



**SEMINOLE
MAINTENANCE MANUAL**

CARD 1 OF 4

PA-44-180 SEMINOLE

PA-44-180T TURBO SEMINOLE

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 664)

1A1

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

INTRODUCTION.

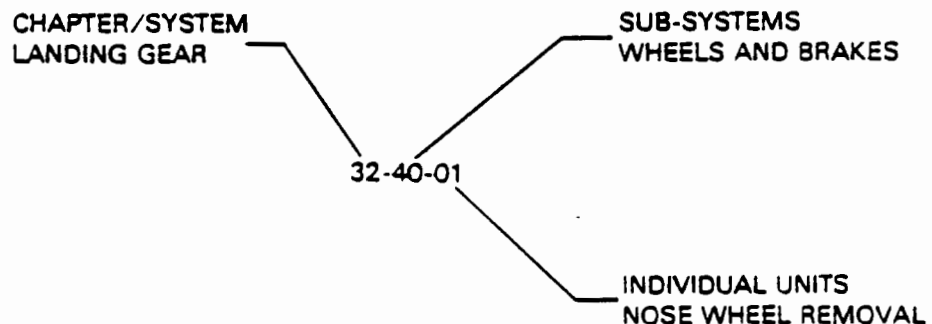
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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

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

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

Example:



This manual does not contain hardware callouts for installation. Hardware callouts are only indicated where a special application is required. To confirm the correct hardware used, refer to the PA-44 Parts Catalog P/N 761 663, and FAR 43 for proper utilization.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual = AVCO LYCOMING - OVERHAUL MANUAL
DIRECT DRIVE ENGINE - P/N 60294-7
Avco Lycoming Division
Williamsport, Pa. 17701

Parts Catalog = AVCO LYCOMING - P/N PC-123
Avco Lycoming Division
Williamsport, Pa. 17701

Operators Handbook = AVCO LYCOMING O-360, HO-360, IO-360,
AIO-360, HIO-360, LIO-360 and TIO-360
SERIES AIRCRAFT ENGINES - P/N 60297-25
Avco Lycoming Division
Williamsport, Pa. 17701

PROPELLER:

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

MAGNETOS:

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

TURBOCHARGERS:

Overhaul Manual = OVERHAUL MANUAL FOR
AIRCRAFT TURBOCHARGERS
VALVES AND CONTROLLERS
NUMBER TP20-0120-1
Airesearch Industrial Division
3201 Lomitor Blvd.
Torrance, Calif. 90505

RADAR ALTIMETER:

Maintenance
Instructions = KING KRA-10 MAINTENANCE OVERHAUL
MANUAL NUMBER 006-5152-00
King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061

BONZER MK10X
Bonzer Incorporated
90th and Cody
Overland Park, Kansas 66214

Introduction

Page - 2

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

VENDOR PUBLICATIONS. (cont)

RADAR ALTIMETER: (cont)

Installation Manual = INSTALLATION MANUAL
NUMBER 006-0152-00
King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061

AUTOFLIGHT:

Manufacturer = EDO-AIRE MITCHELL
P.O. Box 610
Mineral Wells, Texas 76067

PIPER PUBLICATIONS.

AUTOFLIGHT:

AutoControl IIIB
Service Manual = Piper P N 761 502

AutoControl IIIC
Service Manual = Piper P N 761 602

PA-44-180/180T
Parts Catalog = Piper P N 761 663

Inspection Reports = Piper P N 230 963

Programmed Inspection
Manual = Piper P N 761 733

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

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 given 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 illustration.
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 Indication. (1R Month-Year)

Second Revision: Revision Indication. (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)

Introduction

Page - 4

Revised: January 3, 1983

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

AEROFICHE EXPLANATION AND REVISION STATUS (cont)

6. Revisions to this Maintenance Manual 761 664 issued May 1, 1978 are as follows:

Revisions	Date	Aerofiche Card Effectivity
ORG791212	December 12, 1979	1, 2, and 3
PR800822	August 22, 1980	1, 2, and 3
PR810223	February 23, 1981	1, 2, and 3
PR810824	August 24, 1981	1, 2, and 3
PR820826	August 26, 1982	1, 2, and 3
PR820909	September 9, 1982	1, 2, and 3
PR830103	January 3, 1983	1, 2, and 3
PR840326	March 26, 1984	1, 2, and 3

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GAMA SYSTEM/CHAPTER INDEX GUIDE

SYST CHAP	SUB-SYST SECTION	TITLE	AEROFICHE GRID NO.
4		AIR WORTHINESS	1A18
5		TIME LIMITS MAINT CHECKS	1A21
6		DIMENSIONS AND AREAS	1B14
7		LIFTING AND SHORING	1C1
8		LEVELING AND WEIGHING	1C5
9		TOWING AND TAXIING	1C10
10		PARKING AND MOORING	1C14
11		REQUIRED PLACARDS	1C18
12		SERVICING	1C22
20		STANDARD PRACT - AIRFRAME	1E2
21		ENVIRONMENTAL SYSTEM	1E12
22		AUTOFLIGHT	1H21
23		COMMUNICATIONS	1H24
24		ELECTRICAL POWER	1I10
27		FLIGHT CONTROLS	1J24
28		FUEL	2A18
29		HYDRAULIC POWER	2B17
30		ICE AND RAIN PROTECTION	2C17
32		LANDING GEAR	2F1

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

SYST CHAP	SUB-SYST SECTION	TITLE	AEROFICHE GRID NO.
33	LIGHTS		2H16
34	NAVIGATION & PITOT STATIC		2I1
35	OXYGEN		2I16
37	VACUUM		2J12
39	ELECTRICAL ELECTRONIC PANELS AND MULTI-PURPOSE PARTS		2K1
51	STRUCTURES		2K11
52	DOORS		3A18
55	STABILIZERS		3B4
56	WINDOWS		3B14
57	WINGS		3B20
61	PROPELLER		3C9
71	POWER PLANT		3D1
73	ENGINE FUEL SYSTEM		3E1
74	IGNITION		3E13
77	ENGINE INDICATING		3F19
78	EXHAUST		3G10
79	OIL		3G15
80	STARTING		3G21
81	TURBINES		3H8
91	CHARTS AND WIRING DIAGRAMS		3I1

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS

FIGURE NO.	SUBJECT	GRID NO.
6-1.	Three View	1B19
6-2.	Station References	1B20
6-3.	Access Plates and Panels	1B22
7-1.	Jacking	1C4
8-1.	Leveling Airplane	1C8
8-2.	Weighing	1C9
11-1.	Placards and Decals	1C20
12-1.	Service Points	1D1
12-2.	Lubrication Chart - Landing Gear, Main	1D14
12-3.	Lubrication Chart - Landing Gear, Nose	1D16
12-4.	Lubrication Chart - Control System, Part 1	1D18
12-5.	Lubrication Chart - Cabin Door, Baggage Door and Seats	1D20
12-6.	Lubrication Chart - Control System, Part 2	1D21
12-7.	Lubrication Chart - Power Plant and Propeller	1D23
20-1.	Torque Wrench Formula	1E4
20-2.	Method of Installing Rod End Bearings	1E5
20-3.	Cherrylock Rivet Removal	1E6
20-4.	Identification of Aircraft Fluid Lines	1E8
21-1.	Cabin Environmental System Installation	1E24
21-2.	Heater and Combustion Air Blower Assembly	1F1
21-3.	Diagramatic Cutaway of Heater to Show Whirling Flame Action	1F2
21-4.	Fuel Regulator and Shutoff Valve	1F3
21-5.	Top View - Duct Switch	1F3
21-6.	Intake Valve and Switches	1F4
21-7.	Wiring Diagram	1F8
21-8.	Primary Power Circuit	1F9
21-9.	Starting Power Circuit	1F10
21-10.	Spark Plug Fixture	1F12
21-11.	Wiring - Test Setup	1F12
21-12.	Spark Plug Gap Adjustment	1F13
21-13.	Ignition Unit Assembly	1F17
21-14.	Test Setup for Fuel Regulator and Shutoff Valve	1F20
21-15.	Heater Fuel Pump	1F21
21-16.	Suggested Design for Seal Plates, Plugs, and Caps for Combustion Tube Leakage Test	1G1
21-17.	Test Setup for Combustion Air Pressure Switch	1G1
21-18.	Exploded View of Heater Assembly	1G6
21-19.	Exploded View - Combustion Air Blower and Motor Assembly	1G8
21-20.	Suggested Setup of Heater Operation Test	1G10
21-21.	Wiring Connections for Heater Operation Test	1G10
21-22.	Spark Plug Gap Adjustment Tool	1G13

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
21-23.	Heater Hourmeter Installation	1G14
21-24.	Air Conditioning System Installation (PA-44-180T S N 44-8107027 and up)	1G21
21-25.	Test Gauge and Manifold Set	1H2
21-26.	Manifold Set Operation	1H3
21-27.	Leak Test Hookup	1H4
21-28.	Evacuation Hookup	1H6
21-29.	Charging Stand	1H8
21-30.	Charging Hookup	1H9
21-31.	Top Dead Center Casting Mark (Sankyo Compressor)	1H12
21-32.	Rotation of Clutch Front Plate (Sankyo Compressor Oil Check)	1H12
21-33.	Condenser Installation	1H15
21-34.	Expansion Valve	1H17
21-35.	Components Installation	1H19
23-1.	Emergency Locator Transmitter Installation	1I3
23-2.	ELT Using Fixed Aircraft Antenna (Narco)	1I5
23-3.	ELT Portable Folding Antenna (Narco)	1I5
23-4.	Communications Components ELT Schematic	1I9
23-5.	Narco ELT Schematic	1I9
24-1.	Lamp Bank Load	1I22
24-2.	Battery Box	1I24
24-3.	Electrical Component Location	1J3
24-4.	Regulator Diagram (LAMAR)	1J4
24-5.	Testing Regulator (LAMAR)	1J7
24-6.	Adjusting Regulator (LAMAR)	1J8
27-1.	Correct Method of Installing Rod End Bearing	1K8
27-2.	Control Column Assembly	1K11
27-3.	Aileron Controls	1K13
27-4.	Bellcrank Rigging Tool	1K16
27-5.	Aileron Rigging	1K17
27-6.	Rudder Controls	1K20
27-7.	Rudder Rigging	1K21
27-8.	Clamping Rudder Pedals	1K21
27-9.	Rudder Travel Adjustments	1K22
27-10.	Rudder Trim Controls	1L1
27-11.	Rudder Pedal Assembly	1L4
27-12.	Stabilator Controls	1L6
27-13.	Stabilator Rigging	1L8
27-14.	Stabilator Travel Adjustments	1L10
27-15.	Methods of Securing Trim Cables	1L10
27-16.	Stabilator Trim Controls	1L12
27-17.	Wrapping Trim Barrels	1L15
27-18.	Stabilator Trim Screw Adjustment	1L15
27-19.	Flap Controls	1L17
27-20.	Flap Step Adjustment	1L19
27-21.	Flap Rigging Tool	1L22

Introduction

Page - 9

Revised: March 26, 1984

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
28-1.	Fuel System Installation	2A21
28-2.	Fuel Cell Installation	2B1
28-3.	Locking Fuel Cap Assembly	2B9
28-4.	Gascolator Assembly	2B11
28-5.	Fuel Selector Valve	2B12
28-6.	Fuel Gauge	2B15
28-7.	Fuel Pressure Gauge and Calibration	2B16
29-1.	Schematic Diagram of Hydraulic System	2B20
29-2.	Hydraulic System Installation	2B21
29-3.	Hydraulic Pump Reservoir, Exploded View	2C6
29-4.	Test and Adjustments of Hydraulic Pump	2C9
29-5.	Nose Gear Actuating Cylinder	2C12
29-6.	End Gland Locking Device (Main Gear)	2C14
29-7.	Main Gear Actuating Cylinder	2C14
30-1.	Pneumatic Deice System Installation	2D1
30-2.	Deice Control Panel Installation	2D8
30-3.	Electric Prop Deice System Installation	2E1
30-4.	Suggested Use of Dial Indicator	2E5
30-5.	Centering of Brushes on Slip Rings	2E5
30-6.	Modular Brush Assembly Alignment	2E6
30-7.	Measuring Brush Assemblies	2E7
30-8.	Brush Module Assembly 3E2011	2E8
30-9.	Modular Brush Assembly 3E2090-1	2E8
30-10.	Installation of Deicer Boots	2E11
30-11.	Typical Deicer Boot Sealer Application	2E14
30-12.	Wrinkled Deicer	2E14
30-13.	Deicer Wiring Harness Installation (Typical)	2E15
30-14.	Wing Ice Lighting System	2E19
30-15.	Ice Detection System	2E22
30-16.	Heated Pitot and Heated Lift Detector Installation (PA-44-180T)	2E23
32-1.	Main Gear Oleo Strut Assembly	2F13

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
32-2.	Main Gear Service Tolerances	2F15
32-3.	Main Gear Installation	2F20
32-4.	Aligning Main Gear	2G1
32-5.	Nose Gear Oleo Strut Assembly	2G3
32-6.	Nose Gear Installation	2G5
32-7.	Nose Gear Service Tolerances	2G7
32-8.	Nose Gear Downlock and Eccentric Bushing Installation	2G12
32-9.	Nose Gear Adjustment	2G14
32-10.	Clamping Rudder Pedals in Neutral Position	2G16
32-11.	Rudder Pedals at Neutral Angle	2G16
32-12.	Mechanical Nose Gear Door Mechanism	2G18
32-13.	Nose Wheel Assemblies	2G20
32-14.	Main Wheel Assembly	2G22
32-15.	Wheel Brake Assembly	2G24
32-16.	Removal and Installation of Anchor Bolts	2H1
32-17.	Brake Installation	2H3
32-18.	Parking Brake Valve Assembly	2H4
32-19.	Brake Cylinder (1700)	2H5
32-20.	Brake Cylinder (10-27)	2H5
32-21.	Brake Cylinder (10-30) (Toe Brake)	2H6
32-22.	Toe Brake Installation	2H9
32-23.	Adjustment of Main Gear Down Limit Switch	2H11
32-24.	Adjustment of Nose Gear Down Limit Switch	2H11
32-25.	Throttle Warning Switches	2G13
34-1.	Pitot-Static System Installation	2I5
35-1.	Fixed - Oxygen System	2I19
35-2.	Portable - Oxygen System	2I20
35-3.	Test Apparatus for Testing Oxygen System	2I23
35-4.	Oxygen Tubing Installations	2I24
35-5.	Installation of Swagelok Fittings	2J3
37-1.	Vacuum System Installation	2J15
37-2.	Vacuum Regulator	2J17
39-1.	Annunciator Panel Installation	2K5
39-2.	Electric Clock Installation	2K7
51-1.	Skin Materials and Thickness	2K14
51-2.	Surface Scratches or Ground-in-Dirt	2K19
51-3.	Deep Scratches, Shallow Nicks and Small Holes	2K20
51-4.	Mixing of Epoxy Patching Compound	2K20
51-5.	Welding Repair Method	2K21
51-6.	Repairing of Cracks	2K21

Introduction

Page - 11

Revised: January 3, 1983

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
51-7.	Various Repairs	2K22
51-8.	Repair of Stress Lines	2K24
51-9.	Repair of Impacted Damage	2K24
52-1.	Door Installation	3A21
52-1a.	Door Snubber Installation	3A23
52-2.	Fabricated Tool for Baggage Door Lock	3A24
52-3.	Emergency Exit Installation	3B2
55-1.	Stabilator Installation	3B7
55-2.	Stabilator Balance Configuration	3B8
55-3.	Vertical Fin Installation	3B9
55-4.	Rudder Installation	3B11
55-5.	Rudder Balancing	3B12
56-1.	Windshield Installation	3B17
56-2.	Side Window Installation	3B19
57-1.	Wing Installation	3B24
57-2.	Aileron and Flap Installation	3C4
57-3.	Aileron Balancing	3C6
61-1.	Typical Nicks and Removal Method	3C12
61-2.	Propeller Installation	3C13
61-3.	Propeller Governor	3C15
61-4.	Adjustment of Propeller Control	3C15
61-5.	Synchrophaser System Installation	3C17
61-6.	Pulse Generator Assembly	3C19
61-7.	Backup Test of Pulse Generator	3C22
71-1.	Engine and Shock Mount Installation	3D12
71-2.	Engine Cowling Installation	3D17
71-3.	Cowl Flap Installation	3D17
71-4.	PA-44-180 Induction System	3D19
71-5.	PA-44-180T Induction System	3D22
73-1.	Carburetor	3E3
73-2.	Engine Primer System (PA-44-180)	3E6
73-3.	Fuel System Schematic (PA-44-180T)	3E6
73-4.	Engine Primer System (PA-44-180T)	3E7
73-5.	Adjustment of Engine Controls	3E9
74-1.	Height of Spring in Distributor Block Tower	3E18
74-2.	Contact Points	3E18
74-3.	Engine Timing Marks	3E20
74-4.	Timing Light Connected to Magneto	3E20
74-5.	Timing Marks on Magneto Rotor	3E21
74-6.	Painted Tooth Centered in Timing Window	3E22
74-7.	Timing Mark on Rotor Aligned with Pointer	3E22
74-8.	Timing Light Connected to Magneto and Breakers	3F1
74-9.	Cam End View of Magneto	3F2
74-10.	Removing Impulse Coupling	3F4
74-11.	Checking Flyweight to Stop Pin Clearance	3F4
74-12.	Stop Pin Installation Dimension	3F4

Introduction

Page - 12

Revised: January 3, 1983

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
74-13.	Checking Flyweight Axial Wear with Drill Shank	3F5
74-14.	Checking Flyweight Radial Wear with Gauge	3F5
74-15.	Points of Coupling Body Wear	3F6
74-16.	Acceptable and Deformed Coupling Springs	3F6
74-17.	Checking Impulse Coupling for Magnetization	3F8
74-18.	Orientation of Spring in Coupling Body	3F8
74-19.	Lifting Inner End of Spring	3F8
74-20.	Checking Harness Leads Continuity	3F10
74-21.	Checking Harness Leads Insulation Resistance	3F10
74-22.	Modified Pliers	3F10
74-23.	Removing Spring From Lead Assembly	3F10
74-24.	Assembly Tool	3F12
74-25.	Using Assembly Tool	3F12
74-26.	Ferrule Positioned Under Braid	3F13
74-27.	Ferrule Seating Tool	3F13
74-28.	Position of 11-8627 Kit and Contact Spring at Start of Installation	3F14
74-29.	Position of 11-8627 Kit and Contact Spring After Installation	3F14
74-30.	Lubricating Sleeve	3F14
74-31.	Lubricating Ferrule Shoulder	3F14
74-32.	Removing Spark Plug Frozen to Bushing	3F16
74-33.	Magneto and Starter Switches	3F18
77-1.	Engine Instrument Lines Installation	3G21
77-2.	Electric Tachometer Installation	3G2
77-3.	EGT Probe Installation (PA-44-180T)	3G8
78-1.	Inspection of Mufflers	3G12
80-1.	Exploded View of Gear Reduction Starter Motor	3H2
80-2.	Turning Motor Commutator	3H5
80-3.	Testing Motor Armature for Shorts	3H5
80-4.	Testing Motor Fields for Grounds	3H5
80-5.	No Load Test Hookup	3H5
80-6.	Stall Torque Hookup	3H7
81-1.	Schematic Diagram of Typical Turbocharger System	3H17
81-2.	Turbocharger Installation	3H19
91-1.	Tire Balancer Fixture	3I8
91-2.	Control Surface Balancing Tool	3I18
91-3.	Fabricated Aileron Bellcrank Rigging Tool	3I19
91-4.	Fabricated Aileron and Flap Rigging Tool	3I20
91-5.	Fabricated Stabilator Rigging Tool	3I21
91-6.	Fabricated Rudder Rigging Tool	3I21

ELECTRICAL SCHEMATICS

— NOTE —

Refer to Card 3 Grid No. 3J2 for Electrical Schematic Index.

Introduction

Page - 13

Revised: January 3, 1983

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

LIST OF CHARTS

CHART NO.	SUBJECT	GRID NO.
601	Leading Particulars and Principal Dimensions	1B16
1201	Thread Lubricants	1E1
2001	Maximum Distance Between Supports for Fluid Tubing	1E7
2101	Troubleshooting (Janitrol Heater)	1E17
2102	Blower System Wire Color Codes	1E22
2103	Inspection (Ignition Unit)	1F18
2104	Troubleshooting (Air Conditioner)	1G16
2105	Temperature Pressure Chart	1G22
2106	Aluminum Tubing Torque	1H1
2107	Evaporator Blower Motor Wire Codes	1H19
2401	Troubleshooting (Alternator)	1I14
2402	Troubleshooting (Battery)	1I19
2403	Alternator Belt Tension	1I23
2404	Hydrometer Reading and Battery Charge Percent	1J1
2701	Troubleshooting (Surface Controls)	1K4
2702	Cable Tension Vs. Ambient Temperature	1K9
2801	Troubleshooting (Fuel System)	2A22
2802	Sender Fuel Quantity Gauge Tolerances	2B15
2901	Troubleshooting (Hydraulic System)	2B23
2902	Leading Particulars, Hydraulic System	2C10
2903	Characteristics, Hydraulic Pump Motor	2C10
3001	Troubleshooting (Pneumatic Deice System)	2C23
3002	Operating Pressures	3D3
3003	Materials and Supplies for Cold Repair	2D10
3004	Troubleshooting (Propeller Deicer System)	2D19
3005	Required Materials for Repair of Propeller Deicer	2E12
3006	Mixing of Materials	2D15
3007	Electrical Resistance	2E15
3201	Troubleshooting (Landing Gear)	2F6
3202	Toe-In, Toe-Out Correction	2F23
3401	Troubleshooting (Rate of Climb Indicator)	2I6
3402	Troubleshooting (Altimeter)	2I7
3403	Troubleshooting (Airspeed Tubes and Indicator)	2I8
3404	Troubleshooting (Magnetic Compass)	2I10
3501	Troubleshooting (Oxygen System)	2I20
3502	Oxygen System Limits	2J4
3503	Filling Pressure for Certain Ambient Temperatures	2J9
3504	Portable Oxygen System Component Limits	2J11
3701	Troubleshooting (Vacuum System)	2J16
3901	Troubleshooting (Annunciator Panel)	2K4
5101	List of Materials (Thermoplastic Repair)	2K18

Introduction

Page - 14

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

LIST OF CHARTS (cont)

CHART NO.	SUBJECT	GRID NO.
6101	Propeller Torque Limits	3C12
7101	Troubleshooting (Engine)	3D4
7301	Troubleshooting (Fuel Pressure Gauge)	3E10
7302	Troubleshooting (Fuel Pressure Gauge)	3E11
7401	Troubleshooting (Magnetos)	3E15
7402	Coupling Torques	3F15
7701	Manifold Pressure Indicator (Troubleshooting)	3F23
7702	Tachometer (Troubleshooting)	3F24
7703	Cylinder Head Temperature (Troubleshooting)	3G4
7704	Exhaust Gas Temperature (Troubleshooting)	3G5
7901	Oil Pressure Sender Test Specifications	3G18
7902	Oil Pressure Gauge (Troubleshooting)	3G19
7903	Oil Temperature Indicators (Troubleshooting)	3G20
8001	Troubleshooting (Starter)	3G23
8002	Starting Motor Specifications	3H7
8101	Troubleshooting (Turbocharger)	3H10
9101	Flare Fitting Torques	3I3
9102	Recommended Nut Torques	3I4
9103	Decimal Conversions	3I6
9104	Decimal Equivalents of Drill Sizes	3I7
9105	List of Consumable Materials	3I9
9106	Metric Conversion Tables	3I14
9107	Electric Wire Coding	3I22
9108	Electric Symbols	3I23
9109	Electrical System Component Loads	3I24

CHAPTER

4

**AIRWORTHINESS
LIMITATIONS**

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 4 - AIRWORTHINESS LIMITATIONS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
4-00-00	AIRWORTHINESS LIMITATIONS	1A20	
4-01-00	General	1A20	8-81

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

AIRWORTHINESS LIMITATIONS.

GENERAL.

The airworthiness limitations is FAA approved and specifies inspections and maintenance required under Parts 43.16 and 91.163 of the Federal Aviation Regulations.

The following limitations related to fatigue life of the airplane and its components have been established with respect to the PA-44-180/180T airplane:

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

— NOTE —

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

— END —

CHAPTER

5

TIME LIMITS/MAINT CHECKS

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

CHAPTER 5 - TIME LIMITS/MAINTENANCE CHECKS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
5-00-00	GENERAL	1A24	
5-10-00	TIME LIMITS	1A24	
5-11-00	Inspection Requirements	1A24	8-82
5-12-00	Preflight Checks	1A24	
5-13-00	Overlimits Inspection	1A24	
5-20-00	SCHEDULED MAINTENANCE CHECKS	1B1	2-81
5-21-00	Periodic Inspections	1B1	4R 1-83
5-22-00	Programmed Inspection	1B13	8-82
5-50-00	UNSCHEDULED MAINTENANCE CHECKS	1B13	
5-51-00	Special Inspections as Required Upon Condition	1B13	

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

GENERAL.

This chapter provides instructions for conducting inspections. Repair or replacement instructions for those components found to be unserviceable at inspection may be found in the chapters covering the applicable aircraft system. When working on engines, ground the magneto primary circuit before performing any operation.

TIME LIMITS.

INSPECTION REQUIREMENTS.

The required inspection procedures are listed in Periodic Inspections. The inspection procedure is broken down into major groups which include Propeller, Engine, Cabin, Fuselage and Empennage, Wing, Landing Gear, Engine Run-up Inspection and General. The first column in each group lists the inspection or procedure to be performed. The second column is divided into four columns indicating the required inspection intervals of 50 hours, 100 hours, 500 hours, and 1000 hours. Each inspection or operation is required at each of the inspection intervals as indicated by a circle (O). If an item is not entirely accessible or must be removed, refer to the applicable chapter of this manual for instructions on how to gain access to remove the item. When performing inspections, use inspection forms P/N 230 963 furnished by the Piper Factory Service Department, available through Piper Dealers or Distributors.

— NOTE —

*In addition to inspection intervals required in Periodic Inspections,
preflight inspections must be performed.*

PREFLIGHT CHECKS.

This check is for the pilot and or mechanic and should become part of the airplane operational routine and or preflight check before each flight. Refer to Section IV of the Pilot's Operating 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.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

SCHEDULED MAINTENANCE CHECKS.

PERIODIC INSPECTIONS.

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)					
	L	R	50	100	500	1000
A. PROPELLER GROUP						
1. Inspect spinner and back plate for cracks	O	O	O	O	O	O
2. Inspect blades for nicks and cracks	O	O	O	O	O	O
3. Check for grease and oil leaks	O	O	O	O	O	O
4. Lubricate propeller per lubrication chart (Refer to Chapter 12)	O	O	O	O	O	O
5. Check spinner mounting brackets for cracks (See Note 20) ...	O	O		O	O	O
6. Check propeller mounting bolts and safety (Check torque if safety is broken)	O	O		O	O	O
7. Inspect hub parts for cracks and corrosion	O	O		O	O	O
8. Rotate blades of constant speed propeller and check for tightness in hub pilot tube (See Note 20)	O	O		O	O	O
9. Remove constant speed propeller; remove sludge from propeller and crankshaft.	O	O			O	O
10. Inspect complete propeller and spinner assembly for security, chafing, cracks, deterioration, wear and correct installation	O	O		O	O	O
11. Check propeller air pressure (at least once a month)	O	O	O	O	O	O
12. Overhaul propeller (See Note 15)	O	O				
13. Inspect electric tachometer magnetic pickups for security (PA-44-180T only)	O	O	O	O	O	O
B. ENGINE GROUP						
NOTE: Read Note 5 prior to completing this inspection group.						
CAUTION: Ground Magneto Primary Circuit before working on engine.						
1. Remove engine cowl	O	O	O	O	O	O
2. Clean and check cowling for cracks, distortion, and loose or missing fasteners	O	O		O	O	O
3. Drain oil sump and comply with latest revision Lycoming Service Bulletin No. 446. Drain while engine is warm. (See Note 6).	O	O	O	O	O	O

5-21-00

Page 5-02

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)					
	L	R	50	100	500	1000
B. ENGINE GROUP (cont)						
4. Clean suction oil strainer at oil change (Check strainer for foreign particles).....	O	O	O	O	O	O
5. Clean pressure oil strainer or change full flow (cartridge type) oil filter element (Check strainer or element for foreign particles).....	O	O	O	O	O	O
6. Inspect oil temperature sender unit for leaks and security.....	O	O		O	O	O
7. Inspect oil lines and fitting for leaks, security, chafing, dents and cracks (See Note 8).....	O	O	O	O	O	O
8. Clean and check oil radiator cooling fins.....	O	O	O	O	O	O
9. Remove and flush oil radiators.....	O	O			O	O
10. Fill engine with oil per information on cowl or lubrication chart. (Refer to Chapter 12) (See Note 6).....	O	O	O	O	O	O
11. Clean engine.....	O	O	O	O	O	O
CAUTION: Use caution not to contaminate vacuum pump with cleaning fluid. (Refer latest revision to Lycoming Service Letter No. 1221.)						
12. Inspect condition of spark plugs. (Clean and adjust gap as required; adjust per latest revision Lycoming Service Instruction No. 1042).....	O	O		O	O	O
NOTE: If fouling of spark plugs has been apparent, rotate bottom plugs to upper plugs.						
13. Inspect spark plug cable leads and ceramics for corrosion and deposits.....	O	O	O	O	O	O
14. Check cylinder compression (Ref: AC 43.13-1A).....	O	O		O	O	O
15. Inspect cylinders for cracked or broken fins (See Note 11)....	O	O	O	O	O	O
16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds ...	O	O	O	O	O	O
NOTE: Lycoming requires a Valve Inspection be made after every 400 hours of operation (See Note 12)						
17. Inspect ignition harness and insulators for high tension leakage and continuity.....	O	O		O	O	O
18. Check magneto points for proper clearance (Maintain clearance at .018 ± .006).....	O	O		O	O	O

5-21-00

Page 5-03

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)					
	L	R	50	100	500	1000
B. ENGINE GROUP (cont)						
19. Inspect magneto for oil seal leakage	O	O		O	O	O
20. Inspect breaker felts for proper lubrication	O	O		O	O	O
21. Inspect distributor block for cracks, burned areas or corrosion, and height of contact springs	O	O			O	O
22. Check magnetos to engine timing	O	O		O	O	O
23. Overhaul or replace magnetos (See Note 7)	O	O				
24. Remove air filters, tap gently to remove dirt particles and inspect condition of seal and filter material (Replace as required)	O	O	O	O	O	O
25. Inspect condition of air filter housing	O	O	O	O	O	O
26. Inspect security of carburetor throttle arm	O	O			O	O
27. Drain carburetor and clean inlet line fuel strainer	O	O		O	O	O
28. Inspect condition of carburetor heat air door and box - 180 only (See Note 13)	O	O	O	O	O	O
29. Inspect intake seals for leaks and clamps for tightness	O	O		O	O	O
30. Inspect all air inlet duct hoses and replace as required - 180 only	O	O		O	O	O
31. Inspect condition of flexible fuel lines	O	O		O	O	O
32. Inspect primer lines	O	O		O	O	O
33. Inspect primer for condition and security	O	O		O	O	O
34. Inspect sniffle valve for signs of leakage	O	O	O	O	O	O
35. Inspect sniffle valve lines for condition and security	O	O	O	O	O	O
36. Clean screens in electric fuel pump (180 only)	O	O	O	O	O	O
37. Remove, drain, and clean fuel filter bowl and screen (Perform in at least every 90 days)	O	O	O	O	O	O
38. Replace flexible fuel lines	O	O				O
39. Inspect fuel system for leaks	O	O		O	O	O
40. Inspect operation of engine driven and electric fuel pumps ...	O	O		O	O	O
41. Overhaul or replace engine driven and or electric fuel pumps (See Note 7)						
42. Check vacuum pumps and lines	O	O		O	O	O

5-21-00

Page 5-04

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)					
	L	R	50	100	500	1000
B. ENGINE GROUP (cont)						
43. Overhaul or replace vacuum pumps (See Note 7).....	O	O				
CAUTION: The only dry air pump mounting gasket authorized and approved for use on the Airborne dry air pump is the B3-1-2 Airborne gasket. Piper part number 751 859. Use of any other gasket may result in leakage at mounting surface.						
44. Inspect all engine controls for security, travel and operating condition	O	O		O	O	O
45. Inspect exhaust stacks, connections and gaskets (Replace as required and refer to latest revision Piper Service Letter No. 860)	O	O		O	O	O
46. Check operation of alternate air doors	O	O		O	O	O
47. Inspect breather tubes for obstructions and security	O	O		O	O	O
48. Inspect crankcase for cracks, leaks and security of seam bolts	O	O		O	O	O
49. Inspect engine mounts for cracks and loose mountings	O	O		O	O	O
50. Inspect engine baffles for cracks and loose mountings	O	O		O	O	O
51. Inspect rubber engine mount bushings for deterioration (Replace as required)	O	O		O	O	O
52. Inspect firewall seals	O	O		O	O	O
53. Inspect condition and tension of alternator drive belt	O	O		O	O	O
54. Inspect condition and security of alternator and starter	O	O		O	O	O
55. Inspect all lines, air ducts, electrical leads and engine attachments for security, proper routing, chafing, cracks, deterioration and correct installation	O	O	O	O	O	O
56. Lubricate all controls per lubrication chart in Chapter 12	O	O	O	O	O	O
57. Overhaul or replace propeller governor (Refer to latest revision Hartzell Service Letter No. 61)	O	O				
58. Complete overhaul of engine or replace with factory rebuilt (See Note 7)	O	O				
59. Reinstall engine cowl	O	O	O	O	O	O

5-21-00

Page 5-05

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)					
	L	R	50	100	500	1000
C. TURBOCHARGER GROUP						
1. Inspect all air inlet ducting and compressor discharge ducting for worn spots, loose clamps or leaks	O	O	O	O	O	O
2. Inspect exhaust ducting and exhaust stacks for signs of leaks or cracks. Check all clamps for tightness	O	O	O	O	O	O
3. Carefully check turbo support brackets, struts, etc., for breakage or wear	O	O	O	O	O	O
4. Inspect all oil lines and fittings for wear, leakage, heat damage or fatigue	O	O	O	O	O	O
5. Inspect bypass valve for security and safety	O	O	O	O	O	O
6. Run up engines, check all instruments for smooth, steady response	O	O	O	O	O	O
7. Remove all turbocharger components from the engine. Inspect and repair or replace as necessary. Inspect turbocharger rotor for excessive play, carbon and dirt deposits. Remove turbine and compressor housings. Inspect turbine wheel and impeller for physical damage and excessive build up of deposits. Refer to Airesearch Overhaul Manual Part Number TP20-0120-1 for limits. (See Note 7)	O	O				
D. CABIN GROUP						
1. Inspect cabin entrance, doors and windows for damage and operation				O	O	O
2. Check operation of emergency exit window (See Note 23)				O	O	O
3. Inspect upholstery for tears				O	O	O
4. Inspect seats, seat belts, security brackets and bolts				O	O	O
5. Inspect trim operation				O	O	O
6. Inspect operation and condition of rudder pedals				O	O	O
7. Inspect parking brake valve and toe brakes for operation and cylinder leaks				O	O	O
8. Inspect control wheels, column, pulleys and cables				O	O	O

5-21-00

Page 5-06

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS. (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
D. CABIN GROUP (cont)				
9. Inspect condition of flap control cable attachment bolt		O	O	O
10. Check landing, navigation, cabin and instrument lights	O	O	O	O
11. Inspect instruments, lines and attachments		O	O	O
12. Inspect gyro operated instruments and electric turn and bank (Overhaul or replace as required)		O	O	O
13. Replace filters on gyro horizon and directional gyro or replace central air filter		O	O	O
14. Clean or replace vacuum regulator filter		O	O	O
15. Perform pitot-static test if appropriate (Refer to FAR 91.170)		O	O	O
16. Check altimeter (Calibrate altimeter system in accordance with FAR 91.170, if appropriate)		O	O	O
17. Inspect operation of fuel selector valves		O	O	O
18. Inspect operation of fuel drains		O	O	O
19. Inspect condition of heater controls and ducts		O	O	O
20. Inspect condition and operation of air vents		O	O	O
E. FUSELAGE AND EMPENNAGE GROUP				
1. Remove inspection plates and panels		O	O	O
2. Inspect baggage doors, latches and hinges		O	O	O
3. Inspect battery, box and cables (Check at least every 30 days. Flush box as required and fill battery per instructions on box)	O	O	O	O
4. Check fluid in brake reservoir (fill as required)	O	O	O	O
5. Inspect electronic installation		O	O	O
6. Inspect bulkheads and stringers for damage		O	O	O
7. Inspect antenna mounts and electric wiring		O	O	O
8. Inspect hydraulic pump motor brushes (See Note 19)		O	O	O
9. Check hydraulic pump fluid level (Fill as required)	O	O	O	O
10. Inspect hydraulic pump lines for damage and leaks		O	O	O
11. Inspect fuel lines, valves and gauges for damage and operation		O	O	O
12. Remove, drain and clean fuel gascolator bowls (Drain and clean at least every 90 days)		O	O	O
13. Check security of all lines		O	O	O

5-21-00

Page 5-07

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS. (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
E. FUSELAGE AND EMPENNAGE GROUP (cont)				
14. Inspect vertical fin and rudder surfaces for damage		O	O	O
15. Inspect rudder hinges, horn and attachments for damage and operation ...		O	O	O
16. Inspect rudder control stops to ensure stops have not loosened and locknuts are tight		O	O	O
17. Inspect vertical fin attachments		O	O	O
18. Inspect ELT installation and condition of battery and antenna (See latest Piper S/L No. 820)		O	O	O
19. Inspect rudder, tab hinge bolts for excess wear (Replace as required)		O	O	O
20. Inspect rudder trim mechanism		O	O	O
21. Inspect stabilator surfaces for damage		O	O	O
22. Inspect stabilator, tab hinges, horn and attachments for damage and operation		O	O	O
23. Inspect stabilator control stops to ensure stops have not loosened and locknuts are tight		O	O	O
24. Inspect stabilator attachments		O	O	O
25. Inspect stabilator and tab hinge bolts and bearings for excess wear (Replace as required)		O	O	O
26. Inspect stabilator trim mechanism	O	O	O	O
27. Inspect aileron, rudder, stabilator, stabilator trim cables, stabilator actuator tube, bellcrank turnbuckles, guides and pulleys for safety, condition of bearings, damage and operation		O	O	O
28. Inspect all control cables, air ducts, electrical leads and attaching parts for security, routing, chafing, deterioration, wear and correct installation		O	O	O
29. Clean and lubricate stabilator trim drum screw			O	O
30. Clean and lubricate all exterior needle bearings				O
31. Lubricate per lubrication chart in Chapter 12	O	O	O	O
32. Inspect rotating beacon for security and operation		O	O	O
33. Inspect security of Autopilot bridle cable clamps		O	O	O
34. Inspect oxygen system as required (Refer to Chapter 35)		O	O	O
35. Reinstall inspection plates and panels		O	O	O

5-21-00

Page 5-08

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS. (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
F. WING GROUP				
1. Remove inspection plates and fairings		O	O	O
2. Inspect surfaces and tips for damage, loose rivets, and condition of walkway		O	O	O
3. Inspect aileron hinges and attachments (Refer to latest revision Piper Service Bulletin No. 725)		O	O	O
4. Inspect aileron control stops to ensure stops have not loosened and locknuts are tight		O	O	O
5. Inspect aileron cables, pulleys and bellcranks for damage and operation (Inspect bellcrank bearing for freedom of movement)		O	O	O
6. Inspect flaps and attachments for damage and operation		O	O	O
7. Inspect condition of bolts used with hinges (Replace as required)				O
8. Lubricate per lubrication chart (Refer to Chapter 12)	O	O	O	O
9. Inspect wing attachment bolts and brackets		O	O	O
10. Inspect all control cables, air ducts, electrical leads, lines, and attaching parts for security, routing, chafing, deterioration, wear and correct installation		O	O	O
11. Inspect fuel tanks and lines for leaks and water (See Note 16)		O	O	O
12. Fuel tanks marked for capacity		O	O	O
13. Fuel tanks marked for minimum octane rating		O	O	O
14. Inspect fuel tank vents (See Note 17)		O	O	O
15. Inspect fuel tank nipple fittings for damage and proper torque (Refer to Chapter 28)		O	O	O
16. Reinstall inspection plates and fairings		O	O	O
G. LANDING GEAR GROUP				
1. Inspect oleo struts for proper extension (N-2.70 + - .25 in. M-2.60 + - .25 in.) (Check for proper fluid level as required)	O	O	O	O
2. Inspect nose gear steering control and travel		O	O	O
3. Inspect wheel alignment		O	O	O
4. Put airplane on jacks (Refer to Chapter 7)		O	O	O
5. Inspect tires for cuts, uneven or excessive wear and slippage		O	O	O
6. Remove wheels, clean, check and repack bearings		O	O	O

5-21-00

Page 5-09

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS. (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
G. LANDING GEAR GROUP (cont)				
7. Inspect wheels for cracks, corrosion and broken bolts		O	O	O
8. Check tire pressure (N-50 psi/ M-55 psi)	O	O	O	O
9. Inspect brake lining and disc		O	O	O
10. Inspect brake backing plates		O	O	O
11. Inspect brake lines and retaining clamps		O	O	O
12. Inspect condition of centering spring		O	O	O
13. Inspect gear forks for damage		O	O	O
14. Inspect oleo struts for fluid leaks and scoring		O	O	O
15. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security (See Note 22)		O	O	O
16. Inspect downlocks for operation and adjustment		O	O	O
17. Inspect torque link bolts and bushings (Rebush as required)			O	O
18. Inspect drag end side brace link bolts (Replace as required)				O
19. Inspect gear doors and attachments		O	O	O
20. Inspect gear warning horn and light for operation		O	O	O
21. Retract gear - check operation		O	O	O
22. Retract gear - check doors for clearance and operation		O	O	O
23. Inspect operation of squat switch		O	O	O
24. Inspect downlock switches, up switches, and electrical leads for security, operation and condition		O	O	O
25. Lubricate per lubrication chart in Chapter 12	O	O	O	O
26. Remove airplane from jacks		O	O	O
26. Remove airplane from jacks		O	O	O
27. Inspect wearing surfaces of brake discs for "heat checks" (Refer to Chapter 32)		O	O	O

5-21-00

Page 5-10

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS. (cont)

— NOTE —

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2 and 3.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
H. OPERATIONAL INSPECTION				
1. Check fuel pump and fuel tank selector and crossfeed operation	O	O	O	O
2. Check fuel quantity and pressure or flow gauges	O	O	O	O
3. Check oil pressure and temperatures	O	O	O	O
4. Check alternator output	O	O	O	O
5. Check carburetor heat - 180 only	O	O	O	O
6. Check parking brake and toe brakes	O	O	O	O
7. Check vacuum gauge	O	O	O	O
8. Check gyros for noise and roughness	O	O	O	O
9. Check cabin heater operation	O	O	O	O
10. Check magneto switch operation	O	O	O	O
11. Check magneto RPM variation	O	O	O	O
12. Check throttle and mixture operation	O	O	O	O
13. Check propeller smoothness	O	O	O	O
14. Check constant speed propeller action	O	O	O	O
15. Check engine idle	O	O	O	O
16. Check electronic equipment operation	O	O	O	O
17. Check operation of controls	O	O	O	O
18. Check operation of flaps	O	O	O	O
19. Check manifold pressure indicating	O	O	O	O
20. Check operation of cowl flaps	O	O	O	O
21. Check operation of Autopilot, including automatic pitch trim and Manual Electric Trim (See Note 21)	O	O	O	O
I. GENERAL				
1. Aircraft conforms to FAA Specifications	O	O	O	O
2. All FAA Airworthiness Directives complied with	O	O	O	O
3. All Manufacturers Service Letters and Bulletins complied with	O	O	O	O
4. Check for proper Flight Manual	O	O	O	O
5. Aircraft papers in proper order	O	O	O	O

5-21-00

Page 5-11

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS. (cont)

NOTES:

1. Refer to the last card of the Piper - Parts Price List - Aerofiche, for a checklist of current revision date to Piper Inspection Reports and Manuals.
2. All inspections or operations are required at each of the inspection intervals as indicated by a (O). Both the annual and 100 hour inspections are complete inspections of the airplane, identical in scope, while both the **500 and 1000** hour inspections are extensions of the annual or 100 hour inspection, which require a more detailed examination of the airplane, and overhaul or replacement of some major components. Inspections must be accomplished by persons authorized by the FAA.
3. Piper Service Bulletins are of special importance and must be complied with promptly.
4. Piper Service Letters are product improvements and service hints pertaining to servicing the airplane and should be given careful attention.
5. Inspections given for the power plant are based on the engine manufacturer's operator's manual (Lycoming Part Number 60297-12) for this airplane. Any changes issued to the engine manufacturer's operator's manual after this date shall supersede or supplement the inspections outlined in this report. Occasionally, service bulletins or service instructions are issued by Avco Lycoming Division that require inspection procedures that are not listed in this manual. Such publications usually are limited to specific models and become obsolete after corrective steps have been accomplished. All such publications are available from Avco Lycoming distributors, or from the factory by subscription. Consult latest revision Lycoming Service Letter No. L114 for subscription information. Maintenance facilities should have an up-to-date file of these publications available at all times.
6. Intervals between oil changes can be increased as much as 100% on engines equipped with full flow (cartridge type) oil filters - provided the element is replaced each 50 hours of operation. As required by latest revision Lycoming Service Bulletin No. 446, oil additive LW-16702 must be added at each 50 hour oil change. The additive can be purchased thru Lycoming and Piper distribution systems.
7. Replace or overhaul as required or at engine overhaul. (For engine overhaul, refer to latest revision Lycoming Service Instructions No. 1009.)
8. Replace flexible oil lines as required, but not later than 1000 hours of service.
9. Torque all attachment nuts to 135-150 inch-pounds; seat "Pal" nuts fingertight against plain nuts, and then tighten an additional 1/3 to 1/2 turn.
10. Deleted.
11. Check cylinders for evidence of excessive heat which is indicated by burned paint on the cylinders. This condition is indicative of internal damage to the cylinder and, if found, its cause must be determined and corrected before the aircraft is returned to service.

Heavy discoloration and appearance of seepage at the cylinder head and barrel attachment area is usually due to emission of thread lubricant used during assembly of the barrel at the factory, or by slight gas leakage which stops after the cylinder has been in service for awhile. This condition is neither harmful nor detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder should be replaced.
12. At every 400 hours of engine operation, remove the rocker box covers and check for freedom of valve rockers when valves are closed. Look for evidence of abnormal wear or broken parts in the area of the valve tips, valve keeper, springs and spring seat. If any indications are found, the cylinder and all of its components should be removed (including the piston and connecting rod assembly) and inspected for further damage. Replace any parts that do not conform with limits shown in the latest revision for Lycoming Service Table of Limits No. SSP-1776.
13. Check carburetor throttle body attaching screws for tightness; the correct torque for these screws is 40 to 50 inch-pounds.

5-21-00

Page 5-12

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PERIODIC INSPECTIONS. (cont)

NOTES (cont):

14. Check landing gear system in accordance with instructions given in Chapter 32.
15. Inspect and service in accordance with the latest revision of Hartzell Service Letter No. 61.
16. Replace flexible fuel tank supply hoses at time of engine overhaul.
17. Replace fuel tank vent line flexible connections as required, but no later than 1000 hours of service.
18. When using alternate fuels, refer to latest revision Lycoming Service Letter No. L185 for additional information and service procedures.
19. Inspect brushes every 100 hours on airplanes used for training or every 500 hours on airplanes used for normal service. (Refer to Chapter 29.)
20. For information on changing propeller spinner dome attaching locknuts, refer to latest revision Hartzell Service Instruction No. 118.
21. Refer to Flight Manual Supplement for preflight and flight check, for intended function in all modes.
22. For all aircraft in excess of 1,000 hours, carefully inspect the trunnion forging barrel for cracks with a 10 power glass at the lower end of the fillet every 500 hours thereafter unless replaced by P N 67926-14 or 67926-15.
23. Check at each annual or 100 hour inspection, whichever comes first. Refer to Chapter 52 for test procedures.
24. Refer to latest Piper Service Bulletin No. 719 for inspection of engine mount.

— NOTE —

Printed copies of this 100 Hour/Annual Inspection Report can be obtained from Piper Service Sales - under Piper Part Number 230 963.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PROGRAMMED INSPECTION.

The programmed inspection was designed to permit the best utilization of the aircraft, by scheduling inspections through the use of a planned inspection schedule. This programmed inspection schedule has been prepared in a manual form which is available from Piper Service Sales - under Piper Part Number 761 733.

UNSCHEDULED MAINTENANCE CHECKS.

SPECIAL INSPECTIONS AS REQUIRED, UPON CONDITION.

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

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

— END —

CHAPTER

6

DIMENSIONS AND AREAS

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 6 - DIMENSIONS AND AREAS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO	EFFECTIVITY
6-10-00	DIMENSIONS	1B15	4R 1-83
6-11-00	Station Reference Lines	1B19	
6-12-00	Access And Inspection Provisions	1B20	
6-13-00	Weight and Balance Data	1B20	
6-14-00	Serial Number Plate	1B20	8-80

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

DIMENSIONS.

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

CHART 601. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS

MODEL	PA-44-180/180T
ENGINE	
Manufacturer	Lycoming
Model - Left	O-360-E1A6D, (CW), TO-360-E1A6D ¹
Model - Right	LO-360-E1A6D, (CCW), LTO-360-E1A6D ¹
FAA Type Certificate	TC 286, E26EA ¹
Rated Horsepower	180 HP at S.L., 180 HP at 12,000 ft. ¹
Rated Speed	2700 RPM, 2575 RPM ¹
Oil Pressure:	
Minimum Idling	15 psi
Normal	60 to 90 psi
Max. Starting and Warmup	100 psi and 115 psi ¹
Oil, SAE Number	See Lubrication Chart
Oil Sump Capacity	6 U.S. Quarts
Fuel, Aviation Grade, Minimum Octane	100/130, 100 or 100 LL ¹
Magnetos, Bendix:	
TO and O-360-E1A6D	D4RN-2021, D4RN-3021 ² , D4RN-3000 ¹
LTO and LO-360-E1A6D	D4LN-2021, D4LN-3021 ² , D4LN-3000 ¹
Magneto Timing	25° BTC, 20° BTC ¹
Magneto Point Clearance	.016 ± .001
Spark Plug Gap Setting	Refer to Latest Issue of Lycoming Service Instruction No. 1042
Firing Order	1-3-2-4
Starter - Prestolite (12-volt):	
Left Engine	MZ-4222
Right Engine	MZ-4220
Alternator - Prestolite (60 amp)	ALY-6421
Alternator Voltage Regulator, LAMAR	B-00288-1
Alternator Overvoltage Relay, WICO	FOC-4002B
NOTE: ¹ PA-44-180T ONLY. ² PA-44-180 ONLY.	

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

CHART 601. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS (cont)

MODEL		PA-44-180-180T
PROPELLER	TWO BLADE	THREE BLADE
Manufacturer	Hartzell	Hartzell
Hub and Blade Model:		
Right Engine	HC-C2Y(K.R)-2CLEUF FJC7666A-2R	HC-C3YR-2LEUF FJC7663-5R
Left Engine	HC-C2Y(K.R)-2CEUF FC7666A-2R	HC-C3YR-2EUF FC7663-5R
Diameter	74 in.	73 in.
Diameter, Minimum	72 in.	72 in.
Blade Angle, Low Pitch ²	12.4° ± 0.2°, 13.1° ± 0.2° ¹	10.6° ± 0.1°, 11.2° ± 0.1° ¹
Blade Angle, Feather ²	79° - 81°	81° - 83°
Governor Control	Hartzell	Hartzell
Governor Model:		
Left Engine	E-3-2	Same
Right Engine	E-3-2L, E-8-2L ³	Same
Left Engine ¹	E-3-5	Same
Right Engine ¹	E-3-5L, E-8-5L ³	Same
NOTES:		
¹ PA-44-180T ONLY.		
² MEASUREMENT TAKEN AT 30 INCH STATION.		
³ SYNCHROPHASER INSTALLATION ONLY.		
FUEL SYSTEM		
Fuel Tank	2 (1 each wing)	
Capacity	55 U.S. Gallons	
Unusable Fuel	1 U.S. Gallon	
Total Capacity (Both)	110 U.S. Gallons	
Total Unusable Fuel	2 U.S. Gallons	
Total Usable Fuel	108 U.S. Gallons	
LANDING GEAR		
Type	Fully Retractable	
Shock Strut Type	Air - Oil Oleo	
Fluid Required (Struts, Brakes & Hydraulic System)	MIL-H-5606	
Wheel Tread	10.54 ft.	
Wheel Base	8.4 ft.	

6-10-00

Page 6-02

Revised: February 23, 1981

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

CHART 601. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS (cont)

MODEL	PA-44-180 180T	
LANDING GEAR (cont)		
Nose Wheel Travel	21° left, 21° right 27° left, 27° right	
Turning Radius (Minimum):		
Nose Wheel	19.5 ft.	
Wing Tip	37.7 ft.	
Wheel, Nose	Cleveland 40-77B, 5.00 x 5 or McCauley D-30500, 5.00 x 5	
Wheel, Main	Cleveland 40-90C, 6.00 x 6 or Cleveland 40-120C, 6.00 x 6	
Brake, Type	Cleveland 30-65 Double Disc or Cleveland 30-83 (Heavy Duty)	
Tire, Nose	McCreary Type III, 5.00 x 5 (6 ply) or B.F. Goodrich Type III, 5.00 x 5 (6 ply)	
Tires, Main	McCreary Type III, 6.00 x 6 (8 ply) or B.F. Goodrich Nylon Type III, 6.00 x 6 (8 ply)	
Tire Pressure, Nose	50 psi @ Gross Weight	PPN 40025
Tire Pressure, Main	55 psi @ Gross Weight	PPN 40025
Nose Gear Strut Pressure	125 ± 12.5 psi	
Nose Gear Visible Piston Extension (Under Static Load) ¹	2.7 ± .25 inches	
Main Gear Strut Pressure	200 ± 20 psi	
Extension (Under Static Load) ¹	2.6 ± .25 inches	

STATIC LOAD IS THE EMPTY WEIGHT OF THE AIRCRAFT PLUS FULL FUEL AND OIL

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

2293

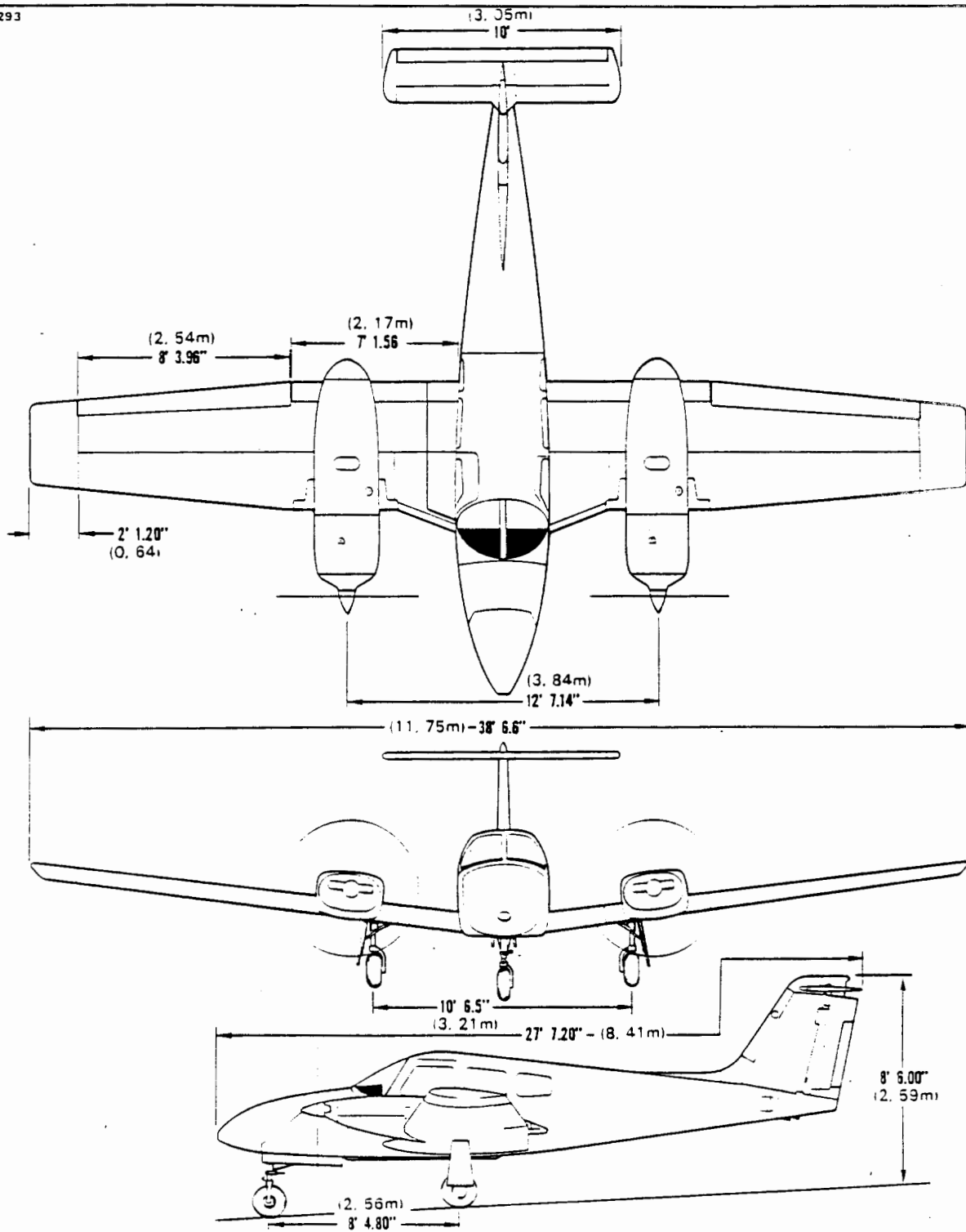


Figure 6-1. Three View

PIPER AIRCRAFT

PA-44-180/180T

*MAINTENANCE MANUAL

STATION REFERENCE LINES.

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

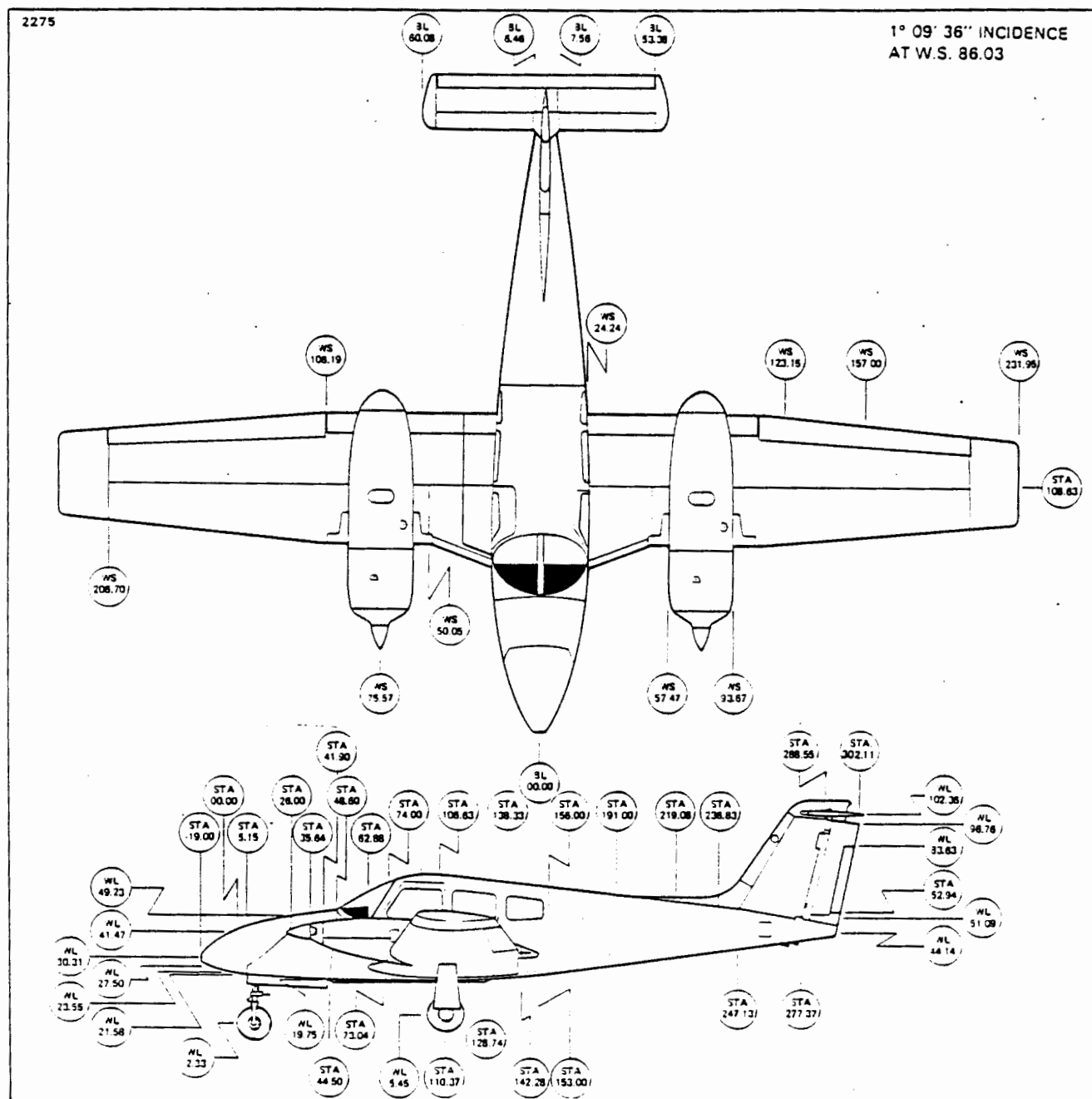


Figure 6-2. Station References

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

ACCESS AND INSPECTION PROVISIONS.

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

WEIGHT AND BALANCE DATA.

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

SERIAL NUMBER PLATE.

The serial number plate is located on the bottom of the fuselage forward of station 247.125. The serial number should always be used when referring to the airplane on service or warranty matters.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

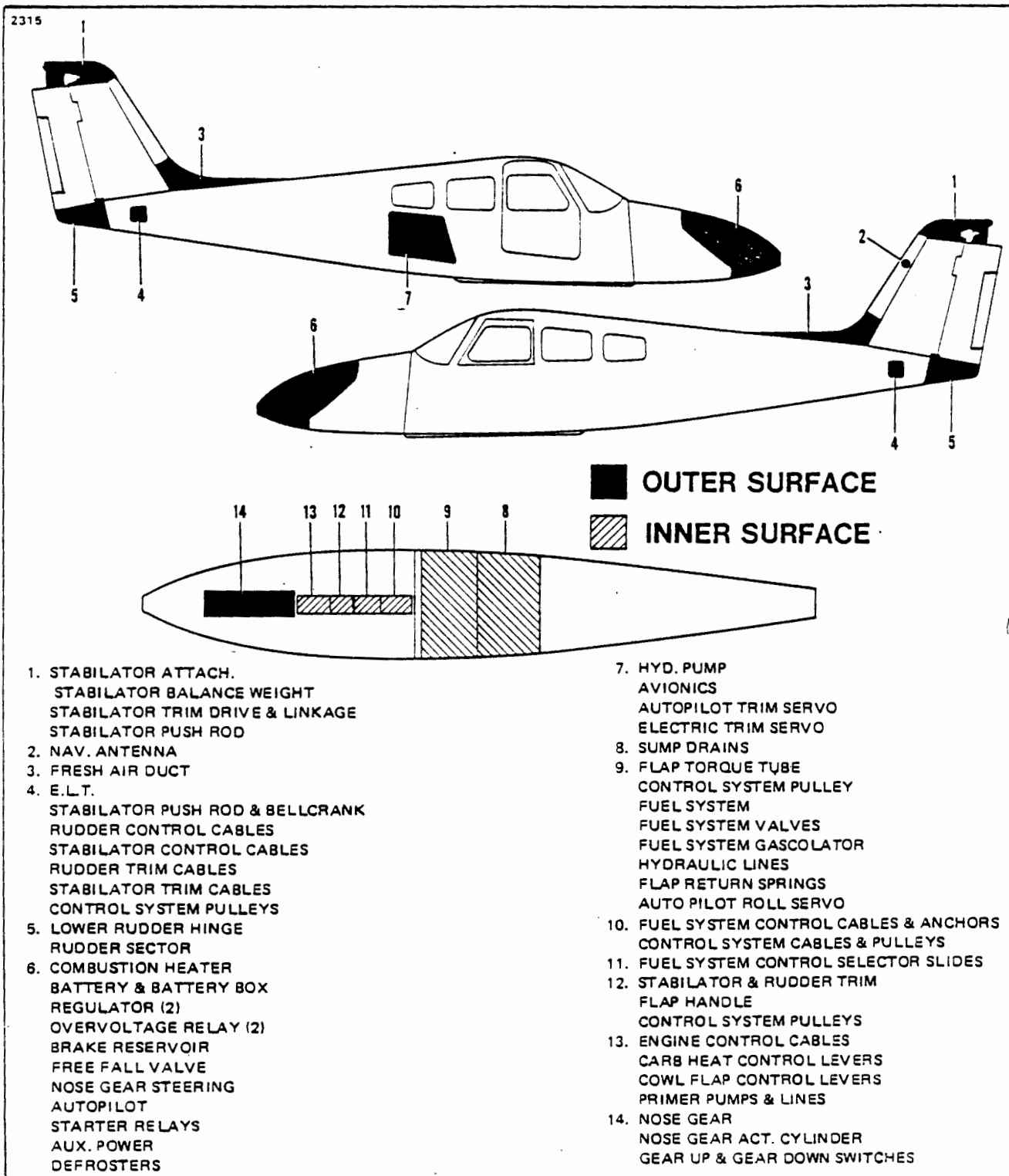


Figure 6-3. Access Plates and Panels

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

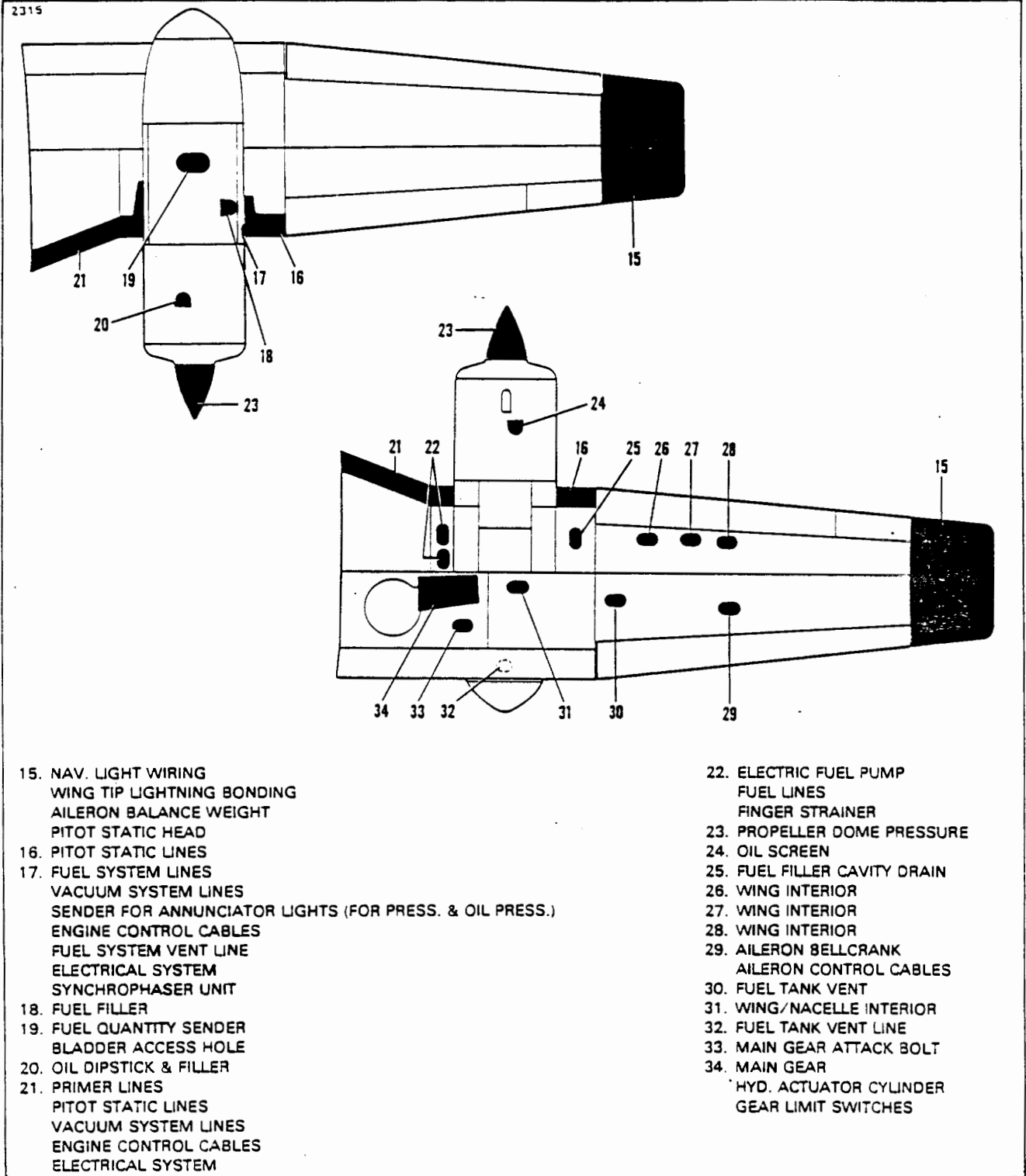


Figure 6-3. Access Plates and Panels (cont)

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

7

LIFTING AND SHORING

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 7 - LIFTING AND SHORING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
7-10-00	JACKING	1C4	8-80

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

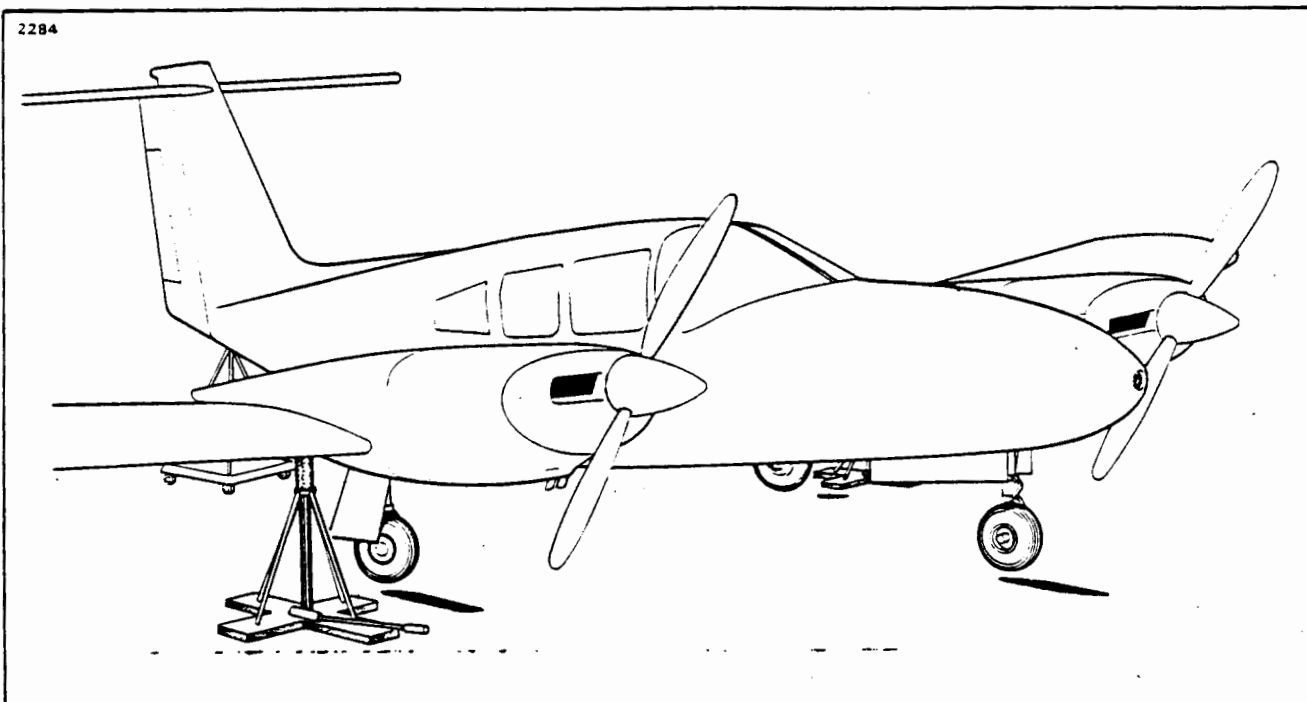


Figure 7-1. Jacking

JACKING.

Jack the airplane as specified to perform various service operations. Proceed as follows:

1. Place the jacks under the jack pads on the wing front spar.

— CAUTION —

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

2. Attach a tail support to the tail skid. Place approximately 600 pounds of ballast on the support to hold the tail down. (Refer to Figure 7-1.)

— CAUTION —

If the purpose for placing the airplane on jacks is to service the hydraulic system, the free-fall valve knob should be pulled full out from the instrument panel.

3. Carefully raise jacks until all three wheels are clear of the surface.

— END —

7-10-00

Page 7-01

Revised: January 3, 1983

CHAPTER

8

LEVELING AND WEIGHING

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 8 - LEVELING AND WEIGHING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
8-10-01	LEVELING	1C8	8-80
8-20-01	WEIGHING	1C9	

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

LEVELING.

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 immediately below the left front side window. (Refer to Figure 8-1.) 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 main spar box (refer to Figure 8-1) and deflate the tire on the high side of the airplane or adjust either jack until the bubble of the level is centered.

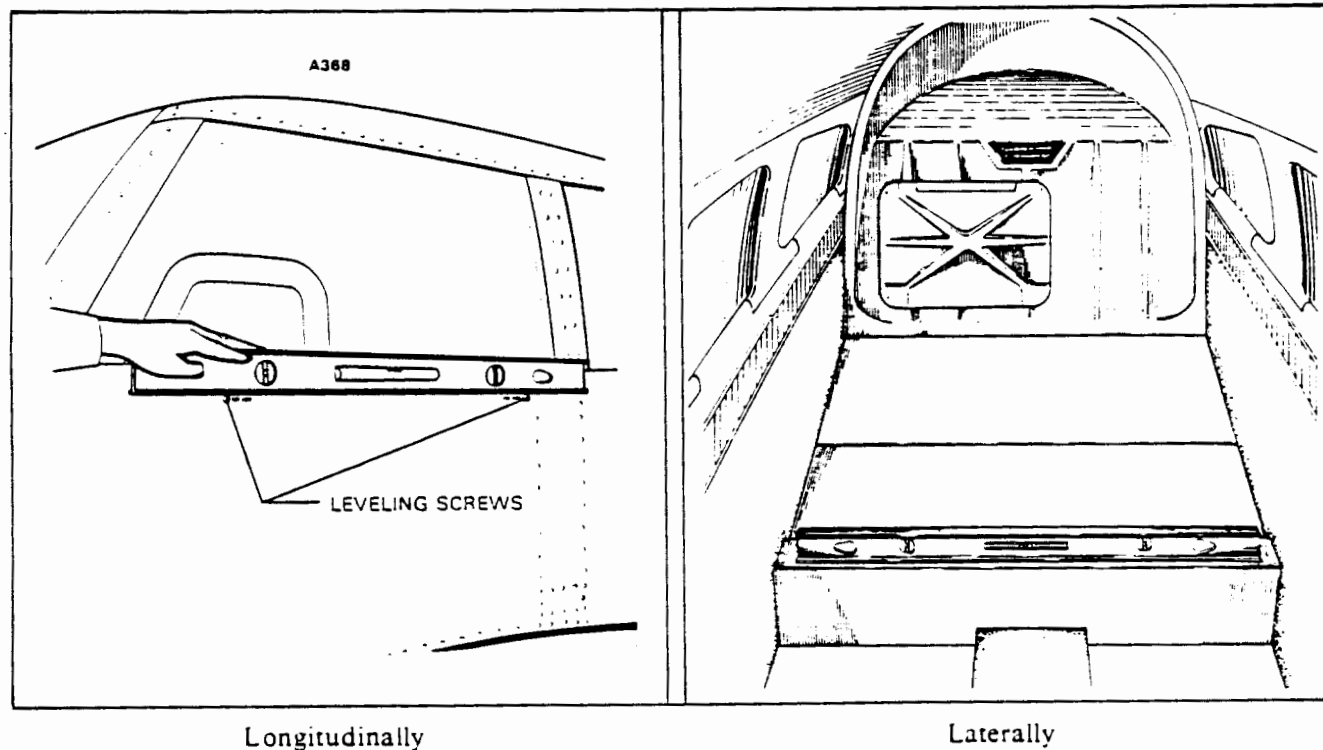


Figure 8-1. Leveling Airplane

8-10-01
Page 8-01

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

WEIGHING. (Refer to Figure 8-2.)

The airplane may be weighed by the following procedure:

1. Position a scale and ramp in front of each of the three wheels.
2. Secure the scales from rolling forward and tow the airplane up onto the scales. (Refer to Towing, Chapter 9.)
3. Remove the ramp so as not to interfere with the scales.
4. If the airplane is to be weighed for weight and balance computations, level the airplane.

— END —

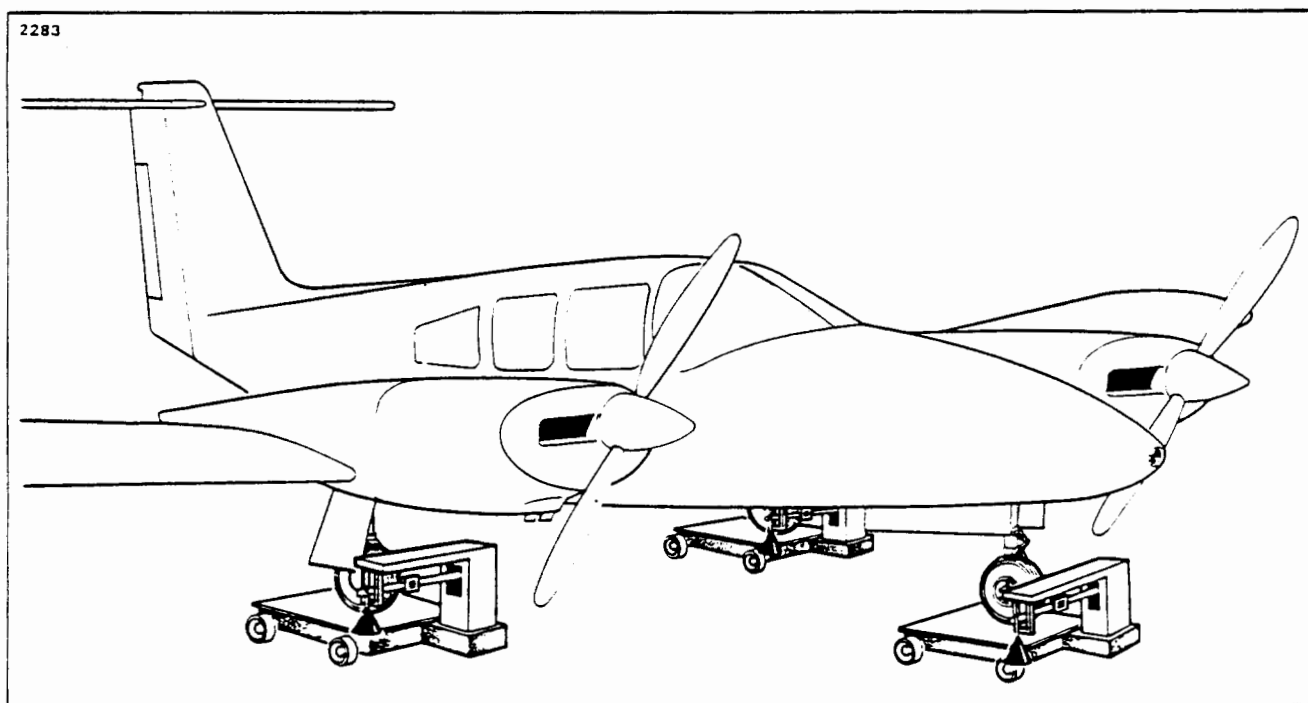


Figure 8-2. Weighing

CHAPTER

9

TOWING AND TAXIING

1C10

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 9 - TOWING AND TAXIING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
9-10-00	TOWING	1C13	
9-20-00	TAXIING	1C13	

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

TOWING.

— CAUTION —

When towing with power equipment, do not turn the nose gear in either direction beyond its steering radius limits as this will result in damage to the nose gear and steering mechanism. When moving the aircraft forward by hand, avoid pushing on the trailing edge of the ailerons as this will cause the aileron contour to change resulting in an out-of-trim condition.

The airplane may be moved by using the nose wheel steering bar that is stowed below the forward ledge of the rear baggage compartment or power equipment that will not damage or cause excess strain to the nose gear steering assembly. Tow bar engages front axle inside fork.

In the event towing lines are necessary, lines (rope) should be attached to both main gear struts as high up on the tubes as possible. 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.

TAXIING.

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

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

— END —

CHAPTER

10

PARKING AND MOORING

1C14

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 10 - PARKING AND MOORING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
10-10-00	PARKING	1C17	
10-20-00	MOORING	1C17	
10-21-00	Locking Airplane	1C17	

10 - Cont./Effec.

Page - 1

Revised: January 3, 1983

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

PARKING.

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

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

— NOTE —

Care should be taken when setting brakes that are overheated or during cold weather when accumulated moisture may freeze the brakes.

3. The aileron and stabilator controls may be secured with the pilot's seat belt.

MOORING.

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

1. Head the airplane into the wind, if possible.
2. Block the wheels.
3. Lock the aileron and stabilator controls by looping the pilot's seat belt around wheel.

— CAUTION —

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

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 airplane when the ropes contract due to moisture.

— NOTE —

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

LOCKING AIRPLANE.

The right cabin door is provided with a key lock on the outside. The cabin door lock and nose baggage compartment door lock use the same key.

— END —

CHAPTER

11

REQUIRED PLACARDS

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

CHAPTER 11 - REQUIRED PLACARDS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
11-00-00	GENERAL	1C20	
11-20-00	PLACARDS AND MARKINGS	1C20	1R 3-84

11 - Cont./Effec.

Page - 1

Revised: March 26, 1984

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

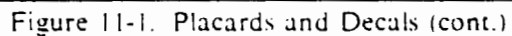
GENERAL.

PLACARDS AND MARKINGS.

1 NAMEPLATE - PIPER SEMINOLE	54 PLACARD - CIRCUIT BREAKER, BOTTOM	105 PLACARD - PROP HEAT
2 MEDALLION - PIPER LOGO	55 PLACARD - EXTERNAL POWER	106 PLACARD - ON-OFF
3 PLACARD - FLAP WARNING	56 PLACARD - PITCH TRIM	107 DECAL - AVGAS
4 PLACARD - OPEN	57 PLACARD - MIKE AND PHONE	
5 PLACARD - LATCH	58 PLACARD - A/P INTR.	
6 PLACARD - DOOR LOCK	59 PLACARD - MIKE	
7 PLACARD - STORM WINDOW	60 PLACARD - WARNING	
8 PLACARD - EMERGENCY EXIT DOOR	61 PLACARD - MIKE	
9 PLACARD - OLEO SERVICE INSTRUCTIONS	62 PLACARD - HEADPHONE	
10 PLACARD - TURN LIMIT	63 PLACARD - MIKE AND PHONE	
11 PLACARD - TURN LIMIT CENTER MARK	64 PLACARD - OMNI COUPLER SWITCH	
12 PLACARD - OLEO SERVICE INSTRUCTIONS	65 PLACARD - ELECTRIC PITCH TRIM	
13 PLACARD - FUEL SELECTOR	66 PLACARD - GLIDE SLOPE COUPLER	
14 PLACARD - STABILATOR TRIM	67 PLACARD - RADIO POWER, ON-OFF	
15 PLACARD - ENGINE CONTROLS	68 PLACARD - EMERGENCY BUS SWITCH	
16 PLACARD - CARBURETOR HEAT	69 PLACARD - ALTITUDE REPORTER INSTALLED	
17 PLACARD - OPERATING LIMITATIONS	70 PLACARD - CAUTION COMPASS DEVIATION	
18 PLACARD - SOFT WEAR	71 PLACARD - CARBURETOR ICE DETECTOR	
19 PLACARD - BAGGAGE LIMITATIONS	72 PLACARD - SENSITIVITY	
20 PLACARD - PITOT STATIC SYSTEM DRAIN	73 PLACARD - MANIFOLD PRESSURE	
21 PLACARD - RUDDER TRIM	74 PLACARD - WARNING	
22 PLACARD - COWL FLAP	75 PLACARD - OXYGEN SUPPORT	
23 PLACARD - STROBE LIGHT WARNING	76 PLACARD - PRIMER	
24 PLACARD - CLOSED-OPEN	77 PLACARD - OIL CHANGE	
25 PLACARD - WARMER	78 PLACARD - PIPER AIRE	
26 PLACARD - OFF-ON	79 PLACARD - DO NOT PUSH	
27 PLACARD - AIR INTAKE, TEMP., DEF	80 PLACARD - LEVEL POINT	
28 PLACARD - OPERATION	81 PLACARD - NO STEP	
29 PLACARD - OVER HEAT	82 PLACARD - DOOR RELEASE	
30 PLACARD - FRESH AIR FAN	83 PLACARD - OIL SPEC	
31 PLACARD - WINTERIZATION KIT	84 PLACARD - CLIMATE CONTROL CENTER	
32 PLACARD - RADIO LIGHTS, PANEL LIGHTS	85 PLACARD - TRANSPONDER IDENTIFIER	
33 PLACARD - GEAR UP-DOWN	86 PLACARD - NAV 1 OFF NAV 2	
34 PLACARD - EMERGENCY GEAR	87 PLACARD - RADAR	
35 PLACARD - PULL TO RELEASE	88 PLACARD - CAUTION COMPASS DEVIATION	
36 PLACARD - PARK BRAKE PULL	89 PLACARD - TAKEOFF AND LANDING OPERATION	
37 PLACARD - LANDING CHECKLIST	90 PLACARD - PROPELLER SYNCHROPHASER	
38 PLACARD - TAKEOFF CHECKLIST	(MANUAL-AUTO)	
39 PLACARD - ALTERNATE STATIC	91 PLACARD - CIRCUIT PROTECTOR, PROPELLER	
40 PLACARD - SINGLE ENGINE STALLS	SYNCHROPHASER	
41 PLACARD - MINIMUM SINGLE ENGINE	92 PLACARD - HYDRAULIC FLUID SPEC	
CONTROL SPEED	93 PLACARD - OXYGEN GAUGE LIGHT	
42 PLACARD - DEMONSTRATED CROSSWIND	94 PLACARD - OXYGEN	
43 PLACARD - MANEUVERING SPEED	95 PLACARD - NOT APPROVED FOR FLIGHT IN	
44 PLACARD - GEAR RETRACT	ICING CONDITIONS	
45 PLACARD - PRESS TO TEST	96 PLACARD - PROP HEAT	
46 PLACARD - FUEL ONLY	97 PLACARD - PROP HEAT AMPS	
47 PLACARD - FUEL DRAIN	98 PLACARD - ELT WARNING	
48 PLACARD - FLAP LEVER	99 PLACARD - ELT LOCATION	
49 MEDALLION - PIPER, CONTROL WHEEL	100 PLACARD - RADAR ALTIMETER ON-OFF	
50 PLACARD - CABIN AIR	101 PLACARD - RADAR ALTIMETER OFF FOR TAKEOFF	
51 PLACARD - DOME LIGHT MAXIMUM	102 PLACARD - RADAR ALTIMETER	
52 PLACARD - CIRCUIT BREAKER, TOP	103 PLACARD - WARNING, MAY BE UNRELIABLE	
53 PLACARD - CIRCUIT BREAKER, CENTER	104 PLACARD - STARTER ON	

Figure 11-1. Placards and Decals

P/C 81



CHAPTER

12

SERVICING

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

CHAPTER 12 - SERVICING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
12-00-00	GENERAL	ID1	
12-10-00	REPLENISHING	ID2	
12-11-00	Fuel System	ID2	8-80
12-11-01	Filling Fuel Tanks	ID2	2-81
12-11-02	Draining Moisture From Fuel System	ID2	2-81
12-11-03	Draining Fuel System	ID2	2-81
12-12-00	Oil System	ID2	2R 8-82
12-12-01	Draining Oil Sump	ID3	
12-12-02	Filling Oil Sump	ID3	
12-12-03	Oil Screen (Suction)	ID3	
12-12-04	Recommendations for Changing Oil	ID3	8-80
12-12-05	Oil Filter (Full Flow)	ID4	
12-20-00	SCHEDULED SERVICING	ID4	
12-21-00	Landing Gear	ID4	
12-21-01	Servicing Oleo Struts	ID4	
12-21-02	Filling Nose Gear Oleo Strut	ID5	
12-21-03	Filling Main Gear Oleo Struts	ID6	
12-21-04	Inflating Oleo Struts	ID7	
12-21-05	Servicing Steering Bungees	ID7	
12-22-00	Brake System	ID7	
12-22-01	Filling Brake Cylinder Reservoir	ID7	
12-22-02	Draining Brake System	ID8	
12-23-00	Tires	ID8	
12-23-01	Tire Balance	ID8	
12-24-00	Hydraulic System	ID9	
12-24-01	Hydraulic Pump Reservoir	ID9	
12-25-00	Battery	ID9	
12-26-00	Induction Air Filter	ID9	
12-26-01	Removal of Air Filter	ID9	
12-26-02	Service Instructions (Inspection and Replacement)	ID10	
12-26-03	Installation of Air Filter	ID10	
12-27-00	Alternate Air Heat Door	ID10	
12-28-00	Cleaning	ID10	
12-28-01	Engine Compartments	ID10	
12-28-02	Landing Gear	ID11	

12 - Cont./Effec.

Page - 1

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 12 - SERVICING (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
12-20-00	SCHEDULED SERVICING (cont)	—	
12-28-00	Cleaning (cont)	—	
12-28-03	Exterior Surfaces	ID11	
12-28-04	Windshield and Windows	ID12	
12-28-05	Headliner, Side Panels and Seats	ID12	
12-28-06	Carpets	ID12	
12-29-00	Lubrication Instructions	ID13	
12-29-01	Application of Oil	ID13	
12-29-02	Application of Grease	ID13	
12-29-03	Lubrication Charts	ID14	2-81

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

GENERAL.

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

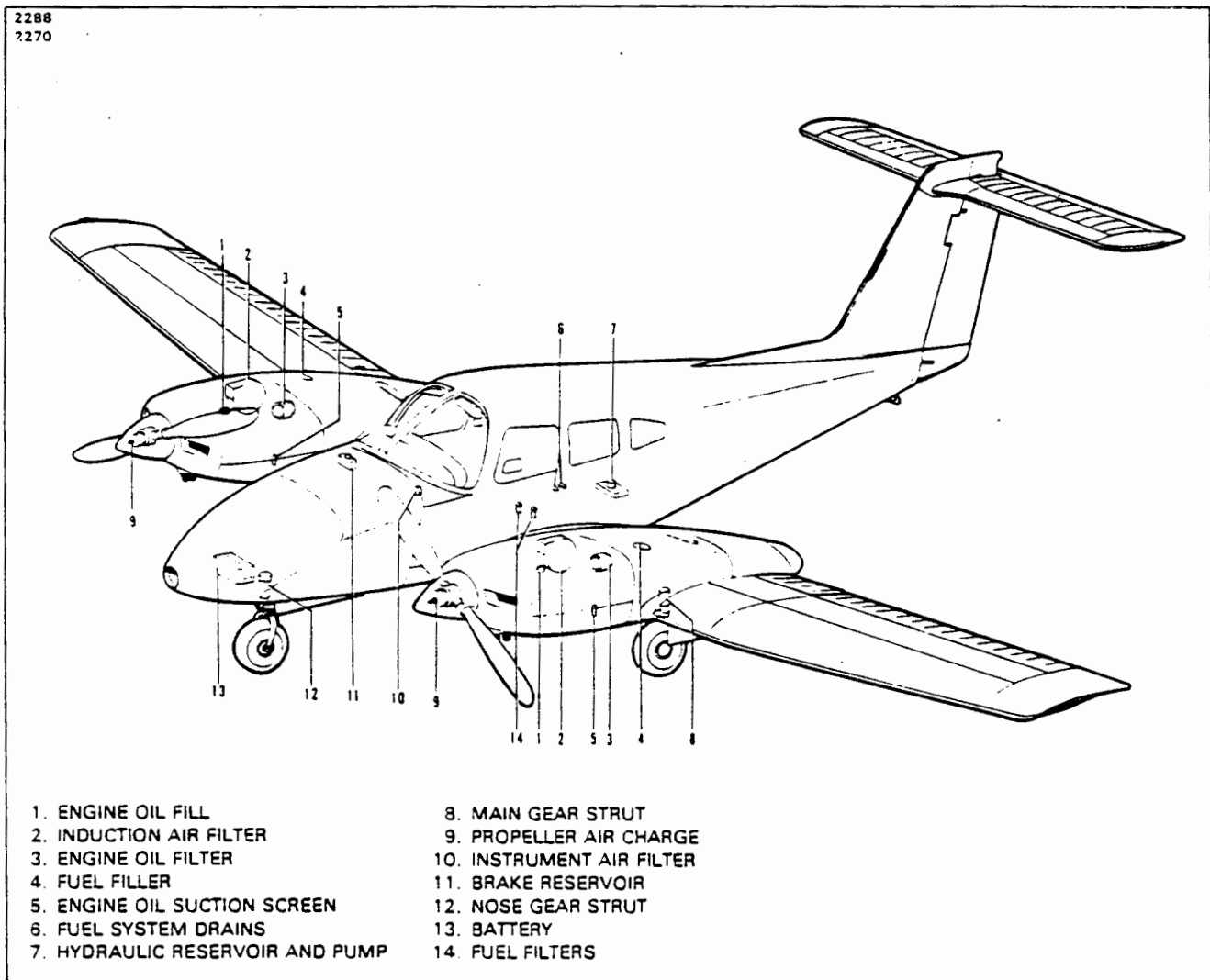


Figure 12-1. Service Points

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

REPLENISHING.

FUEL SYSTEM.

At intervals of 50 hours or 90 days, whichever comes first, clean the fuel filter pack. Remove and clean the filters in accordance with the instructions outlined in Chapter 28. Inspection intervals of the various fuel system components may be found in Chapter 5.

— NOTE —

Refer to Chapter 28 for fuel anti-icing additive information and cautions.

FILLING FUEL TANKS.

The fuel tank of each wing is filled through a single filler located on top of the nacelle. Each tank has a capacity of 55 U.S. gallons, giving a total capacity of 110 U.S. gallons.

1. Observe all required safety precautions for handling gasoline.
2. Fill the tanks with fuel as specified on the placard adjacent to the filler neck.

DRAINING MOISTURE FROM FUEL SYSTEM.

To facilitate draining the fuel system fuel filters, lines and tanks of moisture and foreign matter, drains are incorporated at a point just aft of the right flap trailing edge.

DRAINING FUEL SYSTEM.

The bulk of the fuel may be drained by opening the valves at the right hand side of the fuselage just forward of the entrance step or by siphoning (when draining fuel through the drain valves, the selector valves should be "ON"). The remaining fuel in the lines may be drained through the gascolators.

OIL SYSTEM.

The engine oil level should be checked before each flight and changed after each 100 hours of engine operation. During oil change the oil screen(s) should be removed and cleaned, and the oil filter cartridge replaced. Replace oil filter at 50 hour intervals.

— CAUTION —

Do not introduce any trade additive to the basic lubricant except as recommended by the manufacturer in the latest revision of Lycoming Service Bulletin No. 446.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

— NOTE —

*Add one six ounce can of LW-16702 to the engine oil every 50 hours
or at each oil change in accordance with the latest revision of
Lycoming Service Bulletin No. 446.*

The engine manufacturer does not recommend oils by brand names. Use a quality brand Aviation Grade oil of the proper season viscosity.

DRAINING OIL SUMP.

To drain the oil sump, provide a suitable container with a minimum capacity of that required to fill the sump. Remove the upper cowl, on the inboard lower side of each engine an oil quick drain is provided. To drain oil place a tube of the proper diameter on the quick drain and push into drain. After completion of draining remove tube and check to make sure that quick drain has properly sealed. It is recommended the engine be warmed to operating temperature to insure complete draining of the old oil.

FILLING OIL SUMP.

The oil sump should normally be filled with oil to the mark on the engine dipstick. The specified grade of oil may be found in the Lubrication Chart, or on the cowl panel access door of each engine. To service the engine with oil, open the access door of the cowl and remove the oil filler cap.

OIL SCREEN (SUCTION).

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

RECOMMENDATIONS FOR CHANGING OIL.

Refer to latest revision of Lycoming Service Instruction No. 1014 and Service Bulletin No. 446.

1. In engines that have been operating on straight mineral oil for several hundred hours, a change to ashless dispersant oil should be made with a degree of caution, since the cleaning action of some ashless dispersant oils will tend to loosen sludge deposits and cause plugged oil passages. When an engine has been operating on straight mineral oil and is known to be in excessively dirty condition, the switch to ashless dispersant oil should be deferred until after the engine is overhauled.

2. When changing from straight mineral oil to ashless dispersant oil, the following precautionary steps should be taken:

- A. Except when using LW-16702 (Lycoming Service Bulletin No. 446) do not add ashless dispersant to straight mineral oil. Drain the straight mineral oil from the engine and fill with ashless dispersant.
- B. Do not operate the engine longer than five hours before the first oil change.

12-12-04

Page 12-03

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

C. Check all oil screens for evidence of sludge or plugging and change oil every ten hours if sludge conditions are evident. Repeat 10 hour checks until clean screen is noted, then change oil at recommended time intervals.

— NOTE —

Add one six ounce can of LW-16702 to the engine oil every 50 hours or at each oil change in accordance with the latest revision of Lycoming Service Bulletin No. 446.

OIL FILTER (FULL FLOW).

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

2. Before discarding the throwaway filter, remove the element for inspection by using Champion cutter tool CT-470. Available from Champion Spark Plug Co., Toledo, Ohio 43601. It will cut open any spin-on type oil filter for inspection. Examine the material trapped in the filter for evidence of internal engine damage such as chips or particles from bearings. In new or newly overhauled engines, some small particles of metallic shavings might be found; these are generally of no consequence and should not be confused with particles produced by impacting, abrasion or pressure. Evidence of internal engine damage found in the oil filter justifies further examination to determine the cause.

3. After the filter has been replaced, tighten the attaching bolt within 15 to 18 foot-pounds of torque. Lockwire the bolt through the loops on the side of the housing to the drilled head of the thermostatic valve. Be sure the lockwire is replaced at both the attaching bolt head and the thermostatic oil cooler bypass valve.

SCHEDULED SERVICING.

LANDING GEAR.

SERVICING OLEO STRUTS.

The air-oil type oleo strut should be maintained at proper strut piston tube exposures for best oleo action. The nose gear strut must have approximately $2.70 \pm .25$ inches of piston tube exposed, while the main gear strut requires approximately $2.60 \pm .25$ inches of tube exposure.

— CAUTION —

Do not exceed these tube exposures.

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

— NOTE —

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

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

— WARNING —

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

— CAUTION —

Clean all dirt and foreign particles from around the filler plugs with compressed air and/or with a quick drying solvent.

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

FILLING NOSE GEAR OLEO STRUT.

The nose gear should be serviced with MIL-H-5606 hydraulic fluid only. The nose gear is filled as follows:

1. Raise the airplane on jacks as explained in Chapter 7, and place a pan under the gear to catch spillage.
2. Remove the cap from the air valve and release the air pressure by depressing the valve core.
3. Remove the valve from the filler plug at the top of the strut housing.
4. Fully compress the piston tube and fill the strut with hydraulic fluid to the level of the hole for the valve.
5. Remove the core from the valve and install the valve back in the filler plug. Torque valve 350 to 400 inch-pounds.
6. Attach one end of a *clean* plastic hose to the valve and submerge the other end in a container of clean hydraulic fluid, making sure the end of the hose is below the surface of the fluid.

— NOTE —

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

7. Fully compress and extend the piston tube, thus expelling any air trapped within the strut chamber. By watching the fluid pass through the plastic hose, it can be determined when the strut is full and no air is present in the chamber.
8. When air bubbles cease to flow through the hose, compress the piston fully and remove the hose from the valve stem.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

9. Reinstall the valve core in the filler plug.

— NOTE —

A completely empty strut will take 21 ± 1 ounces of MIL-H-5606 hydraulic fluid.

10. With the airplane still on jacks, compress and extend the gear piston tube several times to ascertain that the strut will operate freely. The weight of the gear, wheel, and fork should allow the piston tube to extend.
11. Clean off any overflow of fluid and inflate the strut.
12. Check that fluid is not leaking around the strut piston at the bottom of the housing.
13. With the aircraft off the jacks, and weight on gears, visible strut extension should be $2.7 \pm .25$ inches.

FILLING MAIN GEAR OLEO STRUTS.

To fill the main gear oleo struts with hydraulic fluid (MIL-H-5606) use the following procedure:

1. Raise the airplane on jacks as explained in Chapter 7, and place a pan under the gear to catch any spillage.
2. Unless already done so, remove the cap from the air valve and by depressing the core, relieve the air pressure.
3. Remove the valve from the filler plug.
4. Fully compress the piston and fill the strut with fluid till it comes level with the hole for the valve.
5. Remove the valve core and install the valve with a torque of 350 to 400 inch-pounds.
6. Attach one end of a clean plastic hose to the valve and submerge the other *end* well into a container of hydraulic fluid.

— NOTE —

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

7. Fully compress and extend the piston tube, thus expelling any air trapped within the strut chamber. By watching the fluid pass through the plastic hose, it can be determined when the strut is full and no air is present in the chamber.
8. When air bubbles cease to flow through the hose, fully compress the piston and remove the hose from the valve stem.
9. Reinstall the air valve core.
10. With the airplane still on jacks, compress and extend the gear piston tube several times to ascertain that the strut will operate freely. The weight of the gear, wheel, and fork should allow the piston tube to extend.
11. Clean off any overflow of fluid and inflate the strut with air to 200 psi.
12. Remove the aircraft from jacks and check strut exposure for $2.6 \pm .25$ inches.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

INFLATING OLEO STRUTS.

After making certain that an oleo strut has sufficient fluid, attach a strut pump to the air valve and inflate the oleo strut. The strut should be inflated until the correct inches of piston is exposed with normal static load (empty weight of the airplane plus full fuel and oil) on the gears. Rock the airplane several times to ascertain that the gear settles back to the correct strut position. (If a strut pump is not available, the airplane may be raised and line pressure from a high pressure air system used. Lower the airplane and while rocking it, let air from the valve to bring the strut down to the proper extension. Before capping the valve, check for valve core leakage.)

SERVICING STEERING BUNGEE.

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

1. Remove the tunnel cover located in the forward compartment.
2. Clamp the rudder pedals in the neutral position.
3. Remove the nut, washers, and bolt that secures the steering bungee and the steering arm.
4. Disconnect the bungee from the idler arm by removing the nut, washer and bolt.
5. Remove the steering bungee from the aircraft.
6. Cut the safety wire from the bungee retainer.
7. Carefully remove the retainer and release the spring.
8. Apply Aero Lubriplate to the spring and mounting hardware as specified in the Lubrication Chart.
9. Compress the spring into the bungee tube and install the retainer securing with MIL-W-6713 Type 316 safety wire.
10. With the nose gear in the neutral position, install the steering bungee into position. The primary web must be in the vertical position with the retaining clip facing down. Safety wire on bottom side.
11. Install the bolt, washers, and nut that secures the bungee to the steering arm.
12. Install the bolt, washer, and nut that secures the bungee to the idler arm.
13. Align the nose gear per Alignment of Nose Landing Gear.
14. Remove the rudder pedal clamps and check the operation of the steering bungee.
15. Install the tunnel cover in the forward compartment with the attachment hardware.

BRAKE SYSTEM.

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

FILLING BRAKE CYLINDER RESERVOIR.

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

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

DRAINING BRAKE SYSTEM.

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

TIRES.

The tires should be maintained at the pressure specified in Chart 6001 of Chapter 6. When checking tire pressure examine the tires for wear, cuts, bruises and slippage. The tire, tube, and wheel should be balanced when installed. Align the index mark on the tire with the index mark on the tube.

TIRE BALANCE.

Proper balancing is critical for the life of aircraft tires. If a new tire is balanced upon installation it will usually remain balanced for the life of the tire without having any shimmy or flat spots, and an inexpensive balancer can be made that will balance almost any tire for light aircraft. Refer to Chapter 91 for balancer details. Balance the tire as follows:

1. Mount the tire and tube (if one is used) on the wheel, but do not install the securing bolts. Install the wheel bearings in the wheel; then, using the -7 bushings, -6 spacers, and -5 nuts, install the wheel-tire assembly on the -8 pipe. Secure the -5 nuts finger-tight so that the wheel halves touch each other. Be sure the bolt holes are aligned. Insert the -4 axle through the -8 pipe and place the wheel in the center of the balancer. Make sure the axle is only on the chamfered edges of the balancer and that it is at 90° to the sides of the balancer.
2. Release the tire. If it is out of balance it will rotate, coming to rest with the heaviest point on the bottom. Tape a 1/2 ounce patch across top center of the tire. Rotate the tire 45° and release it again. If the tire returns to the same position, add a 1 ounce patch and again rotate the tire and release it. Continue this procedure until the tire is balanced.
3. When balance is attained, put a chalk mark on the sidewall directly below the patch. Use one mark for each half ounce of weight needed. Mark the valve stem location 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 inside of the tire with toluol. Apply a coat of patch cement to both the patch and the inside center of the tire in line with the chalk marks. When the cement has dried, install the patches making certain they are on the center line of the tire and aligned with the chalk marks on the sidewall. Burnish the patches to remove trapped air, etc.
4. When reassembling the wheel, powder the inside of the tire. Mount the tire on the valve side of the wheel in the same position it was in when it was balanced. Install the other wheel half, aligning the chalk marks. Install the bolts and tighten to required torque, then air the tire and recheck the balance. The wheel should not be more than 1/2 ounce out of balance.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

HYDRAULIC SYSTEM.

The hydraulic pump and landing gear actuating cylinders should be checked for leaks, tightness of line fittings and general condition. The cylinder rods are to be free of all dirt and grit. To clean the rods, use an oil soaked rag and carefully wipe them. All the hydraulic lines should also be checked for leaks, kinks, corrosion and attachment fittings for tightness and security. Repair and check procedures for the hydraulic pump, cylinders, and various components may be found in Chapter 29.

HYDRAULIC PUMP/RESERVOIR.

The fluid level of the reservoir of the combination pump and reservoir should be checked every 50 hours by viewing the fluid through the filler plug hole in the hydraulic pump. Access to the pump is through the panel at the rear of the baggage compartment.

To check fluid level, remove the filler plug located on the forward side of the pump and ascertain that fluid is visible up to the bottom of the filler plug hole. Should fluid be below the hole, loosen the vent screw and add fluid, MIL-H-5606, through the filler hole until full. Reinstall the filler plug.

— NOTE —

A small vent hole is located under the vent screw head. Retain .015 inch clearance between the screw head and the small vent hole.

BATTERY.

Servicing of the battery which is through the panel of the baggage compartment, involves adding distilled water to maintain electrolyte even with the horizontal baffles, checking cable connections, and checking for any spilled electrolyte that would lead to corrosion. A check for proper fluid level and presence of corrosion should be conducted at intervals of 50 hours or 30 days, whichever comes first. When corrosion is found, at each 100 hour inspection or every 90 days, the battery should be removed from the box and the battery and box should be cleaned. Removal, cleaning, and charging instructions may be found in Chapter 24.

INDUCTION AIR FILTER.

REMOVAL OF AIR FILTER.

The induction air filter is located on the right rear side of the engine compartment, and may be removed by the following procedure:

1. Remove the upper cowling.
2. Release the fasteners, remove filter cover as applicable.
3. Remove the filter.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

SERVICE INSTRUCTIONS (INSPECTION AND REPLACEMENT).

1. The air filter must be inspected at least once every 50 hours. Under extremely adverse operating conditions, it must be inspected more frequently. Replace as required.
2. When returning existing filter to service, rap gently on a hard flat surface to remove embedded debris. Be careful not to damage sealing ends.
3. Inspect filter housing for damage.
4. The filter housing may be cleaned by wiping with a clean cloth soaked in a suitable quick drying type solvent.

INSTALLATION OF AIR FILTER.

1. Properly position the filter in the box assembly and secure the cover assembly with the fasteners.

ALTERNATE AIR HEAT DOOR (180).

The alternate air door is located in the bottom assembly of the carburetor air box to provide a source of heated air to the carburetor should there be an icing condition. The following should be checked during inspection:

1. Check that air door seals are tight.
2. Check that when the cockpit control is in the closed position that the door is properly seated in the closed position.
3. Actuate the door by operating the control lever in the cockpit to determine that it is not sticking or binding.
4. Check the cockpit control cable for free travel.

CLEANING.

ENGINE COMPARTMENTS.

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

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

— CAUTION —

*Do not spray solvent into the alternator, starter, air intake,
alternate air inlets and pressure pump drive area.*

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2. With the engine cowlings removed, spray or brush the engines with solvent or a mixture of solvent and degreaser as desired. It may be necessary to brush areas that were sprayed, where heavy grease and dirt deposits have collected in order to clean them.

— CAUTION —

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

3. Allow the solvent to remain on the engine from five to 10 minutes; then rinse the engine clean with additional solvent and allow to dry.

4. Remove the protective covers from magnetos.

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

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. Do not brush micro switches.

3. Allow the solvent to remain on the gear from 5 to 10 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.

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.

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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

WINDSHIELD AND WINDOWS.

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

— NOTE —

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

4. After cleaning plastic surfaces, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion.
5. A severe scratch or mar in plastic can be removed by using jeweler's rouge to rub out the scratch. Smooth both sides and apply wax.
6. To improve visibility through windows during flights through rain, a rain repellent such as "Repcon" should be applied to the windshield and windows. The surfaces of the treated windshield will become so smooth that water beads up and flows readily off the surface. Make sure to follow manufacturers instructions. (Refer to Chart 9105, List of Consumable Materials.)

HEADLINER, SIDE PANELS AND SEATS.

— CAUTION —

Solvent cleaners require adequate ventilation.

1. Clean headliner, side panels, and seats with a stiff bristle brush and vacuum where necessary.
2. Soiled upholstery, except leather, may be cleaned by using an approved air type cleaner or foam upholstery cleaner. Carefully follow the manufacturer's instructions. Avoid soaking or harsh rubbing.
3. Leather material should be cleaned with saddle soap or mild soap and water.

CARPETS.

Use a small whisk broom or vacuum to remove dirt. For soiled spots, use a non-inflammable dry-cleaning fluid. Floor carpets may be removed and cleaned like any household carpet.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

LUBRICATION INSTRUCTIONS.

Proper lubrication procedures are of immeasurable value both as a means of prolonging the service life of the airplane and as a means of reducing the frequency of extensive and expensive repairs. The periodic application of recommended lubricants to their relevant bearing surfaces, as detailed in the following paragraphs, together with the observance of cleanliness will insure 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 the Lubrication Chart. 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.

— NOTE —

If the airplane is inactive for long periods of time, it should be lubricated in accordance with Lubrication Chart every 90 days.

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.

— CAUTION —

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

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

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 lubrication to the grease fittings.

1. Where a reservoir is not provided around a bearing, apply the lubricant sparingly and wipe off any excess.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

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 constant speed propeller hub to avoid blowing the clamp gaskets. Remove one grease fitting and apply grease to the other fitting until fresh grease appears at the hole of the removed fitting.

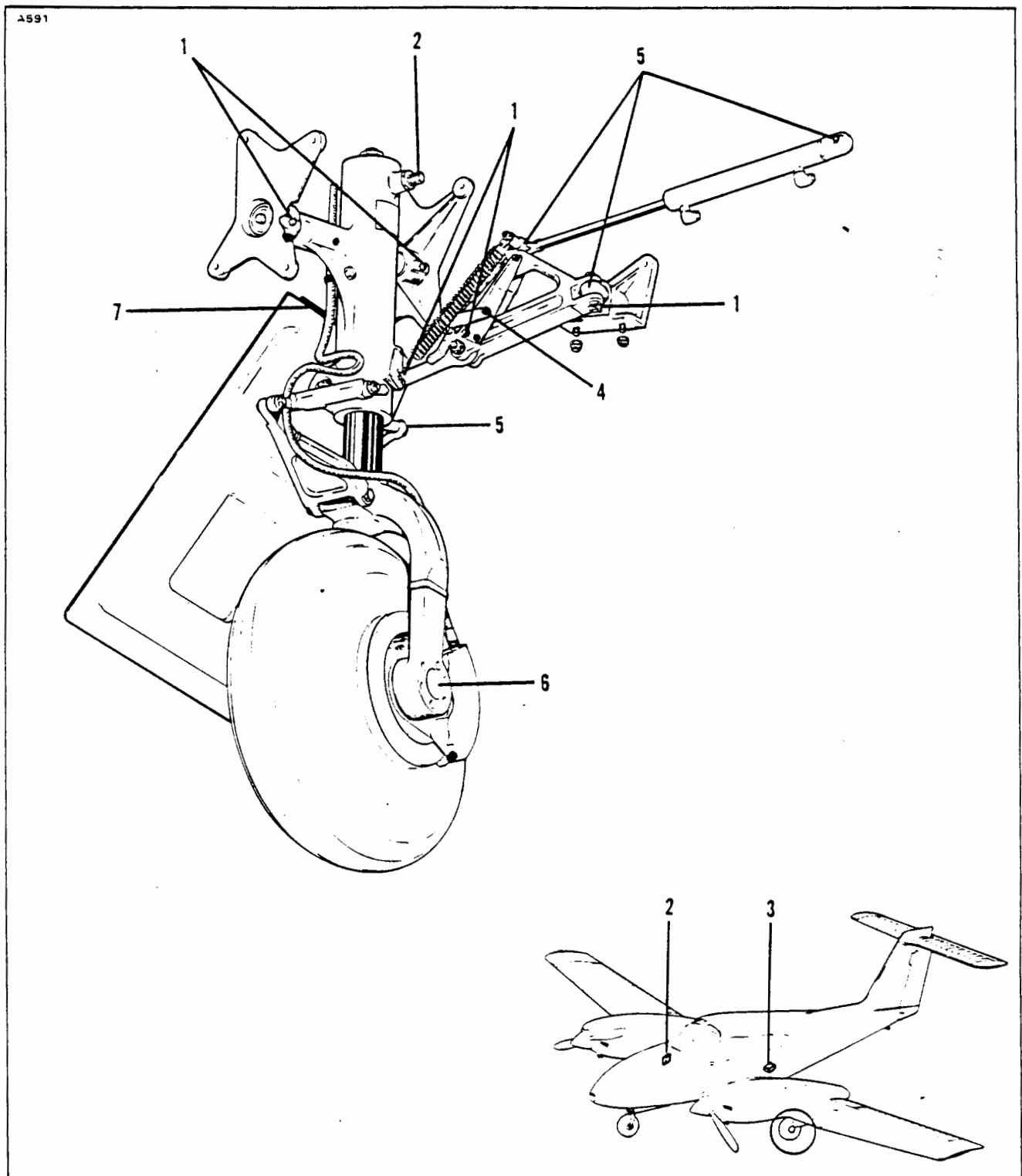
LUBRICATION CHARTS.

The lubrication charts consist of individual illustrations for the various aircraft systems, and each component to be lubricated is indicated by a number, the type of lubricant and the frequency of application. Special instructions are listed at the beginning of the lubrication charts and with the applicable component illustration. Refer to Chapter 91 for a List of Consumable Materials and suggested vendors.

COMPONENT	LUBRICANT	FREQUENCY
1. MAIN GEAR PIVOT POINTS, UPPER SIDE BRACE SWIVEL FITTING, MAIN GEAR SIDE BRACE LINK ASSY. SEE SPECIAL INSTRUCTION 2	MIL-G-23827	100 HRS
2. OLEO STRUT FILLER POINT, BRAKE RESERVOIR SEE SPECIAL INSTRUCTION 4 AND CAUTION 1	MIL-H-5606	AS REQUIRED
3. HYDRAULIC PUMP RESERVOIR - SEE SPECIAL INSTRUCTION 4 AND CAUTION 1	MIL-H-5606	100 HRS
4. MAIN GEAR DOWNLOCK ASSEMBLY - SEE SPECIAL INSTRUCTION 6	MIL-G-7711	100 HRS
5. RETRACTION FITTING AND CYLINDER ATTACHMENT POINTS, MAIN GEAR DOOR CONTROL ROD ENDS, MAIN GEAR TORQUE LINKS - SEE SPECIAL INSTRUCTION 6	MIL-L-7870	100 HRS
6. MAIN GEAR WHEEL BEARINGS - SEE SPECIAL INSTRUCTION 3 AND NOTE 2	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
7. MAIN GEAR DOOR HINGE - SEE SPECIAL INSTRUCTION 6	MIL-L-7870	100 HRS
SPECIAL INSTRUCTIONS		
2. Bearings and Bushings - Clean exterior with a dry type solvent before lubricating.		
3. Wheel Bearings - Disassemble and clean with a dry type solvent. Ascertain that grease is packed between the bearing roller and cone. Do not pack grease in wheel housing.		
4. Oleo Struts, Hydraulic Pump Reservoir and Brake Reservoir - Fill per instructions on unit or container.		
6. Lubrication Points - Wipe all lubrication points clean of old grease, oil, dirt, etc. before lubricating.		
NOTES		
2. Wheel bearings require cleaning and repacking after exposure to an abnormal quantity of water.		
CAUTIONS		
1. Do not use hydraulic fluid with a castrol oil or ester base.		
3. Do not apply lubricant to rubber parts.		

Figure 12-2. Lubrication Chart (Landing Gear, Main)

PIPER AIRCRAFT
PA-44-180/180T
*MAINTENANCE MANUAL



PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

COMPONENT	LUBRICANT	FREQUENCY
1. NOSE WHEEL BEARINGS - SEE SPECIAL INSTRUCTION 3 AND NOTE 2	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
2. NOSE GEAR TORQUE LINK ASSY. NOSE GEAR PIVOT POINT. NOSE GEAR DRAG LINK ASSY. STEERING BELLCRANK PIVOT POINTS. STEERING BELLCRANK ROD ENDS. NOSE GEAR STEERING ROLLERS. HYDRAULIC CYLINDER ROD END & MASTER CYLINDER ROD END. DOOR & RETRACTION MECHANISM. NOSE GEAR CENTERING SPRING PIVOT POINT - SEE SPECIAL INSTRUCTION 2	MIL-L-7870	100 HRS
3. NOSE GEAR DOWNLOCK & CYLINDER - SEE SPECIAL INSTRUCTION 2	MIL-L-7870	100 HRS
4. NOSE GEAR STRUT HOUSING - SEE SPECIAL INSTRUCTION 6	MIL-G-23827	100 HRS
5. EXPOSED OLEO STRUT - SEE SPECIAL INSTRUCTION 4	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122 (PURCH)	100 HRS
6. STEERING BUNGEEES - SEE SPECIAL INSTRUCTION 7 AND CAUTION 3	AERO LUBRIPLATE OR MAG-1, FISKE BROS. REFINING CO. OR AEROSHELL 7, SHELL OIL CO.	AS REQUIRED
SPECIAL INSTRUCTIONS 2. Bearings and Bushings - Clean exterior with a dry type solvent before lubricating. 3. Wheel Bearings - Disassemble and clean with a dry type solvent. Ascertain that grease is packed between the bearing roller and cone. Do not pack grease in wheel housing. 4. Oleo Struts, Hydraulic Pump Reservoir and Brake Reservoir - Fill per instructions on unit or container. 7. Bungee - Lubricate springs if bungee is disassembled. NOTES 2. Wheel bearings require cleaning and repacking after exposure to an abnormal quantity of water. CAUTIONS 3. Do not apply lubricant to rubber parts.		

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

PIPER AIRCRAFT
PA-44-180/180T
*MAINTENANCE MANUAL

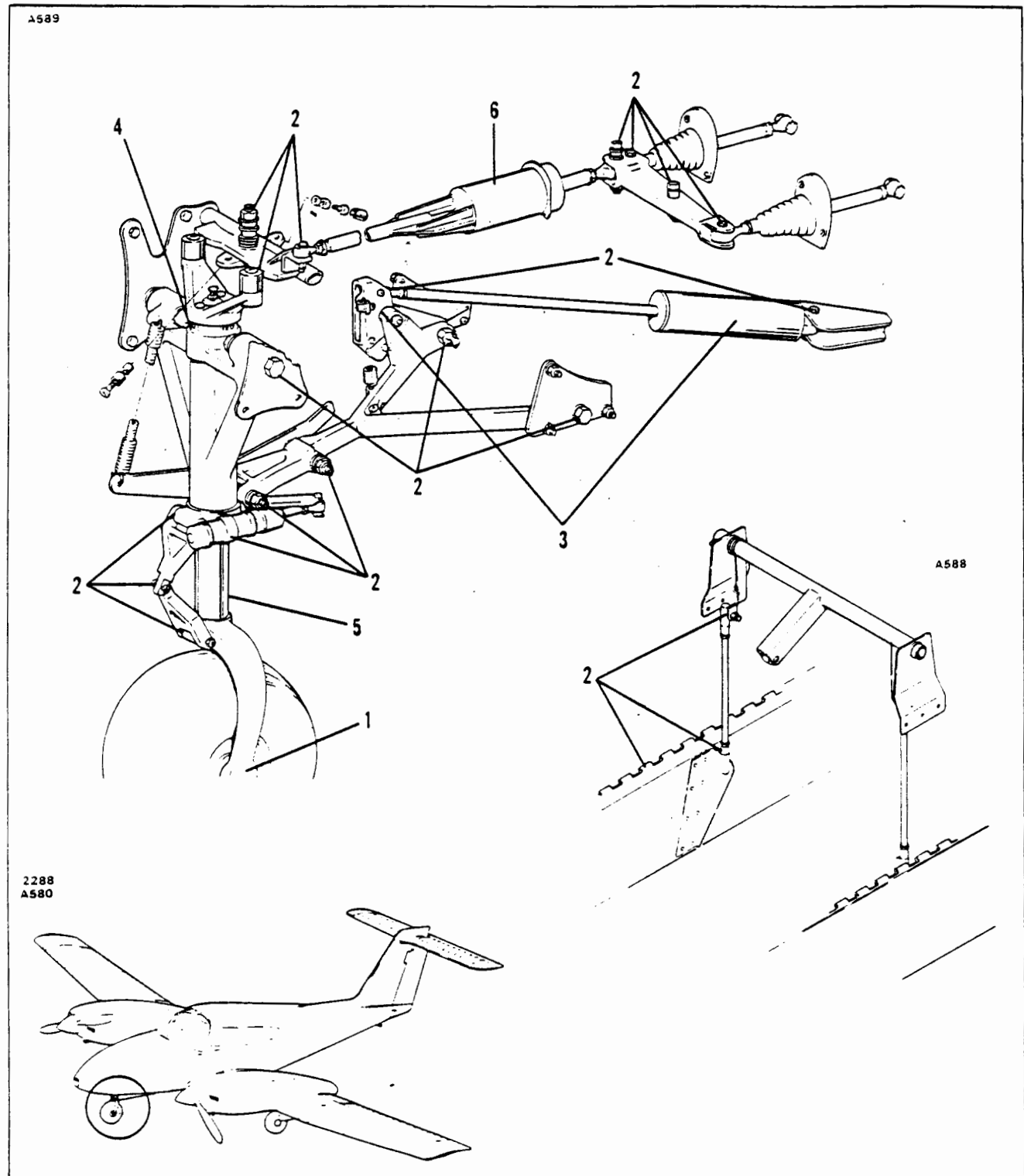


Figure 12-3. Lubrication Chart (Landing Gear, Nose) (cont)

12-29-03
Page 12-17
Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER TAB & STABILATOR TAB ROD END BEARINGS, STABILATOR TRIM TAB LINKS, STABILATOR HINGE POINTS, STABILATOR CONTROL & RUDDER CONTROL CABLE PULLEYS, FLAP TORQUE TUBE BEARING BLOCK, FLAP HANDLE PIVOT POINT & LOCK MECHANISM, TEE BAR PIVOT POINTS, CONTROL COLUMN FLEX JOINT, SPROCKET & "O" RING, AILERON & STABILATOR CONTROL PULLEYS, STABILATOR CONTROL ROD & IDLER PULLEY - SEE SPECIAL INSTRUCTION 6 AND CAUTION 2 AND 4	MIL-L-7870	100 HRS
2. AILERON HINGE BEARINGS, FLAP HINGE BEARINGS, AND FLAP CONTROL ROD END BEARINGS - SEE SPECIAL INSTRUCTION 2	MIL-L-7870	100 HRS
3. FLAP RETURN & TENSION CHAINS, AND AILERON & STABILATOR CONTROL CHAIN — SEE SPECIAL INSTRUCTION 6	MIL-L-7870	500 HRS
4. RUDDER & STABILATOR TRIM SCREW - SEE SPECIAL INSTRUCTION 6	AERO LUBRIPLATE OR MAG-1 (PURCH) FISKE BROS. REFINING CO. OR AERO SHELL 7 (PURCH) SHELL	500 HRS
SPECIAL INSTRUCTIONS		
2. Bearings and Bushings - Clean exterior with a dry type solvent before lubricating.		
6. Lubrication Points - Wipe all lubrication points clean of old grease, oil, dirt, etc. before lubricating.		
CAUTIONS		
2. Do not over-lubricate cockpit controls.		
4. Do not lubricate cables. This causes slippage.		

Figure 12-4. Lubrication Chart (Control System, Part 1)

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

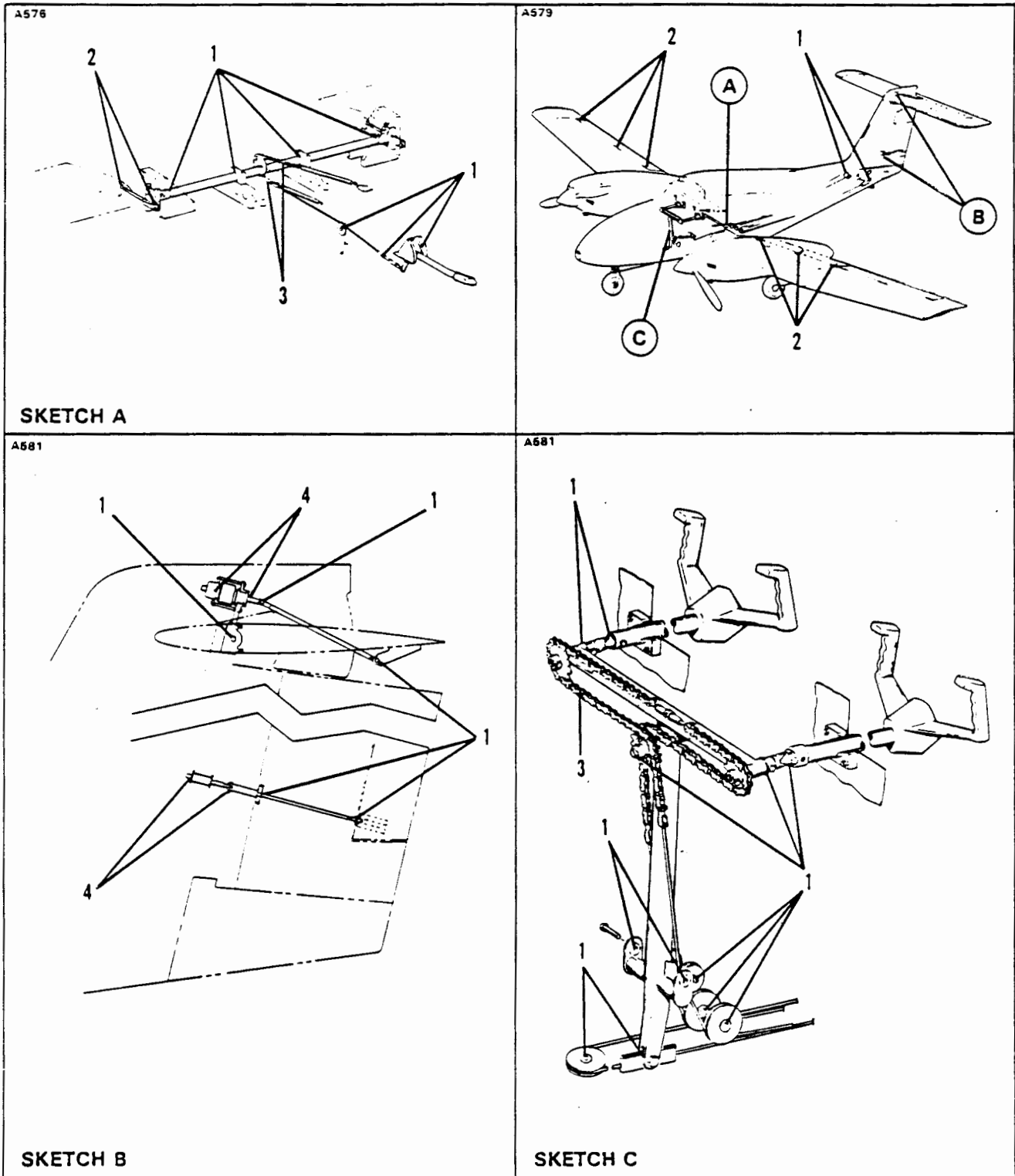


Figure 12-4. Lubrication Chart (Control System, Part 1) (cont)

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

COMPONENT	LUBRICANT	FREQUENCY
1 DOOR & COWL SEALS - SEE SPECIAL INSTRUCTION 6	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	AS REQUIRED
2 NOSE CONE & NOSE DOOR HINGES, BAGGAGE & MAIN DOOR HINGES - SEE SPECIAL INSTRUCTION 6	MIL-L-7870	100 HRS
3 PILOT & COPILOT SEAT ADJUSTMENT - SEE SPECIAL INSTRUCTION 6 AND NOTE 1	MIL-G-7711	500 HRS
4 DOOR LATCH MECHANISM - SEE SPECIAL INSTRUCTION 6	AERO LUBRIPLATE OR MAG-1, FISKE BROS. REFINING CO. OR AEROSHELL 7 (PURCH) SHELL	500 HRS

SPECIAL INSTRUCTIONS

- 6 Lubrication Points - Wipe all lubrication points clean of old grease, oil, dirt, etc. before lubricating.

NOTES

- 1 Pilot and Passenger Seats - Lubricate track rollers and stop pins as reqd (Type of Lubricant: MIL-L-7870).

A687

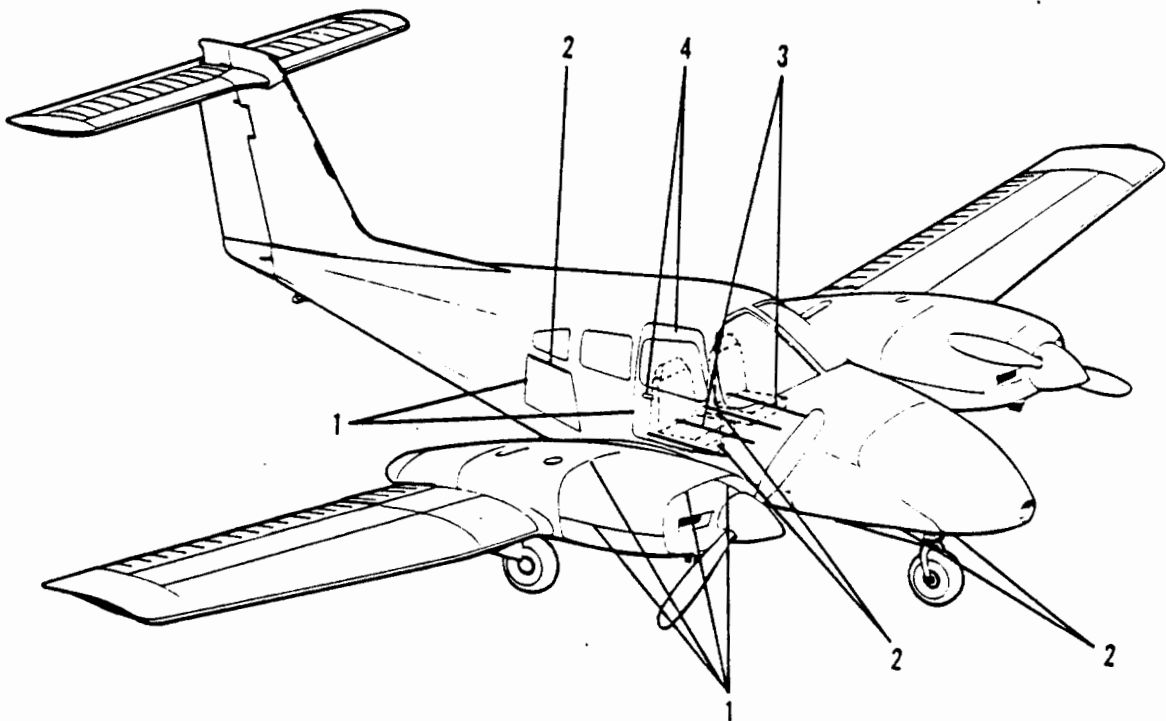


Figure 12-5. Lubrication Chart (Cabin Door, Baggage Door & Seats)

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER HINGE BEARINGS, RUDDER TAB & STABILATOR TAB HINGE PINS - SEE SPECIAL INSTRUCTION 2 AND 6	MIL-L-7870	100 HRS
2. AILERON CONTROL ROD END BEARINGS, AILERON BELLCRANK PIVOT POINTS, AILERON BELLCRANK CABLE ENDS, AILERON CONTROL CABLE PULLEYS, RUDDER CONTROL CABLE PULLEYS, TRIM CONTROL WHEELS (RUDDER & STABILATOR), TOE BRAKE ATTACHMENT, RUDDER TUBE CONNECTIONS, RUDDER TUBE CABLE ENDS, NOSE GEAR STEERING ROD ENDS, BRAKE ROD ENDS, STABILATOR BELLCRANK PIVOT POINT & CABLE ENDS - SEE SPECIAL INSTRUCTION 6 AND CAUTION 2 AND 4	MIL-L-7870	100 HRS
SPECIAL INSTRUCTIONS 2. Bearings and Bushings - Clean exterior with a dry type solvent before lubricating. 6. Lubrication Points - Wipe all lubrication points clean of old grease, oil, dirt, etc. before lubricating. CAUTIONS 2. Do not over-lubricate cockpit controls. 4. Do not lubricate cables. This causes slippage.		

Figure 12-6. Lubrication Chart (Control System, Part 2)

PIPER AIRCRAFT
PA-44-180/180T
*MAINTENANCE MANUAL

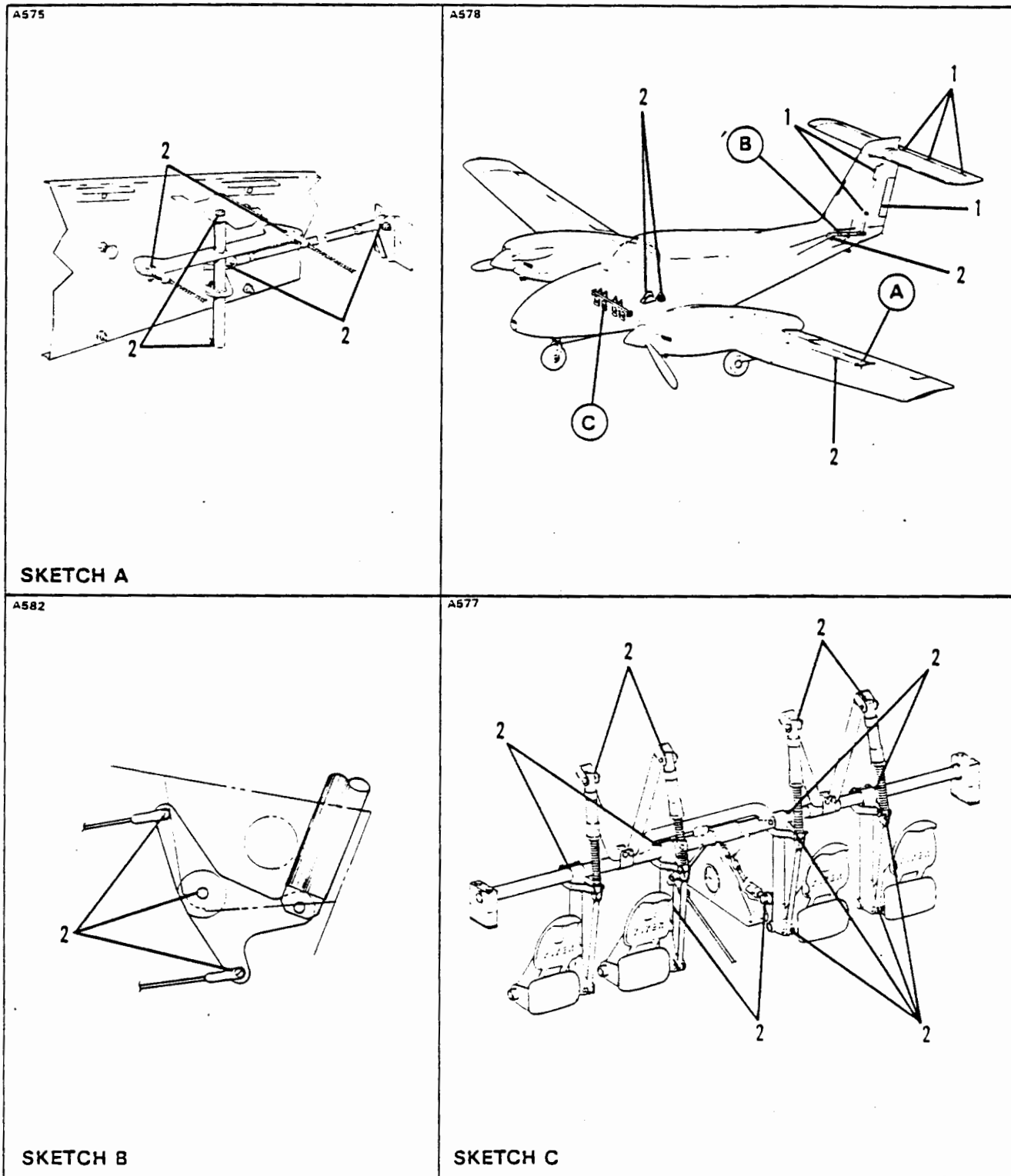


Figure 12-6. Lubrication Chart (Control System, Part 2) (cont)

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

COMPONENT		LUBRICANT	FREQUENCY
1	COWL FLAP HINGE, GOVERNOR CONTROL, CONTROL QUADRANT CONTROLS, CABIN HEAT & DEFROST MECHANISMS, SELECTOR VALVE CONTROL - SEE SPECIAL INSTRUCTION 6 AND CAUTION 2	MIL-L-7870	100 HRS
2	AIR FILTER - SEE SPECIAL INSTRUCTION 1	CLEAN AS OFTEN AS NECESSARY	50 HRS
3	CARTRIDGE TYPE OIL FILTER	CHANGE	50 HRS
4	ENGINE SUMP (6 QTS. CAPACITY) - SEE NOTES 3 AND 6	MIL-L-22851	50 HRS
5	PROPELLER ASSEMBLY - SEE SPECIAL INSTRUCTION 5	MIL-G-23827	100 HRS
6	COWL FLAP ACTUATING MECHANISM - SEE SPECIAL INSTRUCTION 8	AERO LUBRIPLATE OR MAG-1, (PURCH) FISKE BROS. REFINING CO. OR AERO SHELL 7 (PURCH) SHELL	500 HRS.
7	BATTERY - SEE NOTE 5		25 HRS
8	FUEL SYSTEM - SEE NOTE 4		AS REQUIRED
9	CARBURETOR AIR BOX FLAPPER VALVE	AERO LUBRIPLATE OR MAG-1 (PURCH), FISKE BROS. REFINING CO. OR AERO SHELL 7 (PURCH) SHELL	100 HRS
SPECIAL INSTRUCTIONS			
1	Air Filter - To clean filter, tap gently to remove dirt particles. Do not blow out with compressed air or use oil. Replace filter if punctured or damaged.		
5	Propeller - Remove one of the two grease fittings for each blade, apply grease thru 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 lubricating.		
8	Outer surface of inner spacer		
NOTES			
3	Comply with Lycoming Service Bulletin No. 446		
4	Fuel System - Service Regularly - Fuel Pump Strainer, Injector Screen - Filter Bowl - Quick Drain Unit		
5	Battery - Fluid level & condition check every 25 hours		
6	The engine lubricating oil system is serviced with MIL-C 6529 Type II for the initial fill and for the first 25 hours of operation per Lycoming Service Instruction No. 1014 (Latest Revision)		
CAUTIONS			
2	Do not over-lubricate cockpit controls		

Figure 12-7. Lubrication Chart (Power Plant & Propeller)

PIPER AIRCRAFT
PA-44-180/180T
*MAINTENANCE MANUAL

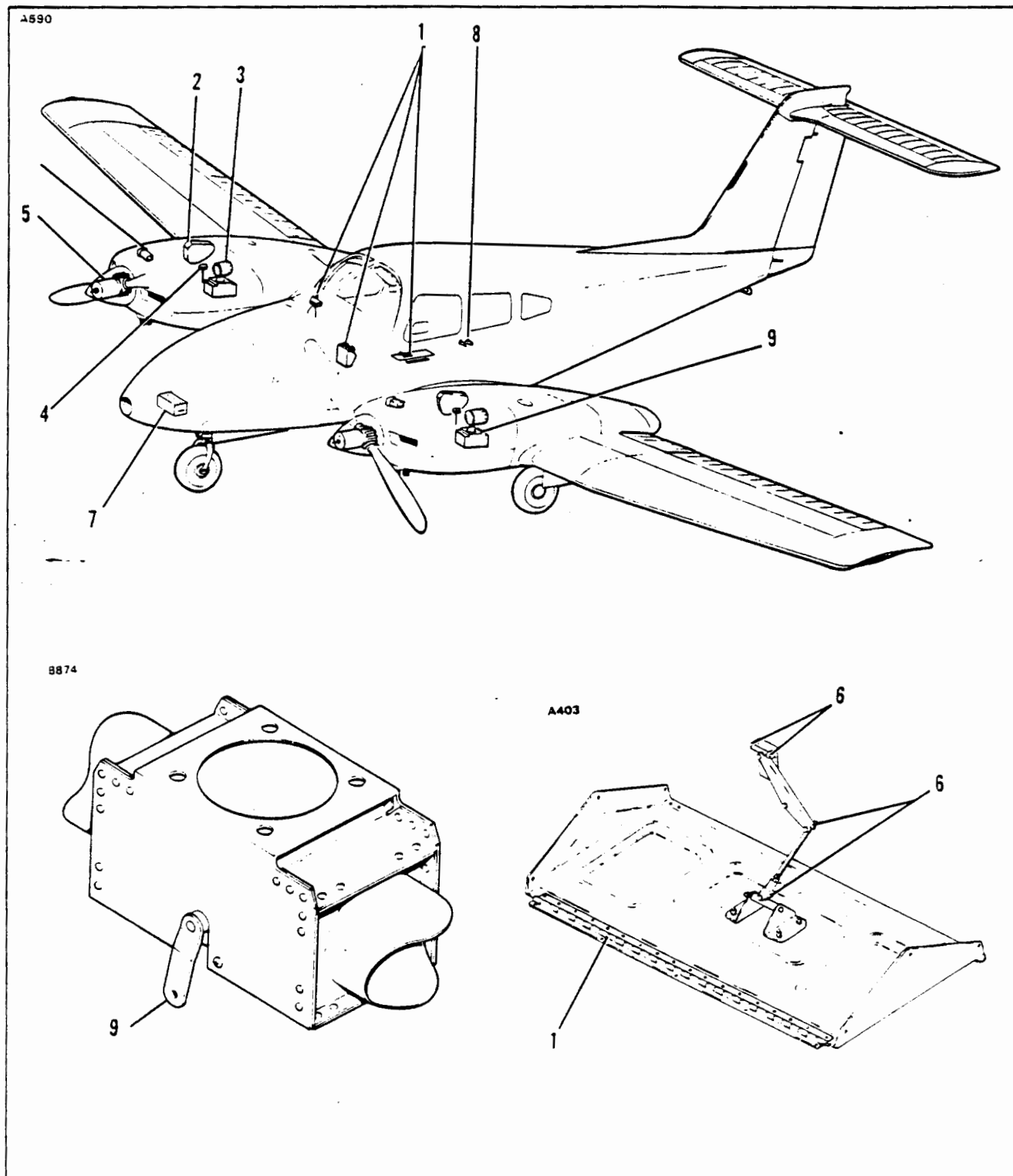


Figure 12-7. Lubrication Chart (Power Plant & Propeller) (cont)

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

CHART 1201. THREAD LUBRICANTS

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

— NOTE —

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

CHAPTER

20

**STANDARD PRACTICES/
AIRFRAME**

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 20 - STANDARD PRACTICES/AIRFRAME

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
20-00-00	STANDARD PRACTICES - AIRFRAME	1E4	
20-01-00	Torque Wrenches	1E4	
20-02-00	Method of Installing Rod End Bearings	1E5	
20-03-00	Cherrylock Rivets, Removal	1E6	A 8-80
20-04-00	Identification of Fluid Lines	1E7	
20-10-00	AIRCRAFT FINISH CARE (CLEANING)	1E9	
20-11-00	Exterior Surfaces	1E9	
20-12-00	Windshield and Windows	1E9	
20-13-00	Headliner, Side Panels and Seats	1E9	
20-14-00	Carpets	1E10	
20-15-00	Engine Compartment	1E10	
20-16-00	Fuel System	1E10	
20-17-00	Landing Gear	1E11	

20 - Cont./Effec.

Page - 1

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

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.

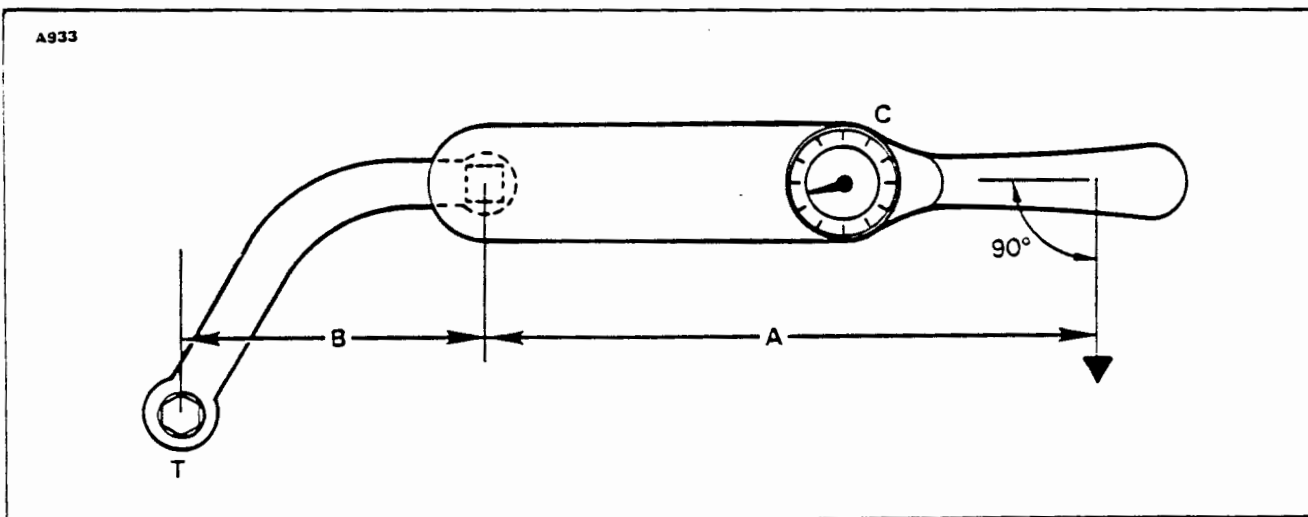


Figure 20-1. Torque Wrench Formula

PIPER AIRCRAFT
PA-44-180/180T
*MAINTENANCE MANUAL

METHOD OF INSTALLING ROD END BEARINGS.

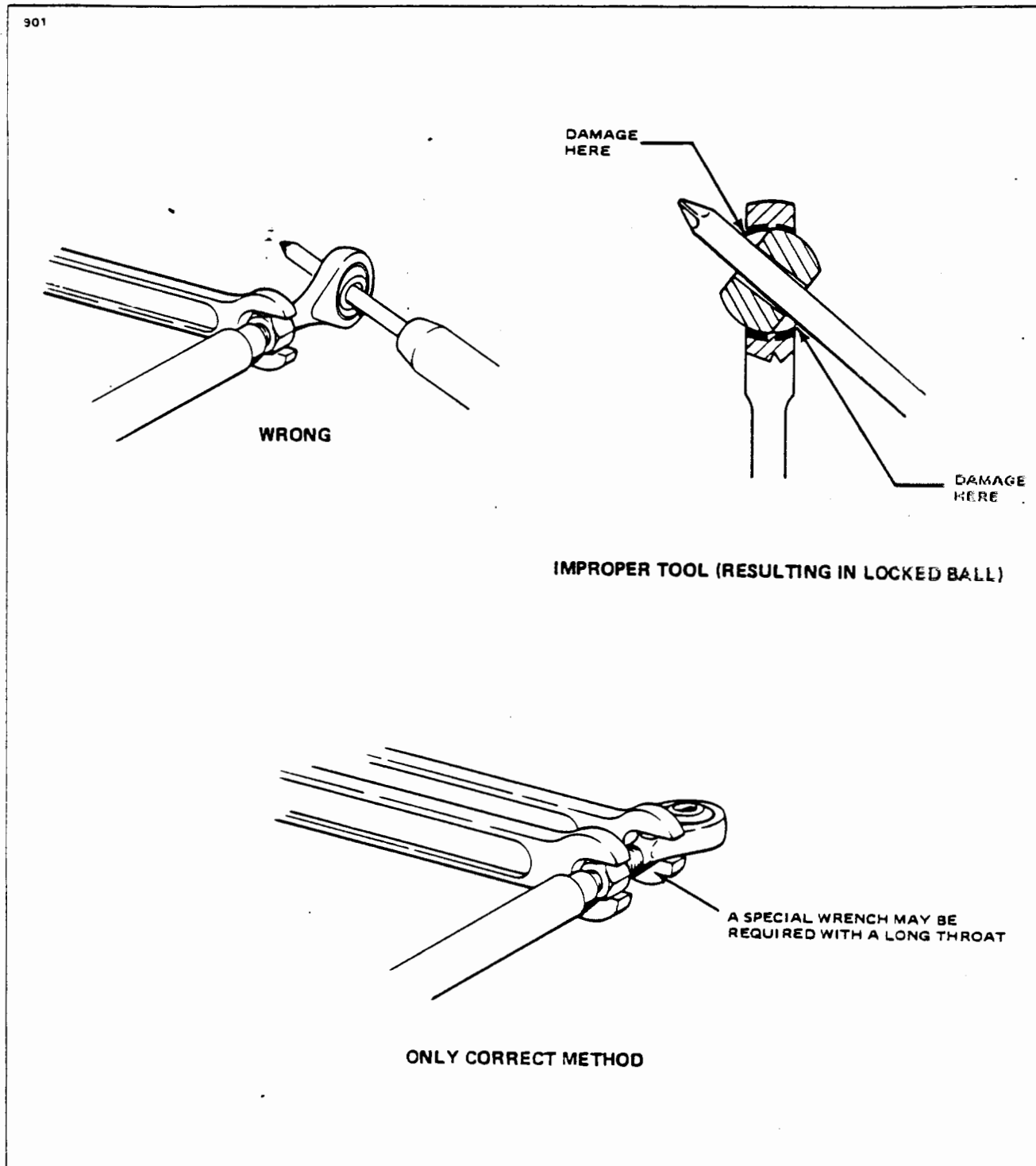


Figure 20-2. Method of Installing Rod End Bearings

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

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

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

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

— NOTE —

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

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

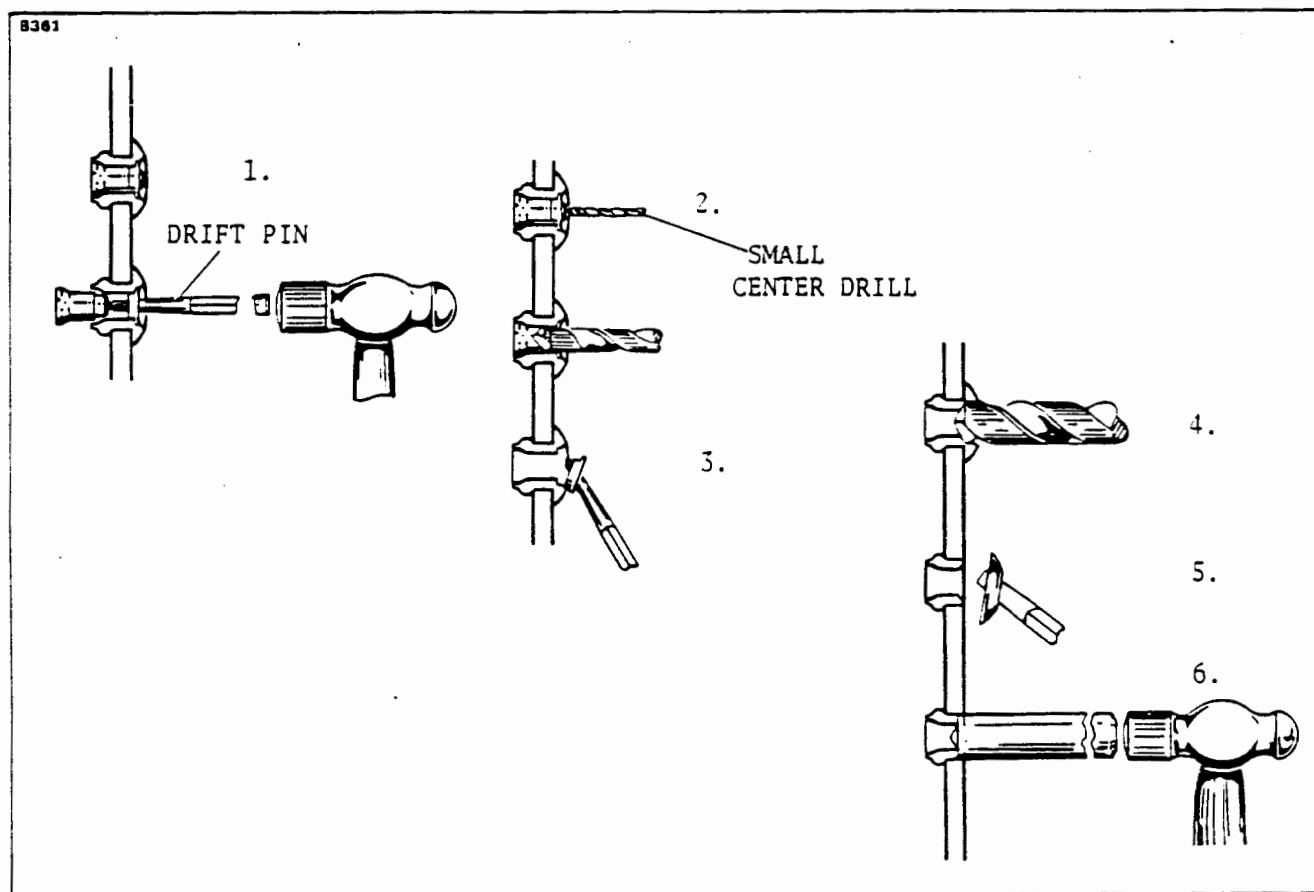


Figure 20-3. Cherrylock Rivet Removal

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

CHART 2001. MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

TUBE O.D. (IN.)	DISTANCE BETWEEN SUPPORTS (IN.)	
	ALUMINUM ALLOY	STEEL
1/8	9 1/2	11-12
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

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.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

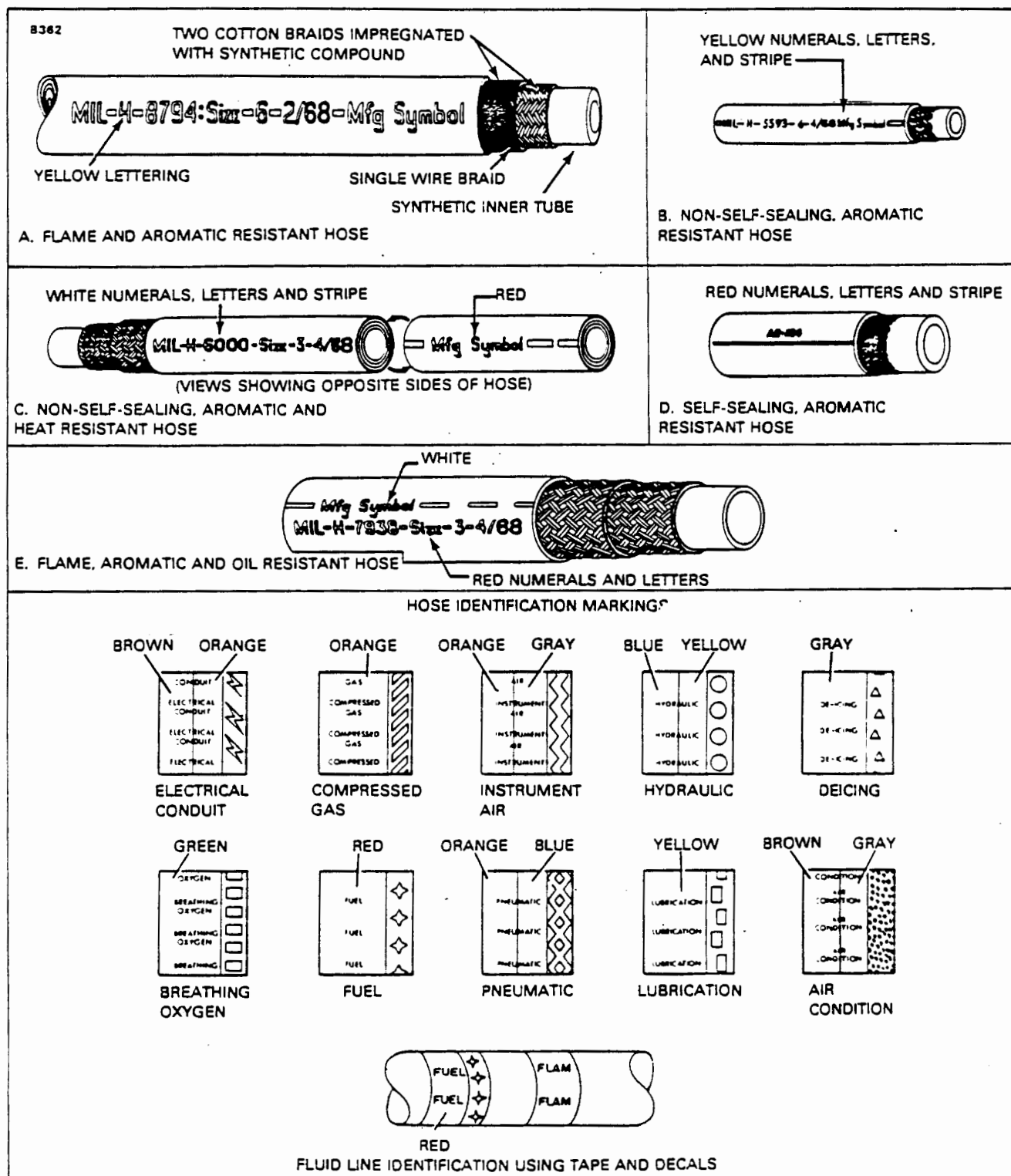


Figure 20-4. Identification of Aircraft Fluid Lines

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

AIRCRAFT FINISH CARE (CLEANING).

EXTERIOR SURFACES.

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

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

WINDSHIELD AND WINDOWS.

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

— NOTE —

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

4. After cleaning plastic surfaces, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion.
5. A severe scratch or mar in plastic can be removed by using jeweler's rouge to rub out the scratch. Smooth both sides and apply wax.

HEADLINER, SIDE PANELS AND SEATS.

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

— CAUTION —

Solvent cleaners require adequate ventilation.

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

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

CARPETS.

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

ENGINE COMPARTMENT.

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

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

— CAUTION —

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

2. With the engine cowlings removed, spray or brush the engine with solvent or a mixture of solvent and degreaser, as desired. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.

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

— CAUTION —

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

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

FUEL SYSTEM.

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

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

LANDING GEAR.

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

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

— END —

CHAPTER

21

ENVIRONMENTAL SYSTEM

1E12

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

CHAPTER 21 - ENVIRONMENTAL SYSTEM

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
21-00-00	GENERAL	1E16	
21-01-00	Description and Principles of Operation	1E16	
21-02-00	Troubleshooting	1E16	
21-20-00	DISTRIBUTION	1E20	
21-21-00	Cabin Vent System	1E20	
21-21-01	Overhead Vent Blower	1E20	
21-21-02	Removal of Blower Assembly	1E20	
21-21-03	Dismantling of Blower Assembly	1E21	
21-21-04	Rebuilding of Blower Assembly	1E21	
21-21-05	Installation of Blower Assembly	1E21	
21-40-00	HEATING	1E22	
21-41-00	Heater System - Operational Test	1E22	
21-42-00	Description of Heater and Basic Components	1E23	
21-42-01	Spark-Spray Ignition	1E23	
21-42-02	Fuel Regulator and Shutoff Valve	1F2	
21-42-03	Duct Switch	1F2	
21-42-02	Combustion Air Blower	1F2	
21-42-05	Ventilating Air Blower	1F2	
21-42-06	Operating Controls	1F4	
21-42-07	Operating Procedure	1F4	
21-43-00	Maintenance Service	1F5	
21-43-01	Inspection of Heater and Heater Components	1F5	
21-43-02	Preflight and/or Daily Inspection	1F5	1-83
21-43-03	100 Hour Inspection	1F6	1-83
21-43-04	Removal of Heater	1F6	1-83
21-43-05	Installation of Heater	1F7	1-83
21-43-06	Heater Electrical System Checks	1F7	
21-43-07	Electrical Checks	1F7	
21-43-08	Vent Blower Power Circuit Check	1F10	
21-43-09	Heater Power Circuit Check	1F11	
21-43-10	General Maintenance	1F11	
21-43-11	Combustion Air Blower	1F11	
21-43-12	Spark Plug	1F13	
21-43-13	Ignition Unit	1F15	
21-43-14	Ignition Unit Removal and Installation	1F15	
21-43-15	Testing Ignition Unit	1F16	
21-43-16	Operational Test of Ignition Unit	1F16	
21-43-17	Vibrator	1F17	
21-43-18	Vibrator Removal and Installation	1F17	
21-43-19	Inspection of Ignition Unit	1F18	

21 - Cont./Effec.

Page - 1

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 21 - ENVIRONMENTAL SYSTEM (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
21-40-00	HEATING (cont)	—	
21-43-00	Maintenance Service (cont)	—	
21-43-10	General Maintenance (cont)	—	
21-43-20	Cycling Switch and Limit (Overheat) Switch	1F18	
21-43-21	Combustion Air Pressure Switch	1F19	
21-43-22	Fuel Regulator and Shutoff Valve	1F19	
21-43-23	Removal of Fuel Regulator	1F19	
21-43-24	Adjustment of Fuel Regulator	1F19	
21-43-25	Installation of Fuel Regulator	1F20	
21-43-26	Heater Fuel Pump	1F20	
21-43-27	Removal of Heater Fuel Pump	1F20	
21-43-28	Disassembly of Pump	1F21	
21-43-29	Cleaning of Pump	1F21	
21-43-30	Inspection and Repair of Pump	1F22	
21-43-31	Assembly of Pump	1F22	
21-43-32	Installation of Heater Fuel Pump	1F22	
21-43-33	Duct Switch	1F22	
21-44-00	Overhaul Instructions	1F23	1-83
21-44-01	Disassembly of Heater	1F23	
21-44-02	Disassembly of Combustion Air Blower Assembly	1F24	
21-44-03	Cleaning of Heating Components	1F24	
21-44-04	Cleaning and Inspecting the Combustion Tube Assembly	1G2	1-83
21-44-05	Inspection of Remaining Components	1G3	
21-44-06	Testing	1G4	
21-44-07	Repair of Combustion Tube Assembly	1G7	1-83
21-44-08	Reassembly of Heater	1G7	
21-44-09	Reassembly of Combustion Air Blower Assembly	1G9	
21-45-00	Test Procedure	1G11	
21-45-01	General Information	1G11	
21-45-02	Equipment Required	1G11	
21-45-03	Operational Test (On Test Bench)	1G11	
21-46-00	Inspection of Fuel Nozzle Orifice	1G12	
21-47-00	Heater Hourmeter	1G13	A 2-81
21-47-01	Removal of Heater Hourmeter	1G13	A 2-81
21-47-02	Installation of Heater Hourmeter	1G13	A 2-81

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

CHAPTER 21 - ENVIRONMENTAL SYSTEM (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
21-50-00	COOLING (PA-44-180T ONLY)	1G15	A 8-80
21-51-00	General	1G15	
21-51-01	Air Conditioning System Description and Operation	1G15	
21-51-02	Troubleshooting	1G15	
21-51-03	Malfunction Detection	1G23	
21-52-00	Servicing Air Conditioning System	1G24	
21-52-01	Safety, Precautions	1G24	
21-52-02	Special Service Precautions	1G24	
21-52-03	Service Valves	1H1	
21-52-04	Test Gauge and Manifold Set	1H2	
21-52-05	Leak Detection	1H4	
21-52-06	Discharging the System	1H5	
21-52-07	Evacuating the System	1H5	
21-52-08	Charging the System	1H7	
21-52-08	Charging Stand Method	1H7	
21-52-09	Airplane Compressor Method	1H8	
21-52-10	Partial Charge of System	1H10	
21-53-00	System Components	1H11	
21-53-01	Compressor	1G11	
21-53-02	Removal of Compressor	1H11	
21-53-03	Installation of Compressor	1H10	
21-53-04	Compressor Oil Level Check	1H13	
21-53-05	Adjustment of Drive Belt Tension	1H14	
21-53-06	Receiver-Dehydrator	1H14	
21-53-07	Removal of Receiver-Dehydrator	1H14	
21-53-08	Installation of Receiver-Dehydrator	1H14	
21-53-09	Condenser	1H14	
21-53-10	Removal of Condenser	1H16	
21-53-11	Installation of Condenser	1H16	
21-53-12	Expansion Valve	1H16	
21-53-13	Removal of Expansion Valve	1H15	
21-53-14	Installation of Expansion Valve	1H17	
21-53-15	Evaporator Assembly	1H17	
21-53-16	Removal of Evaporator Assembly	1H18	
21-53-17	Installation of Evaporator Assembly	1H18	
21-53-18	Pressure Relief Switch	1H20	
21-53-19	Electrical Installation	1H20	
21-53-20	Manifold Pressure Switch	1H20	

21 - Cont./Effec.

Page - 3

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

Instructions for maintaining the cabin vent and heating systems are contained in this chapter. Also incorporated in this chapter are instructions for the inspection and operation of the 45,000 BTU heater unit defroster, and ventilation system.

DESCRIPTION AND PRINCIPLES OF OPERATION.

Vent air can be supplied through the heater unit, and by ram air or fan through the upper vent ducts. Air is supplied to the upper vent system by way of an inlet on the leading edge of the vertical stabilizer.

Heated air for the cabin and defroster operation is obtained from the combustion heater located in the nose section of the airplane. Fresh air is supplied to the heater from an intake located in the nose and routed through the heater and into the cabin through six adjustable outlets. Operation of the heater is controlled by a three-position switch located on the lower right side of instrument panel and labeled FAN, OFF and HEATER. The FAN position will operate the ventilation blower on the heater and may be used for cabin ventilation or windshield defogging on the ground when heat is not desired. For additional defrost capability adjust cabin temperature control and then adjust the three-position switch to HEATER.

For cabin heat, the air intake lever located on the lower right side of the instrument panel must be partially or fully open and the three-position switch set to HEATER. This will start the fuel flow and ignite the burner simultaneously. With instant starting and no need for priming, heat should be felt within a few seconds. There are two safety switches installed at the intake valve located forward of the heater unit which are activated by the intake valve and wired to prevent both fan and heater operation unless the air intake valve is moved off the closed position.

Regulating the heater and airflow is accomplished by adjusting the levers on the instrument panel. The lower lever regulates the defrosters, while the center lever regulates the intake valve and the top lever regulates the cabin temperature. Cabin temperature and air circulation can be varied to suit individual requirements by various combinations of lever settings.

Heat may be supplied before starting the engines by turning on the master switch, opening the air intake valve and placing the heater switch in the HEATER position.

An overheat limit switch is located in the aft outboard end of the heater vent jacket, which acts as a safety device to render the heater inoperative if a malfunction should occur. A red reset button on the switch can be reached through the nose; operation of this switch results in illumination of the overheat light located on the lower right side of the instrument panel. To prevent activation of the overheat limit switch upon normal heater shutdown during ground operation, turn the switch to the FAN position for two minutes, while leaving the air intake lever in the open position, before turning the switch to the OFF position.

There are four overhead fresh air vents which are supplied by a separate inlet in the dorsal fin. The system can be supplemented by an optional blower.

TROUBLESHOOTING.

A troubleshooting chart is provided to assist in locating and correcting possible malfunctions in the heating system.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

CHART 2101. TROUBLESHOOTING (JANITROL HEATER)

Trouble	Cause	Remedy
Heater fails to light.	Heater switch or circuit breaker off.	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 heater switch.
	Regulator not operating properly.	Check for low pressure or replace regulator.
— NOTE — <i>When making the fuel pressure check, be sure fuel is flowing through the nozzle. The fuel regulator can be adjusted. Turn the adjusting screw clockwise to increase fuel pressure and counter-clockwise to decrease it. (Refer to Figure 21-4.)</i>		
	Restriction in fuel nozzle orifice.	Remove the nozzle and clean or replace it.
	Suction leak ahead of pump.	Secure all fittings.
	Fuel heater solenoid not operating.	Remove and check solenoid. Replace if faulty.
	Insufficient fuel pressure.	Low or no current to fuel pump. Check operation of pump.
	Fuel lines clogged or broken.	Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located.
	Ignition vibrator inoperative.	Replace vibrator.
	Regulator not operating properly.	Check for low pressure or replace regulator.
	Manual reset limit (overheat) switch open.	Press reset button firmly (overheat light will illuminate when heater switch is on) and recheck to determine reason for switch opening.

21-02-00

Page 21-02

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2101. TROUBLESHOOTING (JANITROL HEATER) (cont)

Trouble	Cause	Remedy
Heater fails to light. (cont)	Combustion air pressure switch open. (Defective switch or low combustion air blower output.)	Check for low blower output due to low voltage and correct it. If switch is defective, replace it.
	Cycling switch open.	Replace if defective.
	Duct switch open.	Operate control to see if switch will come on. Replace switch if defective.
Ventilating air blower fails to run.	Heater switch "OFF." Broken or loose wiring to motor.	Energize the heater switch. Check and repair wiring.
	Circuit breaker open.	Close circuit breaker.
	Worn motor brushes.	Replace motor brushes.
	Blower wheel jammed.	Remove and check the ventilating air blower wheel and realign if necessary.
	Motor burned out.	Remove blower assembly and replace motor.
	Defective radio-noise filter.	Replace filter.
Combustion air blower fails to run.	Faulty wiring to motor.	Inspect and replace faulty wiring.
	Poor ground connection.	Tighten ground screw. Be sure any metal preservation has been removed for good ground connection.
	Worn motor brushes.	Replace motor brushes.
	Blower wheel jammed. (Usually indicated by hot motor housing.)	Overhaul the combustion air blower.
	Defective radio-noise filter.	Replace filter.
	Faulty or burned-out motor.	Remove combustion air motor for overhaul or replacement of motor.

21-02-00

Page 21-03

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2101. TROUBLESHOOTING (JANITROL HEATER) (cont)

Trouble	Cause	Remedy
Heater fires but burns unsteadily.	Insufficient fuel supply.	Inspect fuel supply to heater, including shutoff valve, solenoid valve fuel pump and fuel lines. Make necessary repairs.
	Spark plug partially fouled.	Replace spark plug. See Caution.
— CAUTION — <i>Do not create a spark gap by holding the lead to the heater jacket. This can result in damage to the lead and ignition unit and the operator may receive an electrical shock.</i>		
	Loose primary connection at ignition assembly.	Tighten the connection.
	Faulty vibrator.	Replace the vibrator.
	Combustion air blower speed fluctuates. (Can be caused by low voltage, loose blower wheel, worn brushes or motor.)	Remove and overhaul the combustion air blower assembly as required or correct low voltage condition.
	High voltage leak in lead between ignition assembly and spark plug.	Replace ignition assembly.
	Inoperative ignition assembly.	If vibrator is in good condition, replace ignition assembly only.
	Restriction in fuel nozzle orifice.	Remove nozzle for cleaning or replacement.
Heater starts then goes out.	Nozzle loose in retainer or improper spray angle.	Tighten or replace the nozzle as required.
	Lack of fuel at heater.	Check fuel supply through all components from the tank to the heater. Make necessary corrections.

21-02-00

Page 21-04

Revised: January 3, 1983

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

CHART 2101. TROUBLESHOOTING (JANITROL HEATER) (cont)

Trouble	Cause	Remedy
Heater starts then goes out. (cont)	Inoperative or chattering combustion air pressure switch.	Adjust or replace switch.
	Inoperative overheat switch.	Replace switch.
	Inoperative cycling switch.	Adjust or replace the switch.
	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.

DISTRIBUTION.

CABIN VENT SYSTEM.

OVERHEAD VENT BLOWER.

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

REMOVAL OF BLOWER ASSEMBLY.

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

DISMANTLING OF BLOWER ASSEMBLY.

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

REBUILDING OF BLOWER ASSEMBLY.

1. Mount the motor on the plate and secure it with the bolts, washers and nuts. Be sure that the motor nuts are snug and the shaft spins freely.
2. Position the cover over the motor plate with the motor wires protruding through the cover grommet.
3. With the holes in the cover matching the holes in the motor plate, secure the two parts together with rivets.
4. Apply PRC-5000 sealant to fill any opening left after the wires are brought through the grommet.
5. Install the wires in the plug and receptacle according to Chart 2102.
6. Position the blower fin on the motor shaft and secure with set screw.
7. Secure the cover to the blower assembly with screws, washers and nuts.
8. Position the hose duct on the blower assembly and secure it with screws, washers and nuts. The screws must be installed with their heads inside the duct.
9. After cleaning the surfaces of all old sealant, use white rubber chalk PRC-5000 sealant to seal where the duct attaches to the blower assembly.

INSTALLATION OF BLOWER ASSEMBLY.

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2102. BLOWER SYSTEM WIRE COLOR CODES

	MOTOR WIRES			AIRCRAFT WIRES		
		Pin Nos.	YY75062 ESB - Universal Elect. Company	Aircraft Harness	Pin Nos.	
Ground	Plug	2	Brown	AC26A	2	Receptacle
Low Speed	Plug	1	Yellow	Black	1	Receptacle
Medium Speed	Receptacle	2	Red	White	2	Plug
High Speed	Receptacle	1	Orange	Red	1	Plug

HEATING.

HEATER SYSTEM - OPERATIONAL TEST.

1. Check all fittings and connections for condition and security of mounting, and all ducts free from obstruction.
2. Disconnect wire (H10A) from the heater terminal No. 2; this will remove electrical power to the fuel valve and pump so heater will not ignite.
3. Turn the master switch and "HEATER" switch on and open the air intake valve. Both blowers (combustion air and ventilating air) should operate. Check at heater exhaust and ventilating air outlets to insure airflow.
4. Momentarily insert a wedge under the leaf of the main gear squat switch. The ventilation blower should stop operating.
5. Turn off heater switch, and remove wedge at squat switch.
6. To insure that the heater fuel line is free of airlock, cautiously loosen the fuel connection at the heater. This will bleed the line between the heater and fuel source. Then tighten the fuel line connection.
7. Reconnect the wire (H10A) to the heater terminal No. 2.
8. Place the air intake lever in the "OPEN" position and the temperature control lever in the center of its travel.
9. Install a 0 to 10 psi pressure gauge in the outlet line of the fuel regulator by installing a "T" fitting in the OUTLET opening of the regulator.
10. Turn on the master switch; then press the press-to-test overheat indicator light. The lamp should illuminate indicating the lamp filament is intact.
11. Turn on heater switch. The heater should ignite and continue to operate until the thermostat turns it off. Cycling in this manner should continue until the heater switch is turned off.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

12. With the heater in operation, check the pressure gauge. The gauge should read from 6.5 to 7.5 psi; if the heater is running and the pressure indicated is more or less than required, adjust the regulator accordingly. If the required pressure cannot be reached after a couple turns of the regulator's adjustment screw, troubleshoot the fuel pump.

13. Place the heater switch in the "FAN" position. The heater should turn off and the ventilation blower should continue to operate. Allow this blower to operate for a full two minutes; then place the air intake lever in the closed position. The blower should turn off.

— NOTE —

This procedure should be followed after every shutdown to cool off the burn chamber.

14. With the air intake closed, turn on the heater switch; the heater should not ignite and neither fan should operate. Turn off the heater switch and master switch.

15. Remove the pressure gauge and "T" fitting from the regulator.

DESCRIPTION OF HEATER AND BASIC COMPONENTS.

SPARK-SPRAY IGNITION. (Refer to Figure 21-3.)

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

Heat is produced by burning a fuel-air mixture in the combustion chamber of the heater. Aviation gasoline is injected into the combustion chamber through the spray nozzle. The resulting cone-shaped fuel spray mixes with combustion air and is ignited by a spark from the spark plug. Electric current for ignition is supplied by an ignition unit which converts 14-volts to high voltage oscillating current to provide a continuous spark across the spark plug gap. A shielded, high voltage lead connects the ignition assembly to the spark plug. Combustion air enters the combustion chamber tangent to its surface and imparts a whirling or spinning action to the air. This produces a whirling flame that is stable and sustains combustion under the most adverse conditions because it is whirled around itself many times. Therefore, ignition is continuous and the combustion process is self-piloting. The burning gases travel the length of the combustion tube, flow around the inside 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

1. HEATER INLET
2. FRESH AIR INLET
3. OVERHEAD VENT BLOWER - OPTIONAL
4. COMBUSTION AIR BLOWER INLET
5. COMBUSTION HEATER ASSEMBLY
6. FRESH AIR OUTLETS
7. HEATER OUTLETS
8. DEFROSTER OUTLETS
9. DUCT ASSEMBLY
10. HEATER AND DEFROSTER CONTROL ASSEMBLY

◀ FRESH AIR

◀ HEATED AIR

2311

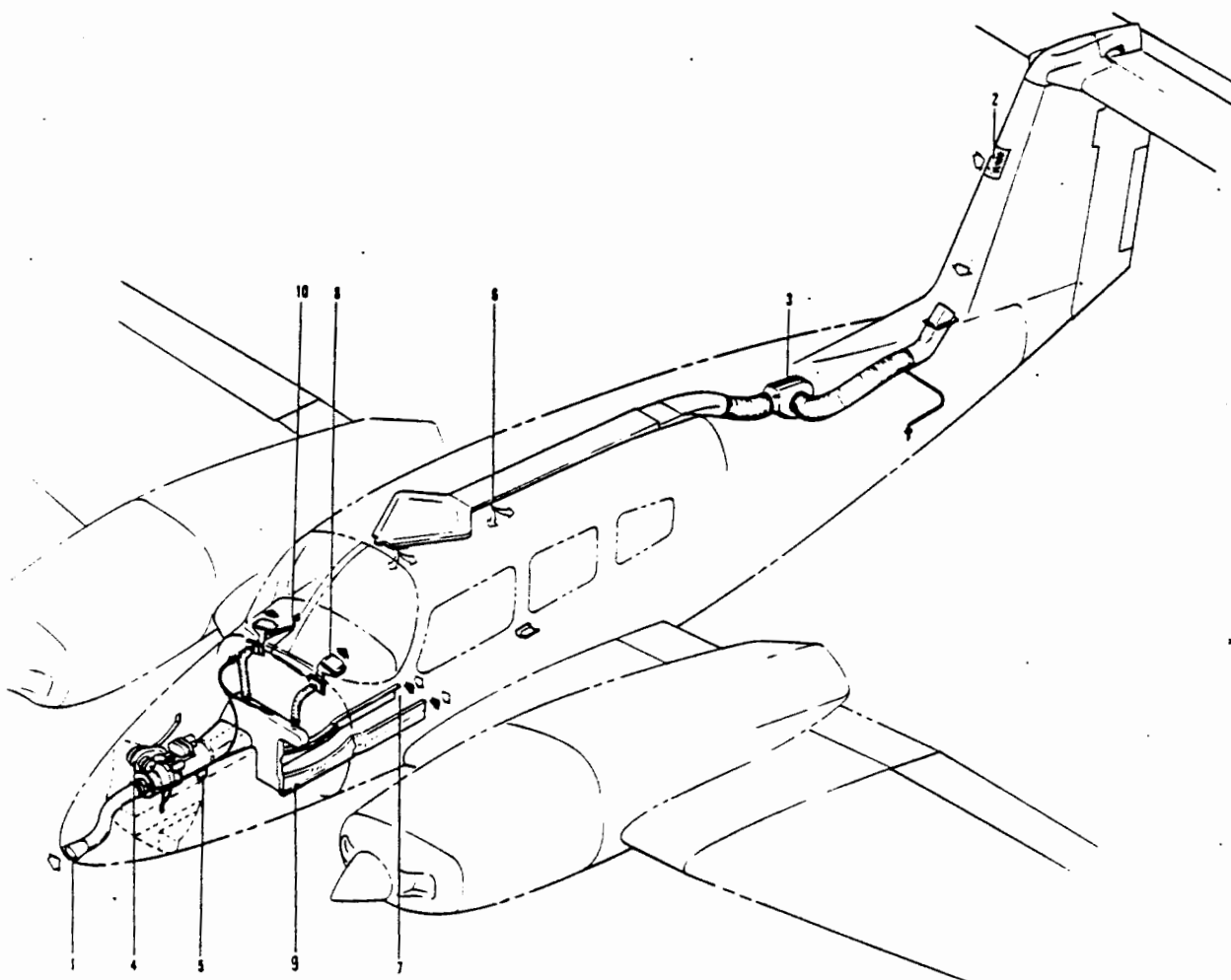


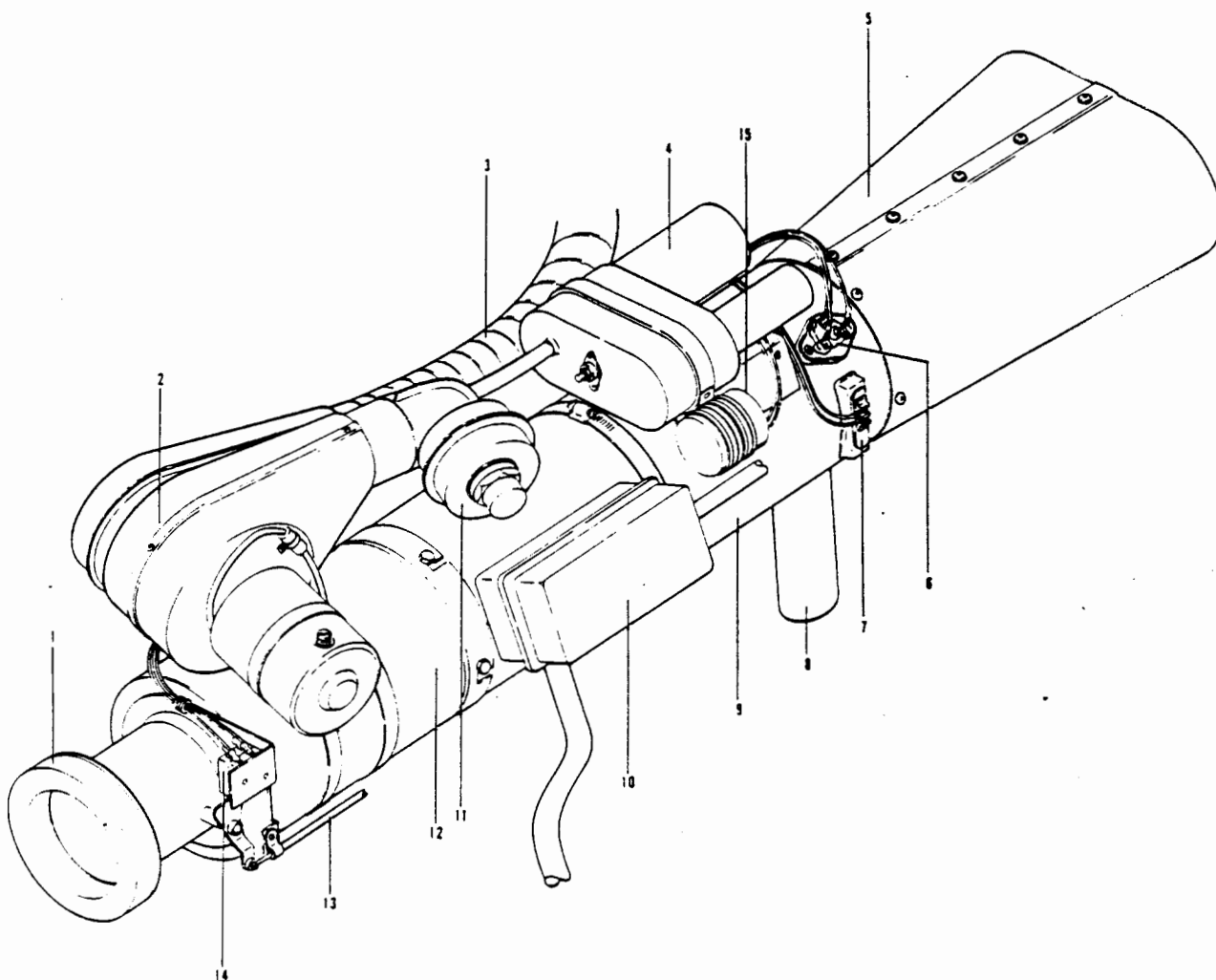
Figure 21-1. Cabin Environmental System Installation

21-41-1
Page 21-09

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2276



1. FORWARD SEAL
2. COMBUSTION AIR BLOWER
3. COMBUSTION AIR INTAKE
4. IGNITION UNIT
5. AIR DUCT
6. LIMIT SWITCH
7. CYCLING SWITCH
8. EXHAUST OUTLET
9. HEATER JACKET
10. FUEL SOLENOID SHROUD
11. PRESSURE SWITCH
12. HEATER BLOWER ASSEMBLY
13. AIR VALVE CONTROL CABLE
14. AIR VALVE SWITCHES
15. HOURMETER (OPTIONAL)

Figure 21-2. Heater and Combustion Air Blower Assembly

21-42-01
Page 21-10

Revised: January 3, 1983

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

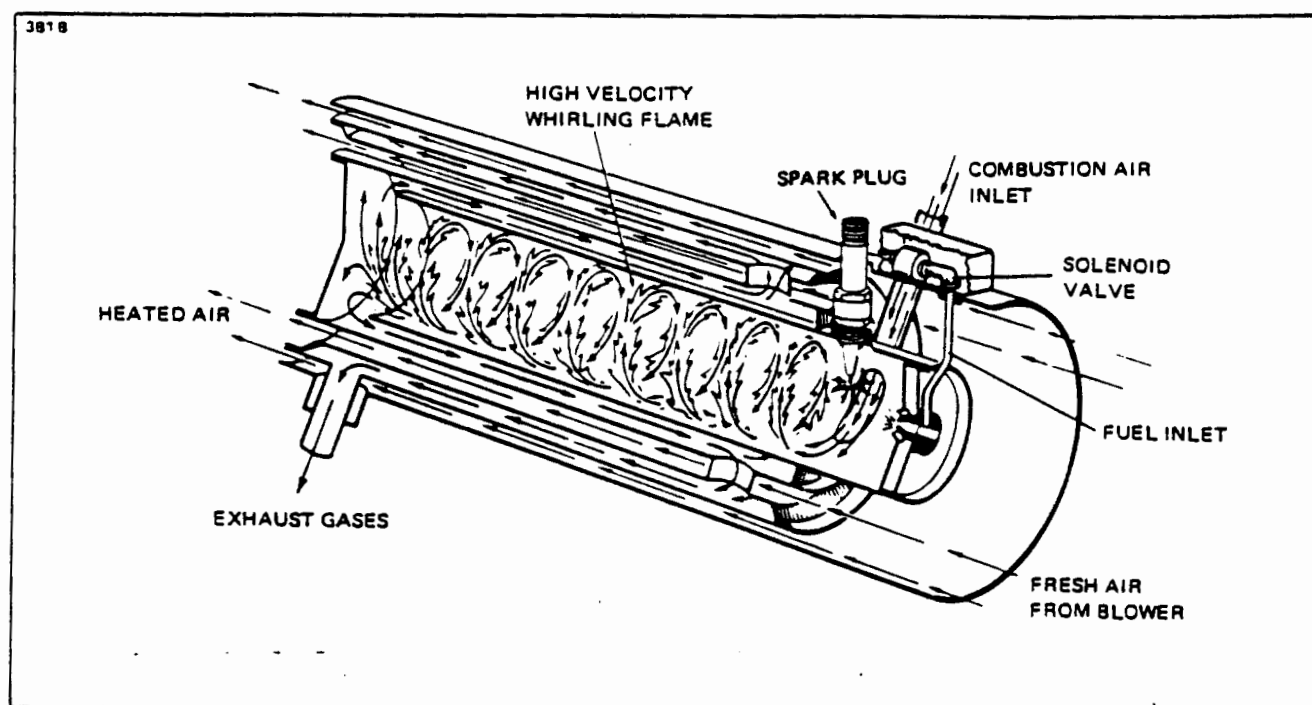


Figure 21-3. Diagrammatic Cutaway of Heater to Show Whirling Flame Action

FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 21-4.)

