305	March 5, 1984	1, 2, 3, 4 and 5
PR840713	July 13, 1984	1, 2, 3, 4 and 5

The date on Aerofiche cards should not be earlier than the date noted for the respective card effectivity. Consult the lastest Aerofiche card in this series for current Aerofiche card effectivity.

VENDOR PUBLICATIONS.

BATTERY:

Gill Lead-Acid Battery
(Teledyne Battery
Products)
Service Manual = P /N: GSM - 682

SAFT Nickel-Cadmium
Battery Operating and
Maintenance Manual = P/N: DC 3176-5A

Marathon Nickel
Cadmium
Battery Instruction
Manual = P/N: BA-89

DE-ICE SYSTEM (PROPELLERS):

B.F. Goodrich
Electrothermal
Propeller Deice
Maintenance Manual = P/N: 68-04-712 (Latest Revision)

B.F. Goodrich
Electrothermal
Propeller Deice
Installation
and Removal
Procedures = P/N: 59-728 (Latest Revision)

ENGINE:

PT6A-11/110
Maintenance Manual = P/N: 3030442

HEATER:

Maintenance and
Overhaul Manual = P/N: 24E25-1

PROPELLER:

Hartzell Overhaul
Manual = P/N: 117-D

Hartzell Spinner
Assembly and
Maintenance
Manual = P/N: 127

VENDOR PUBLICATIONS (cont).

STARTER-GENERATOR

Auxilec. Inc. Maintenance and Overhaul Manual	= P N : 8013C
Lear Siegler. Inc. Maintenance Manual (All Models)	= P N : 23700
Lear Siegler. Inc. Overhaul Manual. Series 23048	= P N : 23202

PIPER PUBLICATIONS.

PARTS CATALOG	= 761 761 Piper Aircraft Corporation 820 E. Bald Eagle Street Lock Haven. Pennsylvania 17745
INSPECTION MANUAL 100 HOUR	= 761 774 Piper Aircraft Corporation 820 E. Bald Eagle Street Lock Haven. Pennsylvania 17745

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 Compressors	Delco Products Div. of General Motors Corp. P.O. Box 1042 Dept. 194-T Dayton, Ohio 45401 (513) 227-5000 Telex: 810-459-1788
	Sankyo Inc. 10719 Sanden Dr. Dallas, Texas 75238 (214) 349-3030 Telex: 73-0497
Air Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
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

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Marathon Battery Company 8301 Imperial Drive P.O. Box 8233 Waco, Texas 76710
	SAFT America, Incorporated 711 Industrial Boulevard Valdosta, Georgia 31601
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
Electrical Relays	Leach Corporation 5915 Avalon Boulevard Los Angeles, California 90003 (213) 232-8221
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington, Penna. 19034 (215) 643-2900
Engines	Pratt and Whitney Aircraft of Canada, Ltd. Box 10 Longueuil, Quebec, Canada JK4X9
Environmental Systems, Heater	Janitrol Aero Division 4202 Surface Road Columbus, Ohio 43228 (614) 276-3561
Fire Detection and Extinguishing Systems	HTL Industries P.O. Box 780 Pasadena, California 91006 (213) 574-7880

VENDOR-SUPPLIER INFORMATION (cont).

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
Gate Valves, Shut-off Valves and Solenoid Valves (Fuel and Hydraulic)	I.T.T. General Controls 801 Allen Avenue Glendale, California 91201 (213) 842-6131
Hoses, Fittings	Aeroquip Corporation Marmon Division 1214 Exposition Boulevard Los Angeles, California 90064 (213) 774-3230
Instruments	Aerosonic Corporation 1212 N. Hercules Avenue Clearwater, Florida 33515 (813) 461-3000
Landing Gear, Hydraulic Actuators, Hydraulic Pressure Regulator, Hydraulic Power Pack, Handpump	Ozone Aircraft Systems, Inc. 101-32 101st Street Ozone Park, New York 11416 (212) 845-5200
	Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Lighting, Tail Recognition	Devore Aviation Corporation 1-T Barstow Road Great Neck, New York 11021 (516) 487-3524
Lighting, Strobe	Whelen Engineering Company, Inc. 3 Winter Avenue Deep River, Connecticut 06417 (203) 526-9504

VENDOR-SUPPLIER INFORMATION (cont).

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	Woodward Governor Company Drake and Lemay Roads Fort Collins, Colorado 80521 (303) 482-5811
Starter-Generator	Auxilec, Incorporated One Willow Park Center Farmingdale, New York 11735 (516) 694-1441
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000
Tools, Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Voltage Regulators	Electro-Delta P.O. Box 898 Stockton, California 95201 (209) 462-8571
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

— NOTE —

Refer to Card 5, Grid No. 5F1 for Electrical Schematic Index

LIST OF CHARTS

LIST OF CHARTS (cont)

LIST OF CHARTS (cont)

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

33

LIGHTS

CHAPTER 33 - LIGHTS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 33 - LIGHTS (cont)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This Chapter provides instructions relating to maintenance of the lighting equipment used on the T-1040.

FLIGHT COMPARTMENT.

COCKPIT LIGHTING.

The lighting in the cockpit area of the T-1040 is controlled by several types of electrical power connections. The overhead map lights are controlled by on/off switches located on the forward part of the overhead panel. In the center of the overhead panel are the potentiometers for the panel lights. All cockpit lighting, except for radio lights, is protected by a single circuit breaker. The radio lights are protected by the radio accessories circuit breaker.

SOLID STATE DIMMER ASSEMBLY.

DESCRIPTION OF OPERATION.

The dimmer is controlled by a Bright/OFF/Dim switch located in the overhead switch panel. In the Bright mode, all panel lights are illuminated to full intensity. In the Dim mode, lighting intensity may be controlled by any of four potentiometers located in the center of the overhead switch panel. The potentiometers control the lighting for the various panel, avionics and placard lights in the aircraft. The Dimmer Control box serves as a release for excess heat generated when the lights are dimmed.

TROUBLESHOOTING. (Refer to Schematic Section - Chapter 91.)

The dimmer control box receives D.C. power via pins 10, 11, 12, and 13 at connector E412. All other pins distribute D.C. power to various lighting systems. Due to high current/power factor of combined lighting and dimming functions the unit dissipates large amounts of heat, thus, the many cooling fins are necessary.

— NOTE —

Pin -17 of connector E412 supplies 24 VDC to the (electro-luminescent) E.L. inverter, which in turn supplies 115v 400 cycle A.C. to the E.L. panels. (When measuring voltage in E.L. lighting system use the 300 V.A.C. scale of voltmeter!)

If only (1) filament type D.C. bulb is "OUT", substitute a new bulb first. If only one (1) E.L. panel is "OUT" check for 115v A.C. at E.L. panel plug-in point. To verify an E.L. panel is faulty, simply connect 110v 60 cycle bench power to E.L. panel connectors and check if panel glows. (If panel is faulty it must be replaced.)

Before troubleshooting wiring harness, first determine if offending lighting system is in E.L. lighting or in filament lighting system, or if trouble is common to both lighting systems.

Should a lighting problem be apparent in more than one light, make sure bright/dim switch is in "Bright" position. Left panel lighting originates at left main bus breaker, right panel lighting, placard lighting, and "Optional" avionic/radio lighting originate at right main bus breaker. Should a breaker not "hold" check connector E412 pins 10, 11, 12, or 13 at dimmer control box (mounted on electrical accessory shelf) at harness end for short to ground. If breaker "holds" and harness end shows bus voltage at pins 10, 11, 12, and 13, proceed to E412 dimmer control box connector and again check for shorts to ground via the dimmer control. If dimmer control is faulty it must be replaced, therefore, determine which lighting circuits do not light and run verification continuity/short tests at harness points, E412, and point to point if necessary, before replacing dimmer control.

If all E.L. lighting is inoperative, check 24 V.D.C. at junction point of RED wire on E.L inverter and dimmer control box located on the electrical accessory shelf for 12 V.D.C. If any E.L. lighting is operating the inverter can be considered good. In this case using the wiring harness schematic in Chapter 91 note the connection where the BLACK wire of the inverter branches to the left instrument panel and to additional branches of the right instrument panel, engine switch panel, overhead switch and meter panel, and right circuit breaker panel. Simply follow the A.C. voltage readings to the problem location.

Finally, should a lighting system exhibit flashing, this may be due to only a misadjustment of the dimmer control box. Should this condition occur or if the dimmer control box is replaced, refer to Adjustment of Dimmer Control Box.

REMOVAL OF DIMMER CONTROL BOX.

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 BOX.

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.

CHART 3301. LAMP REPLACEMENT GUIDE

LOCATION	PIPER PART NO.	LAMP NO.
Annunciator Panel Cap Assembly	29359	GE387
Baggage Light, Forward	472 057	GE313
Bolt Light, Instrument	472 028	GE327
Cabin Door Light, Aft	553 508	GE464
Doorstep Light	761 285	A322-28
Dome Light, Cabin	758 151	306
Floodlight, Tail	761 228	DA-27
Gear Down Light	472 028	GE327
Gear Unlocked Light	472 028	GE327
Gear Warning-Mute	472 028	GE327
Ground Recognition Beacon	758 418	AN3120-1047
Inspection Light, Wing	472 049	GE4593
Landing Light	472 769	GE4596
Map Light	472 052	GE304
Master Caution	472 028	GE327
Navigation Light, Tail	753 477	1683
Navigation Light, Wing Tip	753 478	A7512-24
Navigation Light, Tail Position, Wing Tip	761 208	A508
Reading Light	453 886	GE1309
Reading Light (11 Seat Configuration)	472 029	MAZDA 303
Recognition Light, Wing Tip	761 214	LP1982SP
Strobe Light, Wing Tip	762 003	A610
Surface Deice Indicator	472 061	801-103O-0334-504

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.

ADJUSTMENT OF DIMMER CONTROL BOX.

Four adjustment potentiometers are located under the Serial No./Nameplate of the Dimmer Control Box. (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) are 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.

ELECTRO-LUMINESCENT PANEL INVERTER.

REMOVAL.

The inverter is located on the electrical accessory shelf in the avionics bay.

1. Gain access to the electrical accessory shelf and disconnect the black and white inverter leads.
2. Remove the retaining screws and remove the inverter.

INSTALLATION.

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 +28V.D.C. essential power is applied from the left main bus via 5 amp circuit breaker, and alternate power +28V.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 +28V.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 +28V.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 CONTROLLER.

1. The controller is located aft of baggage compartment on the upper right side of the nose, accessible through the heater power pack access panel (Sta. 24.00 - 57.00)
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 CONTROLLER.

1. Position annunciator and secure with appropriate screws.
2. Reconnect electrical connectors, and secure connect springs with plastic straps.
3. Reconnect battery.
3. Replace access panel and secure.

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.

ANNUNCIATOR PANEL (OIL TEMPERATURE INDICATOR) ADJUSTMENT PROCEDURE.

These adjustments apply to the oil temperature lights only. The adjustment screws are located on the annunciator controller which is mounted on the right upper fuselage between Sta. 35.00 and Sta. 45.00. They are labeled: left oil temperature and right oil temperature. Adjustments will require two people, one in the airplane and one up front at the controller.

1. Remove upper and lower cowlings from both engines.
2. The oil temperature probes are located on the lower aft, right side of both left and right engines.
3. Locate and remove electrical connectors E116, from the left oil temperature probe, and E217, from the right oil temperature probe.
4. Place a resistive load of 128 ohms across pin A and B of electrical harness connectors E116 and E217. Use a locally fabricated test box (See Schematic, Oil Temperature; Right and Left).
5. Ascertain the left fuel flow, left oil temperature, right fuel flow, right oil temperature and the panel circuit breakers are pushed into their ON position.
6. Place the radio master switch to the OFF position.
7. Gain access to the adjusting screws. Gain access to the controller by removing the access panel between Sta. 24.00 and 57.00 on the right side of the airplane.
8. Apply power to the annunciator panel by placing the master switch in the ON position. Observe the needle on both the left and right oil temperature gauges, it should be deflected to the red line near the 100°C position on the gauge.

— NOTE —

The master caution button must be depressed to cutout a time delay circuit (3-5 seconds) before any adjustments are made.

9. With a small slot head screwdriver, adjust the left channel by turning the left oil temperature adjusting screw clockwise to illuminate the left oil temperature annunciator light. Then turn the adjusting screw counterclockwise slowly until the left oil temperature annunciator light extinguishes. Repeat the first step by turning the adjustment screw clockwise very slowly to illuminate the left oil temperature annunciator.
10. Adjust the right channel in the same manner as the left channel in step 9.

— NOTE —

In order to properly calibrate both channels, it may be necessary to reaccomplish steps 9 and 10 several times to achieve simultaneous activation of the oil temperature lights. Place protective covers over adjustment pots when adjustments are complete.

11. Upon completion of adjustment procedure, decrease the resistive load on the left oil temperature probe harness connector E116 by 3 ohms by pressing the switch on the test box. The left oil temperature annunciator panel light should extinguish. Repeat the same change in resistive load for the right oil temperature probe harness connector E217 and the right oil temperature annunciator light should extinguish.
12. Place the aircraft master switch in the OFF position and remove the resistive load from both the left and right oil temperature probe electrical harness connectors.
13. Connect electrical connector E116 to the left oil temperature probe and electrical connector E217 to the right oil temperature probe.
14. Install and secure the access panel between Sta. 24.00 and 57.00, on later models.
15. Install the left and right engine cowlings and secure.

REPLACEMENT OF TRIM INDICATOR LIGHTS.

The trim indicator lights are located in the control pedestal, between the indicator units. The light bulbs may be replaced by first removing the aileron trim control knob by pushing out the roll pin that secures the knob. Then remove the trim panel from the face of the pedestal by removing panel attachment screws. Each bulb is rotated from its socket. Replace bulbs and attachments in reverse order of removal.

PASSENGER COMPARTMENT.

SPEAKER PANEL DOME LIGHTS.

REMOVAL.

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.

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 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 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 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 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 BELT ANNUNCIATOR.

LAMP REPLACEMENT.

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.
3. Replace legend plate in reverse manner of removal.

NO SMOKING, FASTEN SEAT BELT ANNUNCIATOR CHIMES.

The chimes assembly gives audible tone to draw attention to the annunciator display lights.

REMOVAL OF THE (OPTIONAL) CHIMES ASSEMBLY.

1. The chimes assembly is located on the electrical accessory shelf, accessable through the avionics bay panel on the left side of the aircraft. Refer to Chapter 39 for location of electrical accessory shelf.
2. With power "OFF", unplug connector E410, and loosen four (4) mounting screws.

INSTALLATION OF THE (OPTIONAL) CHIMES ASSEMBLY.

1. Position chimes assembly on shelf mount, secure with appropriate screws and reconnect electrical connector.
2. Replace access panel, turn power ON and run an operational check of the system.

CARGO AND SERVICE COMPARTMENTS.

CARGO POD INTERNAL LIGHT.

The (optional) cargo pod has an internal light attached to the inside of the pod between the two door assemblies.

REMOVAL OF THE CARGO POD INTERNAL LIGHT.

1. Remove the screw that secures the lens to the light base assembly.
2. Remove the lens and gasket.
3. The bulb (A708-50/28) may now be removed.
4. Remove the two screws that secure the light base assembly to the side of the cargo pod.
5. Disconnect the electrical leads to the light and remove the base assembly and gasket.

INSTALLATION OF CARGO POD INTERNAL LIGHT.

1. Connect the electrical leads to the light and secure the light base and inner gasket to the side of the cargo pod with the previously remove screws.
2. Reinstall the bulb.
3. Reinstall the gasket and lens to the light base with the two previously removed screws.

EXTERIOR.

LANDING LIGHT.

REMOVAL OF LANDING LIGHT. (Refer to Figure 33-1.)

1. To remove either lamp from the landing light mounting plate, remove the screws from the front of the lamp attachment plate and then remove the attachment plate from the lamp mounting plate. When removing the attachment plate, use caution not to drop the lamps. Disconnect the electrical leads from the desired lamps.
2. To remove the lamp light assembly from the gear strut, disconnect the electrical leads from the lamps and release the clamps that secure the assembly to the strut housing.

THIS SPACE INTENTIONALLY LEFT BLANK

INSTALLATION OF LANDING LIGHT.

1. To install the landing light lamps, attach the electrical leads to the lamp(s) and place against the mounting pad. Position the attachment plate and secure with screws only tight enough to allow the lamps to fit snug in the mount.
2. To install the landing light assembly, position the assembly against the strut housing with the bottom of the mounting bracket 5.63 inches up from the bottom of the housing. (Refer to Figure 33-1.) Align the bracket longitudinally and secure with clamps. The light beam angle may be adjusted by the adjustment screws at the side of the bracket and tilting as desired.

WING STROBE AND POSITION LIGHTS.

The wing strobe and position lights are located in the same unit. This assembly consists of a red or green position light on the front of the assembly and a white light on the aft side. The strobe light is located in the middle of the assembly. The position and strobe lights are controlled by a separate switch located on the overhead panel. There is a separate power supply for each wing strobe light assembly and circuit breakers provide overload protection. Should service be required on the units, refer to the appropriate removal and installation in the following paragraphs.

REMOVAL OF WING STROBE AND POSITION LIGHT ASSEMBLY.

— CAUTION —

Be careful when removing the lens retainer screws, the retainer holds three lens. Take care not to drop lens.

1. Remove the screws securing the lens retainer and remove the lens for lamp replacement.
2. Remove the three screws mounting the light assembly to wing tip.
3. Disconnect the two and three pin connector to remove assembly.

INSTALLATION OF WING STROBE AND POSITION LIGHT ASSEMBLY.

1. Reconnect the two and three pin connector.
2. Position light assembly on the wing tip and secure light assembly with the appropriate screws.
3. Replace the lens and lens retainer and secure with appropriate screws.

REMOVAL OF WING TIP STROBE POWER SUPPLY.

The wing tip strobe power supplies (L or R) are located just inside the outboard wing rib.

1. Remove the access panel on the bottom of the wing just inside wing sta. 239.00.
2. The power supply (L or R) is located inside the outboard wing rib. Disconnect the two electrical plugs.
3. Remove the screws mounting the power supply to the wing. Remove power supply.

INSTALLATION OF WING TIP STROBE POWER SUPPLY.

1. Position the power supply in place and secure with the appropriate screws.
2. Connect the two electrical plugs.
3. Install the access panel on the bottom of the wing inside wing sta. 239.00.

TROUBLESHOOTING.

The strobe light assembly functions as a condenser discharge system. A condenser in the power supply is charged to approximately 450 volts DC; then discharged across the xenon flash tube at intervals of approximately 50 flashes per minute. The condenser is parallel across the xenon flash tube which is designed to hold off the 450 volts DC applied until the flash tube is triggered by an external pulse. This pulse is generated by a solid state timing circuit in the power supply.

When troubleshooting the strobe light system, it must first be determined whether the trouble is in the flash tube or the power supply. Replacement of the flash tube will confirm whether tube is defective. A normal operating power supply will emit an audible tone of 1 to 1.5 KHz. If there is no sound emitted, check the system according to the following instructions. When troubleshooting the system, utilize the appropriate electrical schematic in this manual.

1. Ascertain the input voltage at the power supply is 28 volts.

— CAUTION —

When disconnecting and connecting power supply input connections, do not get the connection reversed. Reversed polarity of the input voltage for just an instant will permanently damage the power supply. The reversed polarity destroys a protective diode in the power supply, causing self-destruction from overheating of the power supply. This damage is sometimes not immediately apparent, but will cause failure of the system in time.

— CAUTION —

When disconnecting the power supply, allow five minutes of bleed down time before handling the unit.

2. Check for malfunction in interconnecting cables.
   A. Ascertain pins 1 and 3 of interconnecting cable are not reversed.
   B. Using an ohmmeter, check continuity between pins 1 and 3 of interconnecting cable. If a reading is obtained on the meter, the cable is shorted and should be replaced.

— NOTE —

A fault of the type described in Steps A and B will not cause damage to the power supply, but the system will be inoperative if such a short exists. Avoid any connection between pins 1 and 2 of interconnecting cable as this will discharge the condenser in the power supply and destroy the trigger circuit.

3. Check interconnecting cables for shorts.
   A. Disconnect the output cables from the power supply outlets.
   B. The following continuity checks can be made with an ohmmeter.
   C. Check for continuity between the connectors of each interconnecting cable by checking from pin 1 to pin 1, pin 2 to pin 2 and pin 3 to pin 3. When making these checks, if no continuity exists the cable is broken and should be replaced.
   D. Check continuity between pins 1 and 2, 1 and 3 and 2 and 3 of the interconnecting cable. If continuity exists between any of these connections, the cable is shorted and should be replaced.
4. Check tube socket assembly for shorts and opens.
   A. Disconnect the tube socket assembly of strobe light from the interconnecting cable.
   B. The following continuity checks can be made with an ohmmeter.
   C. Check for continuity between pin 1 of AMP connector to pin 1 of tube socket, pin 2 of AMP connector to pin 6 and 7 of tube socket and pin 3 of AMP connector to pin 4 of tube socket. When making these tests, if no continuity exists the tube socket assembly is broken and should be replaced.
   D. Check for continuity between pin 1 of AMP connector to pins 4, 6 and 7 of the tube socket and pin 2 of AMP connector to pins 1 and 4 of the tube socket. If continuity exists the tube socket assembly is shorted and should be replaced.

REMOVAL AND INSTALLATION OF WING TIP RECOGNITION LIGHT.

1. Remove the screws securing the light assembly to the wing tip.
2. Remove the cone out enough to disconnect the electrical wiring to the light.
3. Remove the attaching hardware that secures the light in position.
4. Replace light.
5. Installation is the reverse of removal.

REMOVAL AND INSTALLATION OF TIP TANK RECOGNITION LIGHT.

1. Remove the screws securing the light assembly to the wing tip tank.
2. Pull the cone out enough to disconnect the electrical wiring to the light.
3. Remove the attaching hardware that secures the light in position.
4. Replace light and install in reverse order of removal instructions.

TAIL NAVIGATION LIGHT.

REMOVAL OF TAIL NAVIGATION LIGHT.

The tail position light is located on the tip of the tail.

1. Remove the screws securing the lens retainer and remove the lens retainer.
2. Remove the bulb and lens.

INSTALLATION OF TAIL NAVIGATION LIGHT.

1. Install the bulb and lens.
2. Replace the lens retainer and secure with 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.

SERVICING.

The only service required of this unit is the replacement of a burned out lamp with a new lamp P/N 4593.

REMOVAL.

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.

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.

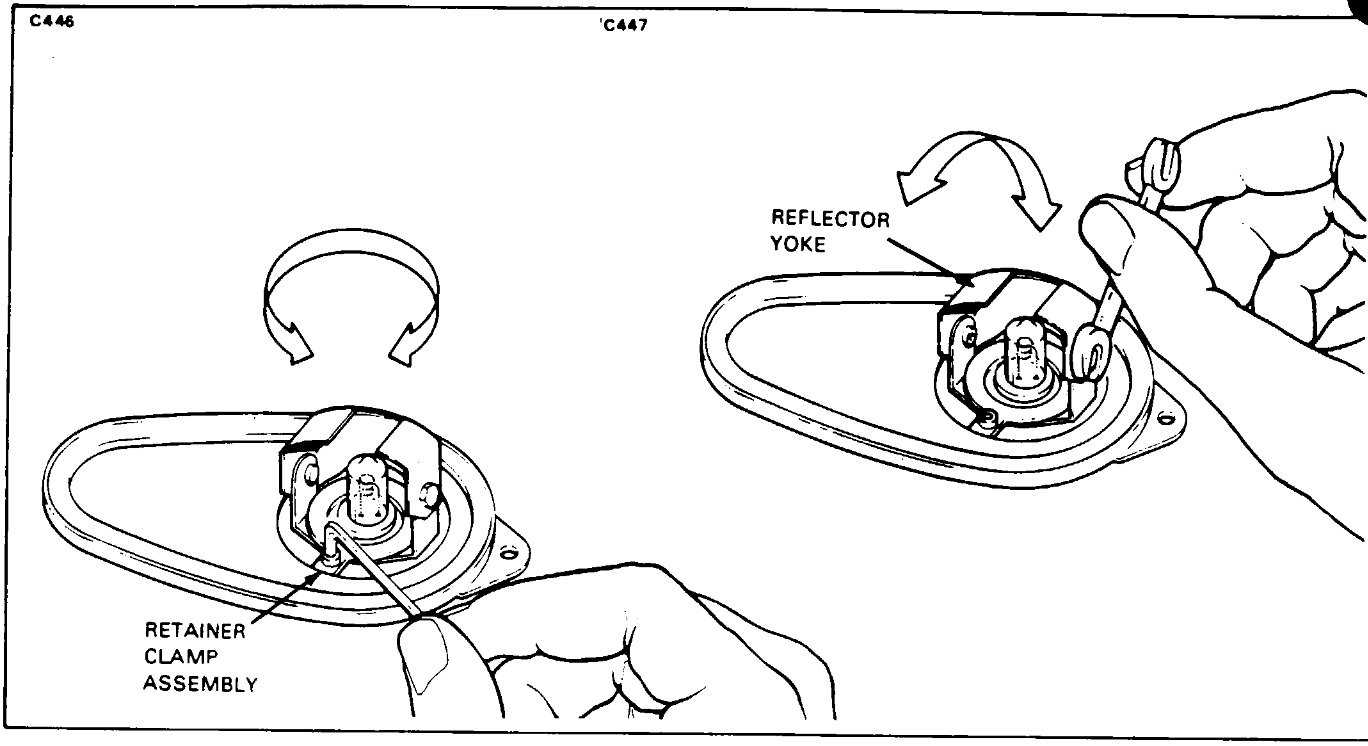


Figure 33-1. Logo Light Assembly Adjustments

LOGO LIGHTS.

The logo lights are located on the upper surface of the left and right stabilizer for vertical tail illumination. The circuit consist of two 75 watt light assemblies, protected by a 7½ amp circuit breaker and controlled by a switch mounted on the overhead switch panel.

— NOTES —

1. ***Handling lamp with bare finger will deposit skin oil on lamp. Remove before illumination of lamp, by cleaning lamp with a grease-free solvent such as acetone.***
2. ***Prior to checking lamp, place lens cover over light assembly for eye protection.***
3. ***When adjusting light assembly turn lamp switch off, allow time for cooling, reflector and lamp become extremely hot.***

LOGO LAMP REPLACEMENT.

1. Remove lens screw and lens cover.
2. Remove bulb.
3. Install new bulb, place lens cover over light assembly, apply electrical power and turn on logo light switch and check for proper illumination of lamp.
4. Place logo light switch in off position, secure electrical power to aircraft, and secure lens cover with appropriate screw.

LOGO LIGHTS ADJUSTMENT. (Refer to Figure 33-1.)

The logo lights are adjustable horizontally and vertically to illuminate the vertical tail section of aircraft.

1. Remove cover lens screw and lens.
2. Loosen locking clamp retainer screws to rotate reflector forward or aft as required.
3. Loosen the reflector screws on yoke assembly to adjust up and down as required.
4. Place lens cover over light assembly, apply power to aircraft and turn on logo light switch. Proper adjustment is even light coverage of vertical tail section.
5. Place logo light switch in off, prior to securing light assembly, or readjusting light asembly.
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.

CARGO POD RAMP LIGHT.

The optional cargo pod ramp light assembly is installed in the left wing root fairing. The light is controlled by a switch near the cabin door or by a switch on the overhead panel.

REMOVAL OF CARGO POD RAMP LIGHT.

1. Remove the screw that secures the lens to the light base assembly.
2. Remove the lens and gasket.
3. The bulb (A708-50/28) may now be removed.
4. Remove the two screws that secure the light base assembly to the plate on the wing root fairing.
5. Disconnect the electrical lead to the light and remove the base assembly and inner gasket.

INSTALLATION OF CARGO POD RAMP LIGHT.

1. Connect the electrical lead to the light and secure the light base and inner gasket to the plate on the wing root fairing.
2. Reinstall the bulb.
3. Reinstall the gasket and lens to the light base with the two previously removed screws.

— END —

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

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 T-1040.

DESCRIPTION.

The instrument air system consists of a pitot air system and a static air system. Refer to Figure 34-1 for system layout.

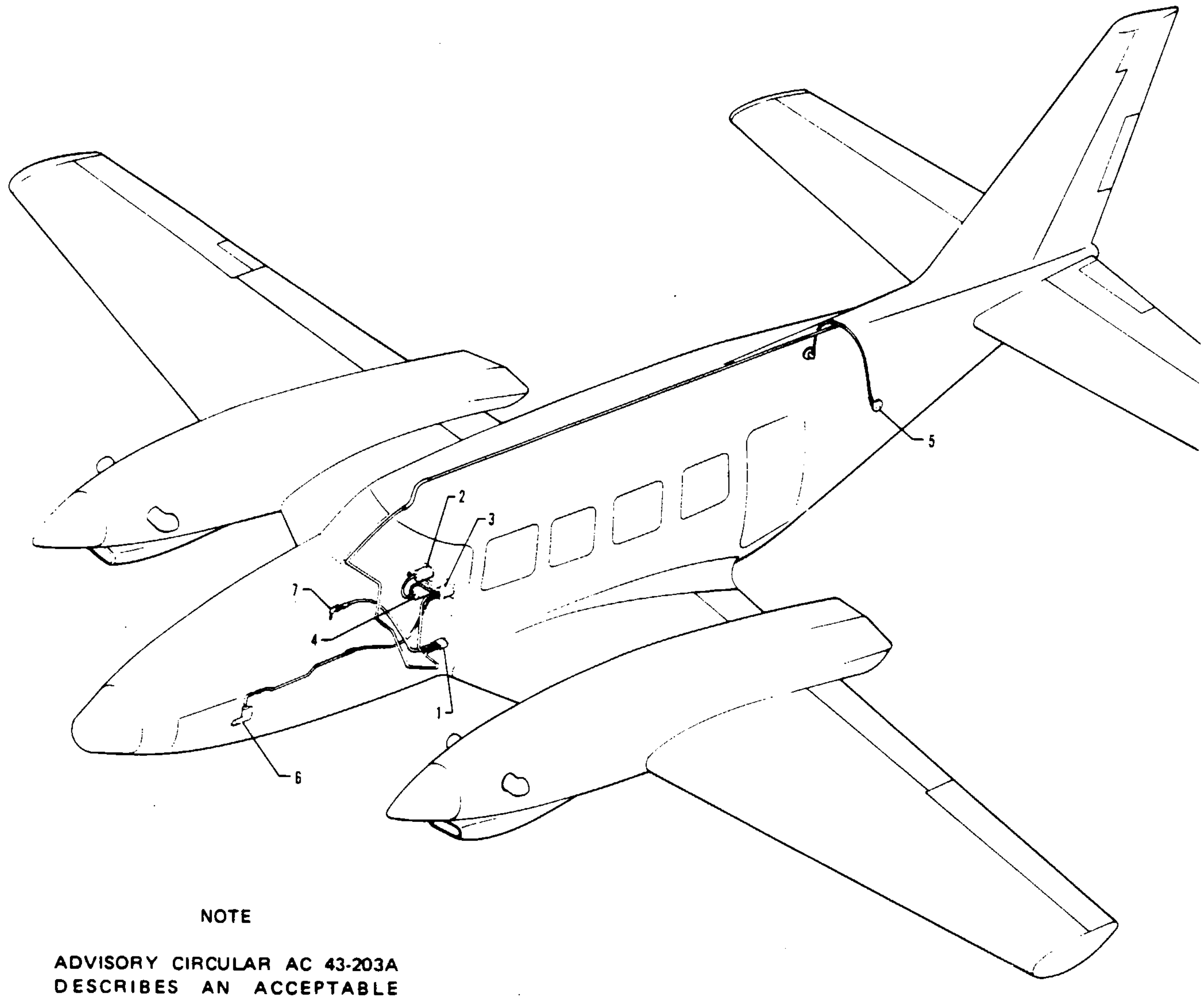
Pitot air system consists of a pitot mast located on the bottom side of the nose section, with its related plumbing. Impact air pressure entering the pitot head is transmitted through the pitot plumbing to the airspeed indicator on the instrument panel.

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 along the top of the fuselage and down the windshield center post to the back of the instrument panel, where it is connected to the airspeed indicator, altimeter and rate of climb indicator. An alternate static air source is located in the lower portion of the instrument panel in front of the pilot. This alternate static source is part of the standard system and has a shutoff valve which closes the port when it is not needed.

TROUBLESHOOTING.

For troubleshooting of the various instruments, refer to the Chart with each particular instrument.

THIS SPACE INTENTIONALLY LEFT BLANK



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 SELECTOR VALVE
2. ALTIMETER
3. AIRSPEED INDICATOR
4. RATE OF CLIMB INDICATOR
5. STATIC SOURCE FOR PILOT'S AND OPTIONAL COPILOT'S STATIC INSTRUMENTS
6. PITOT HEAD
7. ALTERNATE STATIC SOURCE

Figure 34-1. Instrument Air System Installation (Typical)

INSPECTION AND CHECKS OF INSTRUMENTS AND SYSTEM.

During the regular inspection of the airplane or whenever an instrument or instruments is changed or serviced, the following inspection and checks should be made to the complete system:

1. Inspect the pitot - static system for cleanliness, condition, security and operation per Advisory Circular No. AC43.203A for aircraft operated in controlled airspace under IFR conditions. Aircraft not operated in controlled airspace should be tested per Advisory Circular AC43.13-1A, Section 4 of Chapter 16.
2. Inspect the instruments for poor condition, mounting, markings, broken or loose and/or missing 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 and indicating lights and test circuits are operable.
5. Note operation of instruments during engine runup. Check for intermittent or improper operation of any instrument.
6. Inspect the complete system for general condition, apparent and obvious defects, insecurity of attachments, tubing connections and pneumatic tubing for security, leaks, corrosion, cracks, bends, 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. Leaking static system.	Replace instrument. Find leak and correct.

CHART 3403. TROUBLESHOOTING (AIRSPEED TUBES AND INDICATOR) (cont.)

Trouble	Cause	Remedy
Instrument reads low.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
	Pitot-Static head not aligned correctly.	Realign pitot-static head.
Airspeed changes as aircraft is banked.	Water in static line.	Remove lines from static instruments and blow out lines from cockpit to pitot-static head.
Tube does not heat or clear itself of ice with switch "ON."	Circuit breaker popped.	Reset.
	Open circuit.	Repair.
	Excessive voltage drop between battery and pitot head.	Check voltage at pitot head.
	Heating element burned out.	Replace pitot head.

NOTE

When any connections in static system are opened for checking, system must be checked per FAR 23.1325.

ATTITUDE AND DIRECTION.

MAGNETIC COMPASS.

The magnetic compass is a self-contained instrument. This instrument has an individual light which is connected to the instrument lighting circuit. The compass correction card is located in the card holder mounted on the instrument. The compass should be swung whenever instruments or radios are changed and at least once a year.

CHART 3404. TROUBLESHOOTING (MAGNETIC COMPASS)

Trouble	Cause	Remedy
Excessive card error.	Compass not properly compensated.	Compensate instrument.
	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Improper mounting on instrument panel.	Align instrument.
	Insufficient liquid.	Replace or repair instrument.
Card sluggish.	Weak card magnet.	Replace or repair instrument.
	Instrument too heavily compensated.	Remove excess compensation.
	Excessive pivot friction or broken jewel.	Replace or repair instrument.
Liquid leakage.	Loose bezel screws.	Replace or repair instrument.
	Broken cover glass.	Replace or repair instrument.
	Defective sealing gaskets.	Replace or repair instrument.
Discolored markings.	Age.	Replace or repair instrument.
Defective light.	Burned out lamp or broken circuit.	Check lamp or continuity of wiring.
Card sticks.	Altitude compensating diaphragm collapsed.	Replace or repair instrument.
Card does not move when compensating screws are turned.	The gears that turn compensating magnets may be stripped.	Replace or repair instrument.
Compass swings erratically when radio transmitter is keyed.	Normal.	

DIRECTIONAL GYRO-AIR DRIVEN/ELECTRIC.

Both air and electric Directional Gyros are used, depending on the option package installed. Both types are displacement type gyros with "FREE" rotors mounted in Gimbal Assemblies. It is important that if a Magnetic Slaving System, Flight Director, or AutoPilot is coupled to the D.G., the A.F.C.S. manufacturer's Service Manual should be consulted.

AIR DRIVEN DIRECTIONAL GYRO.

The air driven D.G. is driven by the pneumatic system, which is supplied by engine driven dry-pneumatic pumps either on pressure or vacuum, or from cooled and regulated bleed air on Turbine engine installations. It is of prime importance to realize that air VOLUME, and not air pressure, spins the gyro rotor. The air filter can become contaminated and restrict airflow, reducing gyro rotor speed, while the pressure regulator will automatically adjust air pressure within proper limits.

— *NOTE* —

The gyro air filter must be clean or replaced, before adjusting gyro air pressure.

Airflow directed at the gyro rotor vanes, causes the rotor to spin approximately 17,000 to 22,000 R.P.M., thus, providing the gyroscopic ability to remain rigid in space. The instrument case moves freely about the spinning gyro rotor in three dimensions by the use of a gimbal assembly, and the displacement or azimuth readings are presented on the instrument face. This results in a positive and stable presentation.

Since the D.G. has no reference to Magnetic North, it must be set from the Magnetic Compass. The D.G. will agree only with the Magnetic Heading from which it was set, since all other subsequent Magnetic Compass Headings are subject to deviation, Northerly Turning, acceleration, deceleration, dip and other errors. Due to precession, inherent or apparent, the D.G. must be caged at least every 15 minutes while in a level attitude, even though drift may not appear, to ensure rotor position is correct in relation to Earth's surface.

ELECTRICALLY DRIVEN DIRECTIONAL GYRO.

These gyros contain rotors which are electrically driven, with the gyro rotor acting as the armature of an electric motor. To eleminate the friction of brush assemblies, which would induce abnormal precession, the rotor armature is inductively excited. The electric D.G. is subject to the same operational requirements of the air driven D.G., except for the method of obtaining rotor rotation and the design of the erection Mechanism.

TROUBLESHOOTING.

Unless an obvious malfunction of the instrument (such as constantly spinning dial) requires repair or replacement of the Directional Gyro, service is restricted to the instrument installation and power (air electric) requirements. Typical installation examples of gyro instrument malfunctions are due to installation system problems such as: restricted airflow due to air line kinks or leaks, contaminated air filters, deteriorating electrical grounds, sagging instrument panel shock mounts, system regulators, faulty vacuum pressure gauges, etc. (Air pressure must be 5.5 plus or minus .5 P.S.I.G.) Excessive precession is a common complaint and usually results from installation problems such as described above, or can be the result of Pilot operating error.

While D.G. precession can only be exactly measured under closely controlled conditions in an approved gyro overhaul facility, any complaint of abnormal precession should be initially confirmed on the Compass Rose. (Normal precession of the D.G. is plus or minus 3° in 10 minutes or plus or minus 4° in 10 minutes if (4) four Cardinal Headings are used and the total precession does not exceed 12°.)

When confirming precession complaints on the Compass Rose, aircraft position must be established by nose wheel alignment with the Compass Rose lines. Under no conditions should the Magnetic Compass be used for comparison, otherwise, the deviation of the Magnetic Compass Heading can be read mistakenly as precession. Finally, only after abnormal precession has been confirmed and the system installation proven good, should the instrument be "pulled" for replacement or repair.

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.

ATTITUDE HORIZON.

Both air and electric Attitude Horizons are used, depending on the option package installed. Both types are displacement type gyros with "FREE" rotors mounted in Gimbal Assemblies. It is important to consult the A.F.C.S. Manufacturer's Service Manual if a Flight Director, or AutoPilot is coupled to the Attitude Horizon.

AIR DRIVEN ATTITUDE HORIZON.

The air driven Attitude Horizon is driven by the pneumatic system, which is supplied by engine driven dry pneumatic pumps either on pressure or vacuum, or from cooled and regulated bleed air on Turbine engine installations. It is of prime importance to realize that air VOLUME, and not air pressure, spins the gyro rotor. The air filter can become contaminated and restrict air flow, reducing gyro rotor speed, while the pressure regulator will automatically adjust air pressure within proper limits.

— NOTE —

The gyro air filter must be clean or replaced, before adjusting gyro filter air pressure.

Airflow directed at the gyro buckets, causes the rotor to spin approximately 17,000 to 22,000 RPM, thus, producing the gyroscopic ability to remain rigid in the space. The instrument case move freely about the spinning gyro rotor in three dimensions by the use of a gimbal assembly. The resulting displacement in both pitch and roll is mechanically displayed on the instrument face, providing an artificial horizon reference which portrays airframe attitude at any given moment. The display is stable and shows minute attitude changes of only 1°. Unlike the directional gyro, the erection mechanism activity can be seen by a rapidly wobbling and leveling horizon bar, when power is first applied. The instrument can be adjusted for parralex through a knob on the instrument face, this knob when held to the "IN" position engages forks which cage the gyro rotor.

ELECTRICALLY DRIVEN ATTITUDE HORIZON.

These gyros contain rotors which are electrically driven, with the gyro rotor acting as the armature of an induction motor. Brush assemblies are not used since the friction would result in abnormal precession, the rotor armature is inductively excited. The electric A.H. is subject to the same operational requirements of the air driven A.H., except for the method of obtaining rotor rotation and the design of the erection mechanism.

Unlike the D.G., the A.H. has no attitude limits. If, however, pitch reaches 90° the "polar effect" is reached and the Horizon Bar Display will rotate 180° to an inverted position and will again rotate 180° when the aircraft is again right side up. The modern-day A.H. will not be damaged by such an extreme attitude and will correct itself in short time. There are no roll limitations to the present A.H. Another important, but not widely understood, operating limitation of air driven instruments is erection of the Horizon Bar from a full stop, and from a residual running condition. This can lead to wasted service time, and invalid operating complaints. When the gyro rotor is at rest and power is applied, the erection mechanism exerts maximum authority and rapid and noticeable erection results. However, if power is removed from the spinning rotor (engine shut down while briefly discharging passengers) the gyro rotor continues to rotate at high speed, but the erection mechanism is not functional. When power is again applied to the air driven A.H., the erection mechanism again begins to function, but due to the gyro ridigity-because of high rotor speed, erection of the instrument is considerably longer than normal. In flight the air-driven A.H. exhibits small errors at roll out after a coordinated turns, skids, and small pitch changes after acceleration and deceleration. The electric A.H. exhibits small errors in pitch and roll after roll out from a coordinated turn, and also small pitch changes after acceleration or deceleration. In both cases the erecting mechanisms quickly return the gyro to its proper position. The electric A.H. is considered generally more efficient in operation and less subject to error than the air driven A.H.

TROUBLESHOOTING.

Unless an obvious malfunction (such as inability to erect, spinning, or great horizon bar displacement - none of which can be corrected by manually caging the instrument) requires repair or replacement of the instrument, service is restricted to the instrument installation and power source. Typical installation examples of A.H. malfunctions are due to such problems as: restricted air flow due to air line kinks or leaks, contaminated air filters, deteriorating electrical grounds, sagging instrument panel shock mounts, system regulators, faulty vacuum pressure gauges. (Air pressure must be 5.5 plus or minus .5 P.S.I.G.) only after the system has proven to be good, should the instrument be "pulled" for replacement or repair.

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.

CHART 3406. TROUBLESHOOTING (GYRO HORIZON INDICATOR) (cont.)

Trouble	Cause	Remedy
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.	
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.	

TURN AND BANK/PICTORIAL RATE INSTRUMENTS.

Unlike the familiar "FREE" gyro rotor found in the Directional and Attitude gyros both the Turn and Bank, and Pictorial Rate Indicator have captive gyro rotors, the axis of which are attached to the instrument housings. Since the spinning gyro rotors are literally forced to follow airframe movement, the gyro resists changing position by exerting precession forces created by the spinning gyro. The greater the RATE OF CHANGE, the greater the precession forces; thus, the Turn and Bank and the Pictorial Rate Indicator ONLY MEASURE MOVEMENT - NOT POSITION OR DISPLACEMENT. The gyro rotor forces of the Turn and Bank are presented on the instrument face by a vertical turn needle, and on the Pictorial Rate Indicator by a pictorial artificial horizon. Although the visual displays are different, the gyro rotor rate detection designs are the same. The gyro rotor is mounted at a 60° angle to detect both YAW and ROLL MOTION, but the 60° tilt favors the YAW AXIS. Due to the great sensitivity of the rate-gyro, the turn needle artificial horizon displays are mechanically damped to slow or average minute yaw and forces to the human operators ability to interpret and respond to the displays. The "BALL" portion of both instruments is free to roll within the inclined glass tube display on lower instrument face. The glass tube is filled with non-freezing liquid to dampen the movements of the ball within the tube. It must be realized the "BALL" portion of both instruments ONLY INDICATE SIDE FORCES. The Turn and Bank rotor is driven either electrically or by air, while the Pictorial Rate Instrument is electrically driven.

TROUBLESHOOTING.

An obvious malfunction of either instrument requires repair by an F.A.A. approved instrument repair facility, or replacement. Service is restricted to the instrument installation and air electric power requirements.

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.
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.

CHART 3407. TROUBLESHOOTING (GYRO HORIZON INDICATOR) (cont.)

Trouble	Cause	Remedy
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.
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.

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).

— END —

CHAPTER

35

OXYGEN

CHAPTER 35 - OXYGEN

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter provides supplemental information for servicing oxygen system of the T-1040.

DESCRIPTION AND OPERATION.

The oxygen system consists of a storage cylinder, filler valve, dump outlet, regulator assembly, mask outlet ports and masks, distribution lines, pressure gauge and an ON/OFF control.

The storage cylinder is filled through the filler valve and supplies high pressure oxygen to the regulator assembly. The cylinder contains a valve assembly with a safety outlet which will vent the oxygen overboard through the dump outlet in the event of system over-pressurization.

High pressure oxygen is routed from the regulator to the pressure gauge while low pressure oxygen is routed from the regulator to the outlets and masks whenever the control knob is pulled to the ON position. Each outlet has a spring loaded valve which prevents the flow of oxygen until a mask hose is engaged in the outlet.

— CAUTION —

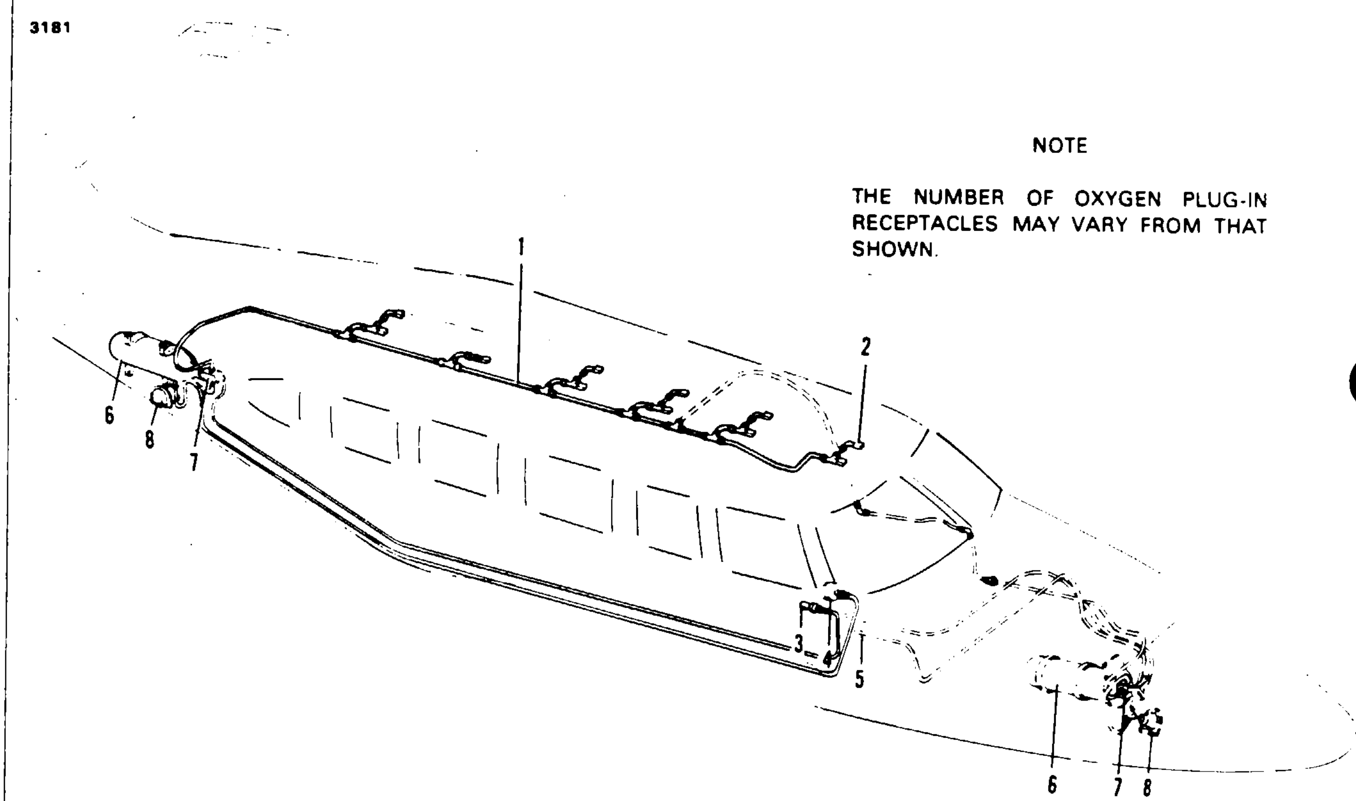
Only specially dried, Aviator's Breathing Oxygen conforming to MIL-O-27210, Type 1 is authorized for use in the oxygen system.

TROUBLESHOOTING.

Chart 3501 lists the troubles which may be encountered along with their probable cause and suggested remedy.

THIS SPACE INTENTIONALLY LEFT BLANK

3181



1. LOW PRESSURE LINE
2. OXYGEN PLUG-IN RECEPTACLES
3. OXYEN FLOW CONTROL KNOB
4. OXYGEN SUPPLY PRESSURE GAUGE
5. HIGH PRESSURE LINE
6. OXYGEN CYLINDER
7. PRESSURE REGULATOR
8. FILLER VALVE

81897.E

Figure 35-1. Oxygen System Installation

CHART 3501. TROUBLESHOOTING (OXYGEN SYSTEM)

Trouble	Cause	Remedy
Pressure indication normal but no oxygen flowing.	Oxygen cylinder regulator assembly defective.	Replace regulator assembly.
	Line obstruction.	Clean and purge lines.
No indication of pressure on pressure gauge.	Oxygen cylinder valve closed.	Open valve.
	Pressure gauge defective.	Replace gauge.
	Safety disc ruptured, cylinder empty.	Replace cylinder and visual indicating disc.
Oxygen cylinder will not retain pressure.	Leak in system.	Locate and repair leak.
Offensive odors in oxygen.	Cylinder pressure below 50 psi. Foreign matter has entered the system during previous servicing.	Purge the oxygen system.

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 cylinder for the ICC identification number and for the date of the last FAA inspection and test.
3. If cylinder is completely empty it must be completely disassembled and inspected in an FAA approved facility before recharging.
4. Any lines that are defective should be replaced with factory replacements.
5. Clean all lines and fittings in accordance with Spec. MIL-I-5585A, PAR 3.11. Refer to Cleaning Oxygen System Components.
6. Ribbon Dope Thread Sealant (Performance 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.	6 Yrs.
Pressure Gauge	300 Flight Hrs.	Replace on Condition
High Pressure Lines	300 Flight Hrs.	
Low Pressure Lines	300 Flight Hrs.	
Outlets (Cabin)	300 Flight Hrs.	Replace Every 6 Yrs.
External Recharge Valve	Each Use	Replace Every 6 Yrs.
Masks	Each Use	Replace as Necessary

CLEANING OXYGEN SYSTEM COMPONENTS.

Clean metal oxygen system components using one of the following methods:

— *WARNING* —

Use cleaning solvent only in a well-ventilated area, away from open flame or high temperatures. Avoid prolonged or repeated skin contact and inhalation of toxic vapors. Do not smoke in presence of solvent fumes.

— *CAUTION* —

Most air compressors are oil lubricated and a minimum amount of oil may be carried by the air stream. A water lubricated compressor should be used to blow tubing clean only when nitrogen is not available. The air must be clean, dry and filtered.

1. Vapor degrease using Trichloroethylene conforming to MIL-I-5585A, PAR 3.11 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 (Performance 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 aft mounted cylinder is located on the upper right side of the fuselage aft of the rear baggage compartment. Remove the screws securing the rear panel in the aft baggage compartment and remove panel to gain access to the regulator and oxygen cylinder.

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. The cylinder can be removed by first sliding it back to remove the retaining cable (on aft mounted cylinder only).
5. Remove the cylinder from the airplane using caution not to bump the neck of the cylinder and regulator.

— CAUTION —

The cylinder must be completely discharged of all pressure prior to removing the regulator.

INSTALLATION OF OXYGEN CYLINDER AND REGULATOR.

1. With the regulator attached to the cylinder, place the cylinder in the mounting brackets with the regulator forward. Be careful not to bump the regulator and cylinder during installation.
2. Install the retaining cable (on aft cylinder only) around cylinder neck and position cylinder so the control on the regulator aligns with the control cable.
3. Secure the cylinder in place by connecting and tightening the mounting bracket assembly clamps.
4. Connect the pressure lines and control cable to the regulator.
5. Install aft panel rear baggage compartment and secure with appropriate screws (for aft cylinder); replace the floor and access panels (for forward mounted cylinder).

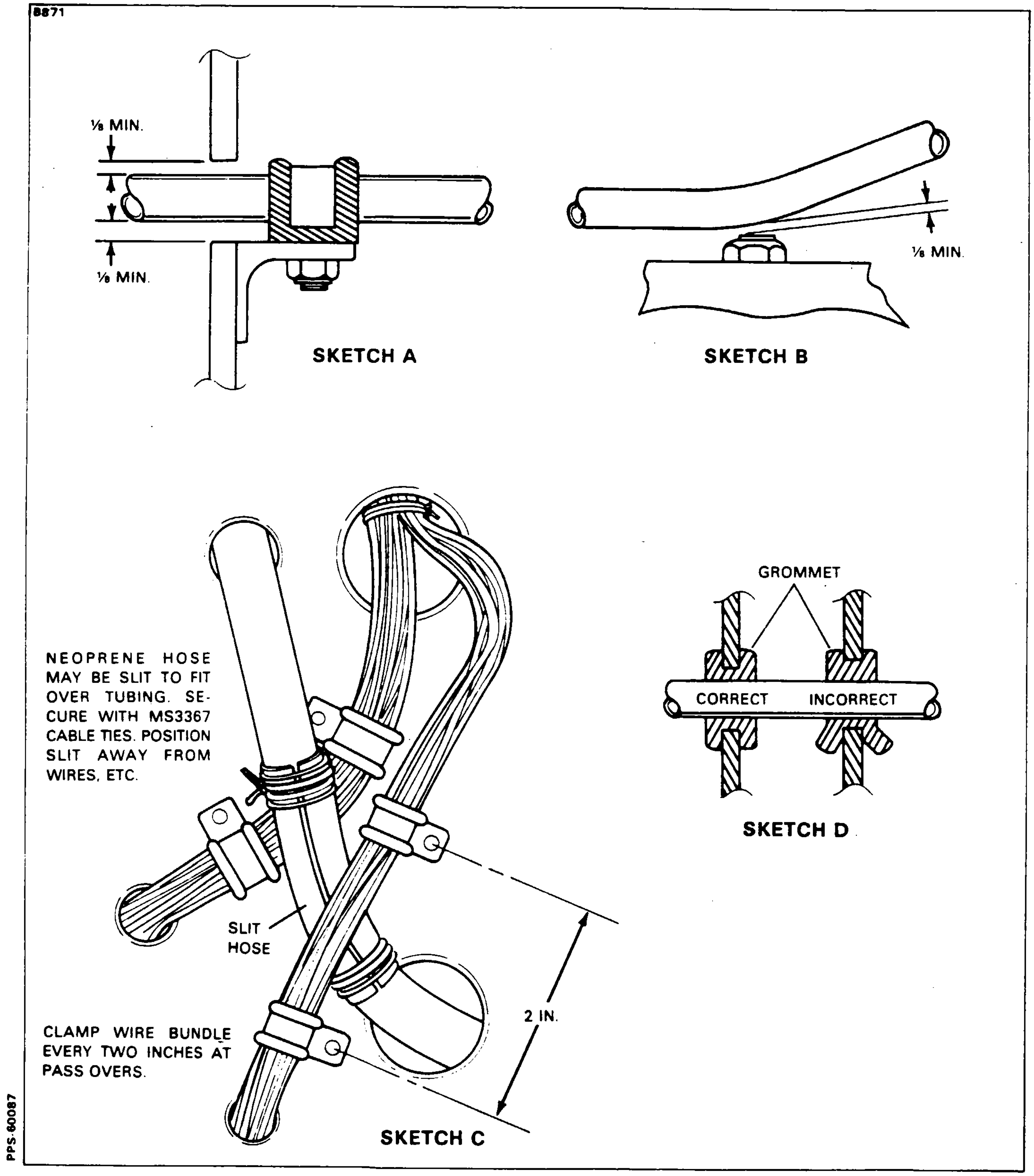


Figure 35-2. Oxygen Tubing Installations

CHARGING VALVE.

REMOVAL OF OXYGEN SYSTEM CHARGING VALVE.

1. Remove the screws securing the rear panel in the aft baggage compartment and remove the panel (for the aft mounted oxygen cylinder). For the forward mounted cylinder, remove the floor panel from the left side at the rear of the forward baggage compartment.
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. Install previously removed panels.

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.

INSPECTION AND OVERHAUL TIME LIMITS.

It is recommended that inspection and overhaul be conducted by an FAA Approved Station or the manufacturer, Scott Aviation. The following checks give recommended inspection and overhaul time for the various parts of the oxygen system:

1. The oxygen cylinder can be identified by the ICC or DOT identification stamped on the cylinder. The standard weight cylinder (ICC or DOT 3AA 1800) must be hydrostatic tested at the end of each 5 year period. 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 4,380 pressurizations, whichever comes first. The month and year of the last test is stamped on the cylinder beneath the ICC or DOT identification.
2. The outlets should be checked for leakage both in the non-use condition, and for leakage around an inserted connector.
3. The high pressure gauge may be checked for accuracy by comparing its indicated pressure with that of a gauge of known accuracy.
4. Inspection of the regulator may be effected by introducing into an outlet a mask connector to which is attached a 100 psi gauge. With one other outlet flowing through a plugged in mask, the indicated regulator output pressure shall be not less than 45 psig at sea level with 200 psig supply cylinder pressure. It should be noted that the permissible leakage through the 1/16 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.)

— END —

INTENTIONALLY LEFT BLANK

INTENTIONALLY LEFT BLANK

CHAPTER

36

PNEUMATIC

CHAPTER 36 - PNEUMATIC

TABLE OF CONTENTS/EFFECTIVITY

THIS PAGE INTENTIONALLY LEFT BLANK

GENERAL.

DESCRIPTION.

Pneumatic system pressure is obtained from bleed air outlets on each engine compressor stage. Pneumatic system bleed air is provided any time the engines are operating. The bleed air moves from the outlets, at a temperature in excess of 400° F and at pressure of up to 80 psi, to a restrictor then enters the heat exchanger (intercooler) where it is cooled to near ambient temperature by air flowing through the heat exchangers.

The bleed air is then routed through the nacelle and wing to a dual check valve assembly which prevents reverse flow to a non-operating engine. From the check valve, the bleed air is routed to a water accumulator where any moisture which may be present in the air is removed to prevent moisture from entering the remainder of the system. Next in line is the pressure regulator which reduces bleed air pressure down to 18 psi for operation of the pneumatic deice boots. This pressure regulator is backed-up by a pressure relief valve which cracks open at 20 psi.

After leaving the pressure relief valve, the bleed air enters a cross fitting which directs the air to the deice system, pneumatic pressure gauge and through a restrictor to the gyro instruments inline filter where the air is filtered before continuing onto the gyro pressure regulating valve. At the pressure regulating valve the pressure is regulated to 5 inches of mercury. From the pressure regulator the pressurized air is routed to the pneumatic manifold in the control pedestal from which it is directed to the turn and bank indicator and the gyro pressure gauge. Incorporated in the manifold is a turn and bank regulating bolt to be used in adjusting the turn rate for the turn and bank.

DISTRIBUTION.

COMPONENTS. (Refer to Figure 36-1.)

The components of the pneumatic system (with the exception of instruments, pneumatic manifold, intercooler and related tubing) are located behind the main spar underneath the cabin floor from stations 140.0 to 170.0; and between right buttock line 12.0 and left buttock line 6.0.

The intercoolers are located on the outboard rear of the firewalls. The pneumatic manifold is located in the control pedestal.

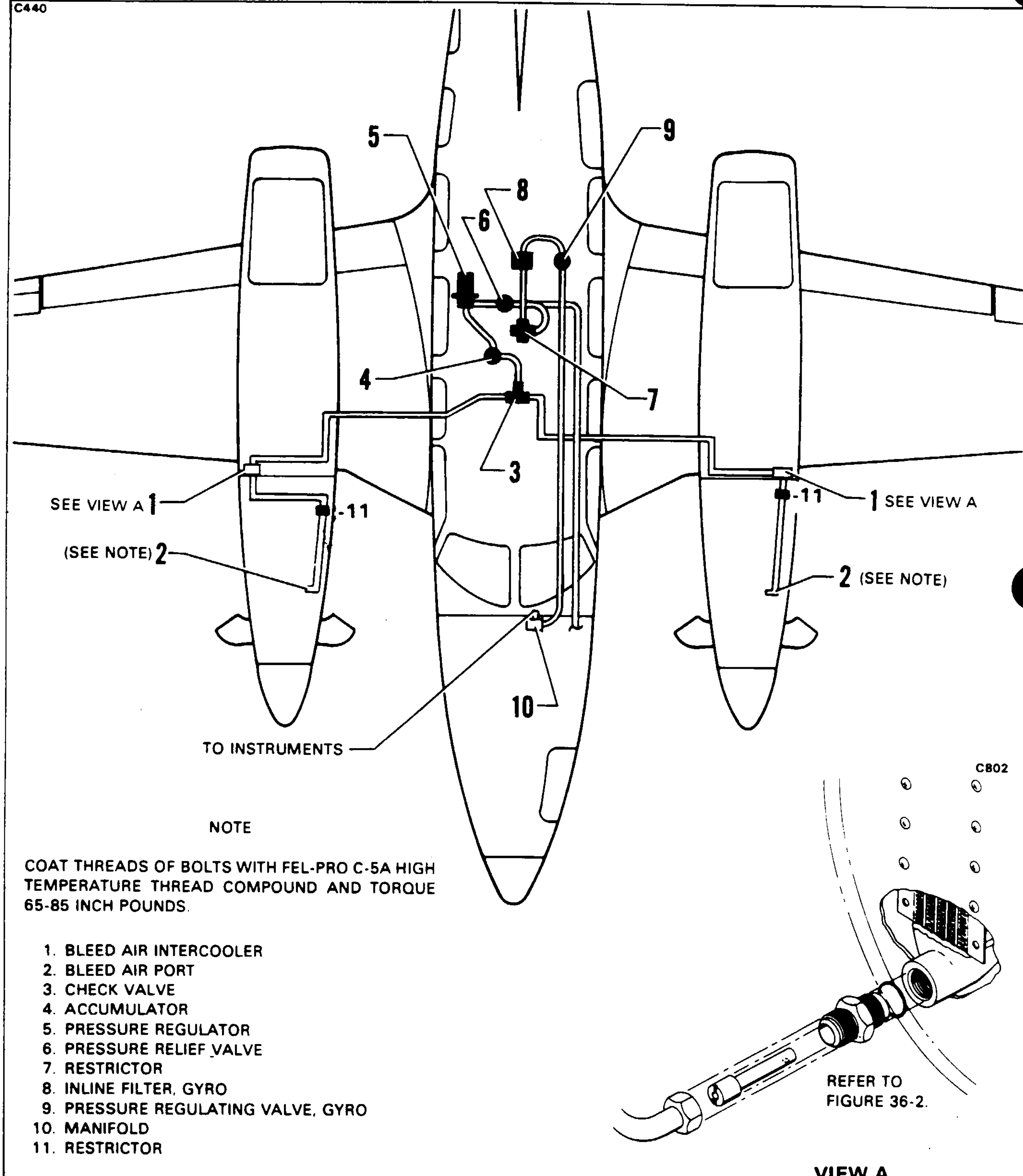
CHECK VALVE.

REMOVAL OF CHECK VALVE.

1. Gain access to check valve.
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 any previously removed access panels.



NOTE

COAT THREADS OF BOLTS WITH FEL-PRO C-5A HIGH TEMPERATURE THREAD COMPOUND AND TORQUE 65-85 INCH POUNDS.

1. BLEED AIR INTERCOOLER
2. BLEED AIR PORT
3. CHECK VALVE
4. ACCUMULATOR
5. PRESSURE REGULATOR
6. PRESSURE RELIEF VALVE
7. RESTRICTOR
8. INLINE FILTER, GYRO
9. PRESSURE REGULATING VALVE, GYRO
10. MANIFOLD
11. RESTRICTOR

Figure 36-1. Pneumatic System

ACCUMULATOR.

REMOVAL OF ACCUMULATOR.

1. Gain access to accumulator.
2. Remove B-nut which attaches accumulator to hose from check valve.
3. Remove hose on aft side of accumulator.
4. Cap lines.
5. Remove screws from accumulator mounting bracket.
6. Remove drain tube from bottom of accumulator.
7. Remove accumulator.

INSTALLATION OF ACCUMULATOR.

1. Attach drain tube to bottom of accumulator using caution to insure that the drain tube is not pulled out of the grommet in the fuselage skin.
2. Attach accumulator mounting bracket to bulkhead with screws.
3. Remove caps from lines.
4. Attach tube to check valve. Torque B-nut.
5. Attach tube to the aft side of the accumulator. Torque hose clamp.
6. Reinstall any access plates previously removed.

RESTRICTOR.

REMOVAL OF RESTRICTOR.

1. Gain access to restrictor.
2. Remove lines going to restrictor.
3. Cap lines.
4. Remove restrictor.

INSTALLATION OF RESTRICTOR.

1. Insure that red mark on restrictor is pointing towards pneumatic filter.
2. Remove caps from pneumatic lines.
3. Attach lines to restrictor.
4. Reinstall any access plates previously removed.

PRESSURE VALVES.

There are two pressure valves; one, a pressure relief valve, is located on the inboard side of the bulkhead at right buttock line 6.0 and station 158.0, the second, a gyro pressure regulating valve, is located on the inboard side of the bulkhead at left buttock line 6.0 and station 160.0. The two valves are not interchangeable; however, removal and installation are the same for both valves.

REMOVAL OF PRESSURE VALVES.

1. Gain access to pressure valve.
2. Remove and cap lines to the pressure valve.
3. Loosen nuts which retain the valve to the bulkhead.
4. Remove valve.

INSTALLATION OF PRESSURE VALVES.

1. Insert valve through hole in bulkhead.
2. Tighten retaining nuts.
3. Remove caps and install lines on check valve. Torque clamps.
4. Reinstall any access panels previously removed.

FILTER.

REMOVAL OF FILTER.

1. Gain access to the filter.
2. Remove and cap both lines going to the filter.
3. Loosen hose clamp that secures filter to bulkhead.
4. Remove filter.

INSTALLATION OF FILTER.

1. Insure that arrow on filter is pointing aft.
2. Remove caps and attach lines to filter. Torque clamps.
3. Reinstall access panels previously removed.

PRESSURE REGULATOR. (Refer to Figure 36-1.)

REMOVAL OF PRESSURE REGULATOR.

1. Gain access to the regulator.
2. Remove and cap the hose and tube going to the regulator.
3. Remove the screws which hold the regulator to the bracket.
4. Remove regulator.

INSTALLATION OF PRESSURE REGULATOR.

1. Attach regulator to the bracket with two screws.
2. Remove caps and attach hose and tube to regulator. Torque clamps.
3. Reinstall access panels previously removed.

ADJUSTMENT OF PRESSURE REGULATOR.

Information not available at this printing.

MANIFOLD.

The manifold is located on a bracket which is attached to the right pedestal cover and the left pedestal bulkhead.

REMOVAL OF MANIFOLD.

1. Gain access to manifold.
2. At the manifold, disconnect the hoses which come from the gyro pressure gauge and the turn and bank.
3. Remove the hose from the bottom of the manifold.
4. Cut safety wire and remove the four retaining bolts. Remove the manifold.

INSTALLATION OF MANIFOLD.

1. Attach manifold to bracket with four bolts. Torque and safety bolts.
2. Connect hose to bottom of manifold.
3. Connect hoses from gyro pressure gauge and turn and bank to manifold.

INTERCOOLER.

The intercooler is located on the back of the outboard side of each firewall. A pneumatic restrictor valve is located in each bleed air line entering the intercoolers.

REMOVAL OF INTERCOOLER.

1. Gain access to the intercooler.
2. Disconnect hoses from intercooler.
3. Remove screws on aft flange of intercooler. Loosen duct from intercooler.
4. Remove screws which secure forward flange of intercooler and aft flange of air inlet duct to firewall.
5. Remove intercooler and gasket.

INSTALLATION OF INTERCOOLER.

1. Prior to installing the intercooler ascertain that the special inlet fitting is positioned so that the drain hole drilled in one flat is positioned to the bottom of the cooler when installed. Also ascertain that the insert part of this fitting is positioned with the hole down, as shown in Figure 36-2.
2. Position intercooler on aft side of firewall. Install screws through aft flange of air inlet duct and forward flange of intercooler. Insure that gasket is in place between firewall and forward flange of intercooler.
3. Seal the top and bottom of the air discharge duct where it joins the intercooler with RTV 106 Sealer using SS 4004 primer on duct before applying seal.
4. Attach forward flange of air discharge duct to aft flange of intercooler.
5. Connect hoses to intercooler.
6. Reinstall any access panels previously removed.

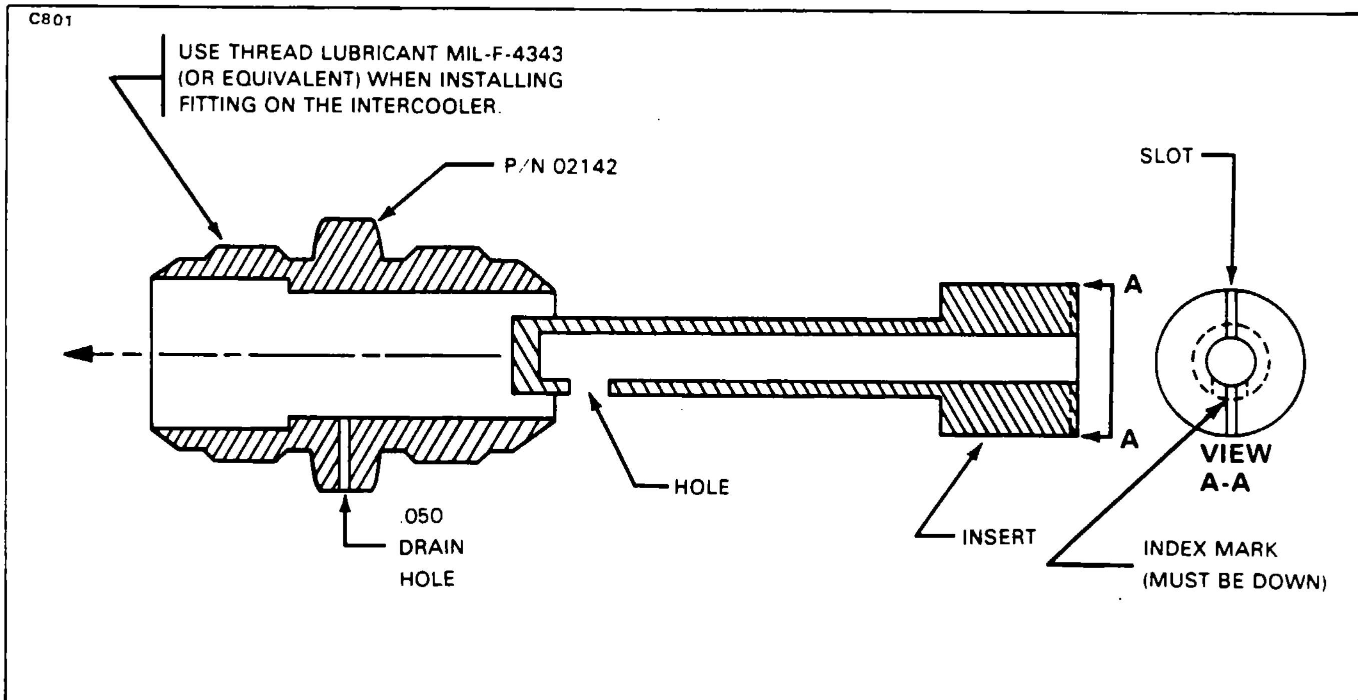


Figure 36-2. Special Intercooler Drain Fitting

GRIDS 4D17 THRU 4D19
INTENTIONALLY LEFT BLANK

CHAPTER

39

ELECTRIC/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS

CHAPTER 39 - ELECTRIC/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 39 - ELECTRIC/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 39 - ELECTRIC/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS (cont)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The instrumentation of the T-1040 is designed to give an actual indication of the 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 AND CONTROL PANELS.

INSTRUMENT PANEL.

The instrument panel is arranged to accommodate flight instruments on the left side, in front of the pilot; engine instruments and electronic 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.

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 instruments.

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:

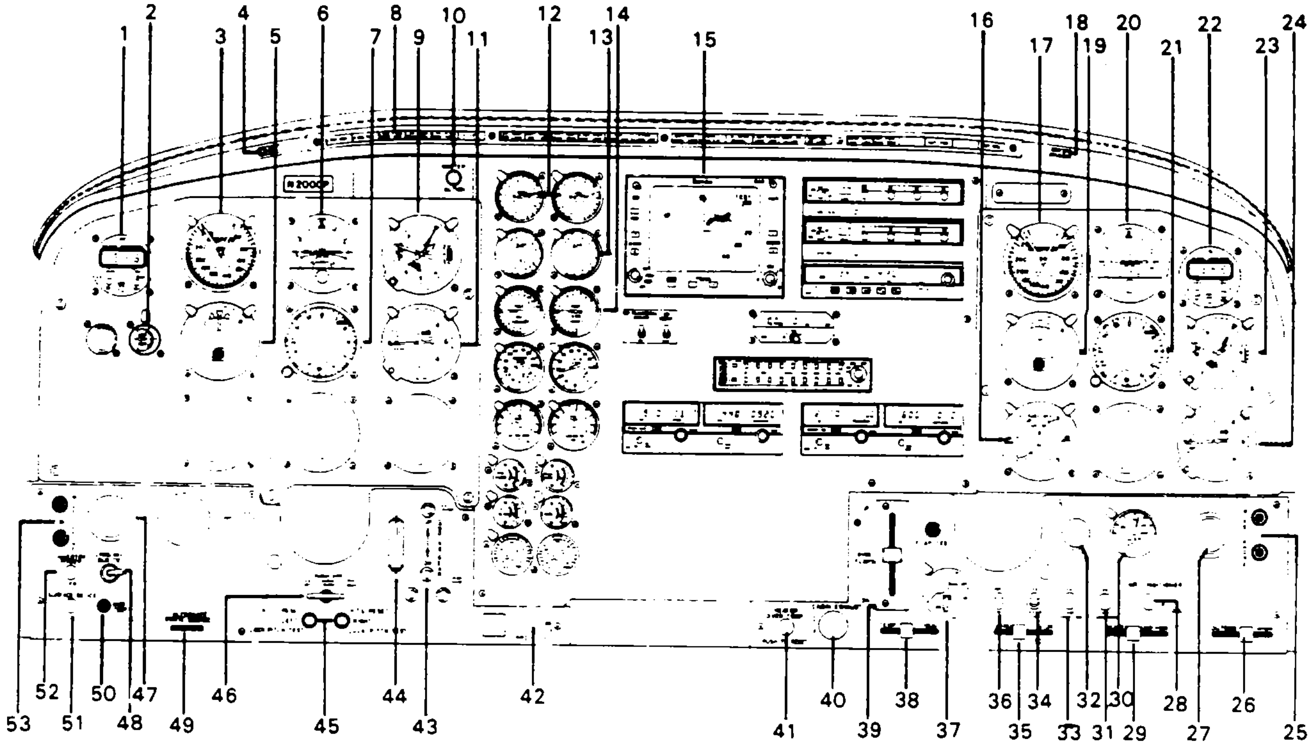
A. Place the instrument in its proper panel cutout and secure with screws.

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.



1. CLOCK
2. GYRO PRESSURE GAUGE
3. AIRSPEED INDICATOR
4. ANNUNCIATOR TEST
5. TURN AND BANK
6. ATTITUDE GYRO
7. DIRECTIONAL GYRO
8. ANNUNCIATOR PANEL
9. ALTIMETER
10. MASTER CAUTION
11. RATE OF CLIMB INDICATOR
12. ENGINE TORQUE GAUGES
13. INTER-TURBINE TEMPERATURE
14. PROPELLER RPM
15. RADAR
16. DUAL FUEL QUANTITY
17. AIRSPEED INDICATOR
18. ANNUNCIATOR HI/LO SWITCH
19. TURN AND BANK
20. ATTITUDE GYRO
21. DIRECTIONAL GYRO
22. CLOCK
23. ALTIMETER
24. RATE OF CLIMB
25. MIKE AND EARPHONE JACKS
26. OUTSIDE AIR LEVER
27. VENT
28. A/C TEMPERATURE CONTROL
29. CABIN HEAT CONTROL
30. OXYGEN GAUGE
31. A/C SWITCH
32. OXYGEN ON/OFF KNOB
33. GROUND VENT FAN SWITCH
34. RECIRCULATING AIR SWITCH
35. DEFROST CONTROL
36. HEATER FAN SWITCH
37. FLAP INDICATOR
38. TEMPERATURE CONTROL LEVER
39. FLAP SWITCH
40. CABIN EXHAUST CONTROL KNOB
41. HEATER OVERTEMP RESET
42. PROPELLER SYNCHROPHASER
43. LANDING GEAR INDICATOR LTS.
44. LANDING GEAR SELECTOR LEVER
45. HYDRAULIC TOPPING GOVERNOR RESET
46. PARKING BRAKE
47. VENT
48. GYRO/INV. BUS TIE
49. ALTERNATE STATIC SOURCE VALVE
50. SURFACE DEICE GROUND TEST
51. SURFACE DEICE INDICATOR
52. INVERTER POWER SWITCH
53. MIKE AND EARPHONE JACKS

Figure 39-1. Instrument Panel (Typical)

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 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.

INSTRUMENTS (Non-Electrical).

— NOTE —

For information regarding the sensitive altimeter, rate of climb indicator and magnetic compass, refer to Chapter 34 - Navigation and Pitot Static.

AIRSPEED INDICATOR.

GENERAL.

The airspeed indicator provides a means of indicating the speed of the aircraft 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. A second pointer on the instrument indicates the maximum allowable airspeed with respect to altitude. The instrument is calibrated in knots per hour and also has the necessary operating range markings for safe operation of the airplane.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3901. TROUBLESHOOTING (AIRSPEED INDICATORS)

Trouble	Cause	Remedy
Pointers of static instruments do not indicate properly.	Leak in instrument case or in pitot lines.	Check for leak and seal.
Pointer of instrument oscillates.	Defective mechanism.	Replace instrument.
Instrument reads high.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
Instrument reads low.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
	Pitot head not aligned correctly.	Re-align pitot head.
Airspeed changes as aircraft is banked.	Water in pitot line.	Remove lines from static instruments and blow out lines from cockpit to pitot head.

PNEUMATIC SYSTEM PRESSURE GAUGE.

GENERAL.

The pneumatic system pressure gauge monitors the regulated pressure of the engine compressor bleed air from the gas generator case. The gauge is mounted in the left instrument panel and is calibrated from 0 to 25 psi.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3902. TROUBLESHOOTING (PNEUMATIC SYSTEM PRESSURE GAUGE)

Trouble	Cause	Remedy
No indication on pressure gauge.	Disconnected, broken or restricted lines.	Locate trouble and correct.
	Faulty gauge. Malfunctioning pressure regulator.	Replace gauge. Check operation of pressure regulator.
Low pressure indication.	Pressure regulator valve incorrectly adjusted. System leakage.	Adjust pressure regulator. Check compressor bleed valve, fittings and lines.
High pressure indication.	Pressure regulator valve incorrectly adjusted.	Adjust pressure regulator.

OIL PRESSURE GAUGE.

GENERAL.

The engine oil pressure gauge monitors engine oil pressure at the main oil pressure pump in the accessory gearbox case. The gauge is calibrated from 0 to 125 pounds per square inch.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3903. TROUBLESHOOTING (ENGINE OIL PRESSURE GAUGE)

Trouble	Cause	Remedy
Excessive error at zero.	Pointer loose on shaft.	Replace instrument.
	Over-pressure or seasoning of bourdon tube.	
Excessive scale.	Improper calibration adjustment.	Replace instrument.
Sluggish operation or pointer or pressure fails to build up.	Engine relief valve open.	Check and clean.
	Defective instrument.	Replace instrument.

FUEL PRESSURE GAUGE (Wet Direct Reading and Electric).

GENERAL.

The fuel pressure gauges monitor fuel pressure at the fuel flow transmitter. The gauges are mounted in the center instrument panel and are calibrated from 0 to 50 psi.

REMOVAL AND REPLACEMENT. (Refer to Removal and Replacement of Instruments.)

TROUBLESHOOTING.

CHART 3904. TROUBLESHOOTING (FUEL PRESSURE GAUGE)
(WET DIRECT READING AND ELECTRIC)

Trouble	Cause	Remedy
No fuel pressure indication.	Defective fuel boost pump.	Check for fuel flow at firewall shutoff valve.
	Defective gauge.	Replace gauge.
WET DIRECT READING ONLY		
Needle fluctuation.	Air in line.	Purge line of air and retighten.

CLOCK.

GENERAL.

The pilot's (and optional copilot's) clocks are battery (AAA Type) powered quartz digital clocks.

REMOVAL AND INSTALLATION OF CLOCK. (Refer to Removal and Installation of Instruments.)

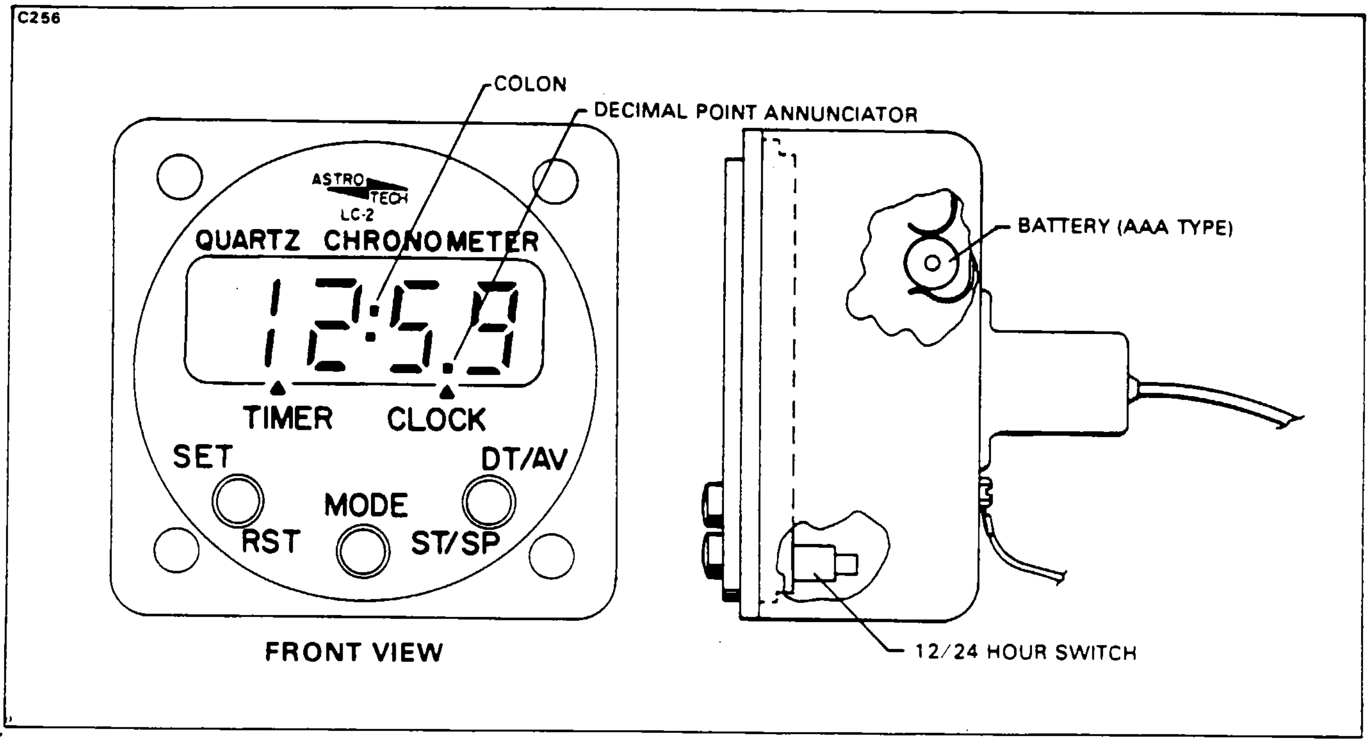


Figure 39-2. Digital Clock

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 39-2.)

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 at 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 the SET button twice to continue the time. If the clock colon is missing or does not blink, press the DT/AV button for two seconds until the date returns to the digital display. Colon activity will resume.

To display the date, press the DT/AV 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.

INSTRUMENTS (Electrical).

— NOTE —

For information regarding the attitude gyro, gyro horizon indicator and the turn and bank indicator, refer to Chapter 34, Navigation and Pitot Static.

AIR TEMPERATURE GAUGE.

GENERAL.

The air temperature gauge is an electrically operated instrument that measure the outside air temperature by means of a temperature bulb located in the lower left fuselage underneath the cockpit. The electrical resistance of the temperature bulb varies directly as the outside air temperature and this resistance is indicated on the gauge in degrees Fahrenheit and Centigrade.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3905. TROUBLESHOOTING (AIR TEMPERATURE GAUGE)

Trouble	Cause	Remedy
Gauge inoperative.	Poor electrical connection.	Check connections and tighten.
Incorrect reading.	Defective temperature bulb.	Replace bulb.
	Instrument out of calibration.	Replace instrument.

AMMETER.

GENERAL.

The ammeters are located in the overhead instrument panel, and are connected in series with the battery charging circuit. The ammeters measure the total current flow in the electrical system.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

VOLTMETER.

GENERAL.

The voltmeter is located in the overhead instrument panel. The meter indicates the total voltage in the electrical system.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3906. TROUBLESHOOTING (VOLTMETER)

Trouble	Cause	Remedy
Meter inoperative or erratic.	Poor electrical connections.	Check connections and tighten.
	Defective instrument.	Replace instrument.
Meter does not indicate properly.	Meter out of calibration.	Replace with a calibrated meter.

FUEL QUANTITY GAUGE (Dual).

GENERAL.

The fuel quantity gauge is a dual needle type calibrated in pounds of fuel from 0 to 1400. The gauge indicates the amount of fuel using a capacitance probe type sending unit located in each tank. (Refer to Chapter 28, Fuel for gauge calibration adjustments.)

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3907. TROUBLESHOOTING (FUEL QUANTITY GAUGE)

Trouble	Cause	Remedy
Fuel gauge fails to indicate.	Broken wiring.	Check and repair.
	Defective gauge.	Replace gauge.
Gauge indicates incorrectly.	Gauge not calibrated properly.	Calibrate gauge. Refer to Chapter 28.

FUEL FLOW GAUGE.

GENERAL.

The fuel flow gauge is an electrical instrument used in conjunction with a fuel flow transmitter to provide an indication of the rate of fuel consumption in pounds per hour. The fuel flow transmitter is mounted on the firewall. and monitors the fuel flow to the fuel control inlet. The transmitter generates an electrical signal which is then transmitted to the fuel flow gauge.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3908. TROUBLESHOOTING (FUEL FLOW GAUGE)

Trouble	Cause	Remedy
Gauge inoperative or erratic.	Defective electrical circuit.	Check circuit breaker and wiring.
	Faulty electrical connections.	Check connections and tighten.
	Defective instrument.	Replace instrument.
	Defective transmitter.	Replace transmitter.
Gauge fluctuates.	Worn or defective fuel control unit drive.	Replace fuel control unit and/or drive.

OIL TEMPERATURE GAUGE.

GENERAL.

The oil temperature gauge electrically monitors engine lubricating oil temperature using a temperature bulb located at the delivery side of the main oil pressure pump in the accessory gearbox case.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3909. TROUBLESHOOTING (OIL TEMPERATURE GAUGE)

Trouble	Cause	Remedy
Instrument fails to show any reading.	Faulty electrical connection.	Check wiring to instrument and tighten connections.
	Defective temperature bulb.	Replace bulb.
Excessive scale error.	Improper calibration adjustment.	Replace instrument.

ENGINE TORQUE GAUGE.

GENERAL.

The engine torque gauge monitors engine torque being produced by the power turbine. The torque pressure value is obtained by tapping the two outlets on the top of the reduction gear box case. The pressure differential between the two outlets is monitored by a pressure transmitter, and then transmitted to the torque gauge which is calibrated in lb.-ft.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3910. TROUBLESHOOTING (ENGINE TORQUE GAUGE)

Trouble	Cause	Remedy
Gauge inoperative or erratic.	Defective electrical circuit.	Check circuit breaker and wiring.
	Faulty electrical connections.	Check connections and tighten.
	Defective pressure transmitter.	Replace transmitter.
	Defective gauge.	Replace gauge.
Gauge out of calibration.	Pressure transmitter not adjusted correctly.	Calibrate pressure transmitter.
Gauge fluctuates.	Propeller governor not adjusted correctly.	Adjust.
	Propeller feedback ring or low pitch stop rods binding.	Check feedback ring for run out and rods for free travel.
Gauges read low.	Engine torquemeter system defective.	If engine torquemeter system is verified defective, return power section to overhaul facility.

INTER-TURBINE TEMPERATURE GAUGE.

GENERAL.

The inter-turbine temperature gauge monitors engine operating temperatures between the compressor and power turbines. Ten individual thermocouple probes projected into the inter-turbine inlet guide vanes provide the indicator with the engine operating temperature.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3911. TROUBLESHOOTING (INTER-TURBINE TEMPERATURE GAUGE)

Trouble	Cause	Remedy
Gauge inoperative.	Faulty connections.	Check connections and tighten.
	Defective gauge.	Replace gauge.
Gauge does not indicate properly.	Temperature system defective.	Check thermocouples, harness and bus-bar. Repair or replace faulty units.
	Gauge not properly calibrated.	Replace with a calibrated unit.

TACHOMETER (Propeller).

GENERAL.

The propeller tachometer monitors the speed of the propeller by means of a tachometer generator mounted on the reduction gear box case. The tachometer generator provides an electric current directly proportional to the speed of the propeller. The gauge is calibrated in revolutions per minute from 0 to 2400.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3912. TROUBLESHOOTING (PROPELLER TACHOMETER)

Trouble	Cause	Remedy
Tachometer inoperative or erratic.	Defective indicator or tachometer generator.	Replace indicator or tachometer generator.
	Loose connection, open or grounded circuit.	Check continuity of wires. Replace defective wires.
	Defective tachometer generator drive mechanism.	Replace drive mechanism.

TACHOMETER (Gas Generator).

GENERAL.

The gas generator tachometer monitors the speed of the gas generator by means of a tachometer generator mounted on the accessory gear box case. The tachometer generator provides an electric current that is directly proportional to the speed of the gas generator. The gauge is calibrated in % RPM with 100% being equivalent to 37,500 RPM.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING. (Refer to Chart 3911, Troubleshooting - Propeller Tachometer.)

FLIGHT HOUR RECORDER.

GENERAL.

The flight hour recorder receives voltage from Batt. Bus #2 at all times. However, the ground circuit is through the Left Gear Safety Switch. When aircraft weight on wheels is removed, flight hour meter ground is completed and meter records flight time.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

Refer to Chapter 91, Sheet 19 and Sheet 17.

HEATER HOUR RECORDER.

GENERAL.

The heater hour meter receives voltage with the fuel control valve, from the heater terminal strip.

TROUBLESHOOTING.

Refer to Chapter 91, Sheet 17.

FLAP INDICATOR.

GENERAL.

The wing flap indicator monitors the position of the flaps by means of a potentiometer attached to the left flap.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING. (Refer to Chapter 27, Flight Controls.)

STALL WARNING INDICATOR AND LIFT DETECTOR. (Refer to Chapter 27.)

ANNUNCIATOR DISPLAY.

GENERAL.

The annunciator system provides audio visual indication as to any malfunction of systems that are essential to the safe operation of the aircraft. The system consists of a master caution light, a warning horn, an individual indicator light cluster with a push-to-test switch for the entire system and an electronic annunciator controller which is connected to sensors on the following systems:

1. CAUTION CHANNELS
   A. Engine Fire Warning (L & R)
   B. Engine Fire Extinguisher Inoperative (L & R)
   C. Engine Oil Temperature (L & R)
   D. Engine Oil Pressure (L & R)
   E. Nose Baggage Door Ajar
   F. Fuel Pressure (L & R)
   G. Generator Inoperative (L & R)
   H. Cabin Door Unsafe
   I. Battery Overtemperature
   J. Engine Fire Tests (1 and 2) (L & R)
   K. Fire Extinguisher (L & R)
   L. Annunciator Power
2. ADVISORY CHANNELS
   A. Starter Energized (L & R)
   B. External Power
   C. Engine Oil Door (L & R)
   D. Deice Door (L & R)
   E. Beta (L & R)
   F. Ignition (L & R)
   G. Deice OFF (L & R)
   H. Free Gyro (Optional)

DESCRIPTION OF OPERATION.

The annunciator controller is powered through the 28 VDC left main bus and the number 2 battery bus. The circuits are protected by 5 amp fuse and 5 amp circuit breaker. A lighted "ANN. POWER" warning light means the system is operating on the backup power circuit.

The annunciator controller is an integral part of the annunciator display circuits. Each channel of the annunciator controller is displayed on the annunciator display as a system that is being monitored. The annunciator controller output connectors have only one or two "DISPLAY POWER" wires, that provide a steady plus voltage to all annunciator warning lights, all the time. The annunciator controller waits for a malfunction signal to come in on one of its many input connector wires, and then switches on the appropriate annunciator warning light, by grounding the minus wire from that light. In most cases, a malfunction connects airframe ground to the appropriate controller input signal wire. The controller then connects its output wire, for that channel, to ground, to switch on that channel's warning light. Any time the controller switches on another warning light, it also switches on the MASTER CAUTION LIGHT and HORN. Pressing this illuminated MASTER CAUTION push button, causes it to switch off, and also switches off the horn. The warning light ground is switched off and on by a flasher circuit, until the MASTER CAUTION IS PRESSED, resulting in no horn and a steady warning light. That way, a warning light that has just switched on, flashes and therefore stands out from any other lights that were already on (and therefore steady). The remote annunciator controller also offers dimming of the warning lights by switching any lamp grounds off and on at a very high speed . . . no warning lamp flicker is visible, but the dimmed lamps appear to be lit by only 10 volts.

A few annunciator channels are signalled for warning lamp turn on by presence or loss of a plus annunciator controller input signal voltage. For instance, the BATTERY OVER TEMPERATURE warning light is kept switched off by a plus 8 to 17 volt signal from the battery temperature sensor. If the battery overtemp sensor wire is broken off, or left not connected, the "BATTERY OVER TEMP" warning light will remain on, while the battery is cold.

The annunciator controller has two adjustment pots, one for each oil temperature indicator. (Refer to the following paragraph for adjustment procedures.) The annunciator controller only activates the master caution warning, should a system failure occur that is essential to flight. (Refer to the appropriate P.O.H. for emergency procedures.)

ANNUNCIATOR PANEL (OIL TEMPERATURE INDICATOR) ADJUSTMENT PROCEDURE.

These adjustments apply to the oil temperature lights only. They are located on the annunciator controller, which is mounted on the nose gear wheel well between STA. 25.60 and STA. 54.00. They are labeled: left oil temperature and right oil temperature. Adjustments made on the annunciator controller will require two people, one in the airplane and one up front at the controller.

1. Remove upper and lower cowlings from both engines.
2. The oil temperature probes are located on the lower aft right side of both left and right engines.
3. Locate and remove electrical connectors E116, from the left oil temperature probe, and E217, from the right oil temperature probe.
4. Place a resistive load of 128 ohms across pin A and B of electrical harness connectors E116 and E217. Use a locally fabricated test box. (Refer to Figure 39-2a.)

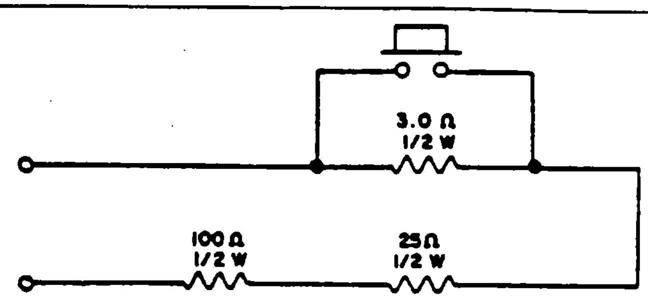


Figure 39-2a. Schematic - Test Box

5. Ascertain the left oil temperature, right oil temperature, and the panel circuit breakers are pushed into their ON position.
6. Gain access to the controller by removing the access panel between STA. 25.60 and 54.00 on the right side of the airplane.
7. Apply power to the annunciator panel by placing the master switch in the ON position. Observe the needle on both the left and right oil temperature gauges, it should be deflected to the red line near the 100° C position on the gauge.

— *NOTE* —

The master caution button must be depressed to cutout a time delay circuit (3-5 seconds) while any adjustments are made.

8. With a small slot head screwdriver, adjust the left channel by turning the left oil temperature adjusting screw clockwise to illuminate the left oil temperature annunciator light. Then turn the adjusting screw counterclockwise slowly until the left oil temperature annunciator light extinguishes. Repeat the first step by turning the adjustment screw clockwise very slowly to illuminate the left oil temperature annunciator.
9. Adjust the right channel in the same manner as the left channel in Step 8.

— *NOTE* —

In order to properly calibrate both channels, it may be necessary to reaccomplish Steps 8 and 9 several times to achieve simultaneous activation of the oil temperature lights. Place protective covers over adjustment pots, when adjustments are complete.

10. Upon completion of adjustment procedure, decrease the resistive load on the left oil temperature probe harness connector E116 by 3 ohms by pressing the switch on the test box. The left oil temperature annunciator panel light should extinguish. Repeat the same change in resistive load for the right oil temperature probe harness connector E217 and the right oil temperature annunciator light should extinguish.
11. Place the aircraft master switch in the OFF position and remove the resistive load from both the left and right oil temperature probe electrical harness connectors.
12. Connect electrical connector E116 to the left oil temperature probe and electrical connector E217 to the right oil temperature probe.
13. Install and secure the access panel between STA. 25.60 and 54.00. Install the left and right engine cowlings and secure.

REMOVAL AND REPLACEMENT. (Refer to Removal and Installation of Instruments.)

TROUBLESHOOTING.

CHART 3914. TROUBLESHOOTING (ANNUNCIATOR PANEL)

Trouble	Cause	Remedy
Annunciator display inoperative. Master Caution or Advisory Caution light glows.	Loss of either +28 V.D.C. Essential Bus or Alternate +28 V.D.C. power	Check circuit breaker* and wiring connections. *— NOTE —* ***+28 V.D.C. Essential originates at Left Main Bus +28 V.D.C. alternate power originates at #2 Batt. Bus.***
False indication on an individual annunciator function.	Grounded circuit or loss of individual A+.	Check individual sensor* for continuity to ground, or A+ input to sensor.
Individual annunciator function does not indicate a malfunction on the annunciator display.	Defective sensor, wiring point	Replace sensor or repair wiring* interconnect.
Warning horn or Master Caution light inoperative.	Faulty horn, indicator light, or reset switch. Replace as necessary. Point to point wiring.	Replace faulty component or* repair wiring.
*Refer to Chapter 91, Electrical System Annunciator Schematic.		

ELECTRICAL SWITCHES AND CIRCUIT BREAKERS.

DESCRIPTION OF OVERHEAD SWITCHES.

These switches are located on electroluminescent panels mounted in royalite trim panels. They are located centrally above the windshield and on the cockpit ceiling. The switches are of the rocker type.