This unit provides preset, regulated fuel pressure as well as remove shutoff to the heater, regardless of fuel inlet pressure variations. It is set for $7.5 \pm .5$ psi. The shutoff valve is operated by a solenoid.

DUCT SWITCH. (Refer to Figure 21-5.)

This switch is installed in the ventilating manifold upstream 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 $250^{\circ}\text{F} \pm 10^{\circ}$ downward through a range of $146^{\circ}\text{F} \pm 6^{\circ}$. The switch has a differential of $15^{\circ}\text{F} \pm 5^{\circ}$ at any given setting.

COMBUSTION AIR BLOWER.

This centrifugal type blower supplies combustion air to the combustion chamber of the heater.

VENTILATING AIR BLOWER.

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

387

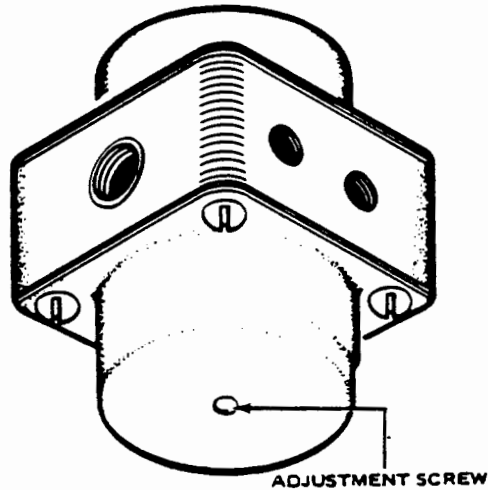


Figure 21-4. Fuel Regulator and Shutoff Valve

A360

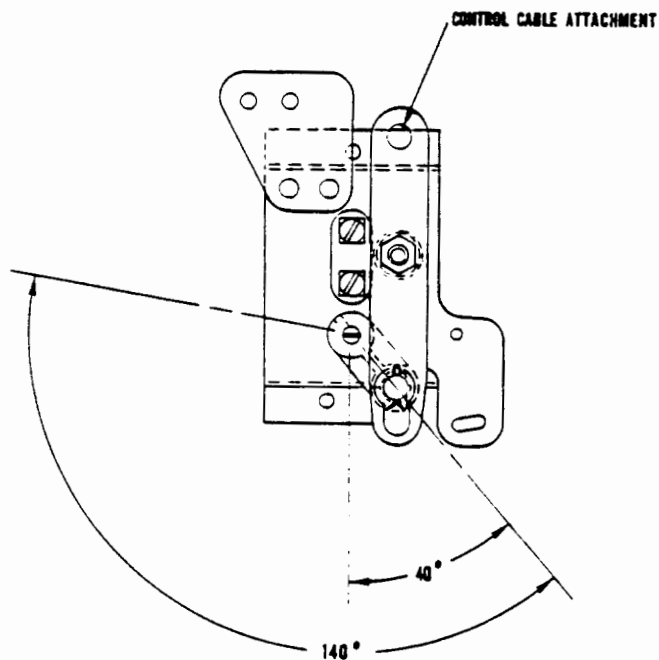


Figure 21-5. Top View - Duct Switch

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

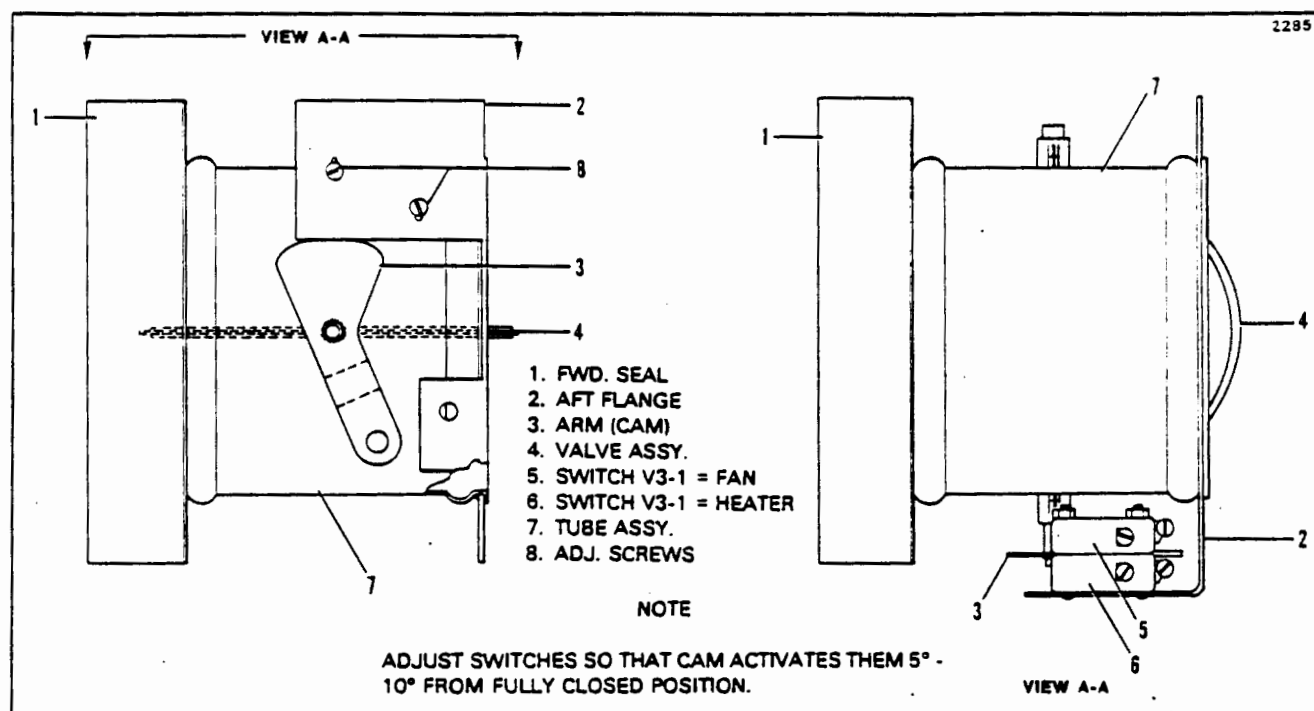


Figure 21-6. Intake Valve and Switches

OPERATING CONTROLS. (Refer to Figure 21-7.)

— NOTE —

The schematic diagram (Figure 21-7) shows the heater circuit including the electrical wiring in the airplane.

The HEATER SWITCH is connected in the line that supplied 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.

OPERATING PROCEDURE.

1. Place the master and heater switches in their "ON" position and place the air intake lever in the "OPEN" position. The ventilating air and combustion air blowers will operate and the heater will ignite.

— NOTE —

The blowers will not operate and the heater will not ignite with the air intake lever in the "CLOSED" position.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2. Set the temperature control lever to the desired temperature setting. This controls the duct switch.

— NOTE —

If this control is set for ground operating comfort, it may be necessary to reposition it after being airborne, since ram air will increase the ventilating airflow and heater output.

3. To stop the heater operation, turn the heater switch to the "FAN" position. The heater will shut off and the ventilating air blower will continue to operate. Allow the blower to operate for two minutes; this will cool down the heater before turning the heater switch off and closing the air intake valve. Turn off master switch.

MAINTENANCE SERVICE.

Instructions contained in this section consist of periodic inspection, adjustments, and minor corrections required at normal designated intervals for the purpose of maintaining the heating system in peak operating condition. These inspections assume that a heating system includes accessory components mentioned in preceding paragraphs.

INSPECTION OF HEATER AND HEATER COMPONENTS.

PREFLIGHT AND/OR DAILY INSPECTION.

1. Inspect the ventilating air inlet, combustion air inlet, exhaust outlet and fuel drains for possible obstructions. Make sure that all of these openings are clear of any restrictions and that no damage has occurred to the exhaust, cold or hot fuel drains, water drain or fuel line drain.
2. Perform an operational check as follows:
 - A. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air blower and combustion air blower should operate. Operate both combustion and ventilating air blowers and check each for unusual current draw, noise or vibration.

— NOTE —

Proceed with the Heater System Operational Check in accordance with paragraph titled "Operating Procedure."

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

100 HOUR INSPECTION.

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

— NOTE —

The 100 Hour Inspection consists of the functional check and inspection listed below and the Pressure Decay Test.

1. Inspect the ventilating air and combustion air inlets and exhaust outlet for restrictions and security at the airplane skin line.
2. Inspect the drain line to make sure it is free of obstructions. Run a wire through it if necessary to clear 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 and ventilating air blowers and check for unusual noise or vibrations.
8. It is recommended that the condition of the spark plug be checked for operation as described in paragraph titled "Spark Plugs".
9. Evaluate the condition of the combustion chamber by performing a "Pressure Decay Test" as described in Janitrol Maintenance and Overhaul Manual P N 24E25-1 dated October 1981.
10. Following the 100 hour inspection, perform the "Preflight and or Daily Inspection".

REMOVAL OF HEATER. (Refer to Figure 21-2.)

1. Ascertain that all heater controls are off.
2. Remove the screw in the nose, lower nose cone to gain access to heater.
3. Disconnect the heater outlet duct from the heater manifold by removing the attachment screws.
4. Remove the clamp from the intake valve control cable and disconnect the control cable from the intake valve.
5. Note the hookup of the electrical leads to facilitate reinstallation. Disconnect the leads from the heater terminal block.
6. Disconnect the fuel supply line at the heater by removing the cover of the fuel line connection shroud and disconnecting the line from the solenoid valve.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

7. Disconnect the fuel and water drains from the bottom of the heater and allow them to slide down.
8. Disconnect the combustion air blower inlet hose from the blower assembly by removing the cotter key and clevis pin at the blower.
9. Loosen the clamps from around the heater and remove the heater from the airplane. The exhaust shroud should remain in the airplane.
10. With the heater removed, the necessary maintenance may be performed as required.

INSTALLATION OF HEATER. (Refer to Figure 21-2.)

1. Ascertain that all the heater components are on the heater. Position the exhaust tube shroud on the tube mounting flange located in the nose section.
2. Position the heater over its mounting brackets and ascertain that the exhaust tube extends into the exhaust shroud. Lower the heater to its mounting brackets. The exhaust tube should extend out the bottom of the nose section.
3. Move the heater slightly to obtain the best fit of the exhaust tube shroud and heater. Place the heater clamps around the heater and mounting bracket flanges and secure.
4. Connect the combustion air blower inlet hose to the combustion air blower assembly on the heater and secure in place with the clevis pin and cotter key.
5. Connect the fuel and water drain lines to the bottom of the heater.
6. Connect the fuel supply line to the heater and cover over the fuel shroud and secure with two screws.
7. Attach the intake valve control cable to the intake valve and install the clamp.
8. Connect the electrical leads to the heater terminal block on the heater as shown in Figure 21-2.
9. Check the operation of the heater.
10. Lift the nose cone up and secure with appropriate screws.

HEATER ELECTRICAL SYSTEM CHECKS.

ELECTRICAL CHECKS.

These tests are listed as an aid in isolating open circuited or inoperative components.

— NOTE —

The schematic wiring diagram (Figures 21-7, 21-8 and 21-9) shows, in addition to the heater circuitry, the aircraft control circuit. For the purposes of this manual, the circuitry shown in these illustrations will be utilized to describe voltage checks.

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

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

3268.

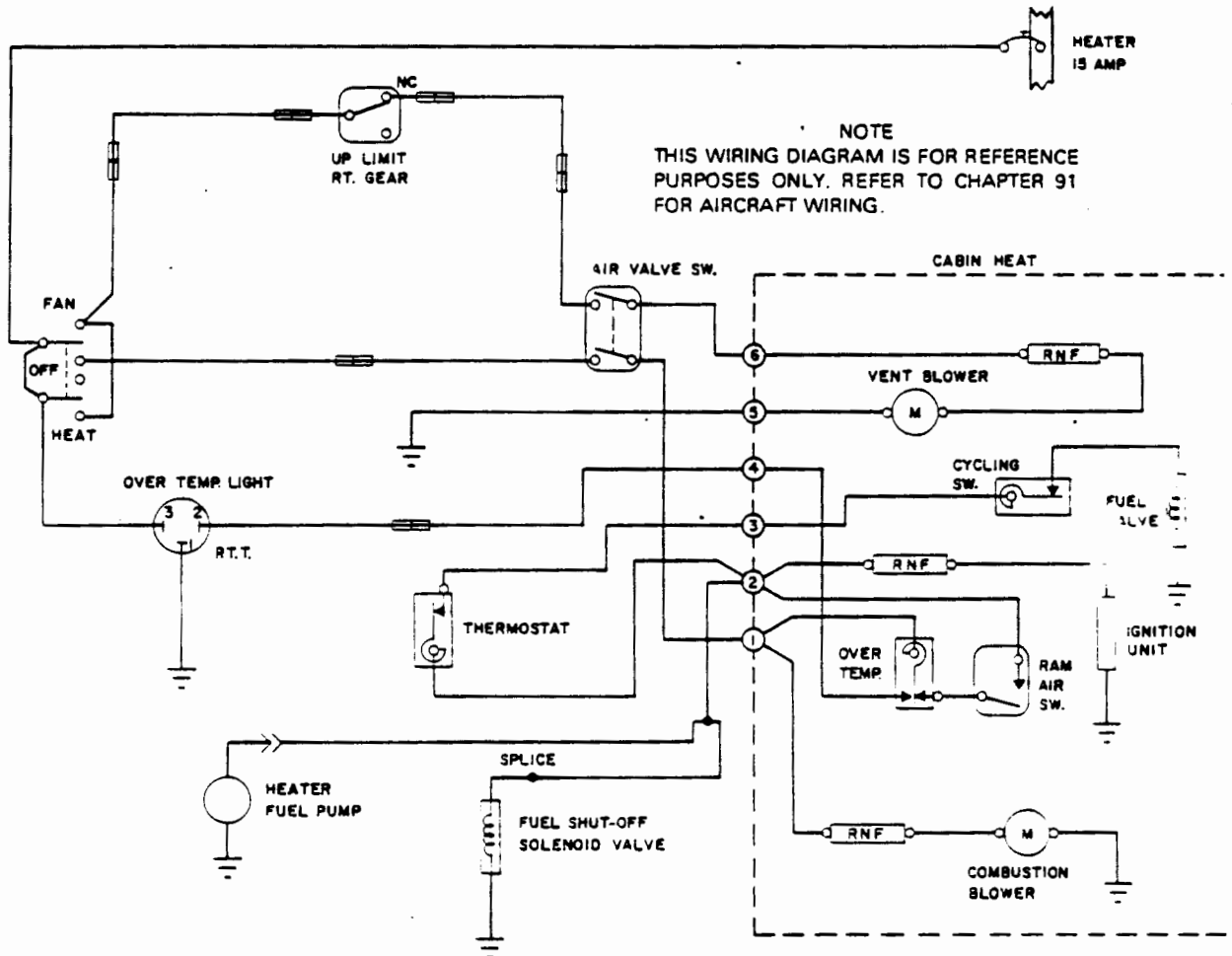


Figure 21-7. Wiring Diagram

21-43-07
Page 21-17

Revised: January 3, 1983

MAINTENANCE MANUAL

3267

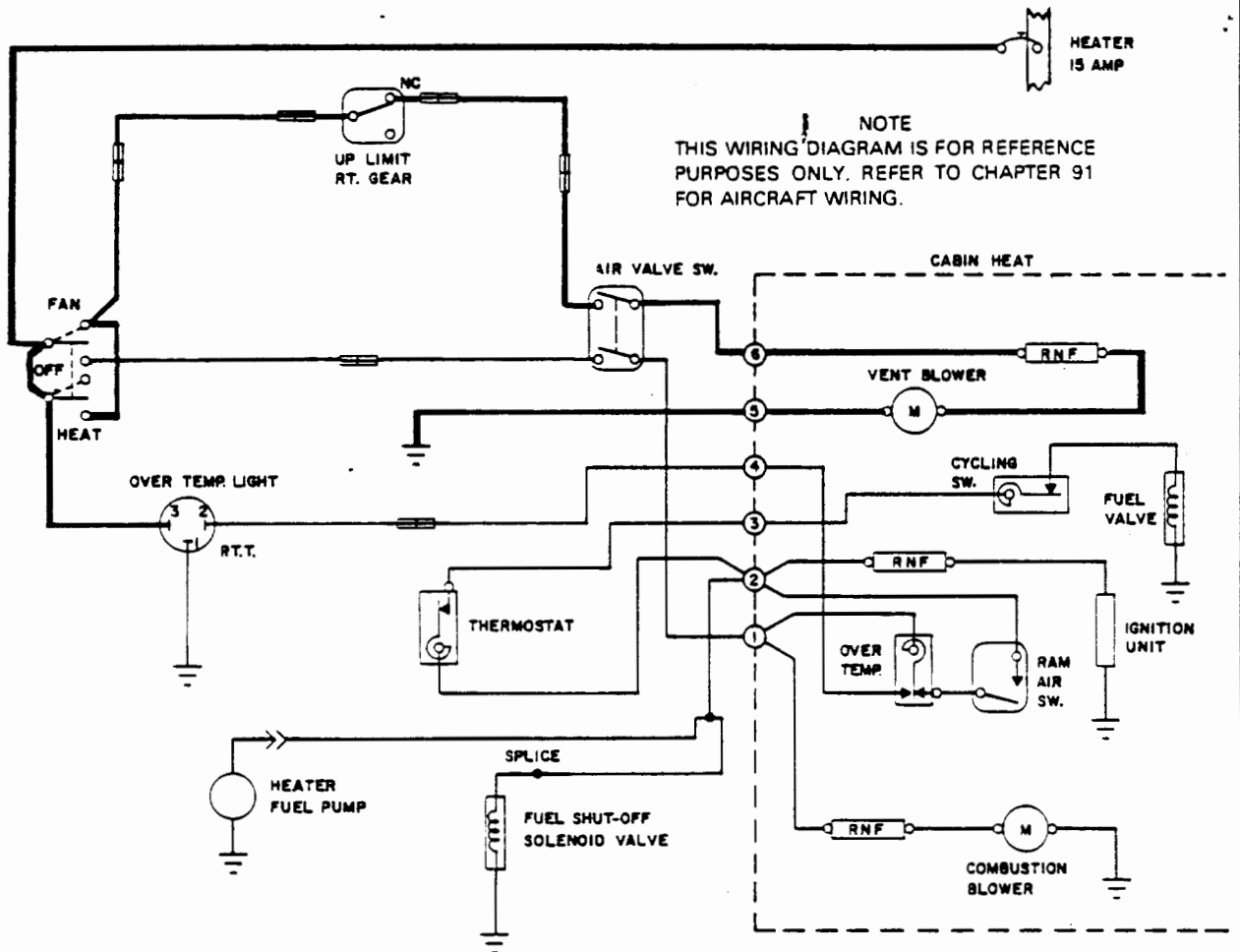


Figure 21-8. Primary Power Circuit

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

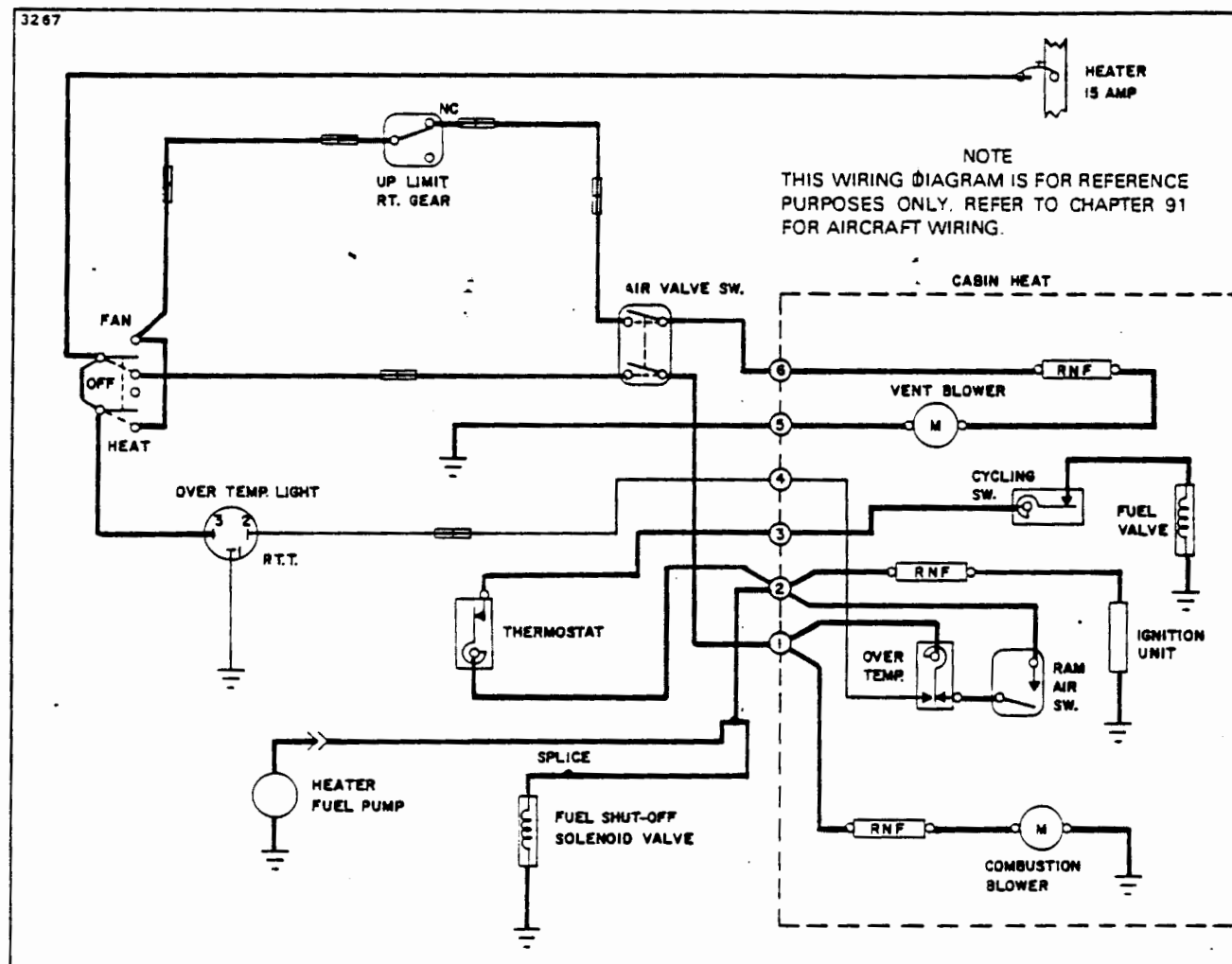


Figure 21-9. Starting Power Circuit

VENT BLOWER POWER CIRCUIT CHECK.

1. With the HEATER SWITCH in the FAN position, voltage (14-volts nominal) should be present at the following locations: (Refer to Figure 21-8.)

- A. Terminal No. 6 on the heater terminal strip if the air valve is open.
- B. From terminal No. 6 of the heater terminal strip through the radio noise filter to the ventilating air motor.
- C. Electrical ground circuit for the ventilating air motor is provided from terminal No. 5 of the heater terminal strip. Ventilating air motor is inoperative when the landing gear is up or air valve is closed.

21-43-0

Page 21-19

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

HEATER POWER CIRCUIT CHECK.

1. With the HEATER SWITCH in the HEAT position, voltage should be present at the following locations: (Refer to Figure 21-9.)

— NOTE —

Power for the ventilating air blower is the same as described above except that power is now supplied through the HEAT side of the HEATER SWITCH.

- A. Terminal No. 1 of the heater terminal strip if the air valve is open.
- B. From terminal No. 1 of the heater terminal strip through the radio noise filter to the combustion air motor and to terminal No. 1 of the overheat switch.
- C. From terminal No. 3 of the overheat switch through the combustion air pressure switch to terminal No. 2 of the heater terminal strip.
- D. From terminal No. 2 of the heater terminal strip to the ignition unit to the fuel regulator and shutoff valve and fuel pump through the adjustable duct switch to terminal No. 3 of the heater terminal strip.
- E. From terminal No. 3 of the heater terminal strip through the cycling switch to the fuel solenoid valve.

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

GENERAL MAINTENANCE.

Instructions in this paragraph pertain to maintenance of the basic heater and components while the heater is installed in the airplane. Instructions for removal of components are included provided the installation permits accessibility.

— NOTE —

No special service tools are required for normal periodic maintenance.

COMBUSTION AIR BLOWER.

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

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

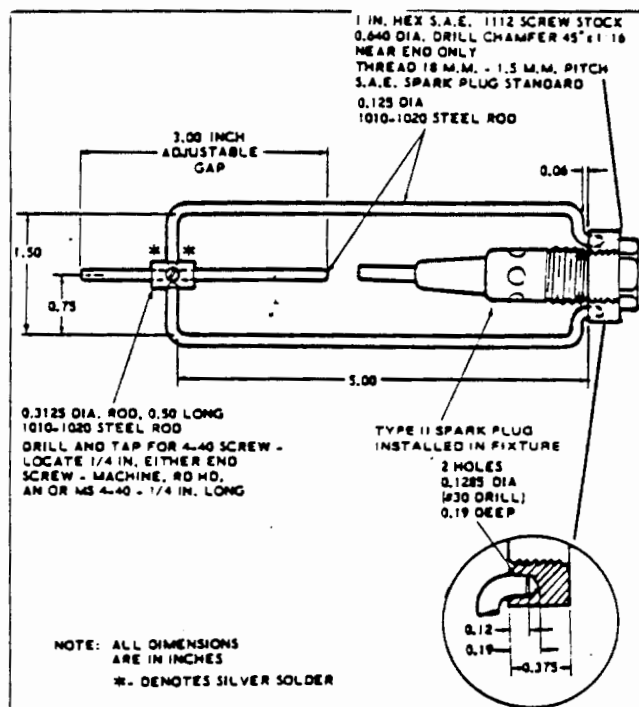


Figure 21-10. Spark Plug Fixture

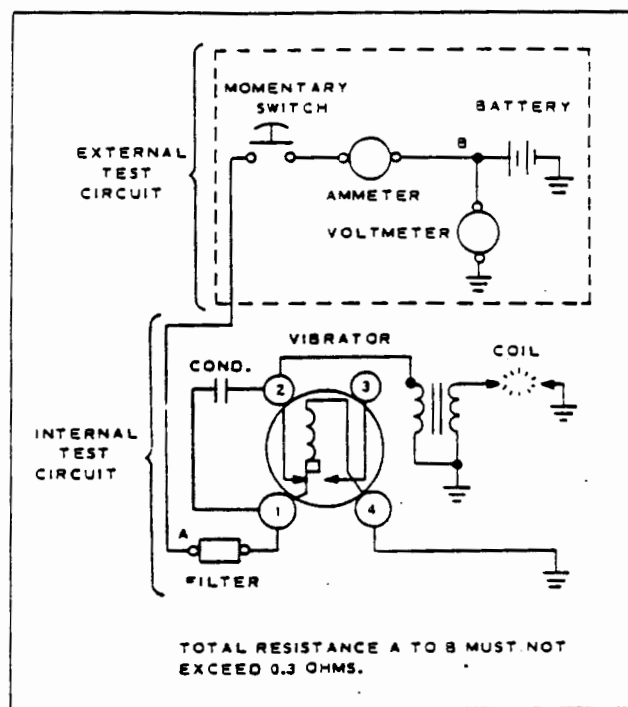


Figure 21-11. Wiring - Test Setup

2. Replacing Motor Brushes: (Refer to Figure 21-19.)

A. 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.

B. Inspect the brush for wear. If brushes are worn to a length of .187 of an inch, they must be replaced.

C. 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.

D. 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 14-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 aircraft.

3. Installation:

A. 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 inlet housing. Blower performance is based upon this close-tolerance clearance. It is recommended that correct voltage be applied for this clearance check.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

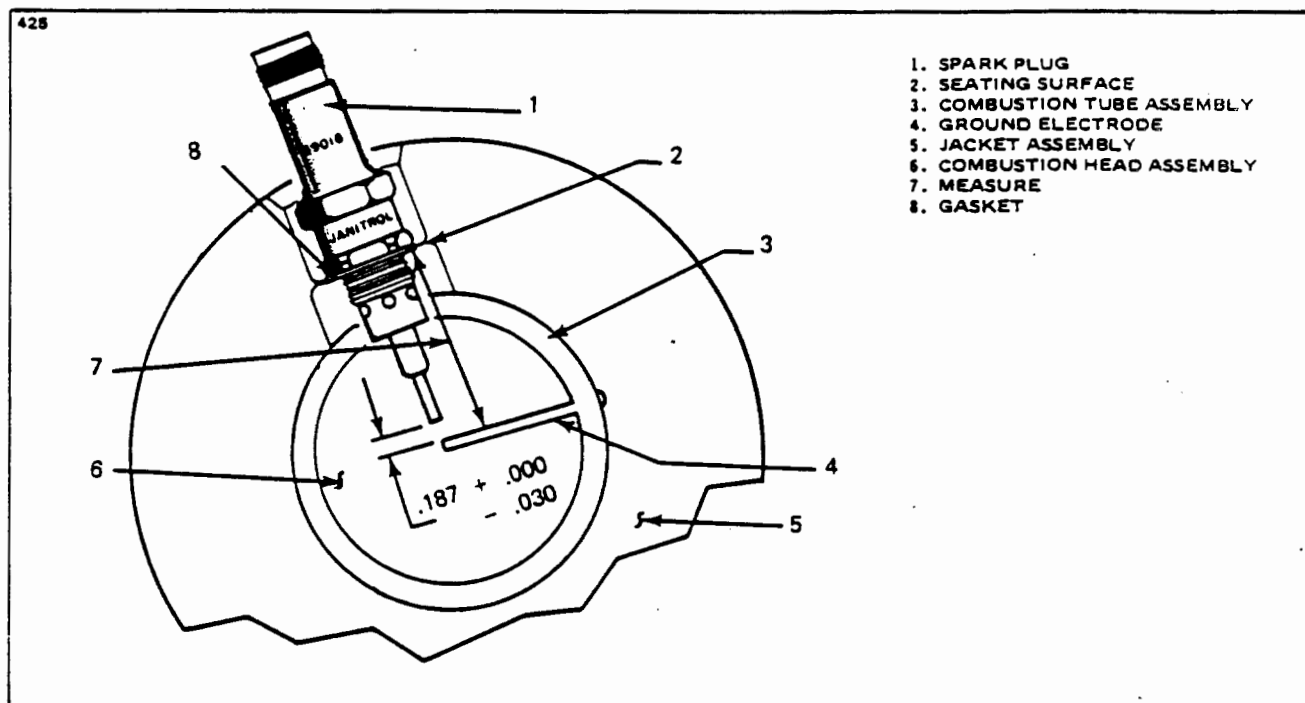


Figure 21-12. Spark Plug Gap Adjustment

- B. Install the blower inlet adapter in the same orientation as before removal.
- C. 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. Do not tighten until after tightening the motor in the attaching strap.
- D. Tighten the blower motor mounting strap securely making certain the air tubing is in proper alignment.
- E. Secure the air tubing by tightening the clamp or installing the sheet metal attaching screws.
- F. Connect the wire lead at the quick-disconnect terminal.
- G. Connect the ground lead securely to the mounting bracket.
- H. 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.

SPARK PLUG.

- I. Removal: (Refer to Figure 21-18.)
 - A. Remove the screws in the nose and lower the nose cone gaining access to the spark plug area of the heater assembly.

— NOTE —

Insure that heater electrical circuits are de-energized.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

B. Unscrew and remove the high voltage lead connector at the spark plug. Exercise care to avoid fouling or damaging the connector.

C. Remove the grommet.

D. 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 with a wire hook.

2. Inspection and Servicing (Spark Plug):

A. If the spark plug appears to be in good condition, except for a mild coating of oxide on the porcelain and electrodes, it may be cleaned and reused. Cleaning is accomplished on a conventional airplane type spark plug cleaner, except that it will be necessary to use two or more adapters in order to raise the long extension of the plug far enough out of the cleaner nozzle opening to perform an effective job. Plug the ceramic insert cavity at the terminal end of the plug with a piece of paper or cloth to keep out any of the cleaning sand. Wipe this cavity out thoroughly with a cloth wet with carbon tetrachloride. If after cleaning the spark plug porcelain is white and the electrodes are not eroded, proceed to check the ground electrode in the heater and adjust the spark gap in accordance with Step 3 of this paragraph.

— NOTE —

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

3. Spark Gap Check and Adjustment: (See Figure 21-12.) A spark gap of 0.156 to 0.188 inches must be maintained on the P/N 39D18 spark plug. This gap should be checked any time a plug is replaced or at the time of heater overhaul. A spark gap greater than that specified can shorten the life of the ignition assembly. There are several methods in which the spark gap of this heater may be checked. Method I is recommended when the heater is being overhauled and before the installation of the fuel nozzle. Methods II and III are suitable for checking the gap through the spark plug well when the heater is not disassembled.

Method I.

A. Using a 5/32 inch drill (0.156) or a piece of 5/32 rod, reach through the small opening in the combustion head and find the ground electrode. (It is welded inside the head.)

B. Move the drill along the side of the electrode on the spark plug side. (Movement should be from the outer edge towards the center.) The drill should just pass through the spark plug gap opening. Should the drill fail to pass through this opening, the gap is too narrow. If it passes through too freely, the gap is too wide. In either case, it will be necessary to bend the ground electrode in the direction required. This may be done by removing the spark plug and reaching through the opening.

C. Recheck the gap after repositioning of the ground electrode.

Method II.

A. Measure the distance between the seating surface of the spark plug with a new gasket installed to the end of the plug electrode.

B. Using a depth gauge, measure the distance between the ground electrode in the heater to the spark plug seating surface in the heater jacket and check this measurement against the measurement obtained in Step A. The difference should be between 0.156 to 0.188 of an inch.

C. The ground electrode can be bent to obtain the required gap.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

Method III.

- A. Fabricate or purchase from Piper the special tool from dimensions given in Figure 21-22.
- B. Install the threaded end of the tool into the spark plug hole.
- C. Slide the rod of the tool into the combustion head until it contacts the ground electrode.
- D. Check that the indicator ring on the rod lines up with the end of the tool. The ground electrode may be bent to obtain the required gap.

— NOTE —

Inspect the ground electrode for erosion. If it is eroded to approximately half of its original 1/8 inch diameter, it should be replaced. This can be done as follows:

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

4. Installation: (Refer to Figure 21-12.)

- A. If a new spark plug is being installed, be sure to adjust the spark gap. Do not bend the electrode on the spark plug.
- B. 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.
- C. Screw the spark plug into the heater with a deep socket wrench. Tighten to a torque of 28 foot-pounds.
- D. Install the grommet (39, Figure 21-18) in the heater jacket opening.
- E. 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.
- F. Operate the heater to check dependability and close all access openings.

IGNITION UNIT.

This unit converts 14-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 and ignition coil.

IGNITION UNIT REMOVAL AND INSTALLATION.

1. Removal: (Refer to Figure 21-18.)

— NOTE —

Make sure heater electrical circuits are de-energized.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

- A. Disconnect the primary wire from the primary terminal of the ignition assembly.
- B. Carefully unscrew and disconnect the high voltage ignition cable at the spark plug. Exercise care to avoid fouling or damaging the connector.
- C. Remove the four attaching screws and lift the ignition assembly off the heater jacket.
2. Installation: (Refer to Figure 21-18.)
 - A. Place the ignition assembly in position on the heater jacket with the high voltage cable facing the spark plug end of the heater.
 - B. Install the four screws. Tighten the screws securely.
 - C. Carefully connect the high voltage lead to the spark plug.
 - D. Connect the primary lead to the primary terminal on the ignition unit and tighten the nut securely.
 - E. Check for proper heater operation.

TESTING IGNITION UNIT.

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

1. A battery that will supply power at approximately 14-volts DC.
2. A voltmeter with a range of 0-15-volts.
3. A lead from the battery to the test fixture in which is included an ammeter with a range of 0-3 amperes and a normally open, momentary-closed switch. The total resistance of the lead including the ammeter and switch must not exceed 0.3 ohms.

— CAUTION —

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

4. A spark gap of 0.187 inch (plus 0, minus .030). A convenient means of arranging the correct spark gap is to install a spark plug, P/N 39D18, in a test fixture arranged to provide a ground electrode and a .187 inch spark gap. (Refer to Figure 21-10 for information on fabricating this fixture.)

— NOTE —

Any one of several spark plugs may be used with the spark plug fixture detailed in Figure 21-10. However, the "A" dimension in that sketch must be varied with the length of spark plug electrode to provide a gap of .187 inch for all spark plugs.

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 21-11.

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 14-volts DC must be 1.50 ± 0.25 amperes.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

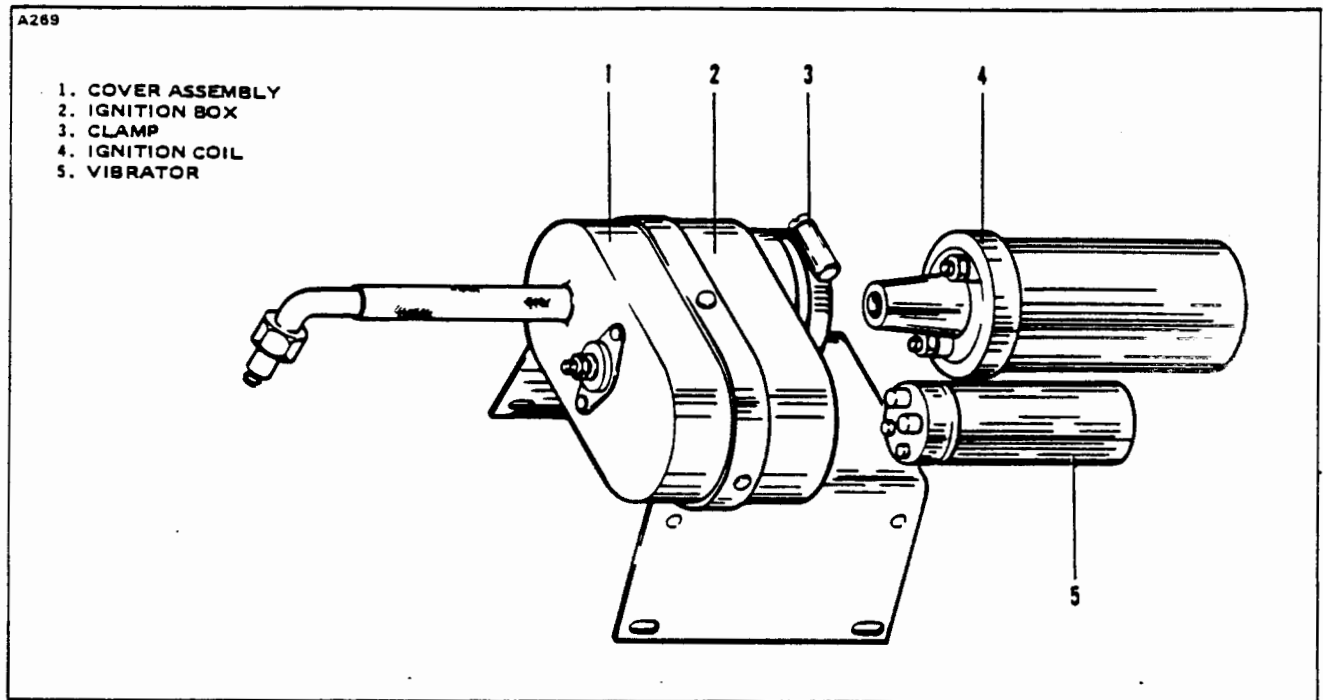


Figure 21-13. Ignition Unit Assembly

VIBRATOR.

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

VIBRATOR REMOVAL AND INSTALLATION. (Refer to Figure 21-13.)

1. Remove the clamp.
2. Remove the vibrator from the ignition unit; it may require a slight back-and-forth movement to remove it from the unit. A piece of masking or friction tape around the exposed portion of the vibrator will help to grip the vibrator for removal.
3. Install the new vibrator with the index marks aligned. The connector pins on the vibrator can be felt entering the pin sockets in the vibrator socket; then press the vibrator fully and firmly into position. Secure with the clamp.

— NOTE —

*If replacement of vibrator fails to correct operational failure,
further disassembly and inspection may be required.*

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2103. INSPECTION (IGNITION UNIT)

Index No.	Nomenclature	Inspection
1	Cover Assembly	Inspect for security of lead assembly to cover. Ignition cable, grommet, terminal and connector for carbon tracks, cracks or distortion. Repair or replace for any of above conditions.
4	Ignition Coil	Inspect for broken bakelite, carbon tracks, oil leaks, and dents in coil cover. Replace for any of the above conditions.

INSPECTION OF IGNITION UNIT.

Inspect components as directed in Chart 2103 and Figure 21-13.

— NOTE —

Replace any component that fails to meet checks listed in Chart 2102.

CYCLING SWITCH AND LIMIT (OVERHEAT) SWITCH. (Refer to Figure 21-18.)

1. Removal:

- A. If the limit switch is damaged or defective, disconnect the three electrical leads from the switch terminals. Be sure to mark the leads for proper reassembly. (The switch terminals are identified by numbers "1," "2" and "3.")
- B. Remove the two attaching screws and lift the limit switch and spacers (gaskets) from the jacket opening.
- C. If the cycling switch is damaged or defective, disconnect the electrical leads being sure to mark them for proper reassembly.
- D. Remove the two screws and lift the cycling switch from the jacket opening.

— NOTE —

No attempt should be made to repair either of these switches. If they do not operate properly, they should be replaced.

2. Installation: (Refer to Figure 21-18.)

- A. Install the limit switch and spacers (gaskets) by placing them in position in the heater jacket opening and installing two screws.
- B. Tighten screws securely; then reconnect the electrical leads in accordance with markings made during disassembly. (Refer to wiring diagram, Figure 21-7.)
- C. Install the cycling switch (refer to Figure 21-18) by placing it in position in the heater jacket opening and securing it with the two screws. Tighten screws securely; then reconnect the electrical leads to their respective terminals as marked during disassembly. (Refer to wiring diagram, Figure 21-7.)

21-43-20

Page 21-27

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 21-18.)

1. Removal:

A. Disconnect electrical leads from the terminals of the combustion air pressure switch, being sure to mark them for proper reassembly. Disconnect the tube from the switch cap. Exercise caution not to exert excessive bending of the tube. (It is "tacked" to the combustion chamber inside the jacket.)

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

2. Installation:

A. 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 over-torque the switch as this could change the setting.

B. Connect electrical leads to their respective terminals in accordance with markings made during removal. If in doubt regarding proper connections, refer to the wiring diagram, Figure 21-7. Connect the tube to the switch cap.

C. Check for proper heater operation.

FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 21-4.)

The fuel regulator and shutoff valve is located on the upper right side of the forward bulkhead assembly. Access is obtained by lowering the nose cone.

REMOVAL OF FUEL REGULATOR.

1. Ascertain that the left fuel tanks are empty and the fuel selector controls are in the OFF position.
2. Gain access to the regulator and disconnect the electrical leads from regulator and shutoff valve.
3. Disconnect the fuel line from the outlet port and remove the regulator from the heater fuel pump. Cap all open fuel lines to prevent contamination.

ADJUSTMENT OF FUEL REGULATOR.

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 21-14.
2. Install a 2.0 gph nozzle (Janitrol Part No. C08D09). Gasoline or Stoddard solvent can be used for testing.
3. Apply fluid pressure from fuel pump and energize the solenoid. Outlet pressure should be $7.0 \pm .5$ psi, if not, correct accordingly.
4. Using a screwdriver, break the seal over the adjustment screw and adjust the regulated outlet pressure to $7.0 \pm .5$ psi. (Turn clockwise to increase pressure or counterclockwise to decrease pressure.)
5. De-energize and energize the solenoid at least twice. The outlet pressure should be 6.5 to 7.5 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.
6. 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

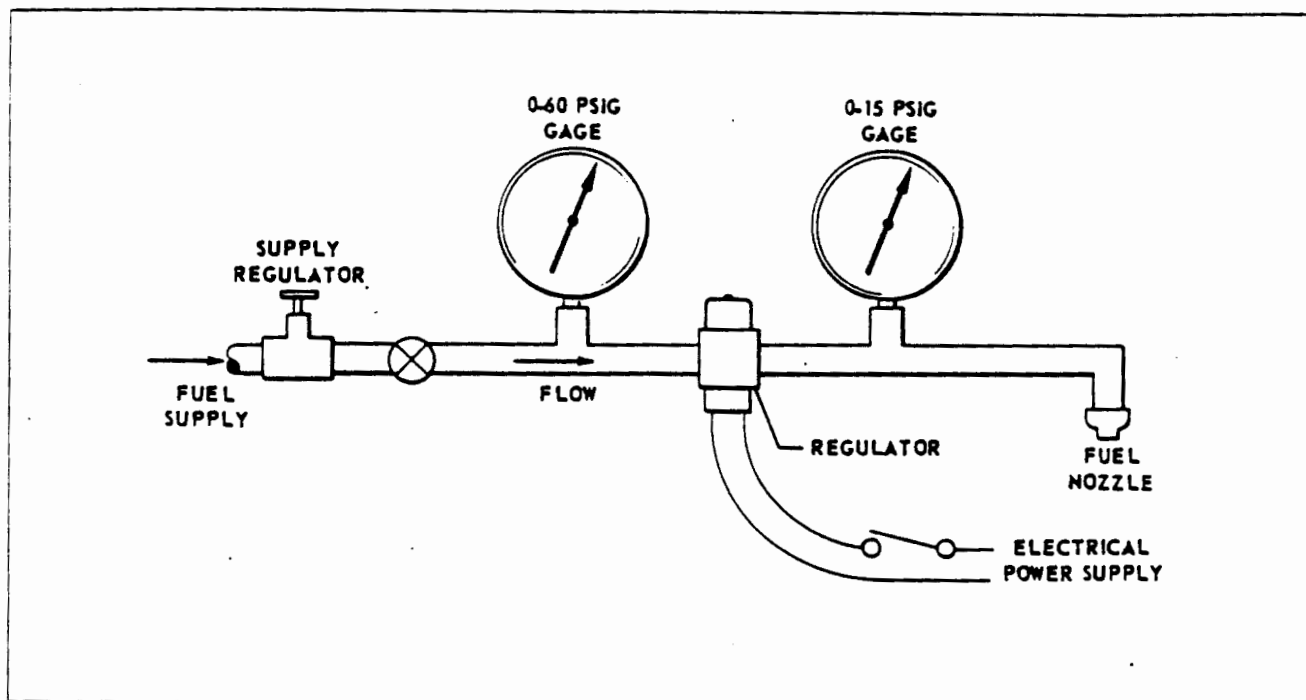


Figure 21-14. Test Setup for Fuel Regulator and Shutoff Valve

INSTALLATION OF FUEL REGULATOR.

1. Position the regulator into position between the fuel line and fuel pump. Ascertain that the inlet side of the regulator is towards the fuel pump.
2. Connect the regulator to the pump and the heater fuel line to the regulator outlet port.
3. Connect the electrical leads from the regulator.
4. Operate the heater to make sure the unit is functioning properly.

HEATER FUEL PUMP. (Refer to Figure 21-15.)

The maintenance required for this type of fuel pump is very limited, consisting of inspection and replacing parts that are worn or broken.

REMOVAL OF HEATER FUEL PUMP.

The heater fuel pump is located on the upper left side of the forward bulkhead assembly. Access is obtained by lowering the nose cone.

1. Ascertain that the left fuel tanks are empty and the fuel selector controls are in the OFF position.
2. Disconnect the electrical lead from the pump.
3. Disconnect the fuel line from the inlet end of the pump and the regulator from the outlet end. Cap all open fuel lines to prevent contamination.
4. Remove the bolts which secure the pump to its mounting bracket.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

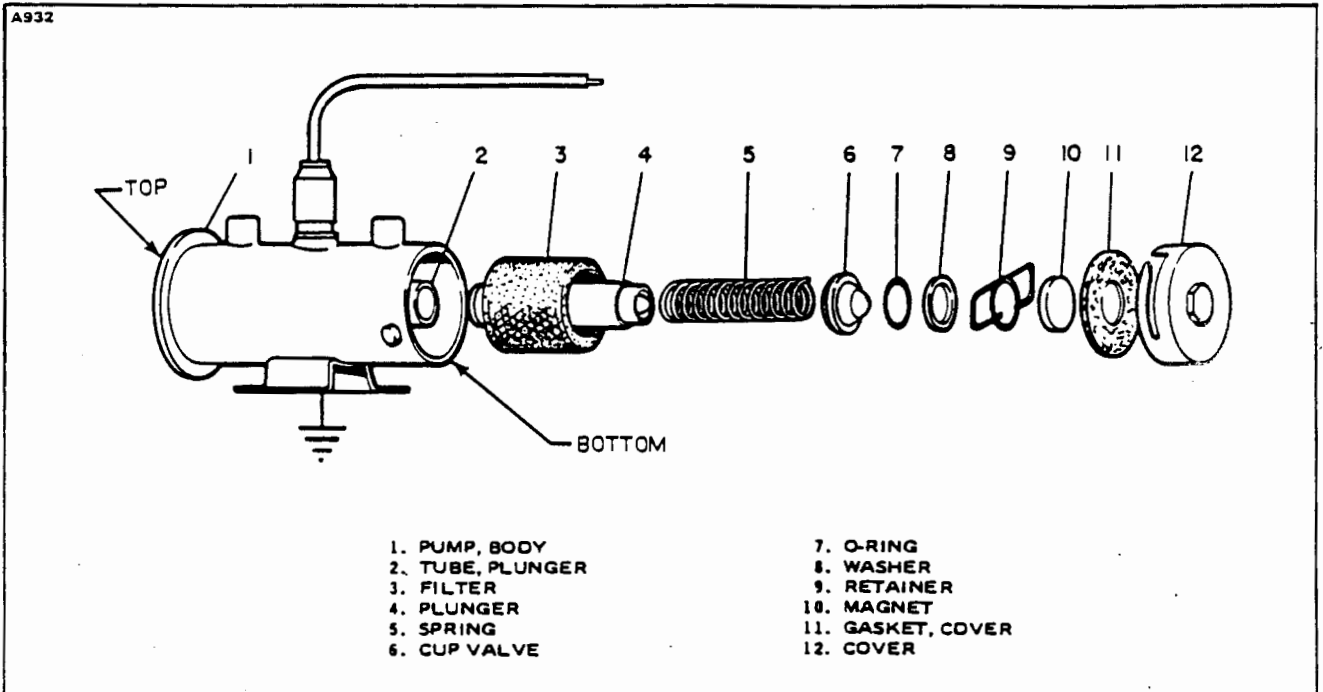


Figure 21-15. Heater Fuel Pump

DISASSEMBLY OF PUMP. (Refer to Figure 21-15.)

1. Remove the safety wire that secures the bottom cover to the pump.
2. Using a 5/8 inch wrench, release the bottom cover from the bayonet fittings. Twist the cover by hand to remove it from the pump body.
3. Remove the filter, magnet and cover gasket.
4. Remove the retainer spring from the plunger tube using thin nose pliers to spread and remove ends of retainer from tube.
5. Remove washers, O-ring seal, cup valve, plunger spring and plunger from the tube.

CLEANING OF PUMP.

1. Wash all parts in cleaning solvent and blow out with air pressure.
2. If plunger does not wash clean or if there are any rough spots, gently clean the surface with crocus cloth.
3. Slosh the pump assembly in cleaning solvent and blow out with air pressure.
4. Swab the inside of the tube with a cloth wrapped around a stick.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSPECTION AND REPAIR OF PUMP.

1. Disassemble the pump.
2. The filter usually comes off with the cover; it may stick inside the fuel pump. Carefully remove the filter and replace it, if distorted.
3. Check cover gasket and replace if deteriorated.
4. Check the O-ring seal and plunger spring and replace if worn.

ASSEMBLY OF PUMP. (Refer to Figure 21-15.)

1. Insert the plunger into the tube with the buffer spring end first. Check fit by slowly raising and lowering the plunger in the tube. It should move fully without any tendency to stick. If a click cannot be heard, the interrupter assembly is not functioning properly in which case the pump should be replaced.
2. Install the plunger spring, cup valve, O-ring seal and washer.
3. Compress spring and assembly retainer with ends of retainer in side holes of tube.
4. Place the cover gasket and magnet in the bottom cover and assemble the filter and cover assembly.
5. Twist the cover by hand to hold in position on pump housing. Using a 5/8 inch wrench, securely tighten the bottom cover with the bayonet fittings on the pump body and install safety wire.

INSTALLATION OF HEATER FUEL PUMP.

1. Position the fuel pump on the forward bulkhead assembly and secure in place with bolts.
2. Connect the regulator to the pump outlet and the fuel line to the pump inlet.
3. Connect the electrical lead from the pump.
4. Operate the heater to make sure the unit is functioning properly.
5. Replace nose cone and secure.

DUCT SWITCH. (Refer to Figure 21-19.)

1. Removal:
 - A. Disconnect the electrical leads from the terminals on the exposed face of the switch and mark to facilitate installation.
 - B. Remove the two attaching screws and washers from the duct switch bracket.
 - C. Carefully lift out the switch and gasket (if gasket is used).
2. Cleaning and Inspection:
 - A. Brush off any dust or lint from the switch operating mechanism (exposed inside the duct) and wipe the external surfaces with a clean cloth.
3. Installation:
 - A. Insert the switch carefully with gasket (if used) into the ventilating duct opening and secure with the two attaching screws and washers.
 - B. Connect the two electrical leads to their respective terminals on the face of the switch as marked during removal.
 - C. Operate the heater with the duct switch set above ambient temperature to check operation.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

OVERHAUL INSTRUCTIONS.

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

DISASSEMBLY OF HEATER. (Refer to Figure 21-18.)

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 reused.

3. Carefully disconnect the high voltage ignition lead at the spark plug. Handle the spring connector on the end of this lead with care to prevent fouling or damage.
4. Remove the four screws and cable straps to free the ignition assembly from the heater jacket and remove the ignition assembly. The vibrator may be removed by releasing the clamp and exerting a firm pull straightaway from the ignition assembly case.
5. Remove the grommet from the jacket and remove the spark plug with a 7/8 inch deep socket. Make sure the spark plug gasket is removed.
6. Remove the two screws and lift out the overheat (limit) switch and spacer gaskets.
7. Remove the two screws and lift out the cycling switch.
8. Remove the four screws to release the terminal strip and insulator from the jacket.
9. Disconnect the tube fitting at the cover of the combustion air pressure switch. Take precaution when bending tube. Unscrew and remove the combustion air pressure switch from the combustion air inlet tube.
10. Remove vent air inlet adapter from the blower housing by removing the three screws.
11. Loosen the four screws and rotate the blower and motor housing to disengage the notched end from the four screws in the end of the heater jacket. Disconnect the motor wiring quick-disconnect.
12. Remove the upper fuel shroud box cover by removing the screws.
13. Remove the grommet from the fuel shroud and carefully pull the fuel solenoid wires through the hole in the shroud.
14. With an open end wrench, remove the fuel solenoid assembly being careful not to damage the wires on the solenoid.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

15. Reach inside the inlet end of the jacket assembly with a 3/4 inch open-end wrench, and while holding the fuel-tube fitting at the jacket, use a 3/4 inch deep socket to remove the elbow, nut, washer, gasket and fuel shroud.

16. Remove the two screws and carefully withdraw the nozzle holder from the combustion head assembly; remove gasket.

17. Remove the six screws and withdraw the combustion head assembly from the combustion tube assembly. Remove gasket.

18. Remove the screws and remaining cable straps, if not previously removed, from the seam of the jacket assembly. Note the position of the cable straps as they are removed. Spread the jacket at the seam and remove it from the combustion tube assembly. This will free the asbestos gasket which can be removed from the particular part to which it remains attached.

19. Carefully unscrew and remove the spray nozzle from the nozzle holder. Remove the gasket.

— 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.

20. Remove the three screws and rubber grommets from the blower housing.

21. Slide the ventilating air blower motor out of the blower housing with the motor bracket assembly and blower wheel attached. Loosen the set screw in the blower wheel and slide it off the end of the motor shaft. Then remove the motor bracket assembly, fasteners and ground bracket.

22. Remove the screw and lock washer to free the capacitor assembly (18) with attached leads.

DISASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 21-19.)

1. Remove the combustion air blower inlet adapter by removing the screw.

2. Remove screws; then separate the outer housing from the inner housing and free the motor leads and capacitor from the inner housing.

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 inner housing off the motor through bolts. The spacer will drop out.

5. Install new motor brushes. If the motor commutator is badly worn or if the motor is defective in any respect, it must be replaced.

CLEANING OF HEATER COMPONENTS. (Refer to Figure 21-18.)

— 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.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

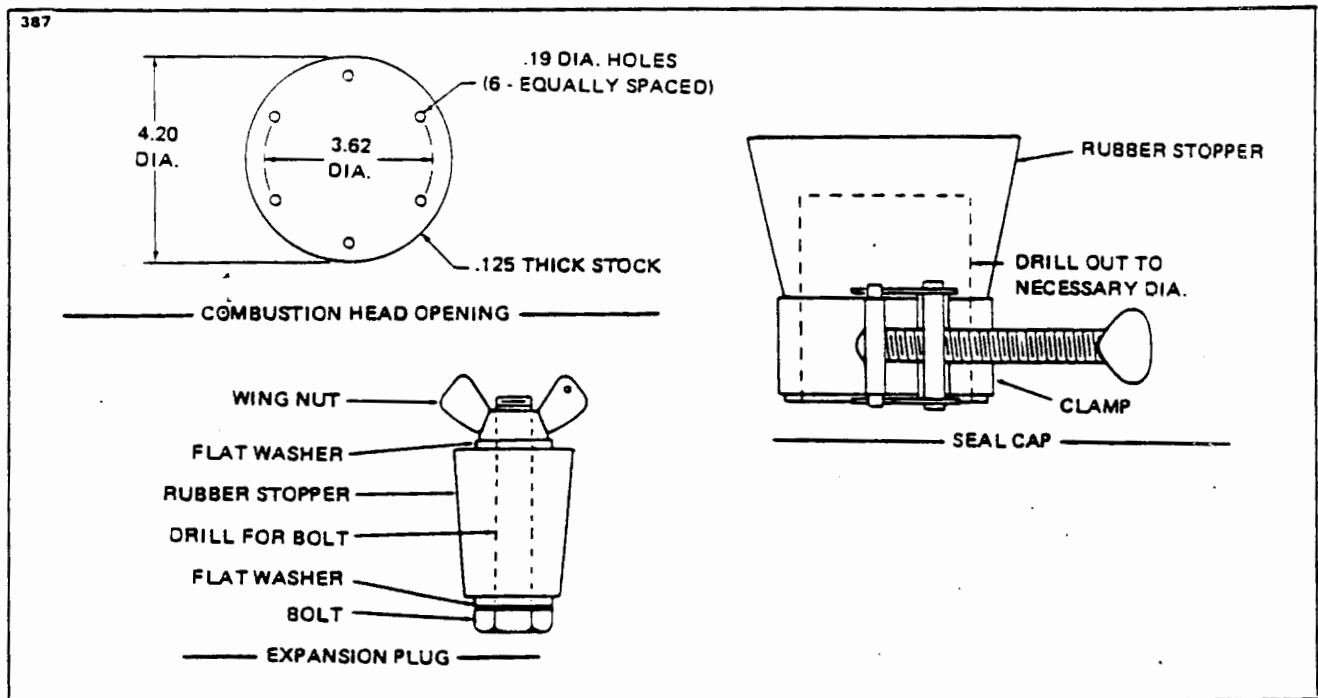


Figure 21-16. Suggested Design for Seal Plates, Plugs, and Caps for Combustion Tube Leakage Test

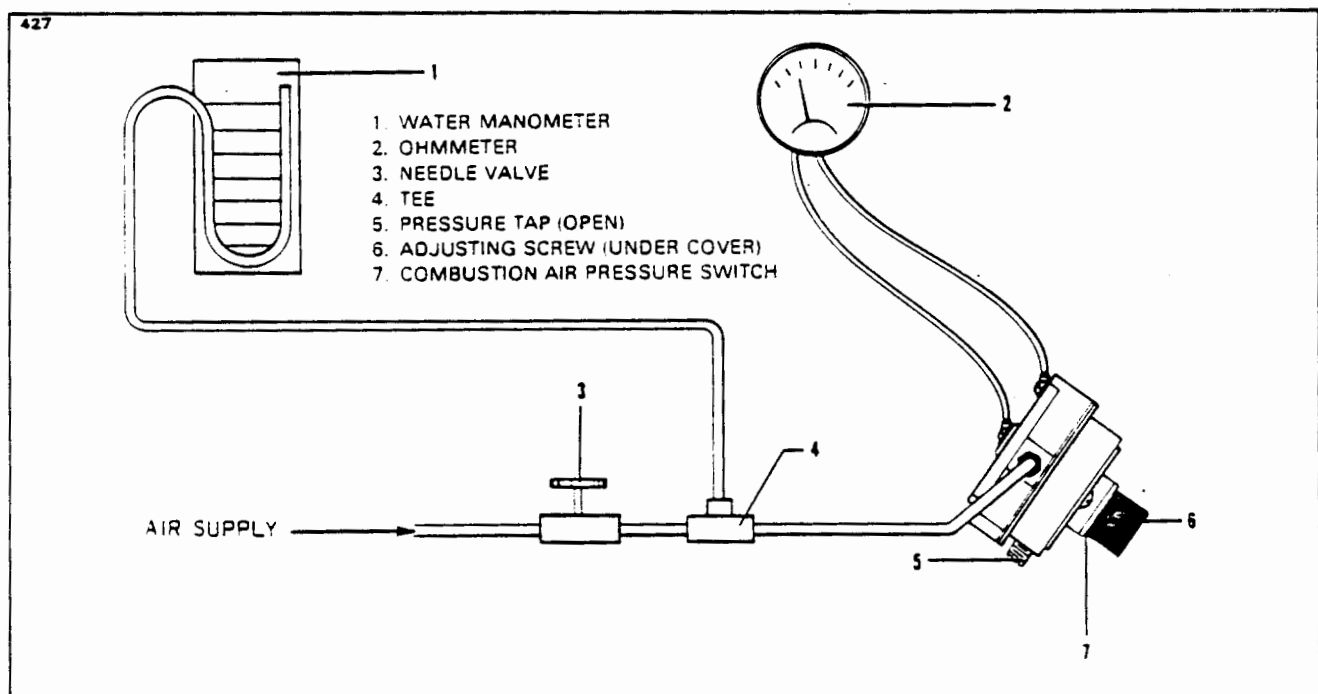


Figure 21-17. Test Setup for Combustion Air Pressure Switch

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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.
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 21-18.)

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

— NOTE —

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

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

3. The combustion tube assembly may be cleaned by either of two methods:

A. One method is to soak the combustion tube assembly overnight in a solution of Kelite No. L235 cleaning solution (1 to 12 parts by volume). The solution should be maintained at a temperature of between 190° F and 210° F. After soaking overnight, rinse the combustion tube assembly thoroughly in water to remove all traces of the Oakite solution. In order to reach all areas of the combustion tube assembly, it is advisable to let it stand in the rinsing water for as long as 1 2 hour while occasionally agitating it to circulate the water. All openings should be left open during this operation. Be sure to dry the combustion tube assembly thoroughly after cleaning by blowing with shop air.

B. A second method of cleaning is what is commonly known as hand "tumbling." Insert shot or other metallic particles through the exhaust outlet opening; then close all openings and shake the combustion tube assembly vigorously while rotating it and changing from end-to-end frequently. Be sure to pour out all of the particles and loosened material; then with all openings uncovered, direct a stream of compressed air into the combustion tube assembly from first one opening, then the other. Make sure all loose material is removed.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSPECTION OF REMAINING COMPONENTS. (Refer to Figure 21-18.)

1. Discard all rubber parts such as grommets, gaskets, etc. These items should always be replaced at overhaul. Also discard the asbestos gasket.
2. Inspect all wires and wiring harnesses for damage to insulation, damaged terminals, chafed or cracked insulation and broken plastic bands. Individual wires can be replaced by making up new wires from No. 16 AWG stock and cut to correct length. It is advisable to use an acceptable crimping tool for installing terminals rather than solder for all heater wiring connections. If wiring harness damage is visible, the entire harness assembly should be replaced. If only one or more wires are damaged, cut the cable ties, make up new wires, install them in the harnesses and restore all cable ties and clamps. If heater controls were operating properly at the time of removal, reinstall them.
3. Inspect all hard parts consisting of bolts, screws, nuts, washers and lock washers. Replace damaged parts.
4. The combustion air pressure switch must respond to delicate pressure changes and should always be checked and, or replaced at overhaul. (Refer to Figure 21-17.)
5. Replace the vibrator in the ignition unit at each overhaul.
6. Inspect the ignition assembly (refer to Figure 21-18) for dented case, loose or damaged primary terminal insulator and broken or obviously damaged high voltage lead. Give particular attention to the condition of the spring connector at the end of the lead. If the spring is burned off, visibly eroded or carbon tracked, the ignition assembly should be replaced.

— NOTE —

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

7. Inspect the terminal strip for distortion and cracks and replace it if either condition exists.
8. Inspect radio-noise filters for short circuits by checking from either terminal to ground with an ohmmeter. An open circuit reading should be obtained.
9. Inspect the spray nozzle with a magnifying glass for any obstructions in the nozzle orifice and any sign of damage to the slight conical protrusion at the nozzle tip. Use compressed air to remove obstructions and re-examine the orifice to make sure it is open. Exercise care when handling the nozzle to avoid pressing or rapping on the tip face. Do not 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 7 psi fuel pressure source. The conical angle spray pattern should be even and dispersed the same in all directions. Exercise caution to keep atomized fuel away from fire.

11. Inspect the nozzle holder assembly for damaged threads at the fuel-tube fitting and for crimped or cracked fuel line or distorted housing. Check the solenoid for continuity by connecting across each wire lead with an ohmmeter. A reading of between 15 to 40 ohms should be obtained at room temperature. If not within these limits, the solenoid should be replaced.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

12. Remove the brushes, one at a time, from the ventilating air blower motor by removing the brush cap and carefully withdrawing the brush from its guide. Remove foreign material from the brush guide and commutator with a stream of filtered compressed air. Check for brush wear. Inspect the commutator for grooved brush track, pitting or burning. The commutator surface should be smooth and medium brown in color. Replace the motor if the commutator or other parts show damage.

13. Inspect the combustion air blower motor as described in the preceding step.

14. Inspect the blower wheel for broken or bent vanes and replace it for either condition.

TESTING.

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

1. Check ventilating air and combustion air motors for correct RPM and current draw:

A. Connect motor to 12-volt DC power supply. Rotation should be counterclockwise when viewed from the shaft end.

B. Both motors should rotate at approximately 7500 RPM at rated voltage. Current draw is approximately five amperes.

C. If current draw is excessive or if speed is too low, replace the brushes. Recheck both current draw and RPM after brushes are properly run in.

D. If after replacing brushes operation is still unsatisfactory, replace the motor.

— NOTE —

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

2. Test the combustion tube assembly for leaks as follows:

A. Fashion a sealing plate from approximately 1/8 inch thick flat stock to seal the combustion head opening in the combustion tube assembly. (Refer to Figure 21-16.) 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 21-16.) Use rubber stoppers as shown. The combustion air inlet tube can be sealed best with a drilled stopper and clamp. Other openings should be sealed with expansion plugs. The seal used in the exhaust tube should be formed so that it will not deform the air pressure switch tube which protrudes into the exhaust.

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

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

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

3. Test the combustion air pressure switch as follows:
 - A. Connect an adjustable air pressure line that can be controlled in a range of zero to 5.0 psi (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 as shown in Figure 21-17.
 - 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 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.
4. Test the fuel line and fuel line shroud tube for leaks as follows:
 - A. Using filtered compressed air, apply 20 psi to the shroud drain port located on the surface near the threaded nozzle cavity.
 - B. Immerse the fuel feed and nozzle holder assembly in clean water with the fuel inlet and nozzle cavity left open.
 - C. Observe for bubbles which would indicate leakage. If bubbles appear at either fuel fitting, there is a leak in the fuel tube. If bubbles appear externally on the shroud tube or at either end of the shroud tube juncture, the shroud tube is leaking.
 - D. In either of the above cases, the complete fuel feed and nozzle holder assembly must be replaced.
5. Spray test the nozzle (refer to Figure 21-18) as follows:
 - A. Install the nozzle in the fuel feed and nozzle holder assembly and connect the fuel tube to the fuel solenoid. Connect the solenoid to a 7 psi fuel pressure source.
 - B. Connect the solenoid leads to a 12-volt battery. Connect a switch in the line to open and close the solenoid when desired.

— WARNING —

Be sure to keep the atomized spray away from fire.

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

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

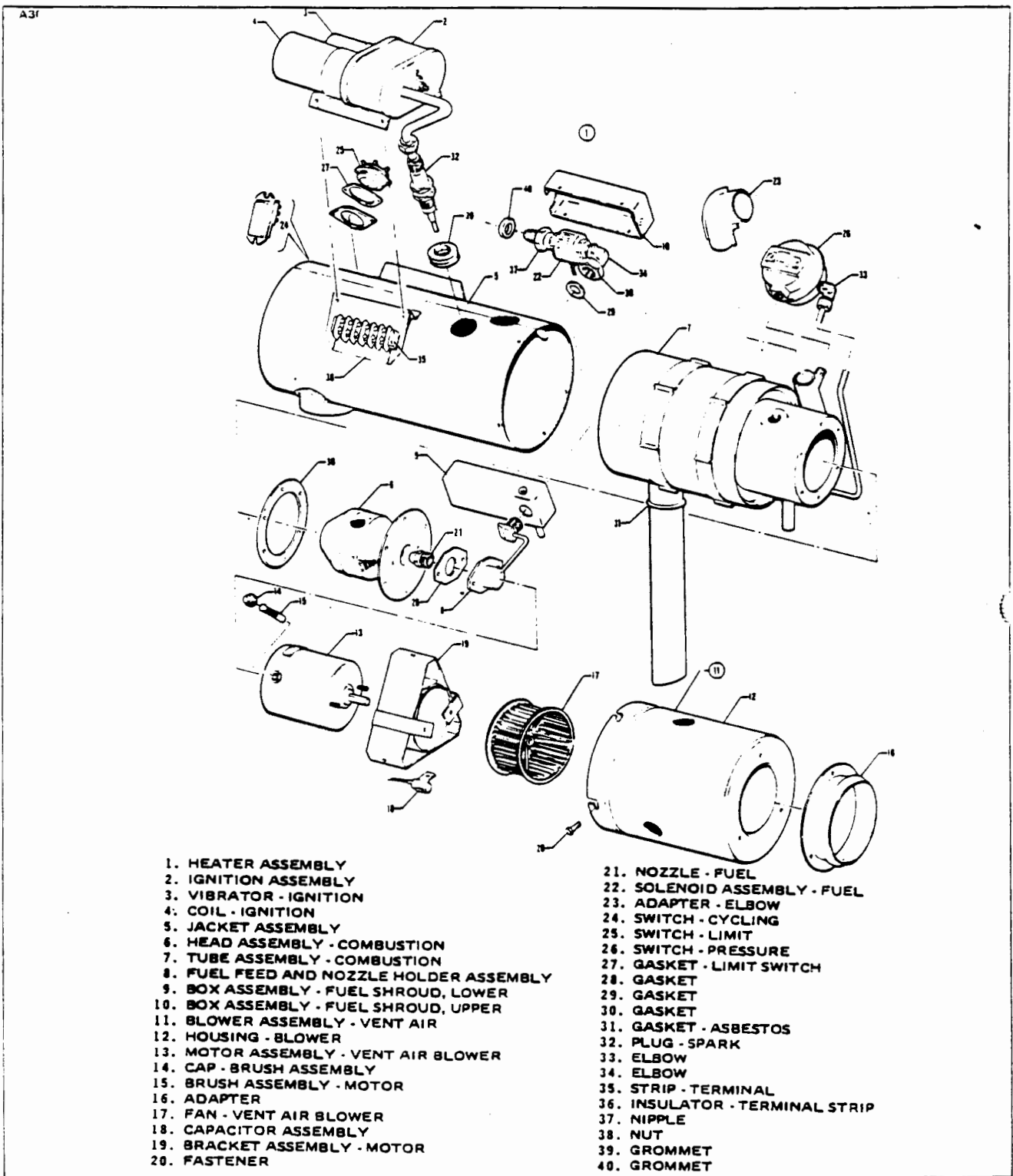


Figure 21-18. Exploded View of Heater Assembly

21-44-06

Page 21-39

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REPAIR OF COMBUSTION TUBE ASSEMBLY.

— NOTE —

No weld or braze repairs are authorized.

REASSEMBLY OF HEATER. (Refer to Figure 21-18.)

1. If removed during disassembly, secure the nipple and elbow to the fuel solenoid.
2. Insert the ventilating air motor into the motor bracket assembly; slide the blower wheel on the end of the motor shaft and rotate it until the set screw is aligned with the flat side of the motor shaft. Tighten the set screw just tight enough to hold it at this time.
3. Attach the capacitor and leads assembly to the motor bracket with screw and lock washer. Make sure a good electrical ground connection is made at this point. Install ground bracket and three new fasteners.
4. Insert this assembly into the blower housing.
5. Make sure all wires are routed and grommeted as they were prior to disassembly and then secure the assembly in the housing with three screws.
6. The motor should be positioned in the bracket to locate the blower wheel properly in the blower housing. The blower wheel should be positioned so it will rotate freely and just clear the contoured spill plate in the blower housing. Tighten the Allen-head set screw and spin the blower wheel by hand for a clearance check. Then apply the appropriate voltage to run the motor as a final clearance check.
7. Attach the inlet adapter to the end of the blower housing with three screws and lock washers.
8. Place a new asbestos 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 asbestos gasket is properly located. Close the gap on the jacket assembly and install screws to secure it at the seam. (Solenoid lead wire is grounded under one of these screws. See notations made during disassembly.) Make sure the seam is in good condition and a tight fit is effected.
9. Install cable straps at locations noted during disassembly.

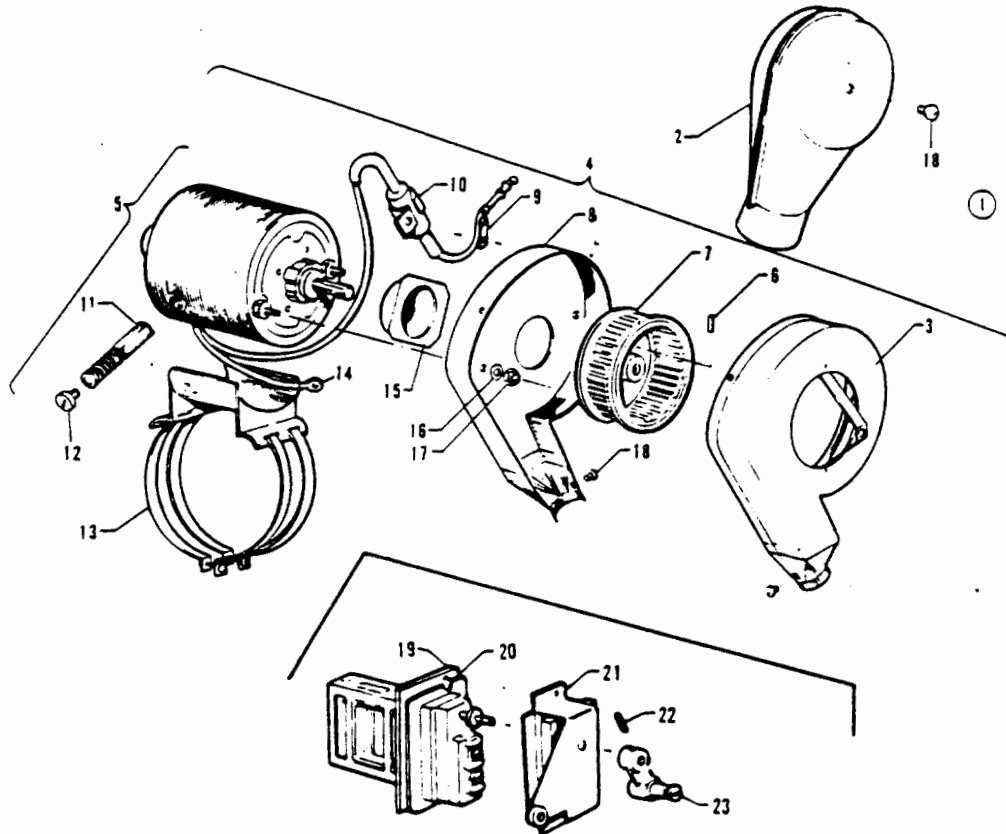
— CAUTION —

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.

10. Remove the spray nozzle from the polyethylene bag. Screw the nozzle into the 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 nozzle "drool."

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

1971



1. COMBUSTION AIR BLOWER AND MOTOR ASSEMBLY	13. MOUNT - COMBUSTION AIR BLOWER SUPPORT
2. ADAPTER ASSEMBLY - BLOWER INLET	14. ELECTRICAL LEAD
3. HOUSING - BLOWER OUTER HALF	15. SPACER
4. COMBUSTION AIR BLOWER AND MOTOR	16. WASHER
5. MOTOR ASSEMBLY - COMBUSTION AIR BLOWER	17. LOCK NUT - AN345-10
6. SET SCREW - BLOWER FAN	18. SCREWS
7. FAN - COMBUSTION AIR BLOWER	19. SPACER
8. HOUSING - BLOWER INNER HALF	20. SWITCH - ADJUSTABLE DUCT
9. STRAP - CABLE	21. COVER - SWITCH
10. CAPACITOR	22. SCREW - AN565 D8 H3
11. BRUSH ASSEMBLY	23. LEVER ASSEMBLY - SWITCH
12. CAP - BRUSH ASSEMBLY	

Figure 21-19. Exploded View - Combustion Air Blower and Motor Assembly

21-44-08

Page 21-41

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

11. Install a new gasket and the combustion head in the combustion tube and secure with the six screws.
12. Insert the fitting on end of nozzle fuel tube through the opening in jacket and attach the nozzle holder to the combustion head assembly with the two screws. It may be necessary to place a slight bend in the shrouded fuel tube to permit alignment of screw holes. Be sure to use a new gasket.
13. 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.
14. 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.
15. Attach the overheat limit switch and two spacer gaskets to the jacket assembly with the two screws. Tighten the screws securely.
16. Attach the cycling switch to the jacket assembly with the two screws.
17. Place the terminal strip insulation in position on the jacket, followed by the terminal strip. Secure both parts by installing the two screws.
18. Center the fuel fitting in jacket opening. Position the fuel fitting shroud gasket, washer and shroud; then install the nut finger tight. Insert a 3/4 inch open-end wrench inside the jacket and hold the fuel-tube fitting while tightening the nut with a 3/4 inch deep socket. Install the fuel solenoid elbow and solenoid. Avoid twisting or damaging lead. Install wires through grommet in lower shroud.
19. Rotate the combustion air switch onto the threaded fitting on the combustion air tube and tighten it firmly.
20. Install grommet over pressure switch line. Connect the tube to the elbow fitting on the combustion air pressure switch.
21. Install the wiring harness and connect all wire leads to their respective terminals. (Refer to the wiring diagram, Figure 21-7.) Place the grommet (refer to Figure 21-18) in position in the jacket; locate the ventilating air blower at the end of the jacket. Thread the quick-disconnect on the motor leads through the grommet and connect it to the mating connector on the wiring harness.
22. Place the blower housing in position on the jacket assembly and secure it by installing the four screws, if removed at disassembly. This operation is easier if the screws are started into their threads and the blower housing rotated into place allowing the screws to enter the notched openings in edge of blower housing. Tighten all screws securely.
23. Install the elbow adapter with the screw.
24. After heater is installed in the aircraft and the fuel line is connected, install the upper fuel shroud box with the screws. Ascertain that the grommet is installed.

REASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 21-19.)

1. Place the spacer over the end of the motor shaft and attach the motor assembly to the inner housing with the two self-locking nuts, flat washers and lock washers.
2. Slide the blower wheel on the motor shaft and tighten the set screw lightly against the flat portion of the motor shaft.
3. Place the outer blower housing in position on the inner housing and install screws.
4. Attach the radio-noise filter at the point shown with the screw. The motor ground lead terminal can be grounded to the motor support bracket.
5. Loosen the Allen-head 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 screw.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

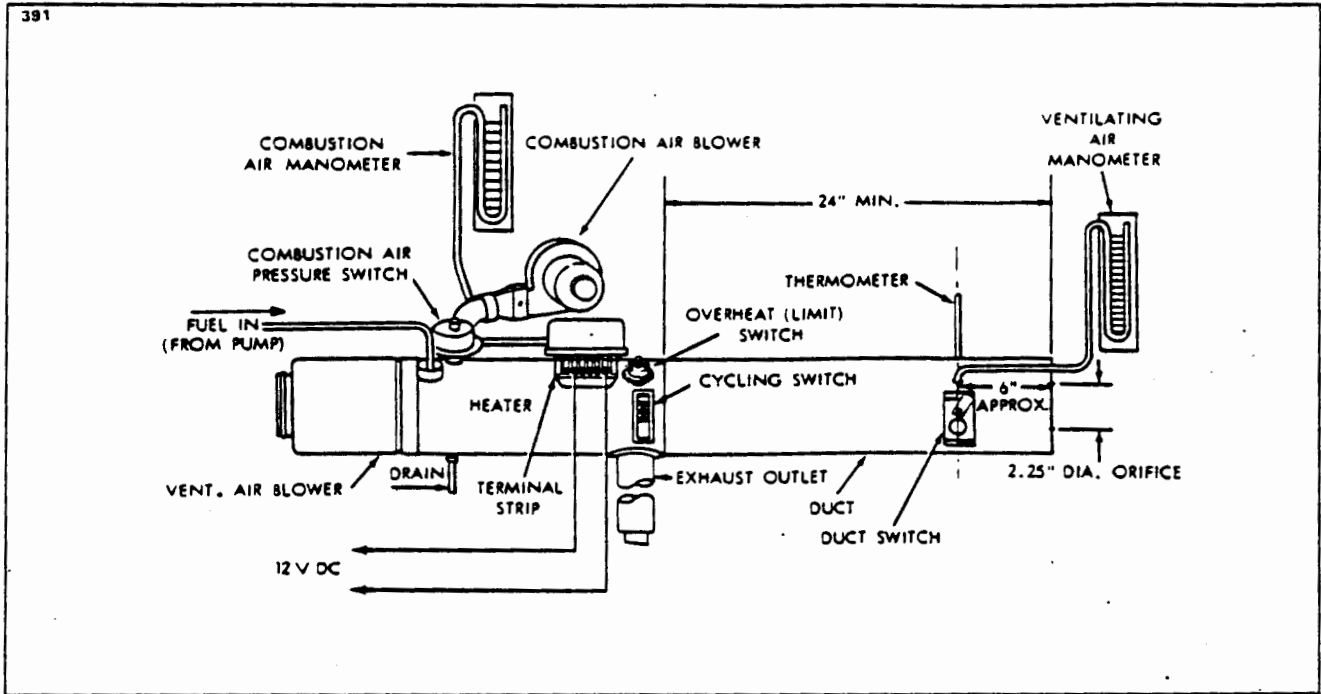


Figure 21-20. Suggested Setup of Heater Operation Test

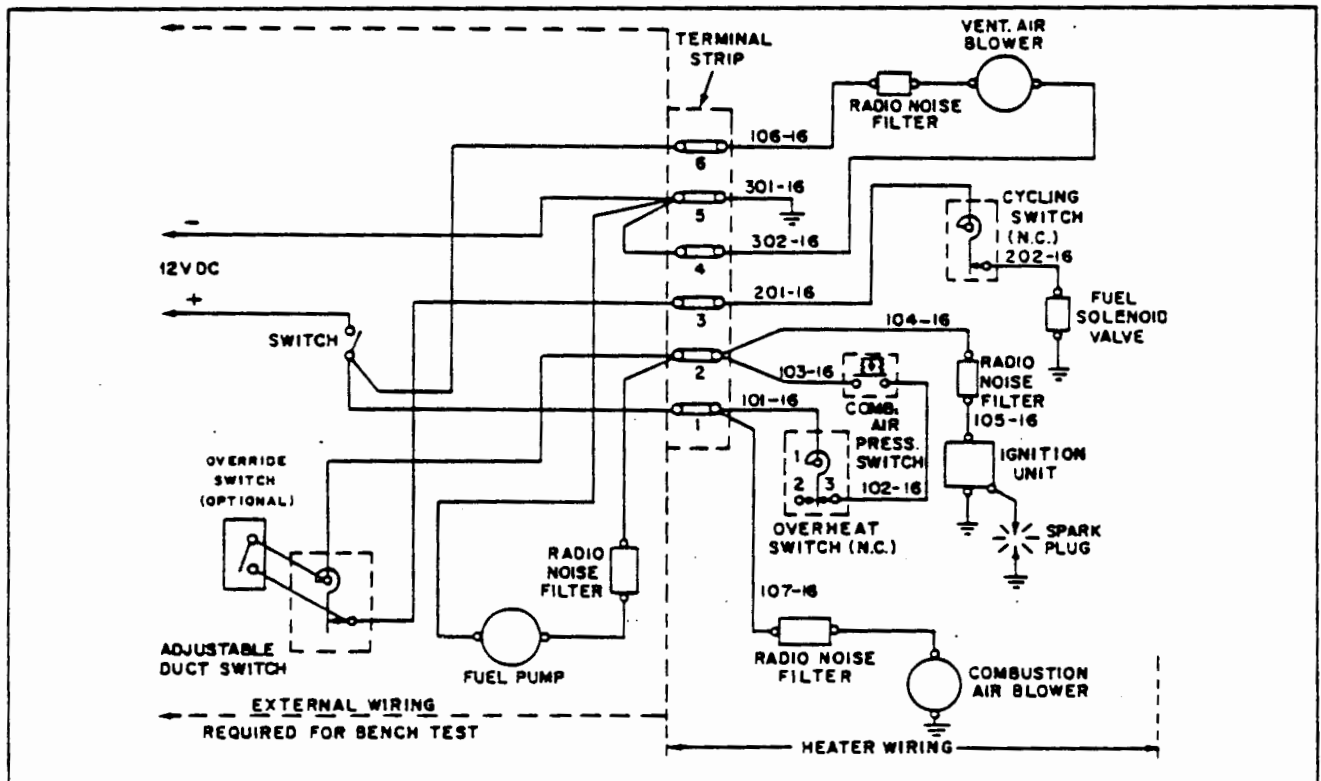


Figure 21-21. Wiring Connections for Heater Operation Test

21-44-09
Page 21-43

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

TEST PROCEDURE.

GENERAL INFORMATION.

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 airflows, pressure drops, and other factors which would be accomplished in a laboratory-type test. If such a test cannot be made, install the heater and check operation on the ground and in the air to determine if operation is normal. In shops where complete test equipment is available and a complete functional test can be performed, the test routine described in subsequent paragraphs should be made.

EQUIPMENT REQUIRED. (Refer to Figure 21-20.)

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 seven psi.
3. The combustion air blower to be used with the heater should be used for the test.
4. A 12-volt current supply which may be a DC generator with a rheostat, ammeter, and voltmeter in the line to control and indicate the current draw and voltage output.
5. Two water manometers (zero to 5.0 inch water column) for measuring the pressure in the ventilating air duct and in the combustion air stream.
6. A piece of duct to be attached to the downstream end of the heater. It should have a minimum length of 24 inches and the same diameter as the heater being tested. A 2.25 inch diameter orifice should be centrally located at the outlet end. An aperture should be provided for the thermometer and duct switch and a static tap should be attached as shown in Figure 21-20.
7. A thermometer with 500° F scale.
8. A fuel-pressure gauge.
9. A controlled source of compressed air for final leakage test.

OPERATIONAL TEST (ON TEST BENCH). (Refer to Figures 21-20 and 21-21.)

1. Connect the heater to the test setup as shown in Figure 21-20. 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 21-20.
3. Connect components and heater as outlined in the wiring connection diagram, Figure 21-21. The power supply switch should be open.
4. Connect the power source to the heater.
5. Disconnect wire lead from terminal No. 3 on the heater side of heater terminal strip to prevent the heater from lighting and close the power source switch to check operation of blowers. The combustion air blower and ventilating air blower should operate at full speed with no blower wheel interference. If either blower fails to run, locate and correct the trouble before proceeding with the test.
6. Connect a voltmeter 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, the combustion air supply is either inadequate or the switch is defective or improperly adjusted. Make necessary corrections.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

7. Observe the manometer connected to the ventilating air pressure tap, which should show a reading of 1.1 inches of water (minimum) at rated voltage.
8. Observe the manometer connected to the combustion air tube tap, which should show a reading of 1.5 inches of water (minimum) at rated voltage.
9. Open the power supply switch and reconnect the terminal lead disconnected in preceding Step 5.
10. Close the power supply switch and turn on the fuel supply. The heater should light within five seconds (may require slightly longer for air to be purged from fuel lines on the first trial).
11. Observe operation of duct switch, which should control heater operation according to the switch setting.
12. If the duct switch fails to control the temperature according to the setting, place the control lever in high "H" position and notice the control variation. A high reading of $250^{\circ}\text{F} \pm 10^{\circ}$ 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 airflow conditions. If operation is within a range of 190°F to 290°F , the switch is operating normally. If the switch is out of range, it can be reset in the same manner as described for the duct switch, except that no control lever or indicator stop are used. If adjustment fails to restore proper temperature range, replace the switch.
14. With duct switch still jumped, place a jumper across the cycling switch terminals to check operation of the overheat switch. Block the ventilating air outlet and notice if the overheat switch shuts off the heater. It should open at between 300°F and 400°F . (This is also a function of ambient temperature and airflow.) After the switch shuts off, remove ventilating air restriction; remove jumpers from cycling and duct switches and press firmly on the overheat 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.

INSPECTION OF FUEL NOZZLE ORIFICE. (Refer to Figure 21-18.)

1. Loosen the four screws and rotate the blower and motor housing to disengage the ventilating air blower from the end of the heater jacket. It is not necessary to disconnect the electrical connections to remove the nozzle.
2. Remove the fuel shroud cover by removing the screws. Remove solenoid and elbow.
3. Reach inside the inlet end of the jacket assembly with a $3/4$ inch open-end wrench and, while holding the fuel-tube fitting of the jacket, use a $3/4$ inch deep socket to remove the nut, washer and gasket and lower fuel shroud box.
4. Remove the two screws and carefully withdraw the nozzle holder and valve assembly from the combustion head assembly.
5. Carefully unscrew and remove the spray nozzle from the nozzle holder. Remove the gasket.
6. After cleaning the nozzle, reinstall the parts removed in essentially the reverse order from removal. Be sure to hold the fuel-tube fitting when tightening the nut to avoid damage to the fuel tube.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

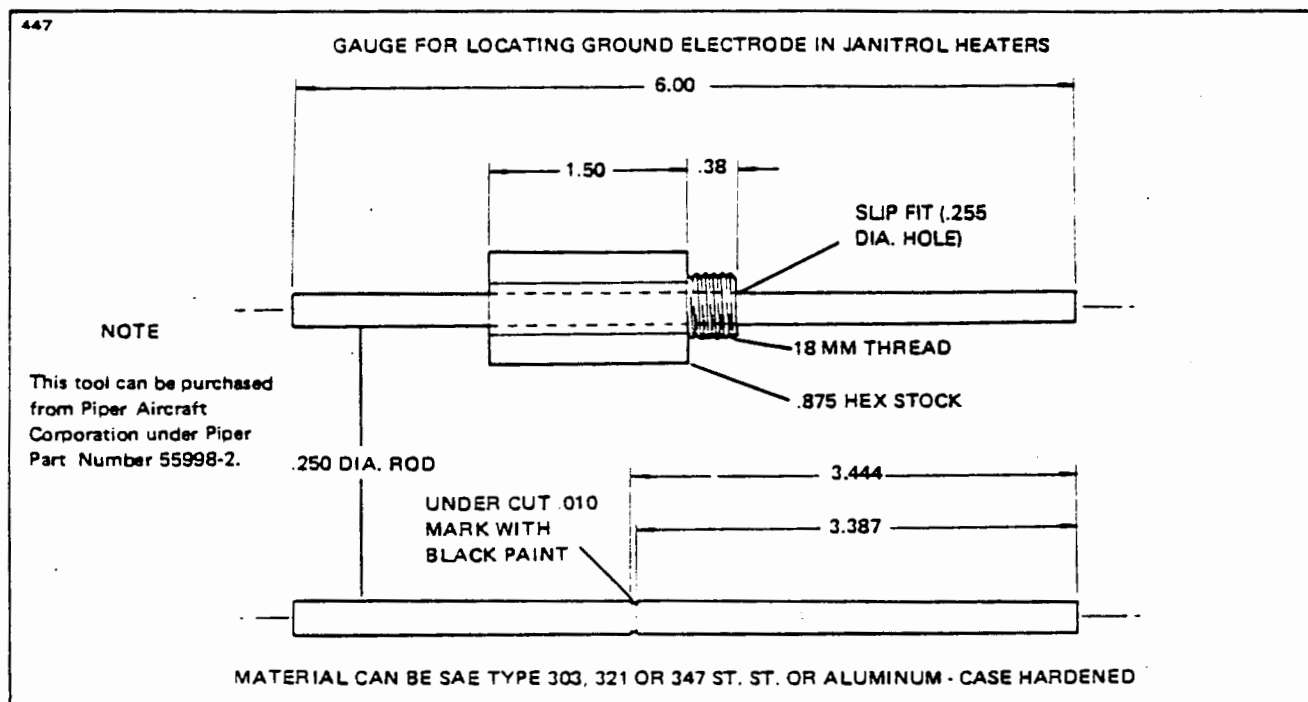


Figure 21-22. Spark Plug Gap Adjustment Tool

HEATER HOURMETER.

REMOVAL OF HEATER HOURMETER.

1. Remove the screws which secure the nose cone and lower the nose cone to gain access to the heater. The hourmeter is located on top of the heater, secured to the ignition assembly. (Refer to Figure 21-2.)
2. Note the position of the wires on the rear of the hourmeter, then disconnect the wires.
3. Remove the screws which secure the mounting clamps to the ignition assembly and remove the hourmeter from the aircraft.

INSTALLATION OF HEATER HOURMETER.

1. Position clamps on hourmeter as indicated in Figure 21-23.
2. Secure first clamp to ignition assembly bracket using screw MS35206-242.
3. Secure second clamp to ignition assembly using remaining screws.
4. Attach wire assemblies to rear of gauge.
5. Raise nose cone into position and secure.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

C182

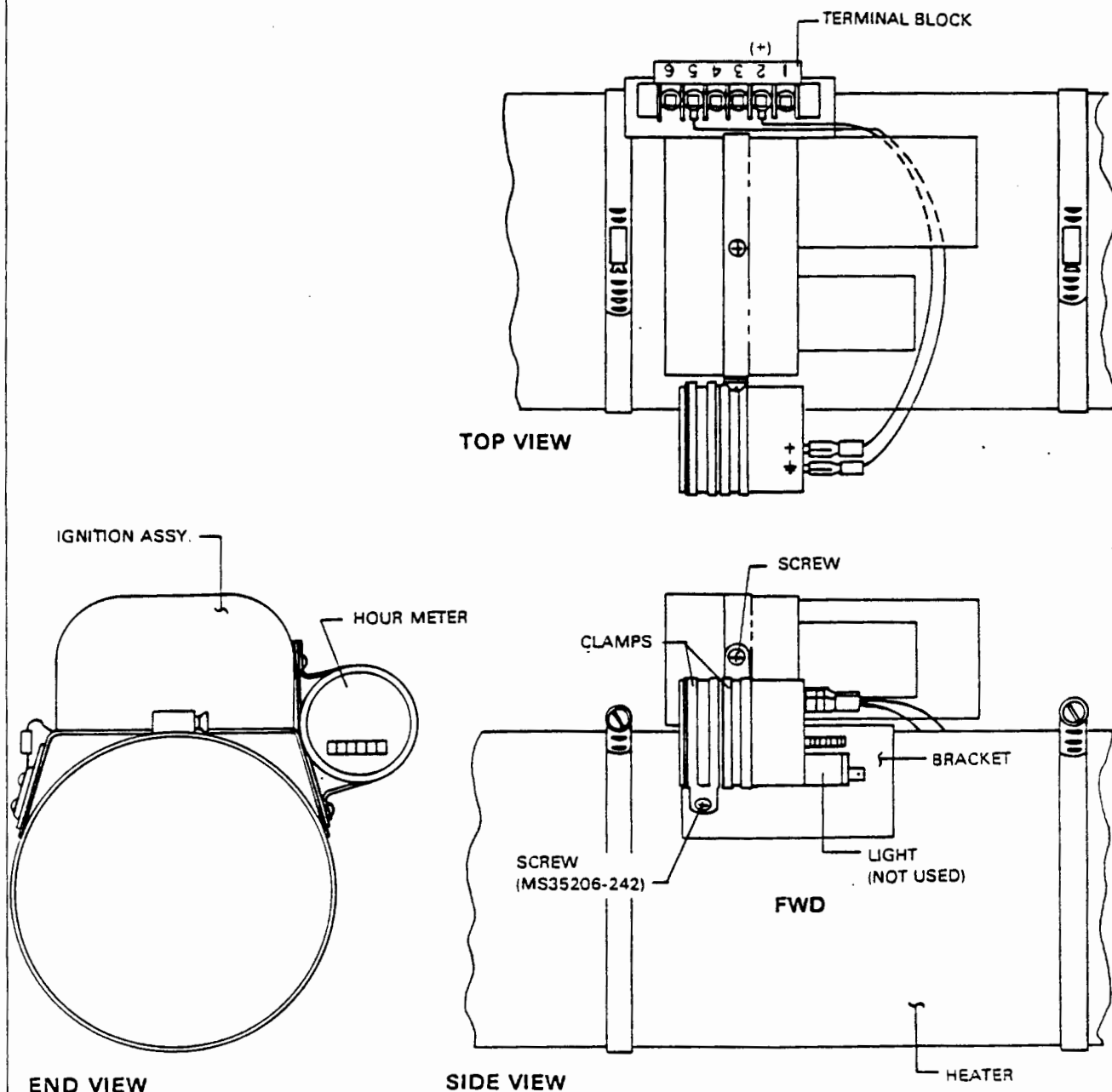


Figure 21-23. Heater Hourmeter Installation

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

COOLING. (PA-44-180T ONLY.)

GENERAL.

AIR CONDITIONING SYSTEM DESCRIPTION AND PRINCIPLES OF OPERATION.

The air conditioning installation is a recirculating, independent unit consisting of a compressor, evaporator, condenser, receiver-dehydrator, circulating fan, thermal expansion valve and related plumbing.

Air is filtered, dehumidified and cooled by the evaporator. The evaporator is mounted in a fabricated housing, along with the receiver-dehydrator, pressure switch, circulating fan and thermal expansion valve. This housing is located at the rear of the cabin aft of the baggage area. The compressor is a piston type unit mounted at the front of the port engine. A V-belt connection drives the compressor through a magnetic clutch. The condenser is installed in the tail cone between stations 156.00 and 191.00.

The system is protected by a pressure switch which automatically controls the condenser maximum head pressures by temporarily de-clutching the compressor in the event the pressure becomes excessively high.

The air conditioner controls are located on the right side of the aircraft instrument panel and consist of an air conditioning ON-OFF control, a two-position fan control (LOW-HIGH) and a temperature control.

The air conditioning system uses Refrigerant 12. The refrigerant enters the compressor as a vapor. The compressor pressurizes the heat laden vapor until its pressure and heat reach a point much hotter than the outside air then pumps the vapor to the condensor where it is cooled and changed to a liquid. The liquid then passes to the receiver-dehydrator. The function of the receiver-dehydrator is to filter, remove any moisture and insure a steady flow of liquid refrigerant into the evaporator through the expansion valve. The expansion valve is a temperature controlled metering value which regulates the flow of liquid refrigerant to the evaporator to allow all the liquid to evaporate and return to the compressor at a reduced pressure. From the evaporator, the refrigerant vapor returns to the compressor where the process is repeated.

TROUBLESHOOTING.

A troubleshooting chart is provided to assist in locating and correcting possible malfunctions in the cooling system.

— NOTE —

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

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

CHART 2104. TROUBLESHOOTING (AIR CONDITIONER)

Gauge Indication	Probable Causes	Remedy
High discharge pressure.	Overcharge of refrigerant. Air in system. Overheated condenser due to blocking air passage. Flooded evaporator indicated by heavy frosting on suction line and compressor suction service valve. Restriction in liquid line from condenser.	Purge excess refrigerant. Check for leaks. Bleed charge from system. Evacuate and recharge system. Clean bugs and dirt from condenser fins. Straighten fins if bent. Check that capillary bulb is securely clamped to suction line. If capillary bulb OK replace expansion valve. Check for kinked hoses and stopped up filter.
Low discharge pressure.	Undercharge of refrigerant. Sight glass shows bubbles or foam. Damaged compressor valves or dirt under valves. Damaged compressor. Worn or broken piston or piston rings.	Add refrigerant until bubbles disappear. Check system leaks. Replace compressor. Replace compressor.
Low suction pressure. (Accompanied by icing evaporator.)	Low air supply through evaporator. Very dirty evaporator fins and coils.	Repair blower or blower motor. Clean stoppage in air ducts. 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. Expansion valve inlet screen clogged. Inoperative expansion valve. Valve stuck closed or capillary bulb has lost its charge. Restriction anywhere in liquid line. Restriction will show frost.	Add refrigerant. Install new dryer. Evacuate and recharge. Remove screen. Clean with solvent and replace. Warm capillary by holding in hand. If suction pressure does not change, replace expansion valve. Locate restriction and repair.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

• CHART 2104. TROUBLESHOOTING (AIR CONDITIONER) (cont)

Gauge Indication	Probable Causes	Remedy
High suction pressure.	Capillary bulb clamp loose on suction line. Suction line shows frost. Expansion valve not closing. Evaporator flooded. Suction line frosted to compressor. Compressor drive belt slipping. Magnetic clutch slipping. Leaking or broken compressor valve.	Clean contact surfaces of suction line and cap bulb. Tighten clamp. Replace expansion valve. Adjust belt tension. Check electrical circuit for correct voltage to clutch coil. Clean clutch surfaces of oil. Replace compressor.
Trouble	Cause	Remedy
System produces no cooling.	<u>Electrical.</u> Blown fuse in control head. Open circuit breaker. Broken or disconnected electrical wire. Broken or disconnected ground wire. Clutch coil burned out or disconnected. Thermostat sensing element defective. Blower motor disconnected or burned out.	Replace fuse. Reset circuit breaker. Check all terminals for loose connections; check wiring for hidden breaks. Check ground wire to see if loose, broken, or disconnected. Check current flow to clutch, replace if inoperative. Check thermostat and cabin comfort control panel. Check current flow to blower motor. Repair or replace if inoperative.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2104. TROUBLESHOOTING (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
System produces no cooling. (cont.)	<u>Mechanical</u>	
	Loose or broken drive belt.	Replace driven belts and or tighten to specifications.
	Compressor partially or completely frozen.	Remove compressor for service or replacement.
	Expansion valve stuck in open position.	Replace expansion valve.
	Refrigeration.	
	Broken refrigerant line.	Examine all lines for evidence of breakage by external stress or rubbing wear.
	Leak in system.	Evacuate system, apply static charge, leak test system, and repair leak as necessary.
	Compressor shaft seal leaking.	Replace compressor.
System will not produce sufficient cooling.	Clogged screen or screens in receiver dehydrator or expansion valve; plugged hose or coil.	Repair as necessary.
	<u>Electrical</u>	
	Blower motor sluggish in operation.	Remove blower motor for service or replacement.
	Mechanical.	
	Compressor clutch slipping.	Remove clutch assembly for service or replacement.
	Obstructed blower passage.	Examine entire passage for obstruction. Correct as necessary.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2104. TROUBLESHOOTING (AIR CONDITIONER) (cont)

Trouble	Cause	Remedy
System will not produce sufficient cooling. (cont.)	<u>Electrical (cont.)</u>	
	Insufficient air circulation over condenser coils: fins clogged with dirt or bugs.	Clean condensor coils.
	Evaporator filter clogged.	Clean with cleaning solvent to remove cigarette tars.
	<u>Refrigeration.</u>	
	Insufficient refrigerant in system.	Recharge system until bubbles disappear in receiver dehydrator and gauge readings stabilize to specifications.
	Clogged screen in expansion valve.	Purge system and replace expansion valve.
	Expansion valve thermal bulb has lost charge.	Purge system; replace expansion valve.
	Clogged screen in receiver dehydrator.	Purge system; replace receiver dehydrator.
Excessively noisy system.	Excessive moisture in system.	Purge system; replace receiver dehydrator.
	Air in system.	Purge, evacuate and charge system (Replace receiver dehydrator.)
	<u>Electrical</u>	
	Defective winding or improper connection in compressor clutch coil.	Replace or repair as necessary.
	<u>Mechanical</u>	
	Loose or excessively worn drive belts.	Tighten or replace as required.
	Noisy clutch.	Remove clutch for service or replacement as necessary.

21-51-02

Page 21-52

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2104. TROUBLESHOOTING (AIR CONDITIONER) (cont)

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

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

8952

REFRIGERANT LINE FITTING TORQUES

FITTING SIZE	TORQUE-IN. LBS.
4	135
5	170
6	215
8	430
10	620

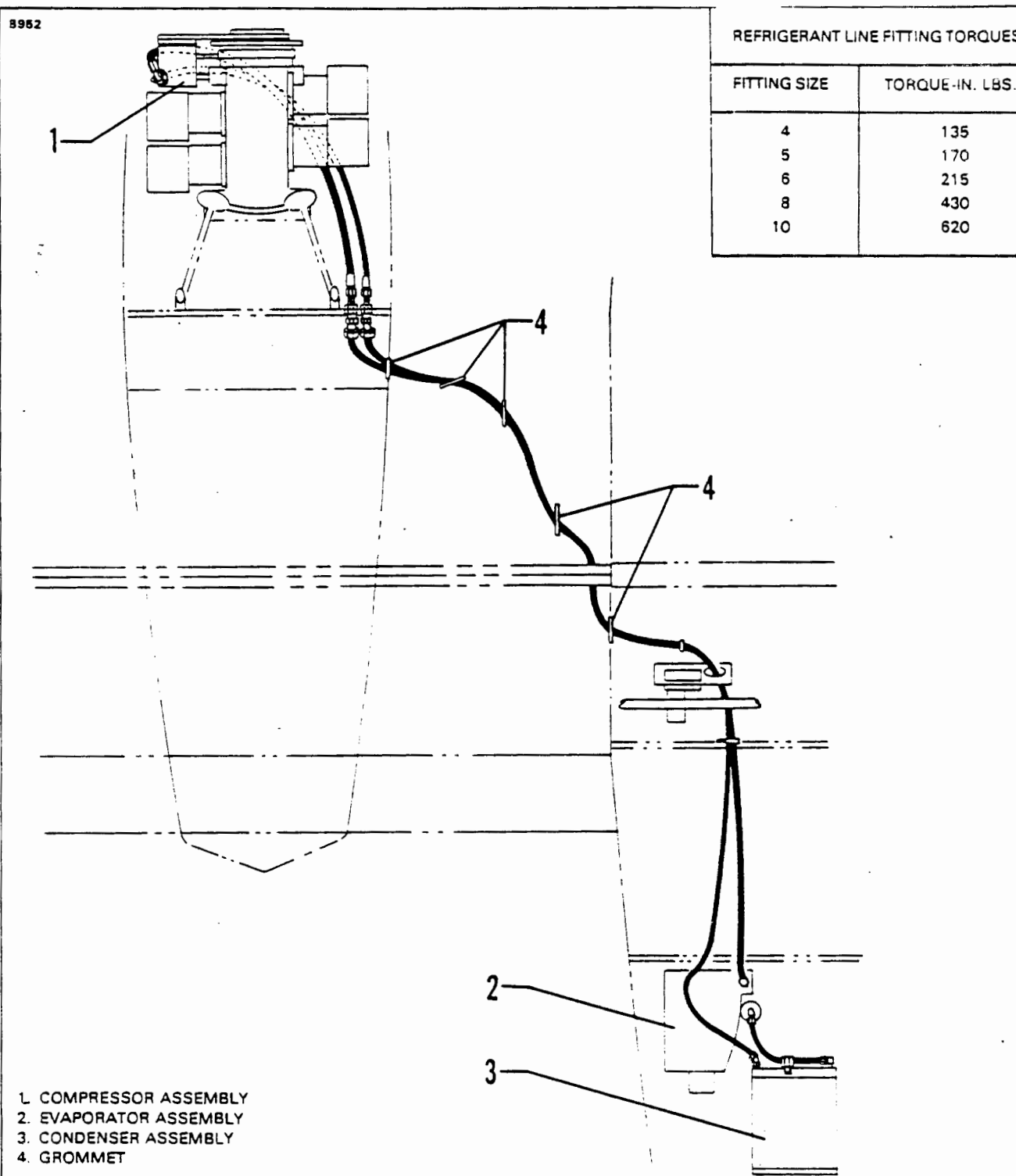


Figure 21-24. Air Conditioning System Installation
(PA-44-180T S N 44-8107027 and Up)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2105. 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

21-51-02

Page 21-55

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

MALFUNCTION DETECTION.

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

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

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

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

— NOTE —

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

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

The importance of a seasonal 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 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

SERVICING AIR CONDITIONING SYSTEM.

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.

SAFETY PRECAUTIONS.

1. Refrigerant 12 (commonly known as R-12 or "Freon" 12) is odorless and colorless in either the liquid or gaseous state. R-12 for charging refrigeration systems is supplied in pressurized containers (approx. 70 psi at 70° F) in liquid form. Since this material is essentially inert at room temperatures the dangers are primarily associated with the pressure and the refrigeration effects of the release and subsequent evaporation of this pressurized liquid.
2. Wear suitable eye protection when handling R-12 due to the possibility of freezing of the eye if contacted by escaping liquid refrigerant. If liquid R-12 does strike the eye, the following actions should be taken:
 - A. DO NOT RUB THE EYE.
 - B. Splash large quantities of cool water into the eye to raise the temperature.
 - C. Tape on an eye patch to avoid the possibility of dirt entering the eye.
 - D. Rush to a physician or hospital for immediate professional aid.
 - E. DO NOT ATTEMPT TO TREAT IT YOURSELF.
3. If liquid R-12 strikes the skin frostbite can occur. Treat with cool water and protect with petroleum jelly.
4. Do not discharge large quantities of R-12 into closed rooms. It may displace most of the air in the room and this could cause oxygen starvation. Gaseous R-12 is heavier than air and flows to the bottom of a container.
5. Do not discharge R-12 into an open flame or onto a very hot surface (500° F+). Poisonous phosgene gas is generated by the action of the heat on the refrigerant.
6. Do not apply direct flame or other high heat source to a R-12 container due to the high pressures which will result. If any heating is done to R-12 containers the container pressure should be monitored and kept below 150 psi.

SPECIAL SERVICE PRECAUTIONS.

1. Systems should be discharged slowly to prevent the escape of liquid refrigerant and the loss of the lubricating oil.
2. Systems should not be left open to the atmosphere when discharged. Moisture and other contamination may enter and damage open systems.
3. Never introduce anything but pure refrigerant and refrigerant oil into a system.
4. Keep refrigerant oil containers tightly sealed and clean to prevent absorption of moisture or other contamination.
5. Use only approved refrigeration oil in the compressor. If any doubt exists about the cleanliness of the compressor oil, replace it with new oil.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

6. Never reuse oil removed from the system. Discard it.
7. When Loctite Refrigerant Sealant has been used on a joint it must be heated to 400° F prior to disassembly. Loctite must be used to seal any pipe threads in the system lines.
8. Replace the receiver-dehydrator assembly on any system which has been operating with a leak allowing air to enter the system. If a receiver-dehydrator is left open to the atmosphere it should be replaced due to the loss of effectiveness of the drying compound it contains.

— NOTE —

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

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

9. Recommended torque values must be used on all flare fitting and O-ring joints. See Chart 2106.

CHART 2106. ALUMINUM TUBING TORQUE

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

SERVICE VALVES.

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

— NOTE —

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

— NOTE —

If a Schrader service valve is not serviceable, the core assembly must be replaced.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

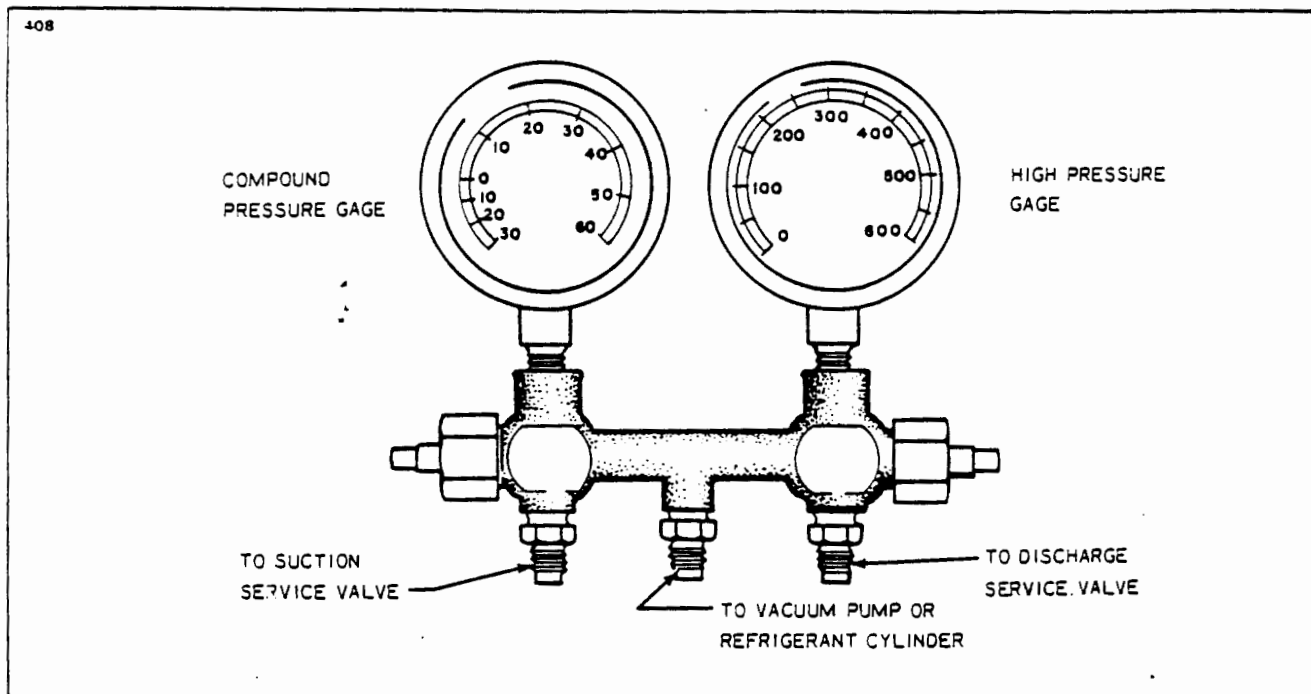


Figure 21-25. Test Gauge and Manifold Set

TEST GAUGE AND MANIFOLD SET.

The proper testing and diagnosis of the air conditioning system require that a manifold gauge set be attached into the system. This set consists of two gauges mounted to a manifold. One gauge is a high pressure gauge used in the discharge side of the system. The other is a low pressure gauge used in the suction side of the system. The manifold is a device having fittings for both gauges and connection hoses with provisions for controlling the flow of refrigerant through the manifold. See Figures 21-25 and 21-26.

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

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

Cracking the hand valve, in the counterclockwise direction, opens the system to the middle service port of the manifold set. This is desirable only when it is necessary to let refrigerant out or into the system. Refer to Figure 21-25 and 21-26.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

1257

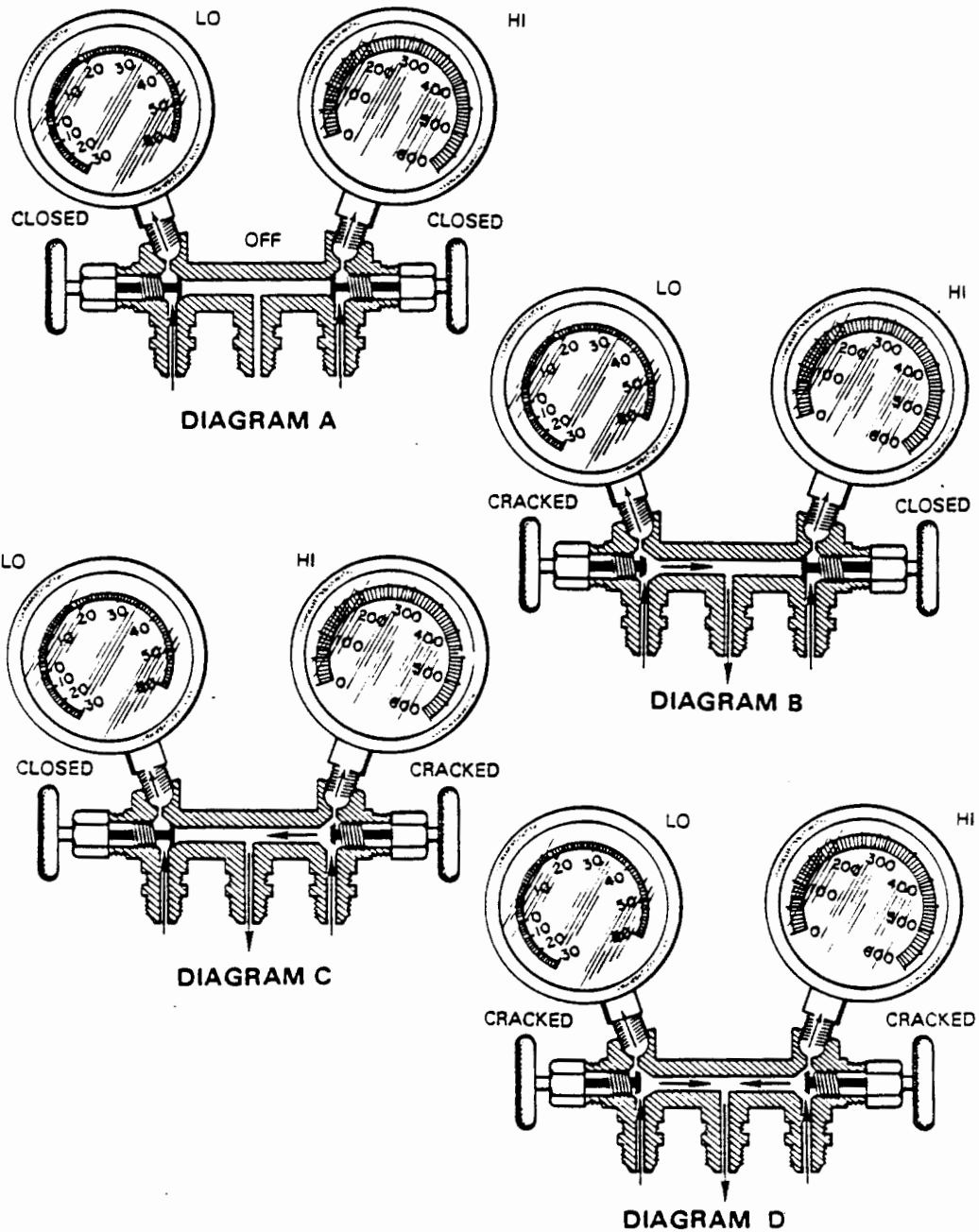


Figure 21-26. Manifold Set Operation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

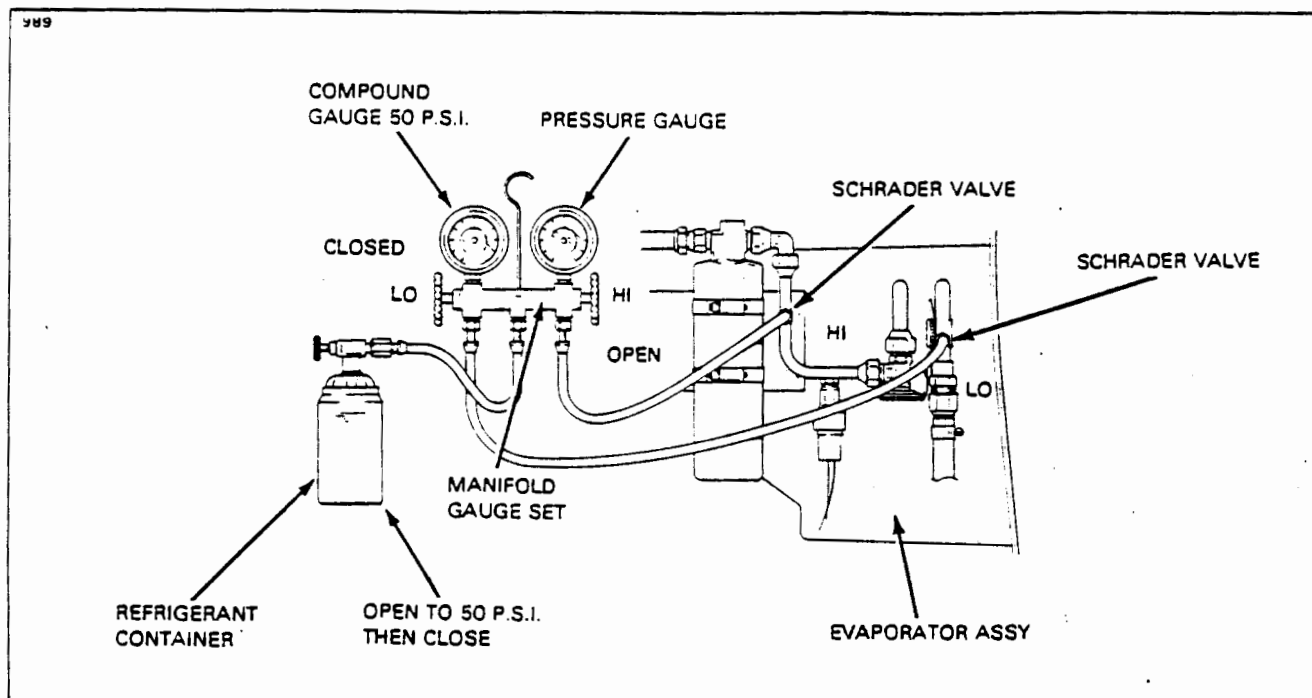


Figure 21-27. Leak Test Hookup

LEAK DETECTION.

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

— NOTE —

Evacuate system prior to leak check.

I. Method I:

- A. Connect the manifold gauge set into the system and determine if there is any refrigerant in the system. A minimum of 50 psi refrigerant pressure in the system is needed for leak detection. (Refer to Figure 21-27.)
- B. 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.
- C. Close the low side manifold valve and open the high side manifold valve.
- D. 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.
- E. Close the refrigerant container service valve and remove the hose if no leaks are evident.
- F. Using an electronic leak detector, check all joints for leaks. If any leaks are found, purge the system of refrigerant, make the necessary repairs and check the compressor oil.
- G. Add oil, if required, then repeat Steps A thru E.
- H. If no further leaks are found, the system may be evacuated and charged.

21-52-01

Page 21-61

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2. Method 2:

- A. Remove the access panel at the rear of the cabin to gain access to the service valves.
- B. Remove the protective cap on the high pressure Schrader valve fitting and connect a charging hose with a shut-off valve arrangement to the fitting. The charging hose must have a Schrader fitting or adapter to fit the valve.
- C. 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.
- D. The cylinder of refrigerant should be placed upright in a container of warm (125° F max.) water on a small scale.
- E. 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.
- F. Using an electronic leak detector, check all joints and repair any leaks.
- G. After completion of repair of any leaks, proceed to check the system in accordance with one of the methods outlined for any other leaks.
- H. If no further repair is required on the system, it is now ready to evacuate.

DISCHARGING THE SYSTEM. (Required only if the system contains refrigerant.)

— NOTE —

Applies to Kent Moore J23500 or similar charging station. Refer to Figure 21-29.

- 1. Close all valves on charging station.
- 2. Connect red high pressure charging line to high pressure Schrader valve at the evaporator fitting.
- 3. Open valve 8 (high pressure control) on charging station one turn.
- 4. Hold end of blue low pressure charging line in a shop rag and slowly open valve 2 (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, system is empty and valve should be closed if no further work is planned.

EVACUATING THE SYSTEM.

— NOTE —

If the system has been operated in a discharged condition or anytime the system has been open to atmospheric pressure, the receiver-dehydrator must be replaced and the system evacuated to remove any trapped air and moisture which has entered it.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

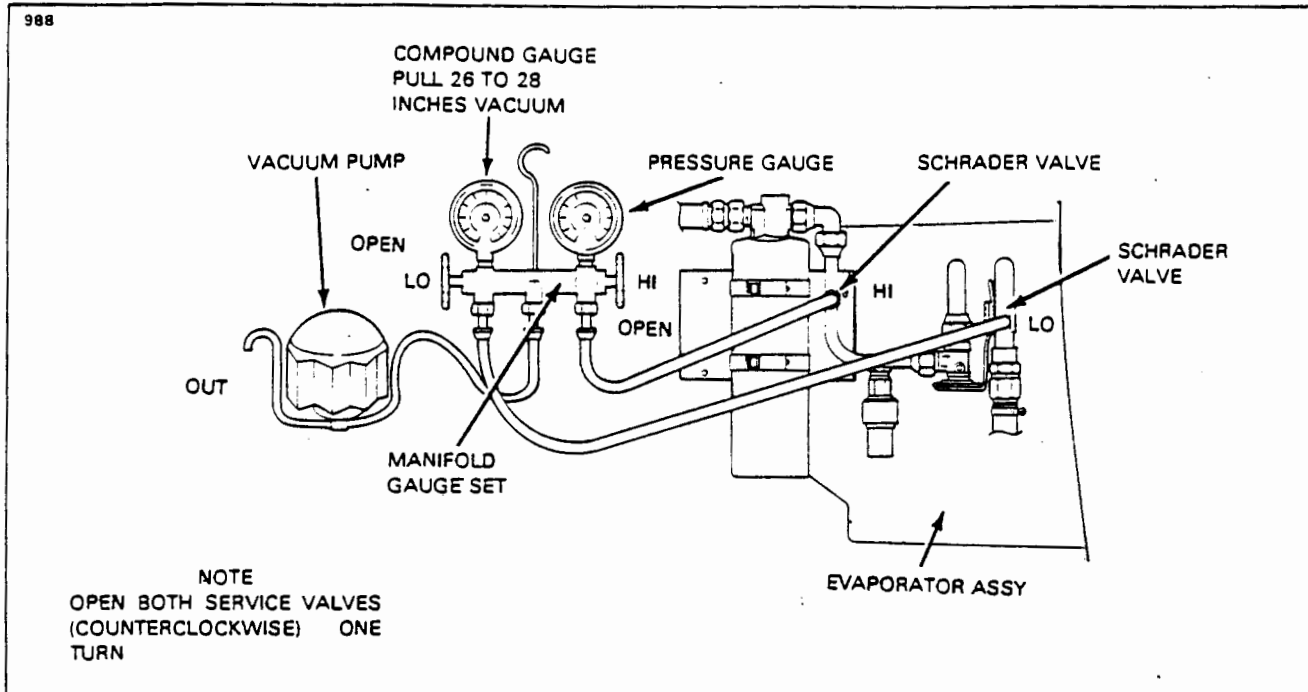


Figure 21-28. Evacuation Hookup

— NOTE —

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

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

— CAUTION —

Determine that all system pressure is released before attempting to evacuate the system.

2. Connect the manifold gauge set to the airplane service valves. (Refer to Figure 21-28.)
3. The high and low manifold hand valves should be in the closed position. (Refer to Figure 21-25 and 21-26.)
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.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

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

— NOTE —

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

CHARGING THE SYSTEM.

Once the system has been completely evacuated, it must be charged utilizing a charging stand (preferred method) or utilizing the airplane's compressor.

CHARGING STAND METHOD.

— NOTE —

The following instructions apply to Kent Moore, J23500 charging stand. Refer to Figure 21-29.

1. With the system discharged and evacuated, proceed to hook-up the charging stand. (Refer to Figure 21-30.)
2. Fill the charging cylinder by operating the valve at the base of the charging cylinder and filling the sight glass with two pounds of liquid refrigerant.
3. As refrigerant stops filling the sight glass, open the valve at the top of the gauge neck assembly intermittently to relieve head pressure and allow refrigerant to continue filling the sight glass to the required amount.
4. When refrigerant reaches the required level in the sight glass, close the valve at the base of the cylinder and the valve at the bottom of the refrigerant tank. Be sure the top valve is fully closed.

— NOTE —

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

5. Connect the heating element plug to a 110 volt outlet.
6. Turn cylinder sight glass to match pressure reading on cylinder pressure gauge. This scale should be used during entire charging operation.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

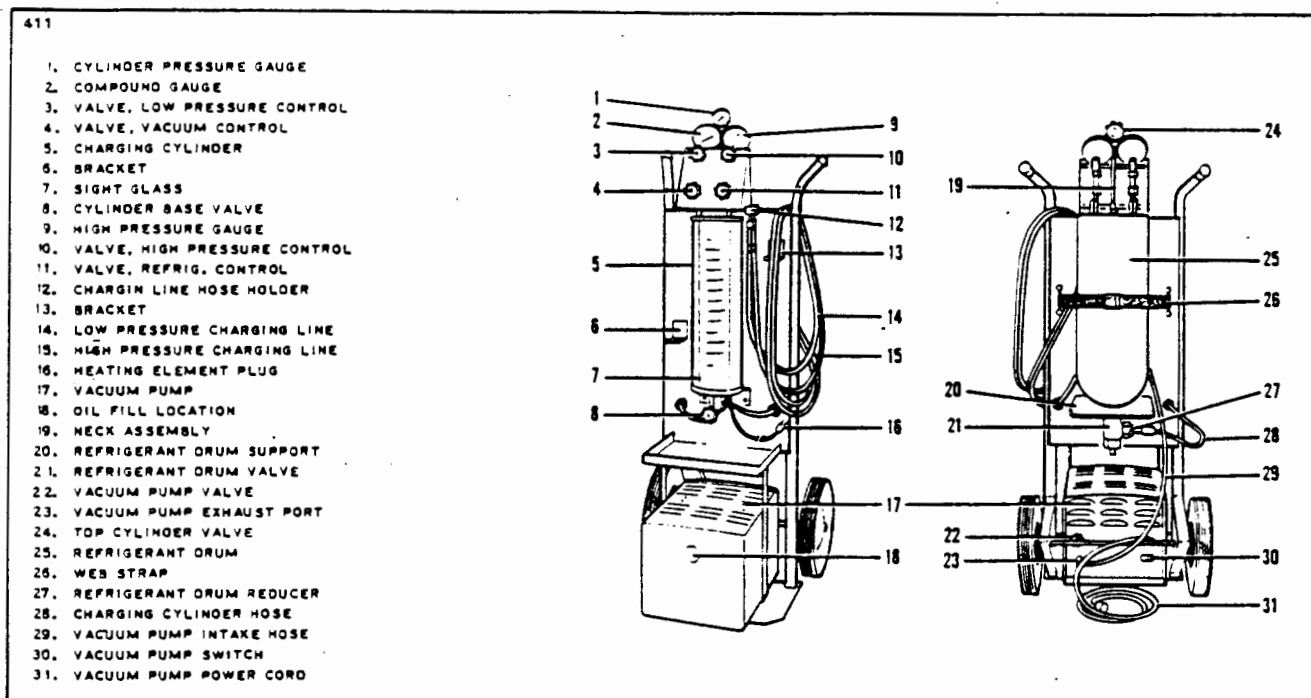


Figure 21-29. Charging Stand

7. Close valve 1 (low pressure control), fully open valve 4 (refrigerant control) and allow all the liquid refrigerant contained in the charging cylinder to enter high side of aircraft system.

8. When the full charge of refrigerant has entered the system, close valve 4 (refrigerant control) and valve 2 (high pressure control).

9. After completion of charging, close all valves on the charging stand. Disconnect the high and low pressure charging lines from the aircraft system. (A small amount of refrigerant remaining in the lines will escape). Replace lines on holder of charging stand to keep air and dirt out of lines. Open the valve at the top of cylinder to relieve any remaining pressure, then reclose the valve.

10. Reinstall protective caps of Schrader valves and any access panels previously removed.

AIRPLANE COMPRESSOR METHOD.

— WARNING —

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

1. With the system evacuated connect the refrigerant charging hose to the manifold (refer to Figure 21-30) and purge the charging hose of air.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

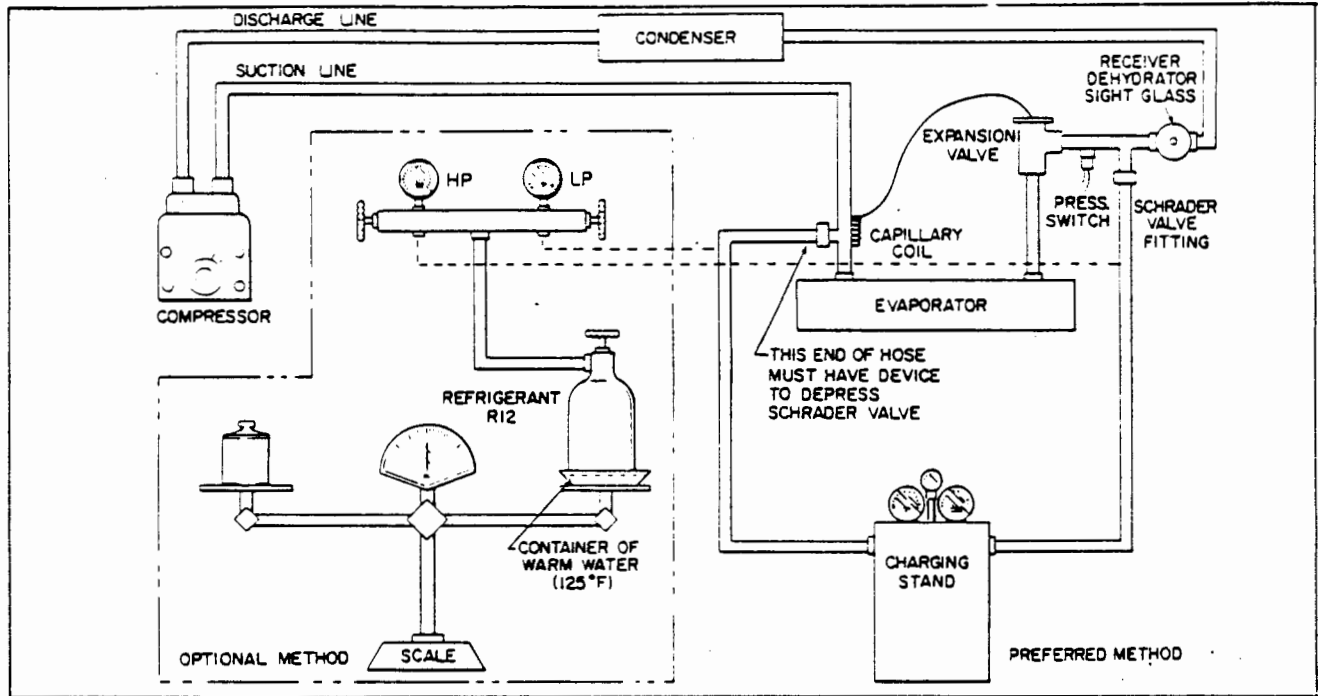


Figure 21-30. Charging Hookup

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

— NOTE —

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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

— NOTE —

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

PARTIAL CHARGE OF SYSTEM.

To "top off" the air conditioning system with refrigerant, proceed as follows:

1. Remove the access panel at the rear of the cabin.
2. Connect a charging hose to a refrigerant cylinder and also to the Schrader valve fitting on the suction line. (Refer to Figure 21-30.)
3. Purge the charging hose by allowing a small amount of refrigerant gas to escape at the Schrader valve fitting.
4. Start the engine and operate at 1000 RPM and turn the air conditioner on maximum cool.
5. Remove the plastic plug from the sight glass in the top of the receiver-dehydrator.
6. With a low refrigerant charge in the system, bubbles will be seen passing thru the sight glass when the system is operating.
7. Open the valve on the refrigerant cylinder.
8. Allow refrigerant to flow into the system until the bubbles disappear from the sight glass.
9. Close the refrigerant valve and check to see that the sight glass remains clear during the system operation.
10. When the sight glass stays clear of bubbles, add an additional 1.4 pound of refrigerant to the system. (Engine should be operating at 1000 RPM.)

— NOTE —

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

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

SYSTEM COMPONENTS.

COMPRESSOR SERVICE.

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

Maintenance to the Sankyo compressor is limited to replacement of worn drive belt. Contact Sankyo International, 3529 Miller Park Drive, P.O. Box 2903, Garland, Texas 75042 for special tools and instructions for detailed compressor maintenance.

— NOTE —

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

REMOVAL OF COMPRESSOR.

— WARNING —

Before removing the suction and discharge lines the air conditioning system must be completely discharged.

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

— NOTE —

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

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

INSTALLATION OF COMPRESSOR.

1. Place the compressor in the mounting brackets and install attachment bolts. Do not torque attachment bolts at this time.
2. Install compressor drive belt. Rotate compressor drive belt. Rotate compressor in mounting bracket slots to obtain belt tension of 45 to 50 pounds. Torque the four attachment bolts 225 to 300 inch-pounds. If installing a new V-belt, recheck belt tension after 1 to 1.5 hrs. of initial operation.
3. Check the oil level in the compressor.
4. Connect the discharge and suction lines to their respective fittings.

21-53-03

Page 21-68

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

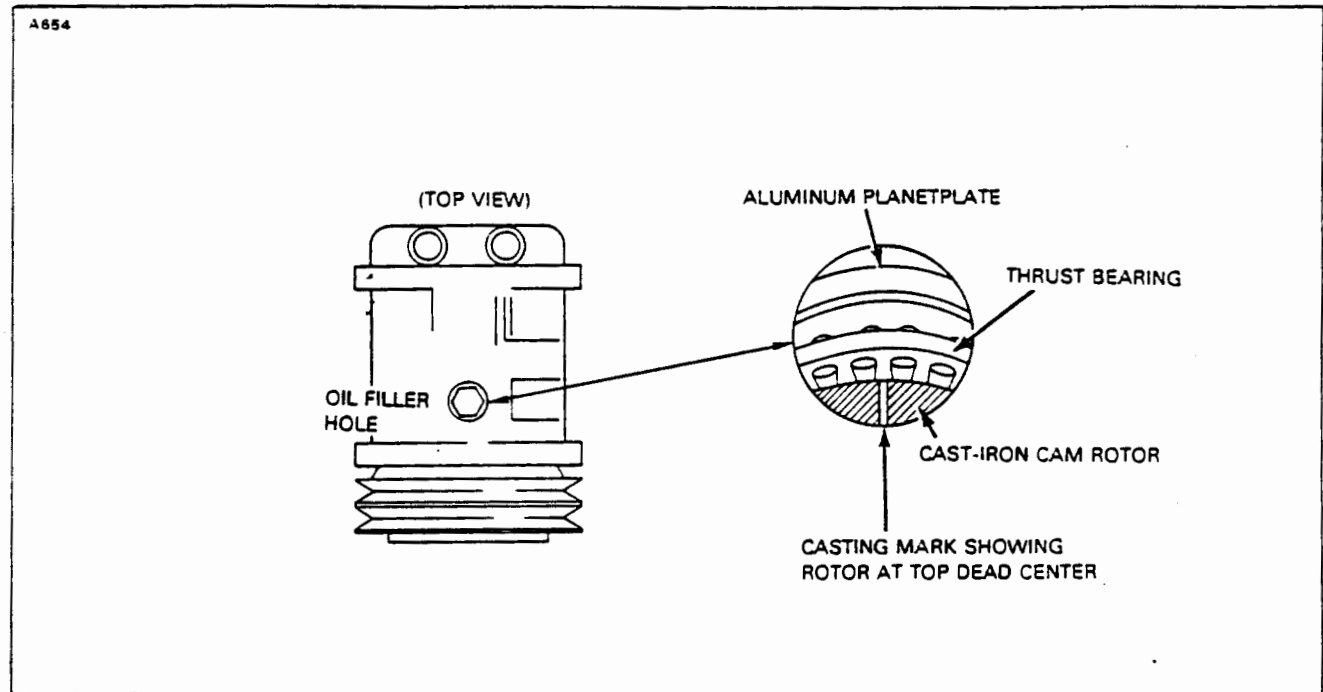


Figure 21-31. Top Dead Center Casting Mark (Sankyo Compressor)

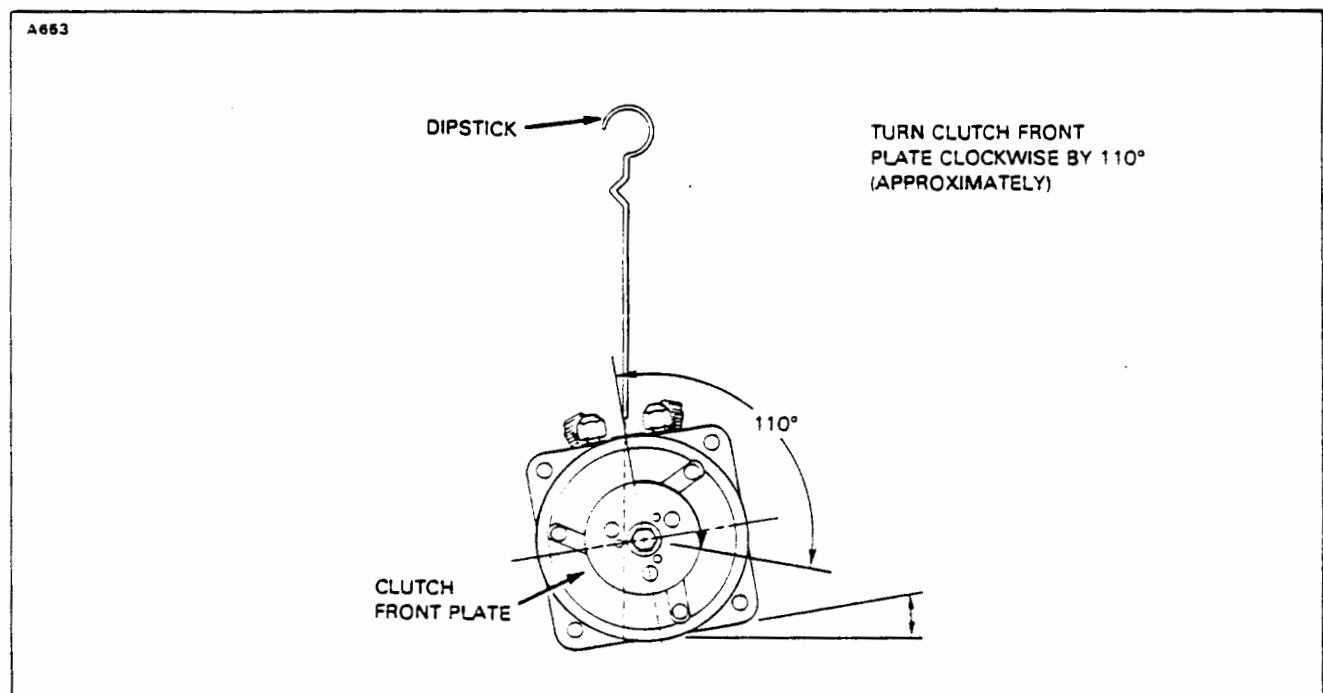


Figure 21-32. Rotation of Clutch Front Plate (Sankyo Compressor Oil Check)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

5. Evacuate and charge the system.

— WARNING —

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

COMPRESSOR OIL LEVEL CHECK.

— NOTE —

Compressor oil level should be checked any time the system is discharged.

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

— WARNING —

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

2. Discharge the system being careful not to lose any oil.
3. Remove the oil fill plug.
4. Position the rotor to top dead center (Refer to Figure 21-31 by rotating the clutch front plate until the casting mark is visible in the center of the hole.
5. Rotate the clutch front plate clockwise by approximately 110°. (Refer to Figure 21-32.)
6. Insert dipstick No. 32447 purchased from Sankyo.
7. Remove the dipstick and count the number of increments of oil. The acceptable oil level in increments is 7 to 10. This represents between 2.6 and 4.4 fluid ounces.
8. When oil is added Piper refrigerant oil PMS-L2000 or equivalent 500 viscosity refrigerant oil must be used.
9. When installing the oil filter plug, make sure the sealing O-ring is not twisted and that no dirt nor particles are on the O-ring or seat. Torque the plug to 6-9 foot-pounds. Do not overtighten the plug to stop a leak; remove the plug and install a new O-ring.
10. Evacuate and charge the system.

— CAUTION —

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

ADJUSTMENT OF DRIVE BELT TENSION.

1. Rotate the compressor to obtain tension of 45 to 50 lbs. for new or old belts.
2. Run the engine for a 15 minute period at 1900 RPM with the compressor engaged.

— WARNING —

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

3. Shut down engine and recheck the belt tensions. Belt tension for new or old installation should remain at 45-50 lbs. Recheck belt tension of new belt after 1 to 1.5 hrs of operation.
4. A tension check should be made at every 100 hours or annual inspection whichever occurs first.

RECEIVER-DEHYDRATOR.

The receiver-dehydrator is mounted in the evaporator assembly housing.

REMOVAL OF RECEIVER-DEHYDRATOR.

1. Discharge the system of all refrigerant.
2. Uncouple the refrigerant lines at the receiver-dehydrator.
3. Remove the clamp attaching the unit to the evaporator housing.

— NOTE —

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

INSTALLATION OF RECEIVER-DEHYDRATOR.

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

— NOTE —

Torque the fitting (Chart 2106).

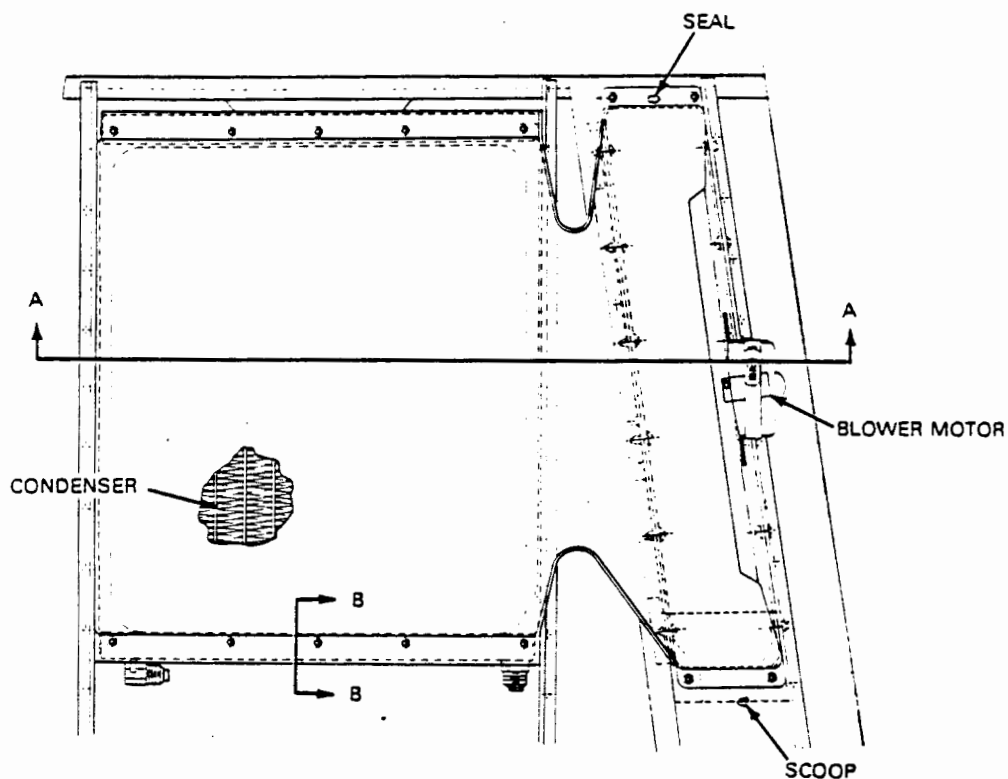
2. Evacuate and recharge the system.

CONDENSER.

The condenser is located in the tail cone of the aircraft between fuselage stations 156.00 and 191.00.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

3016



8961

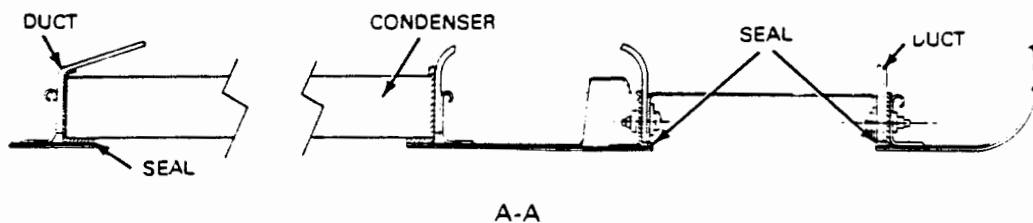
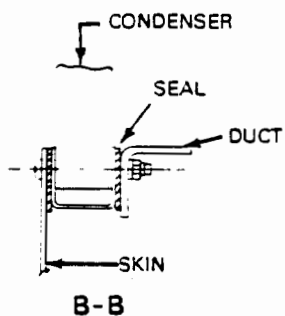


Figure 21-33. Condenser Installation
(PA-44-180T S N 44-8107027 and Up Only)

21-53-09
Page 21-72
Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REMOVAL OF CONDENSER.

1. Remove the baggage compartment close-out panel.
2. Completely discharge the system and disconnect the suction and discharge lines at the condenser.

— NOTE —

Cap all lines and fittings to prevent foreign matter from entering the system.

3. Disconnect the condenser blower motor wires.
4. Remove the twelve screws which secure the condenser blower duct at the blower inlet.
5. Remove the remaining fourteen screws which secure the condenser duct to the airframe and remove the blower assembly.
6. Remove the condenser from the blower assembly.

INSTALLATION OF CONDENSER. (Refer to Figure 21-33.)

1. Install seals to condenser and duct as shown in Figure 21-33 using neoprene rubber adhesive conforming to PMS-C1002. (Example: Scotch Grip 2210.)
2. Place condenser into condenser duct and place duct into position in tailcone.
3. Attach duct to airframe with fourteen screws, nuts, and washers. Do not tighten screws at this point. (Make certain the condenser suction line clamp is attached to the condenser duct as shown in Figure 21-33.)
4. Install twelve screws and washers which secure the blower duct at the blower inlet.
5. Tighten all screws.
6. Attach the suction and discharge lines to condenser. (Refer to Refrigerant Line Fitting Torque Chart, Figure 21-24 for appropriate torque.)
7. Use PRC-5000 Sealant to complete the condenser duct to airframe seal.
8. With the condenser secured, evacuate and recharge the system.
9. With the system completely charged, check for leaks.
10. Replace and secure access panels.

EXPANSION VALVE.

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

REMOVAL OF EXPANSION VALVE.

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

— NOTE —

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

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

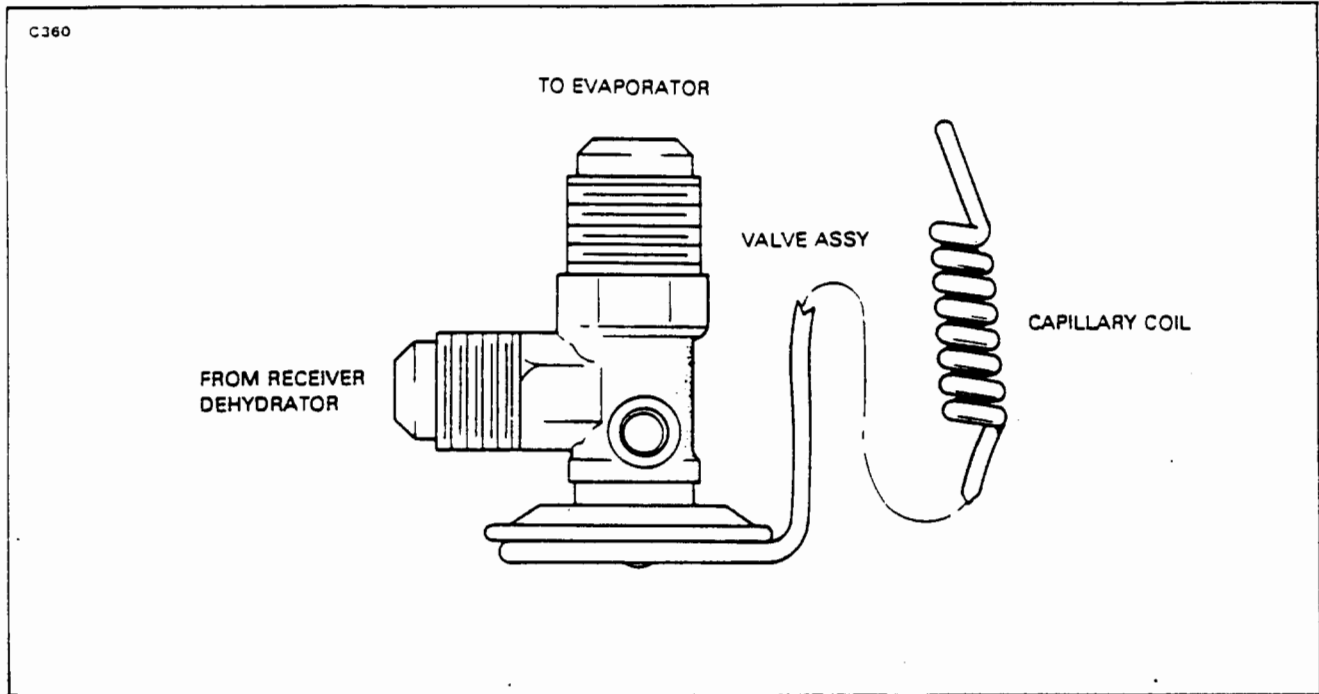


Figure 21-34. Expansion Valve

INSTALLATION OF EXPANSION VALVE.

1. Install the expansion valve in the inlet line of the evaporator core by coupling the related fittings. (Seal all couplings with sealant applied to tube flanges only.) Torque fittings per Chart 2106.
2. Secure the capillary coil to the evaporator outlet line.
3. Evacuate and charge the system. Check for leaks.
4. Replace access panels.

EVAPORATOR ASSEMBLY.

The evaporator assembly consists of the evaporator core, receiver-dehydrator, expansion valve, circulating fan and pressure switch together with necessary housing and plumbing. The housing is fabricated of thermoplastic material. The evaporator assembly is located behind the cabin rear panel.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REMOVAL OF EVAPORATOR ASSEMBLY.

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

— NOTE —

Discharge the system before disassembling.

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

INSTALLATION OF EVAPORATOR ASSEMBLY.

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

— WARNING —

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

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

CHART 2107. EVAPORATOR BLOWER MOTOR WIRE CODES

	MOTOR WIRES		AIRCRAFT WIRES		
	PIN YY15062 ESB.- NOS. UNIVERSAL ELECTRIC CO.		AIRCRAFT PIN HARNESS NOS.		
GROUND	2	BROWN	AC4B	2	
LOW SPEED	1	YELLOW	AC8A	1	
HIGH SPEED	1	ORANGE	AC10A	1	

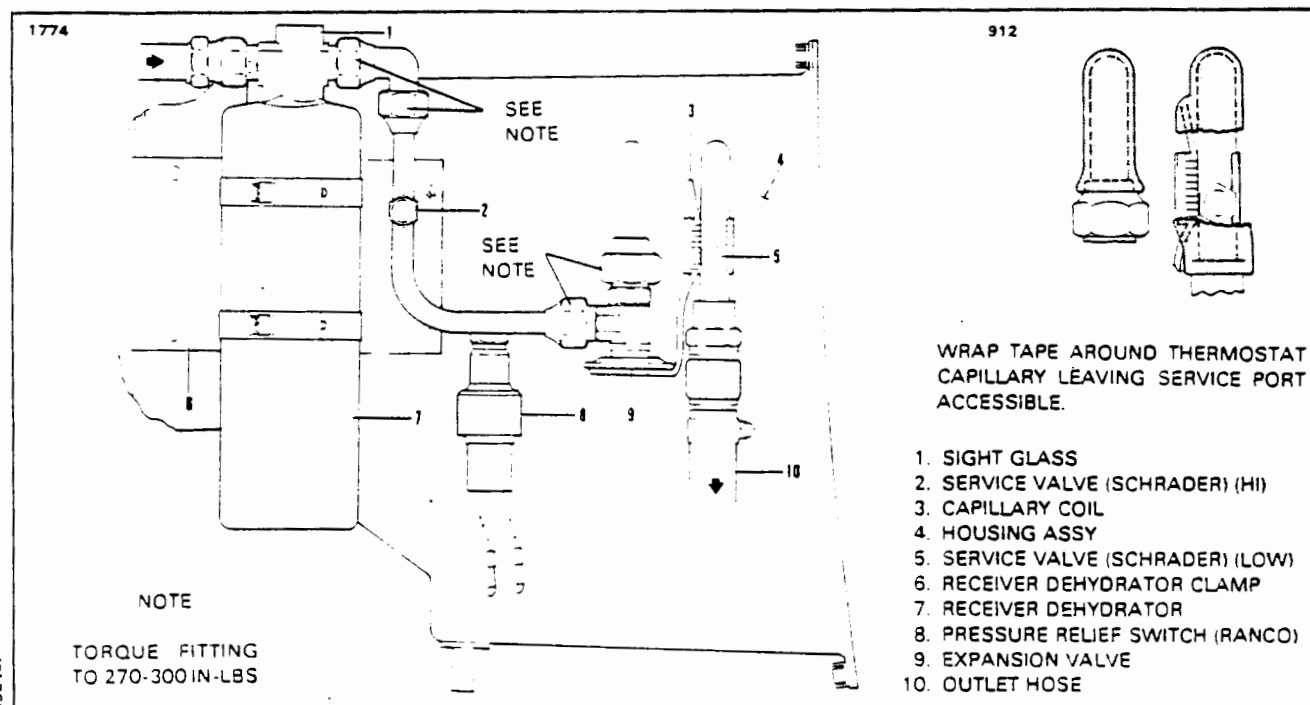


Figure 21-35. Components Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

PRESSURE RELIEF SWITCH.

The pressure relief switch automatically prevents the system from over pressurization by breaking the electrical circuit to the magnetic clutch, stopping the compressor until pressure is reduced. The switch is located in the line between the receiver and expansion valve and is actuated between 250 and 300 psi.

— NOTE —

Before relief switch is removed, the air conditioning system must be discharged.

ELECTRICAL INSTALLATION.

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

Refer to Chapter 91 for air conditioning wiring schematic.

MANIFOLD PRESSURE SWITCH.

A pressure switch is provided in the manifold pressure gauge line in back of the instrument panel. The purpose of the switch is to shut down the air conditioning system when the airplane is at full throttle enabling maximum performance. No adjustment is necessary.

— END —

CHAPTER

22

AUTO FLIGHT

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 22 - AUTOFLIGHT
TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
22-00-00	GENERAL	1H23	8-81
22-10-00	NON-PIPER A.F.C.S. EQUIPMENT CONTACTS	1H23	

— WARNING —

It is very important to never use a substitute trim system component part, for an original design part, because the fail-safe characteristics of the system might be compromised. Refer to the P.O.H. for ground check of electric Pitch Trim System before the first flight after servicing. A trim system running in the wrong direction is the same as a run-away. It is possible to experience excessive pilot yoke force in only 3-4 seconds under such conditions.

PIPER AIRCRAFT
PA-32R-301/301T
MAINTENANCE MANUAL

GENERAL.

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

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

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

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

Collins General Aviation Division
Rockwell International
Cedar Rapids, Iowa 52406
(319) 395-3625 Telex: 464-421

Edo Corporation - Avionics Division
Box 610
Municipal Airport
Mineral Wells, Texas 76067
(817) 325-2517 Telex: 76067

King Radio Corporation
400 North Rodgers Road
Olathe, Kansas 66061
(913) 782-0400 Telex: 4-2299-Kingrad

Sperry Flight Systems Avionics Div.
8500 Balboa Blvd.
P.O. Box 9028
VanNuys, CA. 91409
(213) 894-8111 Telex: 65-1367

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

This chapter of the manual contains information necessary to perform operational checks of the Emergency Locator Transmitter (ELT), with a pilot's remote switch. Included are the appropriate removal and installation instructions to facilitate battery replacement.

EMERGENCY LOCATER TRANSMITTER (ELT).

DESCRIPTION.

The ELT is an automatically activated device which, when activated, will radiate an omni-directional RF signal on the international distress frequencies. The radiated signal is modulated with a distinctive audio swept tone.

The electrical power for the ELT is supplied by its own self-contained alkaline battery. For portable use, the ELT can be easily removed from its mounting in the aircraft. To comply with FAA regulations the battery must be replaced after five years of shelf life. The replacement date is marked on the transmitter label. Also, the battery must be replaced if the transmitter has been used in an emergency situation or if accumulated test time exceeds one hour.

Two types of ELTs are available for installation in the 44-180/180T. The Communications Components Corporation, CIR-11-2 and the Narco ELT-10. Both utilize an alkaline battery.

— NOTE —

PA-44-180 aircraft S/N 44-7995001 to 44-7995290 had installed a CCC, CIR-11-2 ELT which required the lithium sulfur dioxide battery. Refer to Piper Service Letter 820 for instructions on converting CIR-11-2 ELT to alkaline battery per AD 79-18-05.

COMMUNICATIONS COMPONENTS CORPORATION CIR-11-2.

BATTERY REMOVAL AND INSTALLATION. (CCC, CIR-11-2).

The ELT is located on a mounting bracket on the right side of the fuselage aft section at station 247.0.

1. Remove the access plate on the right side of the fuselage aft of station 247.0.
2. Rotate the ON ARM OFF switch to the OFF position.
3. Disconnect the antenna coax cable (twist left, then pull outwards).
4. Disconnect the harness to the pilot's remote switch.
5. Remove the forward mounting bracket by pulling the black plastic knob out. Remove the transmitter from the airplane.
6. Remove the six Phillips-head screws securing the transmitter cover. Remove the cover.
7. Lift out the old battery pack.
8. Copy the expiration date on the battery into the space provided on the external ELT name and data plate.
9. Disconnect and replace with a new battery pack.
10. Insert transmitter into airplane and fit into place. Replace mounting bracket by pushing the black plastic knob into place.

23-12-01
Page 23-01

Revised: January 3, 1983

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

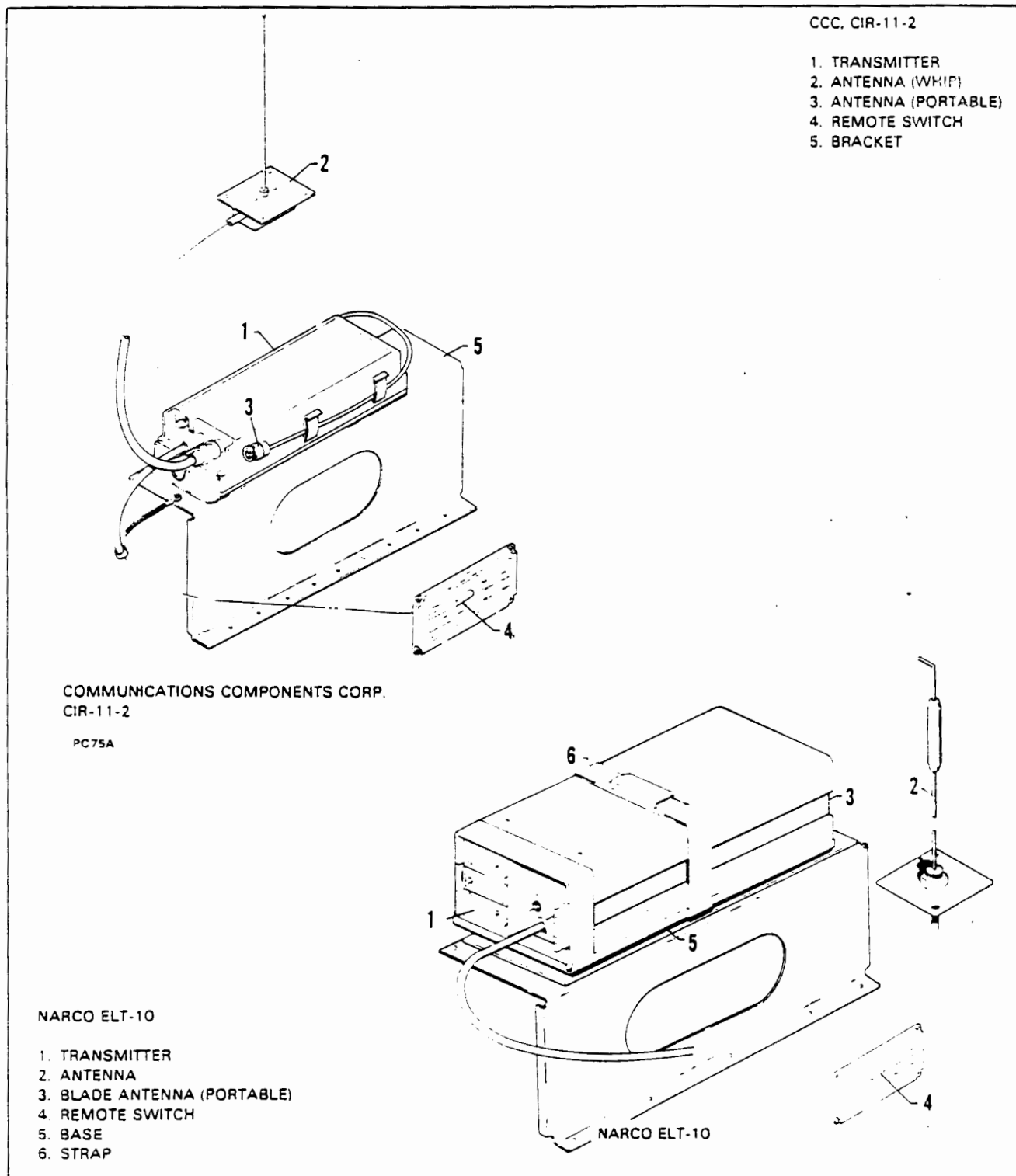


Figure 23-1. Emergency Locator Transmitter Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

11. Reconnect the pilot's remote switch harness and the antenna coax cable to the transmitter.
12. Set the ON ARM OFF switch to the ARM position.

— NOTE —

It may be advisable to test the unit operation before installing the access plate.

13. Reinstall the access plate previously removed.

— NOTE —

Inspect the external whip 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.

NARCO ELT-10.

BATTERY REMOVAL AND INSTALLATION.

The ELT access panel is located on the left side of the fuselage aft of station 247.0.

1. Remove the access panel on the left side of the fuselage.
2. Set the ON OFF ARM switch on the transmitter to OFF.
3. Disconnect antenna coaxial cable and the remote switch wires 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.
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 the 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 reinstall 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 the 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.
14. Connect the remote switch wires.
15. Press RESET button and SET ON OFF ARM switch to ARM.
16. Make an entry in the aircraft logbook, including the new battery expiration date.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

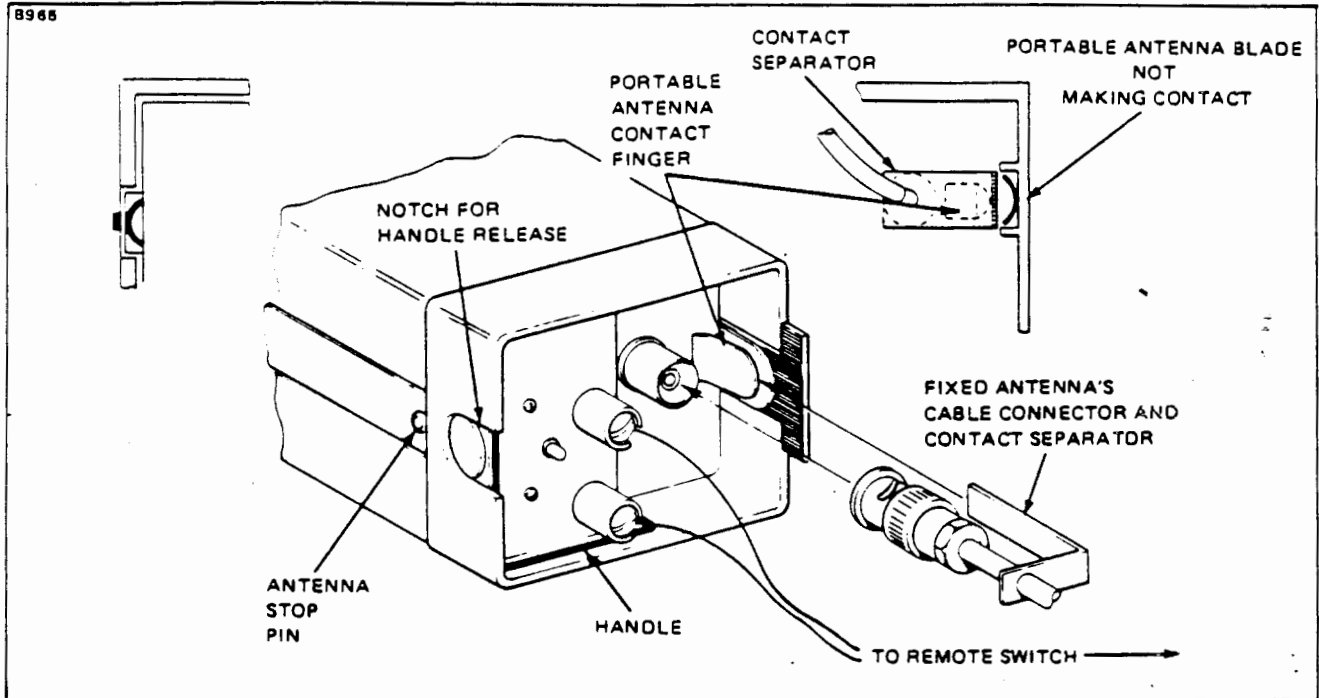


Figure 23-2. ELT Using Fixed Aircraft Antenna (Narco)

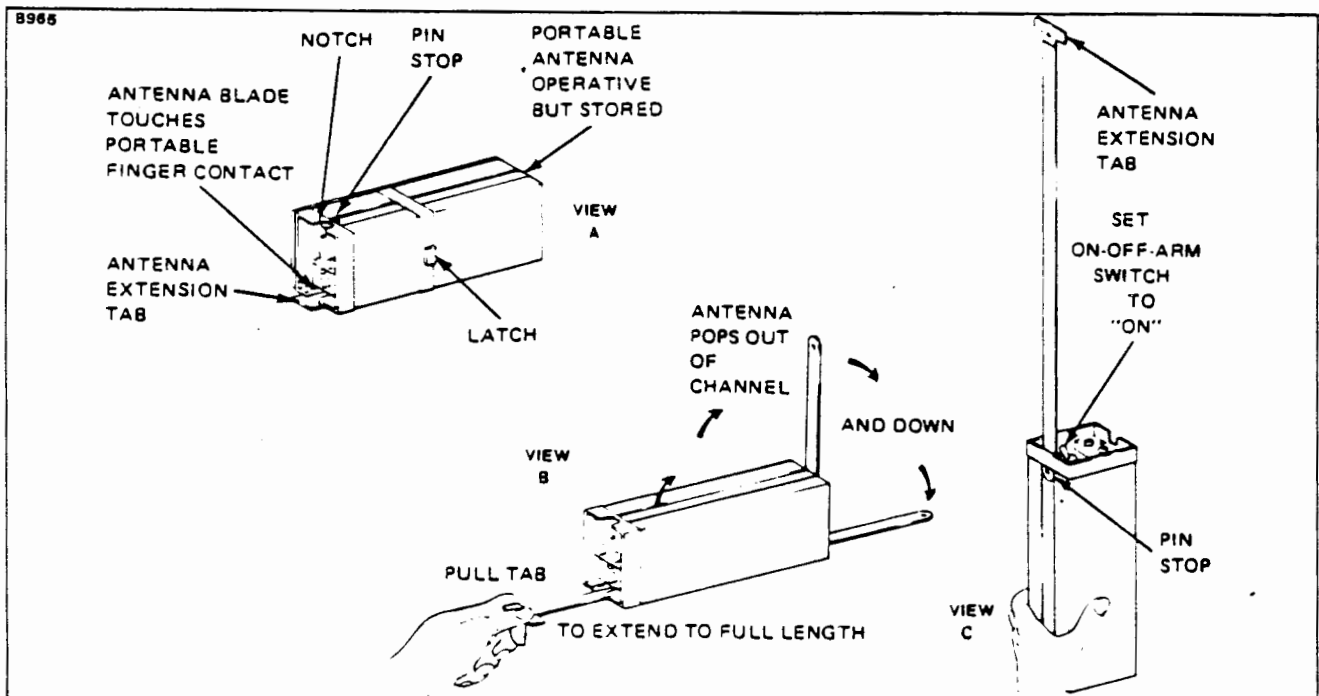


Figure 23-3. ELT Portable Folding Antenna (Narco)

23-13-01
Page 23-04

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

17. 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 sharp, bent or kinked whip should be replaced. Antenna damage may cause structural failure of whip in flight.

TESTING EMERGENCY LOCATOR TRANSMITTER.

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

— CAUTION —

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

- 1. Test should be no longer than three audio sweeps.*
- 2. If the antenna is removed a dummy load should be substituted during the test.*
- 3. Test should be conducted only within the time period made up of the first five minutes after any hour.*
- 4. If the operational tests must be made at a time not included within the first five minutes after the hour, the test should be conducted with the closest FAA Tower or Flight Service Station. Consult FAA Advisory Circular AC20-81 for detailed information concerning the above caution.*

1. Remove the access panel to gain access to the transmitter.
2. Turn the aircraft master switch ON.
3. Tune the aircraft communications receiver to 121.5 MHz and switch the receiver ON; deactivate the squelch, and turn the receiver volume up until a slight background noise is heard.

— NOTE —

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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. Return to the ARM position.

— NOTE —

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

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 before reverting to ARM position again.

— CAUTION —

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

7. Place the access panel on the left side of the fuselage aft of station 247.0.

PILOT'S REMOTE SWITCH.

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

TESTING PILOT'S REMOTE SWITCH.

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

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

— NOTE —

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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

— NOTE —

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

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

INADVERTENT ACTIVATION.

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

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

— NOTE —

As a routine precaution, it is recommended that the ELT battery be replaced at the earliest opportunity after inadvertent activation and a functional test be made in accordance with paragraph titled Testing Emergency Locator Transmitter. Note, however, that the problem may not be in the transmitter. Check the following:

1. *Proper spacing of antennas as to minimize antenna conducted RF.*
2. *Rigidity of the transmitter installation.*

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

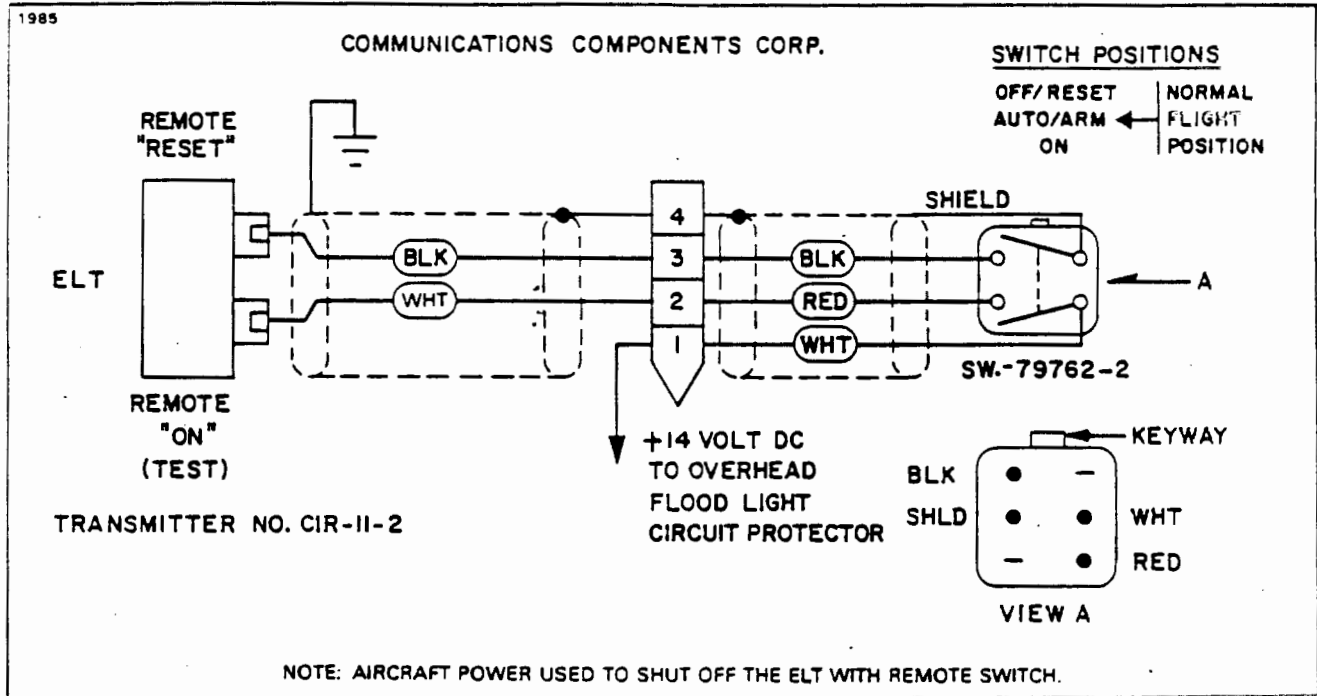


Figure 23-4. Communications Components ELT Schematic

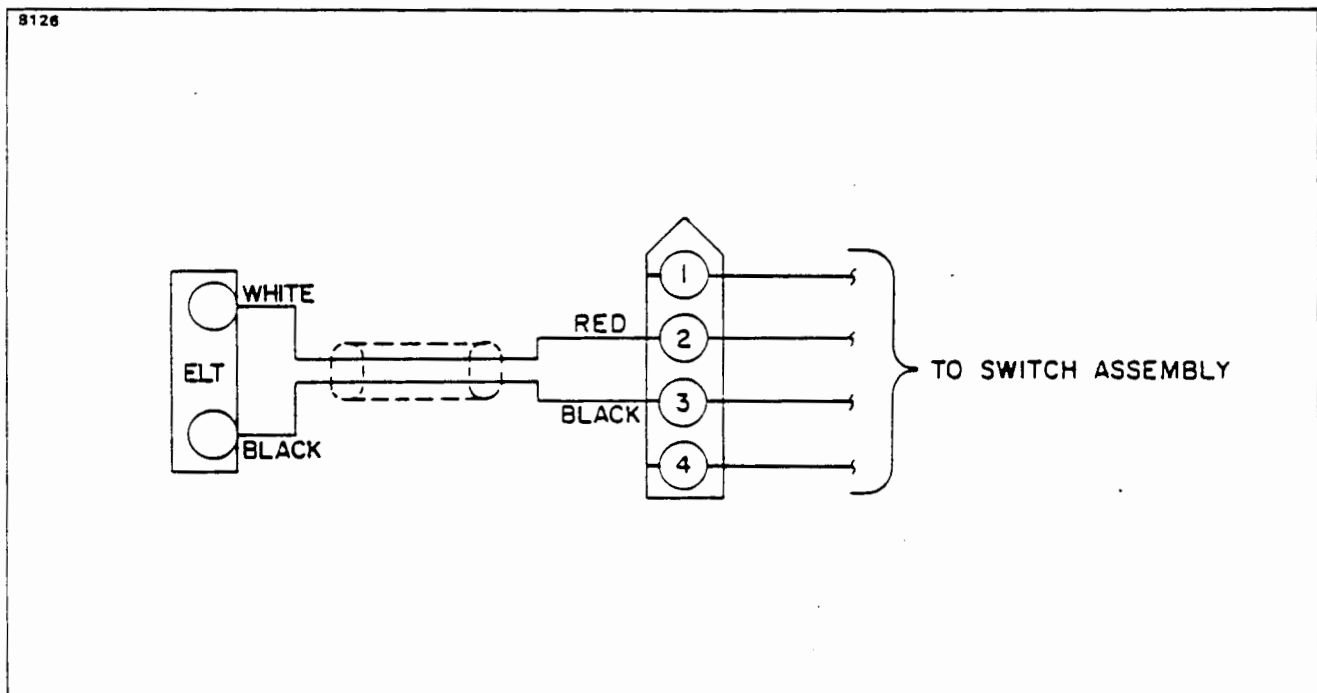


Figure 23-5. Narco ELT Schematic

CHAPTER

24

ELECTRICAL POWER

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

CHAPTER 24 - ELECTRICAL POWER

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
24-00-00	GENERAL	1113	
24-01-00	Description and Operation	1113	1-83
24-02-00	Troubleshooting	1113	
24-30-00	D.C. GENERATION	1121	
24-31-00	Alternator System	1121	
24-31-01	Precautions	1121	
24-31-02	Checking Alternator Belt Tension	1122	
24-32-00	Battery	1123	2-81
24-32-01	Service Procedures	1J1	
24-32-02	Servicing Battery	1J1	
24-32-03	Removal of Battery	1J1	
24-32-04	Installation of Battery	1J2	
24-32-05	Testing Battery	1J2	1-83
24-32-06	Charging Battery	1J2	
24-32-07	Battery Box Description	1J2	
24-32-08	Removal of Battery Box	1J2	
24-32-09	Installation of Battery Box	1J2	
24-32-10	Battery Box Corrosion Prevention	1J13	
24-33-00	Voltage Regulators and Overvoltage Relays	1J4	A 1-83
24-33-01	Removal of Voltage Regulators and or Overvoltage Relays	1J4	
24-33-02	Installation of Voltage Regulators and or Overvoltage Relays	1J4	
24-33-03	Regulator Components (Lamar)	1J5	
24-33-04	Regulator Operation	1J5	
24-33-05	Preparation for Testing Voltage Regulators	1J6	
24-33-06	Testing Regulator (Lamar)	1J6	1-83
24-33-07	Adjusting Regulator (Lamar)	1J7	1-83

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 24 - ELECTRICAL POWER (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
24-30-00	D.C. GENERATION (cont)	—	
24-33-00	Voltage Regulators and Overvoltage Relays (cont)	—	
24-33-08	Balancing Circuit Operation (Regulator)	IJ9	
24-33-09	Checking Overvoltage Relay	IJ9	
24-34-00	Ammeter	IJ10	
24-40-00	EXTERNAL POWER	IJ10	
24-41-00	External Power Receptacle	IJ10	

— NOTE —

Refer to Chapter 91, Charts and Wiring Diagrams for electrical schematics.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

This chapter deals with the complete electrical system and provides service procedures and a trouble-shooting guide to be used to remedy problems which may arise.

Electrical generation, distribution and storage are covered, as well as the optional external power facility.

DESCRIPTION AND OPERATION.

Electrical energy is generated by two engine-driven 60 ampere alternators and stored in a 12 volt, 35 amp hour battery. The battery is used for starting and as a reserve power supply in case of alternator failure. The system is D.C. and has a negative ground.

Access to the battery is gained by opening the hinged fiberglass nose which tips forward and down.

The electrical and avionic equipment is protected from regulator malfunction by an overvoltage relay. The individual circuits are protected from overloads and shorts by resettable circuit breakers located on the right side of the instrument panel.

The lighting system for night operation is optional and consists of a nose mounted landing light, anti-collision lights, navigation lights, and instrument illumination. Refer to Chapter 33 for lighting information.

TROUBLESHOOTING.

Chart 2401 is a handy guide that enables rapid diagnosis of most electrical problems at a glance and provides remedies for them. After the trouble has been corrected, check the entire system for security and operation of its components.

— NOTE —

The master switch must be on before any electrical equipment will operate.

THIS SPACE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

CHART 2401. TROUBLESHOOTING (ALTERNATOR)

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2401. TROUBLESHOOTING (ALTERNATOR) (cont)

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2401. TROUBLESHOOTING (ALTERNATOR) (cont)

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

24-02-00

Page 24-04

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2401. TROUBLESHOOTING (ALTERNATOR) (cont)

Trouble	Cause	Remedy
Field circuit breaker trips. (cont)	ALTERNATOR (cont) Short circuit in field winding of alternator.	Disconnect field wiring at terminal of alternator. Turn on master switch. Reset breaker and if breaker fails to retrip, this isolates short circuit to field of alternator itself. Check brush holders for shorting against frame. If there are no obvious signs of a physical short circuit at field terminal or brush holder, replace alternator. (Note: Intermittent short circuit.) Internal short circuiting of the field can occur at various positions of the rotor, therefore, reconnect field, reset breaker. — CAUTION — <i>Turn magneto switch to off before turning propeller.</i> Pull propeller slowly by hand turning alternator rotor through 360° of travel. Observe circuit breaker for signs of tripping.
Output circuit defective.	Short circuit in output circuit. Battery installed with reversed polarity.	Disconnect wiring at battery post of alternator. Turn on master switch. Disconnect each leg of output circuit, working from the alternator towards the bus bar. Replace component or wire which was isolated as defective. (See schematic.) Remove battery and reinstall with correct polarity.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2401. TROUBLESHOOTING (ALTERNATOR) (cont)

Trouble	Cause	Remedy
Output circuit defective. (cont)	ALTERNATOR (cont) Battery charged backwards.	Remove battery. Connect load such as landing light lamp or similar load and discharge battery. Recharge with correct polarity and test each cell for signs of damage due to reversed charging. — NOTE — <i>This type of condition can only occur in a case where a discharged battery has been removed from the airplane and put on a charger with the polarity reversed. This reversal in polarity cannot occur in the airplane due to any fault in the alternator system.</i>
Excessive ammeter fluctuation.	Excessive resistance in field circuit. High field circuit resistance. Defective voltage regulator.	Check all connections and wire terminals in field circuit for deterioration such as loose binding posts, broken wire strands at terminals, etc. Tighten all connections and replace faulty terminals. If problem persists, jump across terminals of the following components one at a time until the faulty unit is isolated. - Field 5 amp (alternator) circuit protector. - Alternator half of master switch. - Overvoltage relay. Replace voltage regulator.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2402. TROUBLESHOOTING (BATTERY)

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2402. TROUBLESHOOTING (BATTERY) (cont)

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

D.C. GENERATION.

ALTERNATOR SYSTEM.

The alternator is located on the front lower right side of the engine and utilizes a belt drive from the engine crankshaft. The alternating current is converted to direct current by diodes pressed into the end bell housing of the alternator. The diodes are highly reliable solid state devices, but are easily damaged if current flow is reversed through them.

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

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

— NOTE —

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

A simulated load can be made by connecting 8 landing lights wired in parrallel from the main bus to air-frame ground or fourteen 3 ohm, 100 watt resistors. (See Figure 24-1.)

PRECAUTIONS.

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

1. Disconnect the battery before connecting or disconnecting test instruments, except voltmeter, or before removing or replacing any unit or wiring. Accidental grounding or shorting at the regulator, alternator, ammeter or accessories, will cause severe damage to the units and or wiring.
2. The alternator must not be operated on an open circuit with the rotor winding energized.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2812

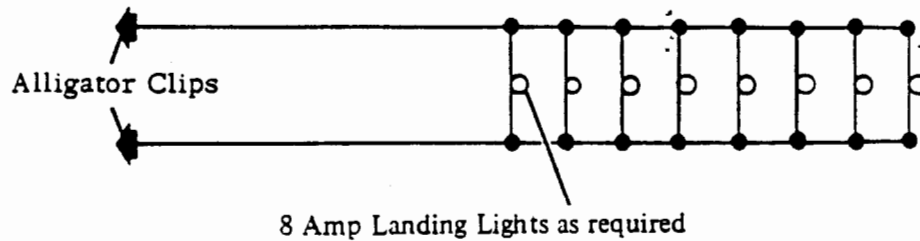


Figure 24-1. Lamp Bank Load

3. Do not attempt to polarize the alternator. No polarization is required. Any attempt to do so may result in damage to the alternator, regulator or circuits.
4. Grounding of the alternator output terminal may damage the alternator and or circuit and components.
5. Reversed battery connections may damage the rectifiers, wiring or other components of the charging system. Battery polarity should be checked with a voltmeter before connecting the battery. This aircraft is negative ground.
6. If a booster battery or fast charger is used, its polarity must be connected correctly to prevent damage to the electrical system components.

CHECKING ALTERNATOR BELT TENSION.

If properly installed, tensioned and checked periodically, the alternator drive belt will give very satisfactory service. However, an improperly tensioned belt will wear rapidly and may slip and reduce alternator output. Consequently, a belt should be checked for proper tension at the time it is installed, again after 25 hours of operation and at each 100 hour inspection thereafter.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

The torque method for checking alternator belt tension is given as follows:

1. Apply a torque indicating wrench to the nut that attaches the pulley to the alternator and turn it in a clockwise direction. Observe the torque shown on the wrench at the instant the pulley slips.
2. Compare the torque indicated in Step 1 with torque specified in the following chart. Adjust tension accordingly.

— NOTE —

The higher tension specified for a new belt is to compensate for the initial stretch that takes place as soon as it is operated. These higher tension values should not be applied to belts which have previously been used.

CHART 2403. ALTERNATOR BELT TENSION

Width of Belt	Condition	Torque indicated at alternator pulley
3/8 inch	New	11 to 13 ft-lbs
3/8 inch	Used	7 to 9 ft-lbs

BATTERY.

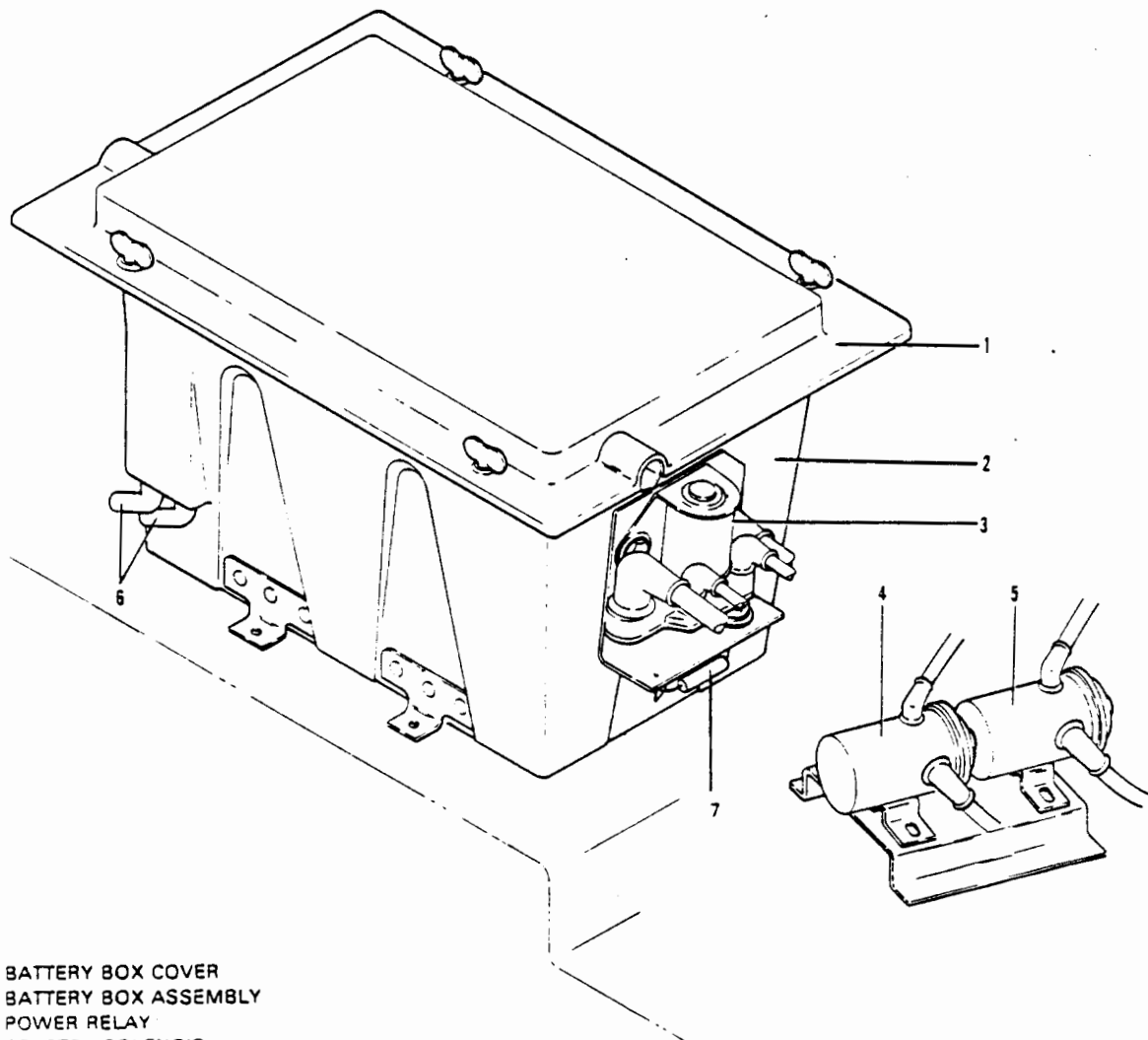
The battery is located in the nose of the aircraft and is accessible by opening the hinged fiberglass nose which tips forward, and then removing the battery box cover. (Refer to Figure 24-2.)

— NOTE —

Proper installation of solderless terminals on aluminum cables presents special difficulty in that each individual strand is insulated by an oxide coating. This coating must be broken down in the crimping process and some method employed to prevent its reforming (usually a corrosion preventive jell material). For this reason Piper does not recommend the repair or replacement of loose, corroded or other unsatisfactory conditions of solderless terminals on aluminum cables. When an unsatisfactory condition is discovered, Piper recommends that the complete cable assembly be replaced. Should this not be practical, it is permissible to replace the aluminum cable assembly with a copper cable assembly, using a copper cable two sizes smaller. Example: AL-1 aluminum cable replaced with AN-3 copper cable.

PIPER AIRCRAFT
PA-44-180/180T
*MAINTENANCE MANUAL

2278



1. BATTERY BOX COVER
2. BATTERY BOX ASSEMBLY
3. POWER RELAY
4. STARTER SOLENOID
5. STARTER SOLENOID
6. VENT TUBES
7. MASTER RELAY DIODE

Figure 24-2. Battery Box

24-31-02
Page 24-12

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

SERVICE PROCEDURES.

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

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

SERVICING BATTERY.

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

CHART 2404. HYDROMETER READING AND BATTERY CHARGE PERCENT

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

REMOVAL OF BATTERY.

1. Open aircraft nose section.
2. Disconnect the four cam locks from the battery box cover and remove the cover.

— CAUTION —

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

3. Disconnect the battery cables.
4. Lift the battery from the box.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF BATTERY.

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

TESTING BATTERY.

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

CHARGING BATTERY.

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

BATTERY BOX DESCRIPTION.

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

REMOVAL OF BATTERY BOX. (Refer to Figure 24-2.)

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

INSTALLATION OF BATTERY BOX. (Refer to Figure 24-2.)

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

BATTERY BOX CORROSION PREVENTION.

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

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

— CAUTION —

Do not allow baking soda to enter battery.

2. Clean the battery and the box. Corrosion effects may be neutralized by applying a solution of baking soda and water mixed to the consistency of thin cream. Continue application until bubbling action has ceased.

3. Rinse the battery and box with clean water and dry.

4. Place the cap over the battery box drain.

5. Reinstall battery. (Refer to battery installation.)

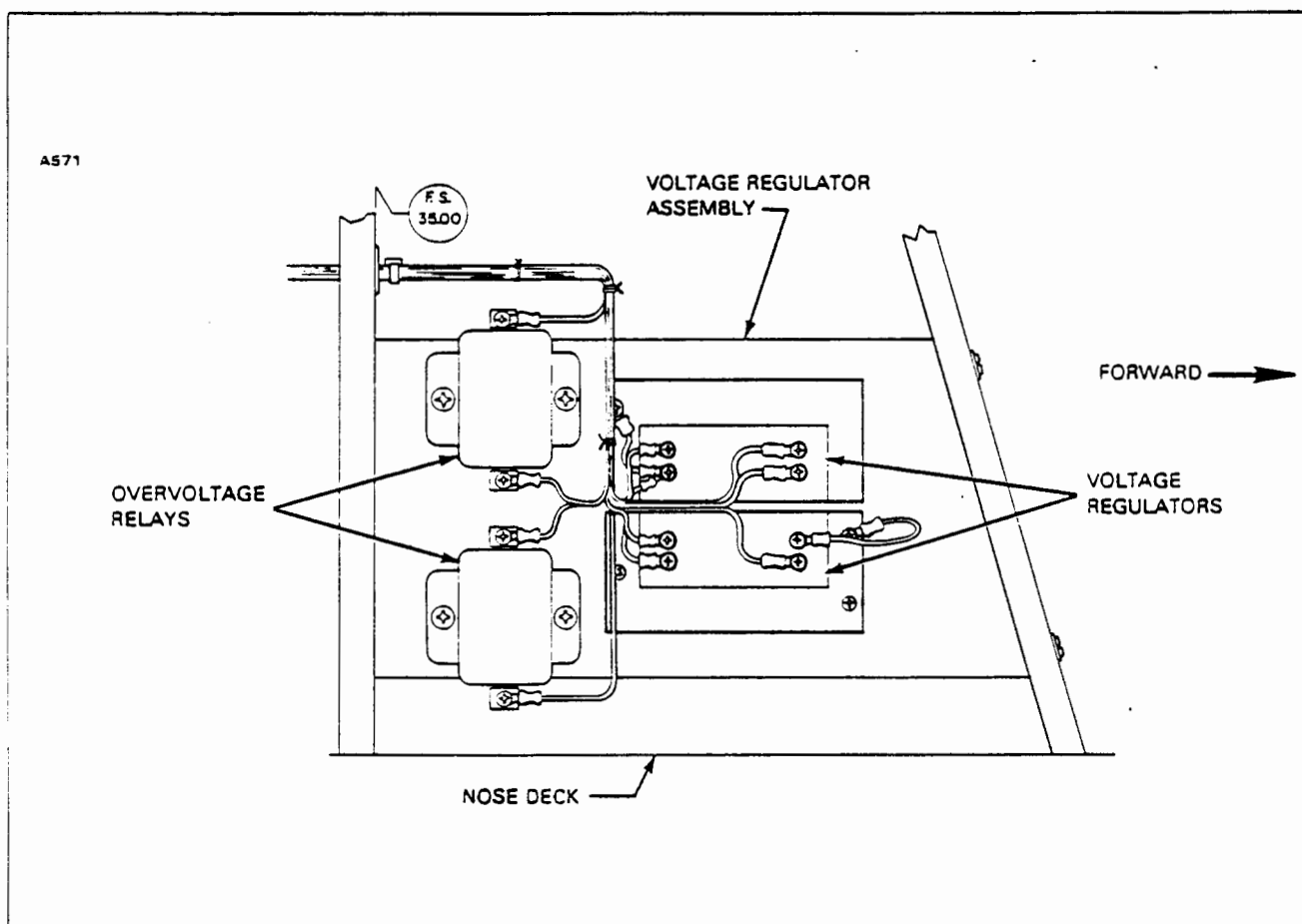


Figure 24-3. Electrical Component Location

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

VOLTAGE REGULATORS AND OVERVOLTAGE RELAYS.

REMOVAL OF VOLTAGE REGULATORS AND OVERVOLTAGE RELAYS.

The voltage regulators and overvoltage relays are mounted on a panel which is secured to the left bulkhead at F.S. 35.000 and is accessible by opening the aircraft nose section. The top units are connected to the left engine alternator and the bottom units are connected to the right side.

1. Identify the voltage regulator or overvoltage relay to be tested.
2. Remove the wires connected to the unit and label or otherwise identify them to facilitate their reconnection.
3. Remove the mounting screws, the unit is now free of the panel.

INSTALLATION OF VOLTAGE REGULATORS AND OVERVOLTAGE RELAYS.

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

— CAUTION —

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

2. Reconnect the wires to the proper terminals.

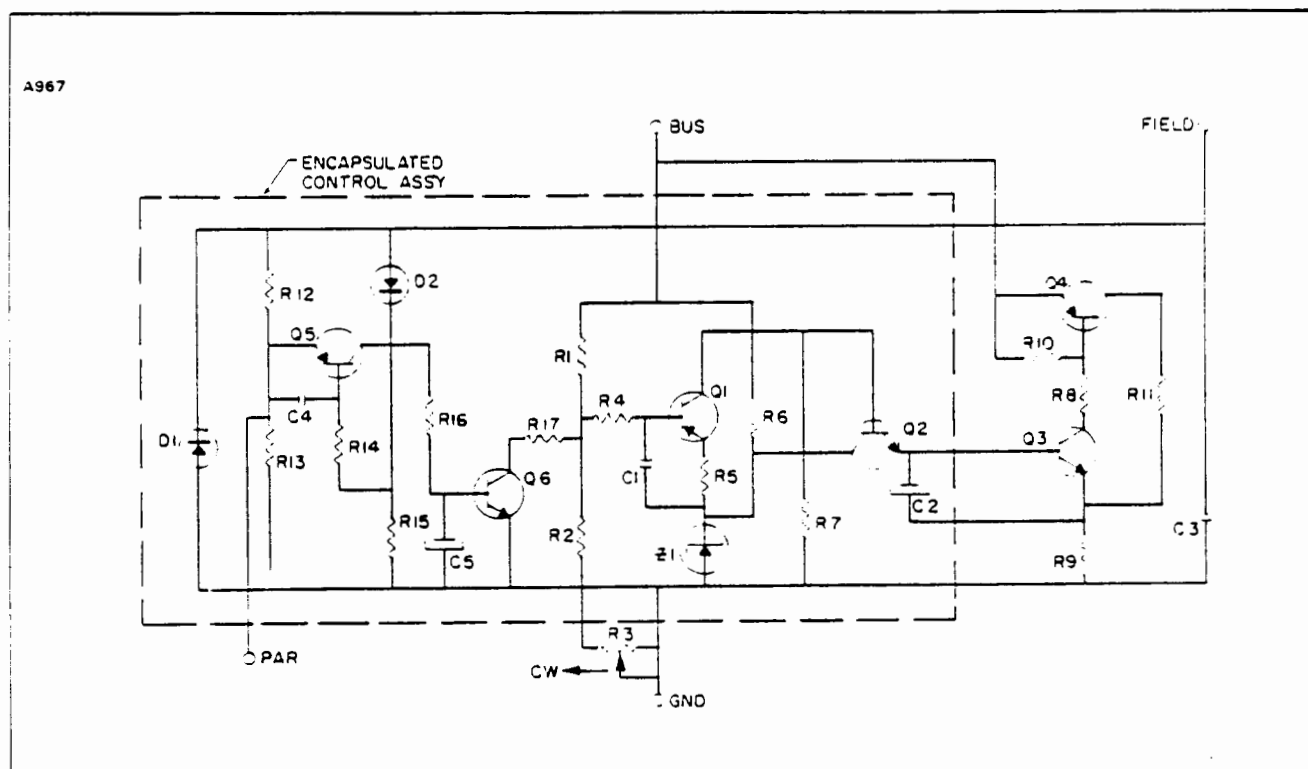


Figure 24-4. Regulator Diagram (LAMAR)

24-33-02
Page 24-16

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REGULATOR COMPONENTS (LAMAR).

Alternator output voltage can, within limits of the design capability of the alternator, be controlled by properly varying the average level of current flow in the rotor winding. The LAMAR solid state electronic regulator is well suited for this purpose. The alternator, due to its design, has self-limiting current characteristics and therefore needs no current-limiting element in the regulator.

1. Transistor: The transistor (Symbol "Q") is an electronic device which can control the flow of current in an electric circuit. It has no mechanical or moving parts to wear out.

2. Rectifier Diode: The rectifier diode (Symbol "D") will pass current in only one direction (forward direction); and in this respect it may be compared to a check valve.

3. Zener Diode: The zener diode (Symbol "Z") in addition to passing current in the forward direction, will also pass current in the reverse direction when a particular value of reverse voltage is applied. This property makes it useful as a voltage reference device in the regular.

4. Capacitor: The capacitor (Symbol "C") is a device which will store electrical energy for short periods of time. This property makes it useful as a filter element to smooth variations of voltage.

5. Resistor: The resistor (Symbol "R") is a device which is used to limit current flow.

REGULATOR OPERATION.

When the alternator is turned on, battery voltage is applied to the "BUS" terminal of the regulator and via Q4 through the "FIELD" terminal of the regulator to the alternator field terminal F2. The amount of voltage applied to the field of the alternator is controlled automatically by action of the regulator in response to alternator output as described below.

Current flow through R6 and Z1 establishes a reference voltage across Z1. Resistors R1 and R2/R3 comprise a voltage divider which is adjustable by means of the variable portion R3. Voltage at the junction of R1 and R2 and the reference voltage across Z1 are applied to comparison transistor Q1. R3 is adjusted so that these voltages are balanced with the desired alternator output voltage present on the "BUS" terminal of the regulator. Thereafter, whenever alternator output voltage (as applied to the "BUS" terminal) falls below the desired regulation value, the comparison transistor Q1 will supply increased current to driver transistors Q2 Q3, which in turn will drive power transistor Q4 to a higher value of field current. This will result in alternator output voltage increasing to a value which will restore balance between the two voltages applied to Q1. Conversely, if alternator output voltage (as applied to the "BUS" terminal) increases due to a greater engine speed or reduced loading of the electrical system, the comparison transistor Q1 will act to reduce current flow to the driver transistors Q2 Q3, and thus reduce the drive to power transistor Q4. This will result in a reduction of alternator field current and automatically restore balance between the two voltages applied to comparison transistor Q1. Capacitors C1 and C2 function, together with their related transistors, in a way to smooth alternator output ripple and voltage spikes so that the alternator field current is controlled at a steady value.

The LAMAR solid state regulator controls alternator field current to a steady value as required by the electrical load conditions and engine speed. It does not continuously switch field current between high and low values as do mechanical regulators and the switching type of electronic regulators. The design of this unit is such as to provide an alternator output voltage that does not vary with ambient temperature.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

PREPARATION FOR TESTING VOLTAGE REGULATORS.

Regulators may be tested using the aircraft's alternator or an alternator test stand.

1. The aircraft technician or other electrical systems specialist, must disconnect the battery ground cable at the battery before connecting or disconnecting a test ammeter or other test equipment or before making wiring changes in the electrical system.
2. Voltmeters with test probes or clips are not recommended. Fully insulated bolted terminal connections are best, and these should be attached when all power is removed as described above.
3. When installing a battery in an aircraft, be sure that the battery negative terminal is in a position so that this terminal can be connected to the battery ground cable for negative ground systems.
4. The regulator under test is to be mounted on a grounded metallic surface using three No. 8 screws pulled up tight. For extended test periods the heat transfer from regulator to the mounting surface is significant.
5. A ground wire between the regulator "GND" terminal and the aircraft or test stand structure is essential for proper operation. The alternator frame must also be solidly bonded to the system ground.
6. The alternator does not need to be polarized; therefore, never connect ground, even momentarily, to either the regulator field terminal or to the alternator field terminals. Do not interchange I and F leads to regulator as this will destroy the regulator.
7. The LAMAR regulator is intended for use with alternator systems having one field terminal grounded at the alternator. The other field terminal F2 of the alternator is connected to the "FIELD" terminal of the regulator. NEVER UNDER ANY CIRCUMSTANCE PERMIT A GROUND TO CONTACT THIS CIRCUIT EVEN FOR AN INSTANT WHILE POWER IS APPLIED TO THE SYSTEM. Due to this precaution, the mechanic should not use tools near these circuits while power is applied.
8. The alternator should be in good condition and capable of producing full output, and the alternator drive belt must be adjusted tight enough to prevent slippage.
9. The battery must be in good condition and should be fully charged.
10. The voltmeter and ammeter should be of the best quality and should be accurate.
11. A carbon-pile connected across the battery may be used to load the charging circuit while testing the regulator.

TESTING REGULATOR (LAMAR).

1. The procedure for testing the regulator, whether on the airplane or on the test bench, remains the same. Connect the test meters and regulator wiring as shown in Figure 24-5.
2. All circuit connections should be clean and tight. This includes the test instrument connections which must not come loose or open the charging circuit at any time while the system is operating.
3. The voltmeter will not indicate the true regulator setting until the regulator has been operating in the charging system or on the test bench for at least five minutes, at a charge rate of from 10 to 15-amperes.
4. With the connections made as shown in Figure 24-5, start the engine and adjust its speed to approximately 920 to 1250 RPM to obtain 3,000 to 4,000 alternator RPM. Turn on accessories as needed to establish a 10 to 15-ampere load value. Note that the battery charge current is indicated by the ammeter. Therefore, the current value may change downward at the beginning of a test run. This will be especially true if the battery was used for engine starting.

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

5. After five minutes operating time, check the regulator operating voltage as indicated by the voltmeter. Refer to Alternator Service Test Specifications for correct operating voltage. The operating voltage is shown for ambient temperature in which the regulator is operating.

6. If the voltmeter reading indicates that the operating voltage is not within limits, carefully insert a small screwdriver (Phillips #0) in the voltage adjustment access hole on top of the regulator and adjust voltage adjustment slowly to obtain desired value. Before condemning the regulator, recheck the alternator and the battery, making sure that they are in good condition. Recheck all circuit connections and all wiring for unwanted resistance (voltage drop test). Recheck the voltmeter for accuracy and repeat the entire operating test.

7. Balance circuit operation is confirmed by closing the press-to-test switch momentarily and observing that the alternator output current increases abruptly to a higher level. Upon release of this switch, the alternator output will be restored to its previous level, except that minor differences may be noted which are due to battery charge conditions.

ADJUSTING REGULATOR (LAMAR).

1. These regulators are normally used in parallel alternator systems of multi-engine aircraft. Their final adjustment should be made in actual operation in the aircraft system with test equipment connected as shown in Figure 24-6. The balance adjustment is made while operating only one engine, either left or right. The engine to be operated must be selected so as to permit the technician a completely safe access to both of the regulators, so that they may be adjusted while the engine is operating without danger. We shall designate the engine selected to be operated as "LEFT" and the inoperative engine as "RIGHT" for purposes of discussion.

2. Lift the wire from the "PAR" terminal of either regulator and insulate the free end so it will not contact other circuits or ground during the adjustment procedure. Breaking this circuit disables the balancing circuits in both regulators.

3. Turn off the "RIGHT" alternator field switch. All the "LEFT" alternator switches are to be on.

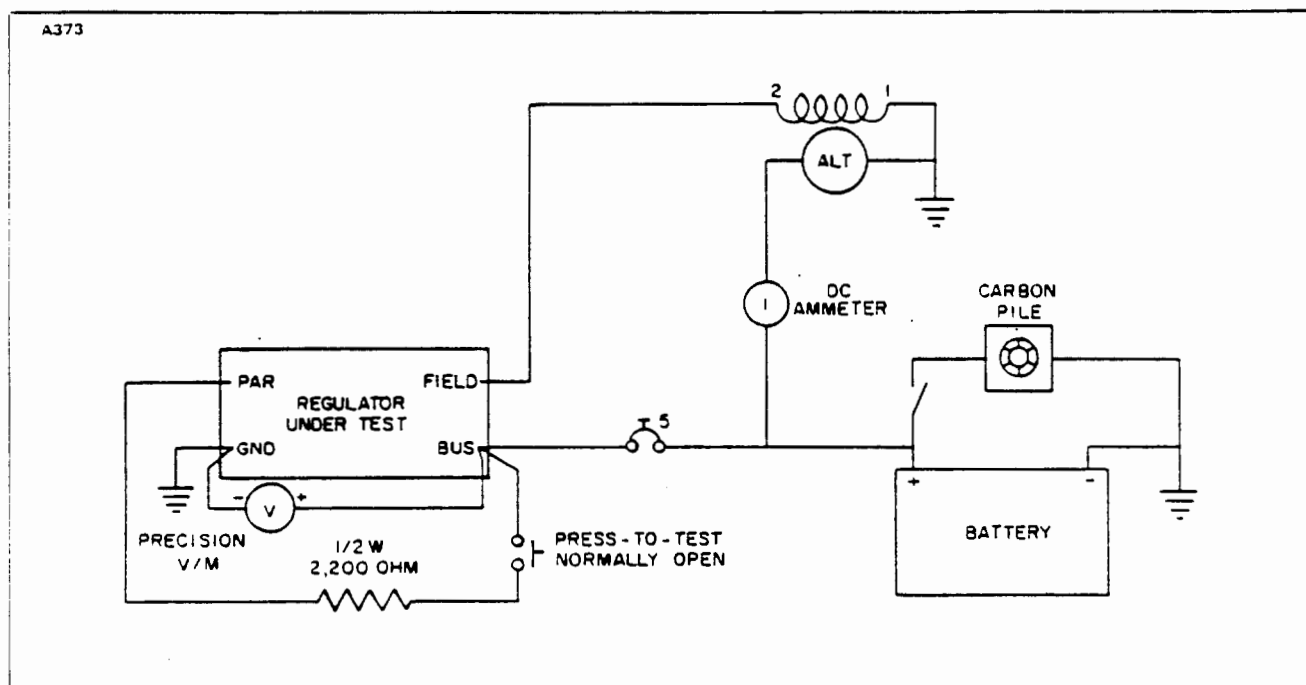


Figure 24-5. Testing Regulator (LAMAR)

24-33-07

Page 24-19

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

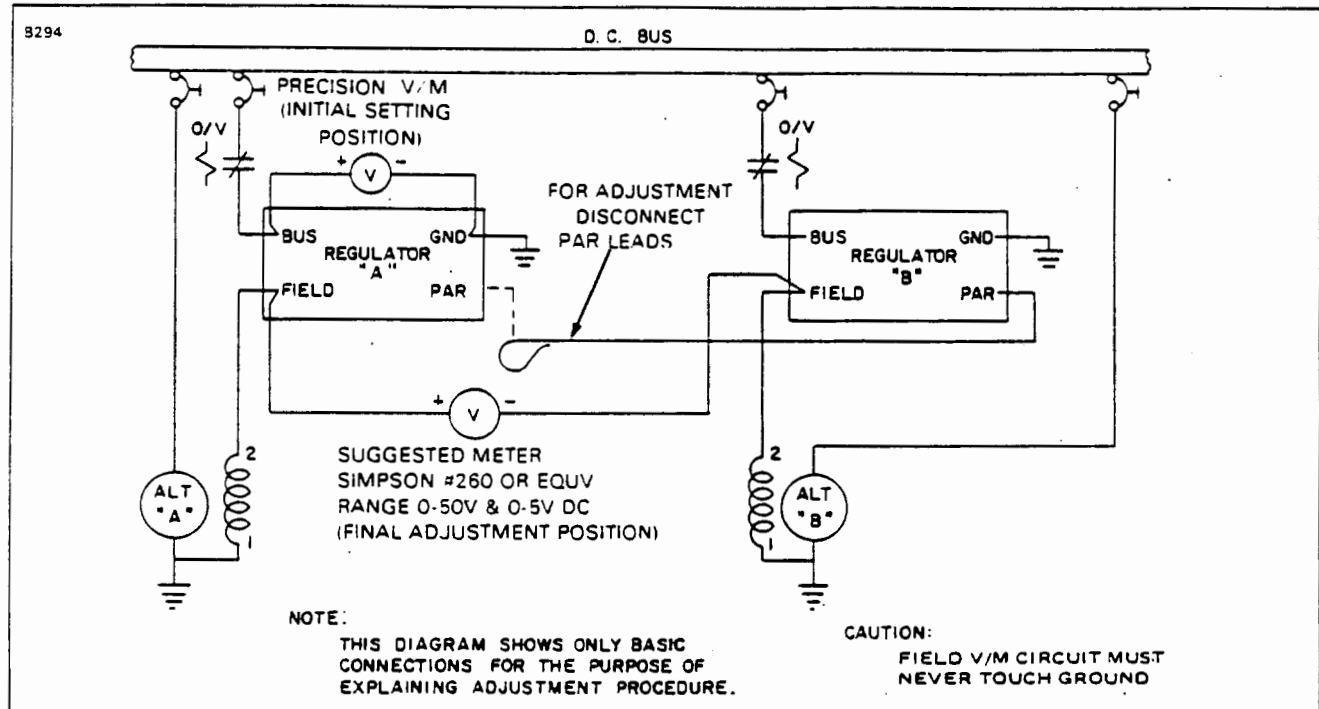


Figure 24-6. Adjusting Regulator (LAMAR)

4. Operate the "LEFT" engine and alternator system with a load of at least 15-amperes and the engine speed at 920 to 1250 RPM to obtain 3,000 to 4,000 alternator RPM for at least one minute. If required, carefully set the "LEFT" regulator voltage adjustment to $14.0 \pm .1$ volts as measured with the precision voltmeter connected to the regulator terminals. Replace the snap plug in the "LEFT" regulator adjustment access hole.

— CAUTION —

DO NOT MAKE ANY FURTHER ADJUSTMENT OF THE "LEFT" REGULATOR.

5. While continuing "LEFT" engine operation with electrical load the same as before, turn on the "RIGHT" alternator system switches. (The "RIGHT" engine, however, is NOT operating.)

6. Now very slowly rotate the "RIGHT" regulator voltage adjustment while observing the field circuit voltmeter. (Suggested range 0-50V.) If a reverse (downscale) reading is obtained, turn the "RIGHT" regulator adjustment counterclockwise to bring the meter up scale. Then, very slowly turn the "RIGHT" regulator adjustment clockwise to make the field voltmeter read near zero. A stable reading should not be expected. A correct adjustment has been achieved when the meter will remain briefly in the vicinity of zero, swinging both upscale and downscale. The use of a low range on the voltmeter is recommended for the final adjustment. (0-50V is suggested.)

7. Replace the snap plug in the "RIGHT" regulator adjustment hole.

8. Shut down the engine and master switch, then replace the connection to the "PAR" terminal which was removed in step 2. Remove all voltmeter leads and test equipment.

24-33-07

Page 24-20

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

BALANCING CIRCUIT OPERATION (REGULATOR).

(Considering two identical alternators and regulators having the "PAR" terminals of the regulators connected.)

1. Balancing circuit operation is initiated within one regulator whenever individual field voltages delivered by the regulator units to their related alternators are not equal.

2. When a difference in individual field voltages occurs, one-half the difference is impressed across R12 within each regulator and is thus applied to the input of Q5.

3. In that regulator which is delivering the lower field voltage, the polarity of R12 voltage drop causes Q5 collector current flow.

4. Q5 collector current flow results in conduction occurring in the collector circuit of Q6.

5. Q6 collector current flows from regulator divider R1/R2+R3 through limiting resistor R17 to ground.

6. Conduction through R17 effectively alters the ratio of the regulator divider R1/R2+R3 in the direction to increase Q1 collector current flow.

7. As described above under REGULATING CIRCUIT OPERATION, increased Q1 current results in increased output from the regulator to the field of its related alternator.

8. Feedback action results in Q6 collector current stabilizing at a value that results in nearly equal field voltage being delivered by the two regulators to their respective alternator fields.

9. The balancing circuit will thus automatically maintain, at a low value, the difference voltage applied to the alternator fields. In a parallel system having identical alternators operating at the same RPM, the output currents of the alternators will thus be maintained nearly equal.

10. In whichever regulator of a pair is set to deliver the highest voltage, the balancing circuits are inactive. Thus system voltage is determined by the regulator of a pair which is set to higher voltage. The lower set regulator will adjust itself automatically, as described above, to deliver the same field voltage as the one which is set higher, within the limits of its design capability.

11. The balancing regulator system as described provides for automatic load balancing of parallel operated alternators having independent field excitation circuits. The pilot can, while in flight, remove either alternator system completely from the aircraft system and maintain operation of the other system.

CHECKING OVERVOLTAGE RELAY.

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

1. B+ is connected to "BAT" terminal of the overvoltage control.

2. B- is connected to the frame of the overvoltage control.

3. Be sure both connections are secure and connected to a clean, bright surface.

4. Connect the positive lead of the voltmeter to the "BAT" terminal of the overvoltage control.

5. Connect the negative lead of the voltmeter to the frame of the overvoltage control.

6. The overvoltage control is set to operate between 16.2 to 17.3 volts. Increase power supply voltage until an audible click is heard when the relay operates.

7. If the relay does not operate between 16.2 to 17.3 volts the overvoltage relay is out of specification and must be replaced.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

AMMETER.

The ammeter is mounted in the instrument panel. This instrument measures the output of the alternator into the entire electrical system including the battery charging demand.

EXTERNAL POWER.

EXTERNAL POWER RECEPTACLE.

The external power receptacle is located on the right side of the nose section. When using external power for operation of any of the airplane's equipment, the master switch must be ON. To start the engine with external power proceed as follows:

— CAUTION —

External power is supplied directly to the electrical bus. Turn off all electrical equipment before applying or removing external power.

1. Turn aircraft MASTER SWITCH and all electrical equipment OFF.
2. Connect the RED lead of PEP (Piper External Power) kit jumper cable to the POSITIVE (+) terminal of external 12-volt battery and the BLACK lead goes to the NEGATIVE (-) terminal.
3. Insert the plug of the jumper cable into the socket located on the aircraft fuselage.
4. Leave MASTER SWITCH OFF and proceed with engine starting technique as follows:
 - A. Start engines with the standard technique but after starting both engines reduce power on the left engine to the lowest possible RPM to reduce sparking, and shut down the right engine.
5. Turn all electrical equipment OFF and remove the jumper cable plug from the aircraft.
6. Turn the aircraft MASTER SWITCH to the ON position and check the alternator ammeter for an indication of output. Do not attempt any flight if there is no indication of alternator output.

— NOTE —

For all normal operations using the PEP jumper cables, the master switch should be OFF, but it is possible to use the ship's battery in parallel by turning the master switch ON. This will give longer cranking capabilities, but will not increase the amperage.

— CAUTION —

Care should be exercised because if the ship's battery has been depleted, the external power supply can be reduced to the level of the ship's battery. This can be tested by turning the master switch ON momentarily while the starter is engaged. If cranking speed increases, the ship's battery is at a higher level than the external power supply. If the battery has been depleted by excessive cranking it must be recharged before the second engine is started. All the alternator current will go to the low battery until it receives sufficient charge, and it may not start the other engine immediately.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

**1J11 THRU 1J23
INTENTIONALLY LEFT BLANK**

CHAPTER

27

FLIGHT CONTROLS

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

CHAPTER 27 - FLIGHT CONTROLS TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
27-00-00	GENERAL	1K3	
27-01-00	Description and Operation	1K3	
27-02-00	Standard Procedures	1K3	
27-03-00	Troubleshooting	1K4	
27-05-00	CONTROL COLUMN ASSEMBLY	1K10	
27-05-01	Removal of Control Column Assembly	1K10	
27-05-02	Installation of Control Column Assembly	1K10	
27-10-00	AILERON CONTROLS	1K12	
27-11-00	Aileron Control Cables	1K12	
27-11-01	Removal of Aileron Control Cables	1K12	
27-11-02	Installation of Aileron Control Cables	1K14	
27-12-00	Aileron Bellcrank	1K15	
27-12-01	Removal of Aileron Bellcrank Assembly	1K15	
27-12-02	Installation of Aileron Bellcrank Assembly	1K15	
27-13-00	Rigging and Adjustment of Aileron Controls	1K18	
27-20-00	RUDDER CONTROLS	1K19	
27-21-00	Rudder Control Cables	1K19	
27-21-01	Removal of Rudder Control Cables	1K19	
27-21-02	Installation of Rudder Control Cables	1K19	
27-21-03	Rigging and Adjustment of Rudder Controls	1K22	
27-22-00	Rudder Trim Controls	1K23	
27-22-01	Removal of Rudder Trim Controls (Forward)	1K23	
27-22-02	Installation of Rudder Trim Controls (Forward)	1K23	
27-22-03	Removal of Rudder Trim Controls (Aft)	1K24	
27-22-04	Installation of Rudder Trim Controls (Aft)	1K24	
27-22-05	Rigging and Adjustment of Rudder Trim Controls	1L2	
27-23-00	Rudder Pedal Assembly	1L3	
27-23-01	Removal of Rudder Pedal Assembly	1L3	
27-23-02	Installation of Rudder Pedal Assembly	1L3	
27-30-00	STABILATOR CONTROLS	1L5	
27-31-00	Stabilator Control Cables	1J12	
27-31-01	Removal of Stabilator Control Cables	1L5	1-83
27-31-02	Installation of Stabilator Control Cables	1L7	1-83
27-32-00	Rigging and Adjustment of Stabilator Controls	1L9	1-83
27-33-00	Stabilator Trim	1L11	
27-33-01	Removal of Stabilator Trim Assembly (Forward)	1L11	
27-33-02	Installation of Stabilator Trim Assembly (Forward)	1L13	
27-33-03	Removal of Stabilator Trim Controls (Aft)	1L14	
27-33-04	Installation of Stabilator Trim Controls (Aft)	1L14	
27-33-05	Rigging and Adjustment of Stabilator Trim	1L14	

27 - Cont./Effec.

Page - 1

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 27 - FLIGHT CONTROLS (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
27-50-00	FLAPS	1L16	
27-51-00	Wing Flap Controls	1L16	
27-51-01	Removal of Wing Flap Controls	1L16	
27-51-02	Installation of Wing Flap Controls	1L18	
27-52-00	Rigging and Adjustment of Wing Flaps	1L18	
27-90-00	STALL WARNING	1L20	A 1-83
27-91-00	Stall Warning Horn and Lift Detector	1L20	A 1-83
27-91-01	Removal of Lift Detector	1L21	A 1-83
24-91-02	Installation of Lift Detector	1L21	A 1-83
24-91-03	Adjustment of Lift Detector	1L21	A 1-83

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

DESCRIPTION AND OPERATION.

The airplane is controlled in flight by the use of three primary control surfaces, consisting of ailerons, stabilator and rudder. Operation of these controls is through the movement of the control column-tee bar assembly and rudder pedals. On the forward end of each control column is a sprocket assembly. A chain is wrapped around the sprockets to connect the right and left controls and then back to idler sprockets on the column's tee bar, which in turn connect to the aileron primary control cables. The cables operate the aileron bellcrank and push-pull rods. The stabilator is controlled by a cable connected to the bottom of the tee bar assembly and operates an aft fuselage bellcrank which controls a push rod connected to the balance arm of the stabilator. Cables also connect the rudder pedals with the rudder sector.

Provisions for directional and longitudinal trim control is provided by an adjustable trim mechanism for the stabilator and rudder. The stabilator trim is controlled by a wheel and drum mounted on the floor tunnel between the front seats. Cables routed aft from the drum to a screw assembly mounted above the stabilator attachment point. This screw assembly in turn moves the push rod which controls the stabilator trim tab. The rudder trim is controlled by a trim wheel behind the flap control lever. Cables for the rudder trim are routed back through the fuselage and up into the tail where they attach to their aft actuator drum. The rudder tab is then driven by a push rod assembly connected to the actuator drum.

STANDARD PROCEDURES.

The following tips may be helpful where applicable in the individual control system procedures.

1. Turnbuckles must be assembled and adjusted in a manner that each terminal end is screwed an approximately equal distance into the barrel. During adjustment, the terminals must not be turned in a manner which would put a permanent twist in the cable.
2. After adjustment is completed, each turnbuckle must be checked. Not more than three terminal threads shall be visible outside the barrel. Locking clips must be installed and checked for proper installation by trying to remove the clips using fingers only. Locking clips which have been installed and removed must be scrapped and new clips used.
3. Torque all nuts in the flight control surface rigging system in accordance with AC 43.13-1A or to torques specified within this manual text.
4. After completion of adjustment, each jam nut must be tightened securely and inspected.
5. On push rods or rod ends provided with an inspection hole, the screw must be screwed in sufficiently far to pass the hole. This can be determined visually or feel, by inserting a piece of wire into the inspection hole. If no inspection hole is provided, a minimum of .375 of an inch thread engagement must be maintained.
6. All cable rigging tensions given must be corrected to ambient temperature in the area where the tension is being checked by using Chart 2702.
7. See Figure 27-1 for the proper method of adjusting rod ends to prevent possible damage and binding of bearing surface in rod end.

— CAUTION —

If ever the flaps and ailerons are both disconnected from the control system and left to hang on their hinges, be careful in letting one rotate down after having released the other as they will "lock-up" and damage their skins.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

TROUBLESHOOTING.

Chart 2701 list troubles peculiar to the flight controls along with their probable causes and suggested remedies. When troubleshooting the flight controls, additional reference may be obtained from Chapters 55 and 57 on control surface balancing if required. After the trouble has been corrected, check the entire system for security and operation.

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.
Control wheels not synchronized.	Cables crossed or routed incorrectly.	Check routing of control cables.
	Incorrect control column rigging.	Rerig control column.
Control wheels not horizontal when ailerons are neutral.	Incorrect rigging of aileron system.	Rerig ailerons.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont)

Trouble	Cause	Remedy
AILERON CONTROL SYSTEM (cont)		
Incorrect aileron travel.	Aileron control rods not adjusted properly.	Adjust control rods.
	Aileron bellcrank stops not adjusted properly.	Adjust bellcrank stops.
Correct aileron travel cannot be obtained by adjusting bellcrank stops.	Incorrect rigging of aileron cables, control wheel and control rod.	Rerig system.
Control wheel stops before control surfaces reach full travel.	Incorrect rigging between control wheel and control cables.	Rerig system.
RUDDER CONTROL SYSTEM		
Lost motion between rudder pedals and rudder.	Cable tension too low.	Adjust cable tension.
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Bolts attaching rudder to bellcrank are loose.	Tighten bellcrank bolts.
Excessive resistance to rudder pedal movement.	System not lubricated properly.	Lubricate system.
	Rudder pedal torque tube bearing in need of lubrication.	Lubricate torque tube bearings.
	Cable tension too high.	Adjust cable tension.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Cables crossed or routed incorrectly.	Check routing of control cables.

27-03-00

Page 27-03

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont)

Trouble	Cause	Remedy
RUDDER CONTROL SYSTEM (cont)		
Rudder pedals not neutral when rudder is streamlined.	Rudder cables incorrectly rigged.	Rerig rudder cables.
Incorrect rudder travel.	Rudder sector stop incorrectly adjusted.	Rerig sector stops.
	Nose wheel contacts stops before rudder.	Readjust nose wheel stops.
RUDDER TRIM CONTROL SYSTEM		
Trim control knob moves with excessive resistance.	System not lubricated properly.	Lubricate system.
STABILATOR CONTROL SYSTEM		
Lost motion between control wheel and stabilator.	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 stabilator 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.
	Cables crossed or routed incorrectly.	Check routing of control cables.
	Bent stabilator hinge.	Repair or replace stabilator hinge.

27-03-G.

Page 27-04

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont)

Trouble	Cause	Remedy
STABILATOR CONTROL SYSTEM (cont)		
Incorrect stabilator travel.	Stabilator stops incorrectly adjusted.	Adjust stop screws.
Correct stabilator travel cannot be obtained by adjusting stops.	Stabilator cables incorrectly rigged.	Rerig stabilator cables.
STABILATOR 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 properly.
	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 properly.
	Trim tab hinge binding.	Lubricate hinge. If necessary, replace.
Trim tab fails to reach full travel.	Cables crossed or routed incorrectly.	Check routing of control cables.
	System incorrectly rigged.	Check and/or adjust rigging.
	Trim drum incorrectly wrapped.	Check and/or adjust rigging.

27-03-00

Page 27-05

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont)

Trouble	Cause	Remedy
STABILATOR TRIM CONTROL SYSTEM (cont)		
Trim indicator fails to indicate correct trim position.	Trim indicator unit not adjusted properly.	Readjust trim indicator.
FLAP CONTROL SYSTEM		
Flaps fail to extend or retract.	Control cable broken or disconnected.	Replace or reconnect control cable.
Flaps not synchronized or fail to move evenly when retracted.	Incorrect rigging of system.	Rerig flap system.

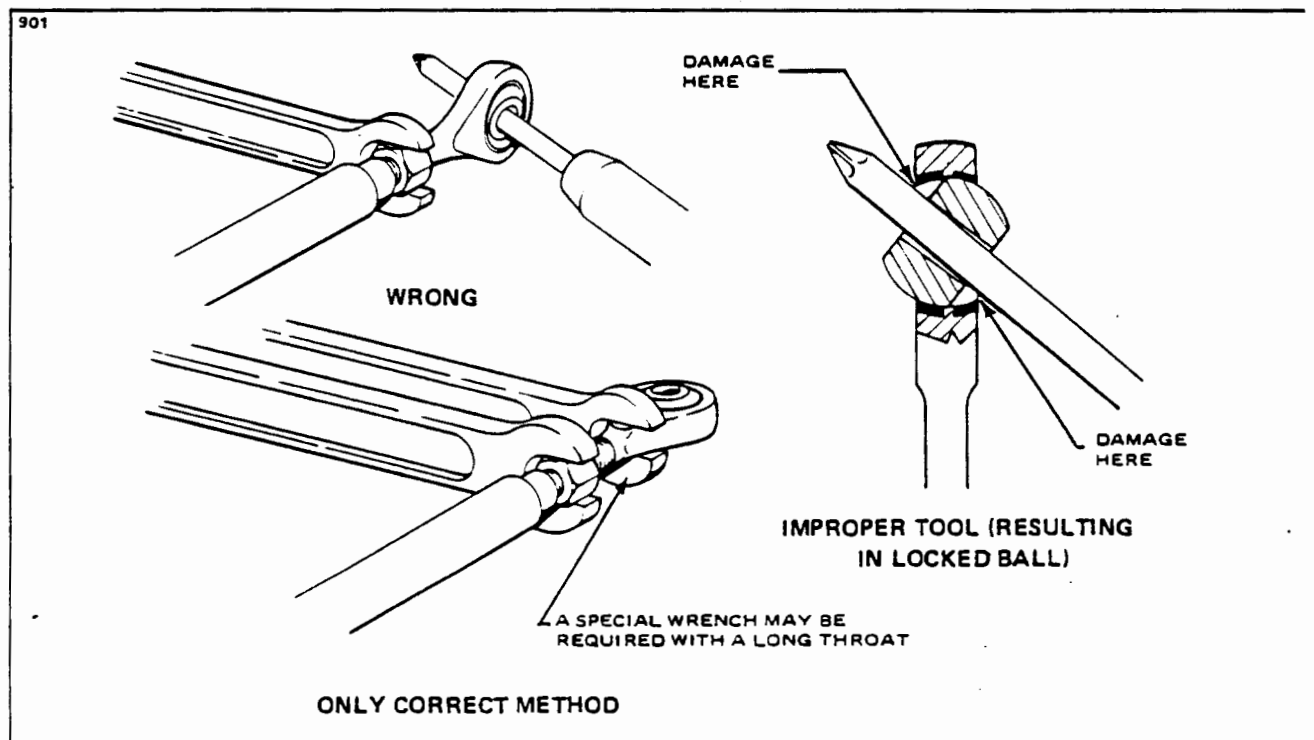
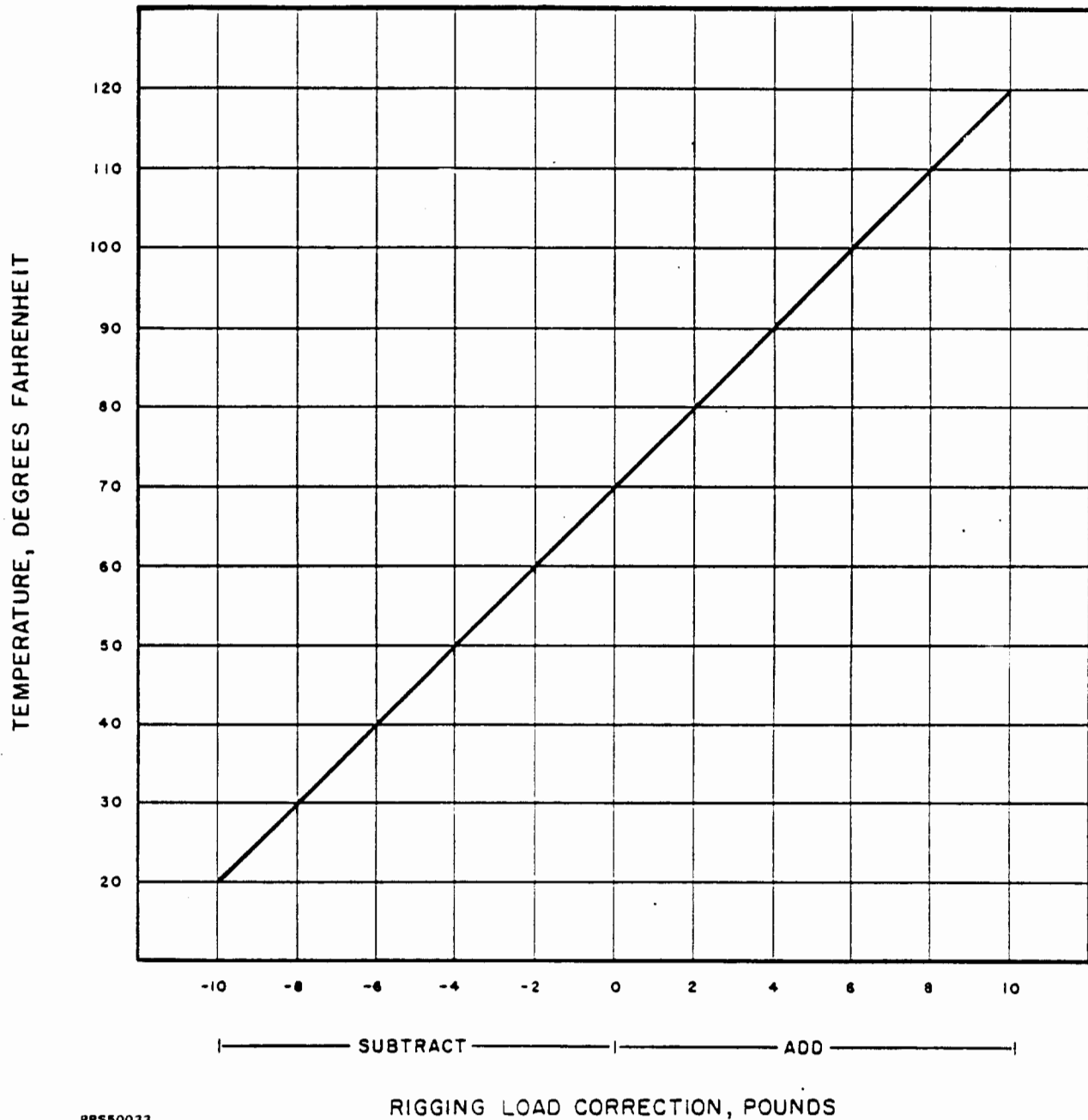


Figure 27-1. Correct Method of Installing Rod End Bearings

PIPER AIRCRAFT
PA-44-180/180T
*MAINTENANCE MANUAL

CHART 2702. CABLE TENSION VS. AMBIENT TEMPERATURE



— NOTE —

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CONTROL COLUMN ASSEMBLY.

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

1. To remove either control wheel with tube, the following procedure may be used:
 - A. Separate the control wheel tube from the flexible joint that is located on either side of the tee bar assembly by removing the nut, washer and bolt. Pull the tube from the flexible joint.
 - B. If removing the left control tube, slide the stop from the tube.
 - C. Should wires for the various Autopilot systems be installed in the control tube, disconnect them at the quick disconnect terminals behind the instrument panel. Draw the wires back into the tube and back out through the forward end of the tube.
 - D. Remove the control wheel assembly from the instrument panel.
2. The tee bar with assembled parts may be removed from the airplane by the following procedure:
 - A. Remove the access panel to the aft section of the fuselage.
 - B. Relieve cable tension from the stabilator control cables at one of the stabilator cable turnbuckles in the aft section of the fuselage.
 - C. Relieve tension from the aileron control cables and chains at the turnbuckle that connects the chains at the top of the tee bar.
 - D. Disconnect the control chains from the control cables where the chains and cables join by removing the cotter pins, nuts, bolts and bushings.
 - E. If the control wheel assemblies have not been previously disconnected from the tee bar assembly, separate the control wheel tubes at the flexible joints by removing the nuts, washers and bolts.
 - F. Remove the tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove the plate attachment screws.
 - G. Remove the two aileron control cable pulleys attached to the lower section of the tee bar by removing the pulley attachment bolt.
 - H. Disconnect the stabilator control cables from the lower end of the tee bar assembly.
 - I. Disconnect the necessary control cables, such as the propeller pitch control, mixture control, etc., that will allow the tee bar assembly to be removed.
 - J. Remove the tee bar assembly by removing the attachment bolts with washers and nuts which are through each side of the floor tunnel, and lifting it up and out through the right side of the cabin.

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

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

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

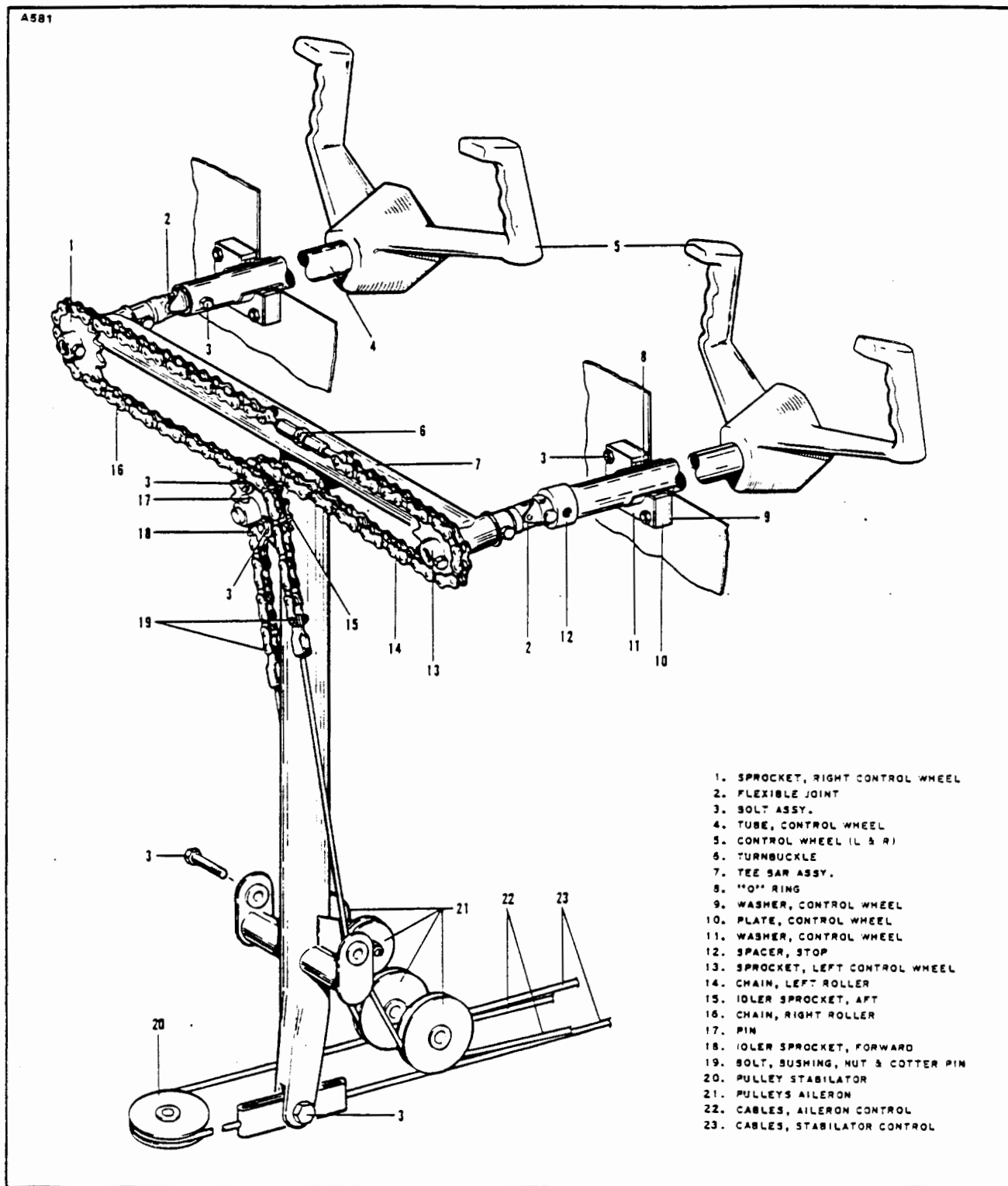


Figure 27-2. Control Column Assembly

27-05-02

Page 27-09

Reissued: December 12, 1979

1K11

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

G. Connect the aileron control cables to the ends of the chains with bolts, bushings, nuts and cotter pins.

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

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

J. Tighten the connecting bolts of the idler sprockets.

K. Install the floor tunnel plate and secure with screws. Fasten the tunnel carpet in place.

2. Either control wheel assembly may be installed by the following procedure:

A. Insert the control wheel tube through the instrument panel.

B. Should wires for the various Autopilot systems need to be installed in the control tube, route them through the hole in the forward side of the tube and out of the small hole in the side. Position the rubber grommet in the hole in the side of the tube.

C. On the left control tube, install the stop.

D. Connect the control wheel tube (4) to the flexible joint of the tee bar assembly. If the control cables and/or chains have not been removed or loosened, place the ailerons in neutral and install the control tube on the flexible joint to allow the control wheel to be neutral. Install bolt, washer and nut and tighten.

AILERON CONTROLS.

AILERON CONTROL CABLES.

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

1. For the removal of any of the control cables in the fuselage or wings, first remove the floor panel that is located directly aft of the main spar by removing the center seats, seat belt attachments and the screws securing the panel. Lift the panel and remove from the airplane.

2. To remove either the right or left primary cables that are located in the fuselage, the following procedure may be used:

A. Remove the fuel selector knobs by loosening the set screws in each knob.

B. Remove the fuel selector knobs and cover assemblies by removing the knob set screws and cover attachment screws.

C. Remove the tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove the plate attachment screws.

D. Remove the forward heat duct from one side of the floor tunnel (preferably from the side from which the cable is to be removed) by removing the trim control wheel cover, the heater baffles from the side of the duct, the floor carpet and the duct attachment screws.

E. Separate the primary control cable at the turnbuckle located in the floor opening aft of the main spar.

F. Remove the cable pulleys attached to the lower section of the control column tee bar assembly by removing the pulley attachment bolt.

G. Move cable guard located under the pulley cluster below the fuel selector by removing the cotter pin from the exposed end of the guard and sliding it to the left or right as required.

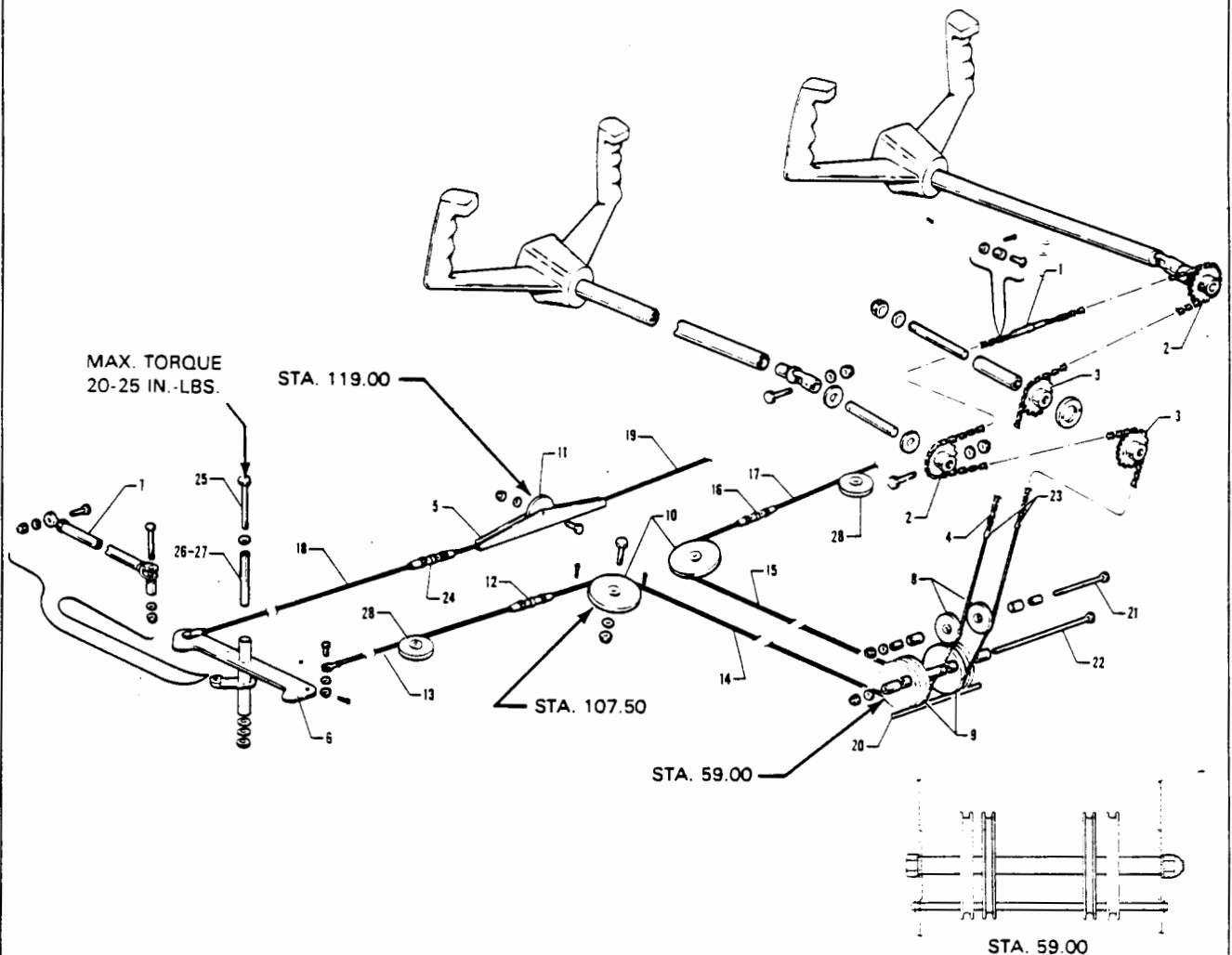
27-11-01

Page 27-10

Revised: January 3, 1983

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

2309



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

A586

Figure 27-3. Aileron Controls

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

- H. Remove the cotter pins used as cable guards at the pulley in the forward area of the floor opening aft of the main spar.
- I. Disconnect the cable from the control chain at the control column tee bar assembly by removing the cotter pin, nut, bolt and bushing that connect the two together. Secure the chains in some manner to prevent them from unwrapping from around the sprockets.
- J. Draw the cable back through the floor tunnel.
- 3. The primary control cable in either wing may be removed by the following procedure:
 - A. Remove the access plate to the aileron bellcrank located on the underside of the wing forward of the inboard end of the aileron.
 - B. If not previously disconnected, separate the cable at the turnbuckle located in the floor opening aft of the main spar.
 - C. Disconnect the pulley guard pin from pulley.
 - D. Disconnect the cable from the forward end of the aileron bellcrank by removing the cotter pin, nut, washer and bolt.
 - E. Draw the cable from the wing.
- 4. Either balance cable may be removed by the following procedure:
 - A. Separate the balance cable at the turnbuckle in the right side of the floor opening aft of the main spar.
 - B. If the left balance cable is to be removed, remove the cotter pin used as a cable guard at the pulley in the center of the floor opening.
 - C. Remove the access plate to the aileron bellcrank located on the underside of the wing forward of the inboard end of the aileron.
 - D. Disconnect the cable from the aft end of the aileron bellcrank by removing the cotter pin, nut, washer and bolt.
 - E. Draw the cable from the wing.

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

- I. The installation of either the right or left primary control cable that is located in the fuselage may be accomplished as follows:
 - A. Draw the cable through the fuselage floor tunnel.
 - B. Connect the cable to the end of the control chain and secure using bushing, bolt, nut and cotter pin.
 - C. Place the cable around the pulley that is located in the tunnel, below the fuel selector. Install cable guard and secure with cotter pin.
 - D. Position cables and install the cable pulleys that attach to the lower section of the tee bar assembly. Secure with bolt, washer and nut.
 - E. Place the cable around the pulley that is located in the floor opening just aft of the main spar and install cotter pin cable guards.
 - F. If the primary control cable in the wing is installed, connect the control cable ends at the turnbuckle located in the floor opening aft of the main spar.
 - G. Check rigging and adjustment.
 - H. Position the heat duct and secure with screws.
 - I. Install the tunnel plate aft of tee bar assembly and secure with screws.
 - J. Put the floor carpet in place and secure.
 - K. Install the lower and upper selector covers and secure with screws.
 - L. Place the fuel selector knobs in place and secure with set screws.

27-11-0.

Page 27-12

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2. The primary control cable in either wing may be installed by the following procedure:
 - A. Draw the control cable into the wing.
 - B. Connect the cable to the forward end of the aileron bellcrank using a bolt, washer, nut and cotter pin. Allow the cable end to rotate freely on the bellcrank.
 - C. If the primary control cable in the fuselage is installed, connect the ends at the turnbuckle located in the floor opening aft of the main spar.
 - D. Check rigging and adjustment.
 - E. Install the access plate on the underside of the wing.
3. Either balance cable may be installed by the following procedure:
 - A. Draw the cable into the wing.
 - B. Connect the cable to the aft end of the aileron bellcrank using a bolt, washer, nut and cotter pin. Allow the cable end to rotate freely on the bellcrank.
 - C. Connect the balance cable ends at the turnbuckle in the floor opening aft of the main spar.
 - D. If the left cable was removed, install the cotter pin cable guard at the pulley located in the center of the floor opening.
 - E. Check rigging and adjustment.
 - F. Install the access plate on the underside of the wing.
 - G. Install the floor panel, seat belt attachments and seats.

AILERON BELLCRANK.

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

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

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

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

27-12-06

Page 27-13

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

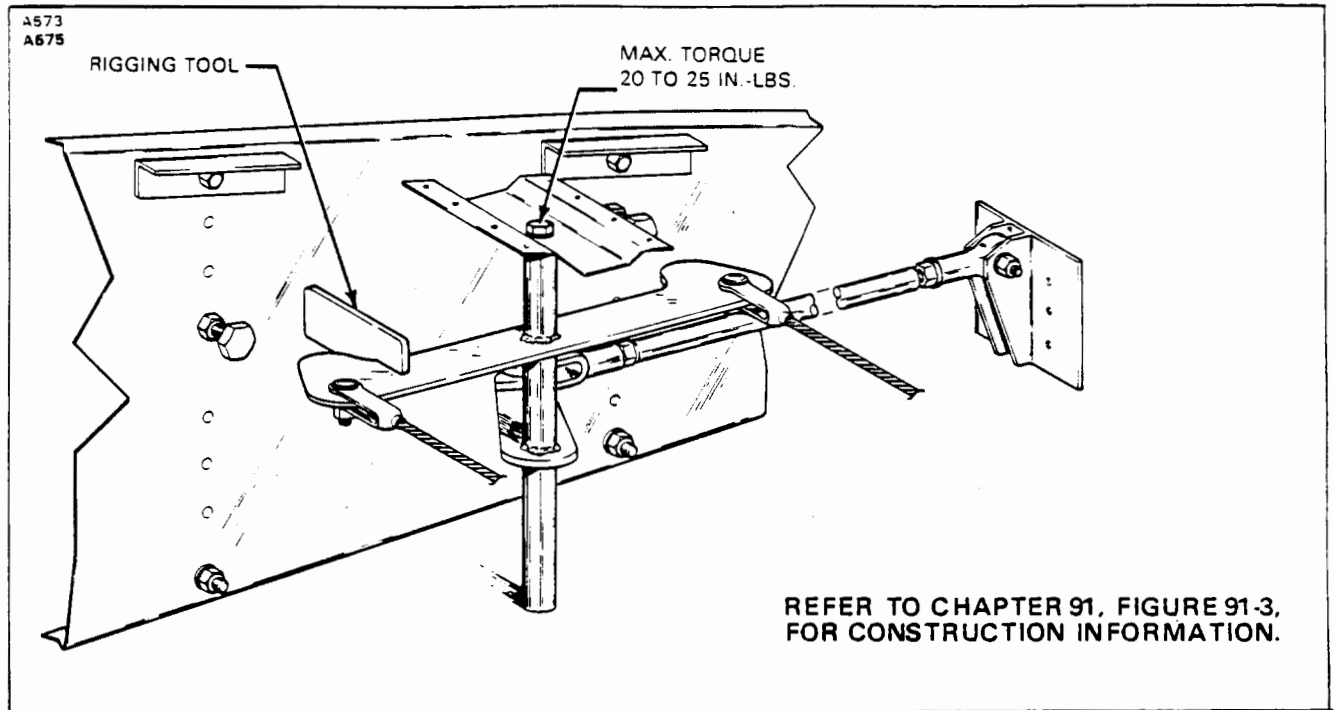
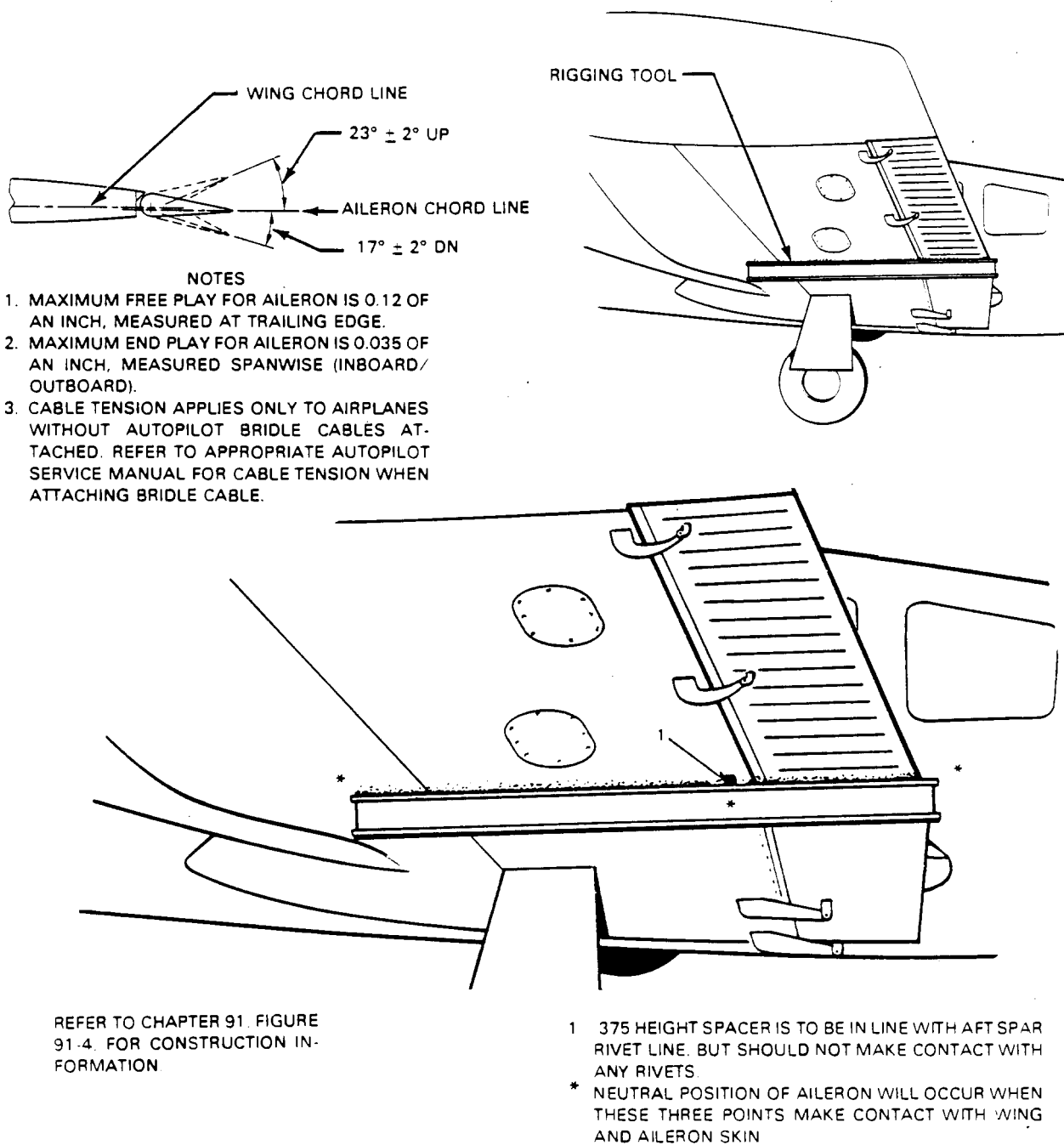


Figure 27-4. Bellcrank Rigging Tool

THIS SPACE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL



CABLE TENSIONS (SEE NOTE 3)
AILERON

40 lbs. ± 5 lbs.

Figure 27-5. Aileron Rigging

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

7. Install the access plate on the underside of the wing, the floor panel aft of the main spar, seat belt attachments and seats.

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

1. To check and adjust the rigging of the aileron controls, first insure that the flaps are adjusted and rigged properly, and in their up locked position.
2. Ascertain that the control wheels are properly adjusted and in their neutral position. Place the tee bar in the full forward position and maintain in this position by use of a suitable tool.
3. Ascertain that both bellcranks are at their neutral positions. The neutral position is obtained when the forward and aft cable connection holes on the bellcrank are an equal distance from the adjacent outboard wing rib. Rigging tools, as shown in Figure 27-4 may be fabricated to hold the bellcranks in their neutral positions. A snug fit of the tool is required between the bellcrank arms and ribs. To do so, it may be necessary to loosen a primary or balance cable. Refer to Chapter 91 for tool fabrication of tool.
4. With the aileron control rod connected between the bellcrank and aileron, check that the trailing edge of the aileron is even with the trailing outboard edge of the flaps. This is the aileron neutral position. The ailerons may be allowed to "droop" by approximately .125 of an inch at this point.
5. Should the two trailing edges (aileron and flap) not align, disconnect the aileron control push rod from the bellcrank and aileron, and loosen the jam nuts at each rod end and adjust the rod ends to obtain trailing edge alignment. Apply a slight up pressure against the trailing edge of the aileron while making this adjustment. Ascertain that there is sufficient thread engagement at both rod ends. Any adjustment should be distributed between both rod ends.
6. Adjust the primary and balance cable tension as given in Figure 27-5 by the following procedure:
 - A. Remove the two front seats if desired, and the bottom of the rear seat to facilitate in the necessary operation.
 - B. Loosen the connecting bolts of the idler crossover sprockets at the control tee bar to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets, then tighten bolts.
 - C. Ascertain that both bellcranks are at their neutral position.
 - D. Adjust the turnbuckles (located in the access opening just aft of the main spar) of the primary and balance cables to their proper cable tension and maintain neutral position of the control wheels. To obtain neutral position of both control wheels, it may also be necessary to adjust the roller chain turnbuckle located between the control wheel sprockets. Finish the adjustment with even tension on all cables and remove any rigging tools.
7. Check control operation to insure that the left aileron up and right aileron down stops are contacted simultaneously and vice versa. Adjust the stops as required.
8. Rotate the left control wheel in each direction until the bellcranks contact the stops. The sprocket stops on the tee bar should not be contacted until additional "override" movement (cushion) of 0.030 to 0.040 is obtained between the sprocket pin and adjustable stop bolts. (Refer to Figure 27-2.)
9. Place the ailerons in the neutral position (aligned with flaps). Check that the up and down travels of each aileron from neutral position is in accordance with specifications given in Figure 27-5. When measuring these travels maintain a light up or down pressure just sufficient to remove the slack between the bellcrank and aileron. Total free play at the aileron trailing edge should not exceed 0.120 of an inch.
10. Should an out-of-trim condition persist despite all rigging corrections that can be made, there is a possibility that the trailing edge of the aileron has been used to move the aircraft forward. This can result in a slight bulging of the aileron contour at the trailing edge which will cause an out-of-rig condition that is very difficult to correct.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

RUDDER CONTROLS.

RUDDER CONTROL CABLES.

REMOVAL OF RUDDER CONTROL CABLES. (Refer to Figure 27-6.)

1. To remove either the forward or aft rudder cables, first remove the access panel to the aft section of the fuselage.
2. Disconnect the desired cable at the turnbuckle in the aft section of the fuselage.
3. Either forward rudder cable may be removed by the following procedure:
 - A. Remove the floor panel located directly aft of the main spar by removing the center seats, seat belt attachments and the screws securing the floor panel. Lift the panel and remove from airplane.
 - B. From within the area of the floor opening, remove the cable rub blocks that are attached to the spar housing by removing the block attachment screws. Also remove the cable guard pin at the pulley cluster in the aft area of the opening by removing a cotter pin from one end of the guard.
 - C. Remove the fuel selector panel cover by removing the selector knobs and the cover attachment screws.
 - D. Remove the lower selector cover.
 - E. Remove the tunnel plate just aft of the tee bar by removing enough carpet from the tunnel to allow the plate attachment screws and the plate to be removed.
 - F. Remove the forward heat duct from one side of the floor tunnel. (Preferably from the side from which the control cable is to be removed.)
 - G. Move the cable guard located under the pulley cluster by removing the cotter pin from the exposed end and sliding it to the left or right as required.
 - H. Disconnect the end of the cable from the arm on the rudder pedal torque tube by removing the cotter pin, nut, washer and bolt.
 - I. Draw the cable from the floor tunnel.
4. The aft rudder control cables may be removed by the following procedure:
 - A. Remove the fairing by removing its attachment screws.
 - B. Disconnect the cable from the rudder sector by removing cotter pin.
 - C. Draw the cable through the fuselage.

INSTALLATION OF RUDDER CONTROL CABLES. (Refer to Figure 27-6.)

1. The forward rudder control cables may be installed by the following procedure:
 - A. Draw the control cable through the floor tunnel.
 - B. Connect the end of the cable to the arm on the rudder pedal torque tube by installing bolt, washer, nut and cotter pin. Allow the cable end to rotate freely.
 - C. Connect the cable to the aft control cable at the turnbuckle in the aft section of the fuselage. If the aft control cables are not installed, install at this time per Step 2. Ascertain that each cable is in the groove of its pulley.
 - D. Move the cable guard that is located in the forward tunnel, at the pulley cluster, into position, and secure with cotter pin.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

2308

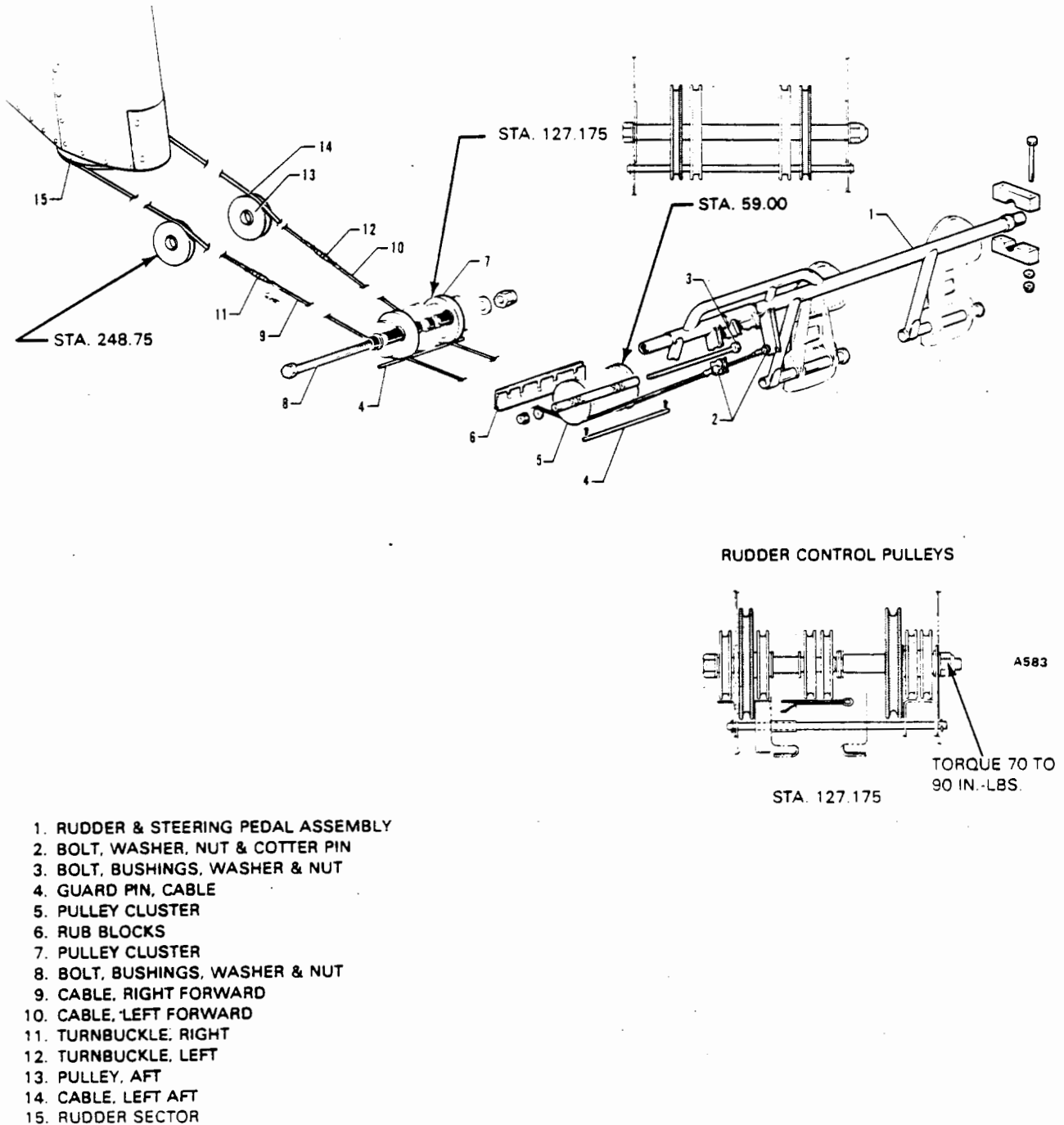


Figure 27-6. Rudder Controls

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

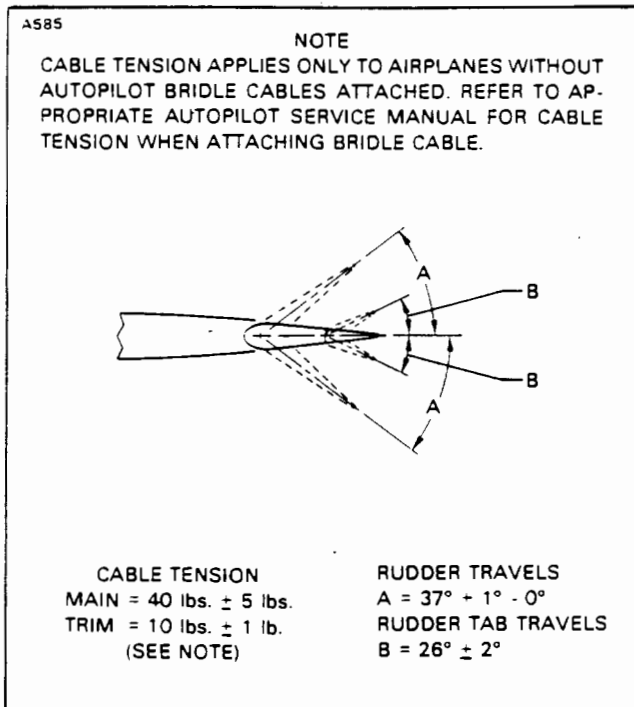


Figure 27-7. Rudder Rigging

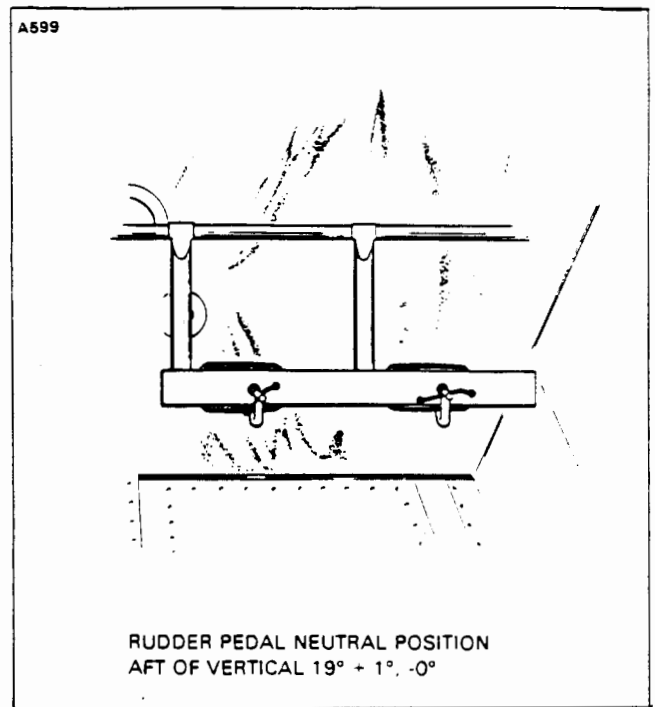


Figure 27-8. Clamping Rudder Pedals

- E. Install the cable guard pin under the pulley cluster located in the aft area of the aft floor tunnel and secure with screws.
 - F. Set cable tension and check rigging and adjustment.
 - G. Install the heat duct and secure with screws.
 - H. Install the forward tunnel plate aft of the tee bar and secure with screws.
 - I. Put the floor carpet in place and secure.
 - J. Install the lower and upper selector covers and secure with screws.
 - K. Place the fuel selector knobs in place and secure with set screws.
 - L. Install the floor panel and seat belt attachment aft of the main spar securing the panel with screws, and install the seats.
2. The aft rudder control cables may be installed by the following procedure:
 - A. Position the control cable in the fuselage.
 - B. Connect the end of the cable to the rudder sector with bolt cotter pin.
 - C. Connect the other cable end to forward control cable at the turnbuckle in the aft section of the fuselage.
 - D. Set cable tension and check rigging and adjustment.
 - E. Install fairing and secure with screws.
 3. Install the access panel to the aft section of the fuselage.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

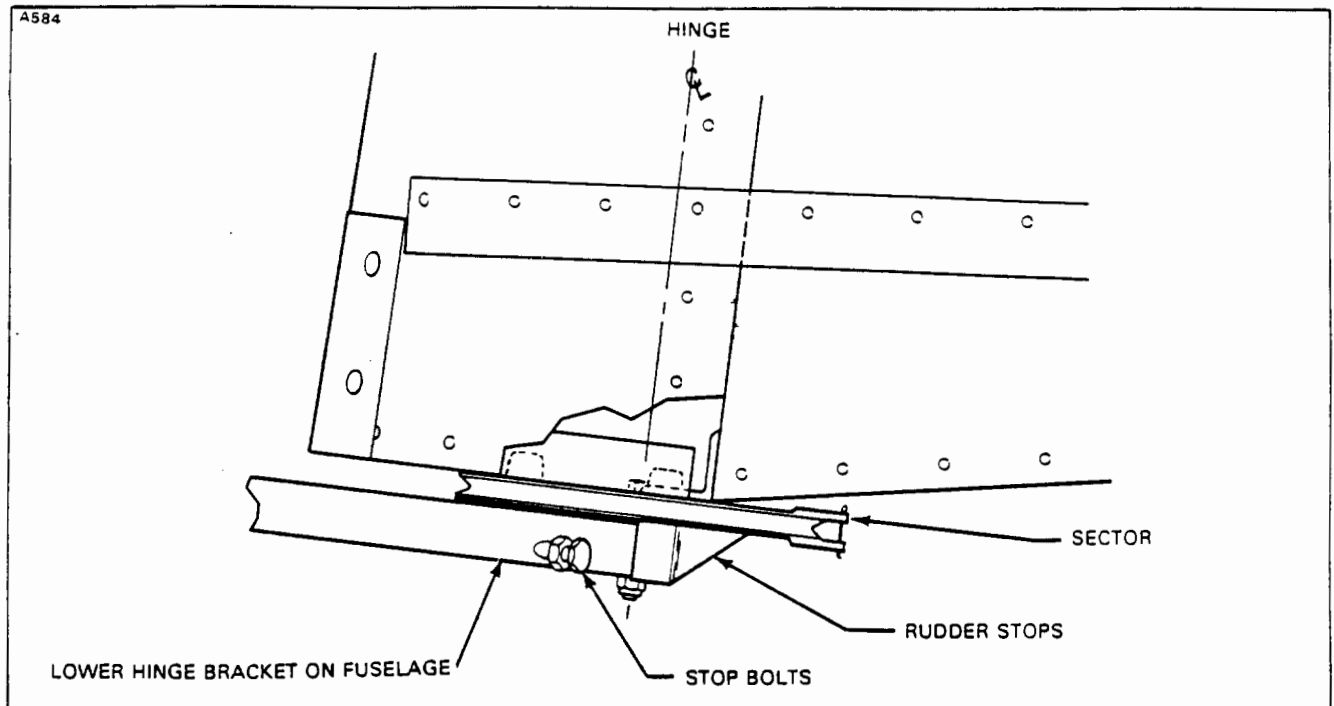


Figure 27-9. Rudder Travel Adjustments

RIGGING AND ADJUSTMENT OF RUDDER CONTROLS.

PPS50033

1. To check and set the correct degree of rudder travel, the following procedure may be used:
 - A. Check the rudder travel by swinging the rudder until it contacts its stop. If the control cables are connected, use the rudder pedals to swing the rudder.
 - B. With the rudder against its stop, place a rigging tool against the side of the rudder and vertical stabilizer as shown in Figure 27-7. (Ascertain that the tool is not contacting any rivets.) If no gap exists between the rigging tool and the surface of the rudder and vertical stabilizer, the rudder stop for one direction of travel is correct as required in Chart 2701. (This tool may be fabricated from dimensions given in Chapter 91.)
 - C. Swing the rudder in the other direction and check travel as directed in Step B.
 - D. Should the rudder travel be incorrect showing a gap between the tool and any part of the control surfaces, the fairing should be removed and the stops reset to obtain correct rudder travel. (Refer to Figure 27-9.)
2. To set cable tension and alignment of the rudder, the following procedure may be used:
 - A. Remove the access panel to the aft section of the fuselage.
 - B. Ascertain that the nose gear steering has been aligned and rudder pedals set fore and aft according to Alignment of Nose Landing Gear, Chapter 32.
 - C. Clamp the rudder pedals to align in a lateral position as shown in Figure 27-8.
 - D. Adjust the turnbuckles in the aft section of the fuselage to obtain proper cable tension as given in Figure 27-7 and to allow the rudder to align at neutral position. Neutral position can be determined by standing behind the airplane and sighting the rudder with the vertical stabilizer.
 - E. Check safety of turnbuckles.

27-21-03

Page 27-20

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

3. Check that when the rudder contacts its stops, the clearance between the nose wheel stops and the nose wheel horn is between .06 and .12 of an inch. A more accurate check can be made with weight off of the nose wheel. Adjust the stops according to Alignment of Nose Landing Gear, Chapter 32.
4. Install the fairing and the access panel to the aft section of the fuselage.

RUDDER TRIM CONTROLS.

REMOVAL OF RUDDER TRIM CONTROLS (FORWARD). (Refer to Figure 27-10.)

1. To remove the trim control wheel assembly and/or trim control cables, first remove the panel to the aft section of the fuselage.
2. If the aft trim cable is not being removed, block the cables aft of the turnbuckles to prevent the cables from unwrapping at the trim barrel in the fin. (Refer to Figure 27-10.)
3. If the trim control wheel is to be removed, loosen the cables at the turnbuckles and proceed with the following steps:
 - A. Remove the trim cover assembly by removing the cover attaching screws.
 - B. Remove the nut, washers and bolt that secures the trim wheel assembly between its mounting bracket. Draw the wheel from the brackets. Use caution not to damage the trim indicator wire.
 - C. Unwrap the lower cable from the drum.
 - D. The wheel and drum are joined by three screws. Remove screws and separate these two items and unwrap the upper cable.
 - E. Tie the cables forward to prevent them from slipping back into the floor tunnel.
4. If the trim control wheel and forward cables are to be removed, block the aft cables aft of the turnbuckles and proceed with the following steps:
 - A. Remove the tunnel cover in the aft area of the cabin by removing the carpet and heater duct over the tunnel and the cover attachment screws.
 - B. Remove the floor panel located directly aft of the main spar by removing the seats, seat belt attachments and screws securing the panel. Remove the panel from the airplane.
 - C. Remove the trim cover assembly to gain access to the trim wheel mounting hardware.
 - D. Disconnect the turnbuckles and remove the guard plate (see Sketch C) at pulley cluster.
 - E. Remove the nut, washers, and bolt securing the rudder trim control wheel and drum assembly to its mounting bracket and remove the complete assembly with cables. Use caution not to damage the indicator wire.

INSTALLATION OF RUDDER TRIM CONTROLS (FORWARD). (Refer to Figure 27-10.)

1. The trim control wheel with drum may be installed by the following procedure:
 - A. Wrap the left cable on the trim drum by inserting the swagged ball of the cable in the slot provided in the upper side of the drum which mates with the control wheel. Looking at this side, proceed to wrap three and a half turns of cable in a clockwise direction.
 - B. Attach the trim control wheel to the cable drum by aligning the long lug of the drum with the long slot of the wheel and securing the two pieces together with three screws.
 - C. Wrap the right cable on the drum by inserting the swagged ball of the cable into the slot provided in the flanged side (lower) of the drum. Looking at this side, proceed to wrap three and a half turns of cable in a clockwise direction.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

D. Lubricate and install the bushing in the lower side of the drum and the bearing on the upper side of the trim control wheel assembly.

E. Align the trim control cables and position the control wheel assembly between its mounting brackets. Ascertain that the trim indicator wire is positioned in the spiraled slot of the wheel with no binding on the end. Install the retainer bolt from the upper side, along with the washer and secure with washer and nut from below.

F. Install the cover assembly over the trim control wheel and secure with screws unless the control cables have yet to be installed.

2. The trim control cables may be installed by the following procedure:

A. Draw the cables through the floor tunnel and route them through the pulley clusters at station 128.70 and 84.0.

B. Wrap the cable drum and install the trim control wheel as given in Step 1.

C. Position the cables over the proper pulleys (as shown in Sketches B and C of Figure 27-10.)

D. Connect the forward cables to the aft cables at the turnbuckles in the aft section of the fuselage. If aft cable is not installed, proceed with instructions given in Paragraph titled Installation of Rudder Trim Controls (Aft).

E. Remove the blocks securing the aft cables and check that the cables are seated on the pulleys. Install the guard pins at the pulley clusters. (Refer to Sketches B and C of Figure 27-10.)

F. Set trim cable tension in accordance with specifications given in Figure 27-10 and check rigging and adjustment. Safety both turnbuckles.

G. Install the tunnel cover on the forward tunnel and secure with screws.

H. Install the carpet over the floor tunnel.

I. Install the cover assembly over the trim control wheels and flap handle and secure with screws.

J. Install the seat belts removed from the top of the floor tunnel and secure with bolt, washer and nut.

K. Install the aft floor tunnel cover, heater duct and carpet.

L. Install the carpet over the aft floor plate.

3. Install the panel to the aft section of the fuselage and the seats.

REMOVAL OF RUDDER TRIM CONTROLS (AFT). (Refer to Figure 27-10.)

1. If the forward trim mechanism is not being removed at this time, block the cables forward of the turnbuckles to prevent the cables from unwrapping at the forward trim drum. (Refer to Figure 27-10.)

2. Secure the trim cables at the aft trim drum barrel.

3. Disconnect the trim cable turnbuckles in the aft section of the fuselage.

4. Remove the cable guards from the pulley bracket located at station 128.70.

5. Disconnect the trim screw link assembly from the screw.

6. Remove the cotter pin from the aft end of the screw.

7. Remove the two bolt assemblies securing the forward support to the mounting bracket.

8. Remove the screw and barrel assembly along with the aft cables from the airplane.

INSTALLATION OF RUDDER TRIM CONTROLS (AFT). (Refer to Figure 27-10.)

1. Insert the complete trim screw and barrel assembly into the fin. Route the trim cable ends around the pulleys at station 128.70.

2. Insert the trim screw and barrel assembly into the mounting bracket. Place the washer on the forward end of the barrel and install the support assembly in the mounting bracket.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

2304

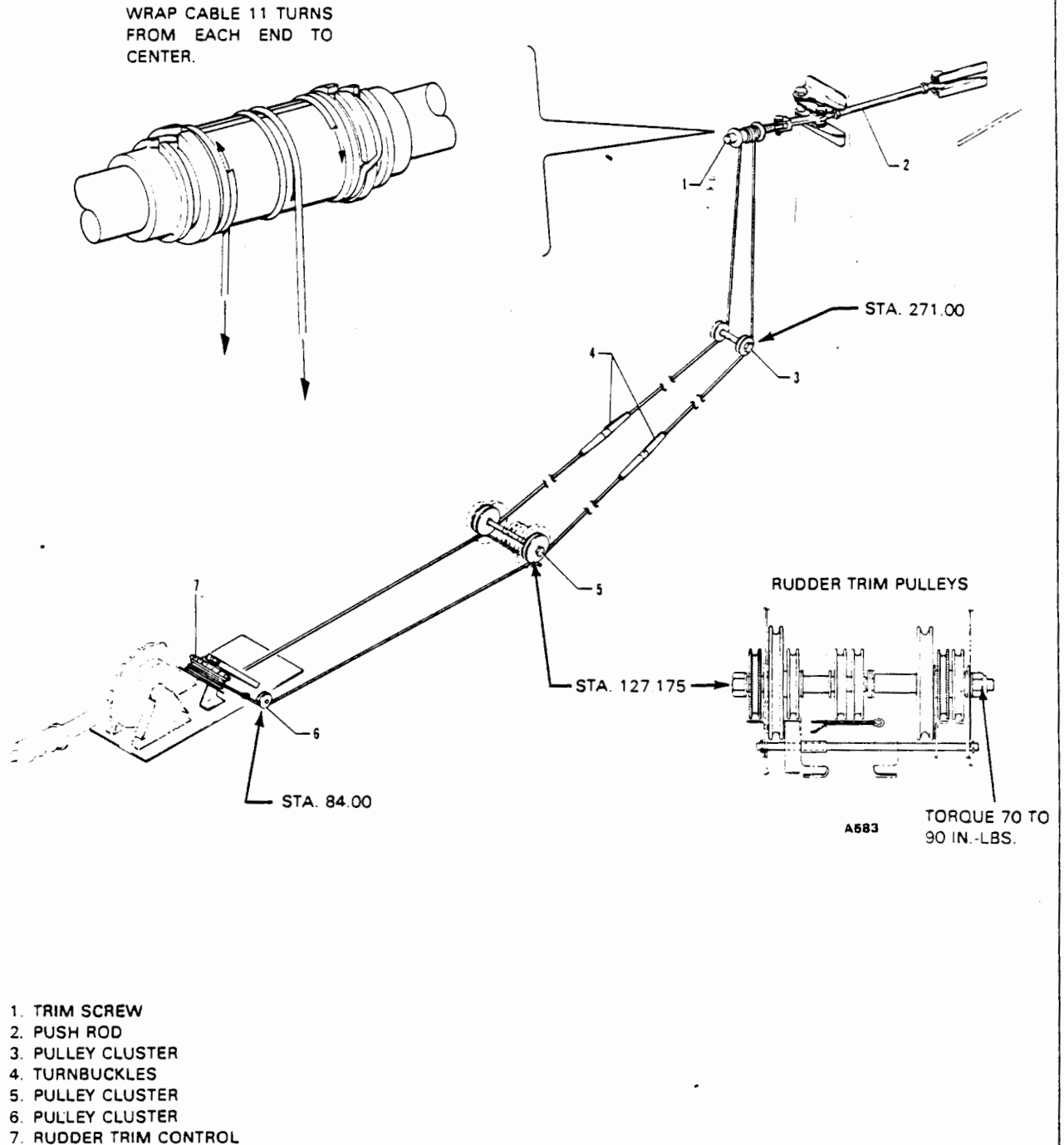


Figure 27-10. Rudder Trim Controls

27-22-04

Page 27-23

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

3. Install the cotter pin in the aft end of the shaft.
4. Adjust the screw assembly to obtain the neutral position. (Refer to Sketch D of Figure 27-10.)
5. Connect the link assembly to the trim screw.
6. Connect the aft trim cables to the forward cables with turnbuckles. Check to insure the cables are properly routed around the pulleys.
7. Install the cable guards at the pulley bracket in the fuselage at station 128.70.
8. Remove the clamp securing the forward trim cables and proceed to rig the system.
9. Lubricate the assembly per Lubrication Chart, Chapter 12.

RIGGING AND ADJUSTMENT OF RUDDER TRIM CONTROLS. (Refer to Figure 27-10.)

PPS50013

1. The following items must be accomplished as a preadjustment check before proceeding with the rigging and adjustment of the tab. If these items were accomplished during the installation, proceed with Step 2.

A. Ascertain that the cable is wrapped 11 turns around the barrel from each end with space at the center as shown in Figure 27-10.

B. The control rod is adjusted to an initial length of 10.38 inches.

C. The trim screw is at its neutral position.

D. The cable tension is set in accordance with Figure 27-10.

E. The nose wheel is off the ground before continuing.

2. Check the servo travel only by swinging the rudder until it contacts its stops. Use the rudder pedals to swing the rudder in each direction. Refer to Figure 27-7 for proper servo travel.

3. To adjust the servo travel, the control rod length may be varied. Ascertain that the initial length of the rod was 10.38 inches.

4. Check the trim only by swinging the rudder until it contacts its stops and turning the trim control wheel to swing the tab to its limits both left and right. Check the travel obtained with specifications given in Figure 27-7.

5. To adjust the trim travel left, perform the following:

A. Add shim washers at the forward end of the barrel to reduce the travel.

B. Remove shim washers at the forward end of the barrel to increase the travel.

6. To adjust the trim travel right, perform the following:

A. Add shim washers at the aft end of the shaft to reduce the trim travel.

B. Remove shim washers at the aft end of the shaft to increase the trim travel.

7. Check the trim and servo travels by swinging the rudder full left with full right trim and full right rudder with full left trim.

8. Check all travels with specifications given in Figure 27-7.

9. Determine the free play of the rudder tab with the rudder securely held against either stop. Total free travel measured at the tab trailing edge must not exceed 0.06 inch. If this tolerance is exceeded, check the travel control arm assembly for wear at the center bolt and bolt attaching the rudder trim rod to the control arm. Replace the arm assembly and associated hardware if there is any noticeable wear or elongation of the holes. Check the rudder trim barrel end play in the mounting bracket.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

RUDDER PEDAL ASSEMBLY.

REMOVAL OF RUDDER PEDAL ASSEMBLY. (Refer to Figure 27-11.)

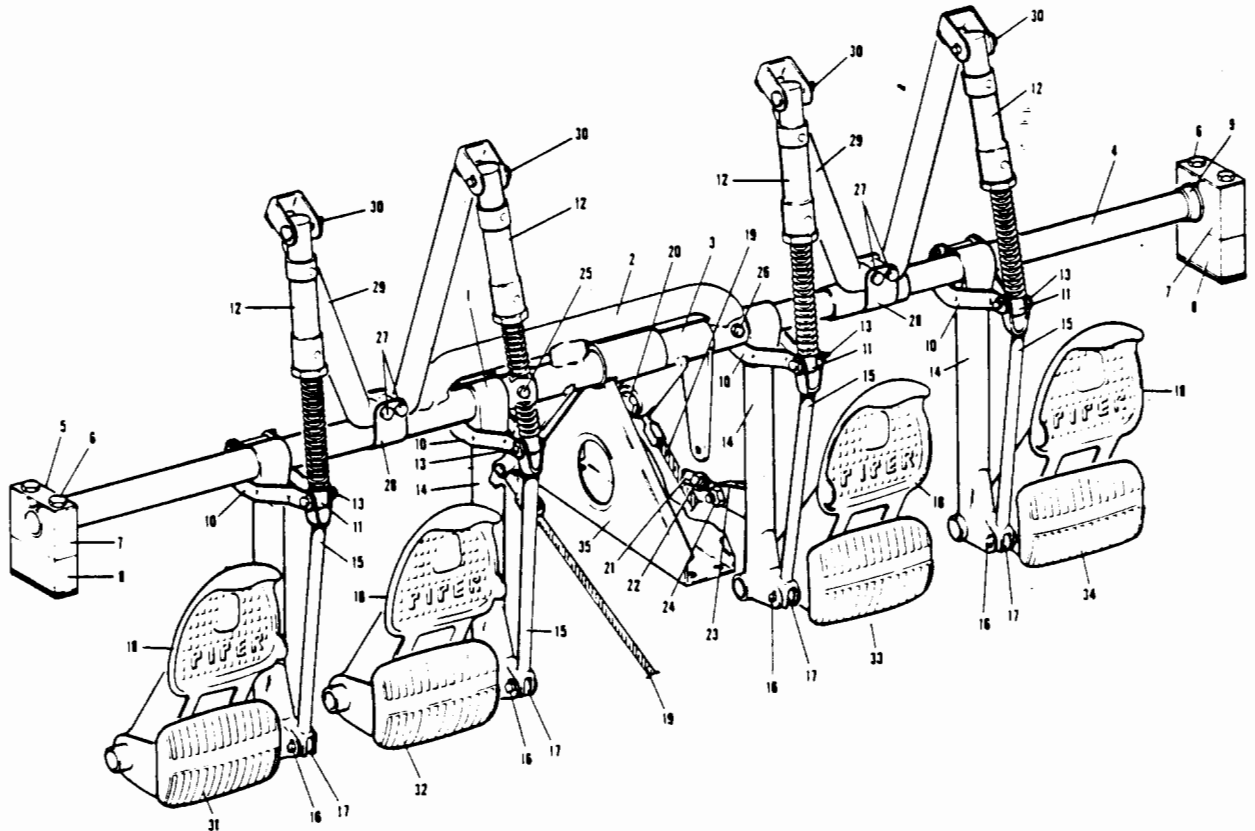
1. Remove the access panel to the aft section of the fuselage.
2. Relieve rudder and stabilator cable tension by loosening one of the rudder and stabilator cable turnbuckles in the aft section of the fuselage.
3. Remove the fuel selector knobs and cover panels by removing the attachment screws.
4. Remove the tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove the plate attachment screws.
5. Disconnect the stabilator control cable from the lower end of the tee bar assembly.
6. Remove the tee bar attachment bolts with their washers and nuts which are through each side of the floor tunnel. Pull the lower end of the tee bar aft.
7. Disconnect the control cable ends from the arms on the torque tube by removing the cotter pins, washers, nuts and bolts.
8. Disconnect the rudder trim from the torque assembly by removing the cotter pin, washers and bolt that connects the arm to the trim.
9. Disconnect the close-out rods at the rudder pedals by removing nuts and bolts.
10. Disconnect the brake cylinders at the lower end of each cylinder rod by removing the cotter pins, washers, nuts and bolts.
11. Disconnect the vee braces (two braces are used with right hand brakes) from the torque tube by removing nuts, washers and bolts that secure the strap bracket to the vee brace.
12. If an AutoPilot amplifier is installed over the torque tube at the right side of the fuselage, disconnect the electrical plug and release the two fasteners that secure it to its mounting bracket.
13. Disconnect the torque tube support bracket where it attaches to the floor tunnel by removing its attachment bolts.
14. Remove the two bolts that extend through the torque tube and are located at the center of the tube assembly over the floor tunnel. Compress the tubes.
15. Disconnect the torque tube support blocks from their support brackets on each side of the fuselage by removing the attachment nuts, washers and bolts.
16. Remove the trim side panels, if desired.
17. Remove the assembly from the airplane. Note the spacer washer on each end and between the support blocks.

INSTALLATION OF RUDDER PEDAL ASSEMBLY. (Refer to Figure 27-11.)

1. Assemble the torque tube assembly as shown in Figure 27-11. Do not at this time install the two bolts through the center of the tube assembly.
2. Place the upper support blocks on the ends of the torque tube assembly. Note that a washer is required on each end of the tube.
3. Position the support blocks on their mounting brackets at each side of the fuselage and secure with bolts, washers and nuts. Note that a bushing is required in the bolt holes of the upper support block, and a plate on top of the upper block, between the upper and lower blocks and under the block mounting bracket.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

A577



- 1. TUBE, L. OUTER
- 2. TUBE, L. CENTER
- 3. TUBE, R. CENTER
- 4. TUBE, R. OUTER
- 5. PLATE
- 6. BOLT & NUT
- 7. SUPPORT BLOCK, UPPER
- 8. SUPPORT BLOCK, LOWER

- 9. WASHER, SPACER
- 10. ARM, IDLER
- 11. ROD, BRAKE CYLINDER
- 12. BRAKE CYLINDER
- 13. CLEVIS PIN & COTTER PIN
- 14. TUBE, RUDDER CONTROL
- 15. CLEVIS ROD
- 16. CLEVIS PIN & COTTER PIN

- 17. CLEVIS END
- 18. TOE BRAKE PEDAL
- 19. CONTROL CABLE, RUDDER
- 20. BOLT, WASHER, NUT & COTTER PIN
- 21. BUNGEE, NOSE WHEEL STEERING
- 22. JAM NUT
- 23. ROD END, BUNGEE
- 24. BOLT & NUT

- 25. BOLT, WASHER & NUT
- 26. BOLT, WASHER & NUT
- 27. BOLT, WASHER & NUT
- 28. BRACKET
- 29. VEE BRACE
- 30. CLEVIS PIN & COTTER PIN
- 31. RUDDER PEDAL, L. OUTER
- 32. RUDDER PEDAL, L. INNER
- 33. RUDDER PEDAL, R. INNER
- 34. RUDDER PEDAL, R. OUTER
- 35. BRACKET, TUBE SUPPORT

Figure 27-11. Rudder Pedal Assembly

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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

STABILATOR CONTROLS.

STABILATOR CONTROL CABLES.

REMOVAL OF STABILATOR CONTROL CABLES. (Refer to Figure 27-12.)

1. To remove either the forward or aft stabilator cables, first remove the access panel to the aft section of the fuselage.
2. Disconnect the desired control cable at the turnbuckle in the aft section of the fuselage.
3. Either forward stabilator cable may be removed by the following procedure:
 - A. Remove the floor tunnel cover in the aft area of the cabin by removing the trim plate, the carpet over the tunnel and the cover attachment screws.
 - B. Remove the cable guard plate from the underside of the pulley cluster in the aft area of the tunnel opening by removing the guard attachment screws.
 - C. Remove the floor panel located directly aft of the main spar by removing the center seats, seat belt attachments and the screws securing the panel. Lift the panel and remove from airplane.
 - D. Within the floor opening, remove the cable rub blocks that are attached to the spar housing by removing the block attachment screws. Also remove the cotter pin cable guard at the pulley cluster in the aft area of the opening.
 - E. Remove the fuel selector panel cover by removing the selector knobs and cover attachment screws.

2310

ALIGN CABLE PLATES WITH HORIZONTAL PLANE TO WITHIN $\pm 10^\circ$.



- Figure 27-12. Stabilator Controls

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

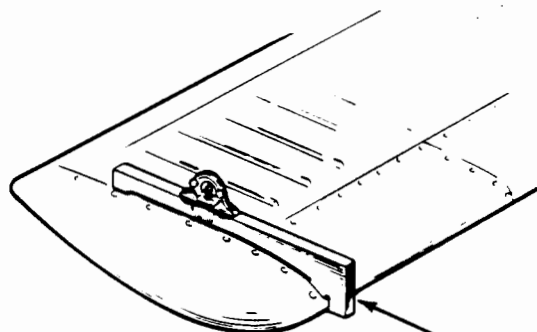
- F. Remove the lower selector cover.
- G. Remove the tunnel plate just aft of the tee bar by removing enough carpet from the tunnel to allow the plate attachment screws and plate to be removed.
- H. If the right (upper) stabilator control cable is to be removed, remove the cotter pin cable guards at the pulley located in the forward area of the tunnel.
- I. Disconnect the cables from the lower end of the tee bar by removing cotter pin, nut, washer and bolt.
- J. Draw the cable aft through the floor tunnel.
- 4. Either aft stabilator cable may be removed by the following procedure:
 - A. Disconnect the assist springs from bulkhead sta. 156. (Refer to Figure 27-12.)
 - B. Disconnect the cable end at the bellcrank by removing the cotter pin, nut, washer and bolt.
 - C. Remove the cable guard pin at the pulley.
 - D. Remove the cable from the pulley.

INSTALLATION OF STABILATOR CONTROL CABLES. (Refer to Figure 27-12.)

- 1. The forward stabilator cables may be installed by the following procedure:
 - A. Draw the control cable through the floor tunnel. Ascertain that the right (upper) cable is routed around the pulley that is in the forward area of the forward floor tunnel.
 - B. Connect the cables to the lower end of the control column tee bar with bolt, washer, nut and cotter pin. Allow the cable to be free to rotate.
 - C. If the aft control cable is not installed, install per Step 2.
 - D. Connect the cable to the aft cable at the turnbuckle in the aft section of the fuselage.
 - E. For the right control cable, install the cotter pin cable guard at the pulley in the forward area of the tunnel.
 - F. Within the forward area of the floor opening aft of the main spar, install the cable rub blocks to the spar housing and secure with screws.
 - G. In the aft area of the floor opening, install the cotter pin cable at the pulley cluster.
 - H. Install the cable guard under the pulley cluster located in the aft area of the aft floor tunnel and secure with screws.
 - I. Set cable tension and check rigging and adjustment.
 - J. Install the tunnel plate directly aft of the tee bar assembly and secure with screws.
 - K. Put the floor carpet in place and secure.
 - L. Install the lower and upper selector covers and secure with screws.
 - M. Place the fuel selector knobs on the selector torque tube and secure with set screws.
 - N. Install the floor panel aft of the main spar and secure with screws. Install the seat belt attachments and seats.
 - O. Install the cover and carpet of the aft floor tunnel.
- 2. Either aft stabilator control cable may be installed by the following procedure:
 - A. Route the cable under pulley.
 - B. Connect the cable to the stabilator bellcrank and secure with bolt, washer, nut and cotter pin. (Tighten nut "finger tight" only.)
 - C. Connect the cable to the forward cable at the turnbuckle in the aft section of the fuselage. The upper aft cable connects to the right forward cable and the lower cable to the left cable.
 - D. Connect assist springs to bulkhead sta. 156 and orient cable plates so that they align with horizontal plate $\pm 10^\circ$. (Refer to Figure 27-12.)
 - E. Install the cable guard pin at the pulley.
 - F. Set cable tension and check rigging and adjustment.
- 3. Install the access panels to the aft section of the fuselage.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

A585

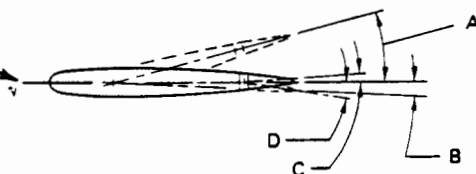


RIGGING TOOL
 (REFER TO CHAPTER 91)

CABLE TENSION (SEE NOTE)
 STABILATOR 40 lbs. $\pm$ 5 lbs.
 STABILATOR TRIM TAB 14 lbs. $\pm$ 1 lb.

NOTE
 CABLE TENSION APPLIES ONLY TO AIRPLANES WITHOUT AUTOPILOT BRIDLE CABLES ATTACHED. REFER TO APPROPRIATE AUTOPILOT SERVICE MANUAL FOR CABLE TENSION WHEN ATTACHING BRIDLE CABLES.

STABILATOR CHORD LINE
 (NEUTRAL POSITION,
 SEE NOTE 3)



STABILATOR TRAVELS
 A = $15^{\circ} \pm 1^{\circ}$ UP
 B = $3^{\circ} \pm 1^{\circ}$ DN
 STABILATOR TAB TRAVELS
 C = $4^{\circ} \pm 1^{\circ}$ UP
 D = $9^{\circ} \pm 1^{\circ}$ DN

STABILATOR
 STABILATOR TRIM TAB

NOTES

1. MAXIMUM FREE PLAY FOR CONTROL SURFACE TAB IS 0.06 OF AN INCH MEASURED AT TAB TRAILING EDGE.
2. REFER TO CHAPTER 55.
3. NEUTRAL POSITION OF STABILATOR IS WITH THE STABILATOR CHORD LINE PARALLEL WITH THE FRONT SEAT TRACKS.

PP550033

Figure 27-13. Stabilator Rigging

27-31-02
 Page 27-30
 Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

RIGGING AND ADJUSTMENT OF STABILATOR CONTROLS.

PPS50033

1. To check and set the correct degree of stabilator travel, the following procedure may be used:
 - A. Level the airplane. (Refer to Leveling, Chapter 8.)
 - B. Place the stabilator in neutral position. Neutral position is obtained when a level placed on stabilator rigging tool (Figure 27-13) indicates that stabilator chord line is parallel with the top of the front seat tracks.
 - C. Check the stabilator travel by placing a rigging tool on the upper surface of the stabilator as shown in Figure 27-13. (This tool may be fabricated from dimensions given in Chapter 91.)
 - D. Set on a bubble protractor the number of degree up travel as given in Figure 27-13 and place it on the rigging tool. Raise the trailing edge of the stabilator and determine that when the stabilator contacts its stops, the bubble of the protractor is centered.

— NOTE —

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

- E. Set on the protractor the number of degrees down travel as given in Figure 27-13 and again place it on the rigging tool. Lower the trailing edge of the stabilator and determine that when it contacts its stops, the bubble of the protractor is centered.
- F. Should the stabilator travel be incorrect in either the up or down position, remove the fin tip by removing the attachment screws and with the use of the rigging tool and bubble protractor turn the stops located at the stabilator hinge in or out to obtain the correct degree of travel. (Refer to Figure 27-14.)
- G. Ascertain that the locknuts of the stop screws are secure and then reinstall the fin tip.
2. To check and set stabilator control cable tension, the following procedure may be used:
 - A. Ascertain that the stabilator travel is correct.
 - B. Remove the access panel to the aft section of the fuselage and fin tip and disconnect the assist springs from bulkhead sta. 156.
 - C. Secure the control column in the near forward position. Allow one-quarter inch $\pm$.031 between the column and the stop bumper.
 - D. Check each control cable for the correct tension as given in Figure 27-13.
 - E. Should tension be incorrect, loosen the turnbuckle of the lower cable in the aft section of the fuselage and adjust the turnbuckle of the upper cable to obtain correct tension. Cable tension should be obtained with control wheel at the one-quarter inch dimension from the stop and the stabilator contacting its stop.
 - F. Check safety of all turnbuckles and bolts.
 - G. With the tension of the upper cable correct and the control wheel still forward, adjust the turnbuckle of the lower cable to obtain correct tension.
 - H. Check the full travel of the control wheel with relation to the full travel of the stabilator to determine that the stabilator contacts its stops before the control wheel contacts its stops. With the control wheel in the fore and aft positions, the travel distance from the joint where the stabilator contacts its stops and the control wheel contacts its stops should be approximately equal. Readjust turnbuckles if incorrect.
 - I. Connect the assist springs to bulkhead sta. 156. (Refer to Figure 27-12.)
 - J. Reinstall access panels and fin tip.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

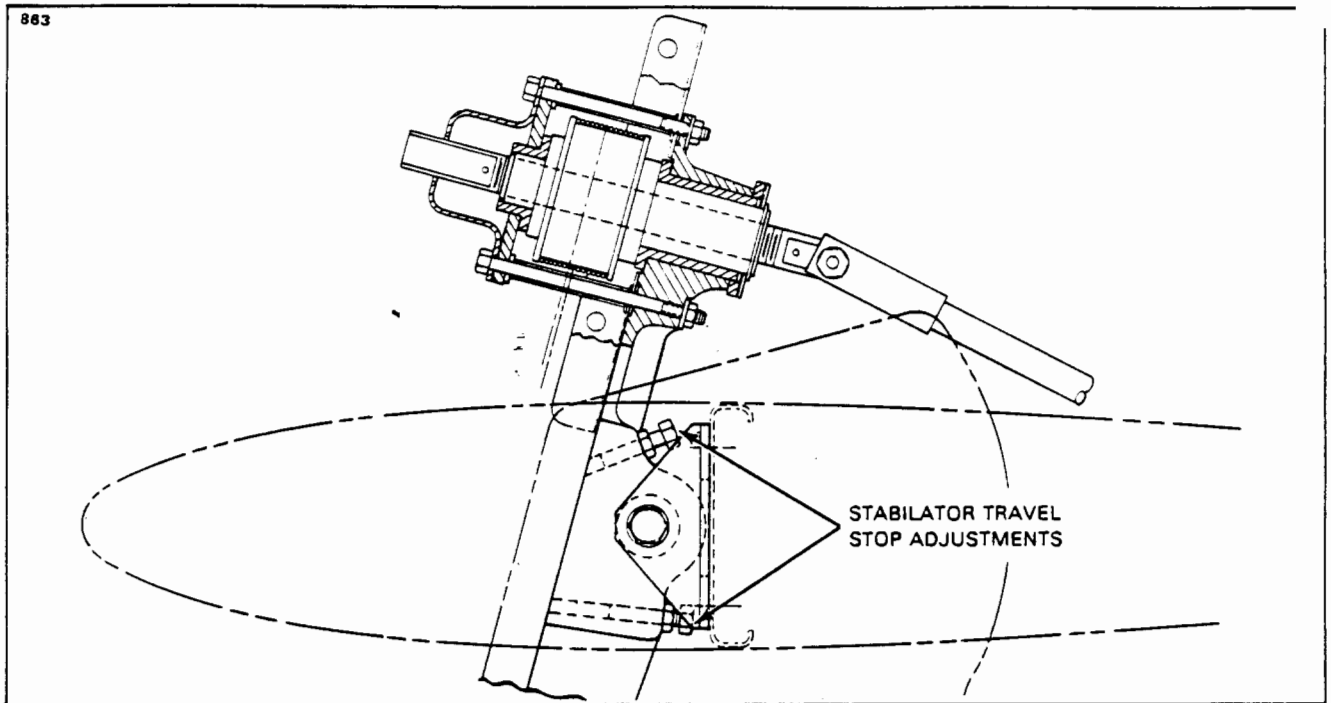


Figure 27-14. Stabilator Travel Adjustments

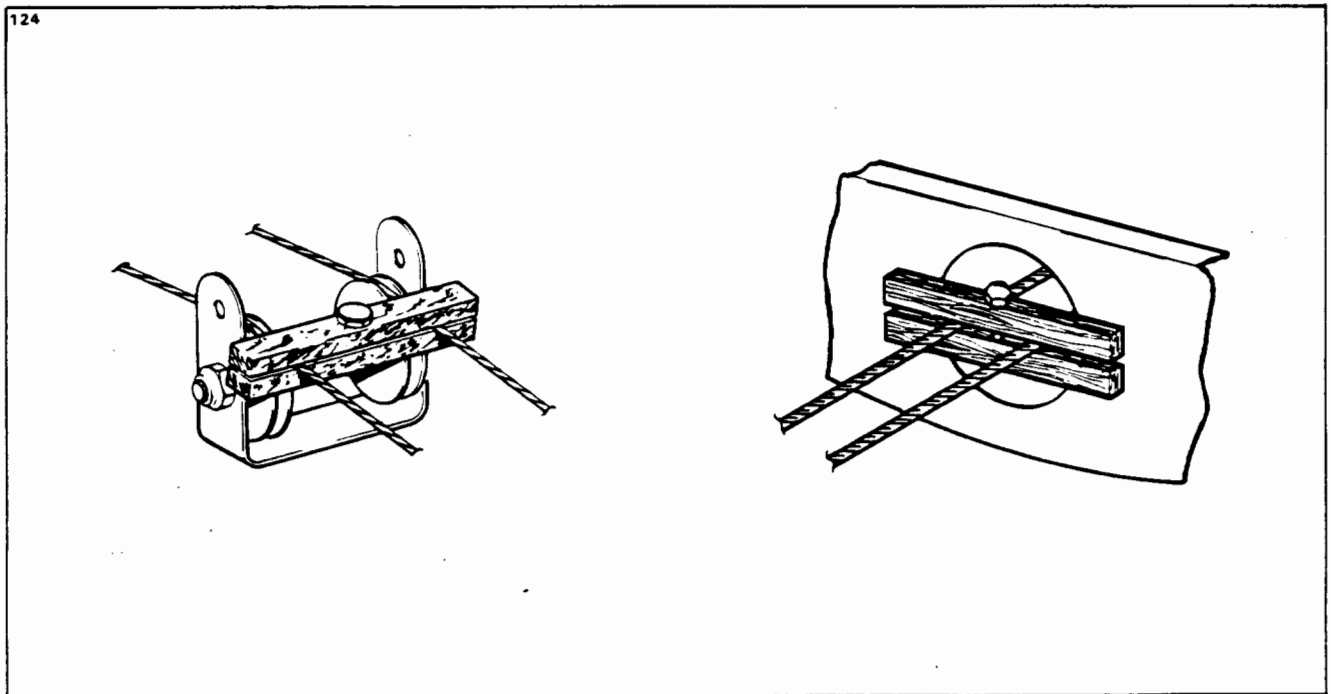


Figure 27-15. Methods of Securing Trim Cables

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

STABILATOR TRIM.

REMOVAL OF STABILATOR TRIM ASSEMBLY (FORWARD). (Refer to Figure 27-16.)

1. To remove the trim control wheel assembly and/or the trim control cables, first remove the panel to the aft section of the airplane.
2. If the aft trim cable is not to be removed, block the cables at the pulleys in the aft section of the fuselage to prevent them from unwrapping from the trim drum. (Refer to Figure 27-15.)
3. Loosen the cables if the trim control wheel is to be removed or disconnect if the cables are to be removed. Do this at the trim cable turnbuckles in the aft section of the fuselage.
4. The control wheel with drum may be removed by the following procedure:
 - A. Remove the control wheel cover by removing the cover attaching screws.
 - B. The wheel assembly may be removed from its mounting brackets by removing nut, washer and bolt that secures the wheel between the brackets. Draw the wheel from the brackets. Use caution not to damage trim indicator wire.
 - C. Unwrap the left cable from the drum.
 - D. The wheel and drum are joined by a push fit, separate these two items with their center bushing and unwrap the right cable.
 - E. Tie the cables forward to prevent them from slipping back into the floor tunnel.
5. The trim control cables may be removed by the following procedure:
 - A. Remove the pilot and rear seats if desired.
 - B. Remove the seat belts attached to the forward floor tunnel by removing attachment nuts, washers and bolts.
 - C. Remove the heater deflectors from each side of the aft end of the forward floor tunnel by sliding the deflector sideways and releasing the retainer spring.
 - D. Unfasten the carpet from the aft portion of the forward floor tunnel and lay it forward.
 - E. Remove the tunnel cover located between the trim control wheel and the spar cover by removing the selector knobs and cover attachment screws.
 - F. Remove the cable pulleys located in the forward tunnel by removing the cotter pin, washer and clevis pin.
 - G. Remove the floor panel aft of the main spar by removing the panel attachment screws and seat belt attachments. Lift the panel and remove from airplane.
 - H. Remove the cable rub blocks located in the floor opening on the aft side of the main spar by removing the block attachment screws.
 - I. Remove the trim plate located on top of the forward end of the aft floor tunnel.
 - J. Remove the carpet from the aft floor tunnel.
 - K. Remove the cover plate from the top of the aft floor tunnel by removing attachment screws.
 - L. Remove the cable guard from the underside of the trim cable pulleys located in the forward area of the aft floor tunnel by removing a tinnerman nut and withdrawing the cable guard.
 - M. Remove the cable guard plate from the underside of the pulley cluster located in the aft area of the floor tunnel by removing the plate attachment screws.
 - N. Remove the cable guard from the cable pulleys in the aft lower section of the fuselage forward of the cable turnbuckles.
 - O. With the cables disconnected from the trim control wheel, draw the cable(s) through the floor tunnel.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

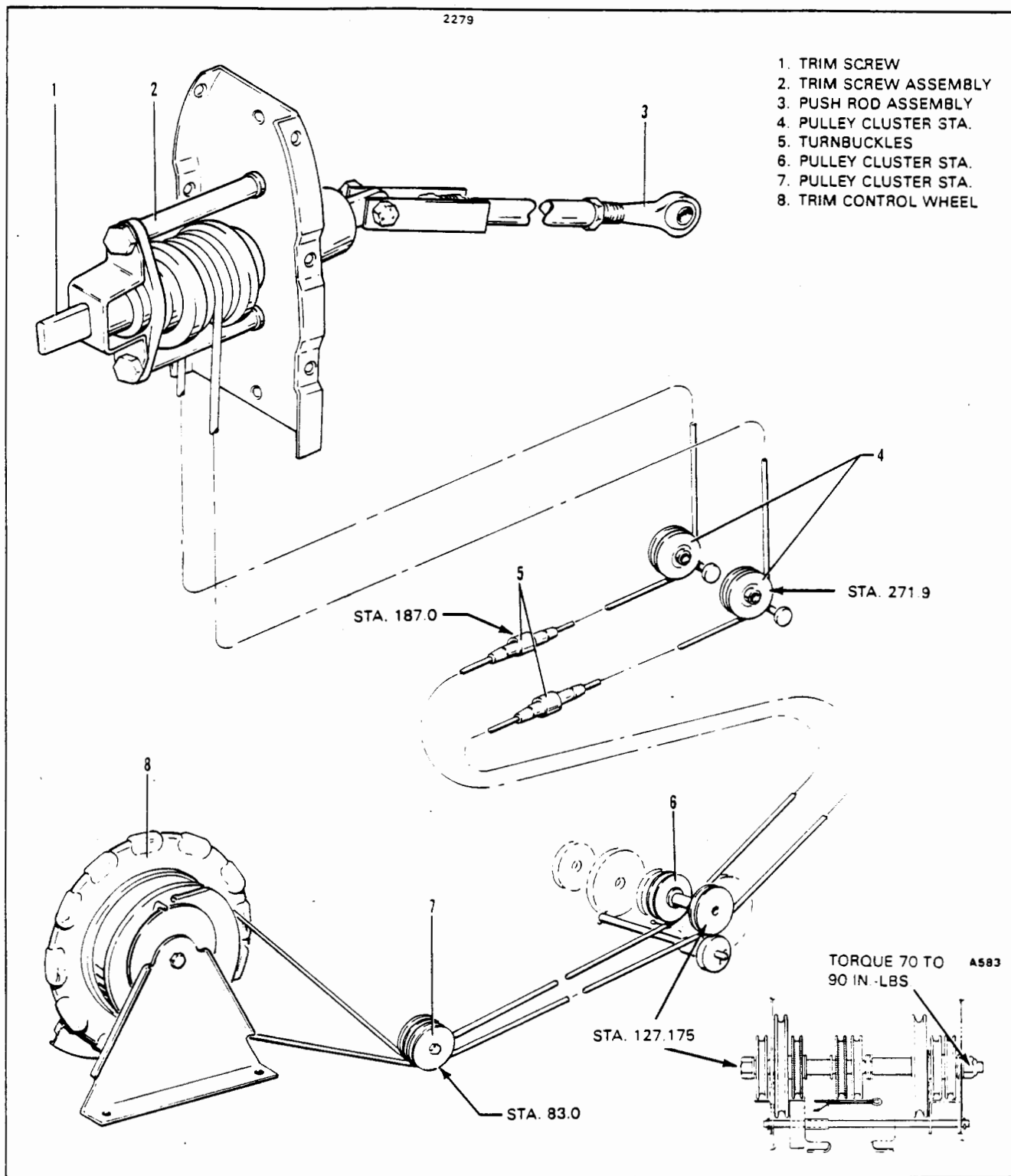


Figure 27-16. Stabilator Trim Controls

27-33-01
Page 27-34

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF STABILATOR TRIM ASSEMBLY (FORWARD). (Refer to Figure 27-16.)

1. The trim control wheel with drum may be installed by the following procedure:
 - A. Wrap the right trim cable on the trim drum by inserting the swagged ball of the cable in the slot provided in the side (right side) of the drum that mates with the control wheel, and looking at this side, wrap the drum with three wraps of the cable in a clockwise direction.
 - B. Attach the control wheel to the cable drum by aligning the long lug of the drum with the long slot of the wheel and pushing the two pieces together.
 - C. Wrap the left trim cable on the drum by inserting the swagged ball of the cable in the slot provided in the flanged side (left side) of the drum and looking at this side, wrap the drum with three wraps of the cable in a clockwise direction.
 - D. Lubricate and install the bushing in the control wheel and drum.
 - E. Align the control cables and position the control wheel assembly between its mounting brackets. Ascertain that the end of the trim indicator wire is positioned in the spiraled slot of the drum with no bind on the end. Install the retainer bolt from the left side and install washer and nut.
 - F. Install the cover over the control wheel and secure with screws, unless the control cables have yet to be installed.
2. The trim control cables may be installed by the following procedure:
 - A. Draw the cable(s) through the floor tunnel.
 - B. Wrap the cable drum and install the trim control wheel as given in Step 1.
 - C. Position the cable pulleys on their mounting bracket and install the clevis pin, washer and cotter pin.
 - D. Connect the cable to the aft cable at the turnbuckle in the aft section of the fuselage. Install aft cable if not installed.
 - E. Install the cable guard at the cable pulleys in the aft lower section of the fuselage forward of the cable turnbuckles.
 - F. Install the cable guard plate at the underside of the pulley cluster located in the aft area of the aft floor tunnel and secure with screws.
 - G. Install the pin type cable guard at the underside of the pulleys located in the forward area of the aft floor tunnel and secure it with a tinnerman nut.
 - H. Install the cable rub blocks located on the aft side of the main spar housing and secure with screws.
 - I. Remove the blocks that secure the aft trim cable and check that the cables are seated on their pulleys.
 - J. Set cable tension and check rigging and adjustment. Check safety of all turnbuckles.
 - K. Install the tunnel cover on the forward tunnel and secure with screws.
 - L. Install the carpet over the floor tunnel.
 - M. Install the heat deflectors on each side of the floor tunnel.
 - N. Install the cover over the trim control wheel and secure with screws and special washers.
 - O. Install the fuel selector knobs and secure with set screws.
 - P. Install the seat belts removed from the top of the floor tunnel and secure with bolt, washer and nut.
 - Q. Install the floor panel and seat belt attachments aft of the main spar, and secure panel with screws.
 - R. Install the aft floor tunnel and secure with screws.
 - S. Install the carpet over the aft floor tunnel.
 - T. Install the trim plate on top of the forward end of the aft floor tunnel.
3. Install the panel to the aft section of the airplane and the seats.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

REMOVAL OF STABILATOR TRIM CONTROLS (AFT). (Refer to Figure 27-16.)

1. Remove the access panel to the aft section of the fuselage.
2. Block the trim cables at the first set of pulleys forward of the cable turnbuckles in the aft section of the fuselage by the method shown in Figure 27-15.
3. Disconnect the cable at the turnbuckles in the aft section of the fuselage.
4. Remove cable guard from pulley cluster and cable guards from pulley cluster.
5. Remove the fin tip by removing attachment screws.
6. Disconnect the push rod by removing the attaching hardware securing push rod to screw.
7. Remove bolts, washers, bushings and nuts securing forward end of barrel. Remove snap ring to free aft end of barrel.
8. Draw the trim cable from the fuselage and up the fin.

INSTALLATION OF STABILATOR TRIM CONTROLS (AFT). (Refer to Figure 27-16.)

1. Wrap the trim barrel by first laying the center (as measured equally from each end to the center of the cable) of the trim cable in the slot of the barrel. Bring the half of the cable to be used on the right side through the diagonal slot in the flange at the forward end of the barrel and wrap aft in a clockwise direction 7 wraps to the center of barrel. Bring the half of the cable to be used on the left side through the diagonal slot in the aft end of the barrel and wrap forward in a counterclockwise direction 7 wraps to the center of barrel. (Refer to Figure 27-17.)
2. Block the cable by clamping between two pieces of wood laid next to the wraps to prevent unwrapping. Fabricate block with a notch so hardware can be installed.
3. Lubricate the bearings and install barrel per exploded view given in Figure 27-16. Install the barrel using any combination of AN960-10, AN960-10L and AN960PD10L washers to achieve free barrel rotation with trim cable rigged and tensioned.
4. Rotate the cables down the fin into the fuselage through the two pulley clusters and attach the ends to the forward trim cables.
5. Install all cable guards.
6. Remove the blocks that are holding the forward cables tight and aft cables at the barrel.
7. Set cable tension and check rigging and adjustment. Check safety of all turnbuckles.
8. Install fin tip and secure with screws.
9. Install the access panel to the aft section of the fuselage.

RIGGING AND ADJUSTMENT OF STABILATOR TRIM. (Refer to Figure 27-16.)

PPN50033

1. Level the airplane. (Refer to Leveling, Chapter 8.)
2. Check for proper stabilator trim cable tension as given in Figure 27-13. If cables were disconnected, rotate the control wheel several times to allow the cables to seat and recheck tension.
3. Secure the stabilator in neutral position; stabilator chord line parallel with front seat tracks.
4. To obtain correct travels, if incorrect, adjust by disconnecting the rod end and turning the end in or out as required. Travel adjustments which cannot be corrected at the rod end adjustment require the repositioning of the screw in the barrel. A screw position of approximately 1.38 inches of screw exposure at the aft end of the barrel is suggested as a preliminary neutral setting from which final adjustments can be made at the rod end. (Refer to Figure 27-18.)
5. If required, adjust the stabilator tab push rod to streamline the tab with the stabilator. This is the neutral position of the tab.
6. Turn the trim control wheel to its full up and full down position alternately. Travel of the tab from its neutral position should match the travels shown in Figure 27-13.

27-33-05

Page 27-36

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
*MAINTENANCE MANUAL

856

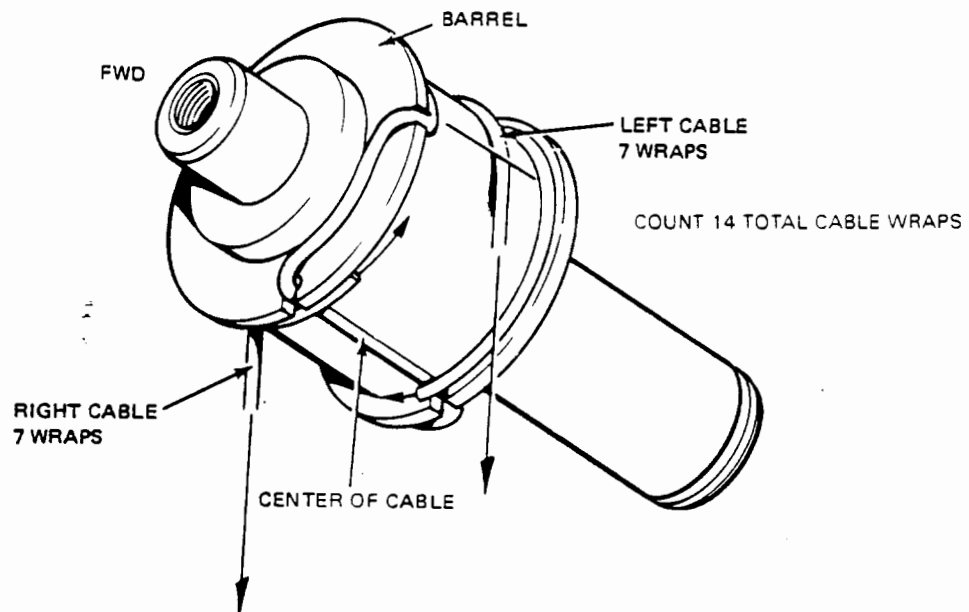
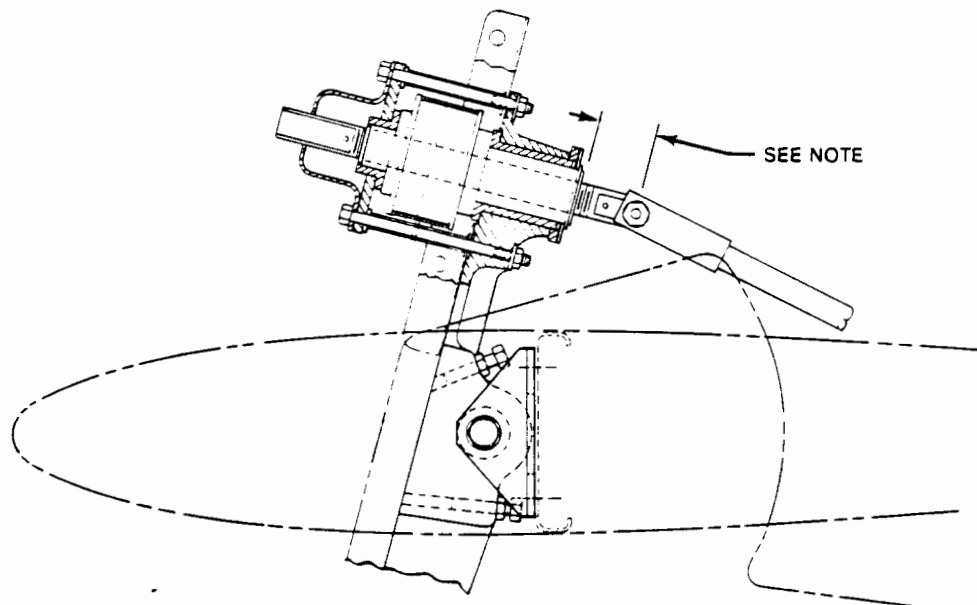


Figure 27-17. Wrapping Trim Barrels

863



NOTE
PRELIMINARY NEUTRAL SETTING 1.38 INCHES.

Figure 27-18. Stabilator Trim Screw Adjustment

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

7. Move the stabilator and trim tab to all extremes of travel and check to insure that there is no interference between the turnbuckles and pulleys.
8. Check to insure that the stabilator up and down stops are contacted before the tee bar stops are contacted.
9. With the stabilator held securely against either stop, determine the free play of the stabilator tab. Total free play, measured at the tab trailing edge must not exceed 0.06 of an inch.

FLAPS.

WING FLAP CONTROLS.

REMOVAL OF WING FLAP CONTROLS. (Refer to Figure 27-19.)

1. The flap torque tube assembly may be removed by the following procedure:
 - A. Remove the access plate located between the underside of the aft section of each wing and the fuselage by removing attaching screws.
 - B. Remove the floor panel located aft of the main spar by removing the center seats, seat belt attachments and the screws securing the panel. Lift the panel and remove from airplane.
 - C. Disconnect the left and right flap control tubes (rods) at the flaps by removing the nuts, washers and bolts or at the torque tube cranks (arms) by removing the bolts and washers from the inner side of each crank. It will be necessary to remove bolt through a hole in the side skin of the fuselage located over the torque tube with the flap handle moved to its 40 degree position.
 - D. With the flap handle, fully extend the flaps and disconnect the flap tension spring at the spar or the aft end of the control cable as desired.
 - E. Grasp the flap handle, release the plunger and allow the flap to return to the retracted position. Use caution as forward pressure will be on the handle with the tension spring disconnected.
 - F. Disconnect the flap return spring at the spar or return chain as desired.
 - G. Disconnect the control cable from the chain by removing cotter pin, nut, and clevis bolt.
 - H. Remove the tube support blocks by removing the block attachment bolts.
 - I. Remove the nuts, washers and bolts securing the right and left cranks and stop fittings on the torque tube.
 - J. From between each wing and the fuselage, remove the cranks from the torque tube.
 - K. Disconnect one bearing block from its mounting brackets by removing nuts, washers and bolts.
 - L. Slide the tube from the bearing block still attached to its brackets, raise the end and lift it from the floor opening.
2. The flap control cable may be removed by the following procedure:
 - A. If the center seats and floor panel have not been removed, remove the seats and the screws securing the floor panel.
 - B. Disconnect the flap tension spring from the cable if not previously disconnected, by extending the flaps to relieve spring tension.
 - C. Retract the flap. Use caution as forward pressure will be on the handle with the spring disconnected.
 - D. Disconnect the cable from the chain by removing cotter pin, nut, clevis pin and bushing.
 - E. Remove the flap handle bracket and trim control wheel cover.
 - F. Remove the aft heat deflectors on each forward floor tunnel by sliding far enough to release the spring fasteners.
 - G. Lift the aft section of the tunnel carpet far enough to remove the screws securing the tunnel cover that is between the flap handle and the spar cover. Remove the cover.

27-51-01

Page 27-38

Revised: March 26, 1984

PIPER AIRCRAFT

PA-44-180/180T

*MAINTENANCE MANUAL

- H. Remove the cotter pin cable guard from the flap cable pulley located inside the floor tunnel just ahead of the spar housing.
- I. Remove the cable rub blocks located in the floor opening on the aft side of the spar housing by removing the attachment screws.
- J. Disconnect the cable turnbuckle at the flap handle by removing cotter pin, nut and bolt.
3. Remove the flap handle and bracket by disconnecting the cable turnbuckle from the handle and removing the bolts securing the bracket to the floor tunnel.

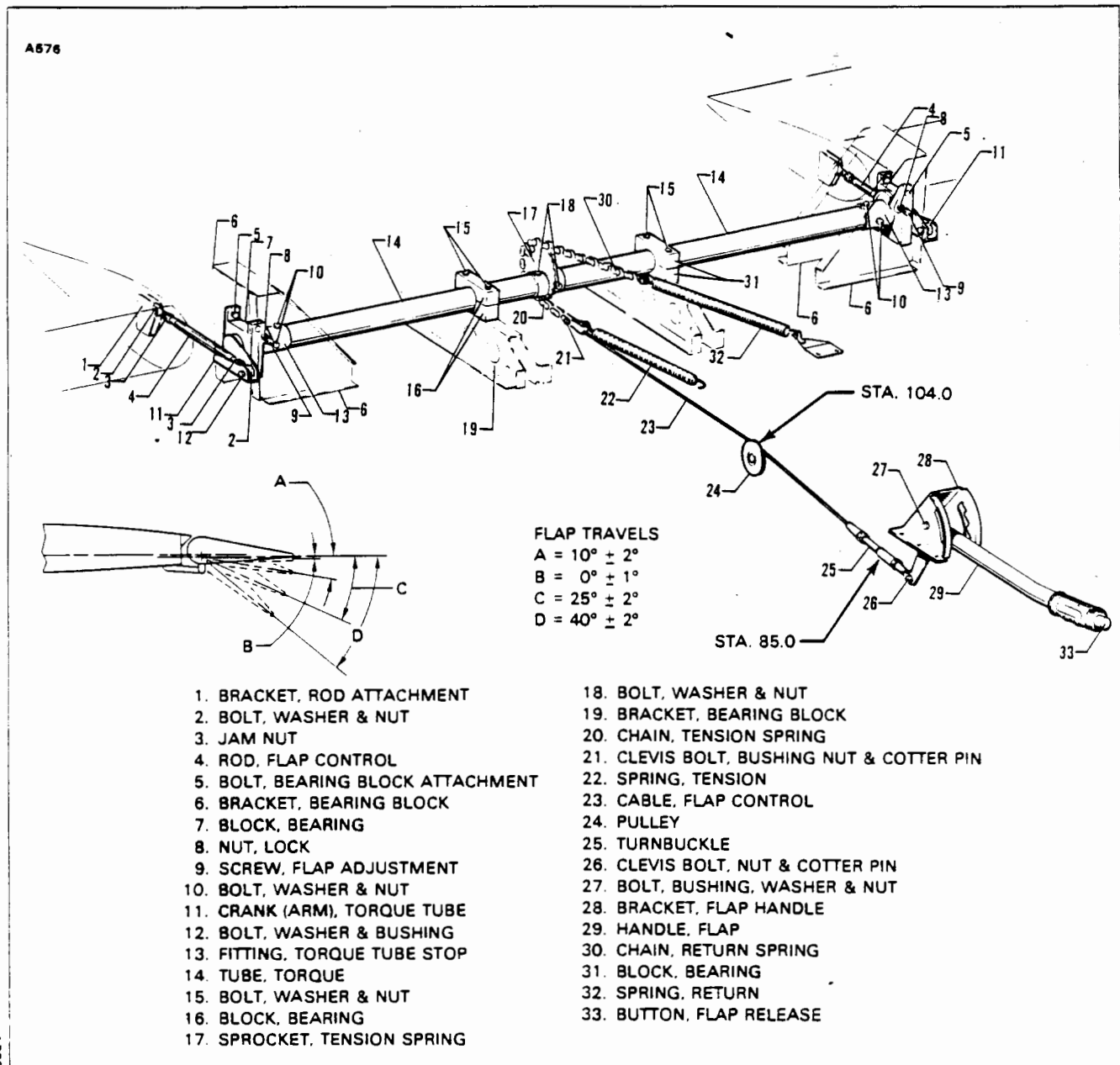


Figure 27-19. Flap Controls and Rigging

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

INSTALLATION OF WING FLAP CONTROLS. (Refer to Figure 27-19.)

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

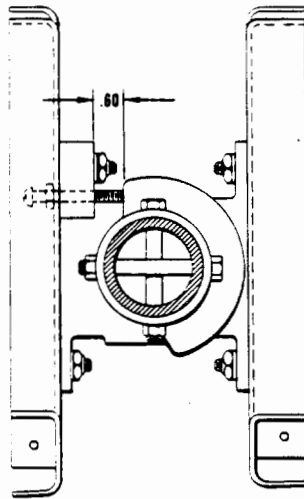
RIGGING AND ADJUSTMENT OF WING FLAPS.

PPN50013

1. Place the flap handle in the full forward, flap retracted position.
2. If not previously accomplished, remove the floor panel just aft of the main spar.
3. If required, adjust the flap up stop and step lock, loosen the jam nut of the right torque tube stop screw, located in the floor opening along the outer end of the flap torque tube, and turn the stop screw to obtain approximately .60 of an inch between the stop fitting and the bearing block as measured along the top side of the screw. (Refer to Figure 27-20.) It may be necessary to loosen the adjustment screw of the left stop.

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

981



PPS60033

Figure 27-20. Flap Step Adjustment

4. Check cable tension and adjust if required to remove all slack. Do not tighten cable to the point that the stop screw comes off the stop.

5. Place a 0.125 of an inch thick spacer between the right hand stop screw and stop fitting. With flaps installed and control rods connected, determine that when down pressure is applied on top of the flap, it will not cause the flap to come down. If the flap extends (comes down under pressure), turn the stop screws out a few turns until the flap remains in the up-lock position with the spacer inserted. Adjust both stop screws, tighten jam nuts and remove the spacer block.

6. To check the up-neutral position of the flaps place a flap rigging tool as shown in Figure 27-21 against the underside of the wing and flap as close as possible to the outboard end of the flap without contacting any rivets. (Refer to Chapter 91 for dimensions to fabricate this tool.) The tool must be positioned parallel with the wing ribs, with the aft end of the tool even with the trailing edge of the flap.

7. With the flap control rods connected between the torque tube crank arm and flaps; check that the surface of the wing contacts the tool at its forward surface and at the spacer, and the aft end of the flap contacts the aft end of the tool. Maintain a light up pressure on the underside of the flap to remove slack in the linkage while making this check.

8. If required adjust each flap push rod so that the chord line of the flap forms a zero degree $\pm 1^\circ$ angle with the wing chord at the outboard end of the flap. This is the neutral position.

27-52-00

Page 27-41

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
***MAINTENANCE MANUAL**

— NOTE —

In the event of wing heaviness during flight, the flap on the side of the heavy wing can be adjusted down from neutral to remedy this condition by lengthening the control rod. Check the inspection hole in each rod end to ascertain that there are sufficient threads remaining and a wire cannot be inserted through these holes. Do not raise the flap of the other wing above neutral.

9. Measuring from the neutral position obtained from Steps 6, 7 and 8, and maintaining the light up pressure on the underside of the flap, check flap down travel, which should be 10 ± 2 degrees at first notch, 25 ± 2 degrees at second notch and 40 ± 2 degrees at the third notch. Readjust the torque tube stop screw in or out as required. After any readjustment of the screw it will be necessary to review Steps 3 thru 9.

10. Check complete operation of the flaps, and handle and ratchet mechanism, then install all access covers removed.

— NOTE —

The flap adjustment must be complete before starting on aileron adjustments.

STALL WARNING.

STALL WARNING HORN AND LIFT DETECTOR.

This system consists of two detectors which are electrically connected to the flap position switch and the stall warning horn. The following ground check can be performed to determine that the lift detectors are functioning properly.

The lift detectors are located on the left wing. With the master switch ON gently lift the tabs on both lift detectors, the stall warning horn should not sound. With the master switch still ON, activate the main gear squat switch to simulate inflight conditions, extend the flaps to the 10° flap position. The 0° to 10° flap positions relate only to the outboard lift sensor. With this in mind gently lift out the outboard sensor, the stall warning horn should sound. Lifting the inboard sensor should not sound the horn. With flaps positioned from 25° to 40° gently lift the inboard sensor, the horn should sound. Lifting the outboard sensor should not sound the horn. With the check completed return the flaps to the full up position, turn the master switch OFF and remove any items used to activate the squat switch.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REMOVAL OF LIFT DETECTOR.

— NOTE —

The master switch must be off prior to performing any work on the lift detector. Place reference marks on holding plate and wing skin for use when reinstalling.

1. Remove four screws holding the plate around the tab. The lift detector is fastened to this plate; remove the unit from wing.
2. Mark the electrical wires and terminals to facilitate reinstallation. Remove electrical wires from lift detector; remove lift detector from aircraft.

INSTALLATION OF LIFT DETECTOR.

1. Attach the electrical leads to the appropriate terminals of the lift detector.
2. Position the lift detector with its mounting plate on the wing, determining that the sensor blade of the unit drops down freely, and secure in position with the four screws previously removed.

ADJUSTMENT OF LIFT DETECTOR.

The lift detector switch is adjusted at the factory when the airplane is test flown, and should not require any further adjustment during the normal service life of the airplane. Should some type of service on the wing require removing the switch, the following instructions will help in positioning the switch at the proper position.

Loosen the two Philips head screws: one on either side of the vane. If the stall warning comes on to late, move the switch up. If the stall warning comes on to 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.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

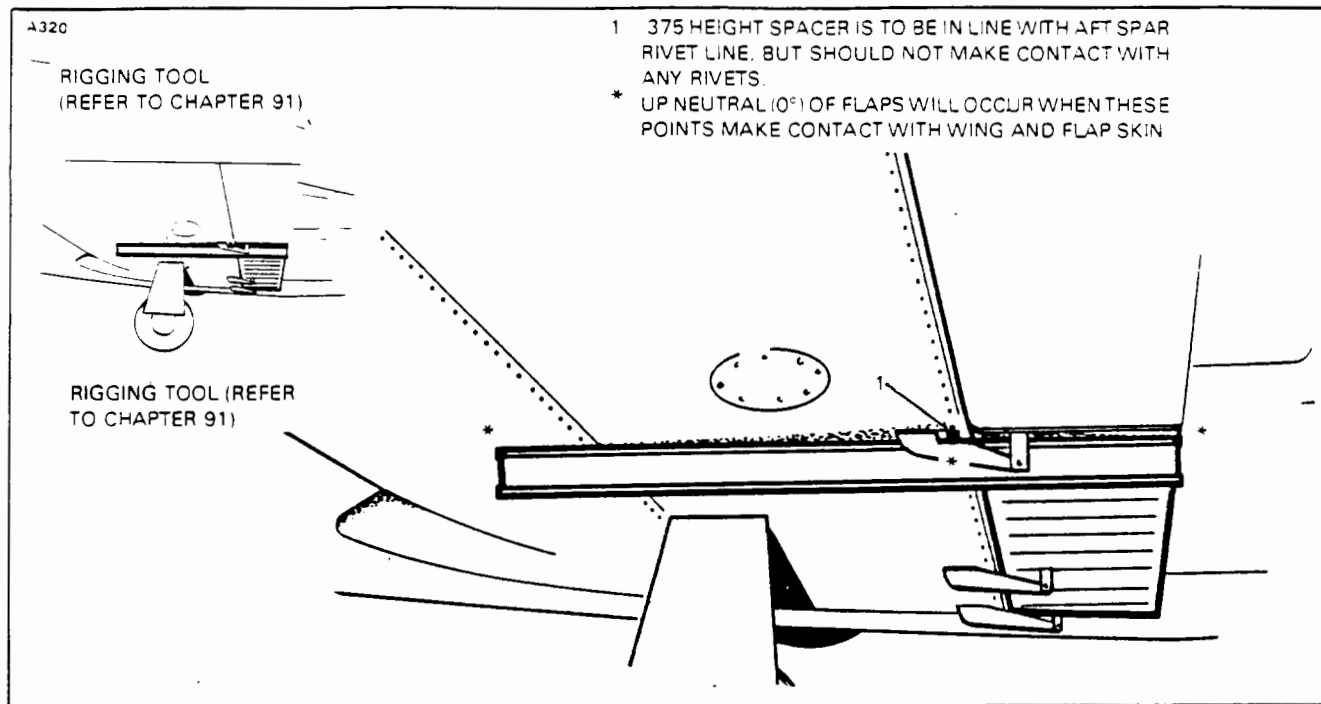


Figure 27-21. Flap Rigging Tool

- END -

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK



**SEMINOLE
MAINTENANCE MANUAL**

CARD 2 OF 4

PA-44-180 SEMINOLE

PA-44-180T TURBO SEMINOLE

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 664)

2A1

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

INTRODUCTION.

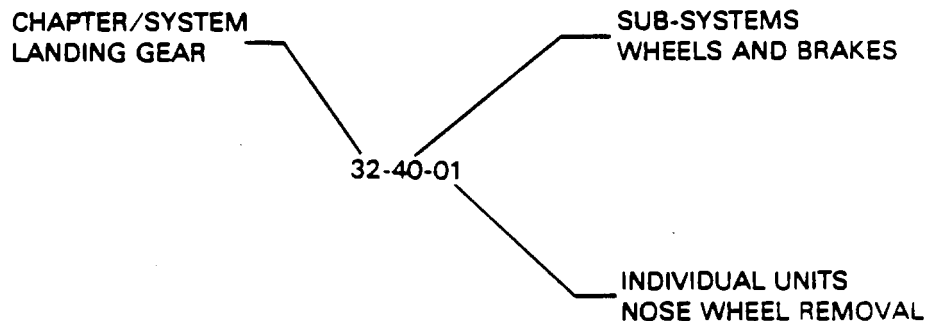
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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

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

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

Example:



This manual does not contain hardware callouts for installation. Hardware callouts are only indicated where a special application is required. To confirm the correct hardware used, refer to the PA-44 Parts Catalog P/N 761 663, and FAR 43 for proper utilization.

Introduction

Page - 1

Reissued: December 12, 1979

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual = AVCO LYCOMING - OVERHAUL MANUAL
DIRECT DRIVE ENGINE - P/N 60294-7
Avco Lycoming Division
Williamsport, Pa. 17701

Parts Catalog = AVCO LYCOMING - P/N PC-123
Avco Lycoming Division
Williamsport, Pa. 17701

Operators Handbook = AVCO LYCOMING O-360, HO-360, IO-360,
AIO-360, HIO-360, LIO-360 and TIO-360
SERIES AIRCRAFT ENGINES - P/N 60297-25
Avco Lycoming Division
Williamsport, Pa. 17701

PROPELLER:

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

MAGNETOS:

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

TURBOCHARGERS:

Overhaul Manual = OVERHAUL MANUAL FOR
AIRCRAFT TURBOCHARGERS
VALVES AND CONTROLLERS
NUMBER TP20-0120-1
Airesearch Industrial Division
3201 Lomitor Blvd.
Torrance, Calif. 90505

RADAR ALTIMETER:

Maintenance
Instructions = KING KRA-10 MAINTENANCE OVERHAUL
MANUAL NUMBER 006-5152-00
King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061

BONZER MK10X
Bonzer Incorporated
90th and Cody
Overland Park, Kansas 66214

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

VENDOR PUBLICATIONS. (cont)

RADAR ALTIMETER: (cont)

Installation Manual = **INSTALLATION MANUAL**
NUMBER 006-0152-00
King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061

AUTOFLIGHT:

Manufacturer = **EDO-AIRE MITCHELL**
P.O. Box 610
Mineral Wells, Texas 76067

PIPER PUBLICATIONS.

AUTOFLIGHT:

AutoControl IIIB
Service Manual = **Piper P N 761 502**
AutoControl IIIC
Service Manual = **Piper P N 761 602**

PA-44-180/180T
Parts Catalog = **Piper P N 761 663**

Inspection Reports = **Piper P N 230 963**

Programmed Inspection
Manual = **Piper P N 761 733**

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

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 given 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 illustration.
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 Indication, (1R Month-Year)

Second Revision: Revision Indication, (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)

Introduction

Page - 4

Revised: January 3, 1983

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

AEROFICHE EXPLANATION AND REVISION STATUS (cont)

6. Revisions to this Maintenance Manual 761 664 issued May 1, 1978 are as follows:

Revisions	Date	Aerofiche Card Effectivity
ORG791212	December 12, 1979	1, 2, and 3
PR800822	August 22, 1980	1, 2, and 3
PR810223	February 23, 1981	1, 2, and 3
PR810824	August 24, 1981	1, 2, and 3
PR820826	August 26, 1982	1, 2, and 3
PR820909	September 9, 1982	1, 2, and 3
PR830103	January 3, 1983	1, 2, and 3
PR840326	March 26, 1984	1, 2, and 3

Introduction

Page - 5

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GAMA SYSTEM/CHAPTER INDEX GUIDE

SYST CHAP	SUB-SYST SECTION	TITLE	AEROFICHE GRID NO.
4		AIRWORTHINESS	1A18
5		TIME LIMITS/MAINT CHECKS	1A21
6		DIMENSIONS AND AREAS	1B14
7		LIFTING AND SHORING	1C1
8		LEVELING AND WEIGHING	1C5
9		TOWING AND TAXIING	1C10
10		PARKING AND MOORING	1C14
11		REQUIRED PLACARDS	1C18
12		SERVICING	1C22
20		STANDARD PRACT - AIRFRAME	1E2
21		ENVIRONMENTAL SYSTEM	1E12
22		AUTOFLIGHT	1H21
23		COMMUNICATIONS	1H24
24		ELECTRICAL POWER	1I10
27		FLIGHT CONTROLS	1J24
28		FUEL	2A18
29		HYDRAULIC POWER	2B17
30		ICE AND RAIN PROTECTION	2C17
32		LANDING GEAR	2F1

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

SYST CHAP	SUB-SYST SECTION	TITLE	AEROFICHE GRID NO.
33	LIGHTS		2H16
34	NAVIGATION & PITOT STATIC		2I1
35	OXYGEN		2I16
37	VACUUM		2J12
39	ELECTRICAL ELECTRONIC PANELS AND MULTI-PURPOSE PARTS		2K1
51	STRUCTURES		2K11
52	DOORS		3A18
55	STABILIZERS		3B4
56	WINDOWS		3B14
57	WINGS		3B20
61	PROPELLER		3C9
71	POWER PLANT		3D1
73	ENGINE FUEL SYSTEM		3E1
74	IGNITION		3E13
77	ENGINE INDICATING		3F19
78	EXHAUST		3G10
79	OIL		3G15
80	STARTING		3G21
81	TURBINES		3H8
91	CHARTS AND WIRING DIAGRAMS		3I1

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS

FIGURE NO.	SUBJECT	GRID NO.
6-1.	Three View	1B19
6-2.	Station References	1B20
6-3.	Access Plates and Panels	1B22
7-1.	Jacking	1C4
8-1.	Leveling Airplane	1C8
8-2.	Weighing	1C9
11-1.	Placards and Decals	1C20
12-1.	Service Points	1D1
12-2.	Lubrication Chart - Landing Gear, Main	1D14
12-3.	Lubrication Chart - Landing Gear, Nose	1D16
12-4.	Lubrication Chart - Control System, Part 1	1D18
12-5.	Lubrication Chart - Cabin Door, Baggage Door and Seats	1D20
12-6.	Lubrication Chart - Control System, Part 2	1D21
12-7.	Lubrication Chart - Power Plant and Propeller	1D23
20-1.	Torque Wrench Formula	1E4
20-2.	Method of Installing Rod End Bearings	1E5
20-3.	Cherrylock Rivet Removal	1E6
20-4.	Identification of Aircraft Fluid Lines	1E8
21-1.	Cabin Environmental System Installation	1E24
21-2.	Heater and Combustion Air Blower Assembly	1F1
21-3.	Diagramatic Cutaway of Heater to Show Whirling Flame Action	1F2
21-4.	Fuel Regulator and Shutoff Valve	1F3
21-5.	Top View - Duct Switch	1F3
21-6.	Intake Valve and Switches	1F4
21-7.	Wiring Diagram	1F8
21-8.	Primary Power Circuit	1F9
21-9.	Starting Power Circuit	1F10
21-10.	Spark Plug Fixture	1F12
21-11.	Wiring - Test Setup	1F12
21-12.	Spark Plug Gap Adjustment	1F13
21-13.	Ignition Unit Assembly	1F17
21-14.	Test Setup for Fuel Regulator and Shutoff Valve	1F20
21-15.	Heater Fuel Pump	1F21
21-16.	Suggested Design for Seal Plates, Plugs, and Caps for Combustion Tube Leakage Test	1G1
21-17.	Test Setup for Combustion Air Pressure Switch	1G1
21-18.	Exploded View of Heater Assembly	1G6
21-19.	Exploded View - Combustion Air Blower and Motor Assembly	1G8
21-20.	Suggested Setup of Heater Operation Test	1G10
21-21.	Wiring Connections for Heater Operation Test	1G10
21-22.	Spark Plug Gap Adjustment Tool	1G13

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
21-23.	Heater Hourmeter Installation	1G14
21-24.	Air Conditioning System Installation (PA-44-180T S N 44-8107027 and up)	1G21
21-25.	Test Gauge and Manifold Set	1H2
21-26.	Manifold Set Operation	1H3
21-27.	Leak Test Hookup	1H4
21-28.	Evacuation Hookup	1H6
21-29.	Charging Stand	1H8
21-30.	Charging Hookup	1H9
21-31.	Top Dead Center Casting Mark (Sankyo Compressor)	1H12
21-32.	Rotation of Clutch Front Plate (Sankyo Compressor Oil Check)	1H12
21-33.	Condenser Installation	1H15
21-34.	Expansion Valve	1H17
21-35.	Components Installation	1H19
23-1.	Emergency Locator Transmitter Installation	1I3
23-2.	ELT Using Fixed Aircraft Antenna (Narco)	1I5
23-3.	ELT Portable Folding Antenna (Narco)	1I5
23-4.	Communications Components ELT Schematic	1I9
23-5.	Narco ELT Schematic	1I9
24-1.	Lamp Bank Load	1I22
24-2.	Battery Box	1I24
24-3.	Electrical Component Location	1J3
24-4.	Regulator Diagram (LAMAR)	1J4
24-5.	Testing Regulator (LAMAR)	1J7
24-6.	Adjusting Regulator (LAMAR)	1J8
27-1.	Correct Method of Installing Rod End Bearing	1K8
27-2.	Control Column Assembly	1K11
27-3.	Aileron Controls	1K13
27-4.	Bellcrank Rigging Tool	1K16
27-5.	Aileron Rigging	1K17
27-6.	Rudder Controls	1K20
27-7.	Rudder Rigging	1K21
27-8.	Clamping Rudder Pedals	1K21
27-9.	Rudder Travel Adjustments	1K22
27-10.	Rudder Trim Controls	1L1
27-11.	Rudder Pedal Assembly	1L4
27-12.	Stabilator Controls	1L6
27-13.	Stabilator Rigging	1L8
27-14.	Stabilator Travel Adjustments	1L10
27-15.	Methods of Securing Trim Cables	1L10
27-16.	Stabilator Trim Controls	1L12
27-17.	Wrapping Trim Barrels	1L15
27-18.	Stabilator Trim Screw Adjustment	1L15
27-19.	Flap Controls	1L17
27-20.	Flap Step Adjustment	1L19
27-21.	Flap Rigging Tool	1L22

Introduction

Page - 9

Revised: March 26, 1984

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
28-1.	Fuel System Installation	2A21
28-2.	Fuel Cell Installation	2B1
28-3.	Locking Fuel Cap Assembly	2B9
28-4.	Gascolator Assembly	2B11
28-5.	Fuel Selector Valve	2B12
28-6.	Fuel Gauge	2B15
28-7.	Fuel Pressure Gauge and Calibration	2B16
29-1.	Schematic Diagram of Hydraulic System	2B20
29-2.	Hydraulic System Installation	2B21
29-3.	Hydraulic Pump Reservoir, Exploded View	2C6
29-4.	Test and Adjustments of Hydraulic Pump	2C9
29-5.	Nose Gear Actuating Cylinder	2C12
29-6.	End Gland Locking Device (Main Gear)	2C14
29-7.	Main Gear Actuating Cylinder	2C14
30-1.	Pneumatic Deice System Installation	2D1
30-2.	Deice Control Panel Installation	2D8
30-3.	Electric Prop Deice System Installation	2E1
30-4.	Suggested Use of Dial Indicator	2E5
30-5.	Centering of Brushes on Slip Rings	2E5
30-6.	Modular Brush Assembly Alignment	2E6
30-7.	Measuring Brush Assemblies	2E7
30-8.	Brush Module Assembly 3E2011	2E8
30-9.	Modular Brush Assembly 3E2090-1	2E8
30-10.	Installation of Deicer Boots	2E11
30-11.	Typical Deicer Boot Sealer Application	2E14
30-12.	Wrinkled Deicer	2E14
30-13.	Deicer Wiring Harness Installation (Typical)	2E15
30-14.	Wing Ice Lighting System	2E19
30-15.	Ice Detection System	2E22
30-16.	Heated Pitot and Heated Lift Detector Installation (PA-44-180T)	2E23
32-1.	Main Gear Oleo Strut Assembly	2F13

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
32-2.	Main Gear Service Tolerances	2F15
32-3.	Main Gear Installation	2F20
32-4.	Aligning Main Gear	2G1
32-5.	Nose Gear Oleo Strut Assembly	2G3
32-6.	Nose Gear Installation	2G5
32-7.	Nose Gear Service Tolerances	2G7
32-8.	Nose Gear Downlock and Eccentric Bushing Installation	2G12
32-9.	Nose Gear Adjustment	2G14
32-10.	Clamping Rudder Pedals in Neutral Position	2G16
32-11.	Rudder Pedals at Neutral Angle	2G16
32-12.	Mechanical Nose Gear Door Mechanism	2G18
32-13.	Nose Wheel Assemblies	2G20
32-14.	Main Wheel Assembly	2G22
32-15.	Wheel Brake Assembly	2G24
32-16.	Removal and Installation of Anchor Bolts	2H1
32-17.	Brake Installation	2H3
32-18.	Parking Brake Valve Assembly	2H4
32-19.	Brake Cylinder (1700)	2H5
32-20.	Brake Cylinder (10-27)	2H5
32-21.	Brake Cylinder (10-30) (Toe Brake)	2H6
32-22.	Toe Brake Installation	2H9
32-23.	Adjustment of Main Gear Down Limit Switch	2H11
32-24.	Adjustment of Nose Gear Down Limit Switch	2H11
32-25.	Throttle Warning Switches	2G13
34-1.	Pitot-Static System Installation	2I5
35-1.	Fixed - Oxygen System	2I19
35-2.	Portable - Oxygen System	2I20
35-3.	Test Apparatus for Testing Oxygen System	2I23
35-4.	Oxygen Tubing Installations	2I24
35-5.	Installation of Swageloc Fittings	2J3
37-1.	Vacuum System Installation	2J15
37-2.	Vacuum Regulator	2J17
39-1.	Annunciator Panel Installation	2K5
39-2.	Electric Clock Installation	2K7
51-1.	Skin Materials and Thickness	2K14
51-2.	Surface Scratches or Ground-in-Dirt	2K19
51-3.	Deep Scratches, Shallow Nicks and Small Holes	2K20
51-4.	Mixing of Epoxy Patching Compound	2K20
51-5.	Welding Repair Method	2K21
51-6.	Repairing of Cracks	2K21

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
51-7.	Various Repairs	2K22
51-8.	Repair of Stress Lines	2K24
51-9.	Repair of Impacted Damage	2K24
52-1.	Door Installation	3A21
52-1a.	Door Snubber Installation	3A23
52-2.	Fabricated Tool for Baggage Door Lock	3A24
52-3.	Emergency Exit Installation	3B2
55-1.	Stabilator Installation	3B7
55-2.	Stabilator Balance Configuration	3B8
55-3.	Vertical Fin Installation	3B9
55-4.	Rudder Installation	3B11
55-5.	Rudder Balancing	3B12
56-1.	Windshield Installation	3B17
56-2.	Side Window Installation	3B19
57-1.	Wing Installation	3B24
57-2.	Aileron and Flap Installation	3C4
57-3.	Aileron Balancing	3C6
61-1.	Typical Nicks and Removal Method	3C12
61-2.	Propeller Installation	3C13
61-3.	Propeller Governor	3C15
61-4.	Adjustment of Propeller Control	3C15
61-5.	Synchrophaser System Installation	3C17
61-6.	Pulse Generator Assembly	3C19
61-7.	Backup Test of Pulse Generator	3C22
71-1.	Engine and Shock Mount Installation	3D12
71-2.	Engine Cowling Installation	3D17
71-3.	Cowl Flap Installation	3D17
71-4.	PA-44-180 Induction System	3D19
71-5.	PA-44-180T Induction System	3D22
73-1.	Carburetor	3E3
73-2.	Engine Primer System (PA-44-180)	3E6
73-3.	Fuel System Schematic (PA-44-180T)	3E6
73-4.	Engine Primer System (PA-44-180T)	3E7
73-5.	Adjustment of Engine Controls	3E9
74-1.	Height of Spring in Distributor Block Tower	3E18
74-2.	Contact Points	3E18
74-3.	Engine Timing Marks	3E20
74-4.	Timing Light Connected to Magneto	3E20
74-5.	Timing Marks on Magneto Rotor	3E21
74-6.	Painted Tooth Centered in Timing Window	3E22
74-7.	Timing Mark on Rotor Aligned with Pointer	3E22
74-8.	Timing Light Connected to Magneto and Breakers	3F1
74-9.	Cam End View of Magneto	3F2
74-10.	Removing Impulse Coupling	3F4
74-11.	Checking Flyweight to Stop Pin Clearance	3F4
74-12.	Stop Pin Installation Dimension	3F4

Introduction

Page - 12

Revised: January 3, 1983

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
74-13.	Checking Flyweight Axial Wear with Drill Shank	3F5
74-14.	Checking Flyweight Radial Wear with Gauge	3F5
74-15.	Points of Coupling Body Wear	3F6
74-16.	Acceptable and Deformed Coupling Springs	3F6
74-17.	Checking Impulse Coupling for Magnetization	3F8
74-18.	Orientation of Spring in Coupling Body	3F8
74-19.	Lifting Inner End of Spring	3F8
74-20.	Checking Harness Leads Continuity	3F10
74-21.	Checking Harness Leads Insulation Resistance	3F10
74-22.	Modified Pliers	3F10
74-23.	Removing Spring From Lead Assembly	3F10
74-24.	Assembly Tool	3F12
74-25.	Using Assembly Tool	3F12
74-26.	Ferrule Positioned Under Braid	3F13
74-27.	Ferrule Seating Tool	3F13
74-28.	Position of 11-8627 Kit and Contact Spring at Start of Installation	3F14
74-29.	Position of 11-8627 Kit and Contact Spring After Installation	3F14
74-30.	Lubricating Sleeve	3F14
74-31.	Lubricating Ferrule Shoulder	3F14
74-32.	Removing Spark Plug Frozen to Bushing	3F16
74-33.	Magneto and Starter Switches	3F18
77-1.	Engine Instrument Lines Installation	3F21
77-2.	Electric Tachometer Installation	3G2
77-3.	EGT Probe Installation (PA-44-180T)	3G8
78-1.	Inspection of Mufflers	3G12
80-1.	Exploded View of Gear Reduction Starter Motor	3H2
80-2.	Turning Motor Commutator	3H5
80-3.	Testing Motor Armature for Shorts	3H5
80-4.	Testing Motor Fields for Grounds	3H5
80-5.	No Load Test Hookup	3H5
80-6.	Stall Torque Hookup	3H7
81-1.	Schematic Diagram of Typical Turbocharger System	3H17
81-2.	Turbocharger Installation	3H19
91-1.	Tire Balancer Fixture	3I8
91-2.	Control Surface Balancing Tool	3I18
91-3.	Fabricated Aileron Bellcrank Rigging Tool	3I19
91-4.	Fabricated Aileron and Flap Rigging Tool	3I20
91-5.	Fabricated Stabilator Rigging Tool	3I21
91-6.	Fabricated Rudder Rigging Tool	3I21

ELECTRICAL SCHEMATICS

— NOTE —

Refer to Card 3 Grid No. 3J2 for Electrical Schematic Index.

Introduction

Page - 13

Revised: January 3, 1983

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LIST OF CHARTS

CHART NO.	SUBJECT	GRID NO.
601	Leading Particulars and Principal Dimensions	1B16
1201	Thread Lubricants	1E1
2001	Maximum Distance Between Supports for Fluid Tubing	1E7
2101	Troubleshooting (Janitrol Heater)	1E17
2102	Blower System Wire Color Codes	1E22
2103	Inspection (Ignition Unit)	1F18
2104	Troubleshooting (Air Conditioner)	1G16
2105	Temperature Pressure Chart	1G22
2106	Aluminum Tubing Torque	1H1
2107	Evaporator Blower Motor Wire Codes	1H19
2401	Troubleshooting (Alternator)	1I14
2402	Troubleshooting (Battery)	1I19
2403	Alternator Belt Tension	1I23
2404	Hydrometer Reading and Battery Charge Percent	1J1
2701	Troubleshooting (Surface Controls)	1K4
2702	Cable Tension Vs. Ambient Temperature	1K9
2801	Troubleshooting (Fuel System)	2A22
2802	Sender/Fuel Quantity Gauge Tolerances	2B15
2901	Troubleshooting (Hydraulic System)	2B23
2902	Leading Particulars, Hydraulic System	2C10
2903	Characteristics, Hydraulic Pump Motor	2C10
3001	Troubleshooting (Pneumatic Deice System)	2C23
3002	Operating Pressures	3D3
3003	Materials and Supplies for Cold Repair	2D10
3004	Troubleshooting (Propeller Deicer System)	2D19
3005	Required Materials for Repair of Propeller Deicer	2E12
3006	Mixing of Materials	2D15
3007	Electrical Resistance	2E15
3201	Troubleshooting (Landing Gear)	2F6
3202	Toe-In, Toe-Out Correction	2F23
3401	Troubleshooting (Rate of Climb Indicator)	2I6
3402	Troubleshooting (Altimeter)	2I7
3403	Troubleshooting (Airspeed Tubes and Indicator)	2I8
3404	Troubleshooting (Magnetic Compass)	2I10
3501	Troubleshooting (Oxygen System)	2I20
3502	Oxygen System Limits	2J4
3503	Filling Pressure for Certain Ambient Temperatures	2J9
3504	Portable Oxygen System Component Limits	2J11
3701	Troubleshooting (Vacuum System)	2J16
3901	Troubleshooting (Annunciator Panel)	2K4
5101	List of Materials (Thermoplastic Repair)	2K18

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

LIST OF CHARTS (cont)

CHART NO.	SUBJECT	GRID NO.
6101	Propeller Torque Limits	3C12
7101	Troubleshooting (Engine)	3D4
7301	Troubleshooting (Fuel Pressure Gauge)	3E10
7302	Troubleshooting (Fuel Pressure Gauge)	3E11
7401	Troubleshooting (Magnet)	3E15
7402	Coupling Torques	3F15
7701	Manifold Pressure Indicator (Troubleshooting)	3F23
7702	Tachometer (Troubleshooting)	3F24
7703	Cylinder Head Temperature (Troubleshooting)	3G4
7704	Exhaust Gas Temperature (Troubleshooting)	3G5
7901	Oil Pressure Sender Test Specifications	3G18
7902	Oil Pressure Gauge (Troubleshooting)	3G19
7903	Oil Temperature Indicators (Troubleshooting)	3G20
8001	Troubleshooting (Starter)	3G23
8002	Starting Motor Specifications	3H7
8101	Troubleshooting (Turbocharger)	3H10
9101	Flare Fitting Torques	3I3
9102	Recommended Nut Torques	3I4
9103	Decimal Conversions	3I6
9104	Decimal Equivalents of Drill Sizes	3I7
9105	List of Consumable Materials	3I9
9106	Metric Conversion Tables	3I14
9107	Electric Wire Coding	3I22
9108	Electric Symbols	3I23
9109	Electrical System Component Loads	3I24

CHAPTER

28

FUEL

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

CHAPTER 28 - FUEL

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
28-00-00	GENERAL	2A20	8-81
28-01-00	Description	2A20	
28-02-00	Troubleshooting	2A20	
28-10-00	STORAGE	2A24	
28-11-00	Fuel Cells	2A24	A 8-82
28-11-01	Removal of Fuel Cells	2A24	
28-11-02	Installation of Fuel Cells	2A24	
28-11-03	Cleaning and Inspection of Fuel Cells	2A24	
28-11-04	Fuel Cell Compartment	2B2	
28-11-05	Molded Nipple Fittings	2B2	
28-11-06	Handling and Storage of Fuel Cells	2B2	
28-11-07	Repair of Fuel Cells	2B3	
28-11-08	Handling of Repair Materials	2B3	
28-11-09	Repair Procedures of Goodyear Vithane Fuel Cells	2B4	
28-11-10	Repair Limitations of Fuel Cells	2B4	
28-11-11	Repair Patch (Heat Cure Method)	2B4	
28-11-12	Repair Patch (Air Cure Method)	2B7	
28-11-13	Metal Fitting - Sealing Surfaces	2B7	
28-11-14	Accessory Replacement	2B7	
28-11-15	Defect Repairs of Fuel Cell	2B8	
28-11-16	Testing Fuel Cells	2B8	
28-12-00	Locking Fuel Cap	2B9	A 8-82
28-12-01	Disassembly of Locking Fuel Cap	2B9	A 8-82
28-12-02	Assembly of Locking Fuel Cap	2B9	A 8-82
28-20-00	DISTRIBUTION	2B10	
28-21-00	Gascolator	2B10	
28-21-01	Removal of Gascolator	2B10	
28-21-02	Cleaning Gascolator	2B10	
28-21-03	Reassembly of Gascolator	2B10	
28-22-00	Fuel Selector Valve	2B11	
28-22-01	Removal of Fuel Selector Valve	2B11	
28-22-02	Disassembly of Selector Valve	2B12	
28-22-03	Cleaning, Inspection and Repair of Selector Valve	2B12	
28-22-04	Assembly of Selector Valve	2B13	
28-22-05	Leak Test of Selector Valve	2B13	
28-23-00	Cleaning Fuel System	2B13	
28-24-00	Electric Fuel Pump	2B14	
28-24-01	Removal and Installation of Electric Fuel Pump	2B14	
28-40-00	INDICATING	2B14	
28-41-00	Fuel Quantity Sender Unit	2B14	
28-41-01	Fuel Quantity Sender Gauge Check - Installed	2B14	2-81
28-42-00	Fuel Pressure Gauge Check (180T)	2B16	2-81

28 - Cont./Effec.

Page - 1

Revised: August 26, 1982

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

GENERAL.

The fuel system components covered in this section consist of fuel cells, fuel selector valves, gascolator and electric fuel pumps. Each wing contains a fuel cell, having a capacity of 55 U.S. gallons, for a total capacity of 110 U.S. gallons.

This chapter also provides instructions for removal, repair, cleaning, reassembly and testing of repairable components of the fuel system.

The aircraft is approved for operation with an anti-icing additive in the fuel. When an anti-icing additive is used it must meet the specification MIL-I-27686, must be uniformly blended with the fuel while refueling, must not exceed .15% by volume of the refueled quantity and to ensure its effectiveness should be blended at not less than .10% by volume. One and one-half liquid ozs. per ten gallons of fuel would fall within this range. A blender supplied by the additive manufacturer should be used. Except for the information contained in this section, the manufacturer's mixing or blending instructions should be carefully followed.

— CAUTION —

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

DESCRIPTION.

An independent fuel system is incorporated into each wing permitting each engine to operate from its own fuel supply. However, the two systems are interconnected by means of a crossfeed that will permit fuel from one cell to be drawn by the opposite engine in the event of an emergency.

Fuel cells are installed in the aft nacelles and consists of bladder type tanks.

Fuel pressure and fuel flow for each system are indicated on their respective gauges located in the instrument panel. A fuel quantity gauge for each system, also located in the instrument panel, indicates the amount of fuel remaining as transmitted by electric fuel quantity sending units located in the wing tanks.

Fuel for each engine is drawn through a finger screen located in the fuel tank to a selector valve. From the selector valve, the fuel goes through a gascolator (fuel filter) to the electric pump and into the engine driven pump which forces the fuel to the carburetor.

TROUBLESHOOTING.

Chart 2801, lists troubles which may occur in the mechanical or electrical portions of the fuel system, the probable cause and a suggested remedy. When troubleshooting, first check from the fuel supply or power source to the item affected.