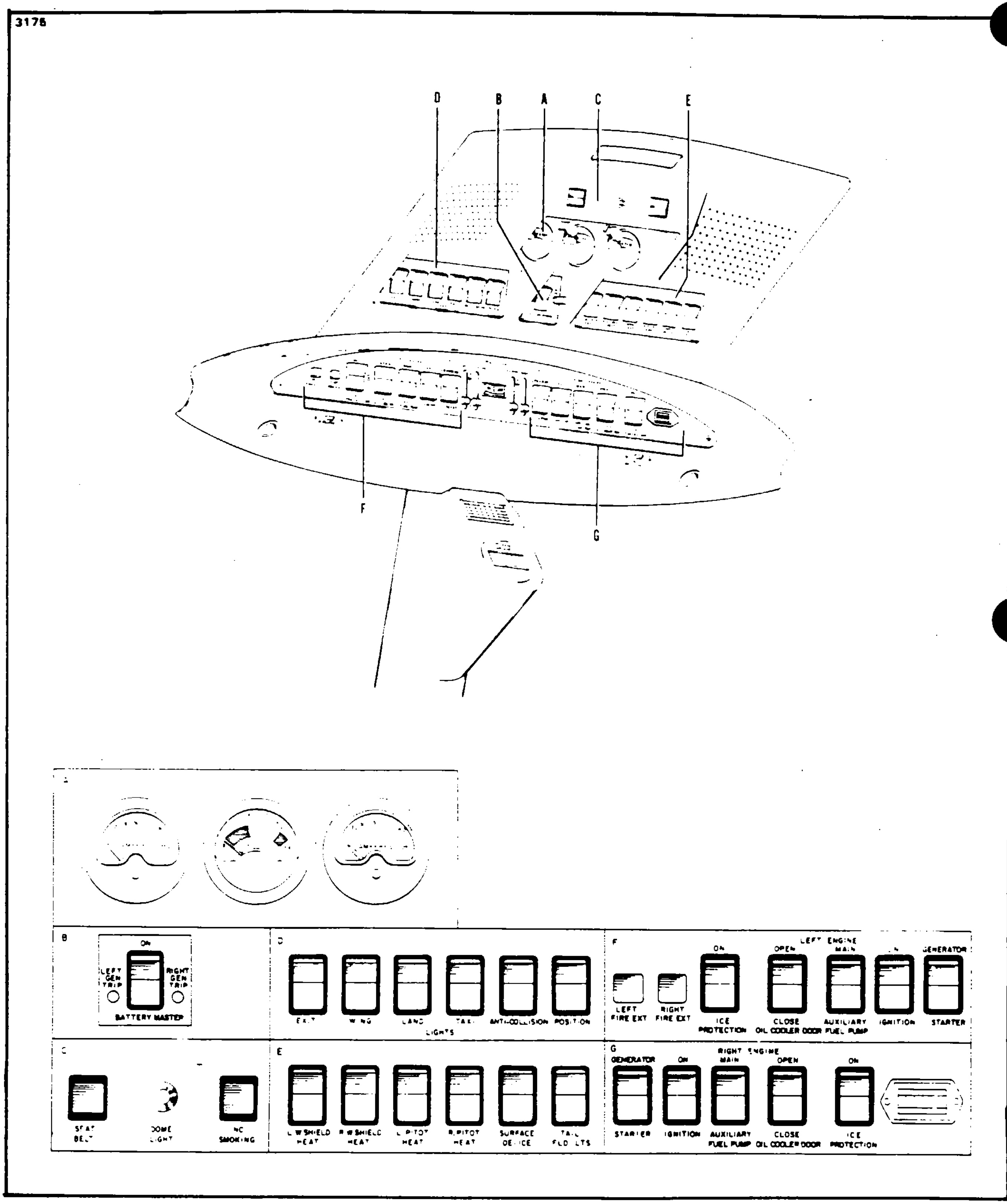


Figure 39-3. Switch Panels

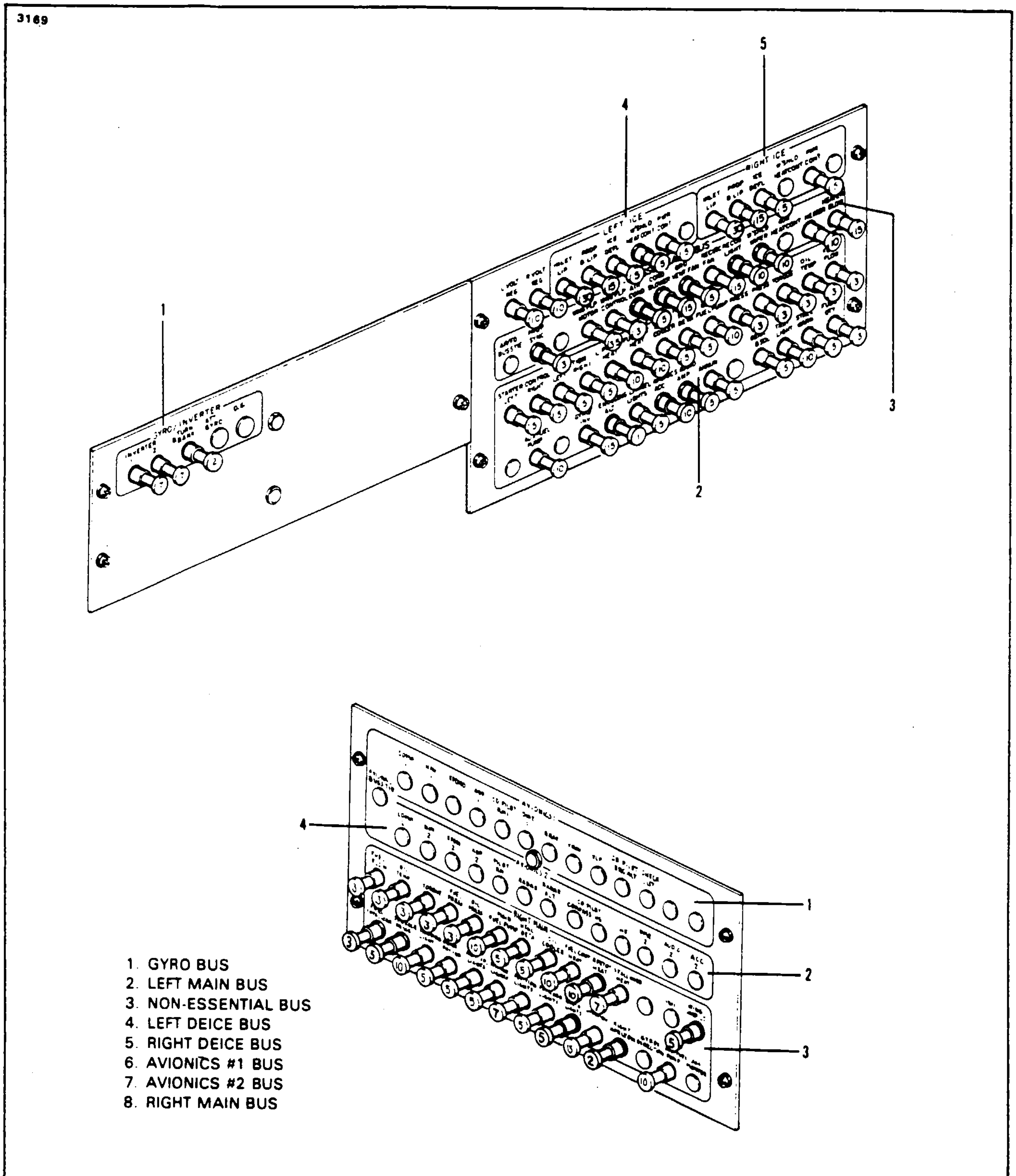


Figure 39-4. Circuit Breaker Control Panels

REMOVAL OF OVERHEAD SWITCHES.

1. Ascertain that the two starter-generator switches and the battery master switch are in the OFF position.
2. Remove the screws securing the electro-luminescent panel containing the switch to be serviced.
3. With the electro-luminescent panel unfastened from the royalite trim panel, it is now possible to gain access to the switch mounting clip at the back of the panel.
4. Working from the rear of the switch, insert a narrow, thin bladed screwdriver between the top of the switch and the mounting clip; disengage the clip from the switch. Also, do the same at the bottom of the switch and mounting clip.

— *CAUTION* —

Use caution when working on the switches and panels that other parts and wiring are not damaged.

5. Remove the various electrical leads from the switch. Remove the switch.

— *NOTE* —

Make note of the place from which the electrical leads were removed to facilitate reinstallation.

INSTALLATION OF OVERHEAD SWITCHES.

1. Connect the various electrical leads to their correct positions on the switch.

— *NOTE* —

The mounting clip has two positions built into it for positioning the switch. Be sure both upper and lower prongs on the switch body are in the same position on the clip.

2. Install the switch in the electro-luminescent panel from the back end of the panel by inserting a narrow, thin bladed screwdriver between the top of the switch and the mounting clip to help enage the prongs on the switch body into the clip. Attach the bottom of the switch by the same procedure.
3. Install the switch panel into the royalite trim panel and secure it in place with the appropriate screws.
4. Check the operation of the new switch to determine correct installation and operation.

DESCRIPTION OF CIRCUIT BREAKER AND SWITCH PANEL.

There are two circuit breaker and switch panels installed in the T-1040. The left circuit breaker and switch panel contains circuit breakers for the left engine and the electrical system. The right circuit breaker and switch panel contain circuit breakers for the right engines, radio equipment, and various electrical systems applying to the right side. The circuit breakers are of the manual reset type and must be pushed to be reset after being tripped. The switches are toggle type and are used for disconnecting the various buses from the system.

REMOVAL AND INSTALLATION OF PLUG-IN CIRCUIT BREAKERS.

Plug-in circuit breakers can be identified by the absence of retaining nuts on the front of the panel. Ascertain that the two starter-generator switches and the battery master switch are at "OFF," and release the padded side trim from beneath the circuit breaker and switch panel assembly.

1. Release the electro-luminescent panels by removing the attaching hardware (including two cap nuts securing the middle of the upper right forward panel). Disconnect the wires connected to the rear of the panels and lower the panels clear of the circuit breakers.
2. Release the panel retaining the circuit breakers by removing the thru screws securing it in place.
3. After removing the circuit breaker retaining panel, the faulty circuit breaker may be pulled from the assembly and replaced by a new one.
4. Replace, in reverse order, all items removed in the preceding steps.

ELECTRICAL AND ELECTRONIC EQUIPMENT RACKS. (Refer to Figure 39-5.)

AVIONICS MASTER AND EMERGENCY SWITCH CIRCUIT. (Refer to Chapter 91.)

DESCRIPTION AND OPERATION.

Electrical power is provided to the avionics buses in a fail safe configuration. When the Avionics Master Switch is placed in the position labeled "ON", the switch is electrically "OFF", and when placed to the "OFF" position the switch is electrically "ON". (Refer to Chapter 91, Sheet 2.)

The Avionics Contactor provides power to Avionics Bus #1, from the left Distribution Bus, and to Avionics Bus #2 from the Right Distribution Bus, ONLY IN THE DISENGAGED (non-powered) CONDITION. When the avionics master switch is placed in its "OFF" position, the switch closes applying power to, and energizing, the avionics contactor, thereby shutting down power to the avionics buses.

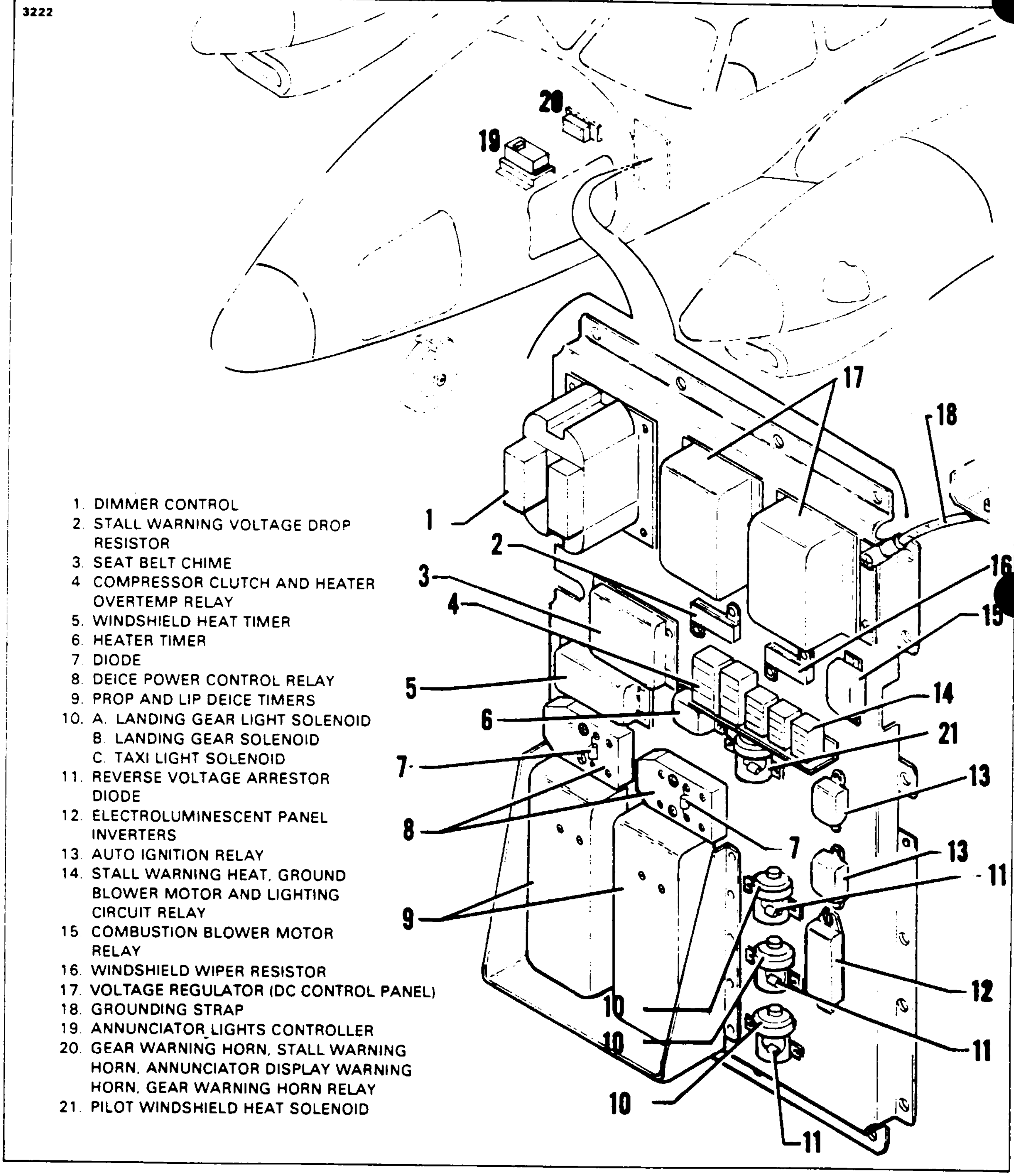


Figure 39-5. Electrical Accessory and Relay Shelf

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.

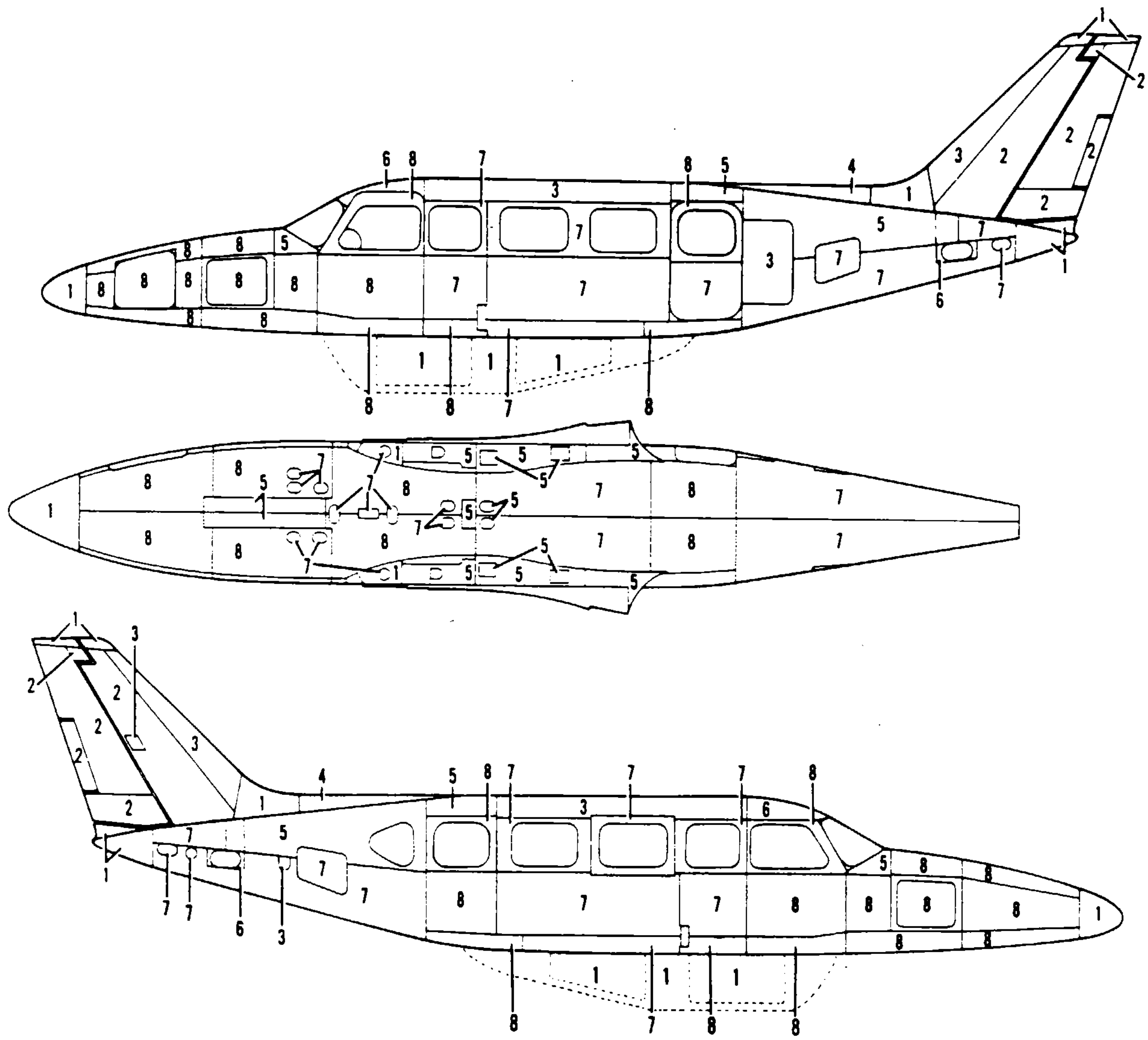
— NOTE —

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.)

DESCRIPTION.

The T-1040 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, pilot entrance (optional) and cargo (optional) doors are located on the left side of the aircraft. An emergency exit is incorporated on the right side of the aircraft. The wings and empennage are also of a full cantilever semi-monocoque type construction.



NUMBER	MATERIAL	THICKNESS	NUMBER	MATERIAL	THICKNESS
1	FIBERGLASS		9	2024-T3	.051
2	2024-T3	.020	10	2024-T3	.064
3	2024-T3	.025	11	321 ST STL	.015
4	2024-0*	.025	12	2024-T3	.081
5	2024-T3	.032	13	2024-0*	.063
6	2024-0*	.032	14	2024-T3	.091
7	2024-T3	.040			
8	2024-0*	.040			

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 Thicknesses

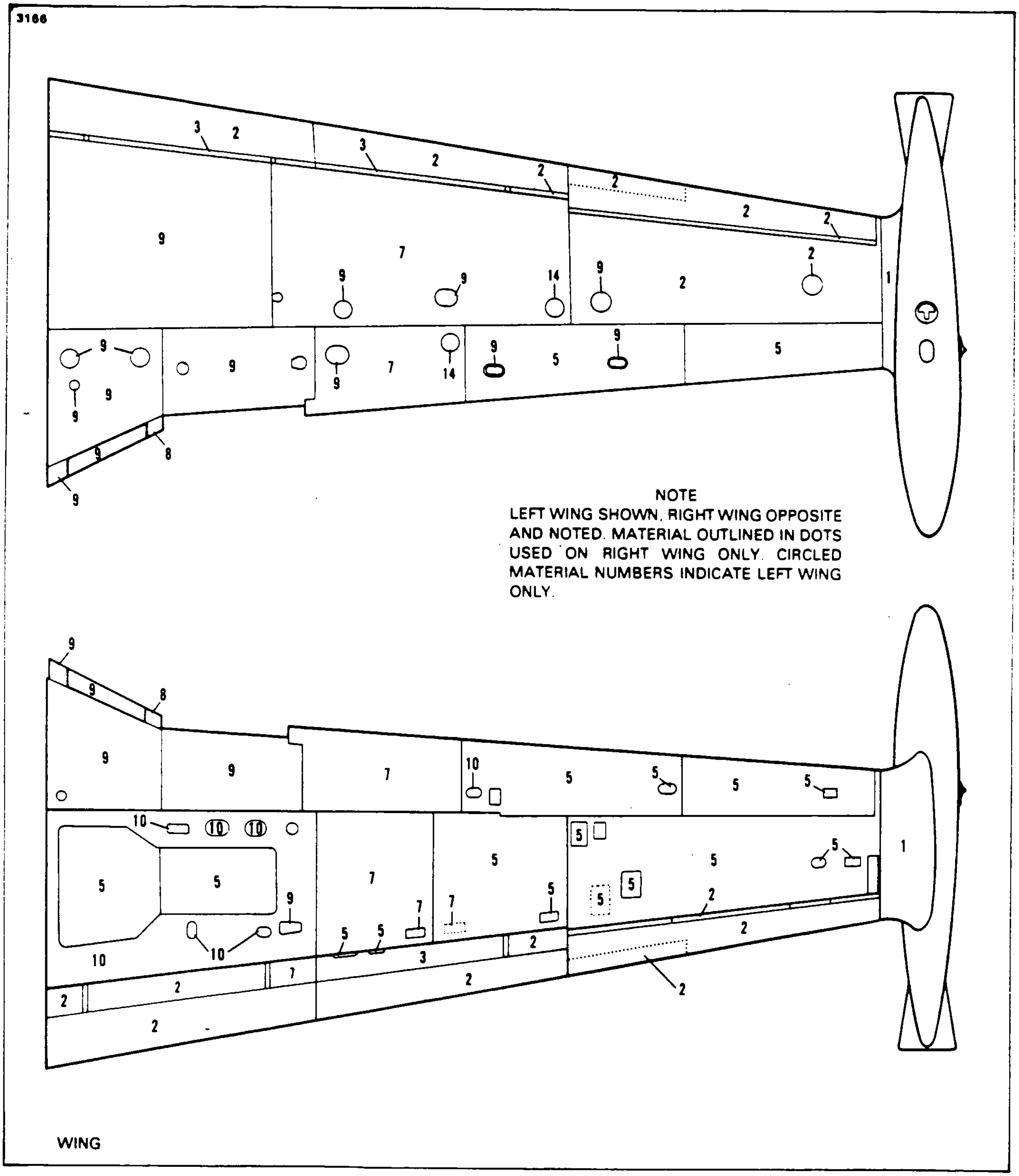
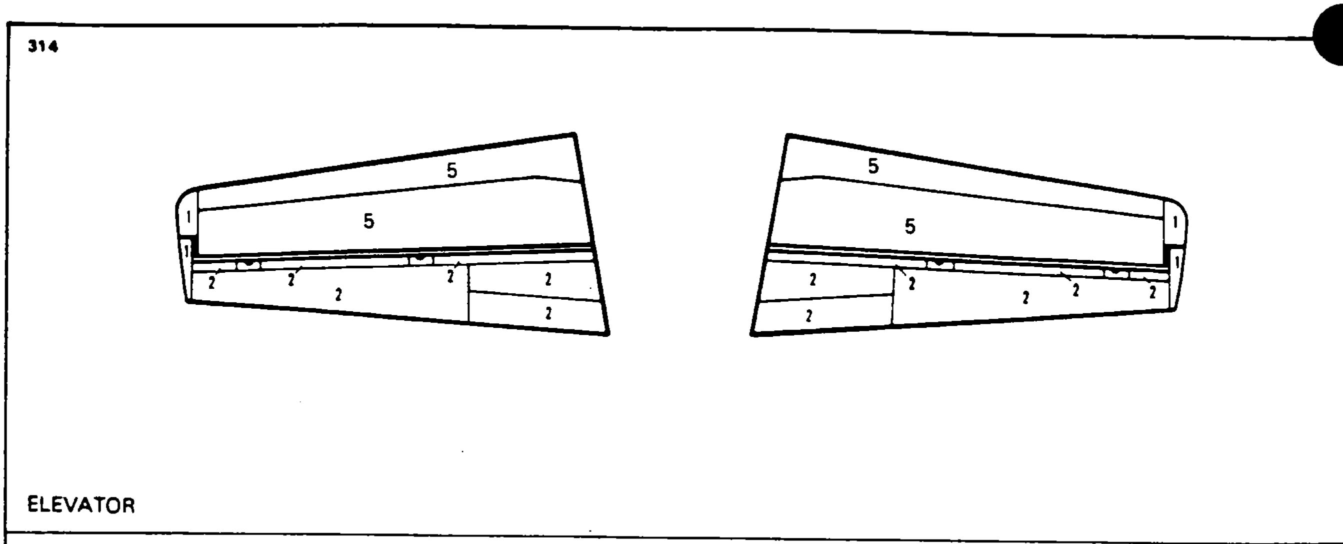


Figure 51-1. Skin Thicknesses (cont.)



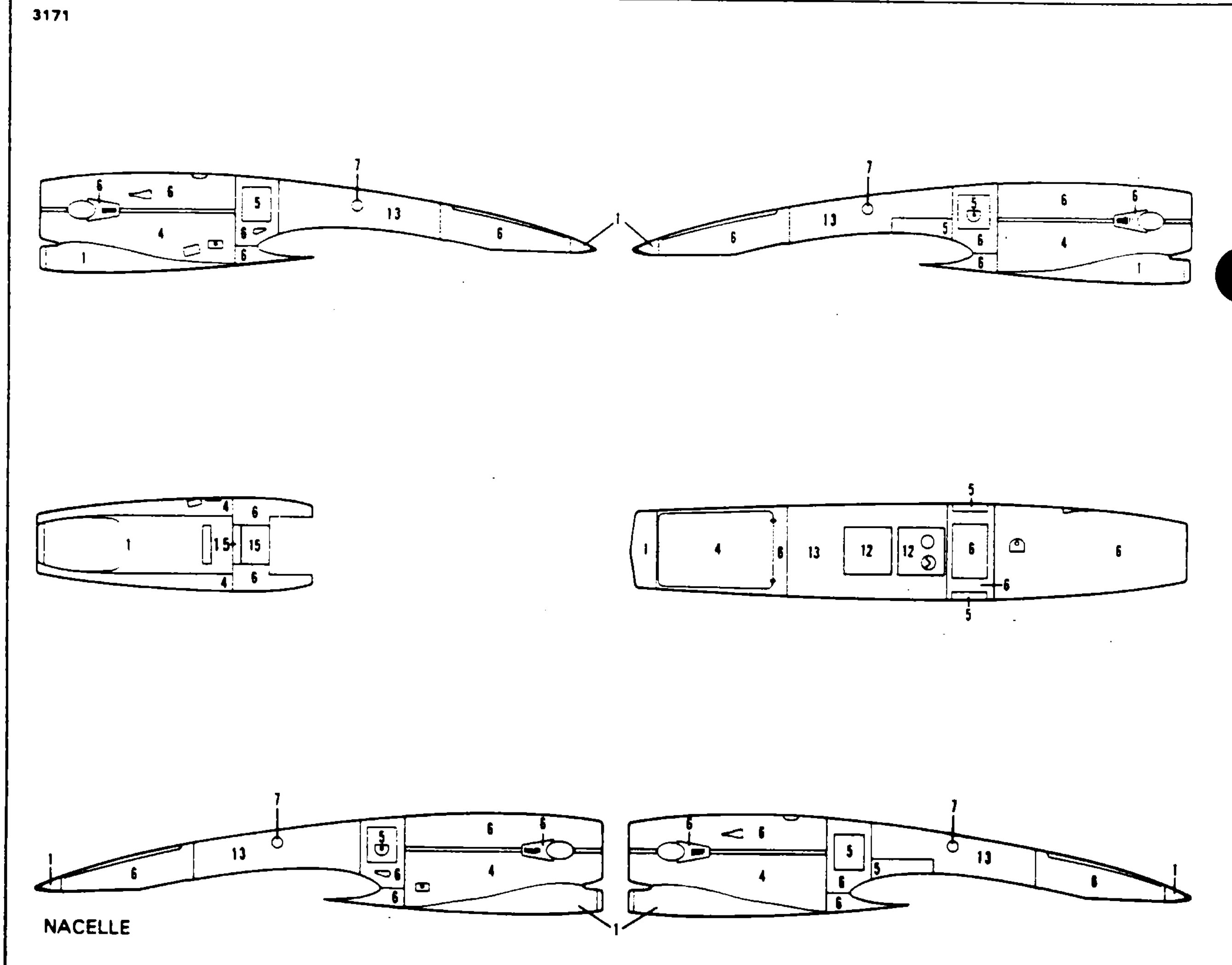


Figure 51-1. Skin Thicknesses (cont.)

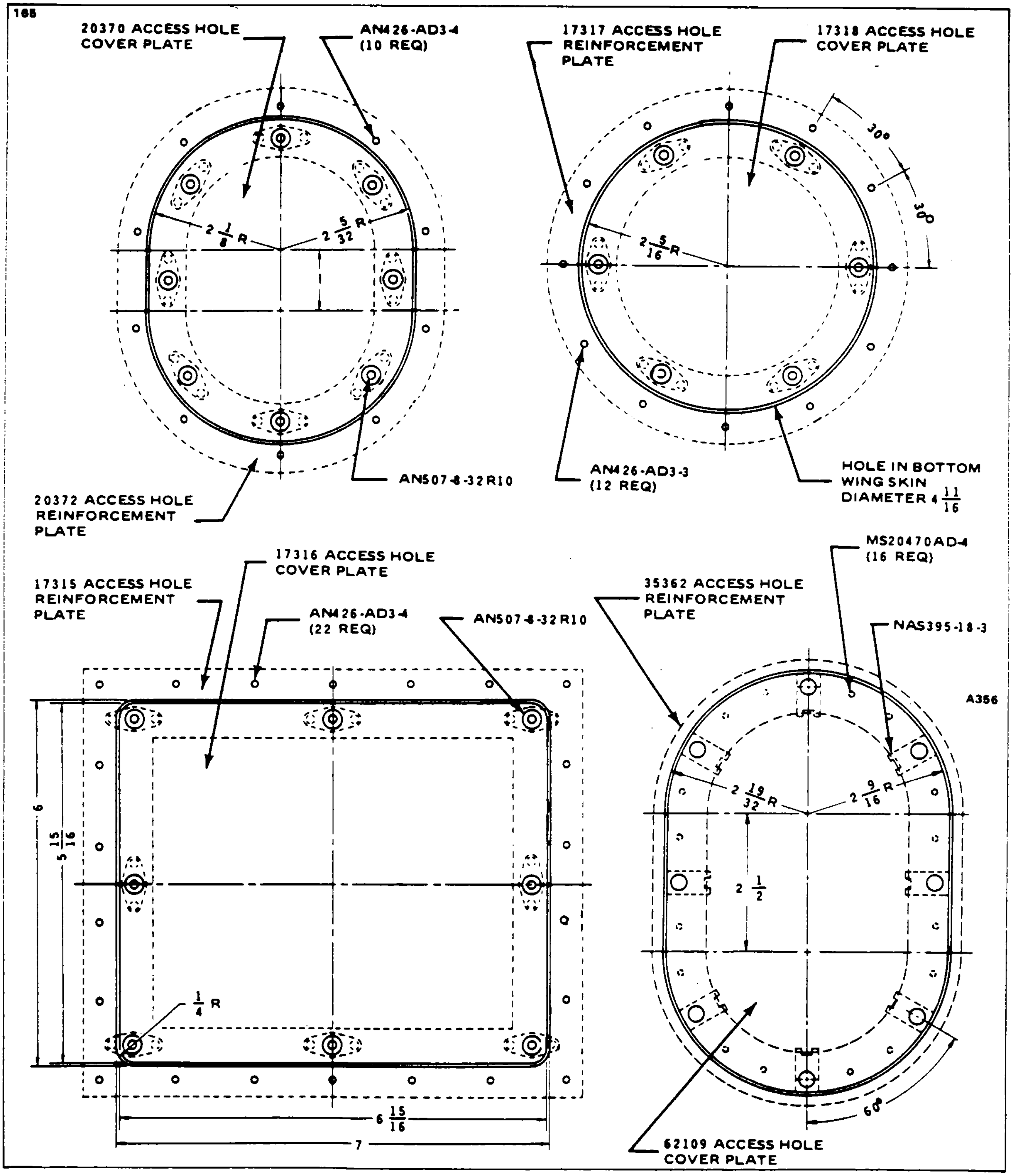


Figure 51-2. Typical Access Plates and Panels

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.

FEBERGLASS 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. Featherback 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 dry 80 grit sandpaper on a power sander or sanding block, smooth patch and blend with surrounding surface. Should air pockets appear while sanding, puncture and fill with catalyzed resin. A hypodermic needle may be used to fill cavities. Let cure and resand.

15. Mix catalyzed resin and work into patch with fingers. Smooth carefully and work into any crevices.
16. Cover with cellophane and squeegee smooth. Allow to cure completely before removing cellophane. Let cure and resand.
17. Brush or spray a coat of catalyzed resin to seal patch. Sand patch, finish by priming, again sanding and applying color coat.

— *NOTE* —

Brush and hands may be cleaned in solvents such as acetone or methylethylketone. If solvents are not available, a strong solution of detergent and water may be used.

THERMOPLASTIC REPAIRS.

The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane. A list of material needed to perform these repairs is given along with suggested suppliers of the material. Common safety precautions should be observed when handling some of the materials and tools used while making these repairs.

CHART 5101. LIST OF MATERIALS (THERMOPLASTIC REPAIRS)

ITEMS	DESCRIPTIONS	SUPPLIERS
Buffing and Rubbing Compounds	Automotive Type - DuPont #7	DuPont Company Wilmington, Del. 19898
	Ram Chemical #69 x 1	Ram Chemicals Gardena, Cal. 90248
	Mirror Glaze #1	Mirror Bright Polish Co., Inc. Irvin, Cal. 92713
Cleaners	Fantastic Spray Perchlorethylene VM&P Naphtha (Lighter Fluid)	Obtain From Local Suppliers
ABS-Solvent Cements	Solarite #11 Series	Solar Compounds Corp. Linden, N.J. 07036
Solvents	Methylethyl Ketone Methylene Chloride Acetone	Obtain From Local Suppliers

CHART 5101. LIST OF MATERIALS (THERMOPLASTIC REPAIRS) (cont.)

ITEMS	DESCRIPTIONS	SUPPLIERS
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp. Linden, N.J. 07036
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. long	Sears Roebuck & Co. or Most Hardware Stores
Hot Air Gun	Temp. Range 300° to 400° F	Local Suppliers

1. Surface Preparation:
   A. Surface dirt and paint if applied must be removed from the item being repaired. Household cleaners have proven most effective in removing surface dirt.
   B. Preliminary cleaning of the damaged area with perchlorethylene or VM & P Naphtha will generally insure a good bond between epoxy compounds and thermoplastic.
2. Surface Scratches, Abrasion or Ground-in-Dirt: (Refer to Figure 51-3.)
   A. Shallow scratches and abraded surfaces are usually repaired by following directions on containers of conventional automotive buffing and rubbing compounds.
   B. If large dirt particles are embedded in thermoplastic parts, they can be removed with a hot air gun capable of supplying heat in the temperature range of 300° to 400° F. Use care not to overheat the material. Hold the nozzle of the gun about ¼ of an inch away from the surface and apply heat with a circular motion until the area is sufficiently soft to remove the dirt particles.
   C. The thermoplastic will return to its original shape upon cooling.
3. Deep Scratches, Shallow Nicks and Small Holes: (Less than 1 inch in diameter.) (Refer to Figure 51-4.)
   A. Solvent cements will fit virtually any of these applications. If the area to be repaired is very small, it may be quicker to make a satisfactory cement by dissolving thermoplastic material of the same type being repaired in solvent until the desired paste-like consistency is achieved.
   B. This mixture is then applied to the damaged area. Upon solvent evaporation, the hard durable solids remaining can easily be shaped to the desired contour by filing or sanding.
   C. Solvent adhesives are not recommended for highly stressed areas, or thin walled parts or for patching holes greater than ¼ inch in diameter.
   D. For larger damages an epoxy patching compound is recommended. This type material is a two part, fast curing, easy sanding commercially available compound.
   E. Adhesion can be increased by roughing the bonding surface with sandpaper and by utilizing as much surface area for the bond as possible.

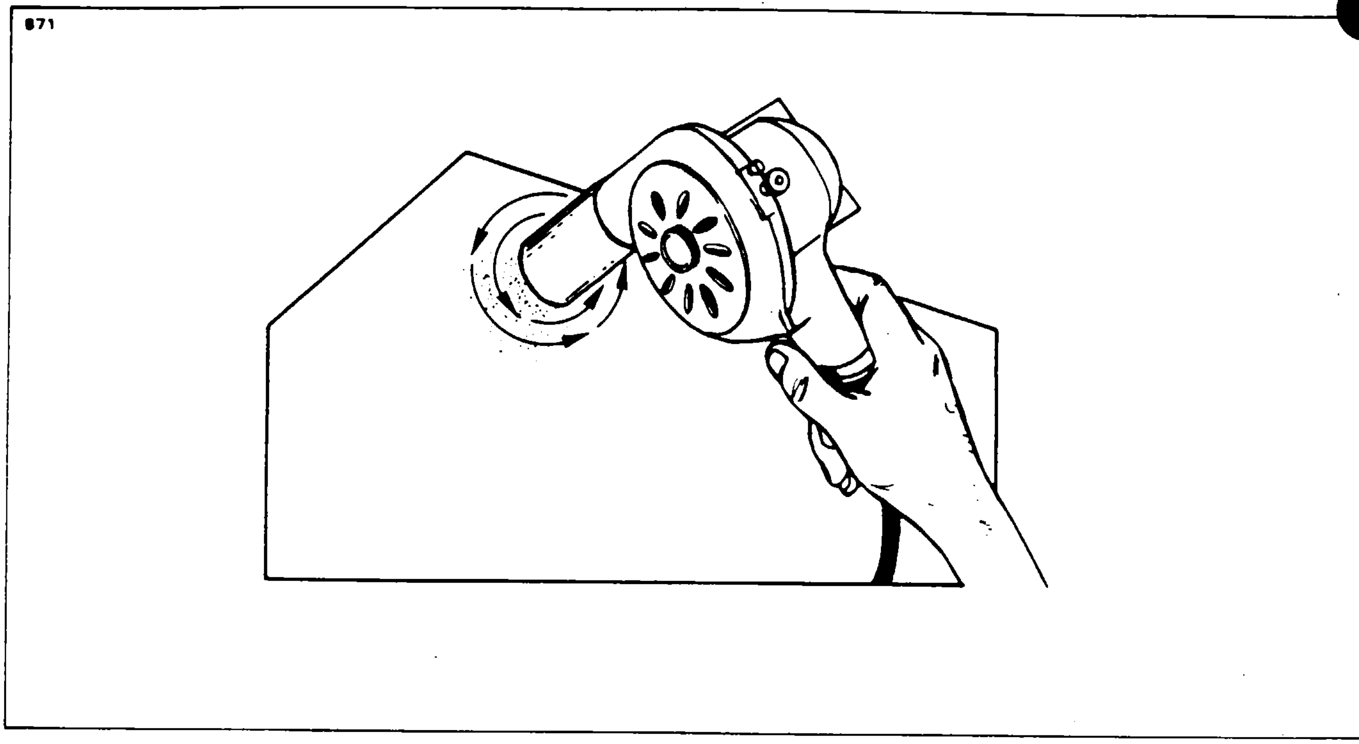


Figure 51-3. Surface Scratches, Abrasions or Ground-in-Dirt

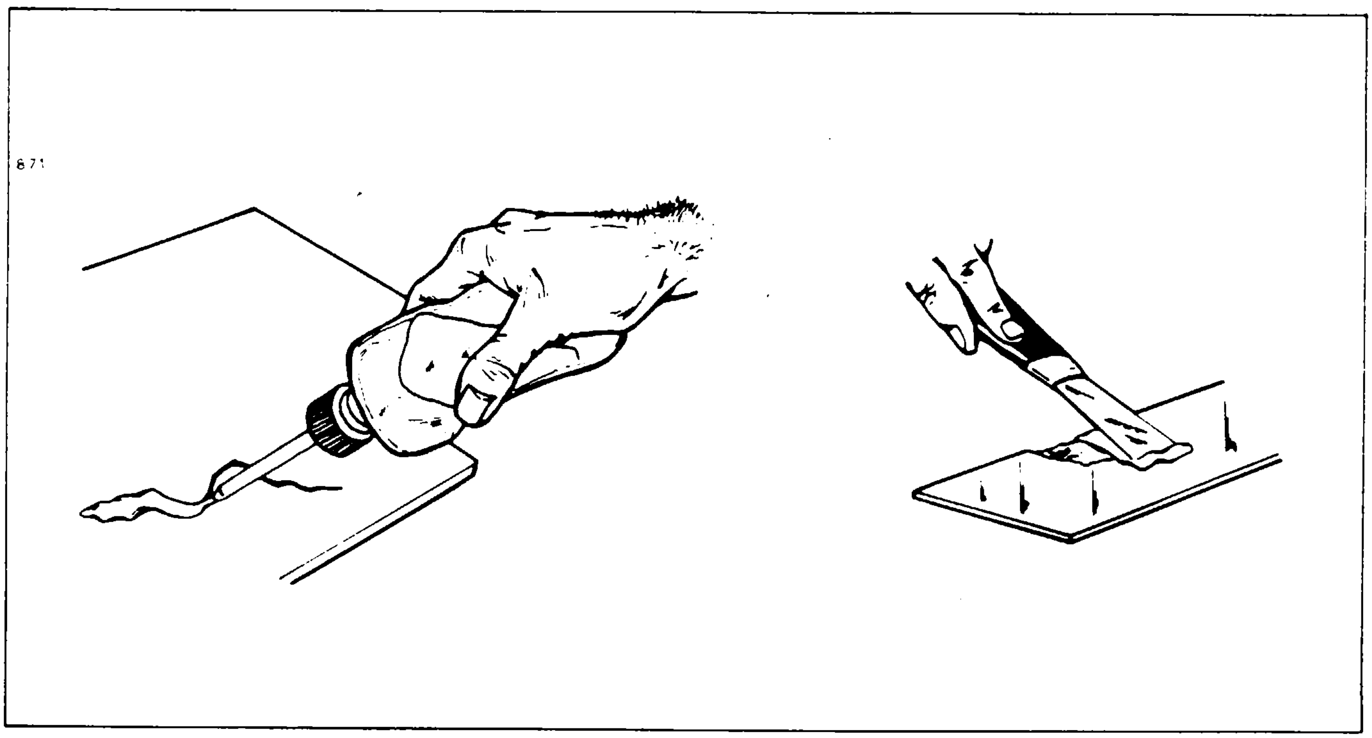


Figure 51-4. Deep Scratches, Shallow Nicks and Small Holes

825

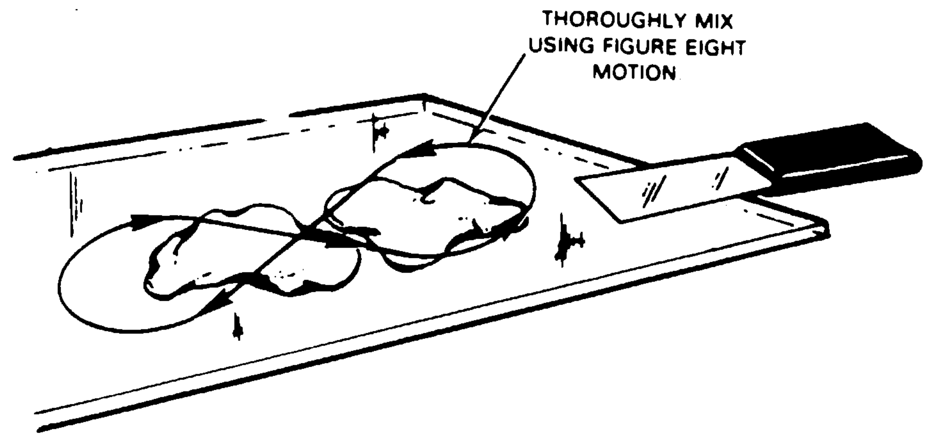


Figure 51-5. Mixing of Epoxy Patching Compound

870

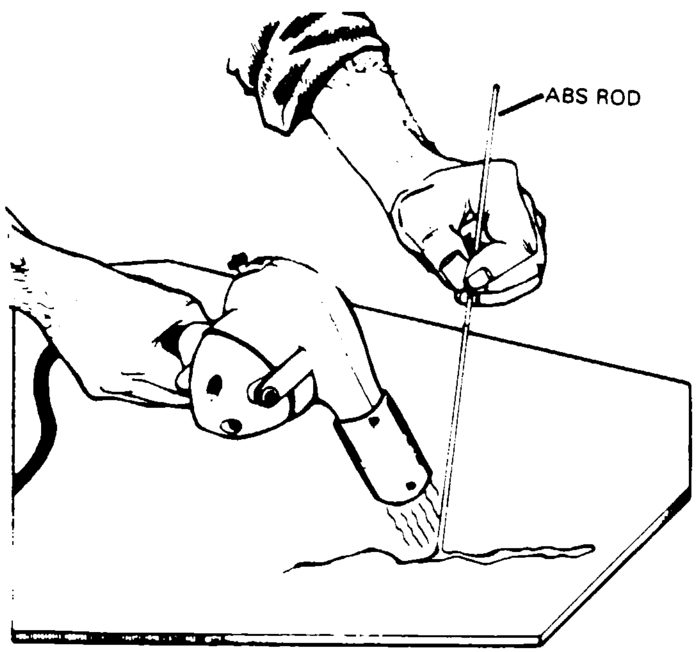


Figure 51-6. Welding Repair Method

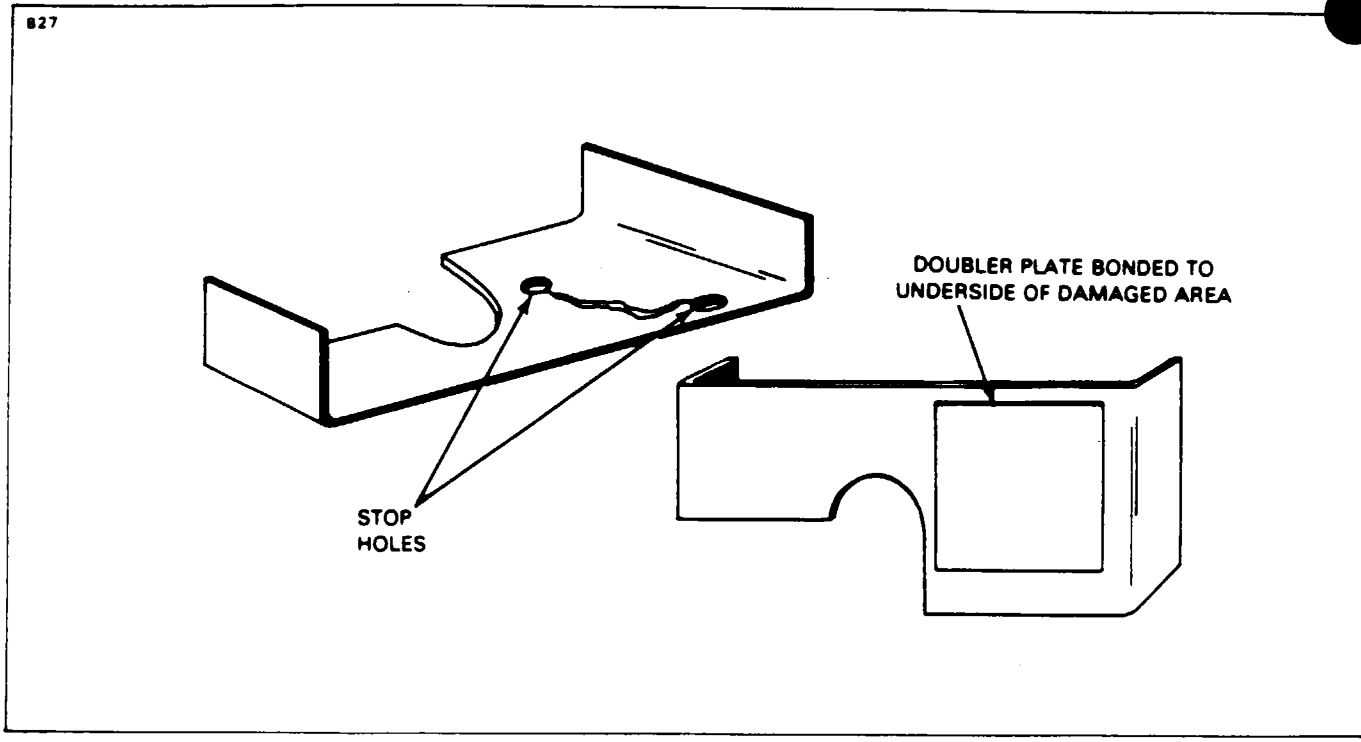


Figure 51-7. Repairing of Cracks

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 where thin walled sections are used, the welding method is suggested.

J. This welding method requires a hot air gun and ABS rods. To weld, the gun should be held to direct the flow of hot air into the fusion (repair) zone, heating the damaged area and rod simultaneously. The gun should be moved continuously in a fanning motion to prevent discoloration of the material. Pressure must be maintained on the rod to insure good adhesion. (Refer to Figure 51-6.)

K. After the repair is completed, sanding is allowed to obtain a surface finish of acceptable appearance.

4. Cracks: (Refer to Figure 51-7.)

A. Before repairing a crack in the thermoplastic part, first determine what caused the crack and alleviate that condition to prevent it recurring after the repair is made.

B. Drill small stop holes at each end of the crack.

C. If possible, a double plate should be bonded to the reverse side of the crack to provide extra strength to the part.

D. The crack should be "V" grooved and filled with repair material, such as solvent cement, hot melt adhesive, epoxy patching compound or hot air welded, whichever is preferred.

E. After the repair has cured, it may be sanded to match the surrounding finish.

5. Repairing Major Damage: (Larger than 1 inch in diameter.) (Refer to Figure 51-8.)

A. If possible a patch should be made of the same material and cut slightly larger than the section being repaired.

B. When appearances are important, large holes, cracks, tears, etc., should be repaired by cutting out the damaged area and replacing it with a piece of similar material.

C. When cutting away the damaged area, under cut the perimeter and maintain a smooth edge. The patch and/or plug should also have a smooth edge to insure a good fit.

D. Coat the patch with solvent adhesive and firmly attach it over the damaged area.

E. Let the patch dry for approximately one hour before any additional work is performed.

F. The hole, etc., is then filled with the repair material. A slight overfilling of the repair material is suggested to allow for sanding and finishing after the repair has cured. If patching compound is used the repair should be made in layers, not exceeding a ½ inch 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.

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.

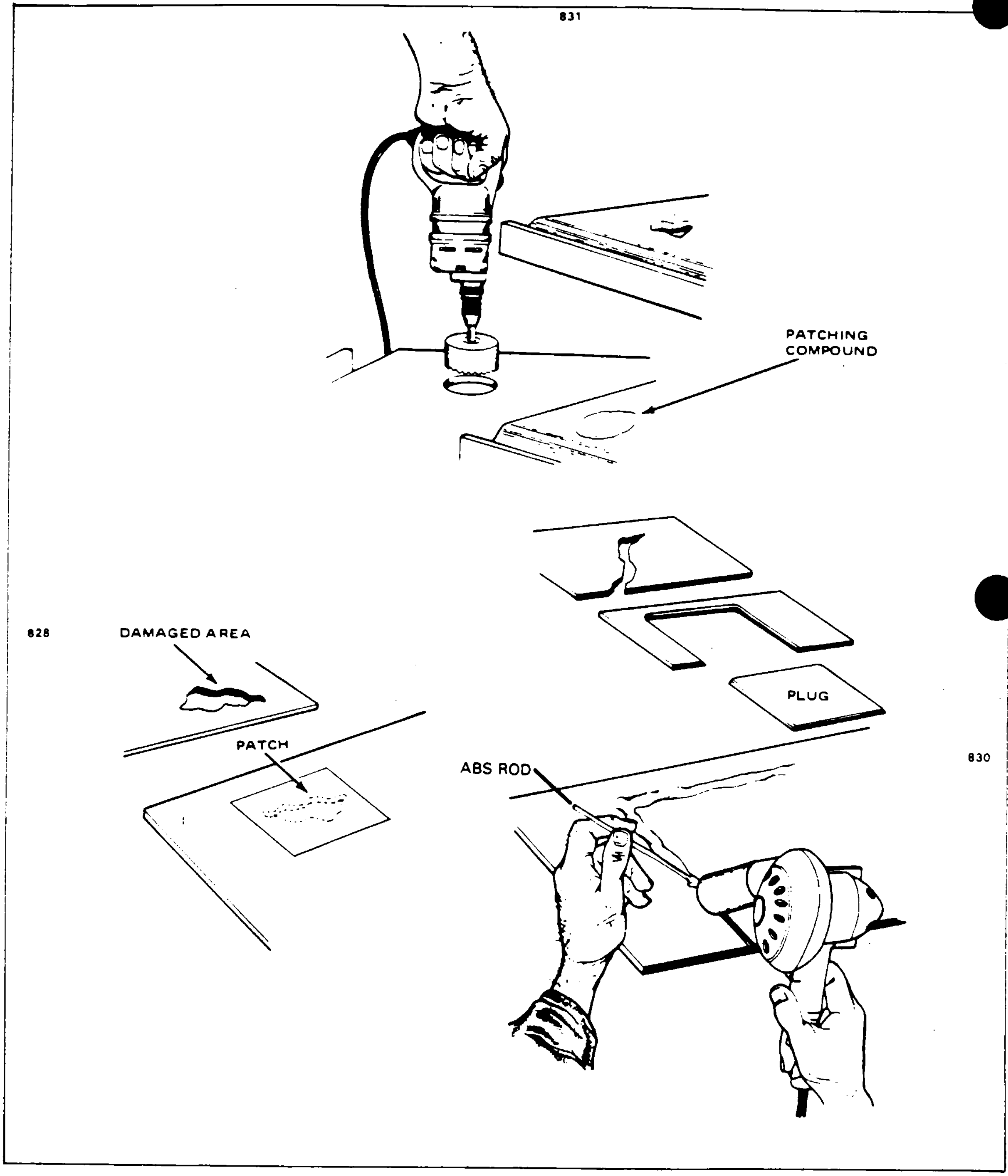


Figure 51-8. Various Repairs

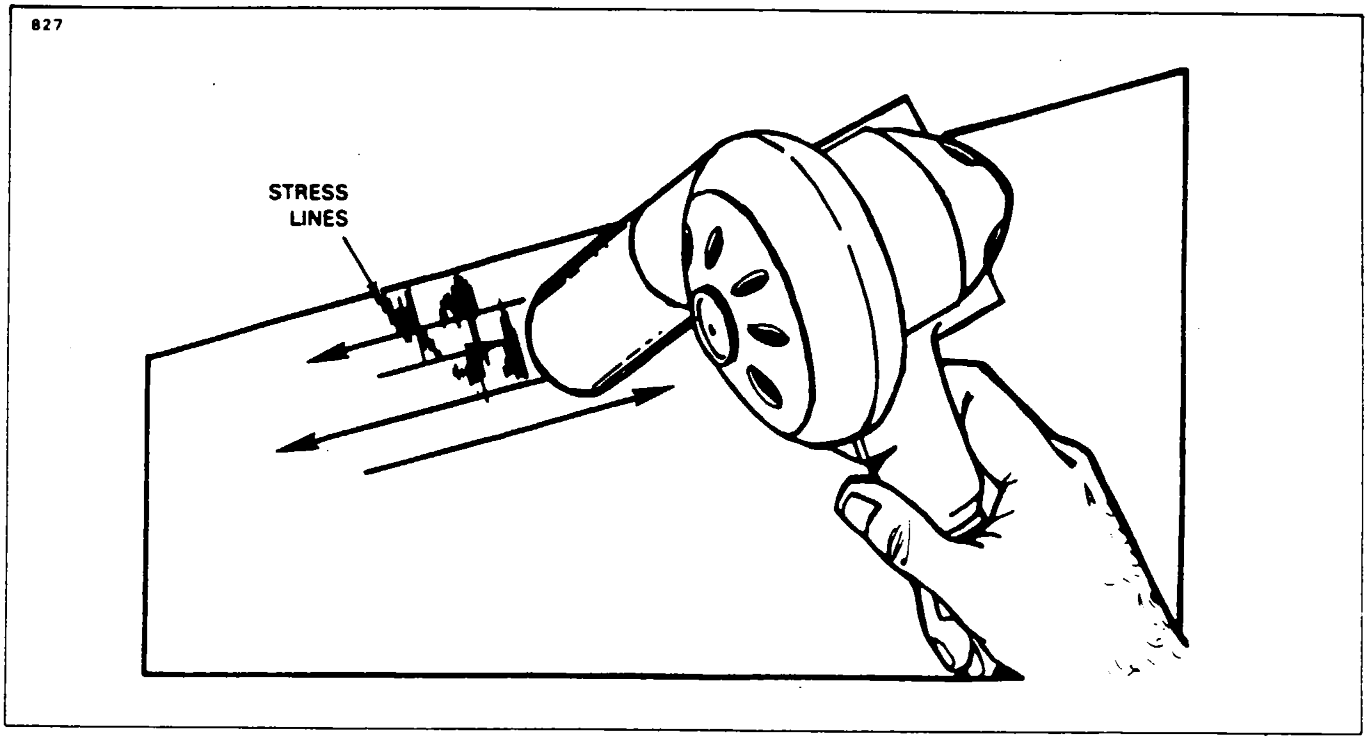


Figure 51-9. Repair of Stress Lines

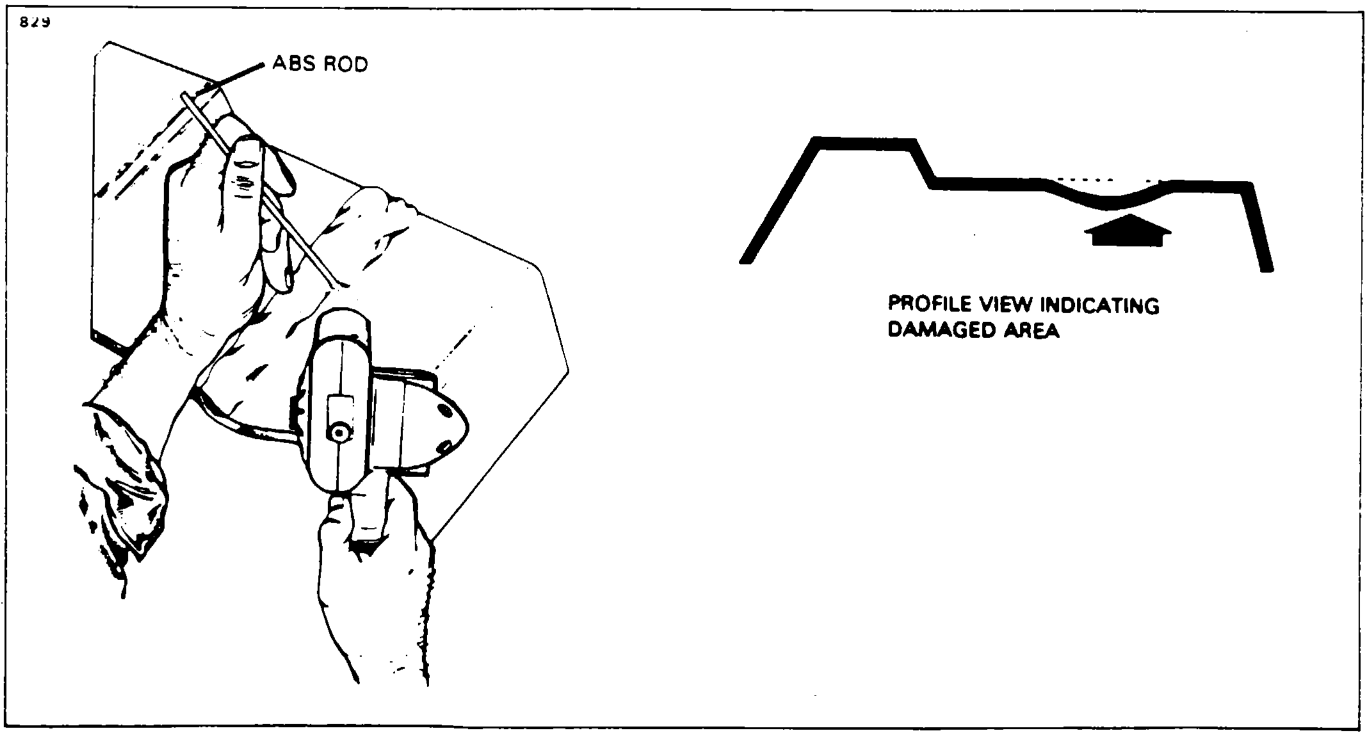


Figure 51-10. Repair of Impacted Damage

SAFETY WALK REPAIR.

SURFACE PREPARATION FOR LIQUID SAFETY WALK COMPOUND.

1. Clean all surfaces with a suitable cleaning solvent to remove dirt, grease and oils. Solvents may be applied by dipping, spraying or mopping.
2. Insure that no moisture remains on the surface by wiping with a clean dry cloth.
3. Outline the area to which the liquid safety walk compound is to be applied, and mask adjacent surfaces.

— NOTE —

Newly painted surfaces, shall be allowed to dry for 2.5 hours minimum prior to the application of the safety walk.

PRODUCT LISTING FOR LIQUID SAFETY WALK COMPOUND.

1. Suggested Solvents:
   Safety Solvent per MIL-S-18718
   Sherwin Williams Lacquer Thinner R7KC120
   Glidden Thinner No. 207
2. Safety Walk Material:
   Walkway Compound and Matting Nonslip (included in Piper Part No. 179872)

APPLICATION OF LIQUID SAFETY WALK COMPOUND.

Liquid safety walk compound shall be applied in an area, free of moisture for a period of 24 hours minimum after application. Do not apply when surface to be coated is below 50° F. Apply liquid safety walk compound as follows:

1. Mix and thin the liquid safety walk compound in accordance with the manufacturer's instructions on the container.
2. Coat the specified surfaces with a smooth unbroken film of the liquid safety walk compound. A nap type roller or a stiff bristle brush is recommended, using fore and aft strokes.
3. Allow the coating to dry for 15 minutes to one hour before recoating or touch-up; if required after application of the initial coating.
4. After recoating or touch-up, if done, allow the coating to dry for 15 minutes to one hour before removing masking.

— NOTE —

The coated surface shall not be walked on for six hours minimum after application of final coating.

SURFACE PREPARATION FOR PRESSURE SENSITIVE SAFETY WALK.

The areas to which the pressure sensitive safety walk is to be installed must be free from all contaminates and no moisture present. If liquid safety walk is installed the area must be prepared as follows:

1. Area must be masked off to protect painted surfaces.
2. Apply suitable stripper MEK Federal Spec. TT-M-261, U.S. Rubber No. 3339 to wingwalk compound. As compound softens remove by using putty knife or other suitable tool.
3. Area must be clean and dry prior to painting.
4. Prime and paint area.

— NOTE —

Newly painted surfaces, shall be allowed to dry for 2.5 hours minimum prior to the application of the safety walk.

APPLICATION OF PRESSURE SENSITIVE SAFETY WALK.

Wipe area with a clean dry cloth to insure that no moisture remains on surface. Do not apply when surface temperature is below 50° F. Apply pressure sensitive safety walk as follows:

1. Peel back the full width of the protective liner approximately 2 inches from the leading edge of the safety walk.
2. Apply the safety walk to the wing area. begin at the leading edge, insure proper alignment and position from wing lap.
3. Remove the remaining protective liner as the safety walk is being applied from front to back of wing area.
4. Roll firmly with a long handled cylindrical brush in both lengthwise directions. Make sure all edges adhere to the wing skin.
5. Install and rivet leading edge retainer.

— END —

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.

REMOVAL OF CABIN ENTRANCE DOOR (UPPER).

1. Remove the upper door support assembly from the door.
2. Disconnect the electrical wire, if installed, at the top of the door frame, being careful not to push the wire back into the frame.
3. While holding the door, remove the hinge pins from both hinges and lower door to remove.

INSTALLATION OF CABIN ENTRANCE DOOR (UPPER.)

1. While holding the door in place, align the hinges and insert new hinge pins. Bend the excess length of the pin into the slot in the hinge.
2. Reconnect the electrical wire, if installed, at the top of the door frame.
3. Replace the upper door support assembly to the door.

REMOVAL OF CABIN ENTRANCE DOOR (LOWER).

1. Disconnect the support strap from the upper left door frame by unfastening the retaining hook.
2. Disconnect the snubber.
3. Remove the scuff plate and rubber cover from the cabin floor.
4. Remove screw from the step extender cable attachment bracket, if installed, and secure cable to prevent it from going into the door assembly.
5. Remove locking roll pins from the hinges.
6. While supporting the door, remove the hinge pins and lift the door out.

INSTALLATION OF CABIN ENTRANCE DOOR (LOWER).

1. Position door and align hinges; then insert hinge pins.
2. Secure hinge pins with locking roll pins.
3. Secure the step extender cable bracket to the lower door frame with a screw.
4. Replace rubber cover and scuff plate between cable floor and door.
5. Connect the support strap hook to the upper left door frame by fastening the hook.
6. Connect snubber.

ADJUSTMENT OF CABIN DOOR.

1. Use the least amount of shims under one lower door hinge only to obtain the proper fit between the door, door frame and upper door.
2. Trim the outer skin of the door to obtain .06 inch gap between the door skin and fuselage skin along the forward and aft edges and between the door halves.

CABIN ENTRANCE DOOR LATCH ASSEMBLY.

REMOVAL OF DOOR LATCH ASSEMBLY. (Refer to Figure 52-1.)

1. Remove the door trim panel assemblies and the protector panel from behind the steps.
2. Remove the safety latch mechanism from the door assembly by removing the latch spring, attached between latch stop bracket, and door assembly by removing the bolt, washer and eccentric bushing.
3. The safety latch actuator rod can be removed from the safety latch stop bracket by removing the cotter pin and washer.
4. Remove one roll pin from the tube assembly and bushing, located to the rear of the steps.
5. Remove two bolts and shim washers holding the inner handle to the actuator assembly. Note the amount and thickness of shim washers for reference when reinstalling handle.
6. Remove the two door latch covers and the latch springs. Also remove the spring between the door assembly and hook on the tube assembly. Then remove hook.
7. Remove four bolts, washers and locknuts holding the latch mechanisms in place (two on each side).
8. The outer handle can be removed by disconnecting the spring between both halves of the actuator assembly and removing the cotter pin and pin. The handle and half of the actuator can now be removed and further disassembled by removing two screws, shim washers and plate from actuator. Note the amount and thickness of the shim washers removed.
9. Each latch mechanism can be removed by pulling it out of its own side of door assembly.
10. The key lock assembly is removed by removing the retainer nut, washer and weather seal.

INSTALLATION OF DOOR LATCH ASSEMBLY. (Refer to Figure 52-1.)

1. Install key lock assembly into hole in door and secure with weather seal, washer and retainer nut.
2. The latch mechanisms should be installed next, being careful to place each half into its proper place. The latch mechanism with the lock assembly going in the right side of door and aligning the tube assemblies and bushing.
3. Secure latch mechanisms with the four bolts, washers and locknuts, two for each side of door.
4. Assemble outer handle with plate and shim washers and secure to the actuator with two screws. (Use shims to align the handle flush with outer door surface.) Place handle assembly into door and connect to the other half of actuator assembly with pin and cotter pin. Connect the spring between both halves of actuator assembly.
5. Install hook on tube assembly and connect spring between hook and door assembly. Also connect springs on both ends of latch assemblies and lubricate lightly. The door latch mechanism covers can now be installed with five screws for each side.
6. Install inner handle with screws and shim washers. Use only enough shims to keep the handle from rubbing against the trim panel.

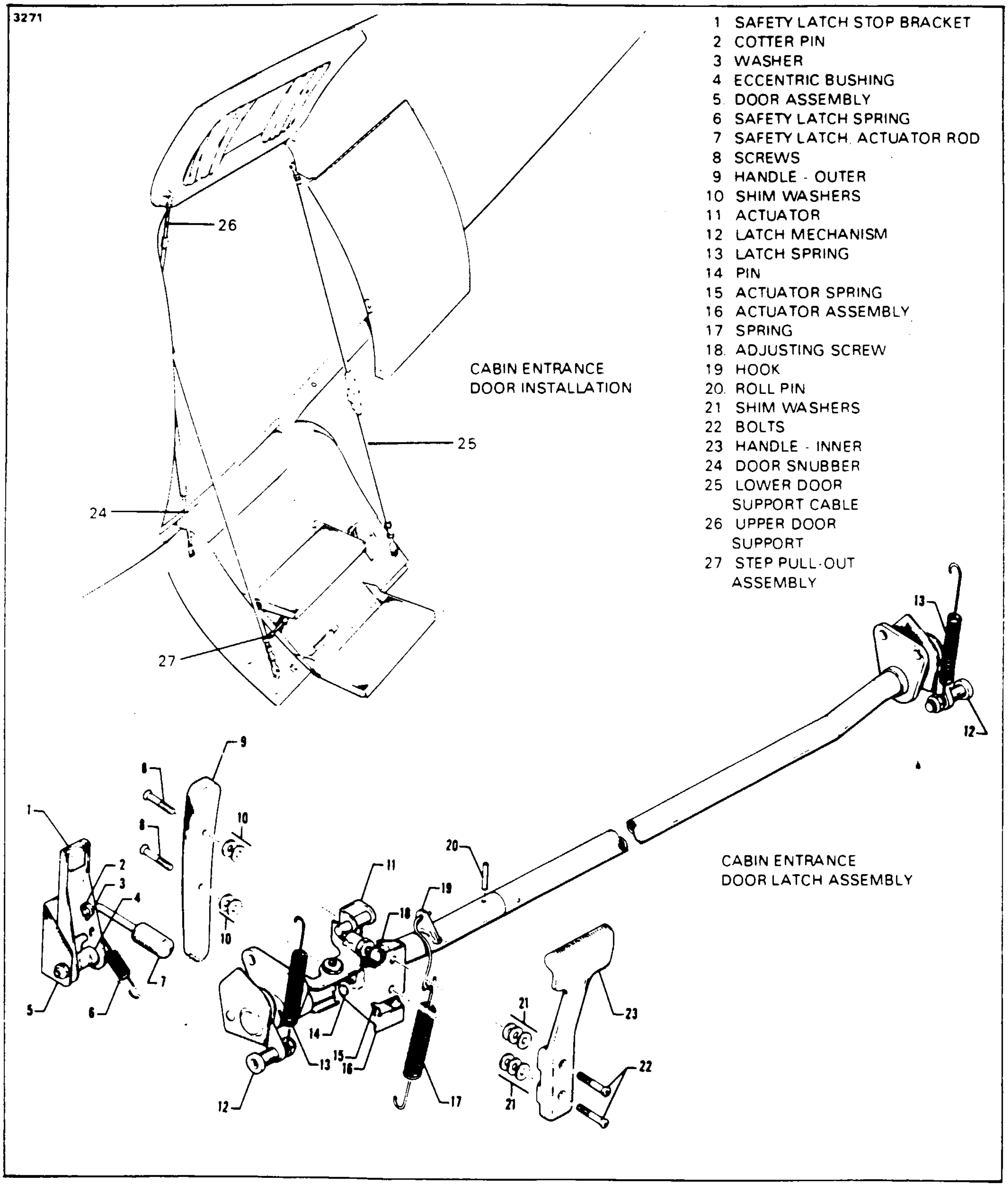


Figure 52-1. Cabin Entrance Door Installation

7. Align the holes in the tube assemblies and bushing, and insert the roll pin.

8. The safety latch actuator rod assembly should be connected to the safety latch stop bracket assembly with washer and cotter pin before installing in door assembly.

9. Install safety latch mechanism into door assembly and adjust the eccentric bushing in latch to position the safety latch with the cam on the tube assembly. Install the spring between the safety latch and door assembly and check for proper engagement of safety latch with the cam. Tighten bolt holding mechanism.

10. Adjust the screw on the door mechanism to remove any excess travel in the outer handle and secure with locknut.

11. Install the protector panel behind the stems, and the door trim panel assemblies with the proper screws.

ADJUSTMENT OF DOOR LATCH ASSEMBLY. (Refer to Figure 52-1.)

1. Remove aft inner door panel.

2. The safety latch mechanism can be adjusted by loosening the pivot bolt and rotating the eccentric bushing to position the safety latch into its proper position with the cam on the tube assembly, which is for the pawl to drop into the cam notch just as the outside door handle becomes flush with the outside skin. Retighten the pivot bolt to lock bushing in correct adjustment.

3. The outside door handle safety lock unlatching mechanism is adjusted by loosening the locknut on the adjusting screw, located next to the inner handle, and turning the screw as required to completely disengage the safety lock before the torque tube starts to rotate as the outside handle is actuated. Secure the locknut after adjustment is complete.

4. Close the lower door without closing the upper door. Completely close the latch, checking to assure safety latch has engaged (inside handle will not open without pushing release button). Check the latch plate spacing on both sides of the door by looking between the door and frame. Ascertain that there is at least 1/16" clearance between the shoulder on the latch pawl and the latch plate and that the pawl is completely engaged to the top of the latch plate notch. The latch plate clearance can be changed by changing the number of washers between the latch plate and the door frame. The pawl engagement can be adjusted by loosening the latch plate screws and sliding the plate vertically. The adjustment of the door "pull in" should be made simultaneously with the engagement adjustment. This can be done by sliding the latch plate horizontally until the door pulls in so that the door skin is flush with the fuselage skin. Retighten latch plate screws securely to hold adjustments. After the last latch adjustment is made, close the door and recheck latch operation and pawl engagement.

5. The door safety pin to pin receptacle clearance should be 1/16". This is checked by closing the bottom door until the latch pawls snap into the latch plates. Do not rotate handle to "lock" position. Look between rear of door and door frame to see distance between the tip of the safety pin and the pin receptacle. If this distance is not correct, adjust the pin actuator rod, inside the door, to obtain the correct setting. Rotate the door handle to full closed position to check safety pin operation.

6. The door ajar warning switches should be adjusted to turn out the warning light just as the latch pawls contact the end of the slots in the latch plates. To accomplish this, turn the adjustment screws (located under both latch plates) counterclockwise until the light goes out when the door is closed; then fine trim each switch individually. Turn one switch adjustment screw clockwise one turn at a time until the light will not go out as the latch is closed; then turn this screw one turn counterclockwise and check that light goes out. Fine trim the other switch in the same manner. Open and close the door several times watching the operation and indicator to ascertain that all latch and indicator parts operate properly.

PILOT DOOR.

REMOVAL OF PILOT DOOR. (Refer to Figure 52-2.)

1. Remove the bolt securing the support assembly to the bottom of the door.
2. Remove hinge pins from upper and lower hinges and carefully pull door away from the fuselage.

— NOTE —

Do not remove the serrated bushings from the door hinge brackets unless in need of replacement. These bushings are either concentric or eccentric in construction and must be replaced with the same type. (Refer to Parts Catalog for appropriate part numbers.)

INSTALLATION OF PILOT DOOR. (Refer to Figure 52-2.)

1. Carefully position the hinges onto the door hinge brackets and insert the hinge pins.
2. Prior to connecting the door support assembly, operate the door latching mechanism to determine if there is a flush fit between the outer skin of the pilot door and the fuselage.

— NOTE —

If the fit is not flush, it will be necessary to remove the door and rotate the serrated door hinge bushing or bushings to obtain hinge center line location that will provide proper door fit.

3. Attach the support assembly to the door.

WEATHERSTRIP INSTALLATION AND SEALING INSTRUCTIONS OF PILOT DOOR.

To obtain an acceptable seal on the pilot door, the seal must apply equal pressure all the way around the striker. This is accomplished in the following manner:

1. Apply EC 1300L cement to seal and mitered joints.
2. Install one piece of seal 87.00 in. from the forward corner up around to the aft lower corner of the door and a piece 38.5 in. along the lower surface of the door.
3. If necessary, use shims (neoprene PMS G0020-1-22) behind the seal to obtain equal pressure and adequate sealing. Neoprene 0.125 thick, Piper P/N 187-361.
4. The striker and water path must be free of any sealant and foreign matter.
5. Install two pieces of clear plastic tubing 1/8 in. OD., 5 in. long covered with a film of seal glyde or Dow Corning lubricant.
6. Insert tube approximately 3 in. into the sealing bead of the striker prior to the sealing operation.
7. Remove all sharp edges from striker joints.
8. With sealant, fill in all irregular surfaces contacting the door seal.

9. Check to see that the latch plate on aft side of door frame extends only to center line of striker be and all edges are smooth to prevent tearing of seal.
10. Fill the empty space behind the forward and aft lower corner fillets of the door frame with sealant to prevent water passing behind these plates to the aircraft interior.
11. Seal the area between the scuff plate, bulkheads, outer skin and bulkheads with PRC 1221B-2 or MIL-S-7505C and smooth with a non-metallic tool.
12. Remove the two pieces of tubing prior to checking for leaks.
13. To check for open water path, funnel small amounts of water into the gap between the pilot door and aircraft skin.

— NOTE —

The water should flow freely from the water path at forward and aft corners of door.

14. Gradually increase the volume of water until water flows from the gap it is being funneled into.
15. A person inside the aircraft can ascertain the sealing of the door.

— NOTE —

It is not a recommended check to place large volumes of water over the aircraft exterior when specifically checking for door seal leaks, as a window leak could appear as if the door seal was leaking.

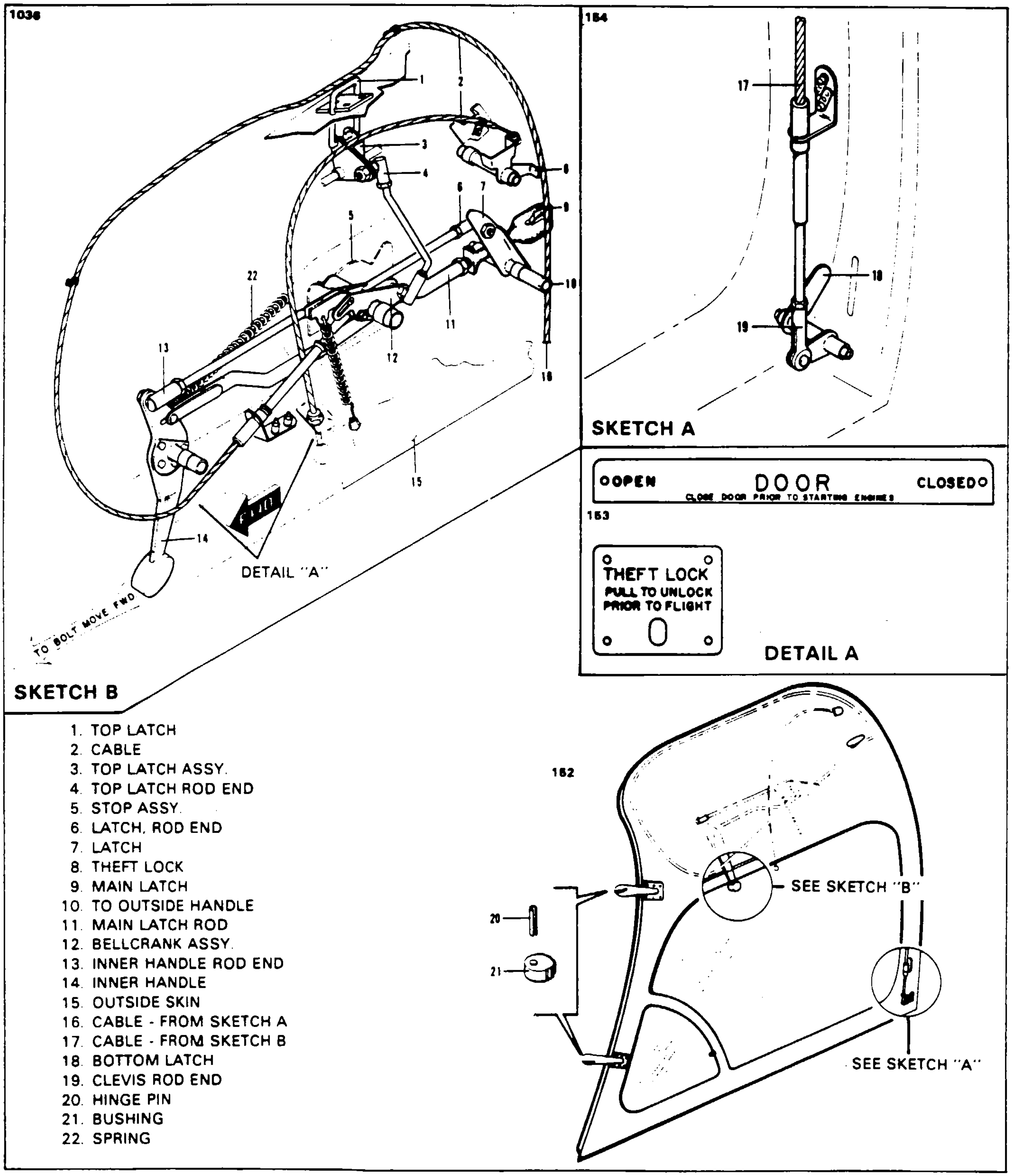
— CAUTION —

The pilot door should not be opened from outside after performing the leak check, as water standing on the scuff plate may have fallen from the overhead seal. However, when opened from inside it can be determined if the door is sealing satisfactorily.

16. The following may be used as an alternate to PRC 1221-2B Product Research Co. (GE RTV-102 silicone weather ban 101) and alternate for EC 847 is (EC 750 Carbolene Neoprene #F1) (1300L per PMS-C10022-4).
17. Door seal (Piper P/N 486 089) is used in all aircraft which have a pilot's door installed.

— NOTE —

Seal P/N 486 089 may be stretched to reduce size to assist door sealing, provided complete all-around seal is maintained.



1. TOP LATCH
2. CABLE
3. TOP LATCH ASSY.
4. TOP LATCH ROD END
5. STOP ASSY.
6. LATCH, ROD END
7. LATCH
8. THEFT LOCK
9. MAIN LATCH
10. TO OUTSIDE HANDLE
11. MAIN LATCH ROD
12. BELLCRANK ASSY.
13. INNER HANDLE ROD END
14. INNER HANDLE
15. OUTSIDE SKIN
16. CABLE - FROM SKETCH A
17. CABLE - FROM SKETCH B
18. BOTTOM LATCH
19. CLEVIS ROD END
20. HINGE PIN
21. BUSHING
22. SPRING

Figure 52-2. Pilot's Door Latch Assembly

ADJUSTMENT OF PILOT DOOR. (Refer to Figure 52-2.)

1. Remove trim panel from pilot's door to gain access to the latching mechanism. Open the door and engage the support assembly.
2. The outside door handle must be parallel with the airplane axis when the handle is in the fully bolted position. The following steps will accomplish this.
   A. Disconnect the rod end connected to the latch.
   B. Loosen the locknut on the latch rod end and rotate the rod end to adjust the outside handle to its proper position.
   C. Connect the rod end to the latch and tighten the locknut.
3. With the handle in the fully bolted position, adjust the bottom latch to obtain the maximum possible travel by adjusting the clevis rod end.
4. The top latch should be adjusted to obtain the best fit between the top of the door and the fuselage skin when the door is closed and bolted. This is accomplished by adjusting the top latch rod end.
5. Install the interior trim panels.

EMERGENCY EXIT.

EMERGENCY EXIT WINDOW.

Removal and installation of the emergency exit window glass is the same as that given for side windows.

EMERGENCY EXIT WINDOW MECHANISM ADJUSTMENT.

Adjustment is made by adjusting two turnbuckles which are located on either side of the emergency exit window frame.

1. Remove the trim panel from between the first and second windows by removing the screws at the panel as well as along the aft side of the first window molding.
2. Remove the trim panel from between the second and third windows by removing the screws that secure the release handle molding and then the screws that secure the trim panel. Pull the panel from the wall.
3. Adjust the turnbuckles of the cables to allow all four latches to position themselves at the same angle to the window channel. Tighten turnbuckles as required to snug up the cables. Move the handle through its full travel to ascertain that the latches move below the surface of the window channel and will also move to the other direction past 90 degrees to the channel. Safety turnbuckles.
4. If removed, reinstall the window frame to the fuselage frame.
5. Check that the window latches are engaged in the window frame by removing the two small plugs in the top and bottom of the molding and ascertaining that the latches are visible at approximately 90 degrees to the frame.
6. Install the trim panels on each side of the emergency exit and secure with screws. Install release handle molding and cover.

CARGO.

CARGO DOOR.

REMOVAL OF CARGO DOOR. (Refer to Figure 52-3.)

— NOTE —

Both upper and lower cabin doors must be open prior to removing the cargo door. Disconnect door support.

1. Remove the lock pin holding the upper and lower cable assemblies together on the right side of the cabin entrance door. Position the clevis of the lower cable assembly onto the eye bolt located directly below the cargo door and insert the lock pin.
2. Disconnect the door support from the door.
3. Pull the door latch full out. Cut and remove hinge pin and pull the door away from the fuselage.

INSTALLATION OF CARGO DOOR. (Refer to Figure 52-3.)

1. Position door and align hinges. Insert new hinge pin and bend both ends.
2. Attach door support assembly to door.
3. Operate the door latch to determine the latch pins engage properly.
4. Remove the clevis securing the lower cable to the eye bolt. Connect the upper and lower cable assemblies together by means of the lock pin attached to the lower cable assembly.

CARGO DOOR LATCH ASSEMBLY.

REMOVAL OF CARGO DOOR LATCH ASSEMBLY. (Refer to Figure 52-3.)

1. Remove bottom trim panel of cargo door.
2. Using access holes in cargo door, locate and remove spring retainer plate and spring.
3. Remove cotter pin and clevis pin securing rod assembly and link to the door latch.
4. Remove bolt, bushing and washer securing the door latch and remove it from its recess.
5. The rod assembly and link with latch pins attached may now be removed from the door.

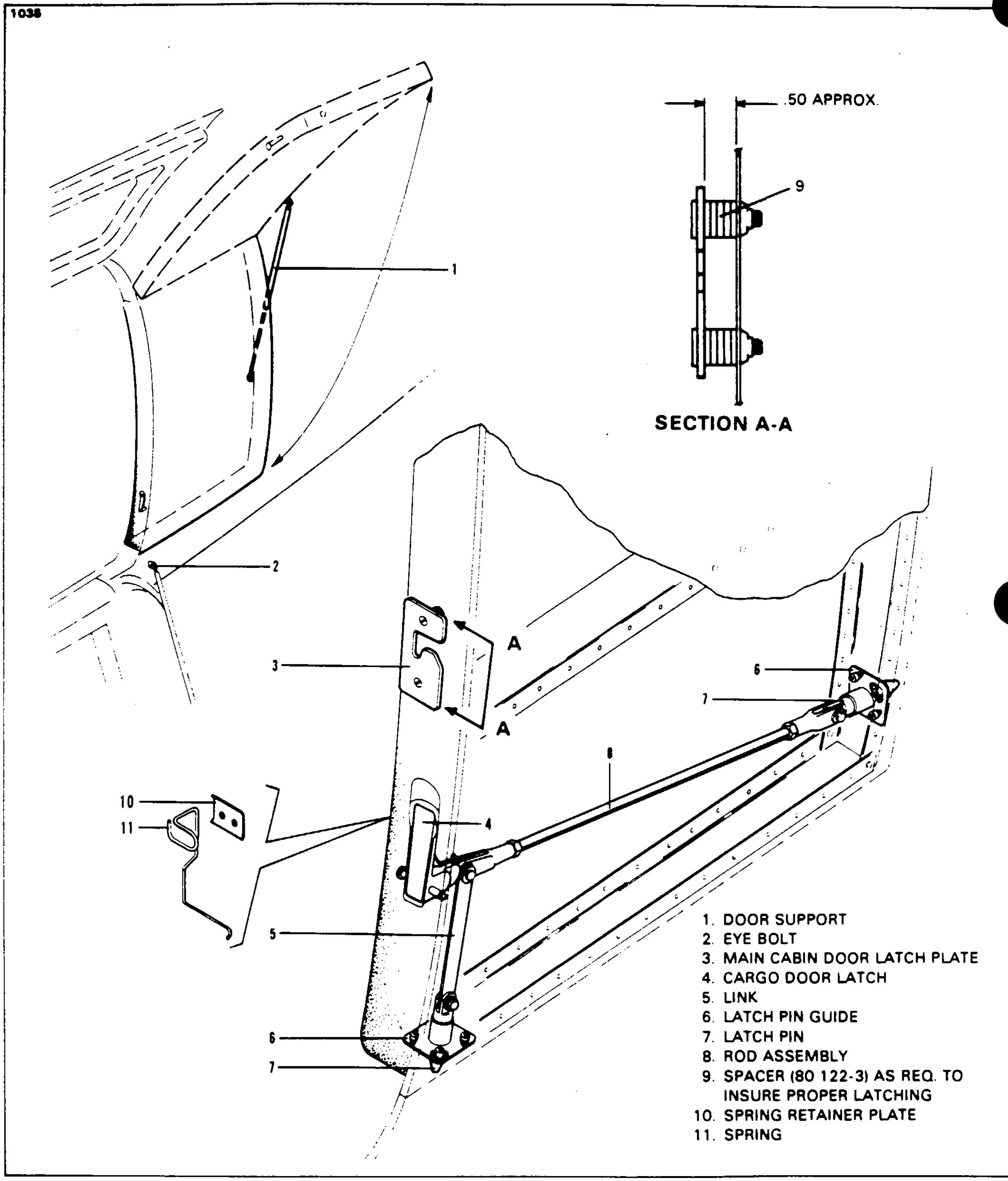


Figure 52-3. Cargo Door Latch Assembly

INSTALLATION AND ADJUSTMENT OF CARGO DOOR LATCH ASSEMBLY. (Refer to Figure 52-3.)

1. Adjustment of the latch assembly is limited to determining that the distance between the center line of the hole in the clevis at end of the rod assembly is 13.88 inches. Securely tighten the locknuts to maintain this dimension.
2. Position the door latch in its recess in the door frame and secure with bolt, bushing and washer.
3. Insert the latch pins on rod assembly and link through their respective guides in the side and bottom door frame.
4. Place the free end of the rod assembly over the end of the handle. Place the free end of the link adjacent to the clevis on the side toward the outer skin. Align the holes and insert the clevis pin, washer and cotter pin.
5. Place the hook end of spring between the clevis and the washer. Secure the other end of the spring in position with retainer plate.
6. With installation complete, operate the door latch to determine the latch pins move in and out of the pin guides smoothly.

WING LOCKER DOORS. (Refer to Figure 52-4.)

The only service required is maintaining a tight fit between the door and door frame. This is accomplished by adjusting the catch assembly. Loosen the attaching screws and move the catch to obtain the desired fit, then retighten the screws.

FORWARD BAGGAGE DOOR.

REMOVAL OF FORWARD BAGGAGE DOOR.

1. With door open and hinges exposed, loosen door support, and then remove the cotter pins and washers from the hinge pins.
2. While supporting door, remove the hinge pins and lower the door for removal.

— NOTE —

When removing the forward baggage door disconnect the baggage door light switch from the electrical system to prevent draining of the battery.

INSTALLATION OF FORWARD BAGGAGE DOOR.

1. While supporting door, align the hinges in the hinge bracket assemblies and insert the hinge pins.
2. Replace the washers and insert the cotter pins into the ends of the hinge pins.

FORWARD BAGGAGE DOOR LATCH ASSEMBLY.

REMOVAL OF FORWARD BAGGAGE DOOR LATCH ASSEMBLY.

1. Removal procedure for forward baggage door tube and arm assemblies is as follows:
   A. With the door open, remove the six machine screws holding the inside cover and remove the cover from door assembly.
   B. Disconnect the spring between the link and tube assembly. Also remove two other springs located on either side of the tube assembly to the baggage door assembly.
   C. Remove the roll pin, located between the tube assembly and door handle. Also remove the spring link at this time.
   D. Remove six machine screws (three on each end) holding the arm assemblies to the door assembly and remove the tube with both arm assemblies from door.
   E. The arm assemblies can be removed from the clevis end of the tube by removing the cotter pins, washers and pins.
2. Removal procedure for forward baggage door handle assembly is as follows:
   A. Disconnect roll pin located between the tube assembly and the handle if not previously done.
   B. Remove six locknuts and machine screws holding the handle and bracket and remove from door assembly.
   C. The handle can be removed from the bracket by removing the cotter pin, washers and pin.
3. Removal procedure for forward baggage door key lock assembly is as follows:
   A. Remove two screws from the outside of the door to disconnect the lock quide plate assembly located on the inside of door.
   B. The key lock assembly can now be removed by removing the retaining nut and washer from the back of the key lock assembly.

INSTALLATION OF FORWARD BAGGAGE DOOR LATCH ASSEMBLY.

1. Procedure for installing the key lock assembly is as follows:
   A. Insert the key lock assembly from the back side of door with the latching arm towards the handle cut out on door.
   B. Replace the washer and retaining nut to back of lock and secure.
   C. Install lock guide plate and secure with two screws from outside of door.
2. Procedure for installing baggage door handle assembly is as follows:
   A. The handle and bracket can be assembled if previously taken apart by placing handle into bracket with two washers between handle and bracket and inserting the roll pin.
   B. Replace the handle and bracket assembly into the back of the door with the handle to the outer skin of door. Secure assembly with six machine screws and locknuts.
   C. If tube assembly was not removed, replace the roll pin between the tube assembly and handle and also replace the spring link. Secure with roll pin.

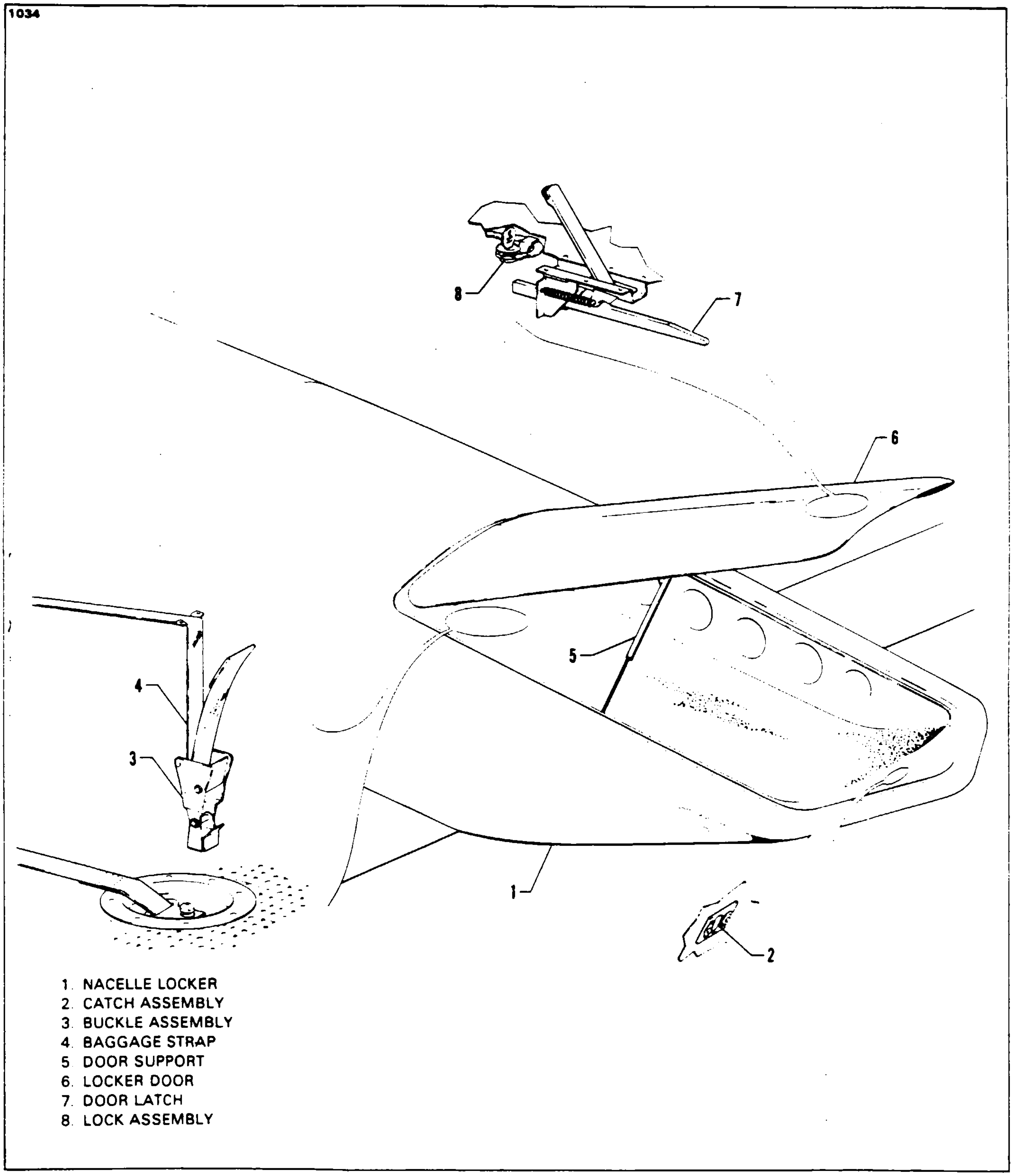


Figure 52-4. Nacelle Wing Locker Latch Assembly

3. Installation procedure for baggage door tube and arm assemblies is as follows:

A. Secure the arm assemblies to the clevis ends on the tube assembly with pins, washers and cotter pins. Be certain that the proper arm assembly is on each end of tube.

B. The complete tube and arm assembly can now be placed onto the rear of the door, making certain that the projection on the tube aligns with the projection on the handle. Replace the six machine screws (three on each end) to hold the arm assemblies to the door.

C. With all holes in both projection and the spring link aligned, insert the roll pin.

D. Connect the three springs at this time. One between the spring link and the tube, and two between the tube assembly and the door assembly.

E. Adjustment should be made at this time before replacing cover. Use the six machine screws to secure the cover on the door assembly.

ADJUSTMENT OF FORWARD BAGGAGE DOOR LATCH.

Adjustment is done through the removal of the cover and adjustment of two clevis fittings located at the ends of the tube assembly.

1. Remove the cotter pin, washer and pin from the clevis and arm assemblies and loosen the locknuts between clevis and tube.
2. With handle in the closed position, turn the clevis in or out to get the arms of the arm assemblies to extend out at a 90 degree angle to the edge of the door assembly.
3. When the adjustment is completed, tighten the locknuts and reconnect the clevis and arm assemblies with the pins, washers and cotter pins. Replace the cover and secure with six machine screws.

CARGO POD DOORS.

FORWARD CARGO POD DOOR.

REMOVAL OF CARGO POD DOOR.

1. Unlatch and open door.
2. Disconnect the gas spring (snubber) from the fitting on the inside of the door.
3. Remove the screws which secure the hinge to the cargo pod.
4. Remove the door and hinge assembly from the cargo pod.

INSTALLATION OF CARGO POD DOORS.

1. Position the cargo door and hinge on the side of the cargo pod. Apply a small bead of RTV sealant to the hinge and secure it in place with the screws.
2. Connect the gas spring (snubber) to the fitting on the inside of the door.
3. Close and pen the door, checking the operation of the door gas spring (snubber) and door ajar warning light.

CARGO POD DOOR LATCHING MECHANISM. (Refer to Figure 52-5.)

REMOVAL AND DISASSEMBLY OF CARGO POD DOOR LATCHING MECHANISM.

1. Unlatch and open the door.
2. Remove the retaining nut from the back of the handle.
3. Remove the screws and nuts which secure the plunger guides to the door.
4. Unhook the spring from the forward pushrod.
5. Remove the latching mechanism from the door.
6. The door latching mechanism may be disassembled as follows:
   A. Slide the spring washer off of the handle assembly and slide the handle assembly out of the latch handle plate.
   B. Slide the plungers from the guides.
   C. Remove the cotter pin, pin and washer from the plunger and pushrod.
   D. Remove the cotter pin, pin and washer from the latch plate and pushrod.

ASSEMBLY AND INSTALLATION OF DOOR LATCHING MECHANISM. (Refer to Figure 52-5.)

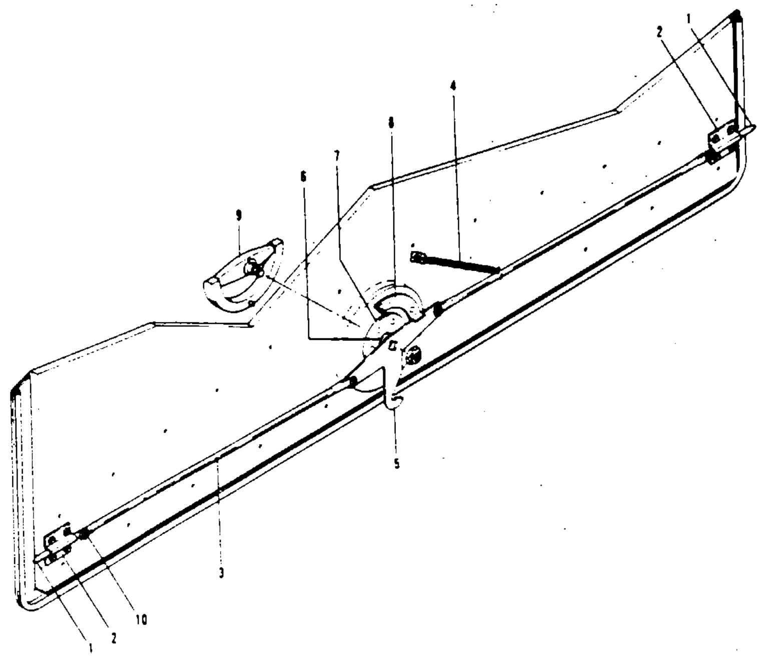
1. To assemble the door latching mechanism:
   A. Attach the latchplate to the pushrods with the pin, washer and cotter pin.
   B. Attach the plungers to the pushrods with the pin, washer and cotter pin.
   C. Slide the plungers into the guides.
   D. Slide the handle assembly through the door into the latch handle plate. Slide the spring washer onto the handle assembly.
2. Position the door latching mechanism on the door secure the handle to the latchplate assembly with the nut.
4. Secure the plunger guides to the inside of the door with the screws, washers and nuts.
5. Attach the spring to the forward pushrod.
6. Check the operation of the door latching mechanism.

CARGO POD DOOR SEAL INSTALLATION.

The cargo pod door seals are bonded to the inside of the doors as follows:

— NOTE —

The seals are installed in two pieces (per door). One piece is attached the length of the upper side of the door. The other piece is attached the length of the three remaining sides. The pieces join at the upper corners of the door, forming a 45° miter joint.