28-02-00

Page 28-01

Revised: August 22, 1981

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

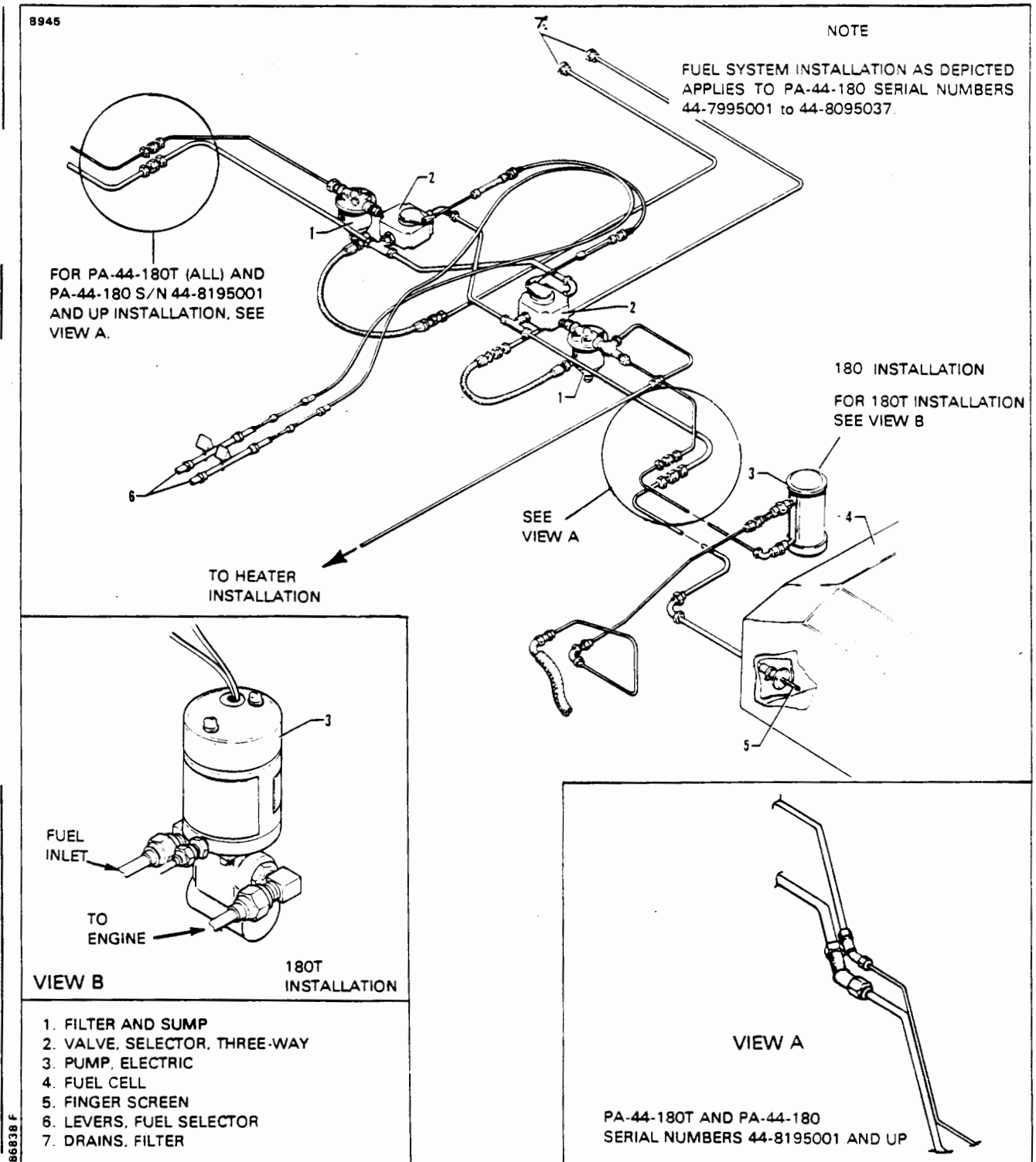


Figure 28-1. Fuel System Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2801. TROUBLESHOOTING (FUEL SYSTEM)

Trouble	Cause	Remedy
Failure of fuel to flow.	Fuel line blocked. Fuel vent cap blocked. Mechanical or electrical fuel pump failure. Fuel selector valve in improper position. Damaged fuel selector valve.	Flush fuel system. Check and clean vent hole in cap. Check and replace if necessary. Reposition as required. Check for obstructions in the fuel selector leverage mechanism. Check fuel selector cable for freedom of movement. Replace fuel selector valve.
Fuel quantity gauge fails to operate.	Broken wire. Gauge inoperative. Fuel sender float partially or completely filled with fuel. Circuit breaker open. Float and arm assembly of fuel sender sticking. Bad ground.	Check and repair. Replace gauge. Replace sender. Check and reset. Check. Check for good contact at ground lip or rear of gauge.
No fuel pressure indication.	Fuel selector valve stuck. Fuel tanks empty. Defective gauge. Fuel selector valve in improper position.	Check fuel selector valve. Check fuel tanks and fill. Replace gauge. Reposition fuel selector valve lever.

28-02-6

Page 28-03

Reissued: December 12, 1979

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2801. TROUBLESHOOTING (FUEL SYSTEM) (cont)

Trouble	Cause	Remedy
Low pressure or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty diaphragm in pump.	Rebuild or replace pump.
	Air in line to pressure gauge.	Bleed line.

28-02-00

Page 28-04

Reissued: December 12, 1979

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

STORAGE.

FUEL CELLS.

REMOVAL OF FUEL CELLS. (Refer to Figure 28-2.)

1. Turn the fuel selector to the off position and drain the fuel cell.
2. Remove the access covers from the top and side of the nacelle, also from underside of wing at rear of nacelle.
3. Reaching through the side access panel loosen the clamps and disconnect the fitting at the vent line.
4. Reaching through the access panel at the bottom rear nacelle, disconnect the clamp to the finger strainer.
5. Disconnect the wires from the sender unit; remove the bolts that secure the sender and carefully draw the sender with its gasket from the cell. Note the installed position of the sender.
6. Remove the bolts from the nut rings on the cell.
7. Reaching through the rear access hole, gently separate the velcro type fasteners holding the fuel cell to the surrounding structures.
8. Place tape or other protective material around the cell access opening to prevent damage to the cell when removing.

INSTALLATION OF FUEL CELLS. (Refer to Figure 28-2.)

1. With protective material around the cell access opening, install folded fuel cell through access hole and orientate, reaching through access hole into fuel cell, press outward firmly to engage cell with velcro tape.
2. Install the bolts into the nut rings and torque all bolts to 30 +0 -5 inch-pounds, wait 30 minutes and retorque to 25 ± 5 inch-pounds.
3. Noting the position of the sender, place sender with its gasket into cell and install bolts, connect the wires to the sender.
4. Reaching through the access panel at the bottom rear nacelle connect the clamp to the finger strainer and torque to 15 inch-pounds.
5. Reaching through the side access panel connect the fitting at the vent line and tighten the clamps to 15 inch-pounds.
6. Service cell and visually inspect all fittings for leaks.
7. Replace the access covers to the top and side of the nacelle and also at the underside of the wing at the nacelle.

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.

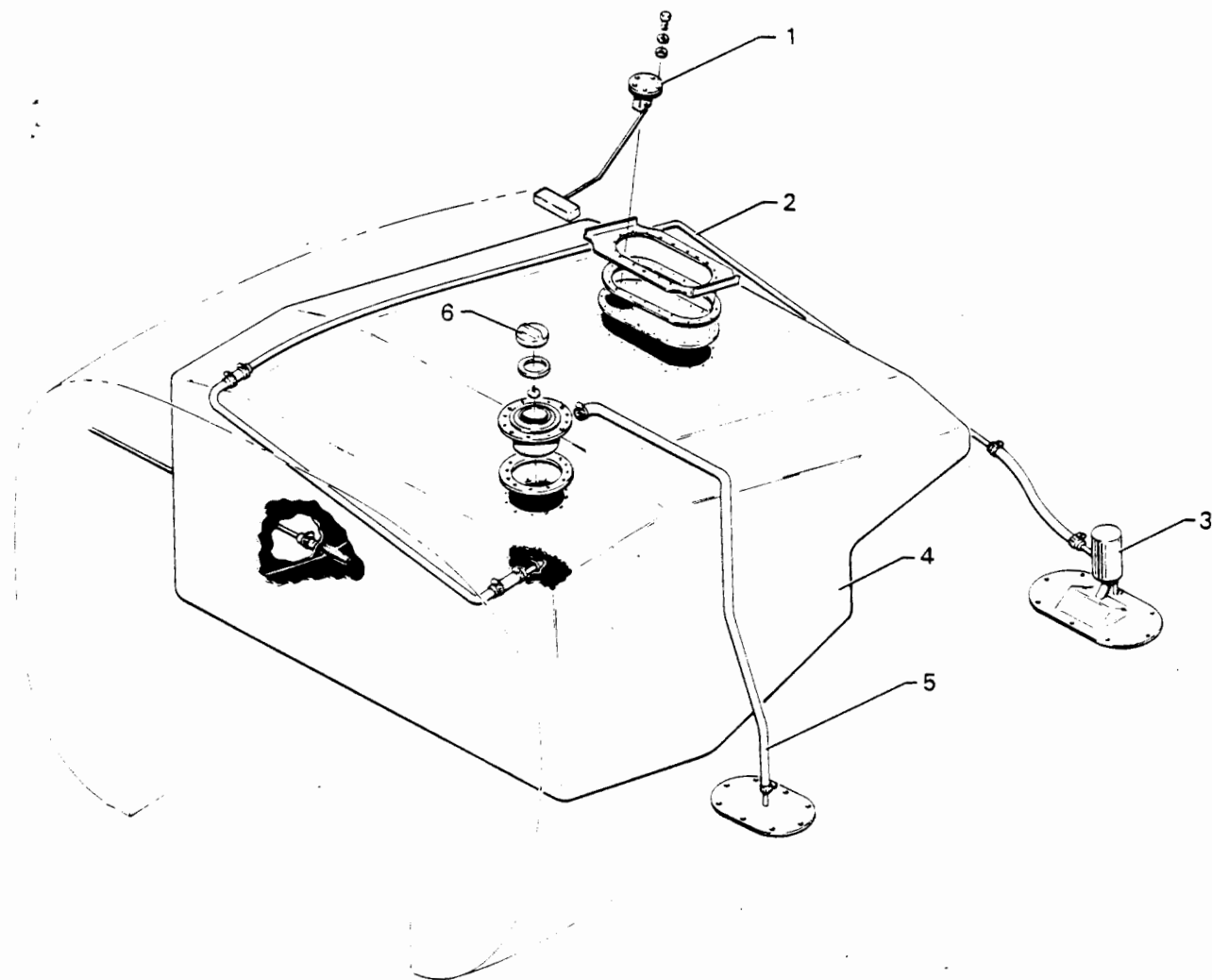
— WARNING —

Use a vapor-proof light for inspection.

28-11-03
Page 28-05
Revised: August 26, 1982

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2280



- 1. FUEL SENDER
- 2. VENT LINE
- 3. VENT CAN
- 4. FUEL CELL
- 5. OVERFLOW LINE
- 6. FILLER CAP

Figure 28-2. Fuel Cell Installation

28-11-03

Page 28-06

Reissued: December 12, 1979

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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.

2. Fuel cells may be inspected by the following procedure:

A. New Cells: Inspect the cell surface inside and outside for cuts, abraded (scuffed) areas and accessory damage. Also, inspect the fitting seals for nicks, scratches and foreign material.

B. Used Cells: Cells removed from the airframe cavity for inspection and repair or cells being returned to service from storage, should be inspected as outlined above.

Cells installed in the airframe cavity may be inspected for possible repairs by reaching through the fuel cell access plate and taking a section of cell between the thumb and forefinger. Wipe the ridge created by this action with MEK. If fine cracks are evident, the fuel cell is not repairable.

FUEL CELL COMPARTMENT.

1. Thoroughly clear the cell compartment of all fittings, trimmings, loose washers, bolts or nuts.
2. Round off all sharp edges of the fuel cell compartment.
3. Inspect the fuel cell compartment just prior to fuel cell installation.
4. Tape over all sharp edges and all rough rivets.

MOLDED NIPPLE FITTINGS.

The molded nipple fitting is a lightweight fitting developed for ease in installation in certain locations in the airplane. In order to get the best service from this type fitting, it is necessary to exercise certain precautions at the time of installation. The specific precautions other than the general care in handling are as follows:

1. Insert the finger strainer into the fuel cell 4.50 inches.
2. Insert the vent tube into the fitting.
3. The hose clamp must be clear of the end of the fitting by 1/4 inch where possible.
4. Locate the hose clamp on the fabric-reinforced area of the nipple.
5. Torque the hose clamp 15 to 20 inch-pounds. Do this once. Do not re-tighten unless the hose clamp is loosened completely and allowed to set for 15 minutes before re-tightening.
6. Do not use sealing paste or gasket compound.
7. Apply a thin film of Simonize Wax to metal flow tubes to facilitate installation and removal.

HANDLING AND STORAGE OF FUEL CELLS.

— WARNING —

Do not permit smoking or open flame near repair area or cells.

1. Prevent needless damage by exercising common sense care in all handling of the cells. Folding or collapsing of cells is necessary to place them in containers for storage, install in airframe cavities and carrying from place to place. Protect fitting seal surface from contact with cavities during removal or installation. Use protective covers over fitting seal when practical. Protect cell from tools, hot lights, etc., when working around them. Avoid stepping on folds or creases in cells. Do not carry cells by fittings. Maintain original cell

28-11-06

Page 28-07

Reissued: December 12, 1979

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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.

2. When storing cells, observe the following rules:

A. Fold cells smoothly and lightly as possible with a minimum number of folds. Place protective wadding between folds.

B. Wrap cell in moisture-proof paper and place it in a suitable container. Do not crowd cell in container, use wadding to prevent movement.

C. Stack boxed cells to allow access to oldest cells first. Do not allow stacks to crush bottom boxes. Leave cells in boxes until used.

D. Storage area must be dry, 70° F, and free of exposure to sunlight, dirt and damage.

E. Used cells must be cleaned with soap and warm water prior to storage. Dry, and box as outlined above.

REPAIR OF FUEL CELLS.

The following is the repair procedure recommended for field repair of fuel cells constructed of Goodyear Vithane material. 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 at approximately 75° F. For each 10° drop in temperature add 20 hours cure time. For instance if room temperature reads 65° F, air cure for 92 hours instead of 72 hours.

HANDLING OF REPAIR MATERIALS.

1. All materials are to be protected from dirt contamination, sunlight, and excessive heat or cold while in storage. Containers are to be tightly capped and stored at a temperature of 70° F.

— CAUTION —

80C27 repair cement requires thorough mixing to obtain full adhesive values.

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 320gms) with cross-linker 80C28 (4 oz. bottle with 81cc).

— CAUTION —

All containers for cements and solvents should be properly identified.

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.

28-11-08

Page 28-08

Reissued: December 12, 1979

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REPAIR PROCEDURES OF GOODYEAR VITHANE FUEL CELLS.

— NOTE —

The repair of Goodyear Vithane fuel cells is restricted to authorized personnel. Authorized personnel are those who have been certified and trained by Goodyear representatives, or those who have received their training from persons who have been certified and trained by Goodyear representatives.

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 of an inch 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 of an 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 .50 of an inch minimum lap or seam is maintained.

— CAUTION —

For each 10° drop in temperature from 75° F, add 20 hours cure time. For example, at 65° F, cure for 92 hours.

10. Air cure repair patches are to remain clamped and undisturbed for 72 hours at room temperature of approximately 75° F.
11. All heat cured patches are ready for use when cool.
12. Fitting repairs are confined to loose flange edges, seal surface rework and coat stock.
13. The maximum number of heat cure repairs in the same area is four.

— NOTE —

Any damage not covered by the above should be returned to The Goodyear Tire & Rubber Company, Rockmart, Georgia, for repair.

REPAIR PATCH. (Heat Cure Method)

1. Prepare exterior cell wall and exterior patch first. Cut repair patch from FT-192 material to size required to insure proper lap over injury in all directions. (See Limitations.) (Hold shears at an angle to produce a beveled edge (feather) on patch.) Round corners of patch. (Dull side or gum contact face of repair patch should be the largest surface after beveling.)

28-11-11

Page 28-09

Reissued: December 12, 1979

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

FUEL CELL REPAIR EQUIPMENT INFORMATION

Repair Kit, Goodyear Drawing No. 2F1-3-37813		
Group I Materials		
80C27 Repair Cement	8	Pint cans, 320gms in each
80C28 Cross-Linker	8	4 oz. bottles, 81cc in each
Methyl Ethyl Ketone	2	Pint cans
FT-192 Repair Fabric	2	Sheet 12" x 12"
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 (250ml)	1	
Cellophane (Sheet 12" x 24")	2	
Torques For Specific Nipple Fitting Sizes		
Fitting Size (I.D.)	Clamp Torques (in.-lbs.)	
1/4" - 1/2"	12 - 16	
3/4" - 1"	15 - 20	
1 1/2"	25 - 30	
2"	30 - 35	
3"	35 - 40	
— 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.		

28-11-11

Page 28-10

Reissued: December 12, 1979

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

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 a 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 (320gms) with the crosslinker 80C28 (8lcc), 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.

— CAUTION —

Do not use first can of mixed cement for this coat.

8. Repeat a second mixing of repair cement and brush a second coat.

— CAUTION —

Make sure cellophane inside cell over injury remains in place as any cement will stick cell walls together without it as a separator.

9. Allow cement to dry approximately five minutes and then center patch over injury. Lay repair patch by rolling down on surface from center to edge without trapping air. Hold the unrolled portion of repair patch off the cemented surface until roller contact insures an air-free union. At this time repair patch may be moved by hand on wet surface to improve lap. Do not lift repair patch, slide it.
10. Cover one smooth surface each of two aluminum plates (plates must be larger than patch), with fabric-backed airfoam fabric side out. Tape airfoam in place. Foam must cover edges of plate for protection. Use a cellophane separator to prevent the cement from sticking in the wrong place.

— 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.

12. Center a repair iron 2F1-3-25721-1 on the plate over the repair patch. Secure the assembly with a "C" clamp. Tighten by hand. Check cement flow to determine pressure.
13. Connect repair iron into 110-volt electrical outlet and cure repair for two hours. After two hours cure, unplug electric and allow repair iron to cool to touch. Then remove "C" clamp. Wet cellophane to remove from repair.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

— CAUTION —

Success of applying both an outside and inside repair patch simultaneously is doubtful and not recommended.

14. Inside patch is applied same as above procedure except for size of repair patch (see limitations) after outside patch has been cured.

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.

— WARNING —

Do not allow solution to come in contact with hands, eyes or clothing.

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.

ACCESSORY REPLACEMENT.

1. Obtain cured repair accessory from cell manufacturer.
2. Mark location of old accessory and preserve markings for guide lines to locate new part.
3. Remove old accessory by gradually loosening an edge with a blunt probe-like instrument.
4. When a loose edge is created, grasp accessory by loose edge with pliers and gently pull accessory off cell wall. Be careful not to pull cell lap open while peeling accessory off. Pull from blind side of a cell lap toward the exposed edge.
5. Buff the cell surface under accessory with emery cloth to smooth roughness and prepare for cement.

— NOTE —

Removal of old accessory will probably leave an uneven cavity and surface.

6. Prepare replacement accessory by buffing and washing contact surface. Also wash cell surface (see repair patch).

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

7. Apply mixed 80C27 repair cement to both surfaces being sure to level cavity left by removal of old accessory.
8. Roll new accessory into place as with a repair patch and place suitable padded plates in position to insure adequate pressure when clamped. Use cellophane separator to prevent cement sticking in the wrong place.
9. Cure as with repair patch either cure method.

DEFECT REPAIRS OF FUEL CELL.

1. Blisters: Remove loose material by trimming. Apply an outside and inside repair patch.
2. Holes, Punctures, Cuts, Tears and Deep Abraded Areas: Trim away any ragged material and apply an outside and inside repair patch.
3. Loose Seams: Buff loose edge and contact surface with emery cloth. Wash three times with Methyl Ethyl Ketone. Apply 80C27 mixed cement two coats as with repair patch. Clamp and cure. Either method may be used. See repair patch. Loose seams may be trimmed if minimum lap remains.
4. Loose Fitting Flange - Inside: Buff edge of flange and contact surface under flange. Apply 80C27 mixed repair cement, cellophane, padded plates and clamp. Follow procedure as outlined for repair patch, except for patch itself.
5. Looseness Against Metal: Prepare metal as per metal fitting - sealing surfaces. Apply 80C27 mixed cement and cure.

TESTING FUEL CELLS.

Either of the following test procedures may be used to detect leaks in the bladder cells:

1. Soap Suds Test.
 - A. Attach test plates to all fittings.
 - B. Inflate the cell with air to a pressure of 1 4 psi MAXIMUM.
 - C. Apply a soap and water solution to all repaired areas and any areas suspected of leakage. Bubbles will appear at any point where leakage occurs.
 - D. After test, remove all plates and wipe soap residue from the exterior of the cell.
2. Chemical Test.
 - A. Attach test plates to all fitting openings except one.
 - B. Make up a phenolphthalein solution as follows: Add 40 grams phenolphthalein crystals in 1 2 gallon of ethyl alcohol, mix, then add 1 2 gallon of water.
 - C. Pour ammonia on an absorbent cloth in the ratio of 3ml 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, and maintain pressure for fifteen minutes.
 - E. Soak a large white cloth in the phenolphthalein solution, wring it 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 rustproof container to prevent evaporation and deterioration.

28-11-16

Page 28-13

Reissued: December 12, 1979

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

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.

LOCKING FUEL CAP.

DISASSEMBLY OF LOCKING FUEL CAP.

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

ASSEMBLY OF LOCKING FUEL CAP.

1. Insert key lock through cover making certain that O-ring is installed under head of key lock.
2. Slide spring, gasket and lock over back of key lock.

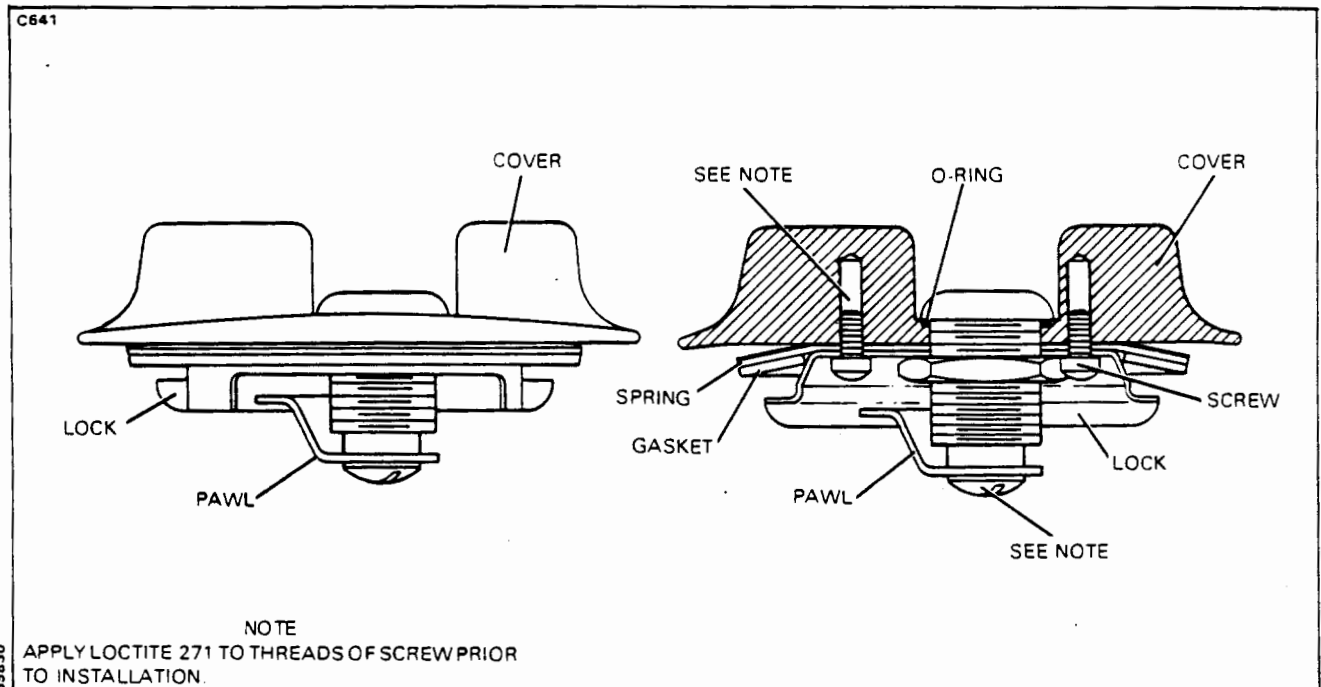


Figure 28-3. Locking Fuel Cap Assembly

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

3. Reinstall nut which secures key lock to cover.
4. Attach pawl to back of lock assembly with screw previously removed.
5. Apply Loctite 271 to thread of two screws previously removed from back of fuel cap, then install screws in back of fuel cap.

DISTRIBUTION.

GASCOLATOR. (Refer to Figure 28-4.)

— NOTE —

The gascolator should be inspected at periodic intervals as explained in Chapter 12, Servicing Fuel System.

REMOVAL OF GASCOLATOR.

1. Determine that fuel selector valve lever is in the off position. Remove scoop and screen from bottom of fuselage to gain access to the gascolator.
2. Drain remaining fuel from gascolator by opening drain valve located on the side of the fuselage just forward of the entrance step.
3. Cut safety wire and remove acorn nut, remove bowl, safety nut and screen assembly.

CLEANING GASCOLATOR.

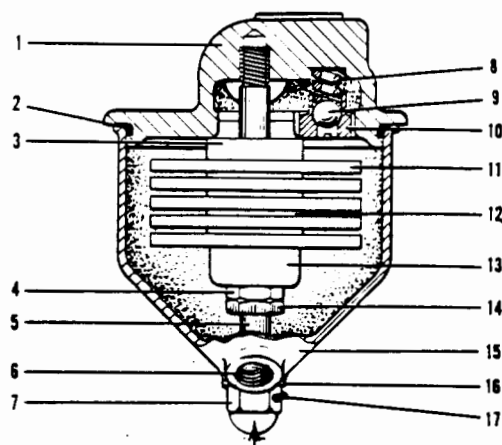
1. Clean screen assembly and bowl thoroughly using acetone or other suitable dry type cleaning solvent. Dry using a light blast of compressed air. Replace screen if any signs of damage or deterioration are evident.
2. Discard gasket and replace it with a new one at reassembly.

REASSEMBLY OF GASCOLATOR.

1. Replace screen assembly and nuts, install new gasket on top of bowl assembly. Carefully insert bowl, and replace washer and nut.
2. Safety nut to adjacent elbow.
3. Determine that the drain valve on the side of the fuselage is closed and place the fuel selector valve lever in the desired position. Replace screen and scoop on bottom of fuselage.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

256



1. BODY, FILTER	10. SEAT, RELIEF
2. O-RING SEAL	11. DISCS, FILTER
3. TUBE, OUTER	12. WASHERS
4. NUT	13. CUP, RETAINER
5. STUD	14. NUT, CHECK
6. DRAIN, FILTER, FITTING	15. BOWL, FILTER
7. NUT	16. WASHER
8. SPRING	17. SAFETY WIRE
9. BALL, RELIEF	

Figure 28-4. Gascolator Assembly

FUEL SELECTOR VALVE.

REMOVAL OF FUEL SELECTOR VALVE.

1. The fuel selector valve need not be removed unless any of the following conditions exist:
 - A. Failure of selector lever to seat in detent.
 - B. Signs of leakage.
 - C. Difficulty in moving fuel selector lever.
2. In the event it is necessary to remove the fuel selector valve, remove rear seat and floor.
3. Drain appropriate fuel tank. (Refer to Draining Fuel Tank, Chapter 12.)
4. Disconnect control cable from valve selector lever. Disconnect fuel lines and mounting hardware, and remove fuel selector valve.

— NOTE —

Except for replacement of O-rings, the fuel selector valve should be overhauled only when necessary.

It is suggested that the selector lever and control cable ends be color coded for correct reassembly.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

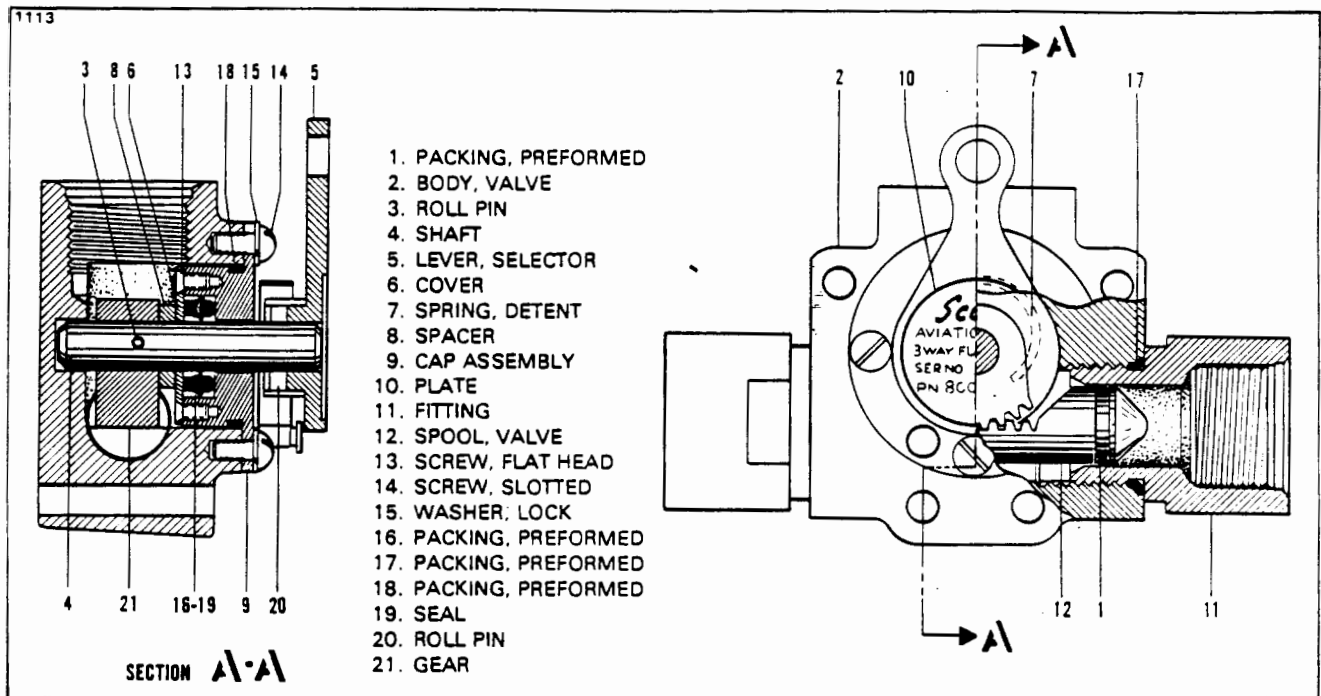


Figure 28-5. Fuel Selector Valve

DISASSEMBLY OF SELECTOR VALVE. (Refer to Figure 28-5.)

1. Remove the four screws and washers that attach the cap assembly to the valve body.
2. Pull the cap assembly straight from the valve body.
3. Push the spool from the valve body.
4. To disassemble the cap assembly, remove the roll pin that secures the gear on its shaft by driving the pin with a 3/32 straight drift punch.
5. Remove the gear and spacer from the shaft.
6. Remove the four screws that secure the packing and seal cover. Remove the cover.
7. Remove old O-rings and seal.
8. If fitting is removed, replace O-ring packing.

CLEANING, INSPECTION AND REPAIR OF SELECTOR VALVE.

1. Clean the valve components in a dry cleaning solvent.
2. Inspect the valve for the following:
 - A. Check that the friction surfaces of the valve are free from nicks, dents and burrs.
 - B. Check that the teeth of the gear and spool are not damaged.
 - C. Check that the threaded surfaces are not stripped or cross-threaded.
 - D. Check that the selector detent mechanism is operating properly.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

3. Repair to the valve is limited to reconditioning of parts, such as smoothing out minor nicks and scratches, and the replacing of O-ring packings and seal.

— NOTE —

Fittings in valve are special. Do Not use A.V fittings.

ASSEMBLY OF SELECTOR VALVE. (Refer to Figure 28-5.)

1. If either fitting was removed, install the O-ring packing and assemble the fitting on the valve body.
2. Lubricate the O-ring packings with a thin coat of stop-lock grease and install on the valve spool.
3. Insert and center the spool in the valve body.
4. Lubricate the seal and O-ring, and install in the cap assembly.
5. Ascertain that the shaft is in place and install cover. Secure with screws.
6. Slide the spacer and gear on the shaft, with the pinholes aligned so that the gear teeth are opposite the selector lever. Secure the gear with roll pin.
7. Install the O-ring packing on the cap assembly.
8. Place the selector handle in neutral in relation to the cap and install the cap assembly in the valve body. Secure the cap assembly with screws and washers.
9. Check valve operation.

LEAK TEST OF SELECTOR VALVE.

1. Connect the inlet port of the valve assembly to a 25 psi air source.
2. Plug the right hand port and close the left hand port by placing the control lever to the right.
3. Apply pressure to 25 psi. There shall be no evidence of leakage either through the port or around the fitting and lever when submerged in kerosene or a similar petroleum base fluid for 30 seconds.
4. Depressurize, remove the plug from the right hand port, place on left hand port and close right hand port by placing the lever to left.
5. Repeat Step 3.
6. Disconnect and wipe fluid from exterior.

CLEANING FUEL SYSTEM.

1. To flush fuel cell and selector valve, disconnect the fuel line from the carburetor.
2. Select a fuel cell, turn on the electric pump and flush fuel through the system until the tank is empty. Agitation of the fuel within the cell during this operation will help pick up and remove dirt and other foreign matter from the fuel cell and selector valve.
3. Repeat this procedure for each fuel cell.
4. When both cells are flushed, clean gascolator and fuel tank filter screens.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

ELECTRIC FUEL PUMP.

REMOVAL AND INSTALLATION OF ELECTRIC FUEL PUMP.

There is one electric fuel pump for each engine. The pump is mounted in the inboard side of wing. To remove pump, proceed as follows:

1. Remove access cover located on the bottom of the inboard wing.
2. Remove the fuel lines from the pump, and disconnect the electrical wiring.
3. Remove bolts holding pump in position and withdraw pump through access opening.
4. Do not attempt to disassemble or repair fuel pump. If fuel pump proves to be defective it should be replaced.
5. Reinstall pump in reverse order of removal.

— CAUTION —

Do not run pump dry.

INDICATING.

FUEL QUANTITY SENDER UNIT.

— NOTE —

The fuel cells in each nacelle are interconnected and have a total capacity of 110 gallons. Fuel quantity sender units mounted in each fuel cell transmit electrically the quantity of fuel in each cell, to fuel quantity gauges mounted in the instrument panel. A dipstick in the side pocket of the cabin, can also be used to manually check the indicating system.

FUEL QUANTITY SENDER/GAUGE CHECK (INSTALLED).

PPS40012-1

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

1. Put the fuel selector levers in the "ON" position. Completely drain fuel cell that relates to the fuel quantity sender and gauge to be checked. (Refer to Draining Fuel System, Chapter 12.)
2. Level airplane laterally. (Refer to Leveling, Chapter 8.)

— NOTE —

An external power supply providing $14 \pm .2$ volts should be utilized for the fuel Quantity Sender/Gauge Check.

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

3. With the master switch in the "OFF" position, $14 \pm .2$ volts D.C. applied to system, fuel selector valves in the "ON" position, and no fuel in the tanks, the gauge needle should be centered on the white dot to the left of the "O" radial mark, with a maximum deviation of 1/2 needle width. If not within this tolerance the gauge should be replaced.

4. Add fuel to the tanks in accordance with the information given in Chart 2802, until tanks are full. Observe the gauge reading at each 10 gallon increment. To reduce internal gauge friction tap the gauge.

5. With the tanks full the needle should be centered on the "F" radial mark within ± 1 needle width. If not within this tolerance adjust (refer to Figure 28-6) just sufficiently to bring it within tolerance - do not center the needle.

CHART 2802. SENDER FUEL QUANTITY GAUGE TOLERANCES

FUEL QUANTITY ADDED (GALLONS)	SENDER RESISTANCE (OHMS) (REF.)	GAUGE INDICATION	TOLERANCE (NEEDLE WIDTHS)
1.5*	9	0	$-\frac{1}{2}$
21.5	54	20	± 1
41.5	84	40	± 1
FULL	95	F	± 1

*Includes 0.5 gallons to fill lines, gascolator and carburetor.

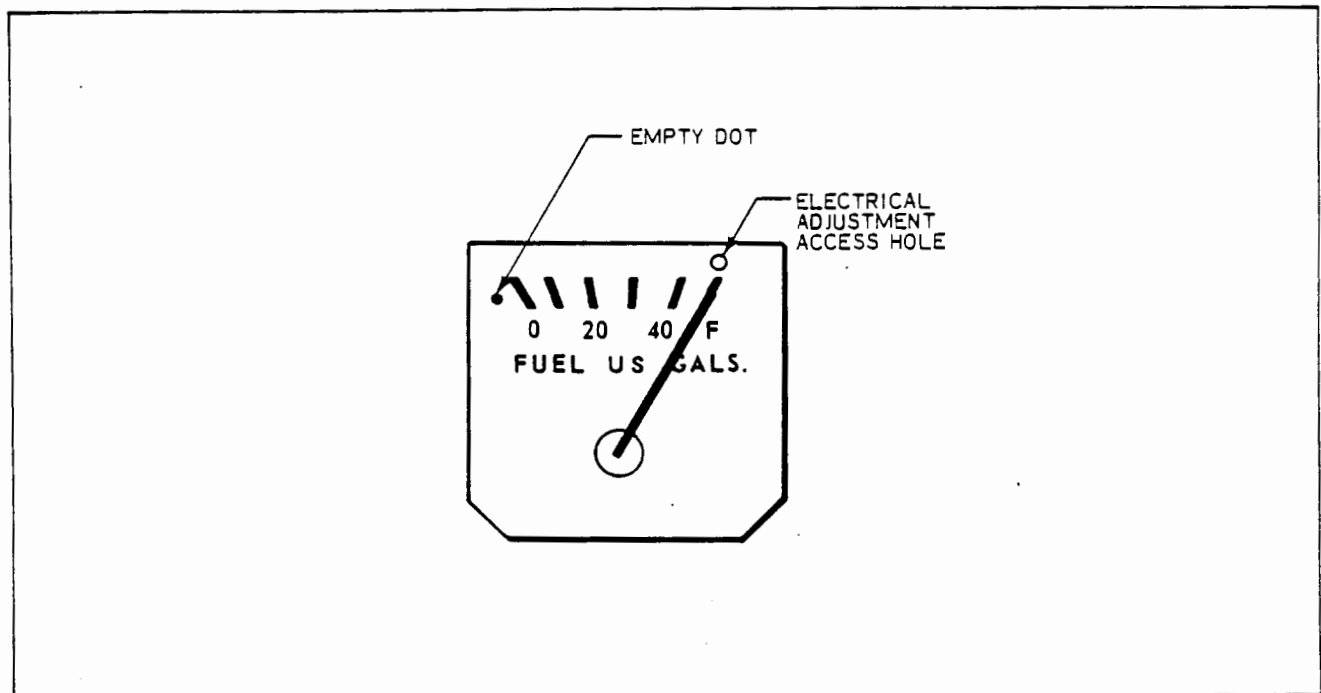


Figure 28-6. Fuel Gauge

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

FUEL PRESSURE GAUGE CHECK (180T).

PPN0012-1

1. With electrical power off, the fuel pressure gauge shall indicate the dot $\pm \frac{1}{2}$ needle width.
2. Apply *positive* 14 VDC to the electrical buss. Each needle should move to a position below the red line at 12 pounds per square inch.
3. Place the electric fuel pump switches in the "ON" position. With fuel in the tanks, the gauge should indicate between the 13 and 35 PSI radial lines.

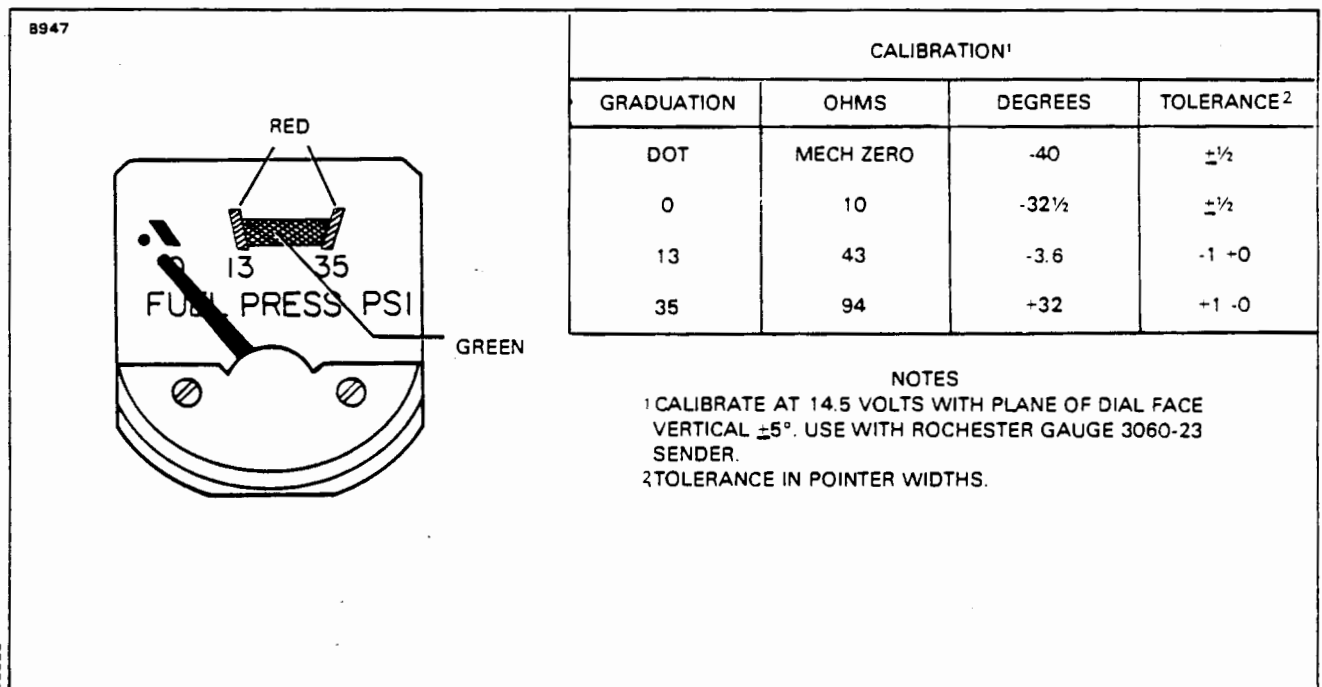


Figure 28-7. Fuel Pressure Gauge and Calibration

28-42-00
Page 28-21

Revised: January 3, 1983

CHAPTER

29

HYDRAULIC POWER

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 29 - HYDRAULIC POWER

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
29-00-00	GENERAL	2B19	-1-83
29-01-00	Description	2B19	
29-02-00	Troubleshooting	2B22	
29-10-00	MAIN	2C4	
29-11-00	Hydraulic Pump	2C4	
29-11-01	Removal of Hydraulic Pump	2C4	
29-11-02	Disassembly of Hydraulic Pump	2C5	
29-11-03	Cleaning, Inspection and Repair of Hydraulic Pump	2C5	
29-11-04	Assembly of Hydraulic Pump	2C7	
29-11-05	Test and Adjustment of Hydraulic Pump	2C7	
29-11-06	Installation of Hydraulic Pump	2C11	
29-12-00	Nose Gear Actuating Cylinder	2C11	
29-12-01	Removal of Nose Gear Actuating Cylinder	2C11	
29-12-02	Disassembly of Nose Gear Actuating Cylinder	2C11	
29-12-03	Cleaning, Inspection and Repair of Nose Gear Actuating Cylinder	2C12	
29-12-04	Assembly of Nose Gear Actuating Cylinder	2C12	
29-12-05	Installation of Nose Gear Actuating Cylinder	2C13	
29-13-00	Main Gear Actuating Cylinder	2C13	
29-13-01	Removal of Main Gear Actuating Cylinder	2C13	
29-13-02	Disassembly of Main Gear Actuating Cylinder	2C13	
29-13-03	Cleaning, Inspection and Repair of Main Gear Actuating Cylinder	2C15	
29-13-04	Assembly of Main Gear Actuating Cylinder	2C15	
29-13-05	Installation of Main Gear Actuating Cylinder	2C15	
29-14-00	Hydraulic Lines	2C16	
29-14-01	Removal and Installation of Hydraulic Lines	2C16	
29-14-02	Testing Hydraulic System	2C16	

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

The hydraulic components covered in this chapter consist of the combination hydraulic pump and reservoir, free fall valve, actuating cylinders and hydraulic lines. The brake system, although hydraulically operated, is not included in this chapter as it has its own hydraulic system independent of the gear retraction system. Refer to Chapter 32 for information on the brake system.

— CAUTION —

Prior to starting any investigation of the hydraulic system, place the airplane on jacks. (Refer to Jacking, Chapter 7.)

DESCRIPTION.

Hydraulic fluid to the landing gear actuating cylinders is supplied by an electrically powered reversible pump located in the aft fuselage on the battery shelf between stations 156 and 191. A reservoir is an integral part of the pump. The pump is controlled by a selector switch on the instrument panel to the left of the control quadrant. As the switch is placed in either the up or down position, the pump directs fluid through the particular pressure line to each individual actuating cylinder. Both lines serve either as pressure or return passages depending on the rotation of the pump to retract or extend the gear.

A pressure switch is installed on a cross fitting connected to the pump mount assembly. During retraction the pressure switch is the primary means to shut down the pump. This switch opens the electrical circuit to the pump solenoid when the gear fully retracts and the pressure in the system increases. The switch will continue to hold the circuit open until pressure in the system drops, at that time the pump will again operate to build up pressure as long as the gear selector handle is in the up position. The down position of the selector does not affect the pressure switch. (For specific pressure refer to Chart 2902.)

The hydraulic pump is a gear type unit driven by a 12 to 14-volt reversible motor designed to operate in a pressure range as given in Chart 2902. A relief valve is incorporated in the pump, which when open allows fluid to flow into the reservoir. Other valves in the pump, channel fluid to the proper outlet during retraction or extension of the gear. A shuttle valve located in the base of the pump allows fluid displaced by the cylinder pistons to return to the reservoir without back pressure. (For specific pressures refer to Chart 2902.) Also in the system is a bypass or free fall valve that allows the gear to drop should a malfunction in the pump system occur. To prevent the gear from extending too fast, there is a special restrictor elbow on the nose gear retraction line. The valve is controlled manually. An emergency gear knob is located on the instrument panel to the left of the control quadrants.

The emergency gear knob, used for emergency extension of the gear, manually releases hydraulic pressure to permit the gear to free fall with spring assistance on the nose gear. The knob must be pulled out for emergency extension. The knob must be pushed in when the hydraulic system operational checks are being conducted.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2314

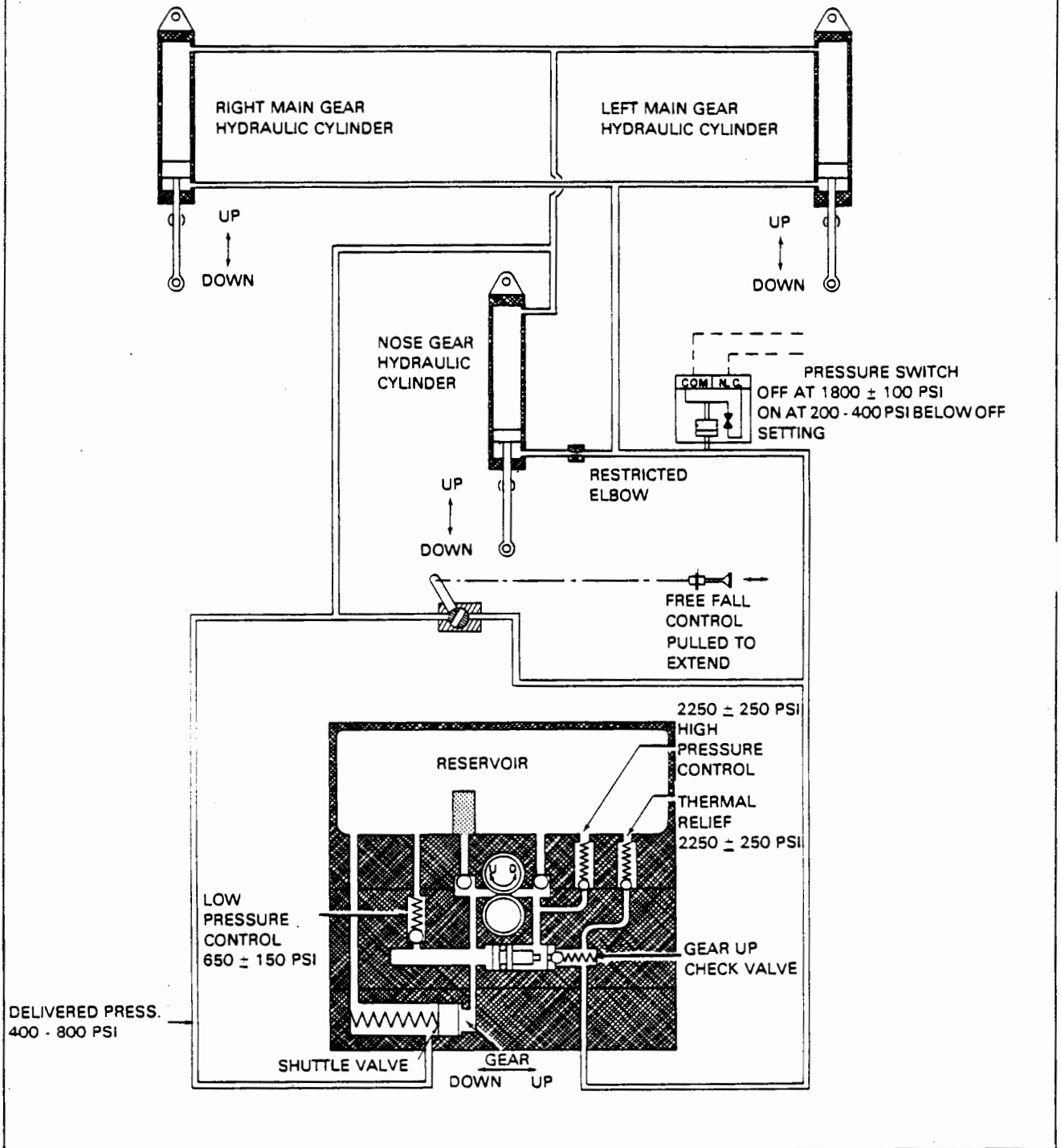


Figure 29-1. Schematic Diagram of Hydraulic System

29-01-6
Page 29-02

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

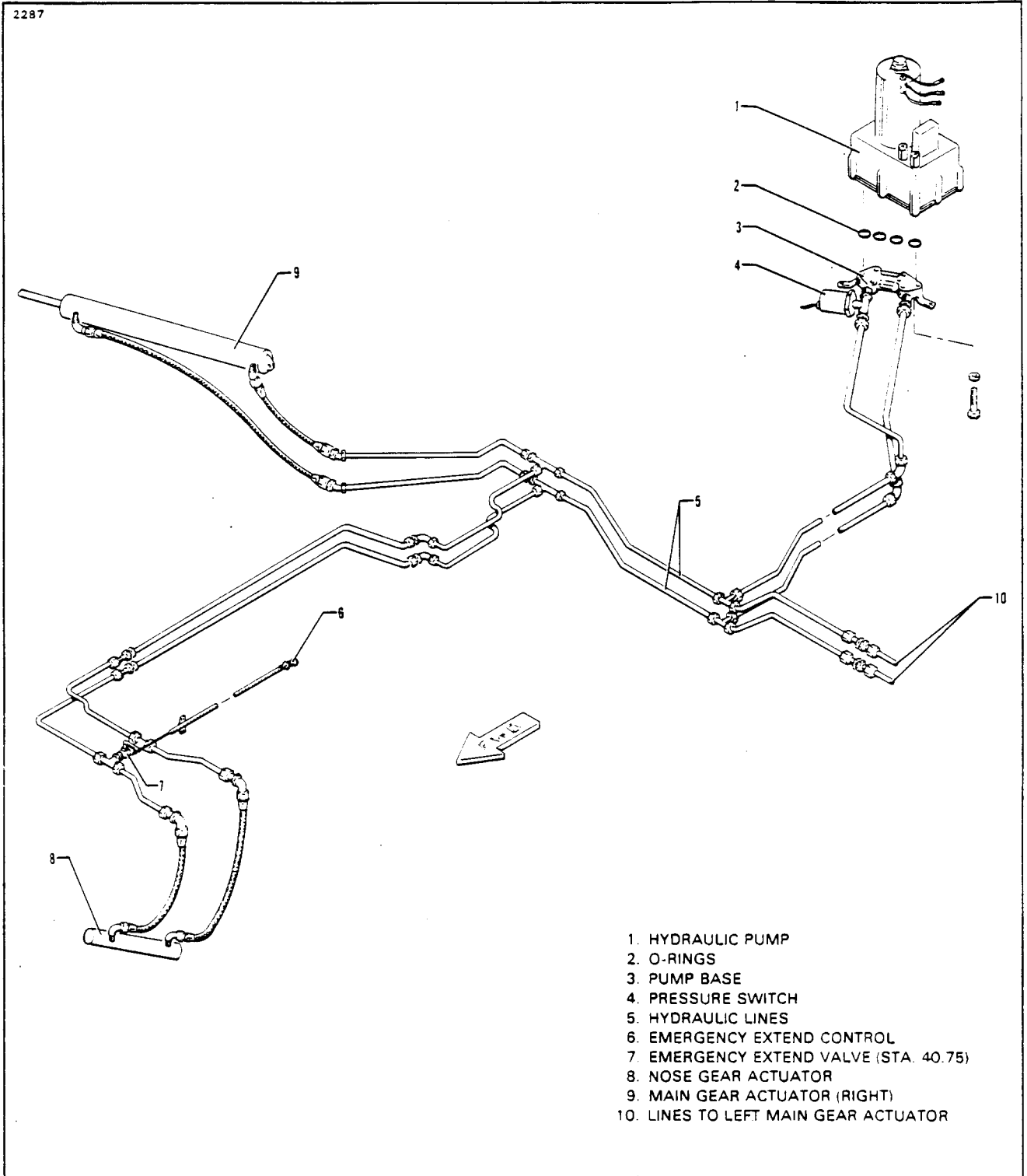


Figure 29-2. Hydraulic System Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

— CAUTION —

Prior to starting any investigations of the hydraulic system, place the airplane on jacks. With the airplane on jacks, pull the emergency extension knob out thus preventing the buildup of unnecessary pressure on the actuating cylinders and connecting hydraulic lines when the gear is raised or lowered manually. Failure to comply with these instructions could result in the buildup of sufficient pressure to unlock the downlock allowing the gear to collapse when the wing jacks are removed. Prior to removing the airplane from the jacks, push the emergency extension knob in, turn on the master switch and select gear down, observe that all three green lights are energized. This will indicate that the landing gears are down and locked. Turn the master switch off.

TROUBLESHOOTING.

Malfunctions in the hydraulic system will result in failure of the landing gear to operate properly. When trouble develops, jack up the airplane (refer to Chapter 7) and then proceed to determine the extent of the trouble. Generally, hydraulic system troubles fall into two types, troubles involving the hydraulic supplying system and troubles in the landing gear hydraulic system. Chart 2901 lists the troubles which may be encountered and their probable cause and suggests a remedy.

— NOTE —

If it is found that the hydraulic pump is at fault and requires disassembly, it is recommended that it be overhauled by an accredited overhaul facility. Pressure checks with adjustments may be accomplished in accordance with instructions given.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM)

Trouble	Cause	Remedy
Landing gear retraction system fails to operate.	Landing gear actuator circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear actuator circuit wires broken.	Check wiring.
	Landing gear selector circuit wires broken.	Check wiring.
	Safety (squat) switch out of adjustment.	Readjust switch. (Refer to Adjustment of Safety Switch.)
	Squat switch inoperative.	Replace switch.
	Pressure switch inoperative.	Replace switch.
	Pump retraction solenoid inoperative (upper solenoid).	Replace solenoid.
— NOTE — <i>If the retracting solenoid of the pump can be heard to actuate when operating the gear selector switch, it may be assumed that the gear control circuit is operating properly and the actuator circuit should be further checked.</i>		
	Gear selector switch ground incomplete.	Check ground.
	Gear selector switch inoperative.	Replace switch.
	Hydraulic pump ground incomplete.	Check ground.
	Hydraulic pump inoperative.	Replace or overhaul pump.

29-02-00

Page 29-05

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont)

Trouble	Cause	Remedy
Landing gear retraction system fails to operate. (cont)	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Battery low or dead.	Check condition of battery.
Landing gear extension system fails to operate.	Landing gear actuator circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear actuator circuit wires broken.	Check wiring.
	Landing gear selector circuit wires broken.	Check wiring.
	Pump extension solenoid inoperative (outboard solenoid).	Replace solenoid.
— NOTE — <i>If the extension solenoid of the pump can be heard to actuate when operating the gear selector switch, it may be assumed that the gear control circuit is operating properly and the actuator circuit should be further checked.</i>		
	Gear selector switch ground incomplete.	Check ground.
	Gear selector switch inoperative.	Replace switch.
	Hydraulic pump ground incomplete.	Check ground.
	Hydraulic pump inoperative.	Replace or overhaul pump.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont)

Trouble	Cause	Remedy
Landing gear extension system fails to operate. (cont)	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Low or dead battery.	Check condition of battery.
Landing gear retraction extremely slow.	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Restriction in hydraulic lines.	Isolate and check hydraulic lines.
	Shuttle valve sticking in pump base.	Check cause.
Pump stops during gear retraction.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Pressure switch out of adjustment.	Remove and readjust or replace switch.
	Mechanical restriction or obstruction in hydraulic system to allow pressure to build up and shut off pump before gear has retracted.	Place airplane on jacks and run retraction check. Isolate and determine cause.
	Shuttle valve sticking in pump base.	Check cause.
Pump stops during gear extension.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine cause for overload.
Pump fails to shut off though gear has fully retracted.	Pressure switch inoperative.	Replace switch.
	Pressure switch out of adjustment.	Replace switch.

29-02-00

Page 29-07

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont)

Trouble	Cause	Remedy
Pump fails to shut off though gear has fully retracted. (cont)	Pump retraction solenoid sticking (inboard solenoid).	Replace solenoid.
	Internal leakage of system.	Check free fall valve for internal leakage. Check gear actuating cylinders for internal leakage. Check for internal damage to hydraulic pump.
	External leakage of system.	Check free fall valve for external leakage. Check gear actuating cylinders for external leakage. Check for broken or damaged hydraulic lines or hoses.
	Pump relief valve out of adjustment.	Replace pump.
Pump fails to shut off though the gear has fully extended.	Pump extension solenoid sticking (lower solenoid).	Replace solenoid.
	Nose gear down limit switch actuator out of adjustment.	Adjust switch actuator. (Refer to Adjustment of Nose Gear Down Limit Switch.)
	Nose gear down limit switch failed.	Replace switch.
	Main gear down limit switch out of adjustment.	Adjust switch. (Refer to Adjustment of Main Gear Down Limit Switch.)
	Main gear down limit switch failed.	Replace switch.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont)

Trouble	Cause	Remedy
— NOTE — <i>The out of adjustment or failed switch may be determined by noting which down light is not lit.</i>		
Pump running intermittently after gear has retracted.	Leakage of high pressure check valve. Internal leakage of system. External leakage of system.	Remove pump and replace check valve. Check free fall valve for internal leakage. Check gear actuating cylinders for internal leakage. Check free fall valve for external leakage. Check gear actuating cylinders for external leakage. Check for broken or damaged hydraulic lines.
Gear stops part way up, but pump continues to run.	Pump high pressure relief valve out of adjustment. Internal leakage of system. Hydraulic fluid in reservoir below operating level.	Replace pump. Check free fall valve for internal leakage. Check gear actuating cylinders for internal leakage. Check for broken or damaged hydraulic lines. Fill reservoir with hydraulic fluid.
All gears fail to free fall.	Free fall valve fails to open.	Check cables connections, valve and replace or connect cables.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

CHART 2901. TROUBLESHOOTING (HYDRAULIC SYSTEM) (cont)

Trouble	Cause	Remedy
With gear selector down and three green lights on, gear unsafe light comes on or intermittently on.	Shorted gear up solenoid.	Replace solenoid.
With gear selector down and three green lights on, pump motor circuit breaker opens.	Shorted gear up solenoid.	Replace solenoid.
With gear unsafe light on, pump operates on and off.	Shorted gear down solenoid.	Replace solenoid.
With gear unsafe light on, pump motor circuit breaker opens.	Shorted gear down solenoid.	Replace solenoid.

MAIN.

HYDRAULIC PUMP.

REMOVAL OF HYDRAULIC PUMP.

The hydraulic pump with reservoir incorporated is located in the aft section of the fuselage between stations 156 and 191. Access to the pump is through the access panel in the baggage compartment.

1. Disconnect the pump electrical leads from the pump solenoid relays and the ground wire from the battery shelf.
2. Disconnect the hydraulic lines from the pump. Cap the line ends to prevent contamination.
3. Remove pump by removing pump attaching bolts.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

DISASSEMBLY OF HYDRAULIC PUMP. (Refer to Figure 29-3.)

After the hydraulic pump has been removed from the airplane, cap or plug all ports, and clean exterior of pump using a dry cleaning solvent to remove accumulated dirt and dust. The three major components of the pump assembly are the pump base, pump motor, and valve and gear case. These three major components should be disassembled as follows:

1. Pump Base: Remove pump base from valve and gear case by:
 - A. Cutting safety wire and removing bolts with washers securing pump base to pump and gear case.
 - B. The check valve within the pump base should be removed for cleaning purposes only. To remove valve, cut safety wire and remove bolt, spring and steel ball. Replace O-ring at reassembly.
2. Pump Motor: The pump motor may be removed from the pump and disassembled as follows:
 - A. Remove thru bolts (4) from head (1) of motor. Using a knife cut the seal coating between the motor head and case.
 - B. Lift the head up from the case approximately .50 of an inch, this will allow inspection of brushes (3) without the brushes unseating from the commutator. (Refer to Paragraph 6-7 for brush inspection.) The brush leads are secured to the head assembly.
 - C. Raise the head assembly (1) off the armature (8) and note the small thrust ball (7) located between the end of the armature (8) and motor head. Do not misplace this bearing.
 - D. Draw the armature from the motor frame (9). Note the number of thrust washers (11) mounted on the drive end of the armature shaft.
 - E. Remove the motor frame from the pump reservoir (13).
3. Valve and Gear Case: Remove valve and gear case from reservoir as follows:
 - A. Remove eight screws from flange of body and separate the two assemblies.
 - B. Pump gears and valves should be removed for cleaning purposes only. To remove cap securing gears, remove attaching bolts. The two valve springs should be positively identified with their cavities, otherwise it will be necessary to readjust each valve for proper operating pressure.

CLEANING, INSPECTION AND REPAIR OF HYDRAULIC PUMP.

— NOTE —

Repair facilities must be clean to prevent contamination of pump components. Proper and careful handling should be exercised to prevent damaging pump components.

1. Discard all O-rings.
2. Remove caps or plugs and clean all components with a dry type cleaning solvent and dry thoroughly.
3. Inspect pump components for scratches, scores, chips, cracks and wear.
4. Inspect motor for worn brushes (minimum of .218 brush remains between the braided wire and commutator end), excess commutator wear and excess bearing wear.
5. Repairs are limited to O-ring and brush replacement as follows:
 - A. One brush holder has the winding wire attached. Locate this wire and remove by using a soldering gun.
 - B. The head assembly can now be removed and worked on for ease of brush replacement if required.
 - C. Remove brush wire and brush from by-metal heat protector.
 - D. Solder new brush wires to head assembly and by-metal heat protector, and wire from winding to one brush holder.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

2024

1. HEAD, MOTOR
2. SPRING, BRUSH
3. BRUSH
4. BOLT, THROUGH
5. O-RING (MS28775-012)
6. WIRE LEAD
7. BALL, THRUST
8. ARMATURE
9. FRAME, MOTOR
10. SLEEVE
11. WASHER, THRUST
12. SCREW, VENT AND FILLER
13. RESERVOIR
14. SEAL
15. CASE, VALVE AND GEAR
16. BASE, PUMP
17. BOLT
18. SCREW (8)
19. BOLT
20. BUSHING
21. WASHER
22. GROMMET
23. WASHER
24. BUSHING
25. SHELF
26. NUT

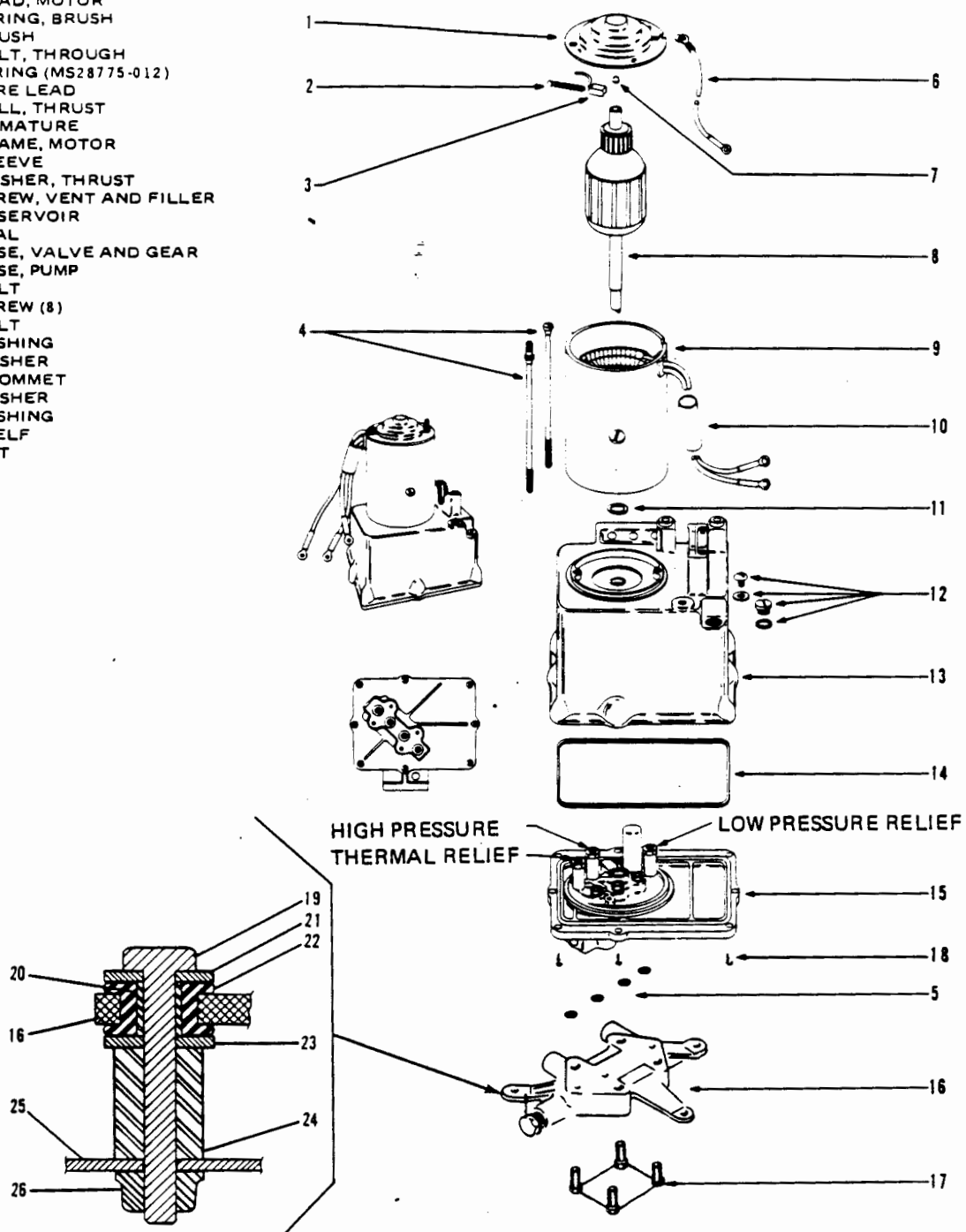


Figure 29-3. Hydraulic Pump/Reservoir, Exploded View

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

E. Install brush springs and brushes into brush holders and secure in place (temporary) with a piece of string looped around the brush and holder and tied in a knot.

— NOTE —

Insure that the braided wire is in the holder slot for proper brush movement.

F. Install the head assembly with new brushes to the frame and commutator in accordance with instructions given in Step 1.

ASSEMBLY OF HYDRAULIC PUMP. (Refer to Figure 29-3.)

1. The pump motor may be assembled and installed on the reservoir as follows:
 - A. Position motor frame on reservoir. Note aligning marks on frame and reservoir.
 - B. Place thrust washers, of the same amount removed, on the drive end of the armature.
 - C. Lubricate the entire length of the armature shaft, on the drive end, with light grease to protect O-ring seal from damage. Insert end of shaft in reservoir.
 - D. Saturate felt oiling pad around commutator end bearing with SAE 20 oil. Allow excess oil to drain off before assembling motor.
 - E. Insert thrust ball in bearing of motor head. To hold ball in position, place a small amount of grease inside the bearing.
 - F. Place head assembly on frame and allow brushes to extend over commutator. Remove the string securing the brushes in the holders. Push head assembly on frame and insure proper indexing of head and frame assemblies. Secure in place with thru bolts (4).
 - G. Check freedom of rotation and end play (thrust) of the armature within the assembly. A minimum of .005 inch end play is permissible. Adjust to this tolerance if necessary by adding or removing thrust washers on drive end of armature shaft.
2. Assemble valve and gear case to the reservoir as follows:
 - A. If removed, place pump gears in valve and gear case and install cover. Install cover attaching bolts and secure.
 - B. Lubricate reservoir seal ring with hydraulic fluid (MIL-H-5606A) and place in recess provided in case.
 - C. Position reservoir on valve and gear case. Care should be taken when aligning the armature shaft with the pump gear. Do not run the motor to accomplish this.
 - D. Ascertain that the seal ring (14) is properly positioned, and place the reservoir on the valve and gear case. Install and tighten one screw to hold the assembly together, then connect a 14-volt source with an ammeter in the circuit and tighten the rest of the screws such that the current draw does not exceed 12 amperes.
3. Attach the pump base to the pump as follows:
 - A. With pump inverted, lubricate O-ring seals and install them in recesses provided in the valve and gear case.
 - B. Install attaching bolts with washers and torque to 70 inch-pounds.
 - C. Safety attaching bolts with MS20995-C32 wire.
4. Conduct motor operational check not to exceed 10 seconds running time.

TEST AND ADJUSTMENT OF HYDRAULIC PUMP. (Refer to Figure 29-4.)

1. Test Equipment:
 - A. Hydraulic pump and mounting base.
 - B. Pressure gauge (0-1000 psi).

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

- C. Pressure gauge (0-3000 psi).
 - D. Hoses with fittings to connect base and gauges.
 - E. Power supply (14 VDC).
 - F. Ammeter (0 to 100 amps).
 - G. Fuse or circuit protector (100 amps).
2. Test and Adjustment:

— NOTE —

Test gauges or gauges of known accuracy should be used when performing the following tests.

- A. Connect the 0 to 1000 psi gauge to the low pressure port of the pump base.
- B. Connect the 0 to 3000 psi gauge to the high pressure port of the pump base.
- C. Connect black lead of pump motor to the negative terminal of the DC power supply.
- D. Remove the filler plug located on the forward side of the pump. Loosen vent screw and add fluid, MIL-H-5606A, through the filler hole until full. Reinstall the filler plug and adjust the vent screw to maintain .015 inch clearance between the screw head and the small vent hole.
- E. Bleed air from the attached lines. (Lines may be bled by alternately connecting blue lead and green lead to the positive terminal of the power supply until all air is exhausted.)
- F. Connect blue lead to positive terminal of power supply. Pump should operate and the high pressure gauge should indicate a specific pressure, as given in Chart 2902. (Should the gauge indicate a pressure below or over the given pressure, adjust valve "A," Figure 29-3 accordingly to obtain the desired reading.)

— NOTE —

When increasing pressure, the pump running time must not exceed 12 seconds. There should be no external leakage while performing Steps E thru H.

- G. Disconnect blue lead. The high pressure reading should not drop more than 300 psi in five minutes. High pressure may not be selected again for five minutes.
- H. Connect green lead to positive terminal of power supply. Pump should operate in reverse, dropping reading on high pressure gauge to zero. The low pressure gauge should indicate 500 to 800 psi. (Should the gauge indicate a pressure below 500 psi or over 800 psi, adjust valve "B," Figure 29-3, accordingly to obtain desired reading.) Disconnect green lead. Both pressure gauges should indicate zero psi.
- I. Should it be necessary to check the pump motor, first connect the ammeter in the electrical circuit with the positive terminal of the meter to the black lead and negative terminal of the meter to the negative terminal of the DC power supply.
- J. Connect the blue lead from the pump motor to the positive terminal of the power supply. With a high pressure indication on the pressure gauge, the ammeter should read 75 amperes maximum. Disconnect the blue lead.
- K. Connect the green lead from the pump motor to the positive terminal of the power supply. With low pressure indication within the 500 to 800 psi range, the ammeter should read between 15 to 35 amperes.

— NOTE —

In the event any of the various tests do not perform satisfactorily, the pump assembly should be replaced.

- L. Disconnect the green lead from the power supply and permit the pressure to drop before disconnecting the hydraulic lines.

29-11-05

Page 29-14

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

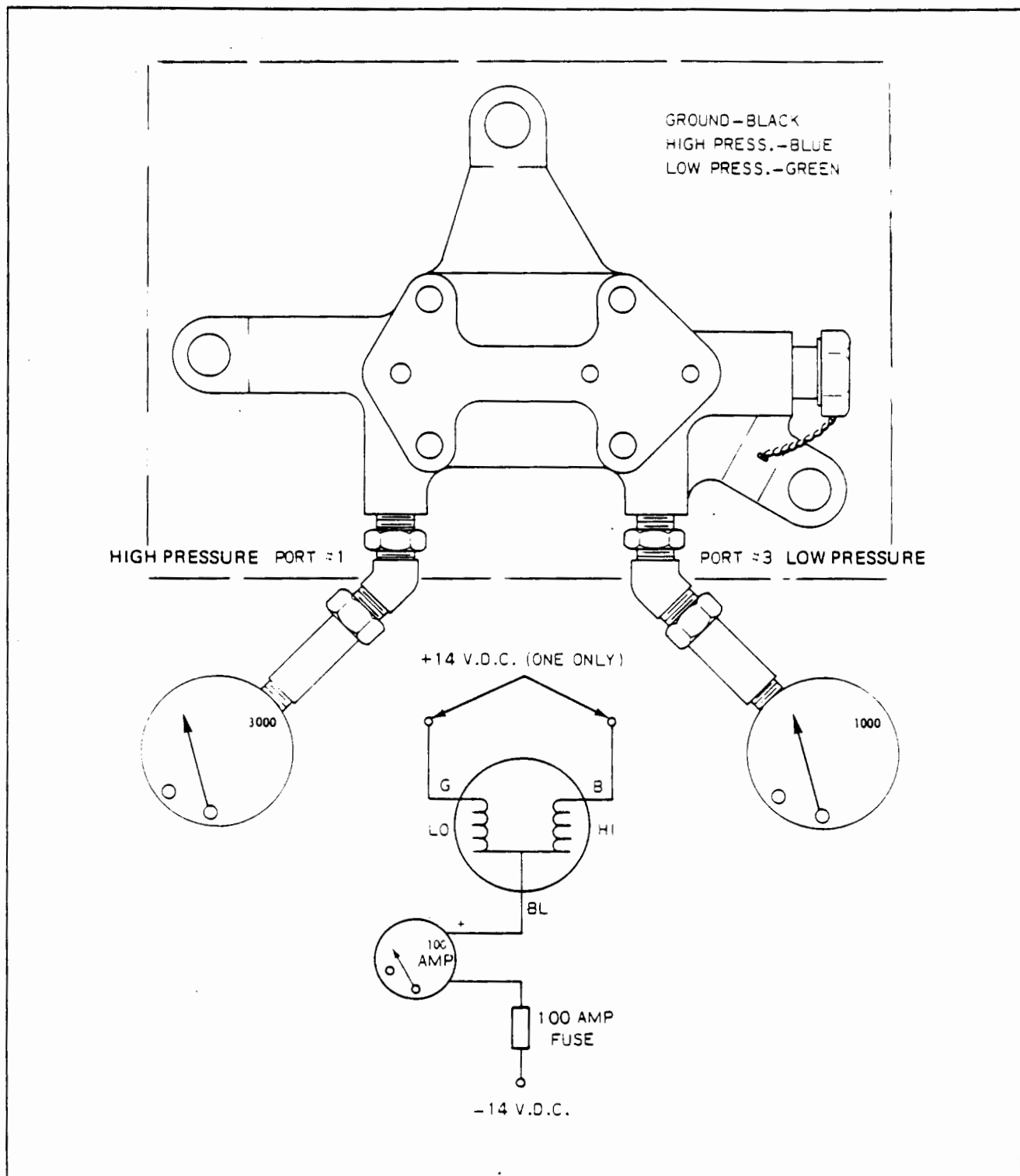


Figure 29-4. Test and Adjustments of Hydraulic Pump

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 2902. LEADING PARTICULARS. HYDRAULIC SYSTEM

HYC5005	
Hydraulic Pump	
High Pressure	2500 to 2000 psi
Low Pressure	650 $\pm$ 150 psi
Flow Rate @ 1000 psi	45 cu. in. per min.
High Pressure Control	1600 to 2000 psi
Hydraulic Fluid	MIL-H-5606A
Relief Valve	4000 psi
Shuttle Valve Delivered Pressure	400 to 800 psi
Pressure Switch	
Open (OFF) Pressure	1800 $\pm$ 100 psi
Close (ON) Pressure	400 $\pm$ 200 psi Differential

CHART 2903. CHARACTERISTICS. HYDRAULIC PUMP MOTOR

Electrical Characteristics:	
Voltage	14 V.D.C.
Rotation	Reversible
Polarity	Negative ground
Operating Current	75 amps. max. at 14-volts (both rotations)
Operating Time	12 seconds max. with a current load of 75 amperes at 77° F
Overload Protection	Thermal circuit breaker
Automatic Reset Time	12 seconds. max.
Location. Automatic Reset	Commutator end head of motor
Mechanical Characteristics:	
Bearings	Absorbent bronze (Drive end bearing in upper pump and valve assembly casting)
	Steel ball (Thrust. between commutator end head and end of armature shaft)
End Play. Armature	.005 inch. min. (Adjust by selection of thrust washers on drive end of armature shaft)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF HYDRAULIC PUMP. (Refer to Figure 29-3.)

1. Insert grommet in pump base mounting hole.
2. Insert bushing in grommet.
3. Place washer over bolt and insert bolt through grommet and bushing and pump base.
4. Place washer and bushing over bolt and secure to mounting shelf.
5. Connect hydraulic lines to pump.
6. Connect pump electrical leads. Blue wire to outboard (lower) solenoid, green wire in inboard (upper) solenoid, and black wire to ground on battery shelf.
7. Check fluid level in pump. Refer to Chapter 12 for filling instructions.
8. With airplane on jacks, operate pump to purge hydraulic system of air, and check for leaks. After operation, recheck fluid level.

NOSE GEAR ACTUATING CYLINDER.

REMOVAL OF NOSE GEAR ACTUATING CYLINDER.

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)

— CAUTION —

Whenever aircraft is placed on jacks for the purpose of manually retracting the nose gear assembly, insure the nose gear downlock is fully disengaged before releasing the nose gear drag links. Damage could occur to the downlock if not disengaged fully.

2. Disconnect both nose gear door actuating rods.
3. Disconnect the hydraulic lines from the actuating cylinder and cover the open line ends to prevent contamination.
4. Disconnect the two gear tension springs from the spring arm that is attached to the right side of the strut housing.
5. Disconnect the aft end of the cylinder from its attachment fitting.
6. Disengage the nose gear downlock, (see CAUTION) retract nose gear slightly to remove gear from its downlocked position.
7. Disconnect the gear downlock spring from upper drag link.
8. Remove the cotter pin, nut and washers from the bolt that secures the lower drag link to the gear oleo housing.
9. Slide out the bolt and the gear tension spring arm and lower the drag links.
10. Pivot upper drag link and downlock until the hydraulic cylinder rod end connecting bolt is clear of the fuselage.
11. Remove nut and washer and slide bolt holding rod end of hydraulic cylinder out of the downlock. Remove cylinder from wheel well.

DISASSEMBLY OF NOSE GEAR ACTUATING CYLINDER. (Refer to Figure 29-5.)

1. With the cylinder removed from the airplane, mark the position of the end gland to facilitate reinstallation.
2. Remove safety wire and unscrew the end gland.
3. Additional disassembly of piston and O-rings may now be accomplished.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

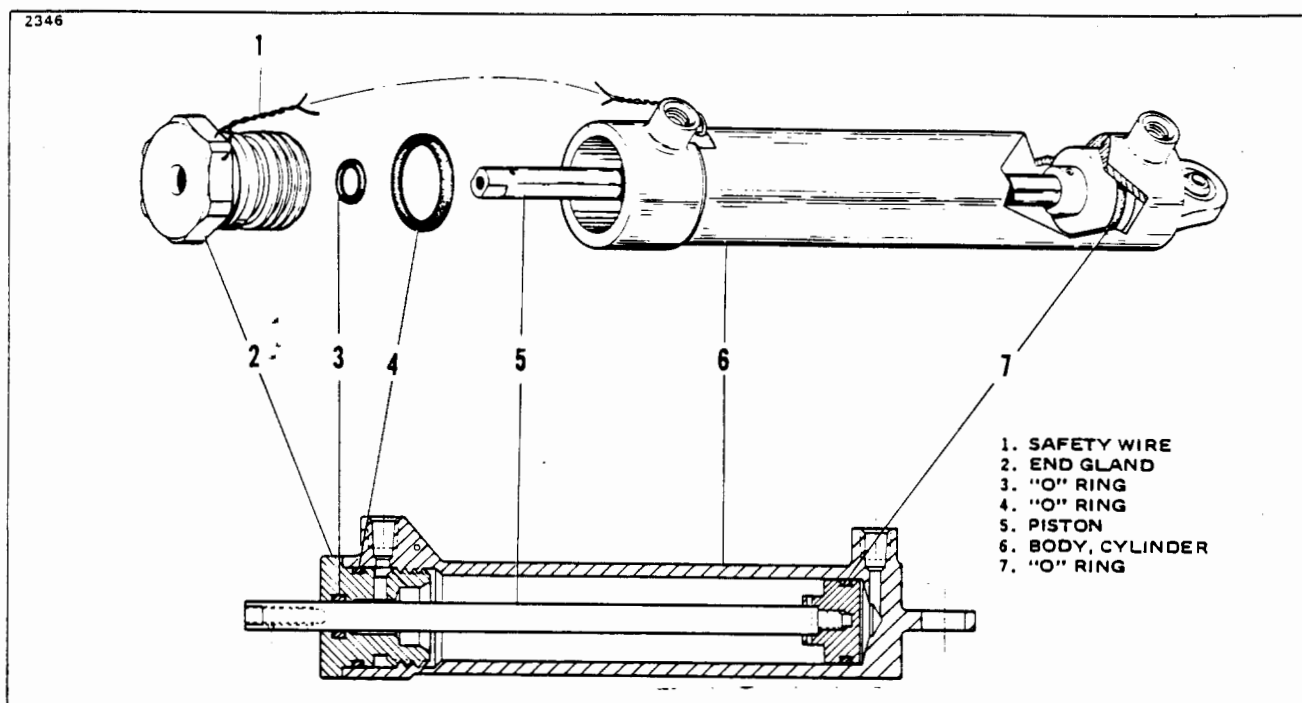


Figure 29-5. Nose Gear Actuating Cylinder

CLEANING, INSPECTION AND REPAIR OF NOSE GEAR ACTUATING CYLINDER. (Refer to Figure 29-5.)

1. Clean the cylinder parts with a suitable dry type solvent and dry thoroughly.
2. Inspect the cylinder assembly for the following:
 - A. Interior walls of the cylinder and exterior surfaces of the piston for scratches, burrs, corrosion, etc.
 - B. Threaded areas for damage.
 - C. Rod end fitting and swivel fitting of cylinder for wear and corrosion.
3. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc., and replacing parts.

ASSEMBLY OF NOSE GEAR ACTUATING CYLINDER. (Refer to Figure 29-5.)

1. Install O-ring on the exterior of the end gland.
2. Install O-ring in the interior of the end gland.
3. Install O-ring on the body of the piston assembly.
4. Lubricate the areas around the O-rings with hydraulic fluid, slide the end gland on the piston rod and screw the end gland into the cylinder housing.
5. Align reference marks and secure the end gland with safety wire.
6. Check smoothness of operation of the piston.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF NOSE GEAR ACTUATING CYLINDER.

1. Attach the cylinder rod end to the downlock using an appropriate bolt, washer and nut making sure the nut is on the inboard side.
2. Pivot upper drag link and downlock to normal position.
3. Insert bolt through gear tension spring arm and insert through right hand side of oleo housing and lower drag link pivot point. Secure and safety. A washer (AN960-516L) is installed on the bolt between the lower drag link and the arm.
4. Reconnect the gear downlock spring to upper drag link.
5. Attach the aft end of the hydraulic cylinder to its attachment fitting using bolt, nut and washer.
6. Reconnect the two gear tension springs to the spring arm.
7. Reconnect both nose gear door actuating rods.
8. Connect the hydraulic lines to the cylinder fittings. The forward fitting (gear up) is a restricted port fitting.
9. Check the adjustment of the cylinder rod end. Refer to Adjustment of Nose Landing Gear (Chapter 32).
10. Operate pump to purge system of air and check fluid level in reservoir.

— CAUTION —

Whenever aircraft is placed on jacks for the purpose of manually retracting the nose gear assembly, insure the nose gear downlock is fully disengaged before releasing the nose gear drag links. Damage could occur to the downlock if not fully disengaged.

11. Remove the airplane from jacks.

MAIN GEAR ACTUATING CYLINDER.

REMOVAL OF MAIN 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 gear downlock spring from the swivel fitting at the upper end of the spring.
4. Remove the downlock spring swivel fitting and disconnect the cylinder operating rod end from the upper side brace retraction fitting by removing the attaching nut, washer and bolt.
5. Disconnect the cylinder from its attachment by removing nut and bolt.
6. Remove the cylinder from the wheel well.

DISASSEMBLY OF MAIN GEAR ACTUATING CYLINDER. (Refer to Figure 29-7.)

1. With the cylinder removed from the airplane, push the piston rod (by hand) toward the clevis to remove oil from the unit.
2. Put clevis in a soft jaw vise and clamp against the clevis bearing.
3. If no pipe fitting is installed in the port of the end gland, install a fitting (1/8 - 27) into the port. This fitting need not be tight as it will be used for leverage only.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

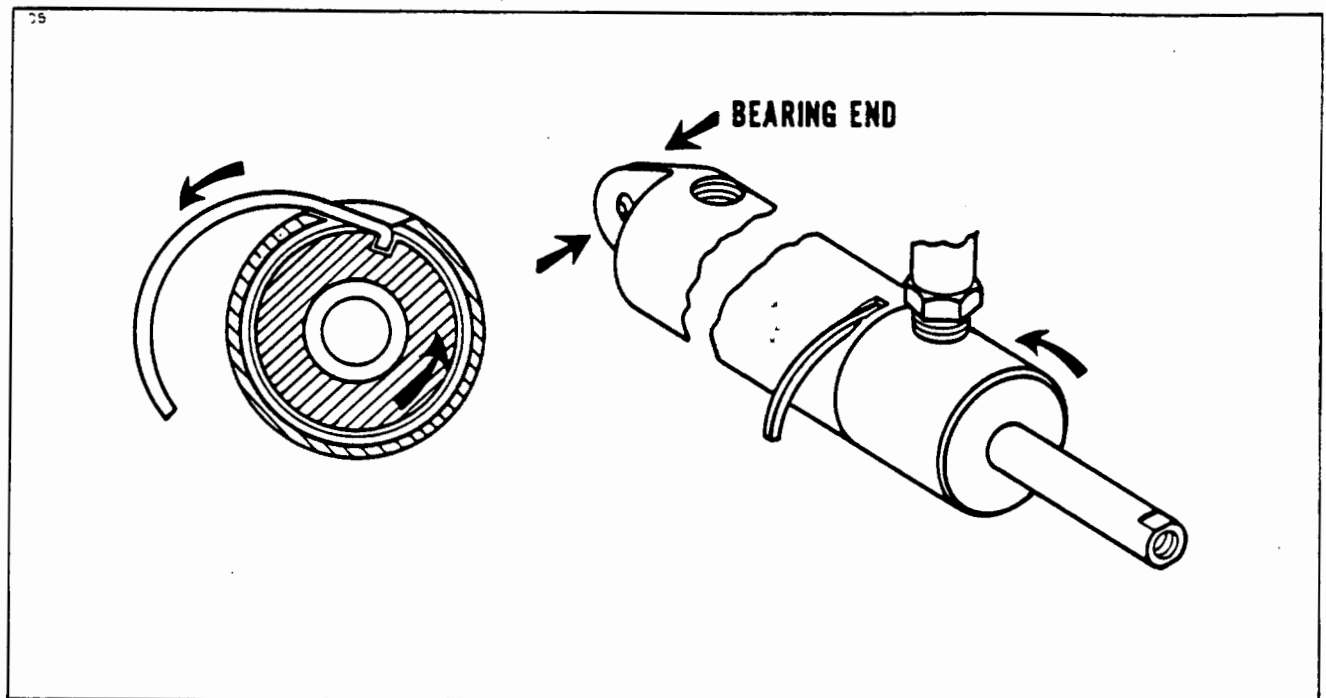


Figure 29-6. End Gland Locking Device (Main Gear)

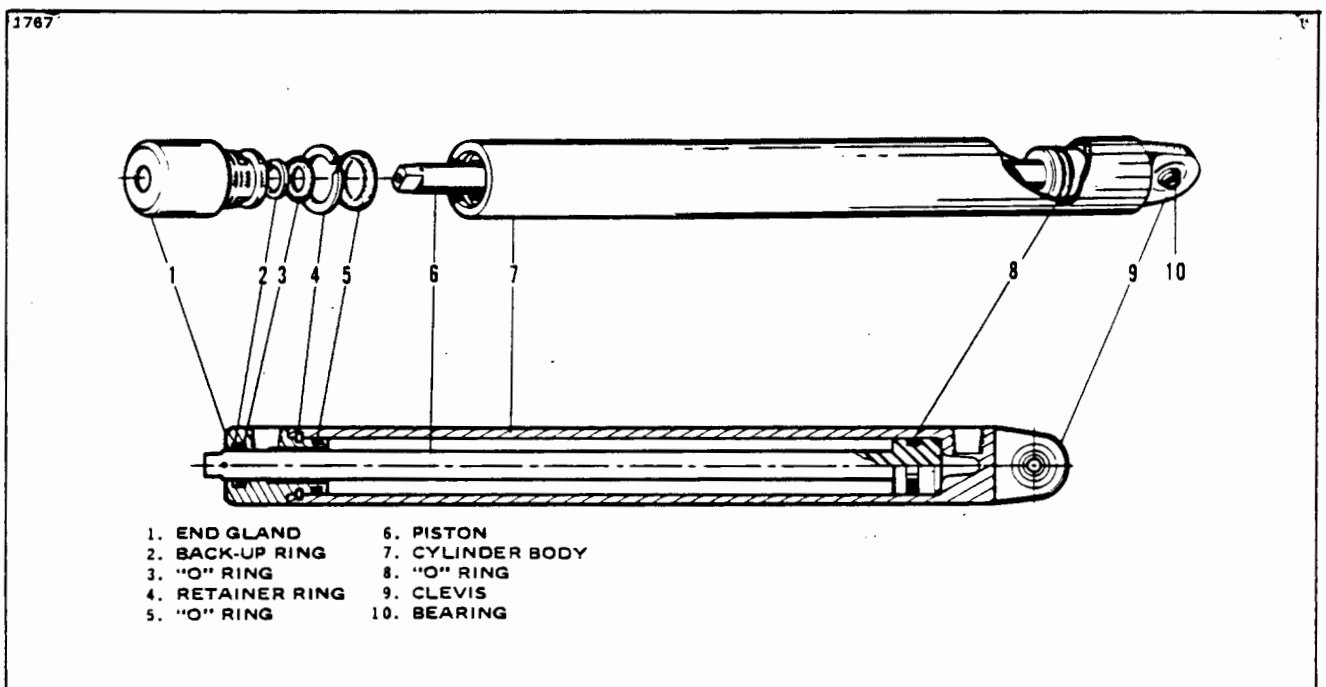


Figure 29-7. Main Gear Actuating Cylinder

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

4. Rotate the gland counterclockwise (with use of fitting) until the end of the gland lock ring shows in the slot in the cylinder body. Reverse rotation of the gland (clockwise direction) to allow the lock ring to move out of the slot. (Refer to Figure 29-6.) (It may be necessary to give the ring an assist to start out of the slot. If so, insert a strong wire pick or other available tool in the slot to lift up the end of the ring and then rotate gland.)
5. Pull the piston and end gland from the cylinder.
6. Remove O-rings as desired.

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR ACTUATING CYLINDER.

1. Clean the cylinder parts with a suitable dry type solvent and dry thoroughly.
2. Inspect the cylinder assembly for the following:
 - A. Interior walls of cylinder and exterior surfaces of piston for scratches, burrs, corrosion, etc.
 - B. Threaded areas for damage.
 - C. End fitting retainer slot for excess wear.
 - D. Rod end fitting and swivel fitting of cylinder for wear and corrosion.
3. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc., and replacing components. (Refer to Parts Catalog for replacement part numbers.)

ASSEMBLY OF MAIN GEAR ACTUATING CYLINDER. (Refer to Figure 29-7.)

1. Install O-ring on the exterior of the end gland.
2. Install O-ring and back-up ring in the interior of the end gland.
3. Install O-ring on the body of the piston assembly.
4. Lubricate the areas around the O-rings with hydraulic fluid, park-o-lube or vaseline; slide the end gland on the piston rod and the piston into the cylinder housing.
5. Insert the hook end of a new lock ring (P/N 755 997) in the slot in the cylinder body and slot in the end gland. Rotate gland counterclockwise to completely wrap lock wing into assembly.
6. Align port in end gland and cylinder body.
7. Check smoothness of operation of piston and static pressure test unit to check for possible cut O-rings.

INSTALLATION OF MAIN GEAR ACTUATING CYLINDER.

1. Attach the cylinder to its attachment fitting in the wheel well using bolt and nut.
2. Attach the operating rod end and downlock spring swivel fitting to the upper side brace retraction fitting by using bolt, washer and nut. Ascertain swivel fitting is free to rotate.
3. Connect the downlock spring to the swivel fitting.
4. Check the adjustment of the cylinder rod end. (Refer to Adjustment of Main Landing Gear, Chapter 32.)
5. Operate pump to purge system of air and check fluid level in reservoir.
6. Remove the airplane from jacks.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

HYDRAULIC LINES.

REMOVAL AND INSTALLATION OF HYDRAULIC LINES.

Remove a damaged hydraulic line by disconnecting the fitting at each end and by disconnecting where secured by brackets. Refer to Figure 29-2 as an aid in the location of attaching brackets and bends in the lines. Provide a small container for draining the line. Install a new or repaired line. Operate the pump to purge the system of air and check fluid level in reservoir.

TESTING HYDRAULIC SYSTEM.

The hydraulic system should be tested to determine that it functions properly after performing any service or repairs.

— CAUTION —

Turn master switch OFF before inserting or removing external power supply plug.

It is suggested that the airplane be connected to an outside power source in order to conserve the battery.

1. Place airplane on jacks. (Refer to Chapter 7.)
2. With gear down, master switch ON, and circuit breaker closed, place landing gear selector switch in the UP position. The pump should immediately start operating and the gear retract. The red gear unsafe light on the instrument panel should light up until the gear is fully retracted. The hydraulic pump should stop operating after full gear retraction.
3. Place gear selector switch in DOWN position. The gear should extend and lock in position. Gear down lights on the instrument panel will light up when all three gears are locked in position. Inspect hydraulic system for leakage of hydraulic fluid.
4. Recycle the landing gear to determine that it functions properly.

— CAUTION —

Prior to removing the airplane from jacks, turn master switch on and determine that all three green lights are energized. This will indicate the landing gear is down and locked.

— END —

CHAPTER

30

ICE AND RAIN PROTECTION

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

CHAPTER 30 - ICE AND RAIN PROTECTION

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
30-00-00	GENERAL	2C21	1-83
30-01-00	Description and Operation	2C21	A 1-83
30-10-00	AIRFOILS	2C22	A 1-83
30-11-00	Troubleshooting	2C22	A 1-83
30-12-00	Inspection	2D2	A 1-83
30-12-01	Ground Procedure	2D2	A 1-83
30-12-02	100 Hour Inspection	2D2	A 1-83
30-12-03	Operation Check	2D3	A 1-83
30-12-04	Electrical Tests	2D4	A 1-83
30-12-05	Testing for Pressure Leaks	2D4	A 1-83
30-13-00	Components Maintenance and Replacement	2D4	A 1-83
30-13-01	Filters	2D4	A 1-83
30-13-02	Control Valves	2D5	A 1-83
30-13-03	Timer	2D5	A 1-83
30-13-04	Pneumatic Boots	2D5	A 1-83
30-13-05	Removal of Boots	2D5	A 1-83
30-13-06	Repair of Boots	2D6	A 1-83
30-13-07	Cold Repair	2D6	A 1-83
30-13-08	Vulcanized Repairs	2D7	A 1-83
30-13-09	Installing Pneumatic Boots	2D9	A 1-83
30-13-10	Preparation of Leading Edges	2D9	A 1-83
30-13-11	Preparation of Deicer Boot	2D12	A 1-83
30-13-12	Mounting Boot on Leading Edge	2D12	A 1-83
30-13-13	Adhesion Tape	2D13	A 1-83
30-13-14	Deicer Boot Maintenance	2D14	A 1-83
30-14-15	Icex Application	2D15	A 1-83
30-13-16	Resurfacing Conductive Cement	2D15	A 1-83
30-14-00	Final Test and Adjustment of Pneumatic System	2D16	A 1-83
30-30-00	PITOT AND STATIC	2D17	A 1-83
30-40-00	WINDOWS AND WINDSHIELDS	2D17	A 1-83
30-41-00	Heated Windshield Panels - Optional	2D17	A 1-83
30-41-01	Removal of Heated Windshield Panel	2D17	A 1-83
30-41-02	Installation of Heated Windshield Panel	2D17	A 1-83

30 - Cont./Effec.

Page - 1

Revised: January 3, 1983

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

CHAPTER 30 - ICE AND RAIN PROTECTION (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
30-60-00	PROPELLER DEICE SYSTEM	2D18	
30-61-00	Description and Operation	2D18	
30-62-00	Troubleshooting	2D18	
30-63-00	Using the Ammeter	2E3	
30-64-00	Helpful Tips	2E3	
30-65-00	Inspection	2E3	
30-65-01	50 Hour Inspection	2E3	
30-65-02	100 Hour Inspection	2E3	
30-66-00	Modular Brush Assemblies	2E7	
30-66-01	Brush Module Replacement	2E6	
30-66-02	Alignment of New Brushes	2E9	
30-67-00	Slip Rings	2E9	
30-67-01	Alignment of Slip Ring Assemblies	2E9	
30-67-02	Replacement of Slip Ring Assemblies	2E9	
30-68-00	Propeller Deice Boots	2E9	
30-68-01	Resistance Check of Deicer Boots	2E10	
30-68-02	Replacement	2E10	
30-68-03	Removal of Boots	2E10	
30-68-04	Installation of Boots	2E10	A 1-83
30-68-05	Blade Preparation	2E10	
30-68-06	Cement Application	2E11	
30-68-07	Installation of Deicer and Required Materials	2E13	
30-68-08	Preparation and Application of Sealer	2E13	1-82
30-68-09	Wrinkled Deicer Boots	2E15	
30-68-10	Electrical Check	2E15	
30-68-11	Installation of Deicer Wiring Harness	2E16	
30-69-00	Adjustments and Testing	2E16	A 1-83
30-69-01	Balancing	2E16	
30-69-02	Final Electric Check	2E16	
30-69-03	Functional Check	2E16	
30-69-04	Other Components	2E18	A 1-83
30-69-05	Timer Test	2E18	

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 30 - ICE AND RAIN PROTECTION (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
30-80-00	DETECTION	2E18	
30-81-00	Wing Ice Detection Light	2E18	
30-81-01	Servicing	2E18	
30-81-02	Removal	2E18	
30-81-03	Installation	2E20	
30-82-00	Carburetor Ice Detector	2E20	
30-82-01	Description	2E20	
30-82-02	Troubleshooting	2E20	
30-82-03	Removal of Ice Detector Probe	2E20	
30-82-04	Installation of Ice Detector Probe	2E20	
30-82-05	Functional Check of Ice Detector Probe	2E21	
30-90-00	LIFT DETECTORS	2E21	A 8-82
30-91-00	Functional Check of Lift Detectors	2E24	A 8-82

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

GENERAL.

The material contained herein provides information for general maintenance of the ice protection system. If further information is necessary contact the product manufacturer or Piper Service Representative.

DESCRIPTION AND OPERATION.

The ice protection system may contain any of five separate systems: a pneumatic deice system; an electrical prop deice system; an electrically heated windshield panel; heated pitot, stall warning system; and a wing inspection light installation. These systems can be installed individually or in several different combinations. Except for the heated pitot/stall warning system, the systems are controlled from a control panel on the center instrument panel.

The pneumatic system which utilizes boots to displace ice from the leading edges of the flight surfaces, necessitates replacing the standard air pumps with pumps of greater capacity. Along with the boots and related plumbing, the system also utilizes two control valves, two check valves, a deflate valve, and a timing module. A control and check valve are used on each side of the system and, being mounted behind their respective firewall, are accessible upon removal of the appropriate nacelle hatch cover. The deflate valve and time module are mounted under the floor on the left side of the fuselage as shown in Figure 30-1.

Boots are attached to the leading edge of the wings, vertical stabilizer, and stabilator. The boots are of a fabric reinforced rubber containing built-in span wise inflation tubes. A ply of conductive neoprene is cured to each boot surface to dissipate static electric charges and prevent damage to the boots from those charges, as well as preventing a fire hazard after each flight. Attached to the flight surfaces with cement, the boots are connected to the plumbing, through the skin by flexible and/or aluminum air connections.

Operation of the pneumatic deice system is controlled by a momentary, single pole, single throw switch on the control panel. During normal operation, vacuum, provided continuously from the pump inlets to the vacuum system, is also directed to the boots system through the deflate valve to hold the boots down in flight. The control valves, closed during normal operation, allow pressure air from the pumps to be dumped overboard. Activation of the momentary switch however, initiates power to the deflate valve units causing: the deflate valve to close the system to vacuum and outside pressure; and, to activate the timer in the timing module.

Having activated the switch, pressure begins to build in the system and upon reaching "10" psi, a pressure switch on the deflate valve activates an indicator light on the control panel. With the system still operating, pressure continues to build until a pressure activated switch (also on the deflate valve) senses 17 psi, or the timer reaches "6" seconds, whichever comes first. At this point power is removed from the control valves and deflate valve causing the control valves to close routing pump pressure overboard and the deflate valve to dump system pressure overboard. As pressure decreases, the 10 psi switch is deactivated extinguishing the light. With the pressure dumped from the system the deflate valve again directs vacuum to the boots. The system, now operating in its normal condition, can be reactivated if necessary, through the momentary switch on the control panel. The vacuum gauge may fluctuate momentarily upon deice cycling.

The propeller deice system, which can be installed by itself or included in a package with others of the ice protection system, is designed for both the two and three bladed propeller installations. Each propeller deice system consists of: an electrically heated boot bonded to each blade; a slip ring assembly connected to the hub of each propeller; modular brush assemblies; a timer; a circuit breaker control switch located on the control panel; an ammeter; and, a shunt installation.

— NOTE —

The three bladed propeller deice system may not be installed in conjunction with the pneumatic deice system.

30-01-00

Page 30-01

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

Both the standard two-bladed propeller installation and the optional three bladed propeller installation utilize single element deicers. When the switch is turned on power is directed through the brush block and slip ring to all the heating elements on one propeller for approximately 34 seconds. The timer then directs the power to the other propeller for approximately 34 seconds. This cycle continues until the switch is turned off.

A heated windshield panel can also be installed as a separate item or with any combination of systems. The installation is controlled by a circuit breaker switch on the "control panel" along with the use of a glass panel imbedded with wire filaments. The panel is mounted to a metal frame and secured by two screws to the fuselage, on the exterior of the windshield on the pilot's side. The frame is hinged at its base to facilitate cleaning of the windshield and panel. When not in use, the panel can be removed by removing the two attaching screws and harness from the fuselage.

The pitot and stall warning heat systems are operated as a single system when they are installed. It should be noted that although the pitot heat system can be installed in the aircraft by itself, the stall warning heat combination can only be included if the pitot heat system is also installed. These systems utilize a switch in the switch cluster on the pilot's side of the instrument panel. Other parts of the systems include a heated pitot head, heated lift detectors (inner and outer), and two circuit breakers (one for each part of the system).

For seeing and detecting ice at night a wing inspection light can also be included with the systems. The light, controlled by a switch on the "deice control panel," is mounted to the outboard side of the left nacelle.

— NOTE —

For wiring diagrams (schematics) refer to Chapter 91.

AIRFOILS.

Airfoil deicing is performed by the pneumatic deicing system. The system utilizes inflatable boots to clear ice off the leading edges of the wings, vertical stabilizer, and stabilator.

The boots are of a fabric reinforced rubber construction containing built-in span wise inflation tubes. Attached to the leading edges of the flight surfaces with adhesive they are connected through the skin by aluminum and/or flexible rubber air connection stems.

A ply of conductive neoprene is provided on the surface to dissipate static electric charges. These charges, if allowed to accumulate, would eventually discharge through the boot to the metal skin beneath creating static interference with radio equipment, and possible punctures in the rubber. Also such static charges would constitute a temporary fire hazard after each flight.

For operational descriptions refer to the general description at the beginning of this chapter.

TROUBLESHOOTING.

The troubleshooting chart contained herein is based on the premise, except as specified, that the engine driven pneumatic pumps and the electrical system are operating properly. It is further assumed that the system components were installed properly.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3001. TROUBLESHOOTING (PNEUMATIC DEICE SYSTEM)

Trouble	Cause	Remedy
Deicers do not inflate. Both engines operating at minimum cruise RPM or either engine at 2575 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. Check for sticking poppet. Clean. Insure that both vent ports on solenoid are open.
	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 se- curely.	Blow out lines and inspect connections. Make air leakage test.
	Deflate valve not functioning properly.	Insure that both vent ports on solenoid are open.
	System pressure not being reached.	Check performance to manufacturers specifi- cations.
	Deicer puncture.	Repair per specification or replace.
Deicers DEFLATE slowly.	Lines partially blocked.	Inspect and blow out lines.
	Deflate valve not func- tioning properly.	Insure that both vent ports on solenoid are open.

30-11-00

Page 30-03

Added: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3001. TROUBLESHOOTING (PNEUMATIC DEICE SYSTEM) (cont)

Trouble	Cause	Remedy
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.
Deicer boots do not hold their form in flight or vacuum to the system inadequate.	Wires loose or broken. Poor grounding of pressure switch.	Make electrical test. Repair or replace broken wires. Check for proper ground.
	Deflate valve not functioning properly	Remove and troubleshoot valve. Replace if necessary.
	Vacuum line restricted.	Disconnect line from instruments and deflate valve, and blow out line.
	Broken line.	Inspect system and repair.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

3254

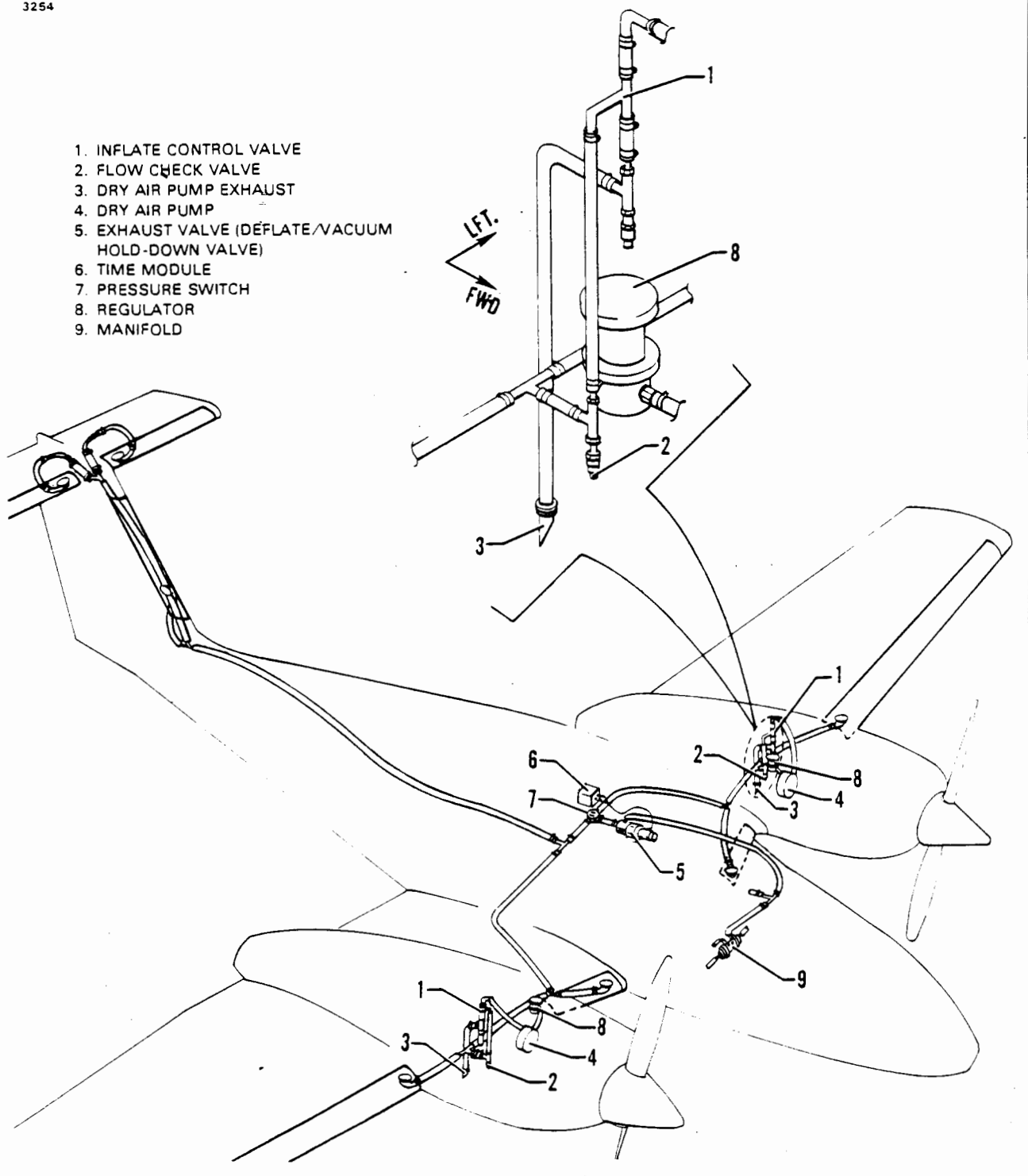


Figure 30-1. Pneumatic Deice System Installation

30-11-00
Page 30-05

Added: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSPECTION.

A ground check of the entire deicer system should be made at least every 100 hours.

Before checking the system, all deicers should be inspected for damaged areas and repaired according to the procedure in this section outlining the cold patch or vulcanized repairs. In order to check the system, refer to Chart 3002 and the paragraph "Pneumatic Regulator Adjustment" for operating pressure and check procedures.

GROUND PROCEDURE.

After the test pressure range is established, connect an external source of air providing this pressure and a pressure gauge to the pneumatic deice line at the manifold assembly. Disconnect the deice line from the manifold to accomplish the test. The deicer system should be within one psig of the recommended operating pressure with each inflation cycle.

If deicers do not reach the operating pressure, check the inflation time to ascertain that the solenoid valves are open the specified length of time (six seconds). If this is not the cause of trouble or if the boots deflate slowly, the lines or valves may be plugged; then the lines should be disconnected and blown clear.

Check the timing of the system through several complete cycles. Boots ON six seconds, then OFF. The wing and empennage boots operate simultaneously. If cycle time is off the specified time, determine and correct the difficulty.

Inflation must be rapid to provide efficient deicing. Deflation should be complete before the next inflation cycle of the boots.

100 HOUR INSPECTION.

At each 100 hour inspection of the airplane, inspect and operate the deicer boots. Make checks as follows:

1. Carefully inspect the deicers for evidence of damage or deterioration, and repair or replace damaged boots.
2. Resurface boots which show signs of considerable wear or deterioration.
3. Inspect all hose connections which form a part of the pneumatic deicing system. Replace deteriorated sections on non-kink hose.
4. Check the operation of the boots and the operating pressure of the system as outlined in this section.
5. If new or replacement boots have been installed, check the tube inflation to make sure that the air connection stems have been properly connected.
6. Disconnect all drain lines in the system and check for proper drainage.
7. Check the on-off control switch for freedom of action. Check associated electric wiring.
8. Clean or replace the air filters.

30-12-02

Page 30-06

Added: January 3, 1983

**PIPER AIRCRAFT
PA-44-180T/180T
MAINTENANCE MANUAL**

CHART 3002. OPERATING PRESSURES

Recommended Operating Pressure PSIG	Test Pressure in PSIG	
	MIN.	MAX.
15	13	17
18	16	20

— CAUTION —

Oil which reaches the deicers will cause rapid deterioration of the rubber.

In cold weather, extreme care must be taken to see that engine oil does not collect in critical parts of the system and congeal. Congealed oil will cause sticking of the control valves and deflate valve. If sticking of these parts is encountered, remove from airplane, clean or replace.

— NOTE —

This operation may be omitted if the boots were installed on the airplane subsequent to the last previous 100 hour check. On the other hand, if operations are being conducted under cold weather conditions below 10° F (-12° C), the air filters should be cleaned out at each 100 hour check, or more often if difficulties are encountered with valves sticking due to congealed oil.

OPERATION 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 operation check of the system.

With one engine operating, activate the deicing system switch. 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.

— NOTE —

Do not manually hold surface de-ice switch on "ON" position, as this switch is spring loaded and holding switch on "ON" may induce system failure.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

ELECTRICAL TESTS.

1. With engines "OFF" turn ON-Master Switch.
2. **TIMER:** Activate the De-Ice System Switch. (Caution: Do not hold Surface De-ice Switch in "ON" position. This switch is a momentary spring loaded center-off switch.)
 - A. Check Timer operates immediately.
 - B. If Timer does not indicate operation, check aircraft power from Circuit Breaker thru switch, to Timer. Also, check for proper ground.
 - C. If no electrical faults are present - replace Timer.
3. **LEFT & RIGHT CONTROL VALVE SOLENOIDS:** Activate the De-Ice System Switch and run engines.
 - A. Check both Control Valve Solenoids actuate. (An audible "CLICK" can be heard or the action can be felt by holding a hand against the unit.)
 - B. Check system pressure begins to build in the boot system.
 - C. If pressure does not build (check LIGHT on control panel after 6 seconds) Control Valves are suspect.
 - D. Disconnect electrical leads from Control Valve Solenoids and measure power is available when system is activated. Also confirm ground is good on BOTH SOLENOIDS.
 - E. If problem is not electrical - perform "TEST FOR PRESSURE LEAKS".
4. **DEFLATE VALVE ASSEMBLY:** Activate De-Ice System Switch.
 - A. Check LIGHT glows on control panel after system pressure builds to 10 P.S.I. Continue to monitor system as pressure continues to build to 17 P.S.I. system pressure, or 6 seconds, whichever occurs first.
 - B. Control Valves should actuate and dump pressure overboard.
 - C. As pressure decreases below 10 P.S.I., LIGHT should extinguish as cycle is completed.
5. If Step 3 shows Control Valves to be operating correctly, but Step 4 shows system cycle to be faulty, and system "Test For Pressure Leaks" shows no leaks; check DEFLATE VALVE ASSEMBLY.
6. **DEFLATE VALVE ASSEMBLY:**
 - A. Check power applied to Deflate Valve and confirm grounds are both good. If no electrical faults exist, replace Deflate Valve Assembly

TESTING FOR PRESSURE LEAKS.

1. This test can be performed in either the left or right nacelles.
2. Cap the overboard ports of the control valve.
3. Connect a source of clean air to the inlet port of the control valve. It is necessary that the inlet pressure be a minimum of 18-20 psig pressure to the system. By means of a hand operated valve, trap the pressure in the deicer system. Observe the system for leakage. The leakage rate should not exceed a pressure drop of 3.0 psig per minute.
4. Remove test equipment, lubricate all threads, and replace all system components.

COMPONENT MAINTENANCE AND REPLACEMENT.

FILTERS.

Air supply for the system is supplied through the vacuum system. Refer to Chapter 37 for replacement of the appropriate filter(s).

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CONTROL VALVES.

After 100 hours of engine operation, the valve poppet and internal lining of the control valve can become coated with a film of dried oil causing the valve to stick. To determine if valve poppet is sticking, perform electrical test. If solenoid checks satisfactory, remove valve poppet and clean control valve bore and poppet. To clean:

1. Remove nacelle hatch cover to gain access to the valve.
2. Remove electrical connector. Unscrew solenoid.

— CAUTION —

Do not lose steel hex actuator pin.

3. Remove valve poppet. It may be necessary to apply slim nose pliers to pin projection to pull poppet from valve.
4. Thoroughly clean valve bore and poppet with commercial hydrocarbon type solvent.
5. Reassemble valve and solenoid.

TIMER.

No field maintenance is recommended. For repair or replacement, contact your B. F. Goodrich dealer or distributor.

PNEUMATIC BOOTS.

REMOVAL OF BOOTS.

The removal of deicer boots should be done in a well ventilated area to avoid difficulty from the fumes of the solvents. Materials required to remove the boots are: Turco 388 dried cement remover, Kelite 21, and a pressure handle squirt can. Proceed as follows:

— 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

4. From the center line 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 (MethylEthylKetone).

REPAIR OF BOOTS.

Deicer repairs are classified as cold repairs (temporary), which are made with the boot installed on the airplane, and vulcanized repairs, which are made on the demounted boot in the shop. (Refer to the appropriate paragraph for vulcanized repairs.)

COLD REPAIR.

The materials and supplies for making cold repairs are listed in Chart 3003.

1. **SCUFF DAMAGE.** This type of damage will be most commonly encountered and, fortunately, it is not necessary in most cases to make a repair. On those rare occasions when the scuff is severe and has caused the removal of the entire thickness of surface ply in spots (the brown natural rubber underneath is exposed), repair the damage using Part No. 74-451-16 and proceed as follows:

A. Clean the area around the damage with a cloth dampened slightly with solvent. Buff the area around the damage with steel wool so that it is moderately but completely roughened. Wipe the buffed area with a clean cloth slightly dampened with solvent to remove all loose particles.

B. Select a patch of ample size to cover the damaged 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, depending on size of damage.

— 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.

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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

B. Buff the area around the damage with buffing stick, Part No. 74-451-75, so that the surface is thoroughly roughened.

C. Apply the patch to the deicer with the stretch in the widthwise direction of the inflatable tubes, sticking edge of patch in place, working remainder down with slight pulling action so the injury is closed. Do not trap air between patch and deicer surface.

3. **LOOSE SURFACE PLY IN DEAD AREA (NON-INFLATABLE AREA).** Peel and trim the loose surface ply to the point where the adhesion of surface ply to the deicer is good.

A. Scrub (roughen) area in which surface ply is removed with steel wool. Scrubbing motion must be parallel to cut edge of surface ply to prevent loosening it. Scrub with steel wool and Toluol directly over all edges, but parallel to edges or surface ply to taper them down to the tan rubber ply.

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 steel wool 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 REPAIRS.

Due to the variety of boot damage possible, it is recommended that the B. F. Goodrich Company be contacted so they can determine the extent of damage and whether it is repairable by the vulcanized method or not. The overall condition of the deicer boot must be given careful consideration before deciding on any repairs. Damages can vary from minor punctures which may be easily repaired, to extensive ripping of the tube or stretch areas which may make repairs exceedingly difficult or actually impossible. The determination of just where this division between repairable and unrepairable damage exists will depend upon the careful judgment of the inspector. For this reason, we recommend contacting the B. F. Goodrich Company at Akron, Ohio.

PIPER AIRCRAFT
PA-34-220T
MAINTENANCE MANUAL

POH

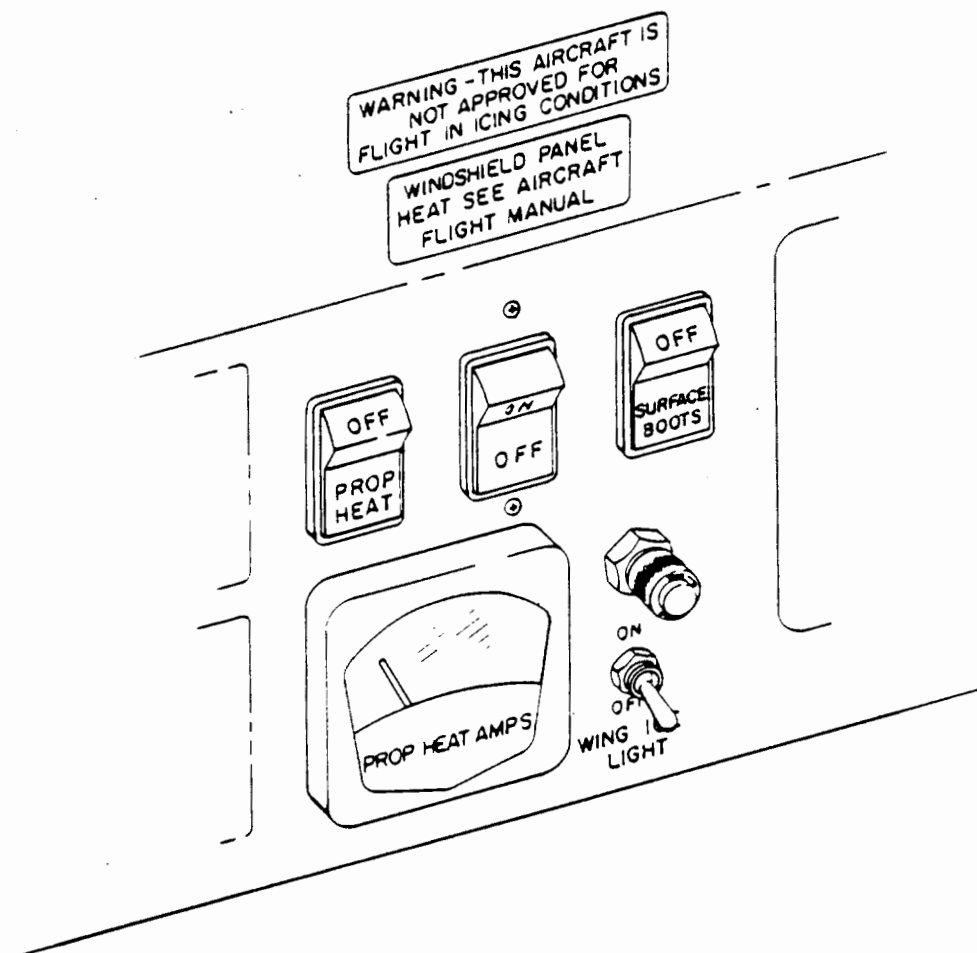


Figure 30-2. Deice Control Panel Installation

30-13-08
Page 30-12
Added: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLING PNEUMATIC BOOTS.

— NOTE —

The following procedures assume the aircraft is set up with the provisions for the necessary connections and hardware.

Balance stabilator per instructions in Chapter 27 of this manual.

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, allowing 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.

THIS SPACE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3003. MATERIAL AND SUPPLIES FOR COLD REPAIR

Part No.	Quantity	Description
74-451-C (FSN 1650-856-7939)	1	Cold Patch Repair Kit (B. F. Goodrich Co.)
74-451-11	1 1 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 in.
74-451-18	10 pcs.	Large Oval Patch 5 x 10 in.
74-451-19	3 pcs.	Patch 5 x 19 in.
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. roll x 8 in. wide	Neoprene Surface Ply
74-451-24 (FSN 8040-628-4199 and or FSN 8040-514-1880)	1 quart	*EC-1403 Cement and or EC-1300 L
74-451-74	1	2-1/2 in. Sponge Rubber Roller
*Minnesota Mining and Manufacturing Company, Adhesives Division, 411 Piquette Ave., Detroit, Michigan.		

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3003. MATERIAL AND SUPPLIES FOR COLD REPAIR (cont.)

Part No.	Quantity	Description
The following materials may be obtained from local supply:		
	As required	Toluol
		Clean, Lint-Free Cloths
		(preferably cheese cloth)
	Rolls	1 in. Masking Tape
	1	Sharp Knife
	6 ft. long	Steel Measuring Tape
	1	Fine Sharpening Stone
	As required	Steel Wool Pads
	As required	Hypodermic needles (22 gauge or smaller)
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.		

THIS SPACE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

PREPARATION OF DEICER BOOT.

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 BOOT ON LEADING EDGE.

Thoroughly mix EC-1403 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 center line leading edge surface and boot in span wise strips approximately six 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 center line to coincide with leading edge center line. Hold boot in this position while reactivating about three 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 roll 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

4. Rubber roll, apply pressure over entire surface of the deicer. All rolling should be done parallel to the inflatable tubes. Roll trailing edges with a narrow stitcher-roller.

— CAUTION —

Avoid excessive soaking or rubbing of the cement which could remove the cement from the surface.

Remove all masking tapes and clean surfaces carefully with Toluol so that no solvent will run under deicer edges.

5. Apply masking tape to deicer edges where exposed trimmed ends or gaps between sections are to be filled with MMM EC-801 sealing compound.

Apply masking tape to deicer approximately 1/4 inch in from trailing edges and tape wing skin approximately 1/4 inch from trailing edges, both forming a neat, straight line.

6. Apply a brush coat of A-56-B cement to surfaces between tapes and to EC-802 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 Toluol to soften the "adhesion" line. A minimum of this solvent should be applied to the seam line while tension is applied to peel back the boot. This removal should be slow enough to allow the solvent to undercut the cement, thus preventing injury to the part. Excessive quantities of solvent must be avoided.

ADHESION TEST.

Using excess boot material trimmed from the ends of any wing and empennage deicers, prepare one test specimen for each deicer installed. This specimen should be a 1 x 8 inch full thickness strip of boot material cemented to the wing skin adjacent to installed boot following the identical procedure used for installation. Leave one inch of the strip uncemented to attach a clamp. Four hours or more after the installation, attach a spring scale to the 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.)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

A minimum of five pounds tension (pull) shall be required to remove the test strip. If less than five pounds is required, then acceptability of the boot adhesion shall be based on the following tests:

1. Carefully lift one corner of boot in question sufficiently to attach a spring clamp.
2. Attach a spring scale to this clamp and pull with force 180° to the surface and in such a direction that the boot tends to be removed on the diagonal.
3. If a force of five pounds per inch of width can be exerted under these conditions, the installation shall be considered satisfactory. Remember, the width increases as the corner peels back.
4. Re-cement corner following previous procedure.
5. Failure to meet this requirement shall result in reinstallation of the boot.

— NOTE —

Possible reasons for failure are: dirty surfaces, cement not reactivated properly, cement not mixed thoroughly. Corrosion of the metal skin may occur if good adhesion is not attained, especially around rivet heads and metal skin splices.

If these adhesion requirements are met, the airplane may be flown immediately. Do not inflate deicers within 12 hours of installation or until adhesion strength of 8 to 10 pounds is obtained.

DEICER BOOT MAINTENANCE.

Clean deicers when the airplane is washed with a mild soap and water solution. In cold weather, wash the boots with the airplane inside a warm hangar if possible. If the cleaning is to be done outdoors, heat the soap and water solution before taking it out to the airplane. If difficulty is encountered with the water freezing on the boots, direct a blast of warm air along the region being cleaned, using a portable type ground heater.

ICEX APPLICATION.

B. F. Goodrich Icx is silicone base material specifically compounded to lower the strength of adhesion between ice and the rubber surfaces of airplane deicers. Icx will not harm rubber and offers added ozone protection.

Properly applied and renewed at recommended intervals, Icx provides a smooth polished film that evens out the microscopic irregularities on the surface of rubber parts. Ice formations have less chance to cling. Ice is removed faster and cleaner when deicers are operated.

It should be emphasized that Icx is not a cure-all for icing problems. Icx will not prevent or remove ice formations. Its only function is to keep ice from initially getting a strong foothold, thus making removal easier.

One 16 ounce pressurized can of Icx will cover deicer surfaces of the average light twin-engine plane approximately three times. It is also available in quart cans (unpressurized).

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

Before applying Icex, thoroughly clean deicer or other rubber surfaces with a rag dampened with non-leaded gasoline. Follow by a scrub wash of mild soap and water. Allow time for surfaces to dry.

Shake the Icex can well. Hold the nozzle approximately 12 inches from the surface and spray. Apply sparingly. If the application is too heavy, it results in a sticky surface which is very undesirable because it will pick up runway dust and prevent best ice removing efficiency.

Due to the natural abrasive effects on leading edges of deicers during flight, reapply Icex every 150 flight hours on wings and empennage deicers.

RESURFACING CONDUCTIVE CEMENT.

The following materials are required to remove and replace the old, damaged coating:

1. Fine grit sandpaper.
2. Two inch paint brush.
3. One inch masking tape.
4. Conductive neoprene cement, No. A-56-B, B. F. Goodrich Company.
5. Isopropyl Acetate, Federal Specification TT-I-721, as cleaning or thinning solvent.
6. Alternate solvent (Toluol or Toluene may be used as an alternate for Isopropyl Acetate).

— CAUTION —

Cements and solvents used for resurfacing are flammable and their fumes slightly toxic. Therefore, all work should be done in a well ventilated area away from any sparks or flames.

During cold weather, place the airplane in a warm hangar and locate so that the boots are 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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.

FINAL TEST AND ADJUSTMENT OF PNEUMATIC SYSTEM.

PPS60054-J

1. Gain access to the pressure switch by removing the passenger seats and floorboards.
2. Install a combination vacuum pressure gauge (minimum range 10 inches mercury [in. Hg.] vacuum to 25 psi pressure) in the crossover line within 12 inches of the pressure switch.
3. Start the left engine and adjust the vacuum regulator on the firewall so that the vacuum gauge reads $5 \pm .2$ in. Hg. with the engine operating at 1800 to 2000 RPM.
4. Bring the engine up to 2300 RPM and cycle the deicer boot system.

— NOTE —

The vacuum gauge may momentarily drop as much as 1.5 in. Hg. during cycling.

5. During the deice boot inflation cycle, ensure that the green wing/tail indicator light on the deice panel illuminates. The indicator light should come on between 8 to 13 psi and remain on above that pressure. With boots fully inflated, pressure shall read 18 ± 1 psi and should occur within 7.0 seconds (approximately). Upon full inflation, deflation and boot hold down shall occur within 20 seconds.

— NOTE —

If more than one deice cycle is required, allow 30 seconds between cycle activations to assure complete cycling.

6. Depress pneumatic deice switch for 20 seconds. Full inflation pressure shall not exceed 23 psi.
7. Shut down the left engine and repeat steps 2 through 5 with the right engine.
8. Repeat the above with both engines running at 2300 RPM.

— NOTE —

Cycle times may decrease.

9. Upon completion of the above steps, shut down engines, remove vacuum pressure gauge, reinstall floorboards and seats.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

PITOT AND STATIC.

The optional heated pitot head is located on the undersurface of the left wing. It is controlled by an ON-OFF type switch labeled PITOT HEAT which is located on the switch panel to the left of the pilot. The heated pitot head has a circuit breaker located in the circuit breaker panel and labeled PITOT HEAT. (Refer to Figure 30-16 for pitot head installation.)

WINDOWS AND WINDSHIELDS.

HEATED WINDSHIELD PANEL — OPTIONAL.

An electrically heated glass panel may be installed on the exterior side of the pilot's windshield to provide visibility in icing conditions. The panel draws its current from the aircraft electrical power supply and is controlled by an ON OFF control switch circuit breaker located in the center of the deice system control panel. The heated panel is hinged at its base to facilitate windshield cleaning.

REMOVAL OF HEATED WINDSHIELD PANEL.

1. Disconnect the electrical connector (located next to the heated panel on the exterior side of the windshield) by removing the two screws and pulling the plug out of the receptacle.
2. Remove the two screws which attach the panel assembly to the windshield collar and remove the pane from the airplane.

— NOTE —

If the airplane is to be flown with the heated panel removed, rotate the receptacle plate 180° and reinstall so that the holes in the fuselage skin are covered. Also, reinstall the windshield collar screws.

INSTALLATION OF HEATED WINDSHIELD PANEL.

1. Position the panel assembly on the windshield collar and secure with two screws previously removed.
2. Press the electrical plug into the receptacle and secure with two screws previously removed.
3. Perform an operational ground check by turning the heated windshield panel switch ON for a period of time not to exceed thirty seconds. Proper operation is indicated by the glass section being warm to the touch.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

PROPELLER DEICE SYSTEM.

DESCRIPTION AND OPERATION.

The B.F. Goodrich propeller deice system installed on the PA-44-180T uses the single element type deicer boots. In this type system each deicer has one electrothermal heating element. When the PROP HEAT switch on the instrument panel is turned ON, the timer directs power through the modular brush assembly and slip ring to all the heating elements on one propeller for approximately 90 seconds. The timer then switches power to all the heating elements of the other propeller for approximately 90 seconds. This cycle will continue as long as the PROP HEAT switch is in the ON position.

The propeller deice system consists of the following: electrically heated boots bonded to each propeller blade; slip ring assemblies connected to the propeller hubs to distribute power to the propeller deicers; modular brush assemblies which transfer electrical power to the rotating slip rings; a timer to cycle power to the deicers in the proper sequence; an ammeter to indicate that the system is functioning correctly; an external ammeter shunt; a manual ON-OFF, rocker-type switch and a circuit breaker.

TROUBLESHOOTING.

Troubles peculiar to the propeller deicing system are listed in Chart 3004 along with their probable causes and suggested remedies.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3004. TROUBLESHOOTING (PROPELLER DEICER SYSTEM)

Trouble	Cause	Remedy
Ammeter shows zero current all phases of the timer cycle.	Tripped circuit breaker switch.	Locate and correct short before setting circuit breaker.
	No power from airplane.	If no voltage into switch, locate and correct open.
	Circuit breaker or switch faulty.	If no voltage at C, B output with voltage at input and C B does not reset, replace C B. If voltage is OK at output, check switch in same manner. If voltage is OK at switch output, go to next step.
	Ammeter faulty. (If some or all deicers heat with ammeter at zero, replace the ammeter.)	Test for voltage up to and out of ammeter. If low output and input satisfactory, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter.
	Open ammeter to timer.	Disconnect harness at timer and check voltage at Pin B (of harness) to ground. If none, locate and correct open.
Ammeter shows normal current part of cycle, zero current rest of cycle.	Open in wiring between timer and brush block assembly.	Use heat test to find deicers not heating and test for voltage on that contact of wire harness plug. (At brush block assembly.) If zero after 1 minute, locate and fix open in wiring from timer to wire harness plug.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3004. TROUBLESHOOTING (PROPELLER DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Ammeter shows normal current part of cycle, zero current rest of cycle. (cont.)	Open between brush block assembly and deicer lead straps. No ground circuit, one engine.	If there is voltage to brush block wire harness plug, try voltage at junction to deicer lead and slip ring lead. If no voltage, find and correct open in wiring within brush block or no contact of brush to slip ring. If voltage is found at deicer leads, locate and fix open from deicer to ground.
Ammeter shows normal current part of cycle, low current rest of cycle.	Open or high resistance in deicer or slip ring leads. High resistance in circuit with low current.	Disconnect deicer leads to check resistance. If not OK, replace faulty deicer. If satisfactory, locate and fix open in slip ring leads. Check deicer wire harness leads for continuity. Ohmmeter needle must not flicker when leads are stretched or flexed. Replace as required. Check for contact of brush to slip ring. Check wiring from timer to deicers for loose or corroded connections and partially broken wiring. Correct as required.
Ammeter shows low current over entire cycle.	Aircraft voltage low.	Check voltage into switch.

30-62-00

Page 30-24

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3004. TROUBLESHOOTING (PROPELLER DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Ammeter shows low current over entire cycle. (cont.)	Ammeter faulty. High resistance up to timer.	Test for voltage up to and out of ammeter. If low output and input satisfactory, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter. Check for partially broken wire, loose or corroded connection in wiring from aircraft supply to timer input.
Ammeter shows excess current over entire cycle.	Ammeter faulty. Ground between ammeter and timer.	Test for voltage up to and out of ammeter. If low output and input satisfactory, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter. Disconnect harness at timer and with ohmmeter check from Pin B (of harness) to ground. If ground is indicated, locate and correct.
Ammeter shows normal current part of cycle, excess current rest of cycle.	Ground between timer and brush block.	Disconnect leads at brush block and with ohmmeter check from power leads to ground. If ground is indicated, locate and correct.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3004. TROUBLESHOOTING (PROPELLER DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Ammeter shows normal current part of cycle, excess current rest of cycle. (cont.)	Ground between brush block and deicers.	If no short exists at brush - slip ring contact, check for ground from slip ring lead to propeller assembly while flexing slip ring and deicer leads. If a ground is indicated, locate and correct.
	Short between two adjacent circuits.	Check for cuts or low resistance between circuits. If any, locate and correct.
	Timer faulty.	Test timer.
Ammeter does not "flick" approximately every 90 seconds.	Timer ground open, timer not cycling.	Disconnect harness at timer and check with ohmmeter from Pin A (of harness) to ground. If no circuit, fix open per schematic diagram.
	Timer contacts are welded (caused by short circuit in system).	Test timer. If timer does not cycle with voltage at Pin B, replace timer but be sure short causing original failure has been located and corrected.
Ammeter flicks between 90 second phase periods.	Loose connection between aircraft power supply and timer input.	Trace wiring from power source to timer input to insure that the electrical contacts at each connection in the circuit are good.

30-62-00

Page 30-26

Revised: January 3, 1983

2D22

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3004. TROUBLESHOOTING (PROPELLER DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Ammeter flicks between 90 second phase periods. (cont.)	Loose or poor connection timer to deicers.	If trouble occurs in part of cycle, find which deicers are affected and check for rough or dirty slip rings causing brush to "skip." Also, check for loose or poor connection. (If all deicers on one propeller are affected, check the ground circuit.)
	Timer cycles erratically.	Test timer.
Radio noise or interference with deicers on.	Brushes "arcing."	Check brush alignment as shown in Figures 30-3 and 30-4. Look for rough or dirty slip rings. If either condition exists, clean, machine or replace slip ring assembly, as required. Check slip ring alignment.
	Loose connection.	Refer to "Ammeter flicks between 90 second phase period."
	Switch or circuit breaker faulty.	Place jumper wire across switch or circuit breaker. If radio noise disappears, replace the switch or circuit breaker.
	Wiring located too close to radio equipment or associated wiring.	Relocate deicer wiring at least 8 inches away from radio equipment and wiring.

30-62-00

Page 30-27

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3004. TROUBLESHOOTING (PROPELLER DEICER SYSTEM) (cont.)

Trouble	Cause	Remedy
Cycling sequence not correct.	Crossed connections between timer and deicers.	Check system wiring against wiring diagram.
Rapid brush wear or frequent breakage.	Brush block out of alignment. Slip ring wobbles.	Check brush alignment. Correct as required. Check slip ring alignment with dial indicator as shown in Figure 30-2.

THIS SPACE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

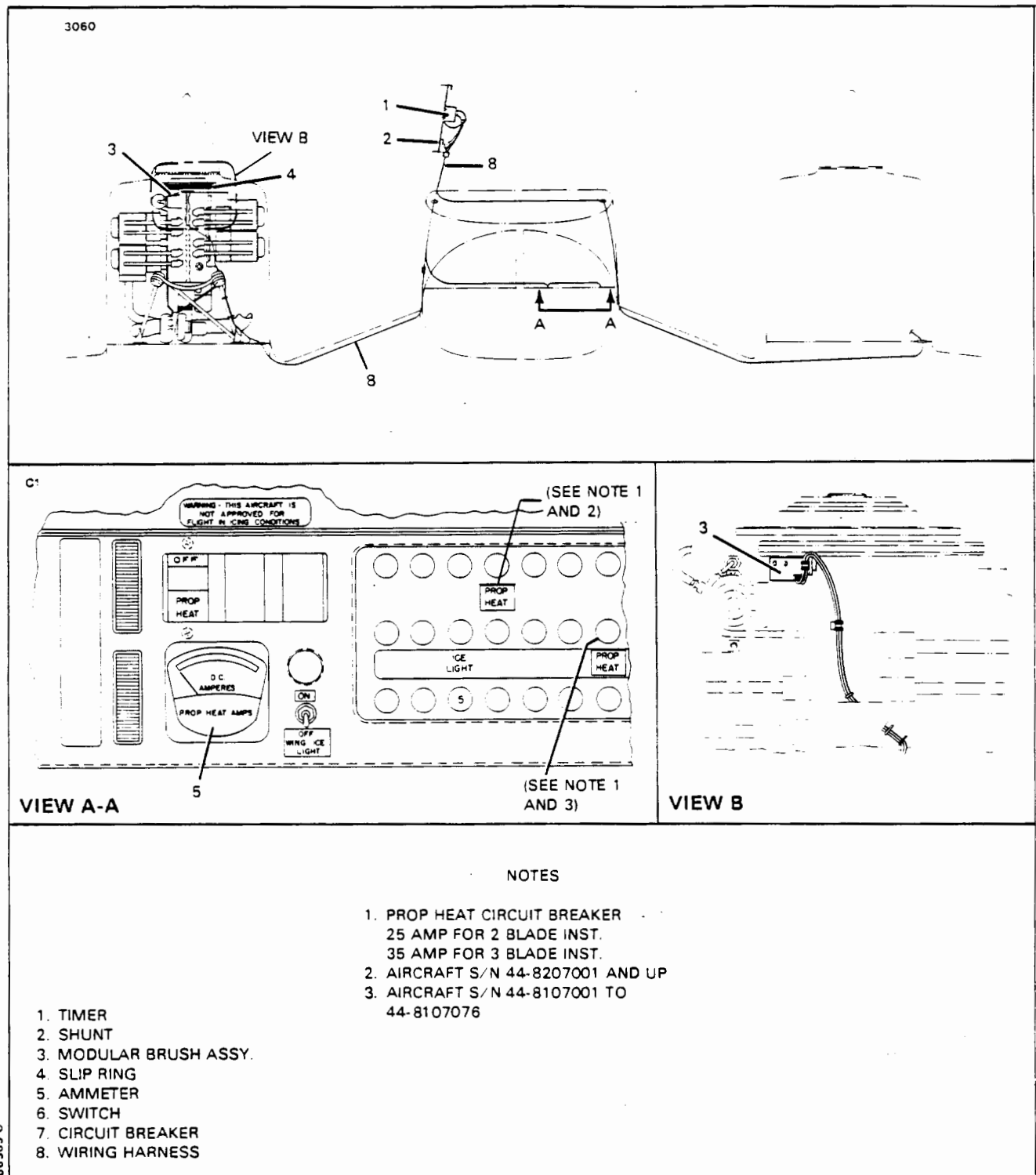


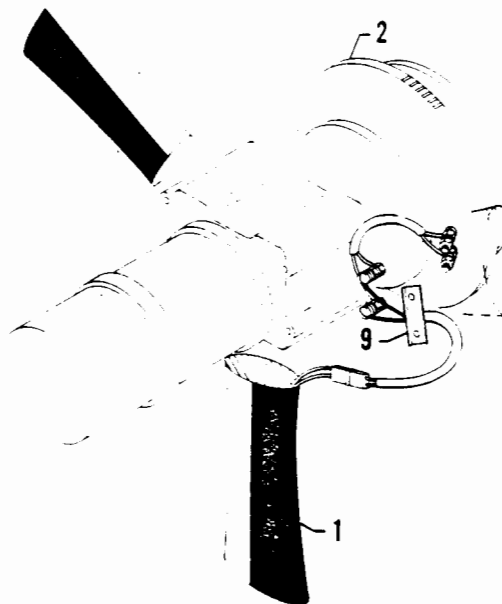
Figure 30-3. Electric Prop Deice System Installation

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

C234

THREE-BLADED INSTALLATION

1. PROPELLER DEICER BOOTS
2. SLIP RING
3. CONNECTOR
4. MODULAR BRUSH ASSEMBLY
5. SHUNT
6. TIMER
7. AMMETER
8. PROP DEICE SWITCH
9. LEAD CLIP
10. MOUNTING BRACKET
11. FUSE (5 AMP)
12. CIRCUIT BREAKER



TWO-BLADED INSTALLATION

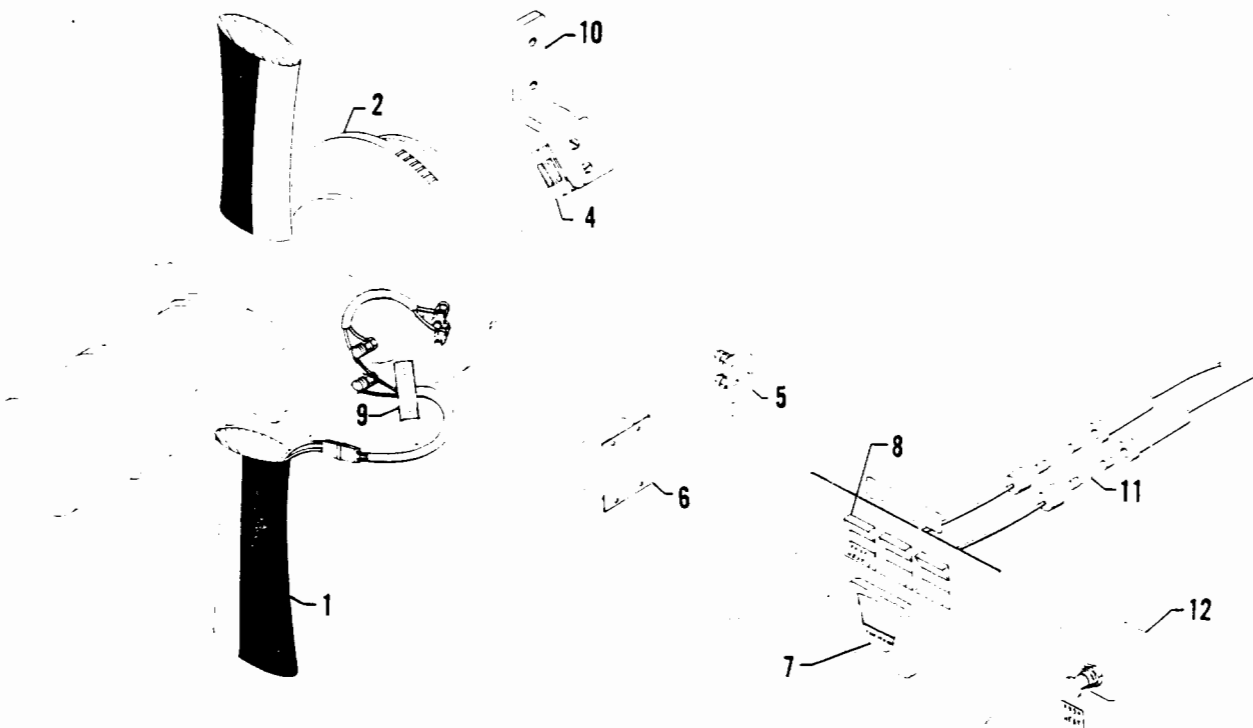


Figure 30-3. Electric Prop Deice System Installation (cont.)

86909 C

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

USING THE AMMETER.

Whether in flight or during ground testing, the ammeter can be used to indicate the general nature of most electrical problems. The troubleshooting chart is primarily based on the use of the ammeter and assumes that the user does understand all normal operating modes of the system.

— NOTE —

When troubleshooting, first use the "ammeter test" and "heat test" to determine which circuits are involved. Use circuit diagram for assistance to check voltages or continuity.

HELPFUL TIPS.

1. If the ammeter reading drops to one-third normal current, this indicates that one heater circuit is open.
2. Excess current reading on the ammeter always indicates a power lead is shorted to ground. Thus, when trouble of this nature is found, it is vital that the grounded power lead be located and corrected.
3. A considerable number of timers that have been returned for repair proved to be fully workable when tested. Accomplish the test described in "Timer Test" before concluding that the timer is defective.
4. Defective wiring in propeller mounted components may be indicated by normal current readings in ground checkouts (propellers not rotating) but low current with propellers rotating at cruise RPM.

INSPECTION.

50 HOUR INSPECTION.

1. Lock brakes and operate engines at near takeoff power. Turn deicer system switch ON and observe deicer ammeter for at least two minutes. Ammeter needle must rest within the shaded band, except for a "flicker," approximately every 90 seconds, as the step switch of the timer operates. Any movement of the needle other than the normal 90 second flicker indicates a short or open that must be located and corrected.
2. With engines stopped, turn deicer switch ON and feel deicers on propellers for proper sequence of heater operation. The deicers should cycle ON for 90 seconds, then OFF for 90 seconds and repeat. Temperature rise should be noticeable and each heater should warm for about 90 seconds. Local hot spots indicate surface damage of deicer heaters requiring replacement of deicer.
3. Remove spinner dome and engine cowling. With assistant observing deicer ammeter and with deicer switch ON, flex all accessible wiring, particularly the deicer wire harness, leads from slip ring assembly, and the firewall electrical connectors and their wiring. Any movement of the ammeter needle other than the "90 second flicker" of cycling indicates a short or open that must be located and corrected.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

100 HOUR INSPECTION.

1. Remove cowling.
2. Conduct 50 hour inspection.
3. Check for radio noise or radio compass interference by operating the engine at near takeoff power with radio gear ON while turning deicer switch ON and OFF. If noise or interference occurs with deicer switch ON and disappears when switch is OFF, see troubleshooting chart.
4. Ascertain that all clamps, clips, mountings and electrical connections are tight. Check for loose, broken or missing safety wire.
5. Deicers: Closely check deicers for wrinkled, loose or torn areas, particularly around the outboard end. Check that terminals and terminal studs are not shorting out to each other or the propeller hub. Inspect wire harness for evidence of chafing or shorting. Insure that all clamps and tie straps are properly installed. Look for abrasion or cuts, especially along the leading edge and the flat or thrust face. If heater wires are exposed in damaged areas or if rubber is found to be tacky, swollen or deteriorated (as from oil or solvent contact), replace the damaged deicer in accordance with the appropriate information in this chapter.

— NOTE —

Operate propeller from "full pitch" to "feathering" and check that deicer lead wires do not come under tension or are pinched by propeller blade. (Refer to Figure 30-9.)

6. Slip Rings: Check slip rings for gouges, roughened surface, cracks, burned or discolored areas, and for deposits of oil, grease or dirt.
 - A. Clean greasy or contaminated slip rings with CRC 2-26 solvent (This solvent is available from C.R.C. Chemical Division, Webb Inc., C-J10 Limekiln Pike, Dreshner, Penna. 19025.) or with Stoddard Solvent. If Stoddard Solvent is used, wipe off with a clean cloth dampened with MEK to avoid leaving a film.
 - B. If uneven wear is found or if wobble is noticed, set up a dial indicator as shown in Figure 30-4 and check alignment of the slip rings to the propeller shaft as explained in this section.
7. Modular Brush Assemblies - Brushes: Examine mounting brackets and housing for cracks, deformation or other physical damage.
 - A. Test that each brush rides fully on its slip ring over 360°. Figure 30-5 shows the wear pattern if this condition is not corrected. If alignment is off, shim where brush block is mounted to bracket or adjust mounting bracket support arm.

— NOTE —

The shim is a series of laminates and may be peeled for proper alignment of brushes to slip ring.

- B. Check for proper clearance of brush block to slip rings as shown in Figure 30-6. If not correct, loosen mounting screws and move in elongated holes to correct block position before tightening securely.
 - C. Visually check brush block for approximately 2° angle of attack. (Refer to Figure 30-6.) If not, loosen mounting screws and twist block, but be sure to hold clearance limits shown when tightening.
8. System Wiring: With deicer system operating, have assistant observe ammeter while visually inspecting and physically flexing wiring from brush blocks through firewall, to timer, to ammeter, to switch and to aircraft power supply. The ammeter will flicker as the timer switches approximately every 90 seconds in the cycle. Jumps or flickers at other times indicates loose or broken wiring in the area under examination at that moment. In such case, check continuity through affected harness, while flexing and prodding each wire in the area that gave initial indication of trouble. Use the wiring diagram to trace circuitry.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

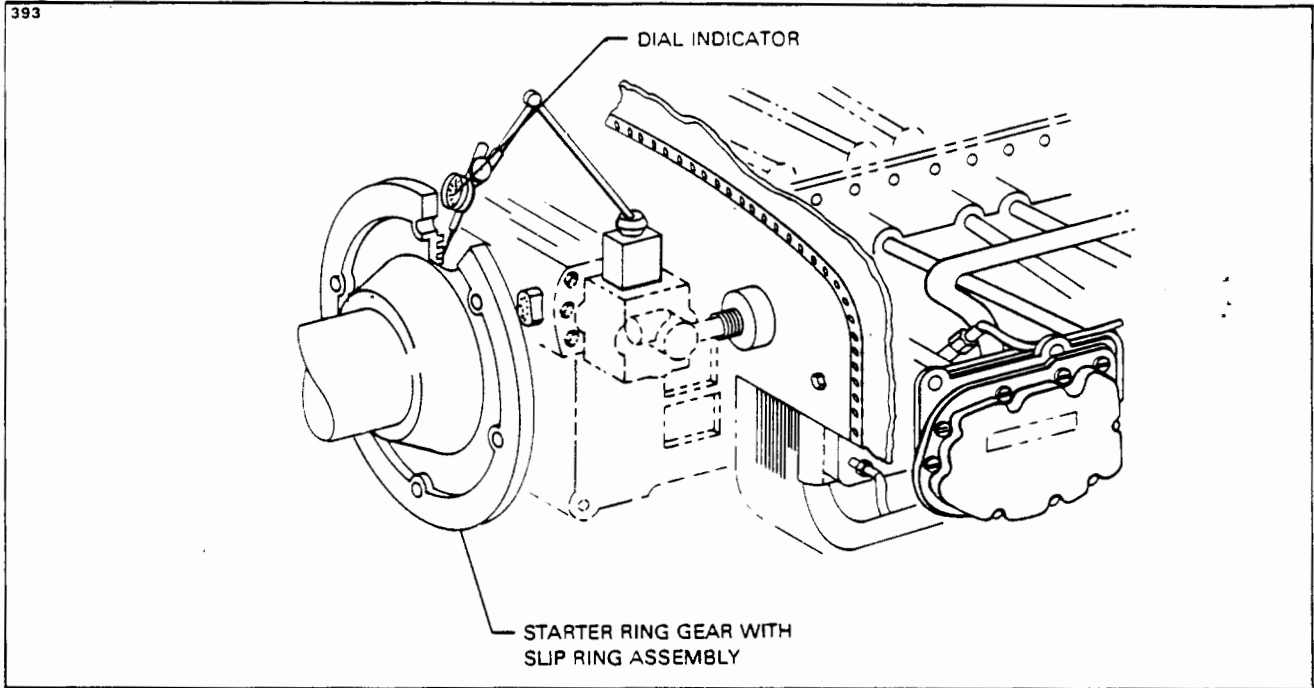


Figure 30-4. Suggested Use of Dial Indicator

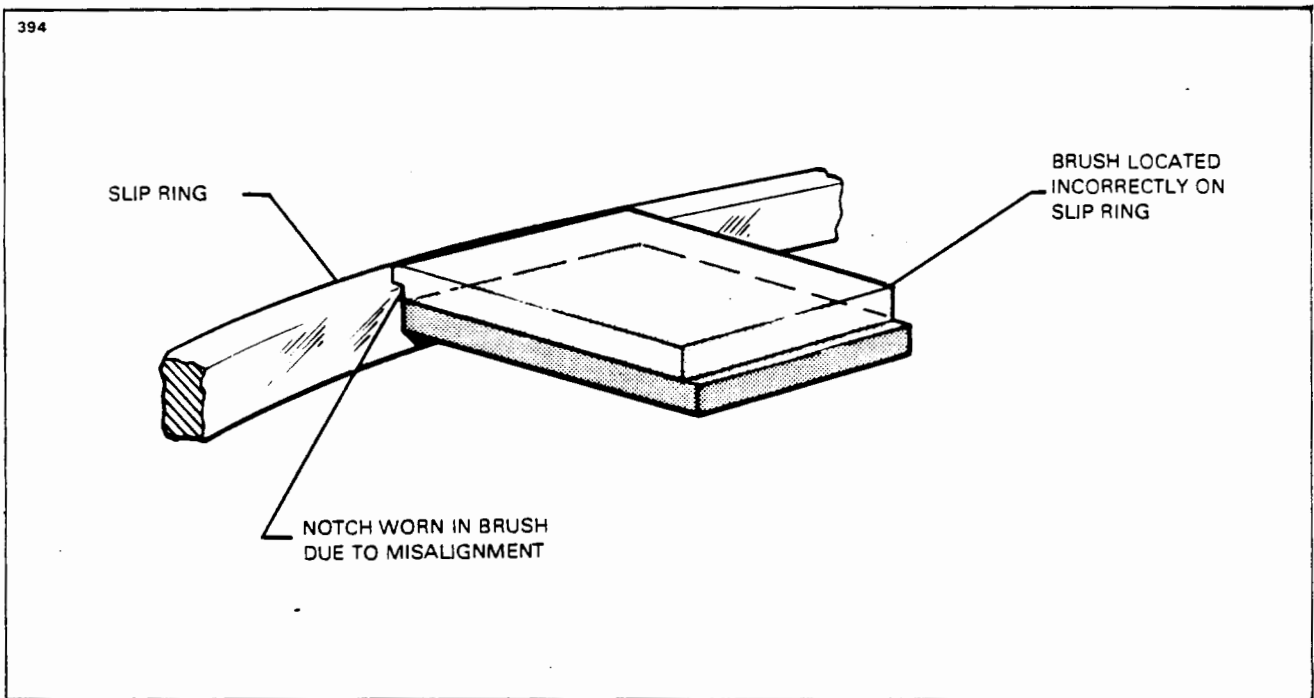


Figure 30-5. Centering of Brushes on Slip Rings

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

C178

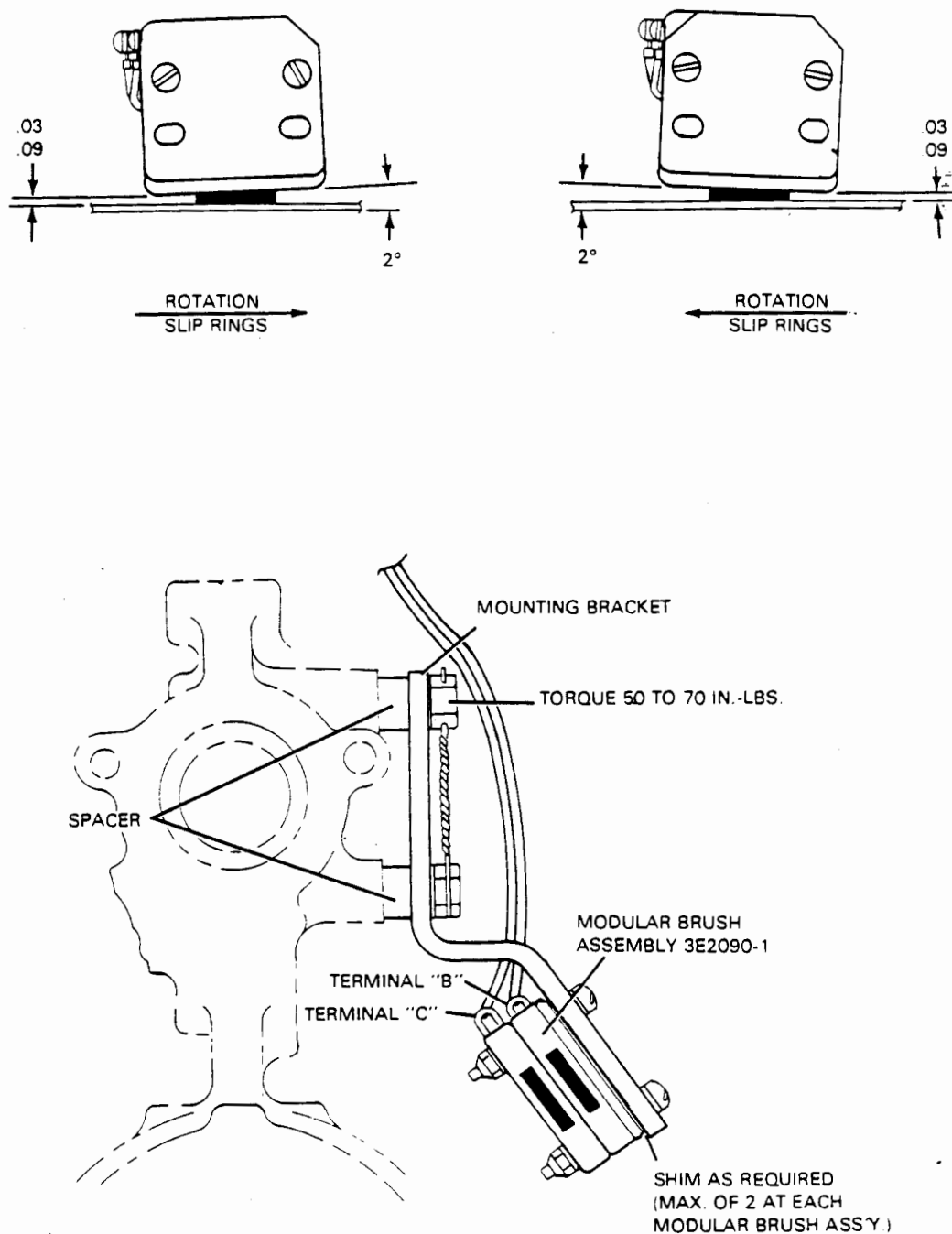


Figure 30-6. Modular Brush Assembly Alignment

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

MODULAR BRUSH ASSEMBLIES.

BRUSH MODULE REPLACEMENT.

Brush wear may be measured as shown in Figure 30-7. The X-dimension given (in inches) indicates when the brushes must be replaced.

— NOTE —

Brushes are not offered individually as replacements. When a brush wears out, the module containing it should be replaced.

1. Remove the modular brush assembly from the aircraft by removing the attachment hardware and disconnecting the engine wire harness.
2. Remove assembly screws and separate modules and spacers.

— NOTE —

The part number of each module is etched into the surface of the plastic housing; replace with the same part number module.

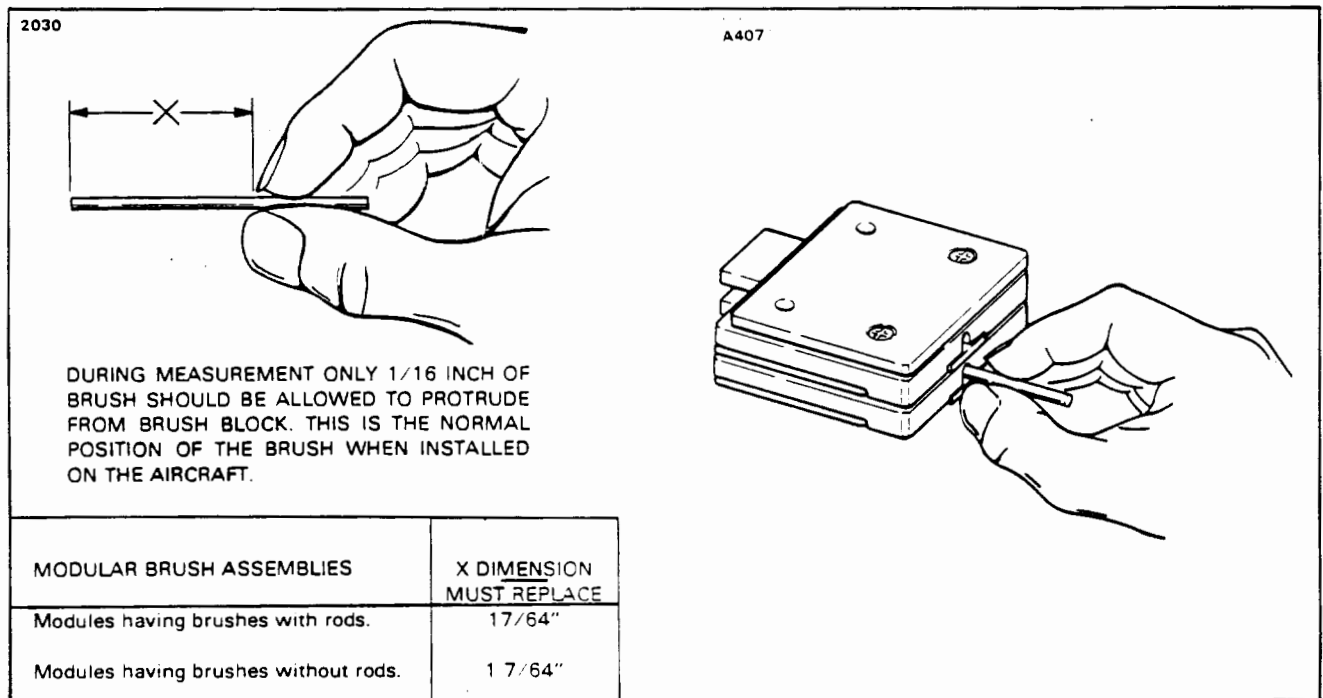
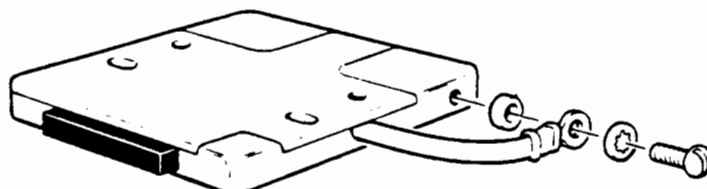


Figure 30-7. Measuring Brush Assemblies

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

A485

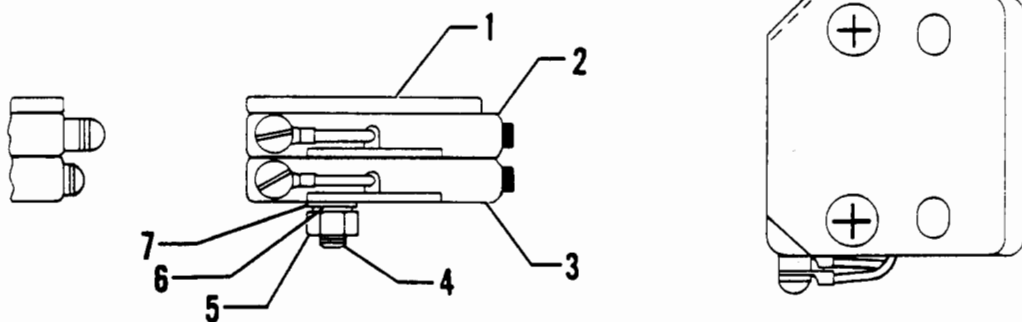


NOTE

TWO 3E2011 BRUSH MODULE ASSEMBLIES ARE REQUIRED TO
 PRODUCE ONE 3E2090-1 MODULAR BRUSH ASSEMBLY.

Figure 30-8. Brush Module Assembly 3E2011

C177



1. SPACER
2. BRUSH MODULE ASSEMBLY 3E2011-2
3. BRUSH MODULE ASSEMBLY 3E2011-3
4. SCREW MS 24693-532
5. NUT MS 35649-262
6. LOCKWASHER MS35333-37
7. WASHER AN960C6

Figure 30-9. Modular Brush Assembly 3E2090-1

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

3. Restack modules and spacer as shown in Figure 30-9.

— NOTE —

Ascertain flat washer is positioned between star washer and housing.

4. Reconnect aircraft wire harness and insure adjacent ring terminals are not touching.
5. Install assembly on aircraft and check adjustment.

ALIGNMENT OF NEW BRUSHES.

Any time the brush block assembly is dismounted, the alignment at reinstallation must be checked as described in Step 7 under "100 Hour Inspection."

SLIP RINGS.

ALIGNMENT OF SLIP RING ASSEMBLIES.

Excessive slip ring run-out will result in severe arcing between the slip ring and brushes and will cause rapid brush wear. If the run-out is not corrected, rapid deterioration of the slip ring and brush contact surfaces will result and lead to eventual failure of the Deicing System. Check the slip ring run-out with a dial indicator securely attached to the engine with the pointer resting on the slip ring. (Refer to Figure 30-4.) Rotate the propeller slowly noting the run-out indicated on the gauge. The total run-out must not exceed 0.005 inch + - 0.0025 inch and 0.002 inch in any 4 inch interval of slip ring travel.

— NOTE —

Some error may be induced in the readings by pushing in or pulling out on the propeller. Care must be taken to exert a uniform push or pull.

Small amounts of run-out may be corrected by varying the torque on the slip ring mounting bolts between 40 to 100 inch-pounds to obtain the required flatness.

REPLACEMENT OF SLIP RING ASSEMBLIES.

Slip ring assemblies that are open or shorted electrically, cracked or damaged structurally, or which have damaged surfaces beyond the scope of minor repair or clean up, should be replaced.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

PROPELLER 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 brush block and use low range ohmmeter to read resistance from each deicer circuit lead (Pins B and C of brush block) to ground; it should read .52 to .56. If this reading is not obtained, disconnect the deicer lead harness to measure heater resistances individually. Individual heater should be 1.04 to 1.12. 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.

REPLACEMENT.

If tests show the blade deicer to have an open circuit, to be the wrong resistance or to be visibly damaged beyond repair as outlined in this section, replace the deicer as directed in the following paragraphs.

REMOVAL OF BOOTS.

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.

— CAUTION —

Do not allow solvents to leak into propeller hubs and cause damage to seals.

3. Starting at one corner of the deicer, loosen enough of the deicer to grasp in the jaws of 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.

INSTALLATION OF BOOTS.

BLADE PREPARATION.

1. Mark and cut from masking tape a pattern the size of the propeller deicer. (Refer to Figure 30-10.)
2. Place a mark at the hub end of the blade in line with the blade leading edge. The location for this mark can be determined by sighting along the leading edge. Starting at the hub (see Note below), center the pattern on this mark and stick the pattern to the leading edge. Mark the position of the deicer harness.

— NOTE —

All deicers on a single propeller must be located at same distance from the hub for rotational balance.

30-68-05
Page 30-38
Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

3. Remove the pattern and remove any paint in the marked off area. Clean down to bare metal. Next, clean the area thoroughly with MEK or acetone. For final cleaning, wipe the solvent off quickly with a clean, dry lint-free cloth to avoid leaving a film.

— CAUTION —

*Cleanliness of metal and rubber parts cannot be too highly stressed.
Only perfectly clean surfaces will assure maximum adhesion.*

4. Using a pencil or pen, mark a centerline at the hub of the propeller blade and on the tape at the outboard edge of the masked area.

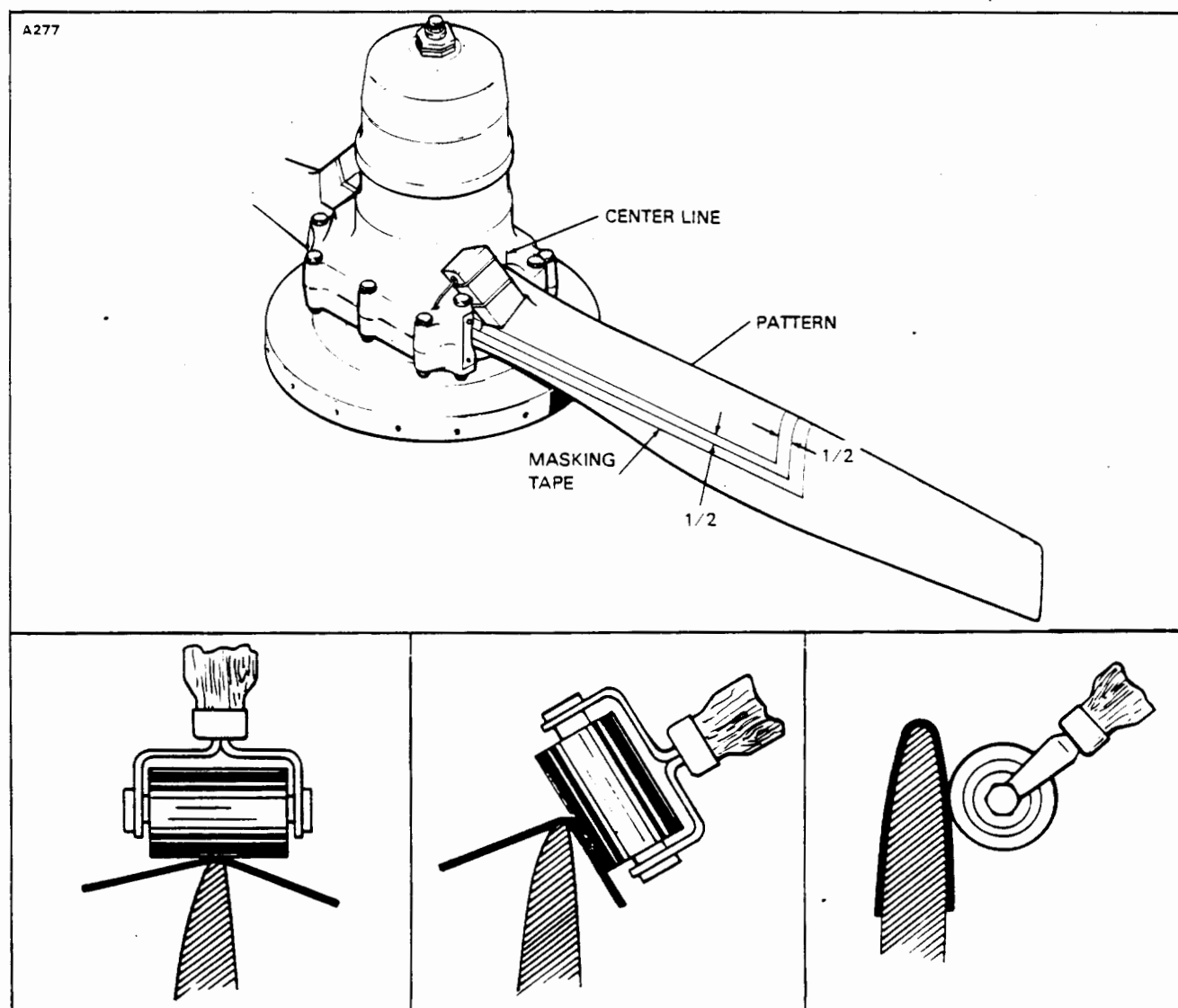


Figure 30-10. Installation of Deicer Boots

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3005. REQUIRED MATERIALS FOR REPAIR OF PROPELLER DEICER

The materials and tools listed below are commercially available and are not supplied by B.F. Goodrich in kit form:

Cement 1300L or EC 1403 (Minnesota Mining & Mfg. Co.)
Sealer 82-076-1 and -2 (B.F. Goodrich, Akron, Ohio, or Sealer
C-19861, C-21871 and C-16176 Lowe Bros., Dayton, Ohio)
Cleaning Solvent - MEK (MethylEthylKetone) or Acetone
Tackifying Solvent - Toluol or MEK (See Note)
Cleaning Cloth - any clean, lint-free cloth
1 inch paint brushes
2 inch rubber hand roller
1/4 inch hand stitcher
Masking tape

— NOTE —

MEK may be used instead of Toluol to tackify cement, but it provides approximately 10 seconds working time for deicer applications, whereas Toluol provides approximately 40 seconds working time.

CEMENT APPLICATION.

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. Cement one inch of the deicer lead strap. Allow to air dry for a minimum of one hour at 40°F or above, when the relative humidity is less than 75%. If the humidity is 75% to 90%, allow two hours drying time. Do not apply cement if the relative humidity is higher than 90%. After allowing the proper amount of drying time, apply a second even brush coat of 1300L cement.

— NOTE —

If curling of the deicer edges is a problem, apply masking tape to the edges of the glazed side before applying 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.

30-68-06

Page 30-40

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF DEICER 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 (slightly sticky to the touch-like masking tape), dry on both the propeller surface and deicer surface, position deicer on blade leading edge. Start at hub end, using centerlines as a guide. (Refer to Figure 30-11.)
2. Make sure that the harness will fall in the previously marked position.
3. Working outward toward the tip, tack the deicer centerline to the leading edge of the propeller blade.
4. Use the tackifying solvent as necessary. If deicer is allowed to get off course, pull up with a quick motion and re-apply deicer.
5. If cement is removed from either surface, completely remove the deicer and re-apply cement as explained in the previous paragraph.
6. When the deicer is correctly positioned, roll firmly along the centerline with a rubber roller. (Refer to Figure 30-10.)
7. Gradually tilt the rubber roller and carefully work the deicer over either side of the blade contour to avoid trapping air. Roll outwardly from centerline to edges. Be especially careful to work out excess material at outboard edge of deicer before other edges are completely rolled down. If excess material at edges tends to pucker, work out puckers smoothly and carefully with fingers.
8. Roll the tapered edges, especially inboard edge of the deicer with the metal stitcher.

— CAUTION —

To avoid damage to deicer resistance wires, do not use metal stitcher on body of deicer. Area where metal stitcher is permitted not to exceed 3/16" along deicer edge.

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 of an inch wide around the circumference of the deicer down to the bare metal. Use MEK or Acetone and clean thoroughly.
2. Clean out .500 of an inch of all deicer edges and back under deicer about .250 of an 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 in accordance with the paragraph on cement application.
4. Mix the filler, sealer, or paint thoroughly and in the proper proportions by weight, as given in Chart 3006.
5. Locate masking tape approximately .125 of an inch beyond the cemented area around the deicer to permit filler material to contact bare metal.
6. Apply one even coat of filler to area around the inboard end and sides of the deicer. (Refer to Figure 30-11.) Immediately remove the masking tape and allow the filler to dry for six hours.
7. Apply masking tape about .125 of an inch beyond filler or .250 of an inch beyond cemented area when no filler is used, to permit sealer to contact bare metal. Apply one even brush coat of sealer to the area around the deicer. (Refer to Figure 30-11.) Remove masking tape immediately and allow sealer to dry. Allow 12 hours cement curing time before starting engine, allow 24 hours cement curing time before operating the deicers.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

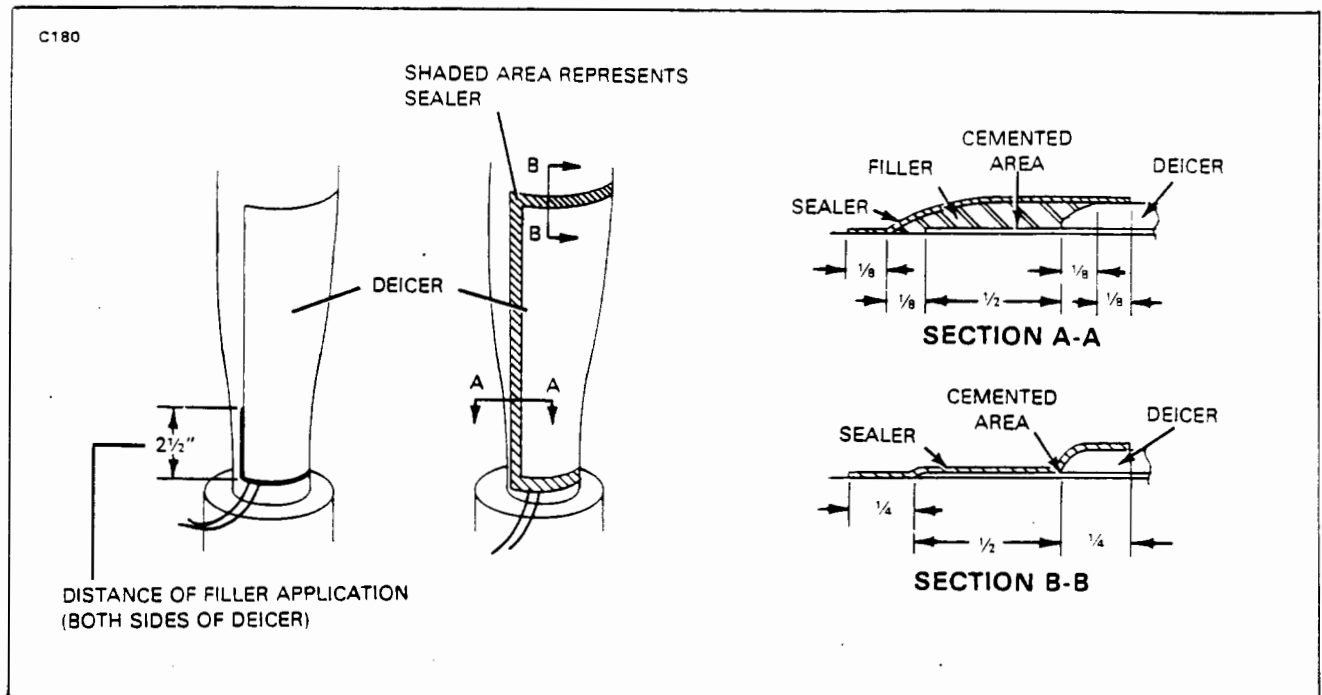


Figure 30-11. Typical Deicer Boot Sealer Application

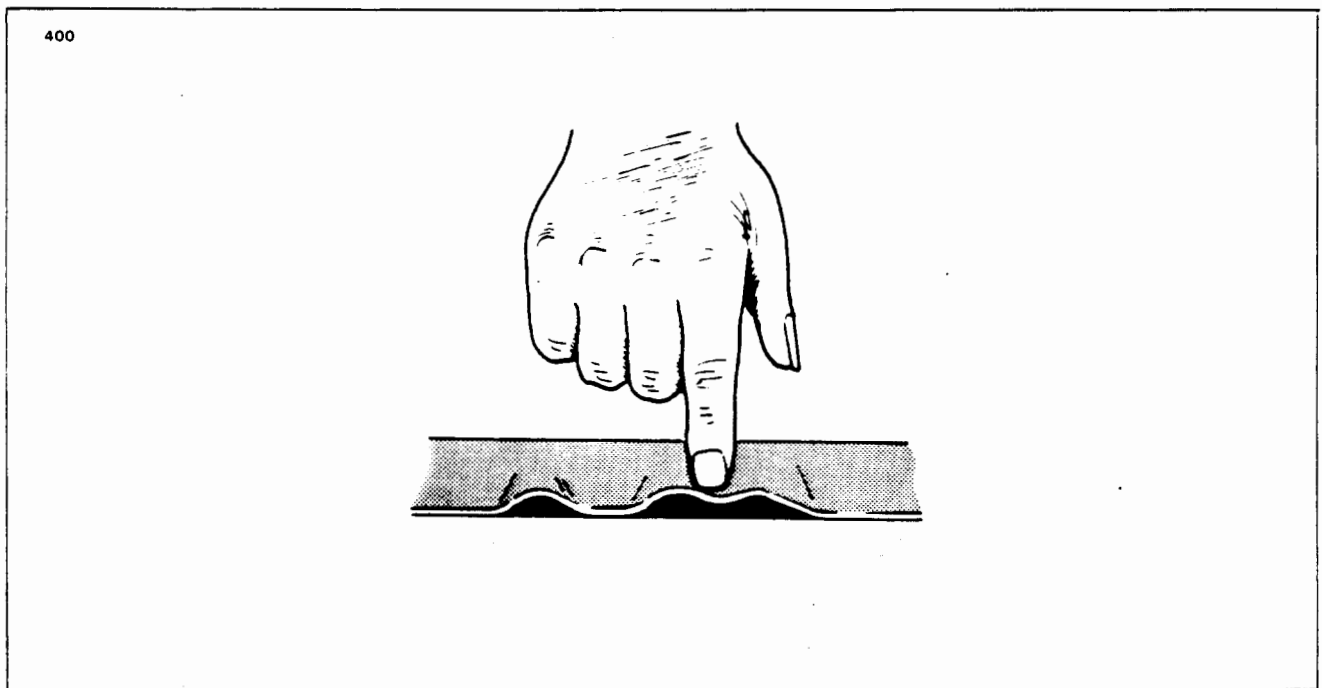


Figure 30-12. Wrinkled Deicer

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

WRINKLED DEICERS. (Refer to Figure 30-12.)

If edge of deicer is found wrinkled or loose, try recementing. Use MEK or Toluol to loosen the bond for an additional 1/4 inch beyond the loose or wrinkled area. Apply one coat of 1300L cement to the deicer and propeller bonding surfaces and allow to air dry for one hour. Then apply a second coat of 1300L cement to both the deicer and bonding surface. Allow to dry. Retackify with MEK or Acetone and press with fingers to work out wrinkles or to secure loose edges. If material has stretched and will not cement flat, replace the deicer.

ELECTRICAL CHECK.

1. Check the electrical resistance of element within the deicer. (Refer to Chart 3007.)
2. Check for intermittent open circuits by tensioning the deicer wire harness slightly while measuring the resistance. Also, press lightly on the deicer surface in the area adjacent to the harness. Resistance must not vary.
3. Identification of the circuits within the element may be confirmed by referring to the resistance values and schematic diagram. Proper identification is necessary in order to make the system cycle properly and to obtain the correct amperage values during system operation. Minimum and maximum ohms between common ground and either of the other terminals is 1.04 to 1.12.

— NOTE —

These resistances apply only to deicers that are not connected to terminal studs.

CHART 3006. MIXING OF MATERIALS

Material	Manufacturing & No.	Mixing Proportions
Filler	3M EC1031 and EC801	Twelve parts EC1031 with one hundred parts EC801
Sealer	BFG 82-076-1 & -2 or Lowe Brothers V66V27, F63B8, & R7K69	Twelve parts -1 with one part -2 One part V66V27 with seven parts F63B8 (and up to two and two-thirds parts R7K69 thinner as needed)

CHART 3007. ELECTRICAL RESISTANCE

Resistance Check	Max.	Min.
1 Blade each Element	1.12	1.04
2 Blades in Parallel	0.56	0.52
3 Blades in Parallel	0.38	0.35

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF DEICER WIRING HARNESS. (Refer to Figure 30-13.)

The propeller deice wiring harness is secured to the propeller counterweight as follows:

1. Insert the deicer wire harness thru the 9/32 diameter hole in the prop counterweight.
2. Connect the plugs of the prop deicers and the deicer wire harness as shown in Figure 30-13.
3. Install tie strap (P/N MS 3367-1-9) between the leads along the length of the plugs. Do not tighten at this time.
4. Install both tie straps (P/N MS 3367-2-9) under the tie strap installed in the previous step and around the counterweight. Do not tighten at this time.
5. Install transflex tubing over deicer wire harness.
6. Route transflex tubing under both tie straps (P/N MS 3367-2-9) and tighten tie straps.
7. Tighten the tie strap around the plugs.
8. Install the terminals on the deicer wire harness.
9. Install the terminals of the harness to the screws on the spinner bulkhead and tighten the lead clip over the harness.

ADJUSTMENTS AND TESTING.

BALANCING.

To assure balance of the propeller assembly, the original balancing weights or their equivalents must be reinstalled. The weights must be left in the 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. The deicer wire harness must be installed on the propeller as just described.

FINAL ELECTRIC CHECK.

1. Make certain that all terminals are tight. Do not over torque.
2. Check the electrical resistance between the deicer terminals or between the slip rings. The reading should be per Chart 3007.

FUNCTIONAL CHECK.

1. Start both engines and operate at 2300 RPM. Place the propeller deice switch in the ON position.
2. The ammeter should show a surge of current to one propeller followed by a surge of current to the opposite propeller. Time between surges must not exceed 90 seconds. During current surges ammeter should indicate within green arc.
3. Return propeller deice switch to the OFF position and shut-down engines.

— NOTE —

Do not operate propeller deice equipment with engines not operating.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

C176

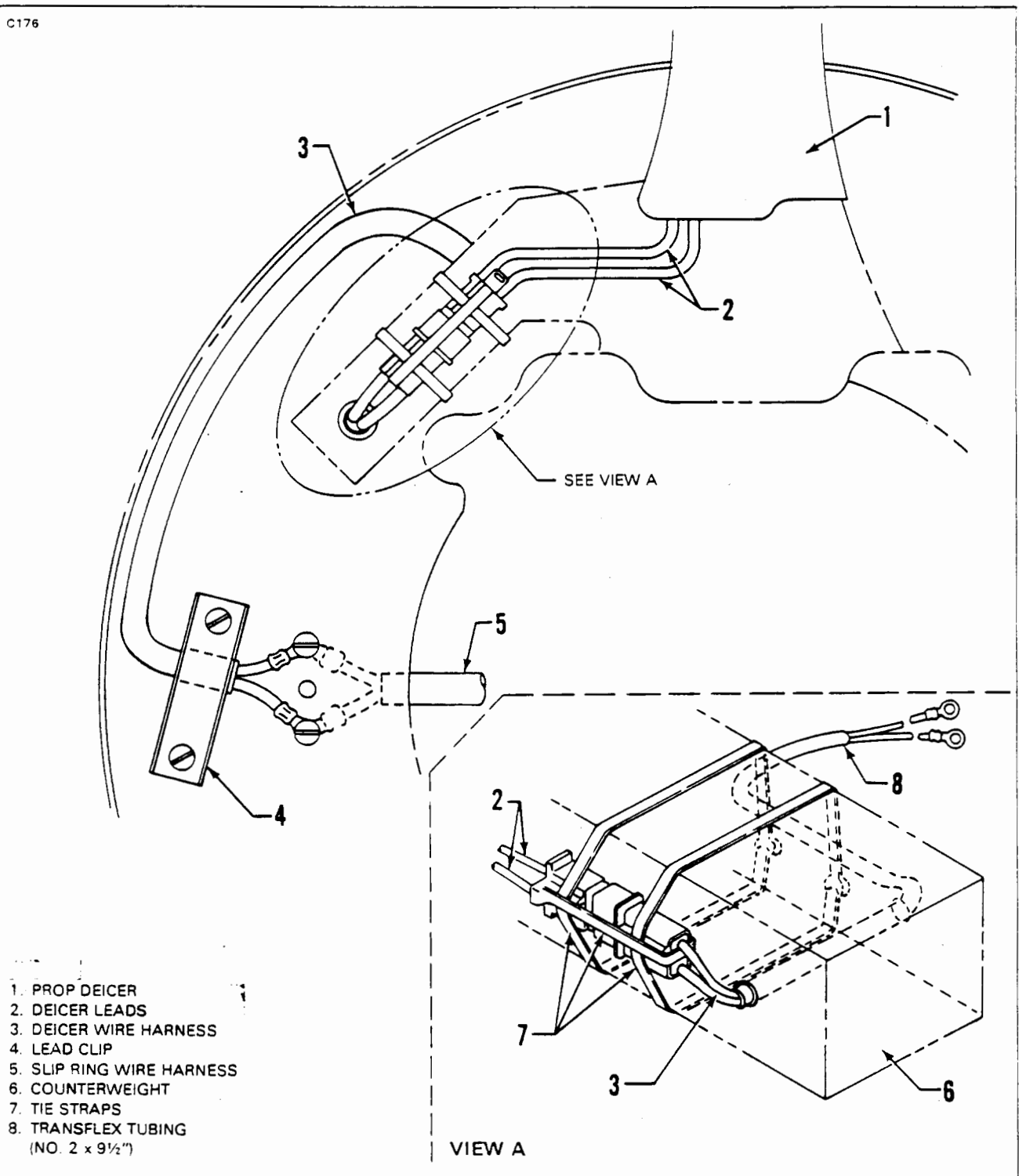


Figure 30-13. Deicer Wiring Harness Installation (Typical)

30-69-02
 Page 30-45

Revised: January 3, 1983

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

OTHER COMPONENTS.

Do not attempt internal repairs of the timer, ammeter or switch. If inoperative, these components must be replaced with one of the correct part numbers. For any other repair or maintenance problems not covered in this manual, inquire at Transportation Products Division of the B.F. Goodrich Company, Akron, Ohio 44138.

TIMER TEST.

Field experience indicates that too often the timer is considered at fault when the true trouble lies elsewhere. Before removing a timer as defective, perform this test:

1. Disconnect wire harness at timer and with deicer switch ON, check voltage from Pin B of harness plug to ground. If system voltage is not present, the fault is not in the timer. If system voltage is present at Pin B, check ground circuit using ohmmeter from Pin A to ground. If no circuit is shown, the fault is in ground lead, not in timer. If ground connection is open, the timer step switch will not change position.

2. When power and ground circuits have been checked, connect a jumper wire from Pin B of harness to B contact of timer socket to power timer. Connect a jumper wire from Pin A of harness to A contact of timer socket to complete the power circuit. Now use voltmeter from ground to the timer socket and check that timer is cycling to deliver system voltage to D and F contacts in that order. Each contact must deliver voltage for approximately 90 seconds, in turn, and there must be zero voltage on the contact not energized.

3. If the timer meets these requirements, it is not the cause of the trouble. If it fails to perform as indicated, the trouble does lie in the timer and it should be replaced.

DETECTION.

WING ICE DETECTION LIGHT. (PA-44-180T Only)

This light is used in conjunction with the pneumatic deicing system and will aid the pilot in detecting ice formation on the left wing leading edge during night flying operations.

The light is mounted in the outboard side of the left nacelle just above leading edge of the wing. It is a sealed beamed, 12-volt unit, which is controlled from a toggle type switch mounted on the switch panel.

SERVICING.

The only service required of this unit is the replacement of a burned out lamp with a new lamp GE1383.

REMOVAL. (Refer to Figure 30-14.)

1. Be sure the switch is in the off position.
2. Remove the nacelle access panel in which the light is installed.
3. Remove the screws which secure the socket in the retainer.
4. Pull the socket aft and remove the lamp.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

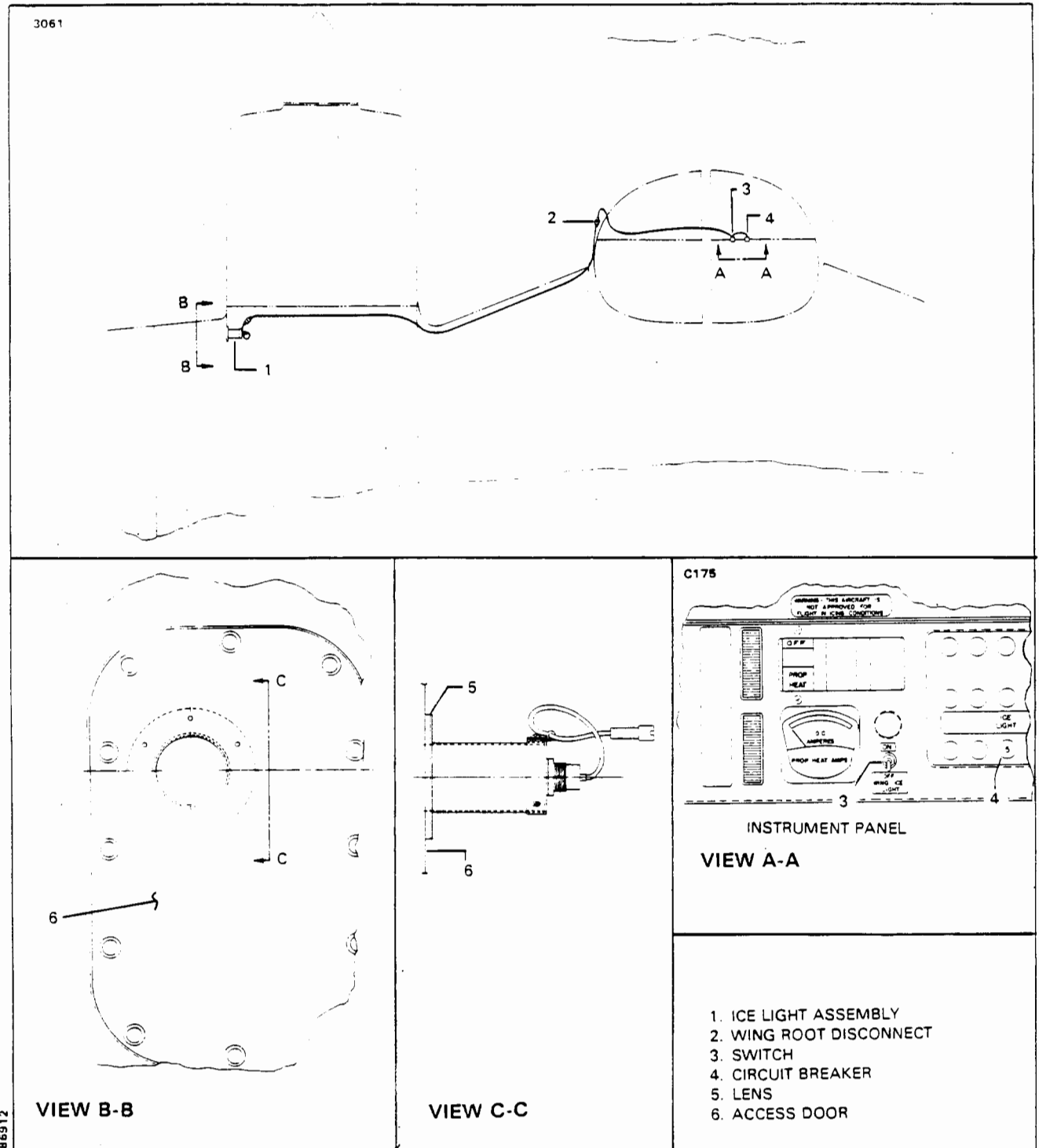


Figure 30-14. Wing Ice Lighting System (PA-44-180T Only)
(S/N 44-8107033, 44-8107035 and up)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION.

1. Position the new lamp in the receptacle of the socket, then secure the socket in the retainer with the screws.
2. Activate the switch in the cockpit to check the lamp operation.
3. Replace the nacelle access panel with the attachment hardware.

CARBURETOR ICE DETECTOR. (PA-44-180 Only)

DESCRIPTION.

The ARP Carburetor Ice Detector unit (one for each carburetor) used on the PA-44-180 utilizes an optical probe installed in the carburetor throat just upstream of the throttle valve. As ice forms and blocks the passage of light within the probe, the warning is triggered. When the ice has melted and enough light is sensed, the warning light will be extinguished. The probe has an expected service life of 50,000 hours. A built-in test circuit is activated such that each time the switch is turned on the light will come on momentarily.

TROUBLESHOOTING.

— CAUTION —

Do not attempt to test the probe or instrument by applying a voltage to each! A voltage of over 2-volts will burn out the probe lamp and sensor and the instrument red light switching transistor.

1. The probe may be tested as follows:
 - (1) Connect red (+) ohmmeter test probe to black wire of ice detector probe.
 - (2) In a subdued light (not in sunlight) touch the black ohmmeter test probe to the red wire of the ice detector probe while observing the ohmmeter. The reading should be approximately 600 ohms in ordinary light. Cover the ice detector probe sensor to eliminate most of the light. The ohmmeter should indicate approximately 10,000 + ohms indicating that the sensor is functioning properly.
 - (3) Remove the black ohmmeter test probe from the red wire and touch it to the white wire. The ohmmeter should read approximately 5 ohms indicating that the probe lamp is functioning properly.
 - (4) If both steps (2) and (3) above are completed satisfactorily the probe should operate.
 - (5) Test probe housing for short to ground. Housing is insulated.
2. The instrument is tested as follows:
 - A. Disconnect the ice detector probe at the probe connectors.
 - B. Apply (+) 12-volts DC to instrument power wire (red wire with fuseholder).
 - C. Connect the black ground wire to (-) 12-volts DC.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

D. Turn the instrument on. The red light should come on. If the red light does not come on, the instrument is inoperative and must be returned to:

ARP Industries, Inc.
36 Bay Drive E.
Huntington, New York 11743
Telephone (516) 427-1585

— NOTE —

*ARP Industries, Inc., is the only FAA approved repair station
for this instrument.*

E. If the red light comes on, touch the red wire connector to the black wire connector (wires to instrument from probe). The red light must go out. If the red light does not go out, the instrument is inoperative and must be returned to ARP Industries, Inc.

3. The probe and instrument are tested as follows:

- A. Turn power on.
- B. Rotate sensitivity control up from full counterclockwise position until the red light just goes out (This should be anywhere from one-quarter to three-quarters turn).
- C. Place a piece of paper in the air gap of the probe (between the sensor and the housing lens). The red light should come on indicating that the system is functioning properly.

REMOVAL OF ICE DETECTOR PROBE.

- 1. Remove the engine cowl.
- 2. The probe is mounted in the carburetor or just below the throttle valve control arm. Remove the safety wire and carefully unscrew the probe from the carburetor. Measure and note how far the probe extends into the carburetor.
- 3. Where the wires for the probe come off the engine mount remove the wire insulation sleeves; make note of the respective wire interconnects; and, disconnect the wires.
- 4. If the engine is to be operated, install a suitable plug.

INSTALLATION OF ICE DETECTOR PROBE.

- 1. If a plug has been installed, remove the plug from the carb. housing. The probe is mounted just below the throttle valve on the left side of the carburetor.

— CAUTION —

Do not bend the probe components.

- 2. Carefully screw in the probe. When installed the index mark on the probe housing should face towards the carburetor air *inlet*. If necessary use AN960-416L shim washers to position the probe properly.
- 3. Tighten the probe as much as possible, by hand, and then *only*, a quarter turn more using a 3/8 inch short handle open end wrench.
- 4. Connect the appropriate wires and position the sleeves over the connectors. If heat shrink has not been used, tie with #6 electrical lacing wire.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

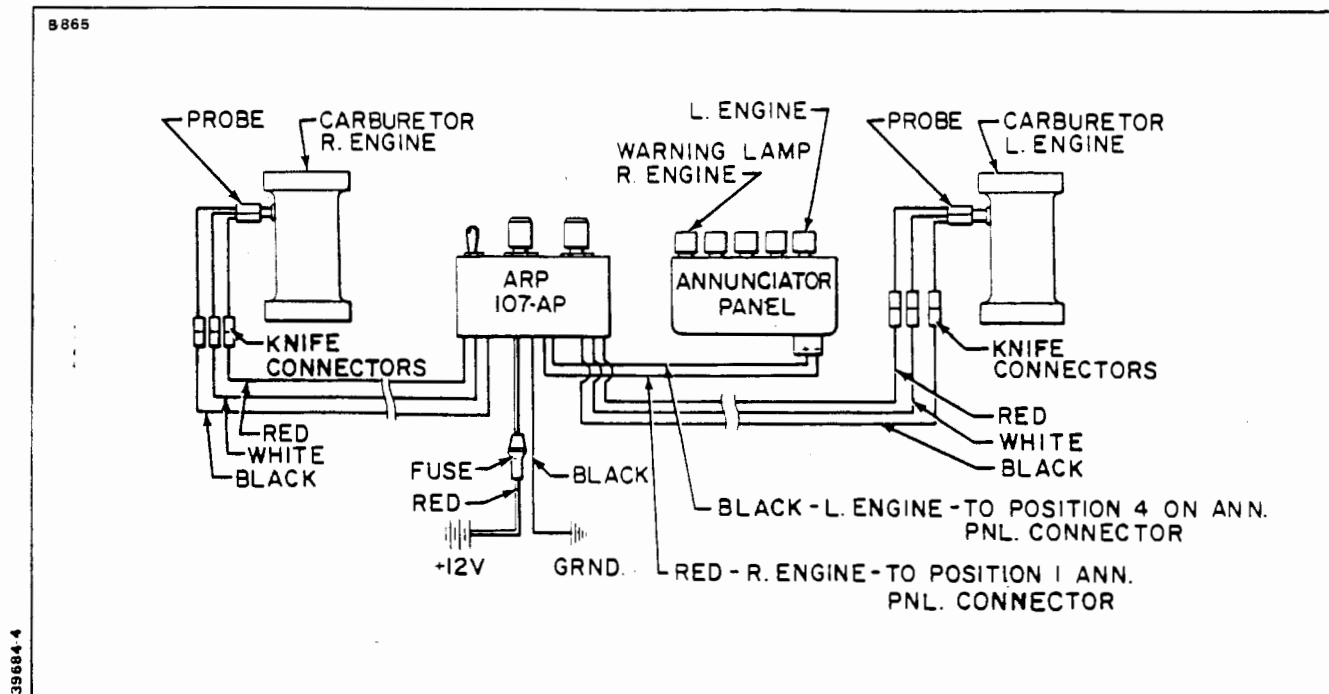


Figure 30-15. Ice Detection System (PA-44-180 Only)

FUNCTIONAL CHECK OF ICE DETECTOR PROBE.

1. Aircraft master switch on.
2. Ice detector system on.
3. Adjust the sensitivity knob until the red light (ice light) goes out. This is the critical setting.
4. Turn the ice detector system off, then on. The red light should flash on then off indicating that all components are operating normally.

LIFT DETECTORS.

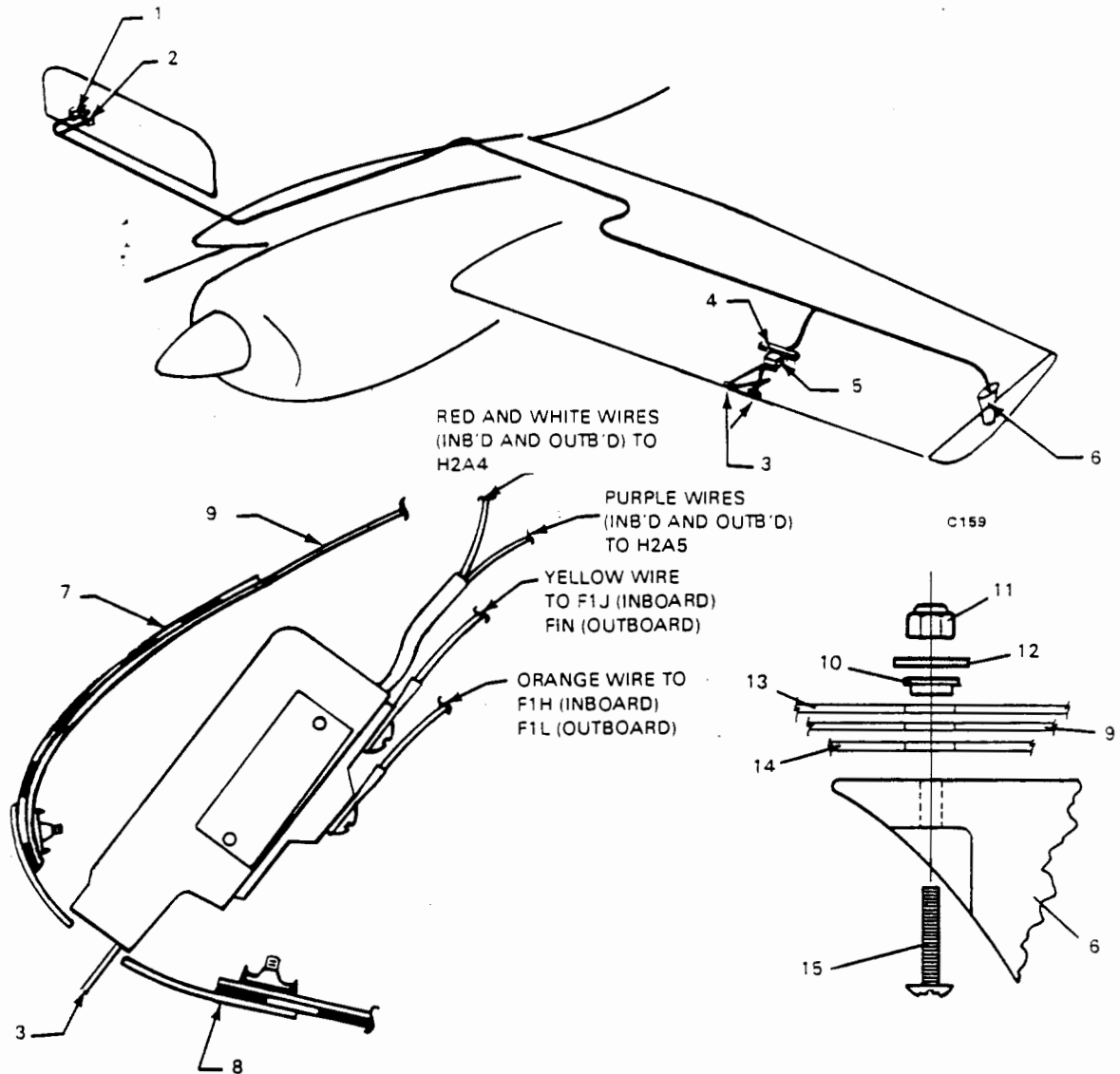
Two heated lift detectors and a heated pitot head installed on the left wing are controlled by a single ON-OFF type PITOT HEAT switch located on the switch panel to the left of the pilot. The lift detectors have a pull type 25 amp circuit breaker marked LIFT DET HEAT. This may be pulled to deactivate the lift detectors in case load shedding is required due to an alternator failure. The lift detectors have an in-line resistor activated by the main gear squat switch which limits the ground electrical load to approximately 25 percent of the inflight load. This allows the pitot heat and lift detectors to be activated prior to takeoff.

For removal, installation and adjustment of lift detectors refer to Chapter 27.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

C692

REFER TO ELECTRICAL SCHEMATIC - CHAPTER 91



LIFT DETECTOR INSTALLATION DETAIL A

1. CIRCUIT BREAKER (LIFT DETECTOR)	9. WING SKIN
2. CIRCUIT BREAKER (PITOT HEAD)	10. FIBER WASHER
3. LIFT DETECTOR(S)	11. NUT
4. RESISTOR (5 OHM, 100 W)	12. WASHER
5. RELAY	13. DOUBLER
6. PITOT HEAD	14. GASKET
7. DEICER BOOT	15. SCREW
8. MOUNTING PLATE	

Figure 30-16. Heated Pitot and Heated Lift Detector Installation (PA-44-180T)

86831-86908

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

FUNCTIONAL CHECK OF LIFT DETECTORS.

1. Insert microswitch key under leaf of main gear squat switch.
2. With flaps in 0° and 10° positions, the outboard lift sensor should activate when lifted.
3. With flaps in 25° and 40° positions, the inboard lift sensor should activate when lifted.
4. After successful completion of functional-check, remove microswitch key from main gear squat switch.

— END —

CHAPTER

32

LANDING GEAR

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 32 - LANDING GEAR

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
32-00-00	GENERAL	2F5	
32-01-00	Description and Operation	2F5	
32-02-00	Troubleshooting	2F5	
32-10-00	MAIN GEAR	2F12	
32-11-00	Main Gear Oleo	2F12	
32-11-01	Disassembly of Main Gear Oleo	2F12	
32-11-02	Cleaning, Inspection and Repair of Main Gear Oleo	2F12	
32-11-03	Assembly of Main Gear Oleo	2F14	
32-12-00	Main Landing Gear Assembly	2F18	A 1-83
32-12-01	Removal of Main Landing Gear	2F18	
32-12-02	Cleaning, Inspection and Repair of Main Landing Gear	2F18	
32-12-03	Installation of Main Landing Gear	2F19	
32-12-04	Adjustment of Main Landing Gear	2F22	
32-12-05	Alignment of Main Landing Gear	2F23	
32-13-00	Main Gear Door	2F24	A 1-83
32-13-01	Removal of Main Gear Door	2F24	
32-13-02	Cleaning, Inspection and Repair of Main Gear Door	2F24	
32-13-03	Installation of Main Gear Door	2F24	
32-20-00	NOSE GEAR	2G2	
32-21-00	Nose Gear Oleo	2G2	A 1-83
32-21-01	Disassembly of Nose Gear Oleo	2G2	
32-21-02	Cleaning, Inspection and Repair of Nose Gear Oleo	2G2	
32-21-03	Assembly of Nose Gear Oleo	2G4	
32-22-00	Nose Landing Gear Assembly	2G6	
32-22-01	Removal of Nose Landing Gear	2G6	
32-22-02	Cleaning, Inspection and Repair of Nose Landing Gear	2G6	
32-22-03	Installation of Nose Landing Gear	2G10	
32-22-04	Nose Gear Downlock and Eccentric Bushing	2G11	A 1-83
32-22-05	Removal of Nose Gear Downlock and Eccentric Bushing	2G11	A 8-80
32-22-06	Installation of Nose Gear Downlock and Eccentric Bushing	2G13	A 8-80
32-22-07	Adjustment of Nose Landing Gear	2G15	8-81
32-22-08	Alignment of Nose Landing Gear	2G15	

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 32 - LANDING GEAR (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
32-20-00	NOSE GEAR (cont)	—	
32-23-00	Nose Gear Doors	2G17	
32-23-01	Removal of Nose Gear Doors	2G17	1-83
32-23-02	Cleaning, Inspection and Repair of Nose Gear Doors	2G18	1-83
32-23-03	Installation of Nose Gear Doors	2G18	1-83
32-23-04	Adjustment of Nose Gear Doors	2G18	
32-40-00	WHEELS AND BRAKES	2G19	
32-41-00	Nose Wheel	2G19	1-83
32-41-01	Removal and Disassembly of Nose Wheel	2G19	
32-41-02	Inspection of Nose Wheel	2G19	1-83
32-41-03	Assembly and Installation of Nose Wheel	2G19	
32-42-00	Main Wheel	2G21	A 1-83
32-42-01	Removal and Disassembly of Main Wheel	2G21	
32-42-02	Inspection of Main Wheel	2G21	
32-42-03	Assembly and Installation of Main Wheel	2G21	
32-43-00	Repair of Nose and Main Wheel Assemblies	2G22	
32-44-00	Brakes	2G23	A 1-83
32-44-01	Brake Adjustment and Lining Tolerance	2G23	1-83
32-44-02	Wheel Brake Assembly	2G23	A 1-83
32-44-03	Removal and Disassembly of Wheel Brake Assembly	2G23	
32-44-04	Cleaning, Inspection and Repair of Wheel Brake Assembly	2H2	2R 8-81
32-44-05	Assembly and Installation of Wheel Brake Assembly	2H2	
32-44-06	Parking Brake Valve	2H4	
32-44-07	Removal of Parking Brake Valve	2H4	
32-44-08	Disassembly of Parking Brake Valve	2H4	
32-44-09	Cleaning, Inspection and Repair of Parking Brake Valve	2H6	
32-44-10	Assembly of Parking Brake Valve	2H6	
32-44-11	Installation of Parking Brake Valve	2H6	
32-44-12	Brake Cylinder (Toe Brake)	2H7	
32-44-13	Removal of Brake Cylinder	2H7	
32-44-14	Disassembly of Brake Cylinder	2H7	
32-44-15	Cleaning, Inspection and Repair of Brake Cylinder	2H7	
32-44-16	Assembly of Brake Cylinder	2H7	
32-44-17	Installation of Brake Cylinder	2H8	
32-44-18	Bleeding Procedure	2H8	

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 32 - LANDING GEAR

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
32-60-00	POSITION AND WARNING	2H10	
32-61-00	Landing Gear Limit Switches	2H10	
32-61-01	Adjustment of Main Gear Up Limit Switch	2H10	
32-61-02	Adjustment of Main Gear Down Limit Switch	2H10	2-81
32-61-03	Adjustment of Nose Gear Up and Down Limit Switches	2H10	8-80
32-61-04	Adjustment of Landing Gear Safety (Squat) Switch	2H12	
32-62-00	Landing Gear Warning (Throttle) Switches	2H12	
32-62-01	Landing Gear Up Power Reduced Warning Switch	2H12	
32-62-02	Switch Location	2H12	
32-62-03	Adjustment of Landing Gear Up Power Reduced Warning Switch	2H12	
32-62-04	Replacement of Landing Gear Up Power Reduced Warning Switch	2H13	
32-62-05	Functional Test of the Gear Retracting System	2H13	

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

GENERAL.

This chapter consists of instructions for the overhaul, inspection and adjustment of the various components of the landing gear and brake system, including adjustment of the electrical limit, safety and warning switches. This chapter does not cover the hydraulic function of the landing gear retracting system. (Refer to Chapter 29.)

DESCRIPTION AND OPERATION.

The airplane is equipped with retractable, tricycle air-oil strut type landing gear which are hydraulically operated by an electrically powered reversible pump.

Gear positions are indicated by three green lights located below the selector lever for gear down and locked, and a red light located at the top of the instrument panel for gear unsafe positions. There is no light to indicate that the gear has fully retracted other than all lights are out. As the landing gear swings to the down and locked position and each downlock hook moves into its locked position, a switch at each hook actuates to the switch normally closed (NC) circuit to indicate by a green light that the individual gear is safely down and locked. The activation of all three downlock switches will also shut the hydraulic pump off. As the instrument lights are turned on, the green lights will dim. When the gear begins to retract and the downlock hooks disengage, the down limit switches actuate to the NC circuit and in series with the NC circuit of the up limit switch allows the gear unsafe light to come on. The gear unsafe light will remain on until the gear is up and all up limit switches are actuated to their normally open (NO) circuit.

Each landing gear is retracted and extended by a single hydraulic cylinder attached to the drag link assembly of the nose gear and the side brace link assembly of the main gears. Gear doors partially enclose the gear and operate through mechanical linkage with each gear. The gears are held in their up position by hydraulic pressure alone within the cylinders. There are no uplocks and loss of hydraulic pressure will allow the gears to drop. It is preferred that the gears be extended and retracted with the use of the gear selector handle; however in the event of hydraulic loss or electrical failure, they can be lowered by pulling on the emergency extension knob which will open a valve between the two hydraulic lines to the nose gear cylinder thus allowing hydraulic pressure to neutralize between each side of the cylinder pistons and allowing the gear to free fall to the downlocked position. To assist the nose gear to extend under these conditions are two springs, one inside the other, mounted on arms above the gear links. The main gears require no assist springs. Once the gears are down and the downlock hooks engage, a spring maintains each hook in the locked position until hydraulic pressure again releases it. A further description of the hydraulic system may be found in Chapter 29.

The nose gear is steerable through a 60 degree arc by the use of the rudder pedals. As the gear retracts, however, the steering linkage becomes separated from the gear so that rudder pedal action with the gear retracted is not impeded by the nose gear operation. A shimmy dampener is also incorporated in the nose wheel steering mechanism. A single bungee spring unit is incorporated between the rudder pedals and nose gear.

The two main wheels are equipped with self-adjusting single disc hydraulic brake assemblies. Hydraulic fluid for the brake cylinders is supplied by a reservoir installed at fuselage station 49.50.

TROUBLESHOOTING.

Mechanical and electrical switch troubles peculiar to the landing gear system are listed in Chart 3201. When troubleshooting, first eliminate hydraulic malfunctions, then proceed to switch malfunctions and last to the mechanical operation of the gear itself. Always place the airplane on jacks before attempting any troubleshooting of the gear.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3201. TROUBLESHOOTING (LANDING GEAR)

Trouble	Cause	Remedy
Red gear unsafe light out while gear is in transit.	Indicator lamp burned out.	Replace lamp.
	Indicator light ground incomplete.	Check ground circuit.
	Indicator light circuit wire broken.	Check wiring.
	Indicator light circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
Red gear unsafe light on though gear has retracted.	One or more up limit switches failed.	Isolate and replace switch.
	Nose gear up limit switch out of adjustment.	Check gear up adjustment and readjust up limit switch.
	Main gear not retracting far enough to actuate switch.	Check gear up adjustment.
Red gear unsafe light on though gear is down and locked.	One or more down limit switches failed.	Isolate and replace switch.
	Nose gear down limit switch out of adjustment.	Readjust down limit switch.
	Main gear down limit switch out of adjustment.	Readjust down limit switch.

— NOTE —

The out of adjustment or failed switch may be determined by noting which down light is not lit.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3201. TROUBLESHOOTING (LANDING GEAR) (cont)

Trouble	Cause	Remedy
Red gear unsafe light operates on and off after gear has retracted.	Light circuit wire loose.	Check wiring.
	Hydraulic system losing pressure.	Refer to Hydraulic System, Chapter 29.
	Gear up switch out of adjustment.	Check gear up adjustment and then switch adjustment.
Red gear unsafe light out and one green gear down light out though gear is down and locked.	Lamp burned out.	Replace lamp.
	Gear down limit switch failed.	Replace switch.
	Light circuit wire broken.	Check wiring.
— NOTE — <i>Ascertain navigation lights are off (daytime).</i>		
Red gear unsafe light and all green lights out.	Indicator lights circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Light circuit wire broken.	Check wiring.
Red gear unsafe light and horn fail to operate when throttle is near closed and landing gear is retracted.	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Micro switch "A" at throttle out of adjustment.	Adjust micro switch "A."
	Micro switch "A" failed.	Replace switch.
	Warning horn and light circuit wire broken.	Check wiring.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3201. TROUBLESHOOTING (LANDING GEAR) (cont)

Trouble	Cause	Remedy
Red gear unsafe light and horn fail to operate when throttle is near closed and landing gear is retracted. (cont)	Diode in circuit between throttle switch "A" and light/horn open.	Replace diode. — NOTE — <i>When replacing diode connect banded end (cathode) to terminal ends of wires G2Q and G2K on mounting block.</i>
Red gear unsafe light and horn fail to stop when throttle is closed and gear has extended. (Gear extended through the use of the free fall lever)	Gear selector handle in up position.	Place handle in down position.
Red gear unsafe light and horn fail to operate when selector switch is moved to up position with gear extended and throttle not full forward.	Warning light and horn circuit wire broken.	Check wiring.
Above condition on ground.	Defective safety (squat) switch.	Replace switch.
Above condition in the air.	Pressure switch open.	Replace switch.
Red gear unsafe light and horn fail to shut off at full throttle. Gear selector at up position and gear extended.	Throttle micro switch "B" out of adjustment.	Adjust switch.
	Throttle micro switch "B" failed.	Replace switch.
Hydraulic pump shuts off, but red gear unsafe light remains on.	Gear not fully retracted.	Determine cause and remedy.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3201. TROUBLESHOOTING (LANDING GEAR) (cont)

Trouble	Cause	Remedy
Green gear down lights dim though position light switch is off, and gear is down and locked.	Failed instrument panel light control switch. (Lights grounding through dimming resistor instead of instrument panel light control.)	Replace switch.
Green gear down light fails to go out with gear in transit or retracted.	Gear down limit switch failed.	Replace switch.
Green gear down lights will go out and not dim when position light switch is turned on though gear is down and locked.	Green light ground dimming resistor open.	Replace resistor.
Green gear down lights blink momentarily before the down lock is engaged on roller.	Micro switch out of adjustment.	Adjust micro switch.
Nose landing gear shimmies during fast taxi, takeoff or landing.	Internal wear in shimmy dampener. Shimmy dampener or bracket loose at mounting. Tire out of balance. Worn or loose wheel bearings. Worn torque link bolts and/or bushings.	Replace shimmy dampener. Replace necessary parts and bolts. Check balance and replace tire if necessary. Replace and/or adjust wheel bearings. Replace bolts and/or bushings.
Excessive or uneven wear on nose tire.	Incorrect operating pressure. Wear resulting from shimmy.	Inflate tire to correct pressure. Refer to proceedings for correction.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3201. TROUBLESHOOTING (LANDING GEAR) (cont)

Trouble	Cause	Remedy
Nose gear fails to steer properly.	Oleo cylinder binding in strut housing. One brake dragging. Steering arm roller sheared at top of strut. Steering bellcrank loose on attachment plate. Steering bellcrank bearing and/or bolt worn. Shimmy dampener galling or binding.	Lubricate strut housing (refer to Lubrication Chart). Cylinder and/or strut housing bushings damaged. Determine cause and correct. Replace defective roller. Readjust and tighten. Replace bearing and/or bolt. Replace.
Nose gear fails to straighten when landing gear extends.	Steering arm roller sheared at top of strut. Incorrect rigging of nose gear steering.	Replace defective roller. Check nose gear steering adjustment.
Nose gear fails to straighten when landing gear retracts.	Centering guide roller sheared. Damaged guide.	Replace roller. Replace guide.
Main landing shimmies during fast taxi, takeoff or landing.	Tire out of balance. Worn or loose wheel bearings. Worn torque link bolts and/or bushings.	Check balance and replace tire if necessary. Replace and/or adjust wheel bearings. Replace bolts and/or bushings.

32-02-0

Page 32-06

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3201. TROUBLESHOOTING (LANDING GEAR) (cont)

Trouble	Cause	Remedy
Excessive or uneven wear on main tires.	Incorrect operating pressure. Wheel out of alignment (toe in or out). Lower side brace link out of adjustment, allowing gear to slant in or out.	Inflate tire to correct pressure. Check wheel adjustment. Check gear adjustment.
Strut bottoms on normal landing or taxiing on rough ground.	Insufficient air and/or fluid in strut. Defective internal parts in strut.	Service strut with air and/or fluid. Replace defective parts.
Landing gear doors fail to completely close.	Landing gear not retracting completely. Door retraction mechanism out of adjustment.	Check adjustment of landing gear. Check adjustment.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

MAIN GEAR.

MAIN GEAR OLEO.

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 in the airplane.

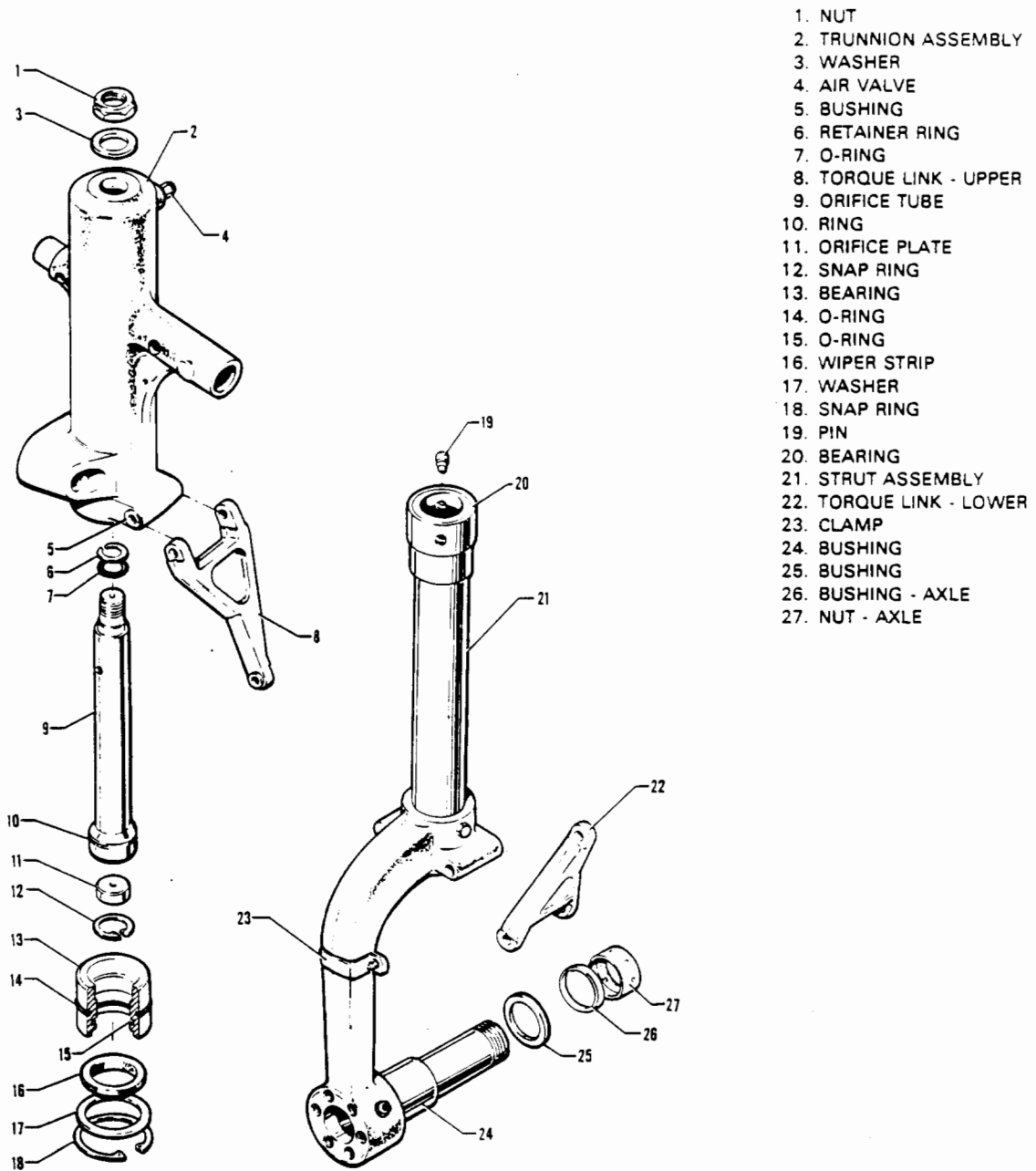
1. Place airplane on jacks.
2. Place a drip pan under the main gear to catch spillage.
3. Remove air and fluid from the oleo. Depress air valve core pin until strut pressure has diminished; remove the filler plug and with a thin hose siphon as much hydraulic fluid from the strut as possible.
4. Disconnect brake line at the joint located in the wheel well.
5. To remove piston tube assembly from oleo housing, remove the upper and lower torque link connecting bolt assembly and separate links. Note number and thickness of spacer washer(s) between the two links.
6. Compress the piston tube; reach up into the tube and release the snap ring from the annular slot at the bottom of the oleo housing.
7. Pull piston tube with component parts from cylinder housing.
8. The piston tube components may be removed by reaching in the tube and pushing out the upper bearing retainer pins. Slide off the upper bearing, lower bearing with O-rings, wiper and washer.
9. To remove orifice tube from the oleo housing, remove locknut and washer from top of housing. Draw tube with O-ring and retainer from housing.
10. The orifice plate is removed from the bottom of orifice tube by releasing snap ring holding the plate in position.
11. To remove piston tube plug and O-ring located in the bottom end of the tube, remove bolt assembly and insert a rod up through the hole in the body of the fork and push plug with O-ring from top of tube.

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR OLEO.

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

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2272



1. NUT
2. TRUNNION ASSEMBLY
3. WASHER
4. AIR VALVE
5. BUSHING
6. RETAINER RING
7. O-RING
8. TORQUE LINK - UPPER
9. ORIFICE TUBE
10. RING
11. ORIFICE PLATE
12. SNAP RING
13. BEARING
14. O-RING
15. O-RING
16. WIPER STRIP
17. WASHER
18. SNAP RING
19. PIN
20. BEARING
21. STRUT ASSEMBLY
22. TORQUE LINK - LOWER
23. CLAMP
24. BUSHING
25. BUSHING
26. BUSHING - AXLE
27. NUT - AXLE

Figure 32-1. Main Gear Oleo Strut Assembly

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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

1. Determine that all parts are cleaned and inspected.
2. To install the piston tube plug, first lubricate the plug O-ring with hydraulic fluid (MIL-H-5606) and install it on the plug. Lubricate the inside wall of the tube. Insert the plug into the top of the tube and push it to the fork end. Align the bolt holes of the fork, tube and plug, and install bolt assembly.
3. If desired, cement a cork in the hole in the bottom of the fork body to prevent dirt from entering between the fork and tube.
4. To assemble components of orifice tube, insert orifice plate into the bottom of the tube and secure with snap ring.
5. To install tube in oleo housing, insert the tube up through the housing. With the end of the tube exposed through the top of the housing, install the O-ring, retainer, washer, and locknut. Tighten locknut only finger tight at this time.
6. Assemble components of piston tube on the tube by placing, in order, snap ring, washer, lower bearing with outer and inner O-ring and upper bearing. Align the two .125 diameter holes and the lock pin holes with the corresponding holes in the piston tube and install pins.
7. Lubricate the wall of the cylinder oleo housing and tube, and carefully insert the tube assembly into the housing, guiding the orifice tube into the piston tube. Install the wiper strip, slide the washer into position and secure the assembly with snap ring.
8. Tighten locknut at top of housing.
9. Ascertain that the bushings are installed in the upper and lower torque links and then install links. The torque link bolt assemblies should be lubricated and installed with the flat of the bolt head hex adjacent to the milled stop of the wide end of the link. (Use the same thickness of spacer washers between the two links as those removed to maintain correct wheel alignment.) Tighten the bolts only tight enough to allow no side play in the links, yet be free enough to rotate.

— NOTE —

Instructions contained in Step 10 pertain to left oleo strut assemblies only.

10. Assemble squat switch actuator bracket on bolt assembly. Insert a rivet through the hole provided in the bracket into the upper link and install the nut. Install squat switch bracket immediately above the actuator bracket.
11. Attach spring attachment plate to the mounting lug on the base of the housing immediately above the upper link.
12. Connect brake line and bleed the brakes.
13. Lubricate gear assembly. (Refer to Chapter 12.)
14. Compress and extend the strut several times to ascertain the strut will operate freely. The weight of the gear wheel and fork should allow the strut to extend.
15. Service oleo strut with fluid and air. (Refer to Chapter 12.)
16. Check main gear alignment and gear operation. Ascertain that gear is down and locked.
17. Remove the airplane from jacks.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

305

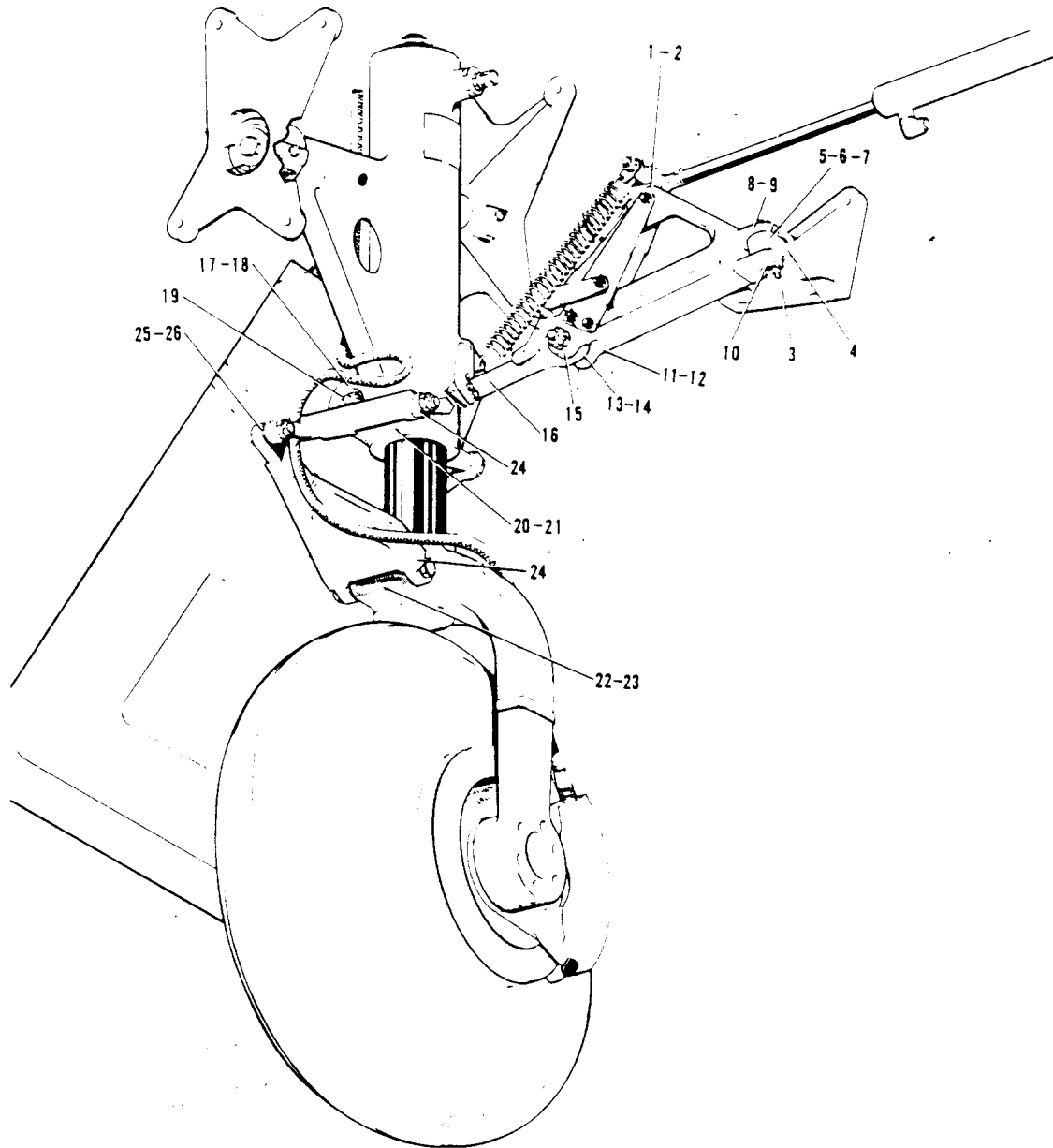


Figure 32-2. Main Gear Service Tolerances

32-11-03
Page 32-11

Revised: January 3, 1983

2F15

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tol.	Remarks
16	78720	Rod End, lowerside brace link	ID .492 .490			
17	67926-06 67926-08 67926-09	Trunnion housing, side brace attachment	ID .7530 .7550	ID .7530 .7550		
18	67026-05	Bushing, trunnion	ID .499 .500	ID .498 .502	.004	Install using Loctite 601.
19	402 974 (NAS 464 P9A-46)	Bolt, trunnion side brace attaching	OD .5616+.0000 -.0009			
20	67926-06 67926-08 67926-09	Trunnion housing, torquelink attachment	ID .4410 .4430	ID .4410 .4440		
21	67026-07 (2)	Bearing, trunnion	** ID .314 .313	ID .315		Press fit. Install using Loctite 601.
22	67037-04	Strut Assembly	ID .4385 .4370	ID .4395 .4370	.0025	
23	67026-07 (2)	Bearing, strut	** ID .314 .313	ID .315 .313	.002	Press fit.
24	67012-00	Torquelink (2)	ID .312+.001 -.000	ID .312+.002 -.000	.002	Line ream.
25	67012-00	Torquelink (2)	ID .3760 .3745	ID .3770 .3745	.0025	
26	31796-00 (2)	Bushing, Torquelink	** ID .252 .251	ID .253 .251	.002	Press fit.
**Line ream to this dimension after installation of new part.						

Figure 32-2. Main Gear Service Tolerances (cont.)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tol.	Remarks
1	67514-0	Link, upperside brace	ID .3645 .3625	ID		
2	63900-89	Bushing, upperside brace link	** ID .249 .251	ID .248 .252	.004	Press fit.
3	95642-08 95642-09 95642-10	Bracket, side brace support	ID .7495 .7505	ID .7490 .7510	.002	Shrink fit.
4	67026-12	Bushing, support bracket	ID .624 .625	ID .624 .626		Shrink fit.
5	78717-2	Stud, side brace support	OD .6235 .6225	OD .6220		
6	78717-2	Stud, side brace support	ID .4365 .4385	ID .4355 .4395	.004	
7	65003-41	Bushing, side brace support stud	ID .373 .375	ID .372 .376	.004	
8	67514-0	Link, upperside brace	ID .4945 .4935	ID .4925		
9	14843-16 (2)	Bushing, side brace link	** ID .376 .375	ID .374		Install using Loctite 601.
10	402 921 (NAS 464 P6-20)	Bolt, link stud attaching	OD .3742 +.0000 -.0009			
11	67514-0	Link, upperside brace	ID .4945 .4935	ID .4925		
12	14843-16 (2)	Bushing, side brace link	** ID .3745 .3755	ID .374		Install using Loctite 601.
13	67797-04 67797-05	Link, lowerside brace	ID .4905 .4925	ID .500		
14	65003-44 (2)	Bushing, lowerside brace link	** ID .373 .375	ID .372 .376	.004	Press fit.
15	402 927 NAS 464 616	Bolt, side brace link assembly	OD .3742 +.0000 -.0009	OD .3740		

**Line ream to this dimension after installation of new part.

Figure 32-2. Main Gear Service Tolerances (cont.)

32-11-03

Page 32-13

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

MAIN LANDING GEAR ASSEMBLY.

REMOVAL OF MAIN LANDING GEAR. (Refer to Figure 32-3.)

1. Place the airplane on jacks.
2. The side brace link assembly may be removed by the following procedure.
 - A. With gear in the extended position, disconnect gear downlock spring.
 - B. Disconnect rod end of actuating cylinder from retraction fitting on the upper side brace link by removing nut, washer, bolt, bushing and spring swivel.
 - C. Disconnect lower side brace link from gear housing by removing attachment nut, washer and bolt. Note bushings on each side of end bearing.
 - D. Disconnect upper side brace link from side brace support fitting stud by removing cotter pin, washer and attachment bolt.
 - E. The side brace support fitting may be removed by removing the cap bolts securing the fitting to the web of the spar.
 - F. Remove the assembly and further disassemble and inspect as needed.
3. The strut housing with components may be removed by the following procedure:
 - A. Disconnect brake line at its upper end in the wheel well.
 - B. Disconnect gear door actuating rod at the gear housing.
 - C. Remove access plate located on underside of wing, aft of landing gear.
 - D. If not previously disconnected, disconnect lower side brace link from the gear housing.
 - E. Disconnect forward support fitting of housing from the web of the main spar by removing fitting attachment bolts.
 - F. Remove retainer tube in aft support fitting that supports the aft arm of the housing by reaching through the access opening on the underside of the wing through the hole in the web and removing bolt that secures the tube in the housing. Insert a hook through the bolt hole in the tube, and slide it aft from the support fitting. Remove the tube from the wing.
 - G. Allow the gear to drop free from the wing.
 - H. The aft support fitting may be removed by holding the nuts in position, reaching through the access opening, and removing the fitting attachment bolts.
 - I. The forward support fitting may be removed from the arm of the housing by removing the bolt washer from the base side of the fitting. Slide the fitting from the arm. Remove washer from the arm.
4. Either bearing installed in the support fittings may be removed by removing the snap rings that hold the bearing in the housing. Push the bearing from the housing.

CLEANING, INSPECTION AND REPAIR OF MAIN LANDING GEAR.

1. Clean all parts with a suitable type cleaning solvent.
2. Inspect the gear components for the following unfavorable conditions.
 - A. Bolts, bearing and bushings for excess wear, corrosion and damage.
 - B. Gear housing, side brace links, torque links and attachment plates for cracks, bends or misalignment.
 - C. Downlock hook for excessive wear of the bearing surfaces.
3. Inspect the gear downlock spring for the following:
 - A. Excessive wear or corrosion, especially around the hook portion of the spring. A spring should be rejected if wear or corrosion exceeds one-quarter the diameter of the spring. Clean away all corrosion and repaint.
 - B. Check the spring for load tensions below minimum allowable tolerance. The minimum tension of the spring is 48 pounds pull at 7.9 inches. Measurement is taken from the inner side of each hook.
4. Check the general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

32-12-02
Page 32-14

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

5. Check side brace link through center travel by attaching the upper and lower links, setting them on a surface table, and ascertaining that when the stop surfaces of the two links touch, linkage is not less than .062 nor more than .125 of an inch through center. Should the distance exceed the required through center travel and bolt and bushings are tight, replace one or both links.

6. With side brace links assembled and checked, ascertain that when stop surfaces of the two links contact, the clearance between each downlock hook and the flat of the downlock pin is not less than 0.010 of an inch. Should clearance be less than that required, the hook only may be filed not to exceed a gap of more than 0.025 of an inch. The maximum allowable clearance between each hook and the downlock pin that are service worn is 0.055 of an inch. Should clearance be more than 0.055 of an inch, replace the pin, check clearance and then if still beyond tolerance, replace hooks. The gap between each hook should be equal.

7. Repair of the landing gear is limited to reconditioning of parts such as replacing components, bearings and bushings, smoothing out minor nicks and scratches and repainting areas where paint has chipped or peeled.

INSTALLATION OF MAIN LANDING GEAR. (Refer to Figure 32-3.)

— NOTE —

When assembling components of the landing gear, lubricate bearings, bushings, and friction surfaces with proper lubricant as described in Chapter 12.

1. Insert a gear support bearing in each support fitting and secure with snap rings. Check bearing for excess end play, shim as necessary with shim washers (P/N 62833-44).

2. The gear housing may be installed in the wheel well of the wing by the following procedure:

A. Place spacer washer and then forward support fitting on forward arm of the housing. Determine that barrel nut is properly positioned in the arm and insert attachment bolt through washer and the fitting into the arm. Tighten bolt and ascertain that the bearing is free to rotate.

B. Position aft support fitting at its attachment point in the wheel well and secure with bolts, washers and nuts. Install nuts and washers by reaching through the access hole on the underside of the wing.

C. With the retainer tube for the aft arm of the housing in hand, reach up through the access opening and insert the tube into the support fitting through the hole in the web.

D. Position the gear housing up in the wheel well and install the forward support fitting with bolts and washers. (One each AN960-416 and AN960-416L washer per bolt.)

E. Push the retainer tube into the arm of the housing and secure with bolt.

F. Check that the gear rotates freely in its support fittings and recheck thrust.

G. Connect the brake line to its mating line in the wheel well and bleed brakes.

3. The gear side brace link assembly may be installed by the following procedure:

A. Position link support bracket with swivel stud installed at its attachment point on the web of the spar and secure with bolts and washers.

B. Ascertain that the upper and lower links are assembled with downlock hook, retraction fitting, etc., attached, and the through travel of the links and downlock hook clearance checked.

C. Attach the upper link to the swivel stud of the support fitting and secure with bolt, bushing, washer, nut and cotter pin.

D. The actuating cylinder rod end bearing and lower side brace link may be attached respectively to the retraction fitting and strut housing during the adjustment of the landing gear.

4. Ascertain that the landing gear is serviced per Chapter 12.

5. Check adjustment of landing gear.

6. Check alignment of the wheel.

7. Install the access plate on the underside of the wing and remove the airplane from jacks.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

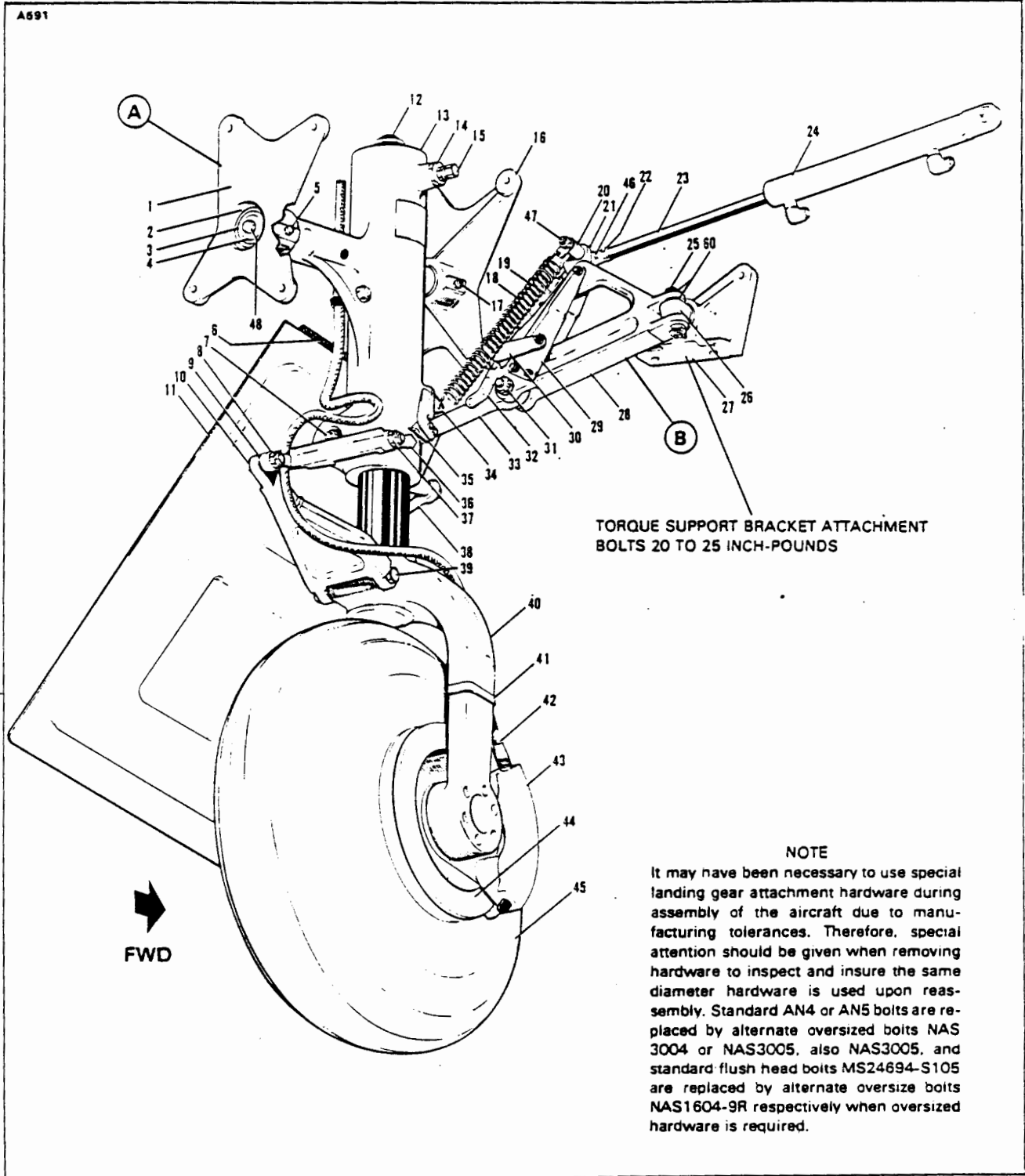


Figure 32-3. Main Gear Installation

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

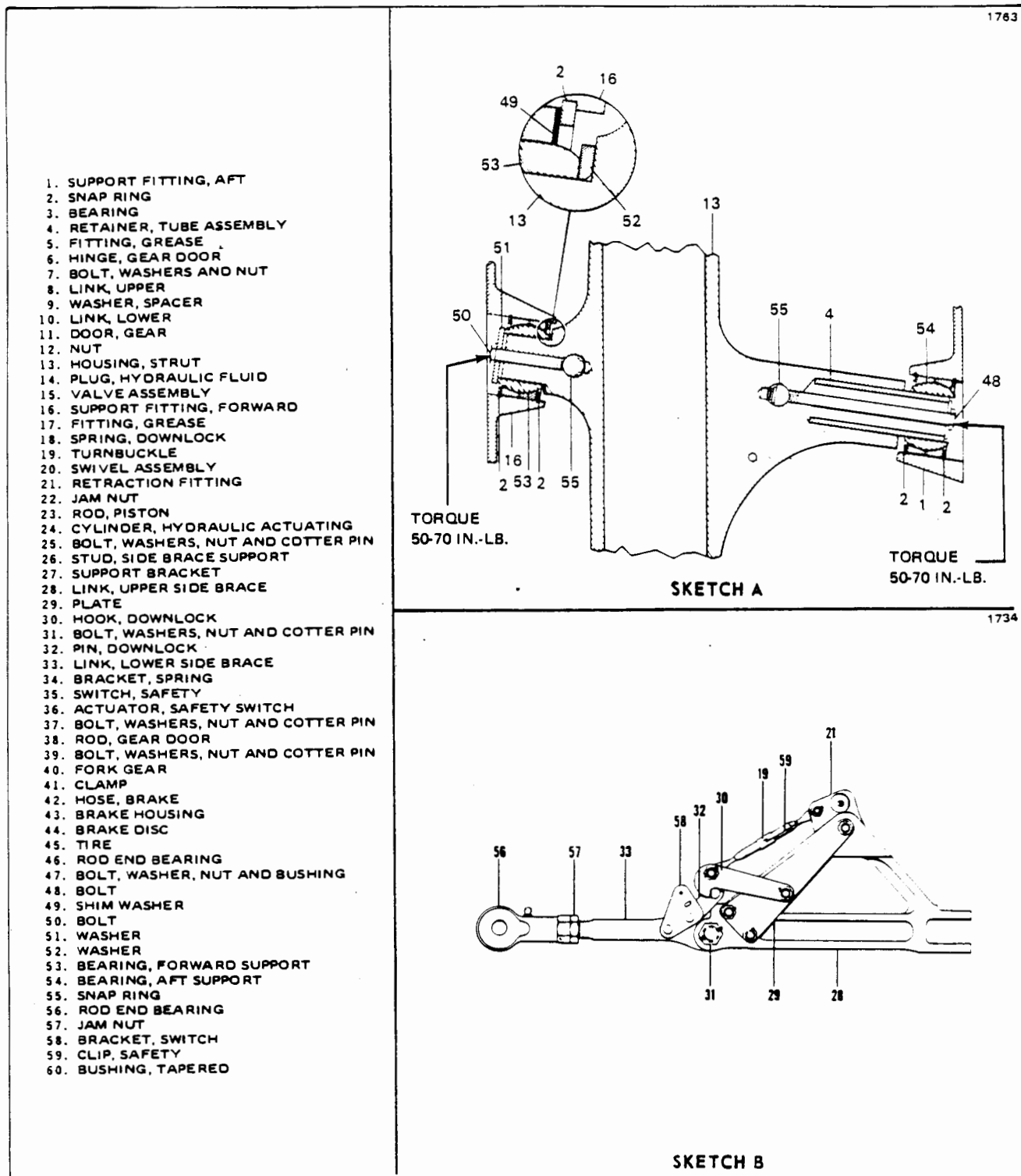


Figure 32-3. Main Gear Installation (cont)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

ADJUSTMENT OF MAIN LANDING GEAR.

1. Place the airplane on jacks.
2. Level the airplane laterally and longitudinally. (Refer to Chapter 8.)
3. Disconnect the gear door actuating rods at either the door or the housing, as desired, by removing the rod attachment bolt. Secure the door out of the way.
4. Adjust rod end on upper side brace link with no load on wheels to obtain 90 degree angle between wheel centerline and level floor line on outboard side of gear.
5. Check that the rod end has sufficient thread engagement in the end bearing, align the flat sides of the bearing casting with the flat side of the bearing and tighten the jam nut.
6. Adjust the turnbuckle of the downlock mechanism by first ascertaining that the gear is down and locked, and then move the retraction fitting outboard until it contacts the stop slot of the side brace link. Hold the fitting in this position and turn the turnbuckle barrel until the downlock hooks make contact with the lock pin. Safety the turnbuckle.
7. For easier adjustment of the downlock limit switch, it may be set at this time.
8. Retract and extend the gear manually several times to ascertain that the side brace link falls through center; the downlock hook falls into position and there is no binding of the gear assembly.
9. The gear should be adjusted in the up position to allow the gear fork to press lightly into the rubber bumper pad on the wing. The adjustment may be accomplished as follows:

— NOTE —

If it requires less than .025 of an inch to move the gear into the correct adjustment, Steps B and F thru H need only be followed.

- A. Ascertain that the rod end bearing of the actuating cylinder is disconnected from the retraction fitting.
- B. Actuate the hydraulic system to bring the hydraulic cylinder to the up position by turning the master switch on and moving the gear selector handle to the up position. The piston of the cylinder should be bottomed.
- C. Raise the gear by pushing up on the retraction fitting, thus disengaging the hooks, and pushing up on the pivot point at the bottom of the side brace links to bring the links out of the locked position. Raise the gear until the fork presses lightly into the rubber pad. Retain the gear in this position.
- D. Loosen the jam nut on the piston rod of the actuating cylinder and turn the rod end bearing in or out to allow a slip fit of the attachment bolt.
- E. Install with the attachment bolt, bushing, spring swivel, and secure with washer and nut. Install the gear downlock spring.

— NOTE —

When adjusting rod end be sure to allow at least a .03 inch cushion prior to bottoming with the downlock in the up position.

- F. When the gear is to within .125 of an inch of correct adjustment, the rod end need not be disconnected and therefore all that will be required is to loosen the jam nut, place a wrench on the flat at the end of the piston rod and turn to obtain correct adjustment.
- G. Check the rod end bearing for adequate thread engagement and tighten jam nut.
- H. If the downlock limit switch is properly adjusted, retract and extend the gear hydro-electrically to ascertain that the gear operates properly.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3202. TOE-IN, TOE-OUT CORRECTION

TOE-IN TOE-OUT ANGLE	SHIM WASHERS	WASHERS UNDER HEAD	WASHERS UNDER NUT	AN 174 BOLT
0°		AN960-416	AN960-416 (3)	-14
0° 33'	AN960-416	AN960-416	AN960-416 (2)	-14
0° 48'	AN960-416L AN960-416	AN960-416	AN960-416	-14
1° 04'	AN960-416 (2)	AN960-416	AN960-416	-14
1° 19'	AN960-416L AN960-416 (2)	AN960-416L	AN960-416	-14
1° 35'	AN960-416 (3)	AN960-416	AN960-416 (2)	-15
2° 05' Max. Allow.	AN960-416 (4)	AN960-416	AN960-416	-15
AN960-416L Washers .031 Thick				
AN960-416 Washers .062 Thick				

ALIGNMENT OF MAIN LANDING GEAR. (Refer to Figure 32-4.)

1. Place a straightedge no less than twelve feet long across the front of both main landing gear wheels. Butt the straightedge against the tire at the hub level of the landing gear wheels. Jack the airplane up just high enough to obtain a six and one-half inch dimension between the centerline of the strut piston and the centerline of the center pivot bolt of the gear torque links. Devise a support to hold the straightedge in this position.
2. Set a square against the straightedge and check to see if its outstanding leg bears on the front and rear side of the brake disc. (It may be necessary to remove the brake assembly to have clear access to the disc.) If it touches both forward and rear flange, the landing gear is correctly aligned. The toe-in for the main landing gear wheels is 0 ± 1.2 degrees.

— NOTE —

A carpenter's square, because of its especially long legs, is recommended for checking main landing gear wheel alignment.

3. If the square contacts the rear side of the disc, leaving a gap between it and the front flange, the wheel is toed-out. If a gap appears at the rear flange, the wheel is toed-in.
4. To rectify the toe-in and toe-out condition, remove the bolt connecting the upper and lower torque links and remove or add spacer washers to move the wheel in the desired direction. Refer to the Toe-in, Toe-out Correction Chart 3202.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

5. Should a condition exist that all spacer washers have been removed and it is still necessary to move the wheel further in or out, then it will be necessary to turn the torque link assembly over. This will put the link connecting point on the opposite side allowing the use of spacers to go in the same direction.

6. Recheck wheel alignment. If the alignment is correct, safety the castellated nut with cotter pin.

7. If a new link on the top left main gear had to be installed or it had to be reversed during the alignment check, it will be necessary to check the gear safety switch (squat switch) bracket for engagement and locking in place. If the large machine surface of the link is inboard, the bracket is mounted with the small rivet hole next to link. (Refer to Sketch A, Figure 32-4.) This hole should be aligned with centerline of the link and a .096 inch hole drilled .150 inch deep. Insert an MS20426AD3-3 rivet in the hole. This locking rivet is held in place by the flat washer, castellated nut and cotter pin. If link has to be reversed, then the bracket and bolt are also reversed. (Refer to Sketch B, Figure 32-4.)

8. Check adjustment of landing gear safety switch (squat switch).

MAIN GEAR DOOR.

REMOVAL OF MAIN GEAR DOOR.

1. With the landing gear extended, disconnect the door retraction rod from the door by removing nut, washers and bolt.

2. Remove the door from the wing panel by bending the door hinge pin straight and from the other end pulling out the pin.

3. The door retraction rod may be removed from the gear housing by cutting the safety wire and removing the attachment bolt and washer. Note the number of washers between rod end bearing and housing.

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR DOOR.

1. Clean the door and retraction rod with a suitable cleaning solvent.

2. Inspect the door for cracks or damage, loose or damaged hinges and brackets.

3. Inspect the door retraction rod and end bearing for damage and corrosion.

4. Repairs to a door may be replacement of hinge, repair of fiberglass and painting.

INSTALLATION OF MAIN GEAR DOOR.

1. Install the door by positioning the hinge halves of the door and wing, and inserting the hinge pin. It is recommended a new pin be used. Bend the end of the pin to secure in place.

2. Install the door retraction rod by positioning the rod at its attachment points at the door and strut housing. At the door attachment, thin washers are inserted at each side of the rod end bearing and it is secured with bolt, washer and nut. At the strut housing, place washers between rod end bearing and housing not to exceed .12 of an inch to obtain proper clearance and secure with bolt. Safety bolt with MS20995C41 wire.

3. Check that the all around clearance between the door and the wing skin is not more than .20 of an inch.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

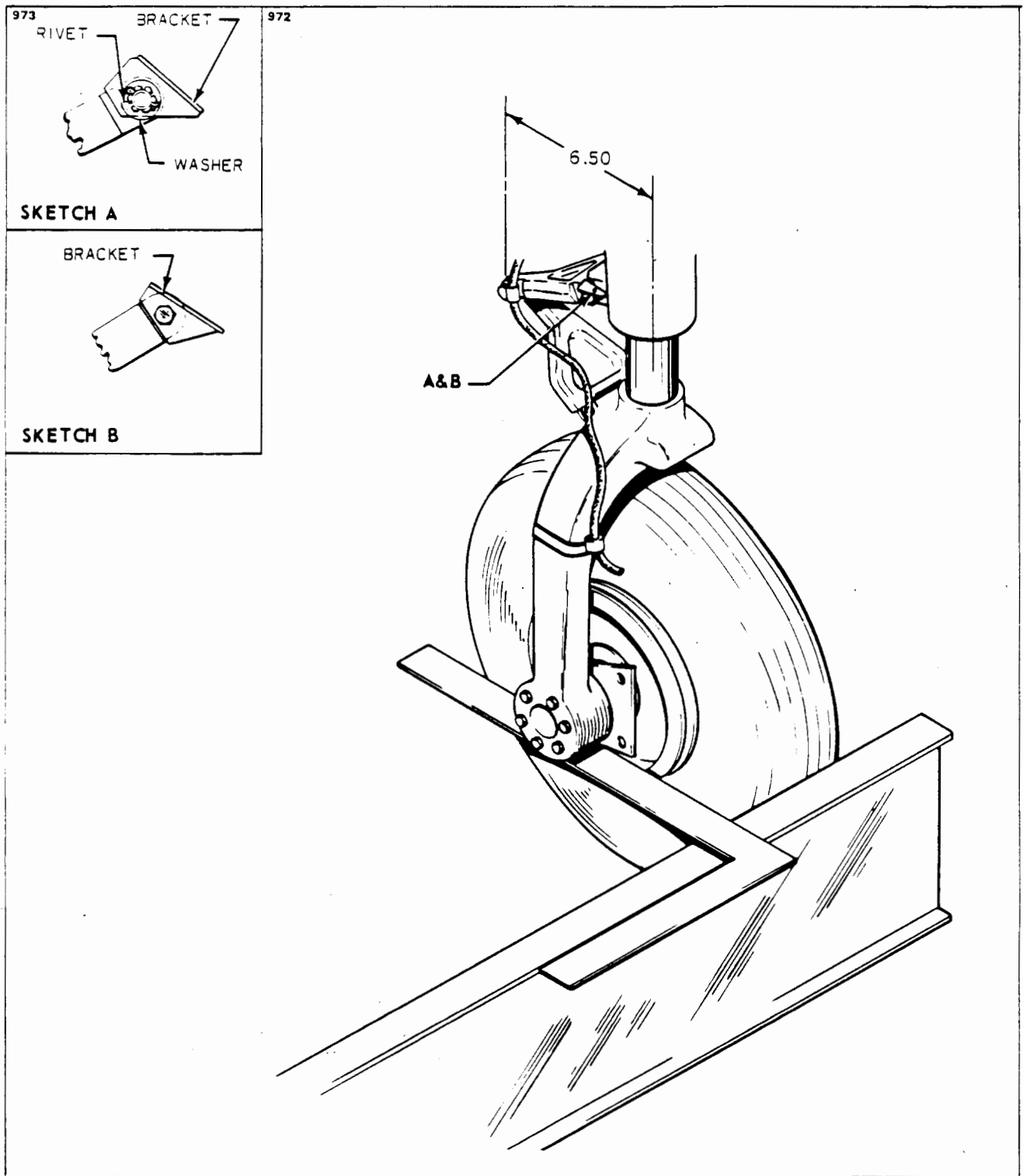


Figure 32-4. Aligning Main Gear

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

NOSE GEAR.

NOSE GEAR OLEO.

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 Chapter 7.)
2. Place a drip pan under the nose gear to catch spillage.
3. Remove air and fluid from the oleo strut. Depress the air valve core pin until strut chamber pressure has diminished, remove the filler plug and with a small hose siphon as much hydraulic fluid from the strut as possible.
4. To remove the complete cylinder and fork assembly from the oleo housing, cut safety wire at the top of the unit and remove cap bolts that attach steering arm and aligner guide bracket to the top of the oleo cylinder.
5. Disconnect the shimmy dampener by removing each cotter pin, nut, washer and bolt that connects the dampener to the oleo cylinder and housing.
6. Release and remove the snap ring and washer(s), if installed, at the top of the housing, and pull the complete cylinder and fork 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 and fork from the cylinder, first separate the upper and lower torque links by removing the link connecting bolt assembly and then separate the two links. Note spacer washer between the two links.
8. Compress the piston tube, reach up along the tube and release the snap ring from the annular slot at the bottom of the oleo housing.
9. Pull the piston tube with components parts from the cylinder.
10. The piston tube components may be removed by reaching in the tube and pushing out the upper bearing retainer pins. Slide from the tube, the upper bearing, lower bearing with outer and inner "O" rings, wiper strip, washer and snap ring.
11. To remove the orifice tube, remove the large lock nut and lock washer from the top of the cylinder. Pull the tube from the cylinder.
12. The orifice plate is removed from the bottom of the orifice tube by releasing the snap ring that holds the plate in position.
13. To remove the piston tube plug with "O" ring, located in the lower end of the tube, remove the bolt assembly and insert a rod up through the hole in the body of the fork. Push the plug out through the top of the tube.

CLEANING, INSPECTION AND REPAIR OF NOSE GEAR OLEO.

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

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

2273

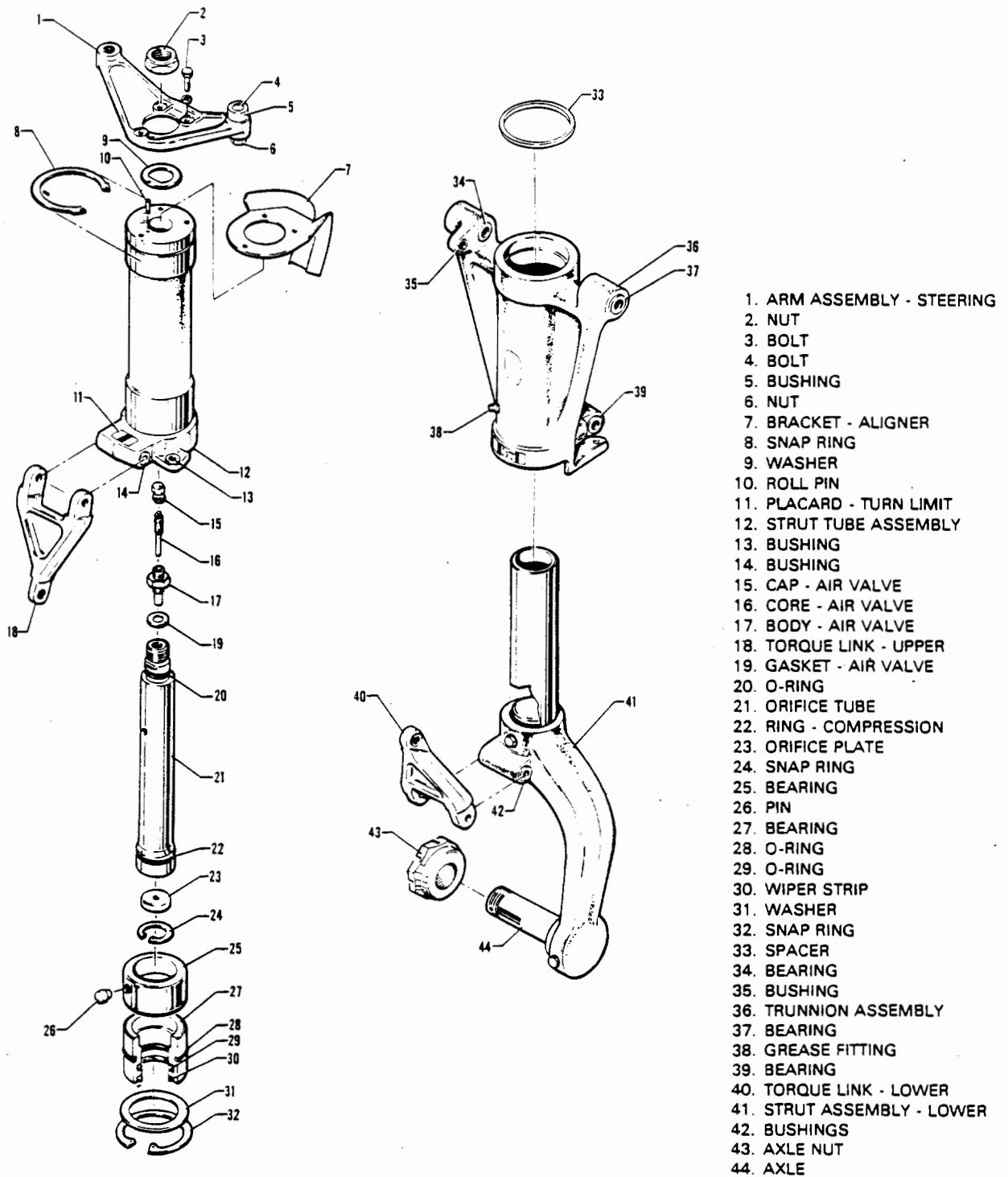


Figure 32-5. Nose Gear Oleo Strut Assembly

32-21-02

Page 32-23

Revised: January 3, 1983

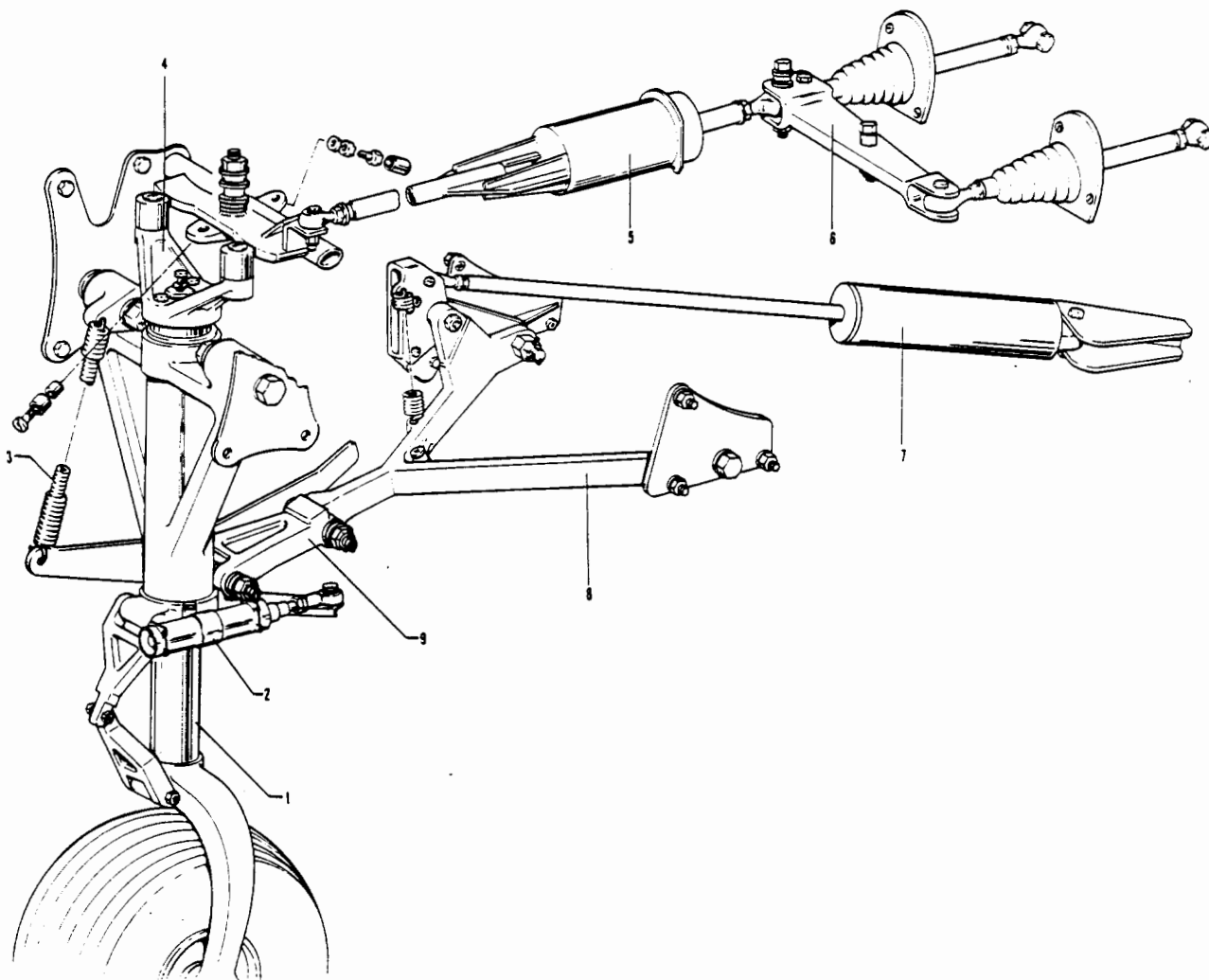
PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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

1. Ascertain that parts are cleaned and inspected.
2. To install the piston tube plug, first lubricate the tube plug and "O" ring with hydraulic fluid (MIL-H-5606) and install the "O" ring on the plug. Lubricate the inside wall of the tube, insert the plug into the top of the tube and push it to the fork end. Align the bolt holes of the fork, tube and plug, and install bolt assembly.
3. If desired, cement a cork in the hole in the bottom of the fork body to prevent dirt from entering between the fork and tube.
4. To assemble the components of the orifice tube, insert the orifice plate into the bottom of the tube, with the countersunk side of the orifice hole exposed. Secure the plate with the snap ring, lubricate and install the "O" ring on the upper end of the tube.
5. Insert the orifice tube up through the bottom of the cylinder. With the tube exposed through the top of the cylinder, install the lock washer and insert roll pin through the lock washer into the piston. Install the tube lock nut finger tight at this time.
6. The fork and tube assembly may be assembled by installing the tube components on the tube. In order slide onto the tube, the snap ring, washer, lower bearing with outer and inner "O" rings and upper bearing. Align the lock pin holes in the upper bearing with the pin holes in the piston tube and install pins.
7. Lubricate the inner wall of the cylinder with hydraulic fluid. Carefully insert the piston tube assembly into the bottom of the cylinder, allowing the orifice tube to guide itself into the fork tube, until the snap ring can be installed in the annular slot at the bottom of the cylinder. Install wiper strip, slide washer into position and secure assembly with snap ring.
8. At the top of the cylinder, tighten (torque) the orifice tube lock nut to 500 (min.) 600 (max.) inch pounds.
9. Ascertain that bushings are installed in the upper and lower torque links and then install both links. The torque link bolt assemblies should be lubricated and installed with the flat of the bolt head hex adjacent to the milled stop on the wide end of the link. Tighten the bolts only tight enough to allow no side play in the link, yet be free enough to rotate.
10. Ascertain that the upper and lower oleo housing bushings are installed. Install the cylinder into the oleo housing, position spacer washer(s) over the top of the cylinder and secure with snap ring. Install spacer washers as required to obtain .0 to .015 of an inch thrust of the cylinder within the housing.
11. At the top of the oleo housing, install on the cylinder the aligner guide bracket and steering arm. Install cap bolts, tighten 20 to 25 inch-pounds torque and safety with MS33540 wire.
12. Install the shimmy dampener and safety.
13. Lubricate the gear assembly. (Refer to Chapter 12.)
14. Compress and extend the strut several times to ascertain that the strut will operate freely. Weight of the gear wheel and form should allow the strut to extend.
15. Service the oleo strut with fluid and air. (Refer to Chapter 12.)
16. Check nose gear for alignment and gear operation.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

A689
2317



1. NOSE GEAR ASSEMBLY
2. CENTERING SPRING ASSEMBLY
3. ASSIST SPRINGS
4. STEERING ARMS
5. BUNGEE ASSEMBLY
6. STEERING BELLCRANK
7. HYDRAULIC CYLINDER
8. UPPER DRAG LINK ASSEMBLY
9. LOWER DRAG LINK ASSEMBLY

86280

Figure 32-6. Nose Gear Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

NOSE LANDING GEAR ASSEMBLY.

REMOVAL OF NOSE LANDING GEAR. (Refer to Figure 32-6.)

1. Place the airplane on jacks. (Refer to Chapter 7.)

— CAUTION —

Whenever aircraft is placed on jacks for the purpose of manually retracting the nose gear assembly, insure the nose gear downlock is fully disengaged before releasing the nose gear drag links. Damage could occur to the downlock if not fully disengaged.

2. Disconnect both nose gear door actuation rods.
3. Disconnect the two gear tension springs from the spring arm that is attached to the right side of the strut housing.
4. Retract nose gear slightly to remove the gear from its downlocked position. (See CAUTION.)
5. To remove the upper and lower drag links, the following procedure may be used:
 - A. Disconnect the aft end of the hydraulic cylinder from the attachment fitting by removing nut and bolt that connects these two parts.
 - B. Retract the gear and disconnect the gear downlock spring from the upper drag link.
 - C. Remove the gear tension spring arm from the right side of the oleo housing and lower drag link by removing the cotter pin, nut and washer from the bolt that connects the drag link to the housing. Slide the arm and spacer washer from the bolt.
 - D. Remove the cotter pin, washers and nuts from the bolts that secure the upper drag link to the nose gear support.
 - E. Slide the attachment bolts from the upper and lower drag links and remove the links.
6. With the lower drag link disconnected from the gear oleo housing, the housing may be removed by removing cotter pins, nuts, washers, and bolts at the attachment points on each side of the housing at the trunnion support.
7. The steering bellcrank may be removed by removing the nut and bolt at the steering rod, and the bolt assembly with bushing at the bellcrank pivot point.

CLEANING, INSPECTION AND REPAIR OF NOSE LANDING GEAR.

1. Clean all parts with a suitable dry type cleaning solvent.
2. Inspect the gear components for the following unfavorable conditions:
 - A. Bolts, bearings and bushings for excess wear, corrosion and damage.
 - B. Gear housing, drag links, torque links, and tension spring arm for cracks, bends or misalignment.
 - C. Downlock hook for excess wear of the hook and bearing surfaces.
 - D. Downlock roller bearing for freedom of movement and excessive wobble.
3. Inspect the gear tension and downlock hook springs for the following:
 - A. Excess wear or corrosion, especially around the hook portion of the springs. A spring should be rejected if wear or corrosion exceeds one-quarter the diameter of the spring. Clean away all corrosion and repaint.
 - B. Check the gear tension springs for load tensions below minimum allowable tolerances. The minimum allowable tension of the inner spring is 46 pounds pull at 13.75 inches and the outer is 75 pounds pull at 13.75 inches. Measurement is taken from the inner side of each hook. If it is found that either spring should be rejected, replace both springs.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

305r

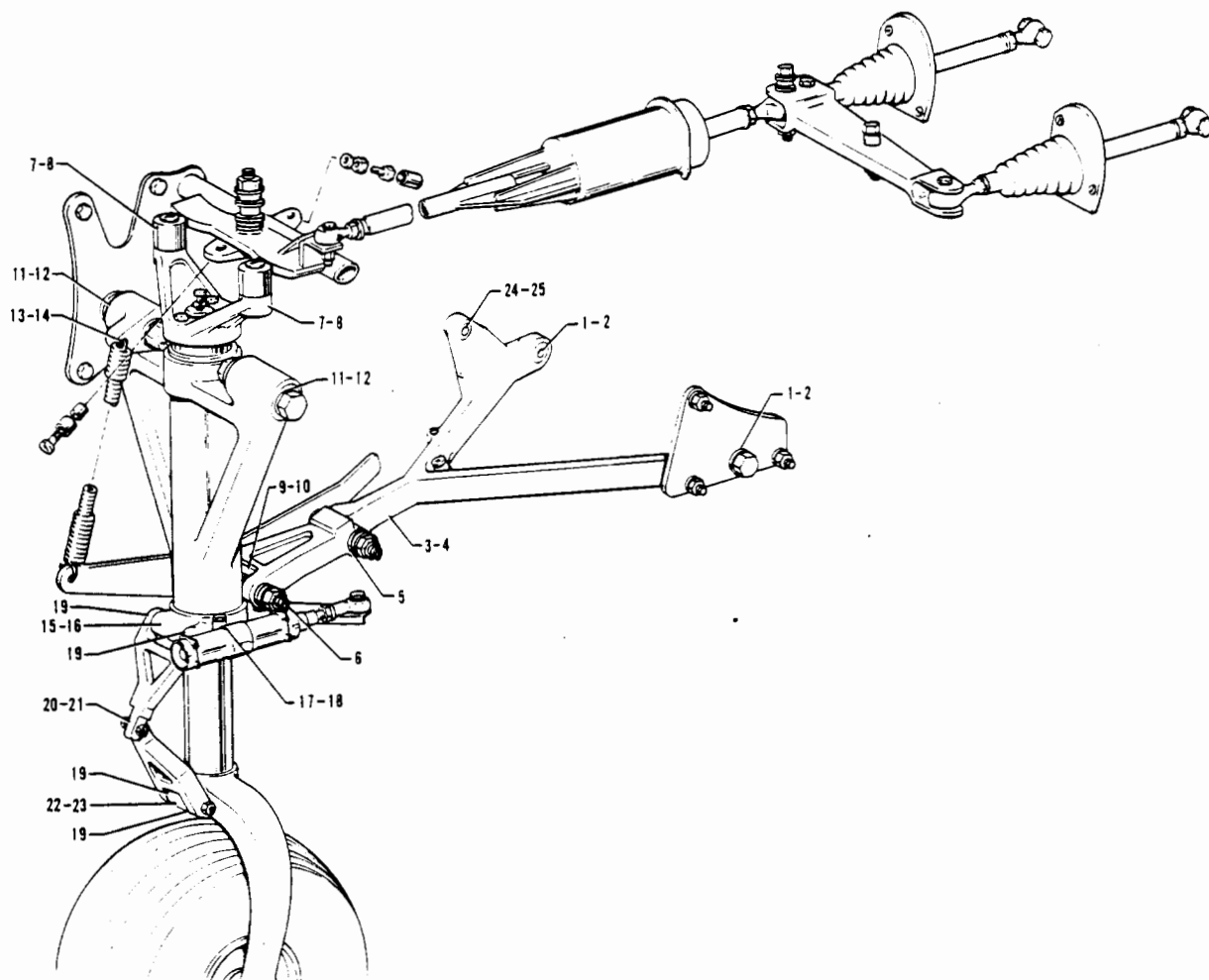


Figure 32-7. Nose Gear Service Tolerances

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tol.	Remarks
1	67146-00	Draglink, upper	ID .6235 .6245	ID .6230 .6250	.002	
2	452 474 (F632-1)	Bearing, upper drag link	** ID .4385 .4375	ID .4395 .4375	.002	
2	65003-45*	Bushing	ID	ID		
3	67146-00	Drag link upper	ID .378 .379	ID .3775 .3795	.002	
4	452 450 (FF310-5)	Bearing upper drag link	** ID .2495 .2505	ID .2495 .2515	.002	
5	67144-00	Drag link lower	ID .2495 .2505	ID .2495 .2515	.002	
6	67144-00	Drag link lower	ID .3120 .3130	ID .3120 .3140	.002	
7	44386-3	Steering arm	ID .4370 .4385	ID .4370 .4385	.0015	
8	14976-11	Bushing, steering arm	** ID .312 .313	ID .312 .314	.002	Press fit.
9	67054-03	Trunnion housing drag link attachment	ID .4415 .4425	ID .4415 .4425	.0015	
10	67026-07	Bearing trunnion housing drag link attachment	ID .312 .313	ID .312 .314	.002	Press fit. Install using Loctite 601.
11	67054-03	Trunnion assembly main attachment fitting	ID .6285 .6295	ID .6285 .6295	.001	
12	67026-11	Bushing, trunnion assembly attachment	** ID .5000 .5015	ID .5000 .5030	.003	Install using Loctite 601.
13	67054-03	Trunnion assembly assist spring fitting	ID .302 .303	ID .302 .3035	.0015	
14	95061-144	Bearing, assist spring fitting	ID .249 .250	ID .249 .259	.010	Install using Loctite 601.
15	67148-00	Tube assembly torque link fitting	ID .4370 .4385	ID .4370 .4385	.0015	

*Used with 452 474 bearing.
**Line ream to this dimension after installation of new part.

Figure 32-7. Nose Gear Service Tolerances (cont.)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tot.	Remarks
16	67026-07	Bearing, tube assembly torque link fitting	** ID .314 .313	ID .3155 .3130	.0025	Press fit. Install using Loctite 601.
17	67148-00	Shimmy damper fitting	ID .3745 .3760	ID .3745 .3760	.0017	
18	21831-04	Shimmy damper fitting bearing	** ID .249 .251	ID .249 .252	.003	
19	20735-05	Torque link	ID .312 .313	ID .312 .314	.002	
20	20735-05	Torque link	ID .377 .3785	ID .377 .3790	.002	
21	452 366 (#F-310-5)	Bearing, torque link	** ID .2495 .2505	ID .2495 .2515	.002	Coat bearing with zinc chro- mate and install while still wet. Press fit.
22	67099-00	Fork assembly, torque link fitting	ID .4370 .4385	ID .4370 .4385	.0015	
23	67026-07	Bearing, fork assembly torque link fitting (FF411-4)	** ID .312 .313	ID .312 .314	.002	Press fit.
24	67146-00	Draglink, upper	ID .372 .373			
25	63900-120	Bushing, upper draglink	ID .2495 .2500			
*Used with 452 474 bearing. **Line ream to this dimension after installation of new part.						

Figure 32-7. Nose Gear Service Tolerances (cont.)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

C. Check the gear downlock hook spring for load tension below minimum allowable tolerance. The minimum tension of the spring is 10.5 pounds pull at 4.5 inches. Measurement is also taken from the inner side of each hook.

4. Check the general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

5. Check drag link through center travel by attaching the upper and lower drag links, setting them on a surface table, and ascertaining that when the stop surfaces of the two links touch, linkage is not less than .062 to .125 nor more than .125 to .250 of an inch through center. Should the distance exceed the required through center travel and bolt and bushing are tight, replace one or both drag links.

6. The shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, the dampener should be replaced rather than repaired.

7. 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 32-6.)

— NOTE —

When assembling any units of the landing gear; lubricate bearings, bushings, and friction surfaces with the proper lubricant as described in Chapter 12.

— CAUTION —

Whenever aircraft is placed on jacks for the purpose of manually retracting the nose gear assembly, insure the nose gear downlock is fully disengaged before releasing the nose gear drag links. Damage could occur to the downlock if not fully disengaged.

1. Attach the steering bellcrank with bushing to its mounting plate on the trunnion support securing with the bolt assembly. Align the top surface of the steering bellcrank and the top surface of the steering arm bushings by positioning the spacer washers as shown in Figure 32-6. Connect the bungee assembly to the bellcrank and install bolt and nut assemblies. The adjustment, fore and aft of the bellcrank may be made after the gear has been installed and rigged and adjusted.

2. To install the gear housing assembly, position the gear so that the bolt attachment points on the housing align with the attachment points on the trunnion support. Install pivot bolts, washers and nuts. Tighten the nuts to a snug fit, yet allowing the gear to swing free, and safely.

3. The drag links and gear tension spring arm may be installed by the following procedure:

A. Ascertain that the upper and lower links are assembled with the downlock hook attached, and the through travel of the links checked.

B. Attach cylinder rod end to downlock using bolt, washer and nut. Nut must be on the inboard side.

C. Position the link assembly to allow the bolt holes in the links to align with the bolt holes in the gear housing and the nose gear support. Install the link attachment bolts.

D. Install nuts and washers on the upper link attachment bolts. Tighten the nut to allow the links to rotate freely and safely.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

E. Check alignment of the downlock hook to determine if it grips the roller bearing so as not to contact the bolt head, the bearing attachment block or washer. If the downlock hook is inboard, or it contacts the bolt head, shim between the bearing and the bearing attachment block with washer AN960-10L, not to exceed three. The bearing must be free to rotate.

F. Install the gear tension spring arm on the drag link bolt on the right side of the gear oleo housing, secure and safety. An AN960-516L washer is installed on the bolt between the lower drag link and the arm.

4. Retract and extend the landing gear several times to ascertain smoothness of operation. Also check that the drag link assembly falls into the through center locked position. (See CAUTION.)

5. Retract the gear and connect the gear downlock spring between the downlock hook and the upper drag link.

6. Extend the gear and connect the two gear tension springs between the attachment point on the oleo housing and the spring arm.

7. Attach the aft end of the hydraulic cylinder to its attachment fitting using bolt, nut and washer.

8. Reconnect both nose gear door actuating rods.

9. Ascertain that the landing gear is serviced per Chapter 12.

10. Check adjustment of the gear.

11. Retract landing gear and check door operation.

12. Check the alignment of the nose gear.

13. Ascertain that the landing gear is down and locked, then remove the airplane from jacks.

NOSE GEAR DOWNLOCK AND ECCENTRIC BUSHING.

REMOVAL OF NOSE GEAR DOWNLOCK AND ECCENTRIC BUSHING. (Refer to Figure 32-8.)

1. Place the aircraft on jacks as described in Chapter 7.
2. Position a temporary support under the nose compartment and remove the four bolts which secure the nose to the fuselage. Remove the temporary support and gently lower the nose.
3. Remove the nose wheel well close out cover.
4. Loosen the ban clamps around the cabin heater to allow access to the lower area.
5. Remove the hydraulic retract cylinder aft mounting bolt.
6. Remove the nose gear downlock spring.
7. Remove the cotter pins, nuts and washers from the drag brace wheel well attach points and push the bolts back into the wheel well far enough to allow the drag brace to be lowered.
8. Remove the bolt which secures the hydraulic retract cylinder forward rod end to the nose gear downlock.

— NOTE —

Exercise caution to prevent the loss of the bushing located on the inboard (nut) side of the downlock hook.

9. Remove the downlock hook to drag brace mounting pivot bolt and remove the downlock hook.
10. Reach under the cabin heater unit and remove the nut from the downlock eccentric bushing mounting bolt and remove the bolt and bushing.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

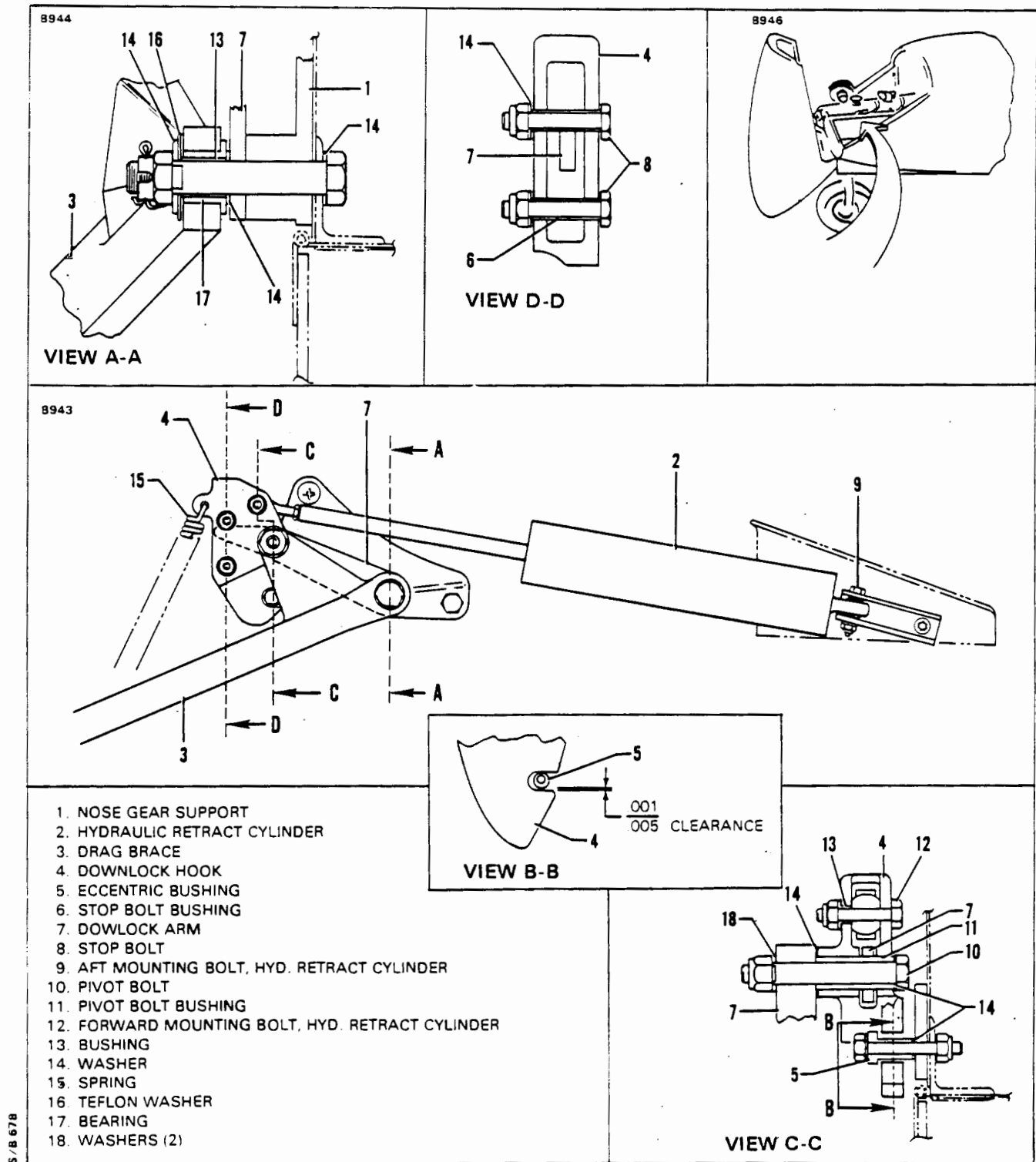


Figure 32-8. Nose Gear Downlock and Eccentric Bushing Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF NOSE GEAR DOWNLOCK AND ECCENTRIC BUSHING. (Refer to Figure 32-8.)

1. Install the new eccentric bushing. (Refer to Figure 32-8 for proper assembly.) Since the eccentric bushing will require adjustment do not tighten the bolt in its final torque.
2. Assemble the new downlock hook with hardware as installed in the hook being removed.
3. Install the two stop bolts and bushings. The bolt heads must be installed outboard with one washer under each nut. Torque the nuts 40 to 45 in. lbs.
4. Install the pivot bushing into the downlock hook and downlock arm. (Downlock arm must be installed with the nose of the arm sloping downward.) Determine that the bushing moves freely in the downlock hook and arm.
5. Install the pivot bolt. Torque to 160 to 190 in. lbs.

— NOTE —

Proper installation of the downlock hook assembly and drag brace is as follows: Bolt, one washer, bushing through downlock hook and downlock arm, one thin washer, drag brace, two washers and one nut.

6. Support the drag brace assembly and place the hydraulic cylinder rod end in position on the downlock hook assembly. Ensure that the bushing is installed on the inboard side of the downlock hook. Install the bolt with the head outboard. Place one washer under the nut and torque the nut 40-45 in. lbs.
7. Slide the drag brace assembly into the wheel well and push the bolts out through the drag link on the left side and the drag link and downlock arm on the right side. Install a teflon washer next to the drag link, a large washer, a castlenut and safety with a cotter pin.

— NOTE —

A thin washer is installed between the downlock arm and the drag brace bearing. A bushing must be installed inside the bearing.

8. Install the downlock spring with the open end of the spring at the downlock hook faring inboard.
9. Allow the downlock hook assembly to seat over the eccentric bushing. Adjust the bushing to obtain daylight to .003 clearance between the bottom of the bushing and the downlock hook.
10. After adjustment, retract the gear and torque eccentric bushing nut 40-45 in. lbs.
11. Cycle the landing gear a minimum of three times to ensure proper operation and engagement. (It may be necessary to check the nose gear up down micro switches for proper position. (Refer to appropriate section of Chapter 32.) Ensure that landing gear is in the down and locked position.
12. Position cabin heater unit and secure.
13. Install wheel well close-out panel.
14. Close nose compartment and secure with four bolts.
15. Remove the airplane from jacks.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

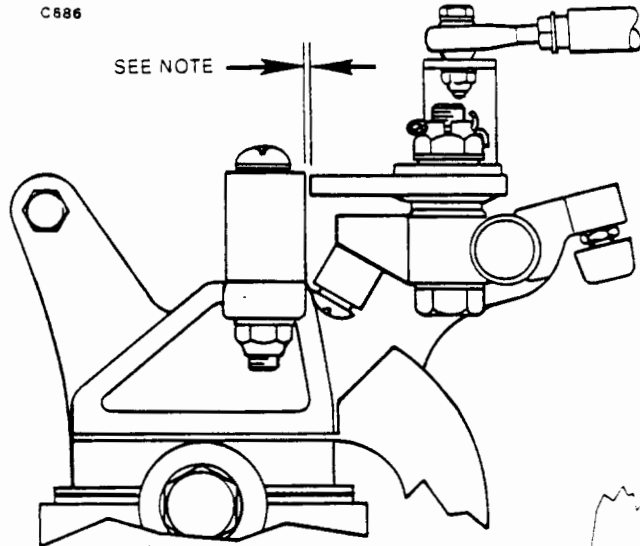
2305

C686

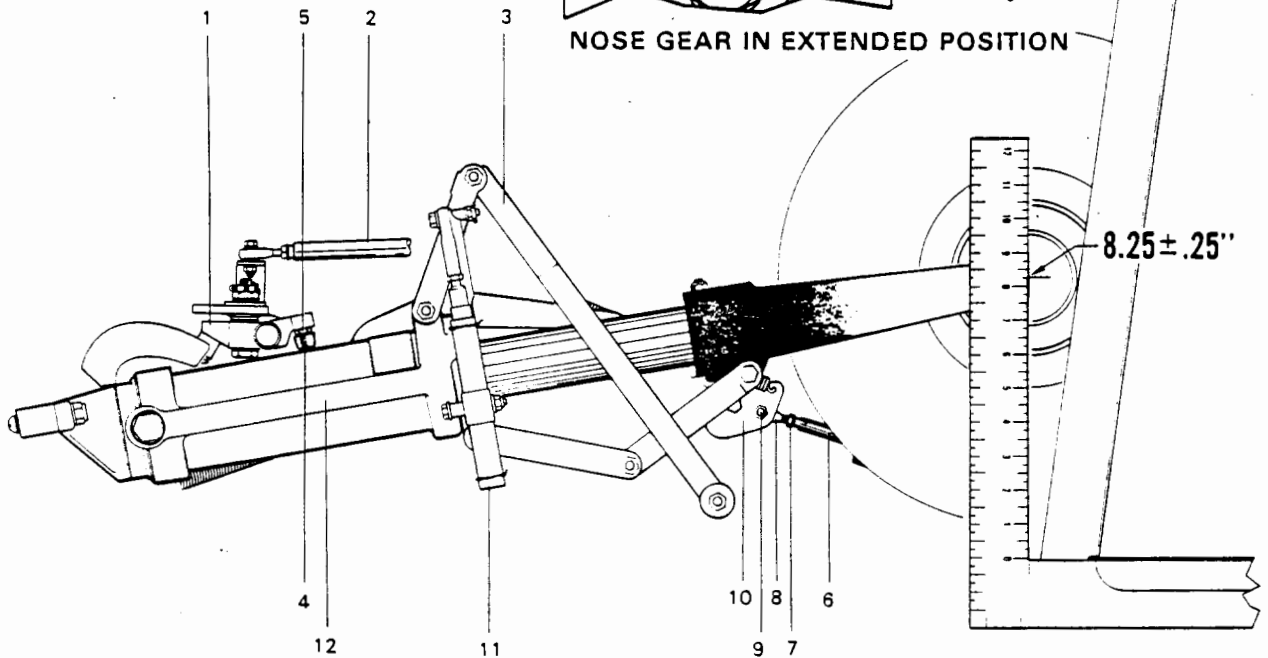
NOTE

ADJUST STEERING CAM TO BUSHING CLEAR-
ANCE OF .031 WITH GEAR DOWN AND AIR-
CRAFT WEIGHT ACTING ON NOSE.

SEE NOTE



NOSE GEAR IN EXTENDED POSITION



1. STEERING BELLCRANK
2. STEERING ROD
3. UPPER DRAG LINK
4. GEAR UP STOP
5. JAM NUT
6. ACTUATOR ROD, CYLINDER
7. JAM NUT
8. ROD END BEARING
9. BOLT ASSEMBLY
10. DOWNLOCK HOOK
11. SHIMMY DAMPENER
12. STRUT HOUSING

Figure 32-9 Nose Gear Adjustment

32-22-06
Page 32-34

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

ADJUSTMENT OF NOSE LANDING GEAR. (Refer to Figure 32-9.)

The gear up stop is located on the steering bellcrank.

1. Place the airplane on jacks. (Refer to Chapter 7.)

— CAUTION —

Whenever aircraft is placed on jacks for the purpose of manually retracting the nose gear assembly, insure the nose gear downlock is fully disengaged before releasing the nose gear drag links. Damage could occur to the downlock if not fully disengaged.

2. Disconnect both nose gear door actuation rods.
3. Turn master switch OFF, pull out Free Fall Control.
4. Disconnect the aft end of the cylinder from its attachment fitting by removing the connecting nut, bolt and washer.
5. Pull out the cylinder rod to its full extended position. Measure and record the exposed length of the rod.
6. Retract the cylinder rod as required and reconnect aft end of the cylinder to its attachment fitting using nut, bolt and washer.
7. Loosen jam nut on secondary up stop and turn in so it will not interfere with initial rigging.
8. Push in free fall control and retract the nose gear by turning the master switch ON and moving the gear selector handle to the UP position. Check the adjustment of the cylinder rod end bearing by placing a carpenter's square with the longest end along the bottom of the fuselage, and the shortest end running up through the centerline of the wheel axle. Measure up along the square from the bottom of the fuselage 8.25 inches, to determine if the center of the wheel axle meets this measurement. If this measurement is incorrect, extend the gear, loosen the jam nut on the rod end bearing and make the required adjustment by turning the bearing in to raise wheel, out to lower.
9. Turn secondary up stop out until finger tight against strut. Lower gear and turn stop out one additional turn and tighten jam nut.
10. Tighten jam nut on rod end bearing and check that threads cover safety hole in actuator rod.
11. Measure length of exposed rod. Subtract from value obtained in Step 5 and determine that at least 0.06 inches of travel remains to full extension.
12. Adjust shimmy dampener by turning nose wheel stops and adjusting the rod ends of the dampener for 30° travel to both extremes.
13. Reconnect both nose gear door actuation rods.
14. Push in Free Fall Control, turn master switch ON. Retract landing gear and check doors.
15. Lower gear. Turn master switch OFF. Ascertain that the landing gear is down and locked, then remove the airplane from jacks.

ALIGNMENT OF NOSE LANDING GEAR.

1. Place the airplane on a smooth level floor that will accommodate the striking of a chalk line.
2. Ascertain that the nose gear is properly adjusted.
3. With the landing gear in the downlock position, weight proportionally on the nose gear and the nose wheel facing forward, adjust the steering bellcrank. The bellcrank may be adjusted by loosening its attachment bolt and sliding the bellcrank fore and aft until it clears each steering arm rollers by .031 of an inch. Retighten the attachment bolt.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

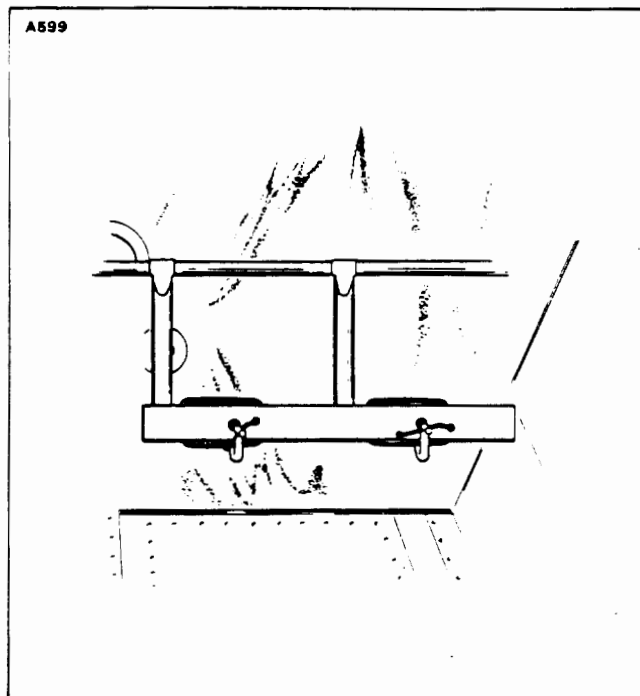


Figure 32-10. Clamping Rudder Pedals in Neutral Position

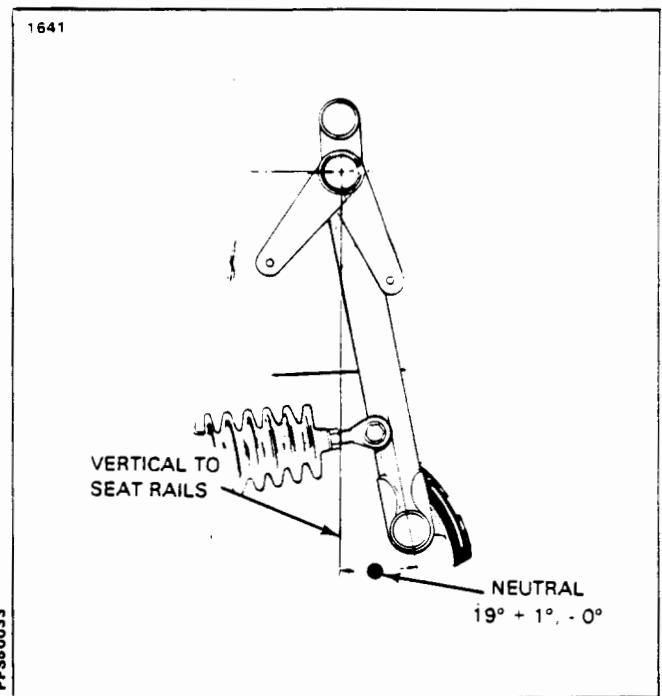


Figure 32-11. Rudder Pedals at Neutral Angle

THIS SPACE INTENTIONALLY LEFT BLANK

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

4. Place the airplane on jacks. (Refer to Chapter 7.)
5. Level the airplane laterally and longitudinally. (Refer to Chapter 8.)
6. From the center point of the tail skid, extend a plumb bob and mark the center point on the floor.
7. Extend a chalk line from the mark on the floor below the tail skid to a point approximately three feet forward of the nose wheel. Allow the line to pass under the wheel at the centerline of the tire. Snap the chalk line.
8. Clamp the rudder pedals to align them in a lateral position. Ascertain that the rudder pedals are in their neutral position. (Refer to Figure 32-10.)
9. Adjust the rod end bearings of each steering control rod to align the nose wheel with the chalk line and to bring the rudder pedals into neutral angle fore and aft.
10. Install the steering push rods on the pilot's rudder pedals. Adjust the rods so the lengths are both the same and the rudder pedals are at their neutral position.
11. 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 straight edge along the side of the tire and parallel the straight edge with the chalk line.
12. Install the nose wheel bungee in its neutral position (no load on the bungee springs.) Adjust bungee rod ends as necessary.
13. Place a bubble protractor against a rudder pedal steering tube to check the neutral angle as shown in Figure 32-11.
14. One end of each rod must be disconnected and the jam nuts loosened to make any adjustments. Do not attempt to make the adjustment by means of one rod end bearing, but divide the adjustment between the bearings at each end of each rod. Check that the rod ends have sufficient thread engagement by ascertaining that a wire will not go through the check hole in the rod. Reinstall the rods and tighten the jam nuts.
15. To check the nose gear steering for its $30^{\circ} + 1^{\circ}$ maximum right and left travel, mark on each side of the nose wheel an angle line from the centerline and wheel pivot point. Turn the wheel to its maximum travel in both directions to check for allowable travel. Should travel be exceeded in one direction and not enough in the other direction, check for possible damage to the gear fork or torque links.

NOSE GEAR DOOR.

REMOVAL OF NOSE GEAR DOOR. (Refer to Figure 32-12.)

1. Disconnect the retraction rod assembly from the door by removing nut and washer from each door half.
2. The doors may be removed by removing the hinge pins from each door.
3. The operating mechanism may be removed by removing the bearing blocks on each side of the wheel well.

— NOTE —

The operating mechanism may be further disassembled as necessary.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

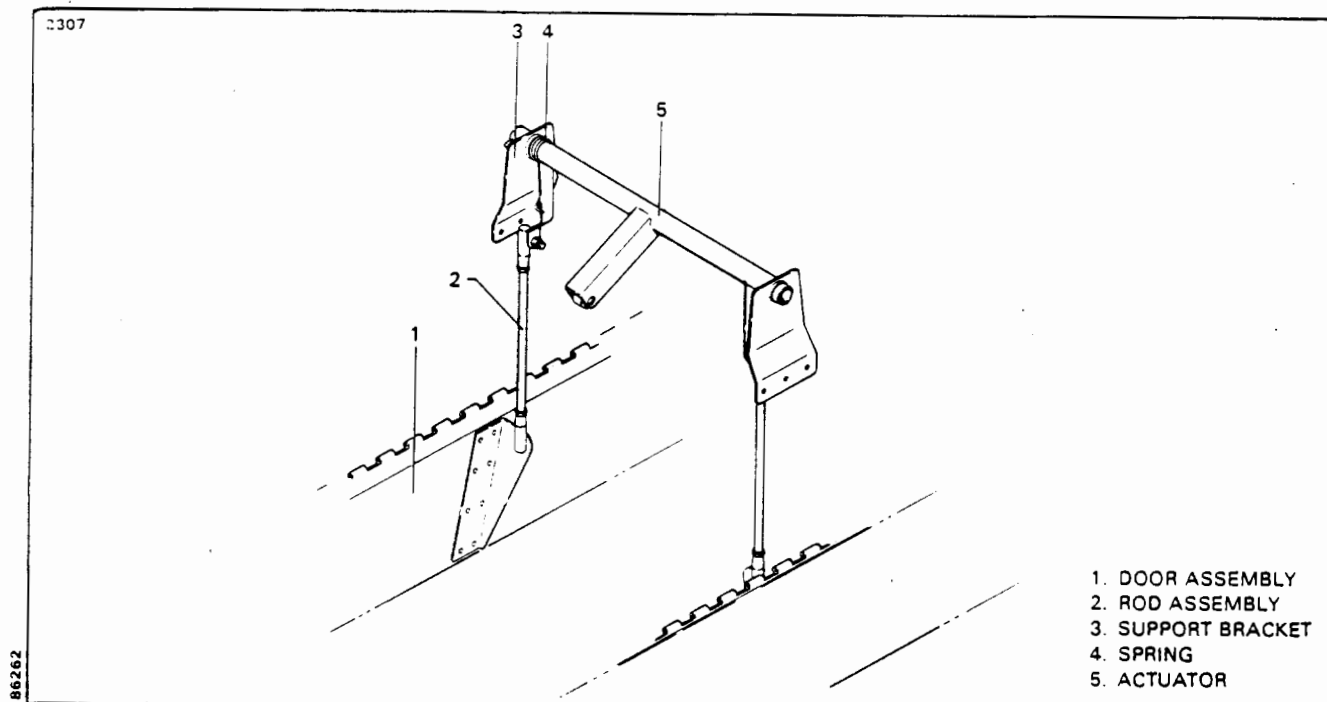


Figure 32-12. Mechanical Nose Gear Door Mechanism

CLEANING, INSPECTION AND REPAIR OF NOSE GEAR DOORS.

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 retracting 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 DOORS. (Refer to Figure 32-12.)

1. Position the complete operating mechanism inside the wheel well and secure the bearing blocks to the sides of the wheel wells.
2. Install the gear doors by positioning the doors and installing a new hinge pin. The hinge pin ends should be bent to provide a safety.
3. Adjust the gear doors.

ADJUSTMENT OF NOSE GEAR DOORS. (Refer to Figure 32-12.)

1. Place the airplane on jacks. (Refer to Chapter 7.)
2. Disconnect the nose gear door retraction rods, if not previously disconnected.
3. Adjust doors one at a time. Close the door to the stop and adjust the retraction rod.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

4. Extend the landing gear and connect both doors.
5. Retract the landing gear fully and ascertain the doors close properly and do not bind.

WHEELS AND BRAKES.

NOSE WHEEL.

REMOVAL AND DISASSEMBLY OF NOSE WHEEL. (Refer to Figure 32-13.)

1. Jack the airplane enough to raise the nose wheel clear of the ground. (Refer to Chapter 7.)
2. Remove wheel by the following procedure:
 - A. Remove the nut and washer from one end of the axle rod and slide out the rod and axle plugs.
 - B. Lightly tap the axle tube out from the center of the wheel assembly by use of an object of near equal diameter.

— NOTE —

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

- C. Remove the spacer tubes and the wheel assembly.
3. The wheel halves may be separated by first deflating the tire. With the tire sufficiently deflated, remove the wheel through bolts. Pull the wheel halves from the tire by removing the wheel half opposite the valve stem first and then the other half.
4. The wheel bearing assemblies may be removed from each wheel half by first removing the snap rings that secures the grease seal retainers and then the retainers, grease seals and bearing cones. The bearing cups should be removed only for replacement, by tapping out evenly from the inside.

INSPECTION OF NOSE WHEEL.

1. Visually check all parts for cracks, distortion, defects and excess wear.
2. Check tie bolts for looseness or failure.
3. Check internal diameter of felt grease seals for distortion or wear. Replace the felt grease seal if surface is hard or gritty. Lightly coat felt grease seals with SAE 10 oil. (Do not soak felts in oil.)
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. (Refer to Figure 32-13.)

1. Ascertain that the bearing cup for each wheel half is properly installed. Install the tire with tube on the wheel half with the valve stem hole and then join the two wheel halves. Install the through bolts with the washers and nuts to the valve stem side.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

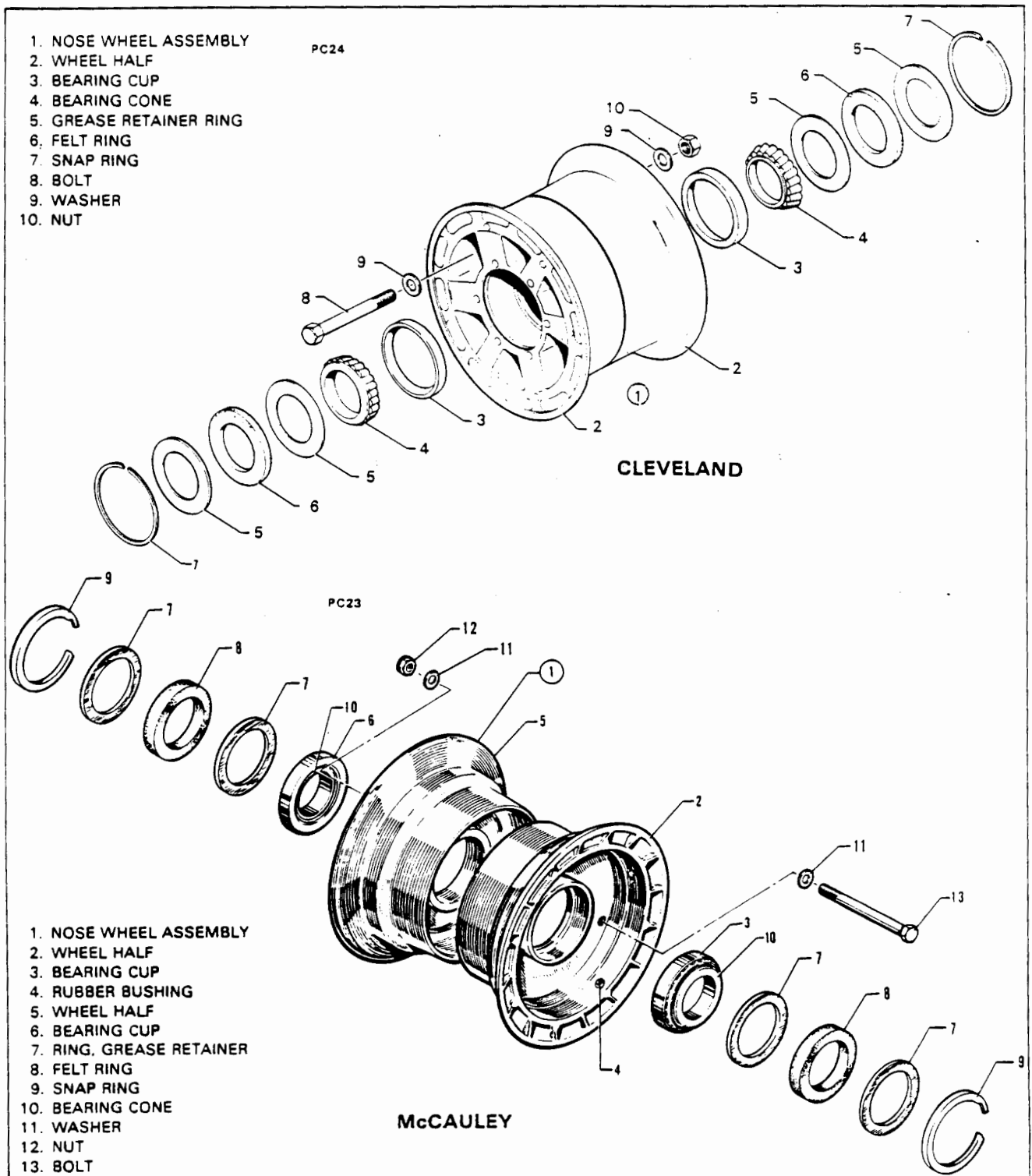


Figure 32-13. Nose Wheel Assemblies

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

— NOTE —

On aircraft models which use the Cleveland Wheel Assembly torque nuts to 90 inch-pounds. Those aircraft models which use the McCauley Wheel Assembly torque nuts to 140-150 inch-pounds.

On McCauley Nose Wheel Assemblies only, bushing is required to prevent tube movement.

2. Position the tire and tube so the index mark on the tire is aligned with the index mark on the tube. This will maintain proper balance of the wheel. Inflate the tire to the specified pressure as given in Chart 6001.
3. Lubricate the bearing cones and install the cones, grease seals, felt rings and seal retainer rings. Secure with snap rings.
4. Install the axle and spacer into the wheel assembly and install the wheel into the fork of the strut assembly. Secure in place with an axle plug on each end, axle rod, washers and self-locking nuts. Tighten the nuts until no side play is felt, yet allowing the wheel to rotate freely.

MAIN WHEEL.

REMOVAL AND DISASSEMBLY OF MAIN WHEEL. (Refer to Figure 32-14.)

1. Place the airplane on jacks. (Refer to Chapter 7.)
2. To remove the main wheel, remove the four cap bolts that join the brake cylinder housing and the lining back plate assemblies. Remove the back plate from between brake disc and wheel.
3. Remove the dust cover and the cotter pin that safeties the wheel nut, remove the wheel nut and slide the wheel from the axle.
4. The wheel halves may be separated by first deflating the tire. With the tire sufficiently deflated, remove the wheel through bolts. Pull the wheel halves from the tire by removing the inner half from the tire first, and then the 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 not be removed only for replacement and may be removed by tapping out evenly from the inside.

INSPECTION OF MAIN WHEEL.

Inspect brake disc for cracks, excessive wear or scoring, rust, corrosion and warpage. Remove rust and blend out nicks, using fine 400 grit sandpaper. Replace disc if cracked or when disc is worn below minimum thickness. In addition also perform the same inspection given for nose wheel.

ASSEMBLY AND INSTALLATION OF MAIN WHEEL. (Refer to Figure 32-14.)

1. Ascertain that the bearing cup for each wheel is properly installed. Install the tire with tube on the outer wheel half and then join the two wheel halves. Position the brake disc in the inner wheel half and install the through bolts with the nuts on the valve stem side. Torque wheel nuts to 150 inch-pounds.
2. Position the tire and tube so the index mark on the tire is aligned with the index mark on the tube. This will maintain proper balance of the wheel. Inflate the tire to the specified pressure.
3. Lubricate the bearing cones and install the cones, grease seals, seal retainer rings and felt rings. Secure with snap rings.

32-42-03

Page 32-41

Revised: January 3, 1983

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

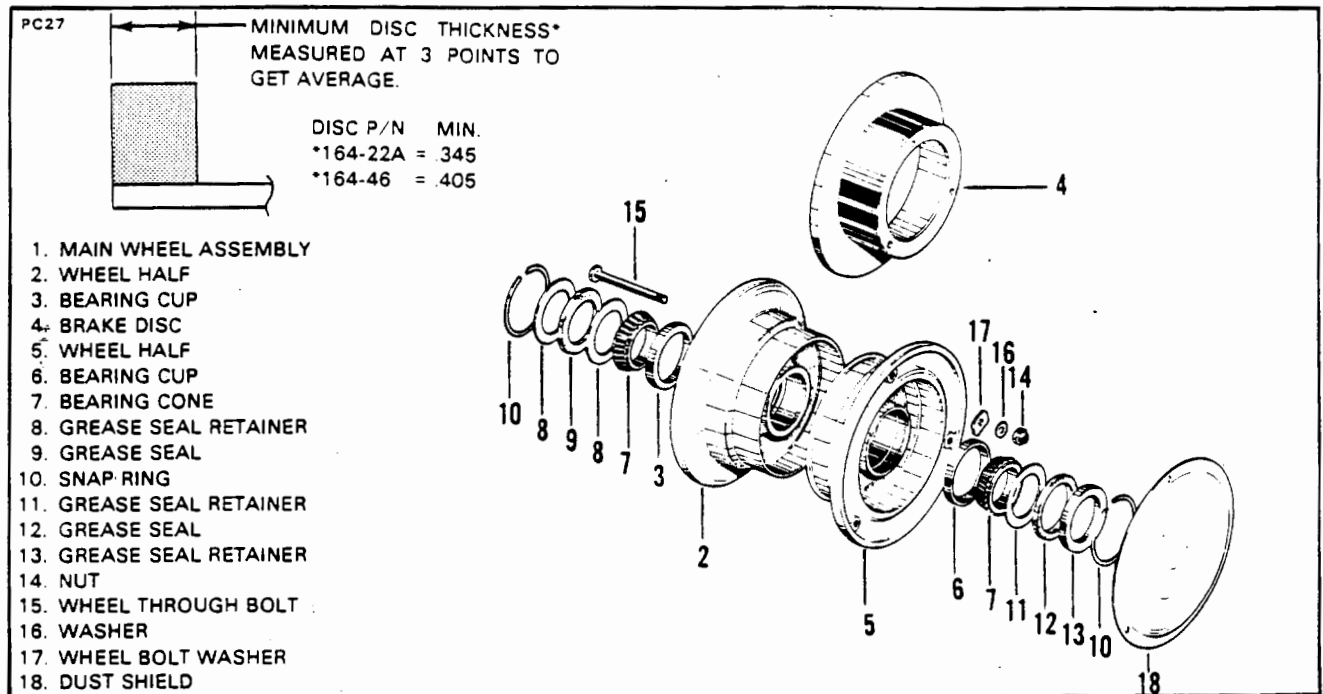


Figure 32-14. Main Wheel Assembly

4. Slide the wheel on the axle and secure with retainer nut. Tighten the nut to allow no side play, yet allow the wheel to rotate freely. Safety the nut with a cotter pin and install a dust cover.

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

REPAIR OF NOSE AND MAIN WHEEL ASSEMBLIES.

Repairs are limited to blending out small nicks, scratches, gouges and areas of slight corrosion, plus the replacement of parts which are cracked or badly corroded.

— NOTE —

Remove rust and blend out small nicks, using fine 400 grit sandpaper.

Wheels may also be repainted if the parts have been repaired and thoroughly cleaned. Paint exposed areas with one coat zinc chromate primer and one coat of aluminum lacquer.

— NOTE —

Never paint working surfaces of the bearing cups.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

1. Bearing Cup Replacement:

A. Removal:

- (1) Insert wheel half into boiling water for 15 minutes or place in an oven not exceeding 250° F (121° C) for 15 minutes.
- (2) Remove from source of heat and invert wheel half. If the cup does not drop out, tap the cup evenly from the axle bore with a fiber drift pin or suitable arbor press.

B. Installation:

- (1) To replace a new cup, apply one coat of zinc chromate primer to wheel half bearing bore.
- (2) Insert wheel half into boiling water for 15 minutes or place in an oven not exceeding 250° F (121° C) for 15 minutes. Chill new bearing cup in dry ice for a minimum of 15 minutes.
- (3) Remove wheel half from source of heat and bearing cup from the dry ice. Install the chilled bearing cup into the gearing bore of the heated wheel half. Tap gently to seat evenly in place, using a fiber drift pin or suitable arbor press.

BRAKES.

BRAKE ADJUSTMENT AND LINING TOLERANCE.

No adjustment of the brake lining clearance is necessary as they are self-adjusting. Inspection of the lining is necessary, and it may be inspected visually while installed on the airplane. Linings of the riveted type should be replaced if the thickness of any one segment becomes worn below .100 of an inch or unevenly worn. The "snap-on" heavy duty linings should be replaced when the expansion groove is no longer visible.

WHEEL BRAKE ASSEMBLY.

REMOVAL AND DISASSEMBLY OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-15.)

1. To remove the brake assembly, first disconnect the brake line from the brake cylinder at the tube fitting.
2. Remove the cap bolts that join the brake cylinder housing and the lining back plate assembly. Remove the back plate from between the brake disc and wheel.
3. Slide the brake cylinder housing from the torque plate.
4. Remove the pressure plate by sliding it off the anchor bolts of the housing.
5. The piston(s) may be removed by injecting low air pressure in the cylinder fluid inlet and forcing the piston from the housing.
6. Check anchor bolt for wear.
7. Remove anchor bolt by the following procedure:
 - A. Position cylinder assembly on a holding fixture. (Refer to Figure 32-16, Step A.)
 - B. Use a suitable arbor press to remove the anchor bolt from the cylinder body.
8. Install anchor bolt by the following procedure:
 - A. Support anchor bolt in a holding fixture. (Refer to Figure 32-16, Step B.)
 - B. Align cylinder body over anchor bolt. (Refer to Figure 32-16, Step C.)
 - C. Use a suitable arbor press and apply pressure on the spot face directly over the anchor bolt hole. (Refer to Figure 32-16, Step D.)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

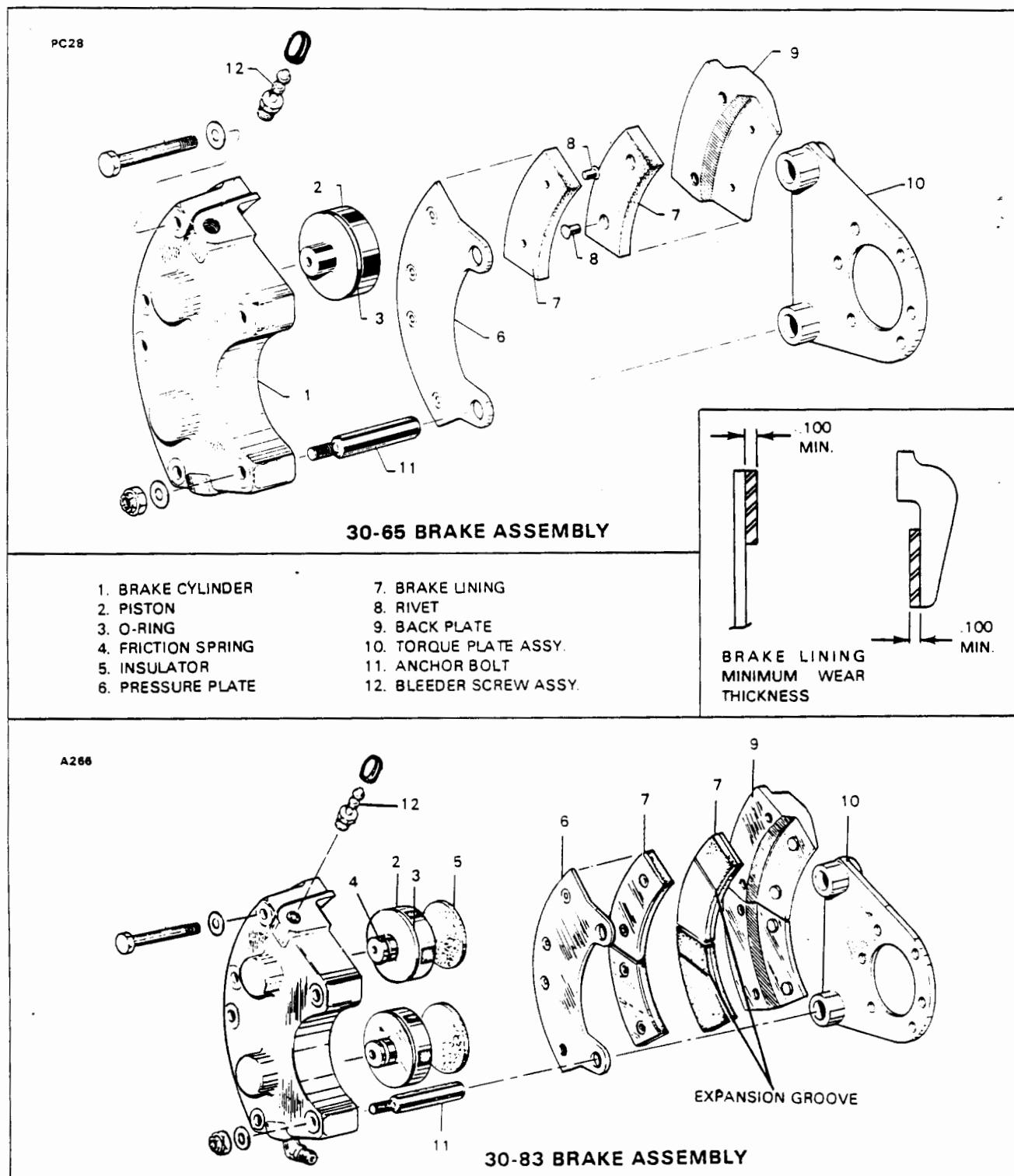


Figure 32-15. Wheel Brake Assembly

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

A127

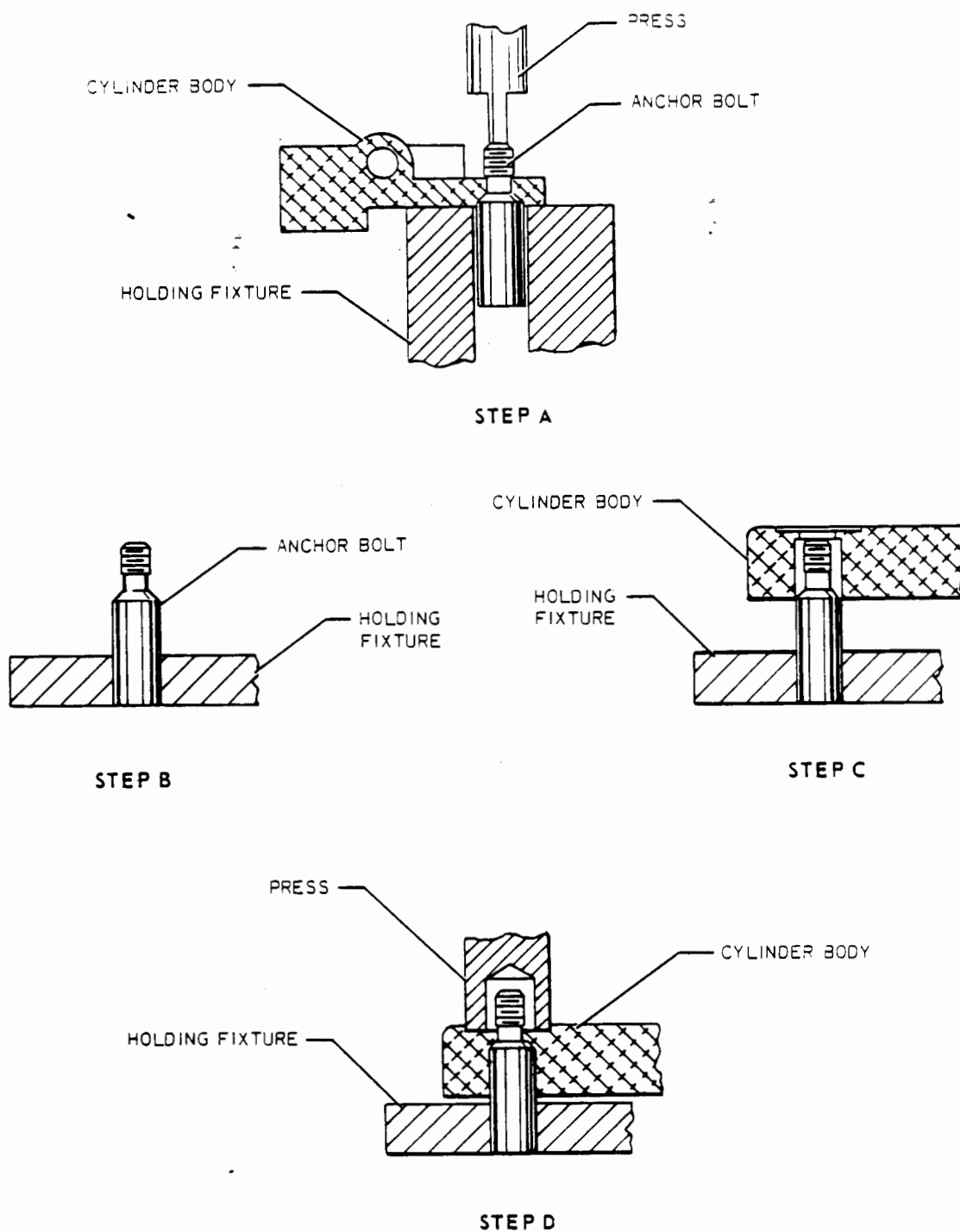


Figure 32-16. Removal and Installation of Anchor Bolts

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CLEANING, INSPECTION AND REPAIR OF WHEEL BRAKE ASSEMBLY.

1. Clean the assembly with a suitable solvent and dry thoroughly.
2. Check the wall of the cylinder housing and piston for scratches, burrs, corrosion, etc., that may damage "O" rings.
3. Check the general condition of the brake bleeder screw and lines.
4. Check the brake disc for wear, grooves, scratches or pits. Minimum service thickness of Disc 164-22A used on Wheel Assembly 40-90A is .345. A heavy duty brake and wheel assembly is optional. The minimum disc thickness of Disc 164-46 used on heavy duty Wheel Assembly 40-120 is .405. A single groove or isolated grooves up to .030 of an inch deep would not necessitate replacement, but a grooving of the entire surface would reduce lining life and should be replaced. Should any cracks be found to exceed a length of .80 inch or a depth of .210 inch in the 164-46 disc assembly, replace the disc. If the crack depth is not measurable, replace the disc if the crack length exceeds .400 inch. The disc should be immediately replaced if any crack extends into the welded seam between the flange and cup.
5. The riveted type lining may be removed from the backing plates by drilling out the old rivets using a 5/32 drill. Install a new set of linings using the proper rivets and a rivet set that will properly stake the lining and form a correct flair of the rivet. The snap-on type lining used on optional heavy duty assemblies may be removed by prying loose with a screwdriver or a thin flat wedge. Install the snap-on type by positioning onto the pins and applying pressure to snap into position.

— NOTE —

Standard duty brake linings should be conditioned by performing a minimum of six light pedal effort braking applications from 25 to 40 mph. Allow the brakes to partially cool between stops. This conditioning procedure will cure the resins in the brake linings, yet will not cause the material to become carburized due to excessive heat.

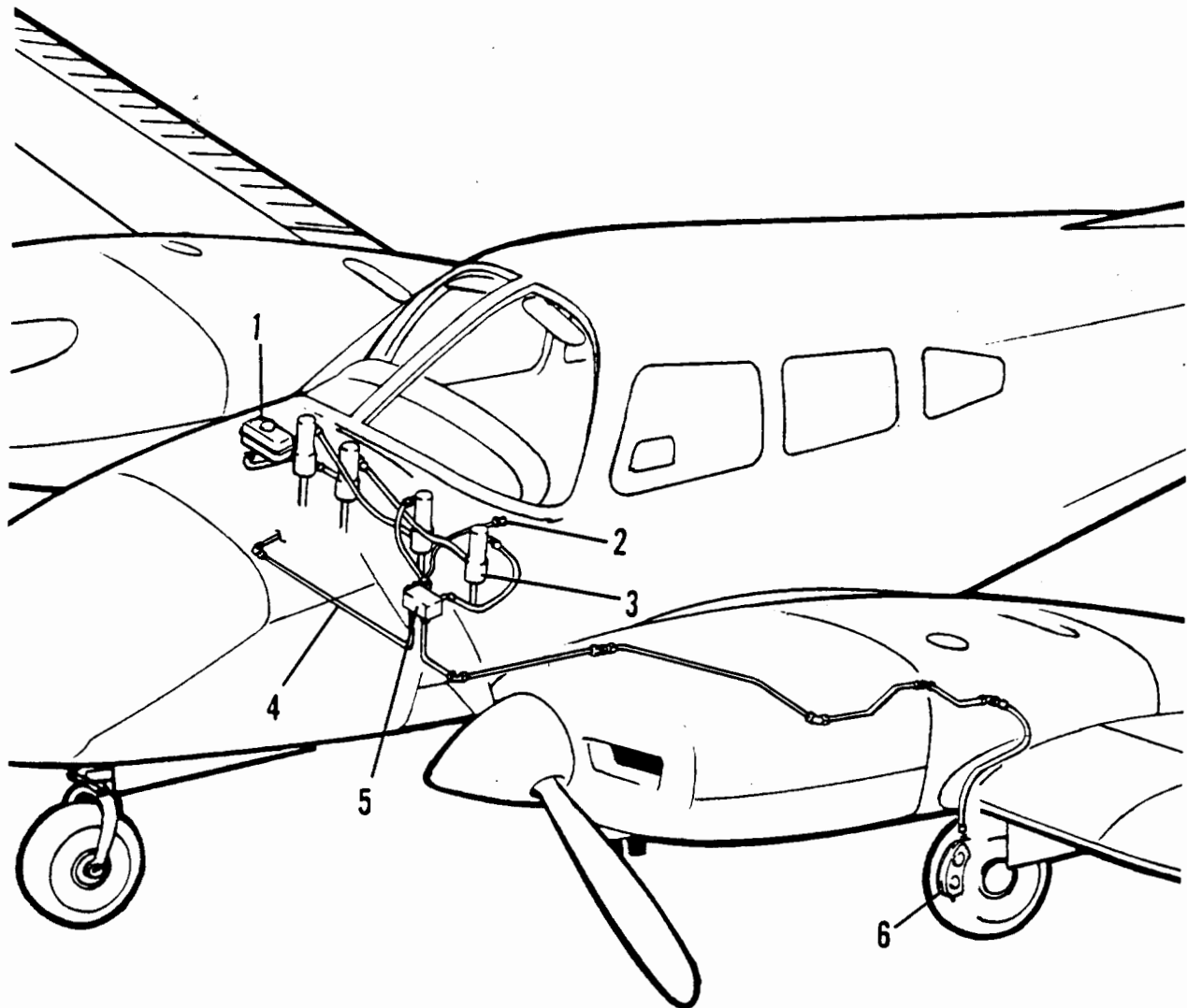
Replacement brake linings used on optional heavy duty brakes should be conditioned by performing 3 consecutive hard braking applications at 45 to 50 mph. Do not allow brake discs to cool substantially between stops. This will wear off any high spots and at the same time generate sufficient heat to glaze the surface of the metallic linings. Once the linings are glazed, they will provide many hours of maintenance free service.

ASSEMBLY AND INSTALLATION OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-15.)

1. Lubricate the piston "O" ring(s) with fluid MIL-H-5606 and install on piston(s). Slide the piston in cylinder housing until flush with surface of housing.
2. Slide the lining pressure plate onto the anchor bolts of the housing.
3. Slide the cylinder housing assembly on the torque plate of the gear.
4. Position the lining back plate between the wheel and brake disc. Install the bolts and torque to 40 inch-pounds to secure the assembly.
5. Connect the brake line to the brake cylinder housing.
6. Bleed the brake system.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2312



- 1. RESERVOIR HANDLE
- 2. HANDLE, PARKING BRAKE
- 3. MASTER CYLINDERS
- 4. FLUID LINE
- 5. VALVE, PARKING BRAKE
- 6. BRAKE ASSEMBLY

86426

Figure 32-17. Brake Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

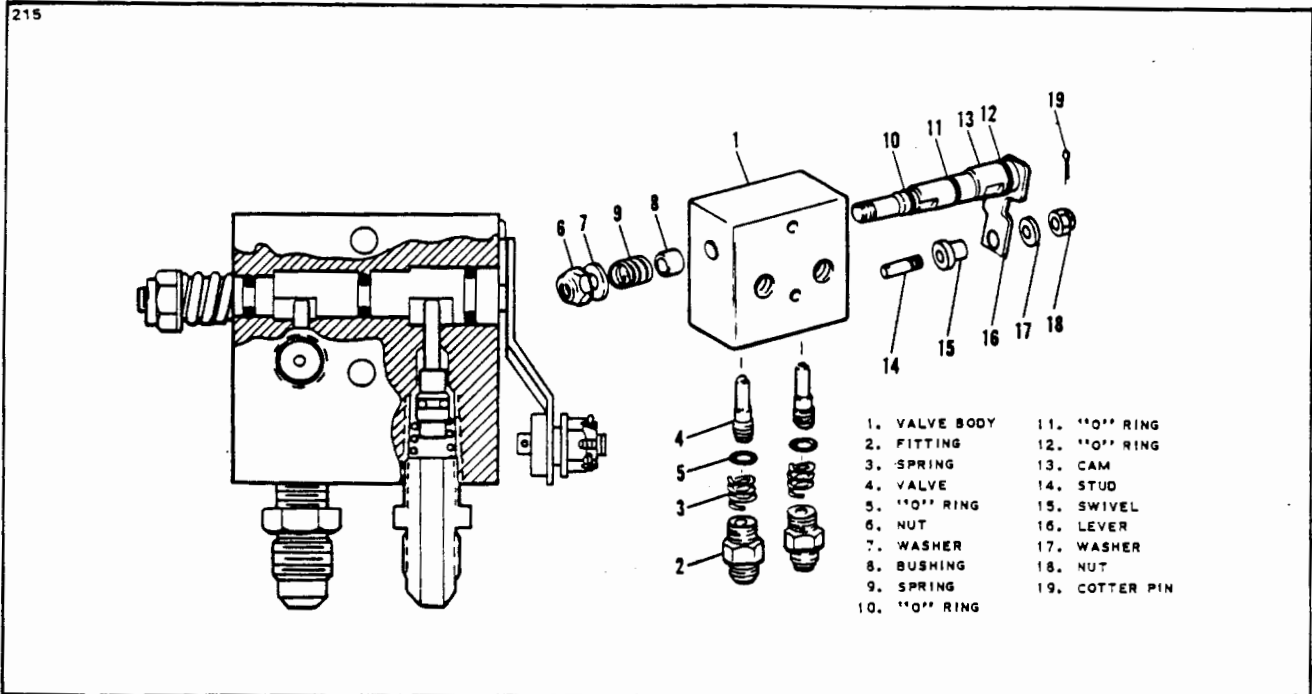


Figure 32-18. Parking Brake Valve Assembly

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 32-18.)

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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

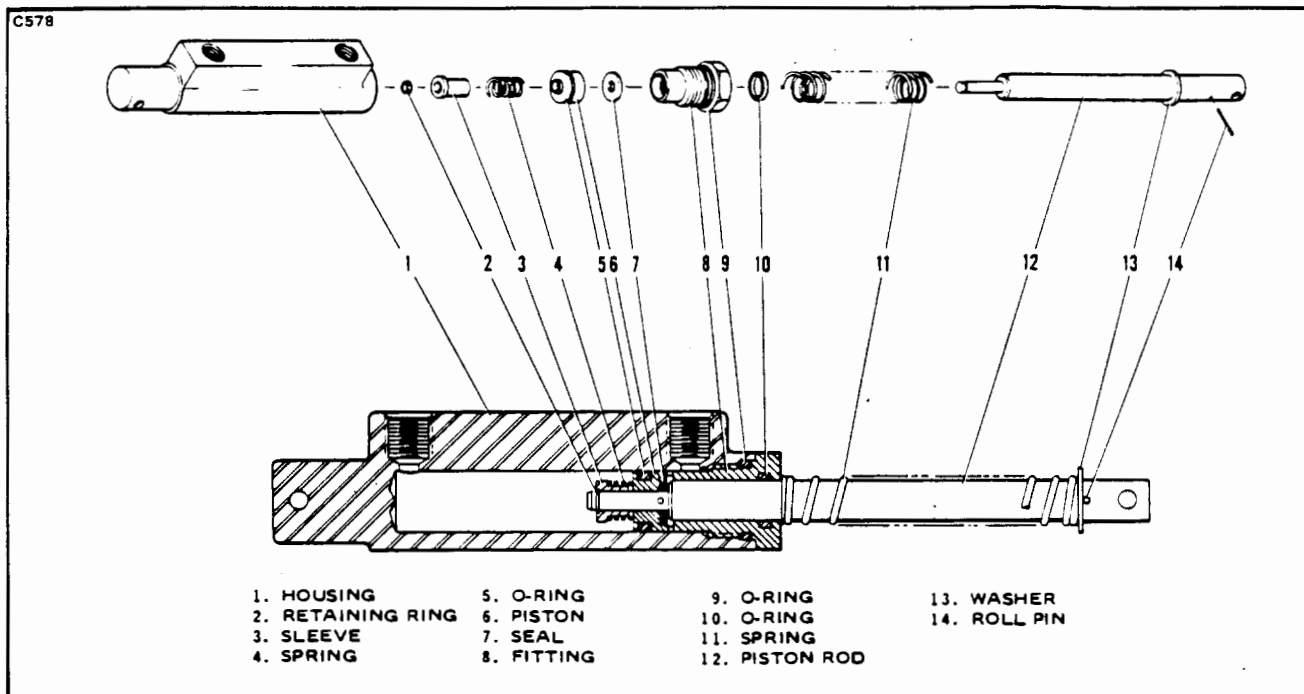


Figure 32-19. Brake Cylinder (17000)

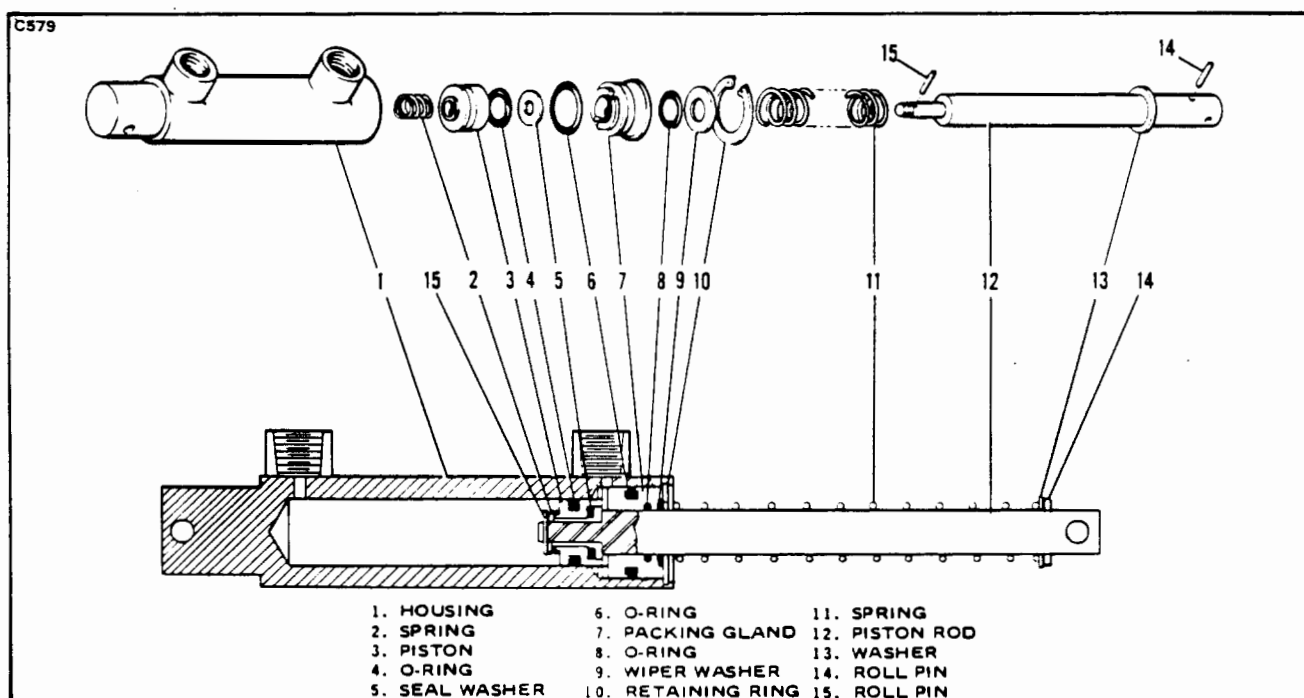


Figure 32-20. Brake Cylinder (10-27)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

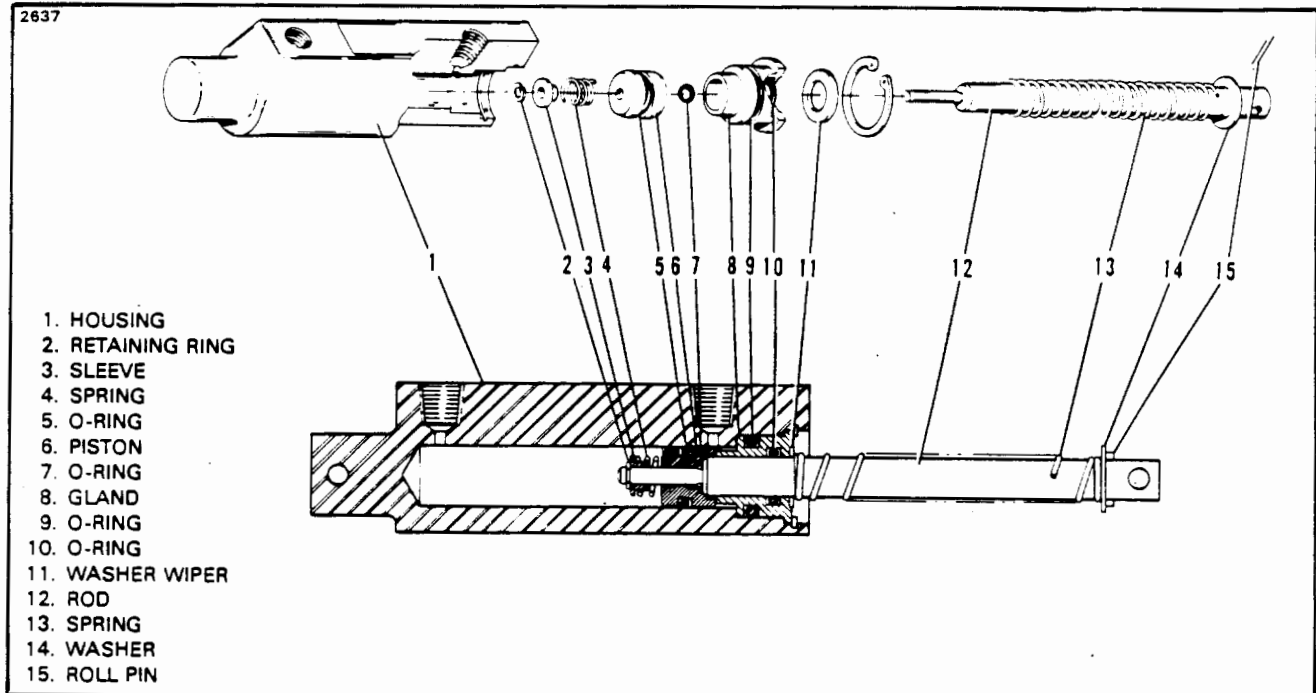


Figure 32-21. Brake Cylinder (10-30) (Toe Brake)

CLEANING, INSPECTION AND REPAIR OF PARKING BRAKE VALVE.

1. Clean the valve parts with a suitable solvent and dry thoroughly.
2. Inspect valve and seat surfaces of valve body for excessive wear and corrosion.
3. Inspect the cam assembly for burrs, scratches, excess wear, loose operating lever, etc.
4. Check general condition of valves and springs.
5. Repair to the valve is largely limited to smoothing burred or scratched surfaces and replacing O-rings.

ASSEMBLY OF PARKING BRAKE VALVE. (Refer to Figure 32-18.)

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 the valve, insert valve in hole of out port, install valve spring and secure with outlet fitting.

INSTALLATION OF PARKING BRAKE VALVE.

1. Attach the valve to the bulkhead mounting bracket with screws.
2. Connect the fluid lines to the valve.
3. Connect the control cable to valve lever and determine that when valve lever fits in the closed detent, parking brake handle is .03 to .06 inch of being full in against stop.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

BRAKE CYLINDER. (Toe Brake)

REMOVAL OF BRAKE CYLINDER. (Refer to Figure 32-19.)

1. Disconnect the upper and lower lines from the cylinder to be removed and cap the lines to prevent fluid leakage or drain the fluid from the brake reservoir and master cylinder.
2. Remove cotter pins and clevis pins securing brake cylinder in position, then remove brake cylinder.

DISASSEMBLY OF BRAKE CYLINDER.

1. Gar-Kenyon cylinder number 17000. (Refer to Figure 32-19.)
 - A. Remove the cylinder from its mounting bracket.
 - B. To disassemble the cylinder, first remove the piston rod assembly by unscrewing the fitting from the cylinder.
 - C. The piston rod assembly may be disassembled by first removing the retaining ring securing the sleeve and then removing the spring, piston, seal, fitting, and, if desired, the large return spring.
 - D. Remove the O-rings from the piston and fitting.
2. Cleveland cylinder number 10-27. (Refer to Figure 32-20.)
 - A. Remove the cylinder from its mounting bracket.
 - B. To disassemble the cylinder, first remove the piston rod assembly by removing the retaining ring from the annular slot in the cylinder housing. Draw the piston rod assembly from the cylinder.
 - C. The piston rod assembly may be disassembled by first removing the roll pin, spring, and then the piston assembly, seal and packing gland and, if desired, the large return spring.
 - D. Remove the O-rings from the piston and packing gland.
3. Cleveland cylinder number 10-30. (Refer to Figure 32-21.)
 - A. Install new O-rings on the inside and outside of the packing gland and on the outside of the piston.
 - B. To assemble the piston rod assembly, install on the rod, in order, the roll pin, washer, spring, washer, packing gland with O-rings, seal, piston assembly with O-ring, spring and roll pin.
 - C. Insert the piston rod assembly in the cylinder and secure with the retaining ring.
 - D. Install the cylinder.

CLEANING, INSPECTION AND REPAIR OF BRAKE CYLINDER.

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

ASSEMBLY OF BRAKE CYLINDER. (Refer to Figures 32-19 and 32-20.)

— NOTE —

Rub a small amount of hydraulic fluid (MIL-H-5606) on all O-rings and component parts for ease of handling during reassembly and to prevent damage.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

1. Gar-Kenyon cylinder number 17000. (Refer to Figure 32-19.)
 - A. Install new O-rings on the inside and outside of the fitting and on the outside of the piston.
 - B. To assemble the piston rod assembly, install on the rod, in order, the roll pin, return spring, retainer washer, return spring, fitting with O-rings, seal, piston with O-ring, spring and sleeve. Secure these pieces with the retaining ring on the end of the rod.
 - C. Insert the piston rod assembly in the cylinder and secure fitting.
 - D. Install the cylinder.
2. Cleveland cylinder number 10-27. (Refer to Figure 32-20.)
 - A. Install new O-rings on the inside and outside of the packing gland and on the outside of the piston.
 - B. To assemble the piston rod assembly, install on the rod, in order, the roll pin, washer, spring, washer, packing gland with O-rings, seal, piston assembly with O-ring, spring and roll pin.
 - C. Insert the piston rod assembly in the cylinder and secure with the retaining ring.
 - D. Install the cylinder.
3. Cleveland cylinder number 10-30. (Refer to Figure 32-21.)
 - A. Remove the cylinder from its mounting bracket.
 - B. To disassemble the cylinder, first remove the piston rod assembly by removing the retaining ring from the annular slot in the cylinder housing. Draw the piston rod assembly from the cylinder.
 - C. The piston rod assembly may be disassembled by first removing the retaining ring, sleeve, spring, and then the piston assembly, O-ring, and gland, and, if desired, the return spring.
 - D. Remove the O-rings from the piston and packing gland.

INSTALLATION OF BRAKE CYLINDER. (Refer to Figure 32-22.)

1. Position brake cylinder at its mounting points and secure in position with clevis pin. Safety clevis pins with cotter pins.
2. Connect brake lines to cylinder fittings. Bleed brakes.

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.

— 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

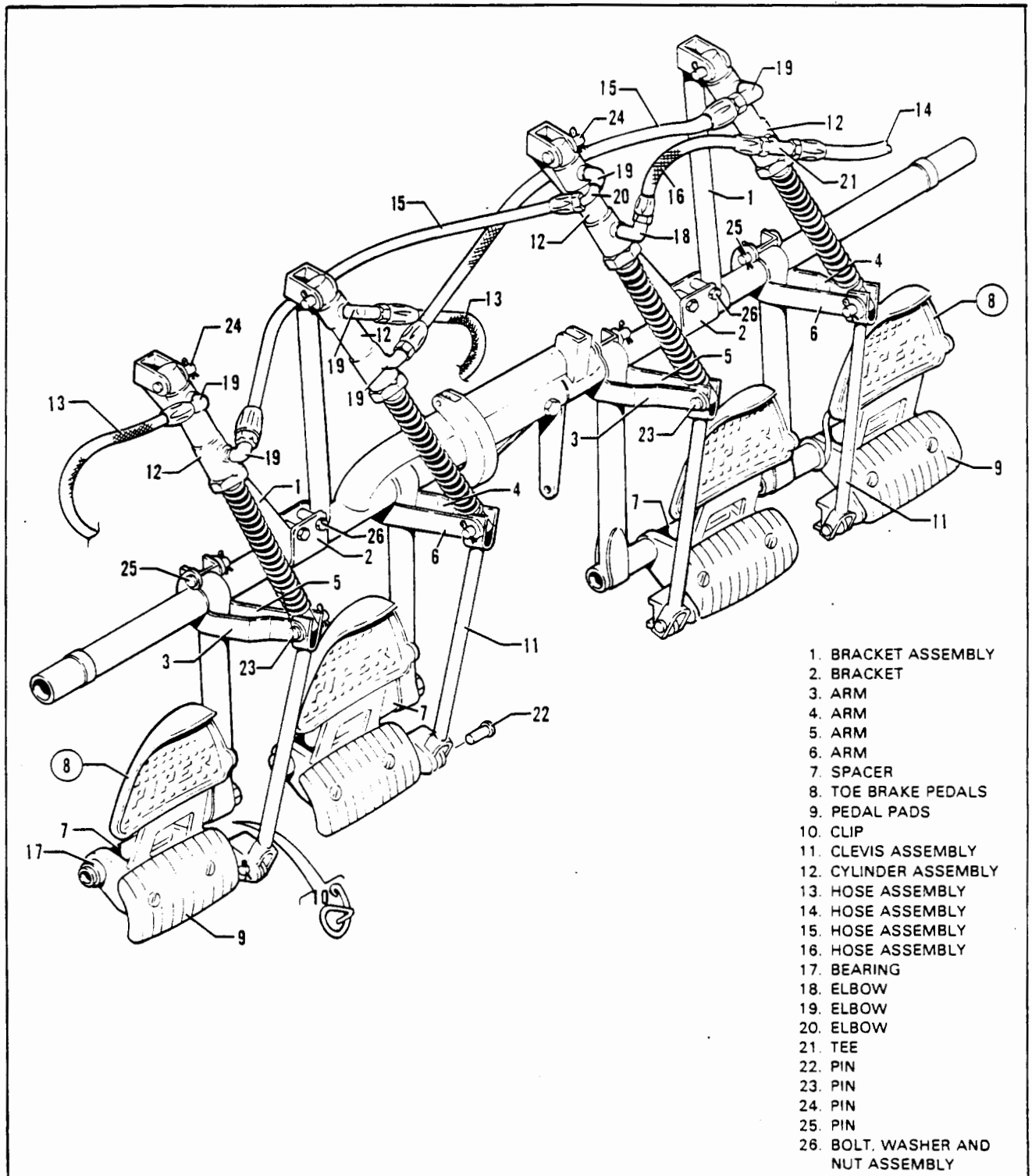


Figure 32-22. Toe Brake Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

POSITION AND WARNING.

LANDING GEAR LIMIT SWITCHES.

— NOTE —

All adjustments of the limit switches should be made with the airplane on jacks. Do not bend actuator springs mounted on the limit switches.

ADJUSTMENT OF MAIN GEAR UP LIMIT SWITCH.

A gear up limit switch is located in each wheel well above the gear door hinge. There is no adjustment of these switches other than check that the gear, when retracting, will actuate the switch within .88 of an inch of full up. Switch operation turns the red gear unsafe light out.

ADJUSTMENT OF MAIN GEAR DOWN LIMIT SWITCH.

A gear down limit switch is mounted on a bracket which is attached to the lower drag link of each main gear. The switch should be adjusted to allow it to actuate thus turning on the green indicator light within the cockpit when the downlock hook has entered the locked position and is within .025 to .035 of an inch of contacting the downlock pin. (Refer to Figure 32-23.) Adjustment of the switch may be as follows:

1. Ascertain that the main gear downlock is properly adjusted.
2. Raise the airplane on jacks. (Refer to Chapter 7.)
3. Ascertain that the landing gear is down and pressure is relieved from the hydraulic system. To relieve pressure, hold down the emergency extender lever.
4. Raise the downlock hook assembly and place a .030 of an inch feeler gauge between the horizontal surface of the hook that is next to the switch (the surface that contacts the downlock pin) and the rounded surface of the pin. Lower the hook and allow it to rest on the feeler gauge.
5. Loosen the attaching screws of the switch and, while pushing up on the center of the link assembly, rotate the switch toward the hook until it is heard to actuate. Retighten the attaching screws of the switch.
6. Manually move the hook assembly up from the pin until the hook nearly disengages from the pin. Then, with pressure against the bottom of the link assembly, move back to ascertain that the switch actuates within .025 to .035 of an inch of full lock.
7. Retract and extend the gear by turning the master switch on and moving the gear selector handle to the up position. As the gear begins to retract, the green light below the selector should go out and the red gear unsafe light at the top of the instrument panel should come on.

ADJUSTMENT OF NOSE GEAR UP AND DOWN LIMIT SWITCHES.

The nose gear up and down limit switches are located on the right nose cone spar assembly and are mounted either side of fuselage station 24.00.

1. To facilitate adjustment of the switches, disconnect the gear doors.
2. With the aircraft placed on jacks (refer to Chapter 7), turn the master switch on. Move the gear selector switch to the gear up position to raise the landing gear. Turn the master switch off.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

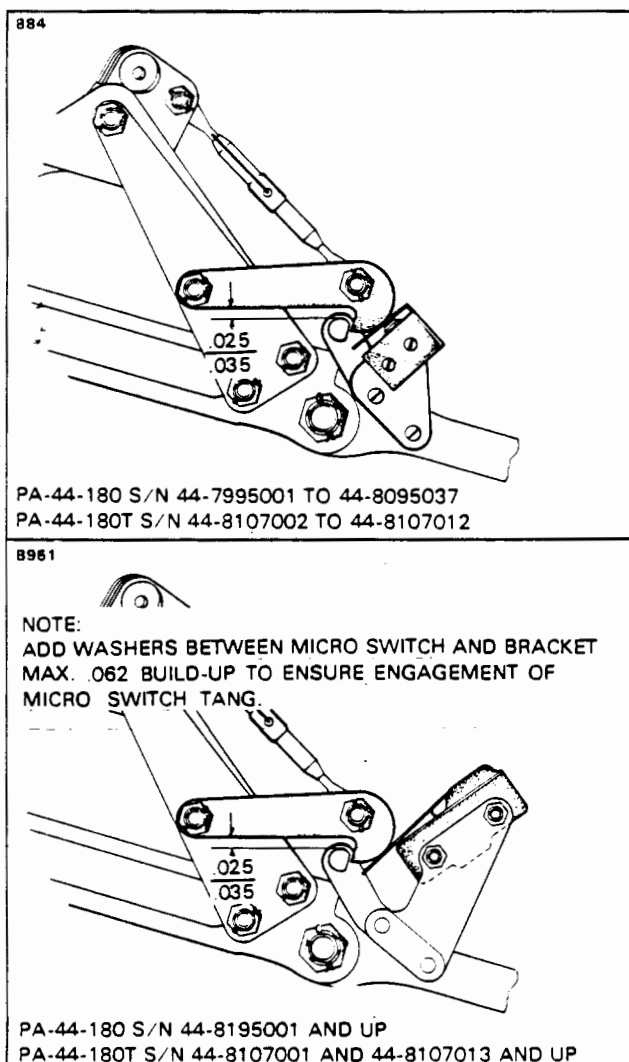


Figure 32-23. Adjustment of Main
Gear Down Limit Switch

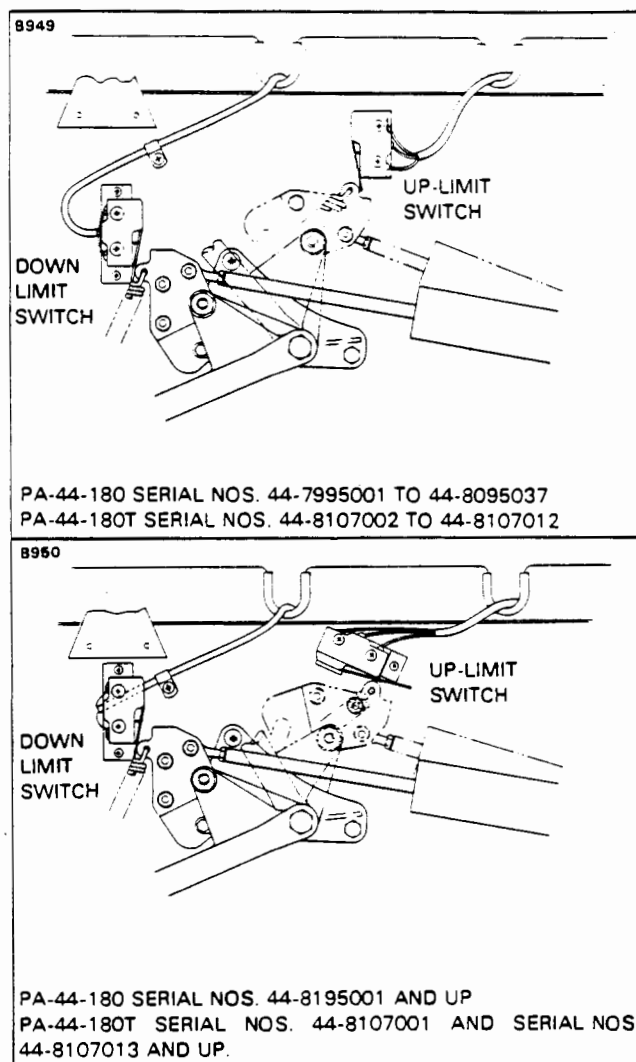


Figure 32-24. Adjustment of Nose
Gear Down Limit Switch

3. Block the nose gear in the up position and slowly pull the free fall knob to relieve the hydraulic pressure and allow the main gear to drop.
4. With the "downlock hook" now in the "up" position adjust the hydraulic cylinder rod end to ensure the cylinder will have 0 to .03 cushion prior to bottoming.
5. Turn the master switch on and raise the gear and remove the block from under the nose gear.
6. Cycle the gear and determine that the gear lights function properly.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

ADJUSTMENT OF LANDING GEAR SAFETY (SQUAT) SWITCH.

The landing gear safety switch, located on the left main gear housing is adjusted so that the switch is actuated within the last quarter of an inch of gear extension.

1. Compress the strut until 7.875 inches is obtained between the top of the gear fork and the bottom of the gear housing. Hold the gear at this measurement.
2. Adjust the switch down until it actuates at this point. Secure the switch.
3. Extend and then compress the strut to ascertain that the switch will actuate within the last quarter of an inch of oleo extension.

LANDING GEAR WARNING (THROTTLE) SWITCHES.

LANDING GEAR UP/POWER REDUCED WARNING SWITCH.

This switch will automatically activate a warning horn when approaching for a landing with the landing gear up and the throttles pulled below 14 inches of manifold pressure.

SWITCH LOCATION.

The landing gear up/power reduced warning switch is located in the control quadrant behind the throttle levers. Access to the switch is from below and behind the quadrant. Refer to Chapter 91 for electrical schematic of the Landing Gear System.

ADJUSTMENT OF LANDING GEAR UP/POWER REDUCED WARNING SWITCH.

The adjustment of this switch will require flying the airplane at 1000 feet AGL and at approach speed. (Refer to the Pilot's Operating Manual.) The following procedure should be used:

1. With the aid of a qualified pilot, fly the airplane to an elevation of 1000 feet above the ground and come to approach speed with propellers set for high RPM. Retard the throttles to 14 ± 2 inches of manifold pressure and mark the quadrant cover adjacent to the throttle levers, in such a manner so that the levers can be returned to the same position after the airplane is landed and the engines shut down.
2. Place the airplane on jacks and retract the landing gear.
3. Reposition the throttle levers at the location which gave the 14 ± 2 inches of manifold pressure per Step 1.
4. With the master switch turned on, loosen the two mounting screws securing the micro switch to the bracket. Move the switch in the direction necessary to make the warning horn operate and tighten the mounting screws.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

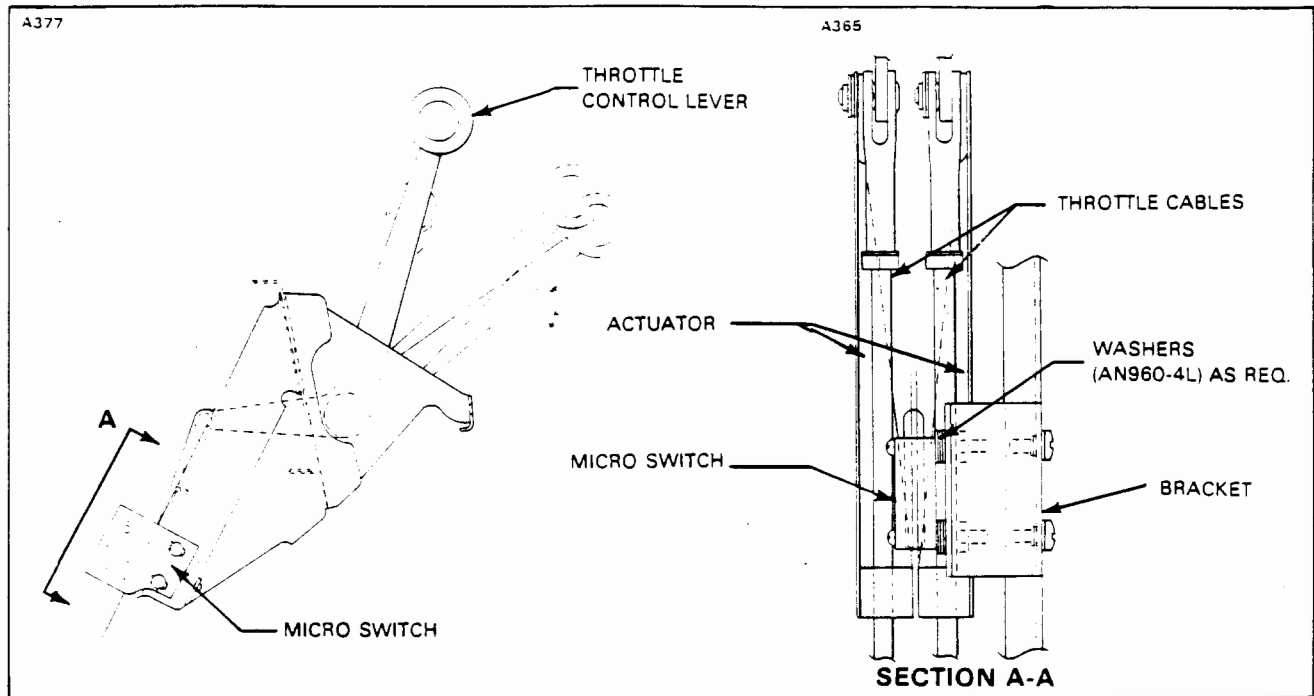


Figure 32-25. Throttle Warning Switches

5. With the warning horn operating, lower the landing gear to determine whether the horn ceases to operate when the gear are down and locked. Turn OFF master switch and remove airplane from jacks.
6. Flight test the airplane to insure proper operation of the gear warning horn with the gear up and power reduced below 14 ± 2 inches of manifold pressure.

REPLACEMENT OF LANDING GEAR UP/POWER WARNING SWITCH. (Refer to Figure 32-25.)

When replacing the switch, it is important to determine how many washers are positioned between the micro switch and the bracket so that an equal amount are reinstalled. This is necessary since the switch when properly positioned should be in the middle of the actuators located on each throttle cable.

FUNCTIONAL TEST OF THE GEAR RETRACTING SYSTEM.

Before proceeding with the test make sure that the tires and struts are inflated as required; the squat and limit switches are at their proper adjustment; a 12 to 14-volt DC, 50 amperes power source is connected to the aircraft electrical system; and the airplane is raised on jacks as explained in Chapter 7.

The following procedure should be carried out in only the sequence designated, as each instruction is a prerequisite for the one following it. Should the system fail to respond as specified, find the malfunction and correct it before continuing.

1. Make provisions for being able to add fluid to reservoir as necessary to keep reservoir full of fluid.
2. Make sure all switches are off and gear selector in the down position.
3. Switch on the Master Switch.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

4. Check that the three green safe lights at the bottom center of the panel are lit, the red unsafe light at the top of the panel is off, the gear warning horn is off, and hydraulic pump does not operate.
5. Move the gear selector switch to the up position.
6. Check that the green safe lights are off, the red unsafe light is on, the warning horn is on, all gear are retracted fully with the nose gear doors closed, and the pump motor stops running.
7. Move the left throttle to the mid travel position.
8. The warning light and horn should remain on.
9. Close left throttle, and move right throttle to mid travel position.
10. The warning horn and light should remain on.
11. Move both throttles to their mid travel positions.
12. The warning horn should go off and the red unsafe light should go out.
13. Extend the flaps to their second notch.
14. The warning light and horn should come on.
15. Retract the flaps and leave the gear up for 5 minutes. The pump motor should not operate at any time. If the pump should operate during the 5 minute period, search for a leak in the "UP" line or a malfunctioning component in the system.
16. Switch off the master switch.
17. Pull gear free fall knob. All of the gear should return to their down and locked position, with the down latches engaged.
18. Move the gear selector switch to the down position.
19. Push in the free fall knob.
20. Switch on the Master Switch, and the three green safe lights should come on with the red unsafe light and warning horn off.
21. Carefully insert a wedge under the leaf of the squat switch on the left main gear.
22. With the microswitch activated, move the gear selector switch to its up position. The warning horn and red unsafe light should come on with the three green safe lights remaining on. The pump should not run.
23. Move the throttles to their mid travel position. The red unsafe light and warning horn should stay on.
24. Move the gear selector switch to its down position. Both the red warning light and horn should be off.
23. Remove the wedge from the squat switch.
24. Manually disengage ("Break") the left main gear downlock. The pump motor should operate with the appropriate green safe light out, and the red unsafe light on without the gear horn.
25. Repeat Step 24 with the right gear downlock.
26. Move the gear selector switch to the up position, and switch on the landing lights. The pump motor should operate to retract the gear in less than 10 seconds. The three green safe lights should go out while the red unsafe light should go on till all gears are up, at which time the pump should shut off. The warning horn should not sound (the throttles should still be at mid travel).
27. Move the gear selector switch down. The pump motor should operate till all gears are down and locked. The three green safe lights should come on with the unsafe light and warning horn off.

— NOTE —

If after the downlocks are engaged a blinking of the red and/or green lights occur, check for a maladjusted microswitch.

28. Switch on the navigation lights and check that the three safe lights remain on, but dim.
29. Switch all switches off and remove aircraft from jacks.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER

33

LIGHTS

2H16

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 33 - LIGHTS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
33-00-00	GENERAL	2H18	1-83
33-01-00	Description and Operation	2H18	
33-02-00	Troubleshooting	2H18	
33-10-00	FLIGHT COMPARTMENT	2H18	1-83
33-11-00	Instrument and Panel Lights	2H18	
33-11-01	Removal of Dimmer Control Assembly	2H18	
33-11-02	Installation of Dimmer Control Assembly	2H18	
33-40-00	EXTERIOR	2H19	
33-41-00	Landing Taxi Light	2H19	A 1-83
33-41-01	Removal of Landing Taxi Light (Single)	2H19	
33-41-02	Installation of Landing Taxi Light (Single)	2H19	
33-41-03	Removal of Landing Taxi Light (Dual)	2H19	8-80
33-41-04	Installation of Landing Taxi Light (Dual)	2H19	8-80
33-42-00	Tail Lights	3H20	A 1-83
33-42-01	Removal of Tail Lights	2H20	
33-42-02	Installation of Tail Lights	2H20	
33-43-00	Anti-Collision Strobe Lights	2H20	
33-43-01	Removal of Strobe Light	2H20	
33-43-02	Installation of Strobe Light	2H20	
33-43-03	Troubleshooting Strobe Light System	2H21	
33-43-04	Removal of Strobe Power Supply	2H22	
33-43-05	Installation of Strobe Power Supply	2H22	

33 - Cont./Effec.