1. PLUNGER
2. PLUNGER GUIDE
3. PUSHROD
4. SPRING
5. LATCHPLATE ASSEMBLY
6. SPRING WASHER
7. LATCH HANDLE PLATE
8. LATCH STOP PLATE
9. HANDLE ASSEMBLY
10. PIN

01900

Figure 52-5. Cargo Pod Doors Latching Mechanism

1. Remove all traces of the old seal and old cement.
2. Cover both surfaces to be joined with a thin even coat of 3M Scotch Grip 2210. 3M Adhesive EC-1300L or Delta Laboratories Inc. Contact Adhesive B10161.
3. Allow the adhesive to dry for 15 minutes minimum, 60 minutes maximum. If the adhesive is allowed to dry more than 60 minutes, another coat may be applied to one of the surfaces, and then bonded after 15 minutes minimum. Both surfaces do not need to be tacky to achieve a bond.
4. Assemble materials when adhesive is dry to the touch, but tacky under slight pressure.
5. Position the surfaces to be joined carefully before allowing adhesive to adhesive contact. Repositioning after contact will not be possible without destroying the bond. If this occurs, remove the adhesive and repeat the cementing process, beginning with step 1.
6. Press firmly into position over the entire area of the bond.

DOOR WARNING.

DOOR AJAR SWITCHES.

REMOVAL OF DOOR AJAR SWITCH (CABIN DOOR).

The switch is located in the upper half of the cabin entrance door.

1. Remove the screws that hold the trim molding and safety catch to the upper door molding. Remove the molding.
2. Disconnect the two wires connected to the switch and mark them for positive identification when switch is reinstalled.
3. Remove the two locknuts, washers and bolts that secure the switch to the bracket on the door. The switch can now be removed.

INSTALLATION OF DOOR AJAR SWITCH (CABIN DOOR).

1. Install the switch in door and secure to bracket with two bolts, washers and locknuts.
2. Connect the two wires to the switch, in their proper place.
3. Replace the trim molding and safety catch. Secure with proper screws.

ADJUSTMENT OF DOOR AJAR SWITCH (CABIN DOOR).

There is a spring striker plate located on the lower half of the entrance door that can be adjusted to obtain the proper indication of the door condition.

1. Close both the upper and lower halves of the cabin entrance door and lock.
2. Apply pressure from inside the door and press the safety latch button. Pull the inner handle to unlock the door. The ajar switch should activate before the doors are completely unlatched. Make certain that the switch activates before the handle has reached a 90 degree position to the door.
3. Remove the trim cover over the end of the strap handle on lower door and loosen the screw holding the spring striker plate. Slide the plate to get the proper indication of ajar switch.
4. When adjustment is satisfactory, tighten the screw holding the striker and replace the trim cover over the end of the strap handle.

— END —

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 to house the nose landing gear, forward baggage, avionics, crew and passengers. Attachment points are provided for the wings, cabin door, cargo door and empennage.

DESCRIPTION.

The fuselage is an all metal semi-monocoque structure. The overall length of the fuselage, including tail cone, is 440.0 inches. The fuselage is constructed of bulkheads, stringers, stiffeners and longitudinal beams, all of which the outer skin is riveted to. Windows include a two piece windshield, five windows along the left side and six windows along the right side. The four forward windows are double pane while the aft or triangular shaped window is a single pane. A storm window is located in the forward lower section of the pilot's side window; when the latch at the lower side is released, the window will swing in and forward. An emergency exit is an integral part of the second right window and is jettisonable when the release just aft of the exit is pulled. The cabin entrance door is located on the left side of the fuselage just aft of the wing. The door separates at the middle with the upper half swinging up and the lower half swinging down to provide cabin entrance steps.

A pilot's door is available as an option.

The pilot's door is located adjacent to the pilot's seat and permits rapid entrance to or exit from the cockpit without the necessity of going the full length of the cabin.

The cargo door is located immediately aft of the cabin entrance door. This door swings up but only after the cabin entrance door has been opened. This door permits rapid loading and storage of cargo and also facilitates loading items normally too bulky to pass through the cabin entrance door.

All components are completely zinc chromate primed and exterior surfaces are coated with Titanine Polyurethane.

— END —

CHAPTER

55

STABILIZERS

CHAPTER 55 - STABILIZERS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The stabilizers consist of the vertical stabilizer (fin), rudder with trim tab, horizontal stabilizer, and elevator with trim tab. The control surfaces are cable controlled, and are statically balanced.

CONTROL SURFACE BALANCING.

CHECKING CONTROL SURFACE BALANCE.

The movable control surfaces have been balanced at the time of installation at the factory and normally need not be rebalanced unless the surfaces have been repainted, repaired or replaced. Each control surface must be complete including paint, trim tab where required, balance weights, static wicks, etc. Tabs must be held in neutral position with a small piece of tape. Tab actuating rods must be in place and connected to the tab. The forward end of the actuating rods must be disconnected from the attachment points. Disconnected actuating rods (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 (+.0 -.04 oz.) Test Weight: Small weight added to the master test weight during balancing procedure when the surface is trailing edge heavy with the basic master test weight installed.
7. Trim Weight: Small weight or weights added to the surface balance weight to bring the surface within tolerances. (Sometimes required depending on variations in surface construction.)

HORIZONTAL STABILIZER.

REMOVAL OF HORIZONTAL STABILIZER. (Refer to Figure 55-1.)

1. Remove the left and/or right elevator assemblies per Chapter 55.
2. Remove the access plates located on each side of the fuselage under the horizontal stabilizers and the panel located on top of the fuselage aft of the vertical fin.
3. Remove the access panel to the aft inside section of the fuselage.
4. To remove the right stabilizer, locate the elevator trim cable turnbuckles in the aft section of the fuselage, mark the ends of one turnbuckle to facilitate reinstallation, and block the cables at one of the fuselage bulkheads and in the stabilizer to prevent the trim cables from unwinding.
5. Disconnect the trim cables.
6. Through the top access hole, remove the two elevator trim cable pulleys, spacer and bolt. Draw the cables through the fuselage to this point.
7. Disconnect the elevator trim tab control tubes and deicer lines.
8. Remove the mounting bolts that attach the front spar to the fuselage bulkhead.
9. Remove the mounting bolts that attach the elevator torque tube hinge bracket and rear spar.
10. Pull the stabilizer directly away from the fuselage.

INSTALLATION OF HORIZONTAL STABILIZER. (Refer to Figure 55-1.)

1. Trial fit to ascertain gap between stabilizer and fuselage skin surface is .187 of an inch. Trim to obtain this gap.
2. Ascertain that the sealer extrusion is attached to the inboard side of the elevator.
3. Put the stabilizer in position and align the front and rear spar mounting holes. If installing a right stabilizer, guide the elevator trim cables and sender wires into the fuselage.
4. Position the elevator torque tube hinge bracket and temporarily install the rear spar mounting bolts.
5. Install the front spar mounting bolts, washers and nuts.
6. Tighten all mounting bolts.
7. If the right stabilizer was removed, enter through the top access hole and route the trim tab control cables forward and install cable pulleys.
8. Connect the trim cable ends and set cable tension. (Refer to Chapter 27.)
9. Install the elevator(s) assemblies per Chapter 55.
10. Check elevator trim and elevator operation. (Refer to Chapter 27 for the rigging and adjustment of elevator and elevator trim controls.)
11. Install all access plates and panels.

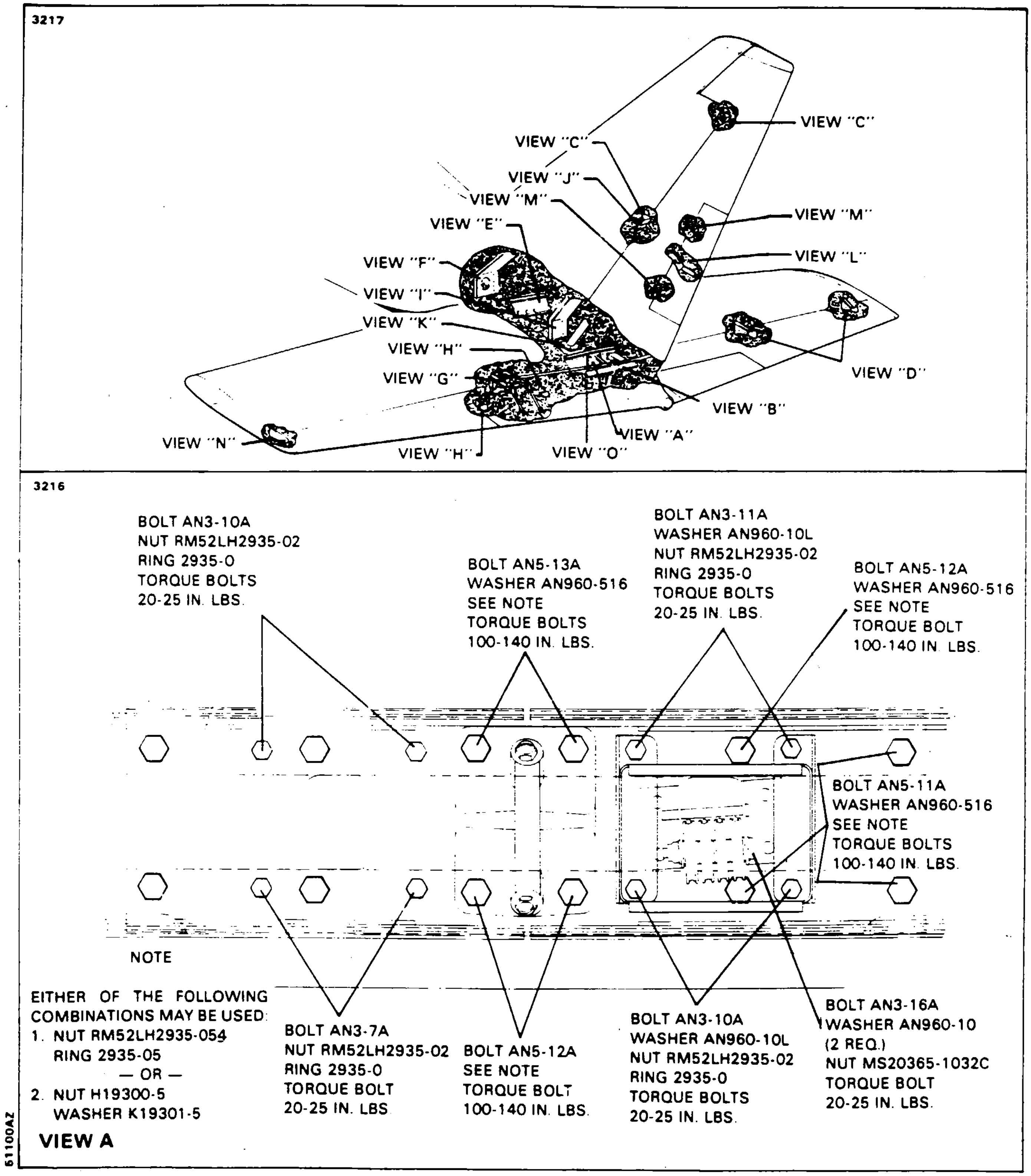


Figure 55-1. Empennage Installation

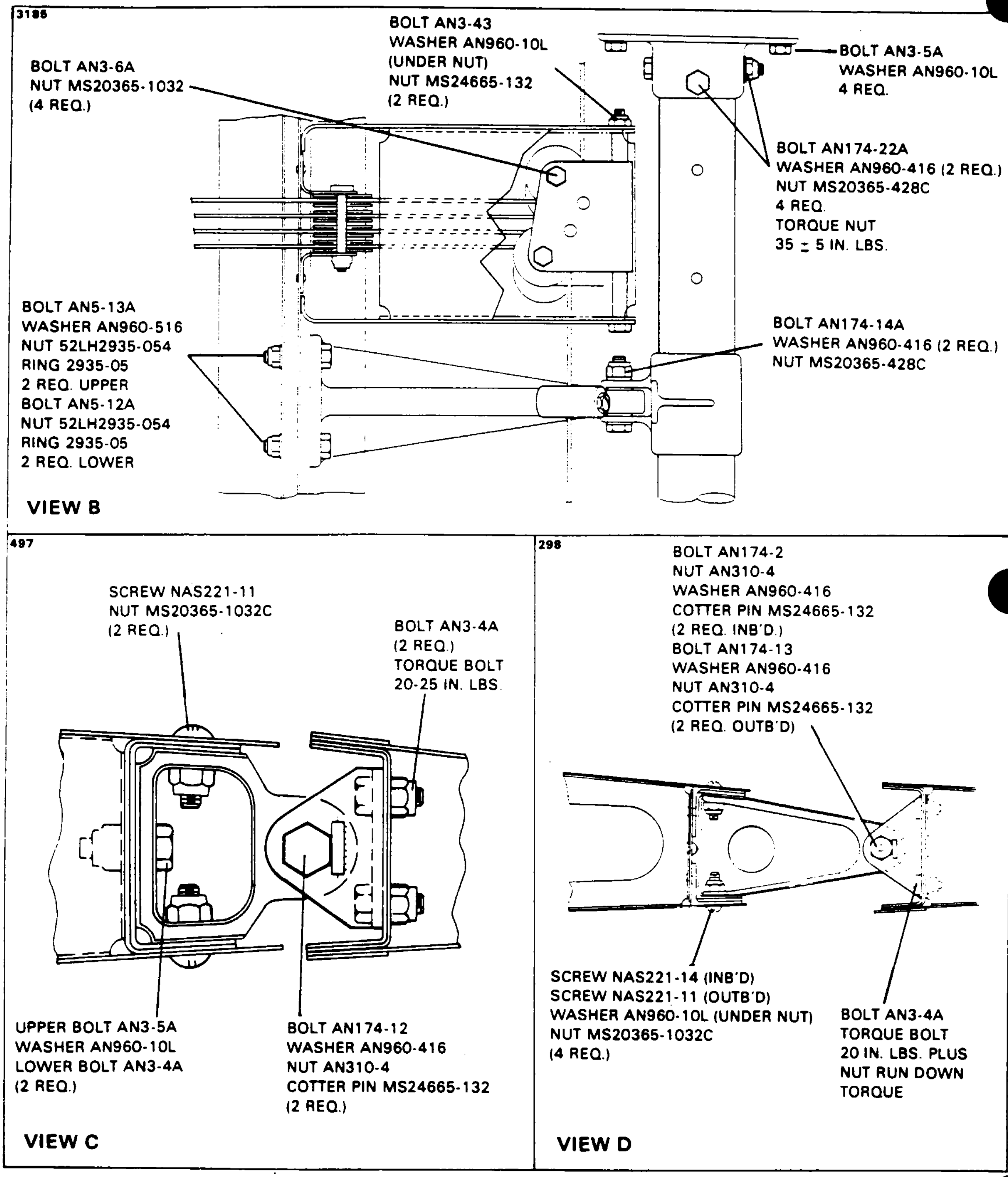


Figure 55-1. Empennage Installation (cont.)

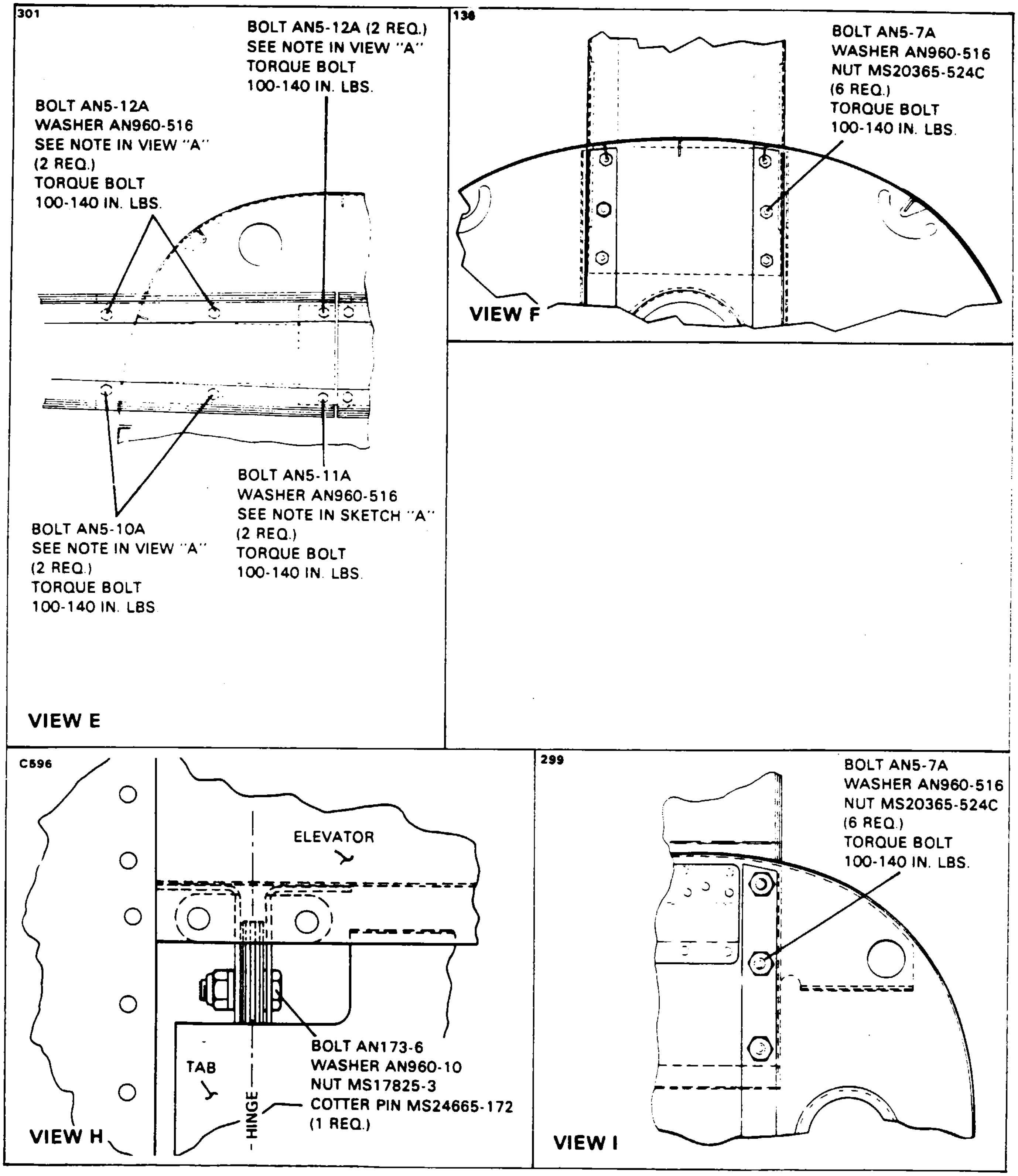


Figure 55-1. Empennage Installation (cont.)

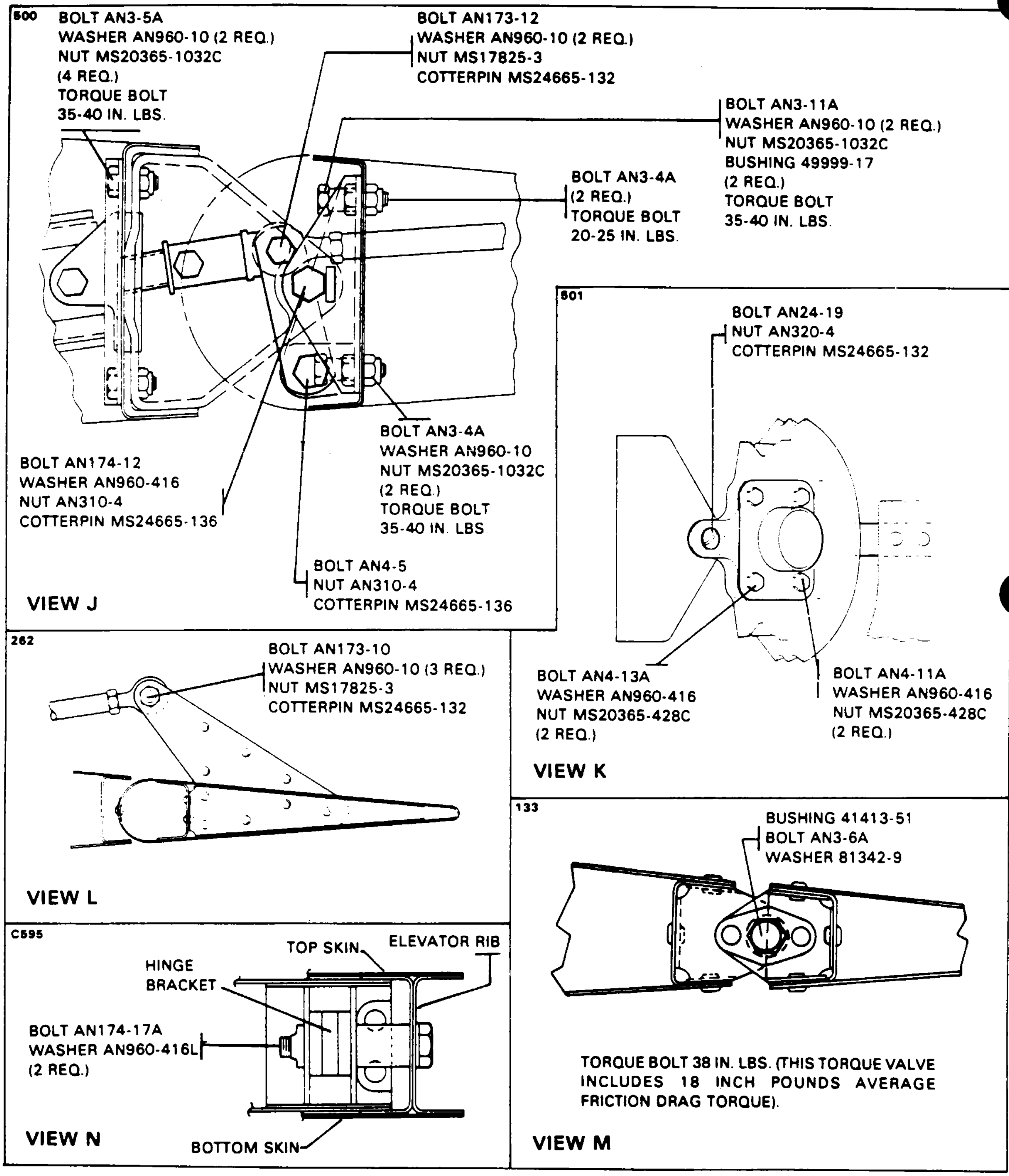
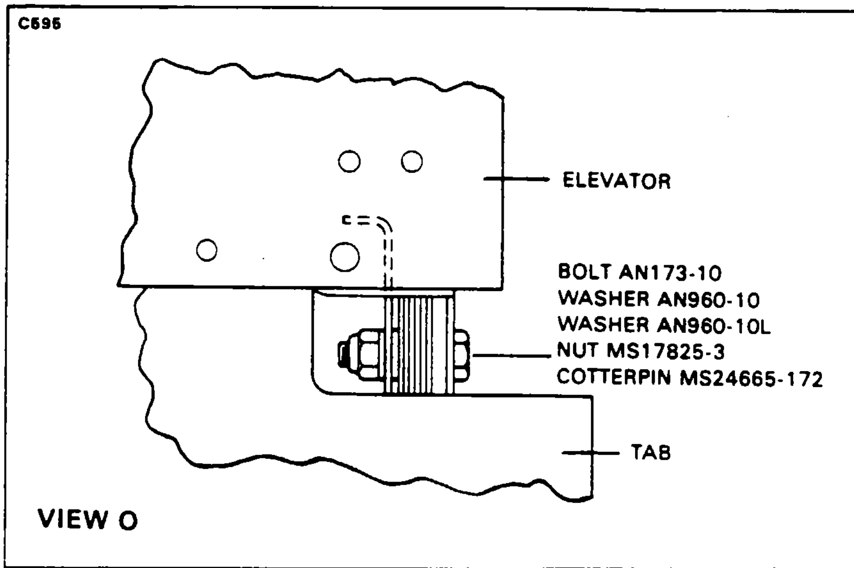


Figure 55-1. Empennage Installation (cont.)



NOTE

DO NOT TIGHTEN BOLT UNTIL TAB LINKAGE HOOKUP IS COMPLETE, THEN TIGHTEN EQUALLY AS REQUIRED TO REMOVE DRUM END PLAY BEING CAREFUL NOT TO OVER TIGHTEN CAUSING BEARING PRE-LOAD

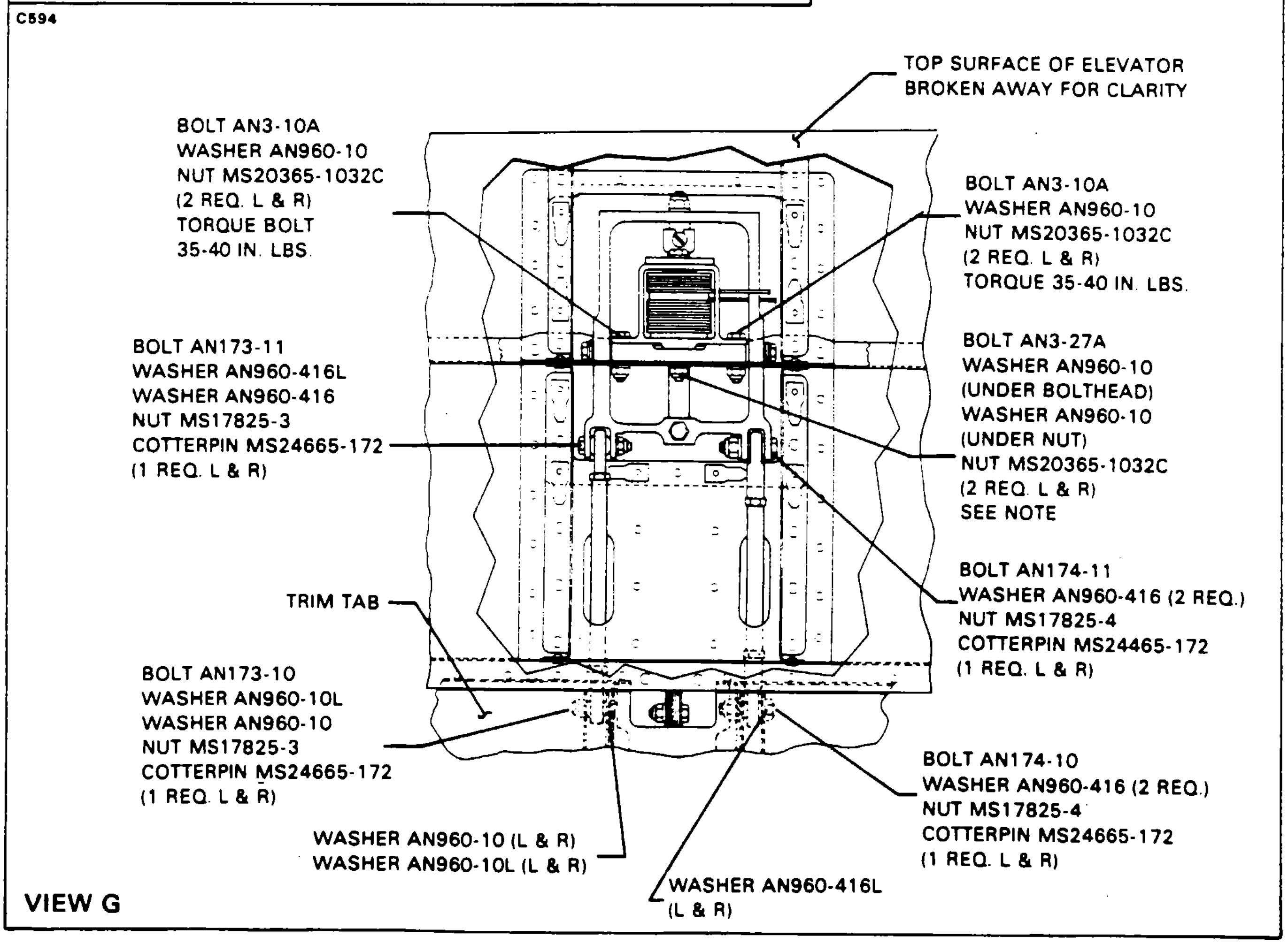


Figure 55-1. Empennage Installation (cont.)

ELEVATOR.

REMOVAL OF ELEVATOR. (Refer to Figure 55-1.)

1. Remove the screws that attach the fuselage tail cone, pull the cone back far enough to disconnect the navigation light wires and then remove the tail cone.
2. At the right elevator, disconnect the trim tab control rod.
3. Remove the bolts that attach the elevator torque tube bracket to the elevator.
4. Remove hinge bolts and remove elevator.
5. To remove the elevator torque tube assembly, after the elevators have been removed, disconnect the elevator push-pull rod at the control arm.
6. Remove the hinge bolt and separate the torque tube assembly from its mating hinge bracket.

INSTALLATION OF ELEVATOR. (Refer to Figure 55-1.)

1. Place the elevator torque tube assembly in position with its mating hinge bracket.
2. Install hinge bolt assembly, torque and safety.
3. The elevator push-pull rod may be connected to the arm of the torque tube assembly.
4. Place the elevator in position, install bolt assembly and torque.
5. Install bolts attaching the torque tube bracket and elevator. Ascertain that the elevator halves align and tighten bolts (use a protractor to check the angle between elevators).
6. Insert the elevator trim tab control rod through the right elevator and secure in position. Torque bolt.
7. Check elevator and tab for proper operation and travel. (Refer to Chapter 27 for rigging.)
8. Connect the navigation light wires and place the tail cone assembly in position. Start all screws with washers and then tighten.

REMOVAL OF ELEVATOR TRIM TAB. (Refer to Figure 55-1.)

1. Disconnect the control rod at the tab.
2. Remove the hinge bolts securing the tab.

INSTALLATION OF ELEVATOR TRIM TAB. (Refer to Figure 55-1.)

1. Place the trim tab in position, install bolts and torque.
2. Position the tab control rod, install bolt and torque.
3. For rigging and adjustment refer to Chapter 27.

ELEVATOR TRIM TAB FREE PLAY.

1. Position the trim tab so that the trailing edge of the tab is .50 inch $\pm$ .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 trailing edge of the elevator.

CHART 5501. ELEVATOR BALANCE SPECIFICATIONS

Master Test Weight (Pounds)	3.40 lbs. $\pm$ .16 oz.
Master Test Weight Arm (Inches)	8.03 in.
Static Balance Limit (Inch-Pounds) Trailing Edge Heavy	$31^{+0}_{-.15}$ in. lbs.
Weight of Lead Balance Weight (Pounds)	4.1 lbs. $^{+.16\ oz.}_{-0\ oz.}$
Trim Weight Part Number (Left and Right)	None
Maximum Number of Trim Weights Allowed per Side	None
Maximum Allowable Balance Weight per Side In Pounds	4.40 lbs.
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.	

PP550022

ELEVATOR BALANCING PROCEDURE. (Refer to Figure 55-2.)

1. Remove the complete (both halves) elevator assembly from the airplane. The complete assembly including trim tab and actuating rod must be assembled and placed on a balancing jig.
2. Fabricate a test weight in accordance with specifications in Chart 5501.
3. With the elevators assembled and mounted in the jig, establish a horizontal reference mark which aligns with the trailing edge of the elevator when held in a level position (chord line level). Ascertain that the assembly rotates freely with no binding at knife edges.
4. Hang the fabricated master test weight over the elevator counterbalance assembly as shown in Figure 55-2. 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 material evenly from both sides.
7. If the elevator is trailing edge heavy with just the specified master test weight installed, then it must be determined that elevator does not exceed the maximum static limits per Chart 5501.

8. Add individual 0.1 pound test weights to master test weight until the elevator balances. If the number of 0.1 pound test weights does not exceed the maximum allowed per Chart 5501, the elevator is within the static balance limits.

9. If the number of 0.1 pound test weights added to the master test weight exceeds the maximum allowable, the elevator balance exceeds the maximum and it will be necessary to determine the cause of the imbalance. If the cause of the imbalance cannot be determined, contact Piper Aircraft Corporation, Lock Haven, Pennsylvania.

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 eleven pounds with 43 ± 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.
5. Repeat above raising and lowering processes until average forces are obtained.
6. The "Total Friction" is obtained by subtracting the two forces.

— NOTES —

1. ***Do not exceed 60 pound force for any measurement.***
2. ***The elevator shall be rotated with a steady movement and the force reading taken when the elevator is passing through the neutral position. Do not stop rotation when taking the reading.***

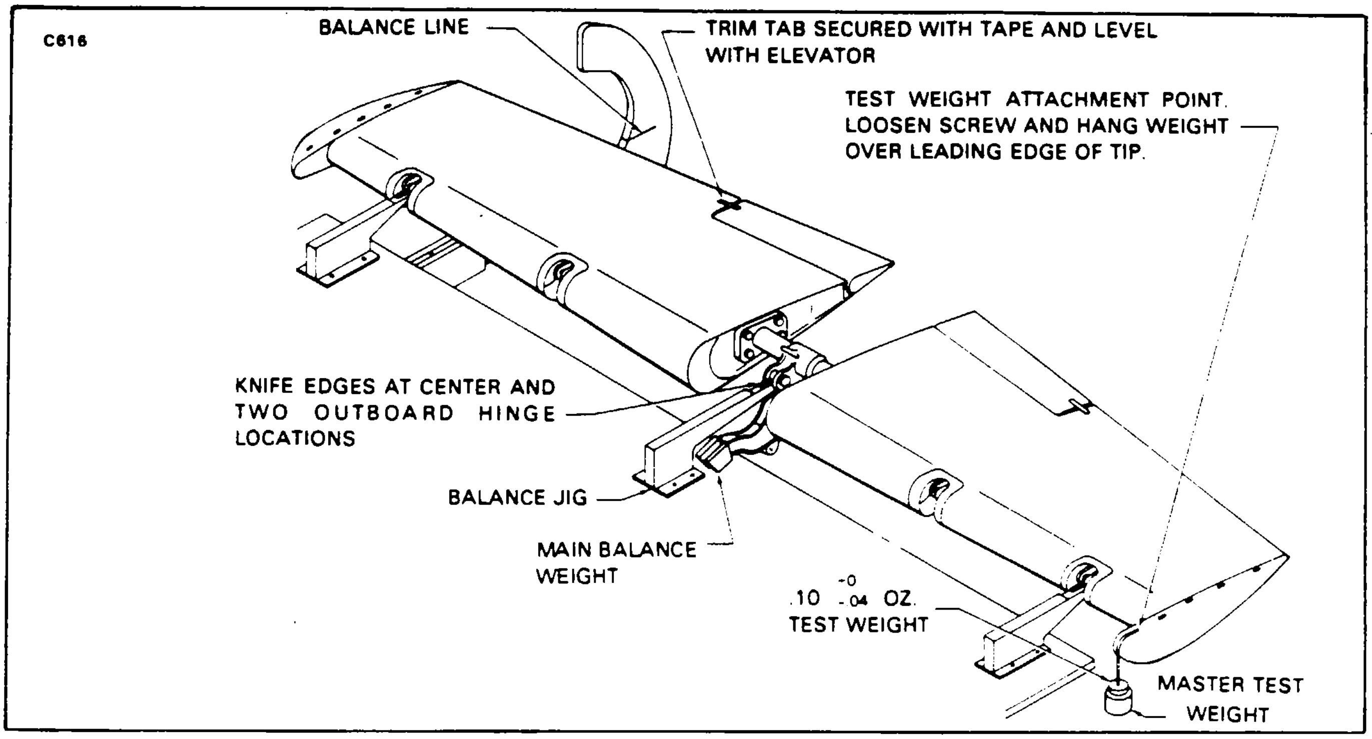


Figure 55-2. Elevator Balancing

THIS SPACE INTENTIONALLY LEFT BLANK

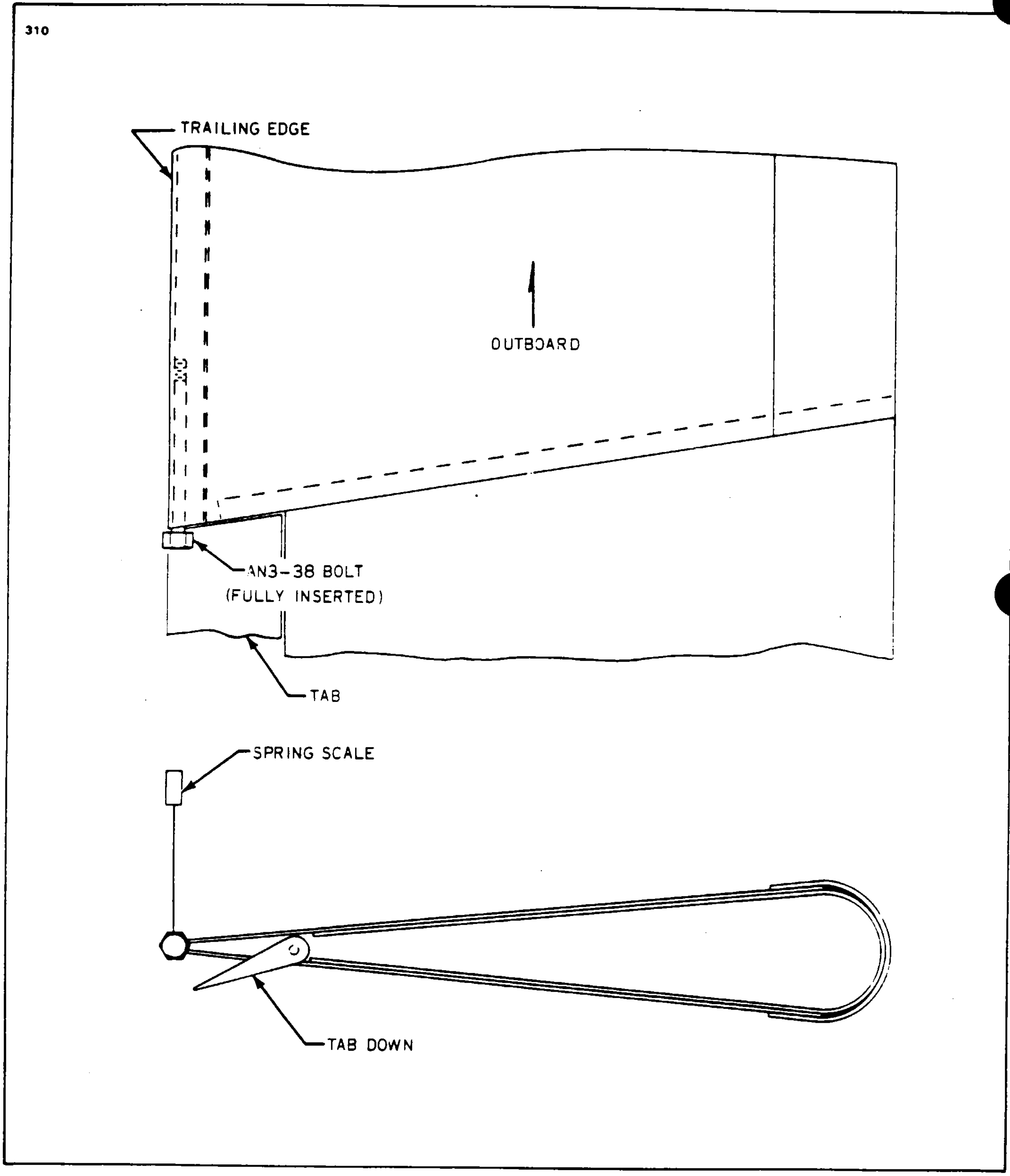


Figure 55-3. Friction Measurement

VERTICAL STABILIZER.

REMOVAL OF VERTICAL STABILIZER. (Refer to Figure 55-1.)

1. Remove the forward fin fairing which is a portion of the dorsal fin.
2. Disconnect the rotating beacon wire, rudder tab sender wires, radio antenna cable and deicer line.
3. Disconnect the antenna wire from the top of the stabilizer.
4. Remove the access plates located on each side of the fuselage, under the horizontal stabilizer and the panel located on top of the fuselage, aft of the vertical fin. The tail cone may be removed if desired.
5. Remove the access panel to the aft inside section of the fuselage.
6. Remove the rudder.
7. Locate the rudder trim cable turnbuckles in the aft section of the fuselage, mark the ends of one turnbuckle to facilitate reinstallation and block the cables in the aft section of the fuselage and in the rudder to prevent the cable from unwinding.
8. Disconnect the trim cables.
9. Through the right fuselage access holes, remove the two sets of trim cable pulleys, spacers and bolts.
10. Remove the mounting bolts that attach the front spar to the fuselage bulkhead.
11. Remove the mounting bolts that attach the rear spar to the fuselage bulkhead.
12. Pull the stabilizer directly up from the fuselage.

INSTALLATION OF VERTICAL STABILIZER. (Refer to Figure 55-1.)

1. Trial fit to ascertain gap between stabilizer and fuselage skin is .187 of an inch. Trim to obtain this gap.
2. Ascertain that the sealer extrusion is attached to the lower side of the vertical stabilizer.
3. Install the rear spar mounting bolts and nuts temporarily.
4. Install the front spar mounting bolts, washer and nuts. Tighten, but do not torque at this time.
5. Install rear mounting bolts, washer and nuts.
6. If removed, position the lower rudder hinge bracket and install mounting bolts.
7. Reinstall the front spar mounting bolts.
8. Torque all mounting bolts.
9. Route the rudder trim cable forward and install the two sets of cable pulleys.
10. Connect the trim sender wires.
11. Connect the trim cable ends, remove cable blocks and set cable tension. (Refer to Chapter 27.)
12. Install the rudder.
13. Check rudder trim and rudder operation. (Refer to Chapter 27 for the rigging and adjustment of rudder and rudder trim controls.)
14. Install all access plates and panels.

RUDDER.

REMOVAL OF RUDDER. (Refer to Figure 55-1.)

1. Relieve cable tension from the control system by removing the floor panel to the left of the control pedestal and loosen one of the rudder cable turnbuckles.
2. Remove the access panel located on top of the fuselage, aft of the vertical fin.
3. With the control cable tension relieved, disconnect the control cable from the rudder sector.
4. Disconnect the rudder trim control rod at fin and tape to rudder with tab in neutral position.
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 sector.
4. Adjust the control cable turnbuckle previously loosened to obtain proper cable tension as given in Chapter 27, with the rudder and control wheels centered.
5. Check rudder for proper operation. (Refer to Chapter 27.)
6. Install fuselage and cabin access panels.

REMOVAL OF RUDDER TRIM TAB. (Refer to Figure 55-1.)

1. Disconnect the control rod at the tab.
2. Remove the hinge bolts securing the tab.

INSTALLATION OF RUDDER TRIM TAB. (Refer to Figure 55-1.)

1. Place the trim tab in position and secure with bolts and bushings.
2. Attach the tab control rod.
3. Refer to Chapter 27 for adjustment and rigging.

RUDDER BALANCING PROCEDURE. (Refer to Figure 55-4.)

1. Remove the rudder from the airplane.
2. Place the rudder horizontally on the balance jig.
3. Fabricate a master test weight per specifications given in Chart 5502 and hang it in the existing tool hole in the rudder counterbalance channel. Ascertain that the tool hole is located to provide the proper master test weight arm as shown in Figure 55-4 and specified in Chart 5502.
4. If the rudder balances with just the specified master test weight, the surface is at the minimum static limits per Chart 5502 and is satisfactory.

5. If the rudder is leading edge heavy with the master test weight installed, trim weights (if installed) or material must be removed from the surface balance weight until a balanced condition is obtained. This would also result in the lower static limit.

6. If the rudder is trailing edge heavy with the master test weight installed, it must be determined that the rudder does not exceed the maximum static limits per Chart 5502.

7. Add individual 0.1 pound test weights to the master test weight until the rudder balances. If the number of 0.1 pound test weights added does not exceed the maximum allowable per Chart 5502, the rudder is within the static limits.

8. If the number of 0.1 pound test weights added to the master test weight to balance the rudder exceeds the maximum allowable per Chart 5502, the rudder balance exceeds the static limits and trim weights must be added to the rudder to produce a balanced condition. (Refer to Chart 5502 for the trim weight part number and the maximum amount allowed for the particular rudder assembly being balanced.)

— NOTE —

During this procedure, the master test weight must carry no more than the maximum number of 0.1 pound test weights as called out in Chart 5502.

10. For the rudder assembly, the trim weights are mounted on the uppermost rib assembly on the rudder. (Refer to Figure 55-5.)

11. With rudder completely reassembled, recheck the balance to insure that it is now within the proper limits.

12. Reinstall the rudder.

CHART 5502. RUDDER BALANCE SPECIFICATIONS

Master Test Weight (Pounds)	5.98 lbs. [illegible]
Master Test Weight Arm (Inches)	9.81 In.
Static Balance Limit (Inch-Pounds) Trailing Edge Heavy	60 $^{+0}_{-10}$ In-Lbs.
Weight of Lead Balance Weight (Pounds)	Not Removable
Trim Weight Part Number	43332
Maximum Number of Trim Weights Allowed	8
Maximum Allowable Balance Weights and Trim Weights (Pounds)	5.05 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.	

PPS50022

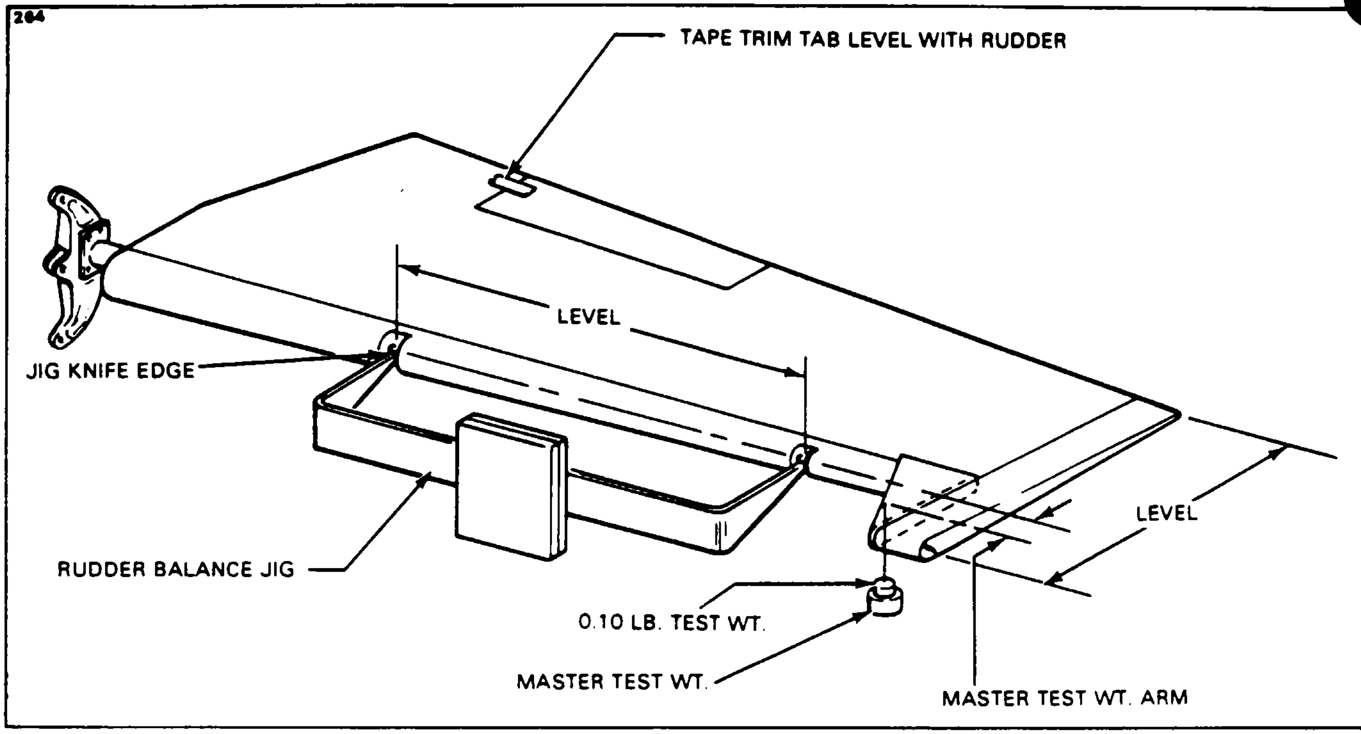


Figure 55-4. Rudder Balancing

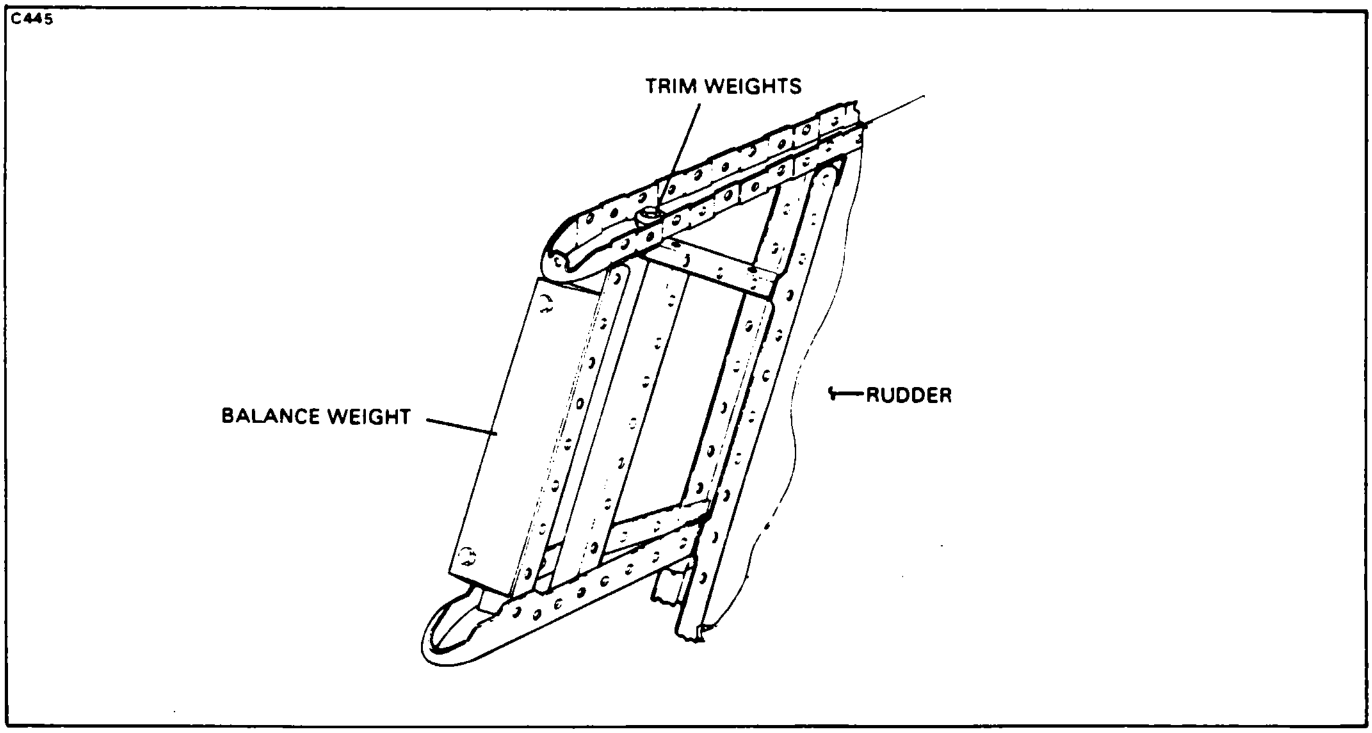


Figure 55-5. Rudder Balance and Trim Weight Location

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

56

WINDOWS

CHAPTER 56 - WINDOWS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter contains information pertaining to the removal and installation of the windowshield and windows.

FLIGHT COMPARTMENT.

STANDARD WINDSHIELD.

REMOVAL OF STANDARD WINDSHIELD.

1. Remove the outside trim strip from between the windshield halves by holding the round nuts in the inside channel and turning out the machine screws.
2. Remove the machine screws that secure the collar molding around the bottom of the windshield.
3. Remove the retainer screws from around the top and outboard side of the windshield.
4. Remove the trim molding from around the inside of the windshield and the switch panel from above the windshield.
5. Loosen the screws that hold the windshield retainer strip around the inside of the windshield.
6. Push the windshield out at the bottom and work out of upper and side channels.
7. Clean old window tape from around inside of channel.

INSTALLATION OF STANDARD WINDSHIELD. (Refer to Figure 56-1.)

1. Ascertain that new windshield is cut to match windshield removed.
2. Apply one piece of Presstite Tape Number 163 or equivalent on each side of windshield. Fold excess around edge. No tape is needed between collar and windshield.
3. Slide the windshield into place with the tape located under the fuselage skin.
4. Install Presstite tape or equivalent on the bottom side of the center windshield trim strip. Install strip, machine screws and round nuts. Do not tighten screws.
5. Install retainer screws around the outside of the windshield. Do not tighten screws.
6. Torque the screws that secure the retainer molding around the inside of the windshield.
7. Torque the retainer screws around the outside of the windshield and center trim strip.
8. Apply a sealant conforming to MIL-S-7502 or MIL-S-8802 Class B along the bottom edge of windshield before installation of collar.
9. Install collar molding and tighten until washers begin to compress snug against strip.
10. After installation of collar, apply masking tape around the windshield and along the edge of the collar, skins and trim strip before applying sealant.
11. Then apply sealant (MIL-S-7502 or MIL-S-8802 Class B) as indicated in Figure 56-1 and check for water seepage.
12. Install switch panel and trim molding around inside of windshield.

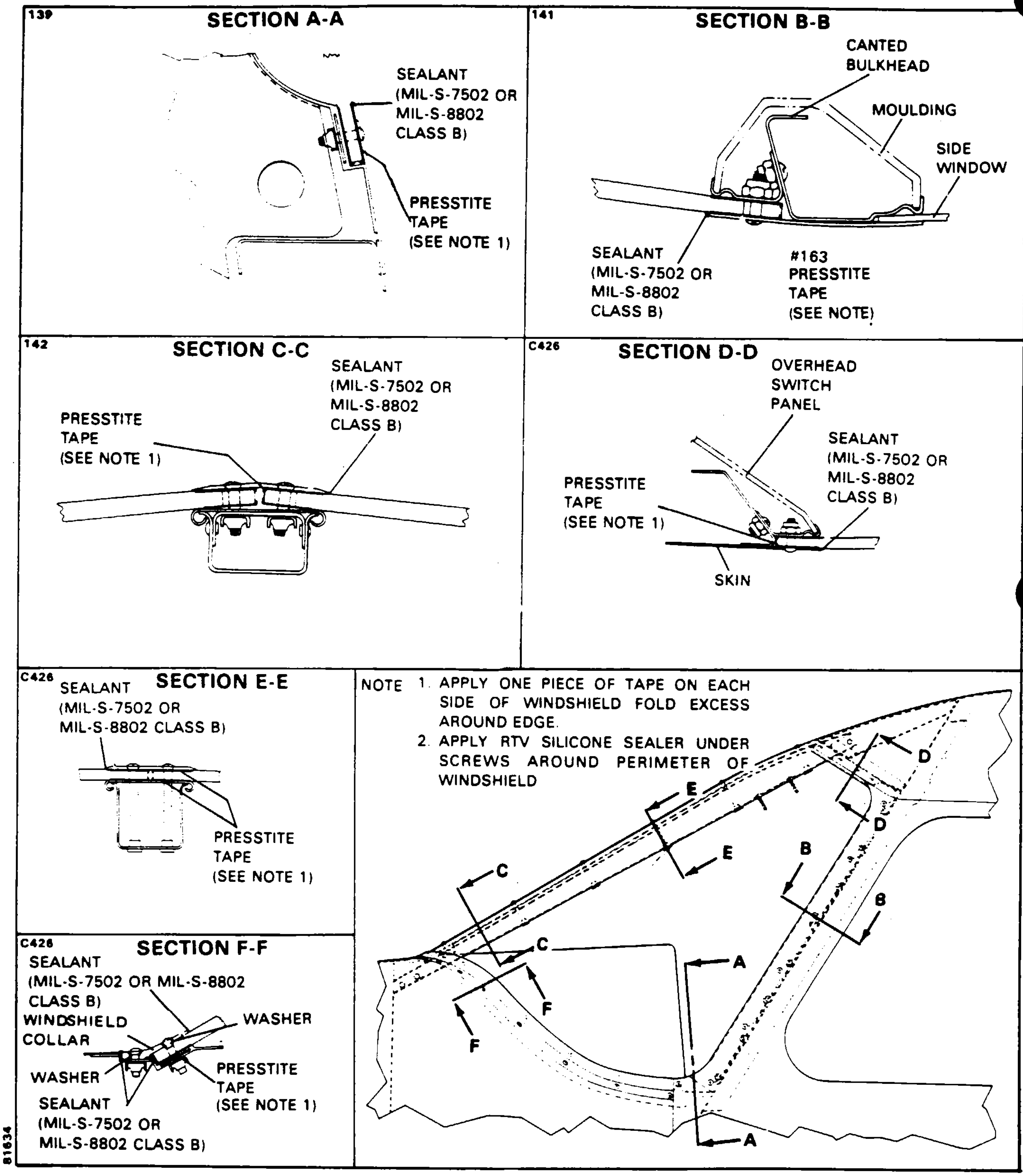


Figure 56-1. Windshield Installation (Standard)

HEATED WINDSHIELD.

REMOVAL OF HEATED WINDSHIELD.

1. Remove the inside cover from the channel that separates the two windshield halves.
2. Disconnect electrical leads from the windshield. Identify the location of each lead at the center of the windshield to facilitate reinstallation.
3. Remove the trim molding from around the inside of the windshield and the switch panel from above the windshield.
4. Remove the outside trim strip from between the windshield halves by holding the round nuts in the center channel and turning out the machine screws.
5. Remove the collar molding from around the bottom of the windshield by removing the machine screws.
6. Remove the retainer screws from around the top and outboard side of the windshield.
7. Loosen the screws that hold the windshield retainer strips around the inside of the windshield.
8. Push the windshield out at the bottom and at the same time work the side and top from the retainer channels.
9. Clean old window tape from around the inside of the channels.

INSTALLATION OF HEATED WINDSHIELD. (Refer to Figure 56-2.)

When installing the heated windshield, to prevent damage, the protective paper on the windshield should remain until the installation is complete. Do not allow the vinyl tape used to install the heated glass to contact any surface of the plastic windshield. Use only a non-metallic window sealer

1. Apply Behr-Manning Vinyl Sponge Tape 1 x 1/16 inches, P/N 542 or equivalent on the outside surface of the windshield, around the outer edges.
2. Apply masking tape around windshield and along the edge of the collar, skins and trim strip before applying sealant (MIL-S-7502 or MIL-S-8802, Class B) on the outside surface of the windshield around the edges of each side and top.
3. Slide the windshield aft and up into place. Use caution not to dislocate the sealer or vinyl tape around the edges of the windshield.
4. Install outside center trim strip, machine screws and round nuts. Do not tighten.
5. Install the retainer screws around the top, outboard side and bottom of the windshield. Do not tighten.
6. Torque (std. torque) the screws that secure the retainer molding around the inside of the windshield.
7. Torque the retainer screws around the outside of the windshield and center trim strip, using standard torque table.
8. Apply sealant (MIL-S-7502 or MIL-S-8802, Class B) at the bottom of the windshield in the hollow between the outside edge and the channel. Do not build up the sealer above the inside contour of the collar molding, thus causing a poor fit of molding against the windshield.
9. Install the collar molding around the bottom of the windshield and tighten the retainer screws until washers begin to compress snug against strip.
10. Apply sealant (MIL-S-7502 or MIL-S-8802, Class B) to any areas around windshield that may allow water to penetrate past the windshield.

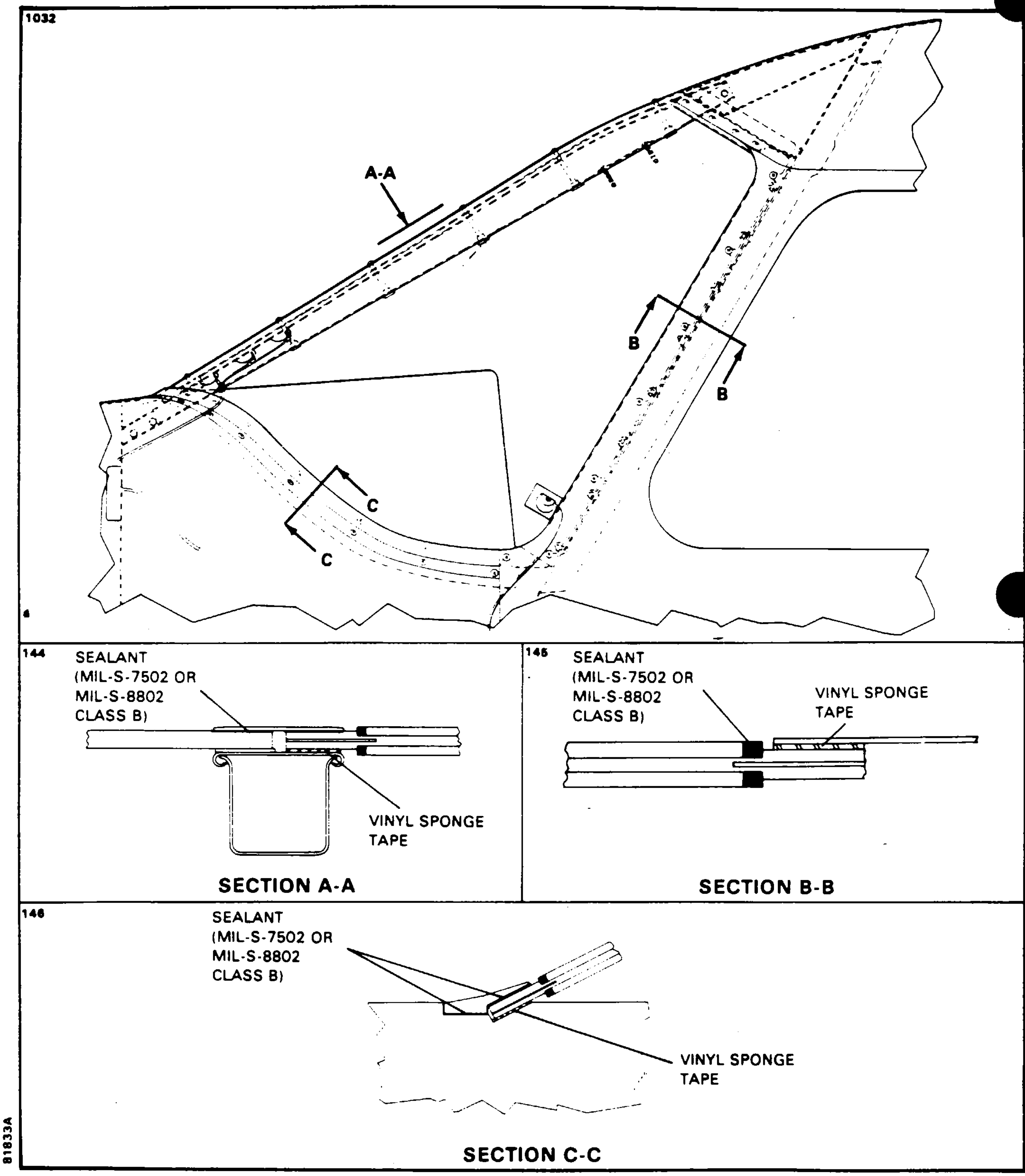


Figure 56-2. Windshield Installation (Heated)

11. Install switch panel and trim molding around inside of windshield.
12. Remove excess exposed sealer or tape.
13. Connect the electrical leads to the windshield. Ascertain that the positive lead at the center of windshield is connected to the red terminal marked "P". The heat sensor leads connect to the white terminals. (Refer to Heated Windshield Schematic, Chapter 91.)
14. Remove protective covering from windshield.
15. Check operation of the windshield heating element and timer by first connecting a 24 volt test light to the positive and negative terminals on the windshield.
16. Turn on the switch labeled "Windshield Heat". The test light should glow indicating current is being delivered to the windshield.
17. Hold a hand against the windshield to determine that the windshield heating element is operating. The test light should go out before it becomes too hot to hold hand against the windshield, indicating that the temperature sensing element is operating properly and it has passed through its thermostatic on/off cycle. Repeat this for one or two more cycles.
18. When check is completed, turn off switch.

WINDSHIELD REPAIRS.

REPAIR OF WINDSHIELD/WINDOW SEALANT.

PPG

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 similiar 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 of 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 to 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.

WINDSHIELD DELAMINATION. PPG

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 form 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.

TERMINAL BLOCK REPAIR (HEATED WINDSHIELD). PPG

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-B½ 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-B½ from edges of terminal block.
5. Allow PR-1221-B½ to cure for 24 hours before removing masking tape.

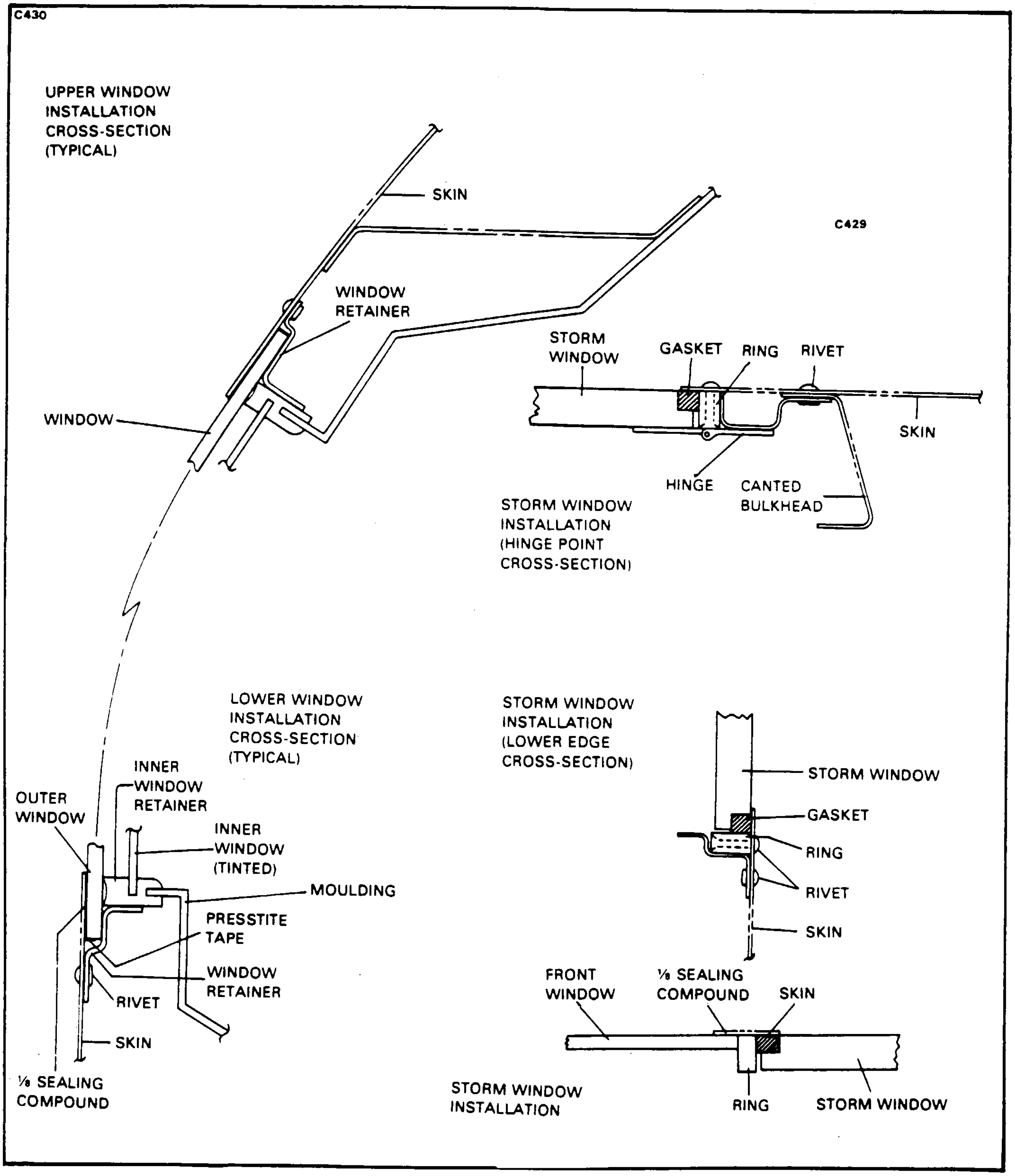


Figure 56-3. Storm Window and Side Window Installations

STORM WINDOW.

REMOVAL OF STORM WINDOW.

1. Withdraw the storm window hinge pin from the hinge assembly.
2. Disengage the storm window fastener and remove the storm window.

INSTALLATION OF STORM WINDOW.

1. Align the storm window hinge halves and insert the hinge pin.
2. Check storm window operation and sealing.

REPLACEMENT OF STORM WINDOW SEAL.

The storm window seal is a vinyl foam (PVC, PMS-K0003, Type I) tape measuring 1/8" x 1/4". It is installed on the recessed, outboard facing surface of the storm window. To install vinyl foam tape, apply thin coat of Industrial Adhesive #EC4475 (3M Co.) to both surfaces to be joined. Allow to dry 15 to 30 seconds. Align tape on storm window and press firmly into place.

CABIN.

SIDE WINDOWS.

REMOVAL OF SIDE WINDOWS.

1. Remove the screws that hold the trim molding around inside of the window.
2. Remove the rivets that secure the window retainer molding and remove window.
3. Remove old window sealer from surfaces.

INSTALLATION OF SIDE WINDOWS. (Refer to Figure 56-3.)

1. Ascertain that the new window is cut to same dimensions as old window.
2. Apply 1/32" x 3/16" Presstite No. 163 tape over the window edge as in Figure 56-3.
3. Apply ⅛" sealing compound (Weatherban 606 [Acrylic] manufactured by 3M; Weatherban 101 [Polysulfide] manufactured by 3M; or PR307 [Polysulfide] manufactured by Prodocts Research and Chemical Corporation) to the outer edge of the window where the window contacts the outer skin.
4. Position window and retainer molding and secure with rivets.
5. Install trim molding around inside of window.

— END —

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 wing tips are removable. The ailerons are cable and push rod controlled and are statically balanced. The trailing edge wing flaps are electrically operated.

AUXILIARY STRUCTURE.

WING TIP.

REMOVAL OF WING TIP.

1. Remove the screws attaching the wing tip to the wing.
2. Pull the wing tip off far enough to disconnect the navigation light positive wire at the quick-disconnect fitting and remove the screw securing the ground wire to the wing structure.
3. Remove the wing tip completely.

REPAIR OF WING TIP.

The wing tip may be repaired in accordance with fiberglass repair procedures in the Structural Repairs portion of Chapter 51.

INSTALLATION OF WING TIP.

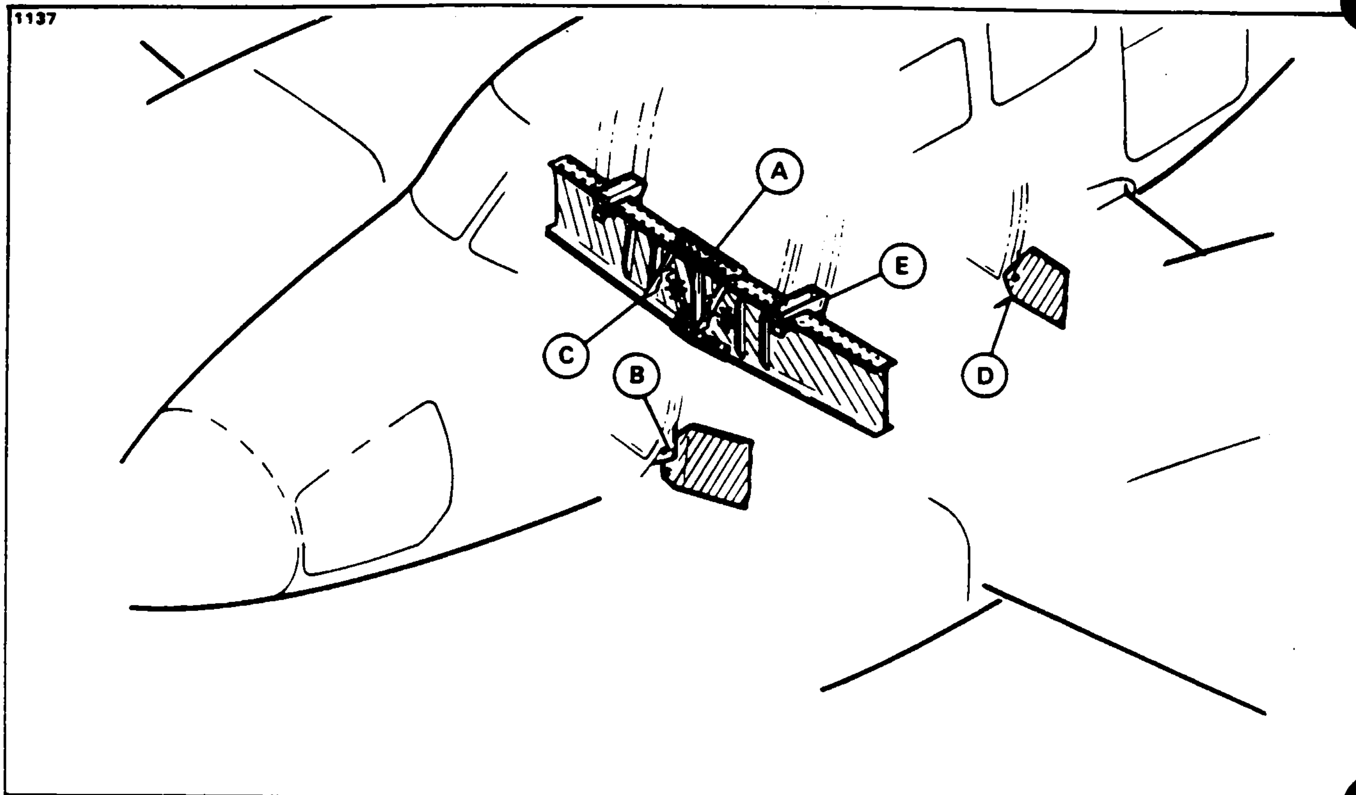
1. Attach the ground wire terminal to the wing structure and connect the positive electrical leads together.
2. Position the wing tip on the wing and start all screws with washers.
3. With all screws in place, tighten.

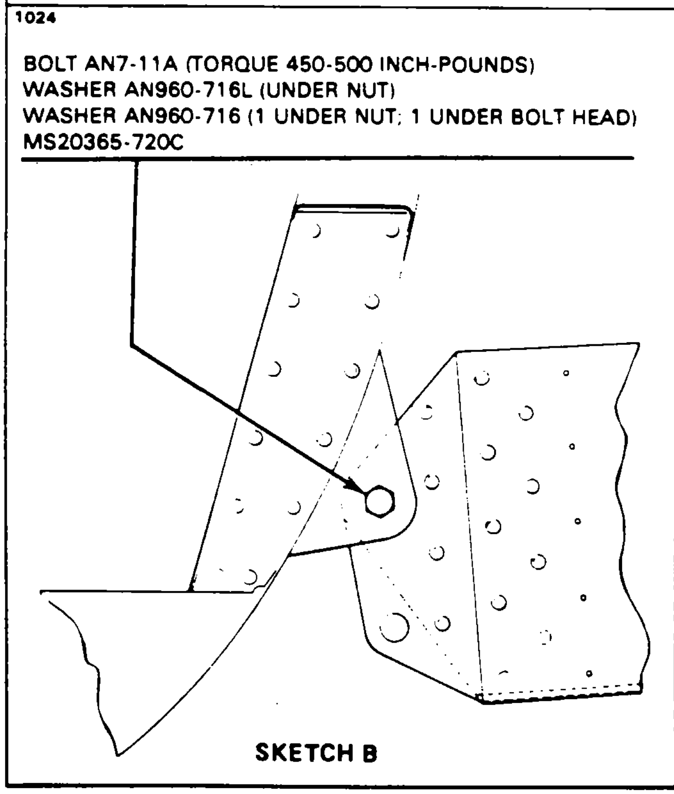
ATTACH FITTINGS.

WING.

REMOVAL OF WING. (Refer to Figure 57-1.)

1. Drain the fuel from the wing to be removed. (Refer to Draining Fuel System, Chapter 12.)
2. Remove the engine from the wing to be removed. (Refer to Removal of Engine, Chapter 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.





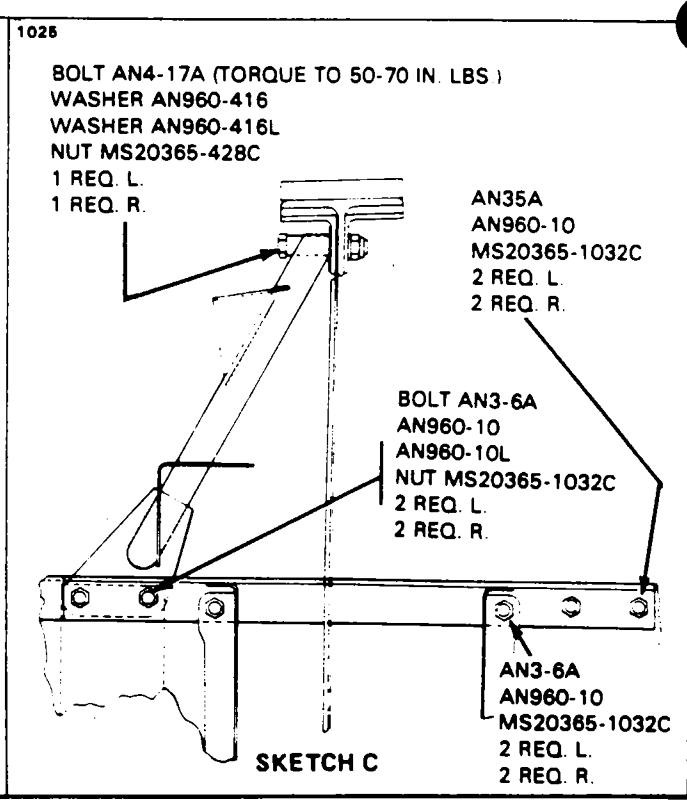


Figure 57-1. Wing Installation

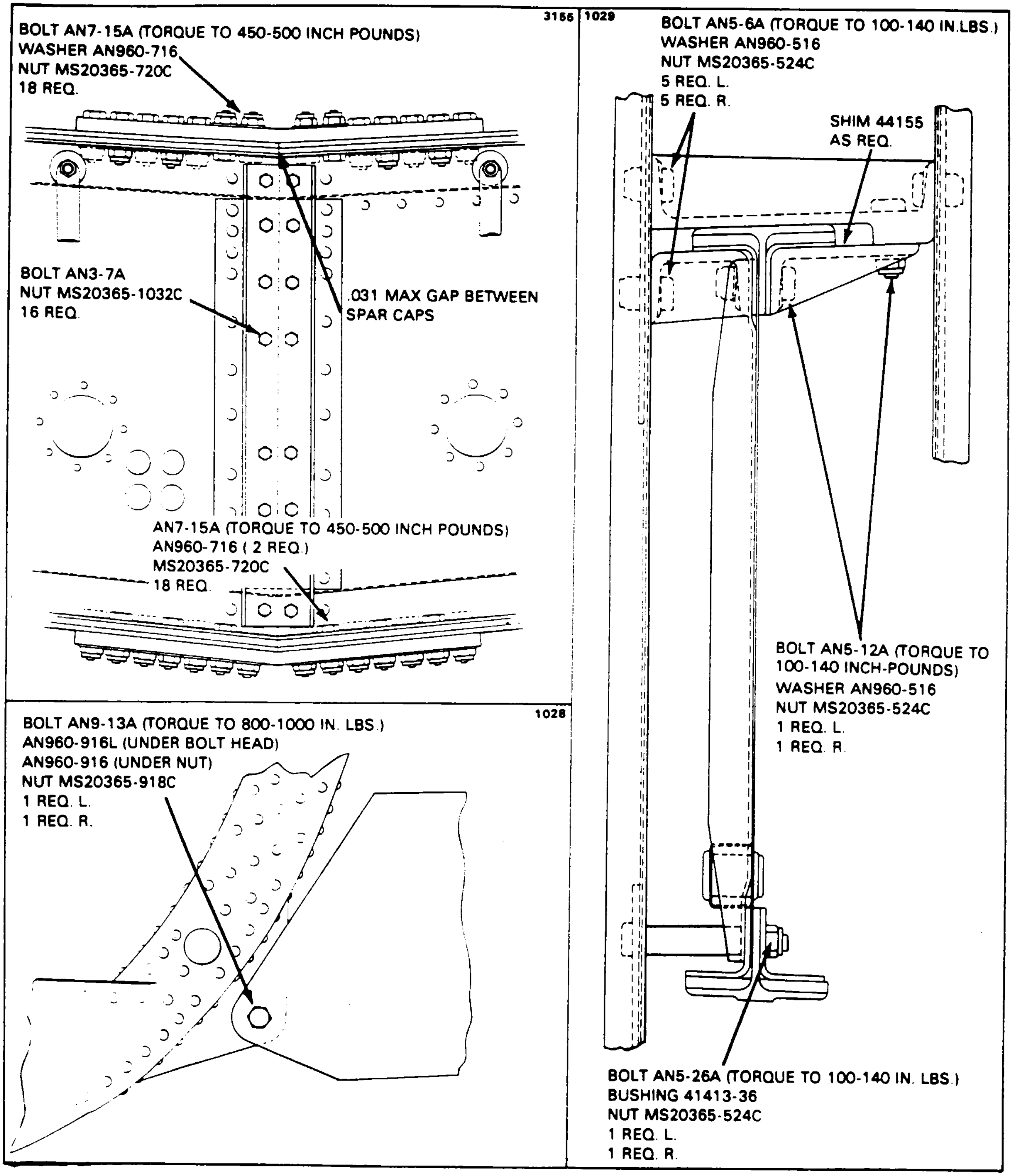


Figure 57-1. Wing Installation (cont.)

5. Remove the access plates from the fairing located between the under side of the wing butt and fuselage and the access plate to the spar splice located on the under side of the fuselage.

6. Within the fuselage, remove the spar cover.

7. Remove the fore and aft floor panels adjacent to the main spar and, if removing the left wing, remove the left forward floor panel between the fuselage side trim panel and control pedestal.

— NOTE —

To help facilitate reinstallation of control cables and fuel or hydraulic lines, mark cable and line ends in some identifying manner before removing and attach a line where applicable to cables before drawing them through the fuselage or wing.

— CAUTION —

To prevent damage or contamination of fuel, hydraulic and miscellaneous lines, place a protective cover over the line fittings and ends.

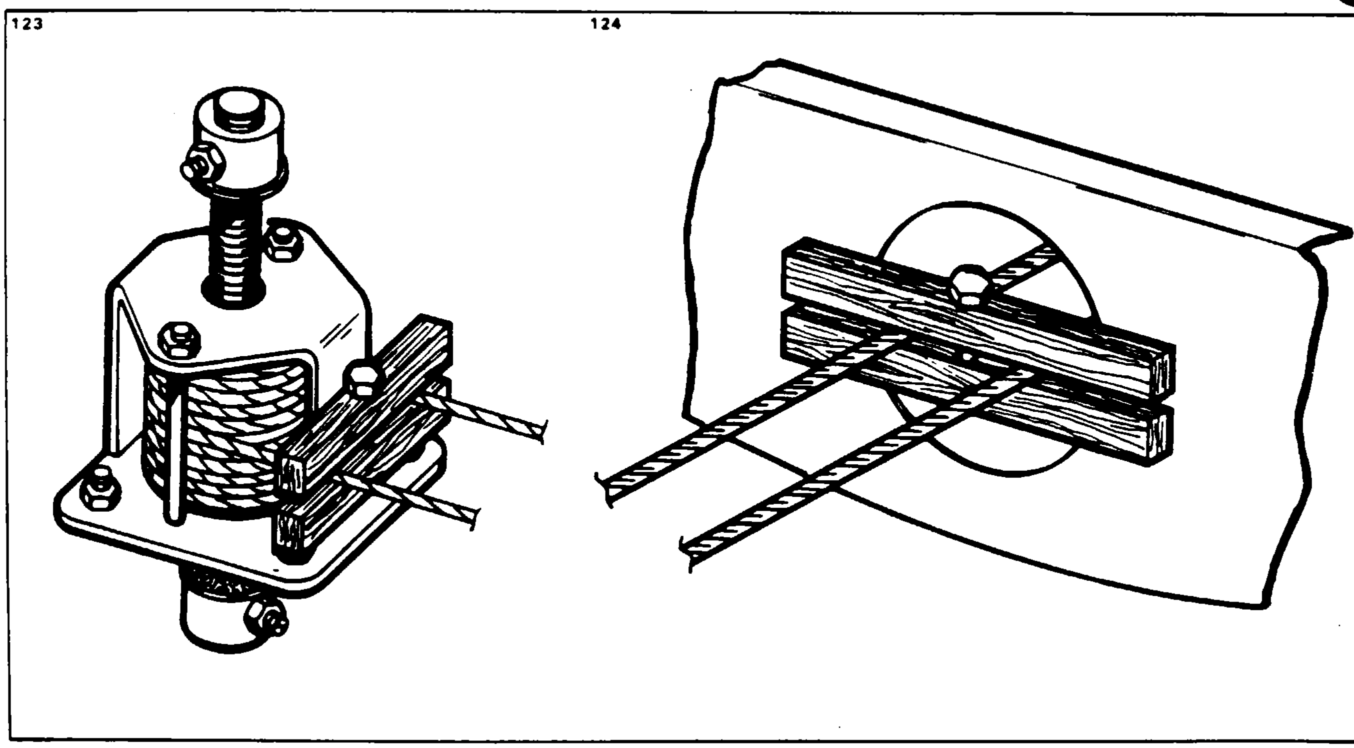


Figure 57-2. Methods of Blocking Trim Cables

8. If the left wing is being removed, the following items pertain to the removal of the left wing only:

A. Disconnect the primary control cables at the turnbuckles between the left forward side trim panel and control pedestal. Draw the cables back through the spar. Remove the elevator cable guard pin to allow the cable ends to pass through.

B. Remove the left aileron cable guard pin.

C. The balance cable to the left wing may be disconnected at the aileron bellcrank, drawn through the wing and taped out of the way at the side of the fuselage. The cable guard pin at the left wing near the bellcrank and wing butt will have to be removed to allow the cable end to pass through.

9. If the right wing is being removed, the following items pertain to the removal of the right wing only:

A. Disconnect the aileron control cable at the aileron bellcrank and draw it out through the wing. The cable guard in the wing near the bellcrank and wing butt will have to be removed to allow the cable end to pass through.

B. Disconnect the aileron balance cable and draw the cable from the fuselage. Remove the cable pulley to allow cable to be removed.

C. Remove the access panel to the aft section of the fuselage. Block the elevator and rudder trim cables ahead of the main spar and in the aft section of the fuselage to prevent the cables from unwrapping at the trim drums. (Refer to Figure 57-2.) Disconnect the elevator and rudder trim cables and draw the cables forward through the main spar. To allow the cables to be drawn through the fuselage, remove the cable guard and rub blocks.

D. Block the aileron trim cable at the side fuselage and within the wing to prevent the trim drum from unwrapping. Disconnect the trim cable turnbuckles and draw the cables inboard through the wing. Remove cable guard at butt end of wing and tape cables out of the way at the fuselage.

E. Disconnect the hydraulic lines, which are routed through the spar, and slide the lines forward through the wing spar.

F. Disconnect the bleed air and freon lines.

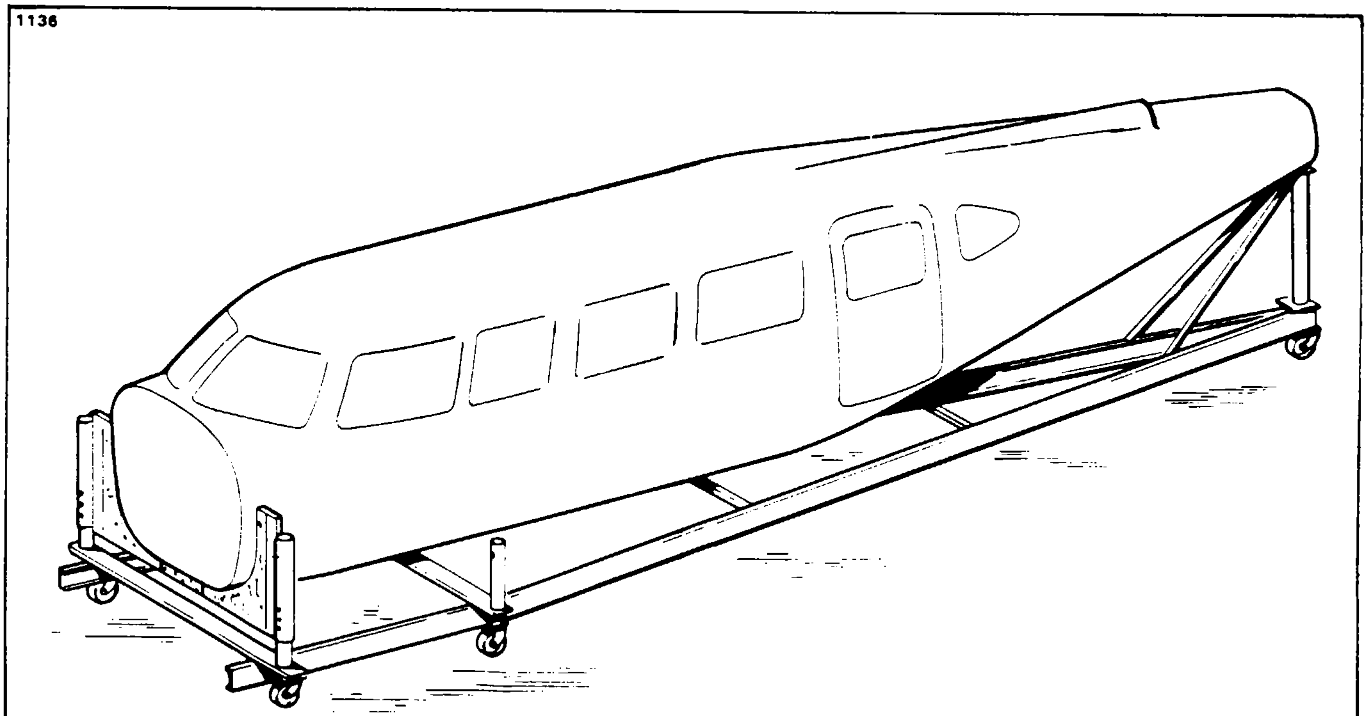


Figure 57-3. Fuselage Cradle

10. Disconnect the flap control cable from the actuating motor and bulkhead and draw the cable o through the fuselage.

11. Through the wing fairing access openings at the under side of the wing, disconnect the fuel line that is routed through the main spar and pull it back through the spar. Disconnect the hydraulic and fuel line at the exposed fittings and control cables from fuel valves.

12. Through the access openings at the wing leading edge and butt, disconnect the engine instruments, vacuum, fuel and hydraulic lines. Remove support blocks and clamps.

13. Disconnect electrical wire connectors.

14. Draw engine control cables back through the firewall, engine nacelle and wing.

15. Arrange a suitable fuselage cradle and supports for both wings.

16. Remove the fuel control panel cover, bracket, lever assembly, and unbolt and remove the angle support that extends through the spar.

17. On 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 on 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 .031 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. On 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 under side of the fuselage, connect the fuel and hydraulic lines and fuel valves' control cables.

18. Draw the flexible drive shaft from the flap transmission into the fuselage, ascertain rigging is set (refer to Rigging and Adjustment of Flap Controls, Chapter 27) and secure cable.

19. Connect the bleed 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 that run through the leading edge. Evacuate and charge the air conditioning system.

B. Route the hydraulic lines through the main spar and connect to their respective fitting.

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. 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 it 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. Install the cable guard pins for the left aileron cable and the elevator cables. 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 under side of the fuselage and wing, insert the retaining screws that draw the fairing against the under side of the wing butt and fuselage. Ascertain that there is a rub strip between the wing and fairing.

28. Reinstall access plates and panel at the under side of fuselage and wing and leading edge of wing.

29. Install the floor panels, spar covers and fuel control panel.

FLIGHT SURFACES.

AILERON.

REMOVAL OF AILERON. (Refer to Figure 57-4.)

1. Remove the wing tip.
2. Remove the wing tip aft attachment rib.
3. Disconnect the aileron control rod.
4. At the right aileron, disconnect the trim tab control rod.
5. Remove the hinge bolts and remove the aileron.

INSTALLATION OF AILERON. (Refer to Figure 57-4.)

1. Place the aileron in position, install hinge bolts and torque.
2. If the right aileron was removed, connect the trim tab control rod.
3. Connect the aileron control rod.
4. Attach the wing tip attachment rib.
5. Install the wing tip.
6. Refer to Chapter 27 for rigging and adjustment procedure.

AILERON BALANCING PROCEDURE. (Refer to Figure 57-5 and Chart 5701.)

1. Remove the aileron from the airplane.
2. Place the aileron on a balancing jig as illustrated in Figure 57-5. Establish a horizontal reference mark which aligns with the trailing edge of the aileron when it is held in a horizontal level position (chord line level).
3. Ascertain that the surface rotates freely with no binding at the knife edges.
4. Fabricate a master test weight. (Refer to appropriate Chart on Control Surface Balancing for specific weight.)
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 appropriate Chart on Control Surface Balancing for static limits.) The following instructions should be used to determine the extent of unbalance:
   A. Add individual 0.1 lb. test weights to the master test weight until the aileron balances.
   B. If the number of 0.1 lb. test weights does not exceed the maximum allowable the aileron is within the static limits and is satisfactory. (Refer to appropriate Chart on Control Surface Balancing for maximum weight.)
   C. If the number of 0.1 lb. test weights added to the master test weight to balance the aileron exceeds the maximum allowable per the appropriate Chart, 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 rechecked.
9. With the balance check complete, install the assembly on the aircraft.

CHART 5701. AILERON BALANCE SPECIFICATIONS (WITHOUT TIP TANKS)

Master Test Weight (Pounds)	0 to 1.0 lbs.	
Master Test Weight Arm (Inches)	6.00 in.	
Static Balance Limit (Inch-Pounds) Trailing Edge Heavy	-3 +3 in.-lbs.	
Weight of Lead Balance Weight (Pounds)	Right	4.75
	Left	3.9
Trim Weight Part Number	54395-2	
Maximum Number of Trim Weights Allowed Per Side	4	
Maximum Allowable Balance Weights and Trim Weights (Pounds) Per Side	Right	5.48
	Left	4.64

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.

PPS 60022

THIS SPACE INTENTIONALLY LEFT BLANK

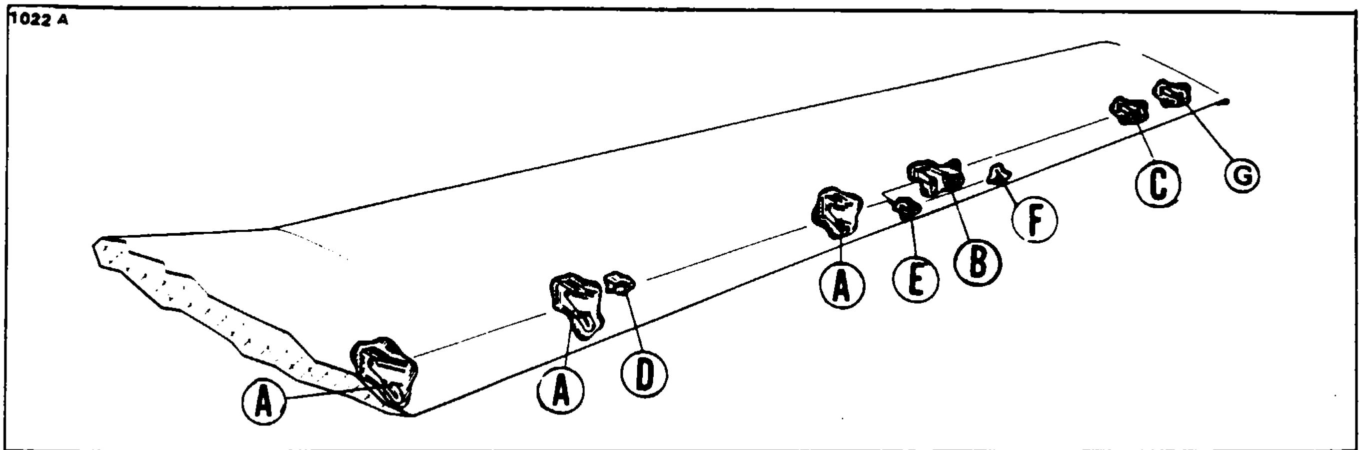
CHART 5702. AILERON BALANCE SPECIFICATIONS (WITH TIP TANKS)

Master Test Weight (Pounds)	.20 to .50 lbs.
Master Test Weight Arm (Inches)	6.00 in.
Static Balance Limit (Inch-Pounds) Trailing Edge Heavy	-1.20^{+0}_{-2} in. lbs.
Weight of Lead Balance Weight (Pounds)	Right 2.43 lbs. Left 1.43 lbs. Inboard 6.00 lbs.
Trim Weight Part Number	Not Allowed
Maximum Number of Trim Weights Allowed Per Side	Not Allowed
Maximum Allowable Balance Weights and Trim Weights (Pounds) Per Side	Right 2.43 lbs. Left 1.43 lbs. Inboard 6.00 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.

PPS50022

THIS SPACE INTENTIONALLY LEFT BLANK



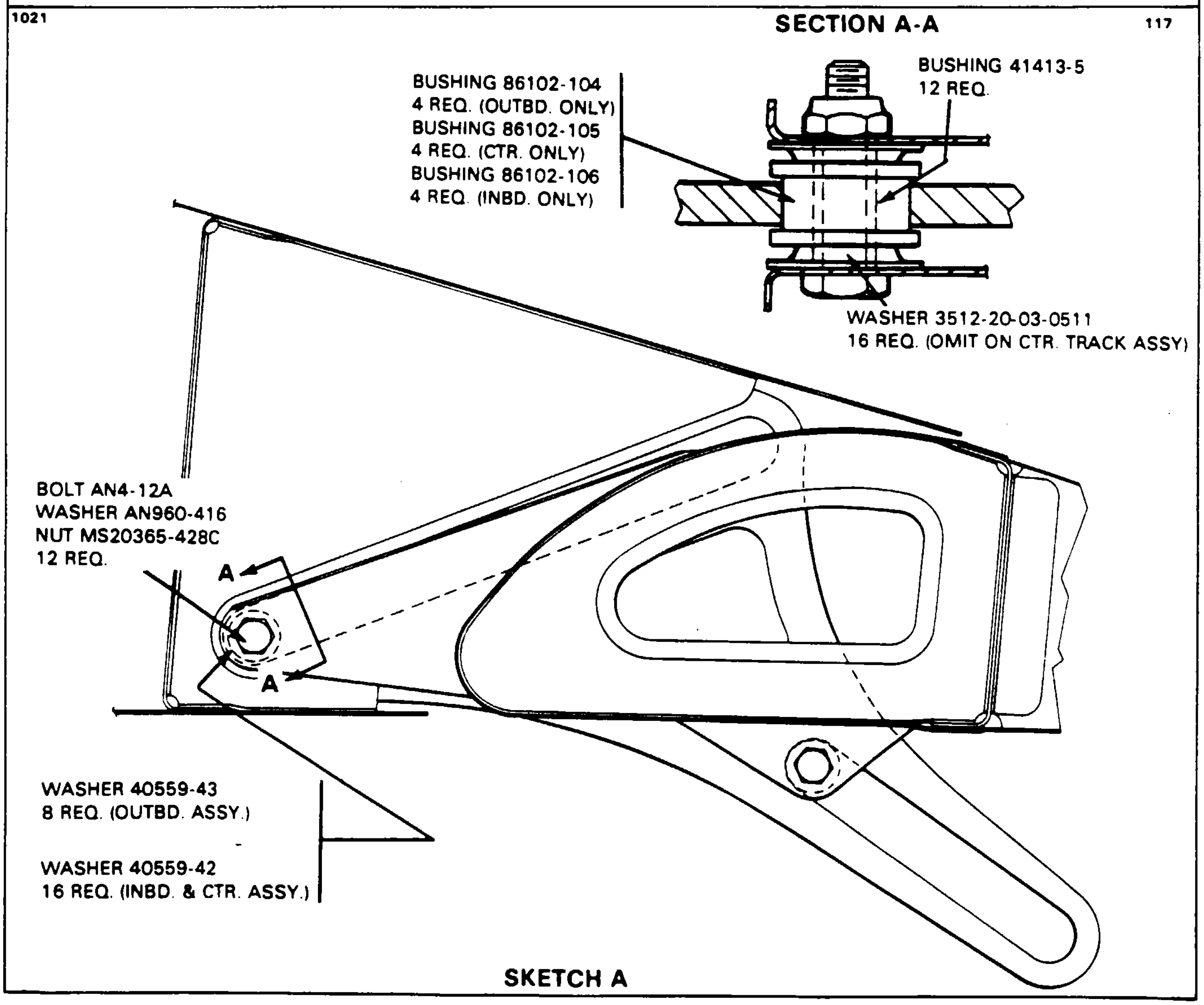


Figure 57-4. Aileron and Flap Installation

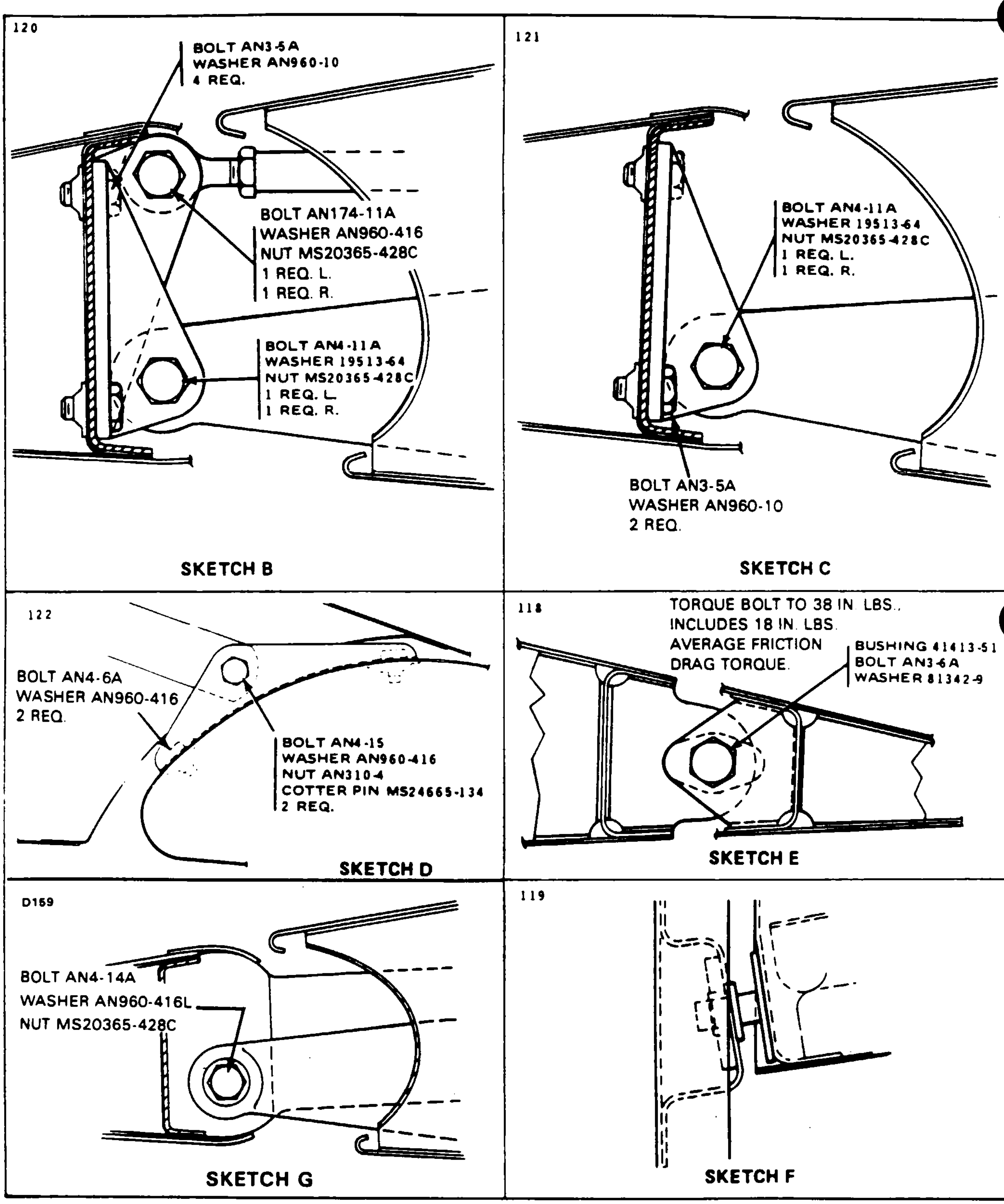


Figure 57-4. Aileron and Flap Installation (cont.)

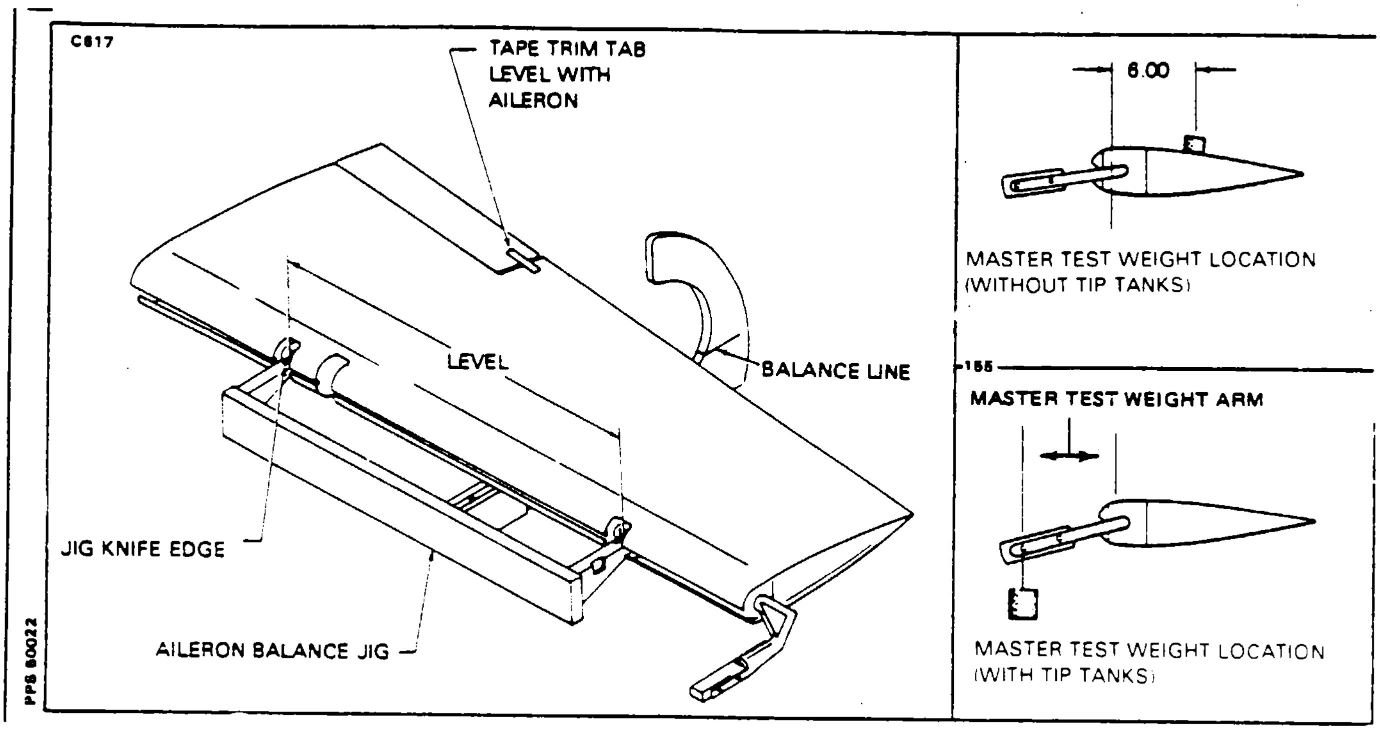


Figure 57-5. Aileron Balancing

AILERON TRIM TAB.

REMOVAL OF AILERON TRIM TAB. (Refer to Figure 57-4.)

1. Disconnect the control rod at the tab.
2. Remove the inboard hinge bolt.
3. Pull the tab back and inboard enough to remove the outboard hinge pin from its bushing. Remove the tab.

INSTALLATION OF AILERON TRIM TAB. (Refer to Figure 57-4.)

1. Insert the tab control rod through the aileron and insert the outboard hinge pin into its bushing.
2. Position the inboard hinge brackets, install hinge bolt and torque to 38 in.-lbs., includes .18 in.-lbs. average friction torque.
3. Connect the tab control rod.
4. Check tab for proper operation. Refer to Chapter 27 for rigging and adjustment procedures.

FLAP.

REMOVAL OF FLAP. (Refer to Figure 57-4.)

1. Lower flap to within a few degrees of full extension.
2. At the left flap, disconnect the position sender rod by removing the cotter pin from the forward end of the rod.
3. Disconnect the flap control tube at the flap. Do not rotate the control tube unless it is intended to adjust the flap.
4. Remove the upper roller assemblies from the flap brackets.
5. Remove the lower roller assemblies and remove flap.

INSTALLATION OF FLAP. (Refer to Figure 57-4.)

1. Put the flap in position and install the lower roller assemblies on the flap brackets and torque bolts.
2. Install the upper roller assemblies and torque bolts.
3. Connect the control tube.
4. If the left flap was removed, connect the position sender rod.
5. Check flap for proper operation. Rigging and adjustment procedure may be found in Chapter 27.

— END —

CHAPTER

61

PROPELLER

CHAPTER 61 - PROPELLERS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 61 - PROPELLERS (cont)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This Section contains information pertaining to the maintenance and repair of the propeller and its controlling unit, the propeller governor and the synchrophaser.

DESCRIPTION AND OPERATION.

The propeller installations are constant speed, full feathering, reversing types, controlled by engine oil pressure through single action propeller governors. Centrifigal counterweights assisted by a feathering spring move the blades toward the low RPM (high pitch) position and into the feather position. This movement is opposed by oil pressure controlled by the propeller governor. Oil pressure moves the propeller to the high RPM (low pitch) hydraulic stop and reverse position. The propellers have no high pitch stop, this allows the propeller to feather after engine shutdown.

PROPELLER ASSEMBLY.

MAINTENANCE.

REMOVAL OF PROPELLER. (Refer to Figure 61-1.)

1. Remove the spinner by removing the attachment screws that secure the spinner to the spinner bulkhead.
2. Remove the engine cowling. (Refer to Chapter 71.)
3. Remove the deicer brush block assembly. Use caution to avoid damaging the brushes.
4. Disconnect and remove the propeller reversing lever and carbon block from the feedback ring.
5. Install the feedback ring puller P/N 51519 and pull the feedback ring fully forward. Use a standard 5/8 inch socket against the propeller hub.

— CAUTION —

Take the necessary precautions to avoid damaging the low stop rods and the feedback ring.

6. Remove the safety wire from the propeller mounting bolts and remove the bolts using the suggested wrench (P/N 51514-00).
7. Place a drip pan under the propeller to catch oil spillage.
8. Remove the propeller from the engine flange. Remove the O-ring and cap the flange, to prevent contamination.

CLEANING, INSPECTION AND REPAIR.

— NOTE —

Refer to the latest revision of Hartzell Propeller Service Letter No. 61 for Recommended Overhaul Periods under various conditions.

1. Check for oil and grease leaks.
2. Clean the spinner, propeller hub exterior, and blades with a non-corrosive solvent.
3. Inspect the hub parts for cracks.
4. Check all visible parts for wear and safety.
5. Inspect blades for damage or cracks. Nicks in the leading edges of blades sometimes provide the conditions that allow fatique cracks to start, and should be filed out and all edges rounded. Use fine emery cloth for finishing. Refer to Figure 61-2 for propeller blade care.
6. Check the condition of the propeller mounting bolts.
7. It is recommended that for severe damage, internal repairs and replacement of parts, the propeller should be referred to the Hartzell Factory or a certified repair station.
8. Each blade face should be sanded lightly and painted, when necessary, with a flat black paint to retard glare. A light application of oil or wax may be applied to the surfaces to prevent corrosion.
9. Check the condition of the low stop rods and feedback ring.
10. Grease blade hub through zerk fittings. Remove one of two fittings for each propeller blade; alternate the next time. Apply grease through the zerk fitting until fresh grease appears at the hole of the fitting removed. Care should be taken to avoid blowing out hub gaskets.

— CAUTION —

Do not attempt to rotate the propeller blades using blade arms, as damage will result to the feedback ring.

INSTALLATION OF PROPELLER. (Refer to Figure 61-1.)

1. Clean propeller and engine flanges.
2. Lubricate and install a new O-ring on the engine shaft.
3. Install feedback ring puller P/N 51519 and pull the feedback ring fully forward. Use a standard 5/8 inch socket against the propeller hub.

— CAUTION —

Take the necessary precautions to avoid damaging the low stop rods and the feedback ring.

4. Position the propeller on the engine flange and install mounting bolts and washers. Torque bolts evenly 100-105 foot-pounds using special tool (P/N 51514-00) and safety with MS20995-C41 wire.

— NOTE —

Lubricate threads with petrolated graphite MIL-T-5544 supplied by Hartzell.

5. Install the deicer block. (Refer to Chapter 30 for brush alignment procedures.)
6. Install the propeller reversing lever with the carbon block in the feedback ring.

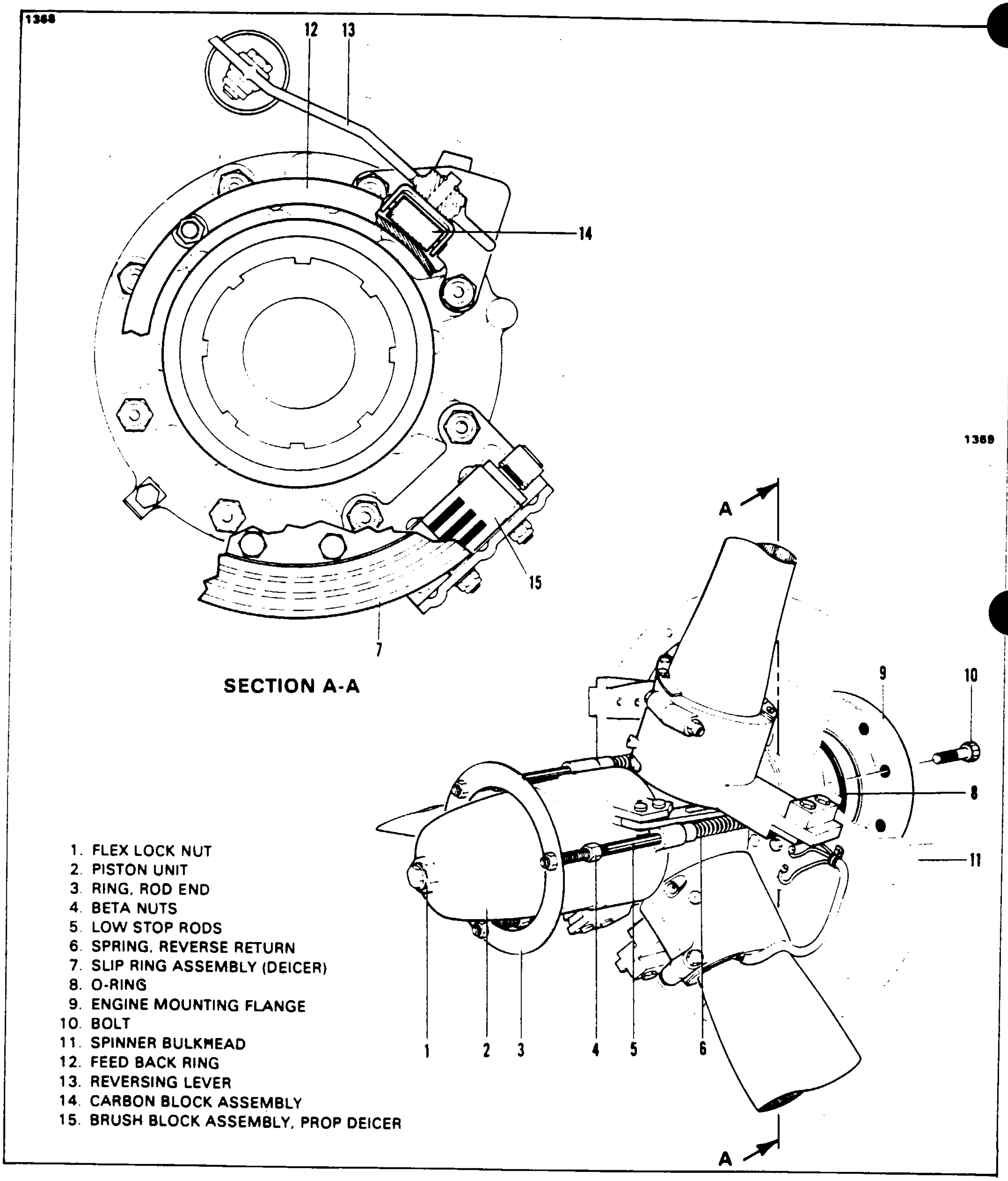


Figure 61-1. Propeller Installation

— *NOTE* —

Check this clearance by holding the carbon block against one face of the feedback ring. Use fine sandpaper on the block to obtain this clearance. Ascertain that the block is free to rotate in the reversing lever.

7. Rotate the propeller slowly and check the run out of the feedback ring with a dial indicator. Run out must not exceed .010 of an inch total indicator. If the run out is excessive, loosen the nut on the front of the low stop rods and the jam nut at the feedback ring; adjust the low pitch stop rods to obtain the specified tolerance. Torque the jam nuts at the feedback ring to 12 foot-pounds. Torque the nut on the front of the low stop rods to 22 foot-pounds.
8. Check the Beta valve Rigging.
9. Perform an engine ground check and check the 2000 rpm torque setting.

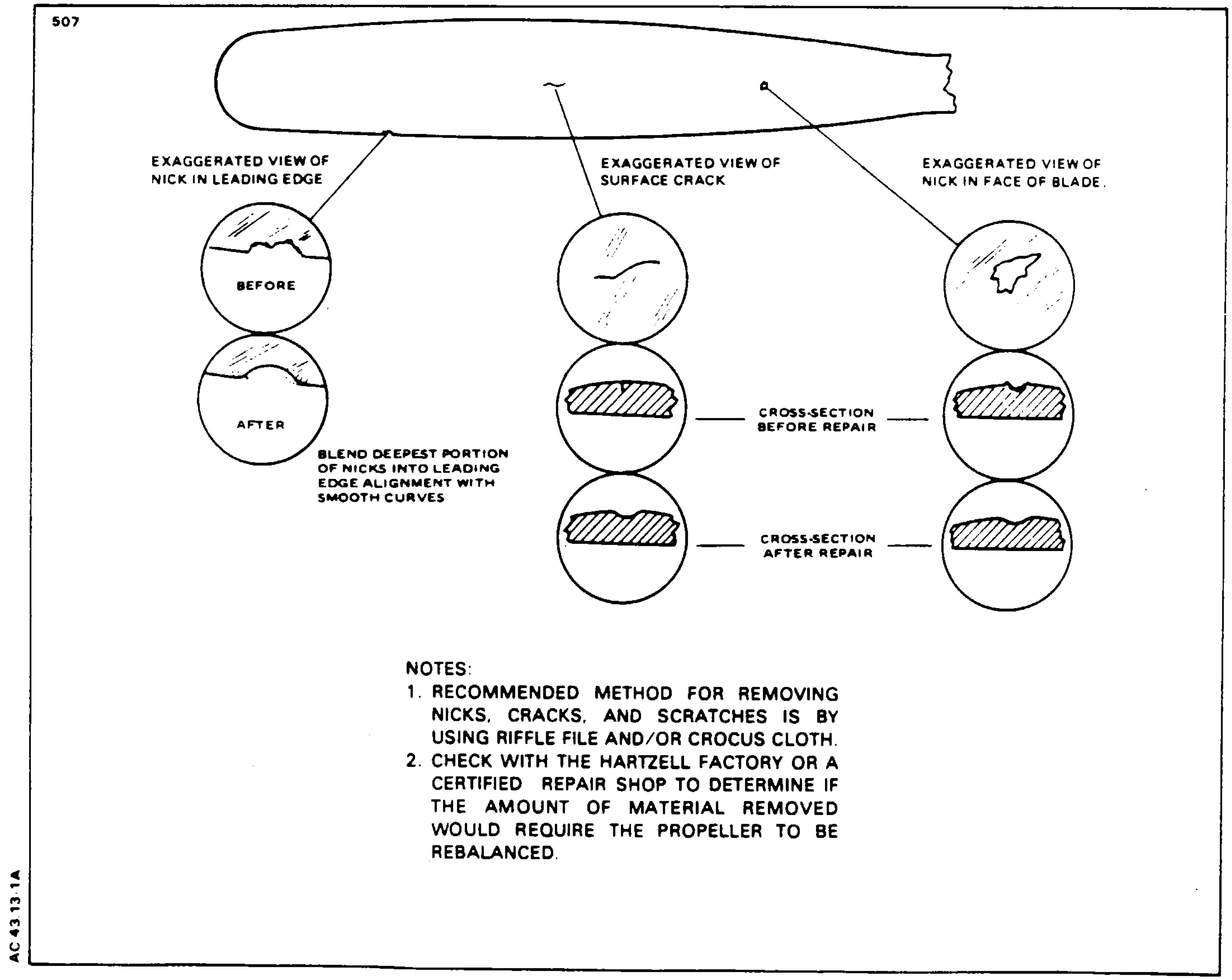


Figure 61-2. Typical Nicks and Removal Method

CHART 6101. PROPELLER SPECIFICATION

Hub. Model Blade. Model	HC-B3TN-3B T10173K-8	
Propeller RPM Setting Beta Nut Setting	Engine Static High RPM @2000 RPM	2200 RPM max. 20.2 degrees
Propeller Torque Limits	Description Propeller Mounting Bolts Spinner Bulkhead Attachment Screws Spinner Attachment Screws Flex Lock (Dome) Nut Beta Ring Jam Nuts Low Pitch Stop. Propeller Nuts	Required Torque (Dry) 100-105 ft-lb (See Note) 65-100 in-lb 40 in-lb 120 ft-lbs 12 ft-lbs 22 ft-lbs Note: Lubricate threads with petrolated graphite MIL-T-5544 supplied by Hartzell.

CONTROLLING.

PROPELLER CONSTANT SPEED GOVERNOR.

REMOVAL.

1. Remove the upper engine cowling per Chapter 71.
2. Disconnect the electrical connections from the governor.
3. Disconnect the prop pitch control rod at the governor control lever.
4. Disconnect the pneumatic tube at the governor.
5. Remove bolt, washer, and nut connecting governor control arm to interconnecting rod.
6. Remove bolt, spacer, and nut which connect the control link to the propeller reverse lever.
7. Remove the clevis pin from the fork end of the Beta control valve.
8. Remove nuts and washers and withdraw governor from mounting pad. Remove gasket.

INSTALLATION.

1. Install gasket over studs on governor mounting pad with the raised side of screen facing up.

2. Install governor and secure with washers and self-locking nuts. Torque nuts 170 to 190 inch-pounds.
3. Connect fork end of Beta control valve to reversing lever with pin and secure with washers and cotter pin.
4. Secure fork end of control link to the propeller reversing lever with bolt, spacer, washer and nut. Torque nut 24 to 36 inch-pounds and secure with cotter pin.
5. Connect governor control arm to interconnecting rod with bolt, washer and nut. Torque nut 25-35 inch-pounds and secure with cotter pin.
6. Connect the pneumatic tube at the governor; torque coupling nut 90 to 100 inch-pounds and lockwire.
7. Connect and secure electrical connections to the governor.
8. Connect the prop pitch control rod to the governor control lever.
9. Check the governor adjustments.
10. Reinstall the engine cowling.

CONSTANT SPEED GOVERNOR ADJUSTMENTS. (Refer to Figure 61-3 and Chapter 76.)

After repair or replacement of the propeller governor, the adjustments must be checked as follows:

1. With the engine static, disconnect the front air pressure tube at the governor connection and blank off nipple and pneumatic line with suitable caps.
2. Perform the pre-start check.
3. Start the engine and allow it to warm up in the idle setting until normal operating oil temperature is reached, 60° C (140° F) minimum.
4. Advance the power control lever to obtain 80% Ng, and perform two feathering cycles to purge air from the system. To reduce feathering time, turn feathering adjuster counterclockwise.

— NOTE —

Two complete turns (counterclockwise from the nominal setting) is the maximum permitted adjuster range.

5. Set propeller control lever in fine pitch, and advance the power control lever sufficiently to allow the propeller to constant speed. Temporarily mark the position of the lever on the quadrant and record Ng.
6. Loosen the locknut and adjust the governing maximum speed adjuster (1, of Figure 61-3) to obtain the desired Np. Counterclockwise rotation of screw increases speed. Tighten the locknut when adjustment is completed.
7. Record Np, torque and fuel flow.
8. Shutdown the engine and reconnect the front air pressure tube at the governor. Torque 90 to 100 inch-pounds, and restart the engine.

— CAUTION —

Do not disturb the pneumatic maximum adjustment (2, of Figure 61-3).

9. Advance the power lever to position previously marked, and compare Ng with figure previously recorded. If Ng has changed from previous value, recheck that the air bleed link (refer to Chapter 76) is locked hard against the pneumatic maximum stop (Refer to Chapter 76). Note than an Ng change of up to .27% rpm is acceptable, but if the change is above this, replace the propeller governor.

10. Shutdown the engine, disconnect the interconnect rod (refer to Chapter 76) at the air bleed link and secure link to minimum stop.

11. Restart and run engine. With the propeller control lever set in fine pitch, advance the power control lever sufficiently to obtain a constant speed condition and check that Np governs in a range of 2068 to 2112 rpm. Adjust the pneumatic minimum eccentric adjuster (3, of Figure 61-3), as necessary to meet this requirement.

12. Shutdown the engine and reconnect the air bleed link to the interconnect rod. (Refer to Chapter 76.)

13. Restart the engine and check the reverse power setting.

PROPELLER OVERSPEED GOVERNOR.

REMOVAL.

1. Remove the engine cowling.
2. Disconnect the electrical leads from the overspeed governor.
3. Remove the nuts and washers securing the overspeed governor to the reduction gearbox and withdraw the assembly from the mounting studs. Discard the mounting gasket.
4. Examine the overspeed governor drive for damage and wear; replace if necessary.

INSTALLATION.

1. Install a new mounting gasket over the studs.
2. Install the overspeed governor on the mounting pad; be certain the drive shaft is properly engaged. Secure with washers and self-locking nuts; torque to 125 to 170 inch-pounds.
3. Connect the electrical leads to the overspeed governor.
4. Check the overspeed governor operation per the following Paragraph.
5. Reinstall the engine cowling.

OVERSPEED GOVERNOR OPERATIONAL CHECKS.

Check the overspeed governor operation as follows:

1. Start the engine and allow the engine instruments to stabilize.
2. Set the power levers to obtain 1625 rpm propeller speed.
3. Set the propeller control to full forward, the "Reverse Not Ready" lights out.
4. Push up the Hydraulic Topping Governor switches and observe the drop in propeller rpm to approximately 1540 rpm.
5. Release the switches; the prop rpm should increase to the original rpm.

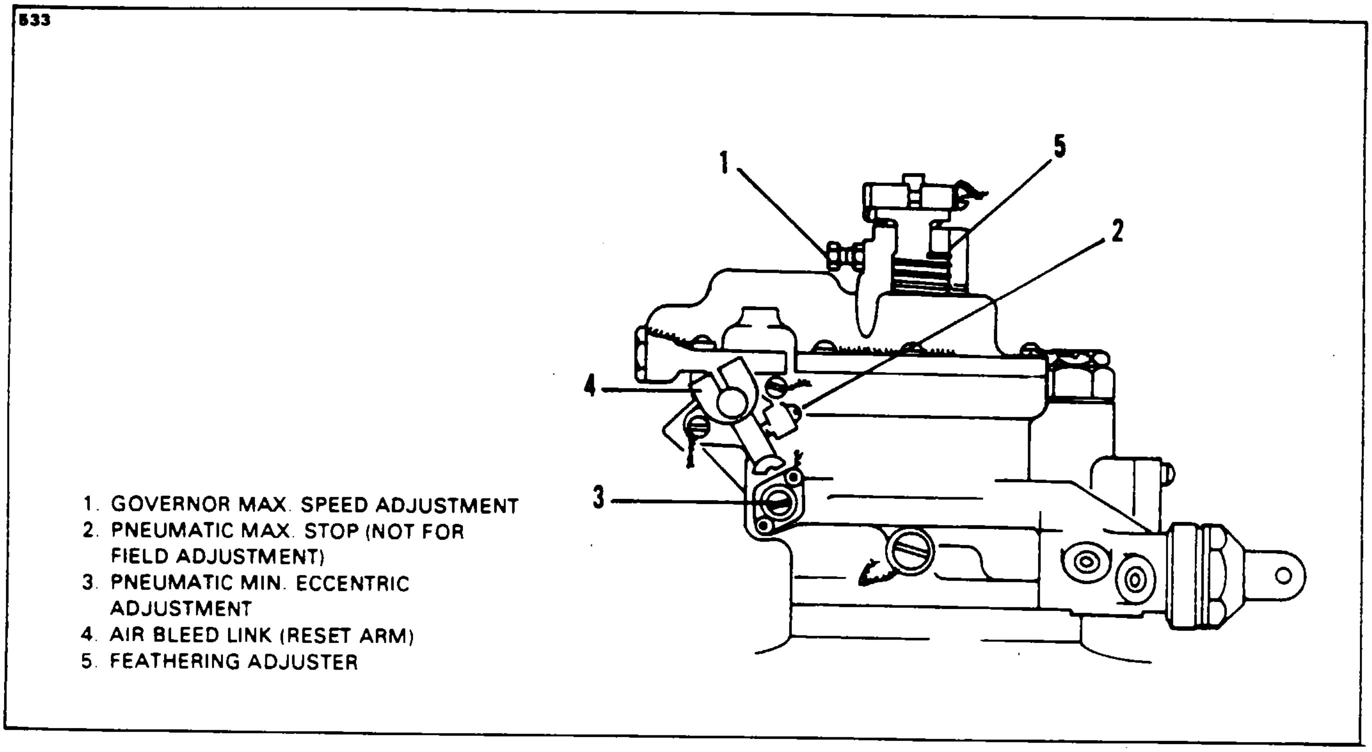


Figure 61-3. Propeller Governor

PROPELLER SYNCHROPHASER. (Woodward Type I)

DESCRIPTION. (Refer to Figure 61-4.)

The Woodward Type I Synchrophaser consists of a control box mounted in the cockpit, an actuator mounted in the slave engine governor and actuator, a speed sensing magnetic pickup located near three phase targets for each engine that rotate with each propeller shaft.

The system operates on electronic impulses, generated by the disc targets passing the magnetic pickups, being fed into the control box. This control box detects any difference in the electrical pulses and in turn activates a stepping type actuator motor mounted on the left engine, which trims the left engine propeller governor through a flexible shaft from the actuator motor to the trimmer asssembly on the left engine propeller governor control, thus maintaining the same propeller RPM as the master right propeller governor, within a limited range. Normal governor operation is unchanged, but the synchrophaser will continuously monitor engine RPM and propeller phase angle and reset the slave engine governor as required.

The RPM of the slave engine will follow changes in the RPM of the master engine over a predetermined limited range. This limited range feature prevents the slave engine from losing more than a fixed amount of RPM in case the master engine is feathered with the synchrophaser "ON". In this installation, the right engine is the master engine.

FUNCTIONAL TEST.

This test should be done in flight. First synchronize the propellers manually, and then switch the the synchrophaser ON. Now slowly adjust the master engine propeller governor control lever, in small increments to increase and decrease the RPM. The RPM range over which the slave engine will remain synchronized with the master engine is the limited range. With the system ON, move the master engine propeller governor control lever to a point which is close to the end of this limited travel. Now turn the system OFF. An unsynchronized condition will develop as the actuator moves the trimmer to its mid-position. When the system is turned ON again, synchrophasing will resume. If the units do not become synchrophased, the actuator has reached the end of its travel and must be recentered in the following manner:

1. Turn the system switch OFF.
2. Manually synchronize the engines.
3. Turn the system switch ON.

If the system does not operate properly, perform the ground check listed in Ground Check.

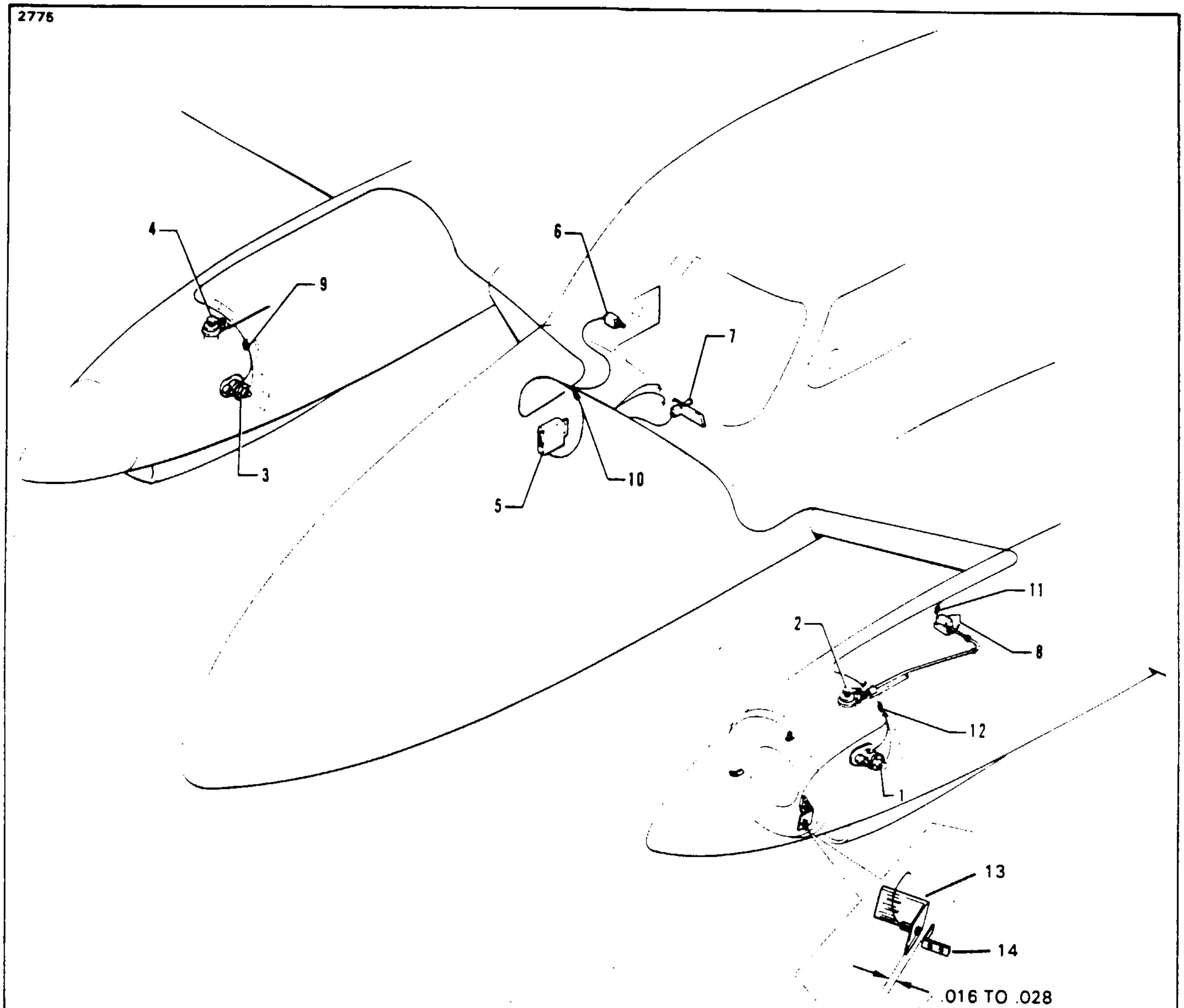
TROUBLESHOOTING WITH MINIMUM FIELD EQUIPMENT.

The following information will help locate system malfunction in the field with the minimum amount of equipment. The usual mechanics tools and an ohmmeter and voltmeter are all that is needed.

GROUND CHECK. (Refer to Figure 61-4.)

1. Ascertain that the master switch is ON and the circuit protector is not tripped. Also, determine that the Jones plug receptacle is properly mated with the plug in the airplane's wiring harness. The two halves of the Jones plug should be safety wired together if it does not have retaining clips.
2. Separate the Jones plugs and complete the tests listed in Chart 6102, Synchrophaser Wiring Test. Complete each step regardless of how recently the installation was made.

THIS SPACE INTENTIONALLY LEFT BLANK



1. OVERSPEED GOVERNOR (LEFT)
2. PROPELLER CONSTANT SPEED GOVERNOR (LEFT)
3. OVERSPEED GOVERNOR (RIGHT)
4. PROPELLER CONSTANT SPEED GOVERNOR (RIGHT)
5. CONTROL BOX
6. CIRCUIT BREAKER
7. SWITCH
8. ACTUATOR
9. CONNECTOR
10. CONNECTOR
11. CONNECTOR
12. CONNECTOR
13. MAGNETIC PHASE PICKUP
14. TARGET (3 EACH)

Figure 61-4. Propeller Synchrophaser Installation (Woodward Type I)

CHART 6102. SYNCHROPHASER WIRING TEST
(WOODWARD TYPE I)
STEP NO'S. 1-6 Test for Defective Actuator

STEP NO.	TEST BETWEEN RECEPTACLE NUMBERS	With Actuator Centered	OBTAIN With Actuator Uncentered 180°		ACTION (If Out of Limits)
			Turn Clockwise (Facing Drive End) To Uncenter	Counterclockwise (Facing Drive End) To Uncenter	
1	5 & 1	open circuit (high resistance)	6.5 to 8.5 ohms	6.5 to 8.5 ohms	Bench Check the Actuator per Chart 6103.
2	5 & 3	open circuit (high resistance)	closed circuit (0 to 1.0 ohms)	13 to 17 ohms	
3	5 & 4	open circuit (high resistance)	13 to 17 ohms	closed circuit (0 to 1.0 ohms)	
4	4 & 1	6.5 to 8.5 ohms	6.5 to 8.5 ohms	6.5 to 8.5 ohms	
5	4 & 3	13 to 17 ohms	13 to 17 ohms	13 to 17 ohms	
6	3 & 1	6.5 to 8.5 ohms	6.5 to 8.5 ohms	6.5 to 8.5 ohms	

STEP NO'S. 7-11 Test for Defective Pickup
STEP NO'S. 12-13 Test Aircraft Wiring

STEP NO.	TEST BETWEEN TERMINAL NUMBERS	10 PIN SYSTEM		ACTION (If Out of Limits)
		Other Than O.S. Gov.	Pickup In O.S. Gov.	
7	8 & 7	52 - 68	90 - 110	Repair wiring or replace pickup if it is defective.
8	8 & 9	52 - 68	-	
9	8 & 6	52 - 68	90 - 110	
10	8 & 10	52 - 68	-	
11	8 & Aircraft Ground	open circuit (very high resistance)		
12	2 & Aircraft Ground*	open circuit (very high resistance)		Trace wiring to remove poor ground.
13	1 & Aircraft Ground	short circuit zero ohms		Trace wiring to remove fault.

*2 and aircraft ground will read some low resistance value if you cannot open the circuit breaker or if there are any indicating lights in the circuit.

CHART 6102. SYNCHROPHASER WIRING TEST
(WOODWARD TYPE I) (cont.)
VOLTAGE CHECK

STEP NO.	TEST BETWEEN RECEPTACLE NUMBERS	METER READING	ACTION (If Out of Limits)
14	2 & 1	Same as supply voltage. Polarity of Pin No. 2 must be positive and Pin No. 1 must be negative.	Trace wiring to determine fault or reversed polarity.

— NOTE —

Before starting this test, be sure the control box is unplugged, the master switch is off, and the snychrophaser circuit protector is pulled.

— CAUTION —

Do not plug in control box until this test has been satisfactorily completed. Even with the switch OFF, the box could be seriously damaged.

— NOTE —

Make the test, using an ohmmeter to a fabricated Jones pigtail connected to the Jones plug socket. Zero the ohmmeter and read on the X1 or X10 scale.

— NOTE —

If another accessory uses the same circuit protector, turn this accessory off before starting tests. The control box must be unplugged for these tests also.

— CAUTION —

Do not probe the Jones plugs with anything thicker than .045 of an inch in diameter. Insert and remove probe carefully. Failure to do so will result in loose pin connections and faulty synchrophaser operation.

3. Visually observe the overspeed governor mounted speed pickups for oil leaks or evidence of loosening. This could indicate a change in the pickup clearance.

4. Remove the flexible shaft at the actuator in the left engine nacelle. Insert a screwdriver in the actuator and rotate it through its range. It should rotate freely except for the ratcheting effect of the detent wheel. Normal output torque is 1.5 inch-pounds. Leave the actuator in the center of its range.

5. Adjust the governor trimmer by rotating the flexible shaft to check the amount of torque required. An excellent torque level is one that allows you to adjust the trimmer by turning the squared end of the flexible cable with your fingers. It is more difficult to turn the shaft in the decrease RPM direction. In no case should you need a turning fixture of over .250 inch in diameter on the end of the cable to rotate the trimmer freely throughout its full range. Recenter the trimmer and secure it to the actuator. This check has verified an acceptable friction level of the rotating parts.

6. Connect a pigtail to the separated Jones plug, and run the engines near cruise RPM; test Pins 6 and 8 for the slave engine synchronizer pickup voltage. Test Pins 7 and 8 for the master engine synchronizer pickup voltage. These values should be between .85-volt minimum and 4-volt maximum for the synchronizer pickup. These are RMS voltages as read on a 5000 ohm/volt AC voltmeter.

7. Test Pins 9 and 8 for slave engine synchrophaser pickup voltage. Test Pins 10 and 8 for master engine synchrophaser pickup voltage. These values should be 3 ± 0.3 volts AC.

8. If all preceding tests are satisfactory, the aircraft can be flown.

FLIGHT CHECKS.

Perform the functional test in accordance with Functional Test. If the system will not pass this test, try the following steps:

1. With the synchrophaser ON, see if the synchrophaser action is affected by RPM and or power setting, particularly at lower cruise RPM and power settings. This would possibly indicate an unacceptably rough governor drive. If operation at lower RPM results in improved synchrophasing, the drives to the governors should be investigated.

THIS SPACE INTENTIONALLY LEFT BLANK

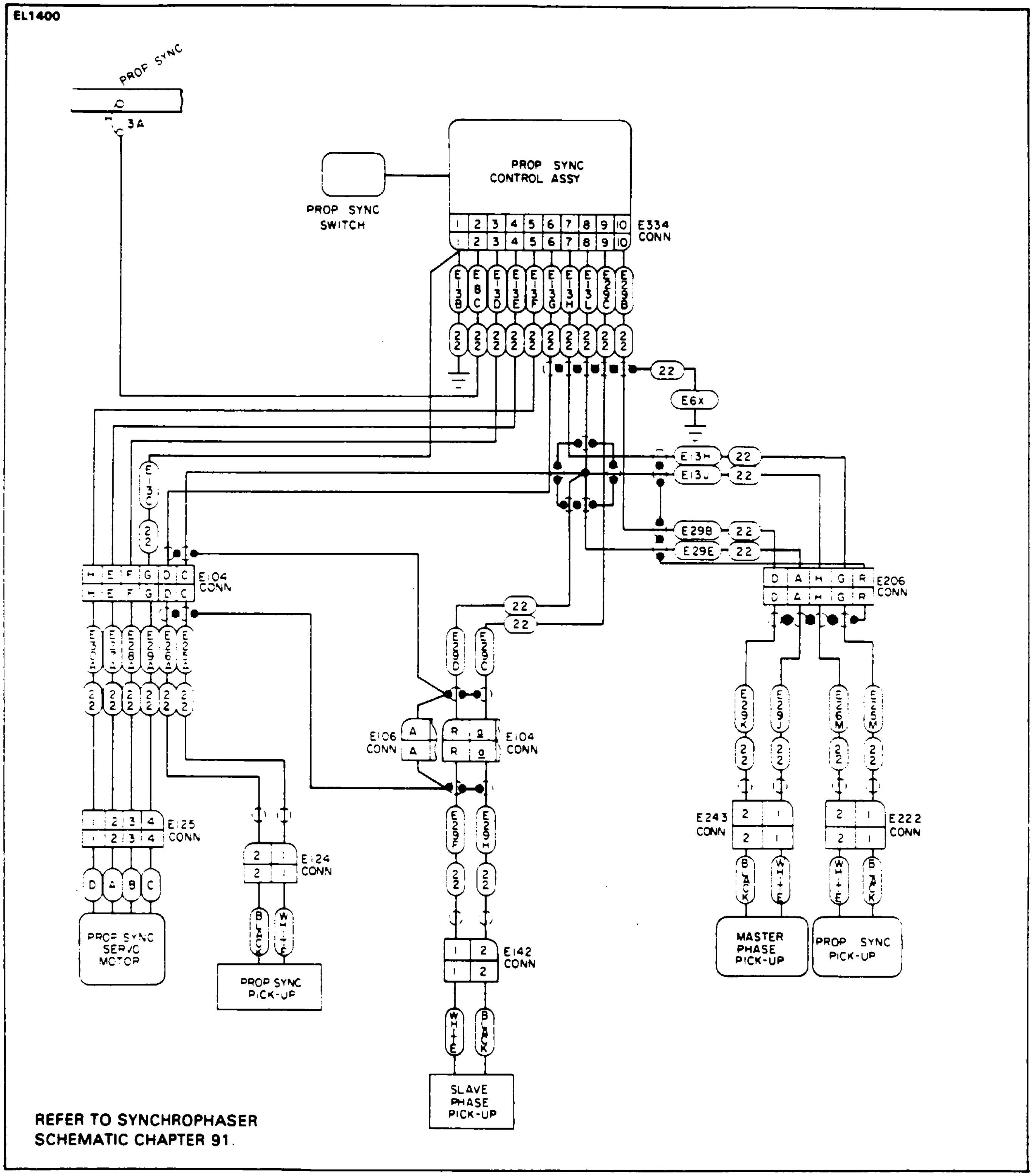


Figure 61-5. Propeller Synchrophaser Diagram
(Woodward Type I)

2. Reduce the electrical load. Turn off all electrical equipment including the alternators. Leave the master and synchrophaser switches ON. If the synchrophasing improves, there is a possibility that abnormal voltage spikes on the bus from some other electrical accessory have been upsetting the synchrophaser. Isolate the offending electrical accessory and repair it. If the trouble has been traced to the control box, exchange it for another unit.

— NOTE —

If troubles still persist with the system, it should be checked by an approved governor overhaul station or the Woodward Governor Company.

MAINTENANCE.

Little maintenance is required on this system apart from visual inspection at the time of regular airplane inspections. Ascertain that the electrical connections, flexible shaft, and related components are securely attached. Every 100 hours inspect the rod end assembly, paying particular attention to the bearing.

— NOTE —

Rod end trimmers are lubricated with a baked-on dry Molykote. DO NOT OIL.

Engine oil should be kept clean. Dirty engine oil will deposit sludge and varnish on the internal governor parts and cause sluggish operation. This would require disassembly and cleaning of the governors by an approved overhaul facility.

— CAUTION —

The control box and actuator have the capability of damaging each other as follows: If the control box turns on steady, it will burn out one or both actuator motor windings. If the actuator leads are shorted to ground, the power transistors in the control box will be permanently damaged. Therefore, when replacing a damaged component, complete the electrical test in Chart 6102 to insure the other component is undamaged.

TRIMMER ASSEMBLY.

REMOVAL OF TRIMMER ASSEMBLY. (Refer to Figure 61-6.)

1. Remove the left engine cowling.
2. Cut the safety wire between the trimmer assembly and the nut securing the flexible shaft to the trimmer.
3. Remove the flexible shaft from the trimmer.

4. Loosen the locknut on the propeller control rod.
5. Remove the locknut, bushing, and bolt securing the trimmer rod end to the governor control lever and remove the trimmer assembly.

INSTALLATION OF TRIMMER ASSEMBLY.

1. Position the trimmer onto the propeller control rod.
2. Align the trimmer assembly rod end with the governor control lever and secure the control rod locknut.
3. Ascertain that the trimmer assembly is at its neutral position by rotating the splined shaft in the trimming assembly by hand and counting the total number of turns available from stop to stop; then return to the center position.
4. Install the bolt, bushing, and locknut securing the trimmer rod end and the governor control lever.
5. Rig the governor control.
6. Again manually rotate the trimmer to one end of its travel. Now move the cockpit propeller control through its complete range and observe the governor speed adjustment lever to be certain it hits both maximum and minimum RPM stops. Repeat this procedure with the trimmer rotated to the opposite end of its travel. This will assure that the standard governor rigging allows stop-to-stop travel with any possible trimmer setting. Reposition the trimmer to its center position.
7. Before connecting the flexible shaft to the trimmer assembly, ascertain that the actuator motor is at its center position. (Refer to Installation Actuator.)
8. With the trimmer assembly and actuator motor at these centered positions, connect the flexible shaft to the trimmer and secure with nut and safety wire as shown in Figure 61-6.
9. Replace the engine cowling.

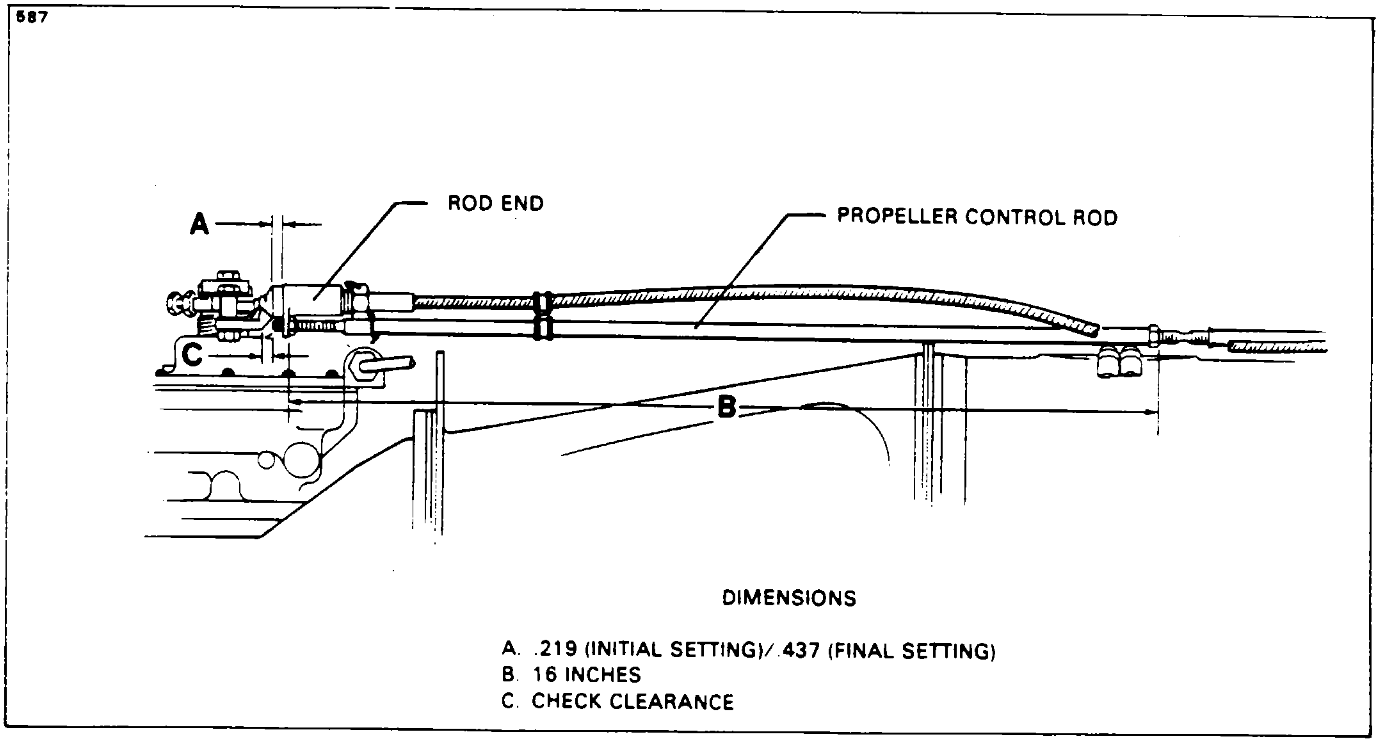


Figure 61-6. Propeller Synchrophaser Rigging (Left Engine Only)

SYNCHROPHASER RIGGING. (Refer to Figure 61-6.)

1. Adjust the propeller lever stop in the pedestal as far forward as possible (large washer type stop).
2. Screw the micro-switch contact screws into the propeller control levers (left and right), this will get the screws out of the way while performing the balance of this rigging procedure.
3. Disconnect the synchronizer flex shaft from the motor and drive the shaft to extend the trimmer from the rod end assembly .219 of an inch. (Refer to Figure 61-6, Dimension A.)
4. Adjust the propeller control rod to obtain 16 inches between the stop nuts at each end of the rod. (Refer to Figure 61-6, Dimension B.) This is an initial setting only.
5. Move the left propeller control lever at the pedestal to its full forward position. The stop on the governor must be contacted, if not, lengthen the propeller control rod.
6. Move the left propeller control lever to its aft stop (push hard as this is in a friction range). The stop on the governor must be contacted.
7. Drive the synchronizer flex shaft to extend the trimmer to .437 of an inch. (Refer to Figure 61-6, Dimension A.)
8. Move the propeller control lever as in Steps 5 and 6 and check for contacts with the governor stops. Make any adjustments if necessary.
9. Rig the right engine to match control alignment.
10. Check the clearance between the trimmer and rod end assembly as shown in Figure 61-6, Dimension C.
11. Safety all joints and adjust pedestal micro-switch.
12. Adjust the propeller lever stop in the pedestal to obtain approximately .062 inch clearance between propeller lever and stop. (The stop on the governor must be contacted first when propeller lever is in its full forward position.

ACTUATOR.

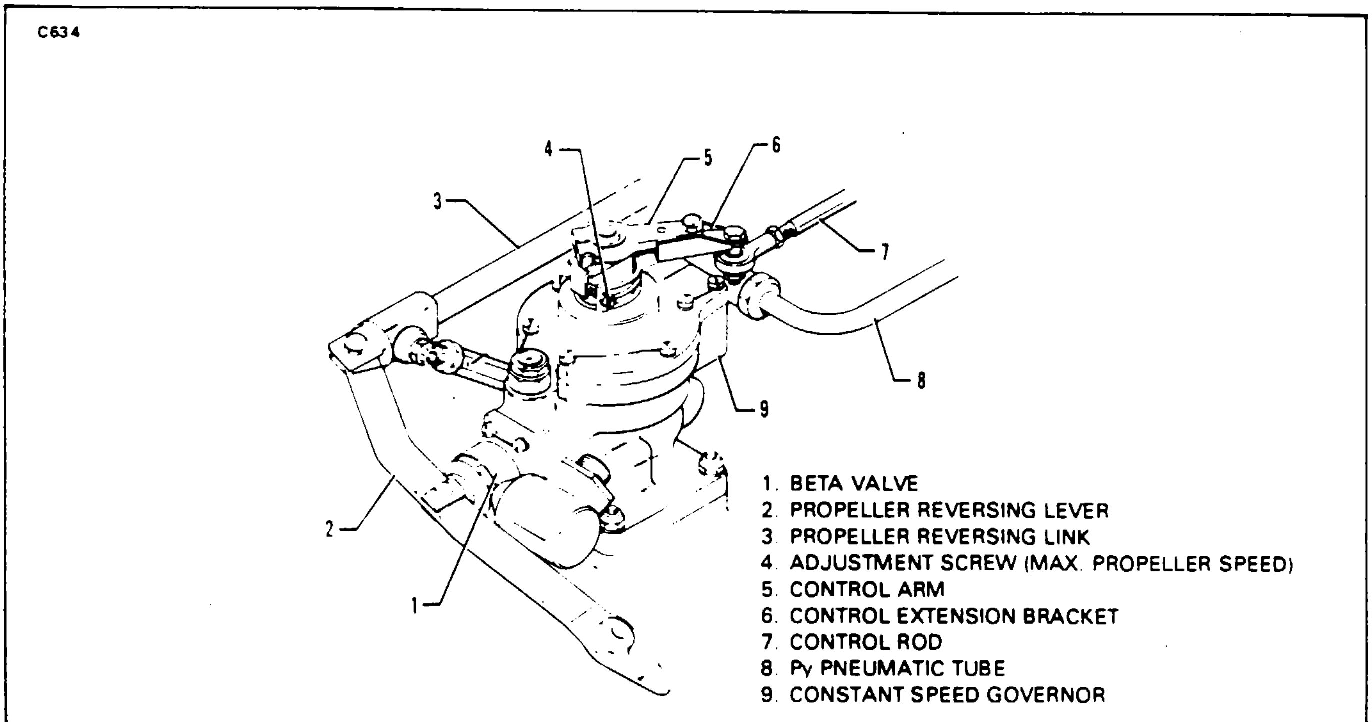


Figure 61-7. Trimmer Assembly (Right Engine Only)

REMOVAL OF ACTUATOR.

1. Remove the left engine cowling.
2. Disconnect the electrical plug from the actuator and also the flexible shaft.
3. Remove the four locknuts and screws holding the actuator in place.

INSTALLATION OF ACTUATOR.

1. Before installing the actuator, ascertain that the motor is at the center of its range by inserting a screwdriver in the actuator drive and turning it by hand and counting the total number of turns from stop to stop; then return the actuator drive to the center position.
2. Install the actuator to the mounting bracket and secure in place with four screws and locknuts.
3. Connect the flexible shaft to the actuator and secure with nut and safety wire.
4. Connect the electrical plug and replace the engine cowling.

SERVICE OF ACTUATOR.

At the time of governor overhaul, remove the cover from the actuator and clean the internal parts, such as micro-switches and electrical connections, etc. Apply Alpha-Molykote "G" to the spiral groove of the switch actuating disc at the end of the motor.

CONTROL BOX.

REMOVAL OF CONTROL BOX.

1. Disconnect the Jones plug, the wire going to the bus and the harness going to the switch.
2. Remove the four machine screws and locknut and remove the control box.

— NOTE —

The control box is a transistorized unit which cannot be serviced in the field. Special Woodward Test Unit No. 213600 can be used to explore the control box and locate any malfunctioning.

— NOTE —

If an actuator is replaced because of shorted or open windings, the control box must also be replaced, unless it is determined that the box is undamaged.

INSTALLATION OF CONTROL BOX.

1. Install the control box to the mounting bracket and secure with four screws and locknuts.
2. Connect the wires going to the switch and airplane bus.
3. Connect the Jones plug and secure with safety wire, if it does not have retaining clips.

TEST EQUIPMENT.

Various test equipment can be purchased from the Woodward Governor Company of Rockford, Illinois to help accomplish a complete check of the synchrophaser system. It is suggested that test instrument, P/N 213600, be purchased from Woodward to allow complete testing of the synchronizing portion of the system. A small test instrument, P/N WT-46192, can be built in the field from the diagram and parts list in Figure 61-9. This instrument has pulse indicating lights and jacks for checking voltage and ohm values only as given in Chart 6102, Synchrophaser Wiring Test. Test instrument, P/N 213600, has pulse indicating lights, jacks for checking voltages and ohm values, and an oscillator system with which magnetic pickup output may be simulated. This allows partially checking the control box without running the engines.

— *NOTE* —

Use of any Woodward test equipment with the Woodward synchrophaser system will require the use of a Jones plug adapter. Use the 10 pin to 8 pin adapter as shown in Figure 61-8. The external leads 9 and 10 can be disconnected or connected to either deactivate, or use the phasing portion of the control box during test. The external leads can also be used to test pickup resistance and volt values.

CHART 6103. BENCH TESTING OF THE ACTUATOR

TEST BETWEEN RECEPTACLE NUMBERS	OBTAIN		
		With Actuator Uncentered 180°	
	With Actuator Centered	Turn Clockwise (Facing Drive End) To Uncenter	Turn Counterclockwise (Facing Drive End) To Uncenter
D & C	open circuit (high resistance)	6.5 to 8.5 ohms	6.5 to 8.5 ohms
D & B	open circuit (high resistance)	closed circuit (0 ohms)	13 to 17 ohms
D & A	open circuit (high resistance)	13 to 17 ohms	closed circuit (0 ohms)
A & C	6.5 to 8.5 ohms	6.5 to 8.5 ohms	6.5 to 8.5 ohms
A & B	13 to 17 ohms	13 to 17 ohms	13 to 17 ohms
B & C	6.5 to 8.5 ohms	6.5 to 8.5 ohms	6.5 to 8.5 ohms

BENCH TESTING THE ACTUATOR. (Refer to Chart 6104.)

Use an ohmmeter on the pinsof the actuator disconnect. Zero the ohmmeter and read on the X1 scale. Chart 6102, Steps 1 to 6, gives actuator test from the Jones plug through the harness to the actuator. See Propeller Synchrophaser Schematic and convert receptacle numbers in Chart 6102 to actuator leads and perform Steps 1 to 6 of Chart 6102 directly on actuator. Replace any actuator which does not meet the values given in Chart 6102 after bench testing.

If either test unit is plugged into the system during flight or ground testing, the pulsing and direction of pulsing of the actuator will be indicated by the flashing lights of the test unit. Refer to Chart 6104 for description of control box malfunction or system defects which can be detected by the lights on the test units, along with the probable cause and suggested remedy.

MAGNETIC PHASE PICKUP REMOVAL, INSTALLATION AND ADJUSTMENT.

1. Remove the engine cowling. (Refer to Chapter 71.)
2. Disconnect electrical wiring from the magnetic pickup.
3. Remove the safety wire from the magnetic pickup locknut and remove locknut.
4. Remove magnetic pickup.
5. Install pickup in bracket and secure in position with locknut.
6. Rotate prop and insure targets do not hit pickup.

— *NOTE* —

Proper clearance between magnetic pickup and targets, should be 0.16 to .028 of an inch. Insure that the magnetic disc protrudes through locknut. (Refer to Figure 61-4.)

7. Insure that all targets are within the clearance specified.
8. Safety wire locknut and connect the electrical wiring.
9. Install engine cowling. (Refer to Chapter 71.)

CHART 6104. TROUBLESHOOTING (ACTUATOR)

Trouble	Cause	Remedy
Double pulsing (both lights flashing simultaneously.)	Excessive voltage spikes on bus caused by generator or other electrical accessory.	Repair the offending accessory.
	Malfunctioning control box.	Return to Woodward Governor Company for repair.
	Magnetic pickup voltage incorrect.	Reset to specific voltage.

CHART 6104. TROUBLESHOOTING (ACTUATOR) (cont.)

Trouble	Cause	Remedy
Either or both lights on continuously.	Malfunctioning control box. actuator, or wiring.	Determine the malfunction with wiring check sheet.
No pulsing activity.	Malfunctioning control box,	Determine the malfunction with the wiring check sheet or 213600 test instrument.
Excessive pulsing in one direction.	Excessive torque required to trim the governor in one direction (this assumes the governor and propeller are equally responsive in each direction).	Check for high friction level or misalignment in the flex shaft or trimmer.

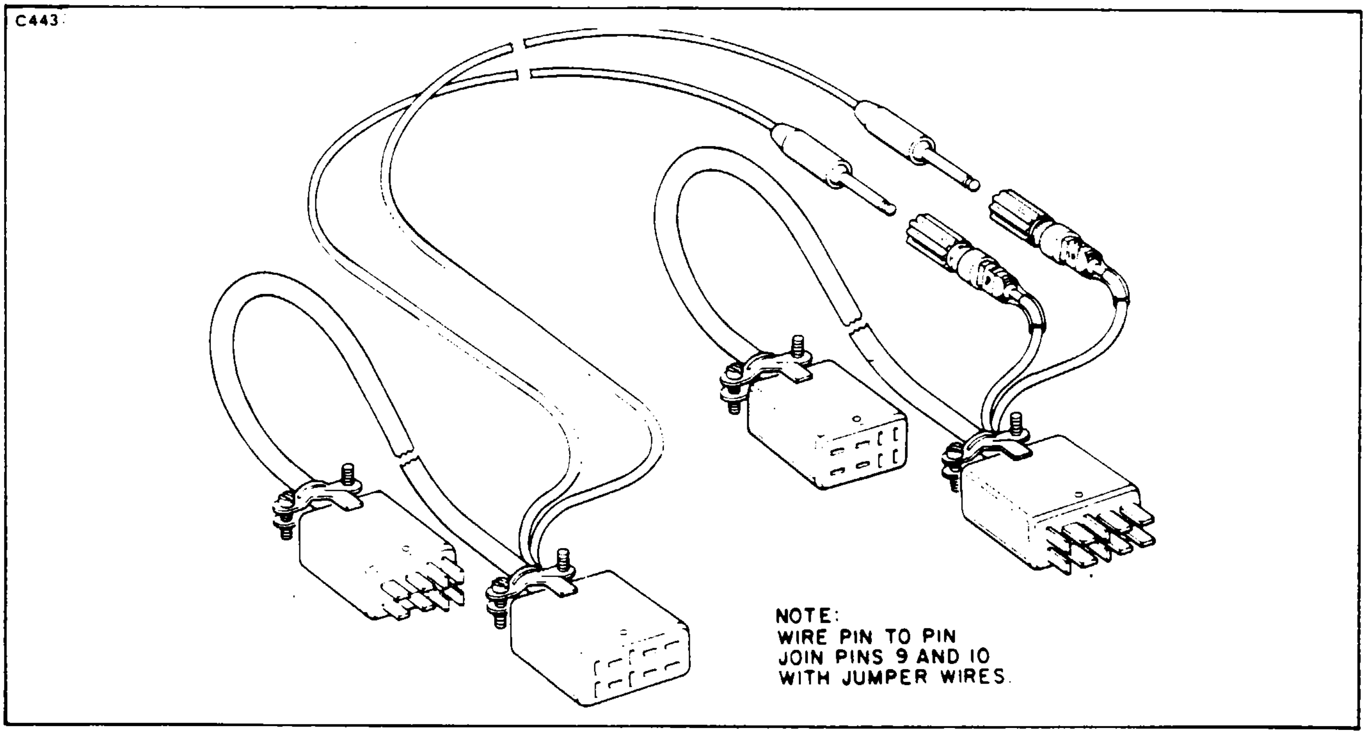
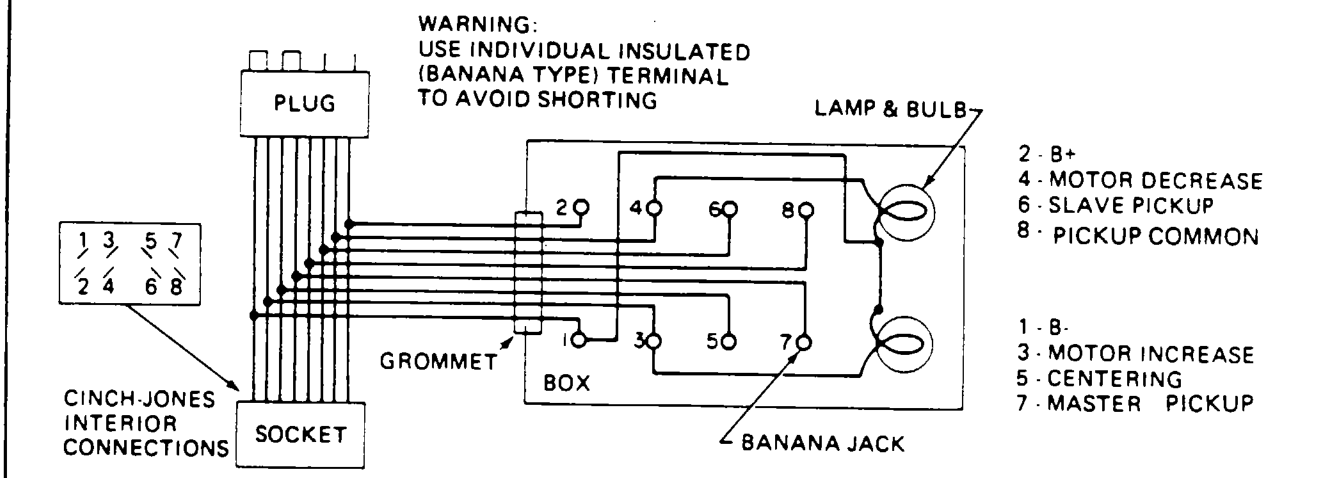


Figure 61-8. 10 Pin to 8 Pin Plug Adapters, P/N 5401-018

PARTS LIST FOR WT-46192 SYNCHRONIZER TEST INSTRUMENT

BOX:	(1) Hammertone gray aluminum 3-1/4" x 2-1/8" x 1-5/8" Bud Box Co. P/N CU-2101-A
BANANA JACK:	(8) H.H. Smith Co., type 1509 (black)
LAMP:	(2) Dialco midget flange type white lens pilot lamp series no. 177-8430, type no. 0975-503 or Drake midget flange type white lens pilot lamp no. 5131-038-303
CABLE:	(6 ft.) Vinyl covered plastic insulated cable, Belden types 8448 (8 #22 stranded wires)
GROMMET:	(1) 5/8" O.D. x 3/8" I.D. black rubber grommet
PLUG:	(1) Cinch Jones 8 connector plug P/N P-308 CCT
SOCKET:	(1) Cinch Jones 8 connector socket P/N S-308 CCT
BULB:	(2) Bayonet type bulb Chicago miniature P/N 327



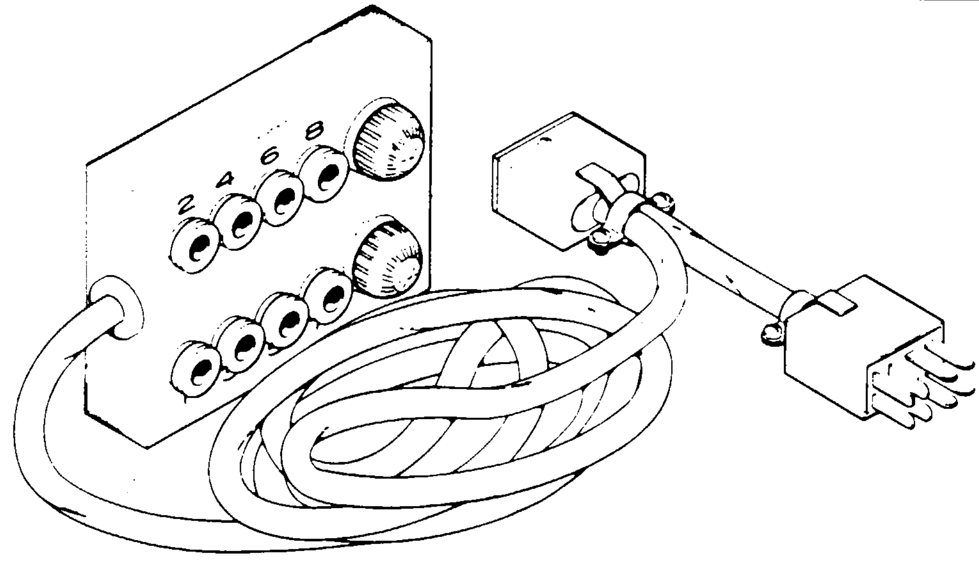


Figure 61-9. Test Instrument, WT-46192

CHART 6105. TROUBLESHOOTING (PROPELLER SYNCHROPHASER)
(WOODWARD TYPE I)

Trouble	Cause	Remedy
Synchrophaser hunting.	Binding of the governor control arm, trimmer assembly, and/or rod end.	Correct any mechanical binding or replace Uniball of rod end if binding.
	Master governor speed is varying.	Overhaul governors.
Synchrophaser runs out of synchronization when turned on.	Reversed speed pickup leads or Jones plug leads.	Perform Steps 7 and 9 of test for defective pickup.(Chart 6102)
	Reverse motors leads to the actuator.	Check motor leads against the installation drawing.
	Intermittent shorts or pens in the pickup or its wiring.	Monitor pickup voltage produced. Replace defective pickup.
Synchrophaser will not center.	Malfunctioning slave governor pickup.	Replace pickup, adjust clearance or repair leads.
	Defective control box.	Replace control box.
	Mechanically misrigged.	Rerig.
	Defective centering mechanism. Switch arm bent.	Replace actuator.
	Defective centering switches.	Replace actuator.
	Rod end, flexible shaft or actuator mechanically bound up.	Reduce friction to an acceptable level.
Lack of range.	Improper rigging.	Rerig properly.
	Trying to synchrophase too close to a mechanical stop.	Adjust prop control lever in cockpit to move speed control lever further away from stop.
	Defective control box.	Replace the control box.
	Mechanical binding of trimmer or actuator.	Adjust trimmer or actuator to operate smoothly from stop to stop.

CHART 6105. TROUBLESHOOTING CHART (PROPELLER SYNCHROPHASER) (WOODWARD TYPE I) (cont.)

Trouble	Cause	Remedy
Synchrophaser corrects in one direction only.	One side of actuator motor defective.	Replace actuator.
	One side of control box defective.	Replace control box.
	Mechanical binding in one direction.	Correct binding.
	Improper rigging.	Rerig.
Slow to synchrophase and won't hold synchrophasing.	Defective control box.	Replace control box.
	Excessive voltage spikes from other electrical accessory.	Repair offending electrical accessory.
	Excessive mechanical friction.	Correct mechanical binding.
Synchrophaser operates intermittently.	Excessive mechanical friction.	Decrease torque required to drive the trimmer.
	Intermittent short in pickup or wiring.	Repair pickup lead or replace pickup.
	Intermittent fault in control box.	Replace control box.
	Intermittent open in actuator or motor leads.	Replace actuator or repair leads.
	Defective electrical plug connector.	Replace plug connector.
	Excessive voltage spikes on bus from other malfunctioning electrical accessory.	Repair offending electrical accessory.

GRIDS 4J20 THRU 4K4
INTENTIONALLY LEFT BLANK

CHAPTER

70

STANDARD PRACTICES
ENGINES

CHAPTER 70 - STANDARD PRACTICES ENGINE

TABLE OF CONTENTS/EFFECTIVITY

STANDARD PRACTICES - ENGINE.

The following suggestions should be applied wherever they are needed when working on the power plant:

1. To insure proper reinstallation and/or assembly, tag and mark all parts, clips, and brackets as to their location prior to their removal and/or disassembly.
2. During removal of various tubes or engine parts, inspect 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 caps in the tube ends.

4. Should any items be dropped into the engine, the assembly process must be stopped and the item removed, even though this may require considerable time and labor. Ensure that all parts are thoroughly clean before assembling.
5. Never reuse any lockwire, lockwashers, tablocks, tabwashers or cotter pins. All lockwire and cotter pins must fit snugly in holes drilled in studs and bolts for locking purposes. Cotter pins should be installed so the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Use only corrosion resistant steel lockwire and/or cotter pins. Bushing plugs shall be lockwired to the assembly base or case. Do not lockwire the plug to the bushing.
6. All gaskets, packings and rubber parts must be replaced with new items of the same type at reassembly. Ensure that 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. Whenever adhesive tape has been applied to any part, the tape and all residue must be removed and thoroughly cleaned of all tape residue with petroleum solvents prior to being subjected to high temperature during engine run. This would also apply to parts that have corrosion preventive compounds applied.
9. Anti-seize lubrication should be applied to all loose-fit spline drives which are external to the engine and have no other means of lubrication. For certain assembly procedures, molybdenum disulfide in either paste or powdered form mixed with engine oil or grease may be used.

— CAUTION —

Ensure that anti-seize compounds are applied in thin even coats, and that excess compound is completely removed to avoid contamination of adjacent parts.

10. Temporary marking methods are those markings which will ensure identification during ordinary handling, storage and final assembly of parts. To ensure that the proper marking methods and materials are used, refer to the Pratt and Whitney Maintenance Manual, Part No. 3030442, Chapter 70 for specific details; this is a very important area of standard practices.

— END —

CHAPTER

71

POWER PLANT

CHAPTER 71 - POWERPLANT

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The maintenance concept of this chapter is supplemental to the Pratt and Whitney Engine Maintenance Manual No. 3030442 and consists of removal and installation of external components and engine accessories. Repairs beyond this level should be accomplished by an approved Pratt and Whitney Aircraft of Canada, Ltd. overhaul facility.

In the interest of maintaining efficient engine performance, an Engine Condition Trend Monitoring System has been established by Pratt and Whitney Aircraft of Canada, Ltd. This is not a mandatory procedure, but is highly recommended by Pratt and Whitney Aircraft of Canada, Ltd. and Piper Aircraft Corporation. Introduction of the monitoring system when engines are new or newly overhauled enables the establishment of a performance baseline before any deterioration of components takes place within the engine. Engine condition can then be observed without actual teardown of components. The complete procedure can be found in the Aircraft Gas Turbine Engine Information Letter No. 18 available from Pratt and Whitney Aircraft of Canada, Ltd.

DESCRIPTION AND OPERATION.

The T-1040 is powered by two lightweight, free turbine, Pratt and Whitney Aircraft of Canada, Ltd. PT6A-11 gas turbine engines. Each engine is rated at 500 shaft horsepower at 2200 propeller RPM. The PT6A-11 utilizes two independent turbine sections: one drives the compressor in the gas generator section and the second drives the propeller shaft through a reduction gearbox.

The engine lubricating system is a pressure type with the main oil pump located in the oil tank which is an integral part of the compressor inlet case. The gas generator driven oil system provides lubrication for all areas of the engine, pressure for the torquemeter and power for the propeller pitch control.

The fuel control system consists of: an oil-to-fuel heater; a single, engine driven fuel pump; a fuel control unit; flow divider and dump valve; dual fuel manifold with 14 simplex nozzles; fuel drain valves and interconnecting pneumatic sense lines. The fuel drain valves consist of an automatic dump valve and combustion chamber dump valves which provide drainage of residual fuel after engine shutdown. A scavenger pump system collects residual fuel after engine shutdown and injects the fuel back into the aircraft fuel tank during engine start.

The ignition system consists of one exciter box, two ignition leads, and two spark igniters for each engine which require about 8000-volts to spark. Ignition is by both igniters simultaneously; there is no provision for single igniter operation.

The engine is also equipped with a 28-volt, 200 amp starter-generator, hydraulic pump, power section tachometer generator, gas generator tachometer generator, and an air bleed system which provides high pressure air for the pneumatic system. The complete engine assembly is supported on a tubular steel mount attached at the firewall.

The propellers are constant speed, full feathering, reversing type, controlled by engine oil pressure through single-acting propeller governors. Centrifugal counterweights assisted by a feathering spring move the blades toward the low rpm (high pitch) position and into the feather position. This movement is opposed by oil pressure controlled by the propeller governor. Oil pressure moves the propeller to the high rpm (low pitch) hydraulic stop and reverse position. The propellers have no high pitch stop; this allows the propeller to feather after engine shutdown.

A compressor wash ring is standard equipment. Routine compressor washes may be performed, without the removal of the cowling, through an access door located on the outboard side of the nacelle.

The engines are completely enclosed by cowlings consisting of an upper and lower section of cantilever construction attached at the firewall. A hinged door on the upper cowls allows access to the oil filler neck and quantity dipstick. The air inlet ice deflector door is an integral part of the lower cowl assembly.

TROUBLESHOOTING.

Troubles concerning the power plant are listed in Chart 7101 along with their probable causes and suggested remedies. Before attempting to locate the difficulty, consult all available sources for any pertinent information which might assist in diagnosing the trouble. Perform the Minimum Checks Required Before Troubleshooting as listed in the Pratt and Whitney Maintenance Manual No. 3030442, Chapter 71.

— NOTE —

Special tools referred to in the following service information are available through the Piper Service Department, or may be fabricated locally from information supplied with the text.

THIS SPACE INTENTIONALLY LEFT BLANK

CHART 7101. TROUBLESHOOTING (ENGINE)

Trouble	Cause	Remedy
Engine fails to start.	No fuel supply to engine.	Check for clean fuel supply at firewall shutoff valve.
	Air in fuel system.	Perform motoring run.
	Open ignition circuit.	Check wiring and connections.
	Defective engine driven fuel pump.	Check for flow from pump while motoring engine. If no flow, replace pump.
	Defective fuel control unit.	Check for flow from FCU outlet tube to starting flow control while motoring engine. If no flow, remove FCU, check bypass valve by applying 5 psi max. to bypass return port and check for air leakage from FCU inlet. If leakage is evidenced, replace fuel control unit and fuel pump. If no leakage, replace only FCU.
	Defective starting flow control.	Disconnect primary tube and check for evidence of flow while motoring engine with start control lever in run position. If no flow, replace starting flow control.
	Restricted fuel nozzles.	Clean and check nozzles. (Refer to Engine Maintenance Manual.)
Engine does not idle properly.	Idle speed setting incorrect.	Adjust idle speed and minimum flow as required.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Engine does not idle properly. (cont.)	Leak or restriction in FCU pneumatic system.	Check all pneumatic tubes and connections for leakage.
Engine does not accelerate properly.	Leak or restriction in fuel control pneumatic system. P3 filter plugged.	Check all connections for leakage. Check for dirt in P3 metering orifice. (Refer to Engine Maintenance Manual for cleaning instructions.)
	Defective fuel control unit.	Replace fuel control unit.
Engine does not decelerate.	Power control linkage adjusted incorrectly.	Adjust linkage.
	Defective fuel control unit.	Replace fuel control unit.
Engine does not develop full power.	Faulty engine instrumentation.	Check instrument system. Replace or recalibrate as necessary. If torquemeter system defect is established, return power section to overhaul facility for repair.
	Control linkage adjusted incorrectly.	Check adjustment.
	Propeller governor pneumatic section adjusted incorrectly.	Adjust.
	Leak or restriction in fuel control pneumatic system.	Check all tubes for restrictions and connections for leakage.
	Engine power settings not adjusted correctly.	Check adjustment settings.
	Defective fuel control unit.	Replace fuel control unit.
	Restricted fuel nozzles.	Clean and check nozzles. (Refer to Engine Maintenance Manual.)

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Excessive vibration.	Propeller out of balance.	Replace propeller.
	Compressor or compressor turbine disc out of balance.	Return disc to an overhaul facility. (Refer to Engine Maintenance Manual.)
Low oil pressure.	Oil pressure indicating system defective.	Check system and repair as necessary.
	Insufficient oil.	Fill oil tank as required.
	Excessive hot air leakage through faulty heat shielding.	Replace engine.
	High oil temperatures.	Check cooling system.
High oil temperature.	Insufficient oil supply.	Refill oil tank as required.
	Faulty instrumentation.	Check instrumentation, repair or replace as required.
	Cooling system defective.	Check system and clean cooler if required.
	Excessive hot air leakage through faulty heat shielding.	Replace engine.
Excessive oil consumption.	Leakage or restriction in pressure or scavenge oil tubes.	Visually inspect all tubes and connections. Repair as required.
	Oil level too high.	Maintain correct oil level.
	Defective Labyrinth seals.	Check inlet and exhaust areas for collections of oil. If evident, replace engine.
	Defective oil to fuel heater (internal leakage).	Pressure check heater. (Refer to Engine Maintenance Manual.)
Engine drops below idle (min. flow) in flight.	P-Y line leaking.	Check P-Y line connections for leakage.
	Leak or restriction in P-3 line.	Check P-3 line for restriction. Replace if required.
	Ice accumulation in P-3 line.	Check wiring and connections of electrically heated P-3 line. Repair or replace as required.

ENGINE REMOVAL. (Refer to Figure 71-1.)

The removal of either engine is basically the same except for the routing of some wires, cables and lines and the freon compressor assembly mounted on the right engine. Remove the engine as follows:

1. Place a tail stand under the aircraft.
2. Turn off all cockpit switches and disconnect battery.
3. Move the fuel shutoff valve to the off position.
4. Remove the engine cowling per paragraph titled Cowling.
5. Remove the access panels on the top and sides of the nacelle.
6. Drain the engine oil. (Refer to Chapter 12.)
7. Remove the propeller. (Refer to Chapter 61.)

— NOTE —

In some manner, identify disconnected items, mark all clamp locations to facilitate installation, and cap all lines and necessary fixtures.

8. Disconnect all fluid hoses, bleed air lines, clamps, and electrical leads attached to the engine and engine mount from the firewall (cap all fluid lines). On the right engine only, disconnect the freon compressor lines and remove the compressor and compressor drive. (Refer to Chapter 21.)

— WARNING —

Use caution when working with the fire extinguisher system. Accidental discharge may cause bodily injury.

9. Remove the fire extinguisher system. (Refer to Chapter 26.)
10. Disconnect and cap oil cooler lines at engine.

— NOTE —

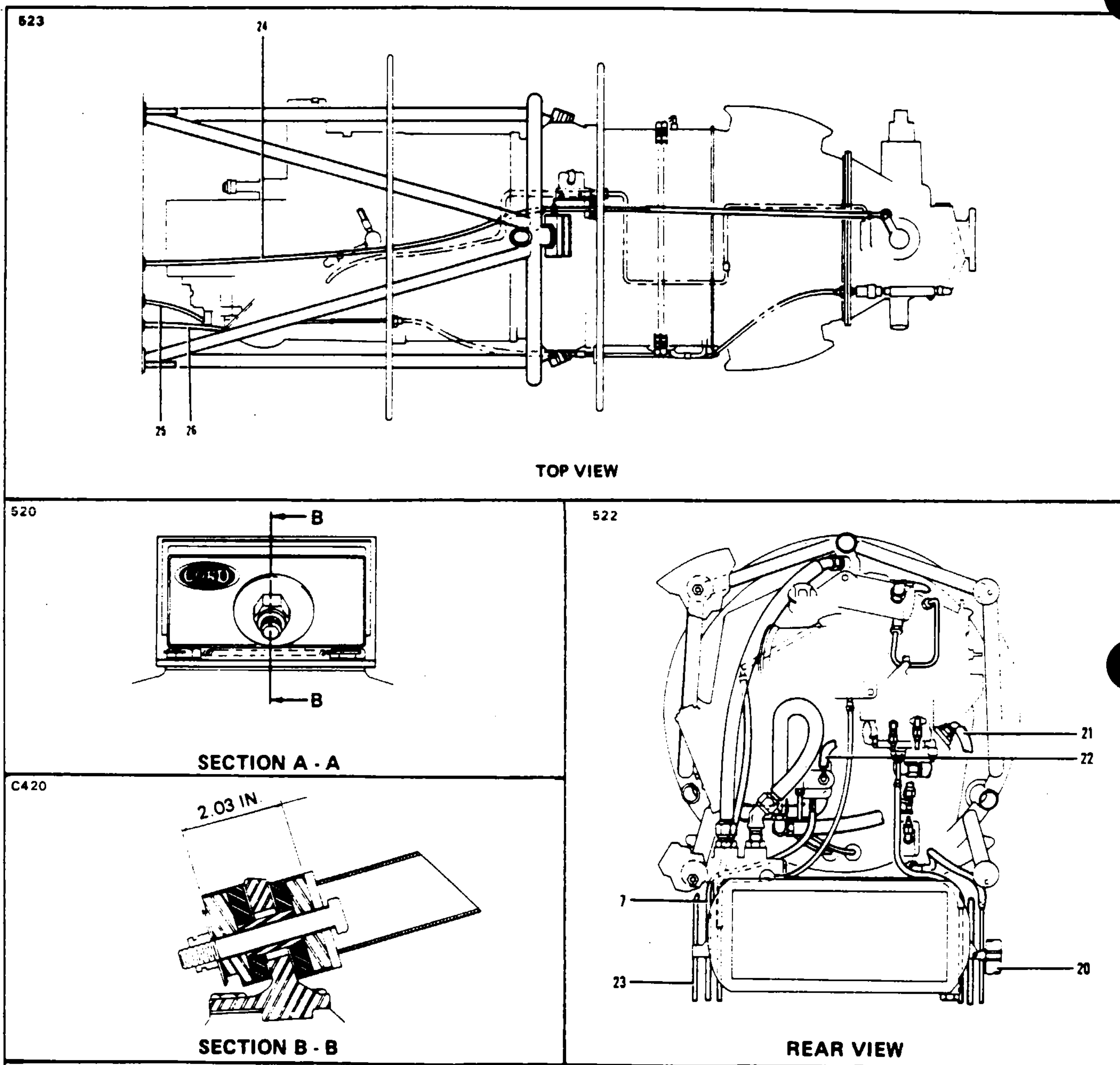
The oil cooler system remains attached to the bulkhead.

11. Disconnect and remove the rear top left and top right fire seals from the engine.
12. Disconnect all drain lines attached to the engine, and the fuel lines attached to the scavenge pump.
13. Disconnect the power control cable from the fuel control unit actuating lever and remove the cable from the support bracket. Disconnect and remove the support bracket.

— CAUTION —

Do not bend the power control cable in the direction offering the greatest resistance, as damage will be done to the cable.

14. Disconnect the starting control cable from the start control lever arm and remove the cable clamp from the cable support bracket. Disconnect and remove the support bracket.
15. Disconnect propeller control cable from the propeller control rod. Remove cable clamps and draw the cable aft to the firewall.
16. Attach lifting sling to the engine suspension points and using a one-half ton hoist, support the engine to allow the engine mount bolts to be removed at the firewall.



1. BLEED AIR PRESSURE
2. JET PUMP INLET DUCT
3. OIL COOLER HOSE
4. PROPELLER GOVERNOR AIR PRESSURE LINE (Py)
5. OIL DRIP SHIELD DRAIN
6. STARTER GENERATOR DRAIN
7. HYDRAULIC PUMP DRAIN
8. ENGINE MOUNT ASSEMBLY
9. OIL DRAIN
10. START CONTROL DRAIN
11. FUEL CONTROL DRAIN
12. SOLENOID VALVE
13. BREATHER LINE
14. P3 LINE
15. P3 FILTER (PA-31T ONLY)
16. DRAIN LINE
17. TORQUE PRESSURE TRANSMITTER
18. REAR FIRE SEAL
19. FRONT FIRE SEAL
20. OIL BREATHER
21. OIL PRESSURE LINE
22. HYDRAULIC LINE
23. FUEL DRAIN
24. PROPELLER CONTROL CABLE
25. START CONTROL CABLE
26. POWER CONTROL CABLE
27. STARTER GENERATOR COOLING DUCT
28. SCAVENGER PUMP
29. CHECK VALVE

81990

Figure 71-1. Powerplant Installation

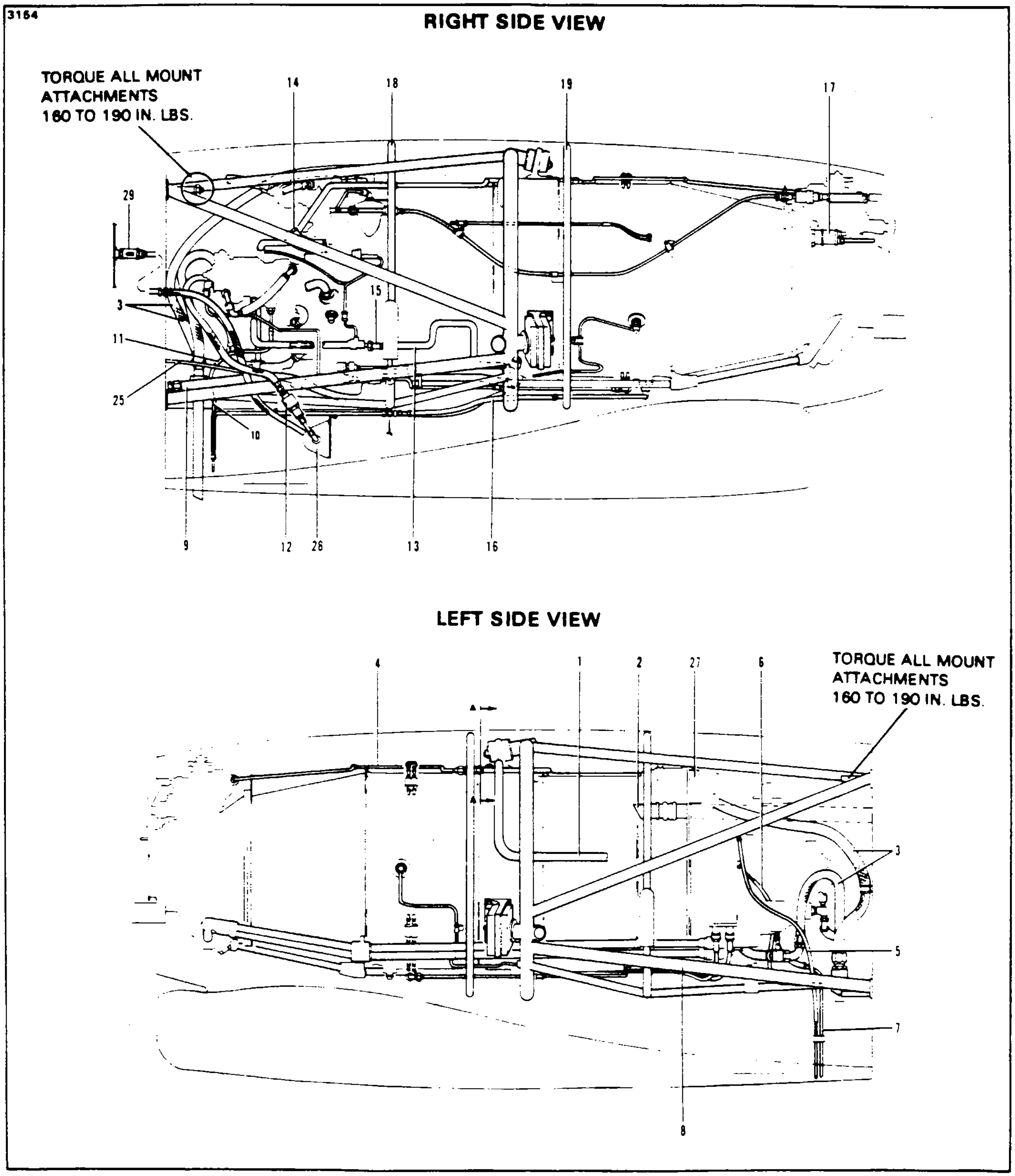


Figure 71-1. Powerplant Installation (cont.)

17. Swing the engine and mount free from the firewall; check to be certain no attachments remain to obstruct its removal.
18. Move the engine away from the aircraft and place on a suitable stand.
19. Remove the accessories and equipment to be installed on the new engine and tag or identify all items removed to facilitate installation.

— NOTE —

If the engine removed is expected to be inactive for a period of time, refer to the Pratt and Whitney Engine Maintenance Manual, Part No. 3030442 for the necessary preservation schedule.

ENGINE BUILDUP.

Engine buildup consists of transferring the necessary accessories and equipment from the engine removed for overhaul to a new engine. Replace safety wire, lockwashers, gaskets, and rubber hoses when needed to complete the engine assembly ready for installation in the aircraft.

— NOTE —

Replacement engines must be purchased through the Piper Service Department to be compatible with the Piper installation.

— CAUTION —

Refer to the Pratt and Whitney Engine Maintenance Manual, Part No. 3030442 before attempting to remove a new engine from the shipping container.

ENGINE INSTALLATION.

The installation of either engine is basically the same except for the hookup and routing of some wires and lines and the freon compressor installation on the right engine. Before installing the engine, be certain all engine accessories are properly installed, torqued and safetied.

1. With the engine suspended from a one-half ton hoist, carefully swing the engine assembly into position. Use caution not to damage any engine components, plumbing or wiring.
2. Install the engine mount and torque the mounting bolts to the specifications shown in Figure 71-1.

— NOTE —

Apply an anti-seize compound to all male tubing threads; be certain the compound does not enter the system. Prior to installing compressor bleed air line fitting to engine, make sure the correct length bolts are used, and coat the bolt threads which secure the fitting to the compressor case with Fel-Pro C5-a Hi-Temp. thread compound. Torque the bolts 65 to 85 inch-pounds and safety with MS20995-C41 safety wire.

3. Route and reconnect all previously disconnected fluid hoses, lines, and electrical leads from the firewall to the respective connections on the engine and secure with the appropriate clamps.
4. Route the propeller control cable through the bracket and clamp assembly and reconnect to the propeller control rod.
5. Connect the start control cable to the start control lever arm and attach the cable clamp to the cable support bracket.
6. Connect the power control cable to the fuel control unit power lever.
7. Install the propeller per Chapter 61.
8. Adjust the engine and propeller controls. (Refer to Chapter 76.)
9. Reinstall the fire extinguisher system, if previously installed.

— *WARNING* —

Use extreme caution when working with the fire extinguisher; accidental discharge may cause bodily injury.

10. Refill the oil tank with the specified type and amount of oil. (Refer to Chapter 12.)
11. Connect the battery.
12. Reinstall access plates on engine nacelle.
13. Perform the post installation procedures described in Pratt and Whitney Maintenance Manual, Part No. 3030442.
14. Check for fuel and oil leaks and security of the engine components.

ENGINE DEPRESERVATION.

After completion of a new engine installation and before the first engine start, the following procedure should be followed to clear the engine:

1. Fill the engine oil tank with the recommended oil. (Refer to the latest revision of Pratt and Whitney Aircraft of Canada Ltd., Service Bulletin No. 12001.)

— *NOTE* —

When filling the oil tank, it is recommended that the oil be strained before entering the engine to eliminate the possibility of foreign material in the engine.

2. Motor the engine to circulate the oil.
3. Recheck the oil level and refill as necessary. Normal oil level is one U.S. quart below the maximum level mark.
4. Disconnect number one and two fuel manifolds at base of nozzle ring. Attach a short piece of hose to permit fuel to drain into a container.
5. Set start control to run; ignition switch OFF; fuel pump on and fuel shutoff valve on. Insure ignition micro switch on condition lever opens before fuel-flow indication.

— *CAUTION* —

Do not exceed starter time limits (30 seconds ON, 1 minute OFF, 30 seconds ON, 1 minute OFF, 30 seconds ON, 30 minutes OFF).

6. Motor engine until clean fuel is draining from number one manifold.

— *NOTE* —

Check for proper operation of oil pressure, fuel flow, fuel pressure, and check that the Ng percent indicator moves in the proper direction during initial motoring run.

7. Remove hose from number one manifold and plug line with a suitable plug.
8. Repeat Step 6 for number two fuel manifold.
9. Remove plugs and reconnect manifolds and safety.

ENGINE MOTORING RUN.

An engine motoring run is used to clear the engine of trapped fuel or vapors after an unsatisfactory start and to check for fuel system leaks after component replacement.

1. Set the power control lever at IDLE.
2. Set the starting control lever at CUTOFF.
3. Master switch ON (to supply electrical power to starter).
4. Fuel shutoff valve ON.
5. Fuel boost pump switch ON (to provide lubrication for engine driven fuel pumping elements).
6. Leave ignition switch OFF.
7. Operate the starter for 10 seconds.

— *CAUTION* —

Do not exceed starter time limits (30 seconds ON, 1 minute OFF, 30 seconds ON, 1 minute OFF, 30 seconds ON, 30 minutes OFF).

8. Release engine starter switch.
9. Fuel boost pump switch OFF, after Ng has stopped.
10. Master switch OFF.

ENGINE GROUND CHECK AND SAFETY PRECAUTIONS.

1. Prior to ground testing the engines, the following safety precautions should be adhered to:
   A. Position the airplane into the wind.
   B. Set the parking brake and chock the wheels.

— *NOTE* —

The importance of placing chocks in front of the wheels cannot be overstressed. It is possible for the airplane to move with just the brakes applied when the power being applied exceeds 600 foot-pounds of torque.

   C. Be certain a fire extinguisher is readily available.
   D. Be certain the area around the airplane is free of loose objects.
   E. Check that the engine intakes and exhausts are free from foreign objects.
   F. Ascertain that the danger areas around the airplane are clear of personnel.

2. Ascertain the engine indicating systems are properly calibrated.
3. Install the lower cowl if not previously installed; remove the upper cowl if installed, and install the ground testing cowl P/N 51520 which is available through the Piper Service Department.

— NOTE —

Before attempting to start the engine, personnel should be checked out by a qualified pilot or other responsible person on the engine starting and shutdown procedures, and any other system functions which may be required to properly and safely operate the power plants. The use of the Pilot's Operating Handbook for this information is required.

4. Start the engine and idle three to five minutes. Cycle the propeller while running. Check the inter-turbine temperature and torque gauges for proper operation.
5. Shutdown the engine and check the oil level. Refill if necessary to proper level (1 quart below the full mark).
6. Restart the engine.
7. Check the secondary low pitch stop operation as follows:
   A. Move the power levers toward reverse until the low pitch "Beta" lights come on.
   B. Push down and hold the lock pitch test switches while continuing to move the power levers toward reverse. The prop should not go into reverse, and the lights should blink.
   C. Continue to move the power levers toward reverse until mechanical resistance is felt.

— CAUTION —

Do not force the power levers to full reverse, this could cause damage to the linkage.

   D. When mechanical resistance is felt in the power levers, release the secondary low pitch switch. The props should go toward reverse (increase in prop RPM).
8. Check the overspeed governor operation as follows:
   A. Set power levers at 1625 RPM.
   B. Set propeller control to full increase RPM; the "Reverse Not Ready" lights out.
   C. Push up the Hydraulic Topping Governor (HTG) switches and observe the drop in prop RPM. RPM should drop to approximately 1540 rpm.
   D. Release the switches; the prop RPM should increase to the original RPM.

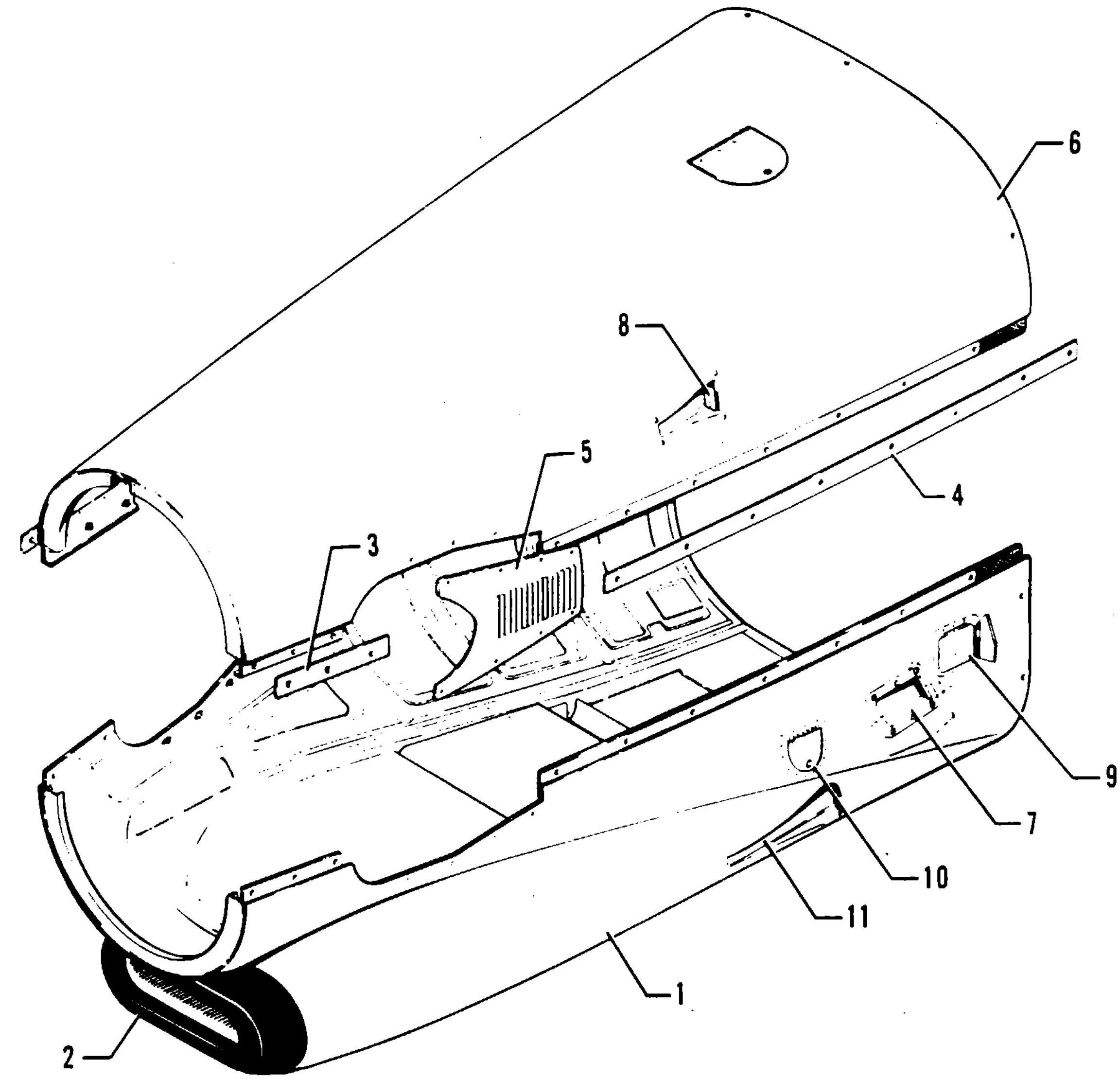
COWLING.