Page - 1

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

The optional night lighting system renders the aircraft operational at night, thus greatly extending its capability and possible flight time in any given period.

DESCRIPTION AND OPERATION.

External lighting comprises white wing tip strobe lights, navigation lights (with two tail lights) and a landing/taxi light located in the nose cone. Internal lighting will comprise instrument panel backlighting, dual overhead flood lights and map lights.

TROUBLESHOOTING.

When checking the lighting system, the master switch must be on in order for the lights to operate. Insure that the circuit breaker which protects the light circuit that is being checked is pushed "ON." If the light still fails to operate, replace the bulb.

FLIGHT COMPARTMENT.

The optional lighting comprises instrument panel backlighting with a dimmer control, dual overhead flood lights, a compass light and map lights.

INSTRUMENT AND PANEL LIGHTS.

REMOVAL OF DIMMER CONTROL ASSEMBLY.

Access to the dimmer control assembly is from beneath the instrument panel.

1. Disconnect the electrical connector from the assembly.
2. Remove the two screws securing the assembly to the instrument panel.
3. Remove the assembly from the airplane.

INSTALLATION OF DIMMER CONTROL ASSEMBLY.

1. Position the assembly in the instrument panel with the control knobs inserted into their appropriate slots.
2. Secure the assembly to the instrument panel with the two screws previously removed.
3. Connect the electrical connector to the assembly.
4. Check operation of dimmer control assembly.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

EXTERIOR.

The optional exterior lighting on the PA-44 comprises wing tip navigation and strobe lights, nose cone landing taxi light(s) and two tail lights.

LANDING/TAXI LIGHT.

REMOVAL OF LANDING/TAXI LIGHT (SINGLE).

— CAUTION —

Ascertain that the master switch is off prior to working on the landing/taxi light and exercise care not to drop the light.

1. Remove the two screws that secure the retaining ring and light to the bracket assembly in the nose cone.
2. Pull the light out gently and remove the two wires on the back, noting their respective terminals.

INSTALLATION OF LANDING/TAXI LIGHT (SINGLE).

1. Ascertain that the master switch is off.
2. Connect the wires to the correct terminals of landing/taxi light.
3. Gently push the light into the bracket and secure with the retaining screws.
4. Check operation of the light.

NOTE

Check and make sure the bonding strap is securely attached to the light mounting bracket within the nose cone and the other end in the fuselage.

REMOVAL OF LANDING/TAXI LIGHT (DUAL).

1. Ascertain that the master switch is off.
2. Remove the four screws which secure the nose cone. Lower the nose cone to gain access to the landing taxi lights.
3. Remove the two wires on the back of the light noting their respective terminals.
4. Remove the three screws which secure the landing light assembly to the mount assembly paying particular attention not to lose the three springs located between the light assembly and the mount assembly.
5. Remove the two screws, washers and nuts from the light assembly and separate the light retainer ring and plate from the light.

INSTALLATION OF LANDING/TAXI LIGHT (DUAL).

1. Ascertain that the master switch is off.
2. Place light in retainer ring and secure with retainer plate held in place by two screws, washers and nuts.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

3. Insert the three screws through their respective holes in the light assembly and place the springs into position on the screws.
4. Place the light assembly in position and secure to mount assembly with the three screws.
5. Connect the wires to the correct terminals of the landing taxi light.
6. Close nose cone and secure with four bolts.
7. Check operation of lights.

TAIL LIGHTS.

REMOVAL OF TAIL LIGHTS.

There are two tail lights on the PA-44, one at the top of the fin and one located at the bottom. They are identical.

1. Remove the two screws holding the lens in place and turn the bulb counterclockwise.

INSTALLATION OF TAIL LIGHTS.

1. Install the bulb in the socket and turn clockwise to secure it.
2. Install the lens and secure with the retaining screws.

ANTI-COLLISION STROBE LIGHTS.

These lights are located in the wing tips and are part of the same assembly as the navigation lights. They are rated to flash at approximately 50 times a minute and are both supplied by one power supply.

REMOVAL OF STROBE LIGHT.

— WARNING —

Make certain the master switch is off when working on the strobe lights as HIGH VOLTAGE is present.

1. Remove the screw securing the navigation lens and remove the lens.
2. Remove the three screws securing the navigation light bracket assembly and pull out.
3. Remove the strobe lamp by cutting the wires on the lamp beneath the mounting bracket.
4. Remove the defective lamp.
5. Remove and discard the plug with the cut wires from its electrical socket.

INSTALLATION OF STROBE LIGHT.

1. Route the wires from the new lamp down through the hole in the navigation light bracket.
2. Insert the wire terminals in the plastic plug supplied with the new lamp. Wire according to the schematic diagram located in Chapter 91 of this manual.
3. Position strobe lamp on navigation light bracket.
4. Secure navigation light assembly and bracket with appropriate screws.
5. Install navigation lens and secure with appropriate screw.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

TROUBLESHOOTING STROBE LIGHT SYSTEM.

The strobe light flashes as a result of capacitor discharge triggered by a timing pulse. The capacitor is charged to 450 volts D.C. by the power supply and then discharges across the xenon flash tube at intervals of approximately 50 flashes per minute. The trigger pulse is generated by a solid state timing circuit in the power supply.

When troubleshooting the strobe light system, it must be determined if the trouble is in the flash tube or the power supply. Replacement of the flash tube will confirm whether or not the tube is defective. A normally operating power supply will emit an audible tone of 1 to 1.5 KHz. If there is no sound emitted, check the system according to the following instructions. When troubleshooting the system, utilize the appropriate schematic in Chapter 91. The power supply is accessible through the access panel in the baggage compartment, aft of F.S. 191.000.

— CAUTION —

When disconnecting and connecting the power supply input connections, do not get the connections reversed. Reversed polarity of the input voltage for just an instant will permanently damage the power supply. The reversed polarity destroys a protective diode in the power supply, causing self-destruction from overheating of the power supply. This damage is sometimes not immediately apparent, but will cause failure of the system in time.

1. Ascertain the input voltage at the power supply is 14-volts
2. Check for malfunction in interconnecting cables.
3. Ascertain Pins 1 and 3 of interconnecting cable are not reversed.
4. Using an ohmmeter, check continuity between Pin 1 and 3 of interconnecting cable. If a reading is obtained on the meter, the cable is shorted and should be replaced.

— NOTE —

A short of the type described in Steps 3 and 4 will not cause permanent damage to the power supply, but the system will be inoperative if such a short exists. Avoid any connection between Pins 1 and 2 of the interconnecting cable as this will discharge the condenser in the power supply and destroy the trigger circuits.

— CAUTION —

When disconnecting the power supply, allow five minutes of bleed down time prior to handling the unit.

5. Check interconnecting cables for shorts.
6. Disconnect the output cables from the power supply outlets.
7. The following continuity checks can be made with an ohmmeter.
8. 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.
9. Check continuity between Pins 1 and 2, 1 and 3, 2 and 3 of the interconnecting cable. If continuity exists between any of these connections, the cable is shorted and should be replaced.

33-43-03

Page 33-04

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

10. Check the tube socket assembly for shorts.
11. Disconnect the tube socket assembly of the anti-collision light from the interconnecting cable.
12. The following continuity checks can be made with an ohmmeter.
13. Check for continuity between Pin 1 of AMP connector to Pin 1 of tube socket. Pin 2 of AMP connector to Pins 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.

REMOVAL OF STROBE POWER SUPPLY.

1. Remove the access panel in the baggage compartment to gain access to the power supply.
2. Disconnect the electrical plugs and make note of their placement to facilitate reinstallation.
3. Disconnect the other electrical leads and label them to facilitate reinstallation.
4. Remove the four screws securing the power supply to the plate and remove the supply.

INSTALLATION OF STROBE POWER SUPPLY.

1. Secure the power supply to the plate with the four screws previously removed.

— CAUTION —

*Make certain all electrical connections are correctly made without
interchanging any leads before applying power.*

2. Connect the electrical leads to the proper terminals. (Refer to the strobe power supply schematic in Chapter 91.)
3. Connect the electrical plugs (left wing, right wing) to corresponding receptacles.
4. Replace access panel on the fuselage in the baggage compartment.
5. Turn on master switch and strobe lights to ensure proper operation.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

**GRIDS 2H23 THRU 2H24
INTENTIONALLY LEFT BLANK**

CHAPTER

34

**NAVIGATION AND PITOT/
STATIC**

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

CHAPTER 34 - NAVIGATION AND PITOT/STATIC

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
34-00-00	GENERAL	214	
34-01-00	Description and Operation	214	
34-10-00	FLIGHT	214	
34-11-00	Rate of Climb Indicator	214	
34-12-00	Altimeter	217	
34-13-00	Airspeed Indicator	218	
	Radar Altimeter		D 1-83
	Removal and Installation of Radar Altimeter		
	Indicator		D 1-83
	Removal of King KA-131 Antenna		D 1-83
	Installation of King KA-131 Antenna		D 1-83
	Removal of King KRA-10 Receiver Transmitter (R T Unit)		D 1-83
	Installation of King KRA-10 Receiver Transmitter (R T) Unit		D 1-83
	Removal of King KA-133 Converter		D 1-83
	Installation of King KA-133 Converter		D 1-83
	Removal of Radar Altimeter Antenna - Bonzer		D 1-83
	Installation of Radar Altimeter Antenna - Bonzer		D 1-83
	Removal of Receiver Transmitter (R T) Unit - Bonzer		D 1-83
	Installation of Receiver Transmitter (R T) Unit - Bonzer		D 1-83
34-20-00	ATTITUDE AND DIRECTION	219	A 1-83
34-21-00	Magnetic Compass	219	
34-21-01	Adjustment of Compass	219	
34-21-02	Troubleshooting	2110	
34-22-00	Directional Gyro-Air Driven Electric	2111	
34-22-01	Air Driven Directional Gyro	2111	
34-22-02	Electrically Driven Directional Gyro	2111	
34-22-03	Troubleshooting	2112	
34-22-04	Removal and Replacement	2112	
34-22-05	Gyro Fitting Installation Procedure	2112	A 1-83
34-23-00	Gyro Horizon	2113	A 1-83
34-23-01	Air Driven Attitude Horizon	2113	
34-23-02	Electrically Driven Attitude Horizon	2113	
34-23-03	Operational Limitations	2114	A 1-83
34-23-04	Troubleshooting	2114	A 1-83

34 - Cont./Effec.

Page - 1

Revised: January 3, 1983

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

CHAPTER 34 - NAVIGATION AND PITOT/STATIC (cont)

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
34-20-00	ATTITUDE AND DIRECTION (cont)	—	
34-24-00	Turn and Bank Pictorial Rate Instruments	2I14	I-83
34-24-01	Troubleshooting	2I15	A I-83
34-25-00	Gyro Installation Inspection	2I15	A I-83
	INDEPENDENT POSITION DETERMINING		D I-83
	Weather Radar System		D I-83
	Precautions		D I-83
	Troubleshooting		D I-83
	Bendix RDR-160 System Components		D I-83
	Removal and Installation of Bendix		
	Antenna-Receiver-Transmitter		D I-83
	Removal and Installation of the Converter Unit		D I-83
	Removal and Installation of Indicator Unit		D I-83
	RCA Weather Scout II System Components		D I-83
	Removal and Installation of RCA		
	Receiver-Transmitter-Antenna		D I-83
	Removal and Installation of Interface Unit (Color		
	Installation Only)		D I-83
	Removal and Installation of RCA Indicator Unit		D I-83

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

The instrument air system consists of pitot air and static air sources. The system supplies both pitot and static air pressure for the airspeed indicator, altimeter and vertical speed indicator. These instruments are face mounted.

DESCRIPTION AND OPERATION.

The pitot air system consists of a pitot mast located on the underside of the left wing, with its related plumbing. Impact air pressure entering the pitot is transmitted from the pitot inlet through hose and tubing routed through the wing to the airspeed indicator on the instrument panel. A partially or completely blocked pitot head will give erratic or zero reading on the instruments.

Static air system consists of a static port located on the bottom of the pitot mast. The static port is directly connected to the airspeed indicator, altimeter and rate of climb indicator on the instrument panel by means of hose and tubing routed through the wing along with the pitot line. An alternate static air source is located below the instrument panel in front of the pilot. The alternate static source is part of the standard system and has a shutoff valve which closes the port when it is not needed. A placard giving instructions for use is located on the instrument panel. Pitot and static lines can be drained through separate drain valves located on the left lower side of the fuselage interior.

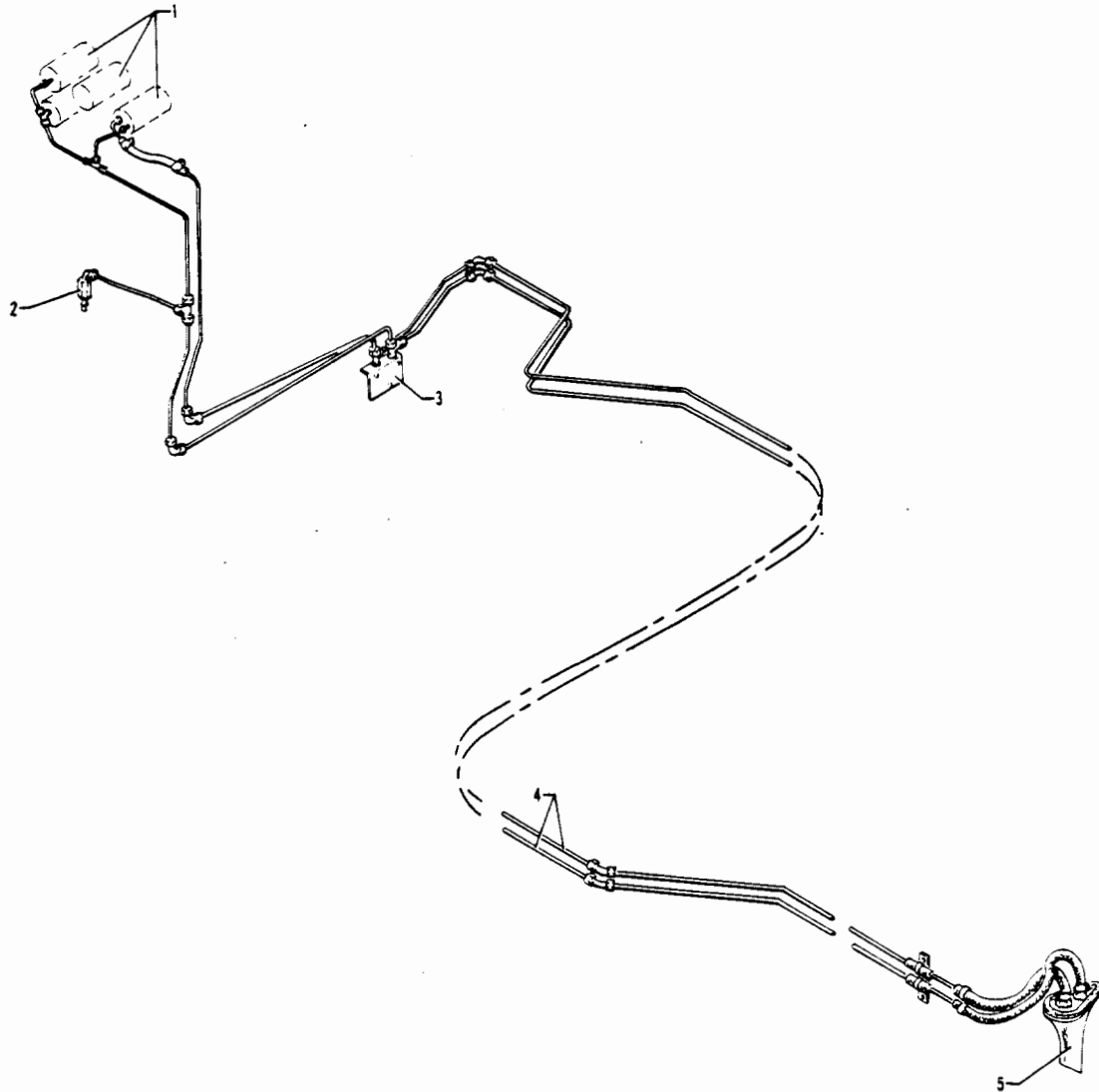
FLIGHT.

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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2289



- 1. INSTRUMENTS
- 2. ALTERNATE STATIC SOURCE
- 3. PITOT-STATIC SUMPS
- 4. PITOT-STATIC LINES
- 5. PITOT-STATIC HEAD

86194

Figure 34-1. Pitot-Static System Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3401. TROUBLESHOOTING (RATE OF CLIMB INDICATOR)

Trouble	Cause	Remedy
Pointer does not set on zero.	Aging of diaphragm.	Reset pointer to zero by means of setting screw. Tap instrument while resetting.
Pointer fails to respond.	Obstruction in static line.	Disconnect all instruments connected to the static line. Clear line.
	Pitot-static head frozen over.	Check individual instruments for obstruction in lines.
	Water in static line.	
	Obstruction in pitot head.	Clean lines and head.
Pointer oscillates.	Leaks in static lines.	Disconnect all instruments connected to the static line. Check individual instruments for leaks. Reconnect instruments to static line and test installation for leaks.
	Defective mechanism.	Replace instrument.
Rate of climb indicates when aircraft is banked.	Water in static line.	Disconnect static lines and blow out lines from cockpit out to pitot head.
Pointer has to be set before every flight.	Temperature compensator inoperative.	Replace instrument.
Pointer cannot be reset to zero.	Diaphragm distorted.	Replace instrument.
Instrument reads very low during climb or descent.	Case of instrument or line broken or leaking.	Replace instrument.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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.	Refer to latest revision of AC 43.13-1.
Altimeter sticks at altitude or does not change with change of altitude.	Water or restriction in static line.	Remove static lines from all instruments, blow line clear from cockpit to sensor.

34-12-00

Page 34-04

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3402. TROUBLESHOOTING (ALTIMETER) (cont)

Trouble	Cause	Remedy
Altimeter changes reading as aircraft is banked.	Water in static line.	Remove static lines from all instruments, and blow line clear from cockpit to sensor.
Altimeter requires resetting frequently.	Temperature compensator inoperative.	Change instrument.
— NOTE — <i>When any connections in the static system are opened for check, system must be rechecked per Part FAR 23.1325.</i>		

AIRSPPEED 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 (AIRSPPEED TUBES AND INDICATOR)

Trouble	Cause	Remedy
Pointers of static instruments do not indicate properly.	Leak in instrument case or in static lines.	Check for leak and seal.
Pointer of instrument oscillates.	Defective mechanism.	Replace instrument.
Instrument reads high.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
Instrument reads low.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
	Pitot-static head not aligned correctly.	Realign pitot-static head.

34-13-00

Page 34-05

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3403. TROUBLESHOOTING (AIRSPEED TUBES AND INDICATOR) (cont)

Trouble	Cause	Remedy
Airspeed changes as aircraft is banked.	Water in static line.	Remove lines from static instruments and blow out lines from cockpit to pitot-static head.
— NOTE — <i>When any connections in static system are opened for checking, system must be checked per FAR 23.1325.</i>		

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.

ADJUSTMENT OF COMPASS.

Before attempting to compensate compass, every effort should be made to place the aircraft in simulated flight conditions; check to see that the doors are closed, flaps in retracted position, engines running, throttles set at cruise position and aircraft in level flight attitude. Aircraft master switch, alternators, radios (except for combustion heater) should be on. All other cockpit controlled electrical switches should be in the off position.

1. Set adjustment screws of compensator on zero. Zero position of adjusting screws is when the dot of the screw is lined up with the dot of the frame.
2. Head aircraft on a magnetic North heading. Adjust N-S adjustment screw until compass reads exactly North.
3. Head aircraft on a magnetic East heading and do the same as Step 2, adjusting E-W adjusting screw.
4. Head aircraft on magnetic South heading and note resulting South error. Adjust N-S adjusting screw until one-half of this error has been compensated. No compensation adjustment shall be made with the combustion heater operating.
5. Head aircraft on magnetic West and do same as Step 4, adjusting E-W adjustment screw.
6. Head aircraft in successive magnetic 30 degree headings and record compass readings on appropriate deviation card. Deviations must not exceed $\pm 10^\circ$ on any heading. An additional deviation card will have to be made out for the combustion heater. This second deviation card shall be accomplished under the above conditions, except the combustion heater shall be operating.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

TROUBLESHOOTING.

CHART 3404. TROUBLESHOOTING (MAGNETIC COMPASS)

Trouble	Cause	Remedy
Excessive card error.	Compass not properly compensated.	Compensate instrument. (Refer to AC 43.13-1A Chapter 16, Section V.)
	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Insufficient liquid.	Replace or repair instrument.
Card sluggish.	Weak card magnet.	Replace or repair instrument.
	Excessive pivot friction or broken jewel.	Replace or repair instrument.
Liquid leakage.	Loose bezel screws.	Replace or repair instrument.
	Broken cover glass.	Replace or repair instrument.
	Defective sealing gaskets.	Replace or repair instrument.
Discolored markings.	Age.	Replace or repair instrument.
Defective light.	Burned out lamp or broken circuit.	Check lamp or continuity of wiring.
Card sticks.	Altitude compensating diaphragm collapsed.	Replace or repair instrument.
Card does not move when compensating screws are turned.	The gears that turn compensating magnets may be stripped.	Replace or repair instrument.
Compass swings erratically when radio transmitter is keyed.	Normal.	

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

DIRECTIONAL GYRO - AIR DRIVEN/ELECTRIC.

Both air and electrical 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 DG, the A.F.C.S. manufacturer's Service Manual should be consulted.

AIR DRIVEN DIRECTIONAL GYRO.

The air driven directional gyro is driven by the pneumatic system which is supplied by engine driven dry-pneumatic pumps either on pressure or vacuum. 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 RPM, 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 directional gyro has no reference to magnetic north, it must be set from the magnetic compass. The directional gyro 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 directional gyro 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 eliminate the friction of brush assemblies which would induce abnormal precession, the rotor armature is inductively excited. The electric directional gyro is subject to the same operational requirements of the air driven directional gyro, except for the method of obtaining rotor rotation and the design of the erection mechanism.

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

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.

— NOTE —

Air pressure must be $5.5 \pm .5$ psig.

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 directional gyro 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.

— NOTE —

Normal precession of the directional gyro is $\pm 3^\circ$ in 10 minutes or $\pm 4^\circ$ in 10 minutes if 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.

REMOVAL AND REPLACEMENT.

Refer to Chapter 39, Removal and Replacement of Face Mounted Instruments.

GYRO FITTING INSTALLATION PROCEDURE.

The following procedure applies to these aircraft having Edo-Aire air driven gyro installation. The use of teflon tape on fitting threads is recommended.

— CAUTION —

Permit no oil, grease, pipe compound or any foreign material to enter parts prior to installation of fittings. Make certain all air lines are clean and free of foreign particles and/or residue before connecting lines to gyro.

— NOTE —

Use of thread lube on fittings or in parts will create a "warranty void" condition.

34-22-05

Page 34-09

Added: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

1. Carefully lay teflon tape on the threads allowing one thread to be visible from the end of the fitting. Hold in place and wrap in the direction of the threads so tape will remain tight when fitting is installed.
2. Apply sufficient tension while winding to assure that tape forms into thread grooves. One full wrap plus $\frac{1}{2}$ inch overlap is sufficient.
3. After wrap is completed, maintain tension and tear tape by pulling in direction of wrap. The resulting ragged end is the key to the tape staying in place.
4. Press the tape well into the threads.
5. Screw fitting into port being careful not to exceed torque requirements as noted on decal on gyro cover.

GYRO 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. 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 prior to adjusting gyro air pressure.

Airflow directed at the gyro buckets causes the rotor spin approximately 17,000 to 22,000 rpm thus producing the gyroscopic ability to remain rigid in space. The instrument case moves freely about the spinning gyro rotor in three dimensions by 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 can show 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 parallax through a knob on the instrument face. This knob, when held in 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 attitude horizon is subject to the same operational requirements of the air driven attitude horizon, except for the method of obtaining rotor rotation and the design of the erection mechanism.

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

OPERATIONAL LIMITATIONS.

Unlike the directional gyro, the attitude horizon 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 right side up. The modern-day attitude horizon will not be damaged by such an extreme attitude and will correct itself in a short time. There are no roll limitations to the present attitude horizon. 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, noticeable erection results. However, if power is removed from the spinning rotor (such as when an engine is 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 attitude horizon the erection mechanism again begins to function. However, due to gyro rigidity because of high rotor speed, erection of the instrument takes considerably longer than normal. In flight, the air-driven attitude horizon exhibits small errors at roll out after a coordinated turn, skids and small pitch changes after acceleration and deceleration. The electric attitude horizon exhibits small errors in pitch and 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 attitude horizon is considered generally more efficient in operation and less subject to error than the air driven attitude horizon.

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 attitude horizon 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, systems regulators, faulty vacuum/ pressure gauges.

— NOTE —

Air pressure must be 5.5 + .5 psig.

Only after the system has proven to be good should the instrument be "pulled" for replacement or repair.

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 the 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 artificial horizon. Although the visual displays are different the gyro rotor rate detection designs are the same. The gyro motor 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/ pictorial horizon displays are mechanically dumped to slow or average minute

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

yaw and roll forces to the human operator's ability to interpret and respond 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 that the "ball" portion of both instruments **ONLY INDICATES 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 FAA approved instrument repair facility, or replacement. Service is restricted to the instrument installation and air electric power requirements.

GYRO INSTALLATION INSPECTION.

1. Ensure proper voltage is available.
2. Ensure electrical grounding is intact.
3. Ensure circuit breaker is functional.
4. Ensure all electrical plugs and connections are secure.

— END —

CHAPTER

35

OXYGEN

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

CHAPTER 35 - OXYGEN

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
35-00-00	GENERAL	218	1-83
35-01-00	Description and Operation	2118	
35-02-00	Troubleshooting	2120	
35-10-00	CREW PASSENGER SYSTEM	2121	
35-11-00	FIXED - Oxygen System	2122	
35-11-01	Inspection and Maintenance	2122	
35-11-02	Cleaning and Purging of Oxygen System Components	2J1	8-80
35-11-03	Swagelock Fitting Installations	2J2	
35-11-04	Application of Teflon Tape Thread Sealant	2J4	
35-11-05	Leak Tests	2J5	
35-11-06	Oxygen System Component	2J5	
35-11-07	Removal of Oxygen Cylinder	2J5	
35-11-08	Removal of Recharge Valve	2J6	
35-11-09	Installation of Recharge Valve	2J6	
35-11-10	Installation of Oxygen Cylinder	2J7	
35-11-11	Removal and Installation of Pressure Gauge	2J7	8-80
35-11-12	Removal of Outlets	2J7	
35-11-13	Installation of Outlets	2J8	
35-11-14	Removal and Installation of Oxygen ON OFF Control	2J8	
35-11-15	Refilling Oxygen System	2J8	8-80
35-12-00	PORTABLE - Oxygen System	2J10	
35-12-01	Testing for Leaks	2J10	
35-12-02	Maintenance	2J11	
35-12-03	Removal of Outlets	2J11	
35-12-04	Installation of Outlets	2J11	
35-12-05	Purging Oxygen System	2J11	

35 - Cont./Effec.

Page - 1

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

The purpose of this chapter is to give supplemental information for the servicing of the oxygen systems. Major repairs to the system and cylinder should be accomplished by an approved shop.

When refilling any oxygen cylinder make sure to use only aviation breathing oxygen as specified in MIL-O-27210C. The moisture content of aviation breathing oxygen cannot exceed 0.005 milligrams of water vapor per liter of gas at a temperature of 70° F and a pressure of 29.92 inches of mercury.

DESCRIPTION AND OPERATION. (Refer to Figures 35-1 and 35-2.)

A fixed and/or portable oxygen system is available for the 180T aircraft. Scott Aviation manufactures the major components for these systems and should be contacted along with Piper Customer Services for any further information not covered herein. For specific parts information refer to the Piper Parts Catalog.

The fixed oxygen system involves a 48.3 cu. ft. cylinder tied into four overhead "shallow wall" outlets, and a "push pull" regulator-control mechanism. A 3AA1800 tank, mounted in the modified tailcone behind the baggage compartment, is connected to an external fill valve mounted to the fuselage behind fuselage station bulkhead 191.0. The manifold for the outlets is set up such that the main feed line for the overhead outlets, is connected to the left rear passenger outlet from which the right rear and pilot outlets are connected. The copilot outlet is connected to the right rear passenger outlet. Push-pull control is provided by a knob on the overhead panel, to the left of the fresh air duct control. A gauge for displaying tank pressure is mounted in the overhead duct behind the passengers and is lighted by a post light.

The portable oxygen system uses a 22 cu. ft. capacity, 3AA1800 cylinder. The tank is incorporated in a carrying case which utilizes a dual manifold, permitting four masks to be used with dual connectors at each outlet. The portable unit fits in a cradle between the back passenger seats.

Refer to pilot operating handbook for operating instructions.

— WARNING —

DO NOT use grease or any type of grease fitting on any hardware connected to the oxygen system. When working with an oxygen system make sure hands, clothing, tools, and the immediate area are free of grease.

— NOTE —

Oxygen cylinders are identified by the ICC or DOT identification stamped on the cylinder. The standard weight cylinder (ICC or DOT 3AA1800) must be hydrostatically tested every 5 years. The month and year of the last test is stamped beneath the ICC, DOT identification.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

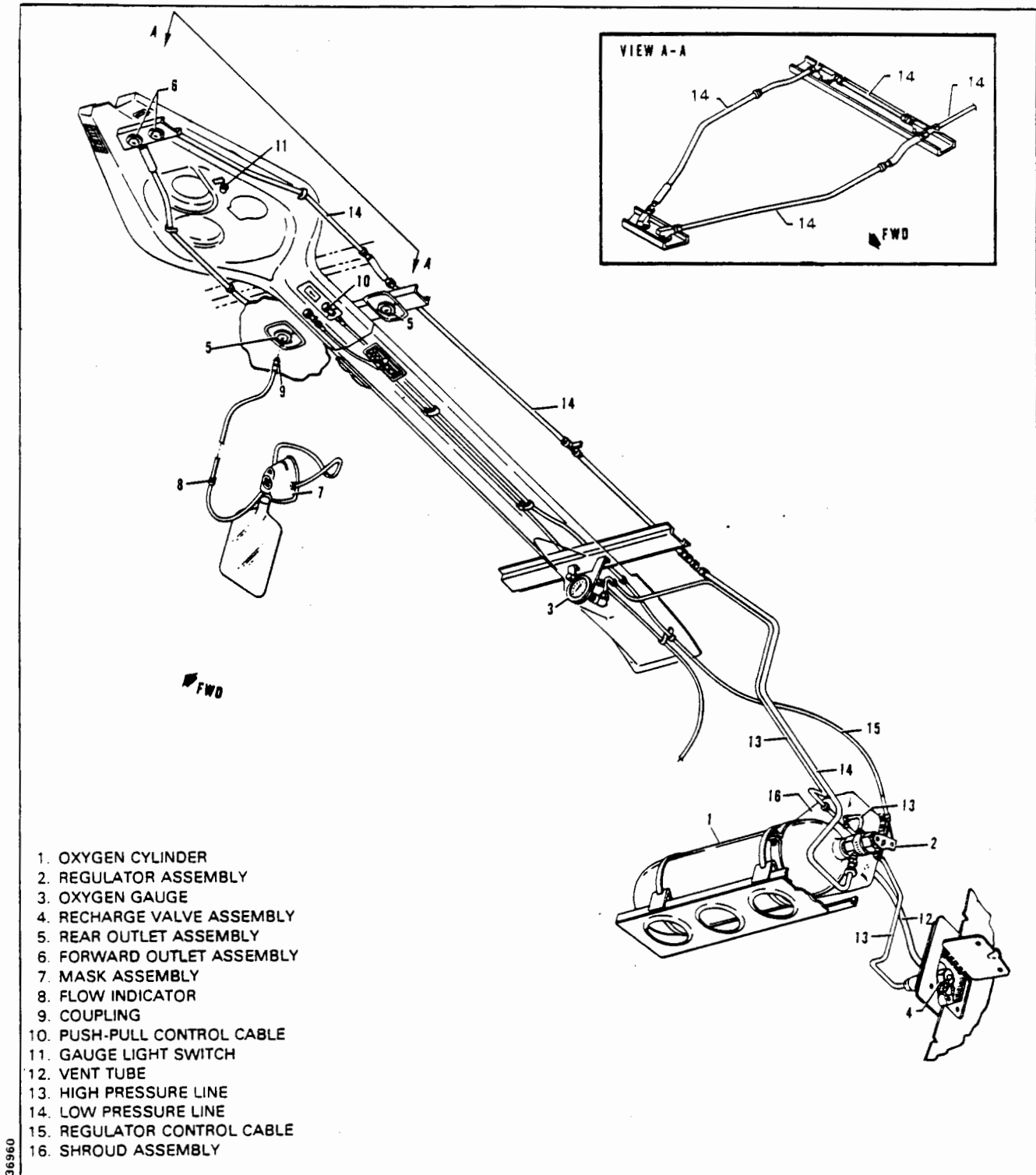


Figure 35-1. Fixed - Oxygen System

35-01-00
Page 35-02

Revised: January 3, 1983

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

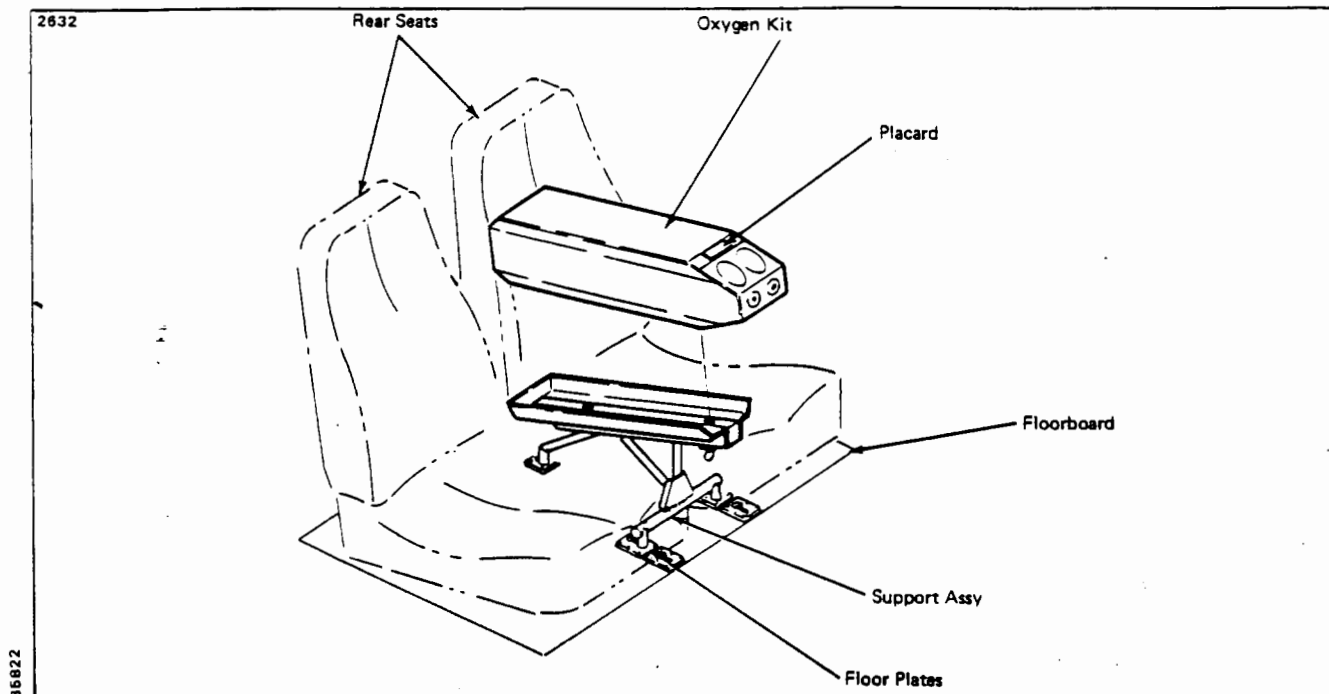


Figure 35-2. Portable - Oxygen System

TROUBLESHOOTING. (Refer to Chart 3501.)

CHART 3501. TROUBLESHOOTING (OXYGEN SYSTEM)

Trouble	Cause	Remedy
No indication of pressure on pressure gauge.	Cylinder empty and/or leak in system has exhausted pressure. (Refer to appropriate section of this chapter for effective maintenance.)	¹ Purge, charge, and check system for leaks. ² Charge bottle and check system for leaks.
	Pressure gauge defective.	¹ Replace pressure gauge. ² Return unit to manufacturer or take to an approved shop.
NOTES: 1. Fixed oxygen system affected only. 2. Portable oxygen system affected only.		

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3501. TROUBLESHOOTING (OXYGEN SYSTEM) (cont)

Trouble	Cause	Remedy
Effective pressure indicated but no oxygen flow with clear lines.	Oxygen cylinder regulator assembly defective.	¹ Vacate bottle and replace regulator assembly. ² Return to manufacturer or have repaired by an approved shop.
Offensive odors in oxygen.	Cylinder pressure below 5 psi, or foreign matter in system.	Purge oxygen system as prescribed in this chapter.
NOTES: 1. Fixed oxygen system affected only. 2. Portable oxygen system affected only.		

CREW/PASSENGER SYSTEM.

— CAUTION —

Do not attempt to tighten any connections while the system is charged. Bottles which have been evacuated to 5 psi for a significant length of time, or those that do not produce an audible hissing sound when the valve is cracked, should be removed and hydrostatically tested. If either of these conditions has existed for a significant length of time it also is recommended that the system be purged. Make sure that no oil, grease, hydraulic fluid, or fuel is in the vicinity of any fittings being serviced. Do not use thread lubricant of any kind. Teflon tape (M.M.M. No. 48) should be used on TAPERED pipe threads without the tape extending beyond the first thread, refer to affective information in this chapter. Before working with the system make sure the aircraft is electrically grounded, and your hands and cloths are free of oil, grease, and dirt.

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

FIXED OXYGEN SYSTEM.

INSPECTION, MAINTENANCE AND OVERHAUL TIME LIMITS.

Due to the nature of the process used to test compressed gas tanks, servicing and hydrostatic tests must be conducted by a DOT or manufacturer (Scott Aviation) approved shop. The following material gives recommended inspection and maintenance information for the various parts of the oxygen systems.

— NOTE —

Oxygen cylinders are identified by the ICC or DOT identification stamped on the cylinder. The standard weight cylinder (ICC or DOT 3AA1800) must be hydrostatically tested at the end of each 5 year period. Lightweight cylinders (ICC or DOT 3HT1850) must be tested every 3 years and be replaced after 4380 refills or 24 years, whichever comes first. The month and year of the last test should be stamped on the cylinder beneath the ICC, DOT identification.

1. Check the outlets for leakage both in the use and non-use condition, and for leakage around an inserted connector. For leak testing information refer to the appropriate subject in this chapter.
2. Check the high pressure gauge for accuracy by comparing its indicated pressure with that of a gauge of known accuracy connected to the fill port.
3. Inspect tank for dents, bulges, corrosion, and major strap chafing marks. Should any of these problems exist, the tank should be removed and hydrostatically tested.
4. An operational check of the regulator can be accomplished as follows: (Refer to Figure 35-3.)
 - A. Interconnect a sensitive pressure gauge having a range of 0 to 100 psi, with a Scott Aviation 8570-00 plug-in, and connect the apparatus to the pilots outlet in the overhead panel. It is recommended that a hose of 1/4 in. I.D. x 1/2 in. O.D. and 18 inches long be used.
 - B. Interconnect a pneumatic flow apparatus having a range of 0-5 liters per min (1 pm.), with a Scott Aviation 8570-00 plug-in. Use the same hose dimensions as explained in the last step. Connect the flow apparatus to the co-pilot's outlet.
 - C. Insert a Scott plug-in in each of the other outlets and pull the oxygen control knob to the on position. The pressure and flow should be 55 to 80 psi and 3.3 to 5.3 l pm. respectively, at sea level.
 - D. There should be no external leakage anywhere on the regulator when it is turned off, and all fittings leak free.
5. Check airframe log book for last maintenance on oxygen system and perform as required per Chart 3502.
6. Test the oxygen for odor. Pure oxygen is odorless and tasteless. Any system having a significant odor present in the gas should be purged and the bottle replaced or removed and purged.
7. Any fittings, connectors, and tubes which have imperfect threads, pitted or disfigured cones, or other damage should be replaced.

— CAUTION —

Oxygen tubes must not be clamped to or supported by electrical wire bundles, hydraulic, pneumatic or other lines.

8. Check plumbing for kinking, cracks, gouges, dents, deep scratches, or other damage, and replace as necessary.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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

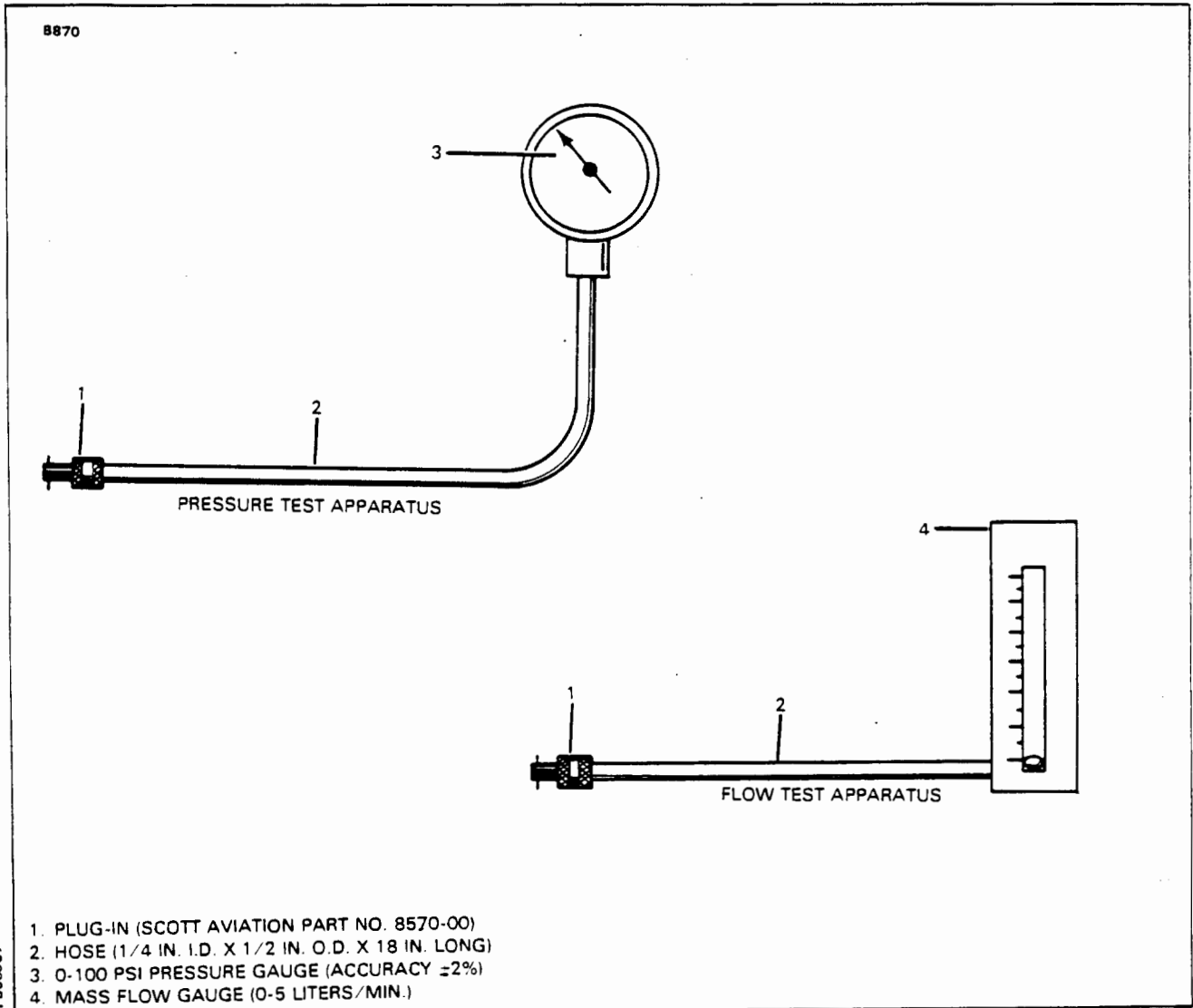


Figure 35-3. Test Apparatus For Testing Oxygen System

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

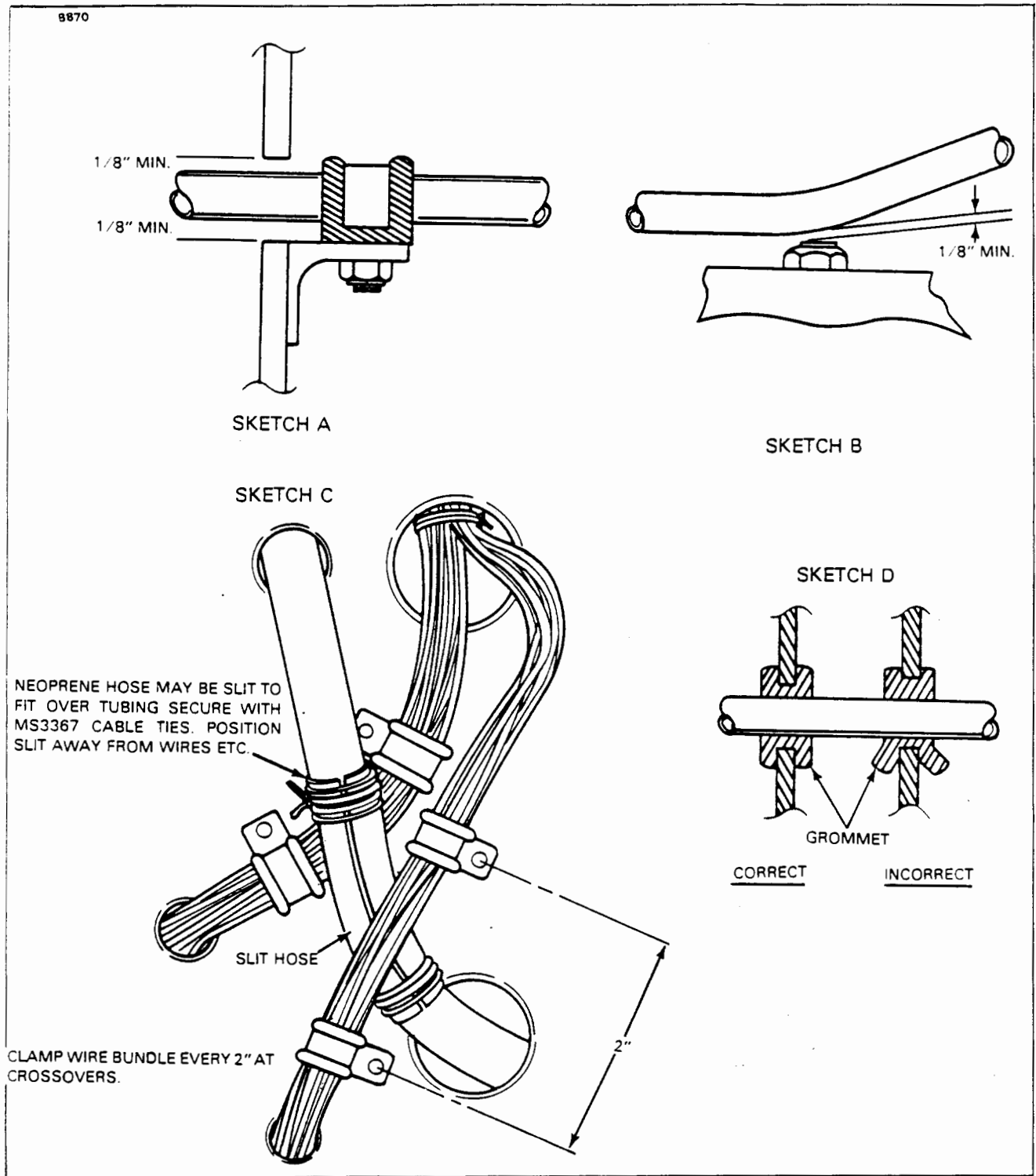


Figure 35-4. Oxygen Tubing Installations

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

9. Make sure to check the oxygen lines for proper clearance as follows: (Refer to Figure 35-4.)
 - A. Two inch minimum between oxygen tubes and all flexible moving parts of the aircraft (flexible control cables, etc.). If enough space cannot be attained, protection from abrasion must be provided.
 - B. At least $\frac{1}{2}$ inch minimum between oxygen tubes and all rigid moving parts of the aircraft such as levers and rigid control rods.
 - C. Six inch minimum separation between oxygen tubes and hydraulic, fuel, and electrical system lines and components.
 - (1) When the six inch requirement cannot be complied with, one inch is allowed as long as electrical cables and other lines are supported at least every two inches; and, the oxygen tube(s) is protected by rubber neoprene hose fastened in place with cable ties at the location the specific item crosses or is near the oxygen tube(s). If an item is near the oxygen tube for a certain distance the oxygen tube for that distance must be covered.
 - D. A minimum of $\frac{1}{8}$ inch between tubing and structure adjoining the supporting clamp, as shown in Figure 35-4, Sketch A.
 - E. Where a tube passes through a grommet, the tube must not bear on the grommet in any way that might cause cutting of the grommet in service as shown in Figure 35-4, Sketch D.
 - F. While in service, items may receive vibrations causing them to come in contact with other parts of the aircraft. With this in mind, low pressure tubing that is supported well enough to prevent relative motion must have at least a minimum clearance of $\frac{1}{8}$ inch from a projection (bolt, nut, etc.). Low pressure tubing that cannot be supported well enough to prevent motion must have a minimum clearance of $\frac{1}{4}$ inch allowed after the maximum travel of the tube. High pressure lines are affected similarly but require $\frac{1}{2}$ inch minimum clearances. Refer to Figure 35-4, Sketch B.
10. Perform any other required maintenance as directed in AC 43.13-1A, Chapter 8.
11. Clean components as necessary per the following subject-paragraph.

CLEANING AND PURGING OF OXYGEN SYSTEM COMPONENTS.

— CAUTION —

Care and attention to detail are essential to prevent contamination of components by oil, grease, water, or foreign matter. Compressed air used in cleaning and flushing tubes must be clean, dry, filtered (oil free) air only.

Three methods are recommended for cleaning oxygen system components as follows:

1. Method I.
 - A. Vapor degrease affected part(s) with trichlorethylene.
 - B. Blow part(s) dry with a stream of compressed air, or dry nitrogen. Refer to previous caution.
2. Method II.
 - A. Flush with naphtha conforming to specification TT-N-95.
 - B. Blow clean and dry off all solvent with clean, dry, filtered air. Refer to previous caution.
 - C. Flush with isopropyl alcohol.
 - D. Rinse thoroughly with fresh water.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

E. Dry with air as described in previous caution or by heating at a temperature of 250° to 300° F for one half hour.

— NOTE —

Solvents can be reused provided they do not become excessively contaminated with oil. This condition can be determined by thoroughly evaporating 100 milliliters of the liquid in a glass dish of a determined weight. Evaporation may be accomplished by heating the dish at 200° F for one half hour. If after evaporation and cooldown, the residue exceeds 100 milligrams in weight, the solvent shall not be reused.

3. Method III.
 - A. Flush with hot inhibited alkaline cleaner until free from oil and grease.
 - B. Rinse thoroughly with fresh water.
 - C. Dry thoroughly with a stream of clean air as described in the previous caution, or by heating 250° to 300° F for one half hour minimum.
4. After cleaning, all tubing must be protected by caps, plugs, and or plastic bags.

— CAUTION —

Do not use adhesive tape on oxygen components for attaching or securing protective coverings. Use Ludlow No. 6 waxed lacing twine or tie wraps.

5. Before reinstallation make sure fitting, tube, and fixture threads are in good condition and that the cones do not exhibit pitting or disfigurement.

SWAGELOC FITTING INSTALLATIONS. (Refer to Figure 35-5.)

— NOTE —

The high pressure line fitting at the regulator should be tightened until it bottoms. Make sure to use teflon tape on all male pipe threads.

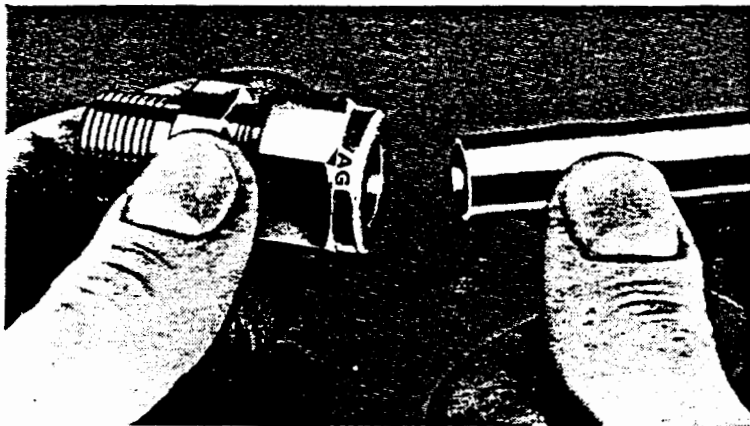
1. For swageloc fittings not preswaged or for in-aircraft installation, proceed as follows:
 - A. Turn the fitting nut onto the fitting finger tight, and insert the tube until it bottoms firmly on the shoulder in the fitting.
 - B. Tighten the nut with a wrench until the tube will not turn by hand.
 - C. Mark the nut at the six o'clock position.
 - D. Hold the fitting body steady with a backup wrench and tighten as follows:
 - (1) On tubing with a diameter bigger then 3-16 inch, tighten 1 1/4 turns (to the nine o'clock position).
 - (2) On tubing of 1-16, 1-8, and 3-16 inch diameter tighten only 3/4 turn.
 - E. If nut and tube must be disconnected from the fitting reconnect by seating the tube on the shoulder of the fitting and tightening the nut finger tight. Follow up by tightening the nut with a wrench, one-quarter turn (if absolutely necessary the original 1 1/4 or 3/4 tight position) and then snug with wrench.

35-11-03

Page 35-09

Revised: January 3, 1983

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

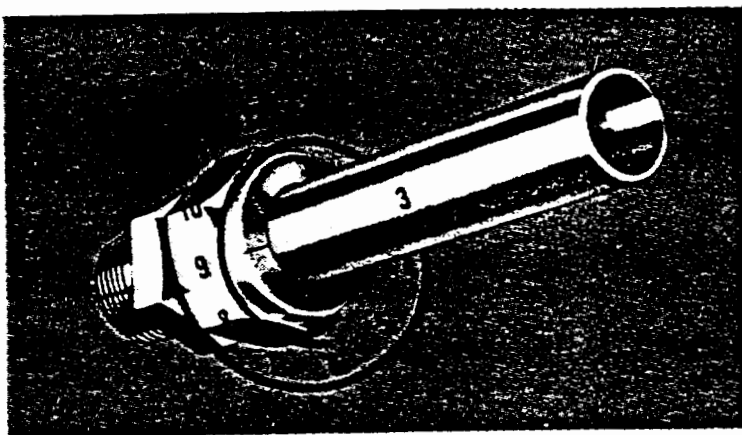
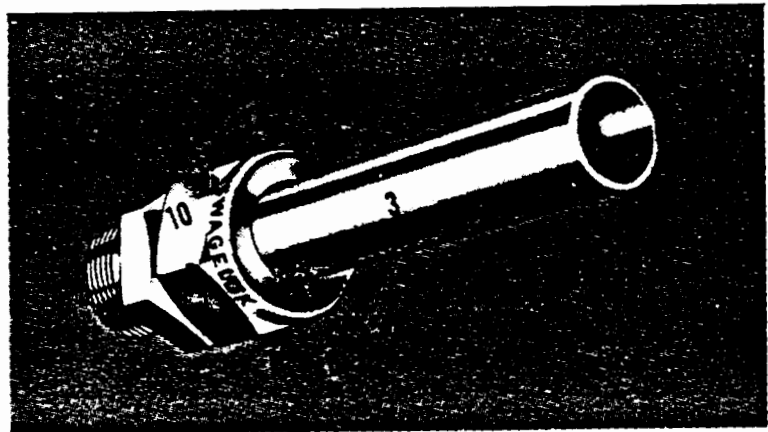


STEP 1

TURN THE FITTING NUT ONTO THE FITTING FINGER TIGHT AND INSERT THE TUBE UNTIL IT BOTTOMS FIRMLY ON THE SHOULDER IN THE FITTING.

STEP 2

MARK THE NUT AT THE SIX O'CLOCK POSITION.



STEP 3

HOLD THE FITTING WITH A WRENCH AND TIGHTEN THE FITTING NUT AS FOLLOWS:

- A. TUBING WITH A DIAMETER GREATER THAN $3/16$ INCH SHALL BE TIGHTENED $1 \frac{1}{4}$ TURNS (THE NINE O'CLOCK POSITION).
- B. TUBING WITH A DIAMETER OF $1 \frac{16}{8}$ OR $3/16$ INCH SHALL BE TIGHTENED ONLY $3/4$ TURN.

Figure 35-5. Installation of Swagelok Fittings

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2. Preswaged swageloc fittings are fabricated and installed as follows:
 - A. Assemble the nut and ferrules finger tight on the pre-swaging tool and insert the tube until it firmly bottoms on the shoulder in the tool. The pre-swaging tool can be attained from Crawford Fitting Company, refer to List of Consumable Materials in Chapter 91.
 - B. Tighten the nut on the fitting just enough that the tube within the fitting will not turn by hand.
 - C. With a wrench tighten the nut as follows:
 - (1) On tubing with diameters over 3/16 inch, tighten 1 1/4 turns.
 - (2) On tubing with 1/16, 1/8, or 3/16 inch diameter tighten 3/4 of a turn.
 - D. Unscrew the nut to release the ferrule tube assembly from the tool.
 - E. The assembly is installed on the fitting as follows:
 - (1) Slide tube in fitting until it bottoms, turn nut to finger tight position, and tighten one quarter turn with wrench.
 - (2) Snug slightly with wrench.

APPLICATION OF TEFLON TAPE THREAD SEALANT.

All male pipe (tapered) threads of the oxygen system should be sealed with 3M No. 48 teflon tape. Teflon tape should not be used on straight threads. Do not use any other lubricants in place of the teflon or on any other threads.

1. Wrap tape on the threads, starting with those farthest from the opening, in the direction of the thread spiral. Circle the threads, making sure that each side of the tape has a slight overlap.
2. Wrap the tape such that it does not extend beyond the last thread on the fitting at the opening. The tape should then be pulled till it separates. Do not cut the tape, it will not stick properly.

CHART 3502. OXYGEN SYSTEM LIMITS

PARTS	INSPECTION	OVERHAUL
Regulator	300 Flight Hrs.	5 Years
Pressure Gauge	300 Flight Hrs.	Replace on Condition
High Pressure Lines	300 Flight Hrs.	Replace on Condition
Low Pressure Lines	300 Flight Hrs.	Replace on Condition
Outlets	300 Flight Hrs.	Every 5 Years ¹
External Recharge Valve	Each Use	Every 5 Years ²
Masks	Each Use	Replace as Necessary

NOTES: 1. On condition replace the rubber components in the assembly or replace assembly.
2. If the screen in front of valve is dirty, replace valve. Valve replacement is recommended for every 5 years.

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

LEAK TESTS.

Solutions recommended for leak testing are Leak-Tec Formula #16-OX, and that available from Scott Aviation. Refer to the List of Consumable Materials for consumer information.

1. Remove the royalite covers in the baggage compartment and, with the oxygen system turned off, disconnect the low pressure supply line and connect it to a regulated cylinder charged with dry nitrogen.

— NOTE —

Whenever a leak check is performed all fitting connections as well as other questionable areas, should be inspected.

2. Apply the leak detector solution to the test surface and watch for indication of leakage.
3. Large leaks will produce bubbles immediately, but small leaks will form a white foam in 5 to 60 seconds.
4. With outlets vacated of masks, connect a test pressure gauge to the co-pilot's outlet as described in the subject paragraph on Inspection and Maintenance. See Figure 35-3.
5. Adjust the regulator on the dry nitrogen cylinder for 100 psi and check for leakage at the outlets.
6. Correct any leaks and wipe off excess leak detector solution.
7. Close the valve on the nitrogen gas tank and insert a Scott plug-in to relieve system pressure.
8. Disconnect test gauge, plug in, and nitrogen tank.
9. If the oxygen cylinder is not to be hooked up or installed immediately, cap and cover the exposed fittings with new clean plastic bags. Temporarily support lines as needed to prevent damage. Make sure caps and coverings are as clean as possible.

OXYGEN SYSTEM COMPONENTS.

Keeping in mind the effect of compressed oxygen on materials, oxygen system components must be handled carefully. Ports on regulators, indicators, and other opened components must also be kept capped or plugged to prevent ingestion of foreign material. Adjustments or modifications should only be initiated under the auspicious of the FAA, Piper, or Scott Aviation.

REMOVAL OF OXYGEN CYLINDER. (Refer to Figure 35-1.)

— NOTE —

Replacement time for the recharge valve is every 5 years. If the cylinder is being removed for the 5 year test, it is recommended the valve be removed and/or replaced at the same time.

The oxygen bottle, located behind the finished bulkhead in the baggage compartment, is secured to a removable shelf mounted to each side of the fuselage. The tank is mounted such that the regulator-control valve is on the left side of the aircraft, the same side as the recharge valve. A shroud also covers the regulator end of the bottle to prevent leaks, should any develop, from filling the aircraft with oxygen. With this in mind, a vent tube interconnects the shroud with the recharge valve fixture permitting any oxygen to vent overboard.

1. Remove the screws attaching the finished bulkhead to the fuselage bulkhead, and remove the finished bulkhead.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

2. It is recommended that when working in the rear of the aircraft an appropriate tailstand be properly attached to the tail.
3. With the immediate area clear of flammables (grease, hydraulic fluid, fuel) and oxygen system off, connect a mask or tube to an outlet to exhaust any pressure in the system.
4. Remove the screws and loosen the clamps securing the shroud to the cylinder and regulator-control valve.
5. Remove the spring clamps securing the vent tube to the cylinder shroud and disconnect the tube.
6. Carefully separate the shroud along the high pressure lines.
7. The high pressure fitting on the regulator-control valve incorporates a valve that opens only when a line is connected with it. With this in mind, carefully unscrew the high pressure line until the pressure decreases, and then remove the line. Disconnect low pressure lines as well.
8. Loosen and open the clamps securing the bottle to the shelf. Carefully move the bottle in such a way that fair access can be made to the control mechanism.
9. Disconnect the control cable. Be careful not to kink the cable.
10. Remove tank from aircraft being careful not to damage the regulator-control valve.

REMOVAL OF RECHARGE VALVE.

The recharge valve is located on the left rear side of the aircraft and is covered by its own access door. The valve is interconnected with the gauge line as well as the regulator-control valve and is constantly under cylinder pressure as long as the high pressure line is attached to the regulator.

— NOTE —

The recommended service life for the recharge valve is 5 years, and the oxygen cylinder must be hydrostatically tested every 5 years. With these circumstances in mind it is recommended that the recharge valve be removed and replaced when the cylinder is removed for services.

1. Due to the location of the recharge valve it is necessary to remove the oxygen cylinder. For ease of removal it is recommended that the cylinder shelf also be removed.
2. Remove the screws that secure the recharge valve's protective shroud to the valve mounting dish, and slide the shroud back over the high pressure line.
3. Unscrew the high pressure line fitting from the recharge valve and with somebody turning the screw from outside the aircraft, back-up the nut to remove the valve.

INSTALLATION OF RECHARGE VALVE.

1. Insert the valve through the aperture in the mounting cup and align the bolt holes.
2. With the safety chain and information plate mounting washer aligned at one of the holes, install the mounting bolts.
3. Apply teflon tape to male threads as explained earlier in this section.
4. Reconnect the high pressure line to the valve and torque the fitting 30 to 50 inch pounds.
5. Install the valve protective shroud.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF OXYGEN CYLINDER.

1. Before mounting the cylinder to the shelf, connect the control cable to the control valve-regulator. If the shelf has been removed reinstall it before continuing. Install teflon tape per prior instructions in this chapter.
2. Position cylinder on shelf and install the pressure lines. Insert tubing into fitting until ferrule seats in fitting. Tighten the nut by hand and then one quarter turn with a wrench. If fitting is relatively new the nut might be turned $\frac{3}{4}$ of a turn. Follow up by snugging the nut slightly with a wrench.
3. Install the cylinder protective shroud and tighten the clamps securing it to the tank, and valve.
4. Secure the cylinder to the shelf by connecting and tightening the clamps.
5. If vent tube has been disconnected from the shroud make sure it is firmly attached to both the cylinder and valve shrouds.
6. Make sure all seals are properly in place in the cylinder shroud. Make sure the MS35489-35 seal is in the bottom of the shroud where the low pressure line comes through. The two seals where the high pressure lines go into the shroud are MS35489-2 grommet seals.
7. Check pressure and refill bottle as necessary.
8. Inspect for leaks, especially at fittings that have been separated.

REMOVAL AND INSTALLATION OF PRESSURE GAUGE.

1. The pressure gauge is tied into the same high pressure line as the recharge valve, through a tee fitting at the tank regulator-control valve. The high pressure line connects into the valve such that it actuates a check valve permitting pressure to the line. Disconnect the high pressure fitting at the tank valve being careful to only unscrew it a little at a time so as to allow the pressure to bleed off. Cap the lines as soon as possible after removal.
2. Remove the overhead vent panel and remove instrument from bracket as follows:
 - A. Disconnect the tube from the fitting at the rear of the instrument.
 - B. Immediately cap the oxygen line.
 - C. Snap off the clip securing the instrument in its bracket.
 - D. If the fitting on the rear of the instrument is to be reused remove, clean threads, and using tape, install fitting on new gauge. Refer to appropriate section in this chapter.
3. Install gauge as follows:
 - A. With fitting installed on rear of instrument install gauge in bracket. Make sure clip is properly secure.
 - B. Remove cap from oxygen line and with teflon tape properly installed, connect the oxygen line to the fitting.
 - C. Reinstall fitting in tank.

REMOVAL OF OUTLETS.

1. Make sure the oxygen system is completely turned off. Insert an oxygen mask to release pressure, and insure the system is off.
2. With a suitable spanner wrench, remove the outer half of the outlet.
3. Remove the screws retaining the trim panel and remove same.
4. The outlet can now be disconnected from the low pressure line(s). Make sure to cap lines immediately after disconnection.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

INSTALLATION OF OUTLETS.

1. Apply teflon tape to male threads of the affected fitting. Refer to appropriate procedure in this chapter.
2. Connect the outlet to the low pressure line.
3. Position the trim panel and secure with screws.
4. Position and secure the outer half of the outlet with a suitable spanner wrench.
5. Torque the fittings onto the outlets to approximately 30 in. lbs. Do not overtorque.

REMOVAL AND INSTALLATION OF OXYGEN ON/OFF CONTROL. (Refer to Figure 35-1).

1. As shown in Figure 35-1, the on/off control is mounted in the overhead vent panel. To remove the control, drop the overhead panel and ducting, and remove the retaining nut from the rear of the control cable fitting.
2. Make access to the bottle, if necessary, and disconnect the cable from the regulator-control mechanism.
3. Cut the tie wraps securing the cable and pull cable from aircraft.
4. When installing a new cable, make sure new cable shield is cut to 84.0 inches long and that the core has sufficient material to make a twin loop two inches from the end of the shield. Install as follows:
 - A. Rout cable through the hole in the overhead duct and as shown in Figure 35-1. Tie wrap the cable as before.
 - B. Make sure the cable properly reaches the valve and reinstall vent and panels. Reconnect cable to control mechanism.

REFILLING OXYGEN SYSTEM.

— CAUTION —

Before servicing the oxygen system make sure the aircraft is securely grounded electrically.

Do not attempt to tighten any connections while the system is charged.

Do not operate any electrical equipment while servicing oxygen system.

Personnel involved in servicing or functionally testing an oxygen system are likely to have their clothing permeated with oxygen. DO NOT smoke or stand near an open flame for a period of 15 minutes after work is completed.

Refilling of oxygen systems should be done by qualified personnel. For comparison of filling pressures to ambient temperatures refer to Chart 3503. The following are parameters to be followed for filling.

1. Only aviators breathing oxygen (MIL-O-27210) and appropriate filling equipment should be used to fill the system.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3503. FILLING PRESSURE FOR CERTAIN AMBIENT TEMPERATURES

Ambient Temperature	Filling Pressure	Ambient Temperature	Filling Pressure
0	1650 (PSI)	70	1975 (PSI)
10	1700	80	2000
20	1725	90	2050
30	1775	100	2100
40	1825	110	2150
50	1875	120	2200
60	1925	130	2250

NOTE: Filling pressures are for 1850 PSI at 70° F. Table assumes 25° F rise due to heat of compression with max fill rate.

2. If a cylinder has less than 5 psi, pressure or has insufficient pressure to produce an audible hissing sound when the valve is cracked, it should be removed and shall not be refilled.
3. Make sure both the charge valve and recharge "cart" fittings are clean and free of contamination.

— WARNING —

***BE CERTAIN THERE IS NO OIL ON THE FITTINGS OR
NEAR THE IMMEDIATE VICINITY.***

4. Attach service cart hose to recharge port. Fill the system at a rate not exceeding 200 psig per minute proceeding as follows:

A. To obtain the correct filling pressure for the oxygen system at various ambient temperatures, a table is included for your convenience. The pressures given are not exact, but sufficiently accurate for practical purposes of working pressures between 1800 and 2400 psig cylinders. The cylinder should be allowed to cool to a stabilized temperature after filling before checking against the values in Chart 3503.

B. When using a recharge unit consisting of one supply cylinder, slowly open the valve of the supply unit and allow the oxygen to transfer.

C. When using a recharge unit consisting of two or more supply cylinders (cascade storage system), it is recommended that the following procedure be used:

- (1) Before opening any valves, check the pressure remaining in the airplane's oxygen cylinder. If it is 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.
- (2) 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.
- (3) 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

- (4) 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 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.
- (5) 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.

D. 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 3503 after the cylinder temperature stabilizes.

5. After detaching the service cart, cap hose and fittings to prevent contamination.
6. Perform a leak check of the high pressure lines and clean off solution afterwards. If solution is not properly cleaned off, unusual corrosion may result.

PORTABLE - OXYGEN SYSTEM. (Refer to Figure 35-2.)

Due to the nature of the process used to test compressed gas tanks, it is recommended that overhaul, service, or hydrostatic tests be conducted by an FAA, DOT, or manufacturer (Scott Aviation) approved shop. The following material gives recommended inspection and maintenance information for the various parts of the oxygen system.

— NOTE —

Oxygen cylinders are identified by the ICC or DOT identification stamped on the cylinder. The standard weight cylinder (3AA 1800) must be hydrostatically tested at the end of every five years. Light weight cylinders (3HT 1850) must be tested every 3 years and be replaced after 4380 refills or 24 years whichever comes first. The month and year of the last test is stamped on the cylinder beneath the identification.

1. Inspect outlets, and test for leaks in the "use" and "non-use" condition. Refer to next subject paragraph.
2. Check pressure gauge for accuracy by removing the back section of the unit and connecting a gauge of known accuracy to the fill port.
3. Inspect tank for dents, bulges, major strap chafing marks or corrosion. Should any of these conditions exist, the tank should be hydrostatically tested.

TESTING FOR LEAKS.

Apply detector fluid Leak-Tec Formula #16-OX (see Chart 9101) or an equivalent. The solution should be shaken to obtain suds or foam. The solution should be applied sparingly to the joints of the system while looking for traces of bubbles. Visible leaks are not allowed and any defective parts replaced or repaired. The system should be further observed for leaks when fully pressurized. All traces of detector fluid should be wiped off at the conclusion of the examination.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

MAINTENANCE.

1. Check the cylinder to be sure it is securely mounted.
2. Check the cylinder for the ICC identification number and for the date of the last F.A.A inspection and test.
3. If cylinder is completely empty it must be completely disassembled and inspected in an F.A.A or manufacturer approved facility before recharging.
4. Refer to FAA Manual AC 43.13-1A for more details.

REMOVAL OF OUTLETS.

1. Make sure the control valve is in the full off position.
2. Connect a mask or connector to the valve to release any pressure.
3. Using a suitable spanner wrench, remove the outlet.
4. The outlet can now be removed from the low pressure fitting.

INSTALLATION OF OUTLETS.

1. Apply sealant (Permacel 412) to the male end of the fitting.
2. Install the outlet to the regulator extension with a suitable spanner wrench.
3. Torque the fittings into the outlets approximately 30 inch-pounds. Do not over torque as this could damage the outlet.

PURGING OXYGEN SYSTEM.

The system should be purged whenever the cylinder pressure falls below 50 psi or if any lines are left open for any length of time. Also, if the bottle is left at below 200 psi it may develop odors from bacterial growth. This will make it necessary to purge the system. Use the following procedures:

— CAUTION —

*When performing this operation make sure the area is a NO
SMOKING AREA, and it is as clean as possible of oil and dirt.*

CHART 3504. PORTABLE OXYGEN SYSTEM COMPONENT LIMITS

PARTS	INSPECTION	OVERHAUL
Regulator	300 Flight Hrs.	5 Years
Pressure Gauge	300 Flight Hrs.	5 Years
Outlets	300 Flight Hrs.	5 Years
Recharge Valve	Each Use	Replace Every 3 Yrs.
Masks	Each Use	Replace as Necessary

— END —

CHAPTER

37

VACUUM

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 37 - VACUUM

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
37-00-00	GENERAL	2J14	
37-01-00	Description and Operation	2J14	
37-02-00	Troubleshooting	2J14	
37-10-00	DISTRIBUTION	2J18	
37-11-00	Vacuum System Service Tips	2J18	2-81
37-12-00	Vacuum Gauge	2J20	
37-13-00	Removal and Installation of Face Mounted Instruments	2J20	
37-14-00	Vacuum Regulator Valve	2J20	
37-14-01	Adjustments to Vacuum Regulator Valve	2J21	2-81
37-14-02	Removal and Replacement of Regulator Valve	2J21	
37-15-00	Vacuum Pump	2J21	8-80
37-15-01	Removal and Installation of Vacuum Pump	2J21	

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

The instrumentation is designed to give a quick and actual indication of the attitude, performance and condition of the airplane. Maintenance, other than described in this chapter shall be done by the instrument manufacturer or an authorized repair station.

DESCRIPTION AND OPERATION.

The vacuum system employed to operate the gyro instruments is comprised of two engine driven dry vacuum pumps, two vacuum regulator valves containing filters, a check valve and the necessary tubing on each engine. A vacuum gauge is used to constantly monitor the system. If vacuum is lost from either vacuum pump or from any other malfunction, the check valve automatically closes and vacuum is supplied by one pump. In this case one of the two red malfunction buttons appears on the face of the gauge, indicating that vacuum is not available from that side. An air filter is incorporated in the system to increase the life of the gyros. The filter is mounted behind the instrument panel in the upper left-hand corner and should be replaced at each 100 hours of operation. The instruments in this system are face mounted located on the instrument panel.

TROUBLESHOOTING.

A Troubleshooting Chart is provided to assist in locating and correcting possible malfunctions in the system.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

2290

1. VACUUM GAUGE
2. INSTRUMENTS
3. FILTER
4. PUMPS
5. REGULATORS
6. MANIFOLD

NOTES

1. WHEN INSTALLING FITTINGS INTO INSTRUMENT CASES, DO NOT EXCEED PLACARDED TORQUE LIMITATIONS.
2. LOCATION OF MANIFOLD ASSEMBLY ON 44-180 S/N: 44-8195019 AND UP, AND 44-180T S/N: 44-8107027, 44-8107049 AND UP.

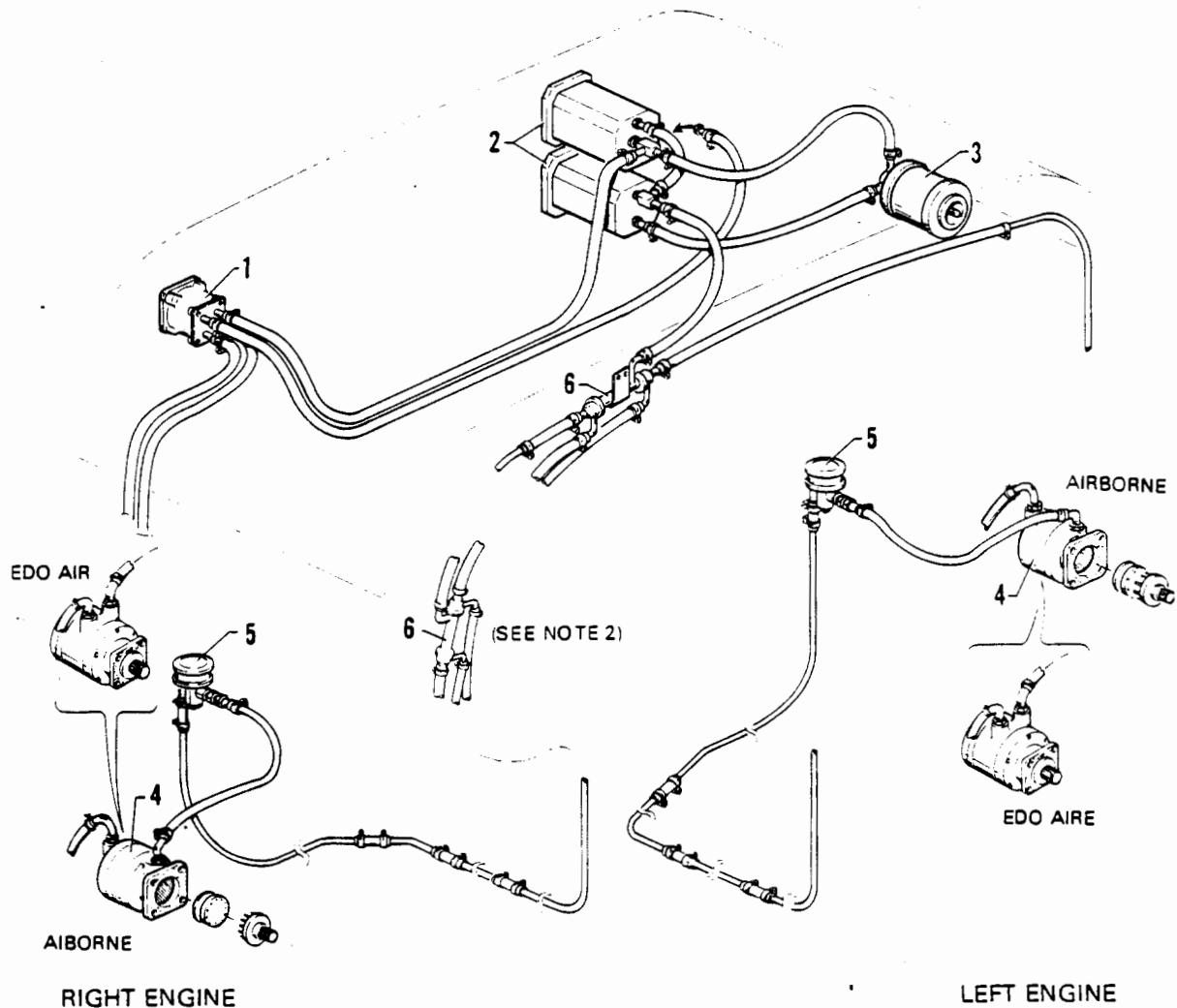


Figure 37-1. Vacuum System Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3701. TROUBLESHOOTING (VACUUM SYSTEM)

Trouble	Cause	Remedy
Vacuum correct on ground but will not maintain pressure at altitude.	Vacuum pump malfunctioning.	Replace pump.
	Regulator sticky.	Clean regulator.
Vacuum correct but pilot reports pressure erratic or shows complete loss in flight.	Regulator sticky.	Clean regulator.
	Oil in pump due to leaky engine seal or cleaning fluid blown into pump while cleaning engine.	Replace pump.
Pressure can only be maintained at full throttle on ground.	Leak in system.	Repair or replace lines.
	Worn pump.	Replace pump.
	Stuck regulator.	Clean or replace regulator.
Normal pressure indication but sluggish operation of instruments.	Faulty flight instrument.	Replace instrument.
High system pressure.	Vacuum regulator incorrectly adjusted.	Adjust regulator.
	Vacuum regulator sticking or dirty filter.	Clean and check operation of regulator.
Regulator cannot be adjusted to produce correct pressure.	Lines leaking.	Check lines and fittings.
	Vacuum pump malfunctioning.	Replace pump.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3701. TROUBLESHOOTING (VACUUM SYSTEM) (cont)

Trouble	Cause	Remedy
No vacuum gauge indication at instrument.	Filter clogged or dirty.	Clean or replace filter.
	Line from gyros to filter restricted or leaking.	Check line.
No vacuum gauge indication at instrument.	Faulty gauge or malfunctioning pump.	Replace gauge. Replace pump.
Low vacuum system pressure.	Filter dirty.	Clean or replace filter.
	Vacuum regulator valve incorrectly adjusted.	Adjust regulator valve in accordance with adjustments in this section.
	Line from gyro to filter restricted or leaking.	Repair line.
	Line from pump to manifold leaking.	Check all lines and fittings.

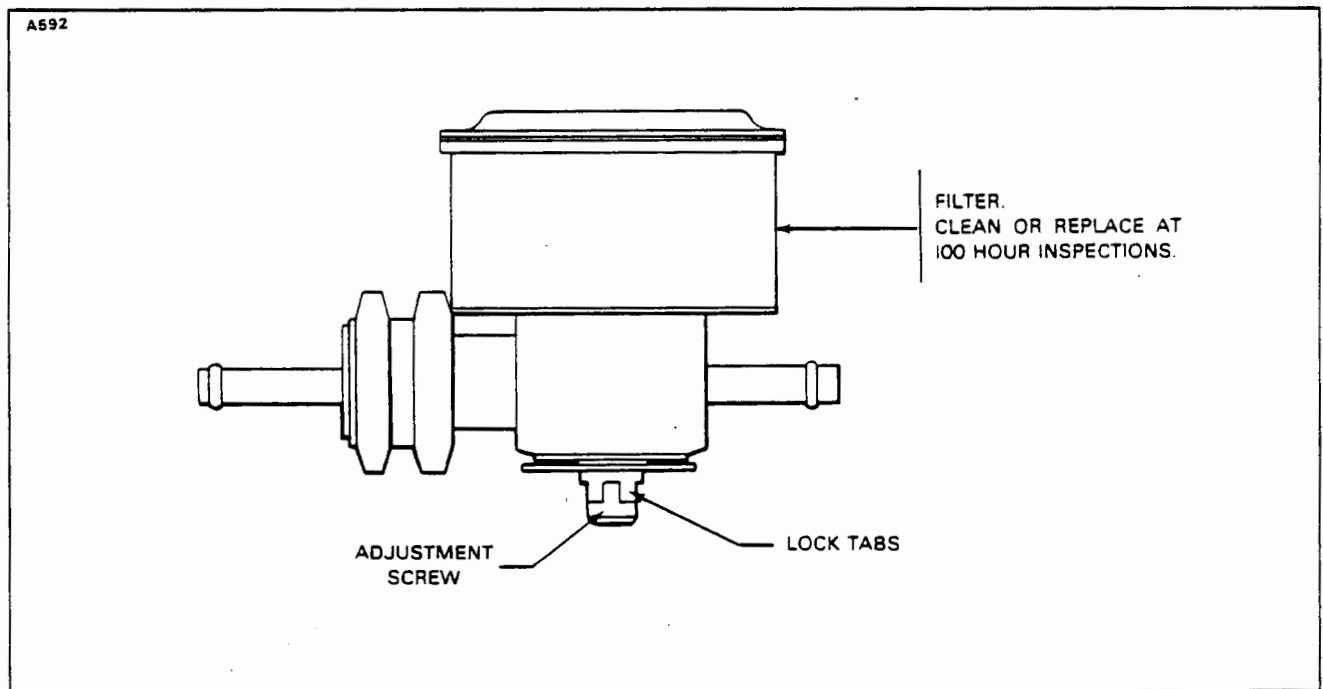


Figure 37-2. Vacuum Regulator

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

DISTRIBUTION.

VACUUM SYSTEM SERVICE TIPS.

The following information is intended to acquaint field service personnel with important vacuum system service procedures on those components which are serviced by removal and replacement. These items include hoses, clamps, gyro filter, vacuum regulating valves and vacuum gauge.

1. Hoses and Clamps:

A. These items should be examined periodically and inspected carefully whenever engine maintenance activities cause hose disconnections to be made at the pump, regulating valve, gyros and or vacuum gauge.

B. The ends of the hoses should be examined for rubber separation and slivers of rubber on the inside diameter of the hoses. These slivers can and do become detached. If this happens, the vacuum pump suck these loose particles and eventually ingest them. This can lead to a need for premature pump service.

— CAUTION —

When replacing any of the threaded fittings, DO NOT USE PIPE DOPE or any other anti-seize tape or compound. The AIRBORNE and Edo-Aire fittings are cadmium plated to avoid the need for any other anti-seize materials. The reason for this caution is to protect the pump from ingesting any foreign materials that could cause premature service. Refer to Step two of this subject paragraph for installation of fittings.

C. Hose clamps and fittings should be replaced when broken, damaged or corroded.

2. Fitting Installations:

A. Make sure all air lines are clean and free of foreign material. Do not permit oil, grease, pipe compound, or any foreign material to enter the ports prior to installation of fittings.

B. With the proper fitting selected apply teflon tape as follows, refer to consumable materials chart for product acquisition.

— CAUTION —

DO NOT use thread lube in fittings or in ports. The use of thread lube can cause contamination which shortens the life expectancy of the gyro and can cause premature failures. Any evidence of thread lube will create a WARRANTY VOID CONDITION.

- (1) Carefully lay the teflon tape on the threads of the fitting allowing one thread from the end of the fitting to be visible.
- (2) Hold in place and wrap in the direction of the threads so the tape will remain tight when fitting is installed. Make sure to apply sufficient tension while winding, to assure that tape forms into thread grooves. One full wrap plus 0.5 inch overlap is sufficient.
- (3) With the wrap completed, maintain tension on the tape and ***pull the tape in the direction of the wrap.*** The resulting ragged edge is the key to securing the tape. ***If sheared or cut tape may loosen.***

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

- (4) Press tape well into threads.
- (5) Screw fitting into port being careful not to exceed torque requirements noted on decal on cover of gyro.
- 3. Vacuum Gauge:
 - A. Vacuum gauge seldom requires service and usually is replaced when malfunctions occur.

— NOTE —

Vacuum gauge failure in a properly operating vacuum system does not impair safety of flight.

B. If the vacuum gauge malfunctions in a manner to cause an incorrect reading in normal cruise conditions, the gauge must be checked by comparing the reading with a gauge of known accuracy. If the gauge is indicating correct values and the system vacuum level is not in accordance with the specified vacuum, then and only then should the regulator be reset.

C. Visual examination of the gauge performance should cover the following steps:

- (1) With engine stopped and no vacuum applied to the gauge, its pointer should rest against the internal stop in the 9 o'clock position. Any other displacement from this position suggests need for replacement.
- (2) A slight overshoot, during engine startup, not to exceed half an inch (1/2") of mercury, is normal and is not cause to replace gauge.
- (3) With engine operating at normal cruise RPM, the gauge should read from 4.9 inches to 5.1 inches of mercury (vacuum).
- (4) At 1200 RPM, the vacuum gauge reading should be more than four inches of mercury.

4. Gyro Filter:

A. Gyro filter must be serviced on a scheduled basis, not to exceed 100 hours, or sooner as condition indicates.

B. The system installation employs a large central filter and differential vacuum gauge that continuously monitors the filter condition while indicating a vacuum readings.

— NOTE —

The vacuum system employs a central filter in combination with a differential vacuum gauge which will indicate a decline in panel gauge reading when the filter becomes clogged and vacuum declines below the recommended value. The filter should be replaced when gauge reading declines below the recommended value; do not adjust regulator.

5. Vacuum Regulator:

A. The vacuum regulating valve seldom needs replacement. Symptoms that suggest replacement are:

- (1) Chatter as indicated by rapid fluctuation of the vacuum gauge needle or an audible sound.
- (2) Non-repeatability of the vacuum gauge reading when the panel gauge is not suspect or has been checked against a known test gauge (cruise RPM only).

B. Regulator malfunction tends to increase the vacuum power applied to the gyros. Thus, although excess vacuum is applied, a loss of vacuum does not occur.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

C. The gyros themselves act as a limiting device to keep the vacuum power applied from exceeding safe levels.

— NOTE —

If the panel gauge has been checked and found OK and the vacuum gauge reading does not repeat within the range of $5.0 \pm .2$ inches of mercury, then the regulating valve should be changed. Observe the usual precautions for maintaining system cleanliness to avoid premature pump service.

VACUUM GAUGE.

The suction gauge is mounted to the right of the right control column. This gauge is calibrated in inches of mercury and indicates the differential pressure across the pilot's attitude gyro. As the system becomes clogged or lines obstructed, the gauge will show a decrease in pressure. Do not reset the regulator until the filter and lines have been checked. The gauge also has two red malfunction indicator buttons. Whenever vacuum is not available from one of the vacuum sources, the appropriate red button appears at the face of the gauge.

REMOVAL AND INSTALLATION OF FACE MOUNTED INSTRUMENTS.

Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide. Special care should be taken when any operation pertaining to the instruments is performed.

1. Remove the face panel.
2. With the face panel removed, the mounting screws for the individual instruments will be exposed. Remove the connections to the instruments prior to removing the mounting screws of the instrument to be removed.

— NOTE —

Tag instrument connections for ease of installation.

3. Installation of the instruments will be in reverse of removal. After the installation is completed and before replacing the instrument face panel, check all components for security and clearance of the control column.

VACUUM REGULATOR VALVE.

Two vacuum regulator valves that contain filters are incorporated in the system to control vacuum pressure to the gyro instruments. A manifold check valve assembly assures vacuum if one engine or pump should fail.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

ADJUSTMENTS TO VACUUM REGULATOR VALVE. (Refer to Figure 37-2.)

1. Remove nacelle cover(s), straighten adjustment screw lock tabs on valve.
2. Adjust regulator screw in accordance with the direction desired, run engine to check results.

— NOTE —

With one engine operating at 2000 RPM and the opposite engine at idle or off, set the vacuum regulator at $5.0 \pm .2$ inches of mercury. Repeat for opposite engine. After adjusting regulators check vacuum is within limits with both engines at 2000 RPM.

3. When the recommended vacuum indications are attained, bend tabs to lock adjusting screw, restore aircraft to airworthy condition.

REMOVAL AND REPLACEMENT OF REGULATOR VALVE.

1. To remove the regulator valve, disconnect the two lines, remove the mounting nut and remove the valve.
2. Replace regulator in reverse order given for removal. Check complete vacuum system for proper operation.

VACUUM PUMP.

The vacuum pump is of the rotary vane, positive displacement dry type. This unit consists essentially of an aluminum housing containing a tempered sleeve in which an offset rotor, with moving blades is incorporated. This assembly is driven by means of a coupling mated to the engine driven gear assembly. A pump is mounted on the accessory section of each engine. The pumps differ to account for engine rotation, the starboard engine utilizes a clockwise pump, the port engine utilizes a counter clockwise pump.

REMOVAL AND INSTALLATION OF VACUUM PUMP.

1. Remove the top portion of the engine cowling.
2. Disconnect the two hoses at the pump.
3. Remove the four mounting nuts, lockwashers and plain washers, and withdraw the pump from the engine.

— CAUTION —

The only dry air pump mounting gasket authorized and approved for use on Airborne dry air pump is the Airborne gasket B3-1-2, Piper part number 751 859. Use of any other gasket may result in oil seepage or leakage at the mounting surface. Torque the four mounting nuts to 50-70 inch-pounds.

4. Reinstall the pump in reverse order of removal.
5. Install the fittings with a torque of 95 to 110 inch-pounds.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

**2J22 THRU 2J24
INTENTIONALLY LEFT BLANK**

CHAPTER

39

**ELECTRICAL/
ELECTRONIC PANELS AND
MULTIPURPOSE PARTS**

2K1

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 39 - ELECTRICAL/ELECTRONIC PANELS AND MULTIPURPOSE PARTS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
39-10-00	INSTRUMENT AND CONTROL PANELS	2K3	A 8-82
39-11-00	Removal and Replacement of Face Mounted Instruments	2K3	A 8-82
39-12-00	Annunciator Panel	2K3	A 8-82
39-12-01	Troubleshooting Annunciator	2K3	A 8-82
39-12-02	Replacement of Annunciator Panel Light Bulbs	2K6	A 8-82
39-12-03	Removal and Installation of Vacuum Gyro Air Sensor Switch	2K6	A 8-82
39-12-04	Removal and Installation of Oil Pressure Sensor Switch	2K6	A 8-82
39-12-05	Removal and Installation of Carburetor Ice Sensor Probe	2K6	A 8-82
39-12-06	Removal and Installation of Overboost Sensor Switch	2K6	A 8-82
39-13-00	Electric Clock	2K6	A 8-82
39-13-01	Removal of Instrument Panel Mounted Clock	2K9	A 8-82
39-13-02	Installation of Instrument Panel Mounted Clock	2K9	A 8-82
39-13-03	Removal of Control Wheel Mounted Clock	2K9	A 8-82
39-13-04	Installation of Control Wheel Mounted Clock	2K9	A 8-82
39-40-00	MULTIPURPOSE ELECTRICAL PARTS	2K9	
39-41-00	Electrical Switches and Circuit Breakers	2K9	8-81
39-41-01	Removal of Electrical Switches	2K10	
39-41-02	Installation of Electrical Switches	2K10	
39-41-03	Removal of Circuit Breakers	2K10	
39-41-04	Installation of Circuit Breakers	2K10	

39 - Cont./Effec.

Page - 1

Revised: January 3, 1983

PIPER AIRCRAFT

PA-44-180/180T

MAINTENANCE MANUAL

INSTRUMENT AND CONTROL PANELS.

REMOVAL AND REPLACEMENT OF FACE MOUNTED INSTRUMENTS.

Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide. Special care should be taken when any operation pertaining to the instruments is performed. The tagging of connections prior to removing an instrument will help in the installation process.

1. Remove the face panel.
2. With the face panel removed, the mounting screws for the individual instruments will be exposed. Remove the connections to the instrument prior to removing the mounting screws of the instrument to be removed. Plug openings on gyro instruments immediately to prevent contamination.
3. Installation of the instruments will be in the reverse of removal. After the installation is completed and before replacing the instrument face panel, check all components for security and clearance of the control column.

ANNUNCIATOR PANEL.

The annunciator panel, located near the top center of the instrument panel, is a series of lights which warns of malfunctions in critical systems and circuits necessary for safe operation. A malfunction is indicated by the illumination of an individual warning light. There are three lights on the PA-44-180 (VAC, ALT, and OIL); five on the 44-180 with carb ice detector (OIL, GYRO AIR, ALT, CARB ICE LEFT and CARB ICE RIGHT); and five on the 44-180T (OIL, GYRO AIR, ALT and two OVERBST).

The VAC warning light (44-180) is controlled by a vacuum sensor switch located at the firewall and is attached to the vacuum regulator. The sensor switch will activate when the differential pressure is below $4 \pm .25$ in. hg.

The OIL warning light is controlled by an oil pressure sensor switch incorporated in the oil line to the oil pressure gauge and is located at the firewall. The sensor switch will activate when the oil pressure is below a safe level.

The ALT warning light is illuminated by current flowing from the bus bar to the alternator circuit. This condition exists when the alternator is not operating properly and the output is zero. During normal operation, the alternator warning circuit is also supplied with power from the top diode terminal. This current flows to two resistors and diodes creating a no-flow condition and extinguishing the ALT light.

The CARB ICE lights are activated when a buildup of ice occurs on the light sensitive probe installed in the throat of the carburetor. The light will remain lit until the ice has melted.

The OVERBST lights are activated whenever the respective engine's manifold pressure exceeds 36.1 to 36.5 inches of mercury.

The GYRO AIR light (44-180T) is tied into both sides of the vacuum system through vacuum switches. The vacuum switches, which are attached to the vacuum regulators, are set to close at $4 \pm .25$ inches of mercury and activate the light on the annunciator panel.

A press to test button is used to check the operation of the annunciator panel lights with the engine running; or with the engine off, provided the master switch is turned on.

TROUBLESHOOTING ANNUNCIATOR.

Chart 3901 gives information on those problems most commonly experienced. For further information contact the service representative at Vero Beach, Florida.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 3901. TROUBLESHOOTING (ANNUNCIATOR PANEL)

Trouble	Cause	Remedy
All lights fail to operate.	No current.	Check all wire segments, connections and the receptacle at the side of the annunciator panel.
All the warning lights fail to extinguish after engine is running.	Test switch grounded out.	Check terminals and replace switch if necessary.
Oil or gyro air warning light fails to extinguish.	Sensor activates at too high a setting.	Replace.
	Sensor terminals bridged.	Remove material between terminals.
	Defective sensor.	Replace.
Oil or gyro air warning light fails to operate.	Lamp burned out.	Replace.
	Sensor activates at too low a setting.	Replace.
	Defective sensor.	Replace.
Overboost warning light fails to extinguish.	Manifold pressure gauge sensors set too low.	Check sensor activation. Sensors should activate at 36.1 to 36.5 inches of mercury.
Overboost warning light fails to activate.	Lamp burned out.	Replace.
	Defective sensor switches.	Check. Replace gauge as necessary.
Alternator warning light fails to operate.	Lamp burned out.	Replace.
Alternator warning light fails to extinguish.	Blown fuse or fuses.	Replace one or both 5 amp fuses.
	Defective alternator output circuit.	Check and repair.
Test switch fails to activate warning lights.	Bad switch or connections.	Check wires and replace switch if necessary.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

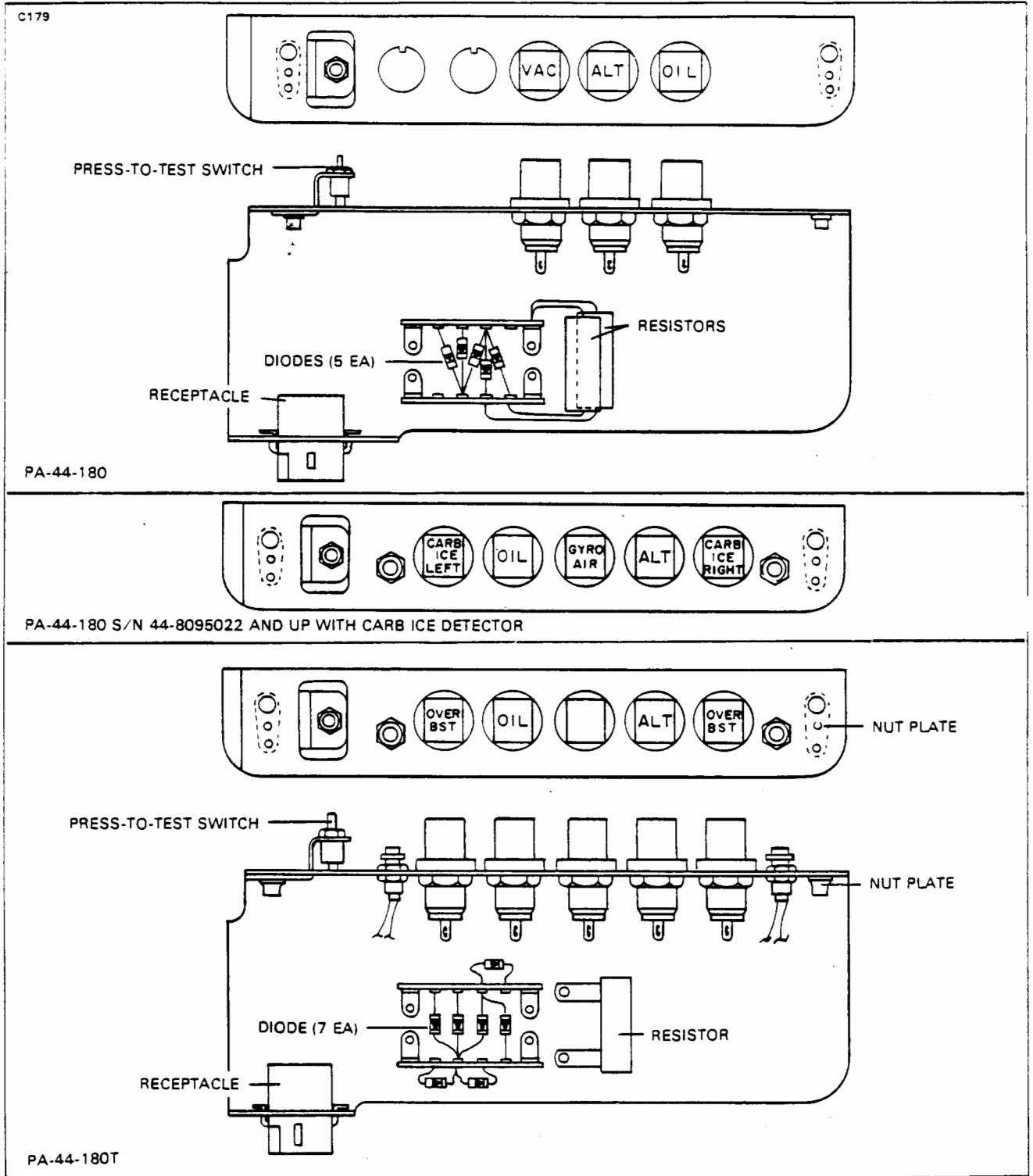


Figure 39-1. Annunciator Panel Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REPLACEMENT OF ANNUNCIATOR PANEL LIGHT BULBS.

Replacement of a bulb does not require removal of the annunciator panel. The lenses are designed to be a friction fit in the annunciator panel and the light bulbs fit into the back side of the lenses. To replace a defective bulb, simply pull the lens out of the annunciator panel. Withdraw the defective bulb from the lens and replace with a new bulb. Align the key on the lens with the key way on the annunciator panel socket and press the lens into position.

REMOVAL AND INSTALLATION OF VACUUM/GYRO AIR SENSOR SWITCH.

The vacuum/gyro air switch for each engine is mounted on the pressure regulator attached to the aft side of the firewall.

1. Remove nacelle panels as necessary to gain access to the sensor switch.
2. Note the position of the wires on the sensor switch, then disconnect the wires from the switch.
3. Unscrew the sensor switch from the pressure regulator.
4. If a new switch is not to be installed immediately, cover the opening to prevent dirt or other foreign matter from entering.
5. Install the switch in reverse order given for removal.

REMOVAL AND INSTALLATION OF OIL PRESSURE SENSOR SWITCH.

For removal and installation procedures, refer to Chapter 79.

REMOVAL AND INSTALLATION OF CARBURETOR ICE SENSOR PROBE.

For removal and installation procedures, refer to Chapter 30.

REMOVAL AND INSTALLATION OF OVERBOOST SENSOR SWITCH.

The manifold pressure overboost switches are built into the manifold pressure gauge and are not field serviceable. Should it be determined that a problem exists within the gauge, the gauge must be removed and sent to an authorized repair station. (Refer to Chapter 77 for removal and installation procedures.)

ELECTRIC CLOCK.

The standard electric clock is a Borg Instruments CA-7287 which receives its power from the aircraft battery. The clock is mounted in the upper left corner of the instrument panel.

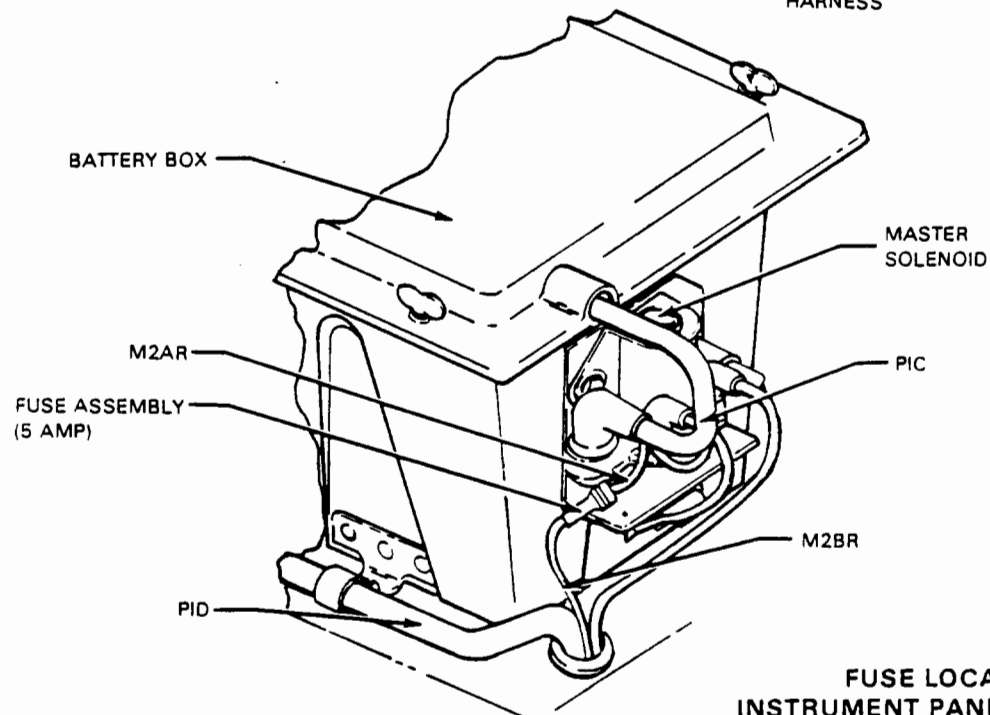
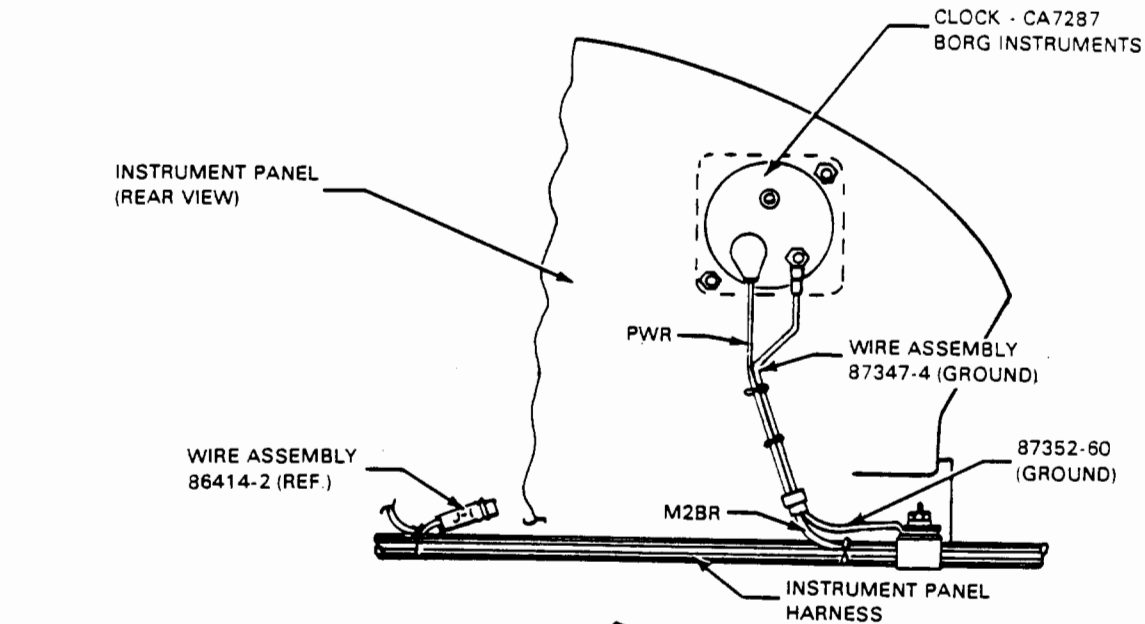
Available as an option is the control wheel mounted Astrotech LC-2P electric chronometer. This clock also receives its power from the aircraft battery.

For electrical schematics, refer to Chapter 91.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

C688

INSTRUMENT PANEL MOUNTED CLOCK



FUSE LOCATION FOR
INSTRUMENT PANEL MOUNTED AND
CONTROL WHEEL MOUNTED CLOCKS

Figure 39-2. Electric Clock Installation

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

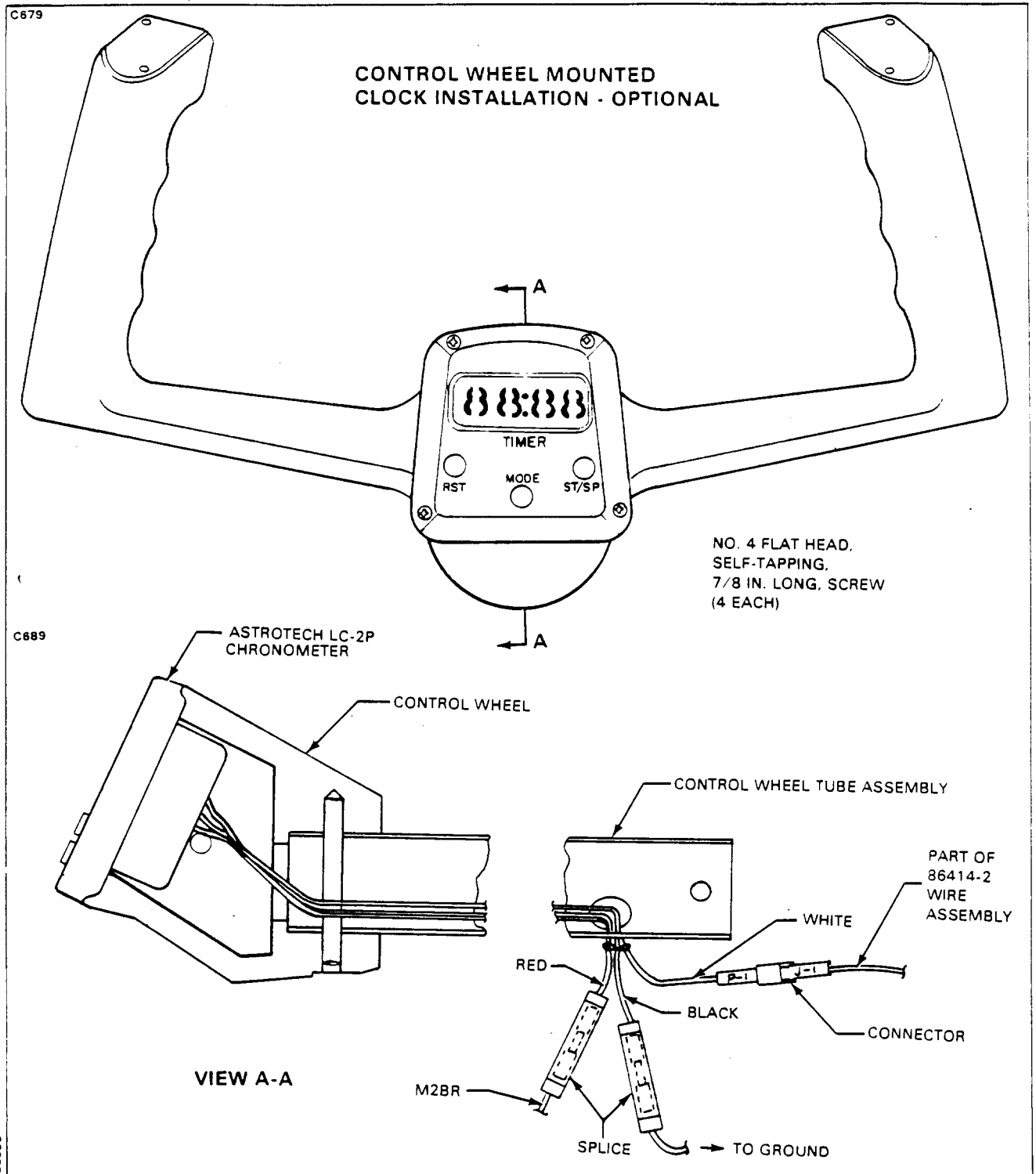


Figure 39-2. Electric Clock Installation (cont.)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REMOVAL OF INSTRUMENT PANEL MOUNTED CLOCK.

1. Remove power from electric clock circuit.
2. Remove two screws from face of clock that secure clock in panel.
3. Withdraw clock from panel and remove wires from back of clock.

INSTALLATION OF INSTRUMENT PANEL MOUNTED CLOCK.

1. Attach wires to back of clock.
2. Position clock in panel and secure with two screws previously removed.
3. Reapply power to circuit.

REMOVAL OF CONTROL WHEEL MOUNTED CLOCK.

1. Remove power from electric clock circuit.
2. Disconnect wires at the point where they exit the control wheel tube assembly (behind instrument panel). Attach a piece of cord of sufficient length to wire connectors to aid in rerouting wire during installation.
3. Remove four screws which secure clock in control wheel and withdraw clock. Disconnect cord from wire connectors on clock and allow cord to remain in control wheel tube assembly.

INSTALLATION OF CONTROL WHEEL MOUNTED CLOCK.

1. Attach cord to wire connectors of clock. Using cords to aid in rerouting electrical wiring, insert clock in control wheel and secure with screws.
2. Remove cords from connectors. Connect wires to appropriate mating wire.
3. Reapply power to circuit.
4. Refer to Pilot's Operating Handbook for instructions on setting clock.

MULTIPURPOSE ELECTRICAL PARTS.

ELECTRICAL SWITCHES AND CIRCUIT BREAKERS.

The switches are of the rocker type. The switches are mounted on the left side panel. The circuit breakers are single hole mounting, push button type with manual reset; they must be reset by the pilot whenever tripped. They are on a circuit breaker panel on the lower right hand corner of the instrument panel.

— NOTE —

*PA-44-180 S/N 44-7995001 thru 44-8195016 and PA-44-180T S/N
44-8107001 thru 44-8107044 refer to latest revision Piper Service
Bulletin No. 696.*

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

REMOVAL OF ELECTRICAL SWITCHES.

1. For a particular switch removal, remove the screws on the front of the panel.
2. From behind the panel remove the switch, and disconnect the electrical connections.

— NOTE —

*Make note of the placement of the electrical leads to facilitate
reinstallation.*

INSTALLATION OF ELECTRICAL SWITCHES.

1. Reconnect electrical leads with mounting screws in their proper place.
2. Insert switch into its designated slot on the panel and secure with the screws previously removed.

REMOVAL OF CIRCUIT BREAKERS.

1. Remove knurl nut from circuit breaker face plate, front of instrument panel.
2. From behind instrument panel remove circuit protector from instrument panel.
3. Disconnect electrical connections fastened with screws to the circuit breaker.

— NOTE —

*Make note of the placement of the electrical leads to facilitate
reinstallation.*

INSTALLATION OF CIRCUIT BREAKERS.

1. Connect the electrical leads to their proper screw and secure.
2. Insert circuit protector into its proper hole on the instrument panel.
3. Fasten and tighten knurl nut to circuit breaker face plate, front of instrument panel.

— END —

CHAPTER

51

STRUCTURES

2K11

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHAPTER 51 - STRUCTURES

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
51-00-00	GENERAL	2K13	
51-01-00	Description	2K13	
51-10-00	STRUCTURAL REPAIRS	2K13	
51-11-00	Fiberglass Repairs	2K13	
51-11-01	Fiberglass Touch-Up and Surface Repairs	2K16	
51-11-02	Fiberglass Fracture and Patch Repairs	2K16	I-83
51-12-00	Thermoplastic Repairs	2K17	
51-13-00	Safety Walk Repair	2L1	
51-13-01	Surface Preparation	2L1	
51-13-02	Product Listing for Liquid Safety Walk Compound	2L1	
51-13-03	Application of Liquid Safety Walk Compound	2L1	
51-13-04	Surface Preparation for Pressure Sensitive Safety Walk	2L2	
51-13-05	Application of Pressure Sensitive Safety Walk	2L2	

51 - Cont./Effec.

Page - 1

Revised: January 3, 1983

2K12

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

GENERAL.

DESCRIPTION.

The PA-44 is an all metal semi-monocoque structure. The fuselage is constructed of bulkheads, stringers and stiffeners, to which all of the outer skin is riveted. The cabin entrance door is located on the right side of the fuselage above the wing. An emergency exit is provided on the left side of the fuselage, and consists of the pilot's side window and surrounding window frame. The wings and empennage are all metal, full cantilever semi-monocoque type construction with removable tips.

STRUCTURAL REPAIRS.

Structural repair methods used must be made in accordance with the regulations set forth in FAA Advisory Circular 43-13-1A. To assist in making repairs and or replacements, Figure 51-1 identifies the type and thickness of various skin material used.

— WARNING —

No access holes are permitted in any control surfaces. The use of patch plates for repairs of all movable 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.

Never make a skin replacement or patch plate from material other than the type of the original skin, or of a different thickness than the original skin. The repair must be as strong as the original skin. However, flexibility must be retained so the surrounding areas will not receive extra stress.

FIBERGLASS REPAIRS.

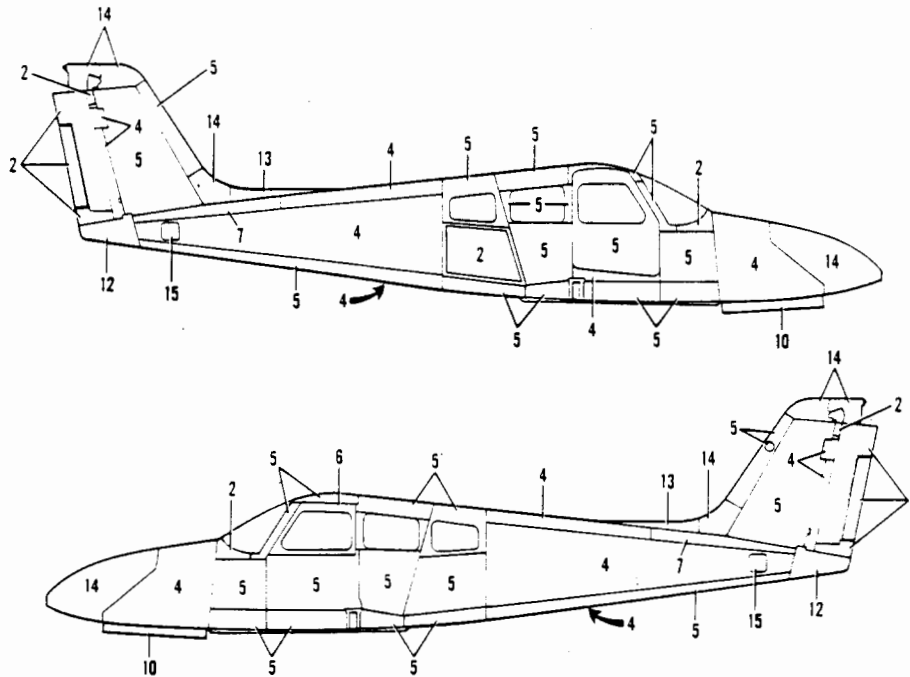
The repair procedure in this manual will describe the methods for repair of Fiberglass Reinforced Structures. Fiberglass Touch-Up and Surface Repairs such as blisters, open seams, delamination, cavities, small holes and minor damages that have not harmed the fiberglass cloth material, Fiberglass Fracture and Patch Repairs as puncture, breaks and holes that have penetrated through the structure and damaged the fiberglass cloth. A repair kit, part number 756 729 will furnish necessary material for such repairs, and is available through Piper Aircraft Dealers.

— NOTE —

Very carefully follow resin and catalyst mixing instructions furnished with repair kit.

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

2316



NO. OF SKIN	MATERIAL	THICKNESS
1	2024-T3	.016
2	2024-T3	.020
3	2024-T3*	.020
4	2024-T3	.025
5	2024-T3	.032
6	2024-T3*	.032
7	2024-T3	.040
8	2024-T3	.051
9	5052-H34	.040
10	BONDOLITE Z-3A	.125
11	THERMOPLASTIC	.125
12	THERMOPLASTIC	.093
13	THERMOPLASTIC	.062
14	FIBERGLASS	
15	2024-T3	.050
16	GALVANIZED STEEL	.018
17	5052-H34	.032

*HEAT TREAT TO 2024-T42
AFTER FORMING.

NOTE: LEFT WING & NACELLE
SHOWN, RIGHT WING OPPOSITE.

Figure 51-1. Skin Materials and Thickness

51-11-00

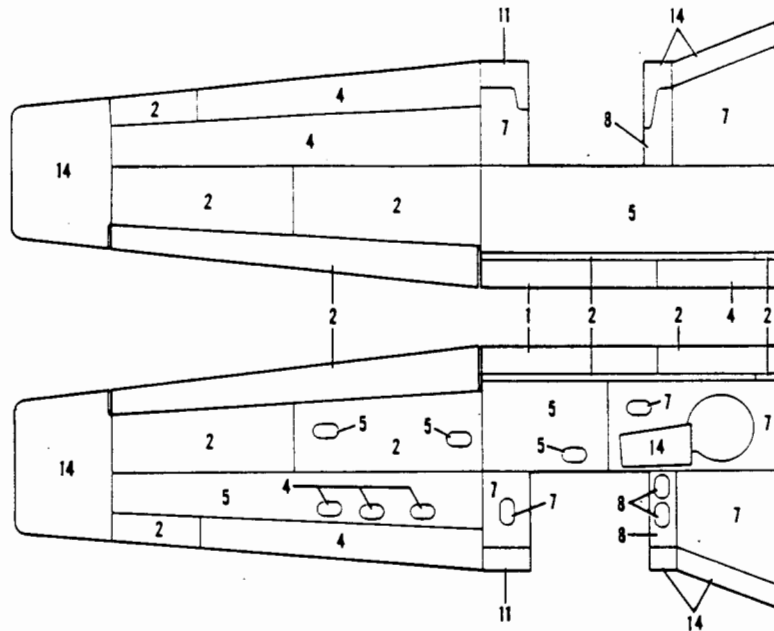
Page 51-02

Revised: January 3, 1983

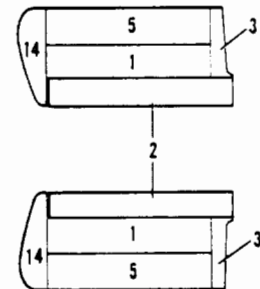
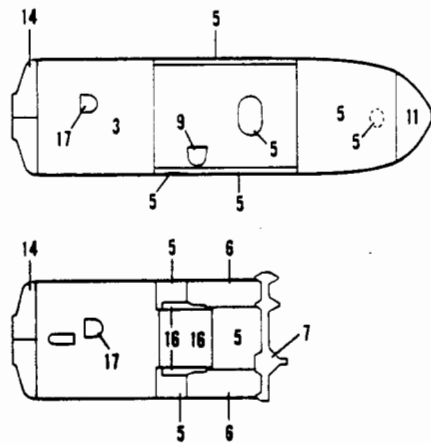
2K14

PIPER AIRCRAFT PA-44-180/180T MAINTENANCE MANUAL

2316



NOTE: LEFT WING & NACELLE
SHOWN, RIGHT WING OPPOSITE.



NOTE: REFER TO PAGE 51-02 FOR
MATERIAL SPECIFICATIONS.

Figure 51-1. Skin Materials and Thickness (cont)

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

FIBERGLASS TOUCH-UP AND SURFACE REPAIRS.

1. Remove wax, oil and dirt from around the damaged area with acetone, Methyl ethyl ketone or equivalent and remove paint to gel coat.
2. The damaged area may be scraped with a fine blade knife or a power drill with a burr attachment to roughen the bottom and sides of the damaged area. Feather the edge surrounding the scratch or cavity. Do not undercut the edge. (If the scratch or cavity is shallow and penetrates only the surface coat, continue to Step 8.)
3. Pour a small amount of resin into a jar lid or on a piece of cardboard, just enough to fill the area being worked on. Mix an equal amount of milled fiberglass with the resin, using a putty knife or stick. Add catalyst, according to kit instruction, to the resin and mix thoroughly. A hypodermic needle may be used to inject gel into small cavities not requiring fiberglass millings mixed with the gel.
4. Work the mixture of resin, fibers and catalyst into the damaged area, using the sharp point of a putty knife or stick to press it into the bottom of the hole and to puncture any air bubbles which may be present. Fill the scratch or hole above the surrounding undamaged area about 1/16 inch.
5. Lay a piece of cellophane or waxed paper over the repair to cut off air and start the cure of gel mixture.
6. Allow the gel to cure 10 to 15 minutes until it feels rubbery to the touch. Remove the cellophane and trim flush with the surface, using a sharp razor blade or knife. Replace the cellophane and allow to cure completely for 30 minutes to an hour. The patch will shrink slightly below the structure surface as it cures. (If wax paper is used, ascertain wax is removed from surface.)
7. Rough up the bottom and edges of the hole with the electric burr attachment or rough sandpaper. Feather hole into surrounding gel coat, do not undercut.
8. Pour out a small amount of resin, add catalyst and mix thoroughly, using a cutting motion rather than stirring. Use no fibers.
9. Using the tip of a putty knife or fingertips, fill the hole to about 1/16 inch above the surrounding surface with the gel coat mixture.
10. Lay a piece of cellophane over the patch to start the curing process. Repeat Step 6, trimming patch when partially cured.
11. After trimming the patch, immediately place another small amount of gel coat on cut edge of the patch and cover with cellophane. Then, using a squeegee or the back of a razor blade, squeegee level with area surrounding the patch, leave the cellophane on patch for one or two hours or overnight, for complete cure.
12. After repair has cured for 24 hours, sand the patched area using a sanding block with fine wet sandpaper. Finish by priming, again sanding and applying color coat.

FIBERGLASS FRACTURE AND PATCH REPAIRS.

1. Remove wax, oil and dirt from around damaged area with acetone, methyl ethyl ketone or equivalent.
2. Using a key hole saw, electric saber saw, or sharp knife cut away ragged edges. Cut back to sound material.
3. Remove paint three inches back from around damaged area.
4. Working inside the structure, bevel the edges to approximately a 30 degree angle and rough-sand the hole and the area around it, using 80-grit dry paper. Feather back for about two inches all around the hole. This roughens the surface for strong bond with patch.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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 structure's surface with cloth on top. Both pieces may be wet out on cellophane and applied as a sandwich. Enough fiberglass cloth and mat reinforcements should be used to at least replace the amount of reinforcements removed in order to maintain the original strength. If damage occurred as a stress crack, an extra layer or two of cloth may be used to strengthen area.

9. Lay patch over hole on inside of structure, cover with cellophane, and squeegee from center to edges to remove all air bubbles and assure adhesion around edge of hole. Air bubbles will show white in the patch and they should all be worked out to the edge. Remove excess resin before it gels on the part. Allow patch to cure completely.

10. Remove cardboard or aluminum sheet from outside of hole and rough-sand the patch and edge of hole. Feather edge of hole about two inches into undamaged area.

11. Mask area around hole with tape and paper to protect surface. Cut a piece of fiberglass mat about one inch larger than the hole and one or more pieces of fiberglass cloth two inches larger than the hole. Brush catalyzed resin over hole, lay mat over hole and wet out with catalyzed resin. Use a daubing action with brush. Then apply additional layer or layers of fiberglass cloth to build up patch to the surface of structure. Wet out each layer thoroughly with resin.

12. With a squeegee or broad knife, work out all air bubbles in the patch. Work from center to edge, pressing patch firmly against the structure. Allow patch to cure for 15 to 20 minutes.

13. As soon as the patch begins to set up, but while still rubbery, take a sharp knife and cut away extra cloth and mat. Cut an outside edge of feathering. Strip cut edges of structure. Do this before cure is complete, to save extra sanding. Allow patch to cure overnight.

14. Using dry 80-grit sandpaper on a power sander or sanding block, smooth patch and blend with surrounding surface. Should air pockets appear while sanding, puncture and fill with catalyzed resin. A hypodermic needle may be used to fill cavities. Let cure and resand.

15. Mix catalyzed resin and work into patch with fingers. Smooth carefully and work into any crevices.

16. Cover with cellophane and squeegee smooth. Allow to cure completely before removing cellophane. Let cure and resand.

17. Brush or spray a coat of catalyzed resin to seal patch. Sand patch, finish by priming, again sanding and applying color coat.

— NOTE —

Brush and hands may be cleaned in solvents such as acetone or methylethylketone. If solvents are not available, a strong solution of detergent and water may be used.

THERMOPLASTIC REPAIRS.

The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane. A list of material needed to perform these repairs is given along with suggested suppliers of the material. Common safety precautions should be observed when handling some of the materials and tools used while making these repairs.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

CHART 5101. LIST OF MATERIALS (THERMOPLASTIC REPAIR)

ITEMS	DESCRIPTIONS	SUPPLIERS
Buffing and Rubbing Compounds	Automotive Type - DuPont #7	DuPont Company Wilmington, Del. 19898
	Ram Chemical #69 x 1	Ram Chemicals Gardena, Cal. 90248
	Mirror Glaze #1	Mirror Bright Polish Co., Inc. Irvin, Cal. 92713
Cleaners	Fantastic Spray Perchlorethylene VM&P Naphtha (Lighter Fluid)	Obtain From Local Suppliers
ABS-Solvent Cements	Solarite #11 Series	Solar Compounds Corp. Linden, N.J. 07036
Solvents	Methylethyl Ketone Methylene Chloride Acetone	Obtain From Local Suppliers
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp. Linden, N.J. 07036
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. long	Sears Roebuck & Co. or Most Hardware Stores
Hot Air Gun	Temp. Range 300° to 400° F	Local Suppliers

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

1. Surface Preparation:

A. Surface dirt and paint if applied must be removed from the item being repaired. Household cleaners have proven most effective in removing surface dirt.

B. Preliminary cleaning of the damaged area with perchlorethylene or VM&P Naptha will generally insure a good bond between epoxy compounds and thermoplastic.

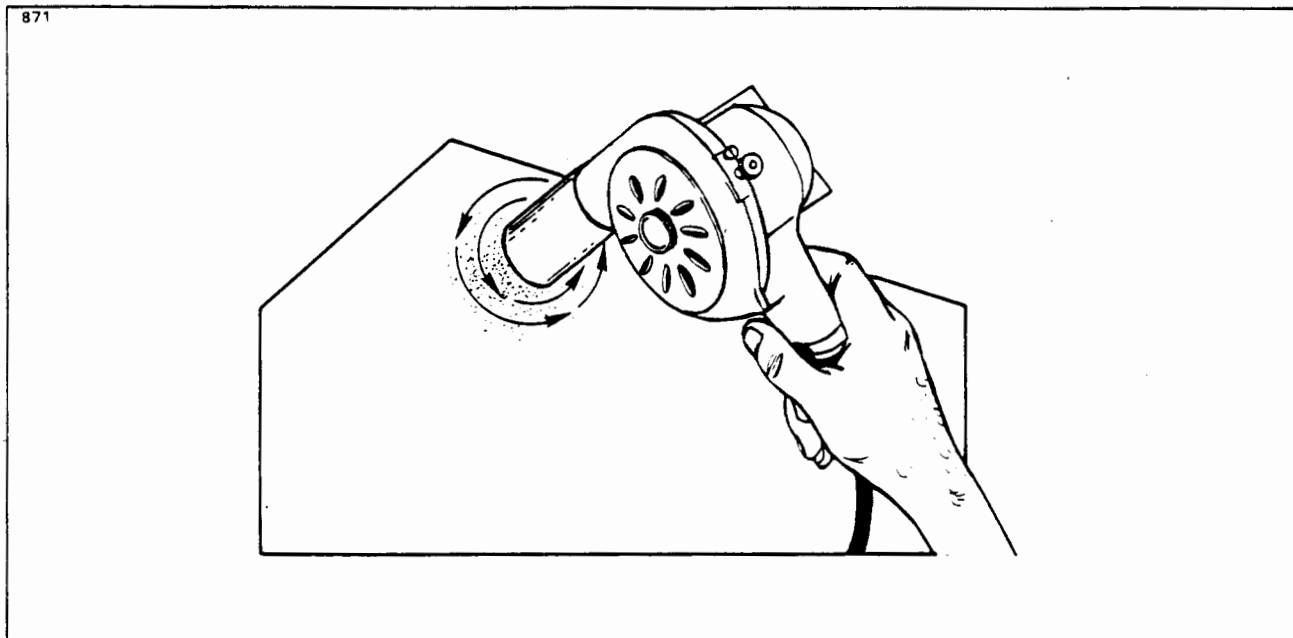


Figure 51-2. Surface Scratches, Abrasions or Ground-in-Dirt

2. Surface Scratches, Abrasion or Ground-in-Dirt: (Refer to Figure 51-2.)

A. Shallow scratches and abraded surfaces are usually repaired by following directions on containers of conventional automotive buffing and rubbing compounds.

B. If large dirt particles are embedded in thermoplastic parts, they can be removed with a hot air gun capable of supplying heat in the temperature range of 300° to 400° F. Use care not to overheat the material. Hold the nozzle of the gun about 1/4 of an inch away from the surface and apply heat with a circular motion until the area is sufficiently soft to remove the dirt particles.

C. The thermoplastic will return to its original shape upon cooling.

3. Deep Scratches, Shallow Nicks and Small Holes: (Less than 1 inch in diameter.) (Refer to Figure 51-3.)

A. Solvent cements will fit virtually any of these applications. If the area to be repaired is very small, it may be quicker to make a satisfactory cement by dissolving thermoplastic material of the same type being repaired in solvent until the desired paste-like consistency is achieved.

B. This mixture is then applied to the damaged area. Upon solvent evaporation, the hard durable solids remaining can easily be shaped to the desired contour by filing or sanding.

C. Solvent adhesives are not recommended for highly stressed areas, on thin walled parts or for patching holes greater than 1/4 inch in diameter.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

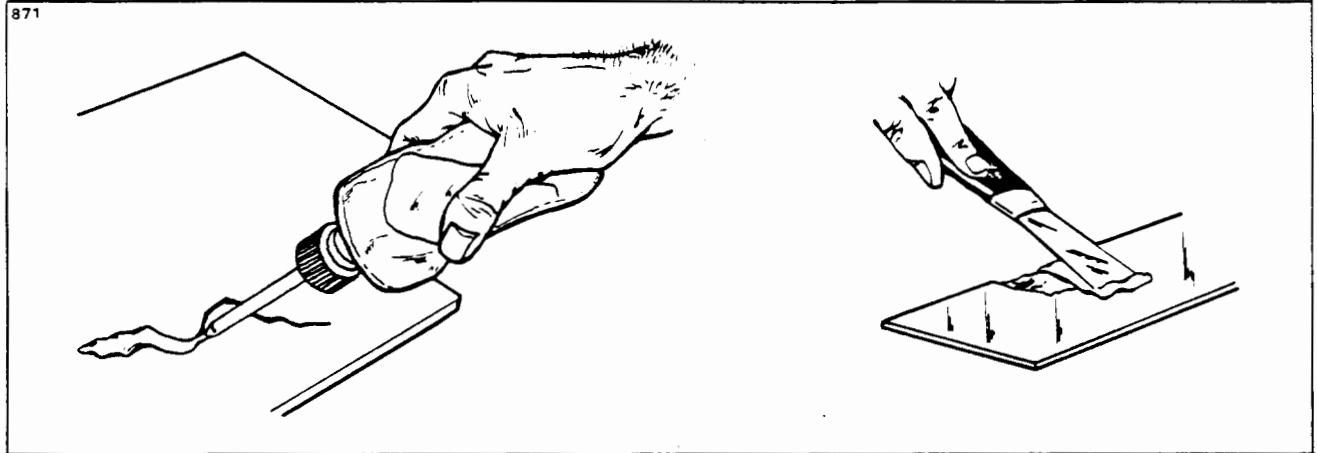


Figure 51-3. Deep Scratches, Shallow Nicks and Small Holes

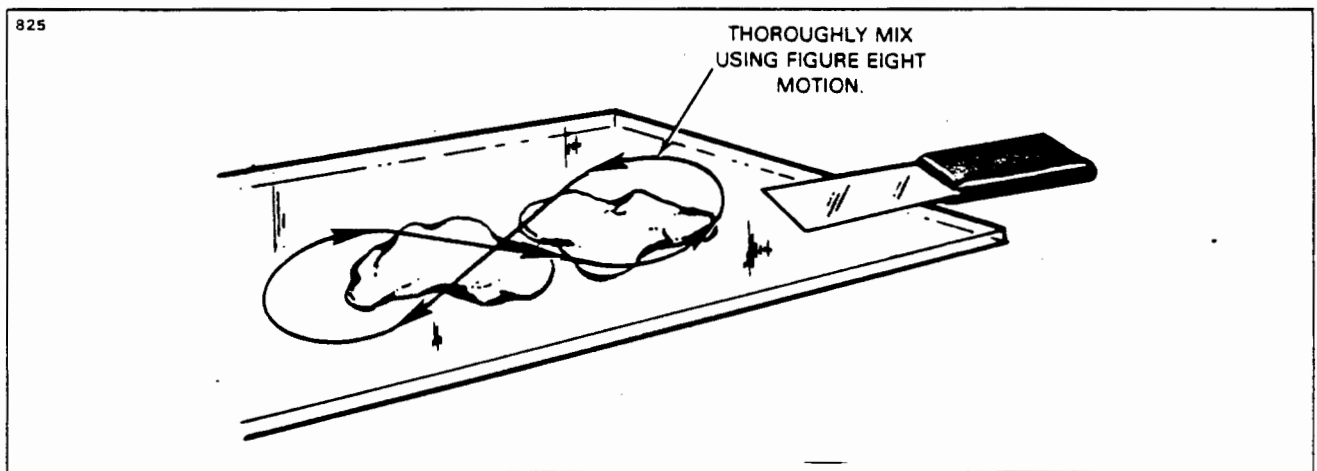


Figure 51-4. Mixing of Epoxy Patching Compound

D. For larger damages an epoxy patching compound is recommended. This type material is a two part, fast curing, easy sanding commercially available compound.

E. Adhesion can be increased by roughing the bonding surface with sandpaper and by utilizing as much surface area for the bond as possible.

F. The patching compound is mixed in equal portions on a hard flat surface using a figure eight motion. The damaged area is cleaned with perchlorethylene or VM&P Naphtha prior to applying the compound. (Refer to Figure 51-4.)

G. A mechanical sander can be used after the compound is cured, providing the sander is kept in constant motion to prevent heat buildup.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

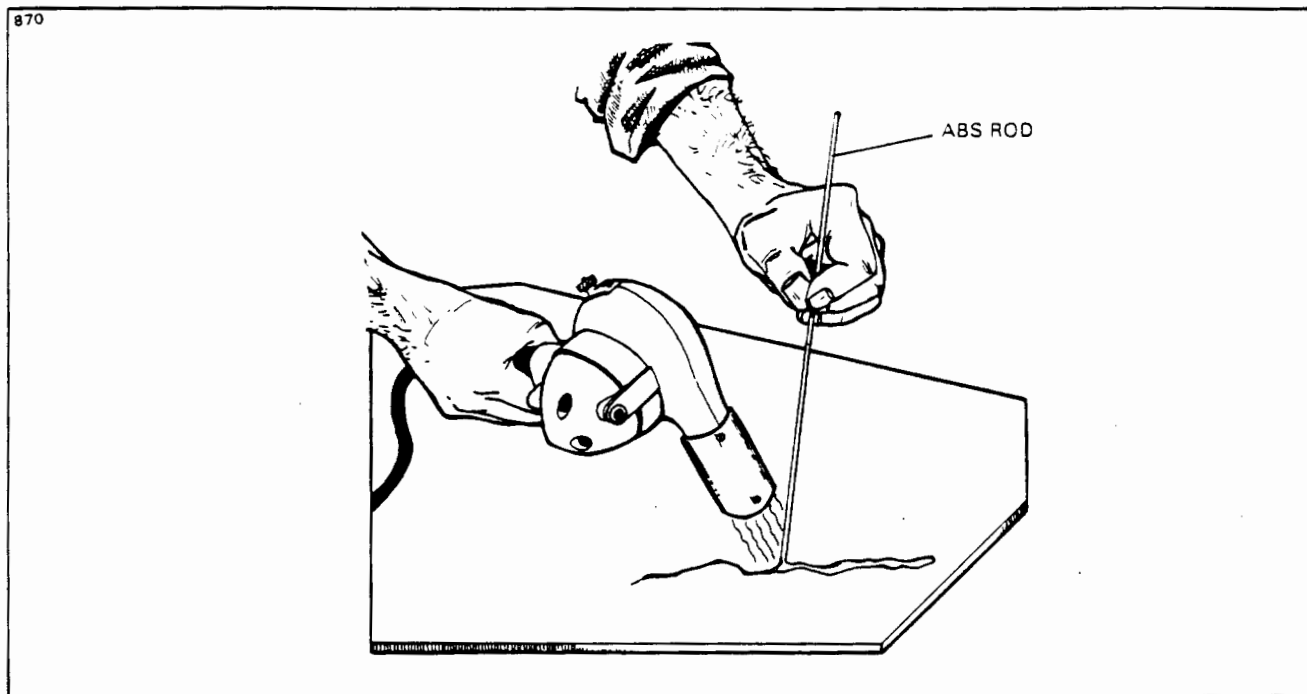


Figure 51-5. Welding Repair Method

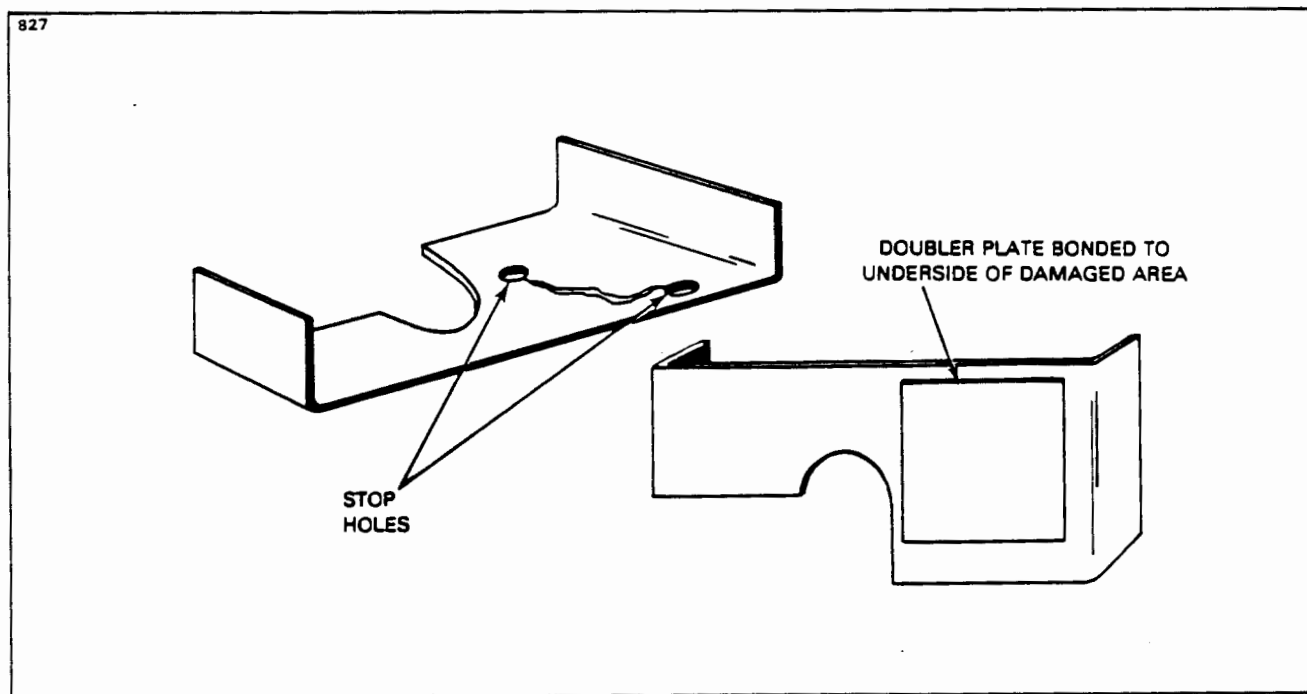


Figure 51-6. Repairing of Cracks

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

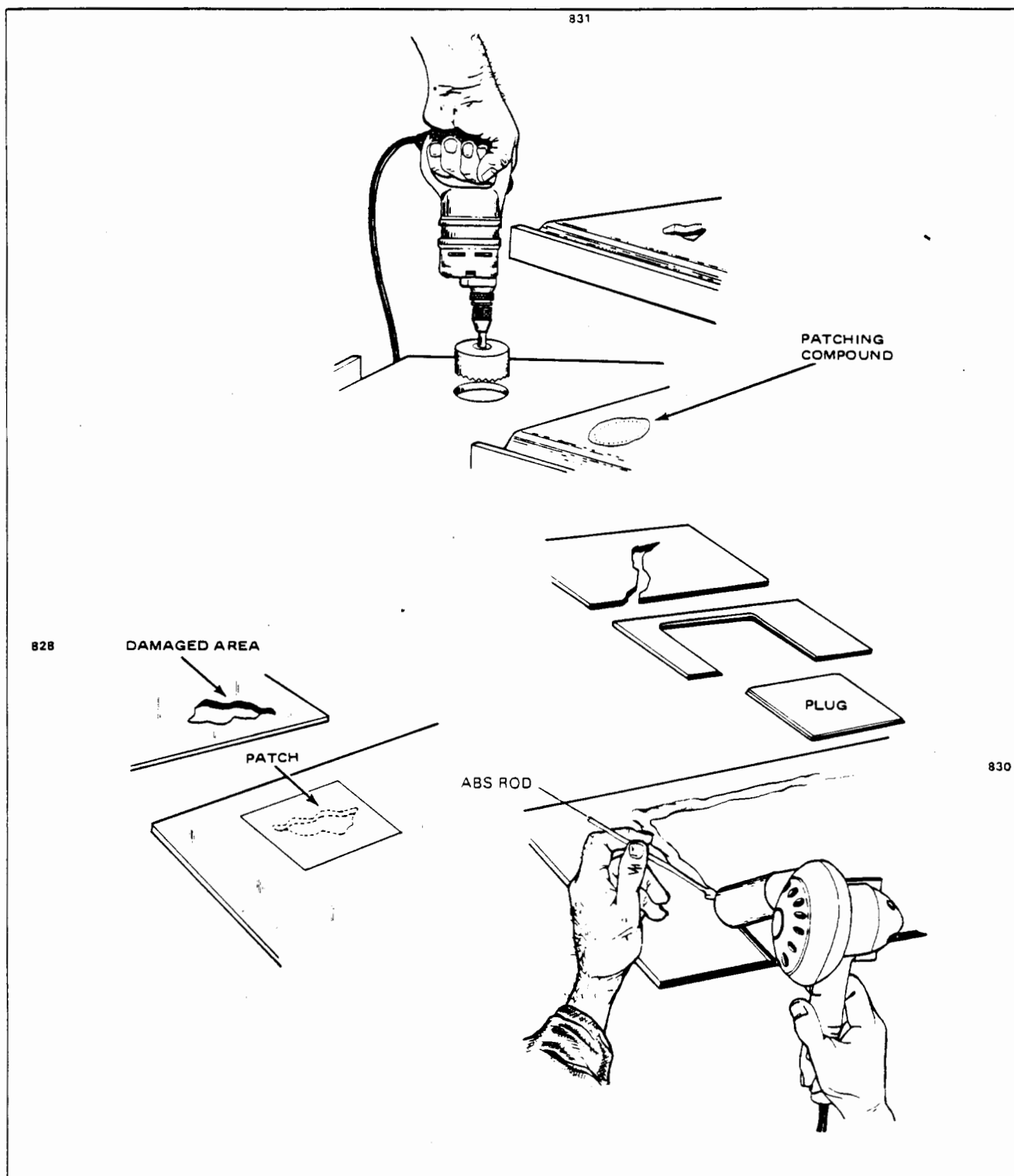


Figure 51-7. Various Repairs

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

H. For repairs in areas involving little or no shear stress, the hot melt adhesives, polyamids which are supplied in stick form may be used. This type of repair has a low cohesive strength factor.

I. For repairs in areas involving small holes, indentations or cracks in the material where high stress is apparent or thin walled sections are used, the welding method is suggested.

J. This welding method requires a hot air gun and ABS rods. To weld, the gun should be held to direct the flow of hot air into the fusion (repair) zone, heating the damaged area and rod simultaneously. The gun should be moved continuously in a fanning motion to prevent discoloration of the material. Pressure must be maintained on the rod to insure good adhesion. (Refer to Figure 51-5.)

K. After the repair is completed, sanding is allowed to obtain a surface finish of acceptable appearance.

4. Cracks: (Refer to Figure 51-6.)

A. Before repairing a crack in the thermoplastic part, first determine what caused the crack and alleviate that condition to prevent it recurring after the repair is made.

B. Drill small stop holes at each end of the crack.

C. If possible, a double plate should be bonded to the reverse side of the crack to provide extra strength to the part.

D. The crack should be "V" grooved and filled with repair material, such as solvent cement, hot melt adhesive, epoxy patching compound or 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 51-7.)

A. If possible a patch should be made of the same material and cut slightly larger than the section being repaired.

B. When appearances are important, large holes, cracks, tears, etc., should be repaired by cutting out the damaged area and replacing it with a piece of similar material.

C. When cutting away the damaged area, under cut the perimeter and maintain a smooth edge. The patch and/or plug should also have a smooth edge to insure a good fit.

D. Coat the patch with solvent adhesive and firmly attach it over the damaged area.

E. Let the patch dry for approximately one hour before any additional work is performed.

F. The hole, etc., is then filled with the repair material. A slight overfilling of the repair material is suggested to allow for sanding and finishing after the repair has cured. If patching compound is used the repair should be made in layers, not exceeding a 1/2 inch in thickness at a time, thus allowing the compound to cure and insuring a good solid buildup of successive layers as required.

6. Stress Lines: (Refer to Figure 51-8.)

A. Stress lines produce a whitened appearance in a localized area and generally emanate from the severe bending or impacting of the material. (Refer to Figure 51-9.)

B. To restore the material to its original condition and color, use a hot air gun or similar heating device and carefully apply heat to the affected area. Do not overheat the material.

7. Painting the Repair:

A. An important factor in obtaining a quality paint finish is the proper preparation of the repair and surrounding area before applying any paint.

B. It is recommended that parts be cleaned prior to painting with a commercial cleaner or a solution made from one-fourth cup 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.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

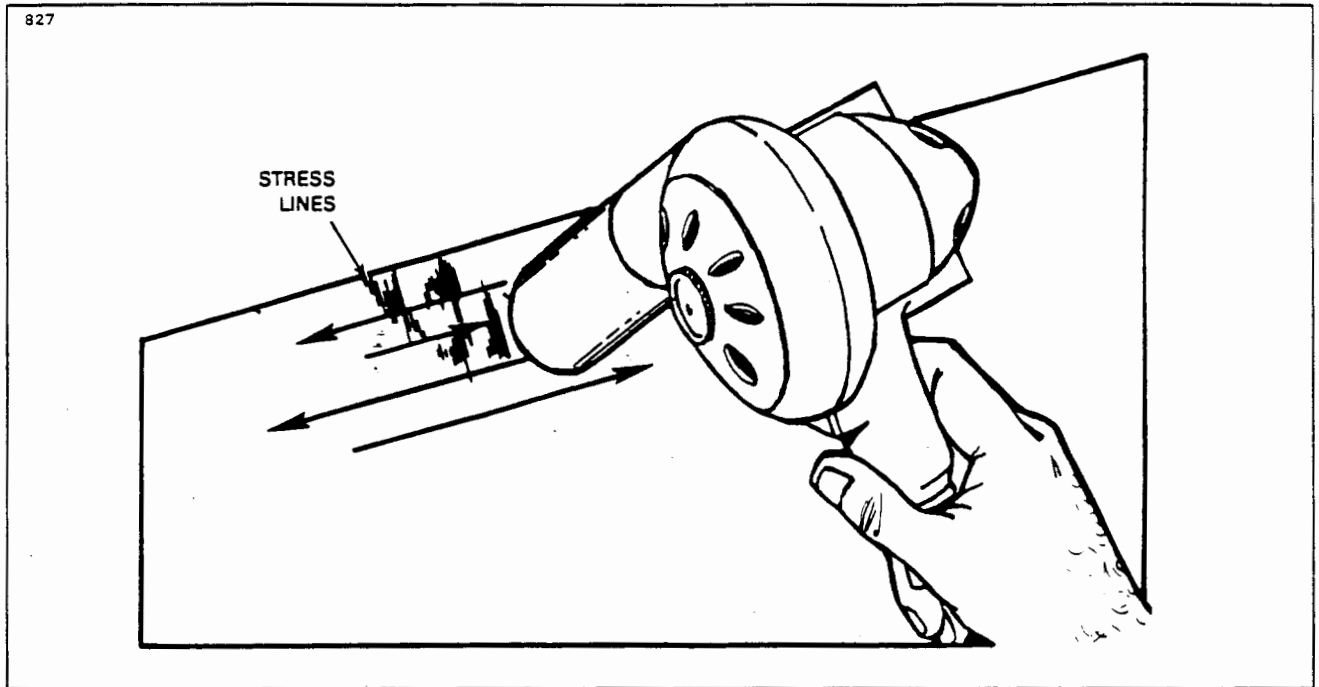


Figure 51-8. Repair of Stress Lines

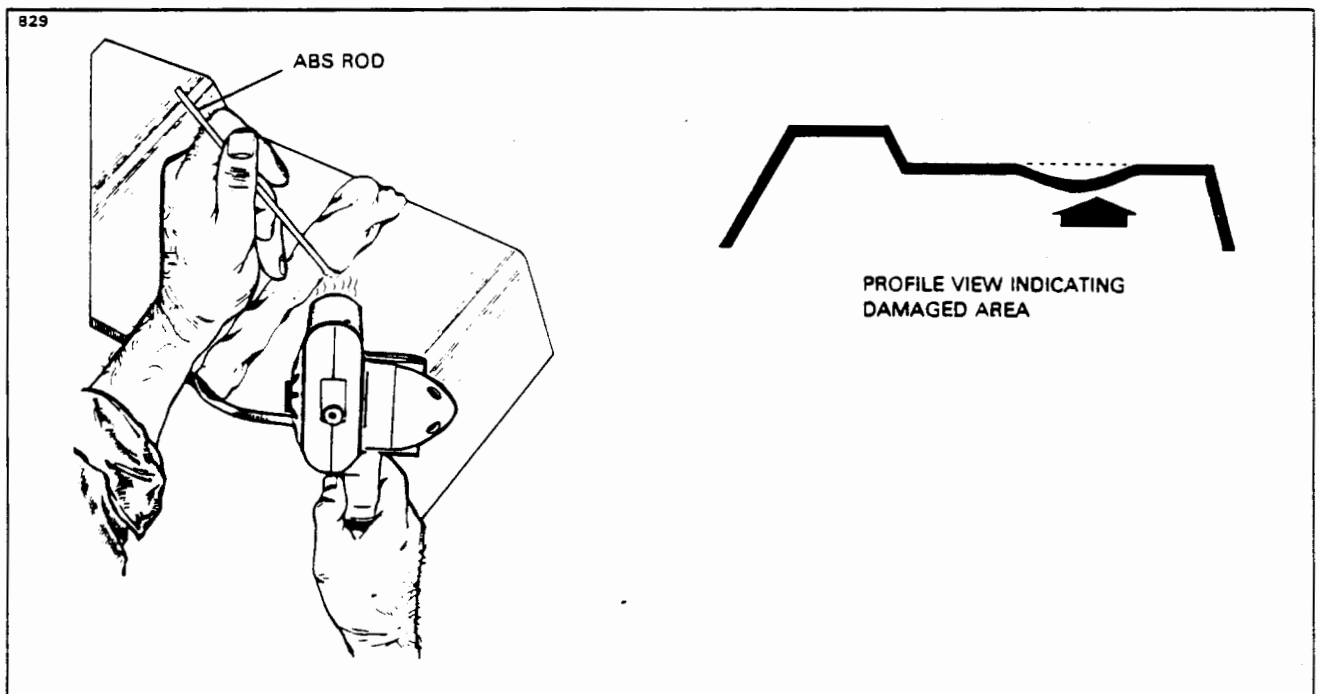


Figure 51-9. Repair of Impacted Damage

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

D. Another important matter to consider is that hard, brittle coatings that are usually best for abrasion resistance should not be used in areas which incur high stress, flexing or impact. Such coating may crack, thus creating a weak area.

SAFETY WALK REPAIR.

SURFACE PREPARATION.

1. Clean all surfaces with a suitable cleaning solvent to remove dirt, grease and oils. Solvents may be applied by dipping, spraying or mopping.
2. Insure that no moisture remains on the surface by wiping with a clean dry cloth.
3. Outline the area to which the liquid safety walk compound is to be applied, and mask adjacent surfaces.

— NOTE —

Newly painted surfaces, shall be allowed to dry for 2.5 hours minimum prior to the application of the safety walk.

PRODUCT LISTING FOR LIQUID SAFETY WALK COMPOUND.

1. Suggested Solvents:
 - Safety Solvent per MIL-S-18718
 - Sherwin Williams Lacquer Thinner R7KC120
 - Glidden Thinner No. 207
2. Safety Walk Material:
 - Walkway Compound and Matting Nonslip (included in Piper Part No. 179872)

APPLICATION OF LIQUID SAFETY WALK COMPOUND.

Liquid safety walk compound shall be applied in an area, free of moisture for a period of 24 hours minimum after application. Do not apply when surface to be coated is below 50° F. Apply liquid safety walk compound as follows:

1. Mix and thin the liquid safety walk compound in accordance with the manufacturer's instructions on the container.
2. Coat the specified surfaces with a smooth, unbroken film of the liquid safety walk compound. A nap type roller or a stiff bristle brush is recommended, using fore and aft strokes.
3. Allow the coating to dry for 15 minutes to one hour before recoating or touch-up; if required after application of the initial coating.
4. After recoating or touch-up, if done, allow the coating to dry for 15 minutes to one hour before removing masking.

— NOTE —

The coated surface shall not be walked on for six hours minimum after application of final coating.

PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL

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 contaminants 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 —

**PIPER AIRCRAFT
PA-44-180/180T
MAINTENANCE MANUAL**

**2L3 THRU 2L24
INTENTIONALLY LEFT BLANK**



SEMINOLE
MAINTENANCE MANUAL

CARD 3 OF 4

PA-44-180 SEMINOLE

PA-44-180T TURBO SEMINOLE

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 664)

NOTE

PLEASE INSERT THE FOLDOUT PAGES, LOCATED AT THE END OF THIS MANUAL,
IN THEIR PROPER NUMERICAL SEQUENCE PRIOR TO USING THE MANUAL.

WARNING

The information contained in this manual is periodically revised. Piper Aircraft Corporation urges all users of this manual to keep it current. Contact your nearest Piper Aircraft Corporation distributor to arrange for a subscription to future revisions.

NOTE

Revision service is available in aerofiche format only.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

INTRODUCTION.

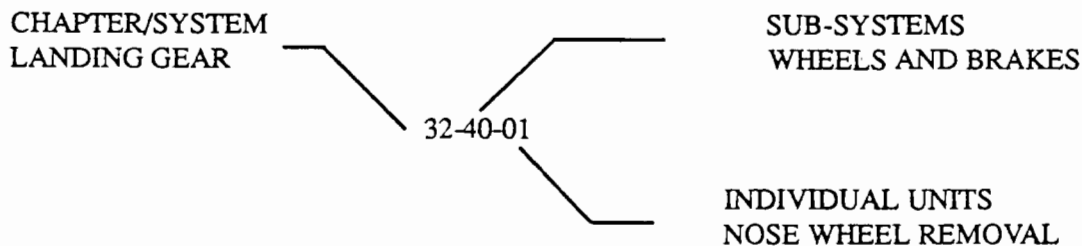
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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

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

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

Example:



This manual does not contain hardware callouts for installation. Hardware callouts are only indicated where a special application is required. To confirm the correct hardware used, refer to the PA-44 Parts Catalog P/N 761 663, and FAR 43 for proper utilization.

WARNINGS, CAUTIONS, and NOTES are used throughout this manual to emphasize important information.

— WARNING —

***OPERATING PROCEDURES, PRACTICES, ETC., WHICH MAY RESULT IN
PERSONAL INJURY OR LOSS OF LIFE IF NOT CAREFULLY FOLLOWED.***

— CAUTION —

**OPERATING PROCEDURES, PRACTICES, ETC., WHICH IF NOT
STRICTLY OBSERVED MAY RESULT IN DAMAGE TO EQUIPMENT.**

— Note —

An operating procedure, condition, etc., which is essential to emphasize.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual = **TEXTRON LYCOMING - OVERHAUL MANUAL**
 DIRECT DRIVE ENGINE - P/N 60294-7
 Textron Lycoming Division
 Williamsport, Pa 17701

Parts Catalog = **TEXTRON LYCOMING — O-360 AND LO-360 E SERIES - P/N PC-123**
 TEXTRON LYCOMING — TO-360 AND LTO-360 E SERIES - P/N PC-124
 TEXTRON LYCOMING — O-360 AND LO-360 A SERIES - P/N PC306-5
 Textron Lycoming Division
 Williamsport, Pa. 17701

Operators Handbook = **TEXTRON LYCOMING O-360 AND LO-360 E SERIES - P/N 60297-25;**
 TEXTRON LYCOMING TO-360 AND LTO-360 E SERIES - P/N 60297-26;
 TEXTRON LYCOMING O-360 AND LO-360 A SERIES - P/N 60297-12;
 AIRCRAFT ENGINES
 Textron Lycoming Division
 Williamsport, Pa 17701

PROPELLER:

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

MAGNETOS:

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

4200 SERIES MAGNETOS
 IGNITION, SYSTEM - P/N L-1199, L-1037
 Slick Electro, Inc.
 Rockford, Illinois 61104

TURBOCHARGERS:

Overhaul Manual = **OVERHAUL MANUAL FOR**
 AIRCRAFT TURBOCHARGERS
 VALVES AND CONTROLLERS
 NUMBER TP20-0120-1
 Airesearch Industrial Division
 3201 Lomitor Blvd.
 Torrance, Calif. 90505

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

VENDOR PUBLICATIONS. (cont)

RADAR ALTIMETER:

Maintenance
Instructions =

KING KRA-10 MAINTENANCE/OVERHAUL
MANUAL NUMBER 006-5152-00
King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061

Installation Manual =

BONZER MK 10X
Bonzer Incorporated
90th and Cody
Overland Park, Kansas 66214
INSTALLATION MANUAL
NUMBER 006-0152-00
King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061

AUTOFLIGHT:

Manufacturer =
KFC-150

EDO-AIRE MITCHELL or	KING RADIO CORPORATION
P.O.Box 610	400 North Rogers Road
Mineral Wells, Texas 76067	Olathe, Kansas 66061

FUEL CELLS:

Maintenance=

LORAL, Engineered Fabrics (or)	Goodyear Aerospace Corp.
669 Goodyear Street	Engineered Fabrics Division
Rockmart, Georgia 30153-0548	Rockmart, Georgia 30153

PIPER PUBLICATIONS.

AUTOFLIGHT:

AutoControl IIIB
Service Manual =
AutoControl IIIC
Service Manual =

Piper P/N 761 502

Piper P/N 761 602

PA-44-180/180T

Parts Catalog =

Piper P/N 761 663

Inspection Reports =

Piper P/N 230 963

Programmed Inspection
Manual =

Piper P/N 761 733

Introduction

Page -3

Revised: May 15, 1989

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

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 given 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 illustration.
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, 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 Indication, (1R Month-Year)
Second Revision:	Revision Indication, (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 761 664 issued May 1, 1978 are as follows:

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

AEROFICHE EXPLANATION AND REVISION STATUS (cont)

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG791212	December 12, 1979	1, 2, and 3
PR800822	August 22, 1980	1, 2, and 3
PR810223	February 23, 1981	1, 2, and 3
PR810824	August 24, 1981	1, 2, and 3
PR820826	August 26, 1982	1, 2, and 3
PR820909	September 9, 1982	1, 2, and 3
PR830103	January 3, 1983	1, 2, and 3
PR840326	March 26, 1984	1, 2, and 3
IR860730	July 30, 1986 (Interim)	1
I PR890515	August 3, 1989	1, 2, 3 and 4

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

GAMA SYSTEM/CHAPTER INDEX GUIDE

SYST CHAP	SUB-SYST SECTION	TITLE	AEROFICHE GRID NO.
4	AIRWORTHINESS		1A18
5	TIME LIMITS/MAINT CHECKS		1A21
6	DIMENSIONS AND AREAS		1B14
7	LIFTING AND SHORING		1C1
8	LEVELING AND WEIGHING		1C5
9	TOWING AND TAXIING		1C10
10	PARKING AND MOORING		1C14
11	REQUIRED PLACARDS		1C17
12	SERVICING		1C22
20	STANDARD PRACT - AIRFRAME		1E2
21	ENVIRONMENTAL SYSTEM		1E12
22	AUTOFLIGHT		1H21
23	COMMUNICATIONS		1H24
24	ELECTRICAL POWER		1I10
25	EQUIPMENT / FURNISHINGS		1J12
26	FIRE PROTECTION		1J17
27	FLIGHT CONTROLS		1J24
28	FUEL		2A18
29	HYDRAULIC POWER		2B17
30	ICE AND RAIN PROTECTION		2D1
32	LANDING GEAR		2F13

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

SYST CHAP	SUB-SYST SECTION	TITLE	AEROFICHE GRID NO.
33	LIGHTS		2I6
34	NAVIGATION & PITOT/STATIC		2I16
35	OXYGEN		2J7
37	VACUUM		2K6
39	ELECTRICAL/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS		2K19
51	STRUCTURES		2L7
52	DOORS		3A18
55	STABILIZERS		3B8
56	WINDOWS		3B22
57	WINGS		3C10
61	PROPELLER		3D1
71	POWER PLANT		3D21
73	ENGINE FUEL SYSTEM		3F1
74	IGNITION		3F16
77	ENGINE INDICATING		3H1
78	EXHAUST		3H19
79	OIL		3I1
80	STARTING		3I11
81	TURBINES		3J1
91	CHARTS AND WIRING DIAGRAMS		4A18

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS

FIGURE NO.	SUBJECT	GRID NO.
6-1.	Three View	1B19
6-2.	Station References	1B20
6-3.	Access Plates and Panels	1B22
7-1.	Jacking	1C4
8-1.	Leveling Airplane	1C8
8-2.	Weighing	1C9
11-1.	Placards and Decals	1C20
11-1A.	Placards and Decals	1C21
12-1.	Service Points	1D1
12-2.	Lubrication Chart - Landing Gear, Main	1D15
12-3.	Lubrication Chart - Landing Gear, Nose	1D17
12-4.	Lubrication Chart - Control System, Part 1	1D19
12-5.	Lubrication Chart - Cabin Door, Baggage Door and Seats	1D20
12-6.	Lubrication Chart - Control System, Part 2	1D22
12-7.	Lubrication Chart - Power Plant and Propeller	1D24
20-1.	Torque Wrench Formula	1E4
20-2.	Method of Installing Rod End Bearings	1E5
20-3.	Cherrylock Rivet Removal	1E6
20-4.	Identification of Aircraft Fluid Lines	1E8
21-1.	Cabin Environmental System Installation	1E24
21-2.	Heater and Combustion Air Blower Assembly	1F1
21-3.	Diagrammatic Cutaway of Heater to Show Whirling Flame Action	1F2
21-4.	Fuel Regulator and Shutoff Valve	1F3
21-5.	Top View - Duct Switch	1F3
21-6.	Intake Valve and Switches	1F4
21-7.	Wiring Diagram (Heater)	1F8
21-8.	Primary Power Circuit (Heater)	1F9
21-9.	Starting Power Circuit (Heater)	1F10
21-10.	Spark Plug Fixture (Heater)	1F12
21-11.	Wiring - Test Setup (Heater)	1F12
21-12.	Spark Plug Gap Adjustment (Heater)	1F13
21-13.	Ignition Unit Assembly (Heater)	1F17
21-14.	Test Setup for Fuel Regulator and Shutoff Valve (Heater)	1F20
21-15.	Heater Fuel Pump	1F21
21-16.	Suggested Design for Seal Plates, Plugs, and Caps for Combustion Tube leakage Test	1G1
21-17.	Test Setup for Combustion Air Pressure Switch	1G1
21-18.	Exploded View of Heater Assembly	1G6
21-19.	Exploded View - Combustion Air Blower and Motor Assembly	

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
21-20.	Suggested Setup of Heater Operation Test	1G10
21-21.	Wiring Connections for Heater Operation Test	1G10
21-22.	Spark Plug Gap Adjustment Tool	1G13
21-23.	Heater Hourmeter Installation	1G14
21-24.	Air Conditioning System Installation (PA-44 - 180T S/N 44-8107027 and up)	1G21
21-25.	Test Gauge and Manifold Set	1H2
21-26.	Manifold Set Operation	1H3
21-27.	Leak Test Hookup	1H4
21-28.	Evacuation Hookup	1H6
21-29.	Charging Stand	1H8
21-30.	Charging Hookup	1H9
21-31.	Top Dead Center Casting Mark (Sankyo Compressor)	1H12
21-32.	Rotation of Clutch Front Plate (Sankyo Compressor Oil Check)	1H12
21-33.	Condenser Installation	1H15
21-34.	Expansion Valve	1H17
21-35.	Components Installation	1H19
23-1.	Emergency Locator Transmitter Installation	1I3
23-2.	ELT Using Fixed Aircraft Antenna (Narco)	1I5
23-3.	ELT Portable Folding Antenna (Narco)	1I5
23-4.	Communications Components ELT Schematic	1I9
23-5.	Narco ELT Schematic	1I9
24-1.	Lamp Bank load	1I22
24-2.	Battery Box	1I24
24-3.	Electrical Component Location	1J3
24-4.	Regulator Diagram (LAMAR)	1J4
24-5.	Testing Regulator (LAMAR)	1J7
24-6.	Adjusting Regulator (LAMAR)	1J8
27-1.	Correct Method of Installing: Rod End Bearing	1K8
27-2.	Control Column Assembly	1K11
27-3.	Aileron Controls	1K13
27-4.	Bellcrank Rigging Tool	1K16
27-5.	Aileron Rigging	1K17
27-6.	Rudder Controls	1K20
27-7.	Rudder Rigging	1K21
27-8.	Clamping Rudder Pedals	1K21
27-9.	Rudder Travel Adjustments	1K22
27-10.	Rudder Trim Controls	1L1
27-11.	Rudder Pedal Assembly	1L4
27-12.	Stabilator Controls	1L6

Introduction

Page -9

Revised: May 15, 1989

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
27-13.	Stabilator Rigging	1L8
27-14.	Stabilator Travel Adjustments	1L10
27-15.	Methods of Securing Trim Cables	1L10
27-16.	Stabilator Trim Controls	1L12
27-17.	Wrapping Trim Barrels	1L15
27-18.	Stabilator Trim Screw Adjustment	1L15
27-19.	Flap Controls	1L17
27-20.	Flap Step Adjustment	1L19
27-21.	Flap Rigging Tool	1L22
28-1.	Fuel System Installation	2A22
28-2.	Fuel Cell Installation	2B1
28-3.	Locking Fuel Cap Assembly	2B9
28-4.	Gascolator Assembly	2B11
28-5.	Fuel Selector Valve	2B12
28-6.	Fuel Gauge	2B15
28-7.	Fuel Pressure Gauge and Calibration	2B16
28-7A.	Fuel Pressure Gauge and Calibration (S/N 44-95001 & up)	2B16
29-1.	Schematic Diagram of Hydraulic System	2B20
29-1A.	Schematic Diagram of Hydraulic System (S/N 44-95001 & up)	2B21
29-2.	Hydraulic System Installation	2B22
29-3.	Hydraulic Pump/Reservoir, Exploded View	2C8
29-3A.	Hydraulic Pump/Reservoir, Exploded View (Oildyne)	2C9
29-4.	Test and Adjustments of Hydraulic Pump	2C12
29-5.	Nose Gear Actuating Cylinder	2C15
29-6.	End Gland Locking Device (Main Gear)	2C17
29-7.	Main Gear Actuating Cylinder	2C17
30-1.	Pneumatic Deice System Installation	2D9
30-2.	Deice Control Panel Installation	2D16
30-3.	Electric Prop Deice System Installation	2E9
30-3.	Electric Prop Deice System Installation (cont)	2E10
30-4.	Suggested Use of Dial Indicator	2E13
30-5.	Centering of Brushes on Slip Rings	2E13
30-6.	Modular Brush Assembly Alignment	2E14
30-7.	Measuring Brush Assemblies	2E15
30-8.	Brush Module Assembly 3E2011	2E16
30-9.	Modular Brush Assembly 3E2090-1	2E16
30-10.	Installation of Deicer Boots	2E19
30-11.	Typical Deicer Boot Scaler Application	2E22
30-12.	Wrinkled Deicer	2E22
30-13.	Deicer Wiring Harness Installation (Typical)	2F1
30-14.	Wing Ice Lighting System	2F3

PIPER AIRCRAFT

PA-44-180/180T

AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
30-15.	Ice Detection System	2F6
30-16.	Heated Pitot and Heated Lift Detector Installation (PA-44-180T)	2F7
32-1.	Main Gear Oleo Strut Assembly	2G1
32-2.	Main Gear Service Tolerances	2G3
32-3.	Main Gear Installation	2G8
32-3.	Main Gear Installation (cont)	2G9
32-4.	Aligning Main Gear	2G13
32-5.	Nose Gear Oleo Strut Assembly	2G15
32-6.	Nose Gear Installation	2G17
32-7.	Nose Gear Service Tolerances	2G19
32-8.	Nose Gear Downlock and Eccentric Bushing Installation	2G24
32-9.	Nose Gear Adjustment	2H2
32-10.	Clamping Rudder Pedals in Neutral Position	2H4
32-11.	Rudder Pedals at Neutral Angle	2H4
32-12.	Mechanical Nose Gear Door Mechanism	2H6
32-13.	Nose Wheel Assemblies	2H8
32-14.	Main Wheel Assembly	2H10
32-15.	Wheel Brake Assembly	2H12
32-16.	Removal and Installation of Anchor Bolts	2H13
32-17.	Brake Installation	2H15
32-18.	Parking Brake Valve Assembly	2H16
32-19.	Brake Cylinder (1700)	2H17
32-20.	Brake Cylinder (10-27)	2H17
32-21.	Brake Cylinder (10-30) (Toe Brake)	2H18
32-22.	Toe Brake Installation	2H21
32-23.	Adjustment of Main Gear Down Limit Switch	2H23
32-24.	Adjustment of Nose Gear Down Limit Switch	2H23
32-25.	Throttle Warning Switches	2I1
34-1.	Pitot-Static System Installation	2I20
35-1.	Fixed - Oxygen System	2J10
35-2.	Portable - Oxygen System	2J11
35-3.	Test Apparatus for Testing Oxygen System	2J14
35-4.	Oxygen Tubing Installations	2J15
35-5.	Installation of Swageloc Fittings	2J18
37-1.	Vacuum System Installation	2K9
37-2.	Vacuum Regulator	2K11
39-1.	Annunciator Panel Installation	2K23
39-1A	Annunciator Panel Installation (PA-44-180, S/N 44-95001 and up)	2K24
39-2.	Electric Clock Installation	2L2
39-2.	Electric Clock Installation (cont)	2L3
51-1.	Skin Materials and Thickness	2L10
51-1.	Skin Materials and Thickness (cont)	2L11

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
51-2.	Surface Scratches or Ground-in-Dirt	2L15
51-3.	Deep Scratches. Shallow Nicks and Small Holes	2L16
51-4.	Mixing of Epoxy Patching Compound	2L16
51-5.	Welding Repair Method	2L17
51-6.	Repairing of Cracks	2L17
51-7.	Various Repairs	2L18
51-8.	Repair of Stress Lines	2L20
51-9.	Repair of Impacted Damage	2L20
52-1.	Door Installation	3A21
52-1a.	Door Snubber Installation	3A23
52-2.	Fabricated Tool for Baggage Door Lock	3A24
52-3.	Emergency Exit Installation	3B2
55-1.	Stabilator Installation	3B11
55-2.	Stabilator Balance Configuration	3B12
55-3.	Vertical Fin Installation	3B13
55-4.	Rudder Installation	3B15
55-5.	Rudder Balancing	3B16
56-1.	Windshield Installation	3C9
56-2.	Side Window Installation	3C3
57-1.	Wing Installation	3C14
57-2.	Aileron and Flap Installation	3C18
57-3.	Aileron Balancing	3C20
61-1.	Typical Nicks and Removal Method	3D4
61-2.	Propeller Installation	3D5
61-3.	Propeller Governor	3D7
61-4.	Adjustment of Propeller Control	3D7
61-5.	Synchrophaser System Installation	3D9
61-6.	Pulse Generator Assembly	3D11
61-7.	Backup Test of Pulse Generator	3D14
61-8.	Propeller Unfeathering System (PA-44-180, S/N 44-95001 and up)	3D17
71-1.	Engine and Shock Mount Installation	3E8
71-2.	Engine Cowling Installation	3E13
71-3.	Cowl Flap Installation	3E13
71-4.	PA-44-180 Induction System	3E15
71-5.	PA-44-180T Induction System	3E18
73-1.	Carburetor	3F3
73-2.	Engine Primer System (PA-44-180)	3F6
73-3.	Fuel System Schematic (PA-44-180T)	3F6
73-3a.	Electric Primer System (PA-44-180, S/N 44-95001 and up)	3F7
73-4.	Engine Primer System (PA-44-180T)	3F8

PIPER AIRCRAFT

PA-44-180/180T

AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
73-5.	Adjustment of Engine Controls	3F10
74-1.	Height of Spring in Distributor Block Tower	3F21
74-2.	Contact Points	3F21
74-3.	Engine Timing Marks	3F23
74-4.	Timing Light Connected to Magneto	3F23
74-5.	Timing Marks on Magneto Rotor	3F24
74-6.	Painted tooth Centered in Timing Window	3G1
74-7.	Timing Mark on Rotor Aligned with Pointer	3G1
74-8.	Timing Light Connected to Magneto and Breakers	3G4
74-9.	Cam End View of Magneto	3G5
74-10.	Removing Impulse Coupling	3G7
74-11.	Checking Flyweight to Stop Pin Clearance	3G7
74-12.	Stop Pin Installation Dimension	3G7
74-13.	Checking Flyweight Axial Wear with Drill Shank	3G8
74-14.	Checking Flyweight Radial Wear with Gauge	3G8
74-15.	Points of Coupling Body Wear	3G9
74-16.	Acceptable and Deformed Coupling Springs	3G9
74-17.	Checking Impulse Coupling for Magnetization	3G11
74-18.	Orientation of Spring in Coupling Body	3G11
74-19.	Lifting Inner End of Spring	3G11
74-20.	Checking Harness Leads Continuity	3G13
74-21.	Checking Harness Leads Insulation Resistance	3G13
74-22.	Modified Pliers	3G13
74-23.	Removing Spring From Lead Assembly	3G13
74-24.	Assembly Tool	3G15
74-25.	Using Assembly Tool	3G15
74-26.	Ferrule Positioned Under Braid	3G16
74-27.	Ferrule Seating Tool	3G16
74-28.	Position of 11-8627 Kit and Contact Spring at Start of Installation	3G17
74-29.	Position of 11-8627 Kit and Contact Spring After Installation	3G17
74-30.	Lubricating Sleeve	3G17
74-31.	Lubricating Ferrule Shoulder	3G17
74-32.	Removing Spark Plug Frozen to Bushing	3G19
74-33.	Magneto and Starter Switches	3G21
77-1.	Engine Instrument Lines Installation	3H3
77-2.	Electric Tachometer Installation	3H9
77-3.	Cylinder Head Temperature Gauge Calibration (S/N 44-95001 and up)	3H12
77-4.	EGT Probe Installation (PA-44-180T)	3H16
78-1.	Inspection of Mufflers	3H21
79-1.	Oil Pressure Gauge Calibration (PA-44-180, S/N 44-95001 and up)	3I6
79-2.	Oil Temperature Gauge Calibration (PA-44-180, S/N 44-95001 and up)	3I8

Introduction

Page -13

Revised: May 15, 1989

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
80-1.	Exploded View of Gear Reduction Starter Motor	3I16
80-2.	Turning Motor Commutator	3I19
80-3.	Testing Motor Armature for Shorts	3I19
80-4.	Testing Motor Fields for Grounds	3I19
80-5.	No Load Test Hookup	3I19
80-6.	Stall Torque Hookup	3I21
81-1.	Schematic Diagram of Typical Turbocharger System	3J10
81-2.	Turbocharger Installation	3J12
91-1.	Tire Balancer Fixture	4B1
91-2.	Control Surface Balancing Tool	4B11
91-3.	Fabricated Aileron Bellcrank Rigging Tool	4B12
91-4.	Fabricated Aileron and Flap Rigging Tool	4B13
91-5.	Fabricated Stabilator Rigging Tool	4B14
91-6.	Fabricated Rudder Rigging Tool	4B14

ELECTRICAL SCHEMATICS

— Note —

Refer to Card 4 Grid No. 4B19 for Electrical Schematic Index.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

LIST OF CHARTS

CHART NO.	SUBJECT	GRID NO.
601	Leading Particulars and Principal Dimensions	1B16
1201	Thread Lubricants	1E1
2001	Maximum Distance Between Supports for Fluid Tubing	1E7
2101	Troubleshooting (Janitrol Heater)	1E17
2102	Blower System Wire Color Codes	1E22
2101	Inspection (Ignition Unit)	1F18
2104	Troubleshooting (Air Conditioner)	1G16
2105	Temperature Pressure Chart	1G22
2106	Aluminum Tubing Torque	1H1
2107	Evaporator Blower Motor Wire Codes	1H19
2401	Troubleshooting (Alternator)	1I14
2402	Troubleshooting (Battery)	1I19
2403	Alternator Belt Tension	1I23
2404	Hydrometer Reading and Battery Charge Percent	1J1
2701	Troubleshooting (Surface Controls)	1K4
2702	Cable Tension Vs. Ambient Temperature	1K9
2801	Troubleshooting (Fuel System)	2A23
2802	Sender/Fuel Quantity Gauge Tolerances	2B15
2901	Troubleshooting (Hydraulic System)	2B24
2902	Leading Particulars, Hydraulic System	2C13
2903	Characteristics, Hydraulic Pump Motor	2C13
3001	Troubleshooting (Pneumatic Deice System)	2D7
3002	Operating Pressures	2D11
3003	Materials and Supplies for Cold Repair	2D18
3004	Troubleshooting (Propeller Deicer System)	2D19
3005	Required Materials for Repair of Propeller Deicer	2E20
3006	Mixing of Materials	2E23
3007	Electrical Resistance	2E23
3201	Troubleshooting (Landing Gear)	2F18
3202	Toe-In, Toe-Out Correction	2G11
3401	Troubleshooting (Rate of Climb Indicator)	2I21
3402	Troubleshooting (Altimeter)	2I22
3403	Troubleshooting (Airspeed Tubes and Indicator)	2I23
3404	Troubleshooting (Magnetic Compass)	2J1
3501	Troubleshooting (Oxygen System)	2J12
3502	Oxygen System Limits	2J19
3503	Filling Pressure for Certain Ambient Temperatures	2J24
3504	Portable Oxygen System Component Limits	2K2
3701	Troubleshooting (Vacuum System)	2K10
3901	Troubleshooting (Annunciator Panel)	2K22
5101	List of Materials (Thermoplastic Repair)	2L14

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

LIST OF CHARTS (cont)

CHART NO.	SUBJECT	GRID NO.
6101	Propeller Torque Limits	3D4
7101	Troubleshooting (Engine)	3D24
7301	Fuel Pressure Sender Test Specifications	3F11
7302	Troubleshooting (Fuel Pressure Gauge)	3F12
7401	Troubleshooting (Magneto)	3F18
7402	Coupling Torques	3G18
7701	Manifold Pressure Indicator (Troubleshooting)	3H6
7702	Tachometer (Troubleshooting)	3H7
7703	Cylinder Head Temperature (Troubleshooting)	3H11
7704	Exhaust Gas Temperature (Troubleshooting)	3H14
7901	Oil Pressure Sender Test Specifications	3I4
7902	Oil Pressure Gauge (Troubleshooting)	3I5
7903	Oil Temperature Indicators (Troubleshooting)	3I7
8001	Troubleshooting (Starter)	3I13
8002	Starting Motor Specifications	3I21
8101	Troubleshooting (Turbocharger)	3J3
9101	Flare Fitting Torques	4A20
9102	Recommended Nut Torques	4A21
9103	Decimal Conversions	4A23
9104	Decimal Equivalents of Drill Sizes	4A24
9105	List of Consumable Materials	4B2
9106	Metric Conversion Tables	4B7
9107	Electric Wire Coding	4B8
9108	Electric Symbols	4B15
9109	Electrical System Component Loads	4B16

CHAPTER

52

DOORS

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 52 - DOORS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
52-00-00	GENERAL	3A20	
52-10-00	PASSENGER, CREW	3A20	1 - 83
52-11-00	Door Assembly	3A20	A 1 - 83
52-11-01	Removal of Door	3A20	
52-11-02	Installation of Door	3A20	
52-11-03	Adjustment of Door	3A20	
52-12-00	Door Latch Mechanism	3A20	A 1 - 83
52-12-01	Removal of Door Latch Mechanism	3A20	
52-12-02	Installation of Door Latch Mechanism	3A20	
52-12-03	Adjustment of Door Latch Mechanism	3A22	
52-13-00	Door Lock Assembly	3A22	A 1 - '83
52-13-01	Removal of Door Lock Assembly	3A22	
52-13-02	Installation of Door Lock Assembly	3A22	
52-14-00	Door Auxiliary Latch	3A22	A 1 - 83
52-14-01	Removal of Door Auxiliary Latch	3A22	
52-14-02	Installation of Door Auxiliary Latch	3A22	
52-14-03	Adjustment of Auxiliary Latch	3A22	
52-15-00	Door Seal Snubbers	3A23	A 1 - 83
52-15-01	Removal and Installation of Door Seal Snubbers	3A23	8 - 80
52-16-00	Baggage Door	3A24	
52-16-01	Removal of Baggage Door	3A24	
52-16-02	Installation of Baggage Door	3A24	
52-17-00	Baggage Door Lock Assembly	3B1	A 1 - 83
52-17-01	Removal of Baggage Door Lock Assembly	3B1	
52-17-02	Installation of Baggage Door Lock Assembly	3B1	
52-20-00	EMERGENCY EXIT	3B1	
52-21-00	Removal and Installation of Emergency Exit	3B1	
52-21-01	Testing of Emergency Exit	3B1	

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

GENERAL.

This airplane has one entrance door located on the right side of the fuselage and a baggage door also on the right side aft of the entrance door.

PASSENGER/CREW. (Refer to Figure 52-1.)

DOOR ASSEMBLY.

REMOVAL OF DOOR.

1. Remove the clevis bolt, washer and bushing from the door holder assembly.
2. Remove the cotter pins and clevis pins from the door hinges.
3. Remove the door from the airplane.

INSTALLATION OF DOOR.

1. Insert the door into position and install the hardware previously removed.
2. Make appropriate adjustments to the door.
3. Install the door holder assembly with the hardware previously removed.

ADJUSTMENT OF DOOR.

1. To acquire proper adjustment of the door insert the necessary washers to eyebolts between the fuselage and flange on the eyebolts.
2. Additional adjustments may be made by loosening the hinges on the door.
3. To insure longer life of the door seals and improve sealing characteristics, it is recommended they be lubricated with a fluorocarbon or similar dry lubricant in a spray can.

DOOR LATCH MECHANISM.

REMOVAL OF DOOR LATCH MECHANISM.