REMOVAL OF COWLING. (Refer to Figure 71-2.)

The procedure for removing the engine cowling is the same for either engine.
1. Disconnect the strip assemblies and the louver assembly that connect the upper and lower cowl halves.
2. Remove the fasteners connecting the starter-generator cooling duct to the upper cowl.
3. Disconnect the fasteners securing the upper cowl to the nacelle and remove the upper cowling.

C475

1. LOWER COWL
2. DEICER BOOT, (ELECTRIC)
3. STRIP ASSEMBLY, (FORWARD)
4. STRIP ASSEMBLY, (AFT)
5. LOUVRE ASSEMBLY
6. UPPER COWL
7. INTER-COOLER INLET
8. STARTER-GENERATOR COOLING DUCT
9. ACCESS PLATE, FUEL FILTER
10. ACCESS DOOR, WASH RING
11. OIL COOLER AIR INLET



81869/81790

Figure 71-2. Cowling Installation

4. To remove the lower cowl, disconnect the wire leads from the limit switches and the deicer boot.
5. Remove the fasteners connecting the intercooler air inlet duct to the lower cowl.

— CAUTION —

To protect against possible damage to the lower cowl and deicer boot leads, support the lower cowl before proceeding with Step 6 below.

6. Disconnect the fasteners securing the lower cowl to the nacelle and remove the cowl from the aircraft.

CLEANING, INSPECTION AND REPAIR OF COWLING.

1. Clean the cowling with a suitable solvent and wipe with a clean cloth.
2. Inspect the cowling for dents, cracks, loose rivets, damaged or missing fasteners.
3. Repair all defects to prevent further damage. Fiberglass repair may be accomplished by using procedures listed in Fiberglass Repairs, Chapter 51.

INSTALLATION OF COWLING. (Refer to Figure 71-2.)

The procedure for installing the cowl is the same for either engine.

1. Position and support the lower cowl in place and secure the cowl to the nacelle with fasteners along the aft section of the cowl.
2. Connect the electrical leads to the respective leads on the limit switches and deicer boot. Reconnect the intercooler air inlet duct.
3. Position the upper cowl half in place and connect the starter-generator cooling duct to the upper cowl. Connect all fasteners and fixtures along the cowl.
4. Secure the strip assemblies and louver assembly.
5. Check the cowling and attachment hardware for security.

MOUNTS.

— NOTE —

Shock mounts should be replaced every 1000 hours or on condition. Black color upper mounts should be replaced every 400 hours or replaced with new upper mounts. Refer to Parts Catalog for part numbers.

REPLACEMENT OF SHOCK MOUNTS. (Refer to Figure 71-1.)

The engine shock mounts may be replaced as follows:

1. Remove the engine cowling.
2. Attach a sling to the engine lift points and using a one-half ton hoist relieve the tension on the mounts.
3. Remove the nut, washer, and bolt that attaches the mounting pad to the tubular engine mount.
4. Remove the safety wire from the mounting pad special bolt; remove the bolts and withdraw the mount assembly.
5. Install the mount assembly in reverse order of removal. Torque the pad mounting special bolts to 225 to 300 inch-pounds and safety with MS20995-C41 safety wire.
6. Torque the mount bolt to the specification given in Figure 71-1, Section B-B.

FIRE SEALS.

GENERAL.

The engine fire seals are bolted to the engine fire seal flange forward and aft of the engine compressor intake. The fire seals are constructed of semi-circular sections and are designed to form a fire seal between the engine and cowling. The fire seals also provide a mounting location and support for lines, wire, and cables routed from the firewall to the engine front accessories.

— END —

CHAPTER

72

ENGINE-TURBO-PROP

CHAPTER 72 - ENGINE - TURBO-PROP

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This aircraft is powered by two lightweight, free turbine Pratt and Whitney PT6A-11 gas turbine, turbo-prop engines rated at 500 shaft horsepower each at 2200 propeller RPM.

The air inlet ice protection and ice deflector doors are an integral part of the lower cowl assembly. (Refer to Chapters 30 and 71.)

The propeller installations are constant speed, full feathering, reversing type. (Refer to Chapter 61.)

The engine lubricating system is covered in Chapter 79.

The engine fuel control system is covered in Chapter 73.

The engine ignition system is in Chapter 74.

For Engine/Compressor Washing information, refer to Chapter 12.

For detailed information concerning the following power plant items, refer to the Pratt and Whitney Engine Maintenance Manual Part No. 3030442.

1. Engine - General
2. Reduction Gear and Shaft Section
3. Air Inlet Section
4. Compressor Section
5. Combustion Section
6. Turbine Section
7. Accessory Drives

— END —

CHAPTER

73

ENGINE FUEL SYSTEM

CHAPTER 73 - ENGINE FUEL SYSTEM

TABLE OF CONTENTS/EFFECTIVITY

THIS PAGE INTENTIONALLY LEFT BLANK

GENERAL.

The part of the fuel system to be considered in this chapter deals with those units tied into the system on the engine side of the airframe supplied fuel filter. The major components to be covered are the main fuel supply pump, fuel flow meter, "oil to fuel" heater, fuel control unit, dual fuel manifold and nozzles, and the jet scavenge pump.

The flow divider and dump valve assembly are mounted on the bottom of the engine gas generator case and performs several operations depending on engine operating condition. During engine start up, the valve allows metered fuel to enter the primary fuel manifold. At a preset pressure the valve allows metered fuel to enter the primary and secondary nozzles. When the fuel control unit shuts off the fuel supply during engine shut down, fuel inlet pressure decreases, and an internal spring in the valve moves a piston within the valve body to block the fuel inlet port and allow the fuel within the primary and secondary manifolds to drain out the dump port. A fuel scavenge system collects this residual fuel after engine shut down and during start up, the excess fuel is injected into the aircraft fuel tank.

The dual fuel manifold assembly delivers metered fuel from the flow divider to the primary and secondary fuel nozzles. The manifold assembly consists of fourteen fuel manifold adapters (seven primary, seven secondary inlet adapter). All the manifold adapters are interconnected by pairs of fuel transfer tubes.

For detailed information regarding removal, installation, and checks to the various engine fuel system components not covered in this manual, refer to Pratt and Whitney Engine Maintenance Manual No. 3030442, Chapter 73.

DISTRIBUTION.

FUEL LINES.

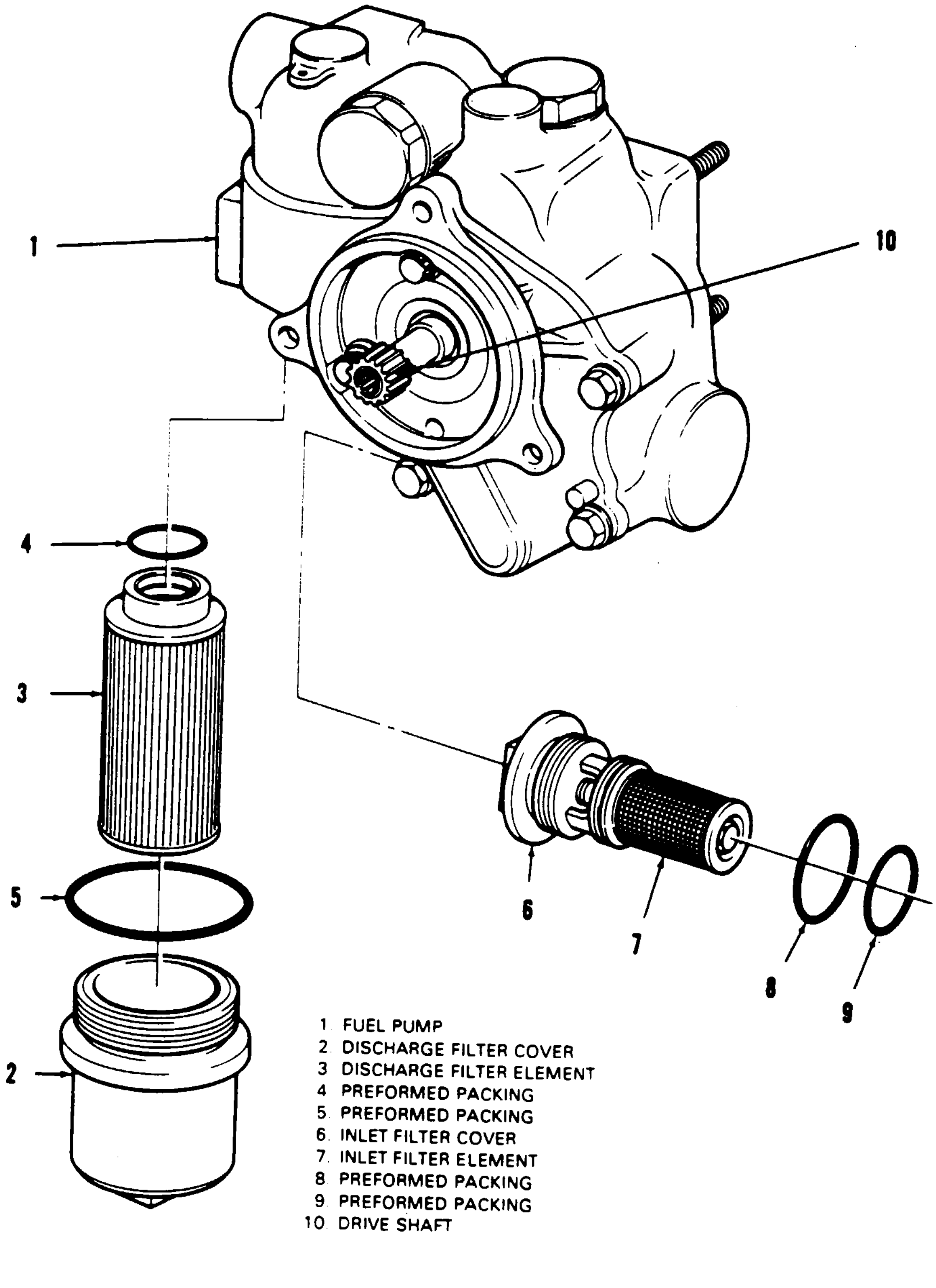
The fuel supply to the engine is routed from the oil-to-fuel heater to the fuel flow transmitter, to the fuel pump and from the fuel pump to the fuel control unit through flexible hoses. The metered fuel from the fuel control unit to the fuel manifold is routed through the stainless steel lines. Refer to the Pratt and Whitney Aircraft of Canada, Ltd. maintenance manual 3030442, Chapter 73 for detailed Removal, Installation, Inspection and Maintenance procedures.

ENGINE DRIVEN FUEL PUMP.

The engine driven fuel pump supplies the FCU with fuel and is the main fuel pressure source for fuel delivered into the engine. This pump is a positive displacement gear-type pump, interconnected with the FCU and mounted to the right side of the accessory gearbox. The pump utilizes a 74 micron inlet screen and a 10 micron outlet screen. The inlet screen is cleanable while the outlet screen is strictly disposable and must be replaced. Refer to P. and W. Engine Maintenance Manual P/N 3030442, Chapter 73 for detailed service of the fuel pump and filters and Chapter 72 for Periodic Inspection time limits.

FUEL MANIFOLD.

The dual fuel manifold delivers metered fuel from the flow divider to the primary and secondary fuel nozzles. The manifold consists of 14 adapter assemblies (seven primary, six secondary and a secondary inlet adapter). The adap``s are interconnected by pairs of fuel transfer tubes and are secured to their respective bosses on the gas generator case by two bolts.



1. FUEL PUMP
2. DISCHARGE FILTER COVER
3. DISCHARGE FILTER ELEMENT
4. PREFORMED PACKING
5. PREFORMED PACKING
6. INLET FILTER COVER
7. INLET FILTER ELEMENT
8. PREFORMED PACKING
9. PREFORMED PACKING
10. DRIVE SHAFT

Figure 73-1. Fuel Pump

FUEL MANIFOLD ADAPTER REMOVAL AND INSTALLATION.

Before removing any adapters from the engine, each adapter should be marked using a suitable marker. (Refer to Pratt and Whitney Aircraft of Canada, Ltd. maintenance manual P/N 3030442, Chapter 73 to insure returning the adapters to their original position on the engine.) Positions should be numbered clockwise 1 to 14, looking from the rear of the engine, with the number 1 position being at the 12 o'clock location. For complete removal, leakage test, and installation of manifold adapters, refer to Pratt and Whitney Aircraft of Canada, Ltd. maintenance manual No. 3030442, Chapter 73.

FUNCTIONAL CHECK OF FUEL MANIFOLD ASSEMBLIES.

Fuel nozzles may be tested alone or in their adapters, using the Pratt and Whitney Aircraft of Canada, Ltd. test rig P/N CPWA30506 or by fabricating a test rig locally from information supplied with this text. (Refer to Figure 73-2.)

— CAUTION —

The test rig must be grounded to prevent possible danger of electrostatic discharge.
Observe all fire precautions when working with fuel.

1. Using the test rig, set the regulator to zero, close the outlet valve, open filler valve and remove plug.

— CAUTION —

Insure that all pressure if any is relieved from the tank before opening filler valve, or removing plug.

2. Fill the tank approximately 3/4 full with clean fuel and close the filler valve and replace the plug.
3. Install a fuel nozzle with or without its adapter using a mounting bracket if desired. Refer to Figure 73-2 for view of mounting bracket.
4. Set the regulator to obtain 20.0 psig on the pressure gauge.
5. Holding the plug against the transfer tube and nozzle adapter (if no bracket is used), gradually open the outlet valve.
6. A good clean spray should appear at less than 20.0 psig, free from spitting or drooling.
7. Increase the pressure to 60 psig. The volume of the spray should increase. There should be a maximum of 12% streakiness and the spray should be evenly spread about the center axis of the nozzle orifice.

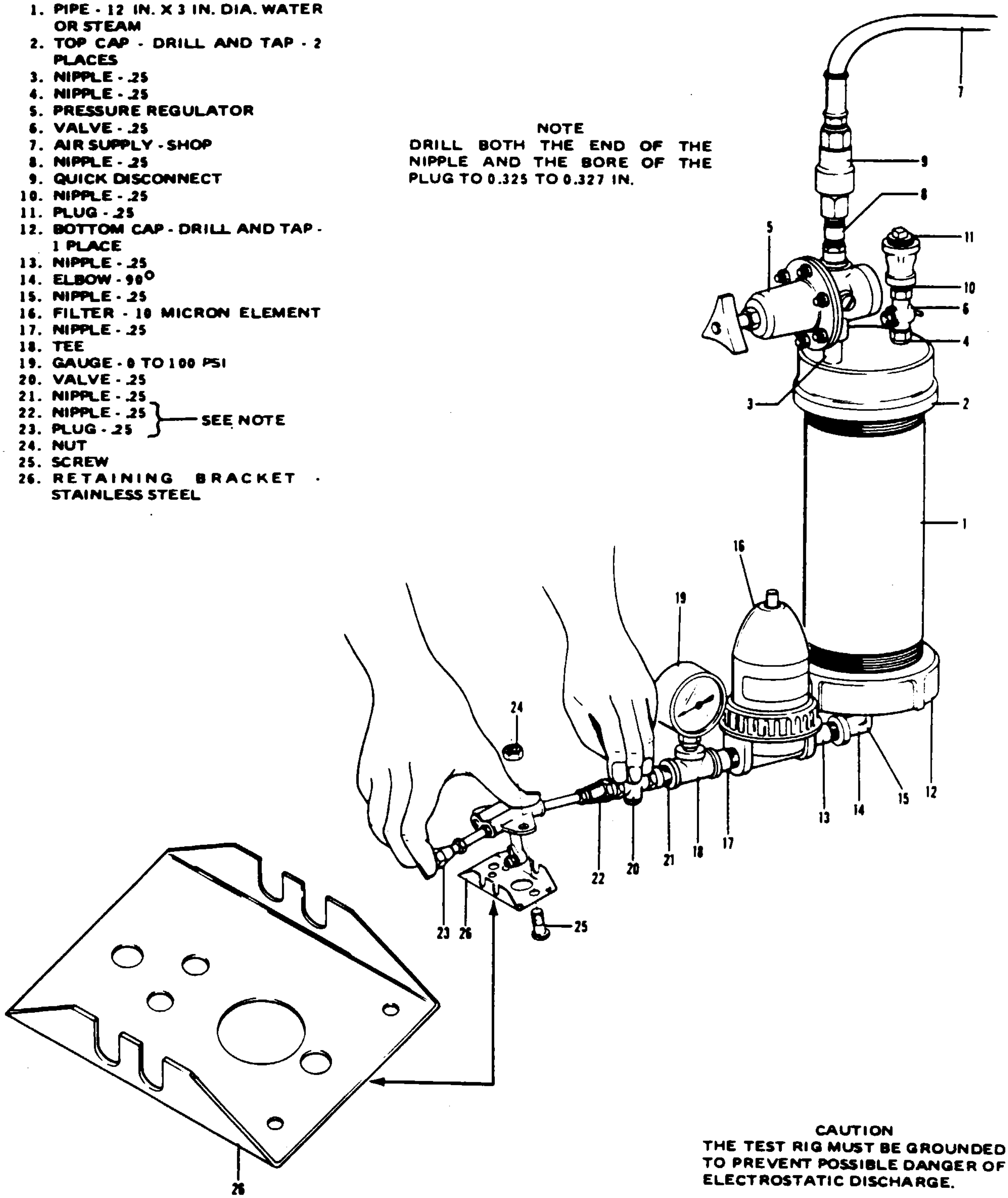
— NOTE —

Streakiness is defined as variation of spray quantity in different parts of the spray cone, showing up as darker streaks in the spray.

1374

1. PIPE - 12 IN. X 3 IN. DIA. WATER OR STEAM
2. TOP CAP - DRILL AND TAP - 2 PLACES
3. NIPPLE - .25
4. NIPPLE - .25
5. PRESSURE REGULATOR
6. VALVE - .25
7. AIR SUPPLY - SHOP
8. NIPPLE - .25
9. QUICK DISCONNECT
10. NIPPLE - .25
11. PLUG - .25
12. BOTTOM CAP - DRILL AND TAP - 1 PLACE
13. NIPPLE - .25
14. ELBOW - 90°
15. NIPPLE - .25
16. FILTER - 10 MICRON ELEMENT
17. NIPPLE - .25
18. TEE
19. GAUGE - 0 TO 100 PSI
20. VALVE - .25
21. NIPPLE - .25
22. NIPPLE - .25 } SEE NOTE
23. PLUG - .25 } SEE NOTE
24. NUT
25. SCREW
26. RETAINING BRACKET - STAINLESS STEEL

NOTE
DRILL BOTH THE END OF THE NIPPLE AND THE BORE OF THE PLUG TO 0.325 TO 0.327 IN.



CAUTION
THE TEST RIG MUST BE GROUNDED TO PREVENT POSSIBLE DANGER OF ELECTROSTATIC DISCHARGE.

Figure 73-2. Fuel Manifold Test Rig

8. If spitting or drooling occurs at 20.0 psig, or more than 12 percent streakiness is evident at 60 psig, reject the fuel nozzle and install a new nozzle.
9. If necessary, remove carbon buildup at the fuel nozzle by lightly brushing the orifice face with either a bronze or non-metallic bristled brush. Cleaning must be accomplished while fuel is flowing through the nozzle.
10. Close the pressure regulating valve and allow the pressure gauge to decrease to zero, then close valve.

— NOTE —

It is suggested that a few new nozzles be tested in order to recognize a good spray pattern.

OIL-TO-FUEL HEATER.

The oil-to-fuel heater is essentially a heat exchanger which utilizes heat from the engine lubricating system to preheat the fuel in the fuel system. Fuel temperature is regulated by a fuel temperature-sensing oil bypass valve which directs oil through the heater circuit or bypasses it to the engine oil tank as required.

Refer to Pratt and Whitney maintenance manual No. 3030442 for Removal, Installation and Adjustment procedures.

FUEL SCAVENGE SYSTEM. (Refer to Figure 73-3.)

The purpose of the fuel scavenge system is to collect residual fuel after engine shutdown and return the fuel to the nacelle fuel tank during engine start. The system consists of a solenoid valve, a jet type pump with an integral reservoir mounted on the engine mount forward of the oil cooler below the accessory gearbox housing and the necessary lines and tubing interconnecting the system.

The system operates during engine shut down and start up only. When the engine is shut down residual fuel is drained into the scavenge pump reservoir from the fuel nozzles. During engine startup, a solenoid valve is energized allowing engine purge fuel to enter the scavenger pump jet. The high velocity fuel from the jet picks up the fuel in the reservoir and returns the fuel to the nacelle tank. When the starter is released, the solenoid valve is returned to the closed position. An overboard vent line is attached to the scavenger pump in the event of a malfunction. The presence of fuel being vented overboard indicates the system is not operating properly. Maintenance to the system is limited to checking the solenoid valve and check valve for proper operation and examining lines and tubing for obstructions or leakage.

CHART 7301. TROUBLESHOOTING (FUEL SCAVENGE SYSTEM)

Trouble	Cause	Remedy
Fuel being drained overboard during engine start.	Restricted jet pump nozzle.	Remove nozzle and clean. Check for proper seating of jet.
Fuel being drained overboard during engine shutdown.	Solenoid valve not opening.	Check operation and replace if necessary.
	Restricted jet pump nozzle.	Remove nozzle and clean. Check for proper seating of jet.

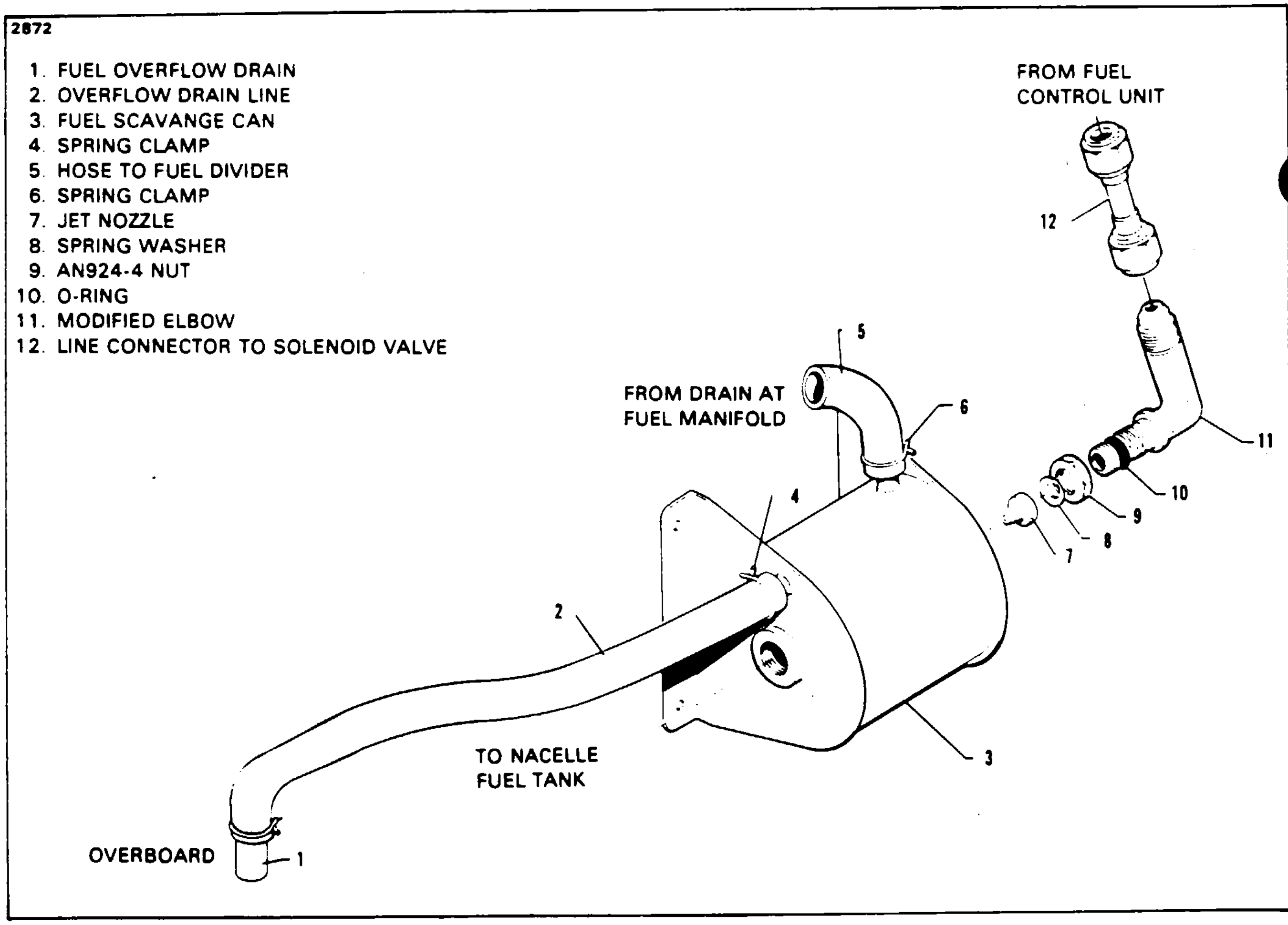


Figure 73-3. Fuel Scavenger Pump

SERVICING FUEL SCAVENGE PUMP. (Refer to Figure 28-3.)

1. For all practical purposes this jet pump canister is a replaceable and not a repairable item. However, should the jet, elbow, or check valve become clogged or fouled, they can be removed to be repaired or replaced as necessary. To remove and replace the jet, proceed as follows:

A. Disconnect the inlet line from the elbow.

B. Release the locknut securing the elbow in position.

C. Carefully remove the elbow and check valve and replace their O-rings if necessary.

D. Slide a piece of 0.02 safety wire through the elbow end of the canister until it comes through the other side and put a 1/16 inch or less bend at the end of the wire.

E. Carefully slide the wire back through and pull out the jet, and spring washer. Replace washer if necessary.

F. Replace that removed in reverse order.

CONTROLLING.

FUEL CONTROL UNIT.

REMOVAL OF FUEL CONTROL UNIT. (Refer to Figure 73-4.)

1. Ascertain that the fire wall fuel shutoff valve is in the OFF position.
2. Remove the engine cowling. (Refer to Chapter 71.)
3. Disconnect the fuel inlet line, outlet line, pneumatic line and fuel bypass tubes at the fuel control unit; cap all lines to prevent contamination. Also make note of position of fuel outlet line and Py outlet elbows and remove them and their hardware.
4. Disconnect the fuel control rod from the fuel control arm and secure the rod in a position which clears the control unit.

— NOTE —

There are various components on the fuel control unit which are safety wired and sealed. These items must not be tampered with.

5. Supporting the fuel control unit, remove the mounting screws and washers that secure the control unit to the fuel pump and withdraw the fuel control unit. As the fuel control unit is withdrawn from the fuel pump, remove the drive coupling and preformed packing.

PREPARATION FOR SHIPPING.

Fuel control units taken out of service or being returned for overhaul should be preserved and packaged using the following procedure:

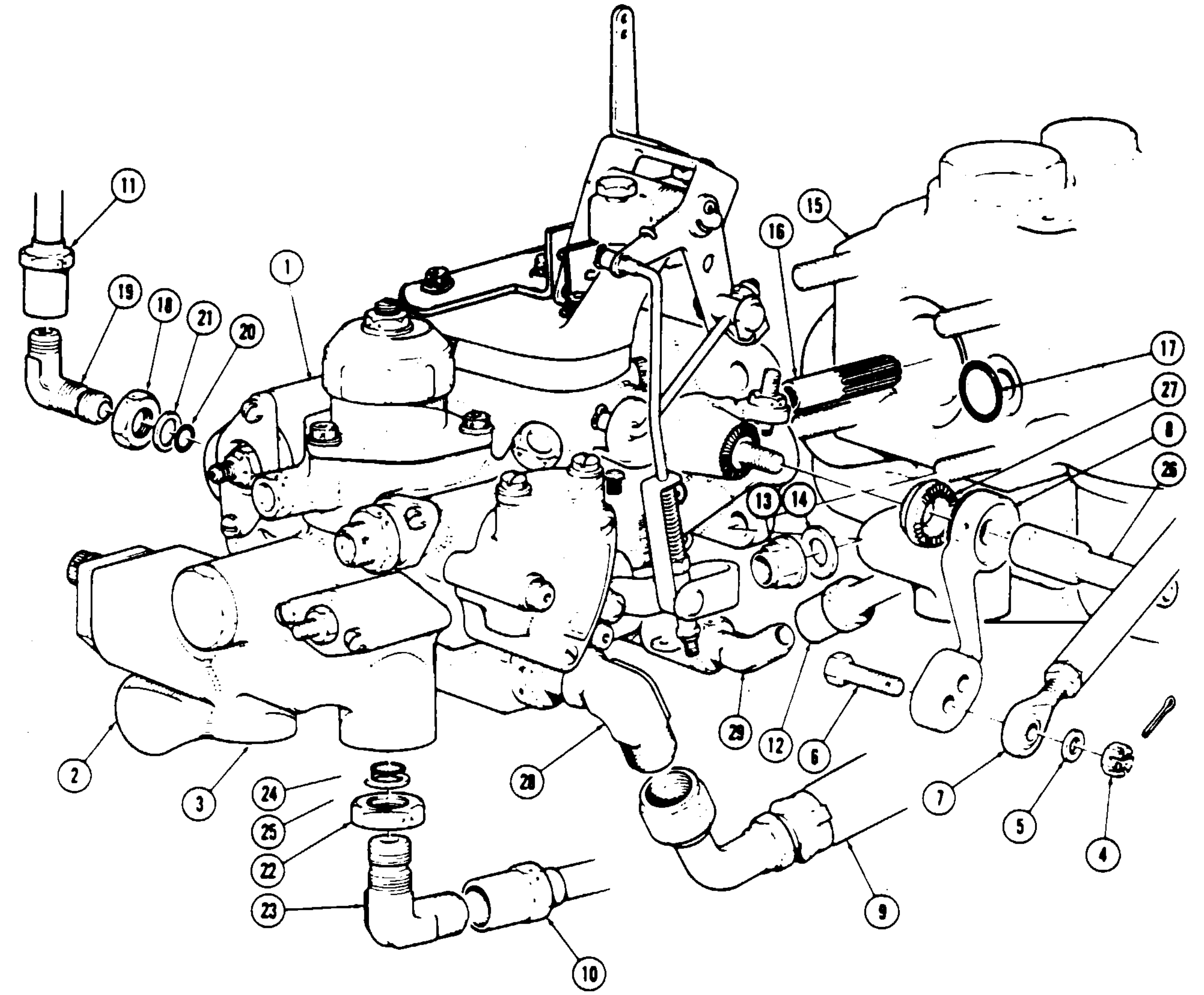
— NOTE —

Do not permit fuel or oil to enter the drive body cavity or any air pressure ports.

1. Drain all residual fuel from the fuel section of the control and completely fill with clean oil conforming to Specification MIL-O-6081, Grade 1010. Tip the control as necessary to assure a complete film on all parts and passages in the fuel section.
2. After preservation is complete, drain the oil from the control and replace all caps and plugs previously removed.
3. When packaging the unit for shipping, be certain all shipping plugs and caps are secure. Place the unit in a moisture and vapor proof container or plastic bag and seal the bag. Pack the sealed unit in a shipping carton or case.

PREPARATION OF FUEL CONTROL UNIT FOR SERVICE - OFF ENGINE. (Refer to Figure 73-4.)

1. Inspect the unit to make sure all components are properly lockwired and sealed. Return the unit if there is any evidence of tampering.
2. Make sure the Py and P3 air section ports are sealed with plugs, and remain so until completion of this procedure.
3. Remove the plugs from the drain and fuel outlet ports and the cap on the fuel inlet fitting.
4. Drain as much residual preservative oil from the unit as possible.
5. Flush the fuel section of the unit which has been passed through a 10 micron (nominal) filter. Refer to Pratt and Whitney Service Bulletin No. 12044.
6. Remove shipping plug from P3 port. Assemble the appropriate nut, backup ring and preformed packing on the elbow. Install the elbow in the P3 inlet port and position at the same angle noted during removal. Tighten the nut and torque to 38-42 in. lbs. Cap the elbow to prevent the entrance of foreign matter into the fuel control.
7. Remove shipping plug from Py port. Assemble the appropriate nut, backup ring and preformed packing on the elbow. Install the elbow in the Py port and position at the same angle noted during removal. Tighten nut and torque to 38-42 in. lbs. Cap the elbow to prevent the entrance of foreign matter into the fuel control.



1. FUEL CONTROL UNIT
2. DRAIN PORT
3. PO PORT
4. NUT
5. WASHER
6. BOLT
7. CONTROL ROD
8. FUEL CONTROL UNIT ARM
9. FUEL INLET HOSE
10. FUEL PRESSURE LINE
11. PY LINE
12. P3 LINE
13. NUT
14. WASHER
15. FUEL PUMP
16. DRIVE COUPLING
17. PREFORMED PACKING
18. NUT
19. PY LINE ELBOW
20. PREFORMED PACKING
21. BACK-UP RING
22. NUT
23. FUEL OUTLET LINE ELBOW
24. PREFORMED PACKING
25. BACK-UP RING
26. FUEL CONTROL ARM EXTENSION
27. SERRATED SPACER
28. FUEL INLET HOSE ELBOW
29. P3 LINE ELBOW AND METERING ORIFICE ASSEMBLY

Figure 73-4. Fuel Control Unit Installation

INSTALLATION OF FUEL CONTROL UNIT. (Refer to Figure 73-4.)

— CAUTION —

If a replacement fuel control unit is to be installed, preservation oil must be removed. See paragraph titled Preparation of Fuel Control Unit for Service - Off Engine, or - On Engine.

1. Check to be certain the fuel control unit drive coupling is properly installed in the fuel pump output drive. If coupling shaft was detached during control unit removal, reinstall by inserting male splined end in fuel pump and engaging pump outdrive. Failure to install coupling will result in uncontrolled Ng increase.
2. Install new O-ring in recess of fuel pump mating face and install over studs. Insure coupling shaft is meshed properly. Secure unit with washers and self-locking nuts; torque 75 to 85 inch pounds.
3. Connect fuel inlet hose and torque coupling nut 270 to 300 inch pounds and lockwire.
4. Connect fuel outlet tube, fuel bypass tube, and pneumatic tubes to fuel control unit; torque coupling nuts 90 to 100 inch pounds and lockwire.
5. Connect fuel control unit interconnect rod; torque nuts 12 to 18 inch pounds and lock with cotter pin.
6. Perform an engine motoring run with starting lever in run position.

PREPARATION OF FUEL CONTROL UNIT FOR SERVICE - ON ENGINE.

1. Disconnect the fuel line at the flow divider inlet and loosen the line to permit fuel to drain. Position a suitable container beneath the line to catch any fuel flow.
2. With the ignition system OFF, flush the fuel system of preservative oil as follows:
   A. Place power control lever to TAKEOFF position and condition lever to IDLE.

— CAUTION —

Observe starter motor operating limits: Do not exceed 30 seconds ON, 1 minute OFF, 30 seconds ON, 1 minute OFF, 30 seconds ON, 30 minutes OFF.

   B. While performing a normal motoring run, move the power control lever to IDLE and return to TAKEOFF. Move the fuel condition lever to OFF and return to IDLE. Continue until clean fuel flows from the drain.
   C. Reconnect the flow inlet line to the flow divider, torque 90-100 inch lbs. and safety wire.
   D. Return power control lever to IDLE and fuel condition lever to OFF.

FUEL CONTROL UNIT CHECKS AND ADJUSTMENTS. (Refer to Figure 73-5.)

The following checks and adjustments must be performed after a fuel control unit has been replaced:

1. Fuel Control Unit minimum governing adjustment.
   A. Start engine (refer to POH procedure).

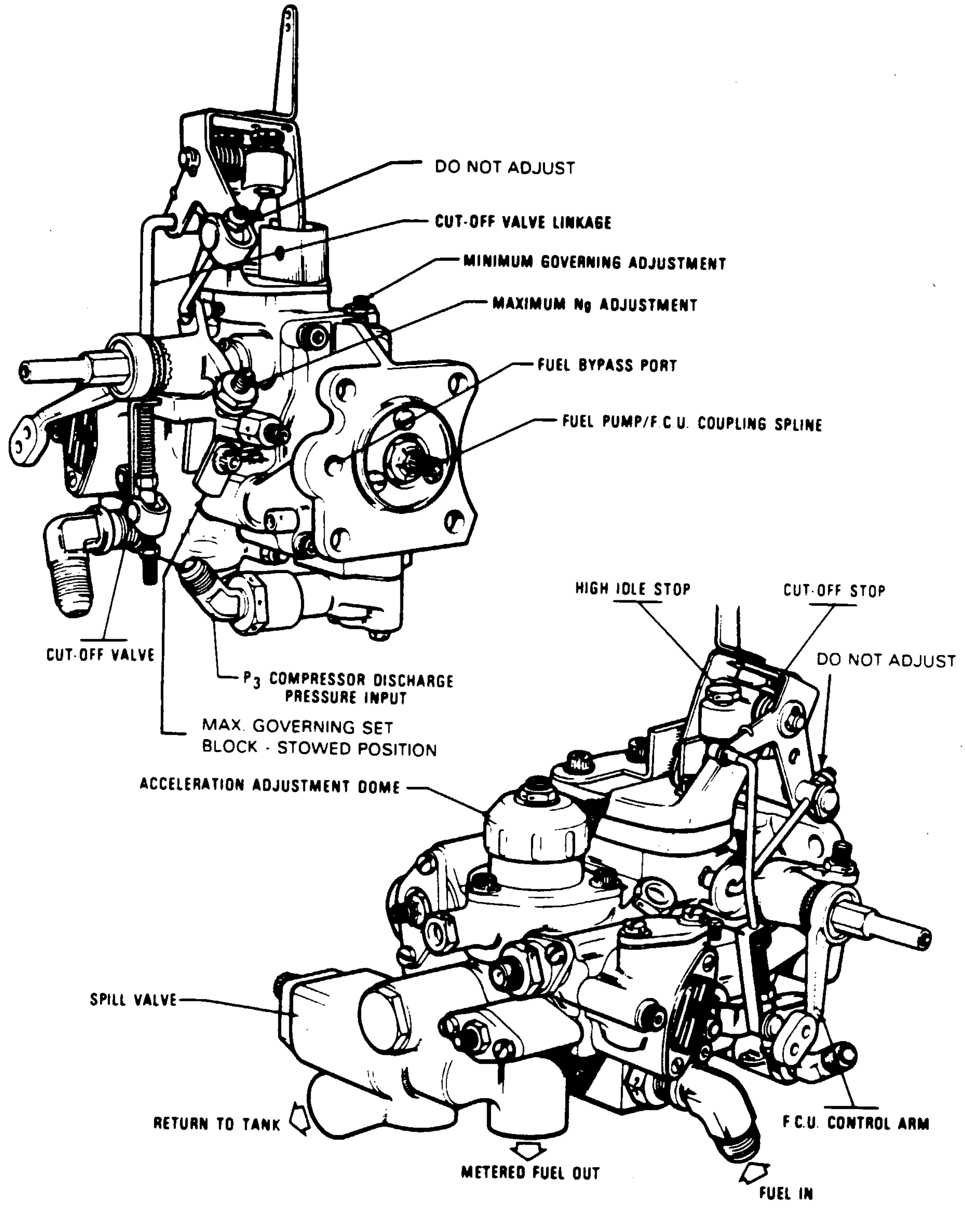


Figure 73-5. Fuel Control Adjustments

B. Condition lever to IDLE.
C. Power control lever at IDLE.
D. Check that Ng is 52.0%. If this value is not attained:
(1) Cut lockwire on the minimum governing speed adjuster.
(2) Using an allen wrench to prevent the adjuster from turning, break the torque on the nut.
(3) Turn the adjuster clockwise to increase Ng or counterclockwise to decrease Ng.
(4) Once the 52.0% Ng has been attained, shutdown the engine.
(5) Tighten the jam nut on the adjuster and torque 20-25 in. lbs. Lockwire the nut and adjuster.

2. Acceleration check and adjustment.

A. Start the engine. (Refer to POH for procedure), and operate at the LO-IDLE setting for five minutes to allow engine temperatures to stabilize.

B. Slowly increase power to MAX. Note and record Ng and mark the position of the power control lever on the cockpit console.

C. Set Ng to 64%.

D. Rapidly (less than 1 second) move the power control lever to position marked in step B.

E. Note and record the time required for Ng. to reach 97.5% of the value recorded in step B.

F. Immediately as Ng passes through 93.5%, retard the power control lever to the IDLE position.

G. The acceleration time should be 2.5 to 4.0 seconds. If not, rotate the acceleration adjuster dome on the FCU one click at a time until the required setting is obtained. Rotate the dome clockwise to increase accleration rate. If the requirement cannot be met within a maximum of three clicks, replace the fuel control unit.

3. Fuel Control Unit maximum governing speed adjustment (Ng). The maximum governing speed stop is preset on all fuel control units at the factory. The units should NOT be adjusted in the field.

4. Fuel control pneumatic system (refer to Pratt and Whitney Aircraft of Canada, Ltd. maintenance manual, Part No. 3030442, Chapter 73).

5. Check the engine performance. (Refer to Chapter 76.)

THIS SPACE INTENTIONALLY LEFT BLANK

INDICATING.

The fuel flow indicating system utilizes a vane type transmitter located in the line between the oil-to-fuel heater and the fuel pump, and a fuel flow indicator mounted in the instrument panel. The fuel flow indicator provides a reference voltage to the fuel flow transmitter output potentiometer which then provides a return voltage to the indicator proportional to the fuel flow rate. A servo system within the fuel flow indicator rotates the pointer to a position corresponding to the voltage input.

The fuel pressure indicating system utilizes a fuel pressure transmitter which measures fuel pressure at the outlet side of the fuel flow transmitter. The transmitter detects changes in the fuel pressure and relays these changes electrically to the fuel pressure indicator on the instrument panel.

The fuel consumed totalizer indicates the total quantity of fuel consumed in pounds. It receives a 15 vdc reference voltage from the fuel flow indicator and the signal output from the potentiometers in the fuel flow transmitters. Integrating the flow rate from the two fuel flow transmitters, it sums the signals and displays from the results on a four digit mechanical counter. A push button on the face of the totalizer resets the counter to zero.

FUEL FLOW INDICATING SYSTEM.

REMOVAL OF FUEL FLOW TRANSMITTER.

1. Remove electrical connector from flow transmitter.
2. Disconnect fuel lines attached to flow transmitter.
3. Cap all open fuel lines to prevent contamination.
4. Cap inlet and outlet ports of transmitter.
5. Remove the two bolts and nuts which secure the transmitter and remove transmitters.

INSTALLATION OF FUEL FLOW TRANSMITTER.

1. Install the flow transmitter on the mounting bracket using the hardware previously removed.

— NOTE —

Ensure that the arrow on the flow transmitter is pointing in the direction of fuel flow.

2. Remove the protective caps from the transmitter and the fuel lines and connect fuel lines to transmitter.
3. Install the electrical connector and safetywire connector.

REMOVAL AND INSTALLATION OF FUEL FLOW INDICATOR.

Refer to Chapter 39 for removal and installation procedure.

FUEL PRESSURE INDICATING SYSTEM.

REMOVAL OF FUEL PRESSURE TRANSMITTER.

1. Remove the access panel on the right hand side of the engine nacelle.
2. Remove electrical connector from transmitter.
3. Disconnect fuel lines attached to transmitter, remove screws and transmitter.
4. Cap all open fuel lines to prevent contamination.

INSTALLATION OF FUEL PRESSURE TRANSMITTER.

1. Position the transmitter and secure with screws.
2. Remove protective caps and connect fuel lines to inlet and outlet on transmitter.
3. Attach electrical connector to transmitter.
4. Install the access panel on the engine nacelle.

REMOVAL AND INSTALLATION OF FUEL PRESSURE INDICATOR.

Refer to Chapter 39 for removal and installation procedure.

FUEL CONSUMED TOTALIZER.

Refer to Chapter 39 for removal and installation procedure.

— END —

4L21 THRU 4L24
INTENTIONALLY LEFT BLANK

T1000

AIRLINE DIVISION

T1040

MAINTENANCE MANUAL

CARD 5 OF 5

PA-31T3 T1040

PIPER AIRCRAFT CORPORATION

5A1

(PART NUMBER 761 765)

INTRODUCTION.

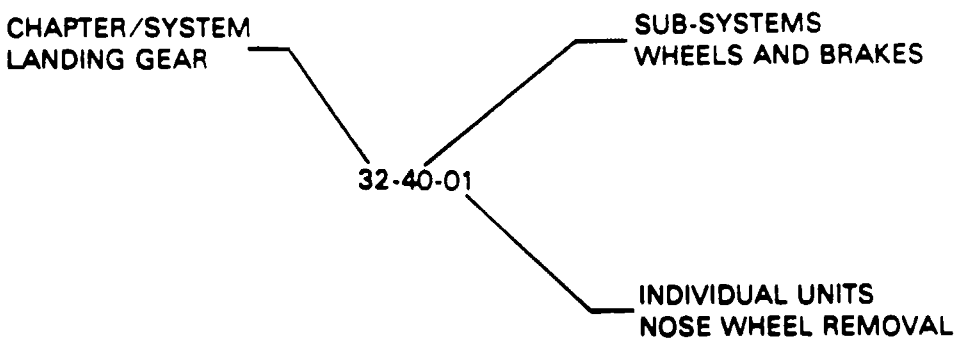
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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-31T3/T-1040 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 T-1040 Parts Catalog P/N 761 761, and FAR 43 for proper utilization.

SERIAL NUMBER INFORMATION

PA-31T T1040-1982
SERIAL NUMBERS 31T-8275001 TO 31T-8275025 INCL.
PA-31T T1040-1983
SERIAL NUMBERS 31T-8375001 TO 31T-8375005 INCL.
PA-31T T1040-1984
SERIAL NUMBERS 31T-8475001 AND UP.

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)

6. Revisions to this Maintenance Manual 761 765 issued March 26, 1982 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
ORG820326	March 26, 1982	1, 2, 3, 4 and 5
PR820804	August 4, 1982	1, 2, 3, 4 and 5
PR821115	November 15, 1982	1, 2, 3, 4 and 5
PR830225	February 25, 1983	1, 2, 3, 4 and 5
PR840305	March 5, 1984	1, 2, 3, 4 and 5
PR840713	July 13, 1984	1, 2, 3, 4 and 5

The date on Aerofiche cards should not be earlier than the date noted for the respective card effectivity. Consult the lastest Aerofiche card in this series for current Aerofiche card effectivity.

VENDOR PUBLICATIONS.

BATTERY:	
Gill Lead-Acid Battery (Teledyne Battery Products) Service Manual	= P /N: GSM - 682
SAFT Nickel-Cadmium Battery Operating and Maintenance Manual	= P/N: DC 3176-5A
Marathon Nickel Cadmium Battery Instruction Manual	= P/N: BA-89
DE-ICE SYSTEM (PROPELLERS):	
B.F. Goodrich Electrothermal Propeller Deice Maintenance Manual	= P/N: 68-04-712 (Latest Revision)
B.F. Goodrich Electrothermal Propeller Deice Installation and Removal Procedures	= P/N: 59-728 (Latest Revision)
ENGINE:	
PT6A-11/110 Maintenance Manual	= P/N: 3030442
HEATER:	
Maintenance and Overhaul Manual	= P/N: 24E25-1
PROPELLER:	
Hartzell Overhaul Manual	= P/N: 117-D
Hartzell Spinner Assembly and Maintenance Manual	= P/N: 127

VENDOR PUBLICATIONS (cont).

STARTER-GENERATOR

Auxilec, Inc.
Maintenance and
Overhaul Manual = P/N: 8013C

Lear Siegler, Inc.
Maintenance Manual
(All Models) = P/N: 23700

Lear Siegler, Inc.
Overhaul Manual,
Series 23048 = P/N: 23202

PIPER PUBLICATIONS.

PARTS CATALOG = 761 761
Piper Aircraft Corporation
820 E. Bald Eagle Street
Lock Haven, Pennsylvania 17745

INSPECTION
MANUAL
100 HOUR = 761 774
Piper Aircraft Corporation
820 E. Bald Eagle Street
Lock Haven, Pennsylvania 17745

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 Compressors	Delco Products Div. of General Motors Corp. P.O. Box 1042 Dept. 194-T Dayton, Ohio 45401 (513) 227-5000 Telex: 810-459-1788
	Sankyo Inc. 10719 Sanden Dr. Dallas, Texas 75238 (214) 349-3030 Telex: 73-0497
Air Conditioning System Electronic Leak Detector	TIF Instruments 3661 N.W. 74th Street Miami, Florida 33147 (305) 696-7100
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

VENDOR-SUPPLIER INFORMATION (cont).

Battery	Marathon Battery Company 8301 Imperial Drive P.O. Box 8233 Waco, Texas 76710
	SAFT America, Incorporated 711 Industrial Boulevard Valdosta, Georgia 31601
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
Electrical Relays	Leach Corporation 5915 Avalon Boulevard Los Angeles, California 90003 (213) 232-8221
Emergency Locator Transmitter	Narco Avionics Inc. 270 Commerce Drive Fort Washington, Penna. 19034 (215) 643-2900
Engines	Pratt and Whitney Aircraft of Canada, Ltd. Box 10 Longueuil, Quebec, Canada JK4X9
Environmental Systems, Heater	Janitrol Aero Division 4202 Surface Road Columbus, Ohio 43228 (614) 276-3561
Fire Detection and Extinguishing Systems	HTL Industries P.O. Box 780 Pasadena, California 91006 (213) 574-7880

VENDOR-SUPPLIER INFORMATION (cont).

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
Gate Valves, Shut-off Valves and Solenoid Valves (Fuel and Hydraulic)	I.T.T. General Controls 801 Allen Avenue Glendale, California 91201 (213) 842-6131
Hoses, Fittings	Aeroquip Corporation Marmon Division 1214 Exposition Boulevard Los Angeles, California 90064 (213) 774-3230
Instruments	Aerosonic Corporation 1212 N. Hercules Avenue Clearwater, Florida 33515 (813) 461-3000
Landing Gear, Hydraulic Actuators, Hydraulic Pressure Regulator, Hydraulic Power Pack, Handpump	Ozone Aircraft Systems, Inc. 101-32 101st Street Ozone Park, New York 11416 (212) 845-5200 Wiebel Tool Company Port Jefferson, New York 11777 (516) 928-9500
Lighting, Tail Recognition	Devore Aviation Corporation 1-T Barstow Road Great Neck, New York 11021 (516) 487-3524
Lighting, Strobe	Whelen Engineering Company, Inc. 3 Winter Avenue Deep River, Connecticut 06417 (203) 526-9504

VENDOR-SUPPLIER INFORMATION (cont).

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	Woodward Governor Company Drake and Lemay Roads Fort Collins, Colorado 80521 (303) 482-5811
Starter-Generator	Auxilec, Incorporated One Willow Park Center Farmingdale, New York 11735 (516) 694-1441
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000
Tools, Air Conditioning	Kent-Moore Corporation Service Tool Division 1501 South Jackson Street Jackson, Michigan 49203 (517) 784-8561
Voltage Regulators	Electro-Delta P.O. Box 898 Stockton, California 95201 (209) 462-8571
	Lear Siegler, Incorporated 17602 Broadway Avenue Maple Heights, Ohio 44137 (216) 662-1000

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

LIST OF ILLUSTRATIONS (cont)

— *NOTE* —

Refer to Card 5, Grid No. 5F1 for Electrical Schematic Index

LIST OF CHARTS

LIST OF CHARTS (cont)

LIST OF CHARTS (cont)

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

74

IGNITION

CHAPTER 74 - IGNITION

TABLE OF CONTENTS/EFFECTIVTIY

GENERAL.

DESCRIPTION AND OPERATION.

The spark ignition system consists of an ignition exciter, two high tension cable assemblies and two spark igniters. The exciter is a sealed unit consisting of electronic components encased by an epoxy resin. When energized, a capacitor within the unit is progressively charged until it reaches a predetermined value at which time the energy stored is sufficient to ionize a spark gap in the unit and discharge the capacitor across the two spark igniters. The design of the system permits operation of one spark igniter should the other cease to function.

The high tension cable assemblies carry the electrical charge from the ignition exciter to the spark igniters. They consist of an electrical lead contained in a flexible metal braiding with coupling nuts on each end and mounting flanges for attachment to the engine fire seals.

The spark igniters are located at the 4 and 9 o'clock positions on the gas generator case adjacent to the fuel manifold. The igniters are energized during the engine starting sequence or when in the "auto" mode (auto ignition optional) when torque falls below 400 ft. lbs. to initiate combustion in the combustion chamber.

ELECTRICAL POWER SUPPLY.

— WARNING —

Voltage in the ignition exciter could be dangerously high. Exercise extreme caution when working around this system. Ensure ignition is switched off, and system has been inoperative for at least six minutes before removing any ignition components. Always use insulated tools to remove cable coupling nuts. Do not touch output connectors or coupling nuts with bare hands. Always disconnect coupling nuts at ignition exciter end first.

— CAUTION —

DO NOT ALLOW LUBRICANT TO CONTACT CONDUCTOR OF CONNECTORS. THIS MAY RESULT IN A HIGH RESISTANCE PATH WHICH COULD GENERATE HEAT AND OXIDATION.

For additional information regarding the items installed on the engines and functional check of the system, refer to the Pratt and Whitney Engine Maintenance Manual No. 3030442, Chapter 74, and Chapter 72 for inspection.

CHECKING IGNITION SYSTEM.

A common cause of ignition problems is a low battery. Before inspecting the ignition system, try a normal start with an auxiliary power unit. If the engine will not start proceed with the check of the ignition system.

During the following procedure it is recommended that an auxiliary power unit be used for dry motoring runs and start attempts to eliminate the possiblity of low voltage at the exciter box and/or excessive battery drain.

— *CAUTION* —

Perform a dry motoring run prior to switching ON the igntion to ensure no fuel remains in the gas generator case. Refer to paragraph titled Dry Motoring Run.

1. Switch ignition system OFF.
2. Disconnect the coupling nut of one ignition cable from the output connector on the exciter box.
3. Switch battery master and ignition switches ON and advance the CONDITION lever to RUN.
4. Listen at the gas generator case for a snapping sound with a frequency of approximately one snap per second. If snapping is audible the ignition is satisfactory.
5. Secure the engine by moving the CONDITION lever to the STOP position and switch the ignition and battery master switches OFF.
6. Reconnect the coupling nut of the ignition cable to the exciter box and remove the other cable coupling nut, then repeat Steps "3" thru "5".
7. If no snapping sound is heard on either check, replace the ignition exciter box and repeat Steps "1" thru "5".
8. If a snapping sound is not heard on one check only, replace the associated spark igniter and or ignition cable and repeat steps "1" thru "5". If spark igniter still fails, replace exciter.

DRY MOTORING RUN.

An engine dry motoring run is used to clear the engine of trapped fuel or vapors after an unsatisfactory start and to check for fuel system leaks after component replacement.

1. Set the starting control lever at CUTOFF.
2. Master switch ON (to supply electrical power to starter).
3. Fuel shutoff valve ON.
4. Fuel boost pump switch ON (to provide lubrication for the engine driven fuel pumping elements).
5. Leave ignition switch OFF.
6. Operate the starter for 10 seconds.

— *CAUTION* —

Do not exceed starter time limits (30 seconds ON, 1 minute OFF, 30 seconds ON, 1 minute OFF, 30 seconds ON, 30 minutes OFF.)

8. Release the engine starter switch.
9. Fuel boost pump switch OFF, after Ng has stopped.
10. Master switch OFF.
11. Check engine oil level and service as necessary.

IGNITION EXCITER REPLACEMENT.

The ignition exciter is located just forward of the engine mount assembly on the upper right-hand side of the right-hand engine, and immediately aft of the engine data plate on the lower left side of the left-hand engine. This is a non-serviceable unit other than cleaning and painting and must be replaced if found defective. Observe all safety precautions when handling this unit.

— *WARNING* —

Residual voltage in the exciter could be very high. Ensure ignition is off and system has been inoperative for at least six minutes before removing any components. Always use insulated tools and remove coupling nuts at exciter end first. Do not touch output connectors or coupling nuts with bare hands.

1. Remove power from ignition system.
2. Disconnect power supply cable from exciter box input connector.

— *CAUTION* —

Do not allow ignition cable braiding or ferrules to rotate when removing coupling nuts.

3. Disconnect the two ignition cable couplings from the output connectors on the exciter.
4. Remove four bolts, washers and self-locking nuts securing the unit to its bracket.
5. Remove the ignition exciter unit.
6. Install the replacement unit to the firewall with hardware removed in Step "4".
7. Lightly coat threads of exciter connectors with fluorocarbon spray lubricant.
8. Connect coupling nuts of supply cable and two ignition cables to their respectve connectors on the exciter.

— *CAUTION* —

Do not allow ignition cable braiding or ferrules to rotate when screwing on coupling nuts.

9. Tighten coupling nuts finger tight plus 45 degrees; then safety with lockwire.

DISTRIBUTION.

SPARK IGNITER.

The spark igniters are located at the 4 and 9 o'clock positions on the gas generator case, adjacent to the fuel manifold. Observe all safety precautions when working on the ignition system.

REMOVAL OF SPARK IGNITER.

— *WARNING* —

Residual voltage in the exciter could be very high. Ensure ignition is off and system has been inoperative for at least six minutes before removing any components. Always use insulated tools and remove coupling nuts at exciter end first. Do not touch output connectors or coupling nuts with bare hands.

1. Remove power from the ignition system.
2. Disconnect the coupling nut from the respective igniter.

— *CAUTION* —

When unscrewing coupling nuts do not allow braiding, ferrules or igniter plug to turn at the same time.

3. Remove the igniter plug from the gas generator case, along with the copper gasket.

CLEANING OF SPARK IGNITER.

1. Cap the cable end of the igniter plug to prevent entry of foreign material during cleaning.

— *NOTE* —

The electrode end (firing) of the igniter should never be cleaned. Do not remove carbon from the electrode or annular gap area. Carbon deposits in the gap area aid the igniter operation.

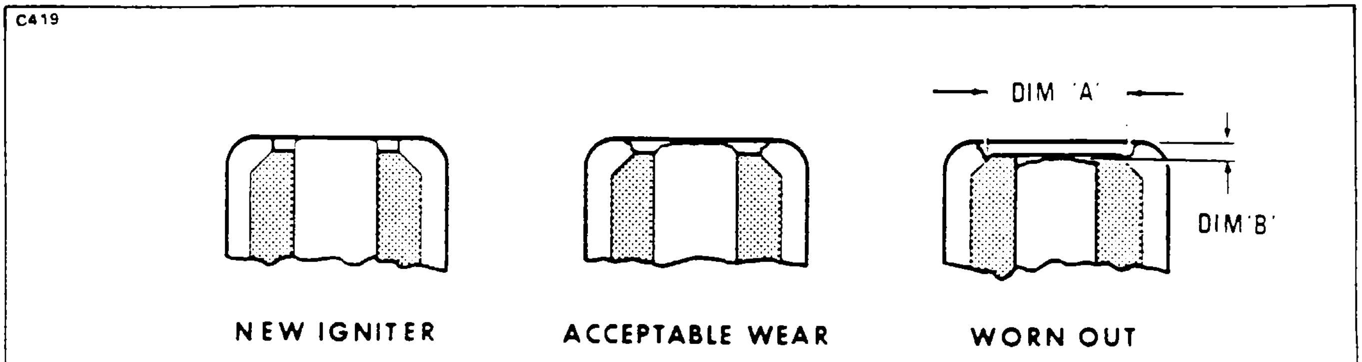
2. Using a felt swab soaked in petroleum solvent or methyl alcohol, clean the inside surface of terminal well.
3. Dry the igniter with dry compressed air.

— *CAUTION* —

Should an igniter plug be dropped, internal damage, possibly not detectable by test can occur. It is recommended to replace the igniter plug.

4. After cleaning the igniter inspect the electrode end for erosion limits.

CHART 7401. SPARK IGNITER EROSION LIMITS



P & W PART NO	VENDOR NAME AND PART NO.		DIMENSION "A"	INCHES "B"
*3014986	Champion	FHE-182	0.3437	0.0312
*3014985	Bendix	10-380700-1	0.2500	0.0310
*3024706	AC	5611760	0.2750	0.1000
**3027280	Champion	CH34055	0.3000	N.A
**3031213	Bendix	10-390667-1	0.3000	N A

*Earlier parts supplied under ordering part number 3014981.
**Later parts supplied under ordering part number 3032096.
Igniters eroded beyond limits should be replaced by latest part(s), if available.

INSPECTION OF SPARK IGNITER.

After cleaning, the igniter should be examined for wear and erosion.

— CAUTION —

Should an igniter plug be dropped, internal damage, possibly not detectable by test, can occur. It is recommended that the plug be replaced.

1. Inspect the exterior cylinder area of the electrode end of the igniter shell for chafing wear. Wear is acceptable to a depth of 0.015 of an inch.

2. Inspect igniter shell and electrode for erosion. If erosion equals or exceeds amounts shown in Chart 7401, the igniter should be replaced.

— *CAUTION* —

Do not use any thread lubricant on igniters during reinstallation into engine.

3. Perform a functional test of the igniters as described in checking Ignition System, Chapter 74.

INSTALLATION OF SPARK IGNITER.

1. Install a new copper gasket on each spark igniter being installed.
2. Install spark igniter(s) in bosses at the 4 and 9 o'clock positions on the gas generator case.
3. Tighten the igniter(s) and torque to 300 inch pounds. Loosen to 0 inch pounds and re-torque to 300-360 inch pounds maximum.

— *CAUTION* —

Do not allow ignition cable braiding, ferrule or igniter plug to turn when screwing on the coupling nut.

4. Insert central conductor of ignition cable into respective spark igniter and connect cable.

IGNITION CABLES.

The two ignition cable assemblies consist of electrical leads contained in flexible metal braiding with coupling nuts at each end and mounting flanges for attachment to the engine fire seals. Observe all safety precautions when working on the ignition system. Refer to Pratt and Whitney Aircraft of Canada, Ltd. Maintenance Manual, Part No. 3030442 Chapter 74-20-13 for complete service information.

REMOVAL OF IGNITION CABLES.

1. Remove power from the ignition system.

— *CAUTION* —

When unscrewing coupling nuts, do not allow braiding, ferrules or igniter to turn at the same time. UNDER NO CIRCUMSTANCE IS A LUBRICANT CONTAINING GREASE OR SILICONE OR LUBRICANTS SUCH AS PETROLATUM TO BE USED ON ANY IGNITION COMPONENT. DO NOT APPLY LUBRICATION ON ANY CABLES HAVING TEFLON INSULATED SLEEVES.

2. Remove coupling nuts of the left and right ignition cables from the ignition exciter and the spark igniters.
3. Remove the self-locking nuts, washers and bolts which secure the loop clamps to the various brackets and to the center and rear fireseals.
4. Remove the self-locking nut and bolt securing the loop clamp to the loop clamp on the fuel line.
5. Remove the self-locking nut and bolt which secures the loop clamp to the bracket at the P3 boss on the gas generator case.
6. Remove the cables from the engine.

CLEANING OF IGNITION CABLES.

1. Remove all corrosion residue using a stainless steel wire brush.
2. Clean surfaces thoroughly using a clean, lint-free cloth moistened with methylethylketone.

— CAUTION —

Do not allow lubricant to come in contact with central conductors of cable connectors. Contact with conductors may result in a high resistance path which could generate heat and oxidation.

3. Apply a light film of fluorocarbon spray lubricant to any cleaned areas.

INSPECTION OF IGNITION CABLES.

1. Inspect the cables for damage to braiding and general condition.
2. Inspect the cable coupling nuts for corrosion.
3. Inspect the central conductor and insulation for damage.

INSTALLATION OF IGNITION CABLES.

1. Locate the cable assemblies between the center and rear fireseal mount rings at the 6 o'clock position. Pass the fittings through their respective clearance holes in the fireseal mount rings. Pull the cables through the mount rings until the cable flanges bear against the mount ring.
2. Install the brackets on the air inlet side of the mount rings and against the cable flanges. Secure the brackets and the cable flanges to the respective mount ring, tighten bolts and torque to 36-40 inch pounds.

— NOTE —

Bolt heads should be located on the air inlet side of the respective fireseal mount ring.

3. Secure the loop clamp on the left hand cable harness to the bracket located at the rear fuel drain plug. Tighten nut and torque 36-40 inch pounds.
4. Secure the loop clamps on the right hand cable harness to the fuel line loop clamp and to the bracket at the P3 boss on the gas generator case. Tighten nuts and torque to 36-40 inch pounds.
5. Lightly spray the insulated cable ends of cables having rubber insulated sleeves with fluorocarbon dry spray lubricant.

— CAUTION —

Do not allow braiding, ferrules or igniter plug to turn when screwing on coupling nuts.

6. Connect coupling nuts of ignition cables to respective spark igniters and connectors on ignition exciter. Screw couplings onto mating threads and tighten fingertight plus 45 degrees. Safety with lockwire.

SWITCHING.

IGNITION CUTOFF SWITCH.

The ignition cutoff switches are mounted within the control pedestal and are activated by the start control levers.

REMOVAL OF IGNITION CUTOFF SWITCH.

1. Remove the top cover plates of the pedestal (one is forward of the control levers, the other surrounds the levers) by removing their attachment screws.
2. 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.
3. Disconnect the necessary electrical leads.

INSTALLATION OF IGNITION CUTOFF SWITCH.

1. Connect the electrical leads to their respective switch terminals. (Refer to Electrical System Schematic, Chapter 91 for wire installation.)
2. 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.
3. Position the pedestal cover plates on the pedestal; install screws and secure.
4. Adjust the switches.

ADJUSTMENT OF IGNITION CUTOFF SWITCH.

1. Set the start control levers in the cutoff position.
2. With the adjustment screw on the switch bracket, adjust each switch separately toward the start control lever until the switch is heard to actuate at 1 inch of forward travel. The adjustment screw may be reached by inserting a long screwdriver through the travel slot of the start control lever in the pedestal cover.
3. Check adjustment of switch.

AUTO IGNITION SYSTEM (OPTIONAL).

DESCRIPTION.

Auto ignition is an available option on the T-1040. The ignition switches are a single pole single throw switch, in series with the red condition lever idle cut off position switch. The standard ignition switch positions are labeled "ON" and "OFF." The optional ignition switch "ON" position is labeled "MANUAL" and the "OFF" position is labeled "AUTO." The optional "AUTO" "OFF" ignition circuit is bypassed to "ON," any time the starter is energized, and also through a low engine torque sensing switch in series with a squat switch. With the ignition switch in the "AUTO," "OFF" position, the ignition will come back on if the starter is switched on, or if the engine torque falls off to a low value in flight. The low torque switch closes when falling through 400 to 275 ft.-lbs. and opens when engine torque rises above 336 to 400 ft.-lbs. the red condition lever will always switch off ignition in the idle cut off position.

TEST OF AUTO IGNITION SYSTEM.

1. To test for proper annunciation and operation proceed as follows:
   A. Position engine control levers for start and place the ignition switch in the "MANUAL" position. The amber annunciator light ("R/L IGN ON") should be illuminated.
   B. Move the ignition switch to "AUTO" and check that the light remains on.
   C. With the switch in auto and observing the annunciator, increase the engine power. As the torque goes above 400 ft. lbs. the annunciator light should extinguish.
2. For just a check of the auto ignition system, move condition lever past the idle detent and, with the ignition switch in "AUTO", observe the amber annunciator light to be illuminated.
3. For any repair condition contact customer service, Lock Haven, Pennsylvania.

— END —

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

75

AIR

CHAPTER 75 - AIR

TABLE OF CONTENTS/EFFECTIVTIY

GENERAL.

The PT6A-11 engine has three separate air systems; one system provides air for bearing compartment sealing, a second provides cooling air to the compressor and power turbine discs, and the third provides air for the compressor bleed valves and airframe services.

For a full description of the systems and their related maintenance, adjustment and inspection procedures, refer to Pratt and Whitney Aircraft of Canada, Ltd. Maintenance Manual Part No. 3030442, Chapter 75.

— END —

CHAPTER

76

ENGINE CONTROLS

CHAPTER 76 - ENGINE CONTROLS

TABLE OF CONTENTS/EFFECTIVTIY

GENERAL.

DESCRIPTION AND OPERATION.

Engine and propeller functions are controlled by conventional levers and special push-pull cables. The PT6A-11 engines are controlled by three levers: The Power Lever which controls engine power and propeller reversing mechanism, the Propeller Control Lever and the Condition Lever (idle and fuel cutoff).

The power lever cable is attached to the propeller cam box and fuel control through a power lever arm. The propeller cam is attached to the fuel control through a fuel control unit interconnect rod. The propeller cam is also attached to the beta valve and propeller governor through this push/pull control.

The propeller control lever controls propeller pitch and propeller RPM through a constant speed governor located at the forward top of the engine reduction gear box.

The condition lever controls the start control valve which is part of the fuel control unit. The condition lever has two positions, "on" and "off." The start control acts as a shut-off valve for the fuel from the fuel control to the flow divider and dump valve assembly for fuel flowing to the primary and secondary fuel nozzles.

As a second function, the condition lever operates one of the two switches necessary for ignition. Power for the ignitor box is supplied through an overhead arm switch to a micro switch located at the pedestal then to the ignitor box.

For complete description and maintenance information on the engine controls, refer to the Pratt and Whitney Engine Maintenance Manual, Part No. 3030442, Chapter 76.

POWER CONTROLS.

— CAUTION —

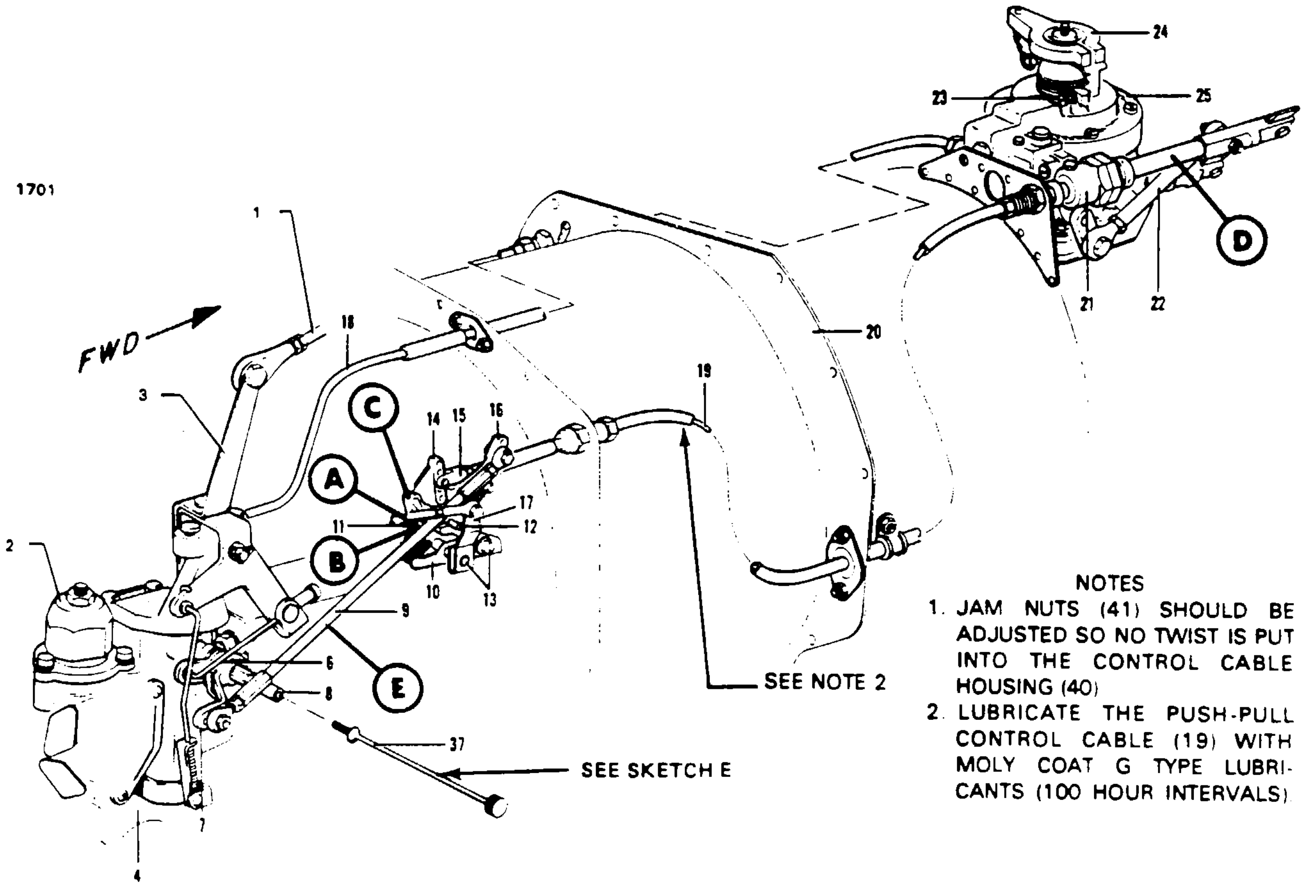
When you are performing any maintenance on the power lever, remember to disconnect the reversing linkage either at forward clevis attachment or at the rear clevis attachment on the propeller cam.

This will prevent damage to the reversing linkage in the event that you have to place the power levers in reverse range with the engine not running.

POWER LEVER CONTROL CABLE.

POWER LEVER CONTROL CABLE REMOVAL AND INSTALLATION.

1. Observe the handling procedures stated in Power Lever Control Cable Handling and Storage.
2. Remove access cover aft of nose gear doors, inboard wing leading edge fairing, nacelle access covers aft of engine firewall, upper engine cowling and pedestal access covers.



NOTES
1. JAM NUTS (41) SHOULD BE ADJUSTED SO NO TWIST IS PUT INTO THE CONTROL CABLE HOUSING (40)
2. LUBRICATE THE PUSH-PULL CONTROL CABLE (19) WITH MOLY COAT G TYPE LUBRICANTS (100 HOUR INTERVALS)

1. START CONTROL CABLE
2. ACCELERATION ADJUSTMENT
3. STARTING CONTROL ARM
4. FUEL CONTROL UNIT
5. ADJUSTMENT, (IDLE SPEED SET)
6. F.C.U. ARM SERRATED SPACER
7. F.C.U. ARM
8. F.C.U. ARM EXTENSION
9. F.C.U. INTERCONNECT ROD
10. CONTROL LEVER MOUNTING BRACKET
11. ADJUSTMENT, (DEAD BAND)
12. CAM FOLLOWER PIN
13. PIVOT PINS
14. PROPELLER CONTROL CAM
15. CLEVIS
16. FUEL CONTROL ACTUATING LEVER
17. POWER LEVER INPUT ARM
18. PROPELLER GOVERNOR AIR PRESSURE TUBE Py
19. PUSH PULL CONTROL, WIRE ROPE
20. CENTER FIRE SEAL MOUNT RING
21. LOW PITCH STOP ADJUSTER
22. PROPELLER GOVERNOR INTERCONNECT ROD
23. PROPELLER SPEED SELECT LEVER, MAX. STOP
24. PROPELLER SPEED ADJUSTMENT LEVER
25. PROPELLER GOVERNOR UNIT
26. JAM NUT
27. AIR BLEED LINK (RESET ARM)
28. MAXIMUM STOP
29. PUSH-PULL CONTROL
30. PROPELLER REVERSING LEVER
31. BETA VALVE CLEVIS
32. CAP NUT
33. CARBON BLOCK
34. TOOL, (BETA RIGGING SHIM P/N 51516
35. VISE GRIP PLIERS
36. TOOL (TEMPLATE P/N 51518)
37. TOOL (LOCATED PIN P/N 51513)
38. GAS GENERATOR MAXIMUM STOP
39. SWITCH, THROTTLE CONTROL
40. CONTROL CABLE HOUSING
41. JAM NUTS
42. SEAL NUT
43. CONTROL SHAFT
44. BETA STOP
45. JAM NUT
45A. WASHER
46. WASHER BOLT
47. CONTROL PIVOT
48. ROD END
49. BOLT
50. JAM NUT

Figure 76-1. Engine Controls

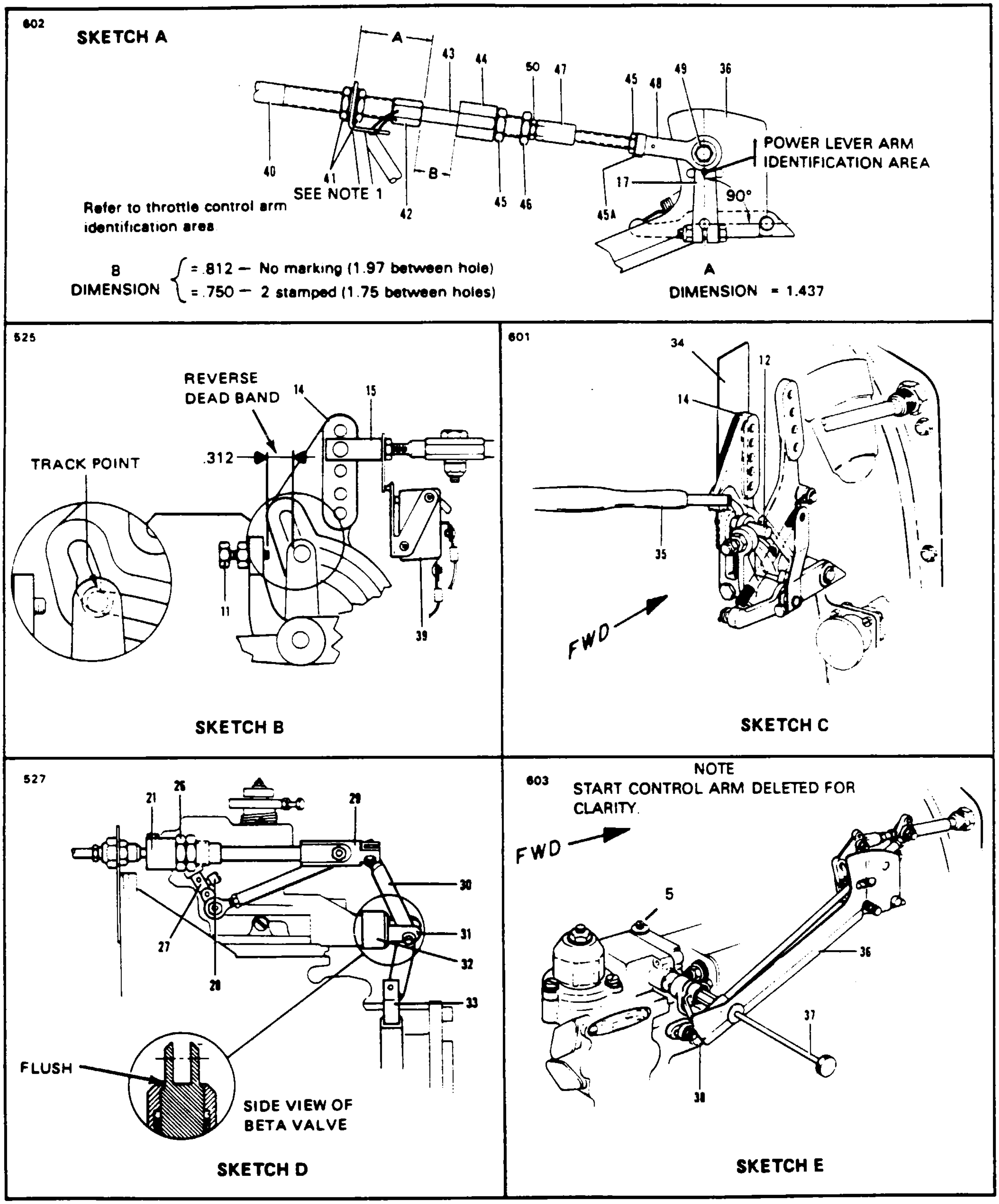


Figure 76-1. Engine Controls (cont.)

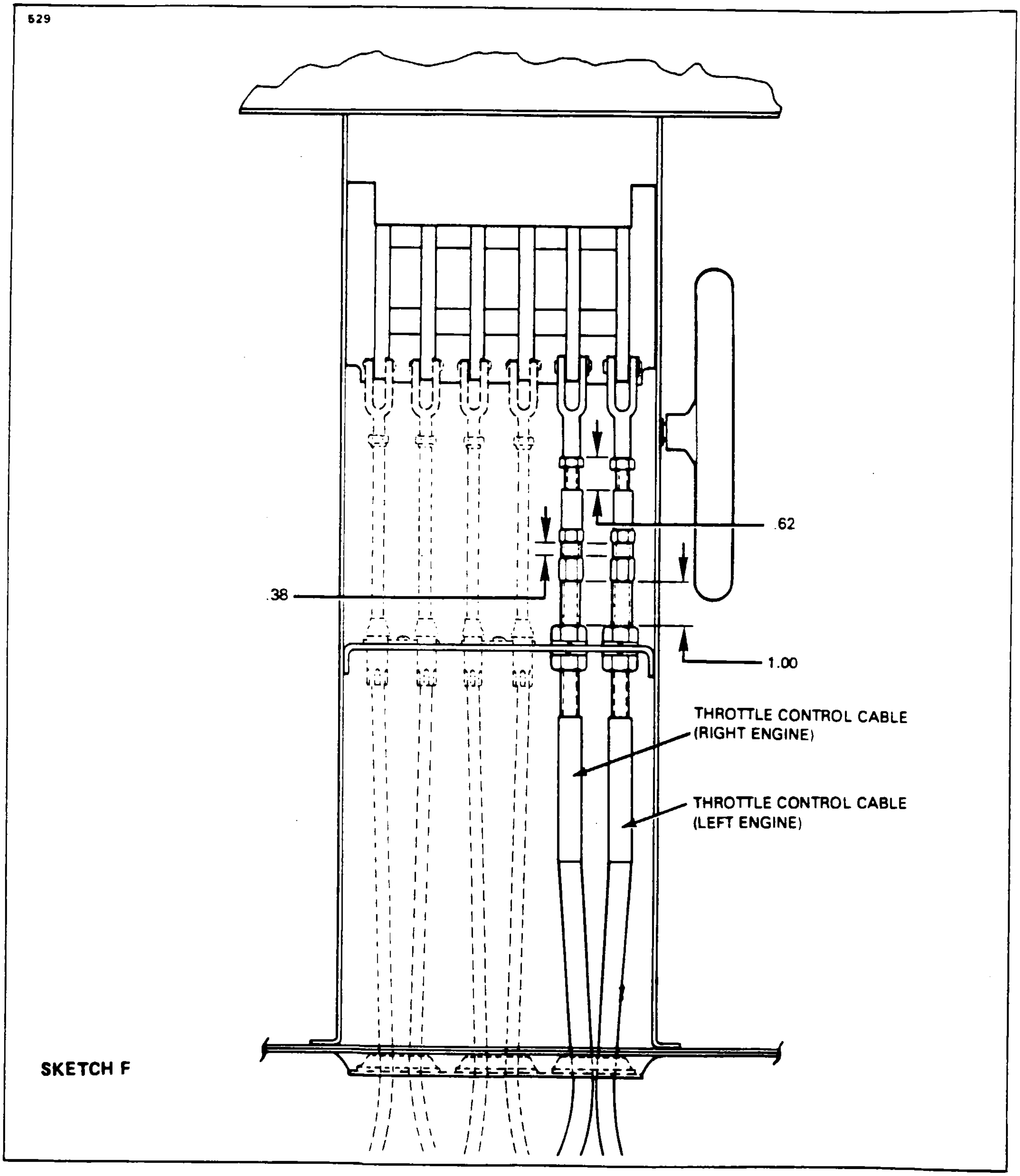


Figure 76-1. Engine Controls (cont.)

3. Before disconnecting cable, obtain measurements of existing installation using the following procedure. (Refer to Figure 76-1.)
   A. Set power lever to idle and lock cam box similar to method for setting track point, do not disturb engine rigging.
   B. Using calipers measure the distance between seal nut and beta stop.
   C. Back seal nut off and measure distance to end of threads.
   D. Count the number of control pivot threads engaged in rod end.
4. Cable to be replaced should be removed. Note routing and attachment points for installation of new cable. Make sure the respective cable ends are at their proper positions before installation.
5. Starting at the access hole aft of nose gear doors, work the control cable through the fuselage into the wing leading edge and up to the nacelle attachment point. The control should be routed without any restraint at either end or any undo forcing, during installation.
6. Ascertain that cable has been routed properly. Clamps should not be overtightened; cables should be free to move through the clamps.
7. Check for smooth operation of control before connecting to attachment points.
8. Connect control cables to power lever per Figure 76-1, Sketch F.
9. Install control cables to power lever arm as shown in Figure 76-1, Sketch A. Use measurements obtained in Step C above.
10. Run the engine and make the following checks:
    A. Forward gas generator (Ng) pickup dead band.
    B. Power lever alignment check.
    C. Reverse maximum power setting.
    D. Check that maximum (Ng) Speed Adjustment contacts part power trim stop.
11. If engine rigging is disturbed, it will be necessary to perform pre-run rigging and adjustments of power control and continue through final engine adjustments.

POWER LEVER CONTROL CABLE HANDLING AND STORAGE.

The throttle control cables require special handling, storage and installation to prevent irreversible damage to the cables. The cables utilize close spaced ball bearings above and below a ribbon core of stainless steel. The following handling and storage procedures should be observed:

1. Uncoiling of the cable should be done as shown in Figure 76-2.
2. After the cable has been uncoiled the ribbon should be straightened as shown in Figure 76-2. This assures that the control is not twisted prior to installation.
3. Pliers or similar devices should not be used to grip any surface of the control cable.
4. Use the wrench flats on the end fittings and the terminal ends to prevent twisting when torquing nuts or attaching hardware.
5. The bend radii shall be seven inches minimum.
6. The plane of bend can be changed by allowing the control cable to coil easily into the new plane.
7. The control cable assemblies should never be lubricated.
8. Do not twist, crimp, dent, apply side pressure, or stand on the cable control assembly. It is a precision ball bearing device and improper handling will seriously affect its operation.

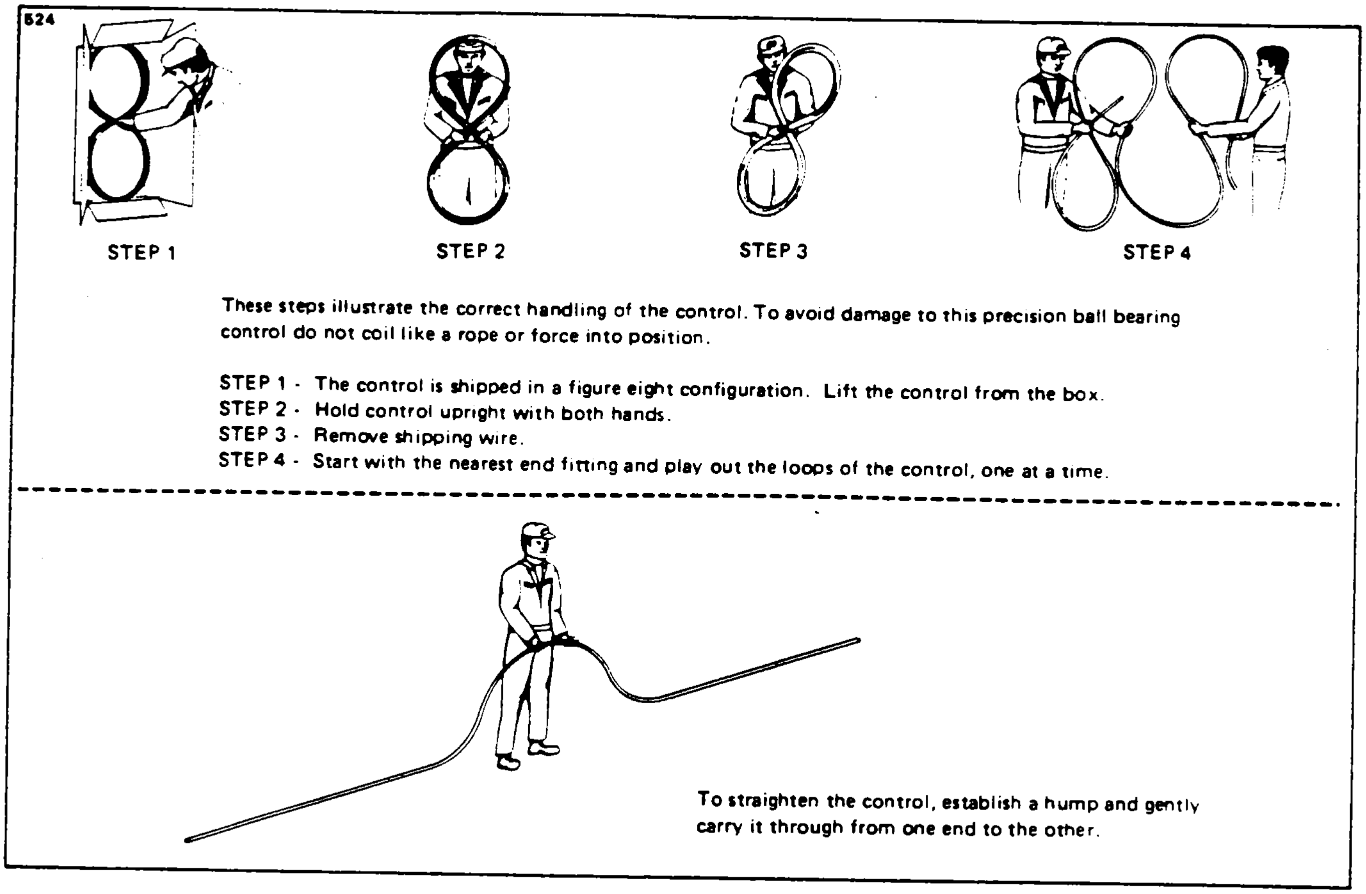


Figure 76-2. Throttle Control Cable Handling Procedure

ENGINE CONTROL ADJUSTMENTS.

The following engine control adjustments are preliminary adjustments. After these adjustments are complete, the engine power adjustments must be checked.

— *NOTE* —

Special tools referred to in the following service information are available through the Piper Service Department, or may be fabricated locally from information supplied with the text.

POWER LEVER.

POWER LEVER ADJUSTMENT.

1. Remove the clevis pin attaching the wire rope to the cam lever.
2. Remove the bolts holding the power lever cable to the input arm and fuel control interconnect rod.
3. Establish the track point by moving the follower pin rearward in the cam slot until the cam just starts to move rearward, then move the follower pin forward until the cam stops moving.

4. While holding the track point position, insert tool P/N 51516 behind the cam onto the pin and hold the cam and tool in position with a small pair of vise grip pliers.

— NOTE —

Install the pliers tight enough to hold everything from moving, but not tight enough to damage the cam.

Use of a dial indicator to sense Beta Cam movement may be an aid to establishing track point.

5. Install rigging template (P/N 51518) with locator pin assembly (P/N 51513). (Refer to Figure 76-1.)
6. When rigging the input arm on the pivot pin, first remove the spline imprints on the inside of the input arm clamp.

— NOTE —

When installing an input arm, make certain both engines have the same length lever. (Refer to the Parts Catalog.)

7. Position the power lever input arm 90 degrees from the pivot pins. (Refer to Figure 76-1, Sketch A.) Place bolt through lower end of arm and lock in place.

— NOTE —

As you tighten the lock bolt, keep checking the arm to assure that it has not moved and do not put too much force on the bolt as you may push or pull the vise grip pliers loose and you will have to start all over again with track point set-up.

It is very important that the input arm be securely locked on the shaft to prevent it from rotating on the shaft during engine operation.

FUEL CONTROL UNIT TO FUEL CONTROL ACTUATING LEVER ADJUSTMENT.

— NOTE —

Cam box must be at "Track Point" for this adjustment and whenever the engine is being rigged.

1. Install Beta Rigging template (P/N 51518) and locator pin (P/N 51513).

2. Remove the interconnecting rod and rotate fuel control unit input arm fully counterclockwise and then slowly clockwise until the fuel governor cam pick-up point is felt. This point must be 22.5 degrees ± 0.6 degrees indicated on the template. (Refer to Figure 76-1.)

— *NOTE* —

Initial movement of the fuel control unit input arm from the fully counterclockwise position is free from resistance until a pick-up point is recognized when a slight resistance is felt.

3. If the fuel control unit input arm must be adjusted, unsafety the fuel control unit input arm extension and loosen the arm. Rotate the serrated washer on the fuel control unit and fuel control arm to obtain the proper rigging.

— *NOTE* —

The inner serrated increments are 15 degrees and the outer serrated increments are 14.4 degrees giving an adjustment in increments of 0.6 degrees.

4. Adjust the length of the fuel control unit interconnect rod so that when the fuel control unit input arm is at the 22.5 degree position, the rod end bearing of the fuel control unit interconnect rod just aligns with the top hole of the fuel control unit actuating lever. Then lengthen the control rod by unscrewing one rod end bearing 1.5 turns. Install the fuel control unit control rod and lock jam nuts and safety.

5. Set the reverse dead band to approximately 5/16 of an inch. (Refer to Sketch B, Figure 76-1.)

THROTTLE CONTROL CABLE TO POWER LEVER ARM ADJUSTMENT. (Refer to Figure 76-1.)

1. Remove control cable attaching bolt from the power lever arm.
2. Lock cam lever at track point with tool (P/N 51516).
3. Install beta rigging template (P/N 51518) and locator pin (P/N 51513).

— *NOTE* —

Power lever arm must be 90 degrees from pivot pins.

4. With the power control lever in the cockpit at idle position, adjust power cable rod end to a slip fit to the power control arm attaching bolt.
5. Adjust the reverse beta stop to the proper length.

— *NOTE* —

Leave the control cable disconnected to prevent someone pulling the power lever into reverse and moving the track point.

PROPELLER PITCH CONTROL LEVER.

PROPELLER PITCH CONTROL LEVER ADJUSTMENT.

1. Adjust the pitch control lever so the governor control arm has contacted the high rpm stop and the pitch control lever has approximately 0.062 inches spring back. This is made by adjusting the pitch control rod end at the propeller governor.
2. Secure jam nuts and check attachment hardware for safety.

BETA VALVE ADJUSTMENT.

1. Check the feedback ring for run out and carbon block clearance. (Refer to Figure 76-3.)
2. Install the dial indicator to measure run out on the forward inside surface of the feedback ring.

— NOTE —

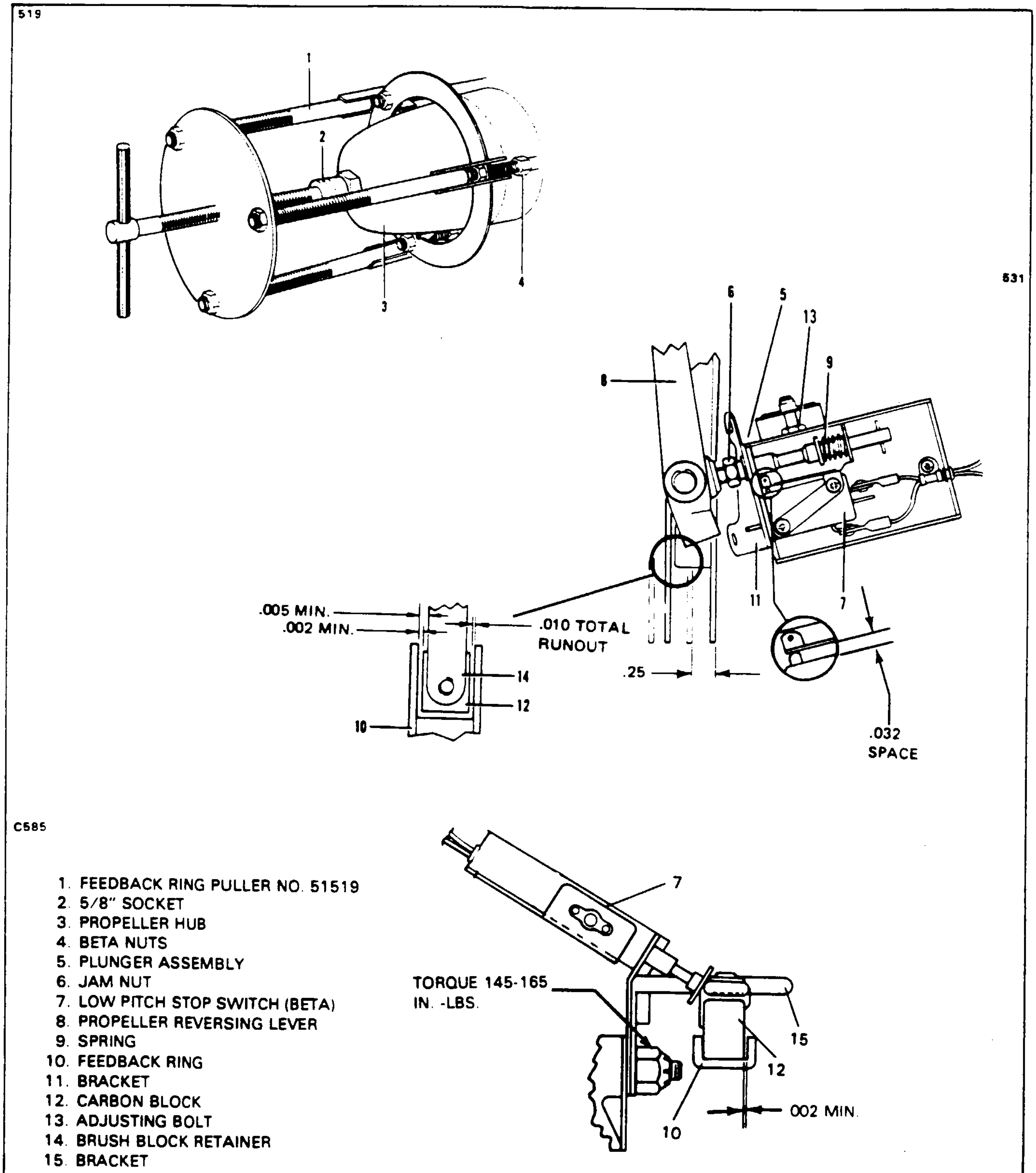
When installing a new brush block, remove an equal amount of material from both sides of the block to obtain proper clearance.

3. Disconnect the propeller governor interconnect rod at the governor arm.
4. While holding the reverse arm forward, the piston should be just flush with the beta valve cap nut. If adjustment has to be made, cut the safety wire on the low pitch stop adjuster and jam nut. Loosen the jam nut and while holding the barrel nut, turn the barrel in or out to adjust the piston flush with the cap nut. Remember to keep checking flush fit while holding forward pressure on linkage. After adjusting the beta valve tighten and safety the barrel and jam nut.

LOW PITCH STOP SWITCH ADJUSTMENT. (Refer to Figure 76-3.)

The low pitch stop switch is mounted on the engine reduction gear case and is actuated by the movement of the feedback ring and propeller reversing lever. Adjust the switch as follows:

1. Remove the spinner.
2. Ascertain that the switch is adjusted to obtain .032 of an inch space between the actuator arm and switch body when the plunger is fully depressed.
3. Should the switch require adjustment to obtain the .032 dimension, loosen the switch mounting screws slightly and make the adjustment with the adjusting bolt; then secure the switch mounting screws.
4. Install the feedback ring puller P/N 51519. Use a 5/8 standard socket against the propeller hub.
5. Adjust the plunger and jam nut to have the micro switch click closed upon reaching 1/4 inch forward movement of the feedback ring.
6. Recheck this setting and make any final adjustments. Lock the jam nut on the plunger and torque 20 to 25 inch-pounds. Remove the puller after making this setting. Ascertain that the plunger moves smoothly in the bracket.



1. FEEDBACK RING PULLER NO. 51519
2. 5/8" SOCKET
3. PROPELLER HUB
4. BETA NUTS
5. PLUNGER ASSEMBLY
6. JAM NUT
7. LOW PITCH STOP SWITCH (BETA)
8. PROPELLER REVERSING LEVER
9. SPRING
10. FEEDBACK RING
11. BRACKET
12. CARBON BLOCK
13. ADJUSTING BOLT
14. BRUSH BLOCK RETAINER
15. BRACKET

Figure 76-3. Low Pitch Stop Switch Adjustment

PROPELLER GOVERNOR INTERCONNECTING ROD TO PROPELLER PUSH-PULL CABLE ADJUSTMENT. (Refer to Figure 76-1.)

— NOTE —

Before rigging the interconnecting rod, make certain the Beta valve is properly rigged.

1. With the interconnect rod removed from the propeller governor air bleed link arm, loosen the rod end lock nuts. Hold the governor link arm forward against the low pitch adjuster stop and adjust the interconnect rod to a slip fit over the attaching bolt.
2. Pre-load the interconnecting rod by shortening the overall length of the rod by turning each rod end fitting one-half turn. Tighten lock nut to 32-36 inch-pounds and safety wire.
3. Secure the rod end with the attaching hardware and torque bolt and nut to 25-35 inch-pounds and safety.

PUSH-PULL CABLE TO CAM BOX ADJUSTMENT. (Refer to Figure 76-1.)

— NOTE —

Cam box must be held at track point.

1. While holding forward pressure on the reversing linkage, attach the clevis at the end of the reversing push-pull cable to the second hole on the reversing cam lever.
2. Install clevis pin to a slip-fit and secure pin.

PROPELLER REVERSE SWITCH ADJUSTMENT. (Refer to Figure 76-1.)

The propeller reverse switch is mounted on the rear propeller reverse linkage and is actuated by movement of the propeller control cam in the reverse direction. Adjust the switch as follows:

1. Be certain that all mechanical linkage is properly adjusted.
2. Loosen the attachment screws and rotate the switch counterclockwise until a click can be heard.
3. Move the switch a slight amount more (approximately 0.031 of an inch) and tighten attachment screws.
4. Check that by depressing the switch pickup trigger, NO click is heard.

REVERSE NOT READY SWITCH ADJUSTMENT.

On the aircraft a reverse not ready light is installed on the pedestal forward of the propeller controls. One switch for each control is actuated off when the propeller controls are full forward (or low pitch). The lights are operational only when the landing gear is placed in the down position and the propeller controls are not full forward. The two micro-switches are adjusted as follows:

1. Adjust the screws on the prop control levers to activate the switches when the control levers are in the full forward position against the stops.
2. Lock the screws in position with nuts.
3. Check the adjustment by moving the control levers full forward and listen for the micro-switch to activate.

CONDITION LEVER.

CONDITION LEVER ADJUSTMENT.

The engine condition lever is adjusted so that when the start control lever is against the stop in the run position, the cockpit control lever should be approximately 0.062 inches from its full forward position.

1. Adjust the control cable ends to provide approximately 0.062 inch spring back of the cockpit control lever when the start control unit lever contacts its stop.
2. Pull the condition lever in the cockpit full aft and be certain the start control unit lever on the start control has reached its limits of travel in the idle cutoff position.
3. Check all jam nuts for security and control linkage attachment hardware for safety.

ENGINE IDLE AND POWER ADJUSTMENTS. (Refer to Figure 76-1.)

Engine adjustments must be performed after installation of an engine; however, each adjustment can be performed independently if a specific component or adjustment is to be checked. An example of an adjustment check sheet is provided to record data obtained during the adjustment procedure. (Refer to Chart 7601.) Before attempting any power adjustments, check to be certain the engine controls are properly rigged.

— NOTE —

All engine instrumentation must be correctly calibrated before attempting any adjustments as all adjustments are made by matching of engine instrument reading. When performing power adjustments, the engines are to be run with no load applied. Disconnect and cap the air bleed tube at the rear fire seal, generators off, etc. Power checks must be carried out under no wind or low wind conditions with the aircraft facing into the wind.

— CAUTION —

Shut down the engine if at anytime inter-turbine temperature (T5) rises abnormally.

1. FORWARD GAS GENERATOR (Ng) PICKUP DEAD BAND. The forward pickup dead band is the amount of travel the power lever linkage moves before the gas generator speed starts to increase. The forward pickup must be matched on each power lever to provide matched power output from the engines. Adjust the forward dead band on the fuel control unit interconnect rod. (Refer to Figure 76-1.) Shortening the rod will decrease the amount of dead band.

CHART 7601. GROUND ADJUSTMENT CHECK SHEET

GROUND ADJUSTMENT CHECK SHEET

NOMINAL SETTINGS	AIRCRAFT NUMBER
IDLE (Ng) - 52% MIN. IDLE ITT - 660°C MAX. OIL PRESSURE - 40 PSI MIN. (IDLE) 80 TO 100 PSI (TAKEOFF) OIL TEMP - 0°C to 99°C FUEL PRESSURE - 15 to 35 psi MAX. PROPELLER SPEED - 2200 RPM REVERSE MAX. POWER - 200 HP	ENGINE NUMBERS L R MECHANIC DATE AMBIENT CONDITIONS PRESSURE ALTITUDE ______ FT OUTSIDE AIR TEMP ______ °C

ADJUSTMENT SETTINGS	LEFT ENGINE	RIGHT ENGINE
FORWARD DEAD BAND	______ IN.	______ IN.
2000 RPM TORQUE SETTING	______ FT-LB	______ FT-LB
ITT	______ °C	______ °C
IDLE SPEED (Ng)	______ %	______ %
REVERSE DEAD BAND	______ IN.	______ IN.
REVERSE MAXIMUM POWER	______ RPM ______ % ______ FT-LB	______ RPM ______ % ______ FT-LB
MAXIMUM PROPELLER SPEED	______ RPM	______ RPM

Engine Ground Performance Check 2200 RPM

TORQUE ______ FT-LB (2)	______ FT-LB	______ FT-LB
FUEL FLOW ______ LBS/HR (2)	______ LBS/HR	______ LBS/HR
Ng ______ % (2)	______ %	______ %
ITT ______ °C (2)	______ °C	______ °C

NOTES
1 INDICATED INSTRUMENT READINGS
2 APPLICABLE CURVE READINGS

REMARKS

2. 2000 RPM TORQUE SETTING. The 2000 rpm torque setting is adjusted using the low pitch stop adjuster on the engine. (Refer to Figure 76-1, Sketch D.) Adjust the 2000 rpm torque using the following procedure:

— *NOTE* —

It is not necessary to cap the bleed air line when checking the 2000 rpm torque setting.

A. Accurately record the stabilized outside air temperature in degrees Centigrade, and set the altimeter window to 29.92 and record the pressure altitude.

B. Start the engine and allow the instruments to stabilize.

C. With the propeller lever full forward, advance the power lever until 2000 rpm propeller speed is obtained.

D. Record the engine torque indicated on the torquemeter.

E. Shutdown the engine.

F. Refer to Chart 7602 and read the desired engine torque for the prevailing ambient conditions.

G. Insure that the Beta valve slot is flush with the Beta valve capnut. Minor torque changes can be made by adjusting the low pitch stop adjuster as follows: (Refer to Figure 76-4.)

(1) Holding track point position on the cam control lever, insert tool P/N 51516 behind the cam onto the pin and hold the cam and tool in position with a small pair of vise grip pliers. Install vise grip pliers tight enough to hold the control cam from moving, but not tight enough to damage the cam. (Refer to Figure 76-1, Sketch C.)

(2) Temporarily secure the reset arm to one of the governor screws; then disconnect the propeller governor interconnect rod from the air bleed link (reset arm).

(3) Loosen the jam nut on the low pitch stop adjuster.

(4) Holding the adjuster, slowly turn the barrel in or out to obtain the desired torque setting.

— *CAUTION* —

Turning the barrel out will increase torque and turning the barrel in will decrease the torque.

DO NOT turn the barrel more than two turns. (1/2 turn equals approximately 50 foot-pounds of torque.)

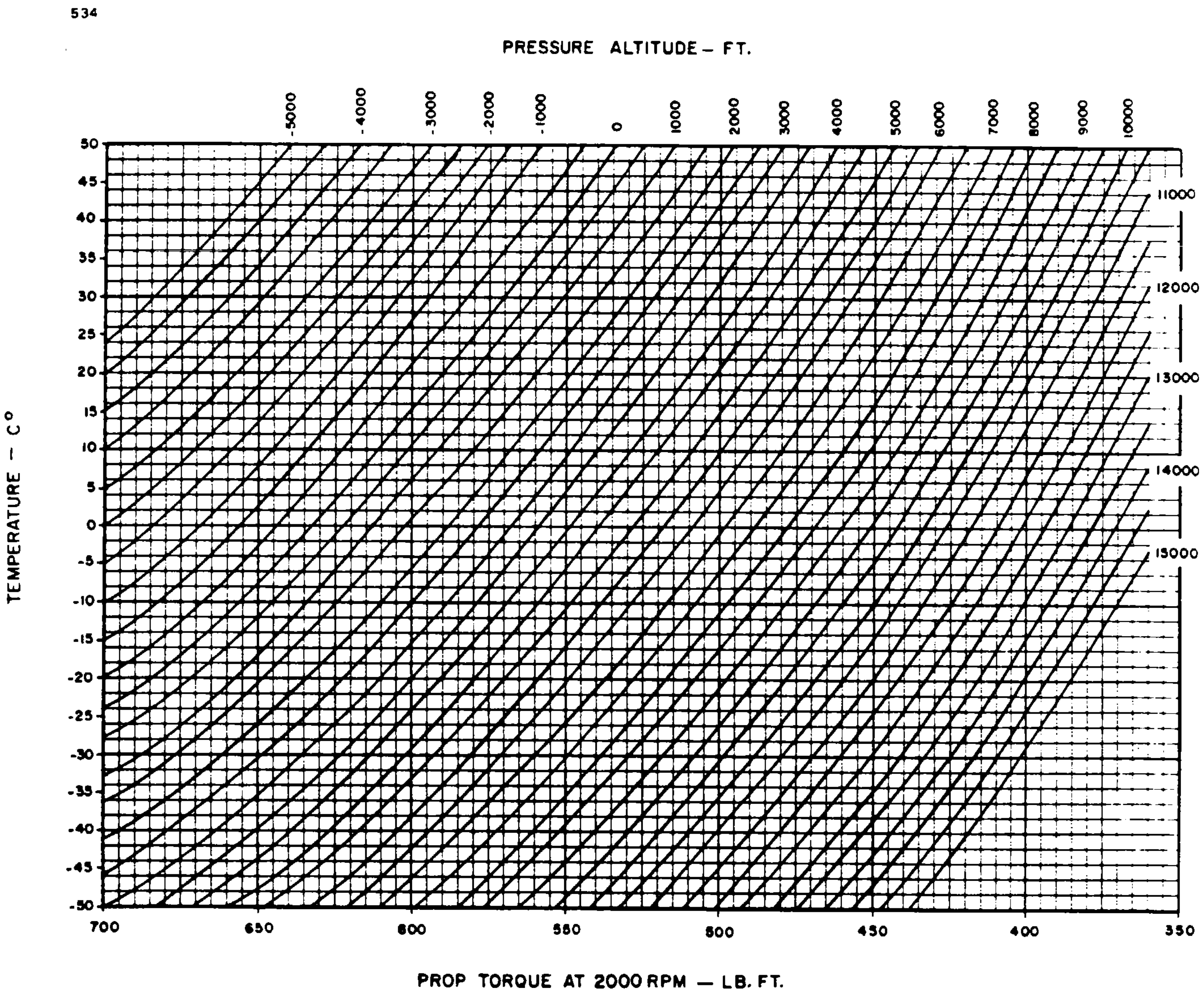
(5) Tighten the jam nut on the adjuster, remove any securing device used to hold the reset arm and reconnect the interconnect rod.

— *NOTE* —

It may be necessary to readjust the interconnect rod.

(6) To insure that no movement was transferred through the wire rope to the cambox, check the clevis pin fit with the cam at track point. The clevis pin must be a slip fit.

CHART 7602. 2000 RPM TORQUE CURVE



— *NOTE* —

The torquemeter reading should be within 40 foot-pounds of the value obtained from chart. Right and left engines should be within 20 foot-pounds of each other.

(7) Ascertain that all holding devices are removed and that all areas are properly safety wired.

3. IDLE SPEED ADJUSTMENTS. The engine idle speed is controlled by two separate adjustments: minimum governing speed and minimum fuel flow. The minimum governing speed adjustment controls engine idle at pressure altitudes from sea level to approximately 3,500 feet at which the fuel flow required to achieve 52% gas generator (Ng) idle is greater than the minimum fuel flow setting. At higher altitudes the minimum fuel flow setting will govern Ng idle speed.

— *CAUTION* —

The minimum fuel flow setting is NOT FIELD adjustable.

— *NOTE* —

Do not attempt idle speed checks at pressure altitudes greater than 3,500 feet.

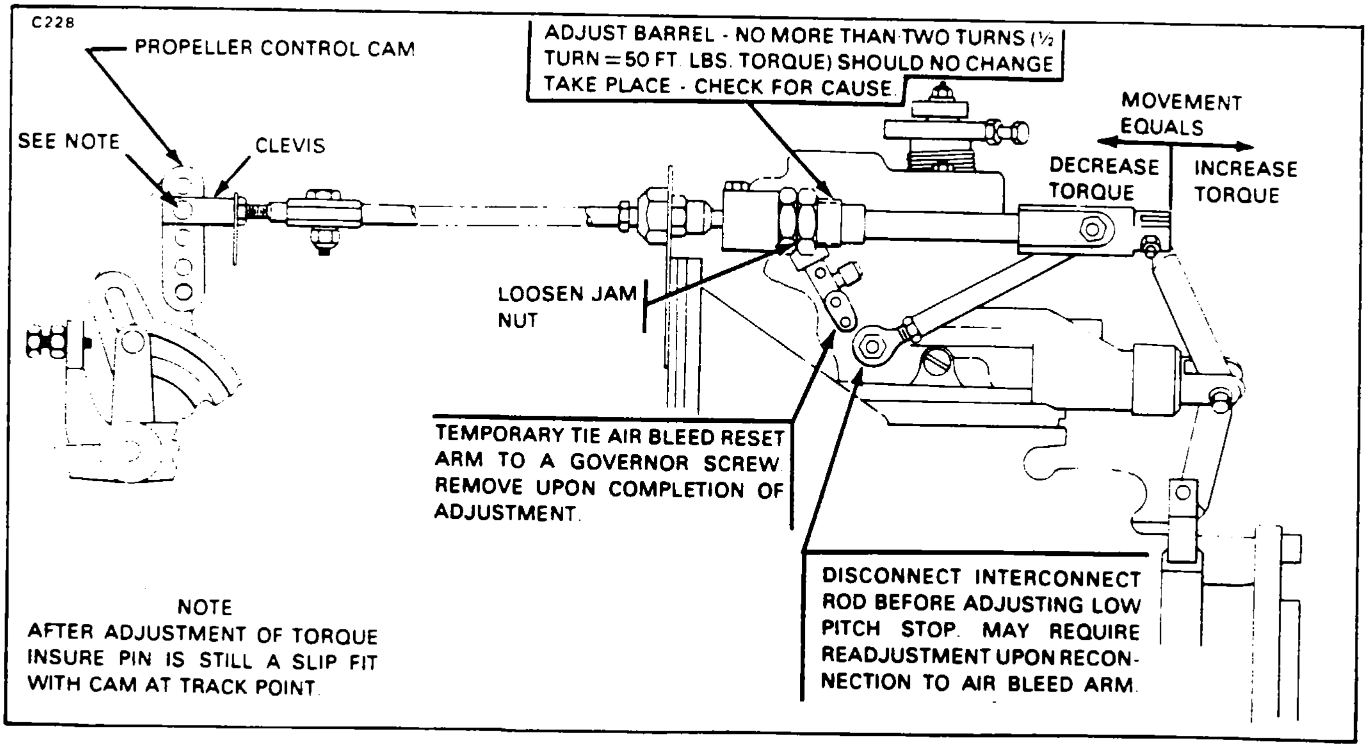


Figure 76-4. Minor Torque Adjustment

Adjust idle speed as follows:

A. Check to insure that the power lever linkage is adjusted.

B. Start the engine and let the oil temperature stabilize.

C. Set the start control lever at IDLE and the power control lever at IDLE.

D. If Ng is less than 52%, adjust minimum governing speed adjuster (refer to Figure 76-5, Sketch B) to obtain 52% Ng minimum.

(1) Cut lockwire on adjuster.

(2) While using an Allen key to prevent the adjuster screw from turning, break the torque on the locknut.

(3) Turn the adjuster in increments until 52% Ng is reached. Turn adjuster clockwise to increase, counterclockwise to decrease.

— NOTE —

The right engine with the air conditioning compressor may require setting idle speed to obtain 55% Ng with compressor not operating to compensate for accessory load when air conditioning system is on.

— CAUTION —

The minimum governing speed adjustment is extremely sensitive; turn the screw in small increments; 1/16 of a turn equals approximately 1% change in Ng speed.

4. POWER LEVER ALIGNMENT CHECK.

— CAUTION —

The wheels should be chocked and the parking brakes set when applying power in excess of 600 foot-pounds, as the aircraft could move.

A. Advance the power levers to 400, 600, 800 and 1,000 foot-pounds of torque and note the dimensions which the power levers are out of alignment.

B. Adjustment is made by repositioning the fuel control arm (refer to Figure 76-1, item 7) clockwise to advance a power lever or counterclockwise to retard a power lever. This adjustment may also require the readjustment of the fuel control unit interconnect rod (refer to Figure 76-1).

C. Repeat Steps A and B as required to insure power lever alignment.

— NOTE —

If alignment of the power levers cannot be maintained throughout their complete travel, it is recommended that a new power lever arm be used.

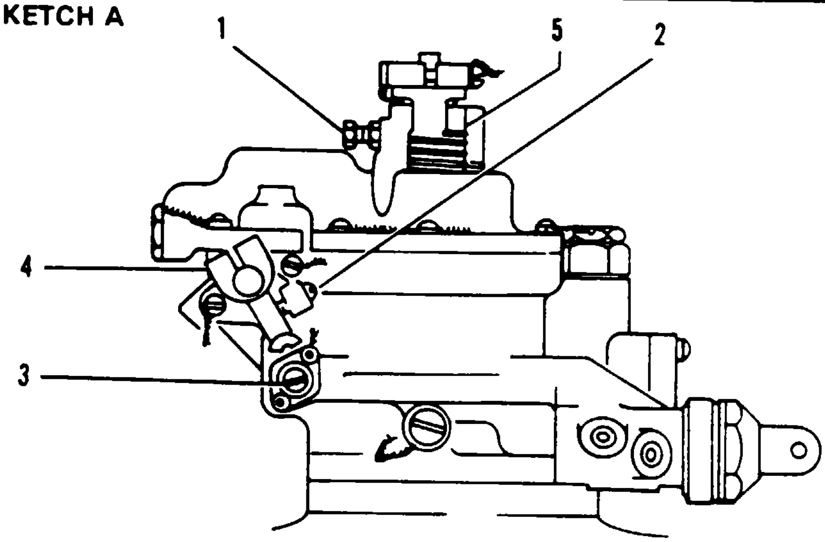
D. After the power levers are aligned, recheck the gas generator pickup and adjust with interconnect arm.

E. With engines shutdown, move power levers full forward and insure gas generator stop is contacted. Power levers should remain aligned at this position. If gas generator stop cannot be contacted on one of the engines, the above adjustments must be made to the opposite power lever.

533

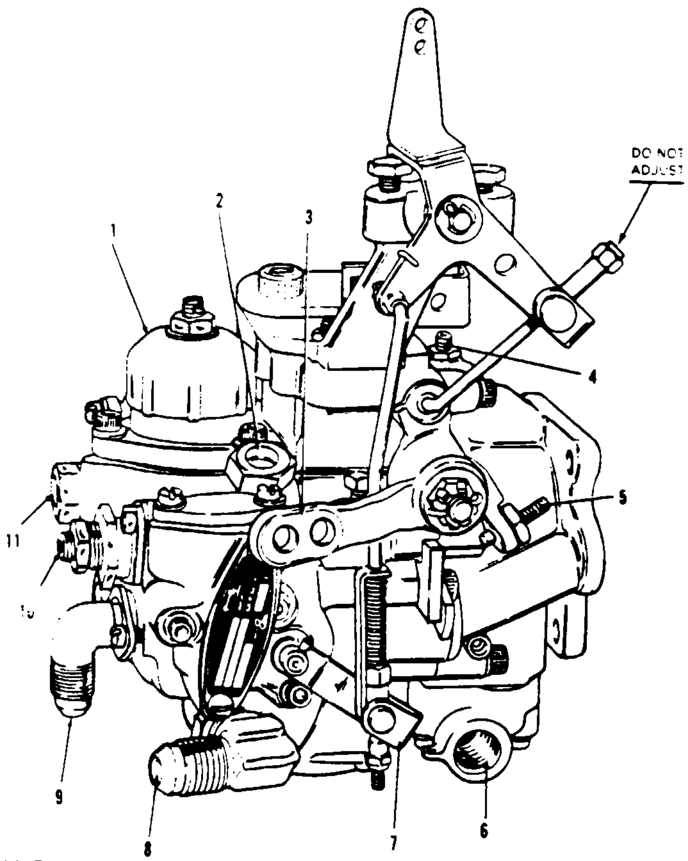
SKETCH A

1. GOVERNOR MAX. SPEED ADJUSTMENT
2. PNEUMATIC MAX. STOP (NOT FOR FIELD ADJUSTMENT)
3. PNEUMATIC MIN. ECCENTRIC ADJUSTMENT
4. AIR BLEED LINK (RESET ARM)
5. FEATHERING ADJUSTER



PROPELLER GOVERNOR

C590



1. ACCELERATION ADJUSTMENT
2. P_1 PRESSURE PORT
3. THROTTLE LEVER
4. IDLE SPEED ADJUSTING SCREW
5. MAXIMUM SPEED ADJUSTMENT
6. P_x PRESSURE PORT
7. CUTOFF LEVER
8. FUEL INLET
9. FUEL OUTLET
10. METERING VALVE MINIMUM FLOW STOP (NOT FOR FIELD ADJUSTMENT)
11. P_2 PRESSURE PORT

SKETCH B

FUEL CONTROL UNIT

Figure 76-5. Fuel Control Unit and Propeller Governor Running Adjustments

5. REVERSE GAS GENERATOR (Ng) PICKUP DEAD BAND. The reverse gas generator pickup dead band is the amount of travel the power lever arm moves before the cam follower pin contacts the fuel control unit reversing lever: at this point the gas generator speed starts to increase. Adjust the pickup dead band to approximately .31 of an inch. Gas generator pickup should occur when propeller rpm speed has dropped 150 rpm. These settings may require additional adjustment to insure gas generator speed on both engines picks up simultaneously in reverse.

6. REVERSE MAXIMUM POWER SETTING. The reverse maximum power setting is limited to 200 shp (shaft horsepower). To achieve the correct reverse power setting, proceed as follows:

A. Start the engine and allow the instruments to stabilize.

— CAUTION —

Do not select reverse power with the engine not running; as damage will be done to the linkage.

B. Move the power levers into the reverse position and record the torque (Q) and propeller speed (Np).

C. Move the power levers to the idle position.

D. To determine the reverse horsepower, use the following equation: Q x Np x 0.00019. This equation will give the reverse power for the prevailing ambient conditions.

E. If necessary, adjust the reverse stop on the power lever linkage. (Refer to Figure 76-1, Sketch A.) An increase in gap is equal to an increase in engine power. One flat on the reverse power stop equals a 25 foot-pound increase in torque. For nominal setting, refer to Figure 76-1, Sketch A dimension B.

F. Secure the jam nut on the reverse stop after the adjustment is complete.

7. MAXIMUM PROPELLER SPEED. The maximum propeller speed is 2200 rpm. Check the maximum propeller speed as follows:

A. Start the engine and allow the instruments to stabilize.

B. With the propeller lever full forward, advance the power lever to obtain 2200 propeller rpm.

C. If necessary, adjust the maximum propeller speed adjustment to obtain the desired 2200 rpm.

8. MAXIMUM GAS GENERATOR (Ng) SPEED. The maximum governing speed stop is preset on all fuel control units. The units should not be adjusted in the field.

9. PROP REVERSING ALIGNMENT CHECK.

A. With the engines running, slowly move the power levers toward reverse and note that the propellers move into Beta together (RPM increase).

B. Matching is determined by carefully rechecking and adjusting the Beta valve.

ENGINE GROUND TESTING.

Ground testing procedures must be carried out periodically to determine any changes in engine performance and detect any mechanical deterioration of the engine. All forms of engine deterioration are accompanied by an increase in inter-turbine temperature and fuel flow at a given power. Compressor deterioration is usually due to dirt deposits and causes an increase in gas generator speed at a given power setting. This form of deterioration can be remedied by a compressor wash as described in the General Procedures section of the Pratt and Whitney Engine Maintenance Manual. P N 3030442. Hot section deterioration will cause a decrease in gas generator speed at a given power setting.

— NOTE —

Engine ground testing must be performed with no load applied (bleed air capped off, generators off, etc.) and under low wind conditions with the aircraft facing into the wind.

— NOTE —

Engine instrumentation must be correctly calibrated before attempting any power checks.

ENGINE GROUND PERFORMANCE CHECK.

Engine performance checking curves enable engine performance to be checked on the ground. over a wide range of ambient temperatures. while reducing the likelihood of an overtorque or overtemperature condition occuring to the engine. Charts 7603 through 7606 are used to determine the desired engine performance parameters. Determine the engine performance as follows:

— NOTE —

Engine instruments must be recently calibrated.

1. Obtain and record the ambient air temperature. Set the altimeter window to 29.92 and record the pressure altitude.
2. Refer to Charts 7603 through 7606 and from the appropriate graph read and record torque. fuel flow. gas generator speed and inter-turbine temperature for the prevailing ambient conditions.
3. With these values established. proceed with engine performance check.

— NOTE —

This check must be performed with generators OFF. It is not necessary to cap off the bleed air lines.

4. Start the engine and run at idle rpm for 5 minutes to allow temperatures to stabilize.
5. Set propeller control lever to give 2200 rpm with power lever set to give torque setting previously determined from the engine performance curve. Allow the instruments to stabilize at this setting.

CHART 7603. FUEL FLOW

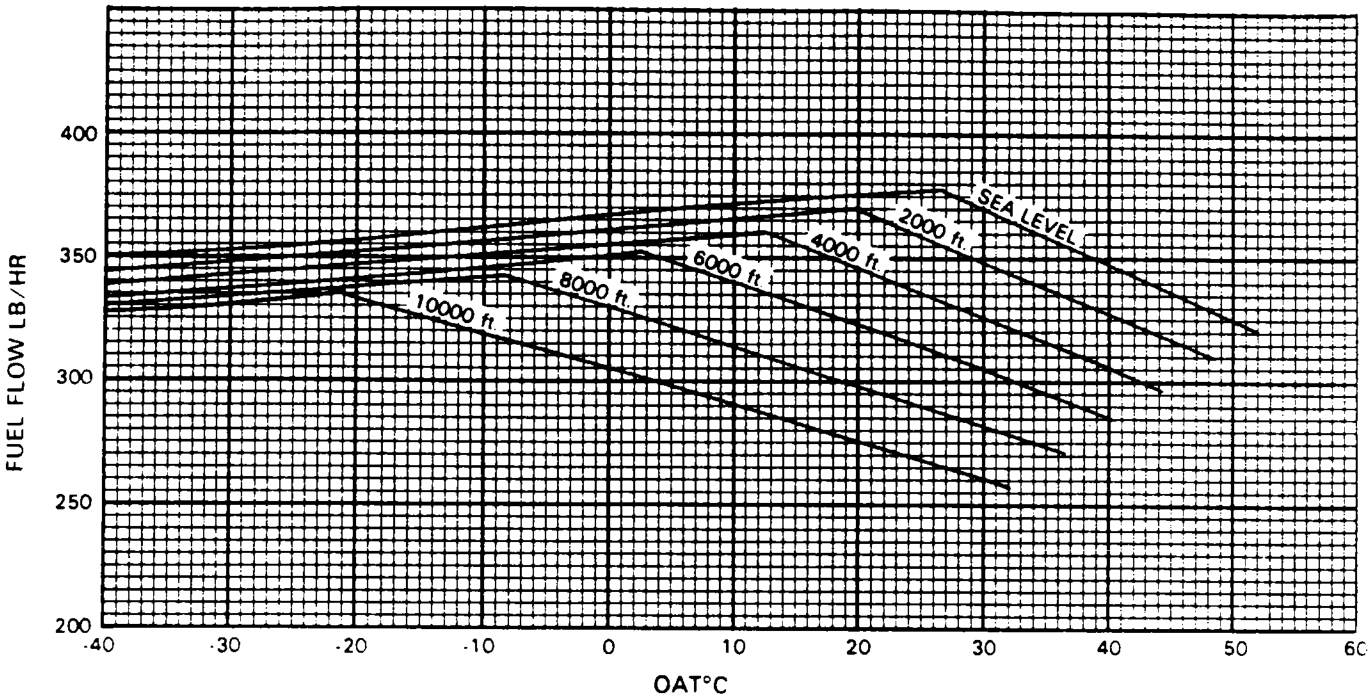


CHART 7604. GAS GENERATOR SPEED

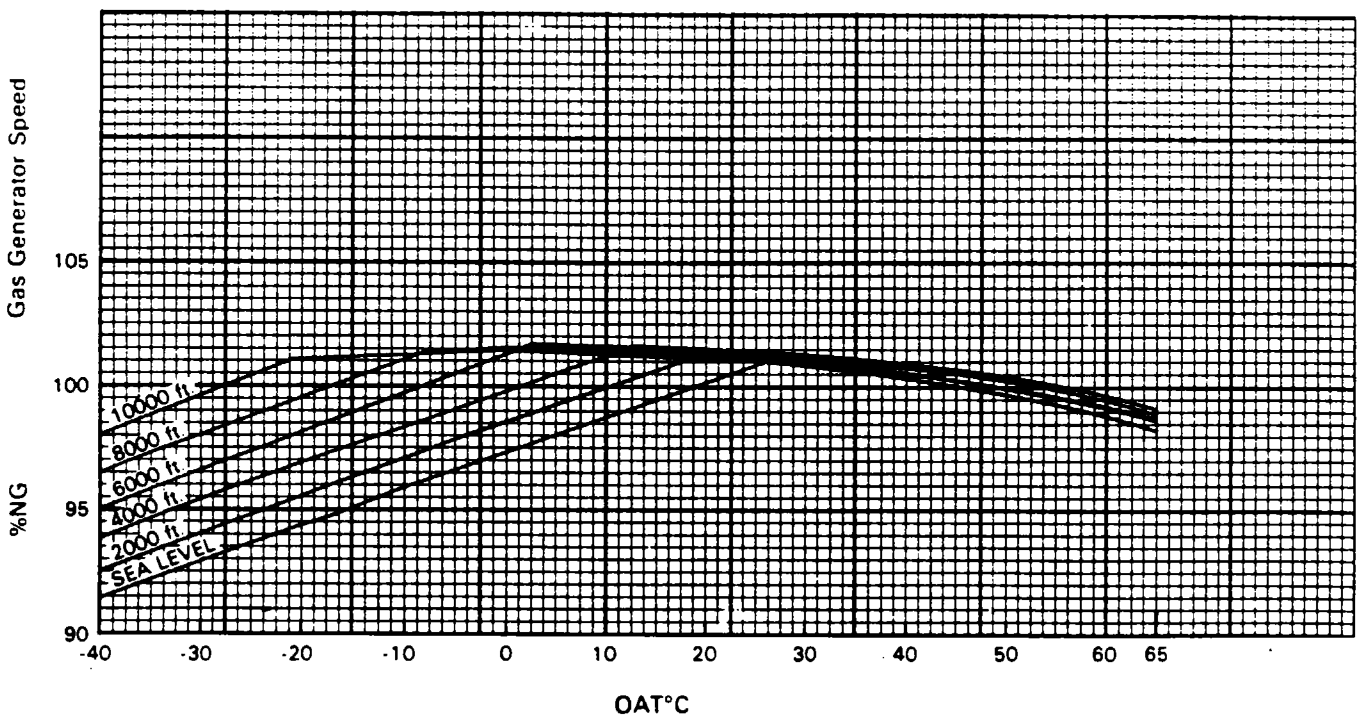


CHART 7605. INTER-TURBINE TEMPERATURE

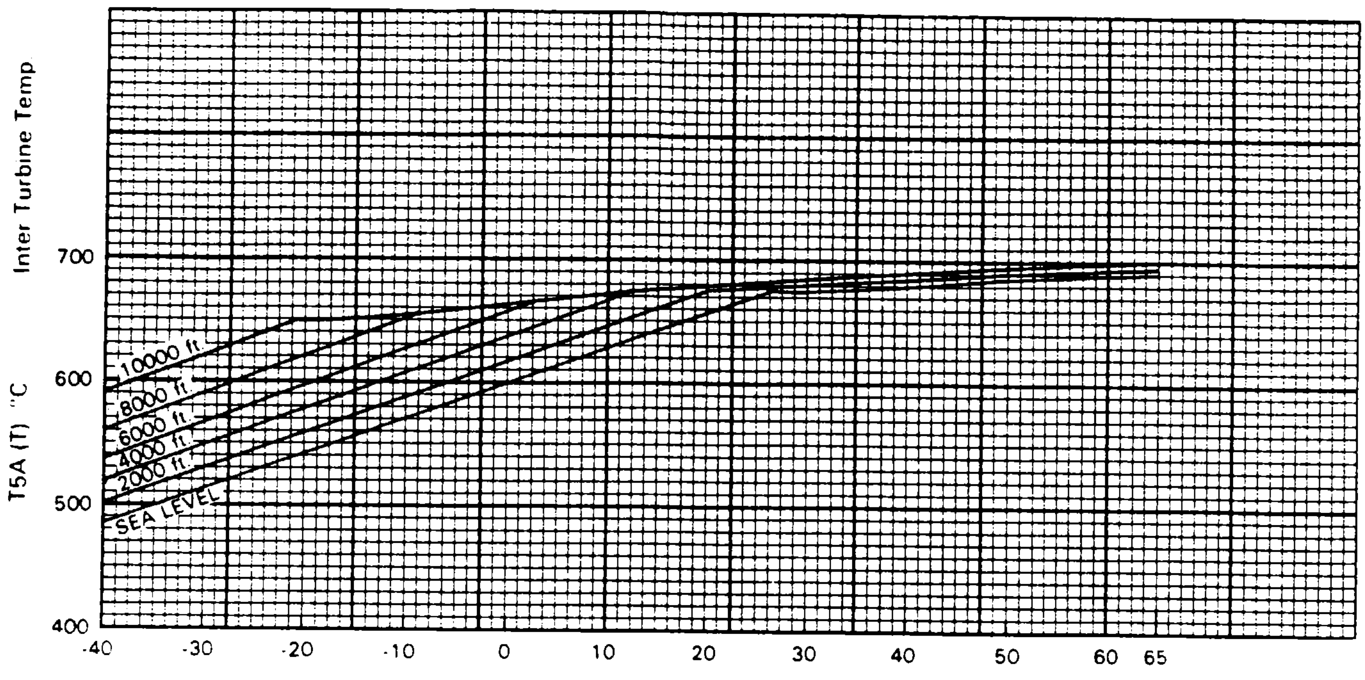
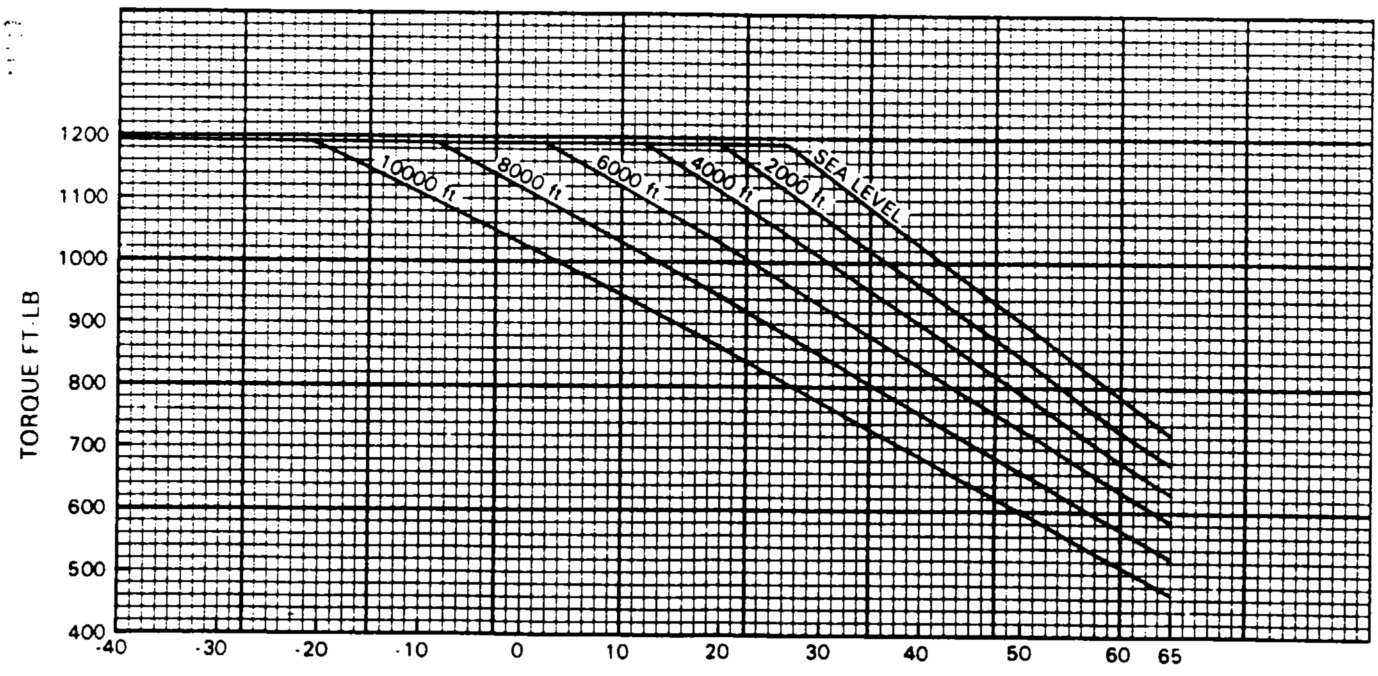


CHART 7606. TORQUE



6. Record and compare observed fuel flow, gas generator speed and inter-turbine temperature with values previously recorded. The values observed must be within the following limits:

A. Fuel flow - do not exceed.
B. Gas generator speed - do not exceed.
C. Maximum inter-turbine temperature not exceeded.

— NOTE —

If temperature is more than 75° C below target temperature, check instrumentation.

It is normal for the fuel flow, ITT and Ng to be below the chart value, but should not exceed it.

7. If engine performance deviates from the preceding limits, refer to Pratt and Whitney Engine Maintenance Manual, P/N 3030442.

— NOTE —

The importance of monitoring the performance of an engine throughout its history cannot be overemphasized. The Aircraft Gas Turbine Operation Information Letter, No. 18, has been devised by Pratt and Whitney Aircraft of Canada, Ltd., and should be consulted to aid in monitoring the engine performance trend.

— END —

CHAPTER

77

ENGINE INDICATING

CHAPTER 77 - ENGINE INDICATING

TABLE OF CONTENTS/EFFECTIVTIY

GENERAL.

This chapter pertains to the components and related systems which are used to indicate engine operation.

POWER.

TORQUE PRESSURE INDICATING SYSTEM (BENDIX).

DESCRIPTION.

The torque pressure indicating system consists of a pressure transducer mounted at (or beside) the reduction gearbox case, and a torque indicator mounted in the instrument panel. The torque value is obtained from the pressure transducer which monitors the pressure differential between reduction gearbox case and outside ambient temperature.

CALIBRATION. (Refer to Figure 77-1.)

The torque indicating system can be calibrated by the low and high adjustments on the rear of the indicator. The tranducer, P N 29287-02 requires no adjustments. Proceed to calibrate the torque indicating system as follows:

1. Remove the torque pressure transducer from the reduction gear box case.
2. Connect a suitable pressure test unit with a calibrated gauge to the pressure transducer using appropriate AN fittings and pressure hose. The pressure tester must be capable of providing and monitoring pressures from 0 to 60 psi using engine oil. Take steps to insure that no air is trapped in the connecting hose or transducer prior to calibration.
3. Reconnect the engine electrical harness to the transmitter and turn the aircraft master switch ON.

— NOTE —

A dead-weight pressure test unit or a Barfield pressure test unit should be used to simulate engine torque pressure. These units must have been calibrated to NBS specifications within six months prior to use. The pressure outlet from the test unit must be on the same level as the high pressure inlet on the transducer during calibration check procedure.

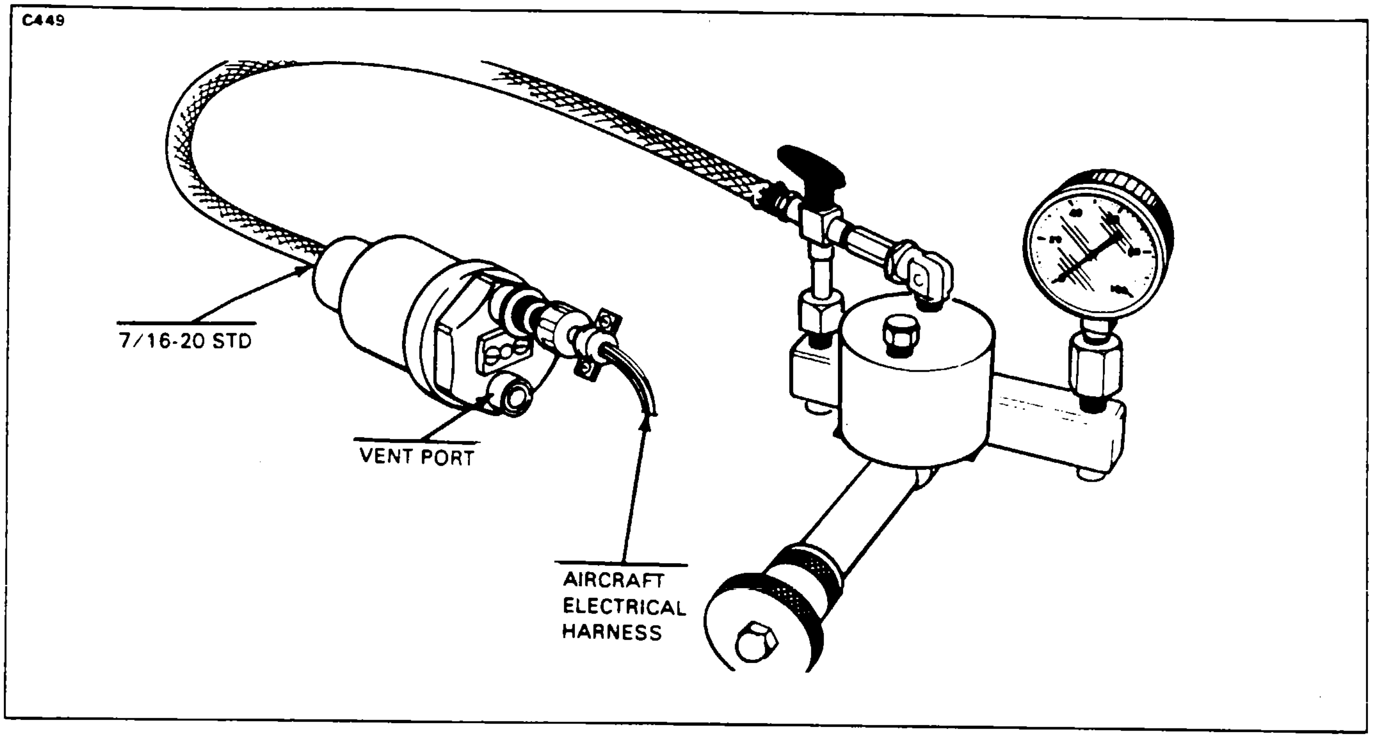


Figure 77-1. Torque System Calibration (Bendix)

THIS SPACE INTENTIONALLY LEFT BLANK

CHART 7701. BENDIX TORQUE SYSTEM CALIBRATION DATA

PSI	FT-LBS	FT LBS TOLERANCE
0	0	+25
3.27	100	+25
6.54	200	+25
9.81	300	+25
13.08	400	+25
16.36	500	+15
19.63	600	+10
22.90	700	+ 5*
26.17	800	+10
29.44	900	+15
32.71	1000	+15
35.98	1100	+15
39.25	1200	+10*
42.52	1300	+15
45.80	1400	+20
49.07	1500	+25
52.34	1600	+25
55.61	1700	+25
58.88	1800	+25

NOTE: Calibration and tolerance with 29287 transducer and indicator are as noted above. Adjust both the low and high end of the scale. Adjust for minimum error at points indicated by an *

4. Adjust pressure tester to 22.9 psi and adjust low setting on gauge to 700 foot pounds. Apply 39.25 psi and adjust high setting to 1200 foot pounds.
5. After making the Low (L) and High (H) adjustments on the indicator, recheck to see that both adjustments remained within the tolerance allowed. (Refer to Chart 7701.)
6. After successful completion of 700 foot pound (L) and 1200 foot pound (H) adjustments to indicator, check from 100 to 1800 foot pounds at 100 foot pounds increments. Adjust to minimize error.
7. If necessary, repeat steps 4, 5 and 6 to obtain correct torque readings. The indicator adjustments are located on the rear of the indicator. Turn the adjustment accordingly to correct the torque reading.

TORQUE PRESSURE INDICATING SYSTEM (WESTON KULITE).

DESCRIPTION.

Refer to Description under Bendix Torque Pressure Indicating System.

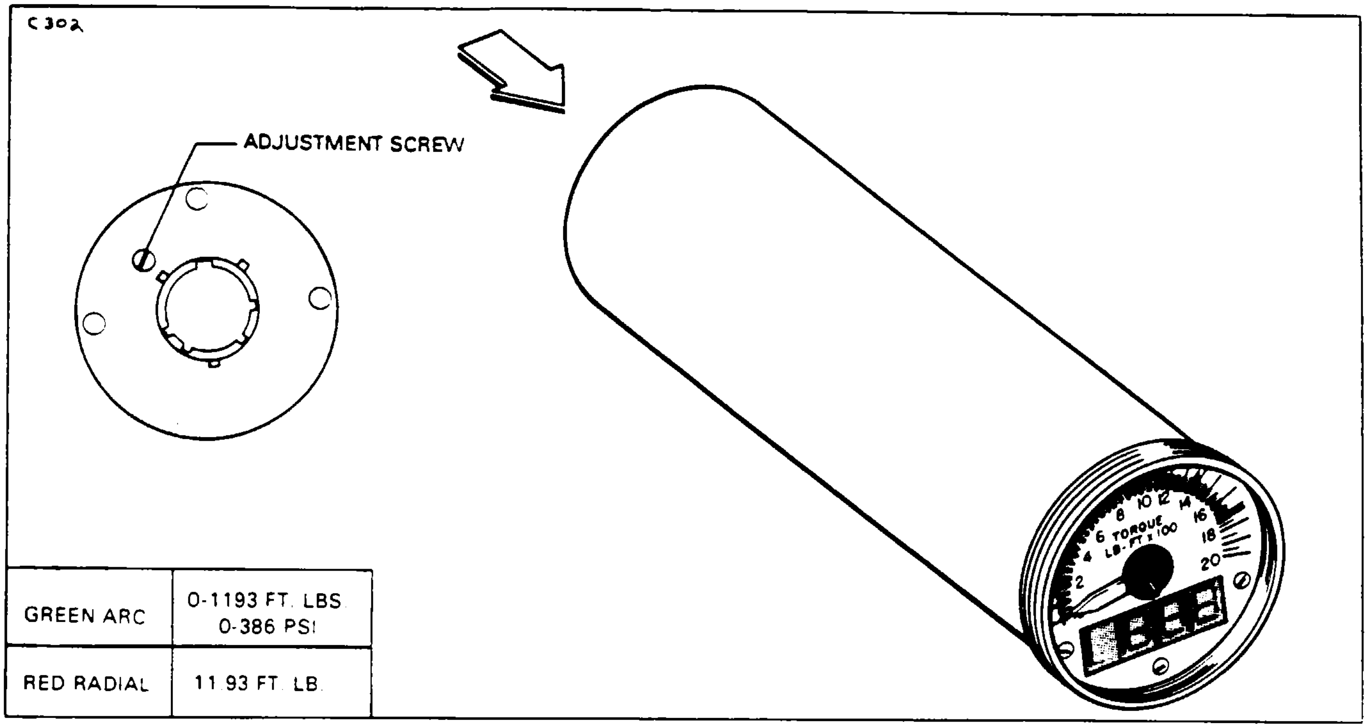
SYSTEM CALIBRATION TEST.

1. Remove the hose from the high pressure port on the transmitter.
2. Connect a suitable pressure system tester to this port, but do not remove the vent line from the transmitter.

— *NOTE* —

A dead-weight pressure test unit or a Barfield pressure test unit should be used to simulate engine torque pressure. These units must have been calibrated to NBS specifications within six months prior to use. The pressure outlet from the test unit must be on the same level as the high pressure inlet on the transducer during calibration check procedure.

3. Attach a 28VDC power source to the external power receptacle.
4. Ascertain that pressure test unit is set at 0 psi.
5. Activate D.C. power source.
6. Increase pressure to the transmitter to 50 psi and check reading. Readings must remain in the tolerances as specified in Chart 7702.
7. If necessary, adjust the gauge to obtain the correct torque readings. The gauge adjustment is located behind the gauge. Turn the adjustment accordingly to correct the torque reading.
8. Decrease pressure to the transmitter to 25 psi and check reading. (Refer to Chart 7702.) If necessary, increase pressure back to 50 psi and adjust indication upwards or downwards in order to obtain an indication at 25 psi that falls within tolerances listed.
9. After completion of adjustments to the gauge at 50 psi, recheck and assure they remain within the tolerances specified in Chart 7702.
10. Check from 0 to 60 psi. Ascertain that all readings remain in tolerances as specified in Chart 7702.
11. If the torque indicating system does not conform to receptable tolerances, the transducer may be tested per the following instructions.



GREEN ARC	0-1193 FT. LBS 0-386 PSI
RED RADIAL	11.93 FT. LB.

Figure 77-2. Digital Analog Torque Calibration

CHART 7702. DIGITAL ANALOG TORQUE CALIBRATION DATA

TEST UNIT PSI	DIGITAL DISPLAY PS50154-3	MAX. ERROR	ANALOG DISPLAY READOUT
0	BLANK	0	NEEDLE MOVEMENT SHALL BE SMOOTH WITH NO JUMPS AND ACCURACY SHALL BE +/- 1.5% OF FULL SCALE
5	153	+ -25	
10	306	+ -25	
15	458	+ -25	
20	611	+ -15	
25	764	+ -10	
30	917	+ -10	
35	1070	+ -10	
40	1223	+ -15	
45	1376	+ -15	
50	1528	+ -15	
55	1681	+ -15	
60	1834	+ -25	

TORQUEMETER TRANSDUCER TEST (WESTON KULITE)

1. Using a D.C. power supply 27.5 VDC to pins A and C of the electrical connector on the transducer.
2. With digital voltmeter, read the voltage output of the transducer on pins B and D versus pressure input in accordance with Chart 7703.
3. If the transducer is within the specified limits and the torque pressure indicating system wiring harness is tested and found to be servicable. The torque pressure gauge should be replaced.

CHART 7703. WESTON KULITE TORQUE PRESSURE INDICATING SYSTEM TRANSDUCER VOLTAGES

$V_{(IN)}$	PSIG	$V_{(OUT)}$	FT LBS (REF)
	0	0 + .070 - .000	0 + -25
	5	.357 + -.046	152.8 + -25
	10	.714 + -.044	305.7 + -25
	15	1.071 + -.044	458.5 + -25
	20	1.428 + -.025	611.4 + -15
	25	1.785 + -.016	764.2 + -10
24-30V	30	2.143 + -.016	917.1 + -10
27.5 Nom.	35	2.500 + -.016	1069.9 + -10
	40	2.857 + -.025	1222.8 + -15
	45	3.214 + -.025	1375.6 + -15
	50	3.571 + -.025	1528.5 + -15
	55	3.928 + - .025	1681.3 + -15
	60	4.286 + -.046	1834.2 + -25
	65	4.643 + -.046	1987.5 + -25
	70	5.000 + -.046	2139.9 + -25

THIS PAGE INTENTIONALLY LEFT BLANK

TACHOMETER-GENERATORS (PROPELLER AND GAS GENERATOR).

DESCRIPTION.

The propeller (Np) and gas generator (Ng) tachometer-generators produce an electric current which is proportional to gas generator and propeller speed. The electric current is monitored by tachometer indicators mounted in the instrument panel which indicate propeller and gas generator speed. The gas generator tachometer-generator is mounted on the backside of the accessory gearbox and rotates counterclockwise. The propeller tachometer-generator is mounted on the right side of the reduction gearbox case and rotates clockwise.

REMOVAL AND INSTALLATION.

1. Disconnect the electrical connector from the generator unit.
2. Remove the four mounting nuts at the base of the generator.
3. Pull the unit straight out and away from the mounting lugs.

— NOTE —

Cover the tach generator mounting pad to prevent contamination from foreign material.

4. To reinstall the generator unit, place a new gasket on the mounting pad.
5. Lubricate the generator unit shaft splines with Molybdenum Disulfide. Type "G", paste form lubricant (MIL-G-21164).
6. With the electrical socket pointing down, slide the generator into place over the mounting studs.
7. Secure the unit in place with the four mounting nuts and torque to 65 to 85 inch pounds.

TEMPERATURE.

INTER-TURBINE TEMPERATURE SENSING SYSTEM (ITT).

The inter-turbine temperature sensing system (T5) is designed to monitor engine operating temperatures at a point between the two turbines (compressor and first-stage power) and provide the pilot with an accurate indication. The system consists of bus-bar assembly, eight individual thermocouple probes in parallel, a harness assembly and an instrument panel mounted indicator. A trim thermocouple is connected in parallel with the T5 harness to provide a consistent T5 temperature by minimizing system readout errors. Refer to Pratt and Whitney Engine Maintenance Manual for detailed information.

The trim thermocouple (T1) consists of chromel/alumel leads encased in a stainless steel tube. This unit has been set by the engine manufacturer and recorded on the engine data plate. The unit, if found defective may only be replaced in the field with a trim harness of the same resistance value.

RESISTANCE CHECK OF I.T.T. SYSTEM.

This check may be performed by using a Turbine Temperature Indicating System Test Set (Barfield 2312G-8, Barfield Inst. Corp., 4101 N. W. 29th St., Miami, Florida 33142) or equivalent. Read the complete test set instruction manual before attempting to use the unit. (Refer to Figures 77-3 and 77-4.)

1. Remove the external leads and trim thermocouple leads from terminal block on gas generator case.
2. Connect test set to alumel and chromel terminals on gas generator case terminal block and measure loop resistance of T5 system. The measured resistance should be between 0.58 and 0.74 ohms.

— CAUTION —

The thermocouples will generate a small potential which will produce errors in the measured values if this check is made while the engine is hot.

— NOTE —

If several probes are broken or damaged, the loop resistance would not necessarily fall outside the allowable tolerance. However, erroneous temperature indications could occur due to reduced sampling. To check for presence of defective probes or harness lead, it is necessary to remove the engine power section assembly. (Refer to Pratt and Whitney Aircraft of Canada, Ltd. Maintenace Manual, Part NO. 3030442, Chapter 72.)

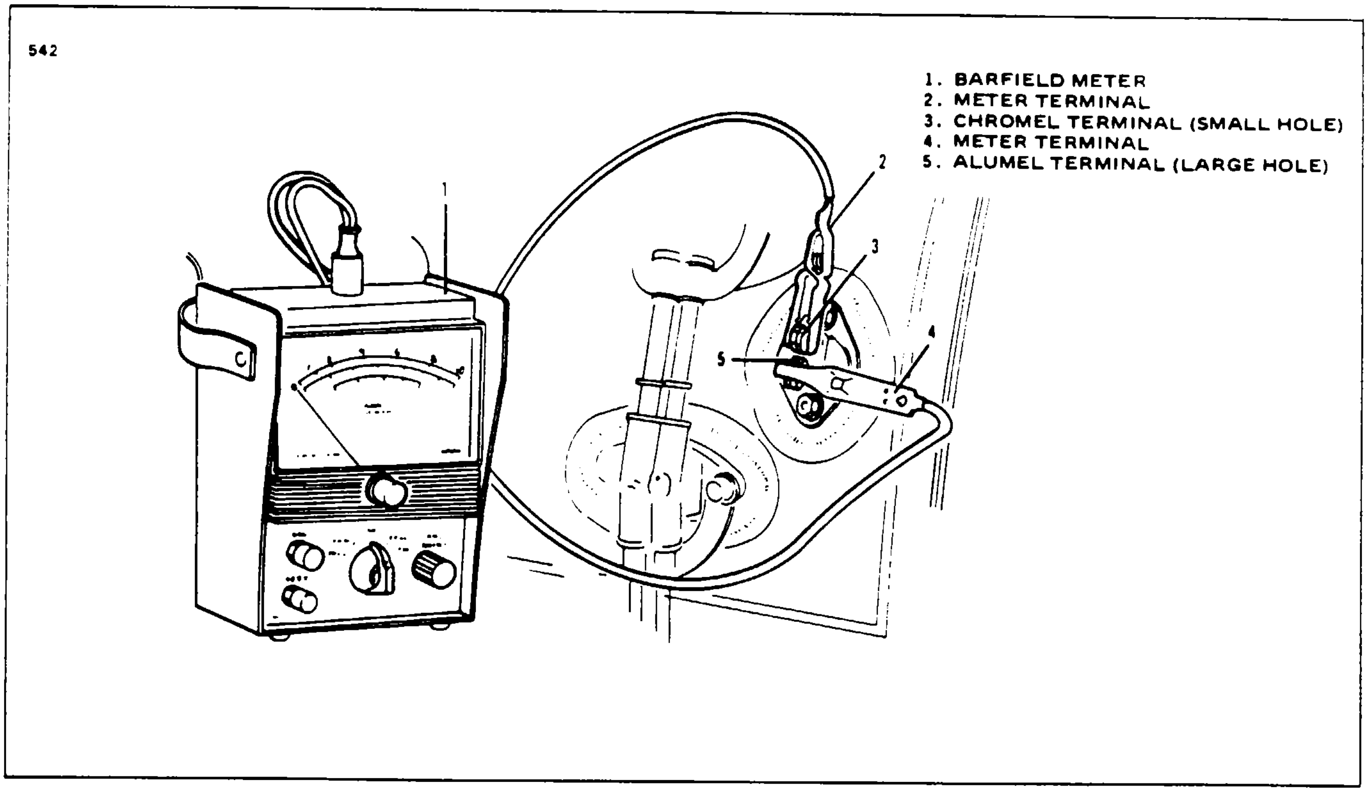


Figure 77-3. T5 Thermocouple Harness Loop Resistance Check

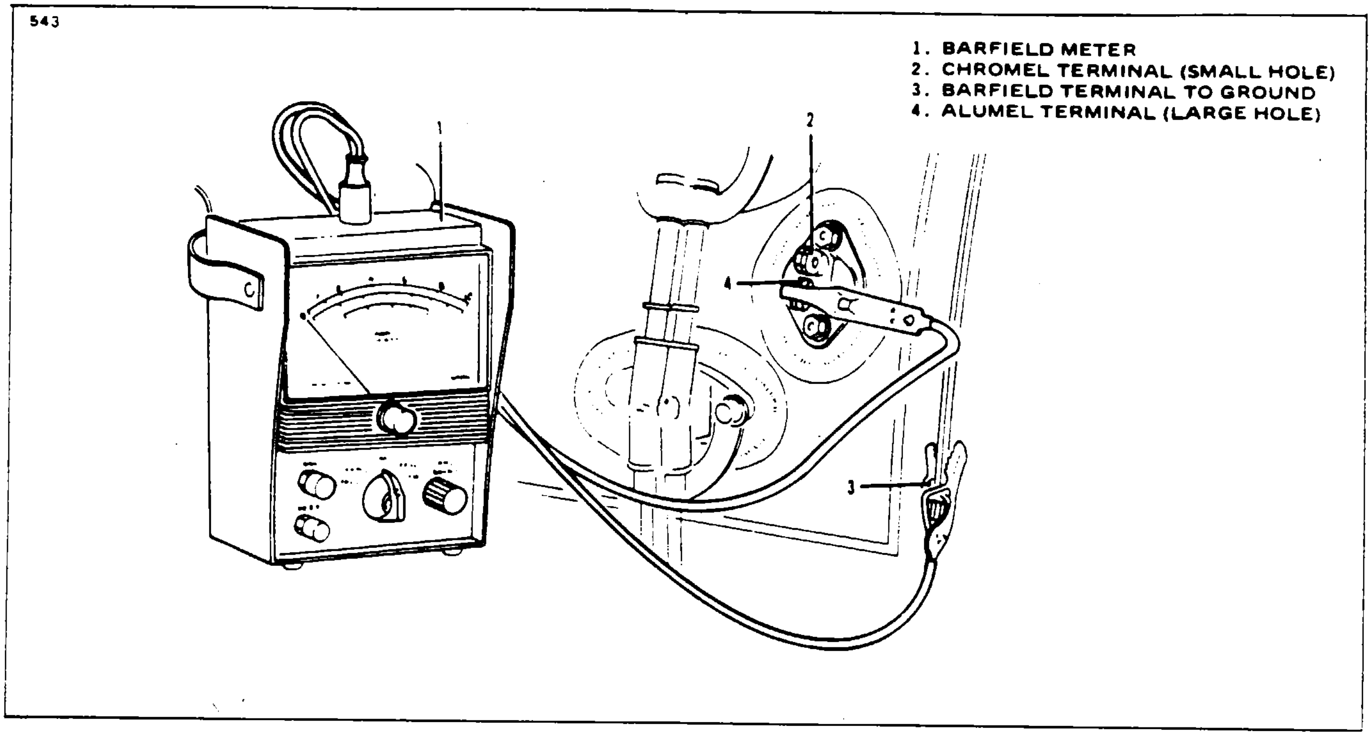


Figure 77-4. T5 Harness Insulation Resistance Check

3. Connect test set leads between either alumel or chromel terminal on terminal block and ground (gas generator case). Measure insulation resistance. The measured insulation resistance must be not less than 5000 ohms.

4. Check the resistance of the aircraft harness with the engine harness disconnected, and the red and yellow wires temporarily bolted together instead of connected to the ITT indicator terminals. The values should be approximately 7.63 + .1 ohms.

— *NOTE* —

Always clean contact surfaces prior to assembly using 400 grit abrasive cloth.

5. Reconnect the external leads and block trim thermocouple leads to the appropriate alumel (AL) and chromel (CR) terminal posts on terminal. Tighten bolts and torque as follows: Torque alumel terminal bolt 10 to 15 inch pounds; torque chromel terminal bolt 8 to 12 inch pounds.

Temperature	mv (Millivolts)	Tolerance
1150 °C	(45.6 mv)	+35 °C −25 °C
1050 °C	(41.9 mv)	+25 °C −15 °C
850 °C	(34.0 mv)	±10 °C
750 °C	(29.9 mv)	±10 °C
700 °C	(27.9 mv)	±10 °C
600 °C	(23.7 mv)	±15 °C
500 °C	(19.5 mv)	±15 °C
400 °C	(15.3 mv)	±25 °C
300 °C	(11.1 mv)	±25 °C

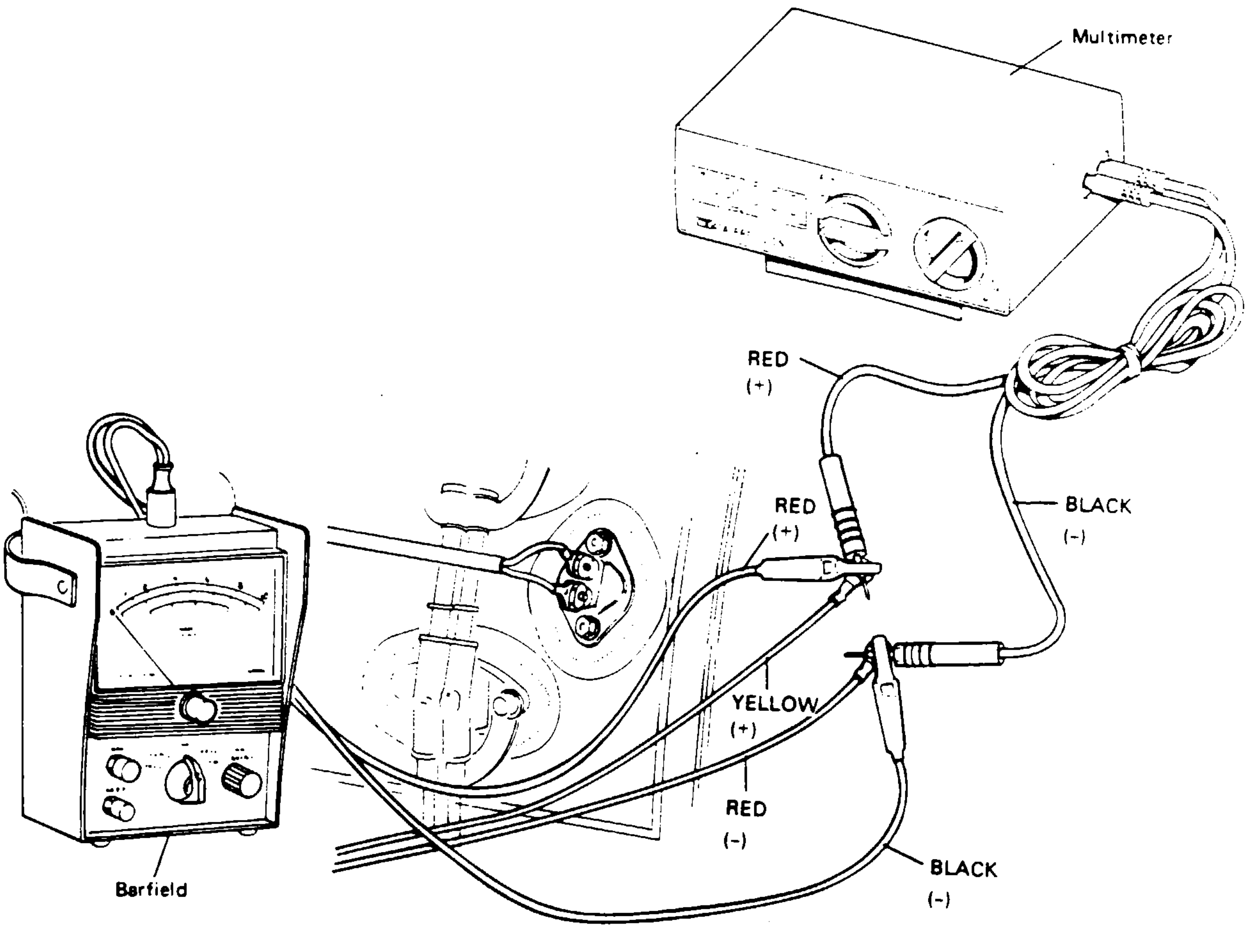


Figure 77-5. Inter-Turbine Temperature Calibration Check

CALIBRATION CHECK OF INTER-TURBINE TEMPERATURE SYSTEM. (Refer to Figure 77-5.)

1. Remove yellow and red wires from the heat probe terminal that go to the ITT gauge.
2. Connect the wires to the Barfield (2312G-8) test set or equivalent, and the Digital Multimeter.
3. Position the Barfield Instrument function switch to Indicate and the Digital Multimeter to DCV and 1 position.
4. Check the ITT gauge for each temperature indication by the following:
   A. While pressing the test switch and turning the calibration adjustment knob on the Barfield instrument, obtain the proper mv (millivolts) indicated on the multimeter for the appropriate temperature given on the chart.
   B. Check each temperature indication and tolerance with the appropriate mv (millivolts).

— END —

CHAPTER

79

OIL SYSTEM

CHAPTER 79 - OIL SYSTEM

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION.

Engine lubrication is provided through a pressure type system. The oil tank being an integral part of the compressor inlet case, also houses the main oil pump. A plunger type of pressure relief valve regulates oil pressure and is secured to the top of the main oil pressure pump. For any particular overhaul or maintenance procedures to the engine, refer to the PT6A-10/110 Maintenance Manual 3030442.

— *NOTE* —

When replacing or repairing any of the aforementioned assemblies or any engine nuts, bolts, or screws; thread lubricant, engine oil or equivalent should be used when obtaining torques.

DISTRIBUTION.

OIL COOLER.

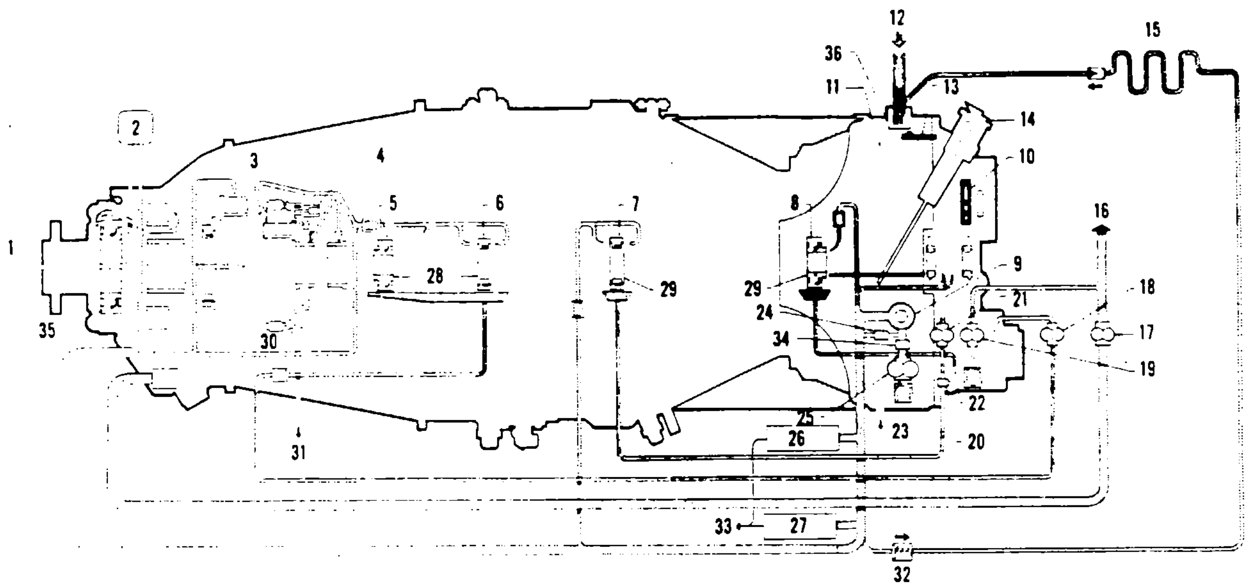
REMOVAL OF OIL COOLER. (Refer to Figures 79-1 and 79-2.)

1. Remove the engine cowling.
2. Remove the access panels on the nacelle.
3. Disconnect the drain lines attached to the oil cooler duct.
4. Disconnect the oil cooler inlet and outlet lines at the oil cooler and cap the lines to prevent contamination.
5. Drain the oil cooler.
6. Remove the attachment hardware connecting the cooler to the duct assembly and firewall and lower the oil cooler from the aircraft.

INSTALLATION OF OIL COOLER. (Refer to Figure 79-2.)

1. Position the oil cooler on the firewall and install the mounting hardware. Install the attachment hardware connecting the oil cooler to the oil cooler duct.
2. Install the hardware securing the lower section of the cowl fire seal assembly to the two upper sections of the fire seal assembly.
3. Attach the drain lines to the oil cooler mounting bolts.
4. Connect the oil cooler inlet and outlet lines to the respective connection on the oil cooler. Install oil cooler drain plug and safety.
5. Perform an engine motoring run to check for oil leaks.
6. Recheck the oil level and fill as required.
7. Install the access panels on the nacelle.
8. Install the engine cowling.

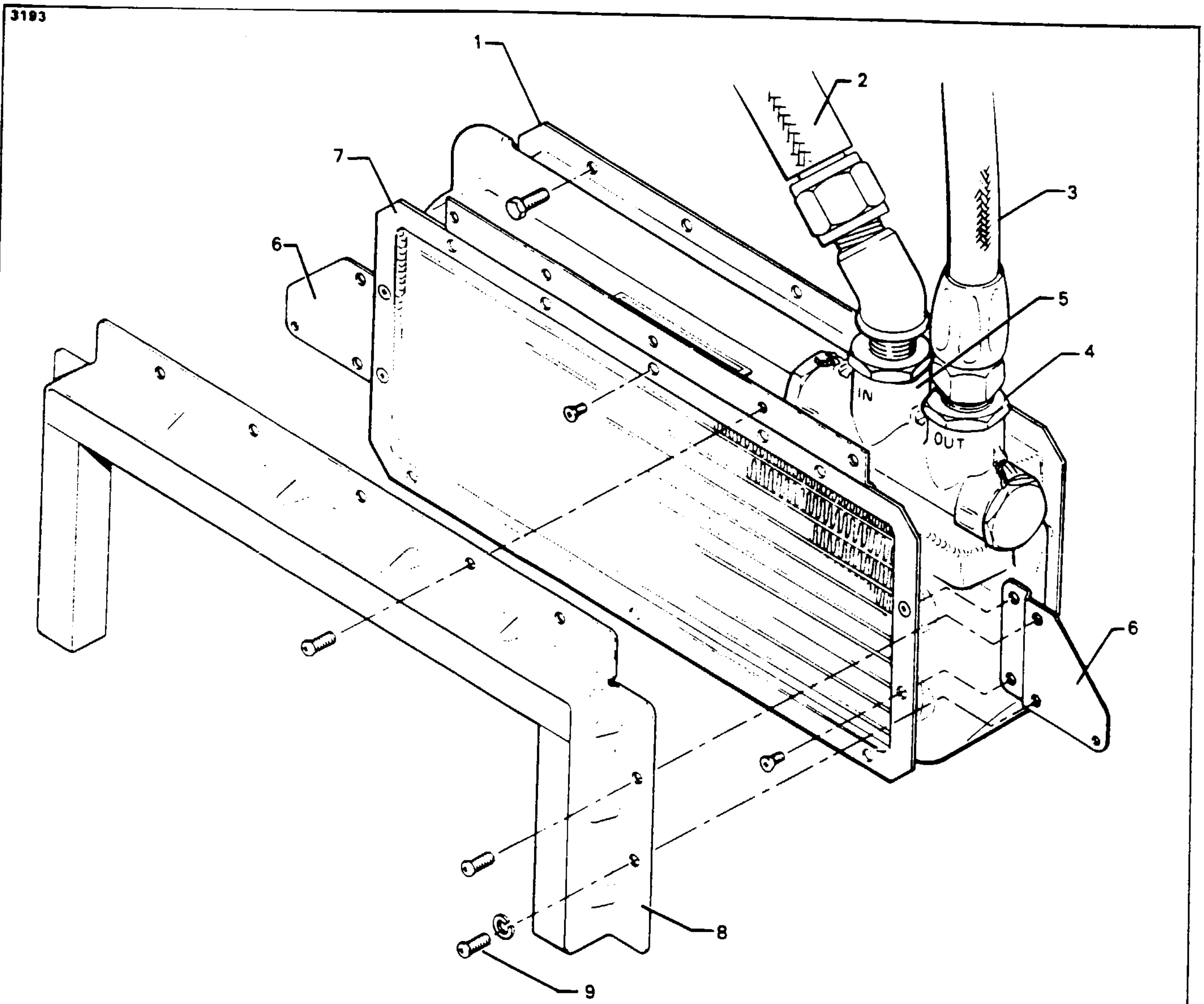
3174



PRESSURE OIL (105-135 PSIG)
DRAIN OIL
PROPELLER PRESSURE OIL
SCAVENGE OIL
BREATHER LINE

1. OIL SUPPLY TO PROPELLER
2. PROPELLER GOVERNOR
3. SPLINES, BEARINGS AND FIRST STAGE REDUCTION GEARS
4. TORQUEMETER OIL CONTROL VALVE
5. NUMBER 4 BEARING
6. NUMBER 3 BEARING
7. NUMBER 2 BEARING
8. NUMBER 1 BEARING
9. OIL FILTER AND CHECK VALVE ASSEMBLY
10. CENTRIFUGAL BREATHER
11. OIL TANK, INTEGRAL
12. RETURN FROM COOLER
13. OIL TANK BREATHER
14. OIL FILLER AND DIPSTICK
15. OIL TO FUEL HEATER
16. TO COOLER
17. REDUCTION CASE SCAVENGE PUMP
18. POWER TURBINE BEARINGS SCAVENGE PUMP
19. ACCESSORY CASE SCAVENGE PUMP
20. BYPASS VALVE
21. NO. 2 SCAVENGE PUMP
22. DRAIN TO ACCESSORY GEARBOX
23. OIL TANK DRAIN
24. FILTER BYPASS VALVE
25. OIL PRESSURE PUMP
26. OIL PRESSURE TRANSMITTER
27. OIL TEMPERATURE BULB
28. POWER TURBINE BEARINGS
29. COMPRESSOR BEARINGS
30. TORQUEMETER
31. TO TORQUEMETER PRESS. IND.
32. MINIMUM PRESSURIZING VALVE
33. TO COCKPIT INSTRUMENTS
34. RELIEF VALVE RETURN TO OIL TANK
35. THRUST BEARING
36. DEAERATOR

Figure 79-1. Engine Oil System Installation



1. OIL COOLER
2. OIL COOLER INLET HOSE
3. OIL COOLER OUTLET HOSE
4. OIL COOLER OUTLET
5. OIL COOLER INLET
6. SUPPORT FOR DRAIN LINES
7. OIL COOLER NUT PLATE ASSEMBLY
8. OIL COOLER INLET HOOD ASSEMBLY
9. MACHINE SCREW AND LOCK WASHER

Figure 79-2. Oil Cooler Installation

OIL FILTER ELEMENT MAINTENANCE. (Refer to Figure 79-3.)

In aircraft with a typical utilization of fifty hours per month or less, the element must be cleaned every 400 hours or 9 months, whichever comes first. Remove, clean, and reinstall the element as follows:

1. Remove the oil filter element by removing the four self-locking nuts and plain washers that secure the filter cover to the right side of the compressor inlet case at the 3 o'clock position.
2. Remove the filter cover, O-ring and teflon spacer (teflon spacer should only be removed if disengaged). Discard the O-ring.
3. Using oil filter element puller (P/N CPWA 30556), withdraw the filter element from the filter body and discard the O-ring from the element.
4. Agitate filter element for five minutes in clean, unused petroleum solvent (Specification AMS 3160).
5. To dry filter element, allow to stand in clean area and air dry.

— NOTE —

If the above method proves ineffective the filter may be electrosonically cleaned as described in Chapter 12, Servicing Oil Filter Elements.

6. Visually inspect filter element for foreign matter. Use a magnifying glass and inspect the element for clogged passages and broken wires. If more than five percent of the element remains clogged after cleaning, return to an overhaul facility. If dents or broken wires are found, replace the element.

— NOTE —

The filter element must be cleaned and inspected at an overhaul facility using the approved equipment every 1000 hours or 30 months whichever comes first, before the filter may be reused.

7. Install the filter element in reverse order of removal (perforated flange first) using new O-rings. Insure that teflon spacer is in position on lugs of filter cover. Install cover and secure with four plain washers and self-locking nuts. Torque nuts 24 to 36 inch pounds.

OIL COOLER EXHAUST DOOR.

REMOVAL OF OIL COOLER DOOR TRANSMISSION. (Refer to Figure 79-4.)

1. Remove the access panels on the nacelle to gain access to the transmission assembly.
2. Extend the oil cooler door to its full open position.
3. Disconnect the electrical leads from the transmission and motor assembly.

— NOTE —

In some manner identify the leads to facilitate installation.

4. Disconnect the transmission rod from the oil cooler door and remove the sleeve, jam nut, spring, spacer, and seal from the transmission rod.
5. Disconnect the transmission from the fire wall mounting bracket and remove the complete assembly from the aircraft.

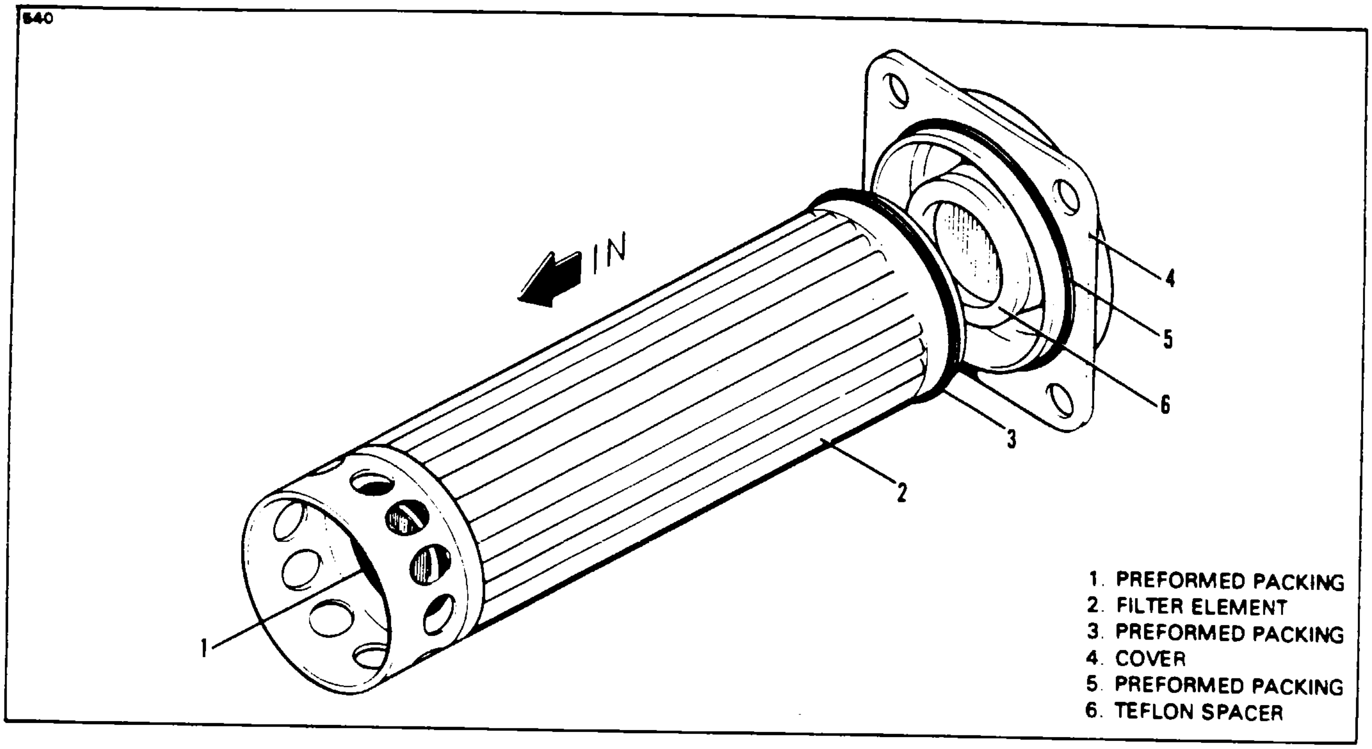
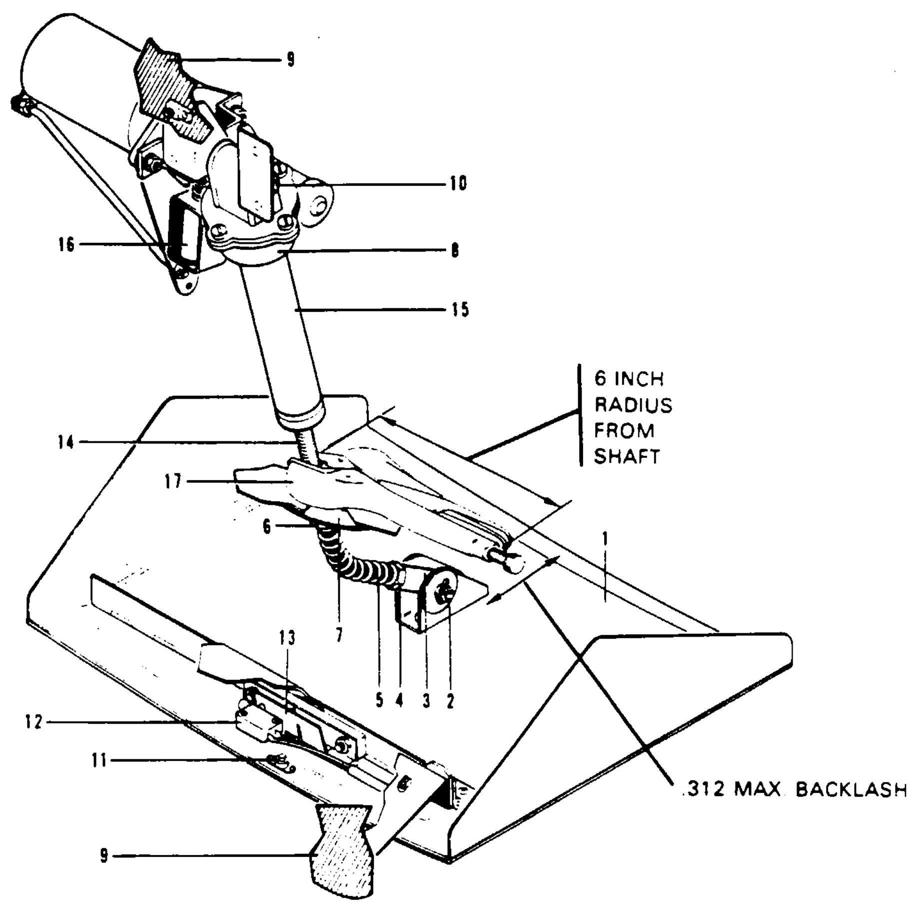


Figure 79-3. Oil Filter Assembly

CLEANING, INSPECTION AND REPAIR OF OIL COOLER DOOR TRANSMISSION.

1. Remove access panel on top of engine nacelle.
2. Position oil cooler door in the open position by activating the switch in the overhead panel.
3. Clean the transmission assembly with a suitable solvent.
4. Inspect the transmission screw shaft for back lash by the following procedure:
   A. Disconnect transmission from Oil Cooler Door.
   B. Clamp a pliers (vise grips) using a light pressure on the transmission screw shaft. (Refer to Figure 79-4.)
   C. Rotate the screw shaft by moving the pliers. A slight movement should be felt, but not to exceed .312 (5/16) of an inch on a 6 inch radius from the shaft.
5. Check transmission sleeve, screw shaft and rod end for distortion.
6. Check brake solenoid assembly for any excessive wear, broken parts, and sticking or burned out solenoid.
7. After the transmission screw shaft and sleeve have been cleaned and dried, a coating of Aircraft Actuator Grease (MIL-G-23827) should be applied to the transmission screw shaft.
8. When the transmission assembly is disassembled for any reason, it should be repacked 75 percent full with Dukes grease (P/N 219674-1).

1367



1. OIL COOLER EXHAUST DOOR
2. BOLT ASSEMBLY
3. ROD END
4. JAM NUT
5. SPRING
6. SPACER
7. SEAL
8. TRANSMISSION ASSEMBLY
9. FIRE WALL
10. BOLT ASSEMBLY
11. SET SCREW
12. SWITCH
13. HINGE ASSEMBLY
14. TRANSMISSION SCREW SHAFT
15. TRANSMISSION SLEEVE
16. BRAKE SOLENOID
17. CLAMP PLIERS

Figure 79-4. Oil Cooler Door Installation

INSTALLATION OF OIL COOLER DOOR TRANSMISSION. (Refer to Figure 79-4.

1. Position the transmission assembly in the mounting bracket with rod protruding through the oil cooler duct and secure with the proper attachment hardware. Allow the transmission to rotate on its mounting bracket.
2. Connect the electrical leads to the transmission assembly.
3. Place the seal, spacer, and spring on the transmission rod. Screw the jam nut and sleeve on the rod.
4. Connect the transmission rod to the oil cooler door with the attachment hardware.
5. Adjust the oil cooler door.

ADJUSTMENT OF THE OIL COOLER DOOR. (Refer to Figure 79-4.)

1. Adjust the sleeve on the transmission rod so the oil cooler door is flush with the bottom of the nacelle in the fully closed position.
2. Adjust the set screw on the oil cooler door to activate the limit switch just before the door is fully open.
3. Check all attachment hardware for proper installation and security.
4. Check the operation of the oil cooler doors and indicator lights through a complete opening and closing cycle.

OIL-TO-FUEL HEATER. (Refer to Figure 79-5.)

The oil-to-fuel heater is a heat exchanger which uses heat from the engine lubricating oil system to preheat the fuel for the fuel system. The assembly, mounted to the rear engine flange, is also interconnected with the diverter valve and oil tank.

The oil-to-fuel heater consists of a honeycomb two-pass oil circuit and fuel circuit, and a thermostatic valve. The thermostatic valve regulates the fuel temperature by either allowing oil to flow through the heating circuit or by passing it back to the engine oil tank.

A minimum pressurizing valve, connected by rigid tubing to the inlet side of the oil-to-fuel heater oil circuit, closes at approximately 40 psig to prevent oil flow to the heater when the engine is shutdown in flight.

REMOVAL OF OIL-TO-FUEL HEATER. (Refer to Figure 79-5.)

1. Disconnect coupling nut of oil tube from elbow on oil-to-fuel heater and cap tube.
2. Disconnect fuel inlet and outlet hoses from oil-to-fuel heater.
3. Remove the bolts which secure retaining plate to adapter on compressor inlet case and remove plate.
4. Remove self-locking nuts and washers which secure oil-to-fuel heater to flange. Remove oil-to-fuel heater.

INSPECTION OF OIL-TO-FUEL HEATER.

— *NOTE* —

Cracks are not permissible. Minor defects may be repaired as described in the Pratt and Whitney Engine Maintenance Manual, P/N 3030442, Chapter 73.

1. Visually inspect mounting lugs and body weldment for cracks and other defects.
2. Inspect all bores, bosses, and threads for damage, corrosion, or cracks.
3. Check for proper installation of helical coil inserts located at the fuel outlet port and boss adjacent to the oil inlet port.
4. Check for security of identification label.
5. Check condition of paint finish. Unpainted and damaged areas should be repainted.

INSTALLATION OF OIL-TO-FUEL HEATER. (Refer to Figure 79-5.)

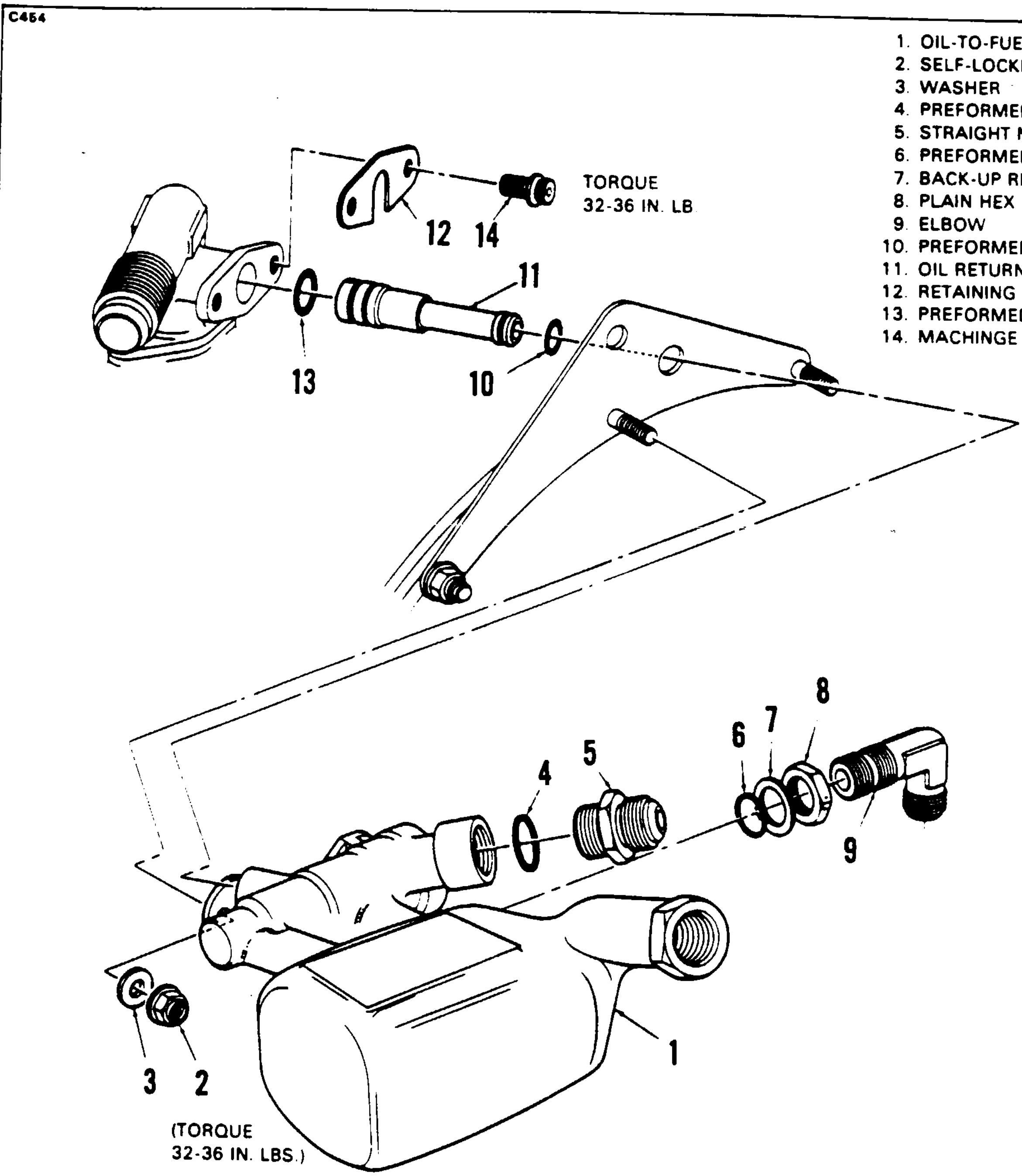
1. If the oil return check valve was previously removed install new preformed packings.
2. Position oil-to-fuel heater on studs of flange on accessory gear box.
3. Insert smaller diameter end of check valve through large hole of rear lifting bracket and into boss or mating flange of heater.
4. Insert large diameter of check valve into boss on oil return adapter as the heater is seated on rear face of rear lifting bracket.
5. Locate retaining plate over check valve and secure. Tighten bolts 32-36 in. lbs. and safety.
6. Secure heater with washers and self-locking nuts. Torque 32-36 in. lbs.
7. Connect all fuel and oil lines and safety wire.

INDICATING.

CALIBRATION OF ENGINE OIL PRESSURE INDICATING SYSTEM.

Check the calibration of the engine oil pressure indicating system as follows:

1. Connect a Barfield pressure tester set with a calibrated test gauge to the oil transmitter using the appropriate AN fitting and pressure line. (The test set must be capable of providing and monitoring static pressures from 0 to 160 psi using engine oil.)



1. OIL-TO-FUEL HEATER
2. SELF-LOCKING WASHER
3. WASHER
4. PREFORMED PACKING
5. STRAIGHT NIPPLE
6. PREFORMED PACKING
7. BACK-UP RING
8. PLAIN HEX NUT
9. ELBOW
10. PREFORMED PACKING
11. OIL RETURN CHECK VALVE
12. RETAINING PLATE
13. PREFORMED PACKING
14. MACHINGE BOLT

NOTE

TORQUE FUEL OUTLET HOSE COUPLING NUT 270-300 IN. LBS.
TORQUE COUPLING NUT OF OIL TUBE (FROM INLET) CHECK VALVE TO ELBOW FITTING) 90-100 IN. LBS.
LOCKWIRE ALL CONNECTIONS.

Figure 79-5. Oil-to-Fuel Heater Installation

2. Turn the aircraft master switch on.
3. Allow fittings to remain loose and position valve towards line.
4. Turn handle counterclockwise until air is bled from line (oil should drip from line). Tighten fitting.
5. Turn valve towards reservoir and turn handle counterclock wise.
6. Turn valve towards line and turn handle clockwise again to attain a high pressure of 135 psi.
7. Compare test gauge reading with oil pressure gauge reading.
8. Turn handle counterclockwise for a low pressure of 105 psi.
9. Again compare test gauge reading with oil pressure gauge reading.

— NOTE —

Test gauge may need tapping to reduce frictional errors.

10. Begin checking oil pressure system by following the values in Chart 7901 keeping within the tolerances stipulated.
11. After completing test, turn tester valve to neutral (perpendicular to the line) and disconnect tester.
12. Reconnect any lines previously removed.

CHART 7901. OIL PRESSURE GAUGE CALIBRATION DATA

PSI	TOLERANCE
50	0-60 psi = ± 5 psi
60	
80	60-120 psi = ±3 psi
105	
120	120-200 psi= ±5 psi
135	
155	

— END —

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

80

STARTING

FOR INFORMATION ON THE STARTER/GENERATOR. REFER TO CHAPTER 24, ELECTRICAL POWER.

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.

THIS SPACE INTENTIONALLY LEFT BLANK

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
Engine Fuel	Refer to Pratt & Whitney, Aircraft of Canada, Ltd. Service Bulletin No. 12044		
Epoxy Patching Compound		Solarite #400	Solar Compounds Corp.
Gasket Cement		Permatex No. 2	Permatex Company, Inc.
Grease, Actuator		2196-74-1	Dukes Astronautics Co.
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.

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, Aircraft Instrument, Gear and Actuator Screw (cont.)		Aeroshell Grease 7A	Shell Oil Corporation
		Royco 78	Royal Lubricants Company
		L-1212	Sinclair Refining Co.
		1916 Uni-Temp. Grease	California Texas Oil Corporation
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, Daring 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	Marfak 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

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, High Temperature	MIL-G-3545	High Temp. Grease, Marfak All Purpose	Texaco Incorporated
		Shellaire Grease HT Alvania E.P. Grease 2 Aeroshell Grease 5	Shell Oil Company
		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 II	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

CHART 9101. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, Lubricating, Plug Valve, Gasoline and Oil Resistant (cont.)	MIL-G-6032	L-237	Lehigh Tenneco Chemicals Co., Inc.
		Rockwell 950	Rockwell International
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 1	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 1 1/2 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
Britannic 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. 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		Torque Limits in-lbs	
	Min.	Max.	Min.	Max.
8 -32	12	15	7	9
10 -24	20	25	12	15
1/4-20	40	50	25	30
5/16-18	80	90	48	55
3/8-16	160	185	95	110
7/16-14	235	255	140	155
1/2-13	400	480	240	290
9/16-12	500	700	300	420
5/8-11	700	900	420	540
3/4-10	1,150	1,600	700	950
7/8- 9	2,200	3,000	1,300	1,800
1 -8	3,700	5,000	2,200	3,000
1-1/8-8	5,500	6,500	3,300	4,000
1-1/4-8	6,500	8,000	4,000	5,000

PPS 20015E

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
				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. FT.	28.320 1.728 7.481 28.32	CU. CM. CU. IN. U.S. GAL. LITERS
CU. IN.	16.39 0.01639 0.004329 0.01732	CU. CM. LITERS U.S. GAL. QUARTS
CU. METERS	1000000 35.314 61.023 264.17 999.97	CU. CM. CU. FT. CU. IN. GAL. LITERS
FEET	0.3048 12.000 304.8 0.3333	METERS MILS. MM. YARDS
FT.-LB.	0.1383 0.001285 0.000000376	M-KG BTU KW-HR
FLUID OZ.	8 29.6	DRAM CU. CM.
GAL., IMPERIAL	277.4 1.201 4.546	CU. IN. U.S. GAL. LITERS
GAL., U.S. DRY	268.8 0.1556 1.164 4.405	CU. IN. CU. FT. U.S. GAL., LIQ. LITERS
GAL., U.S. LIQ.	231.0 0.1337 3.785 0.8327 128	CU. IN. CU. FT. LITERS IMPERIAL GAL. FLUID OZ.
IN.	2.540 .08333	CM. FT.
JOULES	0.000948 0.7376	BTU FT.-LB.

MULTIPLY	BY	TO OBTAIN
KILOGRAMS	2.205 35.27 1000	LB. OZ. GRAMS
LITERS	1000 61.03 0.03532 0.2642 0.22 1.057	CU. CM. CU. IN. CU. FT. U.S. GAL. IMPERIAL GAL. QUARTS
METERS	39.37 3.281 1000	IN. FT. MM.
METER-KILOGRAM	7.233 9.807	FT.-LB. JOULES
OUNCES, AVDP	0.0625 28.35 437.5	LB., AVDP GRAMS GRAINS
OUNCES, FLUID	29.57 1.805	CU. CM. CU. IN.
LB., AVDP	453.6 7000 16.0	GRAMS GRAINS OUNCES
SQUARE INCH	6.4516	SQ. CM.
POUND PER SQUARE INCH (PSI)	0.0703	KG-CM SQUARED
STATUTE MILE	1.609 0.8684	KILOMETER NAUTICAL MILE
NAUTICAL MILE	1.151	STATUTE MILE
QUART	.9463	LITER
MILLIMETER	1000	MICRON
MICRON	0.001 0.000039	MILLIMETER INCH
INCH POUNDS	11.521	METER GRAMS
INCH OUNCES	0.72	METER GRAMS
POUNDS	0.453	KILOGRAMS

CHART 9107. CONVERSION TABLES (cont.)

CENTIGRADE - FAHRENHEIT CONVERSION CHART

Example: To convert 20°C. to Fahrenheit, find 20 in the center column headed (F—C); then read 68.0°F. in the column (F) to the right. To convert 20°F. to Centigrade; find 20 in the center column and read -6.67°C. in the (C) column to the left.

C	F—C	F	C	F—C	F
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
-45.6	-50	-58.0	115.56	240	464.0
-40.0	-40	-40.0	121.11	250	482.0
-34.0	-30	-22.0	126.67	260	500.0
-38.9	-20	-4.0	132.22	270	518.0
-23.3	-10	14.0	137.78	280	536.0
-17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
27.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
38.89	120	248.0	210.00	410	770.0
54.44	130	266.0	215.56	420	788.0
60.00	140	284.0	221.11	430	806.0
65.56	150	302.0	226.67	440	824.0
71.00	160	320.0	232.22	450	842.0
76.67	170	338.0	257.78	460	860.0
82.22	180	356.0	243.33	470	878.0
87.78	190	374.0	248.89	480	896.0
93.33	200	392.0	254.44	490	914.0
98.89	210	410.0	260.00	500	932.0

CHART 9107. CONVERSION TABLES (cont.)