1. Remove the door latch mechanism by removing the door trim upholstery and the screws that attach the latch plate and latch mechanism to the door.
2. Disconnect the latch pull rod from the inside door handle.
3. Remove the complete latch mechanism.

INSTALLATION OF DOOR LATCH MECHANISM.

1. Place the latch assembly into position on the door.
2. Connect the latch pull rod to the inside door handle.
3. Replace the screws that attach the latch plate and mechanism to the door. Install the door trim upholstery and secure with screws.

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

230

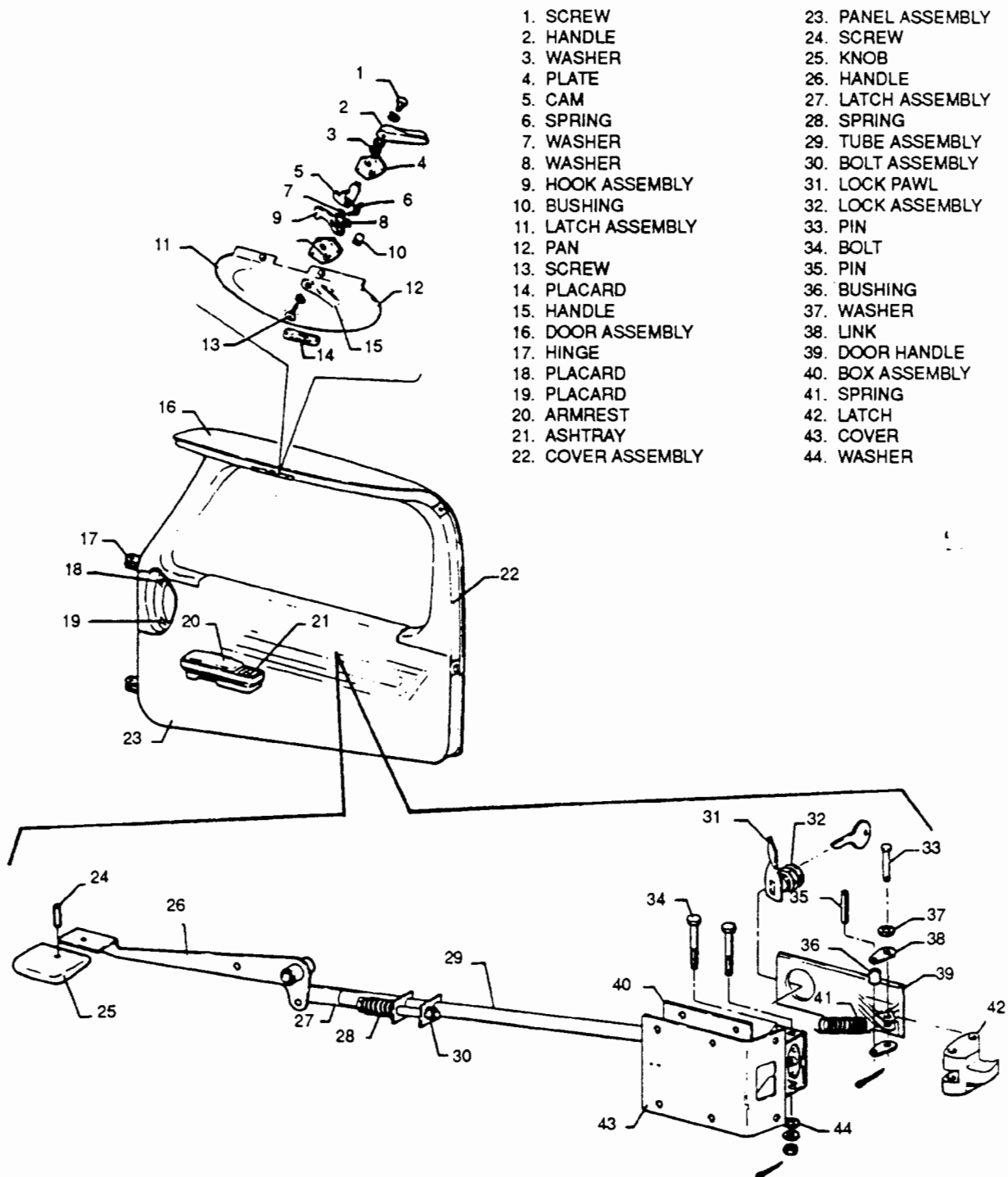


Figure 52-1. Door Installation

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

ADJUSTMENT OF DOOR LATCH MECHANISM.

To adjust the door latch, loosen the screws on the striker plate, make necessary adjustment, and retighten the screws.

DOOR LOCK ASSEMBLY.

REMOVAL OF DOOR LOCK ASSEMBLY.

1. Remove the door trim upholstery by removing the attachment screws.
2. Loosen the nut on the lock assembly and remove the lock by turning it sideways.

INSTALLATION OF DOOR LOCK ASSEMBLY.

1. Install the lock in the door by turning it sideways and placing it through the opening provided.
2. Replace the nut on the back of the lock assembly and tighten.
3. Replace the door trim upholstery and secure with the attachment screws.

DOOR AUXILIARY LATCH.

REMOVAL OF DOOR AUXILIARY LATCH.

1. Remove the latch assembly by removing the two handles.
2. Remove six screws holding the pan on the inside of the door.
3. Remove the pan and pull the latch assembly through the opening on the door.

INSTALLATION OF DOOR AUXILIARY LATCH.

1. Place the latch assembly into position for installation.
2. Replace the pan and install the six screws and handles.
3. Check latch assembly for operation and be certain that it is free of rubbing on the trim panels.

ADJUSTMENT OF AUXILIARY LATCH.

1. To adjust the door auxiliary latch remove the two screws from the latch plate found at the top of the door opening.
2. Remove the plate and turn the loop assembly in or out to make necessary adjustments.
3. Replace the latch plate and secure with the two attachment screws.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

DOOR SEAL SNUBBER.

REMOVAL AND INSTALLATION OF DOOR SEAL SNUBBERS. (Refer to Figure 52-1a.)

1. To remove old seals use a thinner, such as toluol, that won't affect the painted surface, and strip off the old seal.
2. Install the door seal as follows:
 - A. If the surface has just been painted, allow to dry for a minimum of 2 hours before installing the seal.
 - B. Wipe the surface clean with a cleaner solvent, such as DuPont Prepsol 3919S.

— Note —

Refer to the List of Consumable Materials in Chapter 91 for types of appropriate neoprene adhesive.

- C. Make sure both the seal and surface are 65° to 100°F.

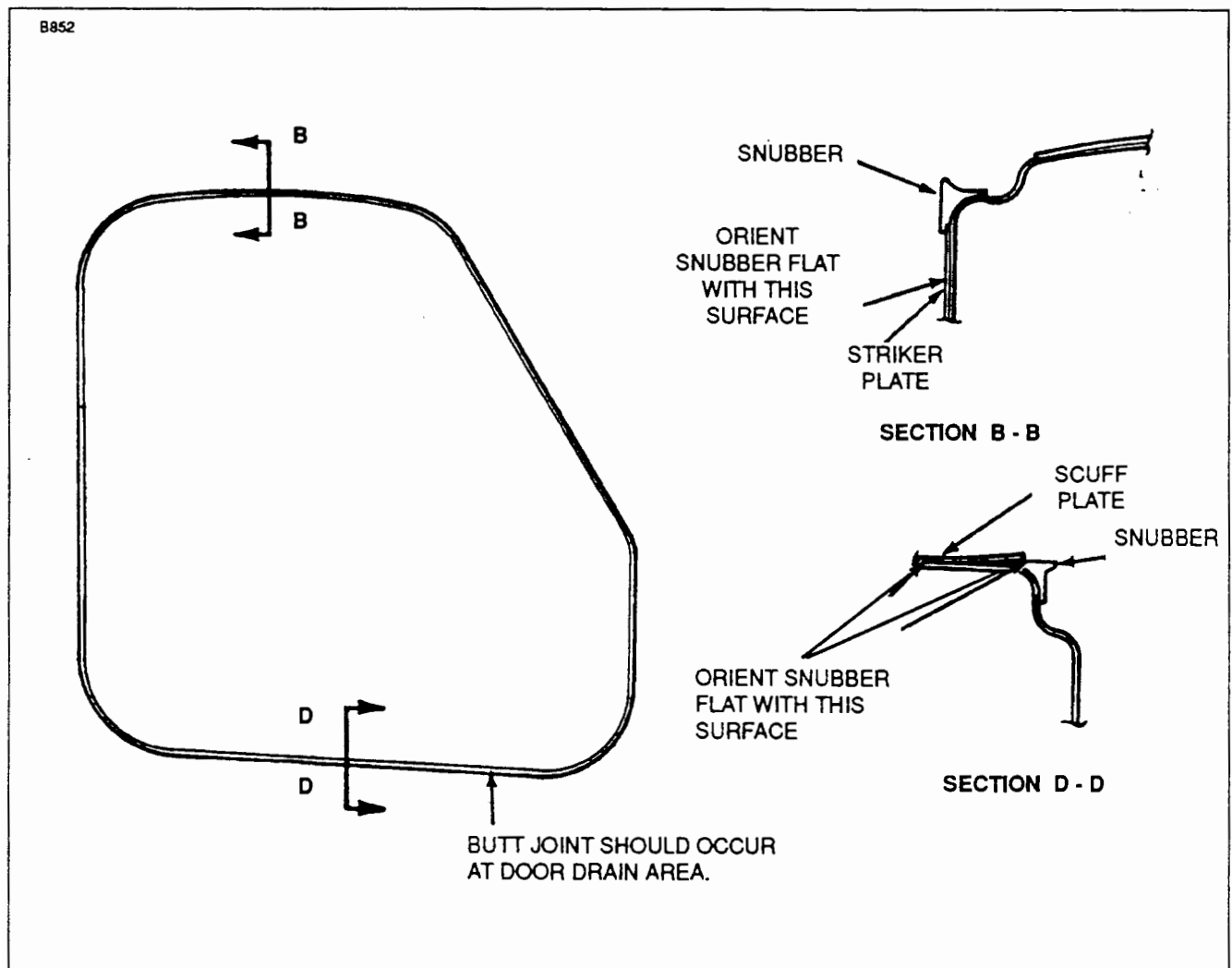


Figure 52-1a. Door Snubber Installation

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

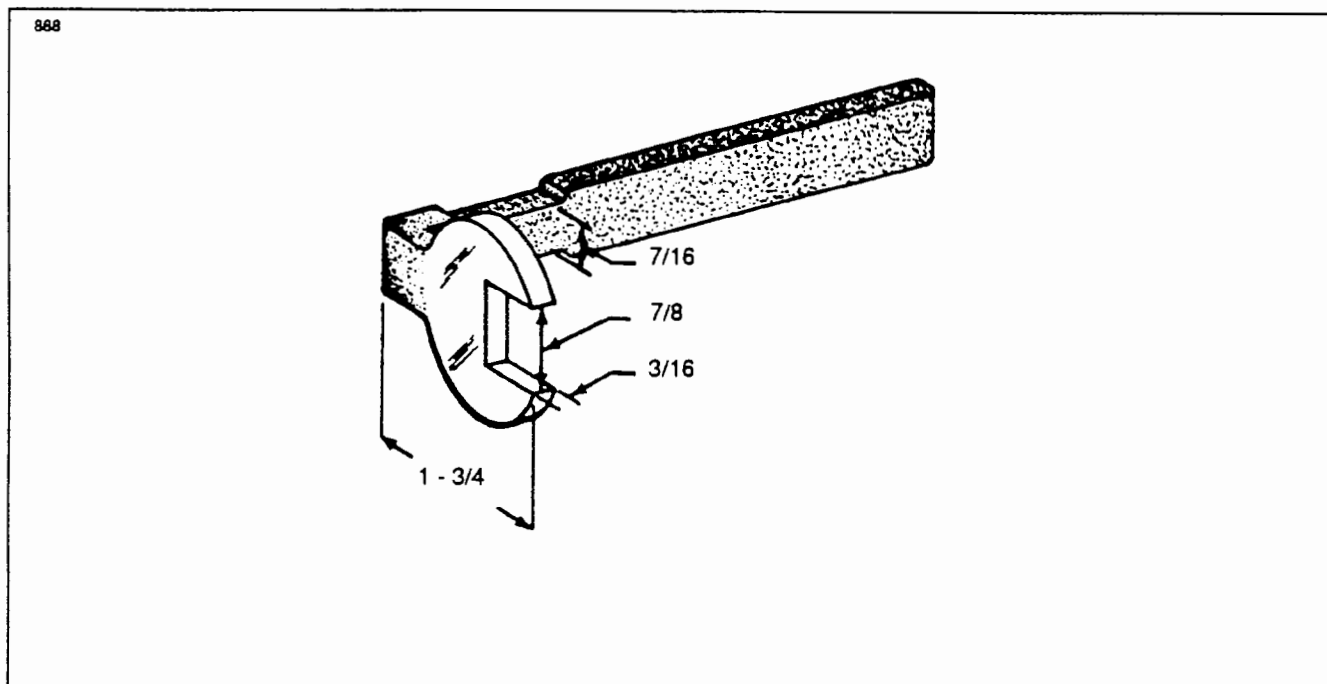


Figure 52-2. Fabricated Tool for Baggage Door Lock

- D. Adhesive should only be applied to that area to be covered by the seal. If necessary, tape off the affected area. The adhesive can be thinned as required with toluol. Apply adhesive in a continuous coat of .002 to .010 of an inch thick.
- E. Apply a continuous coat of adhesive of the same thickness to the seal.
- F. With the adhesive applied to the mating surface and seal, allow them to cure 30 to 60 min. apart before bonding them in place.
- G. With reference to Figure 52-1a, make sure the seal is properly aligned before allowing the surfaces to come in contact. The seal should not be stretched or pulled such that the cross section of the seal is reduced or distorted. Make sure the door closes properly and that an airtight seal is produced.
- H. After positioning the seal, apply pressure to remove air bubbles and assure firm contact.

BAGGAGE DOOR.

REMOVAL OF BAGGAGE DOOR.

With the door open remove the hinge pin from the hinge and remove the door.

INSTALLATION OF BAGGAGE DOOR.

Place the door in position so that the hinge halves are properly matched and install the hinge pin. It will not be necessary to replace the hinge pin with a new pin if it is free of bends and wear.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

BAGGAGE DOOR LOCK ASSEMBLY.

REMOVAL OF BAGGAGE DOOR LOCK ASSEMBLY.

1. With the door open remove two screws securing the access plate, remove the access plate.
2. Remove the nut from the back of the lock assembly with the use of a special wrench. (This tool may be fabricated from the dimensions given in Figure 52-2.)
3. Remove the lock assembly through the front of the door.

INSTALLATION OF BAGGAGE DOOR LOCK ASSEMBLY.

1. Place the lock into position for installation.
2. Install the nut on the lock assembly and tighten with the use of a special wrench.
3. Install access plate and secure with two screws.

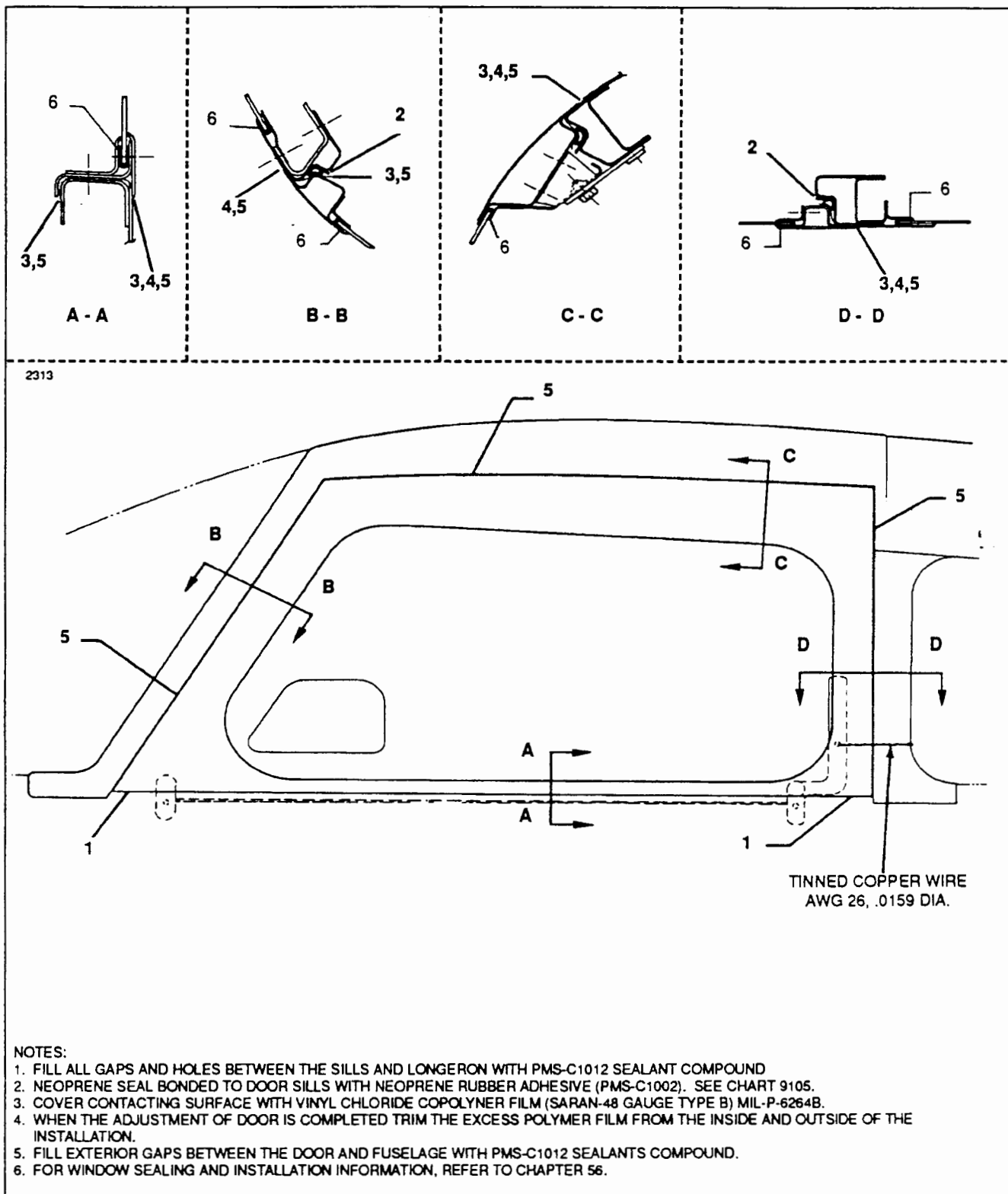
EMERGENCY EXIT.

REMOVAL AND INSTALLATION OF EMERGENCY EXIT. (Refer to Figure 52-3.)

1. Remove the safety wire securing the lock handle and push the handle forward to unlock the exit.
2. Carefully push outward along the bottom of the door (see CAUTION next paragraph) till the door just clears the door sill, and slowly shift the door back and forth out of the top of the fuselage skin.
3. Clean all old sealant from around the exit opening and exit assembly.
4. Inside the door frame apply lubriplate around both fore and aft latch tubes.
5. Insure that all gaps and holes between the sills and longeron are filled with PMS-C1012 sealant compound.
6. Insure that neoprene seal is securely bonded to the emergency exit assembly.
7. Cover the contacting surfaces of the assembly with vinyl film. (Refer to Chapter 91, Consumable Materials list for suppliers.)
8. Insert the bottom edge of the exit assembly over the longeron, then push in on the top and sides until it is properly seated. With the assembly seated push the lock handle aft to lock the assembly in place. Safety the handle in place with tinned copper wire AWG 26, .0159 dia. wire.
9. When exit is secured in place add sealant around perimeter of door and trim any excess vinyl film from inside and outside of the unit.
10. Test the latch mechanism, as explained in the next section, for operation prior to applying any sealant around the door.
11. Fill all gaps around the outside of the emergency exit and fuselage with PRC5000 sealant or equivalent.
12. Check for water leaks by spraying water over the emergency exit and window assembly.

TESTING OF EMERGENCY EXIT DOOR.

1. Remove the side panel access cover to the emergency release handle.
2. Attach a calibrated spring scale 1.0 inch from the top of the handle.



**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

3. With the scale reading the force applied, rotate the handle forward to an angle of 45°. The force required to rotate the handle shall be 20 pounds minimum, 30 pounds maximum.

— Note —

There should be no noticeable increase in force to finish rotating the handle after performing the last procedure.

4. Remove the spring scale and rotate the handle sufficiently to completely disengage the latch mechanism.
5. Sitting in the pilot's seat, carefully push outward (see CAUTION) along the bottom of the door. The force required to cause door to move should not exceed 40 pounds maximum.

— CAUTION —

**DO NOT PUSH DOOR OPEN MORE THAN FOUR INCHES BEYOND THE
BOTTOM DOOR SILL OR THE TOP REAR SKIN OVER THE DOOR WILL
BE DAMAGED.**

6. Push the door just clear of the door sill and wiggle it down out of the overlapping top skin.
7. After inspection of door reinstall as previously directed.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3B4 THROUGH 3B7
INTENTIONALLY LEFT BLANK**

CHAPTER

55

STABILIZERS

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 55 - STABILIZERS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
55-20-00	STABILATOR AND TAB	3B10	A 1 - 83
55-21-00	Stabilator	3B10	
55-21-01	Removal and Installation of Stabilator	3B10	
55-22-00	Stabilator Trim Tab	3B10	A 1 - 83
55-22-01	Removal and Installation of Stabilator Trim Tab	3B10	
55-23-00	Stabilator Balance	3B10	1 - 83
55-23-01	Balancing Equipment	3B12	
55-23-02	Balancing Stabilator	3B12	2 - 81
55-30-00	VERTICAL STABILIZER	3B14	
55-31-00	Vertical Fin	3B14	A 1-83
55-31-01	Removal and Installation of Vertical Fin	3B14	
55-40-00	RUDDER	3B14	
55-41-00	Rudder and Tab	3B14	A 1 - 83
55-41-01	Removal and Installation of Rudder	3B14	
55-42-00	Rudder Trim Tab	3B14	A 1 - 83
55-42-01	Removal and Installation of Trim Tab	3B16	
55-43-00	Rudder Balance	3B16	1 - 83
55-43-01	Balancing Rudder	3B17	1 - 83

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

STABILATOR AND TAB.

STABILATOR.

REMOVAL AND INSTALLATION OF STABILATOR. (Refer to Figure 55-1.)

The stabilator assembly can be removed by following the procedure given below.

1. Remove the fin tip attachment screws and disconnect the light at quick disconnect then remove tip assembly.
2. Disconnect trim push rod and push rod attached to stabilator balance weight arm.
3. Remove balance weight arm from stabilator by removing attachment bolt at the forward and aft arm mounting fitting.
4. Remove the two hinge bolts at the pivot points and remove the stabilator.
5. Reinstall the stabilator in reverse of removal instructions.
6. Check attaching hardware for proper installation.

STABILATOR AND TRIM TAB.

REMOVAL AND INSTALLATION OF STABILATOR TRIM TAB. (Refer to Figure 55-1.)

The trim tab can be removed by following the procedure given below.

1. Disconnect the trim push rod from the trim horn.
2. Remove the hinge pins and remove the trim tab.
3. Reinstall the trim tab in reverse of removal instructions, with new hinge pins.

STABILATOR BALANCE.

The stabilator has been statically balanced at the time of installation at the factory and normally should not require rebalancing. Where possible the stabilator was set with the balance weight on the heavy side of the limits to permit limited repair or paint touch-up without adjusting the balance weight. It should be noted, however, that spare stabilators are delivered unpainted and the static balance will not necessarily fall within the limits provided. This is more pronounced on the stabilators and rudders. The completed stabilator including paint should be within the limits given in Figures 55-2. If the surface is not to be painted, the balance weight will probably require adjustment. Replacement stabilators or stabilators that have been repainted or repaired should be rebalanced according to the procedures given in this chapter. The static balance of the surfaces must be as specified in the figures referenced above.

Before balancing any control surface, it must be complete including tip, trim / servo tabs as applicable and tab actuating arms or push rods with bearings as applicable and all optional equipment which is mounted on or in the control surface when it is flown, including paint, position lights and wiring, static wicks, scuff boots, etc.

If optional equipment is added or removed after balancing, the control surface must be rebalanced. During balancing, trim/servo tabs must be maintained in the neutral position.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

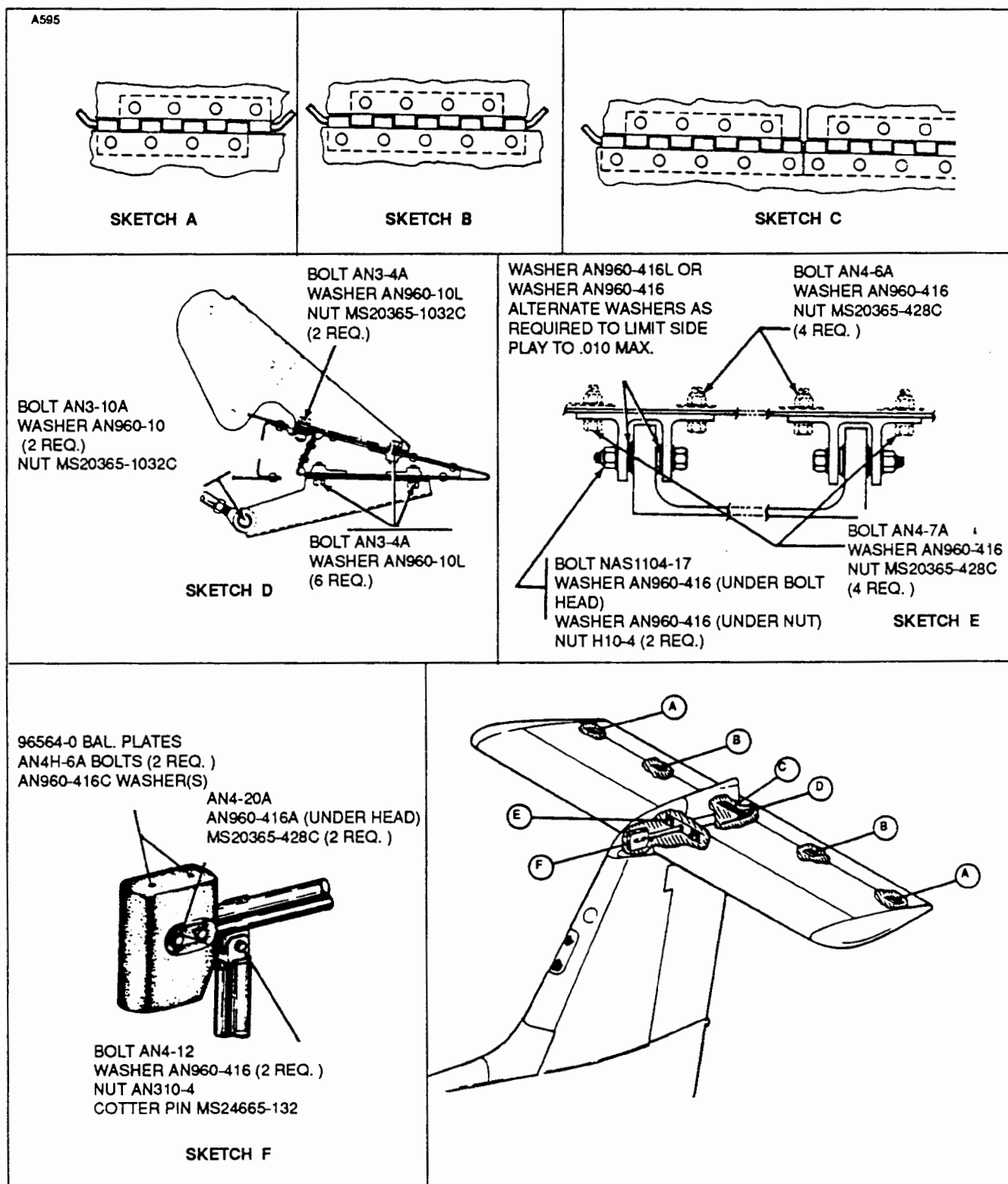


Figure 55-1. Stabilator Installation

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

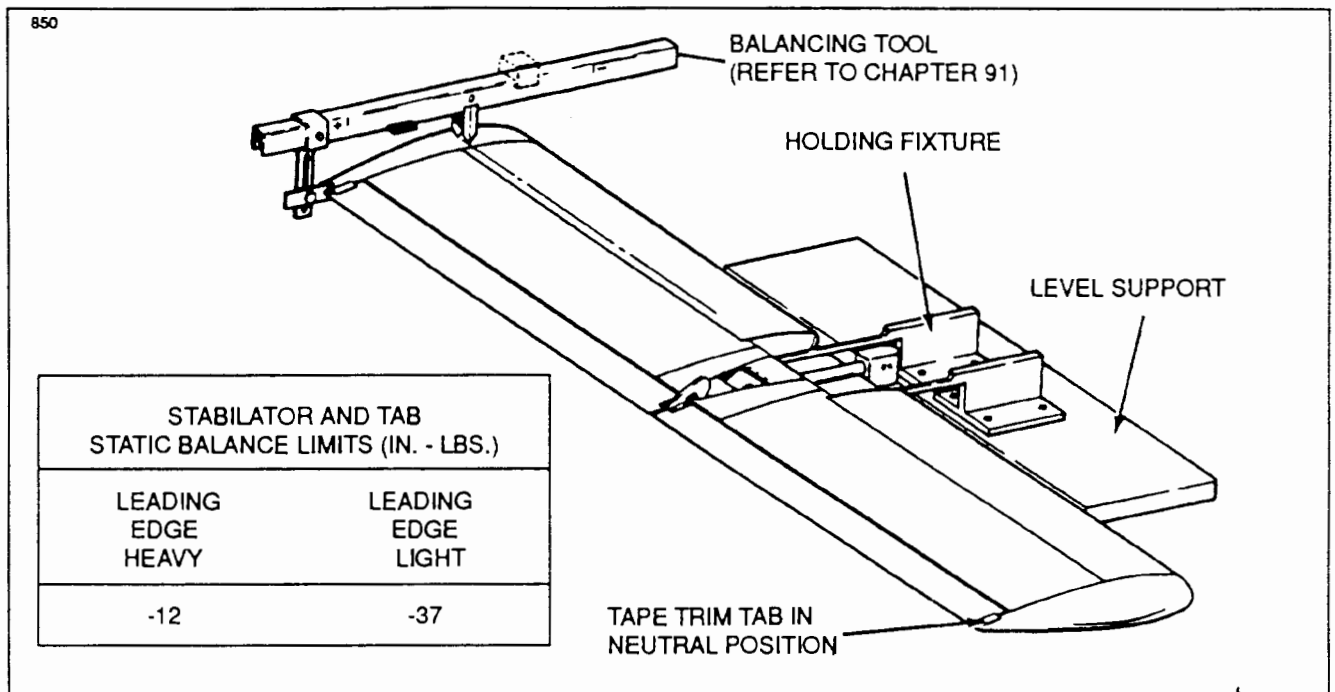


Figure 55-2. Stabilator Balance Configuration

BALANCING EQUIPMENT.

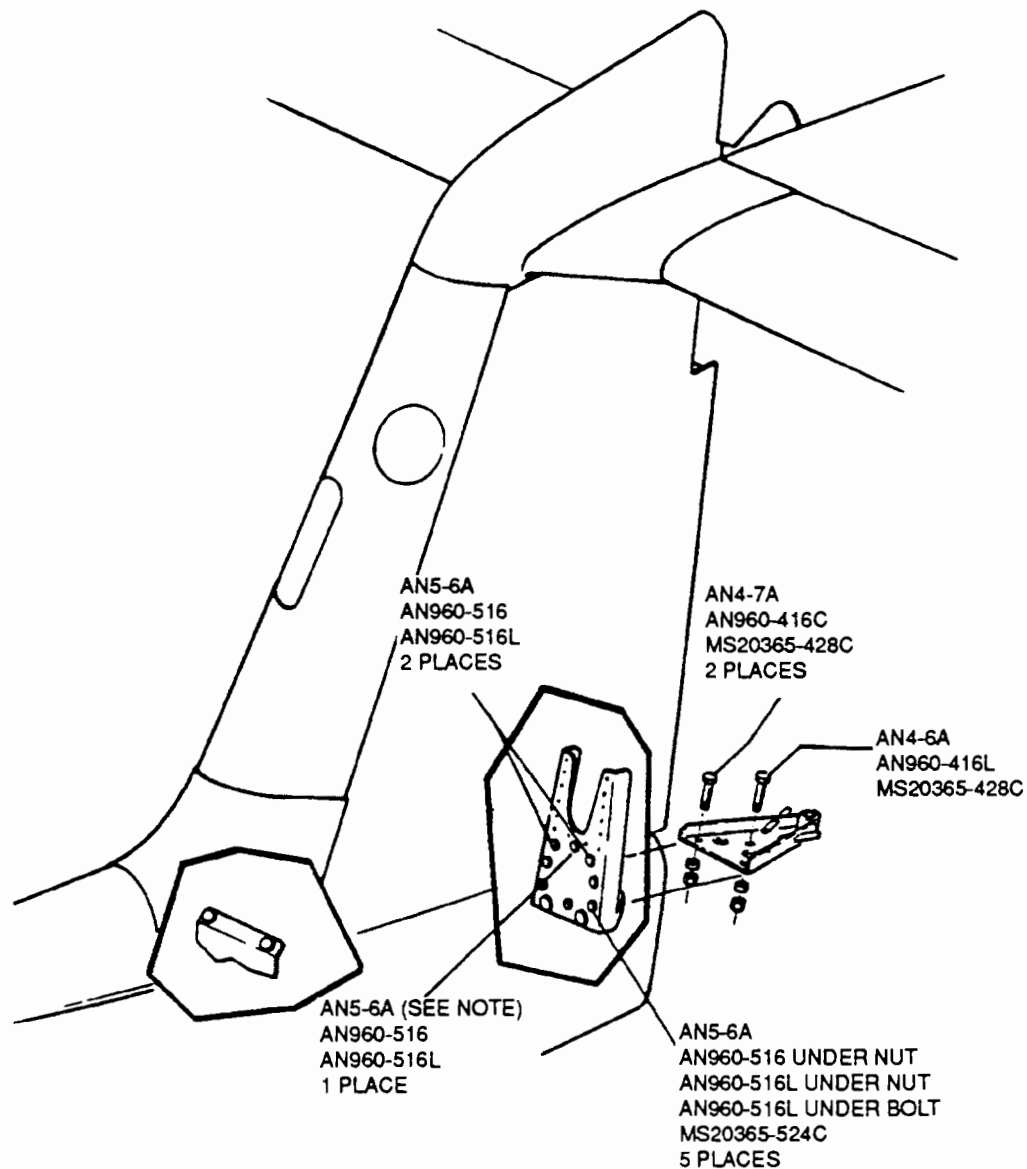
The balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the center line of the control surface hinge line. A suggested tool configuration is shown in Chapter 91. Other tool configurations may be used, provided accuracy is maintained and recalibration capability is provided. The tool shown may be calibrated by placing it on the control surface to be balanced with the balance points over the control surface hinge center line and balance bar parallel to the cord line. Position the trailing edge support on the tool to align the tool with the control surface cord line and secure it in this position. Remove the tool without disturbing the trailing edge support and balance the tool by adding weight to the light end as required. (The movable weight must be at the center line.) Place the tool on the control surface perpendicular to the hinge center line as shown in Figure 55-2. Read the scale when the bubble level has been centered by adjustment of the movable weight.

BALANCING STABILATOR. (Refer to Figure 55-2.)

PPS50011-2

Refer to Balancing Control Surfaces at the end of this chapter.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL



NOTE
 THIS BOLT NOT INSTALLED ON PA-44-180
 S/N 44-8195015 AND UP, AND PA-44-180T
 S/N 44-8107039.

Figure 55-3. Vertical Fin Installation

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

VERTICAL STABILIZER.

VERTICAL FIN.

REMOVAL AND INSTALLATION OF VERTICAL FIN. (Refer to Figure 55-3.)

1. Remove the fin tip, tail fairing, dorsal fin at the forward edge of the fin. Disconnect upper and lower tail lights at the quick disconnects.
2. Separate the stabilator trim cable, rudder trim cable and rudder cable at the turnbuckles and remove the cables.
3. Remove the rudder per removal instructions.
4. Remove the stabilator per removal instructions.
5. Disconnect the antenna wire from the antenna assembly, attach a fishing line to the antenna cable before removing it from the fin conduit.
6. Remove stabilator control push rod from the fin by disconnecting attachment hardware at the balance weight arm and at bellcrank.
7. Remove the two bolts at the leading edge of the fin.
8. Remove the bolts which secure the fin spar to the aft bulkhead. Remove the fin.
9. Install the fin in reverse of removal instructions. Check all bolts for safety. Refer to installation and rigging of stabilator trim cable, rudder trim cable and rudder cable for adjustment of cables.

RUDDER.

RUDDER AND TAB.

REMOVAL AND INSTALLATION OF RUDDER. (Refer to Figure 55-4.)

1. Remove the fairing.
2. Disconnect the trim push rod by removing one bolt from the push rod.
3. Disconnect the rudder cables at the turnbuckles within the fuselage tail section and disconnect the cable from the rudder sector.
4. While supporting the rudder, remove the hinge bolts and remove the rudder from the fin.
5. Install the rudder in reverse of removal instructions; check cable tension if disturbed.

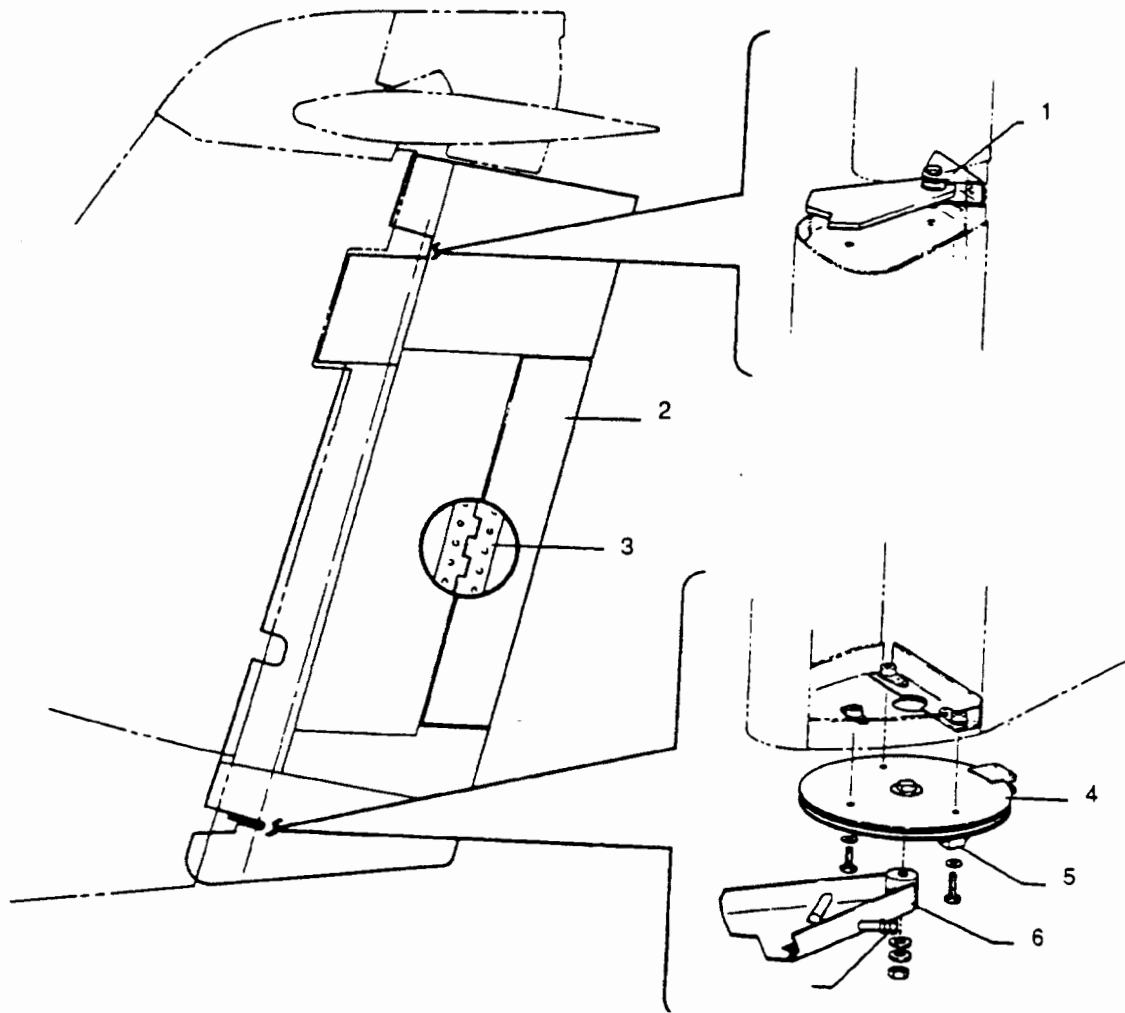
RUDDER TRIM TAB.

REMOVAL AND INSTALLATION OF RUDDER TRIM TAB. (Refer to Figure 55-4.)

1. Disconnect trim push rod.
2. Remove the hinge pin and remove trim tab.
3. Install the trim tab in reverse of removal instructions, with new hinge pin.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

2303



1. UPPER RUDDER HINGE
2. RUDDER TRIM TAB
3. TRIM TAB HINGE
4. RUDDER SECTOR
5. RUDDER SECTOR STOP
6. LOWER RUDDER HINGE
7. RUDDER STOP ADJUSTMENT BOLT

Figure 55-4. Rudder Installation

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

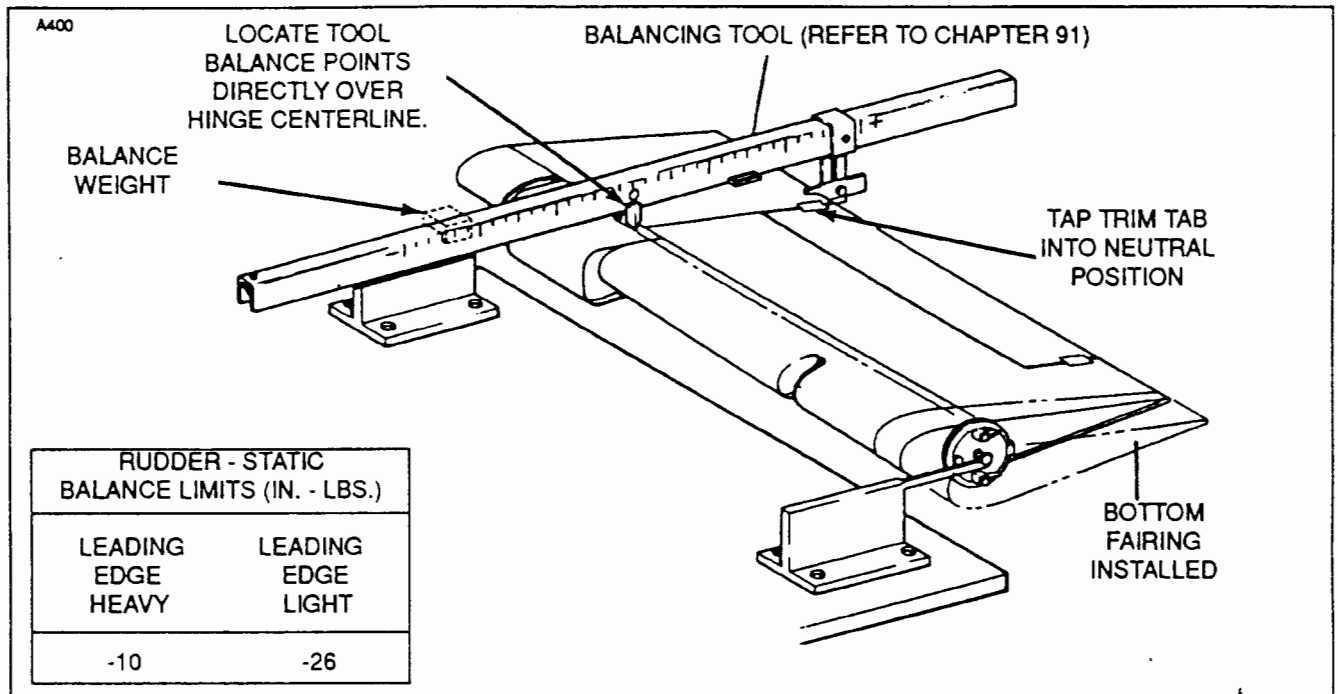


Figure 55-5. Rudder Balancing

RUDDER BALANCE.

The rudder has been statically balanced at the time of the installation at the factory and normally should not require rebalancing. Where possible the rudder was set with the balance weight on the heavy side of the limits to permit limited repair or paint touch-up without adjusting the balance weight. It should be noted, however, that spare rudders are delivered unpainted and the static balance will not necessarily fall within the limits provided. The completed rudder including paint should be within the limits given in Figure 55-5. If the rudder is not to be painted, the balance weight will probably require adjustment. All replacement rudders or rudders that have been repainted or repaired should be rebalanced according to the procedures given in this chapter. The static balance of the rudder must be within the limits specified in the figure referenced above.

Before balancing any control surface, it must be complete including tip, trim/servo tabs as applicable and tab actuating arms or push rods with bearings as applicable and all optional equipment which is mounted on or in the control surface when it is flown, including paint, position lights and wiring, static wicks, scuff boots, etc.

If optional equipment is added or removed after balancing, the control surface must be rebalanced. During balancing, trim/servo tabs must be maintained in the neutral position.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

BALANCING RUDDER. (Refer to Figure 55-5.)

PPS50011-2

1. Insure that the control surface is in its final flight configuration, static wicks, trim tabs, trim tab push-pull rod and control surface tip (as applicable) should be installed. The surface should be painted and trim,servo tabs should be in the neutral position.

— Note —

Because paint is a considerable balance factor, it is recommended that existing paint be removed prior to repainting a control surface.

2. Place hinge bolts through control surfaces and place control surface on a holding fixture.
3. Avoiding rivets, place the balancing tool on the control surface with the tool's hinge centerline directly over the hinge line of the control surface.
4. Adjust the movable trailing edge support to fit the width of the control surface. Tighten the set screw on the trailing edge support.
5. Adjust the trailing edge support vertically until the beam is parallel with the control surface chord line.
6. Remove the tool from the control surface and balance the tool itself by adding or removing nuts or washers from the beam balancing bolt. When balancing the tool, the movable weight must be at the bar's hinge centerline.
7. After balancing the tool, reattach it to the control surface. Keep the beam positioned 90° from the control surface hinge line.
8. Determine balance of control surface by sliding movable weight along the balance beam.
9. Read the scale when the bubble in the level has been centered . Since the movable weight weighs three pounds, every inch it is moved from the center of the beam equals three inch-pounds of force.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3B18 THROUGH 3B21
INTENTIONALLY LEFT BLANK**

CHAPTER

56

WINDOWS

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 56 - WINDOWS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
56-10-00	FLIGHT COMPARTMENT	3B24	
56-11-00	Windshield	3B24	A 1 - 83
56-11-01	Removal and Installation of Windshield	3B24	
56-20-00	CABIN	3B24	
56-21-00	Side Windows	3B24	A 1 - 83
56-21-01	Removal and Installation of Side Windows	3B24	
56-30-00	DOOR	3C2	
56-31-00	Emergency Exit Window	3C2	
56-31-01	Removal and Installation of Emergency Exit Window	3C2	

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

FLIGHT COMPARTMENT.

WINDSHIELD.

REMOVAL AND INSTALLATION OF WINDSHIELD. (Refer to Figure 56-1.)

1. Remove the collar from around the bottom of the windshield and the trim strip from between the windshield halves by removing the attaching screws.
2. Remove the windshield by raising the lower portion of the windshield and carefully pulling it out and down to release the top and side edges.

— Note —

A damaged windshield should be saved to provide a pattern for shaping the new window.

3. Clear old tape and/or sealer off the affected mating surfaces.
4. Cut or grind the new windshield to acquire proper dimensions.
5. Isocrylic sealant as described in Chart 9105 (per PMSC1012-2-2), is used to provide a resilient seal for the windows. Proceed as follows:
 - A. With the protective covering left on, force round bead solvent (PMSC1012-2-2) into the bottom of the windshield channel starting at the top center and continuing to the lower end of the channel on the side of the fuselage. After the sealant is firmly and completely seated in the bottom of the channel, remove the protective paper.
 - B. Firmly press tape type sealant (PMSC1012-2-6) over the edge of the windshield that runs from the top center down to the side of the aircraft. Equal width of tape should be on each surface of the windshield. Remove the protective tape.
6. Insert each windshield into its fuselage channel. The excess sealant will "squeeze-out— but should not be trimmed away immediately.
7. Insert each windshield into its fuselage channel allowing clearance between the two windshields for expansion.
8. Firmly apply sealant tape to the surfaces of the windshield retaining trim strips and then remove protective paper.
9. Install trim strips.
10. A tool made of acrylic sheet with a wedged end (.25 inch thick and 1.5 inch wide) should be used to trim away excess sealant.

CABIN

SIDE WINDOWS.

REMOVAL AND INSTALLATION OF SIDE WINDOWS. (Refer to Figure 56-2.)

PA-44 airplanes are equipped with single frame side windows. For removal and installation of the windows, the following instructions may be used.

1. Remove the retainer molding from around the window by removing the attaching screws.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

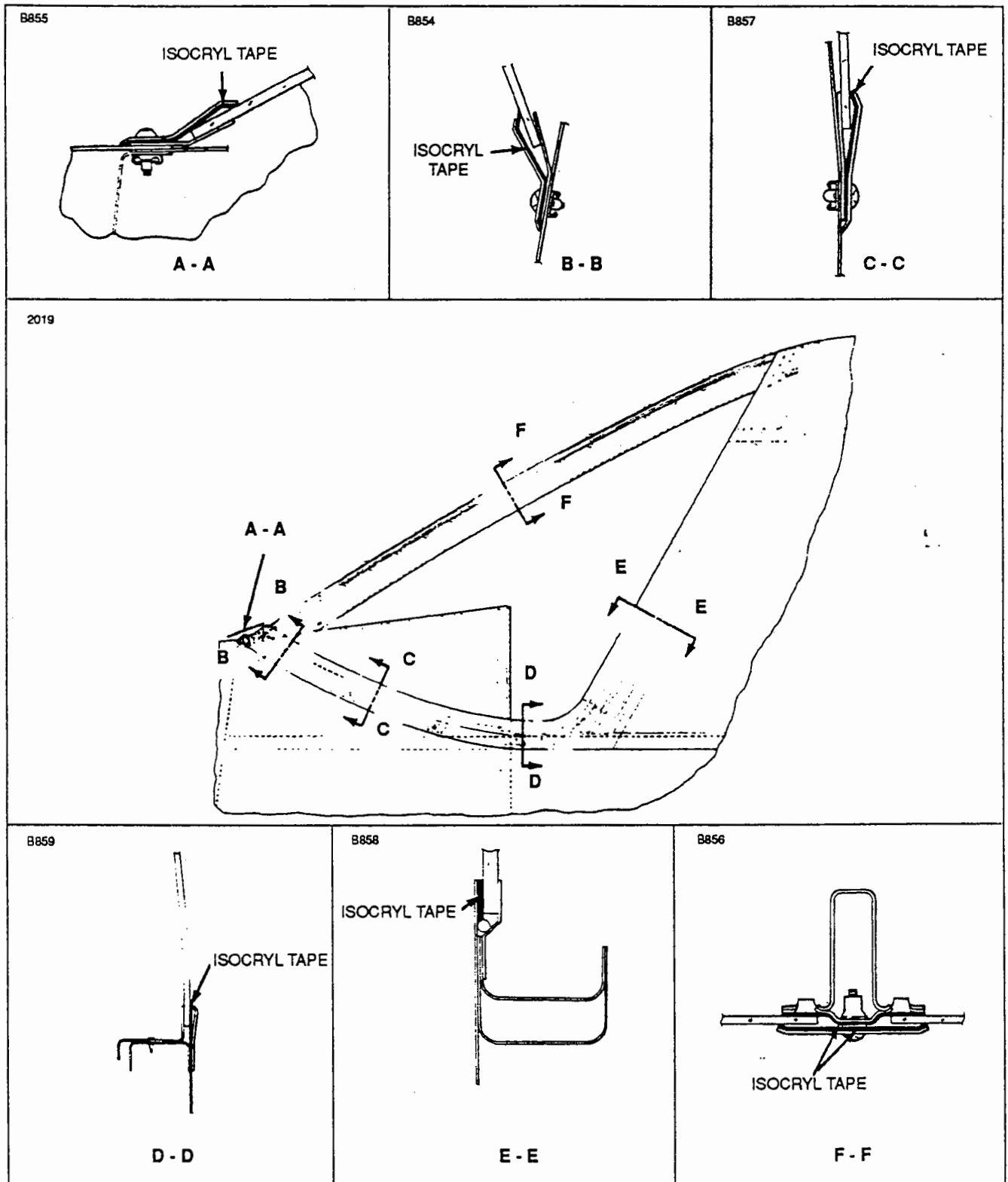


Figure 56-1. Windshield Installation

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

2. Carefully remove the window from the frame.

— Note —

A damaged window should be saved to provide a pattern for shaping the new window.

3. Remove old tape and sealer from window frame and molding.
4. Cut or grind the new window to the same dimensions as the window removed.
5. Apply Norton Tape Division, Troy, New York type II vinyl foam tape series 510 or equivalent, on both sides of the window around the outer edges.
6. Insert the window in the frame and install the retainer moldings.
7. Secure the molding with attachment screws and tighten until the vinyl foam tape is 25 % compressed by the retainers.
8. Apply Behr-Manning, Norton sealant number PR307 or equivalent, completely around the outer surface of the window at all attachment flanges.
9. Remove the excess exposed sealer and tape.

DOOR.

EMERGENCY EXIT WINDOW.

REMOVAL AND INSTALLATION OF EMERGENCY EXIT WINDOW. (Refer to Figure 56-2.)

The PA-44 airplanes are equipped with a single pane window installed in the emergency exit door located on the left side of the pilot's seat. For removal and installation of the emergency exit refer to Chapter 52 of this manual.

— Note —

A damaged window will require the removal of the emergency exit door from The fuselage. If possible the damaged window should be saved to provide a pattern for shaping the new window.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

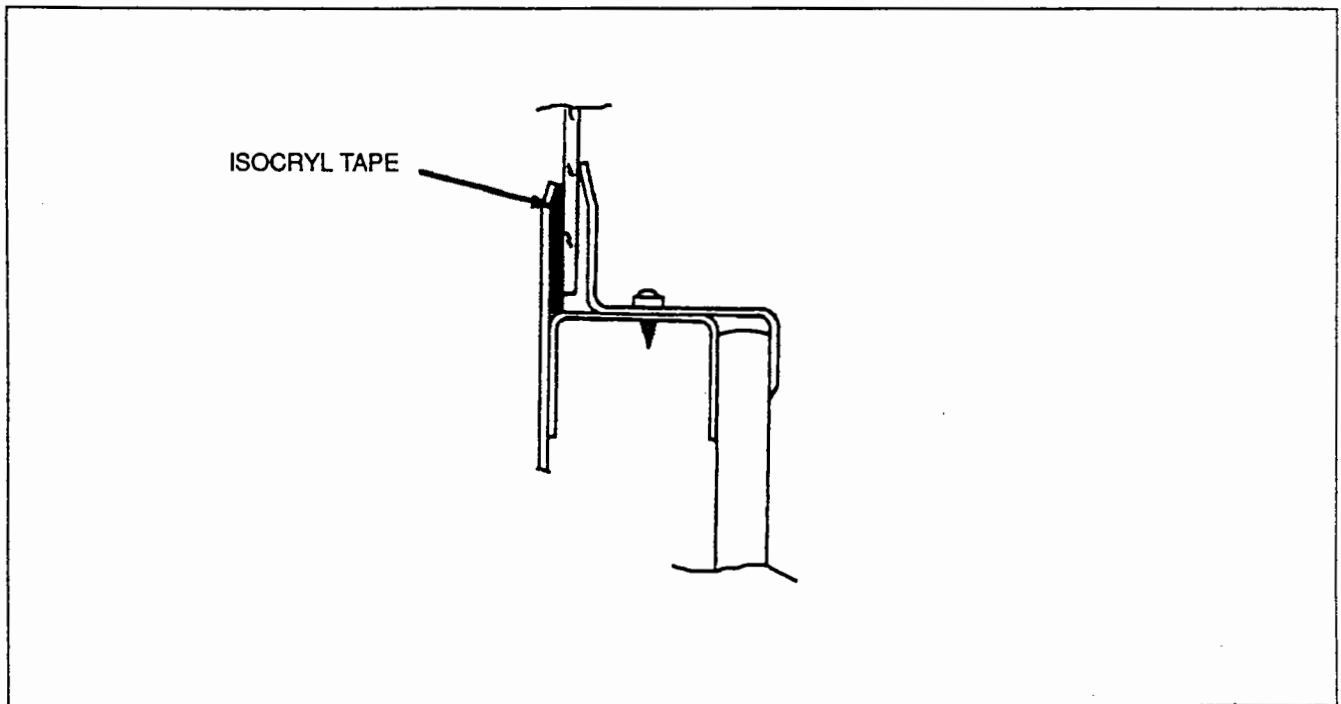


Figure 56-2. Side Window Installation

1. Remove the molding and retainer from around the window by removing attaching screws and rivets.
2. Carefully remove the damaged window from the frame.
3. Remove old tape and sealer from the window frame and molding.
4. Cut or grind the new window to the same dimensions as the one removed.
5. Apply vinyl foam tape series 530 or equivalent (refer to Chapter 91, Consumable Materials list for suppliers) on both sides of the window around the outer edges.
6. Insert the window in the frame and install the retainer molding.
7. Secure the retainer molding with attaching screws and rivets, tighten until the foam tape is 25% compressed by the retainers.
8. Apply PR307 sealant or equivalent completely around the outer surface of the window, remove any excess exposed sealer or tape.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3C4 THROUGH 3C9
INTENTIONALLY LEFT BLANK**

CHAPTER

57

WINGS

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 57 - WINGS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
57-00-00	GENERAL	3C12	
57-01-00	Description	3C12	
57-20-00	AUXILIARY STRUCTURE	3C12	
57-21-00	Wing Tip	3C12	A 1 - 83
57-21-01	Removal of Wing Tip	3C12	
57-21-02	Repair of Wing Tip	3C12	
57-21-03	Installation of Wing Tip	3C12	
57-40-00	ATTACH FITTINGS	3C13	
57-41-00	Wing Attachment	3C13	A 1 - 83
57-41-01	Removal of Wing	3C13	
57-41-02	Installation of Wing	3C16	
57-50-00	FLIGHT SURFACES	3C17	
57-51-00	Aileron	3C17	A 1 - 83
57-51-01	Removal of Aileron	3C17	
57-51-02	Installation of Aileron	3C17	
57-51-03	Aileron Balance	3C17	1 - 83
57-51-04	Balancing Equipment and Procedure	3C20	
57-52-00	Wing Flap	3C21	A 1 - 83
57-52-01	Removal of Wing Flap	3C21	
57-52-02	Installation of Wing Flap	3C21	

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

GENERAL.

This chapter explains the removal and installation procedures for the wings and related components from the aircraft.

DESCRIPTION.

Each wing panel is an all metal, full cantilever, semi-monocoque type structure with removable tips and access panels. Attached to each wing are the aileron, flap, main landing gear and powerplant. Installed in each engine nacelle is a bladder type fuel tank with a capacity of 54 U.S. gallons each or a total capacity of 108 U.S. gallons. The wings are attached to each side of the fuselage by inserting the butt ends of the main spars into a spar box carry through. The spar box is an integral part of the fuselage structure which provides, in effect, a continuous main spar with splices at each side of the fuselage. There are also fore and aft attachments at the front and rear spars.

— Note —

The major subassemblies of the wing may be removed individually or the wing may be removed as a unit. To remove a wing, a fuselage and wing supporting cradle is required

AUXILIARY STRUCTURE.

WING TIP.

REMOVAL OF WING TIP.

1. Remove the screws holding the wing tip to the wing being careful not to damage the wing or wing tip.
2. Pull off the wing tip far enough to disconnect the navigation light wire assembly. The ground lead may be disconnected at the point of connection on the wing rib and the positive lead may be disconnected at the wire terminal or unscrewed from the light assembly.
3. Inspect the fiberglass wing tip to ascertain that it is free of cracks, severe nicks and minor damage.

REPAIR OF WING TIP.

Fiberglass wing tips may be repaired in accordance with fiberglass repair procedures in the structural repairs portion of Chapter 51. Badly damaged thermoplastic tips should be replaced.

INSTALLATION OF WING TIP.

1. Place the wing tip in a position that the navigation light leads may be connected. Connect the ground lead to the wing rib by use of a screw and nut and the positive lead to the navigation light by connecting the wire terminals or screwing the connectors together. Insulate the wire terminals and be certain that the ground lead is free of dirt and film to insure a good connection.
2. Insert the wing tip into position and install the screws around the tip. Use caution to refrain from damaging the wing tip or wing. Check operation of the navigation light.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

ATTACH FITTINGS.

WING ATTACHMENT.

REMOVAL OF WING. (Refer to Figure 57-1.)

1. Close the fuel valve and drain the fuel from the wing to be removed. (Refer to Draining Fuel System, Chapter 12.)
2. Drain the brake lines and reservoir. (Refer to Draining Brake System, Chapter 12.)
3. Remove the engine from the wing to be removed. (Refer to Removal of Engine, Chapter 71.)
4. Drain the hydraulic lines of the landing gear of the wing to be removed by separating the lines and elbows at the actuating cylinder.
5. Remove the access plate at the wing butt rib and wing inspection panels.
6. Remove the front and back seats from the airplane.
7. Expose the spar box and remove the side trim cockpit panel assembly that corresponds with the wing being removed.
8. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)

— Note —

To help facilitate reinstallation of control cables, power plant controls, and fuel and hydraulic lines, mark cable and line ends in some identifying manner and attach a line where applicable to cables before drawing them through the fuselage or wing.

9. Disconnect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar.
10. If the left wing is being removed, remove the cotter pin from the pulley bracket assembly to allow the left aileron balance cable end to pass between the pulley and bracket.
11. Disconnect the flap from the torque tube by extending the flap to its fullest degree and removing the bolt and bushing from the bearing at the aft end of the control rod.

— CAUTION —

**TO PREVENT DAMAGE OR CONTAMINATION OF FUEL, HYDRAULIC
AND MISCELLANEOUS LINES, PLACE A PROTECTIVE COVER OVER
THE LINE FITTINGS AND ENDS.**

12. Disconnect the fuel line at the fitting located inside of the wing by removing the access panel on the forward inboard portion of the wheel well and reaching through to the fuel line coupling.
13. Remove the clamps that are necessary to release the electrical harness assembly. Disconnect the leads from the terminal strip by removing the cover and appropriate nuts and washers.
14. With the appropriate trim panel removed, disconnect the hydraulic brake line at the fitting located within the cockpit at the leading edge of the wing.
15. Disconnect the landing gear hydraulic lines at the fittings aft of the spar and within the fuselage.
16. If the left wing is being removed, it will be necessary to disconnect pitot and static tubes at the elbows located within the cockpit at the wing butt line.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

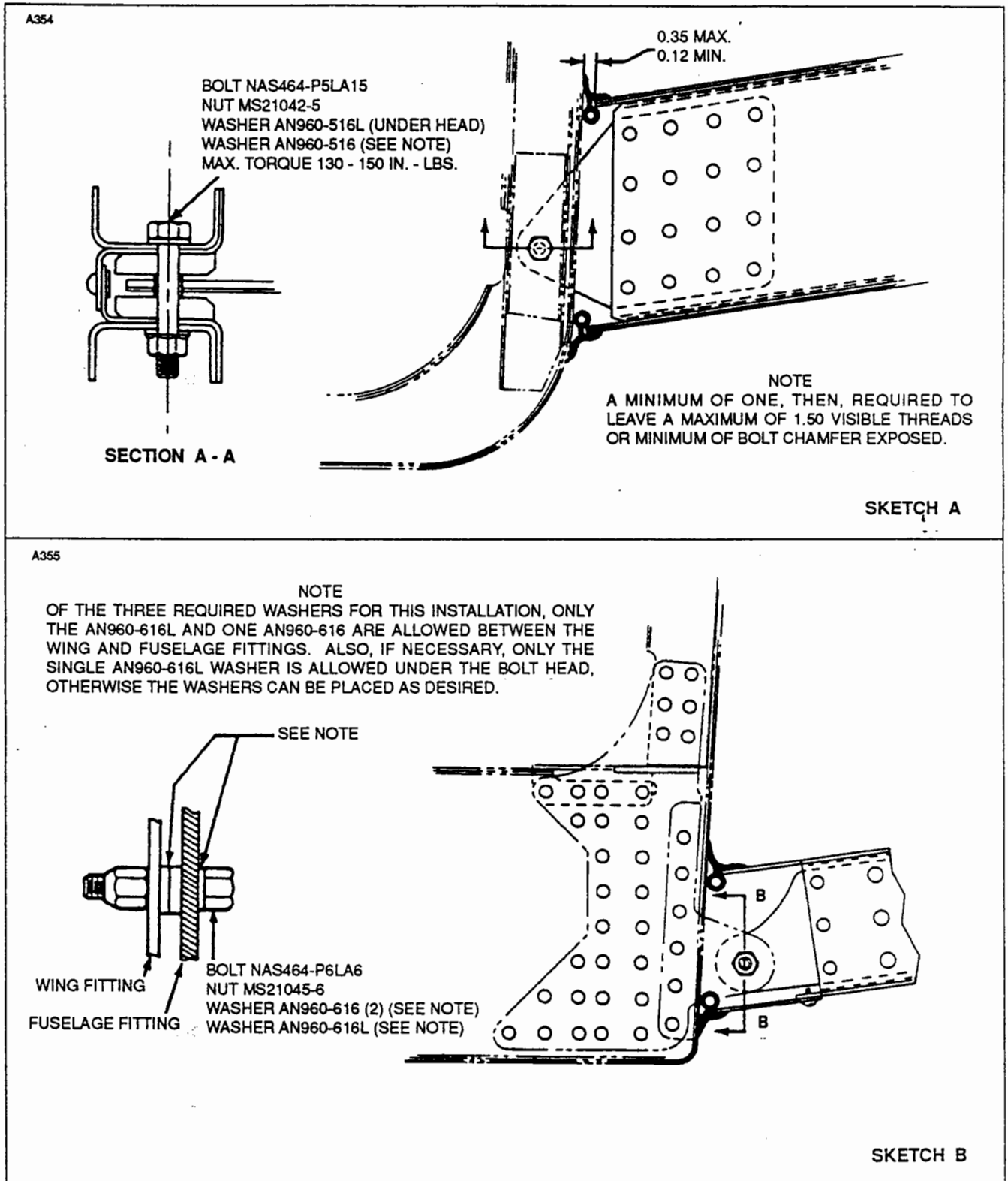


Figure 57-1. Wing Installation

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

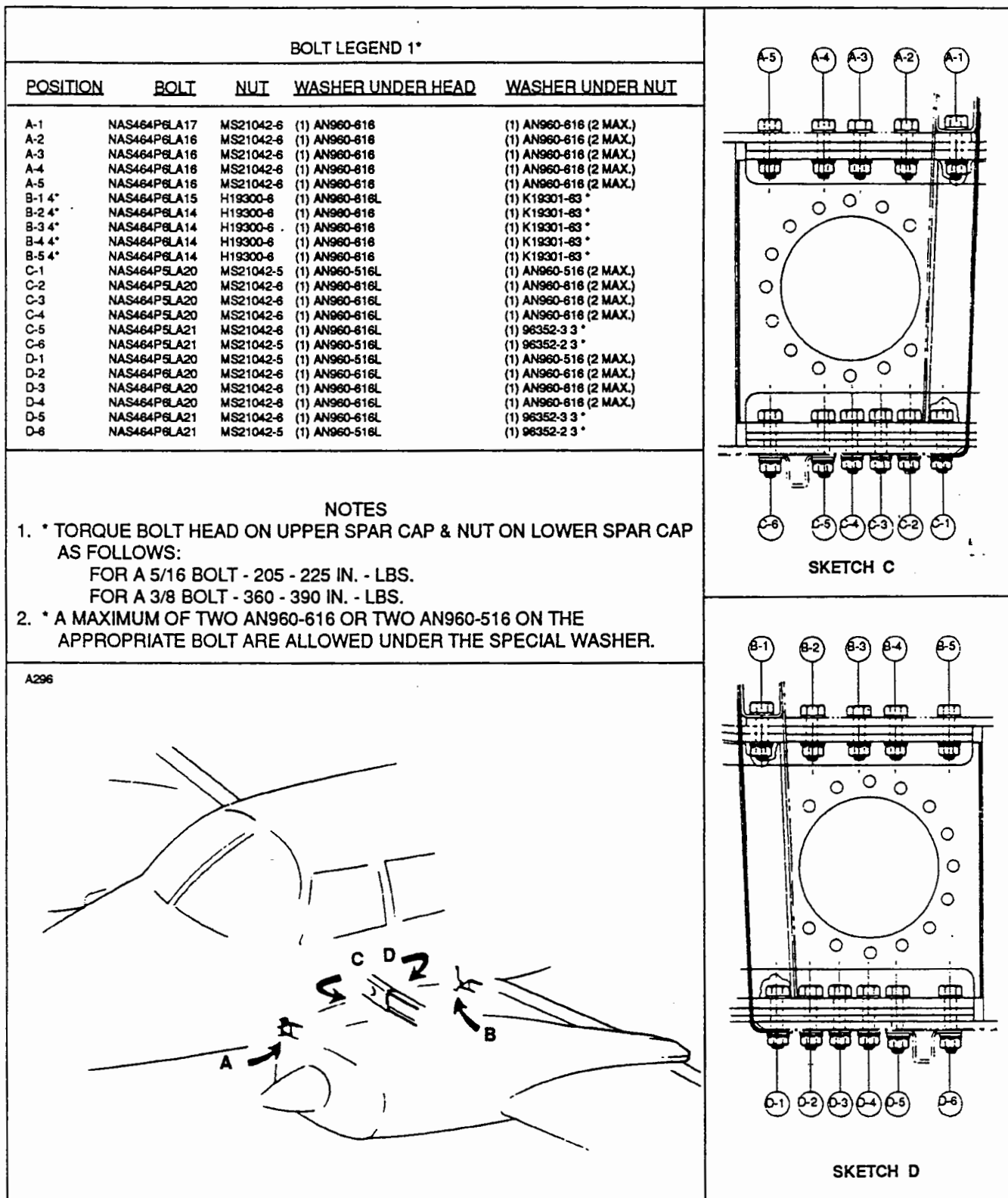


Figure 57-1. Wing Installation (cont)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

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.
3. Prepare the various electrical leads, fuel lines, control cables, and power plant controls for insertion into the wing or fuselage when the wing is eased into place.
4. Slide the wing into position on the fuselage.
5. Install the main spar bolts in accordance with the information given in Figure 57-1, Sketches C and D.
6. Install the bolt, washers, and nut that attaches the front spar and fuselage fitting. A minimum of one washer is required under the bolt head; then add washers as needed to leave a maximum of one and one-half threads visible or a minimum of bolt chamfer exposed. (Refer to Sketch A, Section A-A of Figure 57-1.)
7. Install the bolt, washers, and nut that attaches the rear spar and fuselage fitting. It is acceptable to have the faces of the fittings against each other in which case the AN960-616L washer should be used under the bolt head. The AN960-616 washer may be added under the nut when not used as a shim. (Refer to Sketch B, Section B-B of Figure 57-1.) Check to insure that no threads are bearing on the forward plate prior to installing the nut.
8. Torque the main spar bolts in accordance with specifications given in the bolt legend of Figure 57-1. The forward spar attachment bolt should be torqued to a maximum of 70 to 90 inch-pounds. The rear spar attachment bolt should be torqued to a maximum of 360-390 inch-pounds.
9. Install the wing jacks and tail support to the tail skid with approximately 250 pounds of ballast on the base of the tail support. Remove the fuselage cradle and wing supports.
10. If the left wing was removed, it is necessary that the pitot and static tubes be connected at the elbows located within the cockpit at the wing butt line. Replace or install clamps where found necessary.
11. Connect the hydraulic brake line onto the fitting located within the cockpit at the leading edge of the wing and the landing gear hydraulic lines at the fittings within the fuselage aft of the spar.
12. Connect the leads to the appropriate posts on the terminal strip and install the washers and nuts. (For assistance in connecting the electrical leads, refer to the electrical schematics in Chapter 91.) Place the clamps along the electrical harness to secure it in position and install the terminal strip dust cover.
13. Connect the fuel line at the fitting located inside the wing, by reaching through the access panel on the forward inboard portion of the wheel well.
14. Connect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar. After the left balance cable has been inserted through the bracket assembly and connected, install a cotter pin cable guard into the hole that is provided in the bracket assembly.
15. Connect the nap by placing the nap handle in the full flap position; place the bushing on the outside of the rod end bearing and insert and tighten bolt.
16. Install the engine. (Refer to Installation of Engine, Chapter 71.)
17. Check the rigging and control cable tension of the ailerons and naps. (Refer to Rigging and Adjustment of Ailerons, and Rigging and Adjustment of Flaps, Chapter 27.)
18. Service and refill the brake system with hydraulic fluid in accordance with Servicing Brake System, Chapter 12. Bleed the system as outlined in Chapter 32 and check for fluid leaks.
19. Check the fluid level of the landing gear hydraulic system and fill in accordance with Servicing Hydraulic Pump/ Reservoir, Chapter 12. With the airplane sitting on jacks, operate the gear through several retraction and extension cycles to be certain that there are no hydraulic leaks. Bleed the hydraulic system in accordance with Chapter 29. Ascertain that the landing gear is down and locked.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

20. Service and fill the fuel system in accordance with Servicing Fuel System, Chapter 12. Open the fuel valve and check for leaks and fuel flow.
21. Check the operation of all electrical equipment, pitot and static systems.
22. Remove the airplane from jacks.
23. Install the cockpit trim panel assembly, spar box carpet, the front and back seats and wing root rubber. Replace all the access plates and panels.

FLIGHT SURFACES.

AILERON.

REMOVAL OF AILERON. (Refer to Figure 57-2.)

1. Disconnect the aileron control rod at the center hinge by removing the nut, washers, and bolt from the rod end bearing. To simplify installation, note the location of the washers.
2. Support the aileron and disconnect the inboard, outboard and center aileron hinges by removing the nuts, washers and hinge bolts. Remove the aileron by lifting and pulling aft.

INSTALLATION OF AILERON. (Refer to Figure 57-2.)

1. Position the aileron in the wing and install the bolts, washers, and nuts at the hinges.
2. Connect the aileron control rod to the aileron at the center hinge brackets with bolt, washers and nut.

AILERON BALANCE. (Refer to Figure 57-3.)

PPS50011-2

The ailerons have been statically balanced at the time of installation at the factory and normally should not require rebalancing. Where possible the ailerons were set with the balance weight on the heavy side of the limits to permit limited repair or paint touch-up without adjusting the balance weight. It should be noted, however, that spare ailerons are delivered unpainted and the static balance will not necessarily fall within the limits provided. The completed ailerons including paint should be within the limits given in Figure 57-3. If the ailerons are not to be painted, the balance weight will probably require adjustment. All replacement ailerons or ailerons that have been repainted or repaired should be rebalanced according to the procedures given in this chapter. The static balance of the ailerons must be as specified in the figures referenced above.

Before balancing any control surface, it must be complete including tip, trim/servo tabs as applicable and tab actuating arms or push rods with bearings as applicable and all optional equipment which is mounted on or in the control surface when it is flown, including paint, position lights and wiring, static wicks, scuff boots, etc.

If optional equipment is added or removed after balancing, the control surface must be rebalanced. During balancing, trim servo tabs must be maintained in the neutral position.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

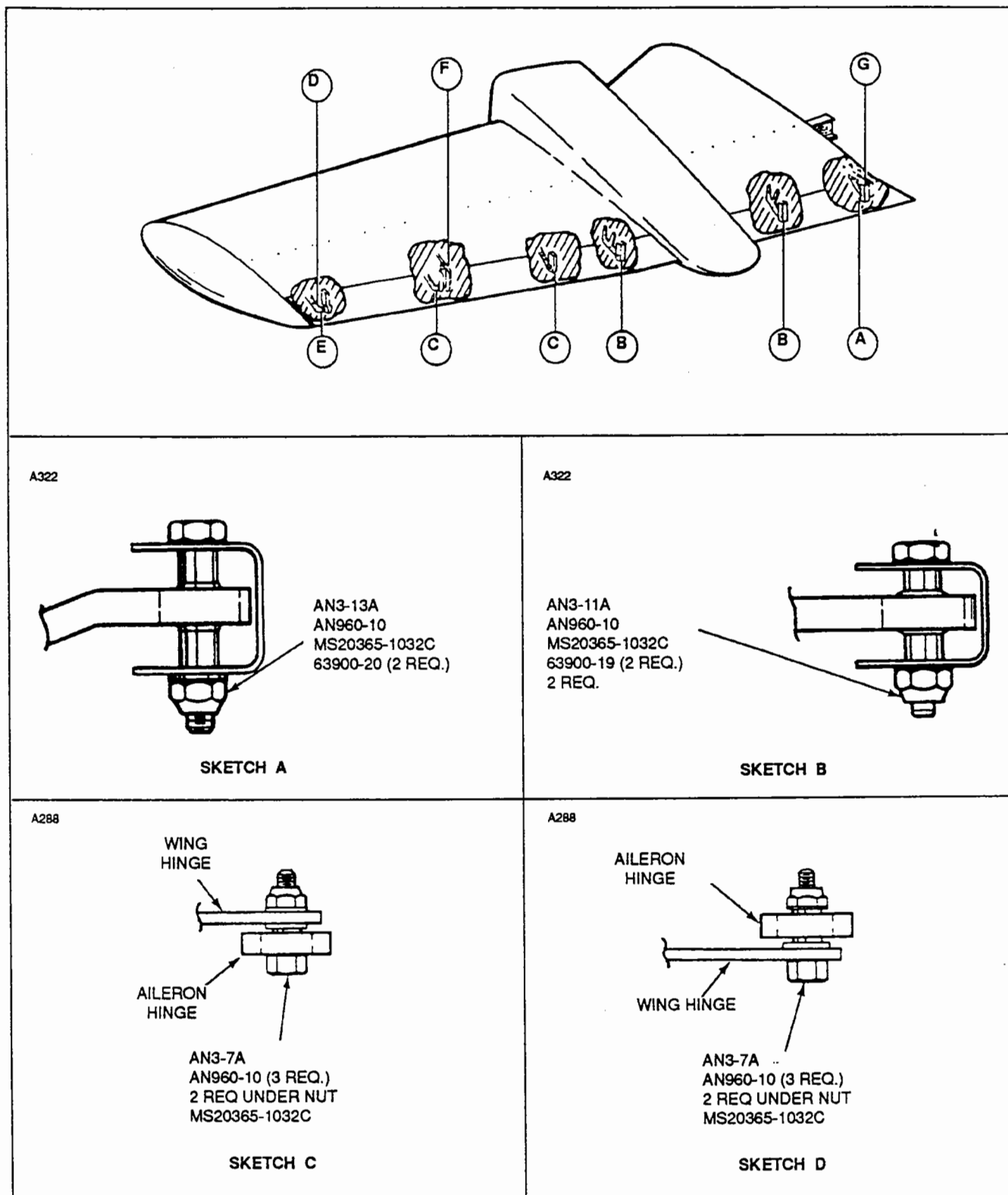


Figure 57-2. Aileron and Flap Installation

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

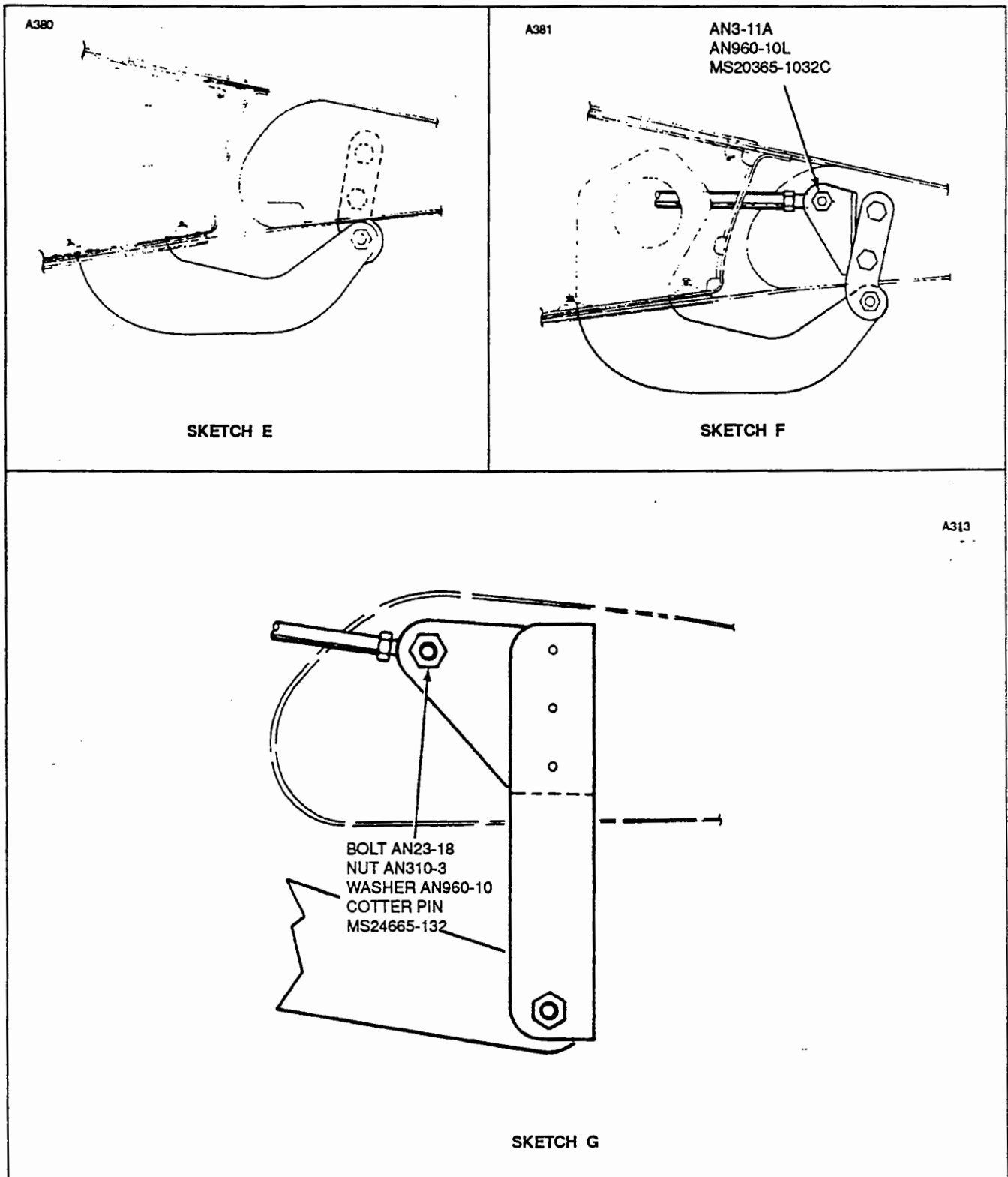


Figure 57-2. Aileron and Flap Installation (cont)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

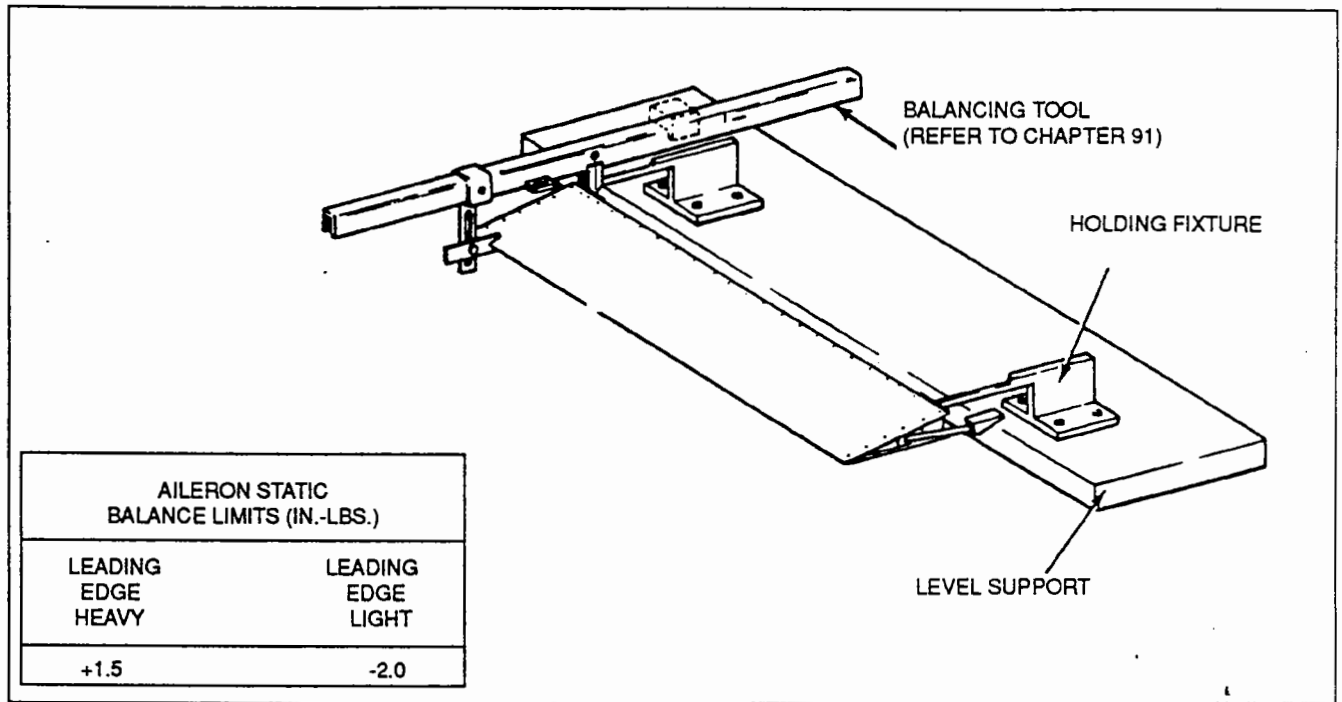


Figure 57-3. Aileron Balancing

BALANCING EQUIPMENT AND PROCEDURE. (Refer to Figure 57-3.)

PPS50011

The balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the hinge pin center line of the control surface. A suggested tool configuration is shown in Chapter 91. Other tool configurations may be used, provided accuracy is maintained and recalibration capability is provided. The tool shown in Figure 57-3 is calibrated by placing it on the control surface to be balanced with the balance points over the control surface hinge center line and the balance bar parallel to the cord line. Position the trailing edge support to align the tool with the control surface cord line and secure in this position. Remove the tool without disturbing the trailing edge support and balance the tool by adding weight to the light end as required. (The movable weight must be at the center line of the bar.) Place the tool on the control surface perpendicular to the hinge center line as shown in Figure 57-3. Read scale when the bubble level has been centered by adjustment of the movable weight and determine the static balance. If the static balance is not within the limits specified, proceed as follows:

1. Leading Edge Heavy: This condition is highly improbable; recheck measurements and calculations.
2. Trailing Edge Heavy: There are no provisions for adding weight to balance weight to counteract a trailing edge heavy condition; therefore, it will be necessary to determine the exact cause of the unbalance. If the aileron is too heavy because of painting over old paint, it will be necessary to strip all paint from the aileron and repaint. If the aileron is too heavy resulting from repair to the skin or ribs, it will be necessary to replace all damaged parts and recheck the balance.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

WING FLAP.

REMOVAL OF WING FLAP. (Refer to Figure 57-2.)

1. Extend the flaps to their fullest degree and remove the bolt and bushing from the rod end bearing by use of an angle or offset screwdriver.
2. Remove the nuts, washers, bushing, and hinge bolts that hold the flap to the wing assembly.
3. Pull the flap straight back off the wing.

INSTALLATION OF WING FLAP. (Refer to Figure 57-2.)

1. Replace the wing flap by placing the flap into its proper position and inserting the hinge bolts, bushings, washers and nuts.
2. With the flap control in the full flap position, place the bushing on the outboard side of the rod end bearing and insert and tighten the bolt.
3. Operate the flap several times to be certain it operates freely.

— *END* —

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3C22 THROUGH 3C24
INTENTIONALLY LEFT BLANK**

CHAPTER

61

PROPELLER

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHAPTER 61 - PROPELLER

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
61-10-00	PROPELLER ASSEMBLY	3D3	
61-11-00	Maintenance of Propeller	3D3	8 - 82
61-11-01	Removal of Propeller	3D3	
61-11-02	Cleaning, Inspection and Repair of Propeller	3D3	
61-11-03	Installing Propeller	3D3	8 - 80
61-11-04	Blade Track	3D6	
61-20-00	CONTROLLING	3D6	
61-21-00	Propeller Governor	3D6	A 8 - 82
61-21-01	Removal of Propeller Governor	3D6	
61-21-02	Installation of Propeller Governor	3D6	3R 1 - 83
61-21-03	Rigging and Adjustment of Propeller Governor	3D6	2 - 81
61-22-00	Engine Synchrophaser	3D8	
61-22-01	Test Equipment	3D8	
61-22-02	Ground Test	3D11	
61-22-03	Prop-Synch Switch	3D12	A 8 - 82
61-22-04	Removal and Installation of Prop-Synch Switch	3D12	
61-22-05	Pulse Generator(s)	3D13	A 8 - 82
61-22-06	Removal of Pulse Generator(s)	3D13	
61-22-07	Installation and Coordinated Timing of Pulse Generator(s)	3D13	
61-22-08	Post Installation Check	3D15	
61-22-09	Flight Check	3D16	
61-22-10	Propeller Unfeathering System	3D16	
61-22-11	Accumulator Service	3D16	

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

PROPELLER ASSEMBLY.

I MAINTENANCE OF PROPELLER.

REMOVAL OF PROPELLER.

1. Insure that the master and magneto switches are off.
2. Move fuel selector to off position.
3. Place the mixture control in idle cut-off.
4. Note position of each component to facilitate reinstallation.
5. Remove the screws from around the spinner assembly and remove spinner. (Refer to latest revision of Hartzell Service Instructions No. 118.)
6. Remove the safety wire from the six propeller nuts on studs and remove studs.
7. Place a drip pan under the propeller to catch oil spillage, then remove the propeller.

CLEANING, INSPECTION AND REPAIR OF PROPELLER.

1. Check for oil and grease leaks.
2. Clean the spinner, propeller hub interior and exterior, and blades with a non-corrosive solvent.
3. Inspect the hub parts for cracks.
4. Steel hub parts should not be permitted to rust. Use aluminum paint to touch up, if necessary, or replate during overhaul.
5. Check all visible parts for wear and safety.
6. Check blades to determine whether they turn freely on the hub pivot tube. This can be done by rocking the blades back and forth through the slight freedom allowed by the pitch change mechanism. If they appear tight and are properly lubricated, the pitch change mechanism should be removed so that each blade can be checked individually. If blades are tight, the propeller should be disassembled.
7. Inspect blades for damage or cracks. Nicks in leading edges of blades should be filed out and all edges rounded, as cracks sometimes start from such places. Use fine emery cloth for finishing. (Refer to Figure 61 -1 for propeller blade care.) 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.
8. It is recommended that for severe damage, internal repairs and replacement of parts, the propeller should be referred to the Hartzell Factory or an authorized Service Station.
9. Grease blade hub through zerk fittings. Remove one of the two fittings for each propeller blade, alternate the next time. Apply grease through the zerk fitting until fresh grease appears at the fitting hole of the removed fitting. Care should be taken to avoid blowing out hub gaskets.
10. Check condition of the propeller mounting nuts on studs.

INSTALLING PROPELLER.

1. Insure master and magneto switches are off.
2. Place fuel selector to off position.
3. Place mixture control in idle cut-off.

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

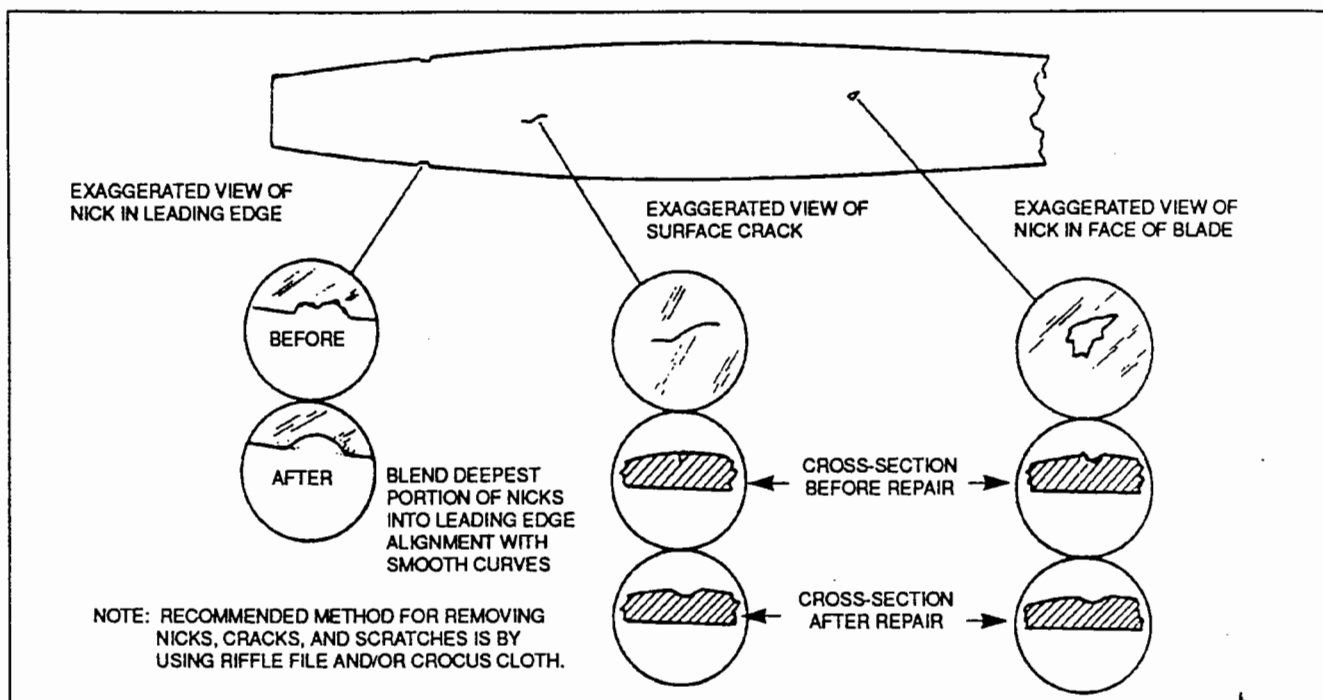


Figure 61-1. Typical Nicks and Removed Method

4. Observe the starter ring gear to make sure it is mounted properly on the engine crankshaft flange. One of the bushings on the crankshaft is stamped with an "O" mark and it must be inserted in the starter ring gear hole. Likewise identified with an "O" mark.
5. Wipe crankshaft and propeller pilot to assure that no chips or foreign matter enter the propeller mechanism .
6. Check interior of propeller hub for proper seating of O-ring. Wipe inside of hub to remove any traces of dirt. Check to see that O-ring is covered with grease.
7. Raise propeller into position so that each stud mates with an engine flange bushing and screw each stud in a few threads at a time until all are tight. Torque to 60 to 70 foot pounds. (Refer to Figure 61-2 for additional information on three blade propeller installation.)
8. Check the propeller blade track.
9. Safety the propeller mounting bolts with MS20995-C41 safety wire.
10. Install the spinner torque cap bolts 35 to 40 inch pounds.

CHART 6101. PROPELLER TORQUE LIMITS

DESCRIPTION	REQUIRED TORQUE
Propeller Mounting Nuts	60 - 70 Foot-Pounds
Forward Bulkhead Attachment Bolts	20 - 22 Foot-Pounds
Spinner Attachment Screws	20 - 25 Inch-Pounds

61-11-03

Page 61-02

Revised: May 15, 1989

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

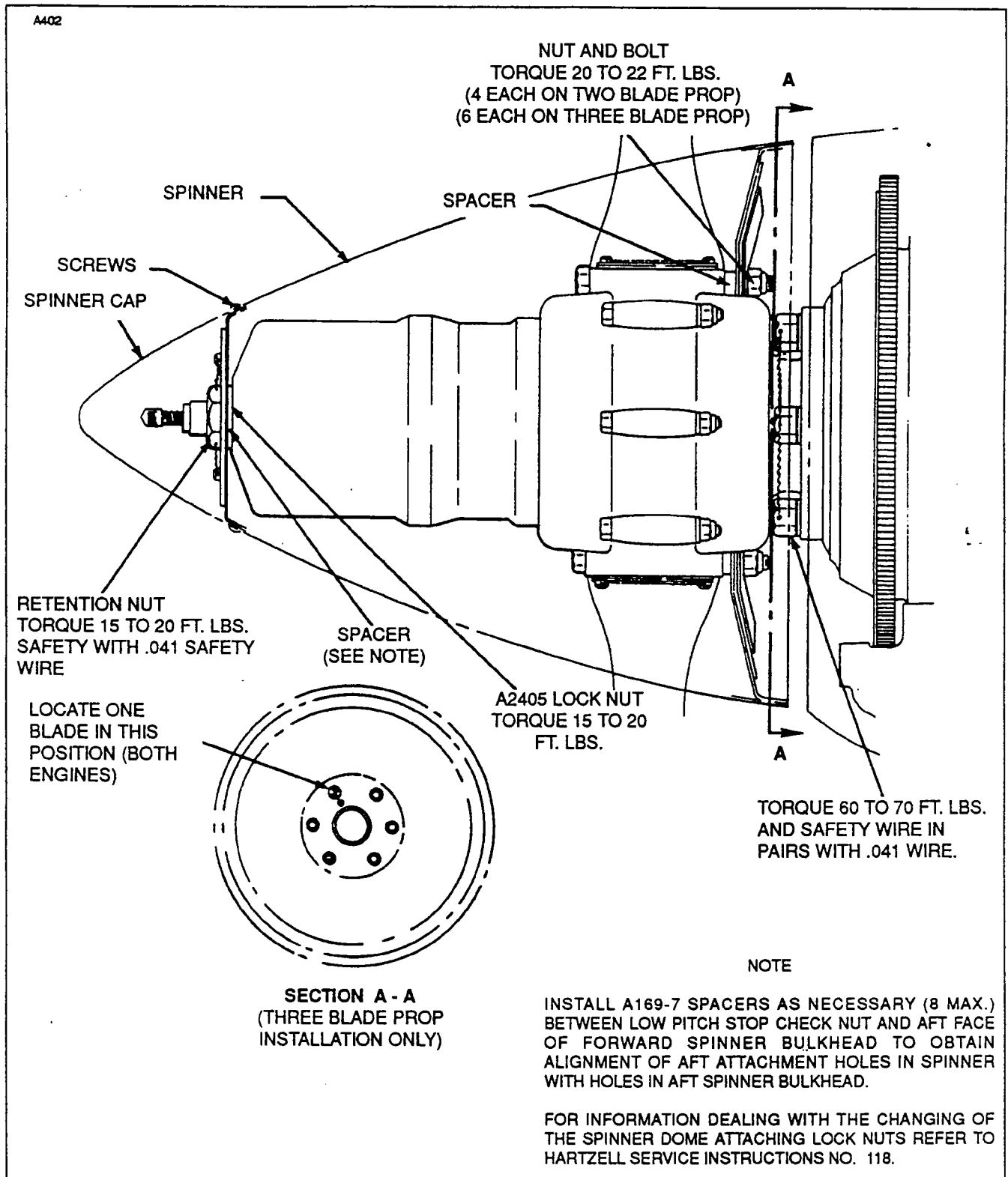


Figure 61-2. Propeller Installation (Two and Three Blade Propellers)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

BLADE TRACK.

Blade track is the ability of one blade tip to follow the other, while rotating, in almost the same plane. Excessive difference in blade track - more than .0625 inch - may be an indication of bent blades or improper propeller installation. Check blade track as follows:

1. With the engine shut down and blades vertical, secure to the aircraft a smooth board just under the tip of the lower blade. Move the tip fore and aft through its full "blade-shake" travel, making small marks with a pencil at each position. Then center the tip between these marks and scribe a line on the board for the full width of the tip.
2. Carefully rotate propeller by hand to bring the opposite blade down. Center the tip and scribe a pencil line as before and check that lines are not separated more than .0625 inch.
3. Propellers having excess blade track should be removed and inspected for bent blades. Constant speed propellers should be checked for parts of sheared "O" ring, or foreign particles, which have lodged between hub and crankshaft mounting faces. Bent blades will require repair and overhaul of assembly.

CONTROLLING.

PROPELLER GOVERNOR.

REMOVAL OF PROPELLER GOVERNOR.

1. Remove the upper engine cowl.
2. Disconnect the control cable end from the governor control arm.
3. Remove the governor mounting stud nuts. It will be necessary to raise the governor as the nuts are being removed before the nuts can be completely removed.
4. Remove the mounting gasket. If the governor is to be removed for a considerable length of time and another unit not substituted, it is advisable to cover the mounting pad to prevent damage caused by foreign matter.

INSTALLATION OF PROPELLER GOVERNOR.

1. Clean the mounting pad thoroughly, making very certain that there are no foreign particles in the recess around the drive shaft.
2. Place the governor mounting gasket in position with the raised portion of the screen facing away from the engine.
3. Align the splines on the governor shaft with the engine drive and slide the governor into position.
4. With the governor in position, raise the governor enough to install washers and start mounting nuts. Torque nuts 110 to 150 inch-pounds.
5. Connect the control cable end to the governor control arm. The ball stud is installed in the inner hole of the control arm.
6. Adjust governor control per the following paragraph.
7. Install engine cowl.

RIGGING AND ADJUSTMENT OF PROPELLER GOVERNOR. (Refer to Figure 61-3.)

1. Start engine, park 90° to wind direction and warm in normal manner.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

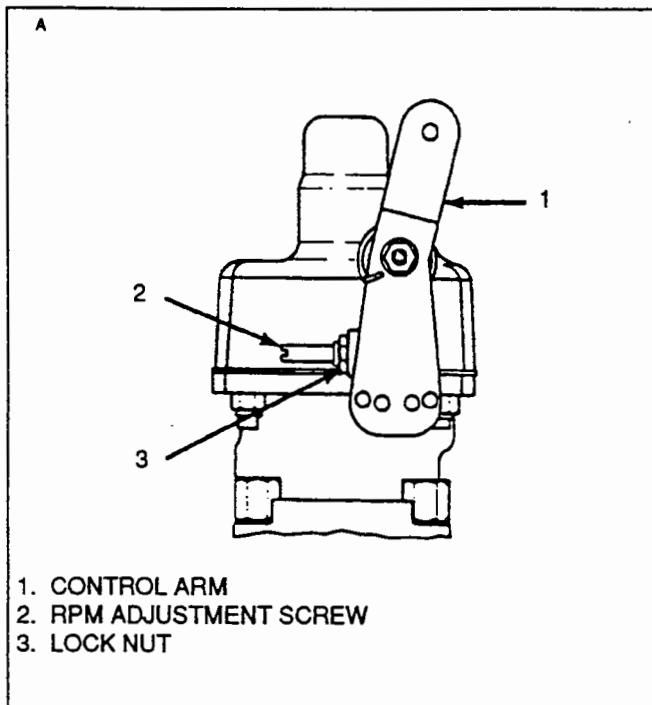


Figure 61-3. Propeller Governor

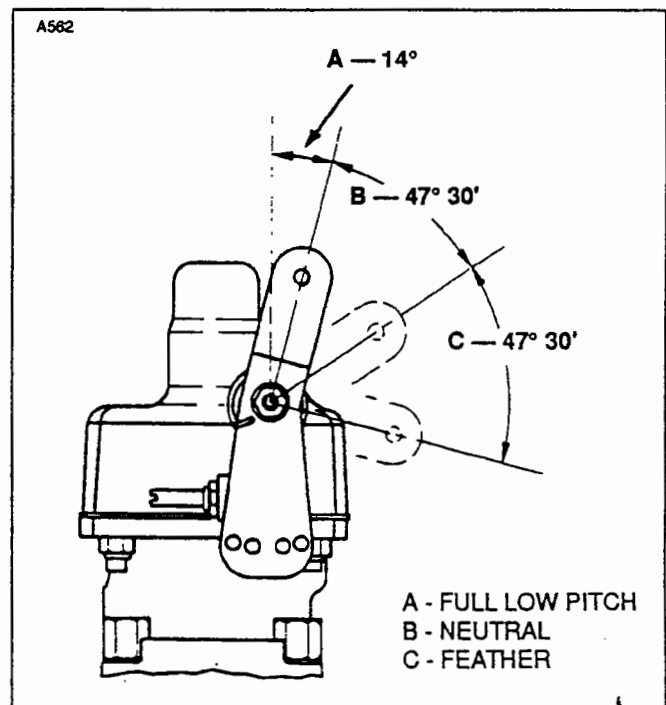


Figure 61-4. Adjustment of Propeller Control

2. To check high RPM, low pitch setting, move the propeller control all the way forward. At this position, the governor speed control arm (1) should be against the high RPM fine adjusting screw (2). With the throttle full forward, observe engine RPM, which should be 2700 RPM with high RPM properly adjusted.
3. Should engine RPM not be as required, the high RPM setting should be adjusted as follows:
 - A. Shut down the engine and remove the upper engine cowl.
 - B. Adjust the governor by means of the fine adjustment screw for 2700 RPM. To do this, loosen the high RPM fine adjustment screw locknut and turn the screw in a clockwise direction to decrease engine speed or in a counterclockwise direction to increase engine speed.

— Note —

One revolution of the fine adjustment screw will increase or decrease the engine speed approximately 20 RPM.

- C. Reinstall upper engine cowl and repeat step b to ascertain proper RPM setting.
- D. After setting the proper high RPM adjustment, run the self-locking nut on the fine adjustment screw against the base projection to lock.
- E. Ascertain that the governor control arm is adjusted to the proper angle on the control wheel (4) as shown in Figure 61-3.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

- F. With the high RPM adjustment complete, the control system should be adjusted so that the governor control arm will contact the high RPM stop. The cockpit control lever should be .031 to .062 of an inch from its full forward stop. (Refer to Figure 61-4.) To adjust the control travel, disconnect the control cable end from the control arm. Loosen the cable jam nut and rotate the end to obtain the desired level clearance. Reconnect the cable end and tighten jam nut.
- G. It is usually only necessary to adjust the high RPM setting of the governor control system, as the action automatically takes care of the positive high pitch setting.

ENGINE SYNCHROPHASER. (Refer to Figures 61-5 and 61-6.)

The synchronizer installation is a Hartzell system which utilizes two pulse generators, a computer, and an electrically slaved, mechanically operated propeller governor.

With this system, the right engine is utilized as the slave engine and the left engine as the master. The pulse generators, attached in line with the tachometer cables, on the 44-180 installation are interconnected through the computer which senses the speed of the engines through the magnetic pickups in the pulse generators. The computer synchronizes the right engine to the left, through a solenoid in the right propeller governor (slave governor) .

TEST EQUIPMENT.

The Hartzell B-4467-1 Test Set should be used to perform the following tests. The test lights as they appear on the set are defined as follows:

- 1. POWER light on, indicates power supply to the system computer is of the correct polarity.
- 2. RIGHT ENGINE and LEFT ENGINE lights on, indicate that their respective pulse generator is wired, and working properly.

— Note —

If the engine lights come ON and STAY ON when the props are rotated, the pulse generator(s), cables, or tester are defective.

- 3. MANUAL and PHASE lights on, indicate that, each respective function of the prop-synch switch is wired correctly.
- 4. COIL light on indicates that the circuit for the propeller governor solenoid coil is correctly wired. With the light off an open circuit is indicated or the wire on Pin 8 is grounded.
- 5. COIL SHORT light on, indicates an internal dead-short in the right engine propeller governor solenoid coil, or a short between the coil leads. The light may also come on if power supply voltage exceeds 14 volts.

— Note —

The prop governor with the solenoid is a Hartzell supplied product. Contact Hartzell for replacement of coil or governor or Piper for replacement of entire assembly. Hartzell also has a unit to test the computer, the "D-4469 Computer Analyzer" and can be purchased from Hartzell.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

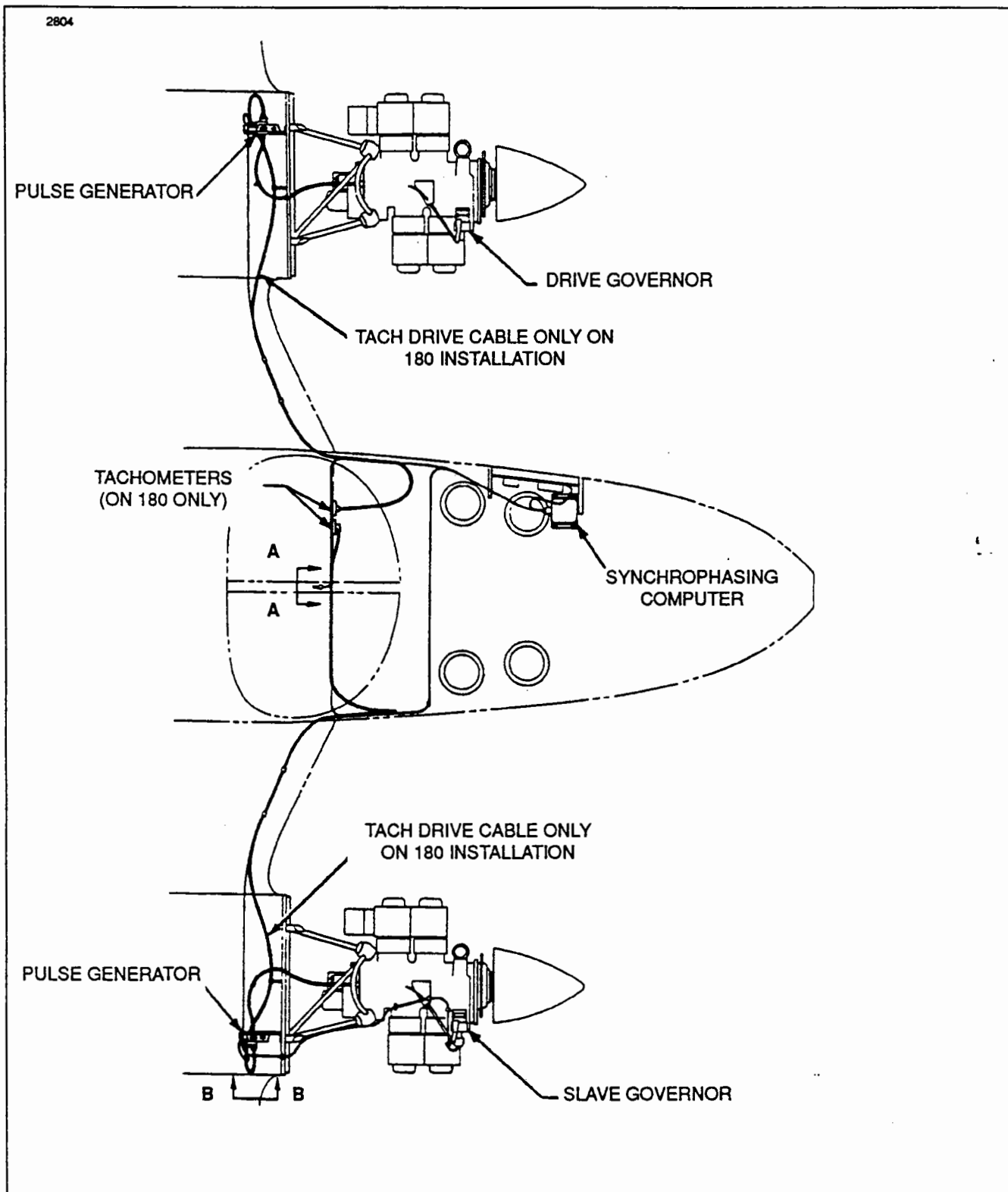
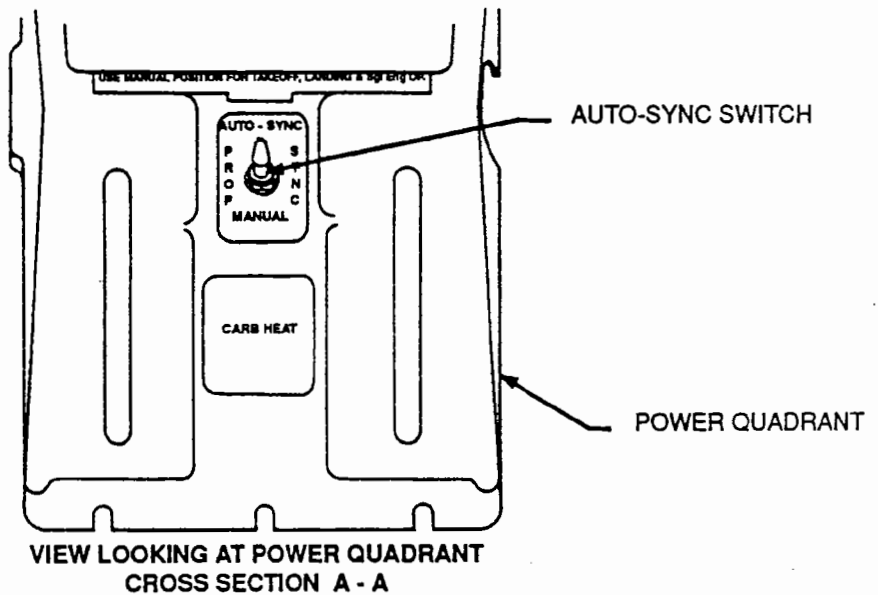


Figure 61-5. Synchrophaser System Installation

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

8130



8131

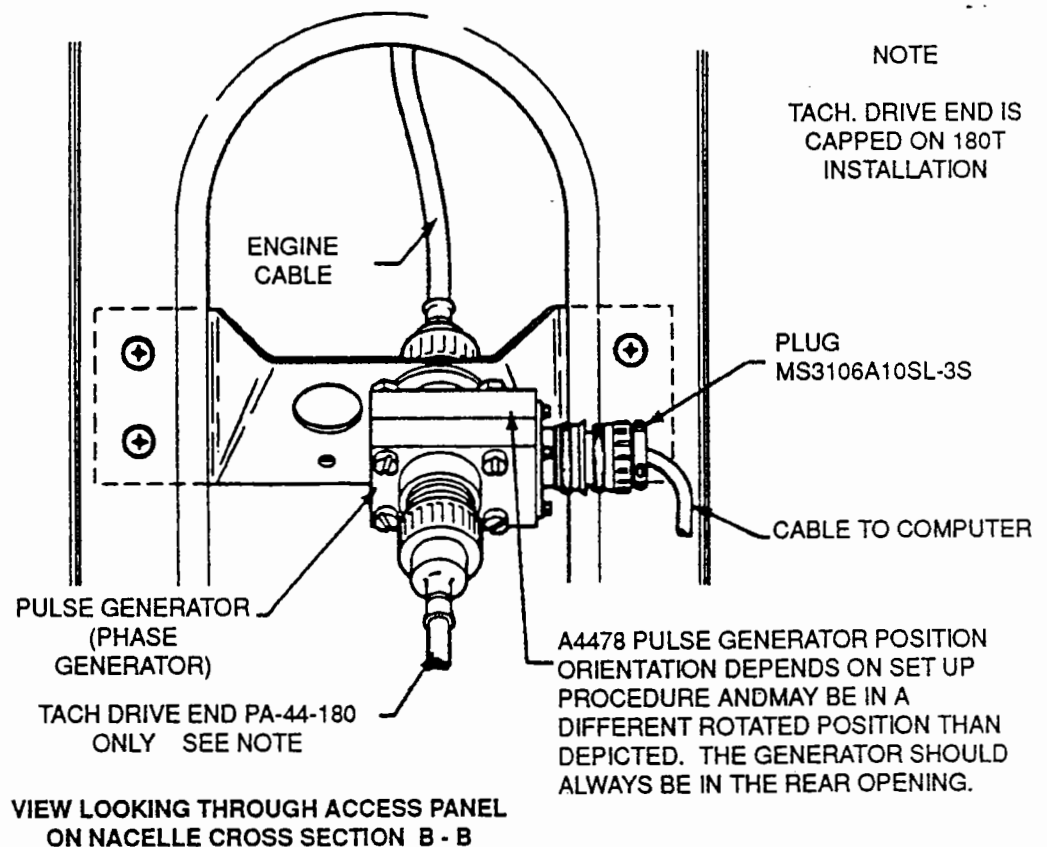


Figure 61-5. Synchrophaser System Installation (cont)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

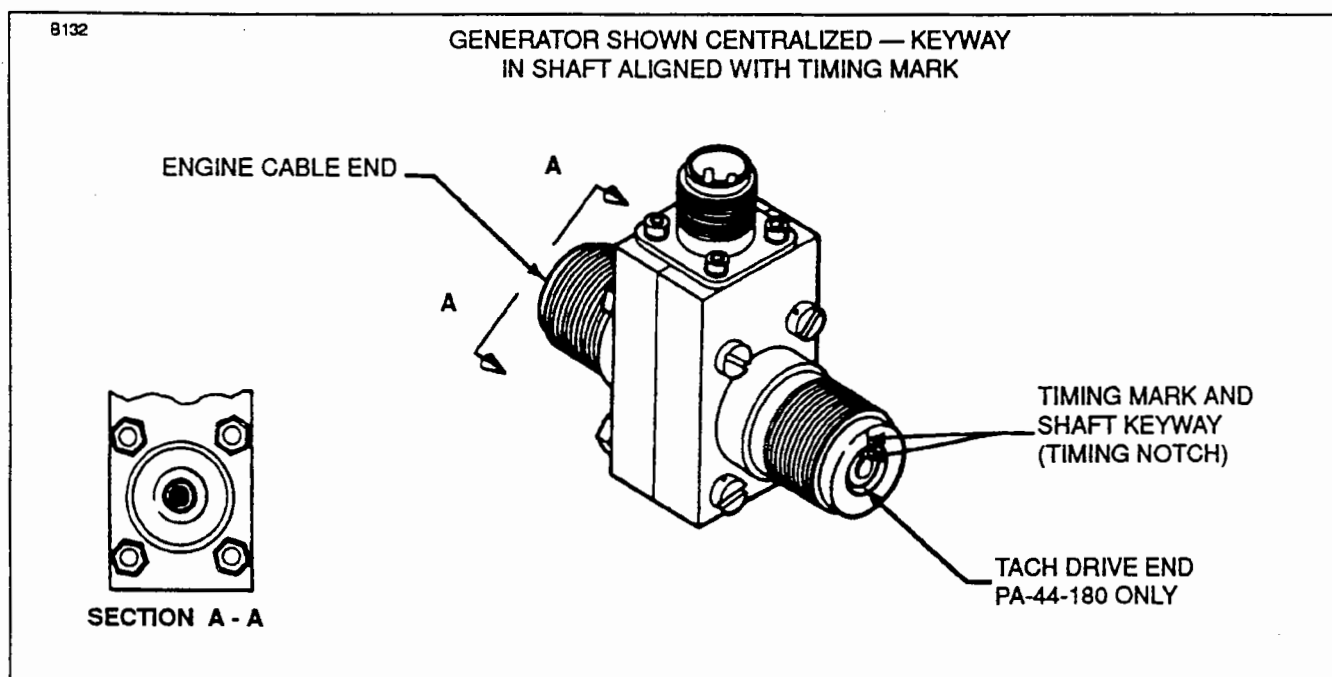


Figure 61-6. Pulse Generator Assembly

GROUND TEST.

PPS-50041C

The purpose of the following procedure is to make sure all circuits and the propeller governor solenoid coil are functioning properly.

— Note —

Before commencing with the test, check that the proper test box is being used (B-4467-1) and that all system hardware and equipment, except for the computer, are installed and connected properly to the wiring harness. Do not plug the computer in until the whole test has been satisfactorily completed

1. Loosen the nose cone and tilt it forward to make access to the computer station 21.55 on the left side of the aircraft.
2. Disconnect the main wiring harness from the computer and connect the test box in its place.
3. Place the master switch in the on position and, with at least 12 to 14-volts applied to the system, the power and coil lights should come on.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

— Note —

If the proper lights fail to light check the input voltage. If there is not at least 12-volts, apply an auxiliary power source.

Other lights may also come on but may be disregarded at this time with the exception of the coil short light.

5. Should the coil short light come on, the indication means that the solenoid coil in the right (slave) prop governor is shorted. Place the aircraft master switch in the off position and replace the coil or governor.
6. If the light for the right engine is out, rotate the propeller in the direction of its normal rotation until it becomes lighted.

— Note —

The propeller may need to be rotated two full turns to illuminate or extinguish the light.

7. If the light is illuminated, rotate the prop as explained in Step 6 until it is just extinguished.
8. Repeat Steps 6 and 7 for the left engine.
9. On the power control quadrant, place the synchronization prop-synch switch in the manual position.
10. Check to see that the MANUAL light is illuminated on the test box, and the PHASE light extinguished. When the switch is reset to the auto-synch position, the PHASE light should be illuminated.
11. If any test set lights did not operate properly, check the following:
 - A. Wiring harness for shorts.
 - B. Open circuit breaker.
 - C. Broken wires.
 - D. Wires connected to the wrong pins.
 - E. Compliance with schematic/wiring diagram.
 - F. Malfunctioning pulse generator as explained in Figure 61-8.
12. If the wiring harness checks good, but the right or left engine, or coil light does not function properly, check the pulse generator as explained in Figure 61-8, Pulse Generator Backup Test, and replace the generator or governor as necessary.

PROP-SYNCH SWITCH.

REMOVAL AND INSTALLATION OF PROP-SYNCH SWITCH.

1. Remove the knobs from the control levers and remove the upper control quadrant cover.
2. Remove the retaining nut from the toggle side of the switch, and remove the switch from the cover.
3. Slide the shaded wire protective covering back off the soldered connections.
4. Make the note of where each specific wire is soldered, and remove the wires from their terminals.
5. Install the wires on the new switch as noted and reinstall the switch in the opposite manner of removal. Remember to install the switch in the cover with the barrel keying slot in the MANUAL direction of the switch.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

PULSE GENERATOR(S).

REMOVAL OF PULSE GENERATOR(S). (Refer to Figure 61-6.)

1. Access to the pulse generator can be made through the access panel on the outboard side of each nacelle just above the leading edge of each wing, see second page of Figure 6-3.
2. Reaching through the access hole remove the electrical connection and then the four screws fastening the bracket (which the pulse generator is attached) to the web, and pull the unit through the hole. If the tach cables are too tight, slightly release, or remove, the clamps holding them.
3. Disconnect the tach cable(s) and tape to the aircraft to prevent it from falling back into the nacelle.
4. To remove the pulse generator from the bracket, release the lock tab washer and unscrew the reliance nut. To facilitate reinstallation note the location of the electrical plug relative to the plate.

INSTALLATION AND COORDINATED TIMING OF PULSE GENERATORS. (Refer to Figures 61-5 and 61-6.)

— Note —

For the synchronization system to work properly, the pulse generators must be adjusted while attached to the aircraft. If the pulse generator has been removed, centralize the shaft before installing and make the final adjustments with the pulse generator loosely attached to its bracket.

1. With the pulse generator mounting bracket removed from the aircraft loosely attach the generator to the bracket. The top of the bracket is considered to be the bent out edge.
2. Rotate the propeller of the affected engine in its proper direction until the forward outboard cylinder is at the top dead center (TDC) of its compression stroke.
3. After determining the keyway in the tack drive end of the generator is aligned with the timing mark on the housing, assimilate the position of the mounted bracket and attach the drive cable from the engine to the inboard side of the generator. If the cable will not line up in the unrotated generator shaft, rotate the generator on the bracket till the cable fits; make sure the slot in the tack drive end still lines up with the timing mark.

— Note —

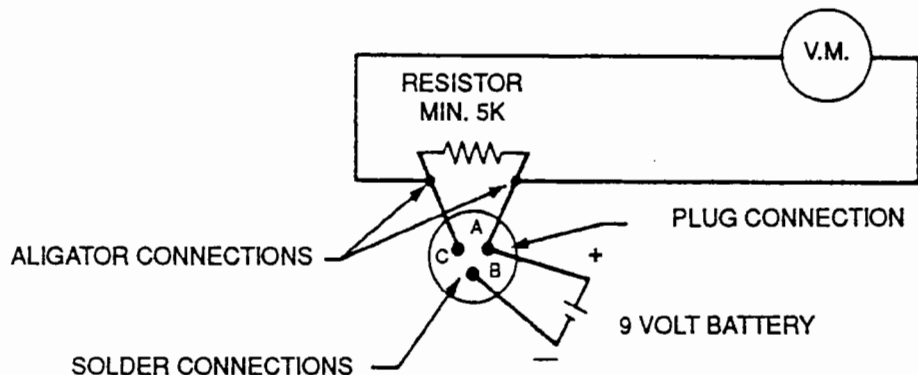
You will find that the lights on the test box for the left and right engine pulse generators will remain illuminated for several degrees of rotation of the generator housing; but, the correct timing position is at the point where the light just comes on.

4. Install the power cable.
5. Positioned as shown in Figure 61-5, temporarily install the bracket on the nacelle web with a screw on each side to hold it firmly, and again check that the timing mark and slot align.
6. If the opposing generator was removed proceed with the same five steps explained above. If it hasn't been removed and the light on the test box for this engine does not come on, proceed as follows:
 - A. Remove the pulse generator as previously explained, and if appropriate the driven cable (tachometer cable). Release the lock tab washer, and slightly release the reliance nut so that the generator can be rotated on its bracket.

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

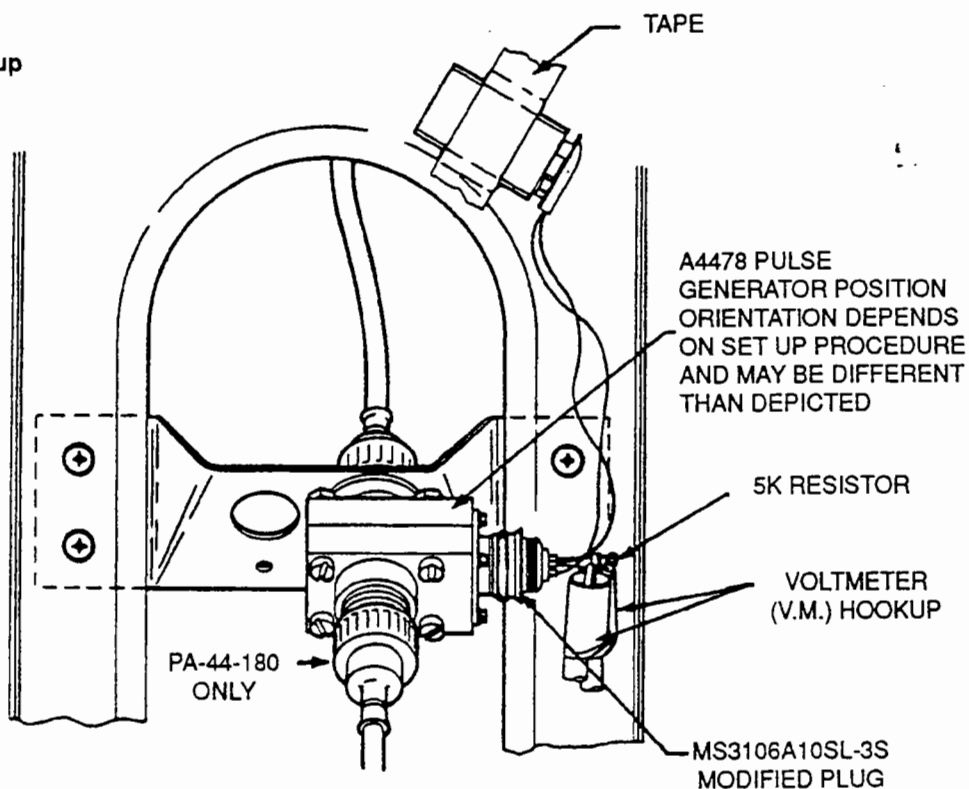
B134

Schematic of Fabricated Tester



B133

Fabricated Tester Setup



To check the pulse generator, disconnect the drive cables and make note of the generator shaft position. Connect this setup to the generator, and with a small screwdriver rotate the shaft. The voltmeter should peak out each time the slot in the appropriate end of the shaft, reaches the notch in the housing.

Figure 61-7. Backup Test of Pulse Generator

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

- B. Temporarily reinstall the assembly with only one screw on each side of the bracket and rotate the generator housing till the timing mark aligns with the key slot in the shaft.
7. With both engines at the TDC of their compression strokes, check to see if their respective lights on the test set are on.

— Note —

As previously explained the correct timing position is signified where and when the light JUST comes on.

8. If the test set lights are NOT ON, rotate the required generator (in the opposite direction of the other) on its bracket to its exact point the light comes on. If BOTH LIGHTS ARE OFF on the test set, rotate the generators to their timing mark alignments remembering to turn the opposing generators in opposite directions in reference to viewing each through their access holes.

— Note —

If at any time a question develops as to the condition of the generator, a test to the generator can be conducted as explained in Figure 61-7.

9. Tighten the reliance nuts as much as possible to prevent the generators from turning, and crossmark the generators to their brackets.
10. Carefully remove bracket and generator.
11. Check mark on bracket and generator to make sure the generator has not moved, and tighten the reliance nuts on the generators to secure them on their brackets. Rebend the tab washer to lock the reliance nut in place.
12. Permanently reinstall assemblies and perform the ground test.
13. Check to make sure the prop synch switch is in the manual position.

POST INSTALLATION CHECK.

1. Refer to the wiring diagram in Chapter 91 and determine that all wiring has been correctly installed.
2. Check continuity between the pins of the Amphenol plug, 57-30140, to see that any two pins are not shorted together. This usually occurs between pins that are side by side. Plug the harness into the computer.
3. Connect a DC ammeter with at least a two amp scale in series with one of the governor wires. Refer to the wiring diagram to be sure the ammeter is connected in with the proper polarity. The solenoid coil gets its power from pin 13 of the Amphenol 57-30140 plug.
4. Put the prop-synch switch in the MANUAL position and turn the ship's master switch on. The current reading should go immediately to about one amp and rest there. Turn the master switch off and connect the governor wire into the harness.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

5. Connect a voltmeter from pin C of the MS3106A 10SL-3S plug at the pulse generator to ground. With the master switch on, rotate the engine in either direction and the voltage reading should alternate from zero to about twelve volts once for every two revolutions of the propeller.

— Note —

See Figure 61-7 for a backup check on the pulse generators.

FLIGHT CHECK.

PPS-55041C

— Note —

It is recommended that this operation be conducted by two people so that one can concentrate on the flying and the other on the procedure.

1. Before starting engines make sure the prop-synch switch is in the manual position.
2. Attain a cruise altitude and set the power controls at 75% power.
3. Beat synchronize the propellers manually.
4. Increase or decrease the propeller speed by 30 RPM with the prop control.
5. Move the prop-synch switch to its auto-synch position. If synchronization is not accomplished, repeat the above procedure but using 25 RPM instead of 30 RPM.
6. If synchronization still is not accomplished repeat the Ground and Installation Checks.

PROPELLER UNFEATHERING SYSTEM.

The optional propeller unfeathering system provides a means for storing air and oil pressure in an accumulator so that the propeller may be moved out of the feathered position when so desired. Refer to the Pilot's Operating Handbook for proper operating procedures.

ACCUMULATOR SERVICE.

This is a free piston type accumulator which is charged with nitrogen to a working pressure of 90 to 100 psig. at normal room temperature. Accumulator overhaul should coincide with governor overhaul. Refer to McCauley — Service Manual No. 780401 for detailed instructions.

General servicing of the accumulator during its use between overhauls consists of periodically checking the nitrogen charge and visually inspecting the unit for any oil leaks. To perform an operational check refer to the Pilot's Operating Handbook for proper operating procedure.

— WARNING —

***COMPLETELY DISCHARGE ALL NITROGEN PRESSURE BEFORE
DISCONNECTING THE OIL LINE, PRIOR TO REMOVAL OF THE UNIT
FROM THE AIRPLANE.***

61-22-09

Page 61-14

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

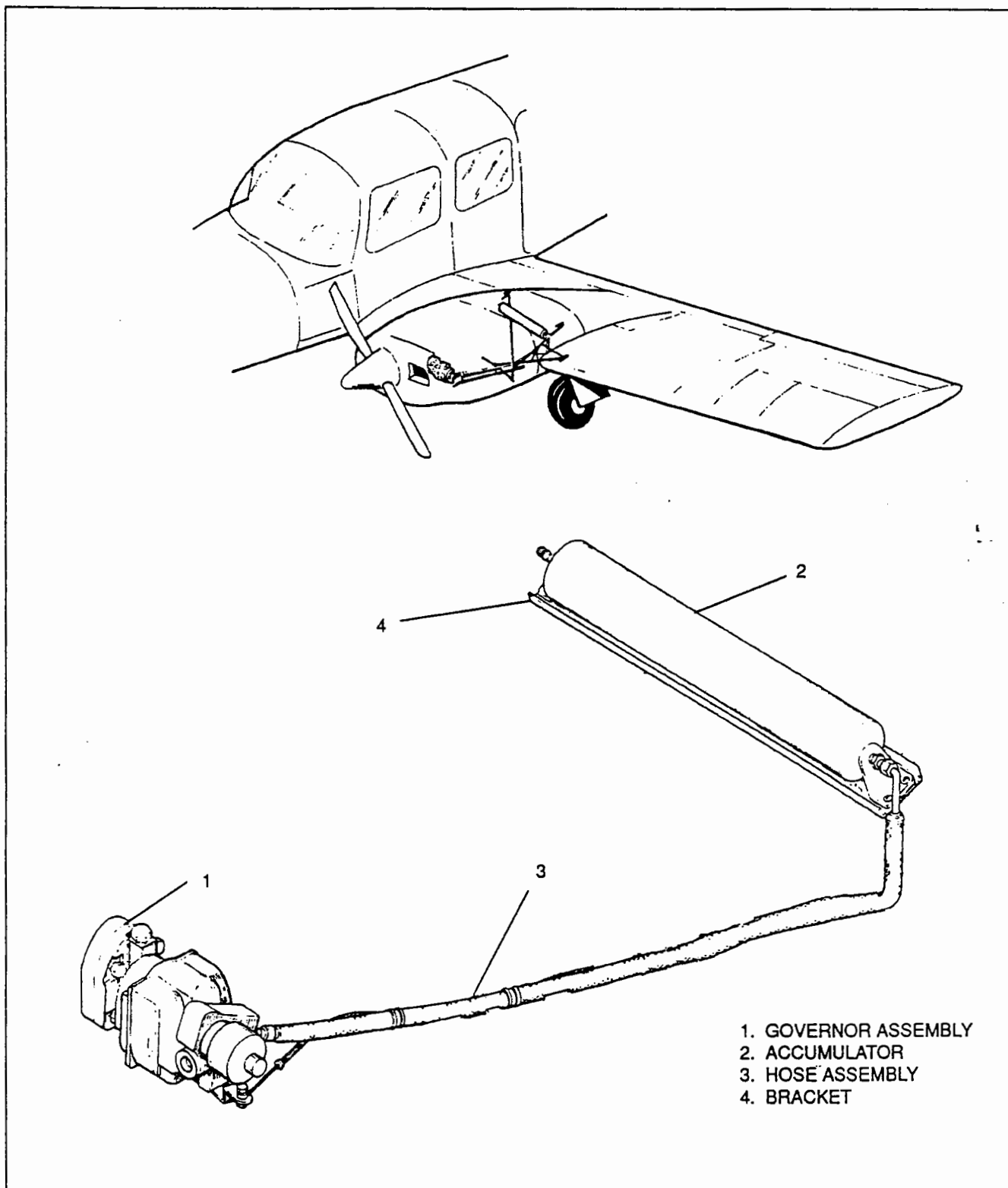


Figure 61-8. Propeller Unfeathering System.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3D18 THROUGH 3D20
INTENTIONALLY LEFT BLANK**

CHAPTER

71

POWER PLANT

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 71 - POWER PLANT

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
71-00-00	GENERAL	3D23	
71-01-00	Description	3D23	
71-02-00	Troubleshooting	3D23	
71-03-00	Removal of Engine	3E6	2 - 81
71-04-00	Installation of Engine	3E10	8 - 81
71-05-00	Engine Pre-oil	3E11	8 - 80
71-10-00	COWLING	3E11	
71-11-00	Cowling Maintenance	3E11	A 1 - 83
71-11-01	Removal and Installation of Engine Cowling	3E11	
71-11-02	Cleaning, Inspection and Repair of Engine Cowling	3E11	
71-12-00	Engine Cowl Flaps	3E12	
71-12-01	Operation and Adjustment of Cowl Flaps	3E12	
71-20-00	MOUNTS	3E12	
71-21-00	Engine Shock Mounts	3E12	A 1 - 83
71-21-01	Installation of Engine Shock Mounts	3E12	
71-60-00	AIR INTAKES	3E14	
71-61-00	Induction System (180)	3E14	
71-61-01	Removal and Installation of Air Filter Housing (180)	3E14	
71-61-02	Inspection, Removal, and Installation of Carburetor Air Box (180)	3E14	
71-61-03	Removal and Installation of Carburetor Heat Shroud (180)	3E16	
71-62-00	Sniffle Valve Maintenance (180T)	3E16	
71-63-00	Induction System (180T)	3E16	
71-63-01	Air Inlet Filter Housing Inspection and Maintenance (180T)	3E17	
71-63-02	Maintenance and Inspection of Compressor Inlet Duct and Alternate Air Door (180T)	3E17	
71-63-03	Compressor to Carburetor Intake Assembly	3E17	

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

GENERAL.

This chapter covers the power plants used in this airplane, and is comprised of instructions for the removal and installation, minor repairs, and service.

DESCRIPTION.

The PA-44-180 is powered by two Avco-Lycoming engines rated at 180 horsepower each. The power plants are either O-360 or LO-360 engines of the E1A6D or A1H6* series which are four cylinder, horizontally opposed units. See Chapter 6, "Leading Particulars", for the differences between these two engine models operating limits.

The Turbocharged Seminole (PA-44-180T) uses TO and LTO 360-E1A6D engines. These engines are very similar to those used in the normally aspirated version with the exception of the turbocharger and related peculiarities. Notable differences involve a sniffle valve, change in timing, and a change in maximum permissible oil pressure during engine start and warmup. The turbocharged version is set to maintain 75% power to approximately 20,000 ft. density altitude. This engine also incorporates a bypass overboost valve but should not be adjusted except by Lycoming procedures. Induction air is forced through an airsearch TA04 turbocharger to the carburetor. Leading particulars on the engine can be found in Chart 601 in Chapter 6.

The propellers installed are Hartzell constant speed units. (Refer to Chapter 61 for complete detail and service information.) The induction system on these engines consists of Marvel-Schebler HA-6 float type carburetors with dry type air filters. Also incorporated with the "180" carburetor is a Piper installed carburetor ice detector. The magnetos are Bendix D4RN-2021 or Slick (4270, 4273, 4202, 4230)* Series, which uses an impulse coupling to provide ignition at engine cranking speed. (Refer to Chapter 74 for detailed information.)

TROUBLESHOOTING.

Troubles peculiar to the power plant are listed in Chart 7101 of the chapter. and consists of Troubles, Probable Causes and Suggested Remedies. When troubleshooting these engines ground the magneto primary circuit before performing any checks on the engines.

* Installed on PA-44-180, S/N 44-95001 and up.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 7101. TROUBLESHOOTING (ENGINE)

TROUBLE	CAUSE	REMEDY
Failure of engine to start.	Lack of fuel	Fill fuel tank. Check fuel system for leaks. Clean dirty lines, strainers or fuel valves. Check fuel selector valve for proper tank. Check fuel pressure with electric boost pump ON. Check mixture control knob for full rich.
	Overpriming	Open throttle and unload engine by engaging starter. Mixture in idle-cut-off.
	Incorrect throttle setting.	Open throttle to one-eighth of its range.
	Defective spark plugs.	Clean and adjust or replace spark plugs.
	Defective ignition wire.	Check with electric tester and replace defective wires.
	Defective battery.	Replace with charged battery.
	Improper operation of magneto breaker.	Clean points. Check internal timing of magnetos.
	Lack of sufficient fuel flow.	Disconnect fuel line at fuel injector and check fuel flow.
	Internal failure.	Check oil screens for metal particles. If found, complete overhaul of engine may be indicated.
	Water in fuel injector or carburetor.	Drain fuel injector or carburetor and fuel lines.
Failure of engine to idle properly.	Incorrect idle mixture.	Adjust mixture.
	Leak in the induction system.	Tighten all connections in the induction system. Replace any parts that are defective.



**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 7101. TROUBLESHOOTING (ENGINE) (cont)

TROUBLE	CAUSE	REMEDY
Failure of engine to idle properly. (cont)	Sniffle valve stuck open, 180T only.	Clean or replace valve.
	Fouled spark plugs.	Clean or replace plugs.
	Incorrect idle adjustment.	Adjust throttle stop to obtain correct idle.
	Uneven cylinder compression.	Check condition of piston rings and valve seats.
	Faulty ignition system.	Check entire ignition system.
	Insufficient fuel pressure.	Adjust fuel pressure.
Low power and uneven running.	Mixture too rich; indicated by sluggish engine operation, red exhaust flame at night. Extreme cases indicated by black smoke from exhaust.	Readjustment of carburetor by authorized personnel is indicated.
	Mixture too lean; indicated by overheating and backfiring.	Check fuel lines for dirt or other restrictions.
	Leaks in induction system.	Tighten all connections.
	Defective spark plugs.	Clean and gap or replace spark plugs as necessary.
	Improper fuel.	Drain fuel tank and refill with recommended grade fuel.
	Magneto breaker points not working properly.	Clean points. Check internal timing of magnetos.
	Defective ignition wire.	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors.	Replace connections on spark plug wire.
	Sniffle valve stuck open, 180T only.	Clean and/or replace valve. Refer to sniffle valve this chapter.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 7101. TROUBLESHOOTING (ENGINE) (cont)

TROUBLE	CAUSE	REMEDY
Failure of engine to develop full power.	Leak in the induction system.	Tighten all connections and replace defective parts.
	Throttle lever out of adjustment	Adjust throttle lever.
	Sniffle valve stuck open, 180T only.	Clean or replace valve.
	Turbocharger malfunctioning, 180T only.	Check for unusual noise in turbo. If malfunction is suspected check for damaged rotor assembly, for possible rubbing in housing, damaged rotor, coked bearings. Repair or replace turbocharger.
	Improper fuel flow.	Check strainer, gauge and flow at the fuel inlet.
	Restriction in air induction.	Examine air intakes and remove restrictions.
	Improper fuel.	Drain and refill tank with recommended fuel.
	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.
	Exhaust system gas leakage, 180T only.	Inspect exhaust system for gas leakage, gaskets at turbine inlet flanges, etc., and correct as applicable.
	Improperly adjusted pressure relief valve, 180T.	Adjust valve.
	Possible leak in lines to sniffle valve.	Inspect and repair. Refer to sniffle valve information in this chapter.
Rough engine.	Cracked engine mount.	Replace or repair mount.
	Defective mounting bushings.	Install new mounting bushings.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 7101. TROUBLESHOOTING (ENGINE) (cont)

TROUBLE	CAUSE	REMEDY
Rough engine. (cont) Low oil pressure.	Uneven compression.	Check compression.
	Insufficient oil.	Fill sump with recommended oil.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line.	Check gasket between accessory housing and crankcase.
	Dirty oil strainers.	Remove and clean oil strainers.
	Defective pressure gauge.	Replace gauge.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.
	High oil temperature.	See "High Oil Temperature" in "Trouble" column.
High oil temperature.	Leaking oil seal in turbo, 180T only.	Check for oil in turbo exhaust outlet. Replace turbocharger.
	Defective check valve in turbocharger oil supply line, 180T only.	Disassemble and clean valve or replace.
	Insufficient air cooling.	Check air inlet and outlet of oil cooler for deformation or obstruction.
	Insufficient oil supply.	Fill oil sump to proper level with specified oil.
	Low grade of oil.	Replace with oil conforming to specifications.
	Clogged oil lines or strainers.	Remove and clean oil strainers.
	Excessive blow-by.	Usually caused by worn or stuck rings.

71-02-00

Page 71-05

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 7101. TROUBLESHOOTING (ENGINE) (cont)

TROUBLE	CAUSE	REMEDY
High oil temperature. (cont)	Failing or failed bearing. Defective temperature gauge. Defective oil cooler lines.	Examine sump for metal particles. If found, overhaul engine. Replace gauge. Check inside of oil lines for obstruction flush out lines and oil cooler.
Excessive oil consumption.	Low grade of oil. Failing or failed bearings. Worn piston rings. Incorrect installation of piston rings. Failure of rings to seat (new nitrided cylinders). Leaking oil seal in turbocharger, 180T only. Leaking or damaged oil lines.	Fill with oil conforming to specifications. Check sump for metal particles. Install new rings. Install new rings. Use mineral base oil. Climb to cruise altitude at full power and operate at 75% cruise power setting with high oil temperature until oil consumption stabilizes. Check for oil in turbo exhaust. Replace turbocharger. Replace item.
Poor acceleration.	Idle mixture too lean. Incorrect fuel air mixture. Worn control linkage or restricted air cleaner. Ignition defective. Malfunctioning turbocharger, 180T only	Readjust mixture. Service carburetor. Tighten loose connections; and/or service air cleaner. Check ignition cables, plugs, timing and magnetos. Check operation and listen for any unusual noises. Check overboost valve and exhaust system for defects. Tighten loose connections.

71-02-00

Page 71-06

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 7101. TROUBLESHOOTING (ENGINE) (cont)

TROUBLE	CAUSE	REMEDY
Low fuel pressure.	Restricted flow.	Check and flush fuel lines.
	Air leakage in fuel pump pressure line.	Locate and correct.
	Fuel selector not to correct travel.	Adjust fuel selector control.
Fluctuating fuel pressure.	Vapor in fuel lines.	Operate auxiliary pump till system clears.
	Fuel gauge line leak.	Purge gauge line and tighten connections.
White smoke emitting from exhaust, 180T only.	Turbo is coking, oil forced through seal in housing.	Clean or change turbocharger.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

REMOVAL OF ENGINE. (Refer to Figure 71-1.)

1. Make sure all electrical switches are turned off, and the battery ground wire is disconnected at the battery.
2. Move the fuel selector to its off position.
3. Remove the engine cowls. On the 180T a snuffle valve, attached to the inboard side of each bottom cowl, must be removed from the cowl or disconnected from the manifold bleed line.
4. Remove the propellers per instructions in Chapter 6. Make sure to cap or cover the end of the crankshaft.

— Note —

After disconnecting any fuel, oil, or vacuum lines, make sure they and their fittings are capped. To prevent any question arising at installation as to where certain lines or fixtures need to be connected, items should be "TAGGED" or identified before separation.

5. Remove the positive and ground leads from the starter. Disconnect from the engine mount and move the leads clear of the engine. For the 180T also refer to Step 7, A.
6. The PA-44-180 engine is removed as follows:
 - A. Disconnect the primer system hose from the tee fitting at the rear of the engine, and tie it back out of the way of the engine.
 - B. Disconnect the throttle, mixture, and carburetor heat controls and make sure they will not interfere with removal. The carburetor can be removed if desired.
 - C. Disconnect the prop control cable from the governor and dismount the cable from the engine. Move the cable out of the way, so as not to interfere with engine removal.
 - D. Separate the fuel supply hose from the "L" fitting at the rear of the engine and make sure it is clear of the engine.
 - E. Remove the tubes from the intake drain valves, at the bottom of the engine.
 - F. Remove the ignition leads from the spark plugs, so they can be made clear of the engine mount. Tag and note the leads as to which cylinder they affect, unscrew the support clamps, and cut the tie raps retaining the leads to the engine mount. Remove the necessary grommets in the baffles and pull the leads back to the rear of the engine. The leads and distributor caps should be removed from the magnetos (making sure they are noted as to their installation), or coiled and wrapped so they can be tied to the back of the engine to keep them out of the way.
7. The PA-44-180T engine is removed as follows:
 - A. Remove the safety wire and bolts retaining the magnetic pickup and bracket to the front of the engine.
 - B. Follow the cable for the primer solenoid back through the rear baffle and separate the plug. If the plug is attached to the magneto harness, remove the tie rap and move the cable leading to the fuselage, clear of the engine. The magnetic pickup must be protected against any adverse handling and should therefore be taped or tied up out of the way.
 - C. Disconnect the fuel pump drain line and pressure feed line from their fittings on the pump, and disconnect the pressure feed line from the carburetor. These lines must be made clear of the engine before removal.
 - D. Unbolt the fuel supply hose from the fitting on the left rear side of the engine and make sure it is clear of the engine during removal.
 - E. Remove the air cooling hose held to the fitting mounted on the left rear baffle.

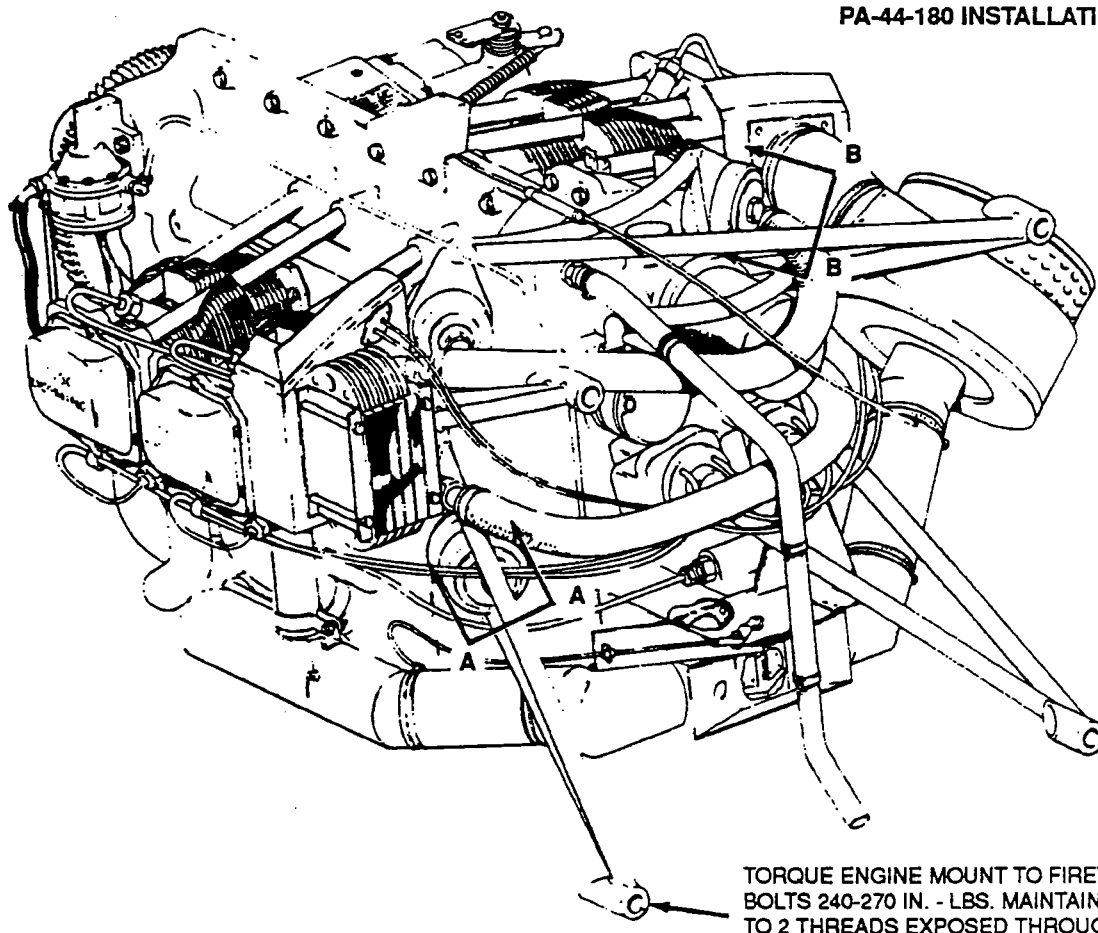
PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

- F. Disconnect the oil cooler drain hose attached to the oil cooler shield.
 - G. Disconnect the throttle, mixture, and alternate air door control cables from their actuating arms.
 - H. The turbocharger is mounted to the engine such that the engine and turbocharger can be removed as a unit or individually. For removal of the engine proceed as follows:
 - (1). If the turbocharger is to remain attached to the engine the compressor intake duct, turbine intake pipe, and turbo exhaust pipe must be removed, refer to the back of this chapter for the removal of the intake duct.
 - (2). The turbo can be removed by removing the compressor inlet duct, carburetor inlet duct, turbine exhaust pipe, and engine manifold. It is recommended that the turbocharger be removed along with its support plate. Make sure to disconnect any lubrication lines from the turbocharger, and the engine.
 - I. Disconnect the propeller governor control cable and with any supporting fixtures removed, move the cable clear of the engine.
- 8. The lines leading to the oil cooler circumvent the engine mount and must therefore be removed or one end of each unattached from its fitting at either the cooler or the filter. Whichever method is followed, make sure the open hoses and fittings are capped.
 - 9. Remove the "P" leads at the magnetos. Install a cap or protective cover over each of the distributor blocks openings.
 - 10. Disconnect the oil temperature lead at the top, aft end of the engine and make sure it is clear of the engine at removal.
 - 11. Unscrew the tachometer cable out of the back of the engine and move clear for removal.
 - 12. Disconnect the vacuum lines from the pump, and if tied to any item being removed with the engine release the line.
 - 13. Disconnect the oil breather tube from the back of the engine and make sure it is held clear of the engine.
 - 14. Disconnect the alternator leads, their cable attachments and move them clear of the engine.
 - 15. If desired, drain the oil from the engine.
 - 16. Remove the lifting lugs from the left side of the nose gear well, just aft of the starter solenoids.
 - 17. Attach a half ton (minimum) hoist to the lifting lugs using a strap arrangement.
 - 18. Check the engine for anything still attached that might be damaged at removal. Make sure all lines and fixtures are clear of the engine and the engine mount if attached to the engine.
 - 19. Up-load the hoist just enough to take the weight off the mounts and remove the four engine mount assemblies.
 - 20. If the hoist is the type that rolls, move the engine and hoist forward so the engine moves out of the engine mount. If the hoist is stationary or attached to an "overhead ham" carefully swing the engine forward out of the mount. If the turbocharger is still attached to the engine (180T), the engine may have to be jockeyed around. Be careful not to damage any attaching assemblies.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

2977

PA-44-180 INSTALLATION



TORQUE ENGINE MOUNT TO FIREWALL
BOLTS 240-270 IN. - LBS. MAINTAIN 1 1/2
TO 2 THREADS EXPOSED THROUGH NUT.

A569

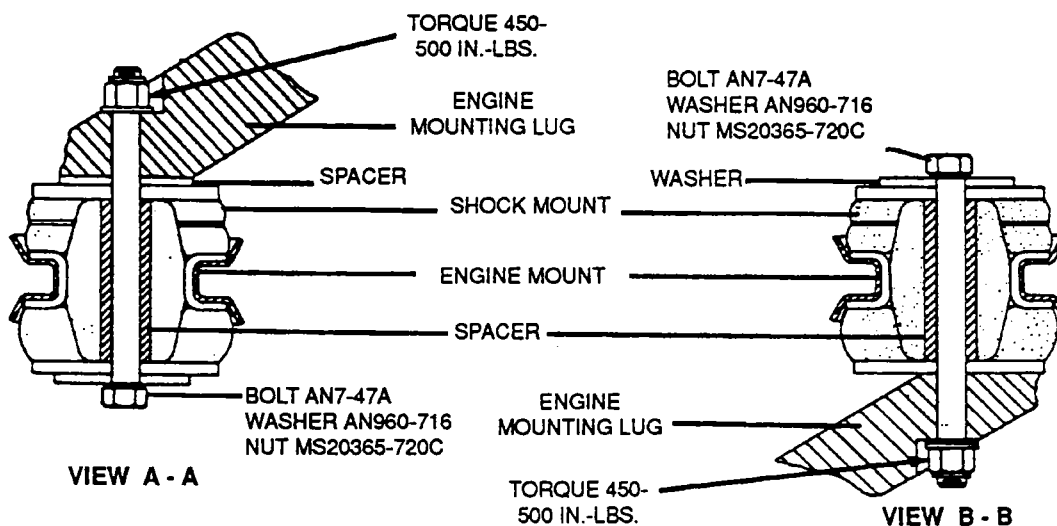


Figure 71-1. Engine and Shock Mount Installations

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

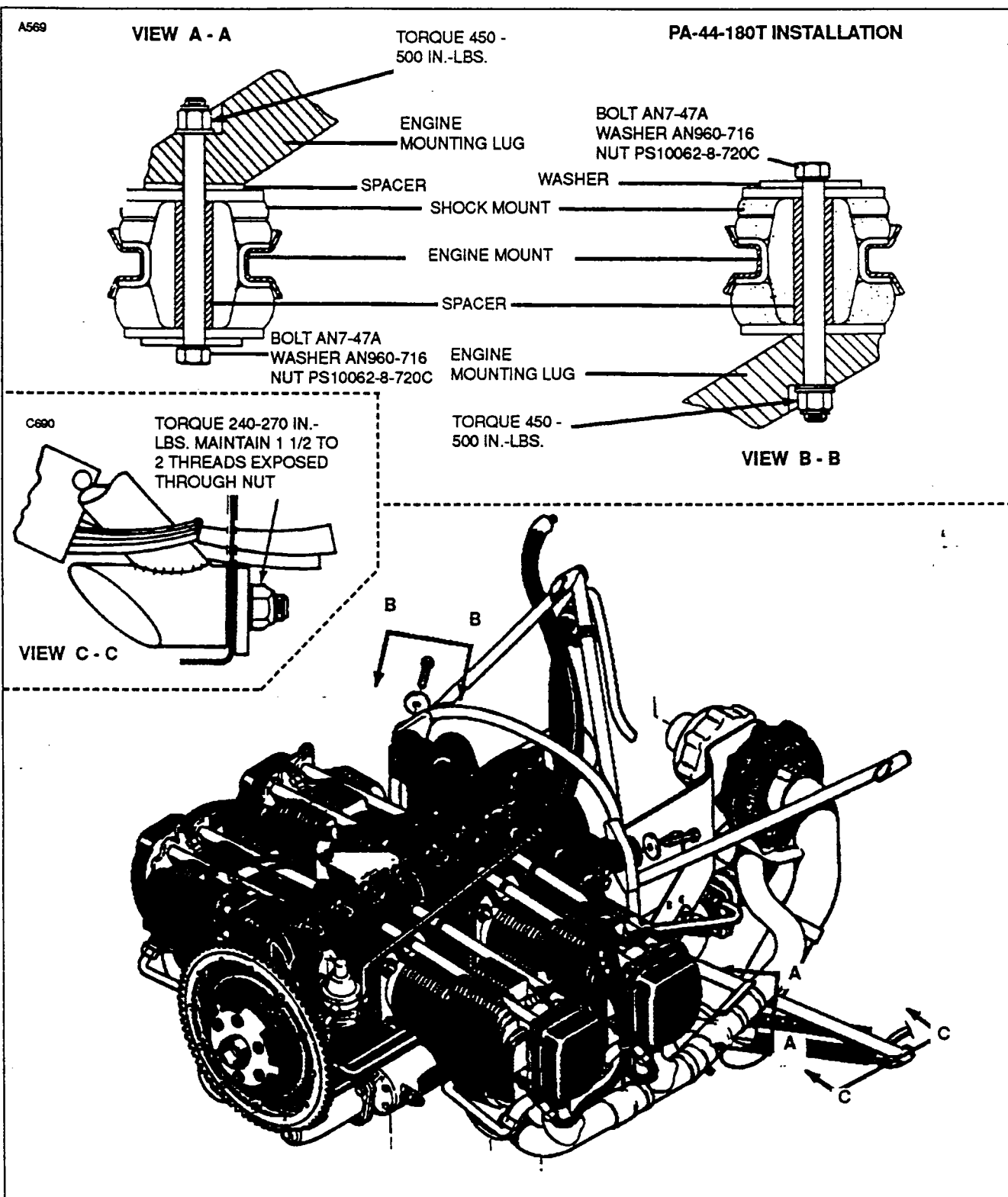


Figure 71-1. Engine and Shock Mount Installations (cont)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

INSTALLATION OF ENGINE. (Refer to Figure 71-1.)

— Note —

The information contained herein deal with the main items affective to both engines. For those items peculiar to a specific installation (180 or 180T) refer to the appropriate removal information and reverse the procedure.

— CAUTION —

THE BYPASS VALVE ON THE TURBOCHARGED VERSION IS SET AT THE FACTORY AND SHOULD NOT NEED ADJUSTMENT. CONTACT PIPER CUSTOMER SERVICE, VERO BEACH FOR ANY ADDITIONAL INFORMATION.

1. Attach a one-half ton (minimum) hoist to the engine hoisting straps and swing the engine into alignment with its attaching points.
2. Install the engine shock mounts. Refer to paragraph titled "Installation of Engine Shock Mounts."
3. Connect the alternator leads and secure cables with clamps.
4. Connect the oil pressure line, tachometer drive cable, oil temperature lead and the engine vent tube to the aft end of the engine.
5. Connect the vacuum pump line at the pump.
6. Secure the ignition harness, hoses and lines at the aft end of the engine.
7. Connect both lines to the oil cooler.
8. Connect the fuel pump supply line.
9. Connect the magneto "P" leads to the magnetos.
10. Connect the throttle, mixture and carburetor heat cable to the engine components.
11. Connect the starter positive and ground leads at the starter and secure with attachment clamps.
12. Be certain that the magneto switches are OFF and install the propeller. Refer to Chapter 61.
13. Install the proper grade and amount of engine oil. Refer to Lubrication Chart. Refer to Chapter 12.
14. Connect the battery ground wire at the battery.
15. Open the throttle and fuel valve completely. Turn on the electric fuel pump and check the fuel line for leaks.
16. Install the engine cowlings and remove the tail stand. Make sure the appropriate drains are installed.
17. Perform an engine operational check. Refer to the engine manufacturer's appropriate operator's manual.

— CAUTION —

UPON COMPLETION OF AN ENGINE INSTALLATION, CERTAIN PRECAUTIONS MUST BE TAKEN TO PREVENT DAMAGE TO THE ENGINE (AND TURBOCHARGER) AT INITIAL RUN-IN. FOR THIS REASON MAKE SURE TO PERFORM THE ENGINE PRE-OILING INSTRUCTIONS IN THE LATEST REVISION OF A AVCO LYCOMING SERVICE INSTRUCTION NO. 1241.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

ENGINE PRE-OILING.

Avco-Lycoming recommends pre-oiling prior to the initial start after an engine change, overhaul or any prolonged period of inactivity in order to avoid possible high speed bearing failure resulting from lack of lubrication. Refer to the latest revision of Avco-Lycoming Service Instruction No. 1241 for proper pre-oiling procedure.

COWLING.

The cowling consists of an upper and lower section and a nose section. A cowl flap is an integral part of the lower cowl.

COWLING MAINTENANCE.

REMOVAL AND INSTALLATION OF ENGINE COWLING. (Refer to Figure 71-2.)

The procedure for removing the engine cowling is the same for both engines.

1. Remove the fasteners securing the top cowl and remove the cowl.
2. Disconnect the cowl flap control, and on the 180T remove the snaffle valve or disconnect it from the tubing.
3. Support the bottom cowl and remove the screws that attach the cowl to nose cowl, engine mount and nacelle.
4. The nose cowl may be removed by removing the attaching screws and separating the two cowl halves.
5. Install the cowling in reverse of removal.

CLEANING, INSPECTION AND REPAIR OF ENGINE COWLING.

1. The cowl should be cleaned with a suitable solvent then wiped with a clean cloth.
2. Inspect the cowling for dents, cracks, loose rivets, damaged or missing fasteners and damaged fiberglass areas.
3. Repair all defects to prevent further damage. Fiberglass repair procedures may be accomplished according to Fiberglass Repairs, Chapter 51.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

ENGINE COWL FLAPS. (Refer to Figure 71-3.)

The cowl flaps are all metal flaps located on the rear of the bottom cowl. The flaps are manually operated through a push-pull control from the cockpit. The cowl flaps are connected to the engine cowl with full length piano type hinges.

OPERATION AND ADJUSTMENT OF COWL FLAPS.

The cowl flaps are all metal flaps located on the rear of the bottom cowl. The flaps are manually operated through the push-pull controls mounted in the lower portion of the console. When the control levers are in the up position, the flaps are closed. To operate the cowl flaps, depress the lock and move the lever down. releasing the lock after the initial down movement will allow the lock to stop the flap travel at the intermediate position. For full open position, depress the lock and move the control down; release the lock after the initial movement and continue to move the control down until the lock stops the travel of the control. To raise the cowl flaps reverse the procedure. The cowl flaps should be adjusted as follows:

1. Place the control in the up position.
2. Ascertain that the control lock is engaged.
3. Check the cowl flap to visually determine that the flap is flush with the bottom of the engine cowl.
4. If the flap is not flush, disconnect the push-pull control from the arm on the inboard side of the flap.
5. Loosen the jam nut on the clevis end and adjust the clevis to get a flush fit between the cowl flap and engine cowl.
6. Reconnect the control to the flap and operate the cowl flap through its full range a few times; then place the control in the closed position and visually check the flap to determine if it is flush with the engine cowl.
7. If the cowl flap is not flush, repeat Steps 4 through 6.
8. When the adjustment is completed, tighten the clevis jam nut and secure the push-pull control to the cowl flap.

MOUNTS.

ENGINE SHOCK MOUNTS.

INSTALLATION OF ENGINE SHOCK MOUNTS. (Refer to Figure 71-1.)

1. Assemble the engine shock mounts on the engine mount as shown in Figure 71-1. Note the position of each mount carefully. The upper right and lower left mounts are the same as are the upper left and lower right.
2. Swing the engine into place, positioning the engine mounting lugs so they align with the engine mount attachment points.
3. Position the shock mount bolts through the shock mounts and then through the mounting lugs and secure with nuts. Torque the nuts progressively, following a circular sequence until a torque value of 450-500 inch-pounds is reached.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

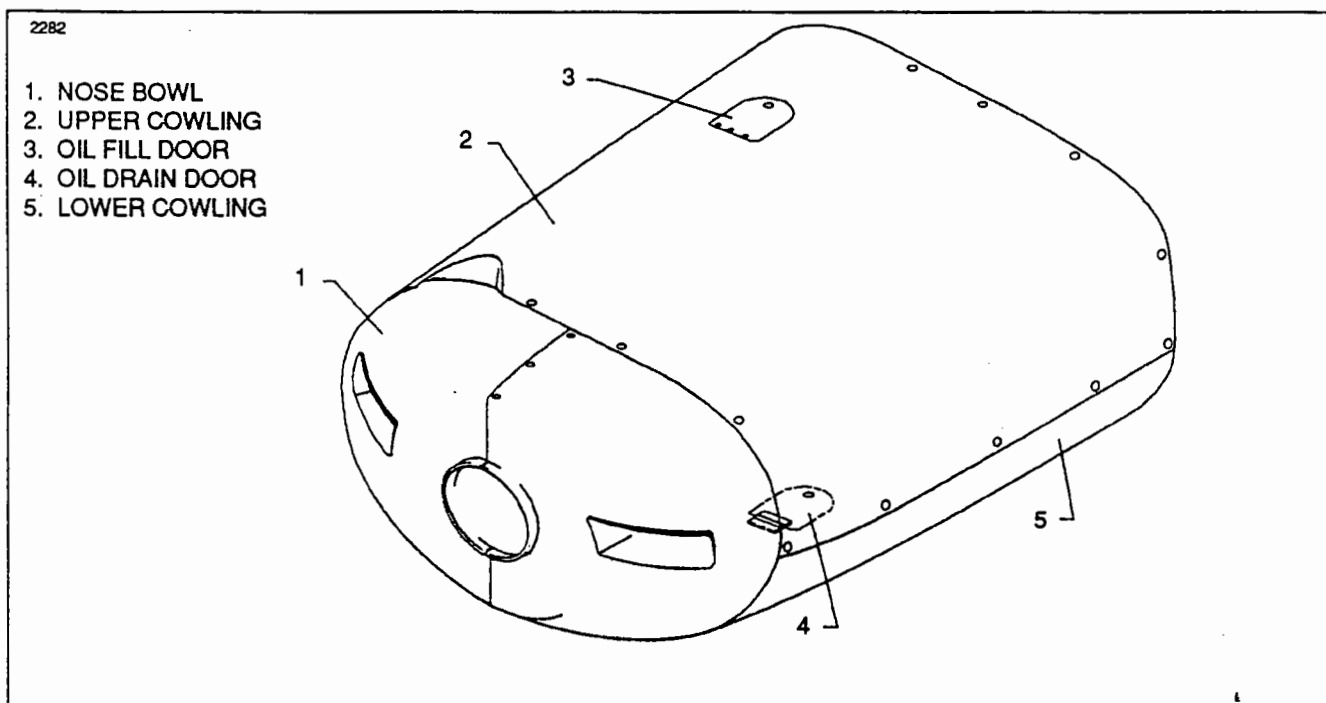


Figure 71-2. Engine Cowling Installation.

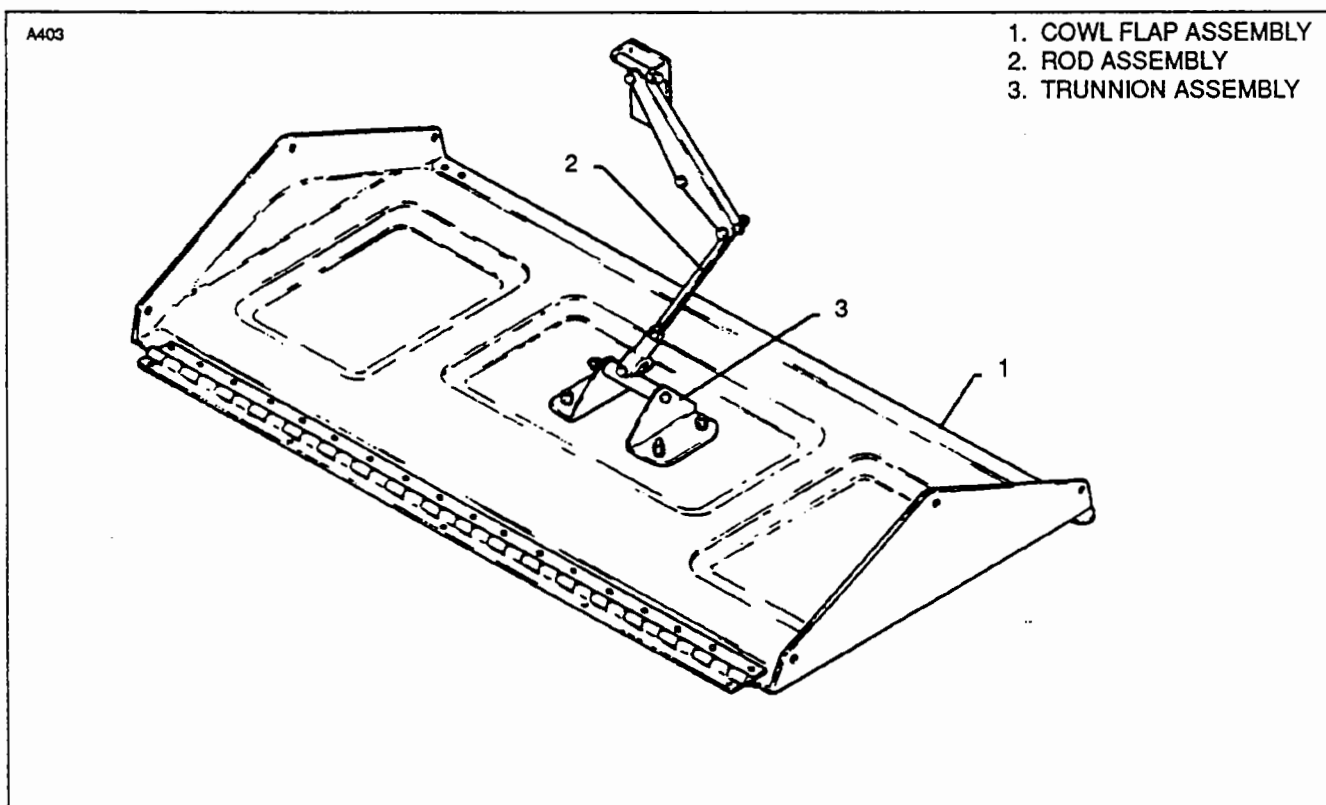


Figure 71-3. Cowl Flap Installation

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

AIR INTAKES.

INDUCTION SYSTEM (PA-44-180). (Refer to Figure 71-4.)

Induction air is taken from the right rear engine baffle, routed through a short duct into the filter housing, and down to the carburetor through another duct and the carburetor air box. The filter housing, mounted to the firewall, is supported by connections to the two ducts and by a bracket to the engine mount structure. The carburetor air box is connected to the carburetor heat duct, which is additionally utilized as an alternate air source should the main inlet become blocked.

REMOVAL AND INSTALLATION OF AIR FILTER HOUSING (PA-44-180).

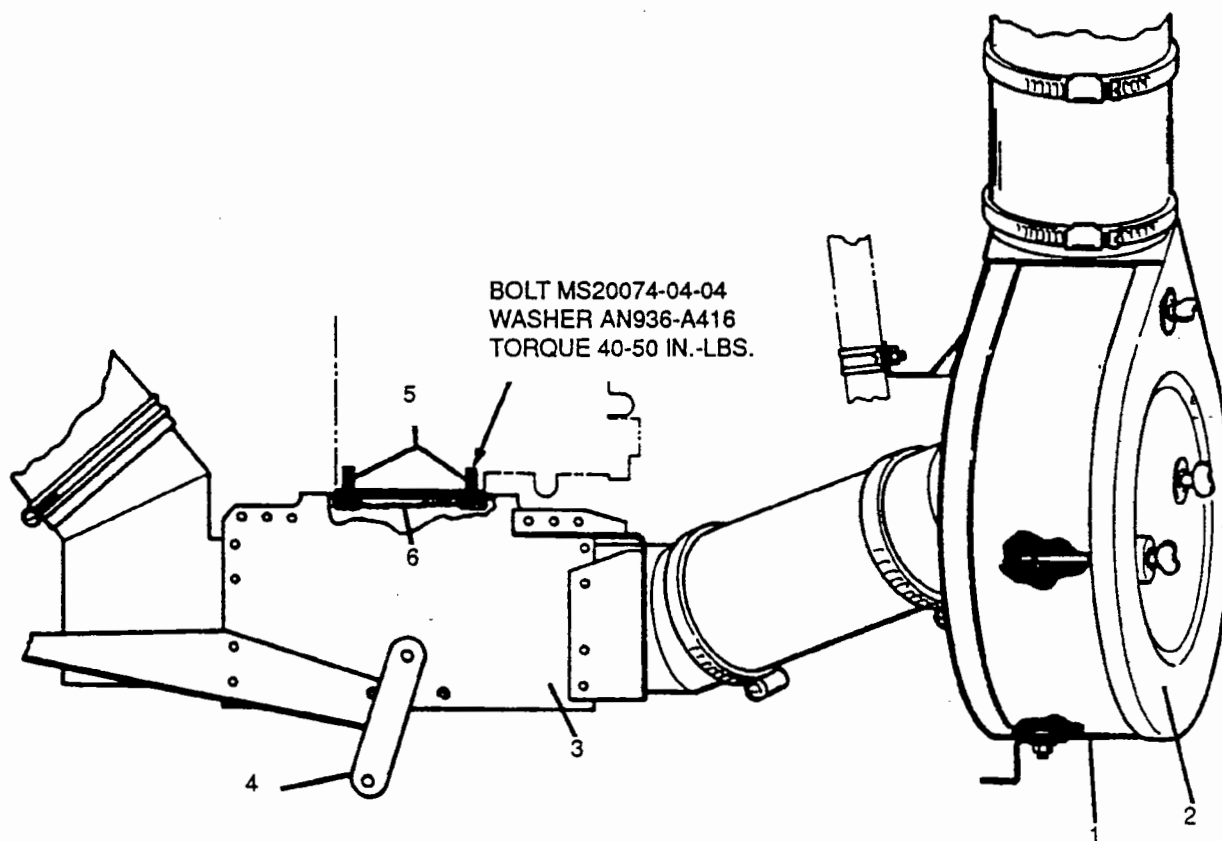
1. To make access to the assembly remove both the top and bottom cowlings.
2. Remove the cover of the filter housing and withdraw the air filter.
3. Loosen the clamps retaining the ducts to the filter housing and move them aside.
4. Where the housing is mounted to the firewall make note of the amount and situation of the spacers, washers used. Remove the bolt and washers.
5. With the housing upheld, remove the bolts from the housing support bracket that attach it to the engine mount.
6. Install the unit in the reverse order.

INSPECTION, REMOVAL, AND INSTALLATION OF CARBURETOR AIR BOX (PA-44-180).

1. The carburetor and air box are at the rear of the engine under the dual magnetos. Access to the carburetor air box must be made with at least the bottom cowl removed. Disconnect the cable from the flutter valve arm.
2. Loosen the clamps on the duct tubes and move them clear of the air box inlets.
3. Remove the eight screws on the back of the box and two on the top and bottom, aft of the valve shaft. These screws secure the back of the box which acts as a bearing support for the flapper valve.
4. Remove the back of the air box and flapper valve assembly. Lubricate the shaft with lubriplate as necessary.
5. Check the condition and operation of the flapper. Make sure the shaft moves freely in the bearings and the rivets retaining the bearings are in proper condition. Replace the rivets if the bearings exhibit any looseness, and make sure the bearings retain their proper alignment.
6. Remove the safety wire and follow with the four bolts securing the assembly to the carburetor.
7. With the assembly removed inspect the box for cracks and proper sealing.
8. Reinstallation should be accomplished in the reverse order of removal. Once the assembly is installed make sure the flapper valve moves freely before installing control cable.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

B861



1. AIR FILTER BOX
2. AIR FILTER
3. CARBURETOR AIR BOX
4. AIR CONTROL ARM
5. MOUNTING BOLTS
6. SAFETY WIRE (.032 DIA.)

Figure 71-4. PA-44-180 Induction System

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

REMOVAL AND INSTALLATION OF CARBURETOR HEAT SHROUD (PA-44-180).

1. Remove the bottom cowl.
2. Carburetor heat is supplied by a duct interconnected with a shroud mounted to the cylinder No. 4 exhaust manifold. The duct can be removed by first removing the clamps retaining it to the air box and shroud fixtures.
3. Remove the screws securing the outboard shell of the shroud and slide it forward out of the main shroud support.
4. Remove the bolts securing the shroud to the exhaust stack.

SNIFFLE VALVE MAINTENANCE (PA-44-180T).

The snuffle valve, located on the inboard side of each bottom cowl, functions to permit any liquid in the intake manifold to drain when the engine is shut down. If the valve mechanism fouls and engine operation is erratic, the valve should be replaced or cleaned as directed herein.

1. Remove the back/up retaining nut and washer, which will release the valve from the bottom cowl.
2. Remove the bottom cowl and inspect the hose, tubing, and fittings interconnected with the valve for excessive wear, corrosion, or other defects.

— Note —

If the engine is found to be running lean at low power settings and rich at high power setting, with the snuffle valve in working condition, it may be possible that the lines interconnecting the snuffle valve and intake manifold are allowing air to enter or escape the manifold.

3. Make sure the hose is not touching the engine and that it is installed without dips.
4. Disconnect the valve from the hose.
5. The valve can be checked for proper operation by trying to inhale or exhale through the valve outlet. The valve should prevent either. If a leak exists soak the valve in an ultrasonic cleaner, or lacquer thinner. The valve should operate properly or be replaced.
6. Connect the valve to the hose.
7. Position the valve in the cowling and secure with nut and washer.
8. Run the engine to insure proper installation.

INDUCTION SYSTEM (PA-44-180T). (Refer to Figure 71-6.)

— CAUTION —

**AFTER ANY REPAIRS TO THE INLET DUCTS MAKE SURE THEY ARE
PROPERLY EVACUATED TO PREVENT INGESTION IN COMPRESSOR
OR ENGINE.**

The induction system for the turbocharged Seminole is only similar to that of the standard version in that it also takes induction air from the right rear baffle. Air flows into the air box through a flat filter and into the compressor inlet duct. The compressor inlet duct also incorporates a means of alternate air with a suck in door. The "alternate air door" can also be manually operated from the cockpit.

At the front of each engine inlet is a deflector to help prevent turbo bootstrap and give protection against ice.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

AIR INLET FILTER HOUSING INSPECTION AND MAINTENANCE (PA-44-180T).

The filter housing is an integral part of the baffling. Repairs to this assembly are limited to standard metal skin repairs as specified in AC 43.13-1 A. Whenever an inspection is carried out or the filter is changed, the housing should be checked for corrosion and cracks. If damage is observed it should be repaired and any holes sealed. For replacement of the filter refer to chapter on servicing.

MAINTENANCE AND INSPECTION OF COMPRESSOR INLET DUCT AND ALTERNATE AIR DOOR (PA-44-180T).

— Note —

For Inspection information refer to Step 2 of the subject paragraph.

1. The compressor inlet duct is an assembly unto itself, and is supported through connection with the filter housing and the compressor inlet. Any repairs to the alternate air door or inlet duct should be done with the assembly removed to prevent foreign object damage to the compressor. The inlet duct should be removed as follows:
 - A. Remove the top cowl of the affected engine. It may be desired to remove the bottom cowl as well.
 - B. Disconnect the alternate air door control cable from the actuating lever, and bracket on air duct.
 - C. Unscrew those clamps retaining the duct to the filter housing and with the aluminum supports removed, slide the sleeve back over the housing.
 - D. Loosen the clamp securing the duct to compressor inlet and move the duct out of the support sleeve.
2. The duct should be checked for pinholes, excessive corrosion, and cracks especially at the welds and flanges. The roller on the door actuating lever should also be checked for wear and freeness of rotation.
 - A. If cracks or pinholes have been determined they should be appropriately welded making sure the surface is smooth on the inside of the tube.
 - B. If corrosion is detected, the surface should be lightly sanded and properly coated or treated.
3. Should the roller on the actuating lever need to be replaced, center punch the rivet and, as accurately as possible to prevent enlarging the hole, drill out the rivet. Replace the rivet with an appropriate MS20470AD4 rivet.
4. The actuating arm and alternate air door can be removed as follows:
 - A. Make note of where and the amount of washers used, and remove the hinge bolt from the actuating arm.
 - B. If the alternate air door doesn't close properly but moves freely the spring may need to be replaced. The door must be removed to replace the spring or the door. To remove the doors drill out the rivets and remove door and spacer.
5. When replacing door remember to use the spacer between the hinge and box wall.
6. Replace all assemblies in the reverse of the removal and make sure to use appropriate replaceable hardware.

COMPRESSOR TO CARBURETOR INTAKE ASSEMBLY.

The relief valve in the intake duct between the compressor and carburetor is a sealed unit. For information on intake rigging refer to Lycoming information.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

C687

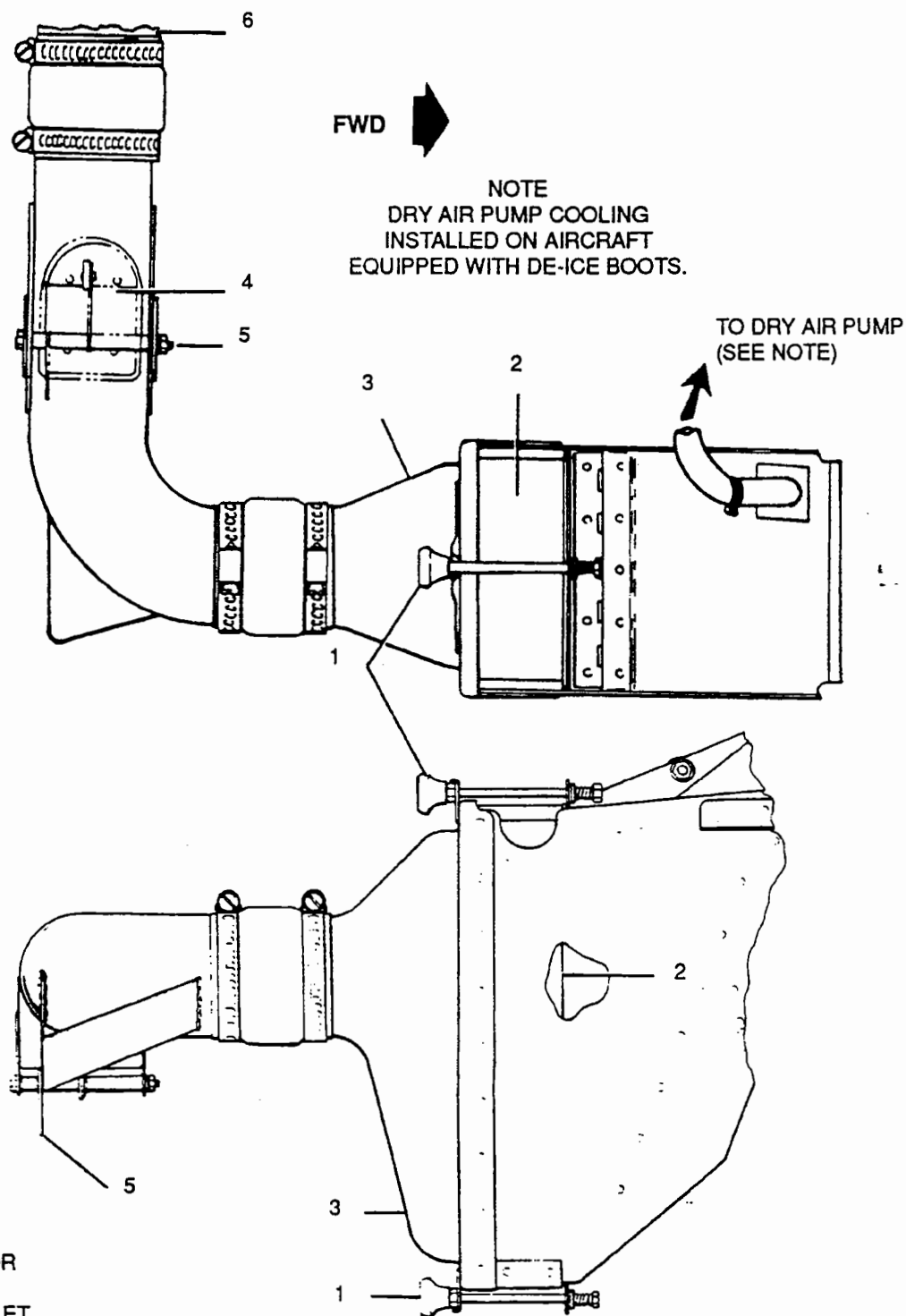


Figure 71-5. PA-44-180T Induction System

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3E19 THROUGH 3E24
INTENTIONALLY LEFT BLANK**

CHAPTER

73

ENGINE FUEL SYSTEM

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 73 - ENGINE FUEL SYSTEM

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
73-10-00	DISTRIBUTION	3F3	
73-10-01	Carburetor Maintenance	3F3	
73-10-02	Adjustment of Idle Mixture	3F4	
73-10-03	Adjustment of Idle Speed	3F4	
73-10-04	Engine Primer Installation	3F5	2R 2 - 81
73-10-05	Manual Primer (180)	3F5	2 - 81
73-10-06	Removal of Primer (180)	3F5	
73-10-07	Disassembly, Cleaning and Assembly of Primer (180)	3F5	
73-10-08	Installation of Primer (180)	3F5	
73-10-09	Electric Primer (180T & 180 S/N 44-95001 and up)	3F9	2R 8 - 81
73-10-10	Primer Jets (180T & 180 S/N 44-95001 and up)	3F9	
73-20-00	CONTROLLING	3F9	
73-20-01	Adjustment of Throttle, Mixture and Carburetor Heat Controls	3F9	
73-30-00	INDICATING	3F10	
73-30-01	Fuel Pressure Gauge	3F10	
73-30-02	Fuel Pressure Sender Testing	3F11	2 - 81
73-30-03	Troubleshooting (Fuel Pressure Gauge)	3F12	

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

DISTRIBUTION.