INCHES TO MILLIMETER

INCHES	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
					MILLIMETER					
0.000		0.0025	0.0050	0.0076	0.0101	0.0127	0.0152	0.0177	0.0203	0.0228
0.001	0.0254	0.0279	0.0304	0.0330	0.0355	0.0381	0.0406	0.0431	0.0457	0.0482
0.002	0.0508	0.0533	0.0558	0.0584	0.0609	0.0635	0.0660	0.0685	0.0711	0.0736
0.003	0.0762	0.0787	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	0.0990
0.004	0.1016	0.1041	0.1066	0.1092	0.1117	0.1143	0.1168	0.1193	0.1219	0.1244
0.005	0.1270	0.1295	0.1320	0.1346	0.1371	0.1397	0.1422	0.1447	0.1473	0.1498
0.006	0.1524	0.1549	0.1574	0.1600	0.1625	0.1651	0.1676	0.1701	0.1727	0.1752
0.007	0.1778	0.1803	0.1828	0.1854	0.1879	0.1905	0.1930	0.1955	0.1981	0.2006
0.008	0.2032	0.2057	0.2082	0.2108	0.2133	0.2159	0.2184	0.2209	0.2235	0.2260
0.009	0.2286	0.2311	0.2336	0.2362	0.2387	0.2413	0.2438	0.2463	0.2489	0.2514

INCHES	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
					MILLIMETER					
0.00		0.025	0.050	0.076	0.101	0.127	0.152	0.177	0.203	0.228
0.01	0.254	0.279	0.304	0.330	0.355	0.381	0.406	0.431	0.457	0.482
0.02	0.508	0.533	0.558	0.584	0.609	0.635	0.660	0.685	0.711	0.736
0.03	0.762	0.787	0.812	0.838	0.863	0.889	0.914	0.939	0.965	0.990
0.04	1.016	1.041	1.066	1.092	1.117	1.143	1.168	1.193	1.219	1.244
0.05	1.270	1.295	1.320	1.346	1.371	1.397	1.422	1.447	1.473	1.498
0.06	1.524	1.549	1.574	1.600	1.625	1.651	1.676	1.701	1.727	1.752
0.07	1.778	1.803	1.828	1.854	1.879	1.905	1.930	1.955	1.981	2.006
0.08	2.032	2.057	2.082	2.108	2.133	2.159	2.184	2.209	2.235	2.260
0.09	2.286	2.311	2.336	2.362	2.387	2.413	2.438	2.463	2.489	2.514

INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
					MILLIMETER					
0.0		0.254	0.508	0.762	0.016	1.270	1.524	1.778	2.032	2.286
0.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
0.2	5.080	5.334	5.588	5.842	6.096	6.350	6.604	6.858	7.112	7.366
0.3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
0.4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
0.5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
0.6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
0.7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
0.8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
0.9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

INCHES	0.00	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
					MILLIMETER					
0.		2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86
1.	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26
2.	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66
3.	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06
4.	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46
5.	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86
6.	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.26
7.	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66
8.	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06
9.	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46

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

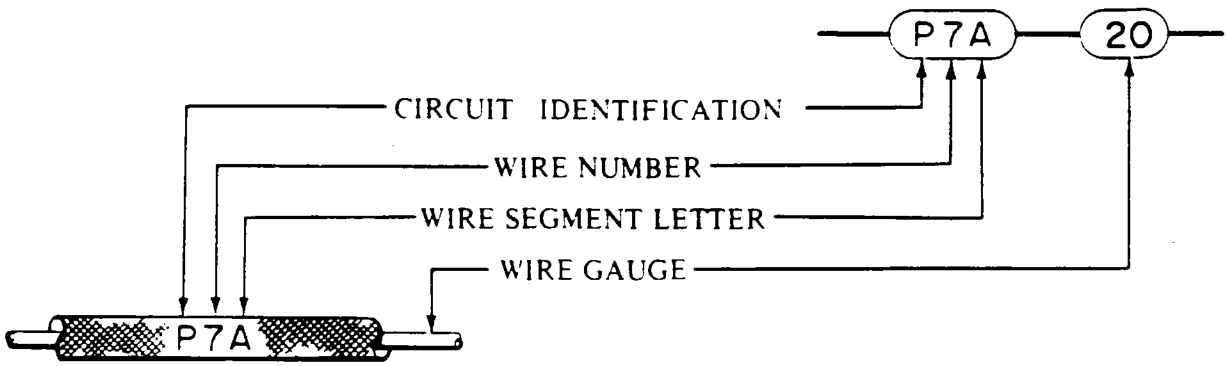
Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.
1/2	0.500	12.7000	G	0.261	6.6294	5/32	0.1562	3.9687	51	0.067	1.7018
31/64	0.4843	12.3031	F	0.257	6.5278	23	0.154	3.9116	52	0.0635	1.6129
15/32	0.4687	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.

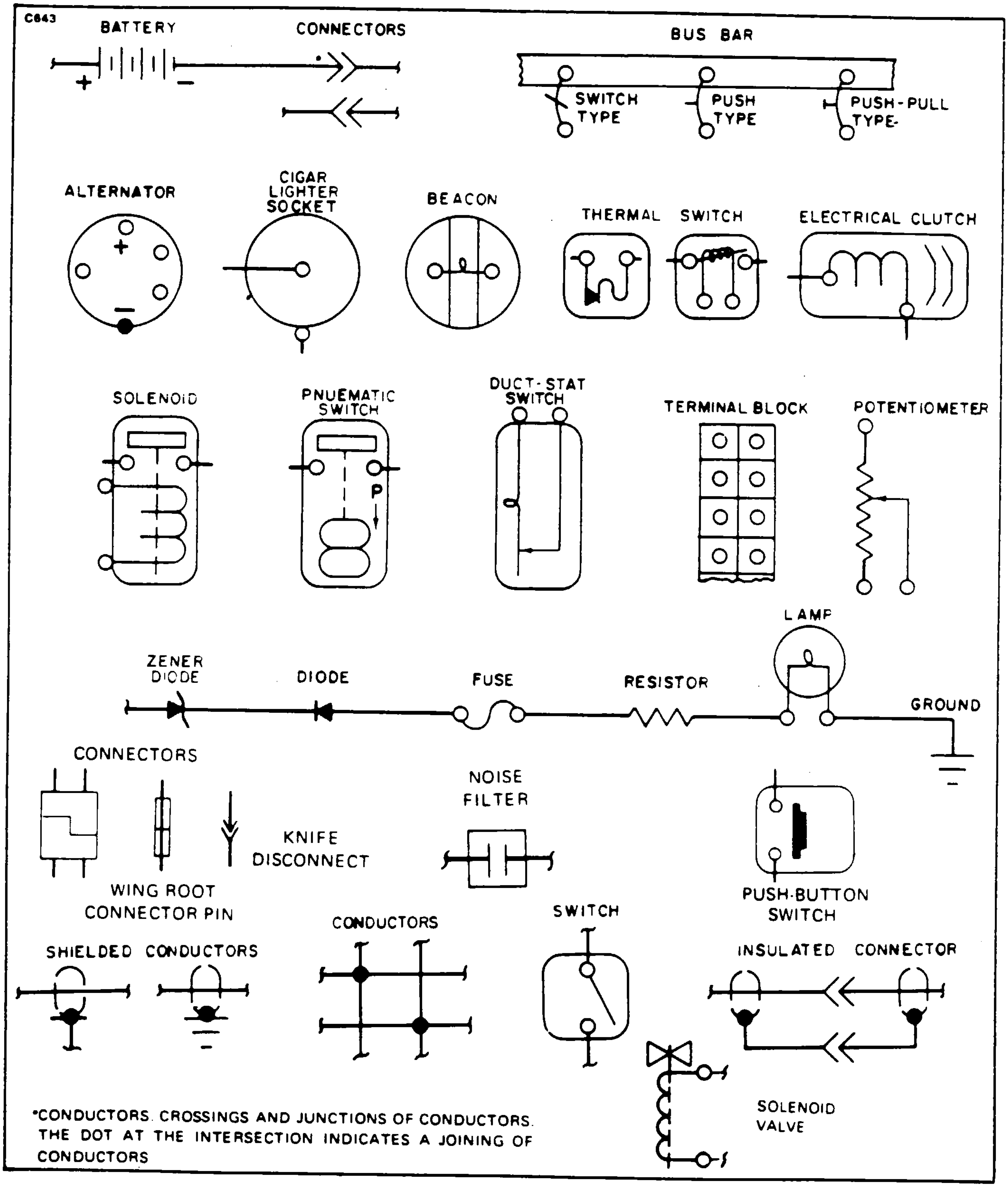
ELECTRICAL WIRE CODING AND SYMBOLS.

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	
H	HEATER - VENTILATING & DEICING	E 400 Series = On Fuselage Station 57.0 and Forward.
L	LIGHTING	
P	POWER	
Q	FUEL. OIL & ENGINE INSTRUMENT	
RP	RADIO POWER	
RZ	RADIO AUDIO	
J	IGNITION	

CHART 9110. ELECTRICAL SYMBOLS



ELECTRICAL SCHEMATIC INDEX

SHEET NO.	SCHEMATIC	GRID NO.
	ANNUNCIATOR	
13	Master Caution Channels	5G5
14	Advisory Channels	5G7
	COMFORT SYSTEMS	
1	Cigar Lighter, Heated Thermos, Razor	5F5
	DEICE SYSTEMS	
24	Ice Deflect, Inlet Lip, Propeller, Power Control (Left)	5H3
25	Ice Deflect, Inlet Lip, Propeller, Power Control (Right)	5H5
18	Pitot Heat Left (Optional Right)	5G15
18	Stall Warning Heat	5G15
18	Surface (Optional)	5G15
18	Windshield Heat and Control (Optional)	5G15
	ELECTRICAL SYSTEMS	
2	Bus-Main Power Dist. Batt. Ext. Pwr. (Nicad Optional)	5F7
3	Starter Generator (Left)	5F9
4	Starter Generator (Right)	5F11
21	Emergency Locator Transmitter E.L.T.	5G21
	ENGINE SYSTEMS	
19	Fire Detection Left Right (Optional)	5G17
19	Fire Extinguishers Left Right	5G17
11	Ignition - Left Right	5G1
11	Ignition-Auto Left Right (Optional)	5G1
5	Oil Cooler Doors Left Right	5F13
	ENVIRONMENTAL SYSTEMS	
16	Air Conditioning Condenser Blower Motor	5G11
16	Ground Vent Fan Recirculating Fans	5G11
17	Heater Heater Blower	5G13
	FLAP SYSTEMS	
12	Wing Flaps - Motor and Control	5G3

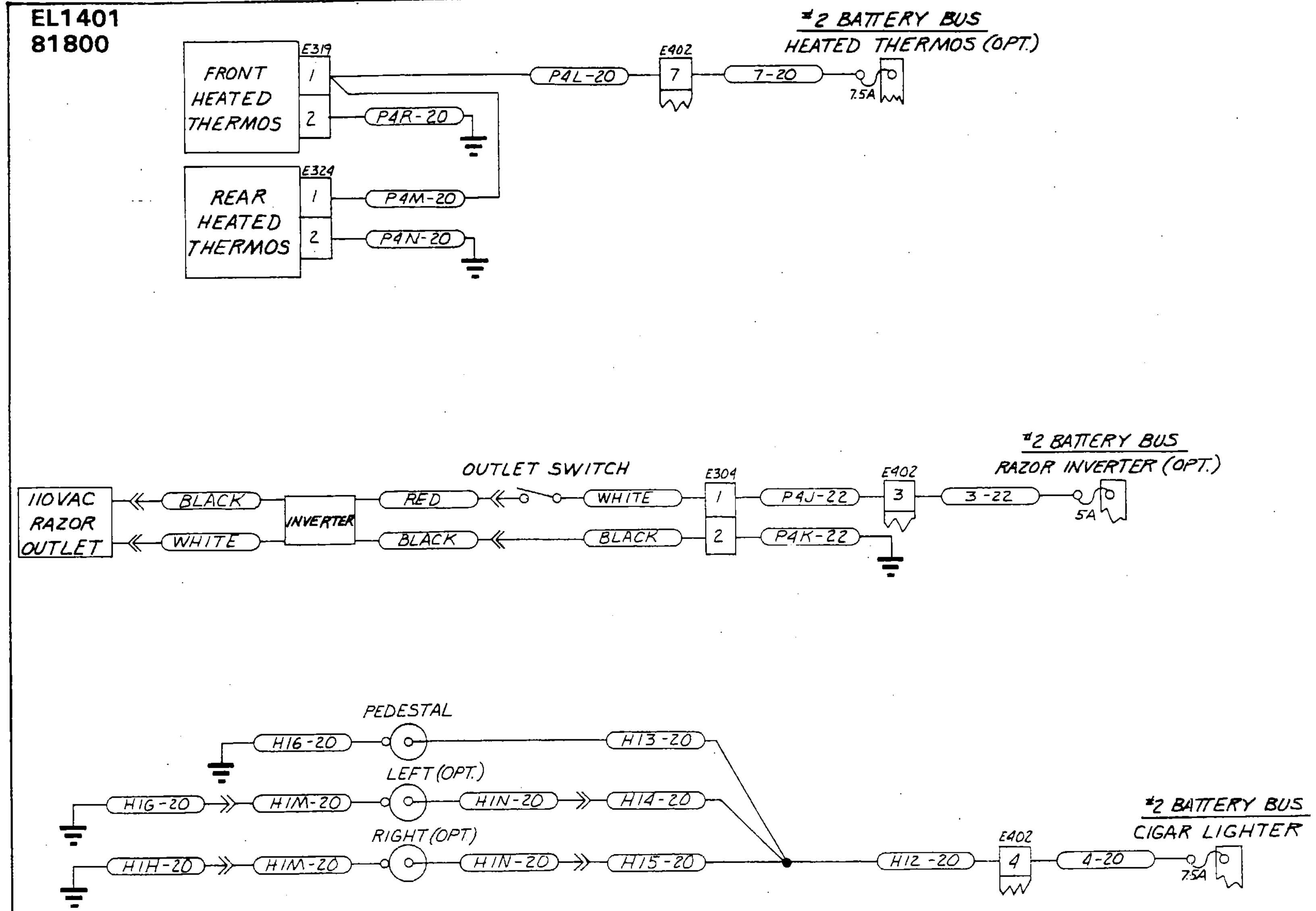
ELECTRICAL SCHEMATIC INDEX (cont.)

ELECTRICAL SCHEMATIC INDEX (cont.)

SHEET NO.	SCHEMATIC	GRID NO.
	WARNING SYSTEMS	
13	(See Annunciators)	5G5
9	Baggage. Door-Ajar	5F21
19	Fire Detection Left Right (Optional)	5G17
9	Nose Cone	5F21
21	Stall (Vane. Horn. A.O.G. Switch and Time Delay)	5G21
18	Windshield Wiper	5G15

THIS PAGE INTENTIONALLY LEFT BLANK

EL1401
81800



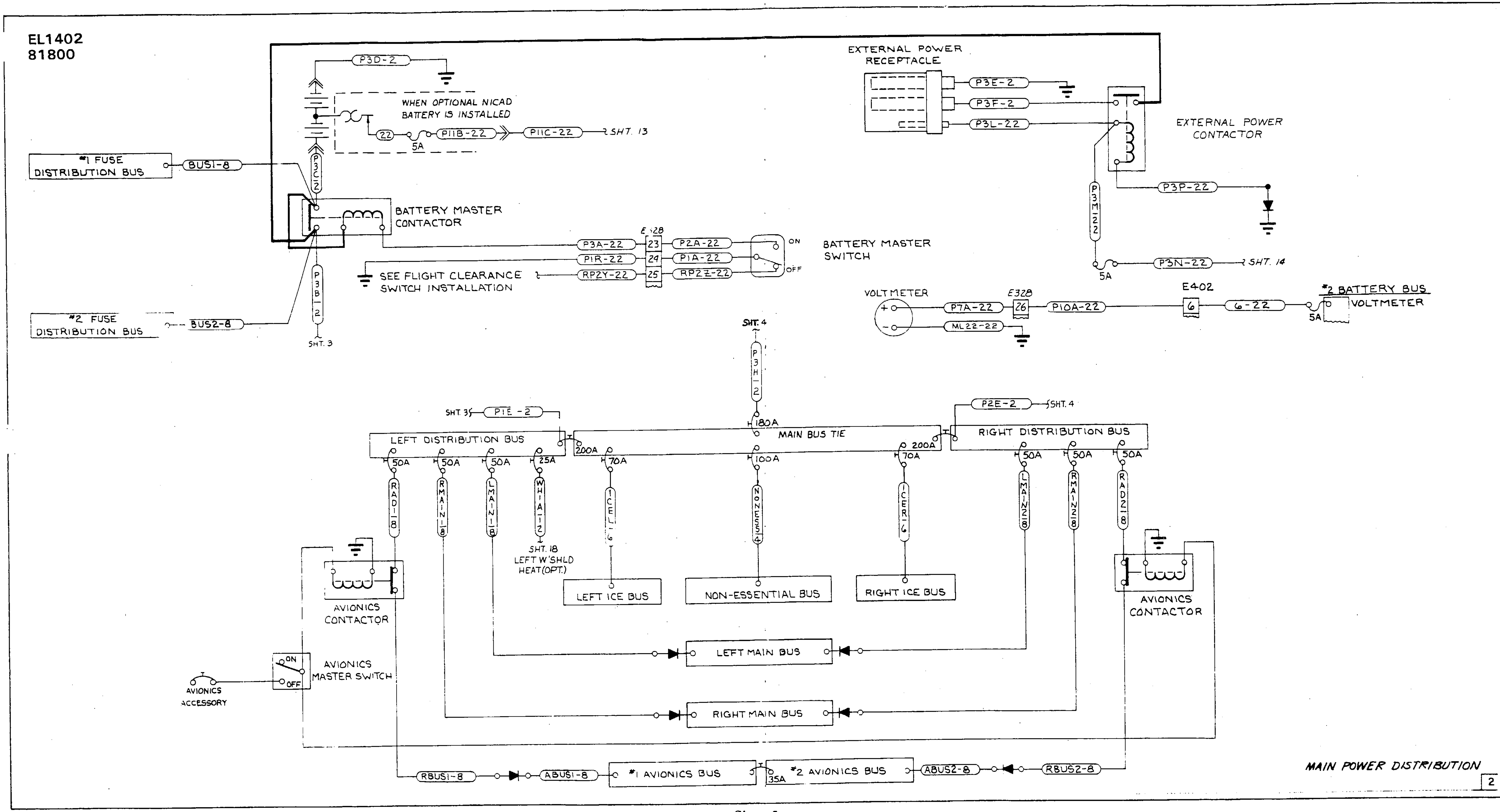
NOTE

1. ELECTRICAL HARNESS CONNECTOR NO.'S
   E100 SERIES: LEFT WING & NACELLE
   E200 SERIES: RIGHT WING & NACELLE
   E300 SERIES: FROM FUSELAGE STA 57.00 AFT.
   E400 SERIES: ON FUSELAGE STA 57.00 & FORWARD
2. GEAR SAFETY SWITCH INDEX

LEFT GEAR		NOSE GEAR		RIGHT GEAR	
FUNCTION	POLE	FUNCTION	POLE	FUNCTION	POLE
LDG GEAR	1-2-3	HTG &	1-2-3	HTG &	1-2-3
L ENG ICE	4-5-6	BETA	4-5-6	BETA	4-5-6
HEATER	7-8-9	IGNITION	7-8-9	STALL WARN.	7-8-9
CABIN LIGHTS	10-11-12		10-11-12	R ENG ICE	10-11-12

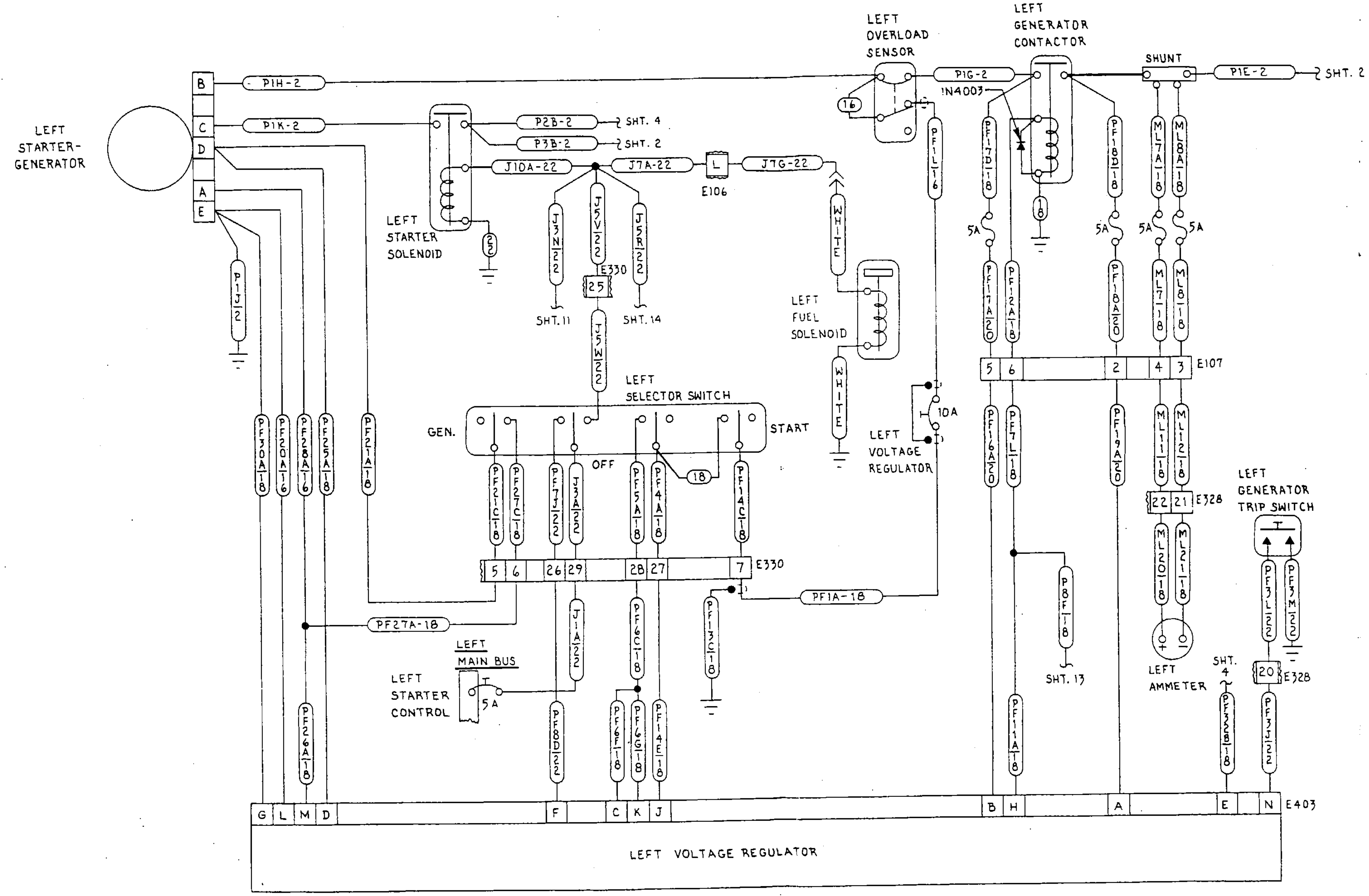
SHT. NO.	-INDEX-
1	HEATED THERMOS, RAZOR INVERTER, CIGAR LIGHTER
2	MAIN POWER DISTRIBUTION
3	LEFT START./GEN.
4	RIGHT START./GEN.
5	L & R OIL COOLER DOORS
6	L & R HTG & BETA, PROP SYNC
7	POSITION, ANTI-COLLISON, TAIL BEACON/LOGO LIGHTS
8	RECOG, TAXI, LANDING & WING INSPECTION LIGHTS
9	COURTESY LTS., CHIMES, EXIT LIGHTS, CABIN MAP LIGHTS,
10	L. PANEL, PLACARD, RADIO & R. PANEL LIGHT
11	L & R IGNITION, L & R AUTO IGNITION
12	FLAPS
13	ANNUNCIATOR-MASTER CAUTION CHANNELS
14	ANNUNCIATOR-ADVISORY CHANNELS
15	LANDING GEAR
16	GND. VENT FAN, RECIRC. FANS, AIR CONDITIONER, CONDENSER BLOWER MOTOR
17	HEATER, HEATER BLOWER
18	L. WINDSHIELD HEAT, WINDSHIELD WIPER, L & R PITOT HEAT, SURFACE DEICE, STALL WARNING HEAT
19	L & R FIRE EXTINGUISHERS, HOURMETER, L & R FIRE DETECTORS
20	L & R TORQUE METERS, L & R OIL TEMPS, L & R OIL PRESSURES, L & R GAS GEN. TACH.'S, L & R PROP TACH.'S
21	GYRO'S, STALL WARNING, ELT
22	L & R FUEL PRESSURES, L & R MAIN & AUX. FUEL PUMPS, FUEL QUANTITY
23	L & R FUEL FLOW, L & R FUEL CONTROL HEAT, FUEL TOTALIZER
24	L ENG. DEICE
25	R ENG. DEICE

Sheet 1


EL1402
81800
EXTERNAL POWER RECEPTACLE
P3E-2
P3F-2
P3L-22
EXTERNAL POWER CONTACTOR
P3D-2
WHEN OPTIONAL NICAD BATTERY IS INSTALLED
P11B-22
P11C-22
SHT. 13
5A
#1 FUSE DISTRIBUTION BUS
BUS1-8
BATTERY MASTER CONTACTOR
P3P-22
P3M-22
P3A-22
P2A-22
P1R-22
P1A-22
RP2Y-22
RP2Z-22
E328
ON
OFF
BATTERY MASTER SWITCH
SEE FLIGHT CLEARANCE SWITCH INSTALLATION
P3N-22
SHT. 14
#2 FUSE DISTRIBUTION BUS
BUS2-8
P3B-2
SHT. 3
VOLTMETER
P7A-22
P10A-22
ML22-22
E402
6-22
#2 BATTERY BUS
VOLTMETER
SHT. 4
P3H-2
SHT. 3
P1E-2
P2E-2
180A
LEFT DISTRIBUTION BUS
MAIN BUS TIE
RIGHT DISTRIBUTION BUS
200A
70A
100A
50A
25A
RAD1-8
RMAIN1-8
LMAIN1-8
WHA1-12
ICEL-6
NONESS-4
ICER-6
LMAIN2-8
RMAIN2-8
RAD2-8
SHT. 18
LEFT W'SHLD HEAT (OPT.)
LEFT ICE BUS
NON-ESSENTIAL BUS
RIGHT ICE BUS
AVIONICS CONTACTOR
LEFT MAIN BUS
RIGHT MAIN BUS
AVIONICS MASTER SWITCH
AVIONICS ACCESSORY
RBUS1-8
ABUS1-8
#1 AVIONICS BUS
35A
#2 AVIONICS BUS
ABUS2-8
RBUS2-8
MAIN POWER DISTRIBUTION
2

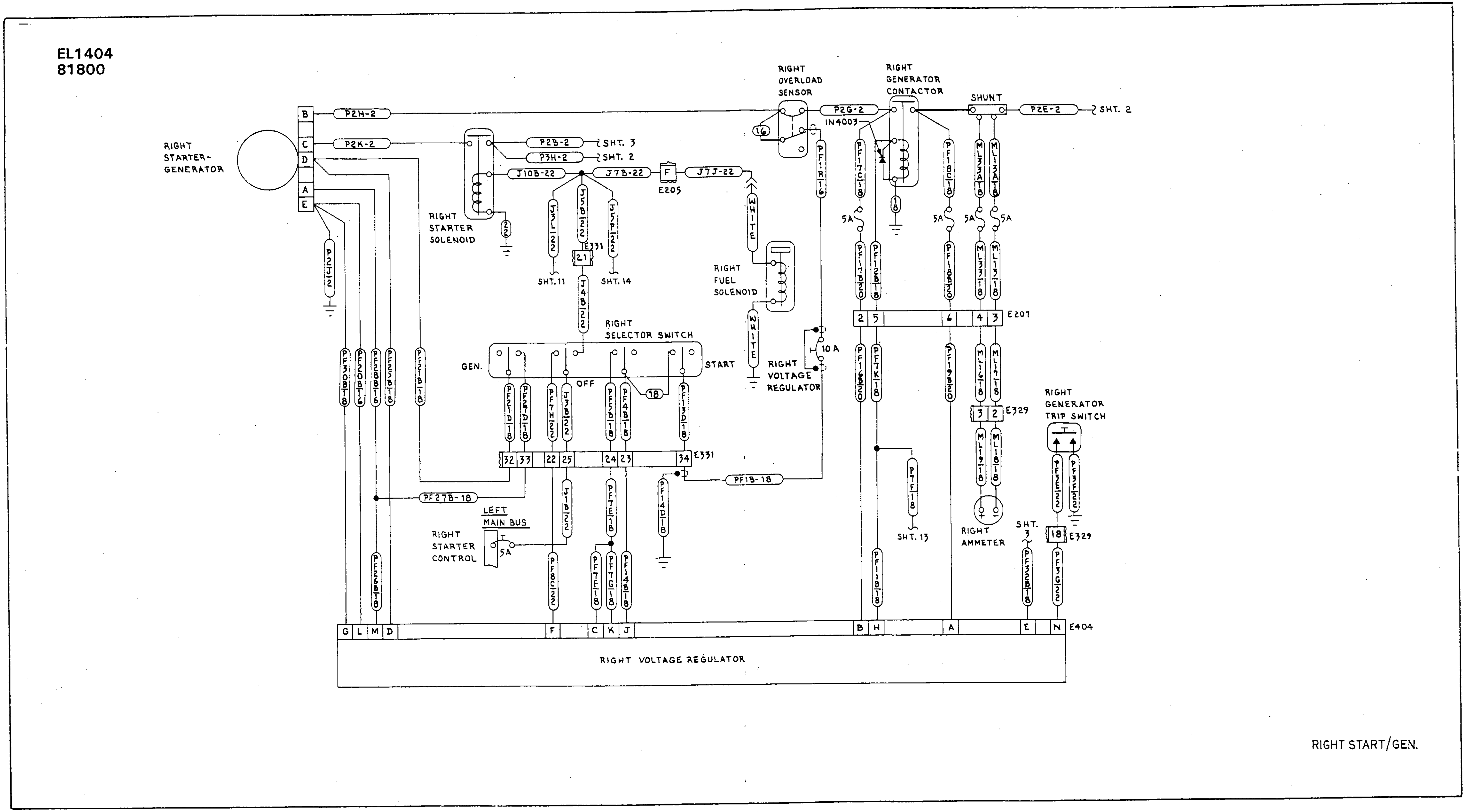
Sheet 2

EL1403
81800

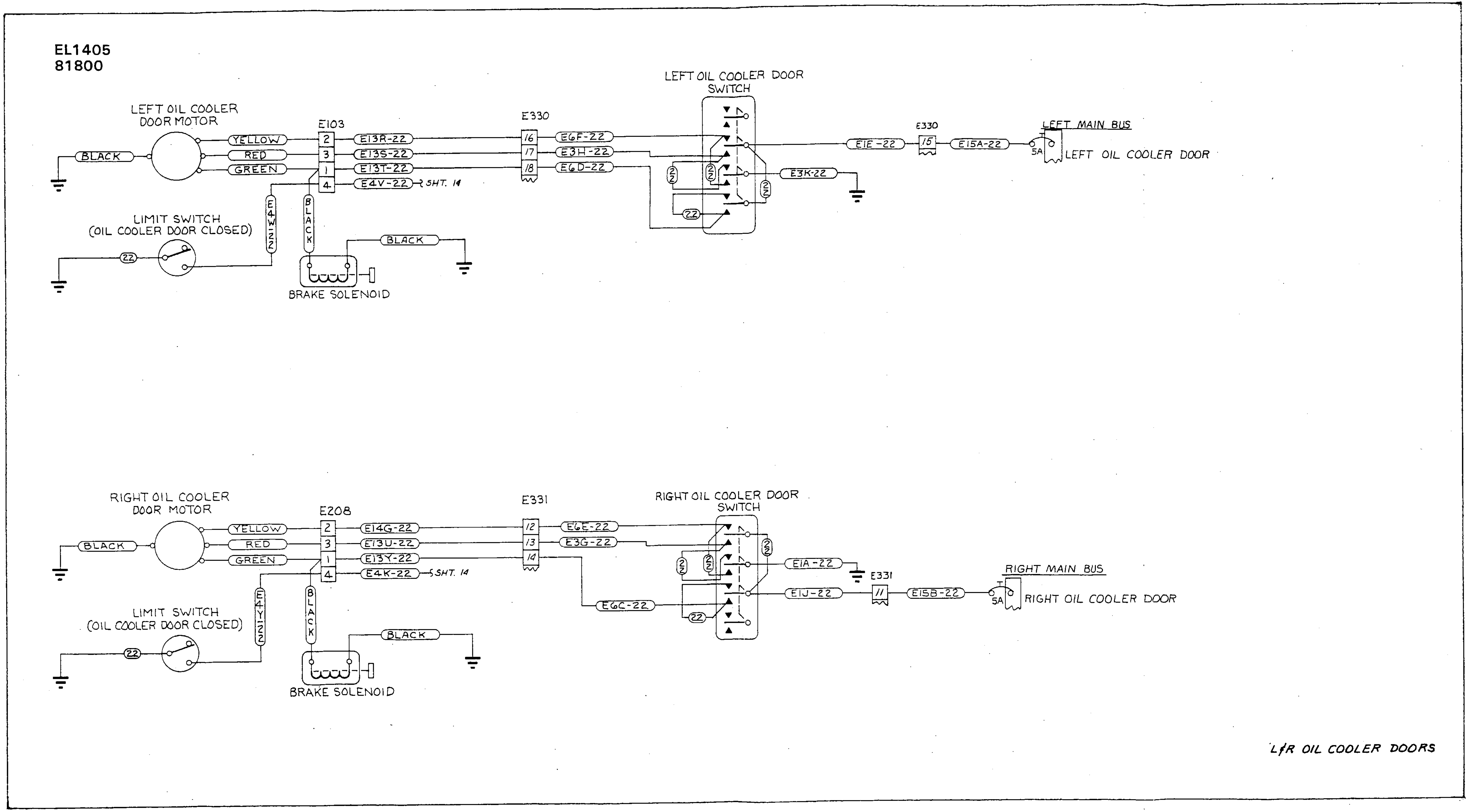


LEFT START./GEN.

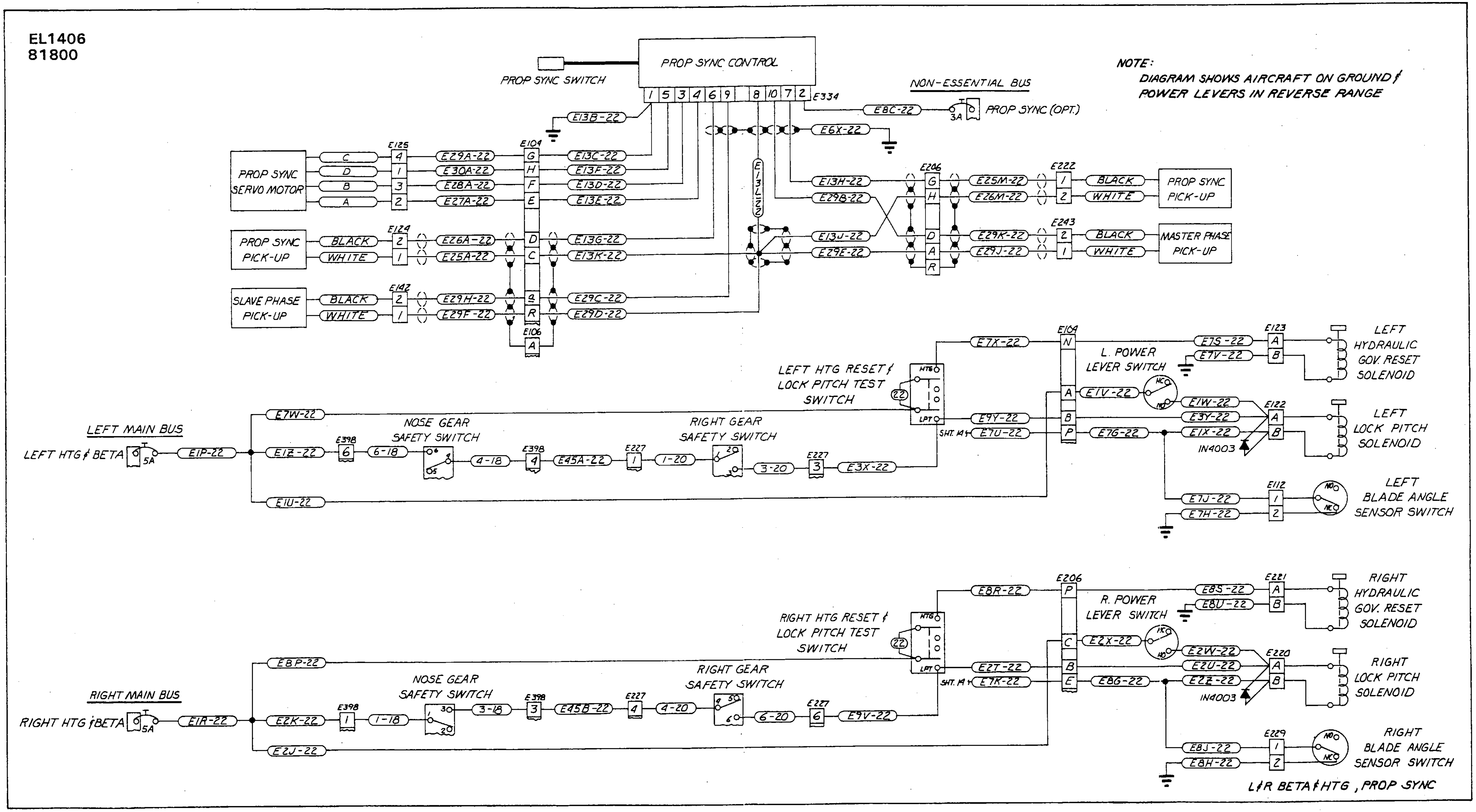
Sheet 3


EL1404
81800
RIGHT STARTER-GENERATOR
RIGHT OVERLOAD SENSOR
RIGHT GENERATOR CONTACTOR
SHUNT
SHT. 2
SHT. 3
RIGHT STARTER SOLENOID
E205
E331
SHT. 11
SHT. 14
RIGHT FUEL SOLENOID
RIGHT SELECTOR SWITCH
GEN.
OFF
START
RIGHT VOLTAGE REGULATOR
E207
E329
RIGHT GENERATOR TRIP SWITCH
LEFT MAIN BUS
RIGHT STARTER CONTROL
SHT. 13
RIGHT AMMETER
E404
RIGHT VOLTAGE REGULATOR
RIGHT START/GEN.

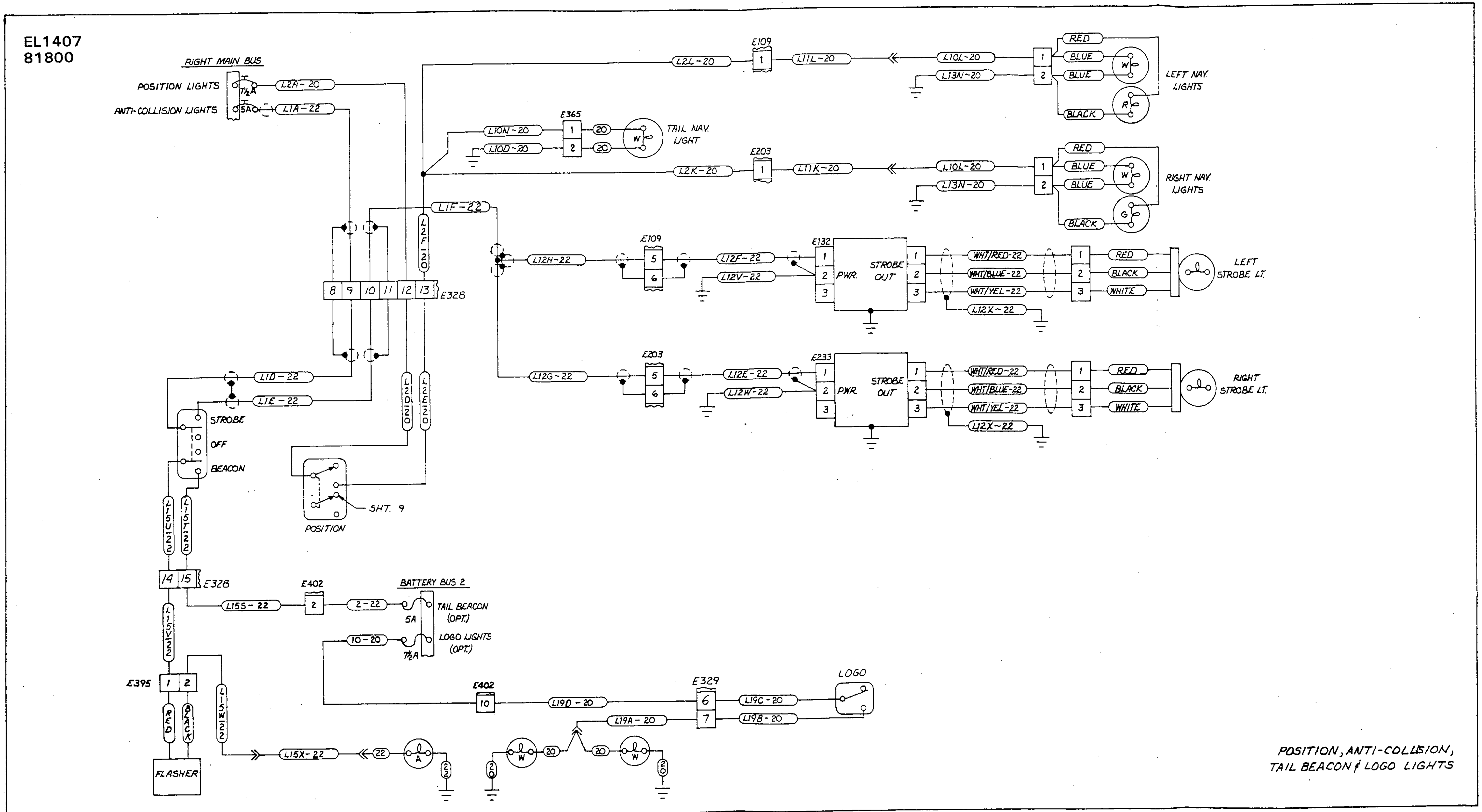
Sheet 4


EL1405
81800
LEFT OIL COOLER DOOR MOTOR
BLACK
YELLOW
RED
GREEN
E103
E13R-22
E13S-22
E13T-22
E4V-22
SHT. 14
E4W22
BLACK
LIMIT SWITCH (OIL COOLER DOOR CLOSED)
22
BLACK
BRAKE SOLENOID
E330
E6F-22
E3H-22
E6D-22
LEFT OIL COOLER DOOR SWITCH
E3K-22
E1E-22
E330
E15A-22
LEFT MAIN BUS
5A
LEFT OIL COOLER DOOR
RIGHT OIL COOLER DOOR MOTOR
BLACK
YELLOW
RED
GREEN
E208
E14G-22
E13U-22
E13Y-22
E4K-22
SHT. 14
E4Y22
BLACK
LIMIT SWITCH (OIL COOLER DOOR CLOSED)
22
BLACK
BRAKE SOLENOID
E331
E6E-22
E3G-22
E6C-22
RIGHT OIL COOLER DOOR SWITCH
E1A-22
E1J-22
E331
E15B-22
RIGHT MAIN BUS
5A
RIGHT OIL COOLER DOOR
L/R OIL COOLER DOORS

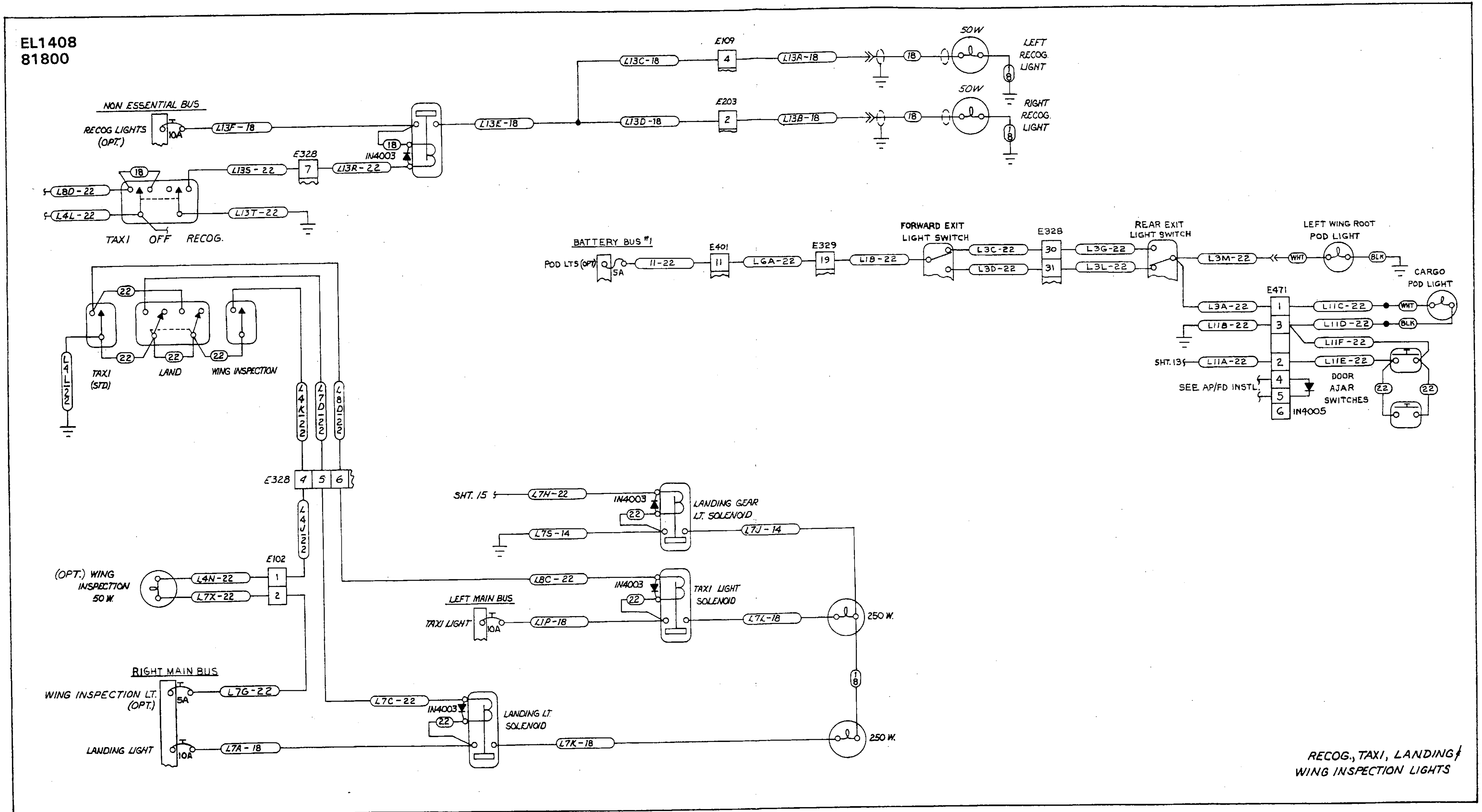
Sheet 5


EL1406
81800
PROP SYNC CONTROL
PROP SYNC SWITCH
NON-ESSENTIAL BUS
PROP SYNC (OPT.)
NOTE:
DIAGRAM SHOWS AIRCRAFT ON GROUND & POWER LEVERS IN REVERSE RANGE
PROP SYNC SERVO MOTOR
PROP SYNC PICK-UP
SLAVE PHASE PICK-UP
MASTER PHASE PICK-UP
LEFT HTG RESET & LOCK PITCH TEST SWITCH
L. POWER LEVER SWITCH
LEFT HYDRAULIC GOV. RESET SOLENOID
LEFT LOCK PITCH SOLENOID
LEFT BLADE ANGLE SENSOR SWITCH
LEFT MAIN BUS
LEFT HTG & BETA
NOSE GEAR SAFETY SWITCH
RIGHT GEAR SAFETY SWITCH
RIGHT HTG RESET & LOCK PITCH TEST SWITCH
R. POWER LEVER SWITCH
RIGHT HYDRAULIC GOV. RESET SOLENOID
RIGHT LOCK PITCH SOLENOID
RIGHT BLADE ANGLE SENSOR SWITCH
RIGHT MAIN BUS
RIGHT HTG & BETA
1N4003
L & R BETA & HTG, PROP SYNC

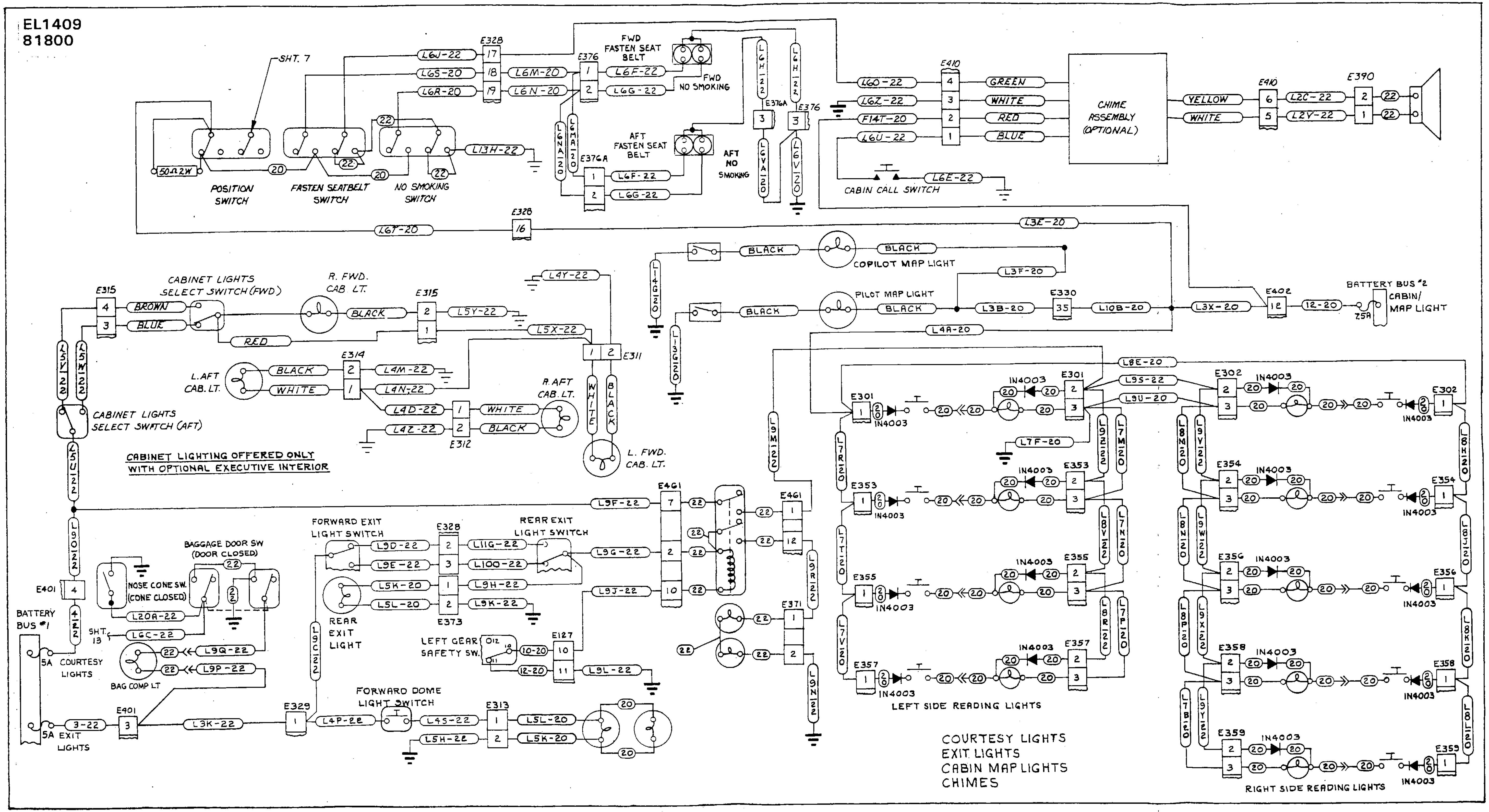
Sheet 6


EL1407
81800
RIGHT MAIN BUS
POSITION LIGHTS
ANTI-COLLISION LIGHTS
LEFT NAV. LIGHTS
TAIL NAV. LIGHT
RIGHT NAV. LIGHTS
LEFT STROBE LT.
RIGHT STROBE LT.
STROBE
OFF
BEACON
POSITION
SHT. 9
BATTERY BUS 2
TAIL BEACON (OPT.)
LOGO LIGHTS (OPT.)
LOGO
FLASHER
POSITION, ANTI-COLLISION,
TAIL BEACON & LOGO LIGHTS

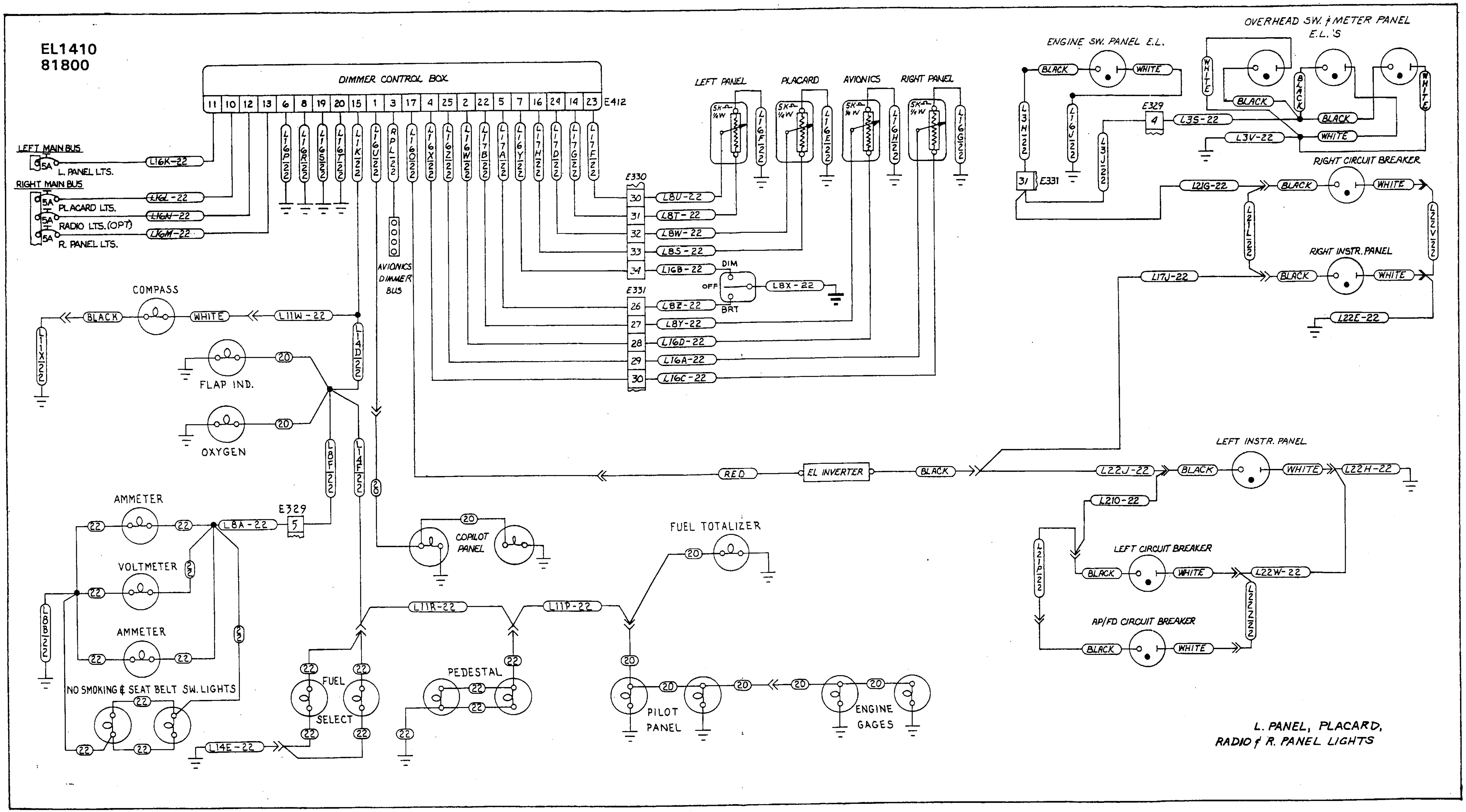
Sheet 7


EL1408
81800
NON ESSENTIAL BUS
RECOG LIGHTS (OPT.)
10A
L13F-18
L13E-18
L13C-18
L13D-18
E109
E203
L13A-18
L13B-18
50W
LEFT RECOG. LIGHT
RIGHT RECOG. LIGHT
IN4003
E328
L13R-22
L13S-22
L8D-22
L4L-22
L13T-22
TAXI OFF RECOG.
BATTERY BUS #1
POD LTS (OPT)
5A
11-22
E401
L6A-22
E329
L1B-22
FORWARD EXIT LIGHT SWITCH
L3C-22
L3D-22
L3G-22
L3L-22
REAR EXIT LIGHT SWITCH
L3M-22
LEFT WING ROOT POD LIGHT
CARGO POD LIGHT
E471
L3A-22
L11B-22
L11A-22
L11C-22
L11D-22
L11F-22
L11E-22
SHT. 13
SEE AP/FD INSTL.
IN4005
DOOR AJAR SWITCHES
TAXI (STD)
LAND
WING INSPECTION
L4K-22
L7D-22
L8D-22
L4J-22
SHT. 15
L7H-22
L7S-14
L7J-14
LANDING GEAR LT. SOLENOID
E102
(OPT.) WING INSPECTION 50 W.
L4N-22
L7X-22
L8C-22
TAXI LIGHT SOLENOID
LEFT MAIN BUS
TAXI LIGHT
L1P-18
L7L-18
250 W.
RIGHT MAIN BUS
WING INSPECTION LT. (OPT.)
L7G-22
LANDING LIGHT
L7A-18
L7C-22
LANDING LT. SOLENOID
L7K-18
RECOG., TAXI, LANDING & WING INSPECTION LIGHTS

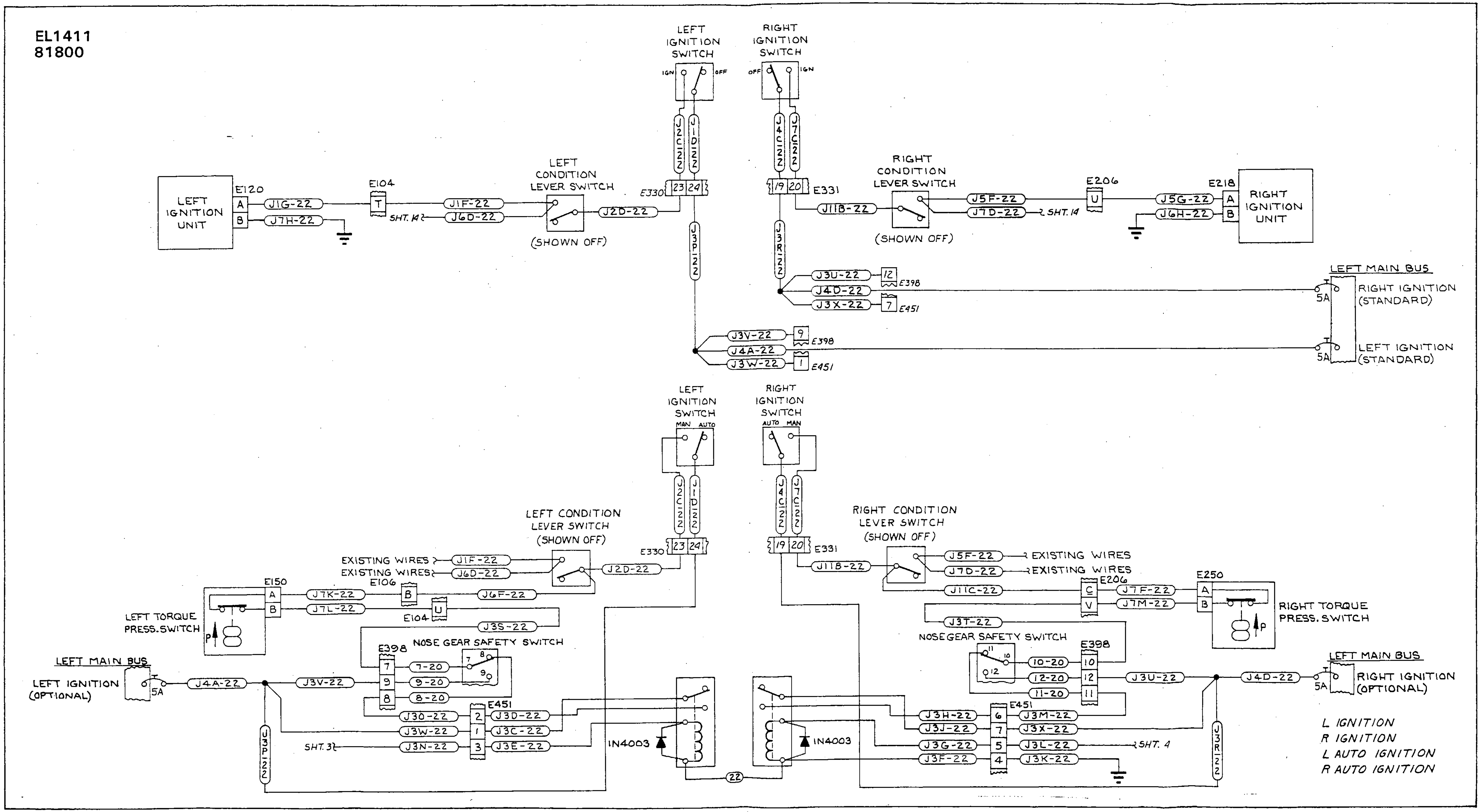
Sheet 8


EL1409
81800
POSITION SWITCH
FASTEN SEATBELT SWITCH
NO SMOKING SWITCH
FWD FASTEN SEAT BELT
FWD NO SMOKING
AFT FASTEN SEAT BELT
AFT NO SMOKING
CHIME ASSEMBLY (OPTIONAL)
CABIN CALL SWITCH
CABINET LIGHTS SELECT SWITCH (FWD)
R. FWD. CAB LT.
L. AFT CAB. LT.
R. AFT CAB. LT.
L. FWD. CAB. LT.
CABINET LIGHTS SELECT SWITCH (AFT)
CABINET LIGHTING OFFERED ONLY WITH OPTIONAL EXECUTIVE INTERIOR
COPILOT MAP LIGHT
PILOT MAP LIGHT
BATTERY BUS #2
CABIN/ MAP LIGHT
BAGGAGE DOOR SW (DOOR CLOSED)
NOSE CONE SW. (CONE CLOSED)
BAG COMP LT
BATTERY BUS #1
5A COURTESY LIGHTS
5A EXIT LIGHTS
FORWARD EXIT LIGHT SWITCH
REAR EXIT LIGHT SWITCH
REAR EXIT LIGHT
LEFT GEAR SAFETY SW.
FORWARD DOME LIGHT SWITCH
LEFT SIDE READING LIGHTS
RIGHT SIDE READING LIGHTS
COURTESY LIGHTS
EXIT LIGHTS
CABIN MAP LIGHTS
CHIMES

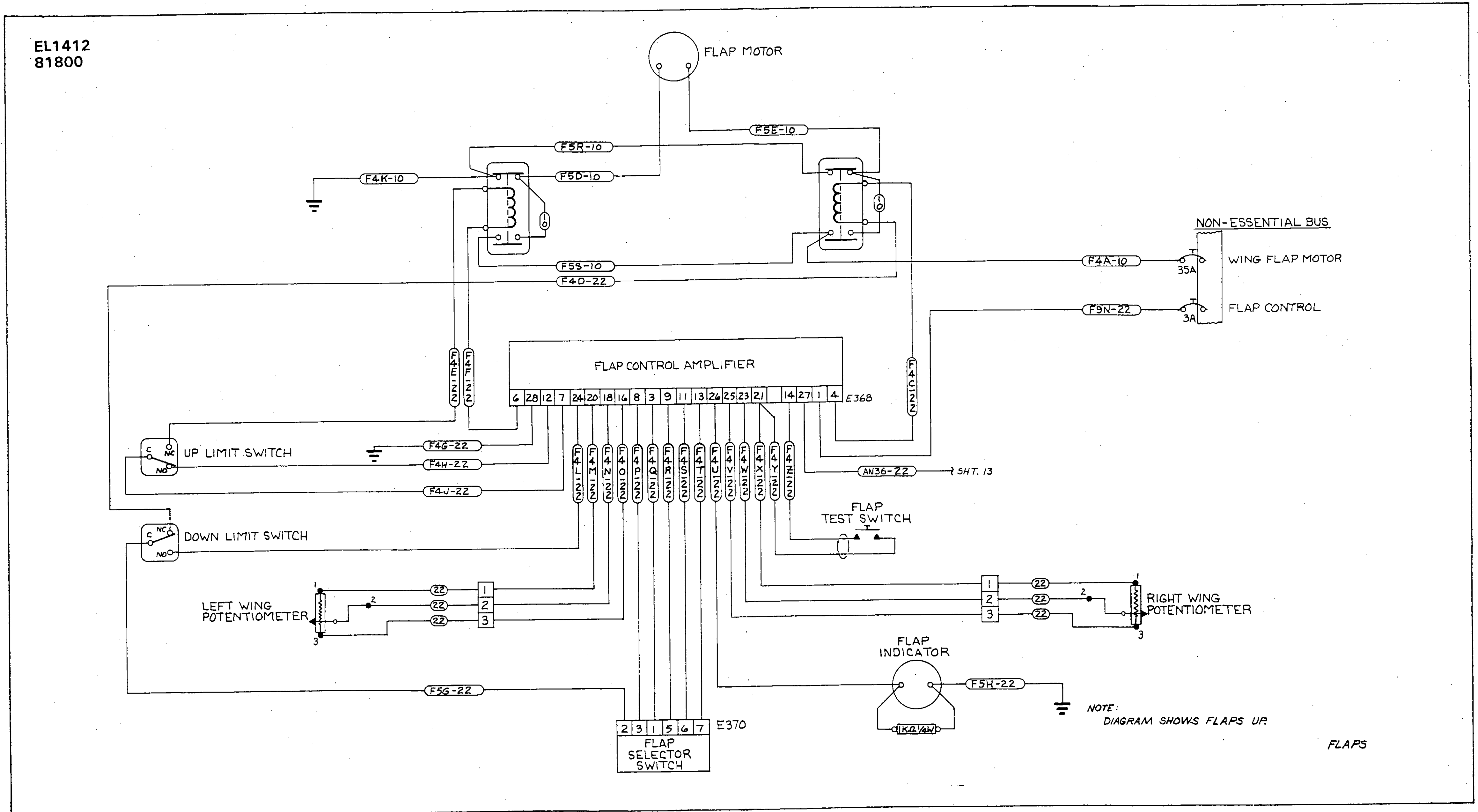
Sheet 9


EL1410
81800
DIMMER CONTROL BOX
E412
LEFT MAIN BUS
L. PANEL LTS.
RIGHT MAIN BUS
PLACARD LTS.
RADIO LTS.(OPT)
R. PANEL LTS.
AVIONICS DIMMER BUS
COMPASS
FLAP IND.
OXYGEN
AMMETER
VOLTMETER
AMMETER
NO SMOKING & SEAT BELT SW. LIGHTS
E329
COPILOT PANEL
FUEL SELECT
PEDESTAL
FUEL TOTALIZER
PILOT PANEL
ENGINE GAGES
EL INVERTER
LEFT PANEL
PLACARD
AVIONICS
RIGHT PANEL
E330
E331
DIM
OFF
BRT
ENGINE SW. PANEL E.L.
OVERHEAD SW. & METER PANEL E.L.'S
RIGHT CIRCUIT BREAKER
RIGHT INSTR. PANEL
LEFT INSTR. PANEL
LEFT CIRCUIT BREAKER
AP/FD CIRCUIT BREAKER
L. PANEL, PLACARD, RADIO & R. PANEL LIGHTS

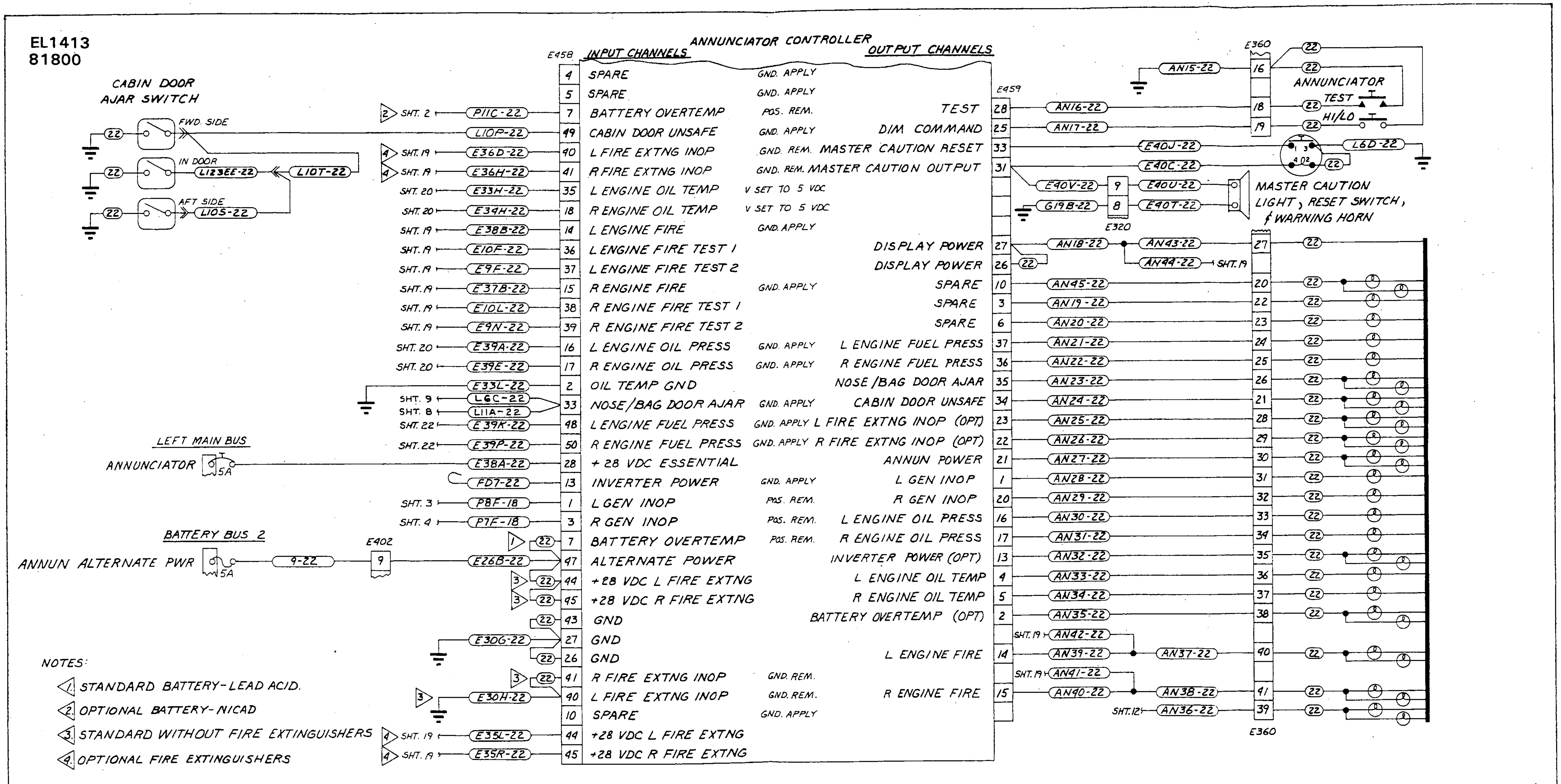
Sheet 10


EL1411
81800
LEFT IGNITION SWITCH
RIGHT IGNITION SWITCH
LEFT CONDITION LEVER SWITCH
(SHOWN OFF)
RIGHT CONDITION LEVER SWITCH
(SHOWN OFF)
LEFT IGNITION UNIT
RIGHT IGNITION UNIT
LEFT MAIN BUS
RIGHT IGNITION (STANDARD)
LEFT IGNITION (STANDARD)
EXISTING WIRES
LEFT TORQUE PRESS. SWITCH
RIGHT TORQUE PRESS. SWITCH
NOSE GEAR SAFETY SWITCH
LEFT IGNITION (OPTIONAL)
RIGHT IGNITION (OPTIONAL)
1N4003
L IGNITION
R IGNITION
L AUTO IGNITION
R AUTO IGNITION

Sheet 11


EL1412
81800
FLAP MOTOR
F5E-10
F5R-10
F4K-10
F5D-10
F5S-10
F4D-22
NON-ESSENTIAL BUS
F4A-10
35A
WING FLAP MOTOR
F9N-22
3A
FLAP CONTROL
FLAP CONTROL AMPLIFIER
6 28 12 7 24 20 18 16 8 3 9 11 13 26 25 23 21 14 27 1 4
E368
F4E-22
F4F-22
F4C-22
UP LIMIT SWITCH
F4G-22
F4H-22
F4J-22
AN36-22
SHT. 13
F4L-22 F4M-22 F4N-22 F4O-22 F4P-22 F4Q-22 F4R-22 F4S-22 F4T-22 F4U-22 F4V-22 F4W-22 F4X-22 F4Y-22 F4Z-22
FLAP
TEST SWITCH
DOWN LIMIT SWITCH
LEFT WING
POTENTIOMETER
RIGHT WING
POTENTIOMETER
FLAP
INDICATOR
F5H-22
1KΩ¼W
F5G-22
2 3 1 5 6 7
E370
FLAP
SELECTOR
SWITCH
NOTE:
DIAGRAM SHOWS FLAPS UP.
FLAPS

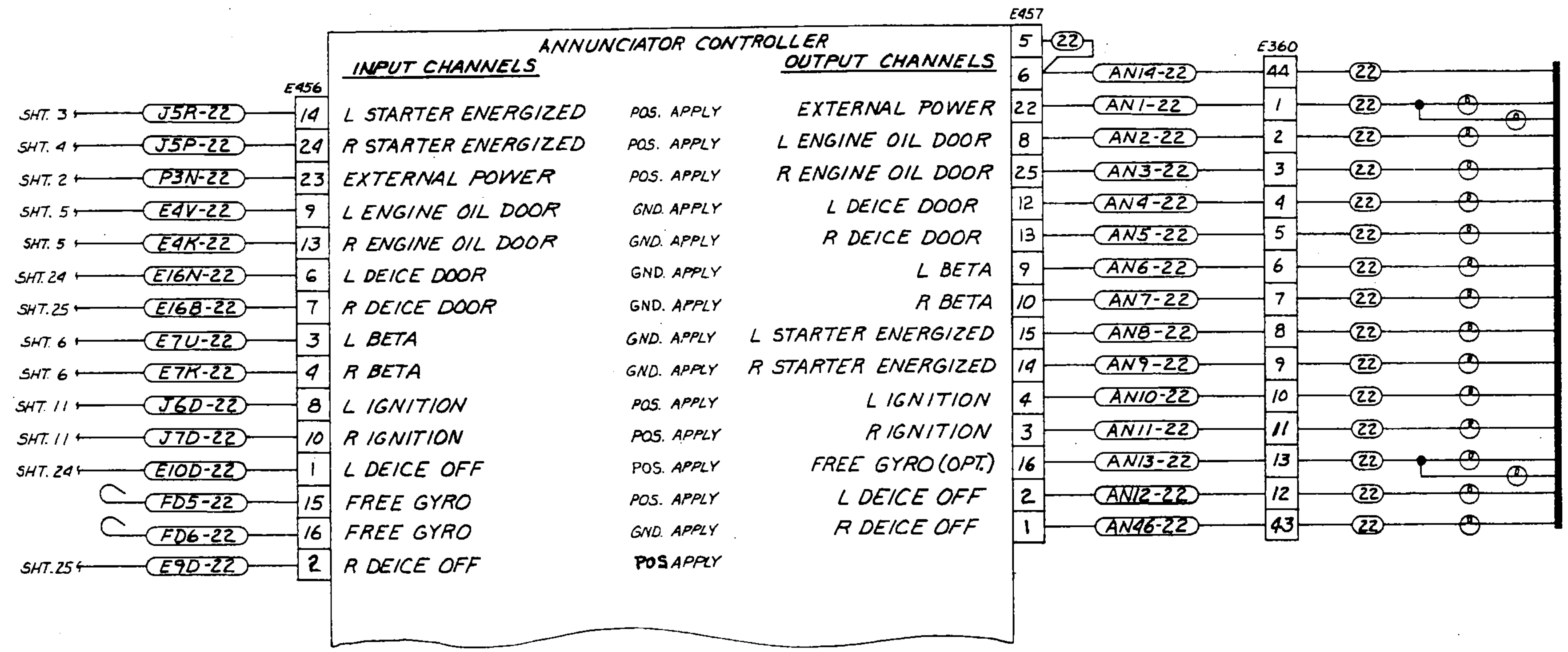
Sheet 12



ANNUNCIATOR - MASTER CAUTION CHANNELS

Sheet 13

EL1414
81800

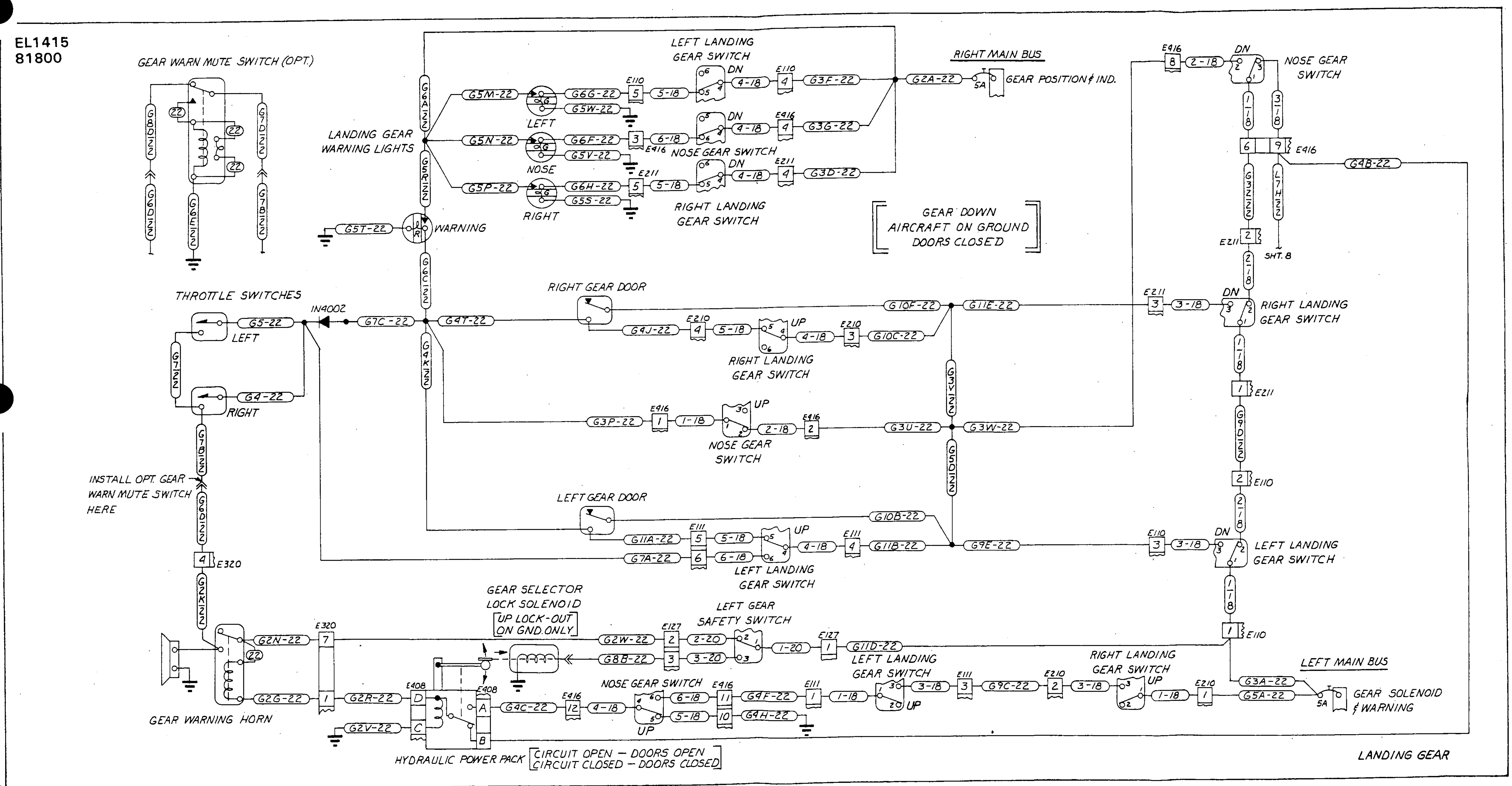


ANNUNCIATOR - ADVISORY CHANNELS

Sheet 14

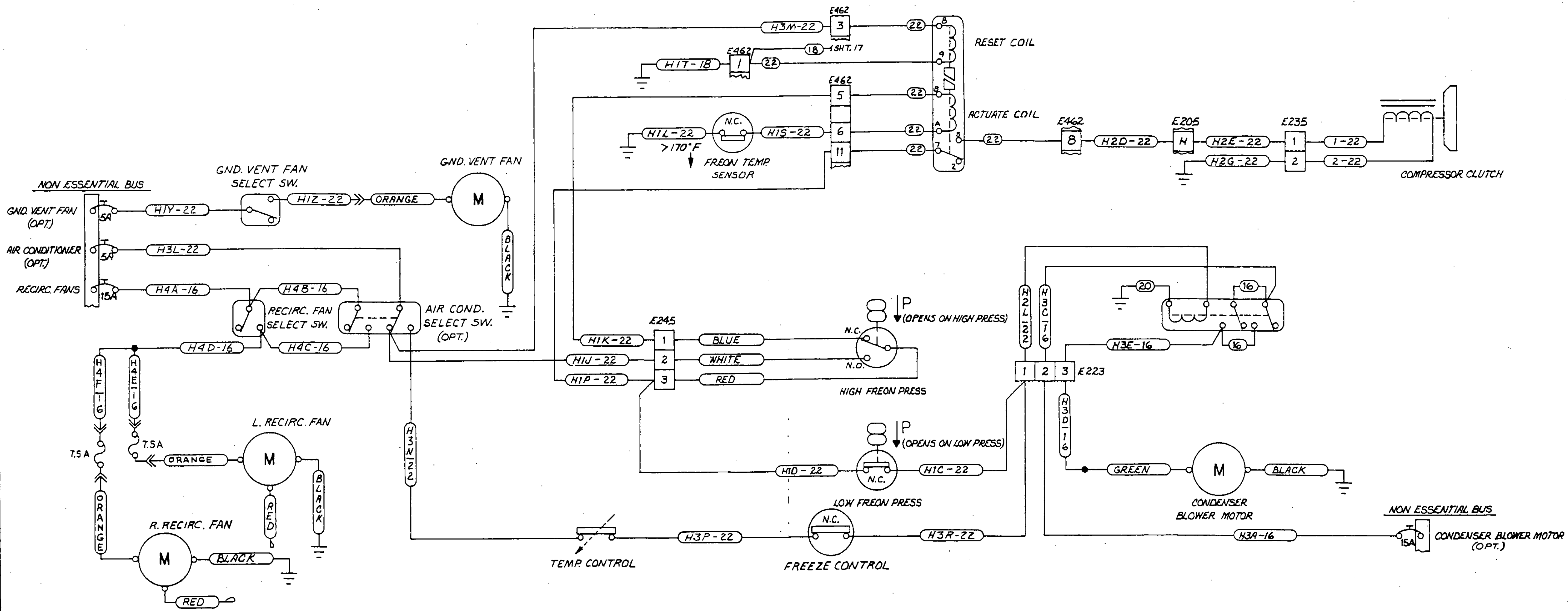
5G7

5G8


EL1415
81800
GEAR WARN MUTE SWITCH (OPT.)
LANDING GEAR WARNING LIGHTS
LEFT
NOSE
RIGHT
WARNING
LEFT LANDING GEAR SWITCH
NOSE GEAR SWITCH
RIGHT LANDING GEAR SWITCH
RIGHT MAIN BUS
GEAR POSITION & IND.
GEAR DOWN
AIRCRAFT ON GROUND
DOORS CLOSED
NOSE GEAR SWITCH
THROTTLE SWITCHES
IN4002
RIGHT GEAR DOOR
LEFT GEAR DOOR
INSTALL OPT. GEAR WARN MUTE SWITCH HERE
GEAR SELECTOR LOCK SOLENOID
UP LOCK-OUT ON GND. ONLY
LEFT GEAR SAFETY SWITCH
GEAR WARNING HORN
HYDRAULIC POWER PACK
CIRCUIT OPEN - DOORS OPEN
CIRCUIT CLOSED - DOORS CLOSED
LEFT MAIN BUS
GEAR SOLENOID & WARNING
LANDING GEAR

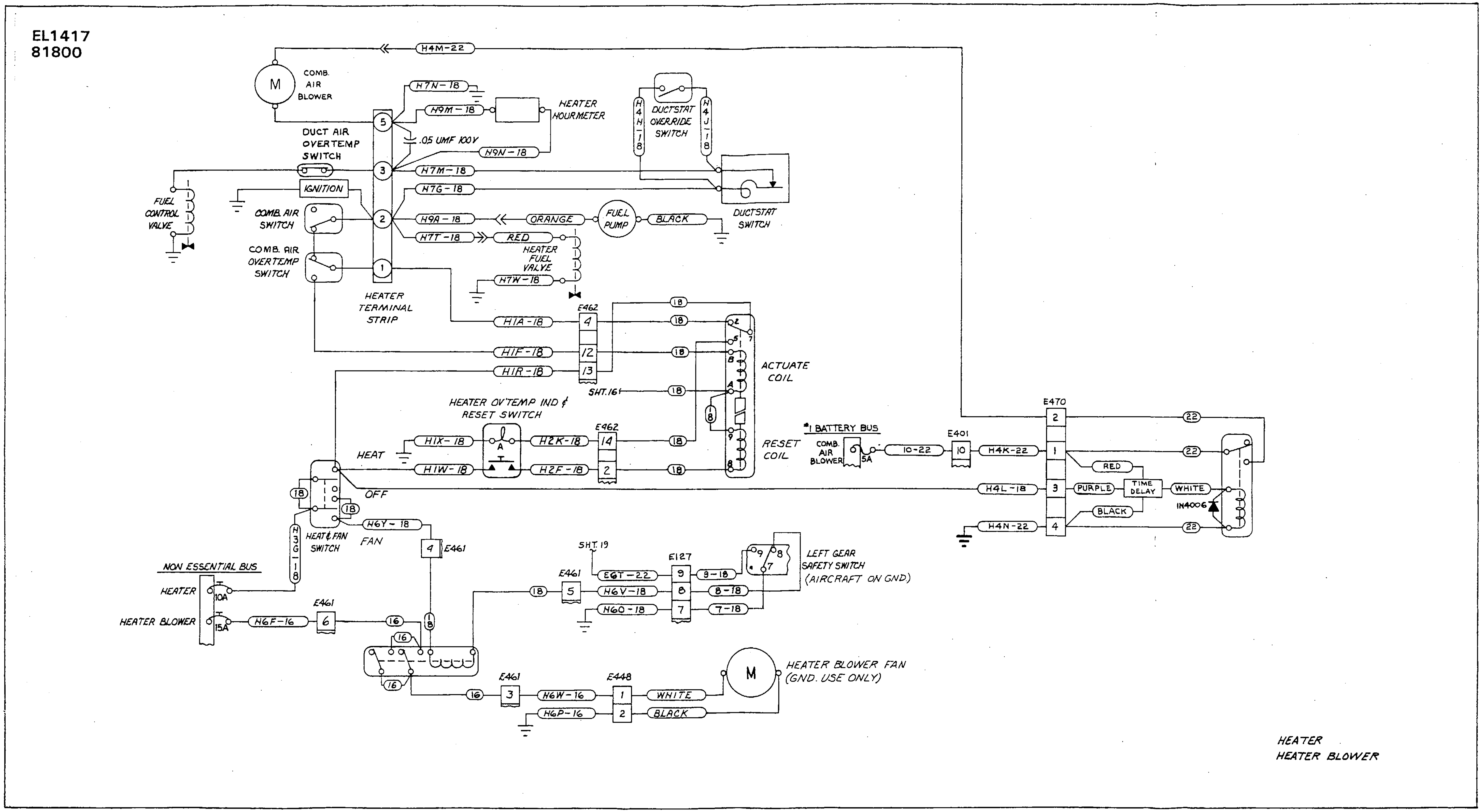
SHEET 15

EL1416
81800

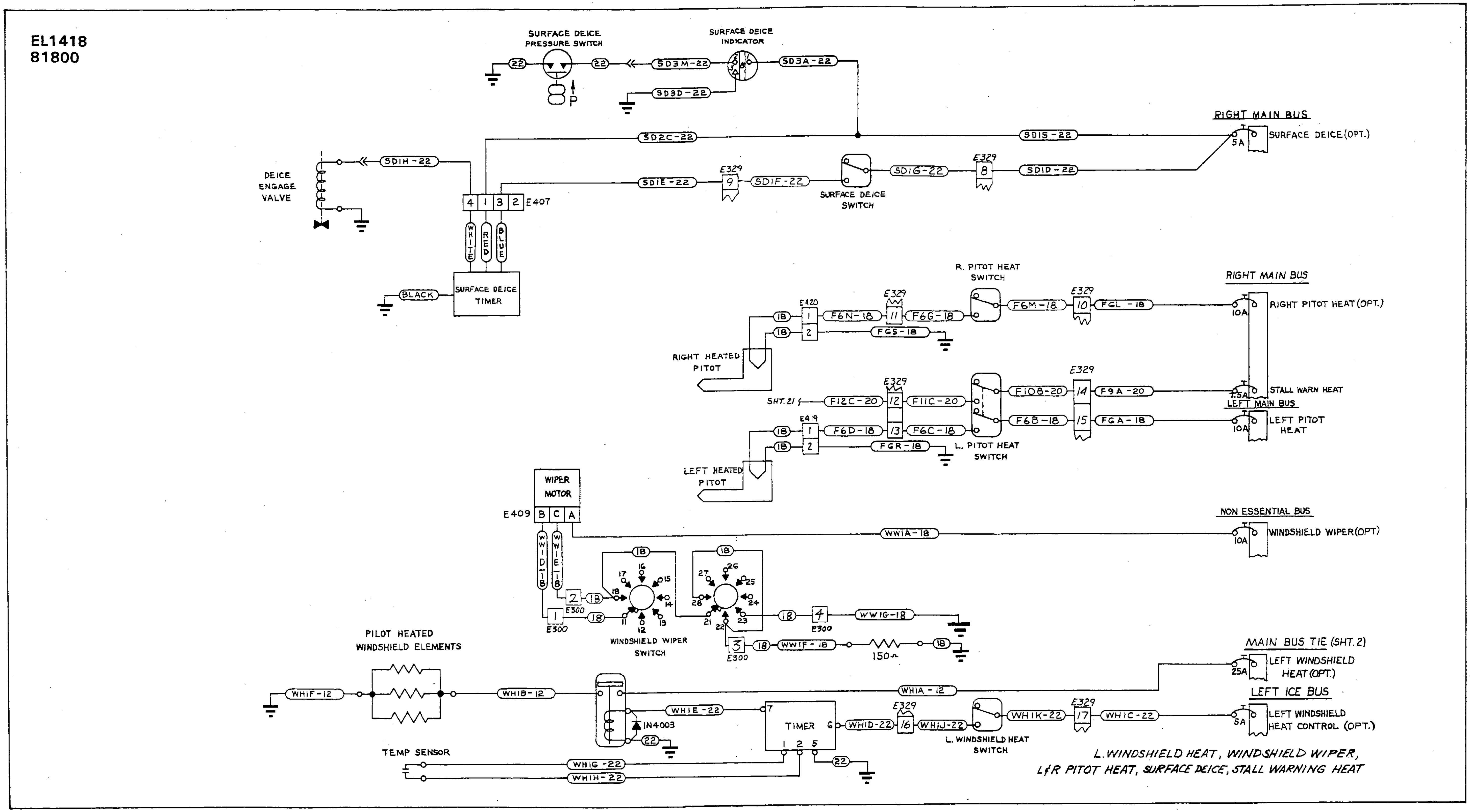


GND. VENT FAN, RECIRC. FANS,
AIR CONDITIONER, CONDENSER BLOWER MOTOR

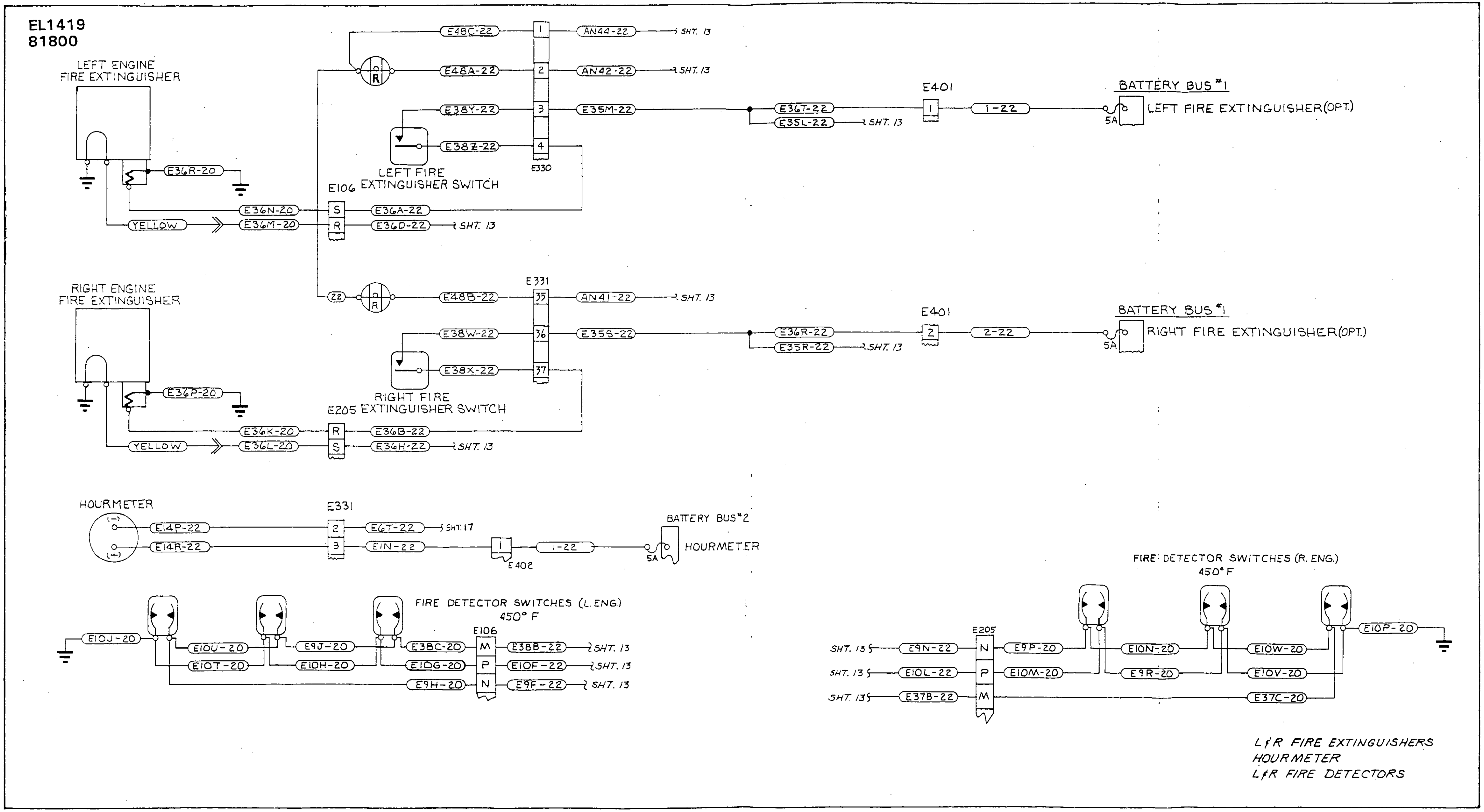
Sheet 16


EL1417
81800
H4M-22
M
COMB. AIR BLOWER
H7N-18
H9M-18
HEATER HOURMETER
.05 UMF 100V
H9N-18
DUCT AIR OVERTEMP SWITCH
H7M-18
IGNITION
H7G-18
H4H-18
DUCTSTAT OVERRIDE SWITCH
H4J-18
DUCTSTAT SWITCH
FUEL CONTROL VALVE
COMB. AIR SWITCH
H9A-18
ORANGE
FUEL PUMP
BLACK
H7T-18
RED
HEATER FUEL VALVE
COMB. AIR OVERTEMP SWITCH
H7W-18
HEATER TERMINAL STRIP
E462
H1A-18
H1F-18
H1R-18
ACTUATE COIL
SHT.16
HEATER OV'TEMP IND & RESET SWITCH
RESET COIL
HEAT
H1X-18
H2K-18
H1W-18
H2F-18
OFF
H6Y-18
HEAT & FAN SWITCH
FAN
E461
H3G-18
#1 BATTERY BUS
COMB. AIR BLOWER
5A
10-22
E401
H4K-22
E470
RED
H4L-18
PURPLE
TIME DELAY
WHITE
IN4006
BLACK
H4N-22
SHT. 19
E127
LEFT GEAR SAFETY SWITCH (AIRCRAFT ON GND)
E6T-22
9-18
H6V-18
8-18
H6O-18
7-18
NON ESSENTIAL BUS
HEATER
10A
HEATER BLOWER
15A
H6F-16
HEATER BLOWER FAN (GND. USE ONLY)
E448
H6W-16
WHITE
H6P-16
BLACK
HEATER
HEATER BLOWER

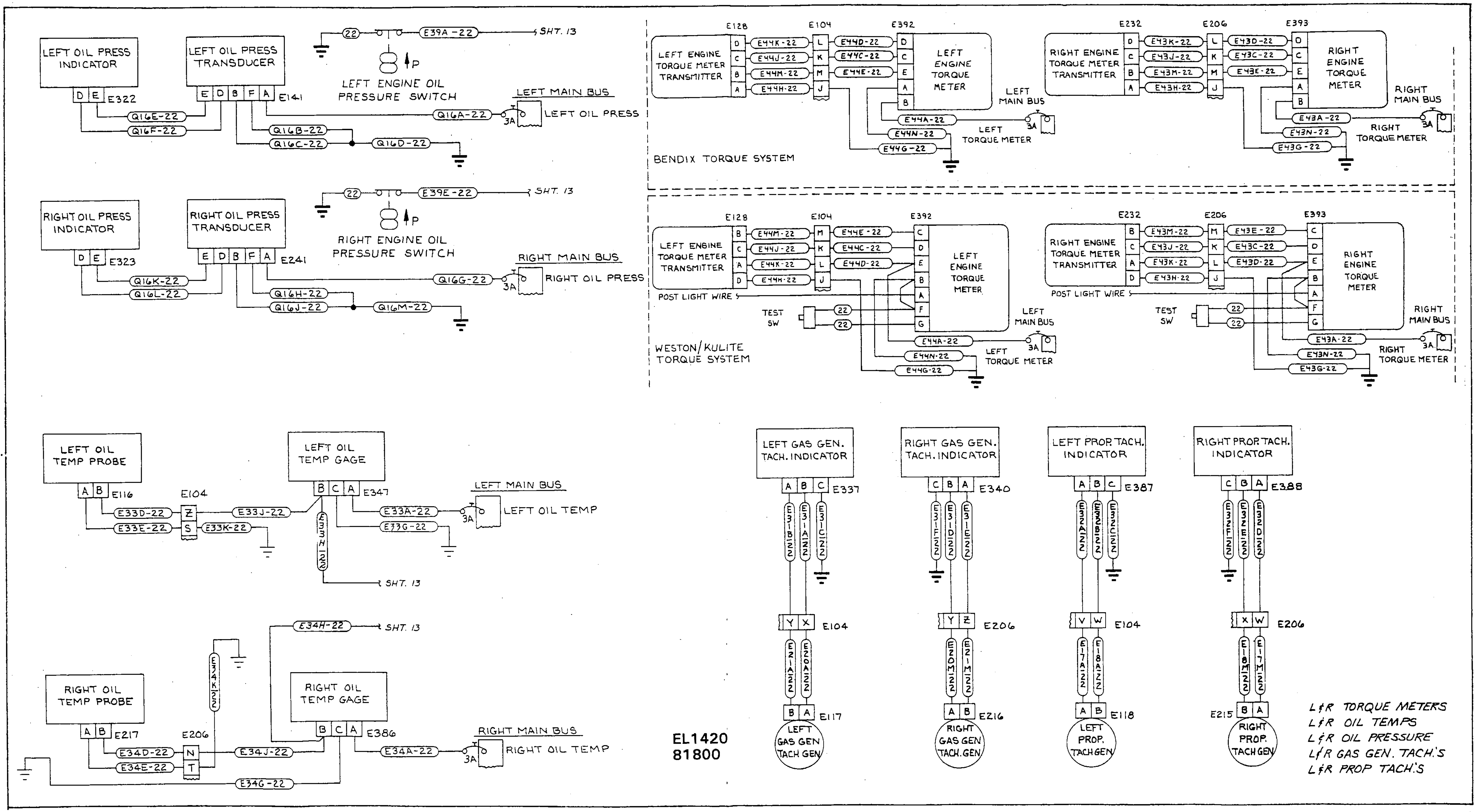
Sheet 17


EL1418
81800
SURFACE DEICE PRESSURE SWITCH
SURFACE DEICE INDICATOR
SD3M-22
SD3A-22
SD3D-22
SD2C-22
SD1S-22
RIGHT MAIN BUS
SURFACE DEICE (OPT.)
DEICE ENGAGE VALVE
SD1H-22
SD1E-22
SD1F-22
SD1G-22
SD1D-22
SURFACE DEICE SWITCH
E407
E329
WHITE
RED
BLUE
BLACK
SURFACE DEICE TIMER
R. PITOT HEAT SWITCH
RIGHT MAIN BUS
RIGHT PITOT HEAT (OPT.)
F6N-18
F6G-18
F6M-18
F6L-18
F6S-18
E420
RIGHT HEATED PITOT
F12C-20
F11C-20
F10B-20
F9A-20
STALL WARN HEAT
LEFT MAIN BUS
LEFT PITOT HEAT
F6D-18
F6C-18
F6B-18
F6A-18
F6R-18
E419
L. PITOT HEAT SWITCH
LEFT HEATED PITOT
WIPER MOTOR
E409
NON ESSENTIAL BUS
WINDSHIELD WIPER (OPT)
WW1A-18
WW1D-18
WW1E-18
E300
WINDSHIELD WIPER SWITCH
WW1G-18
WW1F-18
150Ω
PILOT HEATED WINDSHIELD ELEMENTS
WH1F-12
WH1B-12
WH1A-12
MAIN BUS TIE (SHT. 2)
LEFT WINDSHIELD HEAT (OPT.)
LEFT ICE BUS
WH1E-22
1N4003
TIMER
WH1D-22
WH1J-22
WH1K-22
WH1C-22
L. WINDSHIELD HEAT SWITCH
LEFT WINDSHIELD HEAT CONTROL (OPT.)
TEMP SENSOR
WH1G-22
WH1H-22
L. WINDSHIELD HEAT, WINDSHIELD WIPER,
L & R PITOT HEAT, SURFACE DEICE, STALL WARNING HEAT

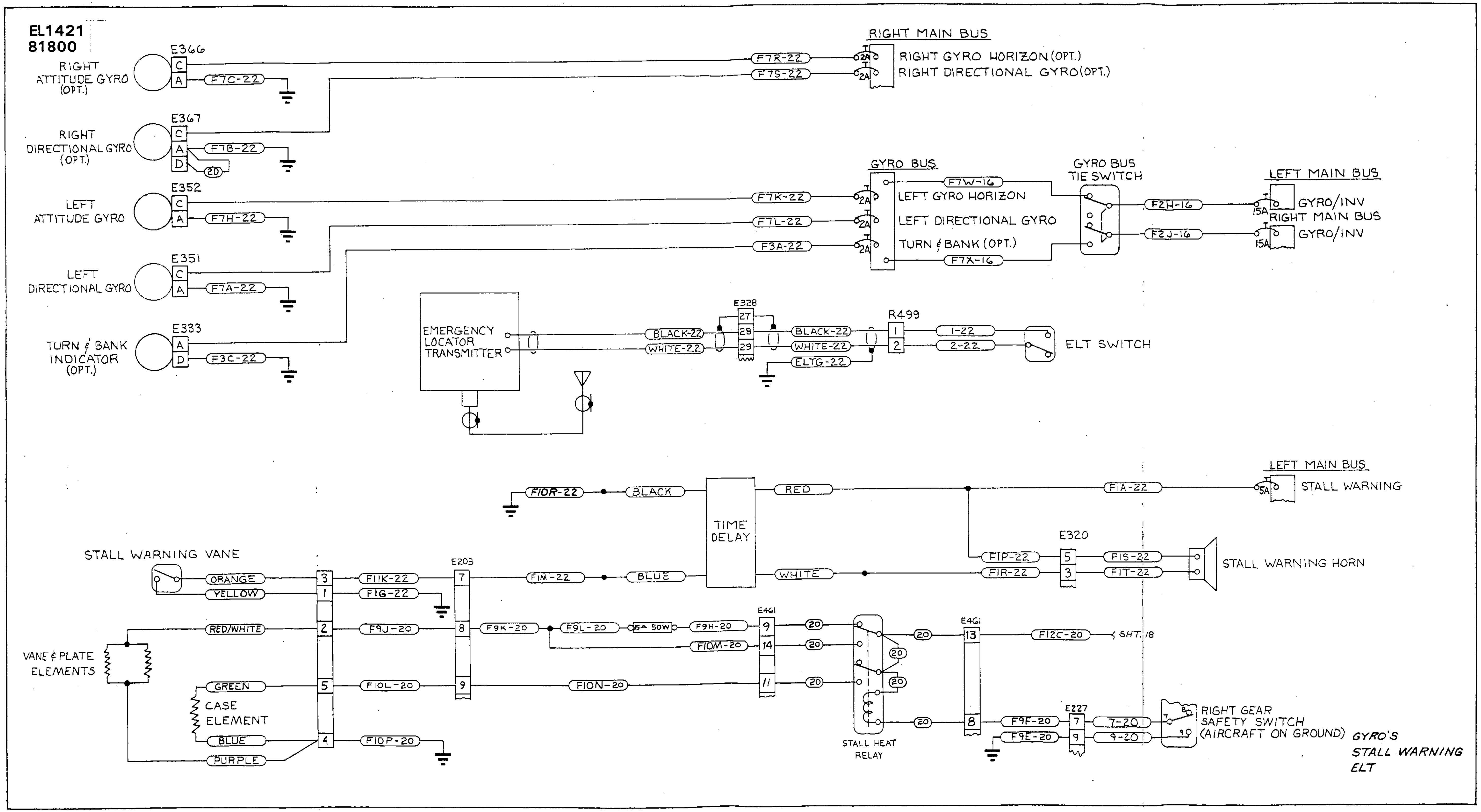
Sheet 18


EL1419
81800
LEFT ENGINE FIRE EXTINGUISHER
E36R-20
E36N-20
YELLOW
E36M-20
E106
S
R
E36A-22
E36D-22
SHT. 13
E48C-22
E48A-22
E38Y-22
E38Z-22
LEFT FIRE EXTINGUISHER SWITCH
E330
AN44-22
SHT. 13
AN42-22
SHT. 13
E35M-22
E36T-22
E35L-22
SHT. 13
E401
1-22
BATTERY BUS #1
5A
LEFT FIRE EXTINGUISHER (OPT.)
RIGHT ENGINE FIRE EXTINGUISHER
E36P-20
E36K-20
YELLOW
E36L-20
E205
E36B-22
E36H-22
SHT. 13
E331
E48B-22
E38W-22
E38X-22
RIGHT FIRE EXTINGUISHER SWITCH
AN41-22
SHT. 13
E35S-22
E36R-22
E35R-22
SHT. 13
E401
2-22
BATTERY BUS #1
5A
RIGHT FIRE EXTINGUISHER (OPT.)
HOURMETER
E14P-22
E14R-22
E331
E6T-22
SHT. 17
E1N-22
E402
1-22
BATTERY BUS #2
5A
HOURMETER
FIRE DETECTOR SWITCHES (L. ENG.)
450° F
E10J-20
E10U-20
E10T-20
E9J-20
E10H-20
E38C-20
E10G-20
E9H-20
E106
M
P
N
E38B-22
E10F-22
E9F-22
SHT. 13
FIRE DETECTOR SWITCHES (R. ENG.)
450° F
SHT. 13
E9N-22
E10L-22
E37B-22
E205
N
P
M
E9P-20
E10M-20
E10N-20
E9R-20
E10W-20
E10V-20
E37C-20
E10P-20
L & R FIRE EXTINGUISHERS
HOURMETER
L & R FIRE DETECTORS

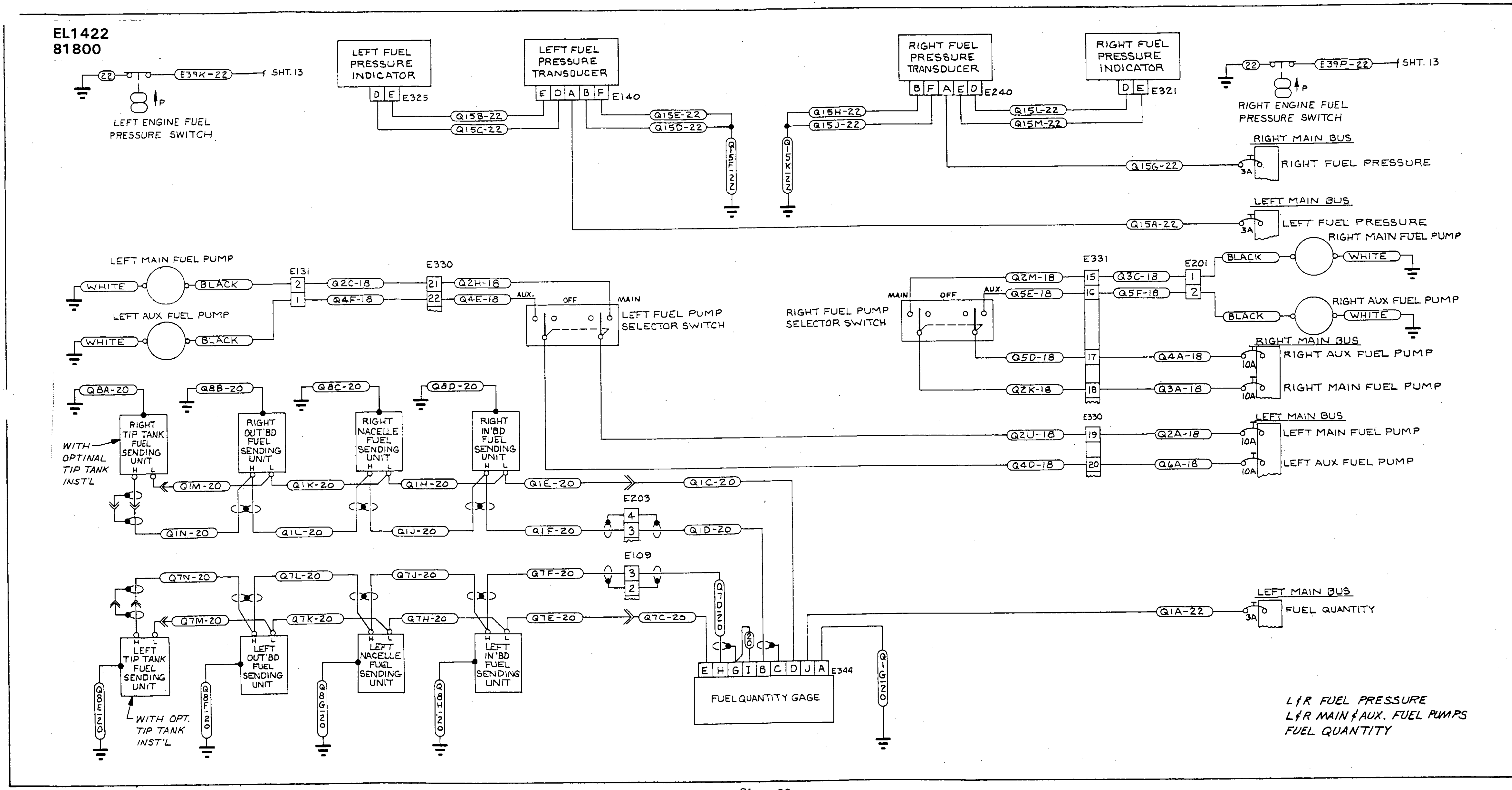
Sheet 19


LEFT OIL PRESS INDICATOR
LEFT OIL PRESS TRANSDUCER
LEFT ENGINE OIL PRESSURE SWITCH
LEFT MAIN BUS
LEFT OIL PRESS
RIGHT OIL PRESS INDICATOR
RIGHT OIL PRESS TRANSDUCER
RIGHT ENGINE OIL PRESSURE SWITCH
RIGHT MAIN BUS
RIGHT OIL PRESS
LEFT ENGINE TORQUE METER TRANSMITTER
LEFT ENGINE TORQUE METER
RIGHT ENGINE TORQUE METER TRANSMITTER
RIGHT ENGINE TORQUE METER
BENDIX TORQUE SYSTEM
WESTON/KULITE TORQUE SYSTEM
LEFT OIL TEMP PROBE
LEFT OIL TEMP GAGE
LEFT OIL TEMP
RIGHT OIL TEMP PROBE
RIGHT OIL TEMP GAGE
RIGHT OIL TEMP
LEFT GAS GEN. TACH. INDICATOR
RIGHT GAS GEN. TACH. INDICATOR
LEFT PROP. TACH. INDICATOR
RIGHT PROP. TACH. INDICATOR
LEFT GAS GEN TACH GEN
RIGHT GAS GEN TACH. GEN
LEFT PROP. TACH GEN
RIGHT PROP. TACH GEN
EL1420
81800
L & R TORQUE METERS
L & R OIL TEMPS
L & R OIL PRESSURE
L/R GAS GEN. TACH.'S
L & R PROP TACH.'S

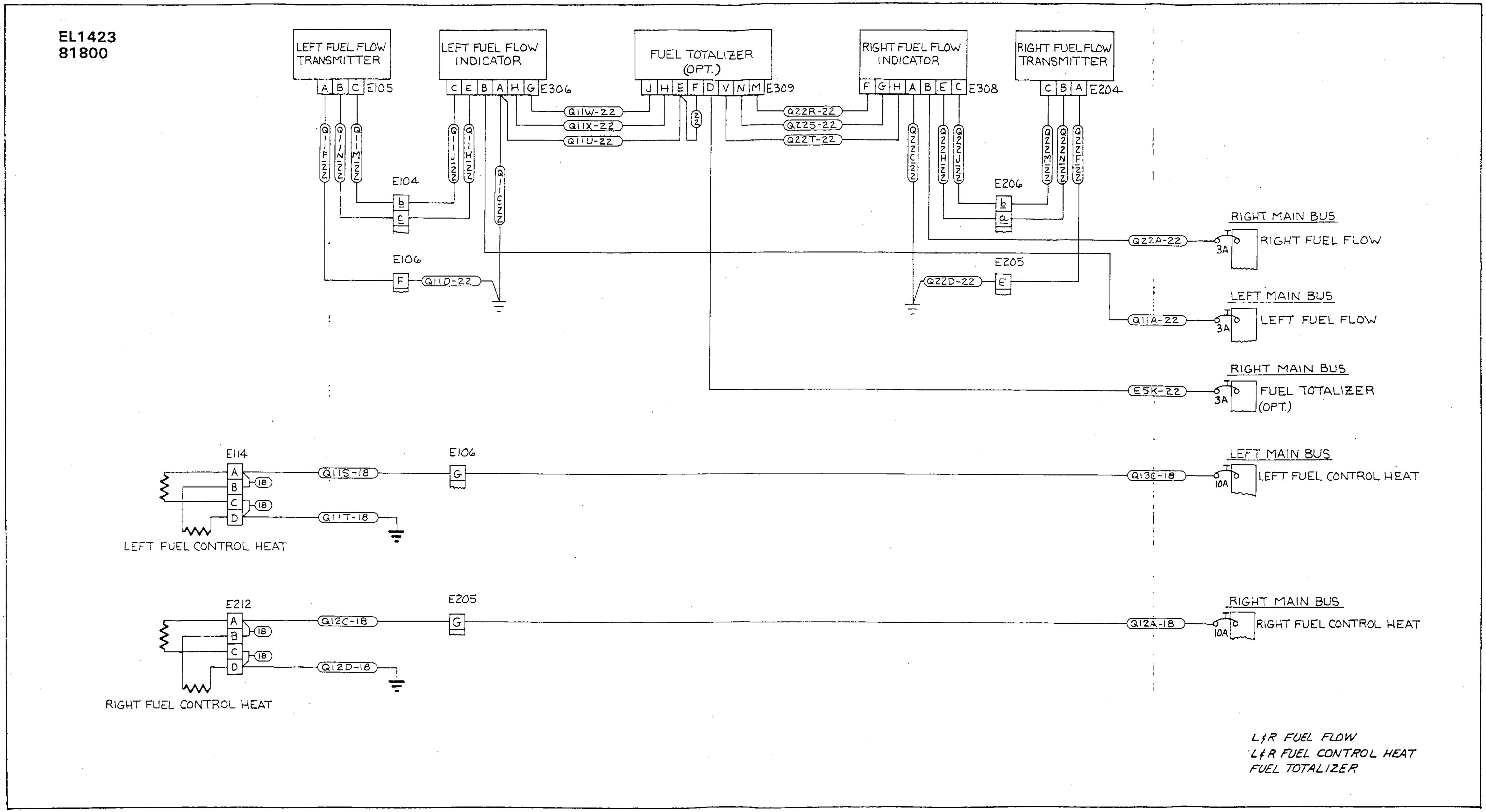
Sheet 20


EL1421
81800
RIGHT ATTITUDE GYRO (OPT.)
RIGHT DIRECTIONAL GYRO (OPT.)
LEFT ATTITUDE GYRO
LEFT DIRECTIONAL GYRO
TURN & BANK INDICATOR (OPT.)
E366
E367
E352
E351
E333
F7C-22
F7B-22
F7H-22
F7A-22
F3C-22
F7R-22
F7S-22
F7K-22
F7L-22
F3A-22
RIGHT MAIN BUS
RIGHT GYRO HORIZON (OPT.)
RIGHT DIRECTIONAL GYRO (OPT.)
GYRO BUS
LEFT GYRO HORIZON
LEFT DIRECTIONAL GYRO
TURN & BANK (OPT.)
F7W-16
F7X-16
GYRO BUS TIE SWITCH
F2H-16
F2J-16
LEFT MAIN BUS
GYRO/INV
RIGHT MAIN BUS
GYRO/INV
EMERGENCY LOCATOR TRANSMITTER
E328
BLACK-22
WHITE-22
ELTG-22
R499
1-22
2-22
ELT SWITCH
LEFT MAIN BUS
STALL WARNING
F10R-22
BLACK
RED
F1A-22
TIME DELAY
E320
F1P-22
F1R-22
F1S-22
F1T-22
STALL WARNING HORN
STALL WARNING VANE
ORANGE
YELLOW
E203
F11K-22
F1G-22
F1M-22
BLUE
WHITE
RED/WHITE
F9J-20
F9K-20
F9L-20
15Ω 50W
F9H-20
F10M-20
E461
F12C-20
SHT. 18
VANE & PLATE ELEMENTS
GREEN
F10L-20
F10N-20
CASE ELEMENT
BLUE
PURPLE
F10P-20
STALL HEAT RELAY
E227
F9F-20
F9E-20
7-20
9-20
RIGHT GEAR SAFETY SWITCH (AIRCRAFT ON GROUND)
GYRO'S
STALL WARNING
ELT

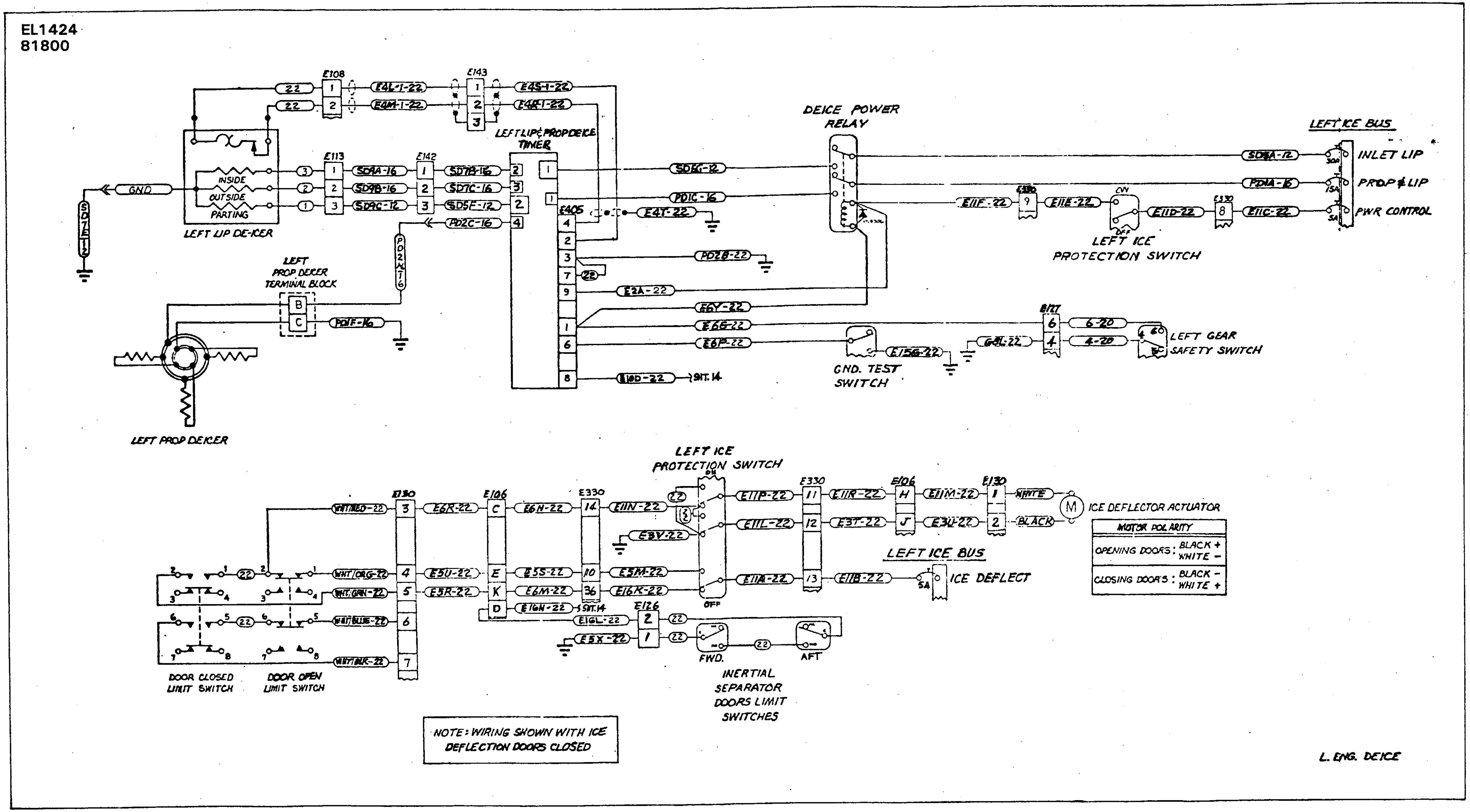
Sheet 21


EL1422
81800
LEFT ENGINE FUEL PRESSURE SWITCH
SHT. 13
LEFT FUEL PRESSURE INDICATOR
LEFT FUEL PRESSURE TRANSDUCER
RIGHT FUEL PRESSURE TRANSDUCER
RIGHT FUEL PRESSURE INDICATOR
RIGHT ENGINE FUEL PRESSURE SWITCH
RIGHT MAIN BUS
RIGHT FUEL PRESSURE
LEFT MAIN BUS
LEFT FUEL PRESSURE
LEFT MAIN FUEL PUMP
LEFT AUX FUEL PUMP
RIGHT MAIN FUEL PUMP
RIGHT AUX FUEL PUMP
LEFT FUEL PUMP SELECTOR SWITCH
RIGHT FUEL PUMP SELECTOR SWITCH
RIGHT TIP TANK FUEL SENDING UNIT
RIGHT OUT'BD FUEL SENDING UNIT
RIGHT NACELLE FUEL SENDING UNIT
RIGHT IN'BD FUEL SENDING UNIT
WITH OPTINAL TIP TANK INST'L
LEFT TIP TANK FUEL SENDING UNIT
LEFT OUT'BD FUEL SENDING UNIT
LEFT NACELLE FUEL SENDING UNIT
LEFT IN'BD FUEL SENDING UNIT
WITH OPT. TIP TANK INST'L
FUEL QUANTITY GAGE
FUEL QUANTITY
L & R FUEL PRESSURE
L & R MAIN & AUX. FUEL PUMPS
FUEL QUANTITY

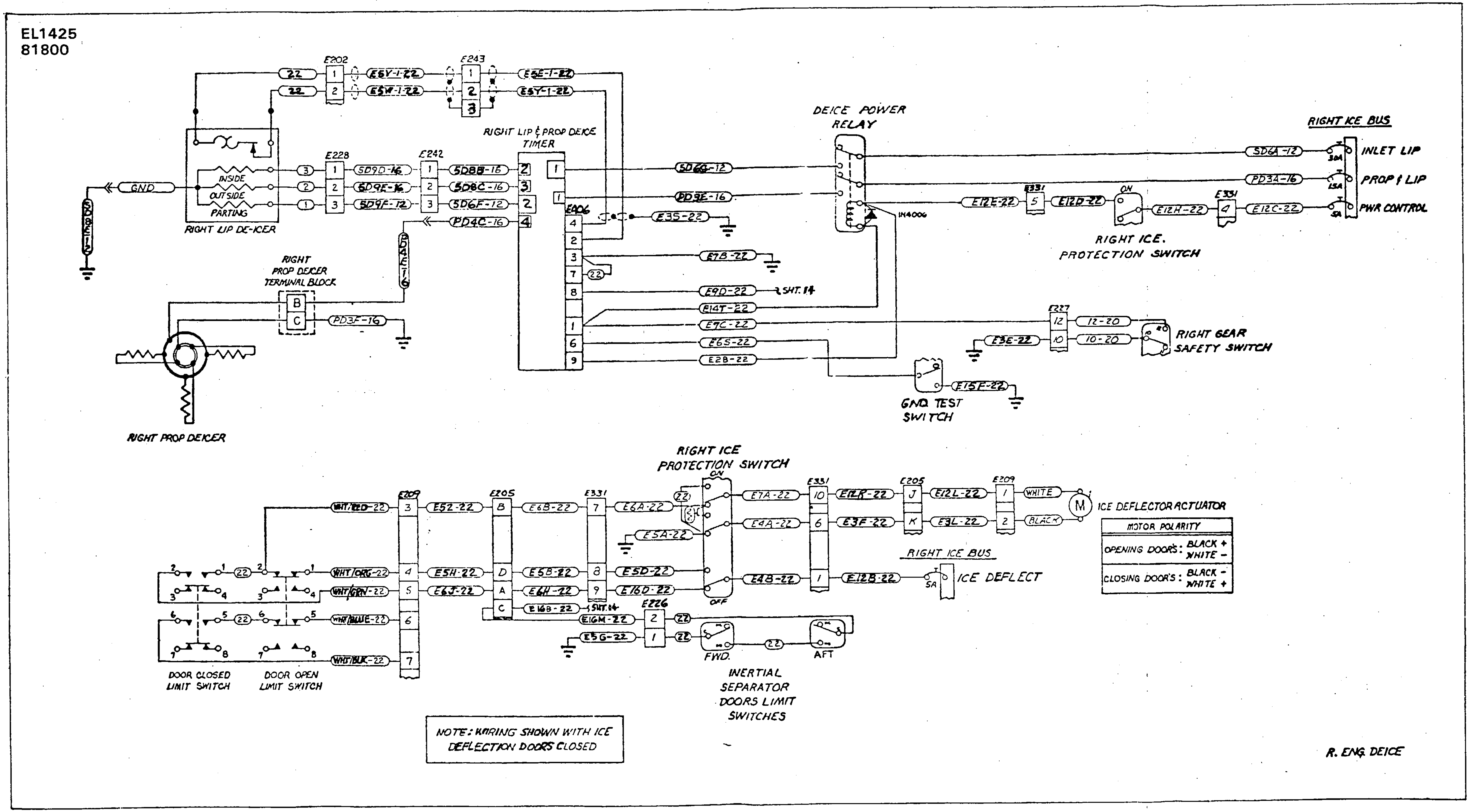
Sheet 22


EL1423
81800
LEFT FUEL FLOW TRANSMITTER
LEFT FUEL FLOW INDICATOR
FUEL TOTALIZER (OPT.)
RIGHT FUEL FLOW INDICATOR
RIGHT FUEL FLOW TRANSMITTER
E105
E306
E309
E308
E204
Q11W-22
Q11X-22
Q11U-22
Q22R-22
Q22S-22
Q22T-22
E104
E206
E106
E205
Q11D-22
Q22D-22
RIGHT MAIN BUS
RIGHT FUEL FLOW
Q22A-22
LEFT MAIN BUS
LEFT FUEL FLOW
Q11A-22
RIGHT MAIN BUS
FUEL TOTALIZER (OPT.)
E5K-22
3A
E114
Q11S-18
Q11T-18
LEFT MAIN BUS
LEFT FUEL CONTROL HEAT
Q13C-18
10A
LEFT FUEL CONTROL HEAT
E212
Q12C-18
Q12D-18
RIGHT MAIN BUS
RIGHT FUEL CONTROL HEAT
Q12A-18
RIGHT FUEL CONTROL HEAT
L & R FUEL FLOW
L & R FUEL CONTROL HEAT
FUEL TOTALIZER

Sheet 23


EL1424
81800
LEFT LIP DE-ICER
INSIDE
OUTSIDE
PARTING
LEFT PROP DEICER TERMINAL BLOCK
LEFT PROP DEICER
LEFT LIP & PROP DEICE TIMER
DEICE POWER RELAY
LEFT ICE BUS
INLET LIP
PROP & LIP
PWR CONTROL
LEFT ICE PROTECTION SWITCH
GND. TEST SWITCH
LEFT GEAR SAFETY SWITCH
LEFT ICE PROTECTION SWITCH
ICE DEFLECTOR ACTUATOR
MOTOR POLARITY
OPENING DOORS: BLACK + WHITE −
CLOSING DOORS: BLACK − WHITE +
LEFT ICE BUS
ICE DEFLECT
DOOR CLOSED LIMIT SWITCH
DOOR OPEN LIMIT SWITCH
FWD.
AFT
INERTIAL SEPARATOR DOORS LIMIT SWITCHES
NOTE: WIRING SHOWN WITH ICE DEFLECTION DOORS CLOSED
L. ENG. DEICE

Sheet 24


EL1425
81800
RIGHT LIP & PROP DEICE TIMER
DEICE POWER RELAY
RIGHT ICE BUS
INLET LIP
PROP & LIP
PWR CONTROL
RIGHT ICE PROTECTION SWITCH
RIGHT LIP DE-ICER
INSIDE
OUTSIDE
PARTING
RIGHT PROP DEICER TERMINAL BLOCK
RIGHT PROP DEICER
RIGHT GEAR SAFETY SWITCH
GND TEST SWITCH
ICE DEFLECTOR ACTUATOR
MOTOR POLARITY
OPENING DOORS: BLACK + WHITE -
CLOSING DOORS: BLACK - WHITE +
ICE DEFLECT
DOOR CLOSED LIMIT SWITCH
DOOR OPEN LIMIT SWITCH
INERTIAL SEPARATOR DOORS LIMIT SWITCHES
FWD.
AFT
NOTE: WIRING SHOWN WITH ICE DEFLECTION DOORS CLOSED
R. ENG. DEICE

Sheet 25

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 T-1040.

TOOLS AND TEST EQUIPMENT.

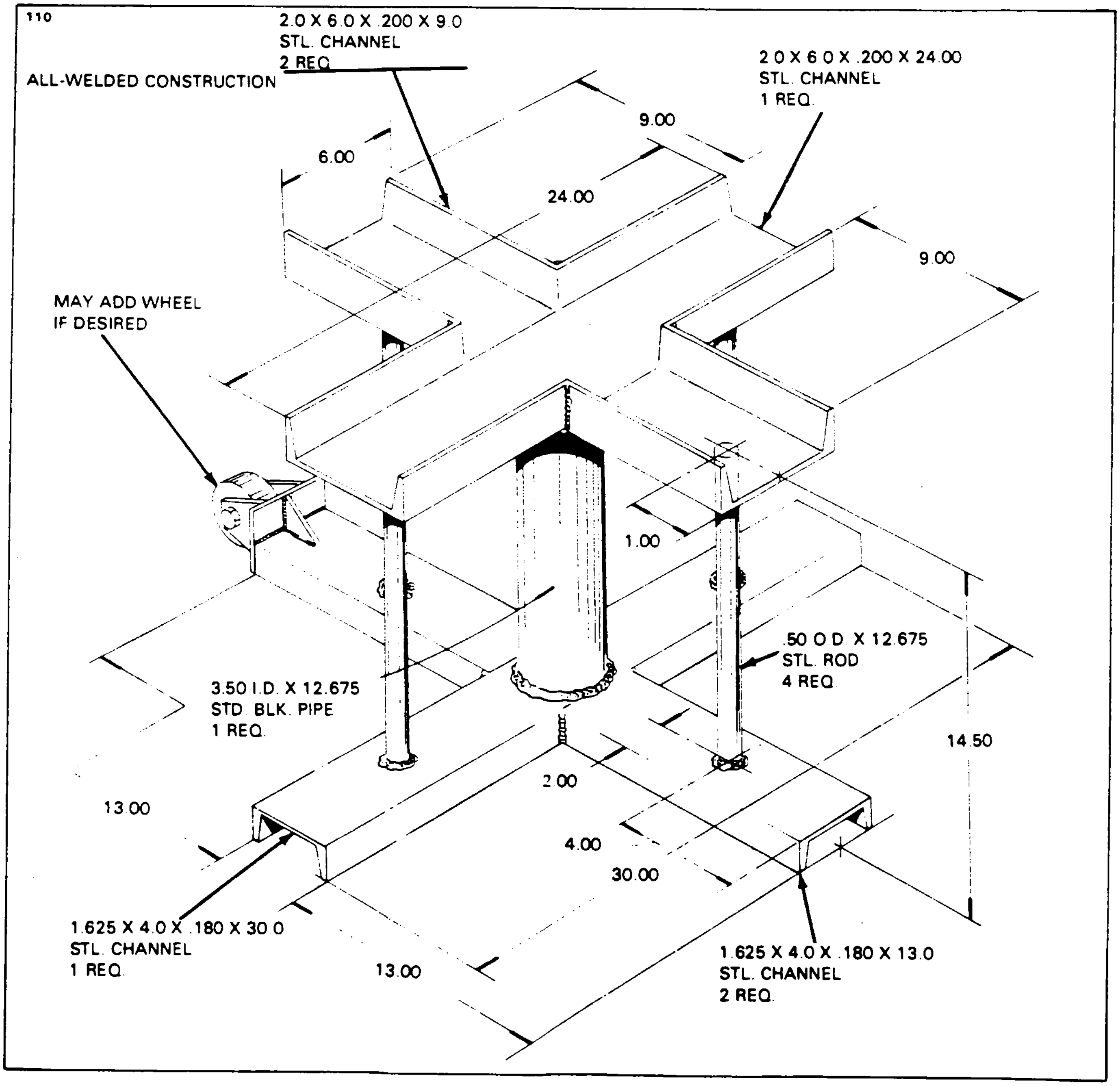


Figure 95-1. Fabricated Jack Stand for Piper Jack, Part No. 18338-00

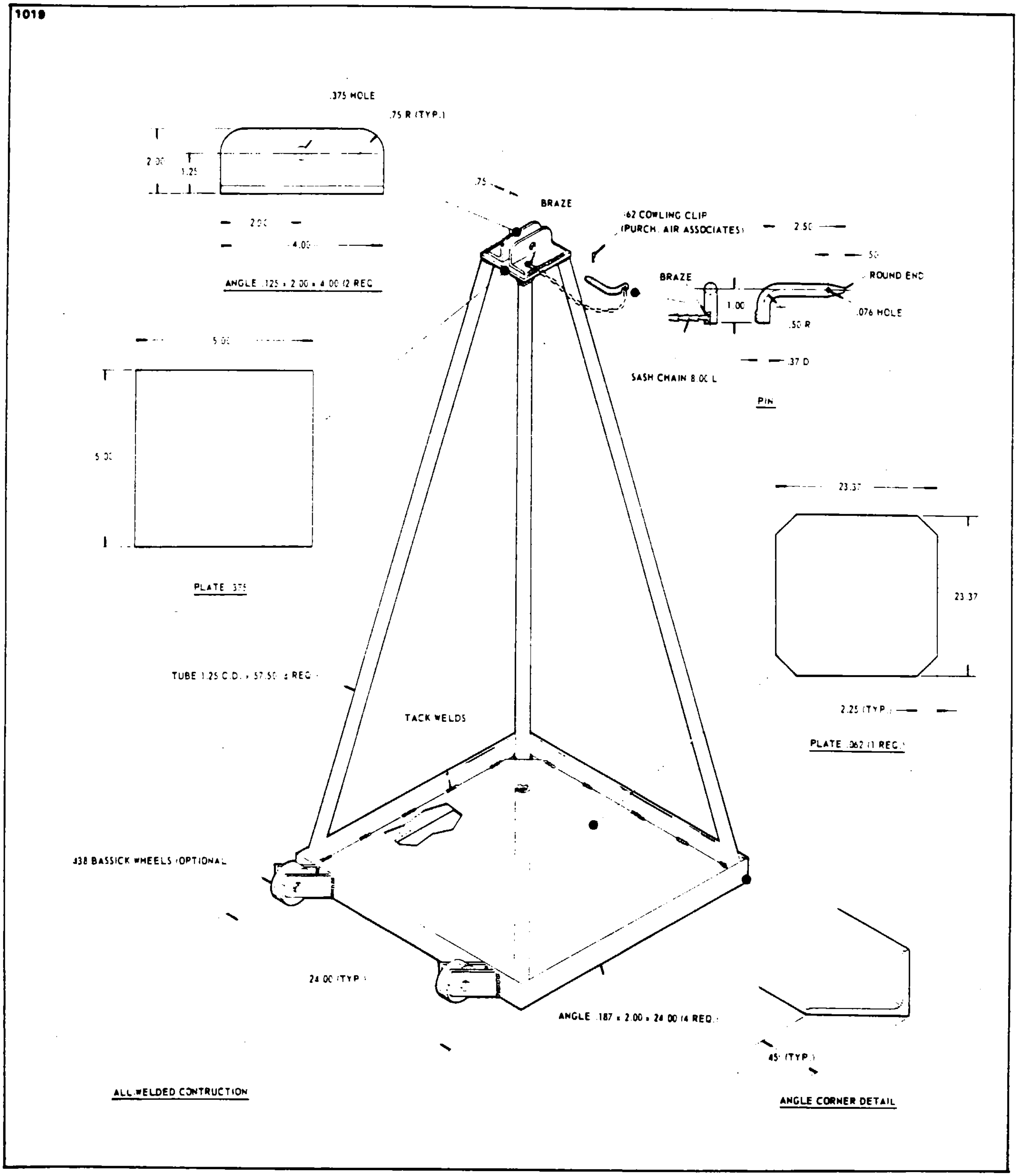
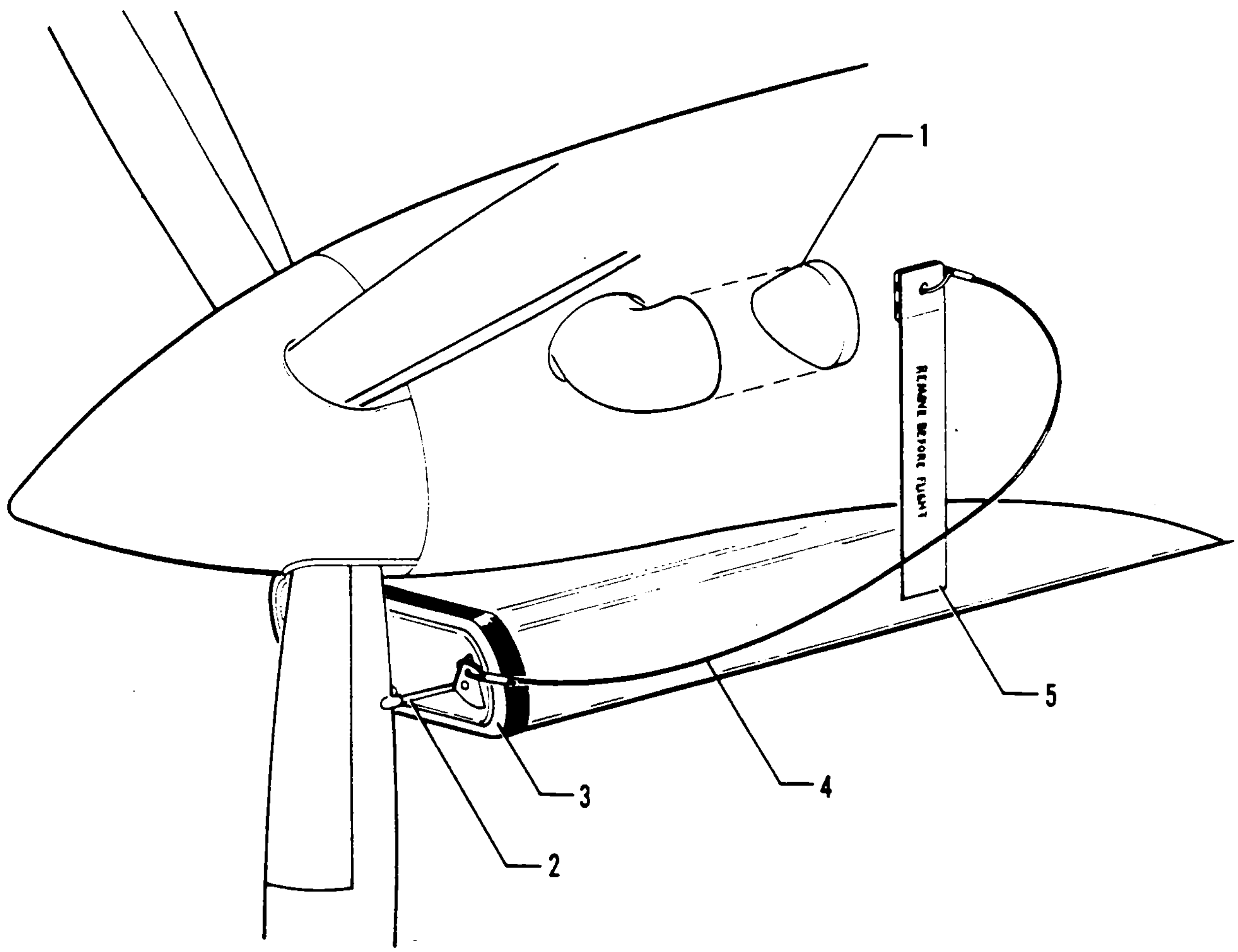


Figure 95-2. Fabricated Tail Stand

4BB



1. EXHAUST STUB PLUG (51456-00)
2. PROPELLER ANTI-SPIN BRACE (82069-2)
3. ENGINE AIR INLET COVER (82082-2)
4. ENGINE GROUND PROTECTION CABLE (51461-02)
5. GROUND PROTECTION WARNING STRAP (51526-00)

Figure 95-3. Protective Closures Installation

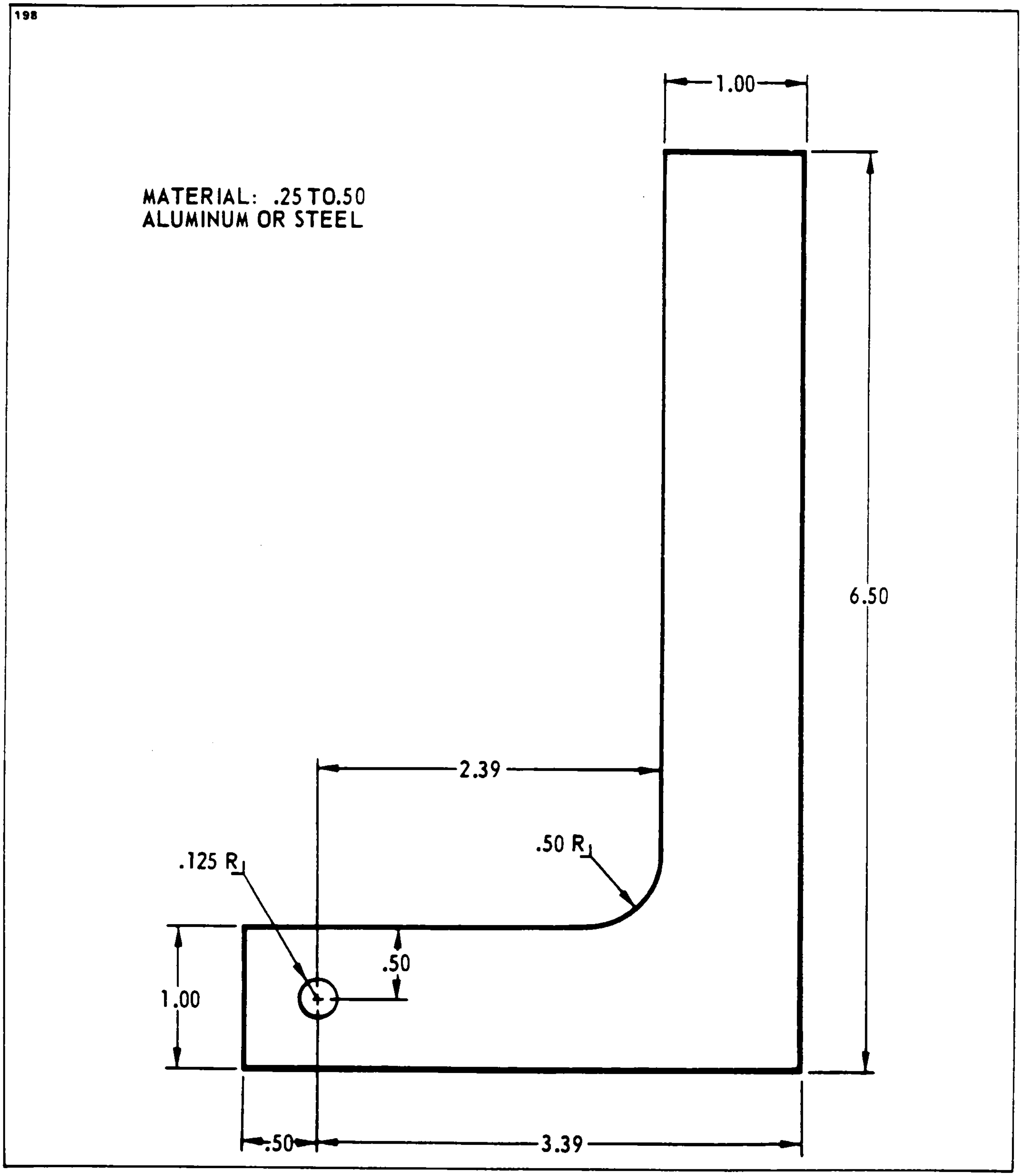


Figure 95-4. Fabricated Bellcrank Rigging Tool

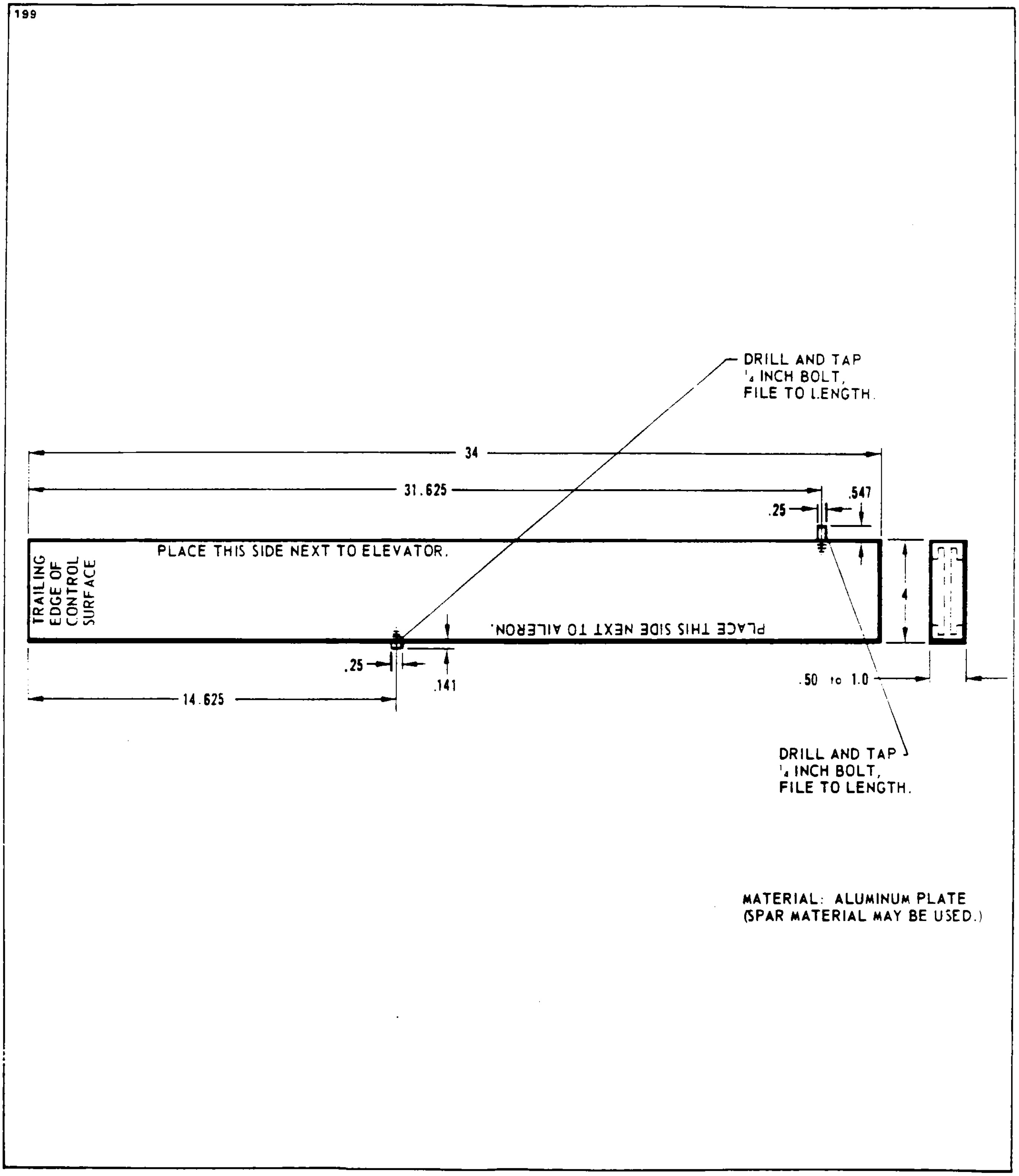


Figure 95-5. Fabricated Aileron and Elevator Rigging Tool

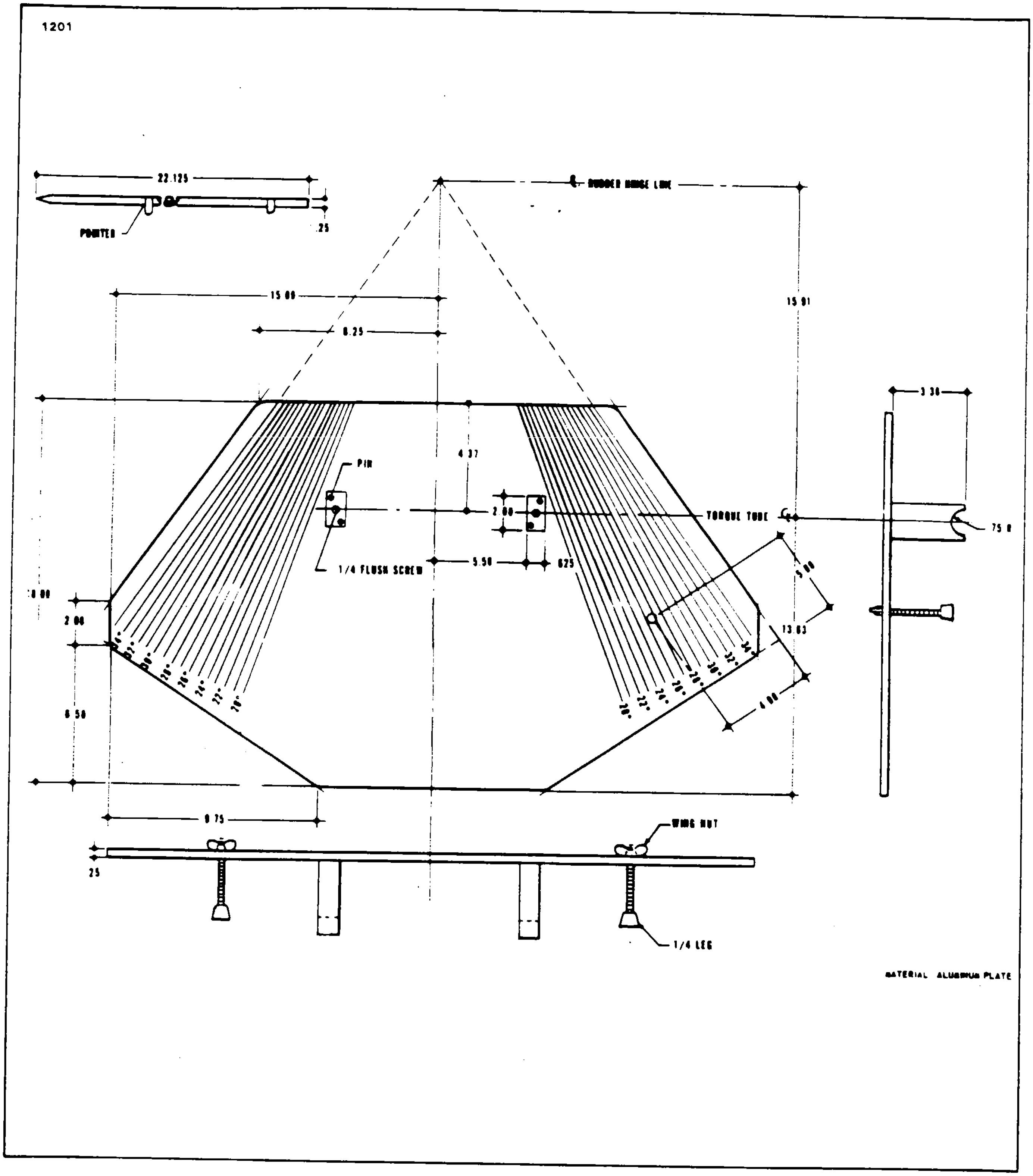


Figure 95-6. Fabricated Rudder Rigging Tool

1360

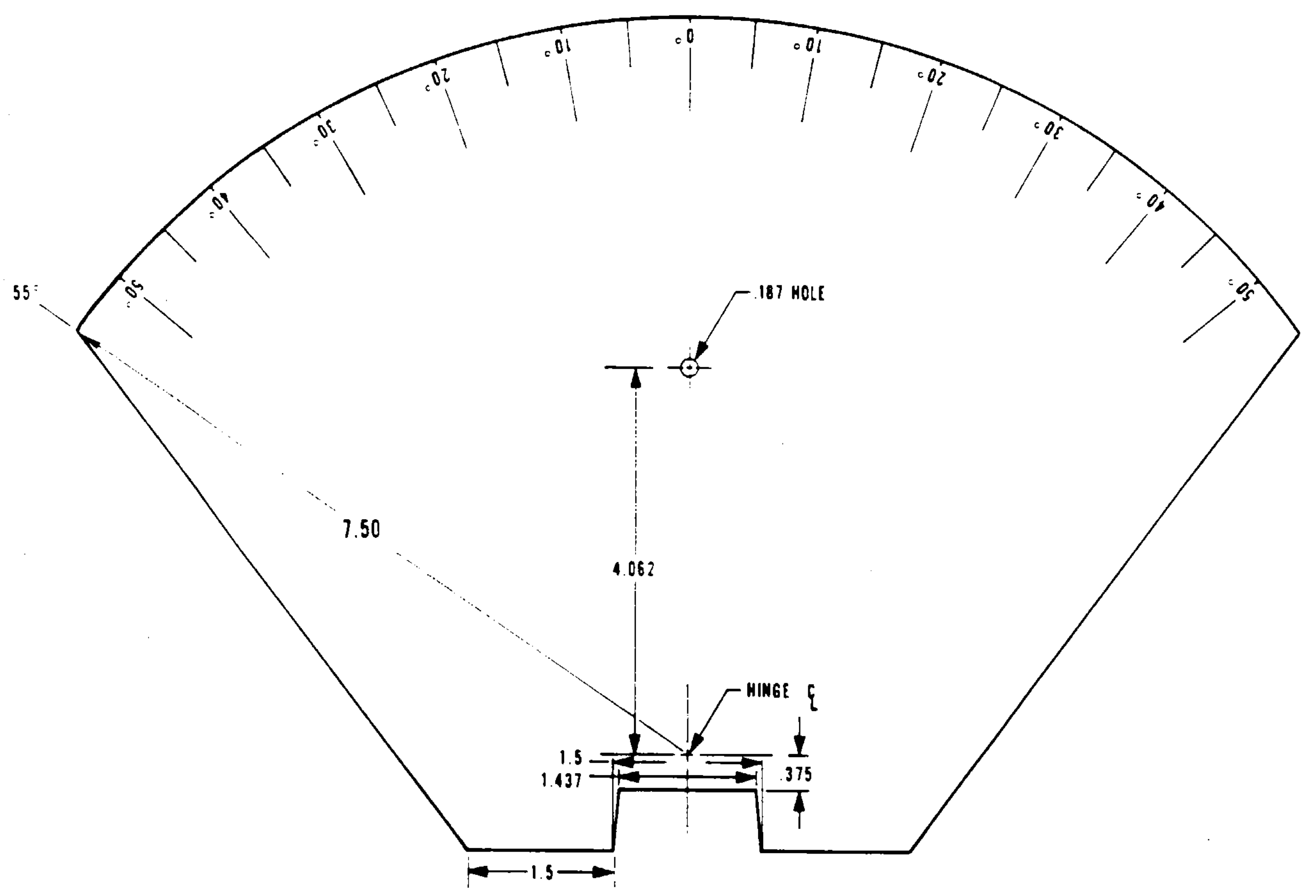


Figure 95-7. Fabricated Rudder Trim Tab Rigging Tool

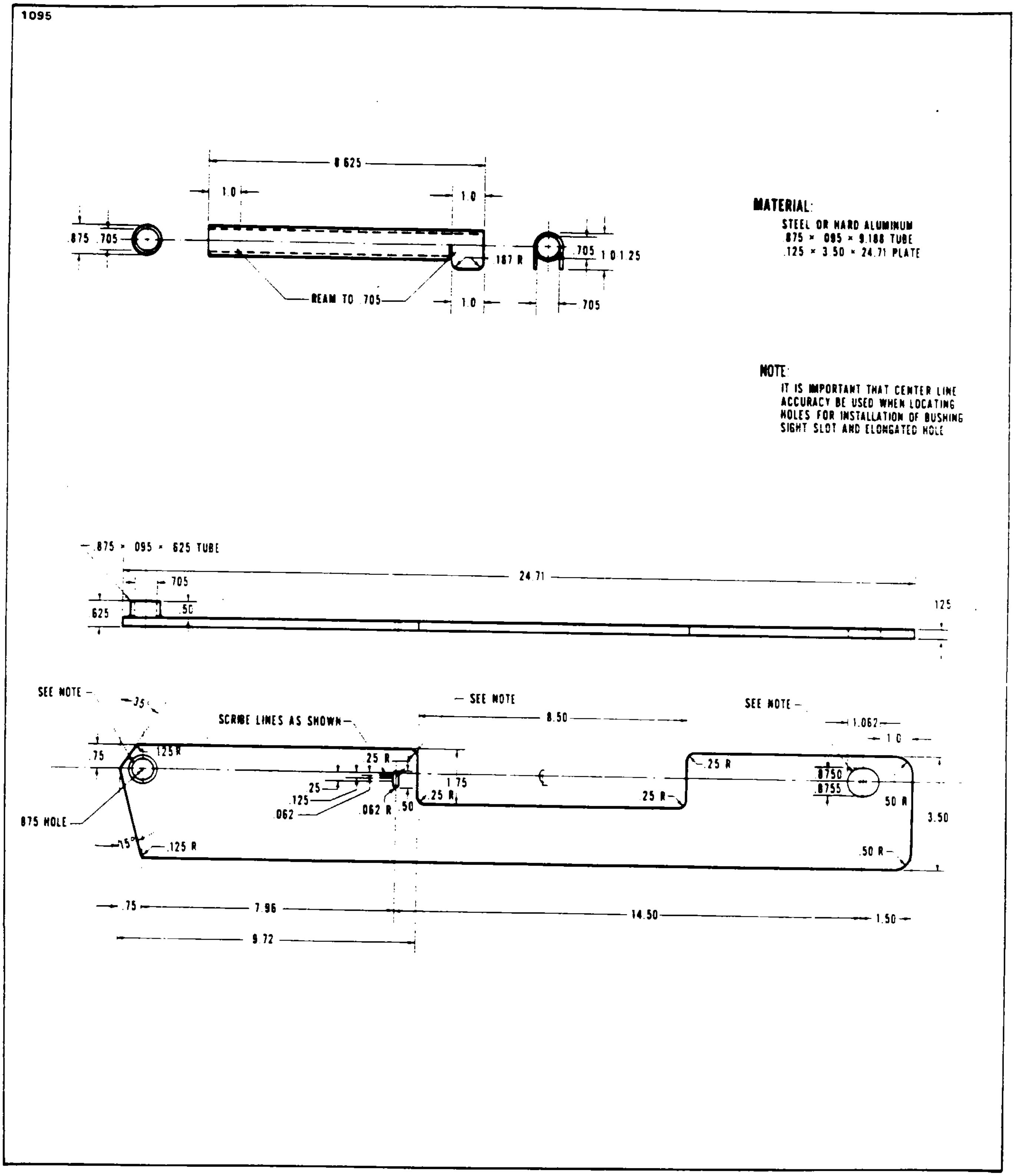


Figure 95-8. Fabricated Tool, Checking Nose Gear Link Travel

1096

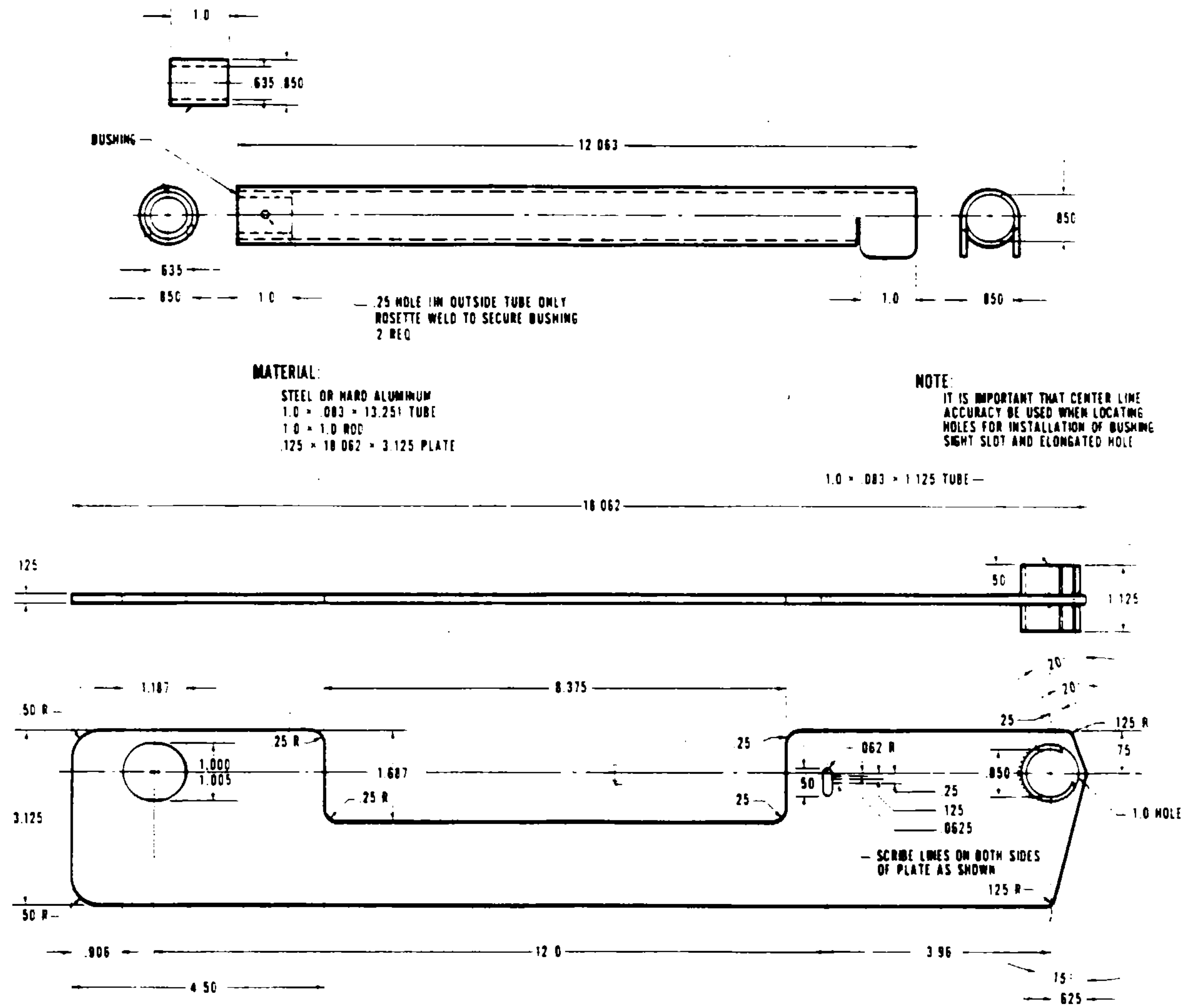


Figure 95-9. Fabricated Tool, Checking Main Gear Side Brace Link Travel

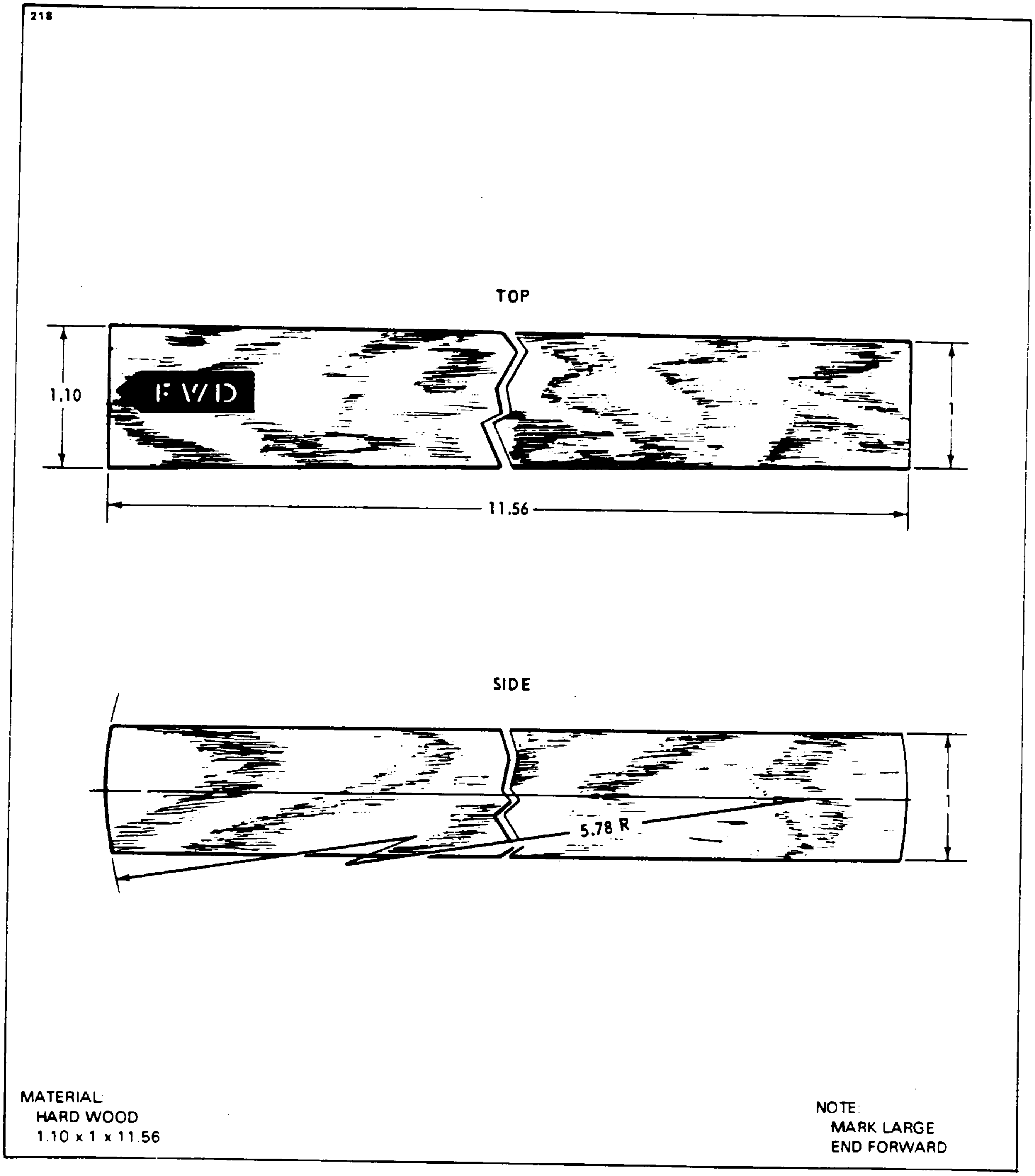
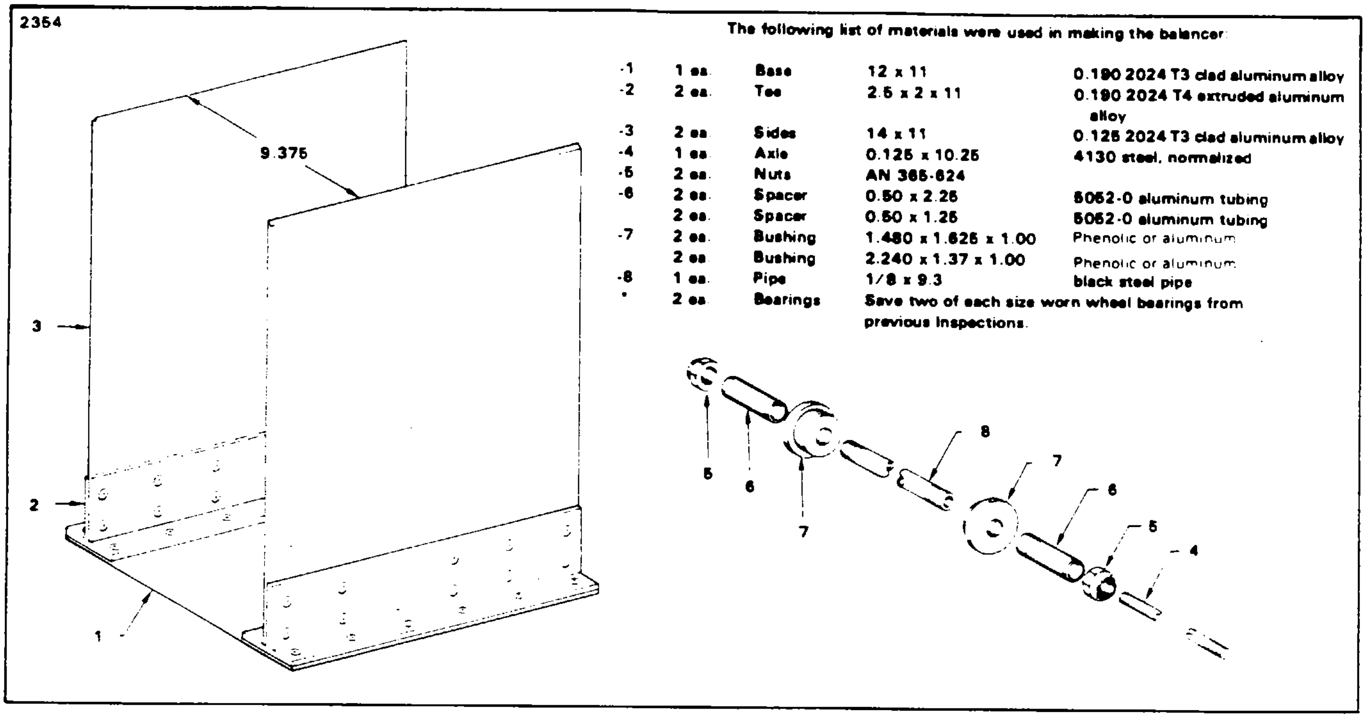


Figure 95-10. Fabricated Tool, Checking Main Gear Toe-In Adjustment



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 95-11. Tire Balancer

CONSTRUCTION OF TIRE BALANCER. (Refer to Figure 95-11.)

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 1 1/2 inch hole saw to cut out the smaller bushing and 1 3/4 inch hole saw to cut out the larger. By inserting a 1/4 inch long threaded bolt through the pilot hole and securing with a washer and nut, a drill press and file may be used to make the off-set on the bushing. The turned-down part should just slide inside the bearing race. Ream the pilot hole to slide over the -8 pipe threads.
5. The -8 pipe was made from a piece of 1/8 inch black pipe and threaded with a 1/8-27 pipe die. Thread 3 inches in from each end of the pipe.

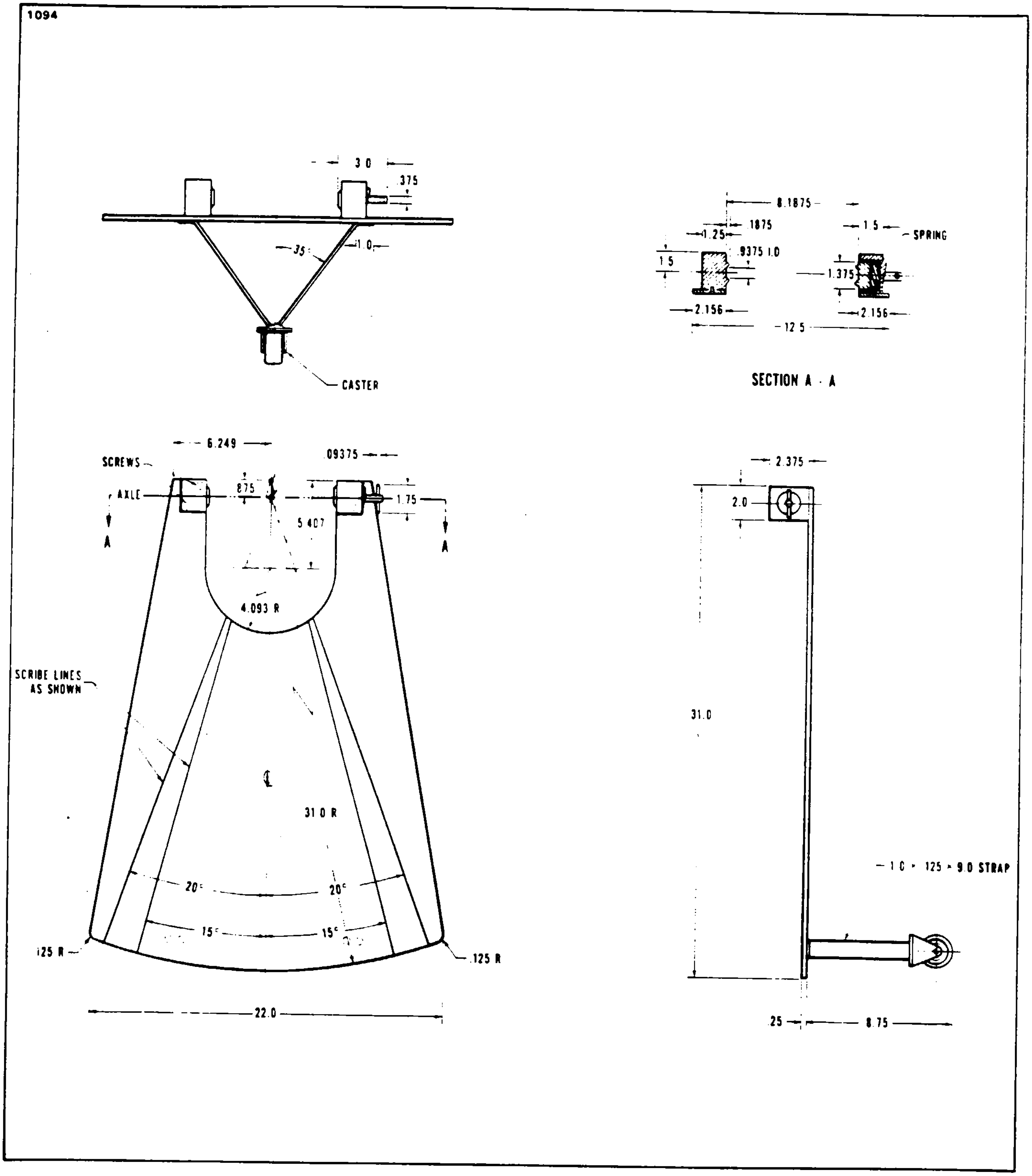


Figure 95-12. Fabricated Tool, Checking Nose Wheel Alignment

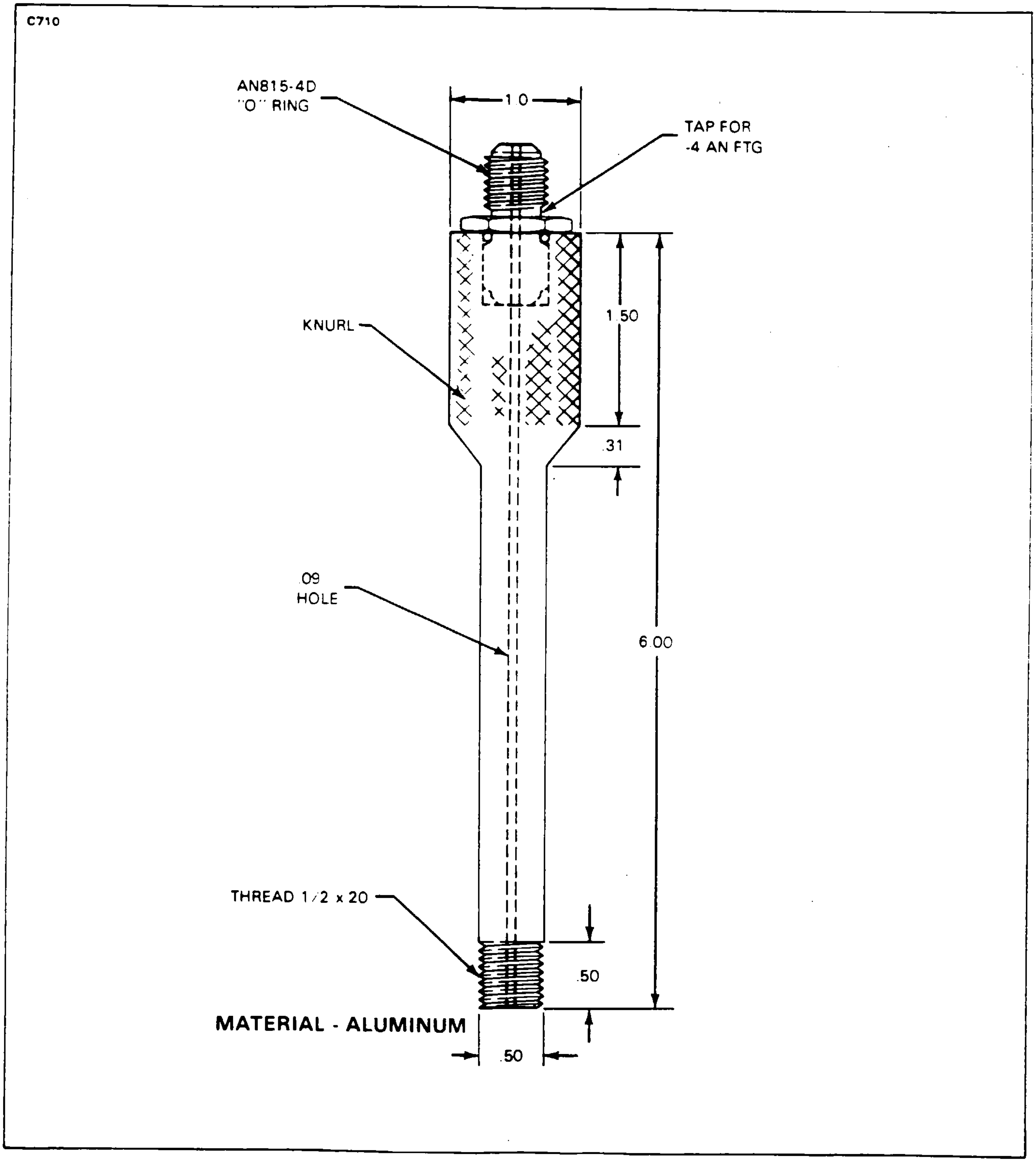


Figure 95-13. Fabricated Test Fitting, Emergency Gear Extension System

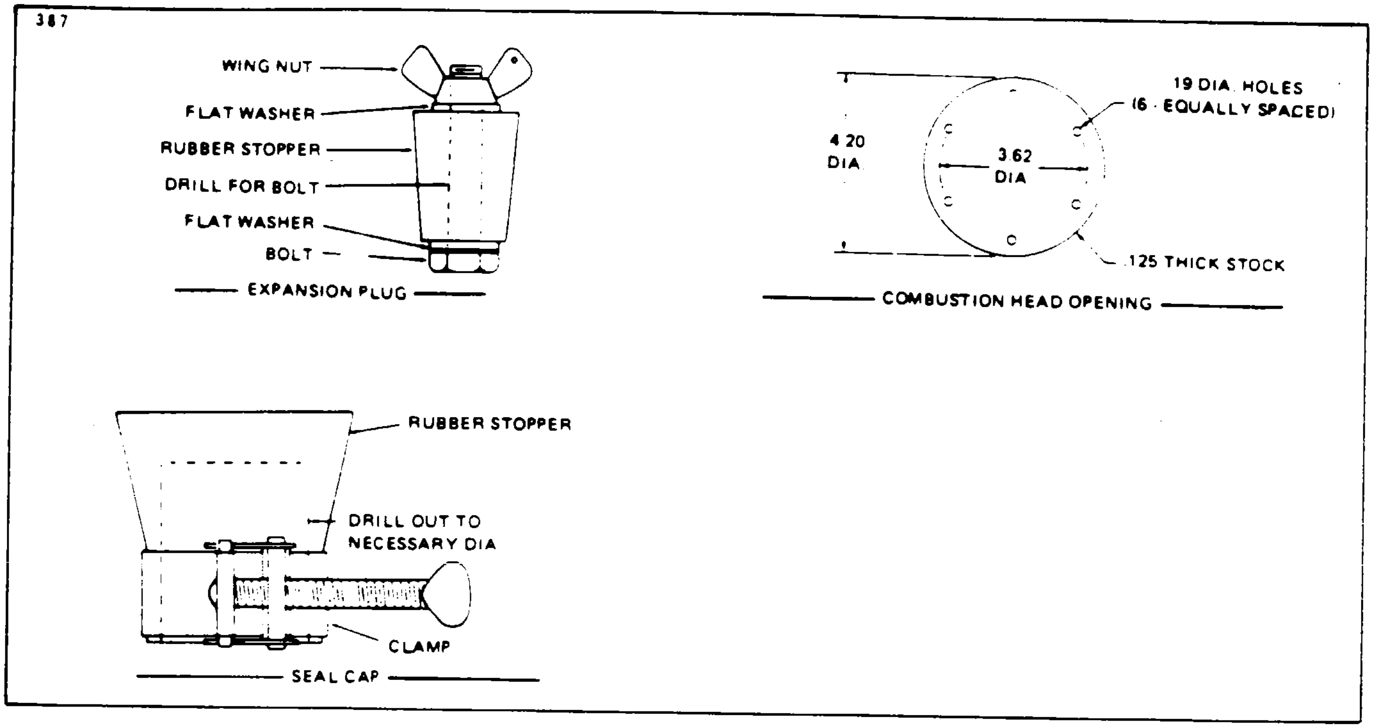
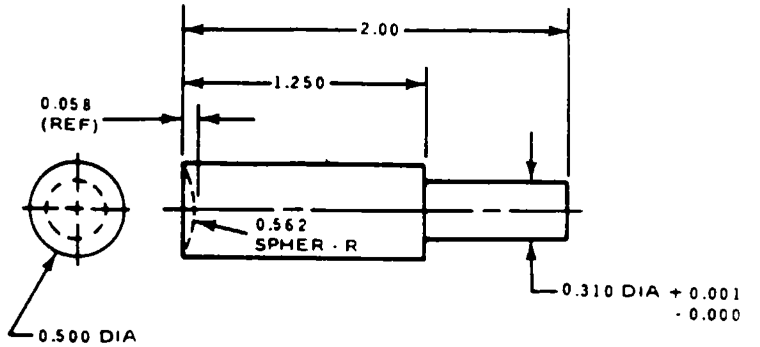


Figure 95-14. Suggested Design for Seal Plate. Plugs and Caps for Combustion Leakage Test

THIS SPACE INTENTIONALLY LEFT BLANK

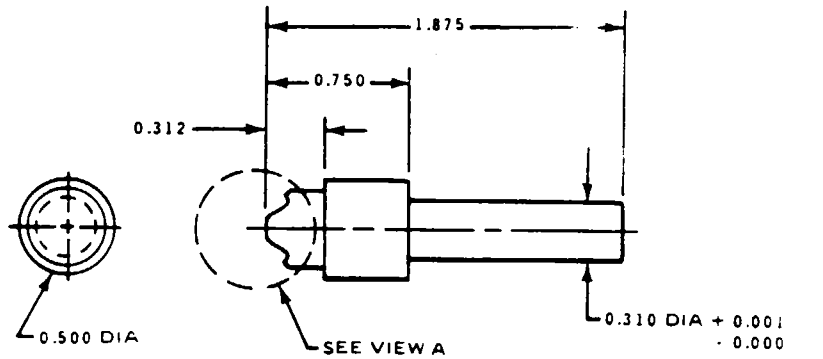
517

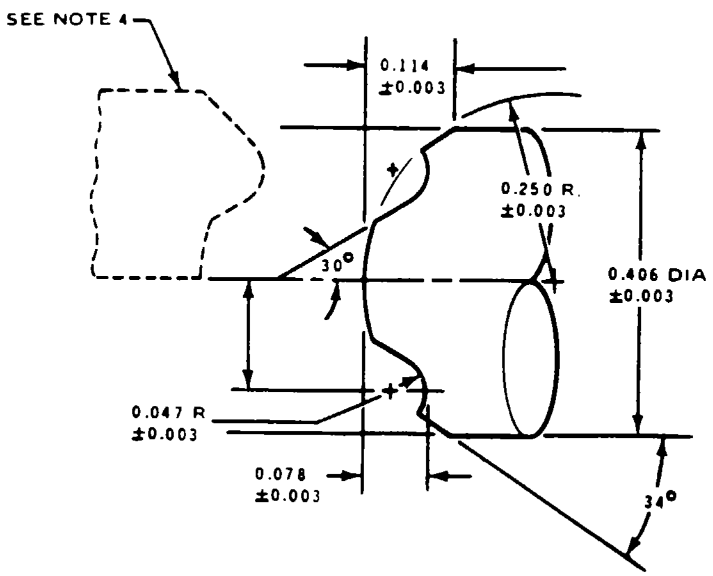
NOTES
1. MATERIAL - AISI TYPE S5 HARDEN TO ROCKWELL C-50-55 AND GRIND.
2. TO BE USED ON ROUND-HEAD RIVETS ONLY - STYLE GY18B (1/4 DIA.).
3. FOR USE ON COMPRESSION RIVETER - CHICAGO PNEUMATIC TOOL CO. P/N 450.



ROUND-HEAD RIVET DRIVER 5T1-25310

NOTES
1. MATERIAL - AISI TYPE S5
2. HEAT TREAT - ROCKWELL "C" (48-50) AND POLISH CONTOUR AREA FREE OF TOOL MARKS 5 TO 10 RMS AFTER HND
3. SERVICE - GY18A, GY18B RIVETS (SEMI-TUBULAR RIVETS)
4. EDGE OF FORMING TOOL MUST BE ON CENTER LINE OF PEEN (AS SHOWN WHEN FORMING CONTOUR OF PEEN). (TOOL NO. 5T1-71219)





SWAGING PEEN 5T1-71219

VIEW A

Figure 95-15. Fabricated Rivet Tools

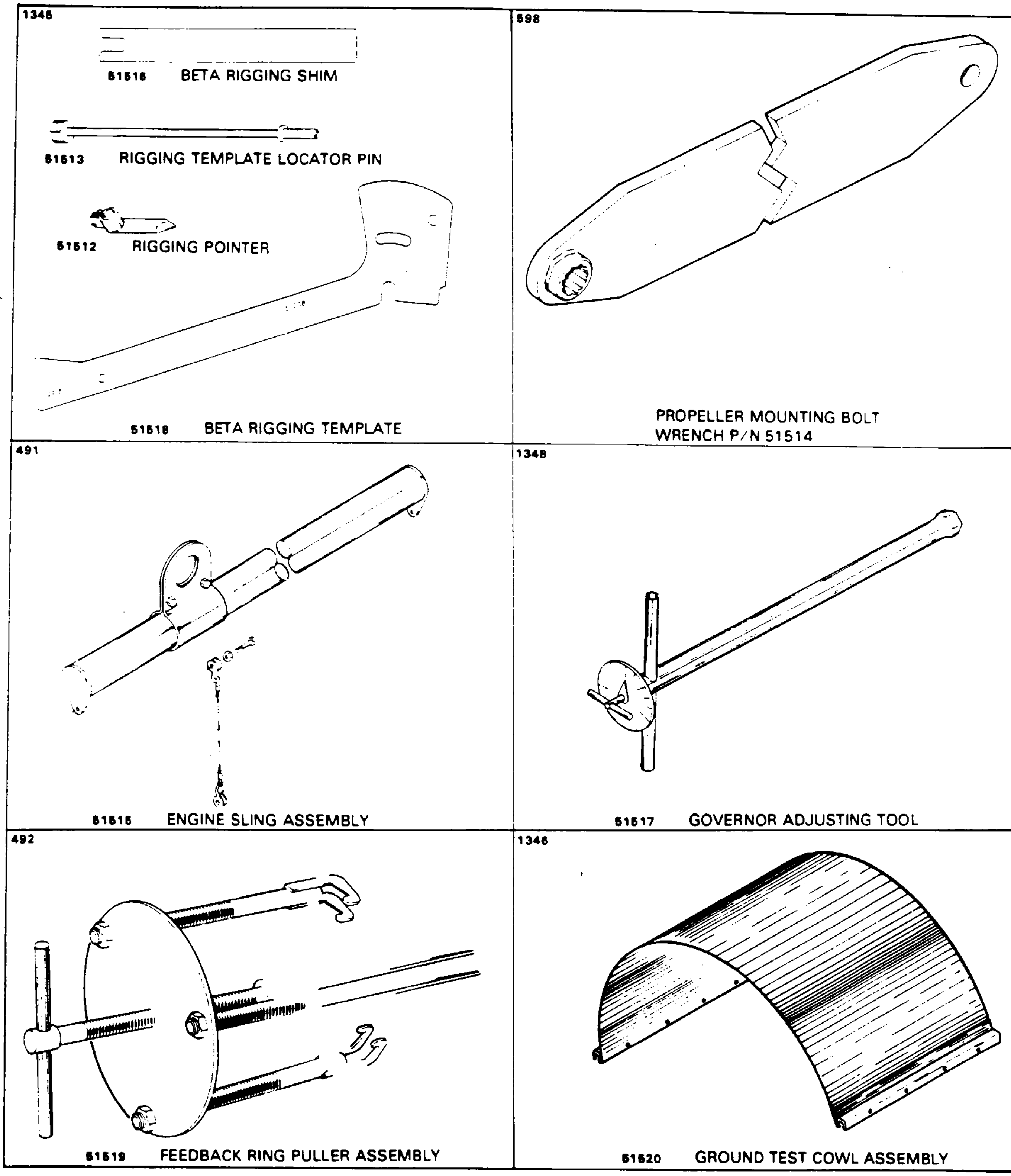
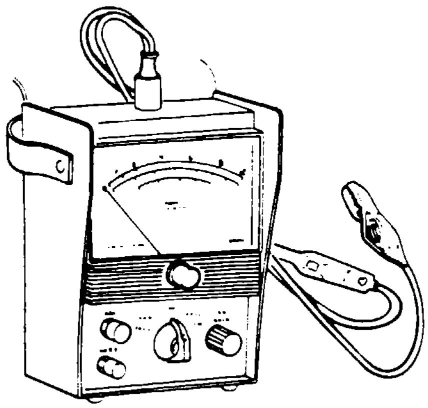


Figure 95-16. Special Tools

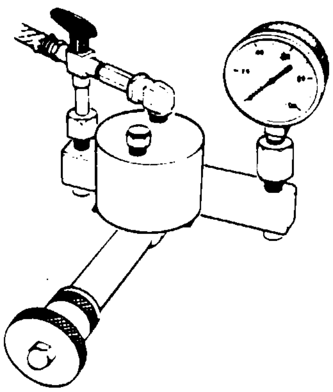
493

TURBINE TEMPERATURE
INDICATING TEST SET



BARFIELD INSTRUMENT CORPORATION
MODEL 2312G

494



TORQUE METER PRESSURE TESTER
MODEL 2311F
BARFIELD INSTRUMENT CORPORATION

Figure 95-16. Special Tools (cont.)

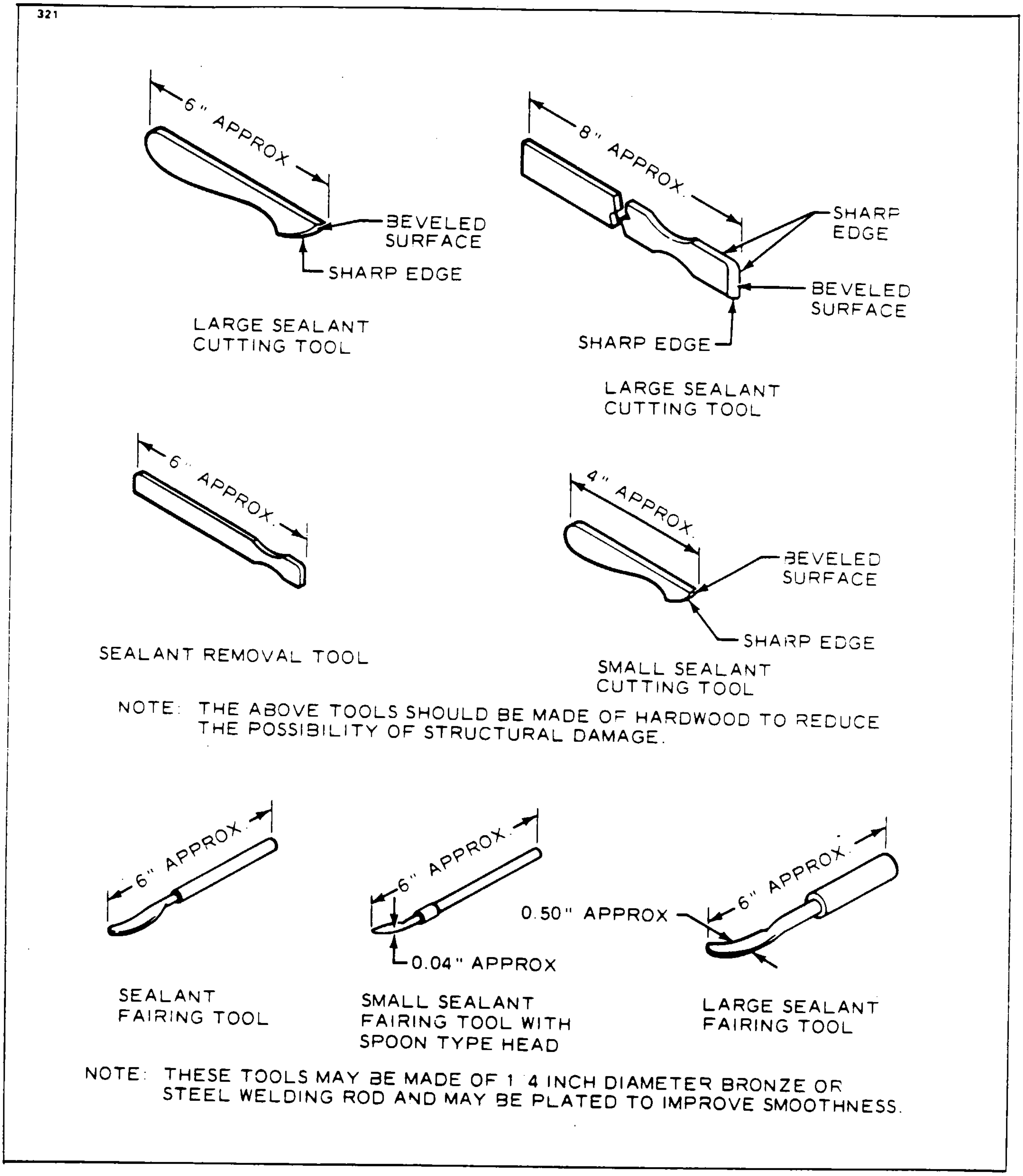
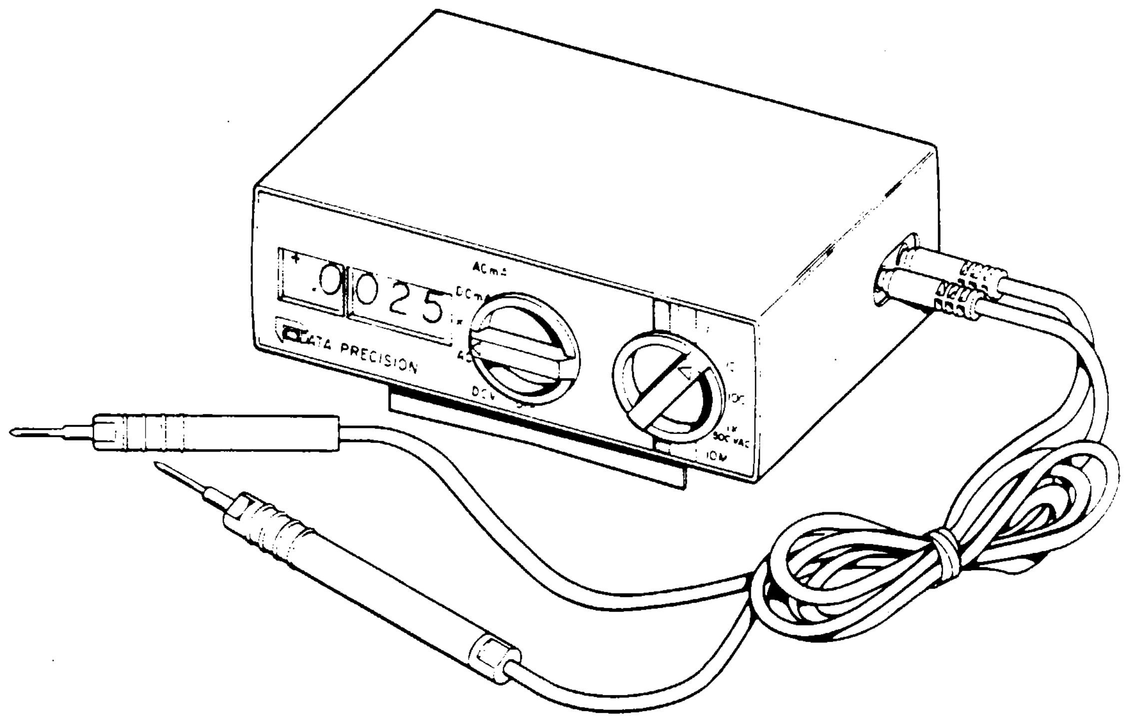


Figure 95-16. Special Tools (cont.)

496



DIGITAL MULTI-METER
MANUFACTURER - DATA PRECISION

SUPPLIER - Q.E.D. COMPANY
2916 FEDERAL STREET
CAMDEN, NEW JERSEY 08105

Figure 95-16. Special Tools (cont.)

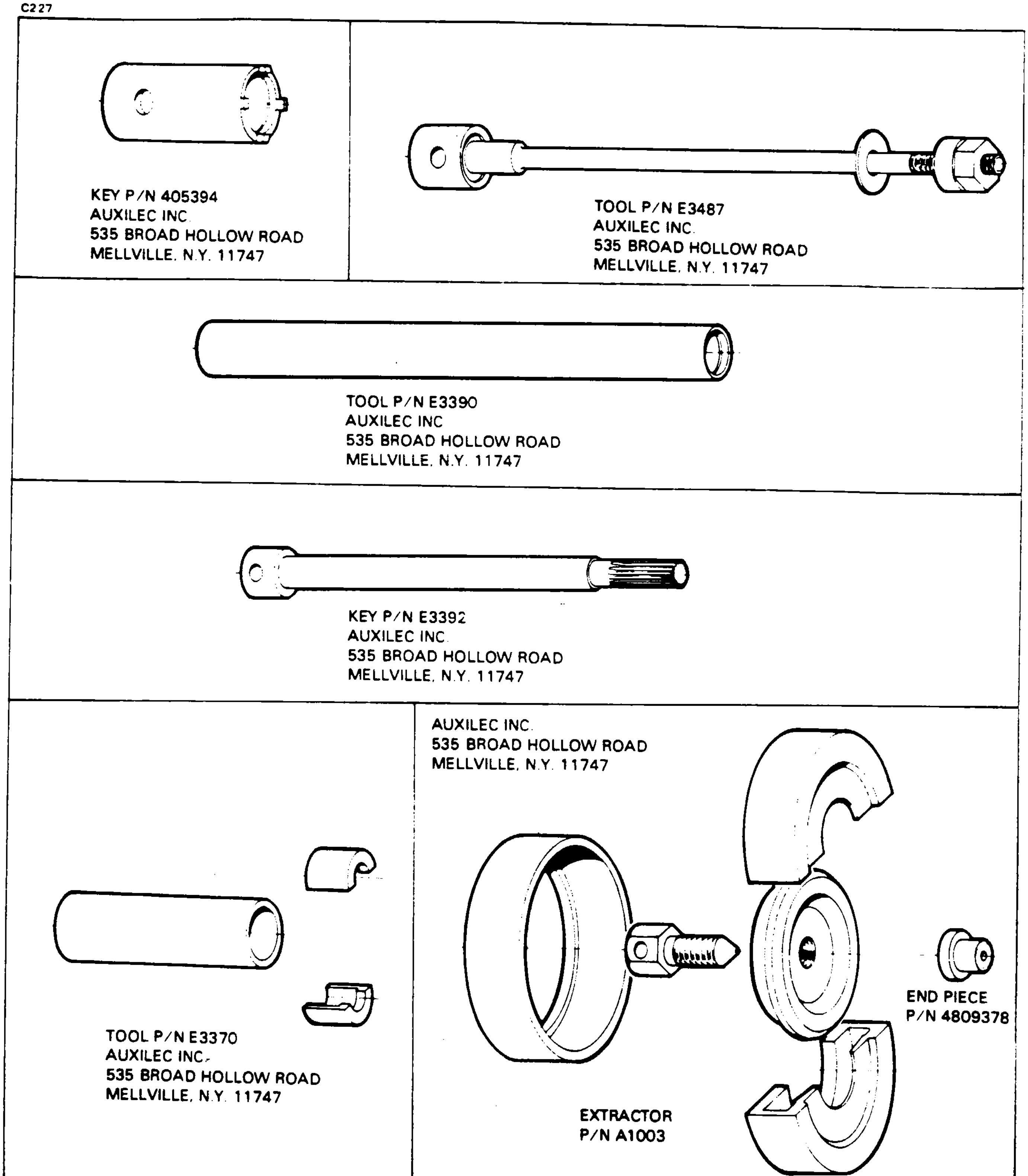


Figure 95-16. Special Tools (cont.)

GRIDS 5I5 THRU 5L24
INTENTIONALLY LEFT BLANK