CARBURETOR MAINTENANCE.

— Note —

For any information on the carburetor ice detector refer to Chapter 71.

In general, little attention is required between carburetor overhauls. However, it is recommended that the following items be checked during recommended inspection periods of the engine.

1. Check tightness and safety of all nuts and screws which fasten the carburetor to the engine.
2. Check all fuel lines for tightness and evidence of leakage.
3. Check throttle and mixture control rods and levers for travel, tightness and safety.
4. Clean the fuel inlet screen. (Refer to Figure 73-1.)
5. Remove the plug at the aft position of the carburetor and drain any accumulation of foreign matter.
6. Check carburetor air box for wear and full travel of heat door.

— CAUTION —

GROUND RUNNING WITH THE COWLING REMOVED: MAXIMUM POWER GROUND RUNNING IS LIMITED TO TWO (2) MINUTES OR CYLINDER HEAD TEMPERATURE OF 475°F, WHICHEVER IS REACHED FIRST. AIRCRAFT WITHOUT CYLINDER HEAD TEMPERATURE GAUGE MUST NOT BE OPERATED AT MAXIMUM POWER WITH COWLING REMOVED. PROLONGED GROUND RUNNING WITH THE COWLING REMOVED COULD CAUSE LOCAL HOT SPOTS IN THE CYLINDERS AND IRREVERSIBLE ENGINE DAMAGE.

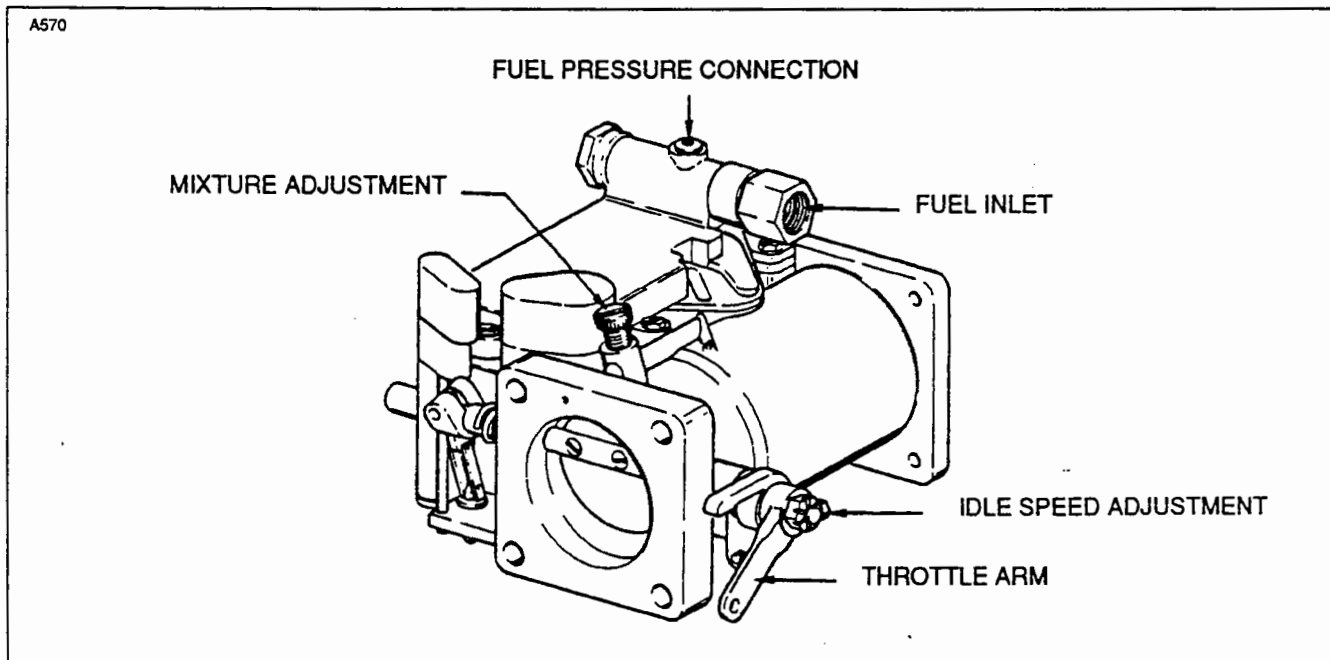


Figure 73-1. Carburetor

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

7. Check the adjustment of the idle mixture and idle speed.

ADJUSTMENT OF IDLE MIXTURE. (Refer to Figure 73-1.)

— WARNING —

WHEN PERFORMING ENGINE WARM-UP INDOORS, PROVIDE A BARRIER ABOUT THE ENGINE TO PREVENT SERIOUS INJURY. ALSO PROVIDE ADEQUATE MEANS OF VENTILATING THE WORK AREA.

1. After performing the standard engine starting procedure, operate the engine for at least two minutes between 800 to 1200 RPM to insure proper engine warm-up.
2. Position the cockpit throttle control lever to obtain a reading of approximately 550 RPM on the tachometer with the idle mixture control at the full rich position.
3. While observing the tachometer, slowly pull the mixture control towards the idle cut-off position. The optimum mixture is obtained when the RPM increases slightly (10 to 50 RPM) prior to engine speed decreasing.
4. Following the momentary increase in RPM, the engine speed will start to drop. Immediately move the mixture control to the full rich position to prevent the engine from cutting out completely.
5. Should these steps reveal that the idle mixture is not correct make the following adjustments and perform Steps 2 thru 4 again.
 - A. With the engine set to idle at 550 RPM turn the idle mixture adjusting screw at the rear of the carburetor, clockwise, leaning the fuel mixture. Continue to do this until the engine begins to run roughly, at which time the engine speed will decrease.
 - B. Turn the adjustment screw counterclockwise until the engine runs smoothly again. Continue to turn the screw in the same direction until the engine begins to run roughly once more. At this point, the fuel mixture will be too rich and engine speed will decrease again.
 - C. Now adjust the screw to a midway position between the lean and rich fuel mixture; the RPM of the engine will reach a minimum speed for idle mixture settings.
6. After adjusting the idle mixture, recheck it several times to insure its remaining consistent from high power settings back to idle.

ADJUSTMENT OF IDLE SPEED. (Refer to Figure 73-1.)

1. Pull back the cockpit throttle control lever until it is completely aft and in the closed position. Observe the engine speed on the tachometer.
2. Adjust the idle speed adjustment screw to obtain from 550 to 650 RPM. Rotate the screw clockwise to increase the speed of the engine; counterclockwise to decrease the engine speed. The screw is located on the throttle arm.

— Note —

One complete revolution of the carburetor idle screw provides a variation of approximately 100 RPM in idling speed.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

ENGINE PRIMER INSTALLATION (Refer to Figure 73-2.)

The PA-44-180 and PA-44-180T, as shown in Figure 73-2, utilize different systems. The PA-44-180 uses hand pumps, except on S/N 44-95001 and up, high pressure electric pumps for priming are utilized and the PA-44-180T uses high pressure electric pumps for the priming system.

MANUAL PRIMER (PA-44-180).

The PA-44-180 primer pumps, one for each engine, are mounted on the control pedestal above the cowl flap lever. Each primer can be operated, after rotating the handle to unlock it, by pulling and pushing the handle to create a pressure. Fuel is forced through the related primer lines and jets mounted in the bottom of each intake of the number 2, 3 and 4 cylinders.

REMOVAL OF PRIMER (PA-44-180). (Refer to Figure 73-2.)

1. Disconnect the fuel lines from the primer behind the instrument panel.
2. Loosen the locknut from behind the panel.
3. Unscrew the knurled face nut and remove the pump handle and piston from the cylinder.
4. Remove the remaining portion of the primer.

DISASSEMBLY, CLEANING AND ASSEMBLY OF PRIMER (PA-44-180). (Refer to Figure 73-2..)

1. The primer may be further disassembled after removal by removing the screws, springs and check balls from the end of the cylinder housing.
2. Clean the primer parts with acetone or a dry type solvent.
3. Install new O-rings to the piston and lubricate with light motor oil.
4. Install the balls, springs and screws to the cylinder housing.
5. Insert the pump handle and piston into the cylinder and finger tighten the knurled face nut.
6. Immerse the pump in gasoline and operate several times to insure proper operation.

INSTALLATION OF PRIMER (PA-44-180). (Refer to Figure 73-2.)

1. Remove the pump handle and piston by unscrewing the knurled face nut, if previously installed.
2. Insert the cylinder assembly through the back side of the panel.
3. Insert the piston into the cylinder and tighten the knurled face nut.
4. Position the primer and tighten the locknut on the cylinder behind the panel.
5. Connect the fuel lines to the primer.
6. Disconnect the primer line inside the engine compartment. Operate the pump to ascertain proper operation.

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

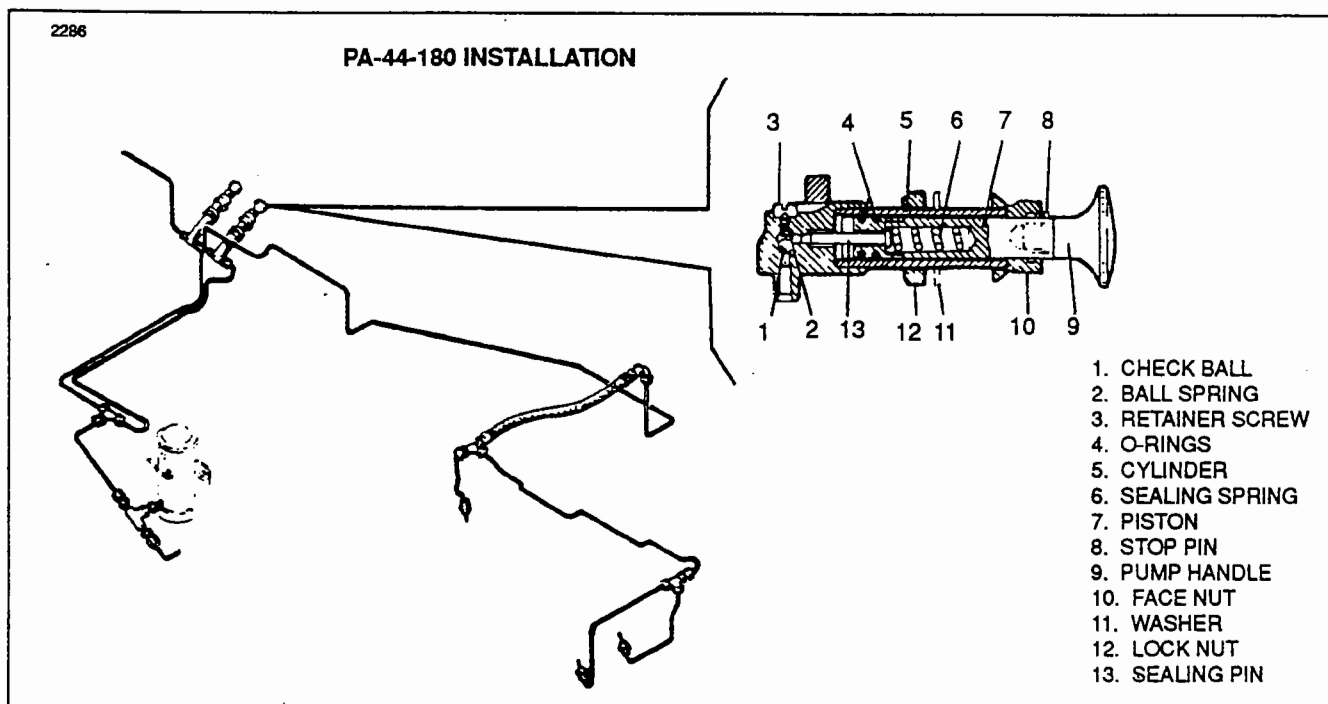


Figure 73-2. Engine Primer System (PA-44-180)

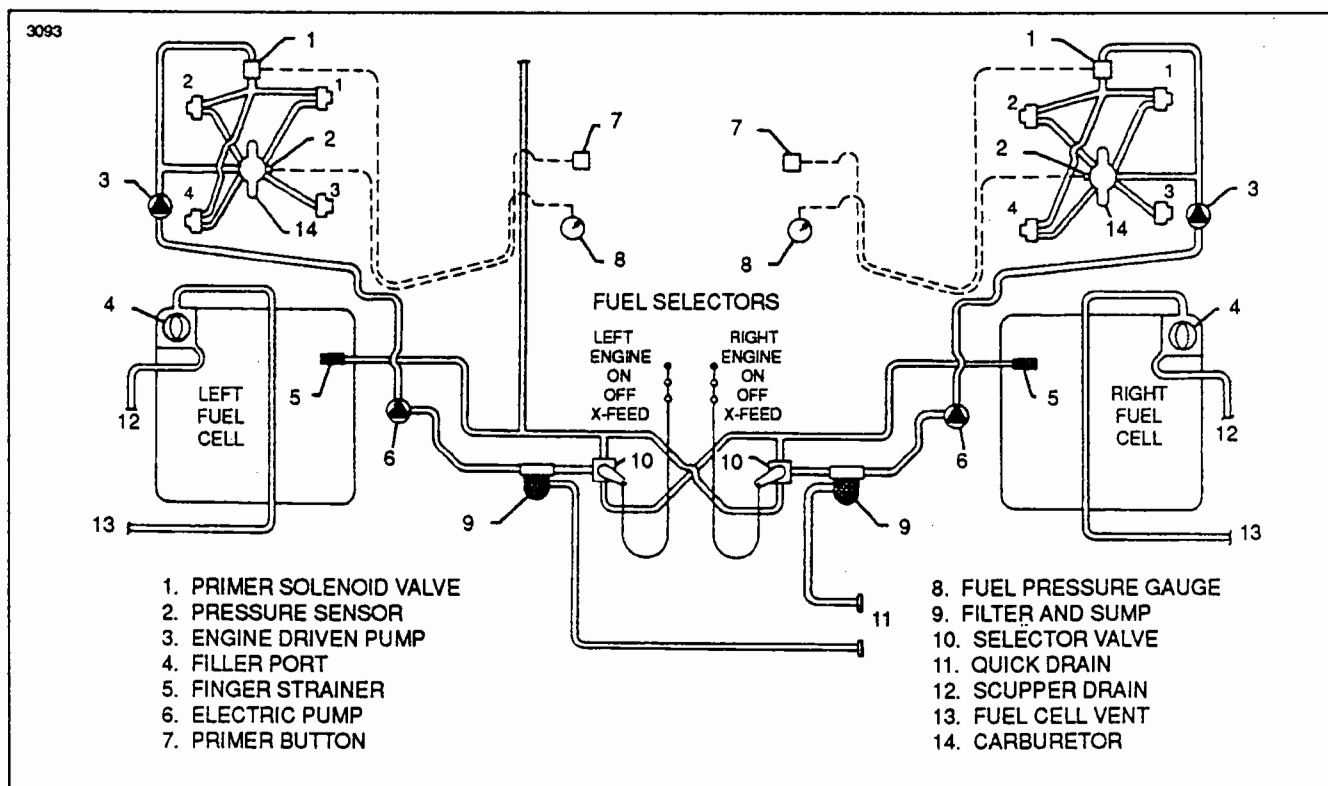


Figure 73-3. Fuel System Schematic (PA-44-180T)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

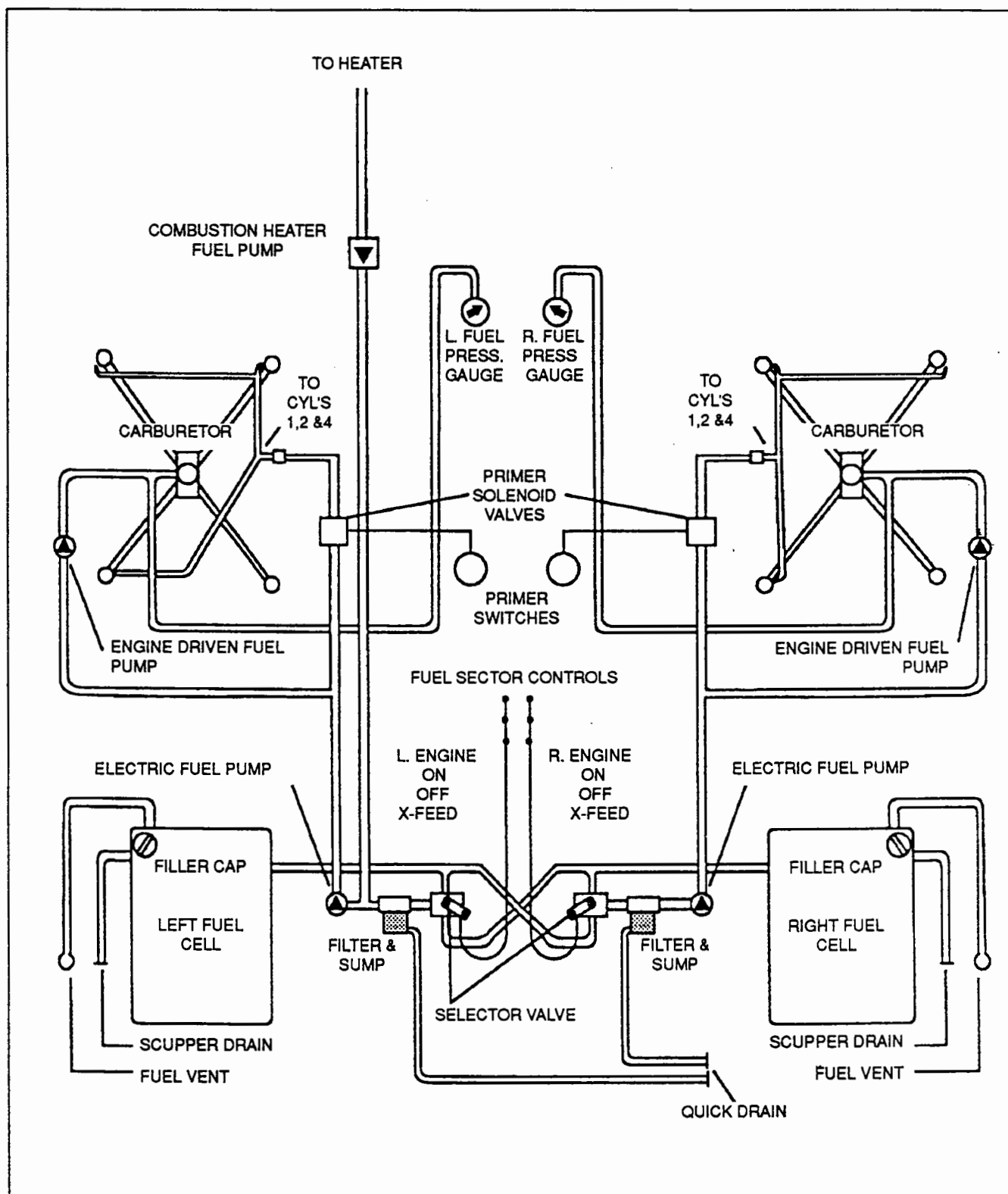


Figure 73-3a. Electric Primer System (PA-44-180 S/N 44-95001 and up)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

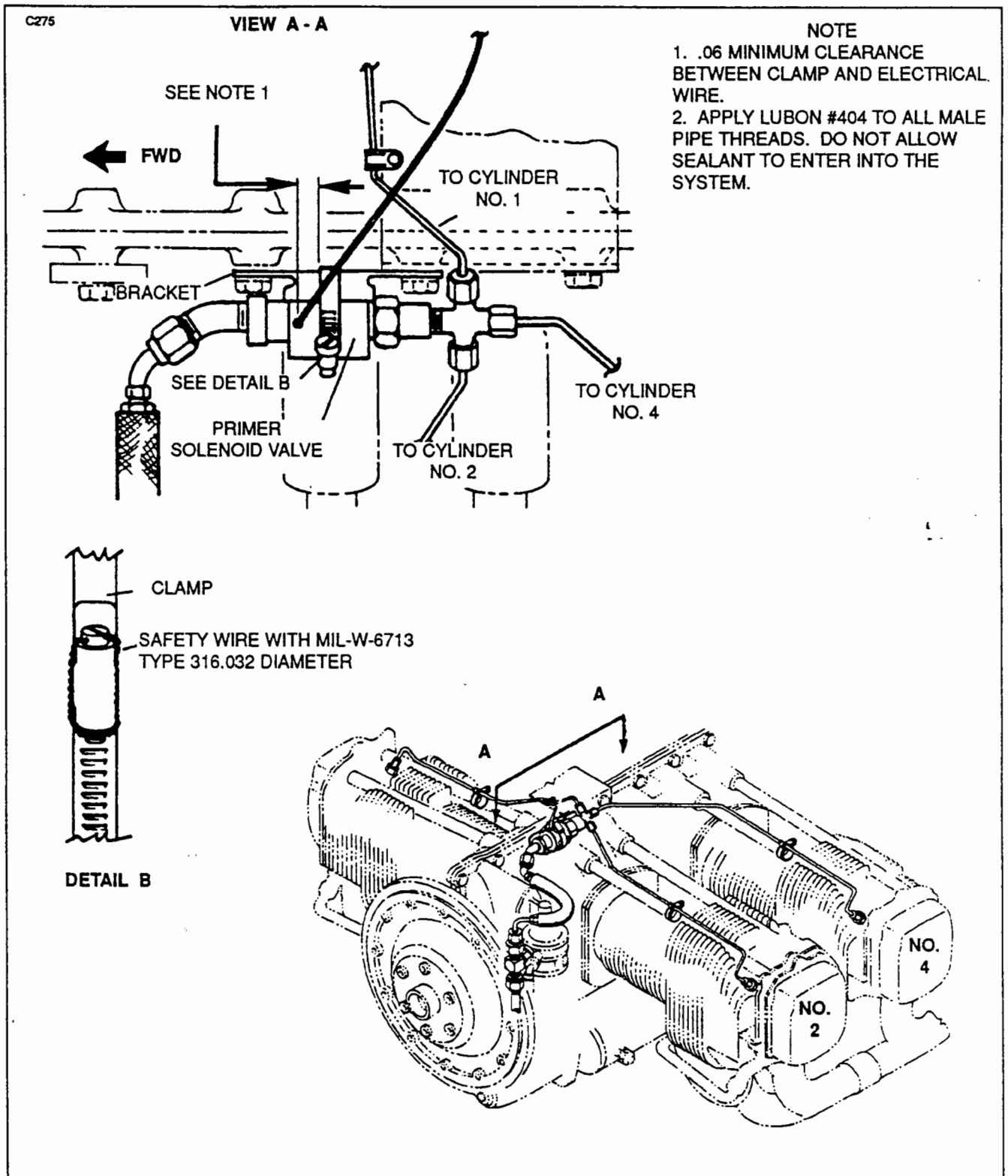


Figure 73-4. Engine Primer System (PA-44-180T)

73-12-04

Page 73-05

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

ELECTRIC PRIMER (PA-44-180T & PA-44-180 S/N 44-95001 AND UP).

The PA-44-180T priming system makes use of high pressure electric pumps mounted in each wing and solenoid controlled primer valves. Each system is operated by switching on the appropriate electric fuel pump thus supplying fuel to the engine driven pump. Fuel for the primer system is fed through the engine driven pump to the primer solenoid valve. With fuel pressure available, the primer button is depressed actuating the primer solenoid valve and allowing fuel to flow through the lines to the primer jets in the intake of the number 1, 2 and 4 cylinders.

— Note —

The electric fuel pumps must be on to operate the electric primers.

PRIMER JETS.

1. To remove the primer jets, disconnect the supply line from each jet. With a deep socket and light pressure, remove the jet from the cylinder.
2. To clean the jet, soak in carbon remover solution long enough to loosen any dirt and blow clean with air pressure. Do not use sharp objects or wire brush to clean the jet tube.
3. Install the jet finger tight to assure that the threads are not crossed and then torque 60 inch-pounds. Align and install the fuel supply lines, tighten to a snug fit.

— Note —

Should further fuel stoppage of the primer system exist, check the supply lines for stoppage, bent or collapsed walls.

CONTROLLING.

ADJUSTMENT OF THROTTLE, MIXTURE AND CARBURETOR HEAT CONTROLS. (Refer to Figure 73-5.)

Throttle and mixture controls are adjusted so that when the throttle arm on the carburetor is rotated forward against its full throttle stop and the mixture control is rotated forward against its full rich stop, the cockpit control levers of the throttle and mixture should have 0.030 of an inch spring back on instrument panel stop when in full throttle or full rich position.

1. The throttle may be adjusted as follows:
 - A. At the carburetor, disconnect the clevis end of the throttle control cable from the control arm. Loosen the jam nut that secures the clevis end.
 - B. Adjust the linkage by rotating the clevis end of the cable to obtain 0.030 to 0.060 of an inch spring back on instrument panel stop when in full throttle position.
 - C. Reconnect the clevis end to the control arm and safety.
2. The mixture may be adjusted as follows:
 - A. At the carburetor, disconnect the clevis end of the mixture control cable from the control arm. Loosen the jam nut that secures the clevis end.
 - B. Adjust the linkage by rotating the clevis end on the cable to obtain 0.030 to 0.060 of an inch spring back on the instrument panel stop when in full rich position.
 - C. Reconnect the clevis end to the control arm and safety.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

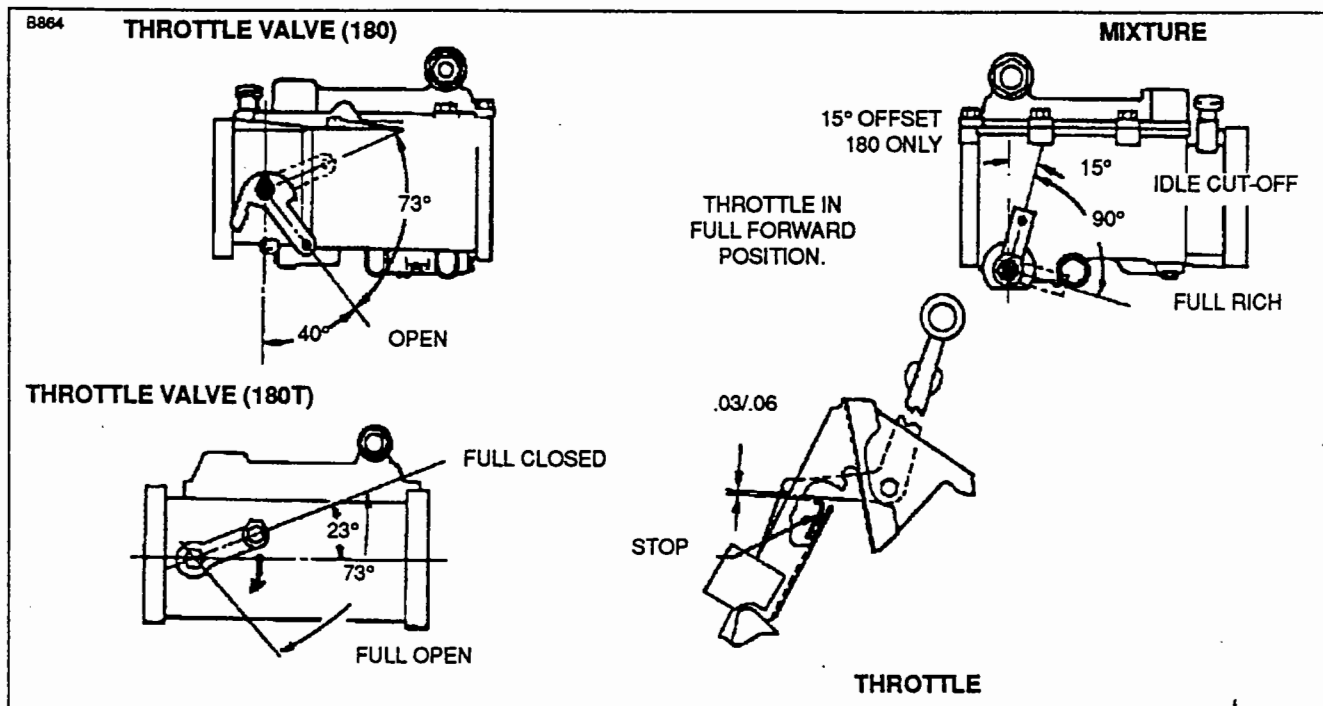


Figure 73-5. Adjustment of Engine Controls

3. Check security of cable casing attachments.
4. Pull the throttle and mixture levers in the cockpit full aft to ascertain that the idle screw contacts its top and the mixture control arm contacts its lean position.
5. The carburetor heat control may be adjusted as follows:
 - A. Position the air box valve in the full cold position and the cockpit control .16 below the cold detent.
 - B. The air box valve must be in the full heat position when the cockpit control is in the hot position .

INDICATING.

FUEL PRESSURE GAUGE.

The fuel pressure gauge instruments are mounted on the instrument panel in the cluster for their respective engines. The gauges are electrically connected to pressure senders for their respective engines: The senders are mounted through the aft side, and outboard half of each firewall to the fuel pressure line, running from each engine's carburetor to the firewall. The oil pressure senders are those units with the two terminals on the aft side of the instrument.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

FUEL PRESSURE SENDER TESTING. (Refer to Chart 7301.)

The fuel pressure sender works on the relationship of pressure to resistance. As the pressure rises the resistance rises and alters the position of the needle in the instrument.

1. The sender may be tested by removing it from the aircraft and applying a calibrated pressure to the pressure port.
2. Attach an ohmmeter to the two terminals on the reverse side of the pressure port, and check the resistances as shown in Chart 7301.
3. To test the sender and gauge in conjunction with each other, disconnect the gauge from the aircraft system, connect it in series (using a 12 to 14-volt system) with the sender, and proceed as follows:
 - A. Slowly increase the pressure to the sender till 9 + 0.5 psi is reached.
 - B. Let the system set at the pressure for a couple of seconds, recheck the pressure, and lower the pressure to 8 psi.
 - C. Reduce the pressure to .5 psi. The gauge should indicate .5 +1, -0 needle widths.

— Note —

The sender and gauge are nonadjustable, therefore that which does not meet specifications should be replaced.

4. Reinstall the gauge and sender.

CHART 7301. FUEL PRESSURE SENDER TEST SPECIFICATION

Pressure (Psi)	Resistance (Ohms)	Tolerance (Ohms)
0	10	—
.5	11.5	+1, -0
5	42	±1
8	60	+1/2, -0
10	72	±1

The gauge (Piper P/N 86750-2) should indicate 8 psi +1/2, -0 needle widths.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

TROUBLESHOOTING. (Fuel Pressure Gauge)

CHART 7302. TROUBLESHOOTING (FUEL PRESSURE GAUGE)

Trouble	Cause	Remedy
No fuel pressure indication.	Fuel valve stuck. No fuel in tanks. Defective fuel pump.	Check valve. Check fuel, fill. 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.
Pressure low or pressure surges.	Obstruction in inlet side of pump. Faulty bypass valve. Faulty diaphragm.	Trace lines and locate obstruction. Replace. Replace or rebuild pump.
Needle fluctuation.	Surge dome or pump filled with fuel. Air in line.	Remove and empty. Loosen line at gauge, turn on electric pump. Purge line of air and retighten.
High fuel pressure with engine shut off right after flight.	Fuel in line expanding due to heat build up in cowl.	Normal.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3F13 THROUGH 3F15
INTENTIONALLY LEFT BLANK**

CHAPTER

74

IGNITION

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 74 - IGNITION

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
74-00-00	GENERAL	3F18	
74-01-00	Description and Operation	3F18	8 - 82
74-02-00	Troubleshooting	3F18	
74-10-00	ELECTRICAL POWER SUPPLY	3F19	
74-11-00	Magneto	3F19	
74-11-01	Inspection of Magneto	3F19	2R 8 - 82
74-11-02	Magneto Installation and Timing Procedure (Timing Magneto to Engine)	3F22	8 - 82
74-11-03	Magneto Timing Procedure (Internal Timing)	3G2	
74-11-04	Impulse Coupling Removal	3G6	
74-11-05	Inspection of Impulse Coupling	3G6	
74-11-06	Impulse Coupling Installation	3G10	
74-20-00	DISTRIBUTION	3G12	
74-21-00	Ignition Harness	3G12	
74-21-01	Inspection of Harness	3G12	
74-21-02	Maintenance of Harness	3G12	
74-22-00	Spark Plugs	3G18	
74-22-01	Removal of Spark Plugs	3G18	
74-22-02	Inspection and Cleaning of Spark Plugs	3G20	
74-22-03	Installation of Spark Plugs	3G20	
74-30-00	SWITCHING	3G21	A 8 - 81
74-31-00	Magneto and Starter Switches	3G21	A 8 - 81
74-31-01	Removal and Installation of Magneto Switches	3G21	A 8 - 81
74-31-02	Removal and Installation of Starter Switch	3G21	A 8 - 81

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

GENERAL.

DESCRIPTION AND OPERATION.

The magnetos feature two electrically independent ignition circuits in one housing. A single four pole rotor provides the magnetic energy for both circuits. This magneto uses an impulse coupling to provide reliable ignition to engine cranking speed. A single cam operates the main breakers for both magneto circuits. Suppression of contact point arching and conducted radio interference is accomplished by feed-thru capacitors which are mounted in the magneto cover which forms a part of the magneto harness assembly. At low engine cranking speeds the impulse coupling automatically retards the magneto until the engine is also at its retard firing position. The spring action of the impulse coupling is then released to spin the rotating magnet and produce the spark required to fire the engine. After the engine starts, the impulse coupling flyweights do not engage due to centrifugal action. The coupling then acts as a straight drive and the magneto fires at the normal firing position of the engine.

— CAUTION —

**ASCERTAIN THAT THE PRIMARY CIRCUITS OF BOTH ENGINES ARE
GROUNDED BEFORE WORKING ON THE ENGINE.**

TROUBLESHOOTING.

CHART 7401. TROUBLESHOOTING (MAGNETO)

Trouble	Cause	Remedy
Failure of engine to start.	Defective spark plugs.	Clean and adjust or replace spark plugs.
	Defective ignition wire.	Check with electric tester and replace defective wires.
	Defective battery.	Replace with charged battery.
	Improper operation of magneto breaker.	Check points. Check internal timing of magnetos.
Failure of engine to idle properly.	Faulty ignition system.	Check entire ignition system.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 7401. TROUBLESHOOTING (MAGNETO) (cont.)

Trouble	Cause	Remedy
Low power and uneven running.	Defective spark plugs.	Clean and gap or replace spark plugs.
	Magneto breaker points not working properly.	Clean points. Check internal timing of magnetos.
	Defective ignition wire.	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.
Failure of engine to develop full power.	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.

ELECTRICAL POWER SUPPLY.

MAGNETOS.

INSPECTION OF MAGNETO.

— Note —

Comply with Bendix Service Bulletin No. 608 at first opportunity, but no later than next magneto overhaul. Install self-locking cam retaining screw (10-391213) and torque 21-25 inch-pounds. If self-locking screw is removed at any time, always replace with new self-locking screw and torque to the specified value.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

After the first 50 hour period and every 100 hours thereafter, the magneto ignition system should be checked. If engine operating troubles develop which appear to be caused by the ignition system, it is advisable to check the spark plugs and wiring first before working on the magneto. Should trouble appear definitely associated with the magneto, the most effective measure is to install a replacement magneto which is known to be in satisfactory condition and send the suspected unit to the overhaul shop for test and repair. Should this not be possible, a visual inspection of the following items may disclose the source of trouble.

1. Check the lead terminals for definite contact with spring contacts in outlets.
2. Remove the harness outlet cover from the magneto and inspect for the presence of moisture and carbon tracking due to moisture.
3. Check contact springs in distributor block for evidence of spark erosion.
4. Check height of contact springs (0.422 maximum from top of block tower to spring). (Refer to Figure 74-1.)
5. With the cover and harness separated from the magneto housing, check contact assemblies to see that cam follower is securely riveted to its spring.
6. Examine the contact points for excessive wear or burning. Figure 74-2 shows how the average contact point will look when surfaces are separated for inspection.

— CAUTION —

DO NOT OPEN POINT CONTACTS MORE THAN .0625 OF AN INCH FOR EXAMINATION OF CONTACT SURFACES EXCESSIVE SPREADING OF THE BREAKER POINTS WILL OVERSTRESS AND DAMAGE THE CONTACT SPRING.

Desired contact surfaces have a dull gray, sand-blasted (almost rough) or frosted appearance, over the area where electrical contact is made. This means that points are worn in and mated to each other, thereby providing the best possible electrical contact and highest efficiency of performance. Minor irregularities or roughness of point surfaces are not harmful. (Refer to Figure 74-2, center.) Neither are small pits or mounds, if not too pronounced. If there is a possibility of pit becoming deep enough to penetrate pad (refer to Figure 74-2, right), reject contact assembly.

— Note —

No attempt should be made to stone or dress contact points. Should contact assembly have bad points or show excessive wear, the complete contact assembly should be replaced.

7. Check condition of cam follower felts for proper lubrication. If oil has migrated from one follower felt to another, it may be necessary to remove the lubrication from one felt strip while oiling another. If felt is overlubricated, remove oil by using a clean, lintless cloth. If dry, apply one or two drops of Bendix Breaker Felt Lubricant 10-86527.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

236

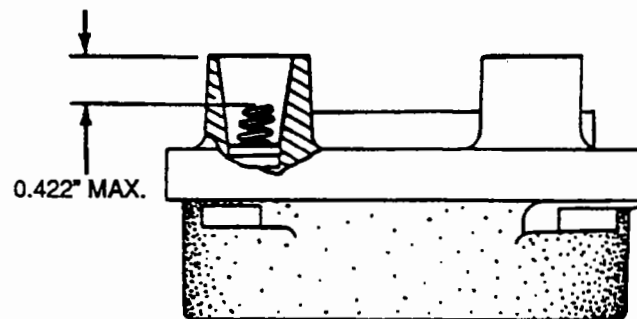
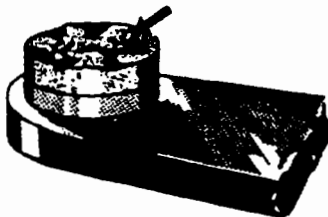


Figure 74-1. Height of Spring in Distributor Block Tower

236

WELL DEFINED MOUND
EXTENDING NOTICEABLY
ABOVE SURROUNDING
SURFACE, REJECT POINTS.



NORMAL POINT IS SMOOTH
AND FLAT. SURFACE HAS
DULL GRAY "SANDBLASTED"
APPEARANCE



MINOR IRREGULARITIES -
SMOOTH ROLLING HILLS
AND DALES WITHOUT ANY
DEEP PITS OR HIGH PEAKS.
THIS IS A NORMAL
CONDITION OF POINT WEAR.



Figure 74-2. Contact Points

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

8. Check the capacitors for looseness in the magneto cover of the harness assembly and for any physical damage. Using a Bendix 11-1767-1, -2 or -3 condenser tester or equivalent, check capacitors for capacitance, series resistance and leakage. Capacitance shall be 0.34 to 0.41 microfarads.
9. Check magneto to engine timing per instructions given in the following paragraph.
10. Check action of impulse coupling. With the ignition switch off, observe breaker cam end of rotor while manually cranking the engine through a firing sequence. The rotor should alternately stop and then (with an audible snap) be rotated rapidly through a retard firing position. If impulse action is not correct, remove the magneto for overhaul.

MAGNETO INSTALLATION AND TIMING PROCEDURE. (Timing Magneto to Engine)

1. Installation of the magneto to the engine may be accomplished without removal of the cover from the magneto. Also, the magneto cover has switch terminal outlets for the right and left sides of the magneto located in the center of the harness lead outlet sections of the cover.
2. The magneto incorporates a built-in pointer and a degree wheel with sufficient reference to assist the mechanic in magneto timing procedures. Printed upon the rotating magnet are marks to indicate magneto neutral and magneto "E" gap (8°). (Refer to Figure 74-5.) Also included are retard angle references of 15, 20 and 25 degrees. These marks are set up for either clockwise (R) or counterclockwise (L) rotation of the magneto as viewed from the magneto drive end. The timing tooth of the large distributor gear is marked with red paint. (Refer to Figure 74-6.)
3. When correctly timed internally, a magneto will have the timing teeth of the large distributor gears approximately centered in the timing windows, the R or L ("E" gap) mark on the rotor in alignment with the pointer and both main breaker points opening, all occurring simultaneously. These three references, "E" gap, painted teeth and point opening, are all used when timing the magneto to the engine.
4. Remove the spark plug from the No. 1 cylinder and turn the crankshaft in the direction of normal rotation until the compression stroke is reached.
5. Continue turning the crankshaft until the 23° advance timing mark is in alignment with the small hole located on the top face of the starter housing at the two o'clock position. (Refer to Figure 74-3.)
6. Install the magneto-to-engine gasket on the magneto flange.

— WARNING —

***DO NOT ATTACH HARNESS SPARK PLUG ENDS TO THE SPARK PLUGS
UNTIL AN MAGNETO TO ENGINE TIMING PROCEDURES AND
MAGNETO-TO-SWITCH CONNECTIONS ARE ENTIRELY COMPLETED***

— Note —

The use of a timing light, unit Part No. 11-9110 or 11-9110-1 will simplify the timing procedure. This unit is available from the Bendix Corporation, Sidney, New York 13838.

It is recommended that short adapter leads be fabricated to facilitate connecting the timing light unit to the switch outlet terminals of the cover. (Refer to Figure 74-4.)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

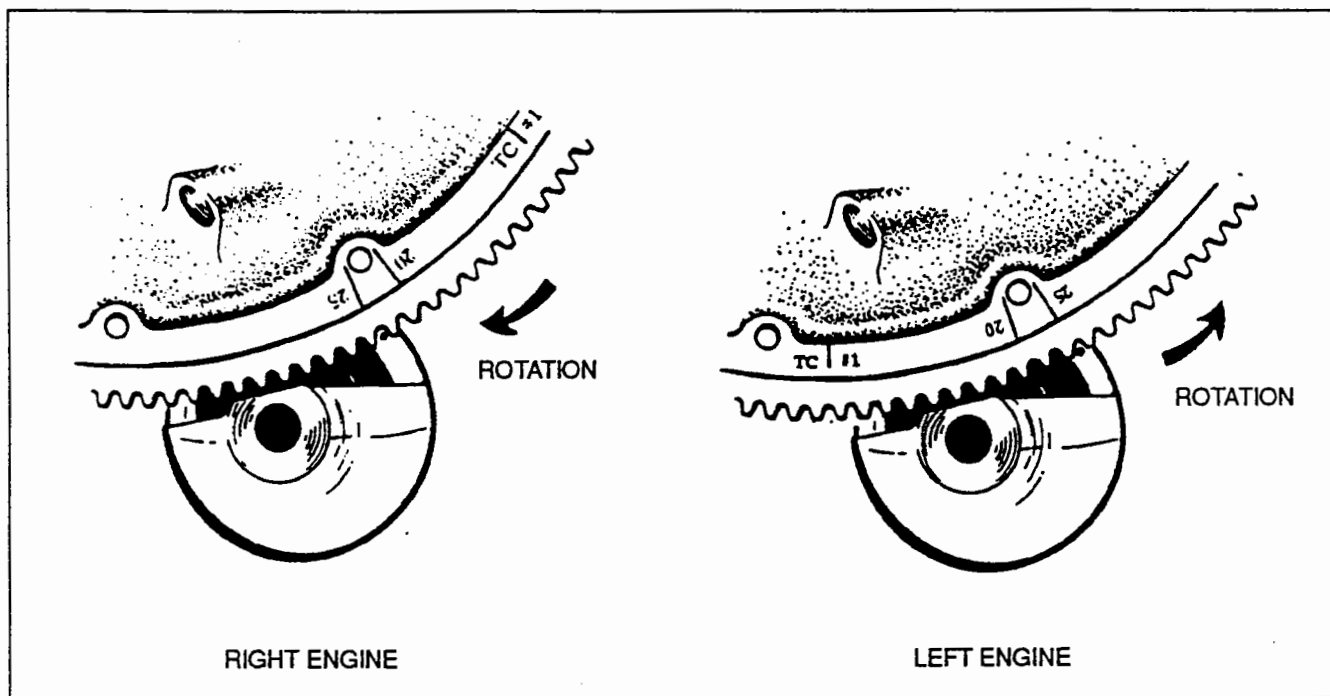


Figure 74-3. Engine Timing Marks

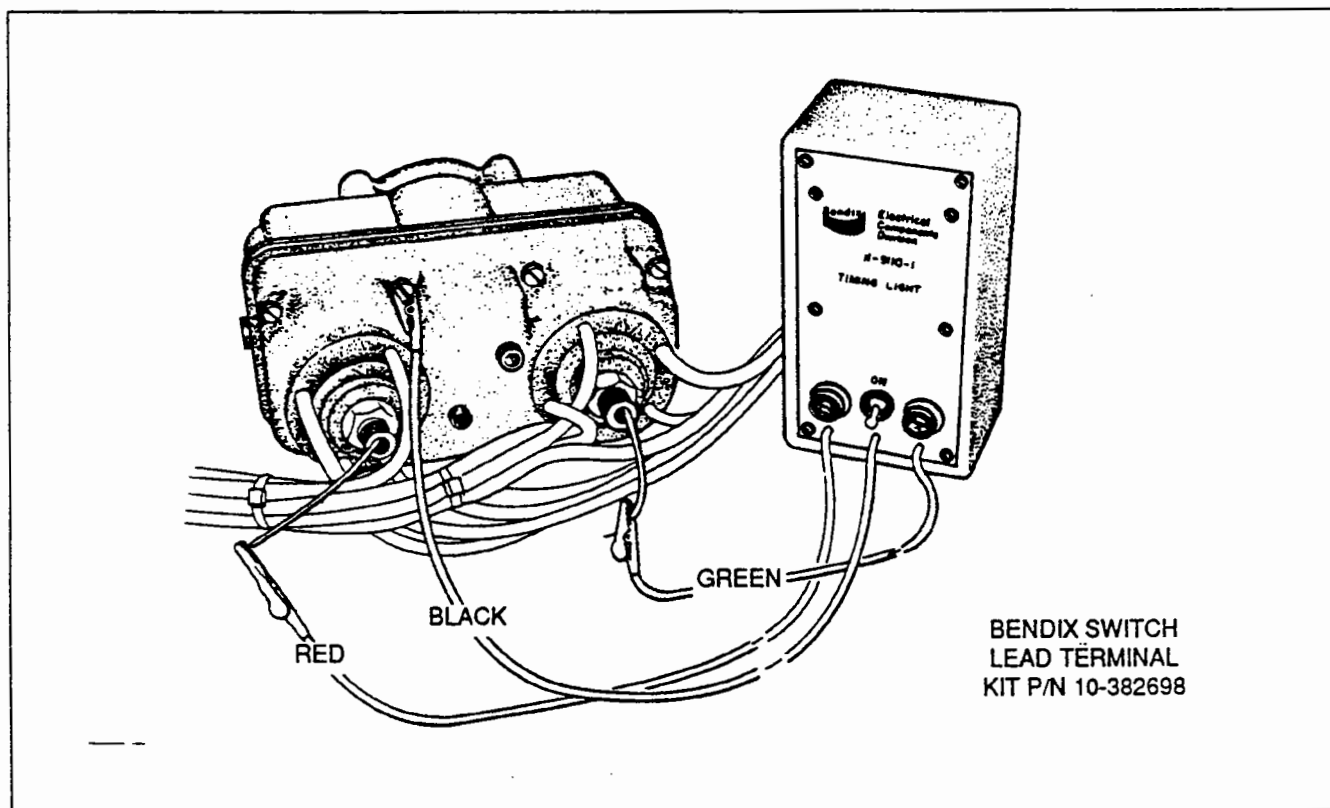


Figure 74-4. Timing Light Connected to Magneto

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

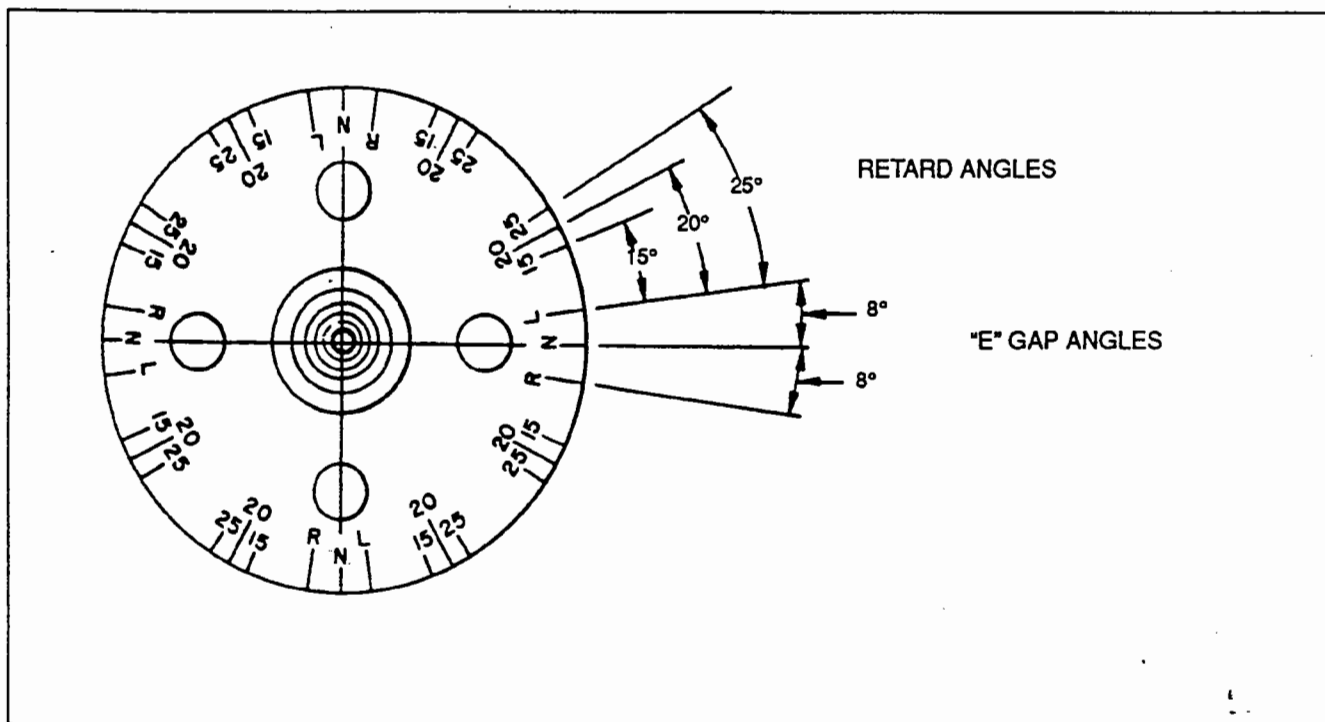


Figure 74-5. Timing Marks on Magneto Rotor

7. Remove the magneto drive gear backlash by turning the propeller opposite to normal rotation approximately 40° past the No. 1 firing position. Then turn the propeller in the direction of normal rotation up to the No. 1 firing position of 23° BTC.
8. Remove the timing window plug from the most convenient side of the magneto housing. Also, remove the plug from the rotor viewing window in the center of the housing.
9. Turn the rotating magnet drive shaft in the normal direction of magneto rotation until the red distributor tooth is centered in the timing hole. Also, check to ensure that the built-in pointer just ahead of the rotor viewing window aligns with the R or L mark on the rotor depending on whether the magneto is for right or left-hand rotation as specified by the magneto data plate.
10. While holding the magneto in its No. 1 firing position (tooth in window center and pointer over R or L mark on rotor), install the magneto to the engine and loosely clamp in position.

— Note —

Engine should be in No. 1 cylinder firing position of 23° BTDC.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

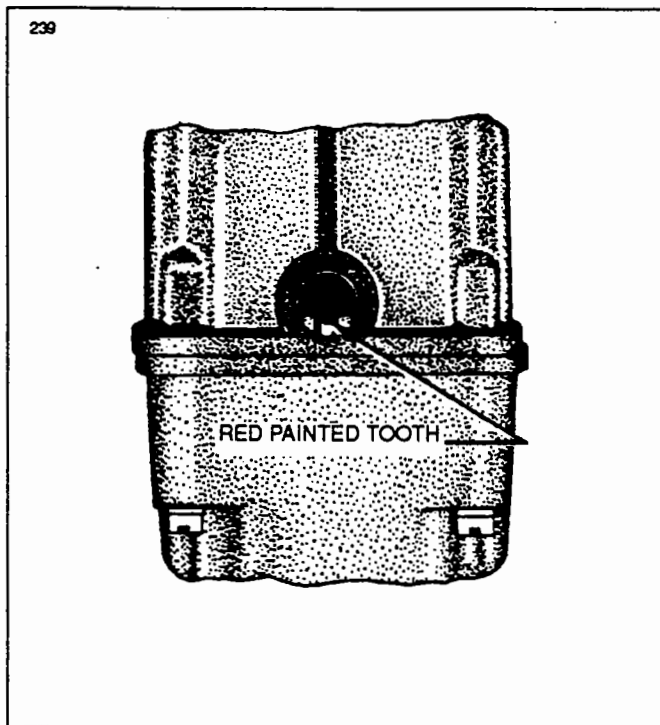


Figure 74-6. Painted Tooth Centered in Timing Window

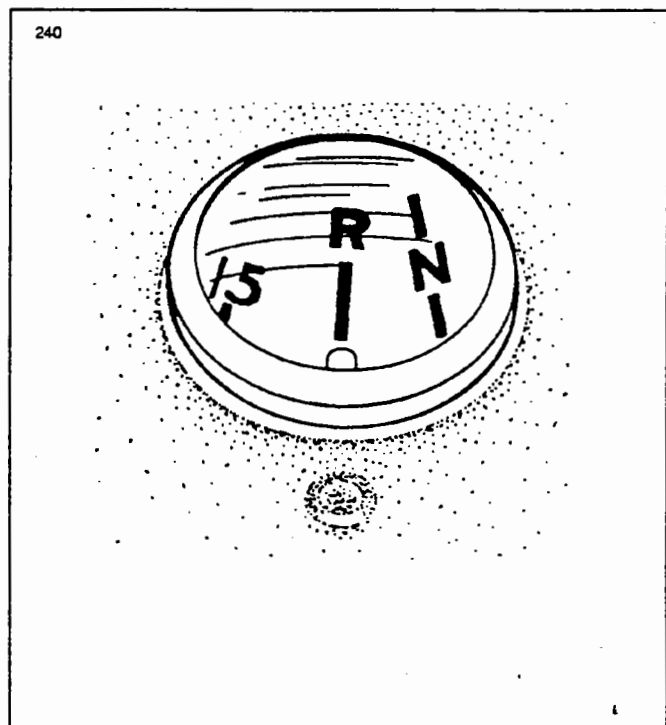


Figure 74-7. Timing Mark on Rotor Aligned with Pointer

11. Attach red lead from the 11-9110 timing light to the left switch adapter lead, the green timing light lead to the right switch adapter lead and the black timing light lead to the magneto housing. (Refer to Figure 744.)

— Note —

An internal timing tolerance is allowed when adjusting the two main breakers. Therefore, one of the main breakers may open slightly before the other. Magneto-to-engine timing should be accomplished using the first main breaker to open as a reference point when the engine is in the firing position for the No.1 cylinder. This will insure that ignition created by either spark plug will not occur prior to the desired engine firing point.

12. If both timing lights are ON (indicating breaker contacts are closed) proceed to Step 13. If either or both are OFF proceed as follows:
 - A. Turn the entire magneto to the right until both timing lights are ON.
 - B. Ensure that the red painted distributor gear tooth is still visible in the timing hole.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

13. Rotate the entire magneto in the direction of rotor rotation until one of the timing lights just goes OFF. Then, evenly tighten the magneto mounting clamps.
14. Back the engine up approximately 10° and then carefully "bump" the engine forward while observing the timing lights.
15. At the No. 1 cylinder firing position the same timing light mentioned in Step 13 should go OFF. Continue turning the engine in its normal direction of rotation until the other timing light goes OFF. This should not be more than 3 engine degrees later than the first light.
16. Repeat Steps 12 13 and 14 until the condition described in Step 15 is obtained.
17. Complete tightening of the magneto securing clamps by torquing to 150 inch-pounds.
18. Recheck timing once more and if satisfactory, disconnect the timing light and remove the adapter leads.
19. Reinstall plugs in timing inspection holes and torque to 12-15 inch-pounds.
20. Loosely install the harness with clamps and/or brackets.

MAGNETO TIMING PROCEDURE. (Internal Timing)

— Note —

On aircraft equipped with counter-rotating engines, the engines utilize counter-rotating magnetos as well. Refer to the data plate on the magneto to determine magneto rotation. As explained earlier, the "L" mark refers to left-hand or counterclockwise rotation, and the "R" mark refers to right-hand or clockwise rotation as viewed from the shaft end.

1. Remove magneto cover.
2. Loosen flange clamps and remove magneto from engine.
3. Check condition of points: replace if necessary.
4. Rotate the magneto drive shaft until a main cam lobe touches the follower of the left main breaker assembly and adjust the breaker points to an initial opening of .016 inch. Wire feeler gauge is recommended.
5. Adjust right main breaker contact assembly to an initial point opening of .016 inch just as in Step 4.
6. Fixed contact support may be bent to adjust clearance. If support is bent, main breaker contact must be rechecked. Torque breaker securing screws to 20-25 inch-pounds.

— Note —

Bend bracket carefully. Do not correct by bending back y bent too much; this weakens the bracket.

7. Position rotor so keyway is at 12 o'clock position and red painted distributor teeth are visible in timing windows.
8. Loosen drive shaft nut and position the Rotor Holding Tool(Bendix P/N 11-8465)under washer or bushing on drive end of rotor shaft with clamp at 4 o'clock position so any shaft deflection caused by clamping action will be in a plane parallel to breaker contacts. Tighten nut to secure holding tool to shaft. Check to insure proper location of keyway and tighten adjusting screw of holding tool to lock rotor in position.
9. Loosen rotor holding tool and turn magnet in direction of rotation until adjacent "R" or "L" ("E" gap) mark is aligned with pointer and lock in position. Both red painted teeth should be approximately centered in timing windows.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

— Note —

The use of the timing light unit, P/N 11-9110-1 available from Bendix will simplify the internal timing procedure and breaker synchronization.

10. Connect the timing light black lead to any unpainted surface of the magneto.
11. Connect the red timing light lead to the left breaker terminal and the green lead to the right main breaker terminal. (Refer to Figure 74-8.)
12. Loosen rotor holding tool and move the rotor back a few degrees; then move it forward. Both lights should go out to indicate opening of the main breakers when the timing pointer is indicating within the width of the "R" or "L" mark and the red painted teeth are centered in timing windows.
13. If breaker timing is not correct, loosen cam securing screw (refer to Figure 74-9) and unseat main breaker cam from taper. Using 11-3031 Retaining Ring Pliers inserted in holes in cam, rotate main breaker cam in direction of rotation until left main breaker points just open and press cam onto taper. Tighten screw to seat main breaker cam.
14. Loosen rotor holding tool to turn rotating magnet back a few degrees; then turn rotating magnet in normal direction of rotation. Timing light should go out when timing pointer is aligned with "R" or "L" ("E" gap) mark. Lock rotating magnet in position where points just open.
15. Loosen right main breaker securing screws and position breaker so cam follower is pressed against cam with points closed. Tighten contact assembly securing screws to prevent contact assembly from bouncing back when moved. Using a small mallet and drift, tap right breaker in until points just open.
16. Turn rotating magnet back a few degrees; then turn rotating magnet in normal direction of rotation. Both timing lights should go out within one degree or half the width of "R" or "L" mark on rotor. If breakers are not properly synchronized, reset right breaker.
17. Check right main breaker contact for $0.016 + .004$ inch point opening and torque right breaker contact securing screws to 20-25 inch-pounds. If point opening is out of limits, repeat timing procedure setting left main breaker opening at $.016 + .002$ inch. If right contacts open beyond $.020$ inch, set left contacts closer to $.018$ inch. If right contacts open less than $.012$ inch, set left contacts closer to $.014$ inch.
18. Using timing light, recheck timing to insure main breakers open within one-half the width of "R" or "L" mark and that retard breaker opens at correct degree setting. Using a wire feeler gauge, check left main breaker for $.016 + .002$ inch point opening and right main breaker and retard breaker for $.016 \pm .004$ inch point opening.

— Note —

If correct breaker timing cannot be achieved, refer to Bendix Service Bulletin No. 605 or remove magneto and have it overhauled.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

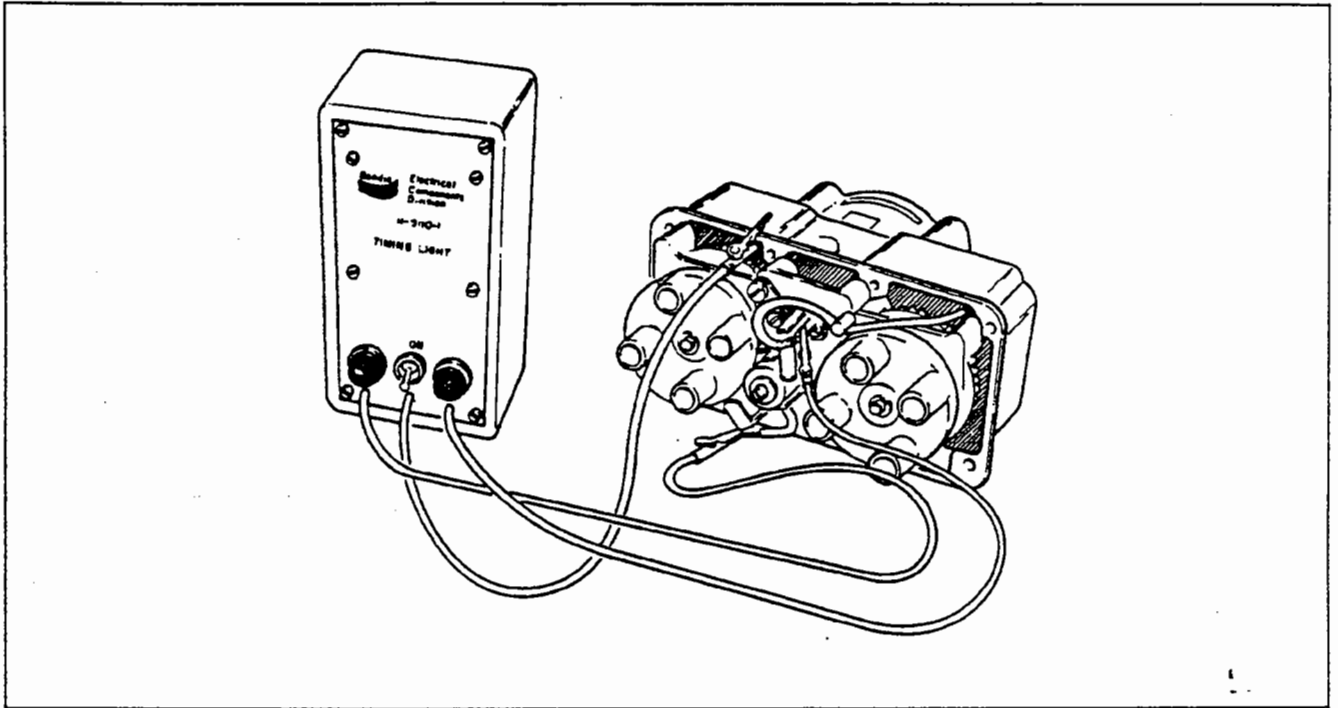
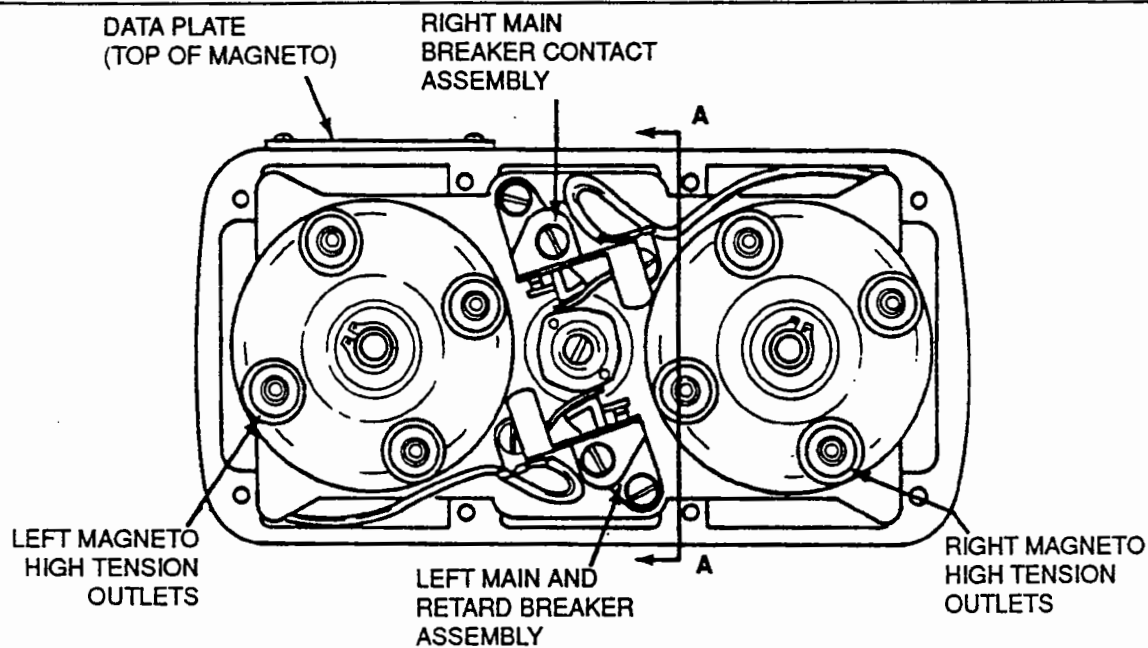


Figure 74-8. Timing Light Connected to Magneto and Breakers

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

A561



1. RIGHT MAIN CONTACT ASSEMBLY
2. LEFT MAIN CONTACT ASSEMBLY
3. RETARD BREAKER
4. SCREW
5. LOCK WASHER
6. FLAT WASHER
7. RETARD CAM
8. MAIN CAM

VIEW A - A

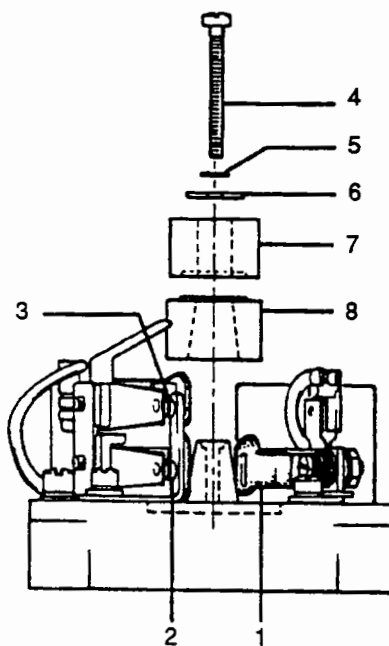


Figure 74-9. Cam End View of Magneto

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

19. Check capacitors for looseness in the magneto cover of the harness assembly and for any physical damage. The capacitors should be checked for capacitance, series resistance and leakage. Capacitance should be 0.34 to 0.41 microfarads. The use of a Bendix condenser tester, part number 11-1767 -1, -2 or -3 or equivalent will simplify this test. Replace defective capacitors and torque securing nut to 60-70 inch-pounds.

— Note —

Spring in capacitor outlet may cause an indication of a short to ground if adapter lead is not used. (Refer to Figure 744.)

IMPULSE COUPLING REMOVAL.

1. Using heavy gloves or shop cloth, grasp the coupling body firmly to prevent the internal spring from unwinding suddenly. Pull outward on the coupling body only enough to release it from the cam assembly. Keep the coupling body close against the cam and allow the body to turn as the spring unwinds. After one or two turns, the spring coils will wedge against the projections on the body, restraining the spring from further unwinding.
2. Look into the hole in body and note the location of the inner eye of spring where it engages with mating recess in cam hub. Insert a screwdriver under spring end and pry spring eye out of recess. Remove the body and spring together. Uncoil spring from body and pry spring eye from body recess to disengage spring.
3. Thread protective cap of 11-702-1 puller securely on end of shaft. Engage puller over protective cap and cam assembly with wide jaws of puller hooked under cam assembly as shown in Figure 74-10.
4. Tighten puller handle to remove coupling from shaft. If coupling does not release with maximum hand torque at puller handle, apply penetrating thread release compound between coupling and shaft. Then while puller is still fully tightened, hold tip of hot heavy duty soldering iron in contact with hub of coupling cam assembly. Solder wetting of the tip at point of contact with the cam hub will assist in heat transfer to the parts. Retighten puller after about a minute of heat application.

— CAUTION —

DO NOT STRIKE THE PULLER WITH A HAMMER. IF PULLER IS STRUCK WITH A HAMMER THE MAIN BEARINGS MUST BE REPLACED.

5. Do not tighten puller handle further after coupling cam releases from the shaft. This could damage the flyweight if the flyweight is caught under the woodruff key. Remove the puller from the shaft. Then while holding both flyweight tips inward, lift cam from the shaft, and remove woodruff key from rotor shaft.

INSPECTION OF IMPULSE COUPLING.

1. Check clearance between each flyweight and each stop pin by the following method:
 - A. Bend the end of a stiff piece of wire into a right angle, 1/8 inch long maximum.
 - B. Hold the magneto as shown in Figure 7411. Pull the heel of the flyweight outward with the fabricated hooked wire and make certain that a feeler gauge of 0.015 of an inch minimum thickness will pass between the stop pin and the highest point of the flyweight.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

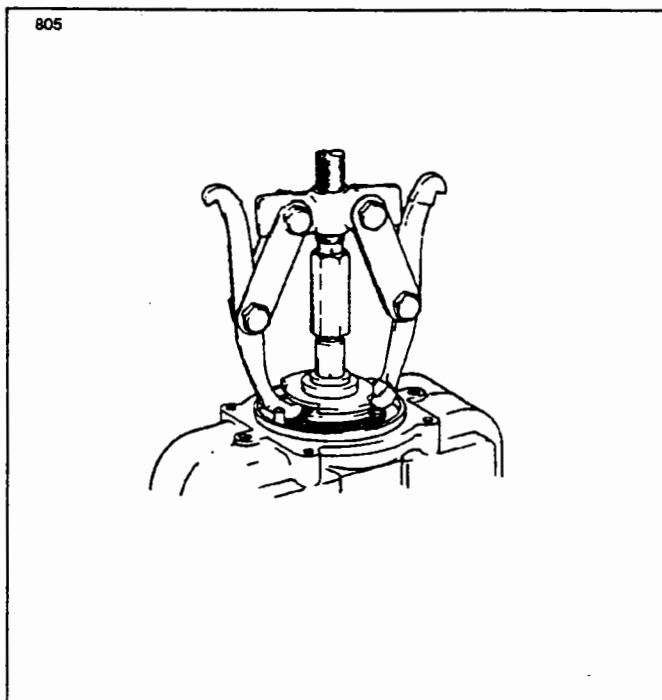


Figure 74-10. Removing Impulse Coupling

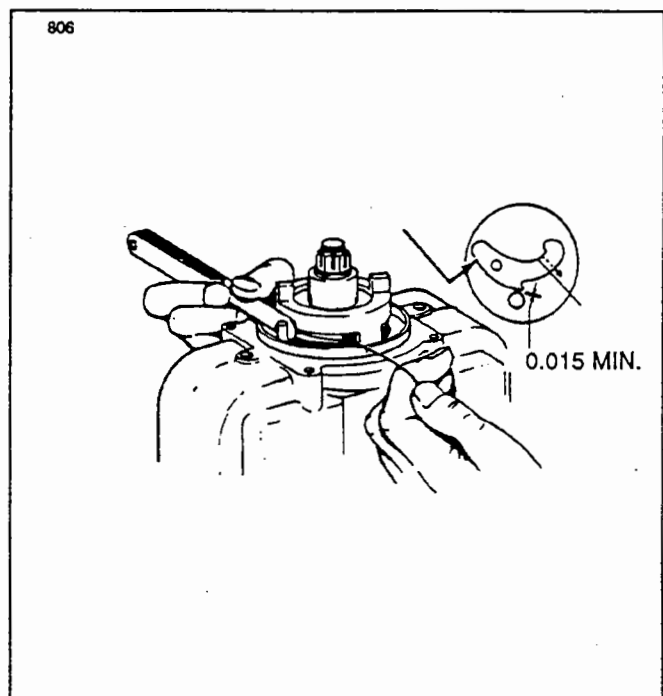


Figure 74-11. Checking Flyweight to
Stop Pin Clearance

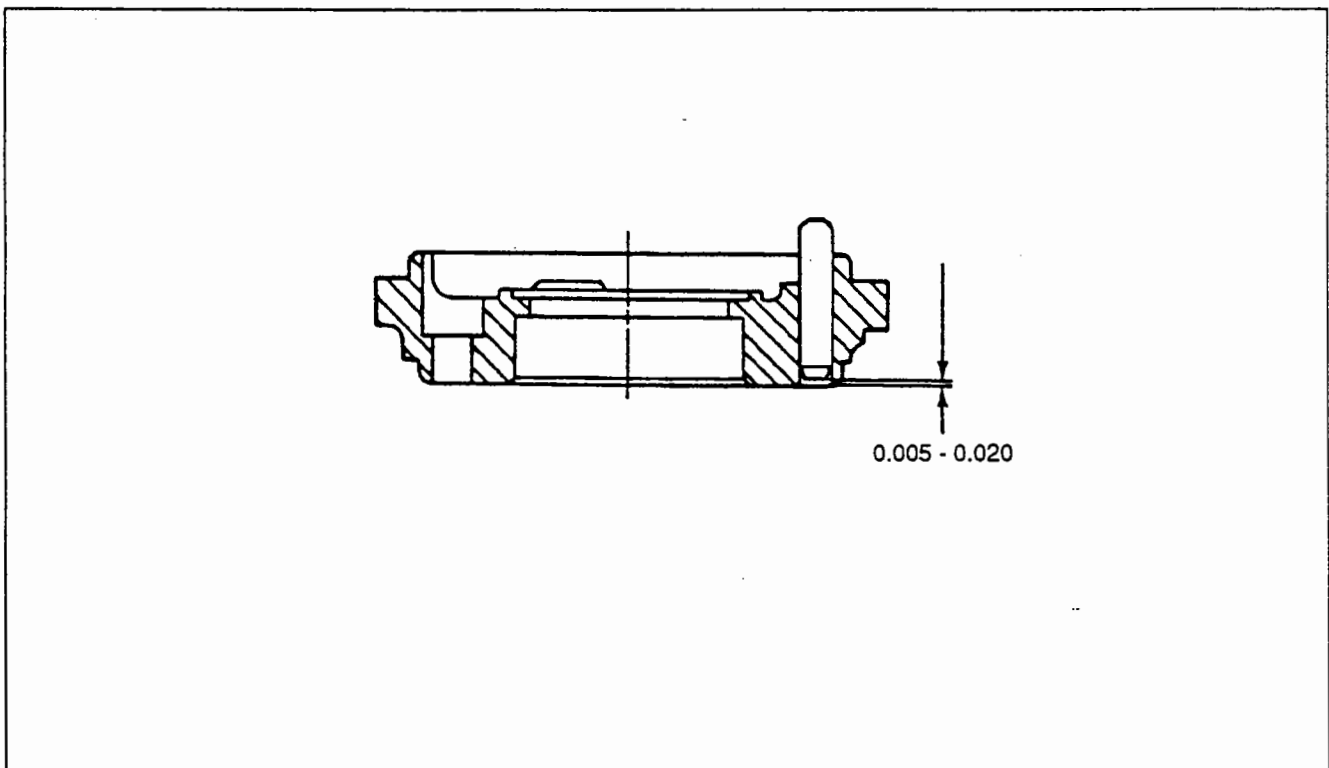


Figure 74-12. Stop Pin Installation Dimension

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

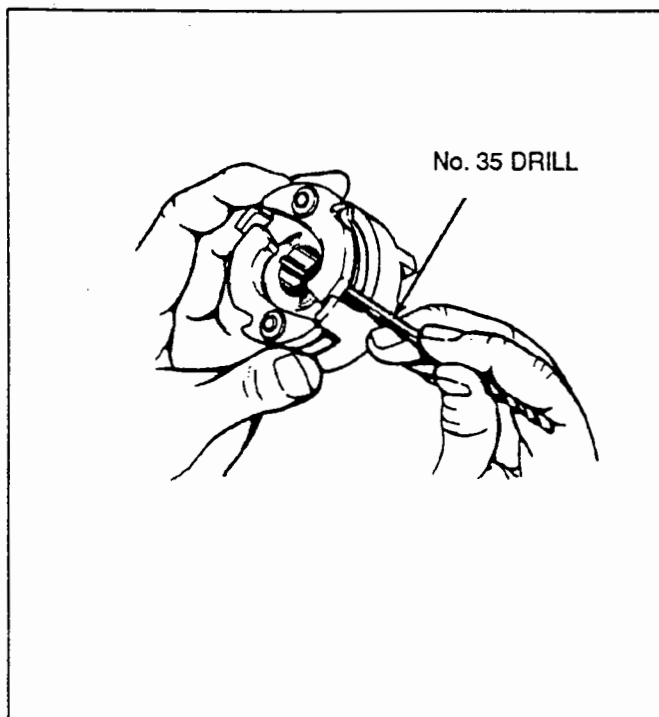


Figure 74-13. Checking Flyweight Axial Wear with Drill Shank

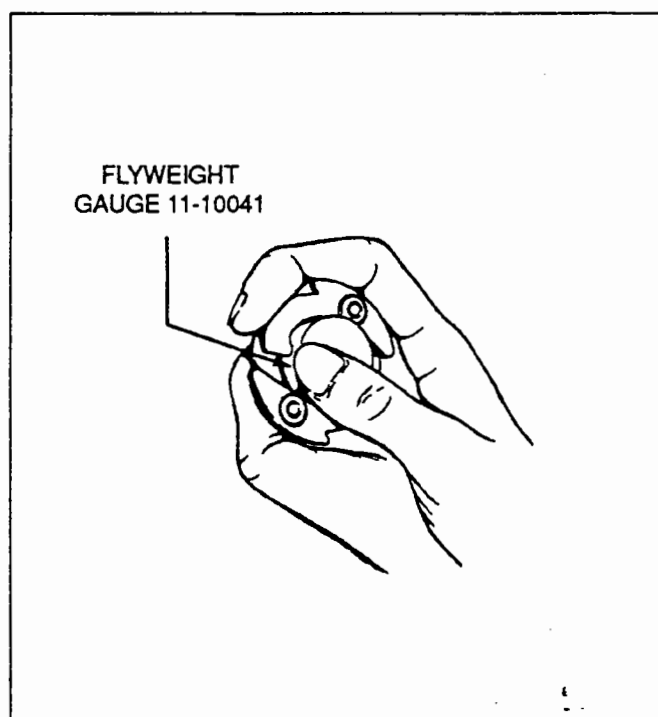


Figure 74-14. Checking Flyweight Radial Wear with Gauge

— NOTE —

A true and accurate check of the clearance between the flyweights and stop pins can only be obtained by pulling the flyweight outward as described. Do not attempt the check by pushing in on the flyweight at point "A" of Figure 74-11.

2. Inspect impulse coupling stop pins for damage. If pins are bent, damaged or excessively worn, remove pins using a suitable drift and arbor press. Press new pins into flange until dimension shown in Figure 74-12 is obtained.
3. Visually inspect flyweight securing washers and flyweights, particularly in area around the axle hole for cracks. Grip washers with pliers and exert moderate turning force to check looseness. If washer moves or any cracks are found, reject cam assembly.
4. Inspect for axial wear between flyweight and axle using shank of a new No. 35 drill as a gauge. Hold flyweight so the outer radius is in alignment with the rim of the cam flange and try to insert the drill shank between the flange and flyweight as shown in Figure 74-14. Do not force the drill. If the drill can be inserted, replace the cam assembly.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

823

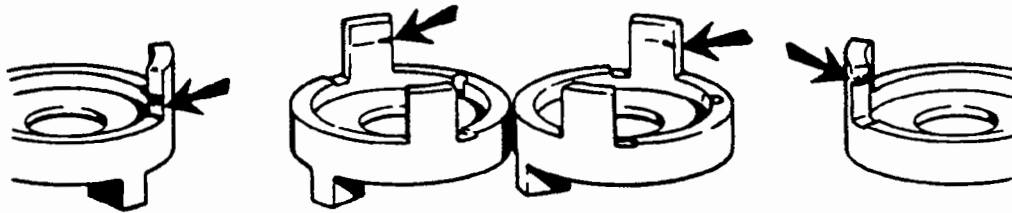


Figure 74-15. Points of Coupling Body Wear

803

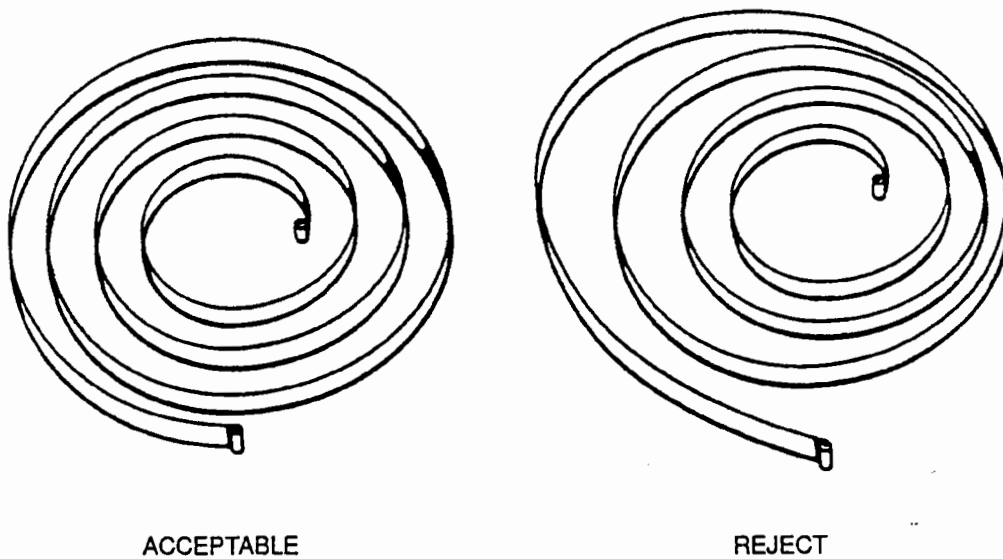


Figure 74-16. Acceptable and Deformed Coupling Springs

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

5. Inspect for excess radial wear between the flyweight and axle using the 11-10041 flyweight gauge. Insert the gauge between flyweights and against cam hub as shown in Figure 7414. If the gauge cannot be inserted easily, remove burr from edges of hub keyway with a small file. Hold the gauge firmly against the hub, at the same time squeezing the flyweights against the gauge. If the inner end of either flyweight heel touches the gauge, replace the cam assembly. If parts are near limits, check clearance between flyweight and gauge with a .003 inch feeler. If flyweight heel is tight on feeler, replace the cam assembly.

— CAUTION —

**NEVER ATTEMPT TO REPAIR ANY PART OF A REJECTED CAM AND
FLYWEIGHT ASSEMBLY.**

6. Inspect ears of the coupling body for grooves worn by the tail of the flyweights and wear at the triggering ramp and cam stop contact areas. (Refer to Figure 7415.) If either ear shows a perceptible groove or a ridge can be felt when fingernail is drawn across the surface, replace the coupling body.
7. Inspect drive lugs of body. If wear is noted, measure difference between worn and unworn areas on drive lug surface. If difference is in excess of .015 of an inch, replace the body.
8. With spring released and free, it should form a smooth spiral curve with no sharp bends or flat spots. (Refer to Figure 7416.) If spring is deformed, replace it.
9. Inspect spring for cracks particularly at the ends and around spring eyes. Inspect coils of spring for excessive wear. If grooves or ridges are worn in coils or cracks are found, replace spring.
10. Inspect the housing for cracks, stripped threads or other damage. Replace if necessary.

IMPULSE COUPLING INSTALLATION.

1. Check mating cam assembly and body for magnetization which would prevent flyweights from engaging. Hold the assembly as shown in Figure 7417 and push upper flyweight against body. When released, flyweight must drop down. If flyweight sticks to body, parts are magnetized and coupling may not function. Perform test on both flyweights.
2. To demagnetize, place body over shaft of a charged rotating magnet and spin body rapidly by hand. While body is still spinning, invert magnet so body falls off. Catch body in hand and repeat test for magnetization.
3. Clamp one drive lug of the body in a padded jaw vise with the spring recess side up.
4. Orient the spring with the body for correct rotation. On clockwise couplings, the spring must coil in a clockwise direction from the outside toward the center when viewed from the spring recess side of the body. (Refer to Figure 7418.) Insert eye of outer end of spring into hole drilled in inner rim of body.
5. Using heavy gloves to protect the hands, wind spring into body manually, lifting spring coils one at a time over projections on body. Extreme care should be used to avoid scratching or nicking the spring. After winding the spring, brush a coating of light oil over the spring coils.
6. Pry up one and one-half turns at the inner end of the spring with a small screwdriver and support in position as shown in Figure 7419.
7. Engage recess in the hub on the cam assembly with eye at inner end of spring. With eye engaged, rotate cam assembly slightly in direction to unwind spring to permit hub of cam to slip into the inner turn of the spring. Rotate the cam in the opposite direction, winding spring slightly, until projections on edge of cam clear over the projections on the body. Push the cam assembly down into the body, at the same time taking the screwdriver out.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

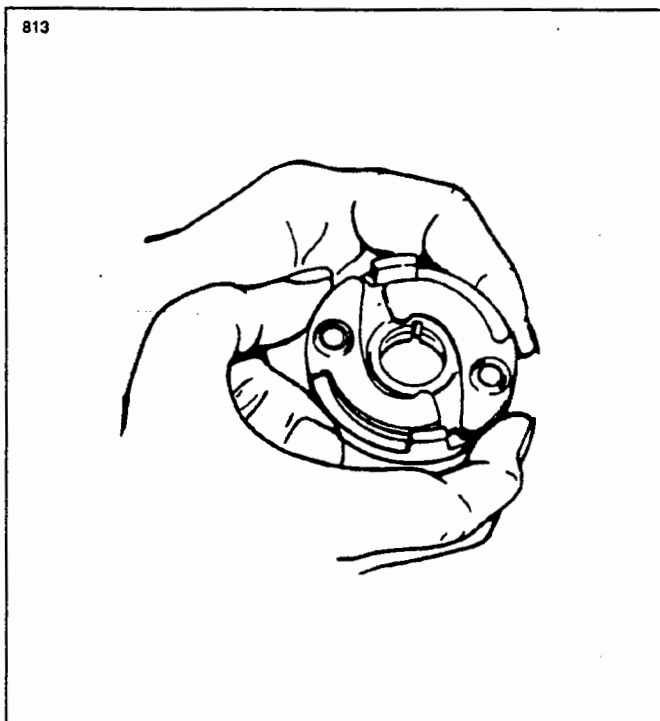


Figure 74-17. Checking Impulse Coupling
for Magnetization

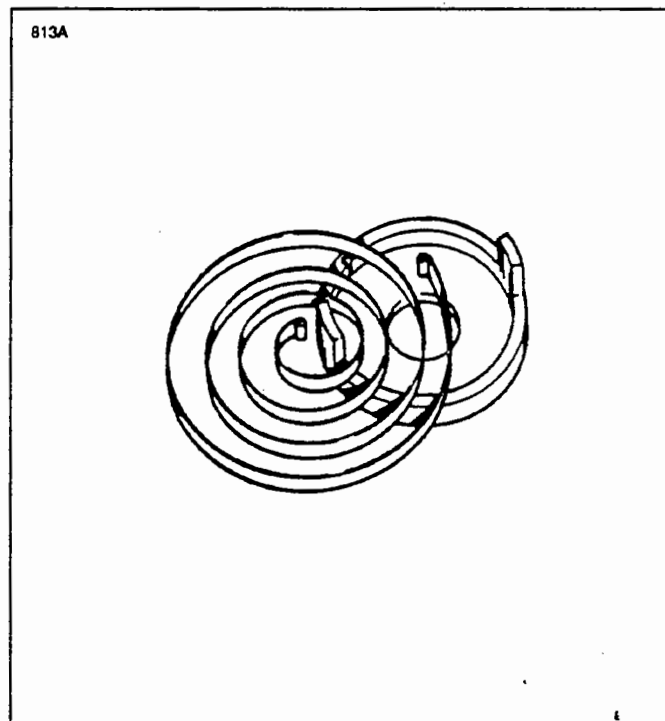


Figure 74-18. Orientation of Spring
in Coupling Body

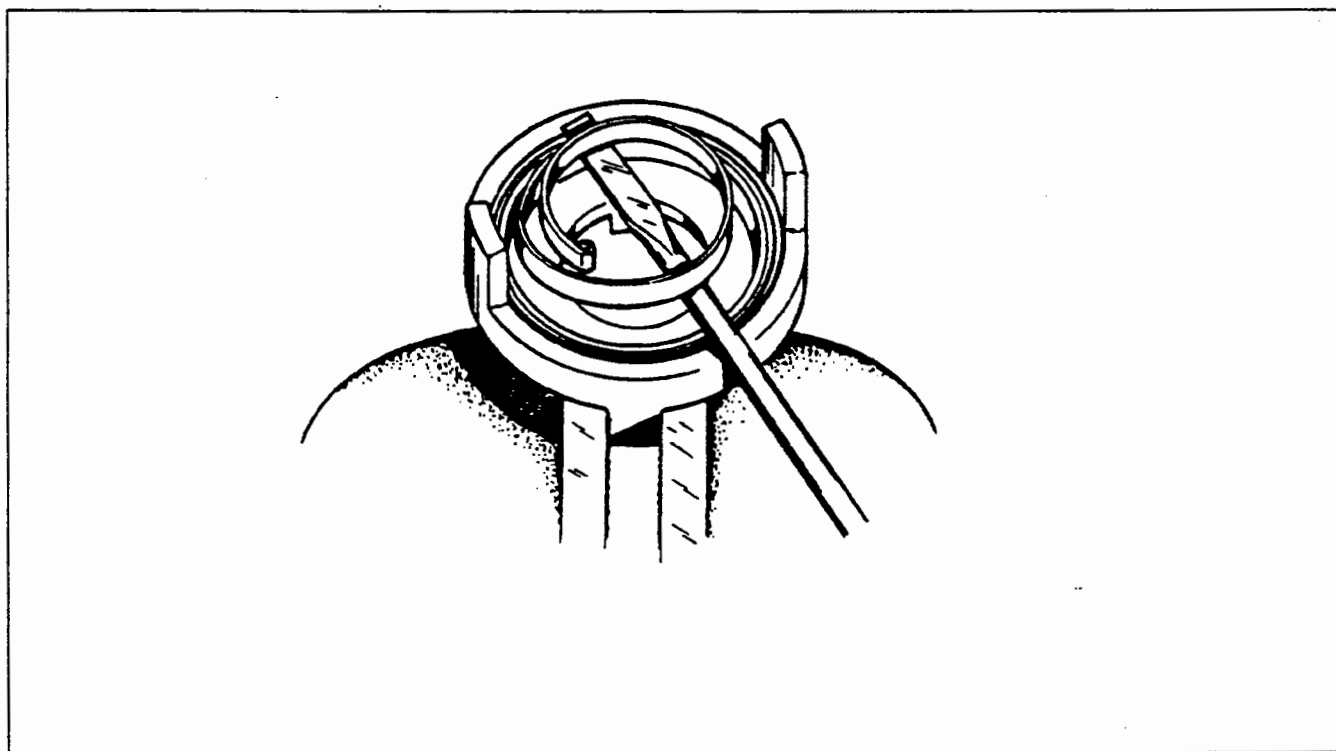


Figure 74-19. Lifting Inner End of Spring

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

8. Insert a spare rotating magnet, with woodruff key in taper, into cam assembly. Turn magnet slightly in direction of coupling rotation (to wind spring). Lift magnet with cam only enough to clear projections on the body. Wind spring one-half turn and re-engage the cam assembly into the body.
9. Tension of the spring assembly in the assembled coupling when wound to point of impulse tripping must not be less than 9 or more than 15 inch-pounds.

DISTRIBUTION.

IGNITION HARNESS.

INSPECTION OF HARNESS.

1. Inspect cover for cracks or other damage. Inspect lead assemblies for abrasions, mutilated braid or other physical damage.
2. Inspect grommets for tears and eyelets for spark erosion.
3. Disconnect harness coupling nuts from the spark plugs and extract the lead terminations. Inspect contact springs and compression springs for any damage or distortion. Inspect sleeves for cracks or carbon tracking.
4. Inspect coupling nuts and elbow assemblies for damaged threads or other defects.

— Note —

Replace any damaged components per instructions given in paragraph titled
Maintenance of Harness.

5. Test continuity of each harness lead using a High Tension Lead Tester, Part No. 11-8888 or 11-8888-1 from Bendix as follows:
 - A. Connect black test lead to contact spring and red lead to eyelet of the same lead. (Refer to Figure 74-20.)
 - B. Observe that the continuity lamp illuminates.
6. Test insulation resistance of each harness lead by using the 11-8888 or 11-8888-1 tester as follows:
 - A. Attach the red high voltage test lead to contact spring of harness lead. (Refer to Figure 74-21.)
 - B. Attach the black test lead to the ferrule of the same harness lead. (Refer to Figure 74-21.)
 - C. Depress PRESS-TO-TEST pushbutton switch.
 - D. Observe that indicator lamp flashes and GAP fires simultaneously as long as the PRESS-TO-TEST switch is held depressed. Whenever indicator lamp flashes and GAP fails to fire, lead under test is defective and must be replaced.

MAINTENANCE OF HARNESS.

Minor repairs of the harness assembly, such as replacement of contact springs, sleeves, compression springs, eyelets, or grommets can be accomplished with the harness mounted on the engine. Lead assemblies may also be replaced with harness mounted on the engine unless inaccessibility of installation or number of leads to be replaced makes it unreasonable.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

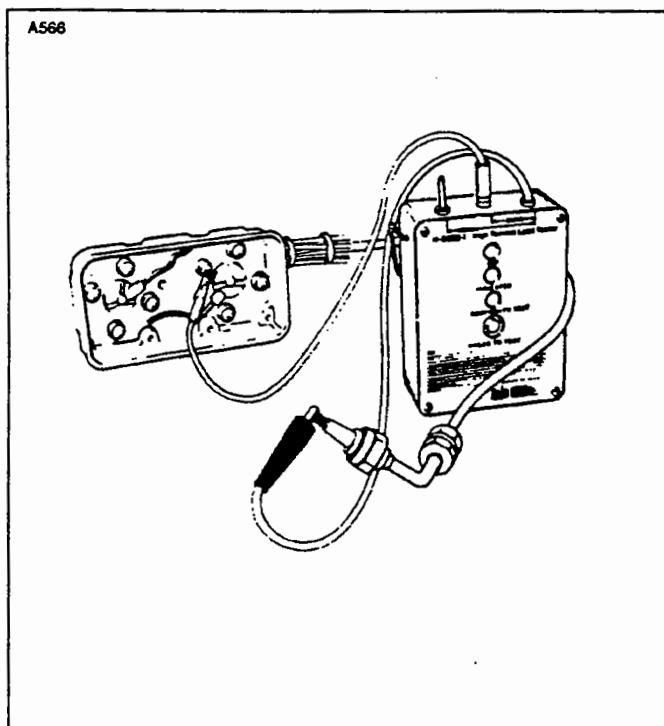


Figure 74-20. Checking Harness Lead Continuity

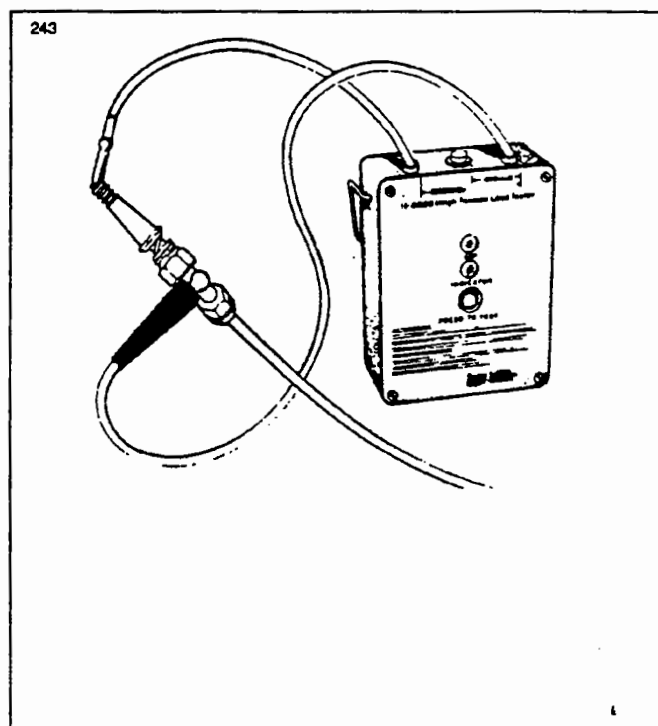


Figure 74-21. Checking Harness Lead Insulation Resistance

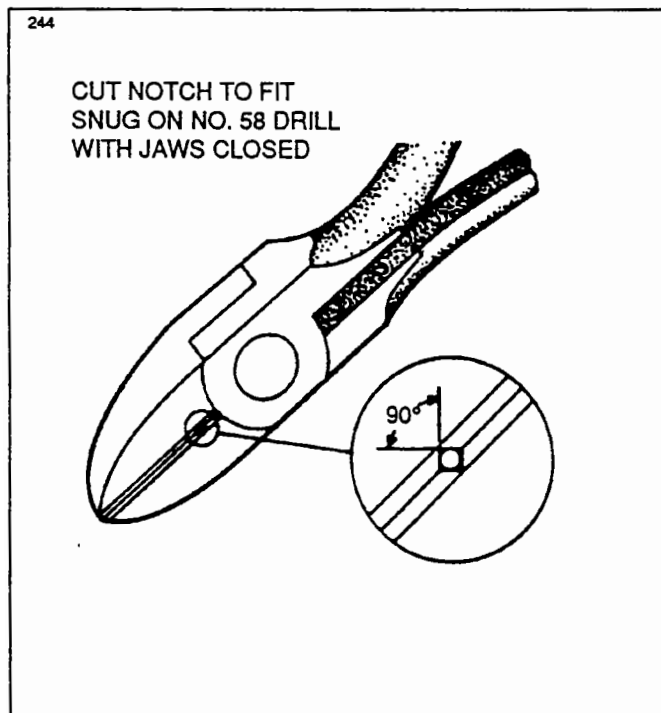


Figure 74-22. Modified Pliers

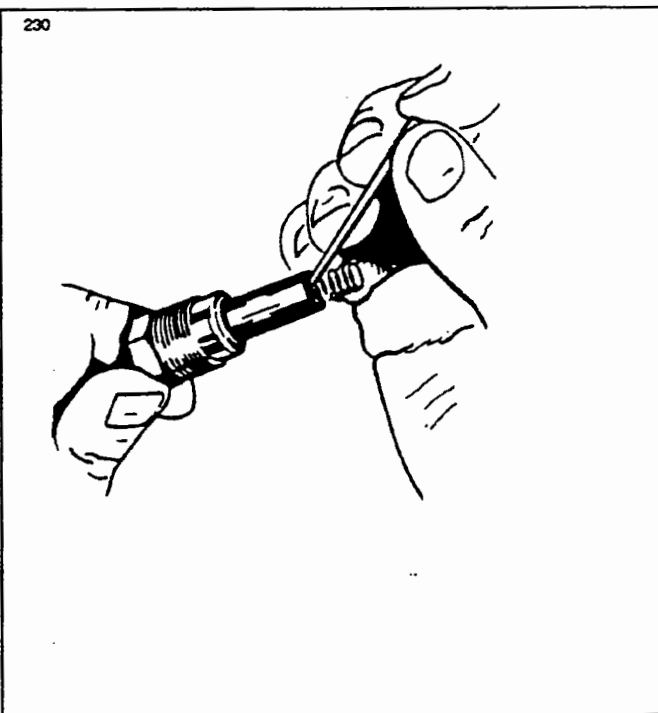


Figure 74-23. Removing Spring From Lead Assembly

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

To replace grommets or eyelets, pull the conductor through the shielding sufficiently to make eyelet accessible. Remove the eyelet being careful not to damage conductor wire. Replace grommet and eyelet using the "AB" groove of Crimping Tool No. 11-152 or a pair of diagonal pliers modified as shown in Figure 7422. Work the wire back into the shielding so the grommet fits properly against the ferrules in the plate. Slack in shielding or wire can be removed by grasping the lead in one hand and sliding the other hand firmly along the lead towards the magneto cover.

To replace contact springs, insulating sleeves, compression spring or elbows, proceed as follows:

1. Using a Bendix 11-7073 needle or a mechanical pencil with the lead retracted, hook the end of the contact spring as shown in Figure 7423.
2. Using the needle or pencil, unscrew the spring.
3. Slide insulating sleeve and spring retainer assembly off end of lead assembly.
4. Replace defective component and reassemble as follows:
 - A. Fabricate a tool as shown in Figure 7424 for installing the insulating sleeves over cable terminals.
 - B. Slide elbow assembly over lead and attach nut finger tight to ferrule.
 - C. Push the fabricated tool through insulating sleeve and spring retainer assembly as shown in Figure 7425. Screw the cable terminal into the tool.
 - D. Work insulating sleeve and spring retainer assembly into position over the cable and unscrew the tool. Install contact spring on cable terminal.

— Note —

It may be necessary to lubricate the cable and insulating sleeve with a thin film of DC-200 (200,000 centistokes) or commercial grade alcohol to facilitate assembly.

5. To replace one of the lead assemblies, proceed as follows:
 - A. Remove clamps and brackets from defective lead assembly. Cut cable ties from assembly and discard.
 - B. Cut the eyelet from the lead and remove grommet.
 - C. Grip the ferrule of the lead with a pair of vise grip or water pump pliers and with a twist-pull action remove the ferrule from the cover and discard ferrule. Pull lead from cover.
 - D. Thread pre-stripped end of replacement lead through cover.

— Note —

Replacement leads are available from Bendix in lengths of 17 thru 74 inches in 3 inch increments. Use nearest next longer length to replace defective lead.

- E. Scrape blue coating being careful not to cut braid for .50 of an inch from end of lead.

— CAUTION —

**NEW FERRULES MUST BE USED AND INSERTED UNDER THE BRAID
EXACTLY AS STATED IN STEP F.**

- F. Push back braid and thread a new ferrule over wire and under braid until braid just covers knurling. (Refer to Figure 7426.)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

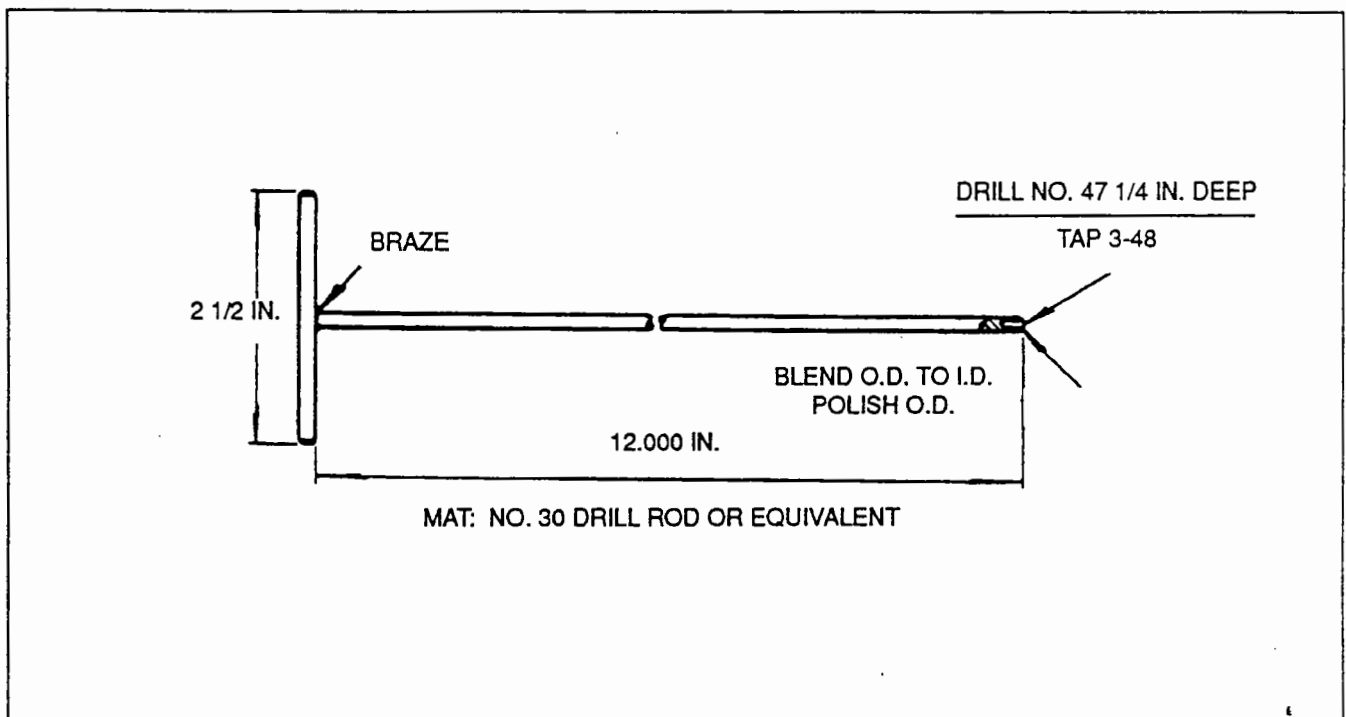


Figure 74-24. Assembly Tool

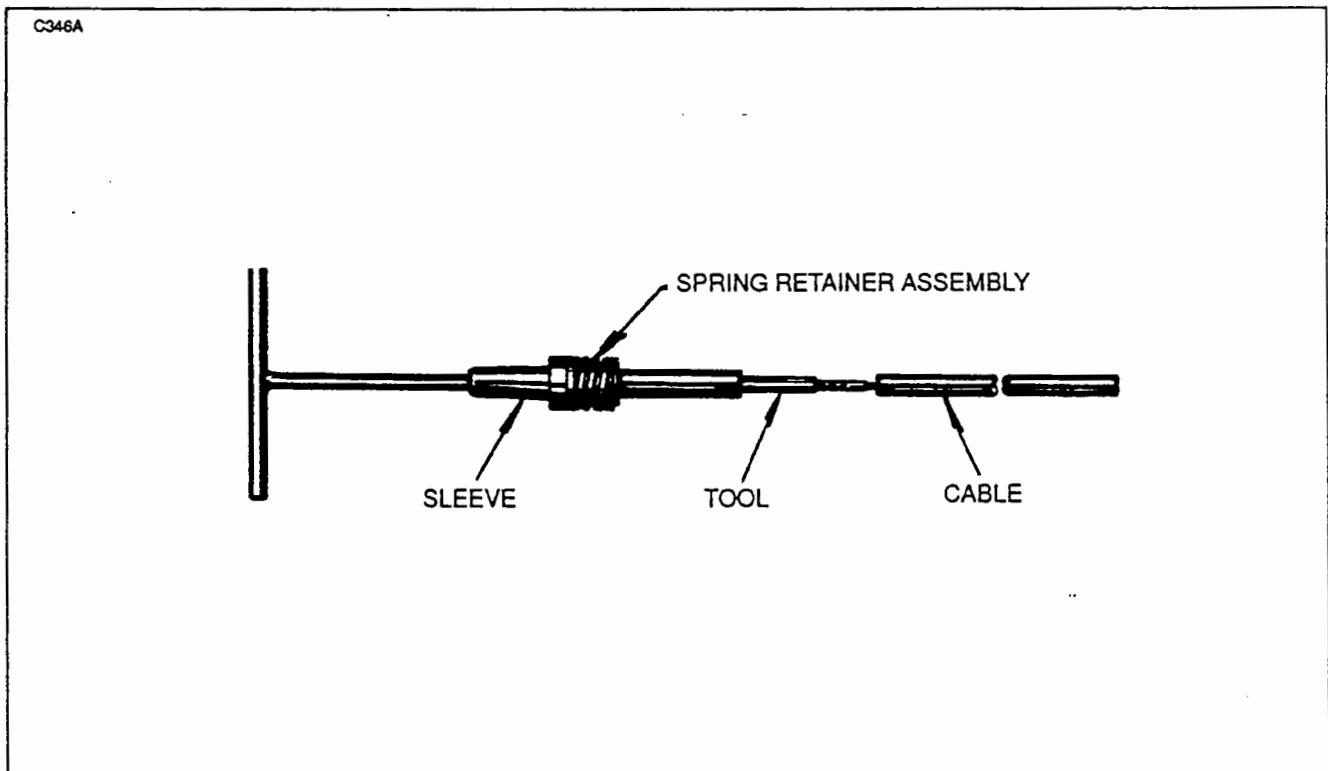


Figure 74-25. Using Assembly Tool

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

C473

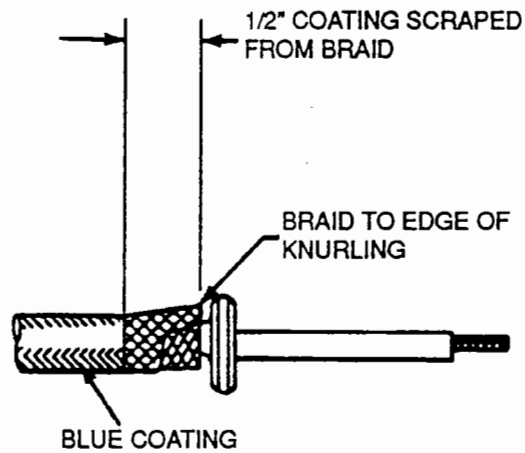


Figure 74-26. Ferrule Positioned Under Braid

C347

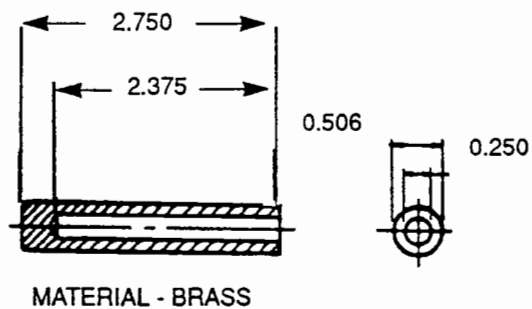


Figure 74-27. Ferrule Seating Tool

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

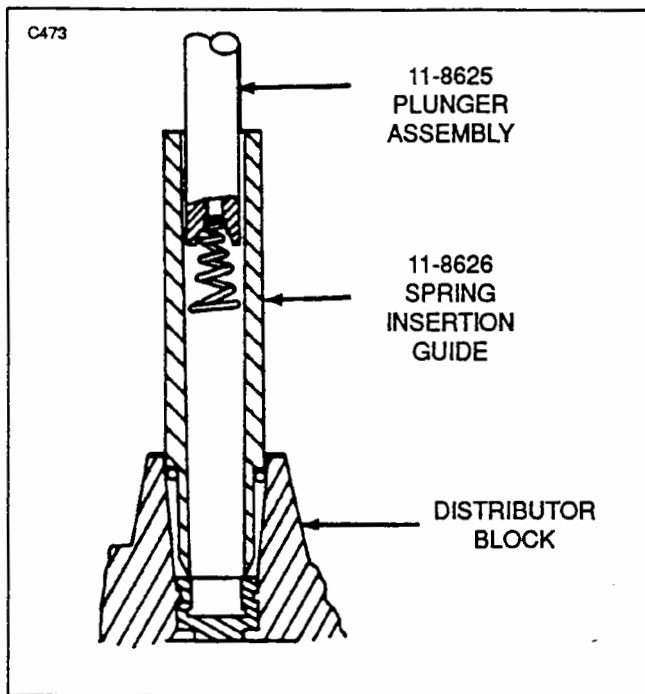


Figure 74-28. Position of 11-8627 Kit and Contact Spring at Start of Installation

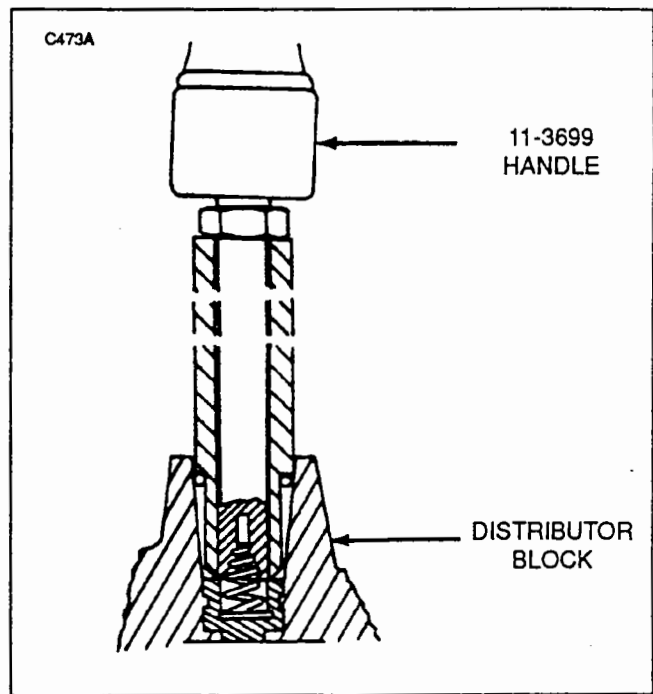


Figure 74-29. Position of 11-8627 Kit and Contact Spring after Installation

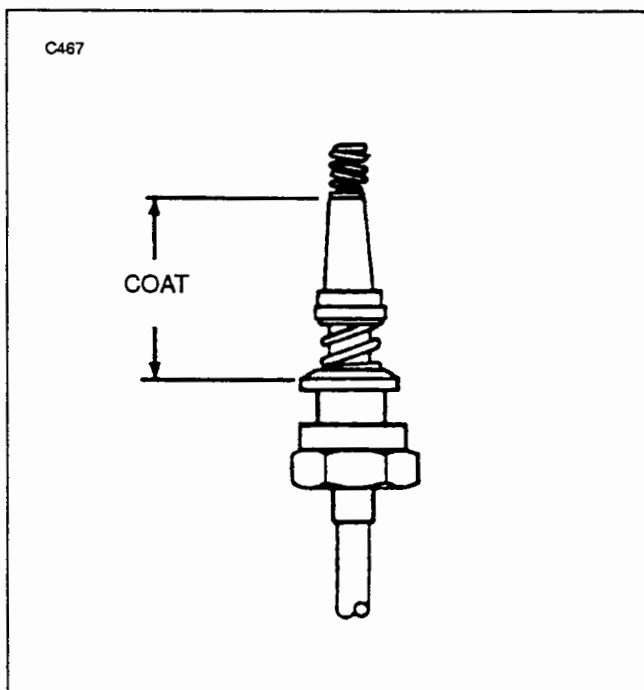


Figure 74-30. Lubricating Sleeve

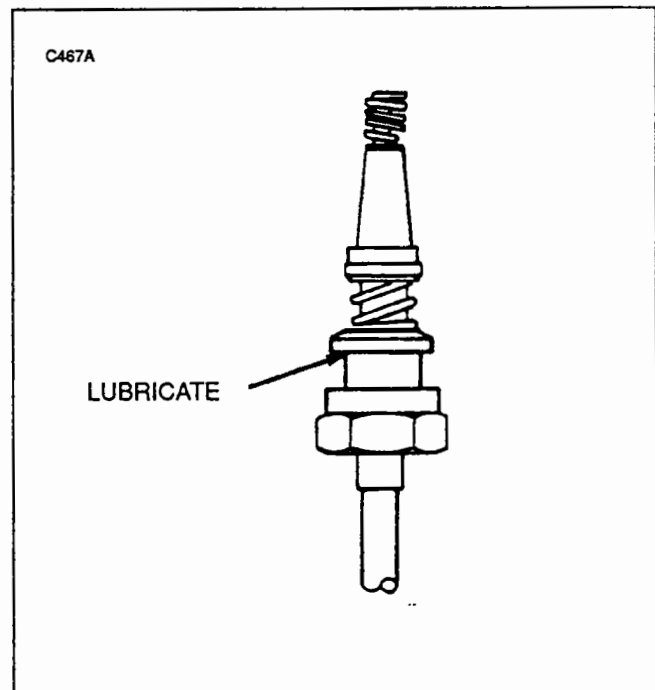


Figure 74-31. Lubricating Ferrule Shoulder

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

- G. Pull the lead back into the cover to wedge the braid between the tapers of the cover and ferrule.
 - H. Provide a back up support for the cover and seat the ferrule using the 11-7074 Ferrule Seating Tool (refer to Figure 74-27) and a mallet. Ferrule must be driven straight into the cover and fully seated.
 - I. Thread the pre-stripped end of conductor through grommet. Place a new eyelet on conductor and Crimp per instructions given in second paragraph of Maintenance of Harness.
- 6. When lead being replaced is of the elbow type, salvage the used elbow and compression springs for installation on replacement lead. Install these and new sleeve and contact spring (refer to Figures 74-28 and 74-29) furnished with replacement lead per instructions given in Steps I thru 4.
 - 7. Reposition clamps and brackets and replace cable ties removed earlier. Clean the grommets, sleeves and the inside of the cover with methylethylketone or denatured alcohol.
 - 8. Spray grommets and sleeves with Fluorocarbon Spray, such as MS 122, supplied by Miller-Stephenson Chemical Co. Inc., 16 Sugar Hollow Road, Danbury, Connecticut 06810, or equivalent.
 - 9. Prior to seating spark plug lead terminal in plug barrel use fluorocarbon spray on spark plug terminal insulating sleeve (refer to Figure 74-30) to prevent heat from sticking sleeve to spark plug barrel. Lightly lubricate the shoulder of ferrule to minimize twisting of ferrule. (Refer to Figure 74-31 .) Use GO-JO NO LOK manufactured by GO-JO Inc., Akron, Ohio 44309.
 - 10. Check cam securing screw. Screw must be torqued to 16-20 inch-pounds.
 - 11. With all high tension terminal grommets seated against the ferrules in the cover, attach the bottom capacitor lead to the right main breaker and then the top capacitor lead to the left main breaker. Position the cover on the magneto and secure. Torque cover screws to 30-35 inch-pounds.
 - 12. Carefully route the high tension spark plug leads away from any hot spots such as manifolds and sharp edges which might cause heat damage or chafing. Check leads for proper location in clamps so when clamps are tightened the leads will not be crushed. Leads should be taut to prevent chafing due to vibration, but not so taut as to produce undue strain on leads.
 - 13. After all leads have been properly routed and secured to the engine, recheck all clamp securing screws for tightness. Fasten coupling nuts to proper spark plugs and torque as specified in Chart 7402. Do not allow ferrules to turn while torqueing nuts.

CHART 7402. COUPLING TORQUES

Spark Plug Coupling Threads	Torque (lb.-in.)
5/8-24	90 - 95
3/4-20	110 - 120

SPARK PLUGS.

REMOVAL OF SPARK PLUGS.

- 1. Loosen the coupling nut on the harness lead and remove the terminal insulator from the spark plug barrel well.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

234

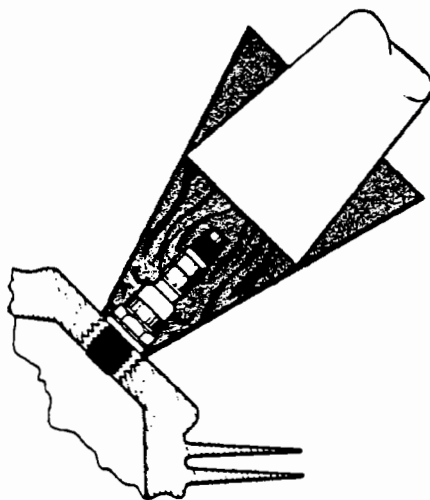


Figure 74-32. Removing Spark Plug Frozen to Bushing

— Note —

When withdrawing the ignition cable lead connection from the plug, care must be taken to pull the lead straight out and in line with the center line of the plug barrel; otherwise a side load will be applied, which frequently results in damage to the barrel insulator and connector. If the lead cannot be removed easily in this manner, the resisting contact between the neoprene collar and the barrel insulator will be broken by a rotary twisting of the collar. Avoid undue distortion of the collar and possible side loading of the barrel insulator.

2. Remove the spark plug from the engine. In the course of engine operation, carbon and other combustion products will be deposited on the end of the spark plug and will penetrate the lower threads to some degree. As a result, greater torque is frequently required for removing a plug than for its installation. Accordingly, the torque limitations given do not apply to plug removal and sufficient torque must be used to unscrew the plug. The higher torque in removal is not as detrimental as in installation, since it cannot stretch the threaded section. It does, however, impose a shearing load on this section and may, if sufficiently severe, produce a failure in this location.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

— Note —

Torque indicating handle should not be used for spark plug removal because of the greater torque requirement.

3. Place spark plugs in a tray that will identify their position in the engine as soon as they are removed.

— Note —

Spark plugs should not be used if they have been dropped.

4. Removal of seized spark plugs in the cylinder may be accomplished by application of liquid carbon dioxide by a conical metal funnel adapter with a hole in the apex just large enough to accommodate the funnel of a CO₂ bottle. (Refer to Figure 74-32.) When a seized spark plug cannot be removed by normal means, the funnel adapter is placed over and around the spark plug. Place the funnel of the CO₂ bottle inside the funnel adapter and release the carbon dioxide to chill and contract the spark plug. Break the spark plug loose with a wrench. A warm cylinder head at the time the carbon dioxide is applied will aid in the removal of an excessively seized plug.
5. Do not allow foreign objects to enter the spark plug hole.

INSPECTION AND CLEANING OF SPARK PLUGS.

1. Visually inspect each spark plug for the following non-repairable defects: A. Severely damaged shell or shield threads nicked up, stripped or cross-threaded. B. Badly battered or rounded shell hexagons. C. Out-of-round or damaged shielding barrel. D. Chipped, cracked or broken ceramic insulator portions. E. Badly eroded electrodes worn to approximately 50% of original size.
2. Clean the spark plug as required, removing carbon and foreign deposits.
3. Test the spark plug both electrically and for resistance.
4. Set the electrode gap at 0.015 to 0.018 inches.

INSTALLATION OF SPARK PLUGS.

Before installing spark plugs, ascertain that the threads within the cylinder are clean and not damaged.

1. Apply anti-seize compound sparingly on the threads and install gasket and spark plugs. Torque 360 to 420 inch-pounds.

— CAUTION —

**MAKE CERTAIN THE DEEP SOCKET IS PROPERLY SEATED ON THE
SPARK PLUG HEXAGON AS DAMAGE TO THE PLUG COULD RESULT IF
THE WRENCH IS COCKED TO ONE SIDE WHEN PRESSURE IS APPLIED**

2. Carefully insert the terminal insulator in the spark plug and tighten the coupling nut.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

SWITCHING.

MAGNETO AND STARTER SWITCHES. (Refer to Figure 74-33.)

The magneto switches and the starter switch are located on a switch panel positioned to the left of the instrument panel.

REMOVAL AND INSTALLATION OF MAGNETO SWITCHES. (Refer to Chapter 30 for removal and installation procedures.)

REMOVAL AND INSTALLATION OF STARTER SWITCH. (Refer to Chapter 39 for removal and installation procedures.)

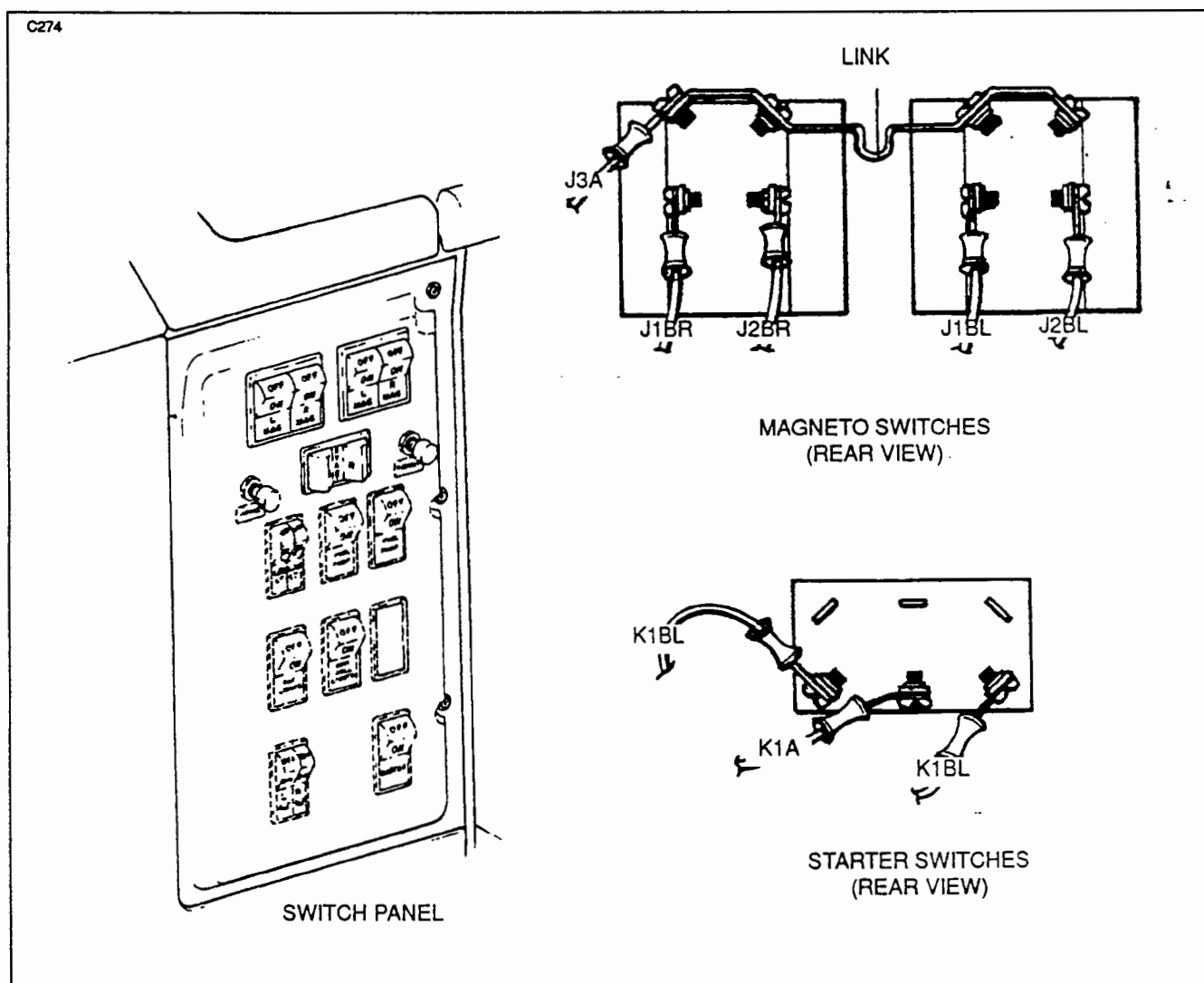


Figure 74-33. Magneto and Starter Switches

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3G22 THROUGH 3G24
INTENTIONALLY LEFT BLANK**

CHAPTER

77

ENGINE INDICATING

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 77 - ENGINE INDICATING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
77-00-00	GENERAL	3H3	
77-01-00	Cluster Mounted Instruments	3H5	A 8 - 82
77-01-01	Removal and Replacement of Cluster Mounted Instruments	3H5	
77-01-01	Removal and Replacement of Cluster Mounted Instruments (PA-44-180 S/N 44-95001 and up)	3H5	
77-10-00	POWER	3H5	
77-11-00	Manifold Pressure Gauge	3H5	
77-11-01	Troubleshooting Manifold Pressure Gauge	3H6	
77-11-02	Removal and Replacement of Manifold Pressure Gauge	3H6	8 - 82
77-12-00	Tachometer Indicator (PA-44-180)	3H6	
77-12-01	Troubleshooting Tachometer	3H7	
77-12-02	Removal and Replacement of Tachometer Indicator	3H7	
77-13-00	Electric Tachometer Installation (PA-44-180T)	3H8	A 8 - 82
77-13-01	Removal and Installation of Tach Indicator	3H8	A 8 - 82
77-13-02	Removal and Installation of EMI Filter	3H8	A 8 - 82
77-13-03	Removal and Installation of Magnetic Pickup	3H8	A 8 - 82
77-20-00	TEMPERATURE	3H11	A 8 - 82
77-21-00	Cylinder Head Temperature Gauge	3H11	
77-21-01	Troubleshooting Cylinder Head Temperature Gauge	3H11	
77-21-02	Removal and Replacement	3H11	
77-21-03	Cylinder Head Temperature Gauge Calibration (PA-44-180 S/N 44-95001 and up)	3H12	
77-30-00	ANALYZERS	3H13	
77-31-00	Exhaust Gas Temperature Gauge	3H13	8 - 80
77-31-01	Cleaning and Inspection	3H13	
77-31-02	Troubleshooting Exhaust Gas Temperature Gauge	3H14	
77-31-03	Removal and Replacement of Gauge	3H14	
77-32-00	Exhaust Gas Temperature Probe	3H14	A 8 - 82
77-32-01	Removal of EGT Probe (PA-44-180)	3H14	8 - 80
77-32-02	Installation of EGT Probe (PA-44-180)	3H14	8 - 80
77-32-03	Removal of EGT Probe (PA-44-180T)	3H15	A 8 - 80
77-32-04	Installation of EGT Probe (PA-44-180T)	3H15	A 8 - 80

77 - Cont. /Effec.

Page - 1

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

GENERAL.

The power plant instrumentation is designed to give an accurate and quick indication of the power conditions at which the engines are operating. Line routing for the instruments may be seen in Figure 77-1.

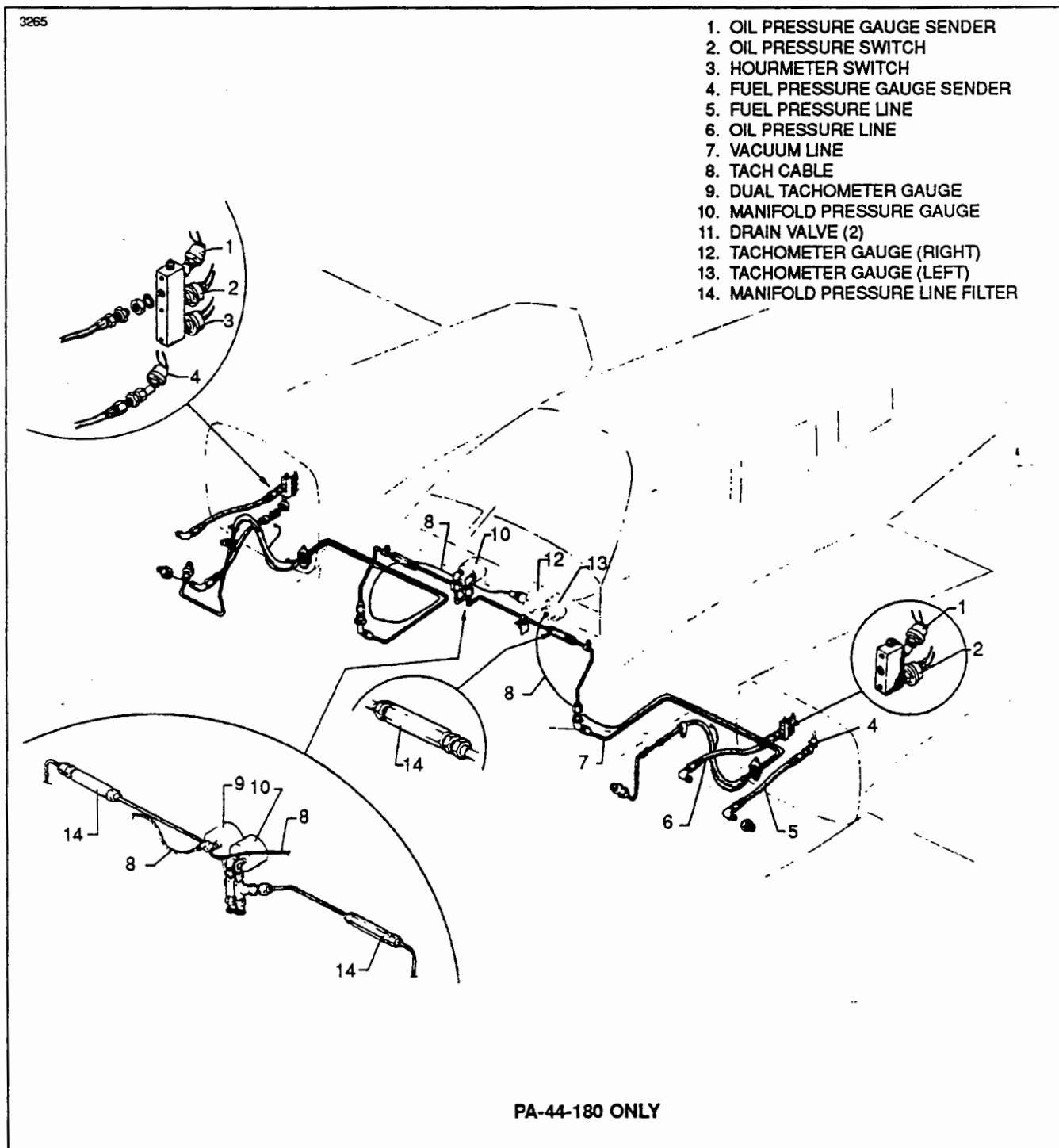
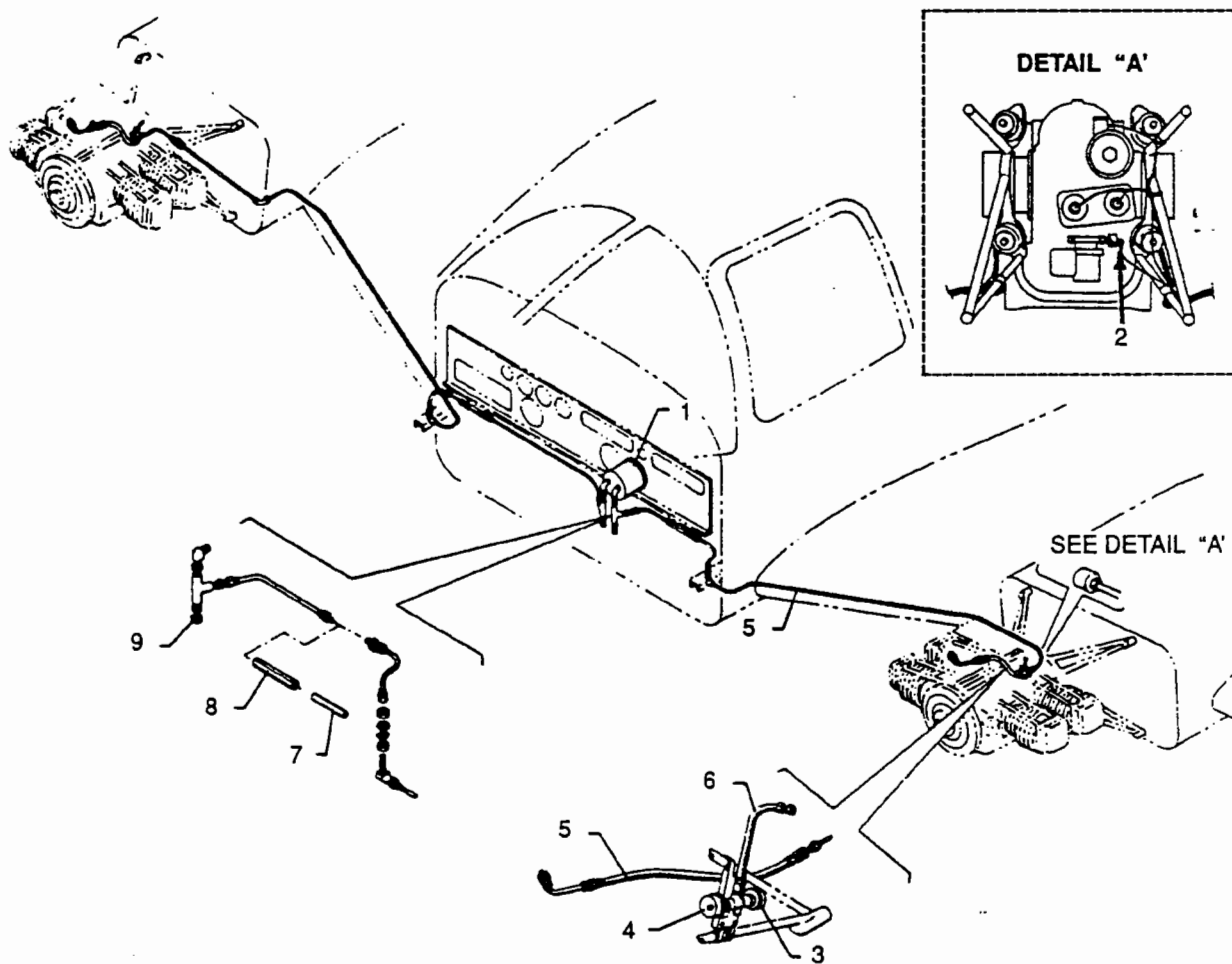


Figure 77-1. Engine Instrument Lines Installation

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

3264

1. MANIFOLD PRESSURE GAUGE
2. FUEL PRESSURE GAUGE SENDER
3. OIL PRESSURE SWITCH
4. OIL PRESSURE GAUGE SENDER
5. MANIFOLD PRESSURE LINE
6. OIL PRESSURE LINE
7. MANIFOLD PRESSURE LINE FILTER
8. MANIFOLD PRESSURE LINE FILTER HOUSING
9. MANIFOLD PRESSURE LINE DRAIN



PA-44-180T ONLY

Figure 77-1. Engine Instrument Lines Installation (cont.)

77-00-00

Page 77-02

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CLUSTER MOUNTED INSTRUMENTS.

REMOVAL AND REPLACEMENT OF CLUSTER MOUNTED INSTRUMENTS.

1. Remove the face panel by springing the plastic material from the channels.
2. With the face panel held in a vertical position the screws securing the clusters are accessible. Remove the screws and the lens of the cluster to be repaired.
3. Remove the plastic light seals adjacent to the instrument to be replaced.
4. Remove the wires or tube to the instrument. Tag wires so they can be returned to the same terminal during the replacement of the instrument.
5. Remove the nuts and insulating washers on electrical instruments, then move instrument aft. Mechanical instruments have only one large nut and lock washer.
6. Replace instrument in the reverse order of removal. Check all mountings and connections for security.

REMOVAL AND REPLACEMENT OF CLUSTER MOUNTED INSTRUMENTS.

(PA-44-180 S/N 44-95001 and up.)

1. Remove the four screws on the panel which will be holding the cluster to the panel.
2. Label the wires to facilitate reinstallation.
3. Remove the clear lens cluster cover.
4. Remove the nuts and washers from the terminals of the gauge to be replaced.
5. Remove the gauge through the front of the cluster housing.
6. Replace instrument in the reverse order.
7. Check all connections for security and correctness.

POWER.

MANIFOLD PRESSURE GAUGE.

The manifold pressure gauge is a vapor proof, absolute pressure type instrument. Pressure from the intake manifold of each engine is transmitted to the instrument through individual lines. There are two in line filters which are located in the lines ahead of each instrument. They are accessible from underneath the instrument panel and should be checked for moisture and/or replaced at each 100 hour or annual inspection. Also connected to the back of the gauge are quick drains to permit draining of any fuel or liquid that might accumulate in the lines.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

TROUBLESHOOTING MANIFOLD PRESSURE GAUGE.

CHART 7701. MANIFOLD PRESSURE INDICATOR

TROUBLE	CAUSE	REMEDY
Excessive error at existing barometric pressure.	Pointer shifted.	Replace instrument.
Excessive error when engine is running.	Line Leaking.	Tighten line connections.
Sluggish or jerky pointer movement.	Defective instrument.	Replace instrument.
Dull or discolored marking.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line.	Disconnect lines and blow out.

REMOVAL AND REPLACEMENT OF MANIFOLD PRESSURE GAUGE.

Refer to Chapter 34 and Removal of Face Mounted Instruments.

TACHOMETER INDICATOR (PA-44-180)

Each tachometer is connected to the engine accessory cover by a flexible cable and provides an indication of crankshaft speed in revolutions per minute. The instrument has a recording mechanism for recording the time that the engine is in actual operation. The right-hand tachometer has a reversing drive to correct for the counter-rotation of the right-hand engine.

— Note —

Tachometer P/N 62177-3 must be used with Hartzell Propeller HC-C2YK-2CLGF/FJC7666A or HC-2YK-2CGF/FC7666A. For information on the electric tachometer in the 180T refer to Chapter 61.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

TROUBLESHOOTING TACHOMETER.

CHART 7702. TACHOMETER

TROUBLE	CAUSE	REMEDY
No reading on indicator, either permanent or intermittent.	Broken drive cable.	Replace cable.
	Loose cable connections.	Tighten cable.
Pointer oscillates excessively.	Rough spot on, or sharp bend in cable.	Repair or replace.
	Excessive friction in instrument.	Replace instrument.
Indicator changes in climb.	Excessive clearance in speed cup.	Replace instrument.
Pointer goes all the way to stop, more noticeable in cold weather.	Excessive lubricant in instruments.	Replace instruments.
Pointer jumps at idle.	Speed cup hitting rotating magnet.	Replace instrument.
Tachometer cable breaks.	Cable bent too sharply.	Reroute cable, replace shaft.

REMOVAL AND REPLACEMENT OF TACHOMETEER INDICATOR.

Refer to Chapter 34 and Removal of Face Mounted Instruments.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

ELECTRIC TACHOMETER INSTALLATION (PA-44-180T). (Refer to Figure 77-2.)

The tachometer on the 44-180T is an electrical instrument which utilizes an EMI filter, and magnetic pickups on the engines. On top of each engine is a pickup mounted to a bracket. The pickup is positioned so that it senses the passing of the ring gear teeth. The pulse is then read by the indicator. The electrical schematic can be found in Chapter 91.

REMOVAL AND INSTALLATION OF TACH INDICATOR.

The tachometer is located on the pilot's side of the instrument panel and is back mounted to the panel.

1. Disconnect the harness from the back of the instrument.
2. With the instrument supported, remove the four retaining screws, and withdraw the unit from the airplane.
3. The unit can be reinstalled in the reverse order.

REMOVAL AND INSTALLATION OF EMI FILTER. (Refer to Figure 77-2.)

1. Under the panel mounted to the panel support, remove the electrical connections making note of their installed positions, and remove the two screws securing the filter.
2. Install the wires where previously noted and reinstall filter.

REMOVAL AND INSTALLATION OF MAGNETIC PICKUP. (Refer to Figure 77-2.)

1. Remove the top cowl of the desired engine.
2. Remove the screws and clamps attaching the pickup to the bracket.
3. The unit can now be removed by cutting the tie wrap and disconnecting the butt splices.
4. For installation, proceed as follows:
 - A. The clearance between the teeth of the ring gear and pickup should be $.015 \pm .005$ inch with the crankshaft pushed aft. Using a feeler gauge align the mounting clamps and pickup to give the proper gap, and install the mounting screws.
 - B. Rotate propeller, making sure the crankshaft is pushed aft and insure the proper clearance is maintained.

— CAUTION —

**WHEN REMOVING A PROPELLER, FIRST REMOVE THE PICKUP TO
PREVENT DAMAGE TO THE UNIT.**

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

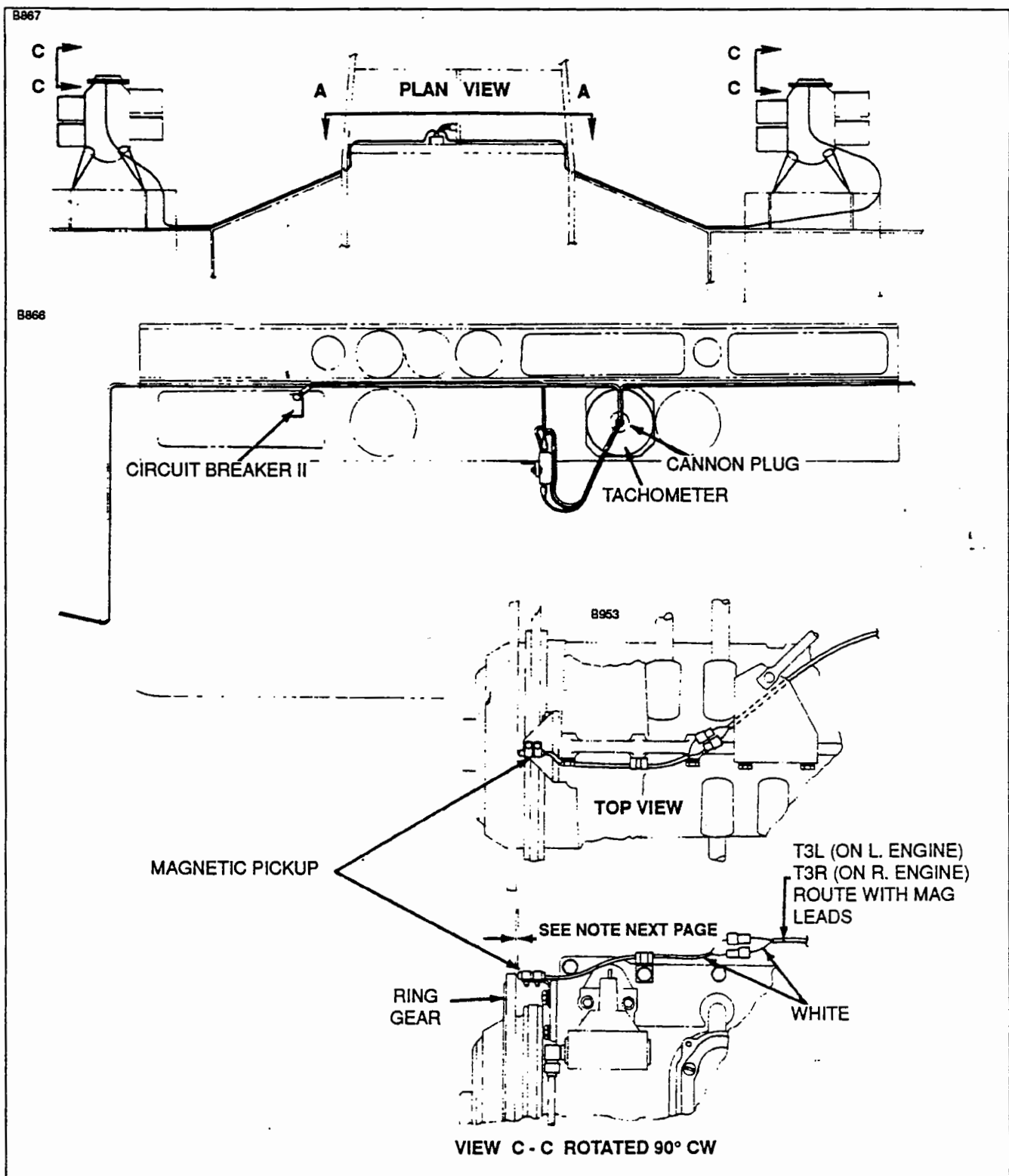


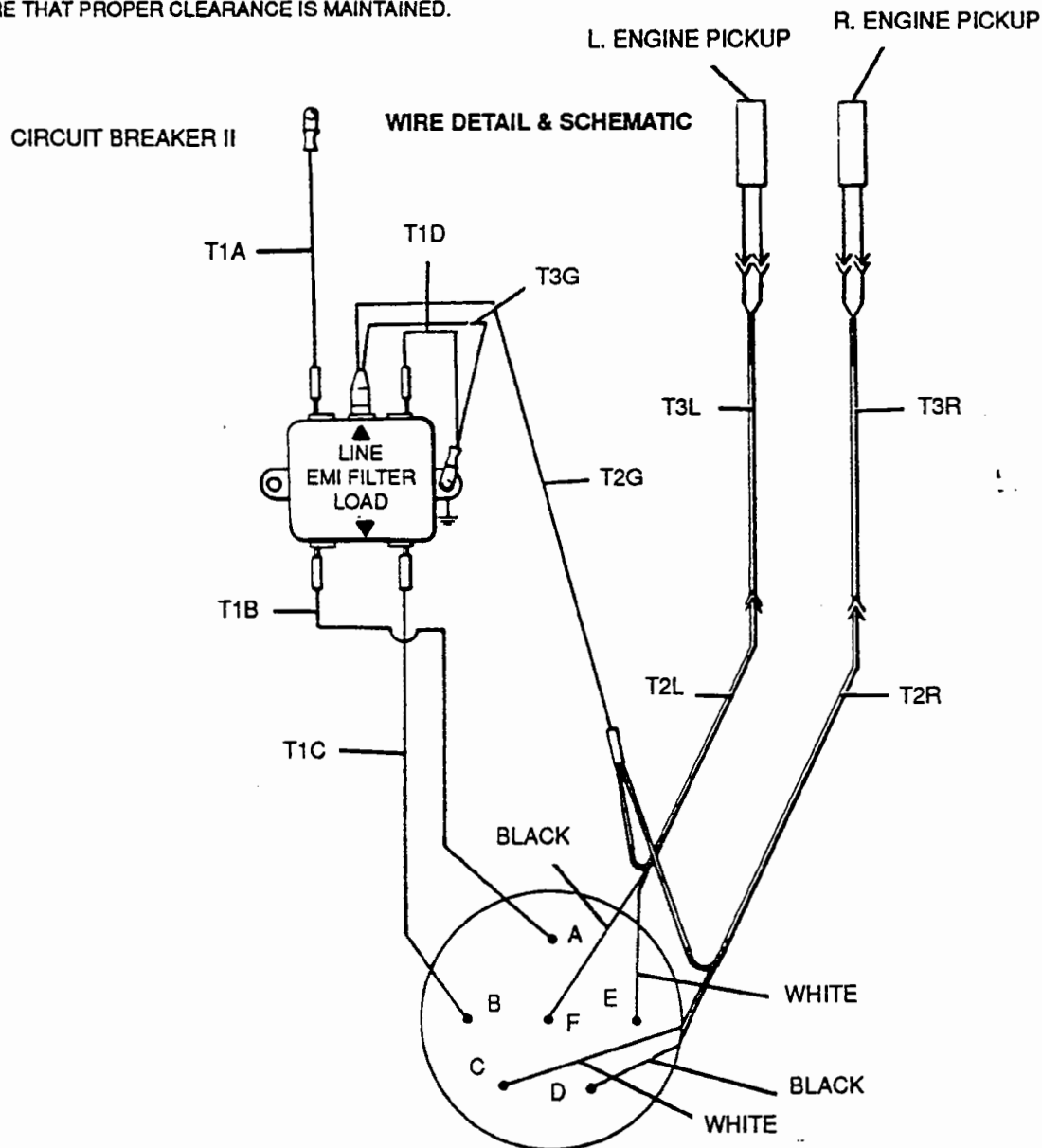
Figure 77-2. Electric Tachometer Installation

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

B868

NOTE

INSTALL MAGNETIC PICKUP AND SET CLEARANCE AFTER PROPELLER INSTALLATION. USE FEELER GAUGE TO ADJUST CLEARANCE BETWEEN RING GEAR AND TIP OF PICKUP TO .015 / .005 WITH CRANKSHAFT PUSHED AFT. CHECK ALL AROUND RING GEAR TO INSURE THAT PROPER CLEARANCE IS MAINTAINED.



CAUTION

ANYTIME THE PROPELLER IS REMOVED OR INSTALLED THE PICKUP SHOULD ALSO BE REMOVED TO PREVENT DAMAGE TO THE UNIT.

Figure 77-2. Electric Tachometer Installation (cont.)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

TEMPERATURE.

CYLINDER HEAD TEMPERATURE GAUGE.

The cylinder head temperature gauges are in their respective instrument clusters, located on the instrument panel. These instruments measure cylinder head temperature using a sender located in a cylinder head in each engine. The cylinder head used is determined by the engine manufacturer. This gauge is an electrical instrument and is wired thru the instruments circuit breaker.

— Note —

Each cylinder head gauge needle should be centered + 1/2 a needle width on the dot with electrical power off. With 14 VDC applied to the system the gauge should indicate approximately the known temperature. On a cold engine there should be a drop of the needle.

TROUBLESHOOTING CYLINDER HEAD TEMPERATURE GAUGE.

CHART 7703. CYLINDER HEAD TEMPERATURE

Trouble	Cause	Remedy
Instrument shows no indication.	Engine is cold.	Warm up engine.
	Power supply wire open.	Repair wire.
	Defective sender.	Replace sender.
	Defective instrument.	Replace instrument.
	Open circuit breaker.	Troubleshoot for fault.
Instrument goes all the way to upper stop.	Wire grounded between sender and gauge.	Repair wire.
	Defective sender.	Replace sender.

REMOVAL AND REPLACEMENT.

Refer to the General section of this chapter under Removal of Cluster Mounted Instruments.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CYLINDER HEAD TEMPERATURE GAUGE CALIBRATION (PA-44-180 S/N 44-95001 and up)

A calibration chart has been included for use in verifying that the suspected faulty gauge is within tolerance. Actual recalibration of the gauge must be performed by the manufacturer or an approved instrument repair facility.

1. With the instrument installed in the aircraft, the aircraft's power connected (14 VDC) and the ground connected.
2. Remove the connection to the terminal marked SEND and connect a specified amount of resistance as indicated on the chart, by use of a fixed resistor or a test unit capable of simulating the resistance indicated on the chart (Power Resistor Decade Box).
3. If the gauge does not meet the tolerances set forth in the chart, it must be replaced or recalibrated.
4. Reinstallation should be the reverse of the procedure used to disconnect it.

— Note —

To facilitate installation, mark or label all wires prior to removal.

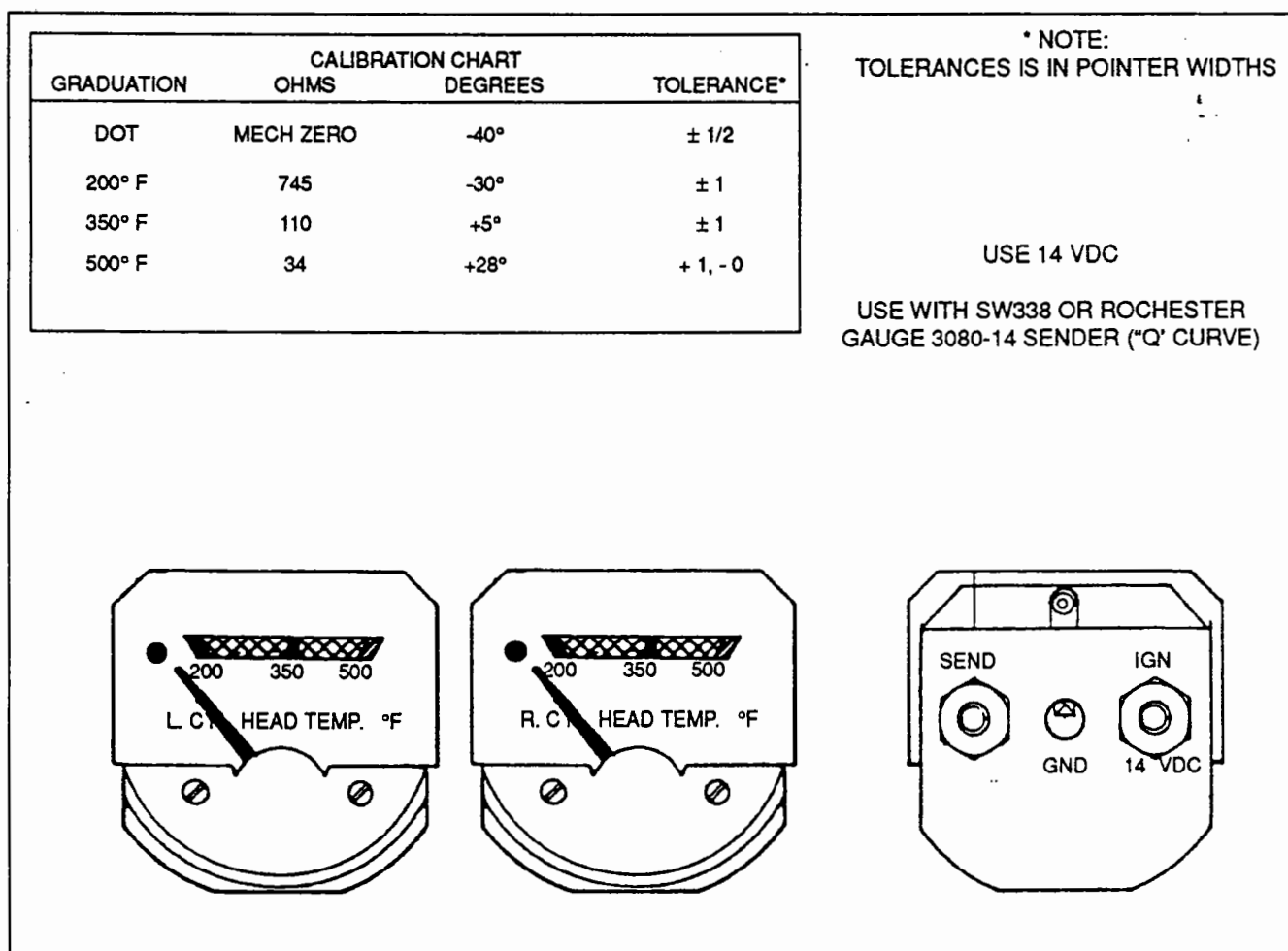


Figure 77-3. Cylinder Head Temperature Calibration (PA-44-180 S/N 44-95001 and up)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

ANALYZERS.

EXHAUST GAS TEMPERATURE GAUGE.

This dual instrument, which is commonly referred to as EGT, is used to aid the pilot in setting the most economical fuel-air mixture for cruising flight at a power setting of 75% or less. It is a sensing device which monitors the temperature of exhaust gases leaving the engine cylinders. If it is found defective after checking with the troubleshooting chart, it should be replaced. If the leads to the gauge are defective in any way, they must be replaced. When replacing leads, it is necessary to use the same type and length of wire, because the resistance of the leads is critical for the proper operation of this gauge. When troubleshooting this instrument be certain the system being checked coincides with the system selected on the indicator.

CLEANING AND INSPECTION.

Unless mechanical damage is evident such as broken glass, bent or broken pointer, or broken case, the following checks should be performed before removing the instrument:

1. Remove probe from exhaust stack and check for broken weld (at tip end) or burnt off end. Measured resistance of probe should be .8 ohms. Clean the connections with steel wool before reassembly.
2. Disconnect lead wires at instrument and measure length and diameter. Resistance with lead wires connected to probe should be 3.3 ohms. Clean connections with steel wool before reassembly.
3. With leads connected to instrument, heat probe with propane torch to dull red. The meter should read up to the fourth graduation or approximately 1500° F. Before making this check, make sure that the adjustment screw, which is located in the rear of the instrument case, is in the center of its travel. If this screw has been turned to either end of full travel, it will shut the instrument off and no indication will be shown on the pointer. If meter still does not read, replace it.

— CAUTION —

**DO NOT CONNECT OHMMETER ACROSS METER. IT WILL BURN OUT
THE MOVEMENT OF THE METER.**

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

TROUBLESHOOTING EXHAUST GAS TEMPERATURE GAUGE.

CHART 7704. EXHAUST GAS TEMPERATURE

Trouble	Cause	Remedy
Gauge inoperative.	Master Switch OFF. Circuit Breaker OUT. Defective gauge, probe or wiring. Adjusting potentiometer turned off scale.	Turn switch ON. Push breaker IN. Check probe and lead wires for chafing, breaks or shorting between wires and/or metal structure. Reset potentiometer.
Fluctuating reading.	Loose, frayed or broken electrical leads or faulty connections.	Clean and tighten connections. Repair or replace defective leads.

REMOVAL AND REPLACEMENT OF GAUGE. (Refer to Figure 77-1.)

1. Disconnect and label the wires from the EGT gauge at the instrument panel.
 2. Remove the three bolts (*four screws) securing the instrument to the panel.
 3. Install the gauge by reattaching the cables to their appropriate terminals.
- * Referenced PA-44-180 S/N 44-95001 and up.

EXHAUST GAS TEMPERATURE PROBE.

REMOVAL OF EGT PROBE (PA-44-180).

1. Disconnect the lead cable from the rear of the instrument and remove it through the aircraft to the engine.
2. Cut the safety wire at the probe clamp and remove the probe from the number one cylinder exhaust.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

INSTALLATION OF EGT PROBE (PA-44-180).

— Note —

When installing the probe, make sure to leave a minimum of 1/2 inch slack between where the lead cable attaches to the engine and engine mount, to accommodate engine shock movement.

1. If not already done, drill a .129 inch hole for the probe in the number one cylinder exhaust manifold at 45°(typical) to the centerline of the cylinder, and 1.5 inches down from the mounting flange of the manifold.
2. Install the probe in the hole drilled for it, and torque the worm screw clamp to 45 inch-pounds.
3. Cut off any excess of the clamp over .75 inch and file corners smooth.
4. Safety wire the screwhead of the clamp to the .75 inch clamp extension with .032 diameter safety wire.

— CAUTION —

WHEN COILING THE LEAD CABLE, DO NOT LET IT BEND PAST A 1/8 INCH RADIUS.

5. Run the cable back across the engine and mount, through the leading edge of the wing (where extra cable should be coiled and tied to an existing bundle), and into the fuselage to the rear of the instrument.
6. Attach the lead wires to their appropriate terminals of the instrument as shown in Figure 77-1.

REMOVAL OF EGT PROBE (PA-44-180T).

1. Disconnect the wires from the rear of the instrument and remove the wires through the aircraft to the engine.
2. Loosen the EGT probe jam nut and unscrew the EGT probe from the exhaust stack.

INSTALLATION OF EGT PROBE (PA-44-180T).

— Note —

When routing lead cable, leave a minimum of 1/2 inch slack between the engine and the engine mount to compensate for engine shock movement.

1. Install the probe in the exhaust stack. (Refer to Figure 77-3.) Maintaining the 2.75 inch dimension indicated, secure the probe by tightening the jam nut.

— CAUTION —

DO NOT KINK OR PINCH THE LEAD WIRE. MINIMUM BEND RADIUS OF THE LEAD WIRE IS 1/8 INCH.

2. Secure the lead cable to the engine mount and route cable through the leading edge of the wing and into the fuselage to the rear of the EGT gauge.
3. Attach the lead wires to the appropriate terminals of the gauge.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

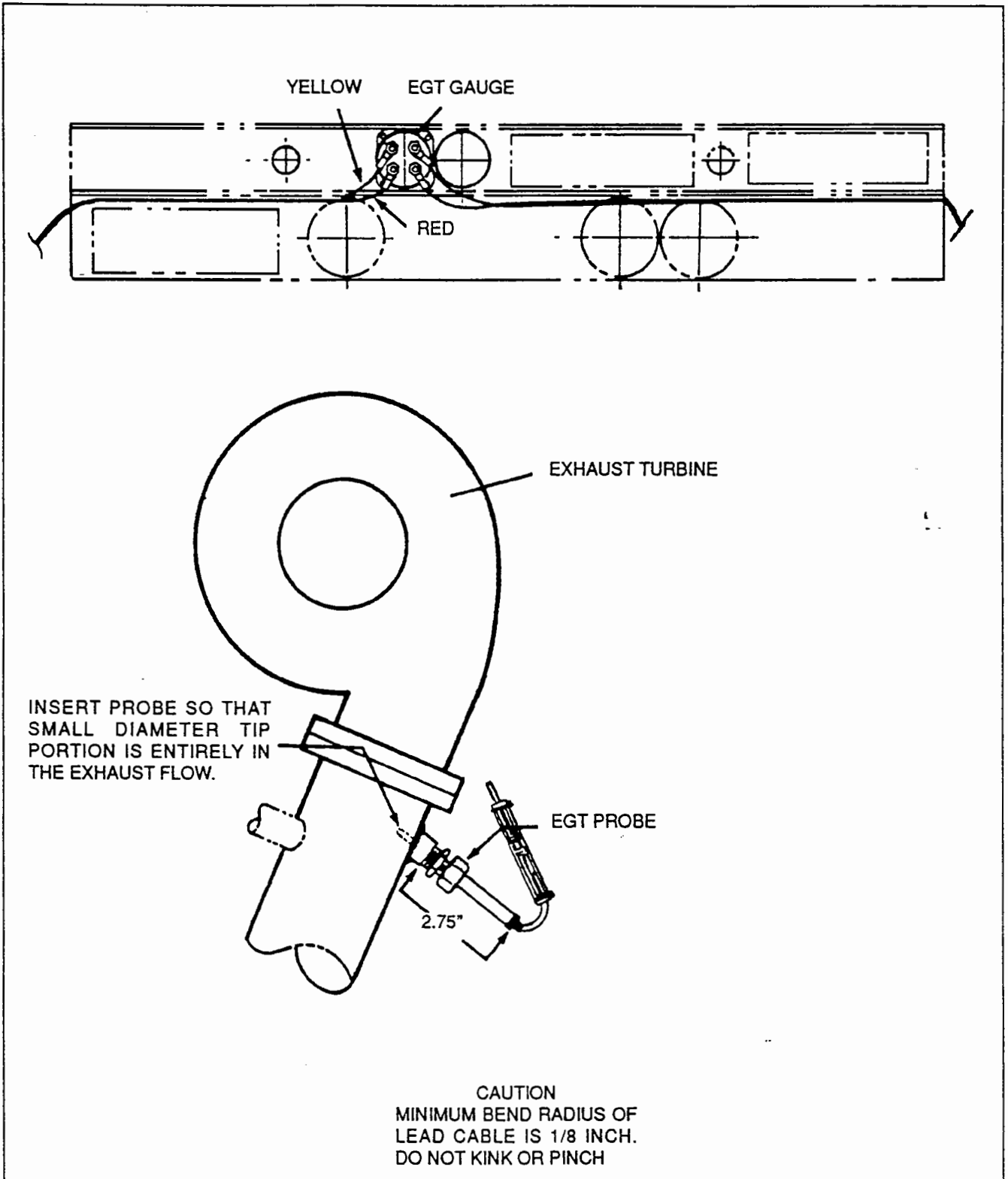


Figure 77-4. EGT Probe Installation (PA-44-180T)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3H17 THROUGH 3H18
INTENTIONALLY LEFT BLANK**

CHAPTER

78

EXHAUST

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 78 - EXHAUST

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
78-00-00	GENERAL	3H21	
78-01-00	Description (PA-44-180)	3H21	
78-02-00	Leak Test of Muffler (PA-44-180)	3H21	

CHAPTER

79

OIL

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 79 - OIL

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
79-00-00	GENERAL	3I3	
79-01-00	Oil Coller	3I3	A 1 - 83
79-01-01	Installation of Oil Cooler	3I3	
79-30-00	INDICATING	3I3	
79-31-00	Oil Pressure	3I3	
79-31-01	Removal of Oil Pressure Sensors	3I3	A 1 - 82
79-31-02	Oil Pressure Sender Test	3I3	
79-31-03	Installation of Oil Pressure Senders	3I4	
79-31-04	Engine Oil Pressure Gauge	3I4	
79-31-05	Troubleshooting Oil Pressure Gauge	3I5	
79-31-06	Removal and Replacement of Gauge	3I5	
79-31-07	Oil Pressure Gauge Calibration	3I5	
79-32-00	Oil Temperature Gauge	3I7	
79-32-01	Troubleshooting Oil Temperature Gauge	3I7	
79-32-02	Removal and Replacement of Gauge	3I7	
79-32-03	Oil Temperature Gauge Calibration	3I7	

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

GENERAL.

DESCRIPTION (PA-44-180).

This exhaust system is a muffler system, exhaust gases are discharged through an opening in the center of the lower cowl. A heat shroud is installed for an alternate air heat rise for the carburetor. For removal of the exhaust system, the following procedures may be performed:

1. Remove lower cowl.
2. Remove hardware from the alternate air tube and disconnect tube from shroud.
3. Remove hardware attaching exhaust system to engine, remove exhaust system.
4. Reinstall the exhaust system in reverse of removal instructions.

LEAK TEST OF MUFFLER (PA-44-180).

— Note —

Make sure to inspect each muffler clip joint for excessive exhaust leakage, minor discoloration and leakage is normal. If excessive leakage is displayed repair as described in Service Letter No. 860.

Each muffler should be subjected to the following leak test:

1. Plug muffler inlets.
2. Connect low pressure air supply to outlet (approximately 2 psi).
3. Submerge the muffler in water.
4. Repair or replace any muffler that leaks.
5. Upon completion of repairs, retest mufflers.

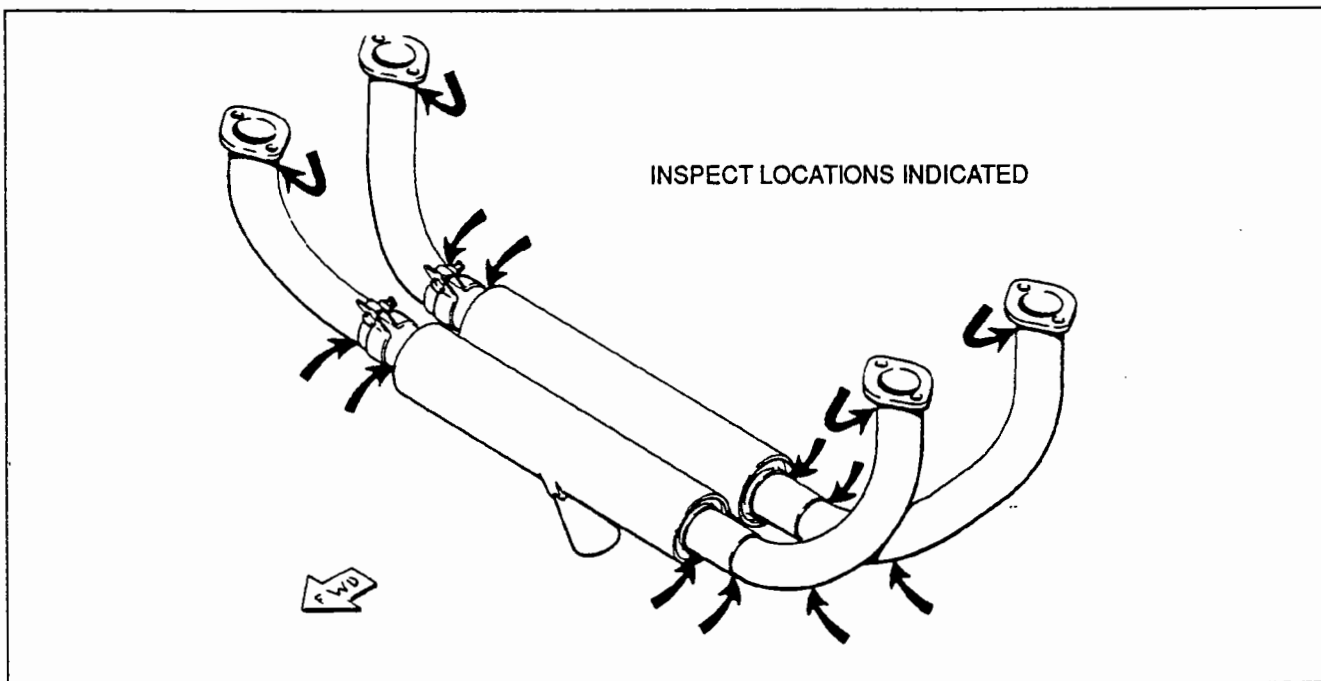


Figure 78-1. Muffler Inspection

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3H22 THROUGH 3H24
INTENTIONALLY LEFT BLANK**

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

GENERAL.

OIL COOLER.

INSTALLATION OF OIL COOLER.

1. When installing fittings in the oil coolers, care should be used to prevent excessive torque being applied to the cooler. When a rectangular fitting boss is provided, a backup wrench should be used, employing a scissor motion, so that no load is transmitted to the cooler. When the oil cooler has a round fitting boss, care should be taken not to permit excessive torque on the fittings.
2. If a pipe thread fitting is used, it should be installed only far enough to seal with sealing compound.
3. Apply Lubon No. 404 to all male pipe thread fittings, do not allow sealant to enter the system.
4. When installing hoses and fittings make sure a minimum of .5 inch clearance is maintained between hose and engine mount, and .12 inch between hose and oil filter case.
5. If fitting cannot be positioned correctly using a torque of 10 to 15 foot-pounds, another fitting should be used.
6. When attaching lines to the cooler, a backup wrench should be used.
7. After installation, inspect the cooler for distorted end cups.
8. Run-up engine, after run-up check for oil leaks.

— Note —

Winterization plates should be installed between oil cooler seal and engine baffle when ambient temperature is below 50° F.

INDICATING.

OIL PRESSURE.

REMOVAL OF OIL PRESSURE SENDERS.

There are two sending units for each engine. One for oil pressure and the other for a warning light. Both units are mounted on a common manifold located behind each engine firewall. The upper unit is for the pressure gauge and the lower unit is for the warning light. Access to the units is through access panels on each side of the forward nacelle. Removal is accomplished by the following:

1. Disconnect the electrical leads from the particular unit. It is suggested that the leads be marked for easy connection upon reinstallation of the sensor.
2. Unscrew the unit from the manifold.
3. catch spillage and cover the fitting on the manifold to prevent foreign matter from entering the system.

OIL PRESSURE SENDER TEST. (Refer to Chart 7901)

The oil pressure sender works on the relationship of pressure to resistance. As the pressure increases so does the resistance and in turn alters the position of the needle of the instrument.

To test the sender the following procedure should be followed:

1. Connect a calibrated pressure source to the pressure port.
2. Attach ohmmeter leads to the one pole extending from the sender and one to the sender itself.
3. Raise and lower the pressure to the sender and crosscheck with the required tolerances in Chart 7901.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 7901. OIL PRESSURE SENDER TEST SPECIFICATIONS

Pressure (Psig)	Resistance (Ohms)	Tolerance(Ohms)
0	10	—
25	46	-5, +0
60	90	—
90	126	-0, +15

INSTALLATION OF OIL PRESSURE SENDERS.

1. Apply thread sealant tape (3M - Teflon 48 x 1/4") to the male threads of the sensors being careful not to cover the first three threads.
2. Remove the protective cover from the fitting and screw the unit into the manifold.
3. Reconnect the electrical leads to the unit.
4. Perform an operational check of the system.

— Note —

Refer to Chapter 91 for Electrical Schematics.

ENGINE OIL PRESSURE GAUGE.

The oil pressure gauges are mounted in two respective clusters or in an adjacent configuration on the instrument panel, the latter is installed on S/N 44-95001 and up. Each gauge indicates the amount of oil pressure available at the pressurized engine oil passage through a sender at the firewall.

— Note —

The needle of each gauge should be centered +1/2 a needle width on the dot with electric power off. With positive 14 VDC applied to the electrical bus, each gauge should indicate 0 psi +1 needle width.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

TROUBLESHOOTING PRESSURE GAUGE.

CHART 7902. OIL PRESSURE GAUGE

Trouble	Cause	Remedy
Excessive error at zero.	Pointer loose on shaft. Overpressure or seasoning of burdon tube.	Repalce instrument.
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Air in line or rough engine relief.	Disconnect line and fill with light oil. Check for leaks. If trouble persists, clean and adjust relief valve.
Sluggish operation of pointer or pressure fails to build up.	Engine relief valve open.	Clean and check.
	Line restriction to instrument.	Clean and check.
	Loss of oil in engine or other engine failure.	Shut down engine.
	NOTE	
	Gauge will take longer to indicate in cold weather.	

REMOVAL AND REPLACEMENT.

Refer to the General sectrion of Chapter 77 for Removal of Cluster Mounted Instruments.

OIL PRESSURE GAUGE CALIBRATION. (PA-44-180 S/N 44-95001 AND UP)

A calibration chart has been included for use in verifying that the suspected faulty gauge is within tolerance. Actual recalibration of the gauge must be performed by the manufacturer or an approved instrument repair facility.

1. With the instrument installed in the aircraft, the aircrafts' power connected (14 VDC) and the ground connected.
2. Remove the connection to the terminal marked SEND and connect a specified amount of resistance as indicated on the chart, by use of a fixed resistor or a test unit capable of simulating the resistance indicated on the chart (Power Resistor Decade Box).

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

OIL PRESSURE GAUGE CALIBRATION. (cont)

3. If the gauge does not meet the tolerances set forth in the chart, it must be replaced or recalibrated.
4. Reinstallation should be the reverse of the procedure used to disconnect it.

— Note —

To facilitate installation, mark or label all wires prior to removal.

GRADUATION	CALIBRATION CHART		TOLERANCE*
	OHMS	DEGREES	
DOT	MECH ZERO	-40°	± 1/2
0#	10	-34.5°	± 1/2
25#	45	-16°	± 1
55#	84.5	+8.5°	± 1
95#	132	+27.5°	± 1
115#	153	+32°	+1, -0

* NOTE:
TOLERANCES IS IN POINTER WIDTHS

USE 14 VDC

USE WITH ROCHESTER GAUGE 3060-18 SENDER ("K" CURVE)

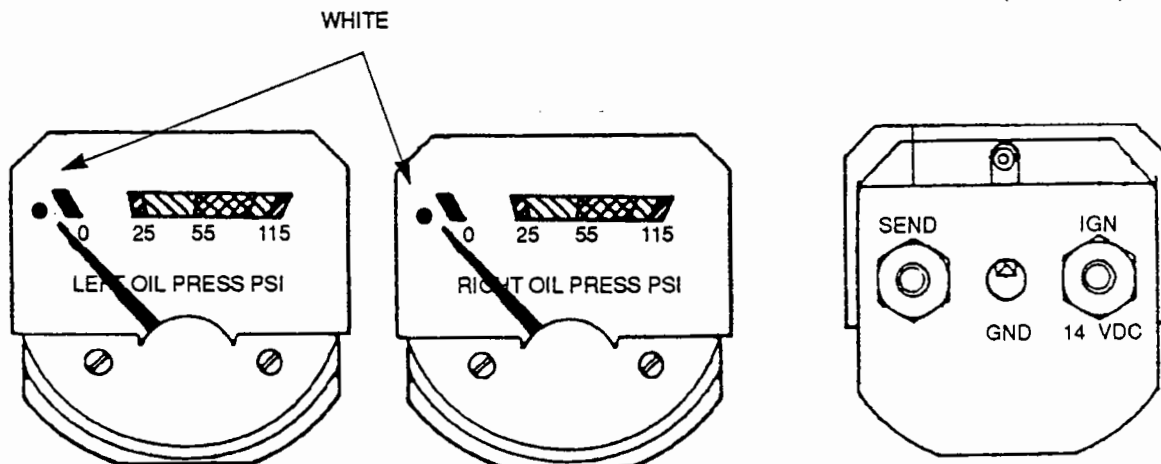


Figure 79-1. Oil Pressure Gauge Calibration (PA-44-180 S/N 44-95001 and up)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

OIL TEMPERATURE GAUGE.

The oil temperature indicator is mounted in the instrument cluster or in an adjacent configuration on the instrument panel. This instrument will provide a temperature indication of the engine oil in degrees Fahrenheit. The instrument has a temperature bulb located in the oil screen assembly, on the engine accessory section.

— Note —

With electrical power off, each gauge pointer should center $\pm 1/2$ a needle width on the dot. When positive 14 VDC is applied to the bus, the gauge should indicate the approximate known temperature,

TROUBLESHOOTING OIL TEMPERATURE GAUGE.

CHART 7903. OIL TEMPERATURE GAUGE

TROUBLE	CAUSE	REMEDY
Instrument fails to show any reading.	Broken or damaged bulb. Wiring open.	Check engine unit and wiring to instrument.
Excessive error.	Improper calibration adjustment.	Replace instrument.
Pointer fails to move as engine is warmed up.	Broken or damaged bulb or open wiring.	Check engine unit and wiring.
Dull or discolored marking.	Age.	Replace instrument.

REMOVAL AND REPLACEMENT.

Refer to the General section of Chapter 77 for Removal of cluster mounted instruments.

OIL TEMPERATURE GAUGE CALIBRATION. (PA-44-180 S/N 44-95001 and up)

A calibration chart has been included for use in verifying that the suspected faulty gauge is within tolerance. Actual recalibration of the gauge must be performed by the manufacturer or an approved instrument repair facility.

1. With the instrument installed in the aircraft, the aircrafts' power connected (14 VDC) and the ground connected.
2. Remove the connection to the terminal marked SEND and connect a specified amount of resistance as indicated on the chart, by use of a fixed resistor or a test unit capable of simulating the resistance indicated on the chart (Power Resistor Decade Box).

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

OIL TEMPERATURE GAUGE CALIBRATION (cont)

3. If the gauge does not meet the tolerances set forth in the chart, it must be replaced or recalibrated.
4. Reinstallation should be the reverse of the procedure used to disconnect it.

— Note —

To facilitate installation, mark or label all wires prior to removal.

GRADUATION	CALIBRATION CHART		TOLERANCE*
	OHMS	DEGREES	
DOT	MECH ZERO	-40°	± 1/2
75° F	903.5	-33.5°	± 1
180° F	100	+12.5°	± 1
245° F	36	+35°	-0, + 1

* NOTE:
TOLERANCES IS IN POINTER WIDTHS

USE 14 VDC

USE WITH SW362 OR ROCHESTER
GAUGE 3080-13 SENDER ("E" CURVE)

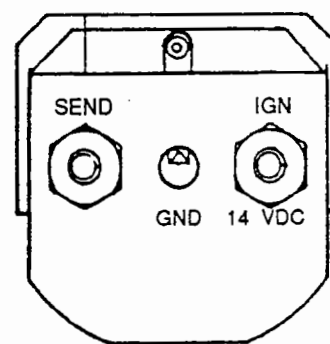
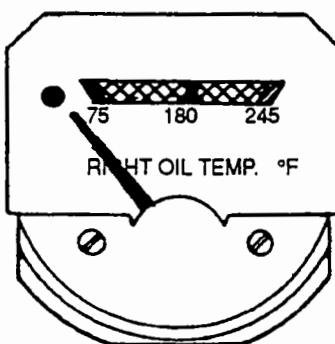
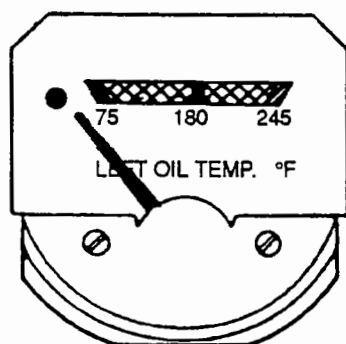


Figure 79-2. Oil Temperature Gauge Calibration (PA-44-180 S/N 44-95001 and up)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3I9 THROUGH 3I10
INTENTIONALLY LEFT BLANK**

CHAPTER

80

STARTING

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 80 - STARTING

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
80-00-00	GENERAL	3I13	
80-00-01	Description of Operation	3I13	
80-00-02	Troubleshooting	3I13	
80-10-00	CRANKING	3I16	
80-10-01	Maintenance of Starting System	3I16	
80-10-02	Overhaul of Starting Motor	3I17	
80-10-03	Removal of Starting Motor	3I17	
80-10-04	Disassembly of Starting Motor	3I17	
80-10-05	Brushes	3I17	
80-10-06	Armature	3I18	
80-10-07	Field Coils	3I18	
80-10-08	Brush Holders	3I18	
80-10-09	Gear and Pinion Housing	3I18	
80-10-10	Bendix Drive	3I18	
80-10-11	Assembly of Starting Motor	3I20	
80-10-12	Bench Tests	3I20	
80-10-13	Starting Motor Control Circuit	3I20	
80-10-14	Starting Motor Service Test Specifications	3I21	

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

GENERAL.

DESCRIPTION OF OPERATION.

The gear reduction starting motor consists of six major components: The Commutator End Head Assembly, the Armature, the Frame and Field Assembly, the Gear Housing, the Pinion Housing, and the Bendix Drive Assembly.

When the starting circuit is energized, battery current is applied to the starting motor terminal. Current flows through the field coils, creating a strong magnetic field. At the same time, current flows through the brushes to the commutator, through the armature windings to ground. The magnetic force created in the armature combined with that created in the field windings begins to turn the armature.

The gear cut on the drive end of the armature shaft extends through the gear housing, where it is supported by a roller bearing. The gear mates with the teeth of the reduction gear that drives the bendix shaft. The shaft is keyed to the reduction gear. The Bendix drive is held in position on the shaft by a "spiral" pin. The shaft is supported in the gear housing by a closed end roller bearing and in the pinion housing by a graphitized bronze bearing.

When the armature turns the reduction gear, the Bendix drive pinion meshes with the flywheel ring gear by inertia and action of the screw threads within the Bendix sleeve. A detent pin engages in a notch in the screw threads which prevents demeshing if the engine fails to start when the starting circuit is de-energized.

When the engine reaches a predetermined speed, centrifugal action forces the detent pin out of the notch in the screw shaft and allows the pinion to demesh from the flywheel.

TROUBLESHOOTING.

CHART 8001. TROUBLESHOOTING (STARTER)

Trouble	Cause	Remedy
Starter fails to operate.	STARTER	
	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to electrical wiring diagram and check all wiring.
	Defective starter solenoid or control switch.	Replace faulty unit.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 8001. TROUBLESHOOTING (STARTER) (cont)

Trouble	Cause	Remedy
Starter fails to operate. (cont)	Binding, worn, or improperly seated brush, or brushes with excessive side play.	Brushes should be a free fit in in the brush boxes without excessive side play. Binding brushes and brush boxes should be wiped clean with a gasoline (undoped) moistened cloth. A new brush should be run in until at least 50 percent seated; however, if facilities are not available for running in brushes, then the brush should be properly seated by inserting a strip of number 000 sandpaper between the brush and commutator, with the sanded side next to the brush. Pull sandpaper in the direction of rotation, being careful to keep it in the same contour as the commutator. — CAUTION — DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. AFTER SEATING, CLEAN THOROUGHLY TO REMOVE ALL SAND AND METAL PARTICLES TO PREVENT EXCESSIVE WEAR. KEEP MOTOR BEARING FREE FROM SAND OR METAL PARTICLES.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 8001. TROUBLESHOOTING (STARTER) (cont)

Trouble	Cause	Remedy
Starter fails to operate. (cont)	Dirty commutator.	If commutator is rough or dirty, smooth and polish with number 000 sandpaper. If too rough and pitted, remove and turn down. Blow out all particles.
	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good condition.
	Grounded or open field circuit.	Test, repair if possible or replace with a new part.
Low motor and cranking speed.	Worn, rough, or improperly lubricated motor or starter gearing.	Disassemble, clean, inspect, and relubricate, replacing ball bearings if worn.
	Same electrical causes as listed under "Motor fails to operate."	Same remedies listed for these troubles.
Excessive arcing of motor brushes.	Binding, worn, or improperly seated brush or brushes with excessive side play.	See information above dealing with this trouble.
	Dirty commutator, rough pitted or scored.	Clean as outlined above.
Excessive wear and arcing of motor brushes.	Rough or scored commutator.	Remove and turn commutator down on a lathe.
	Armature assembly not concentric.	Reface commutator.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CRANKING.

MAINTENANCE OF STARTING SYSTEM.

The starting system should be inspected at regular intervals, the frequency of which should be determined by the amount of service and the conditions under which the aircraft is operated. It is recommended that such inspection be made at each 100 hours and include the following:

1. The battery should be checked with a hydrometer to be sure it is fully charged and filled to the proper level with approved water. A load test should be made to determine battery condition. If dirt and corrosion have accumulated on the battery, it should be cleaned with solution of baking soda and water.
2. The starting circuit wiring should be inspected to be sure that all connections are clean and tight and that the insulation is sound. A voltage loss test should be made to locate any high resistance connections that would affect starting motor efficiency. This test is made with a low reading voltmeter while cranking the engine or at approximately 100 RPM. The following limits should be used:
 - A. Voltage loss from insulated battery post to starting motor terminal 0.3 volt maximum.
 - B. Voltage loss from battery ground post to starter frame 0.1 volt maximum.

— Note —

If voltage loss is greater than the above limits, additional tests should be made over each part of the circuit to locate the high resistance connections.

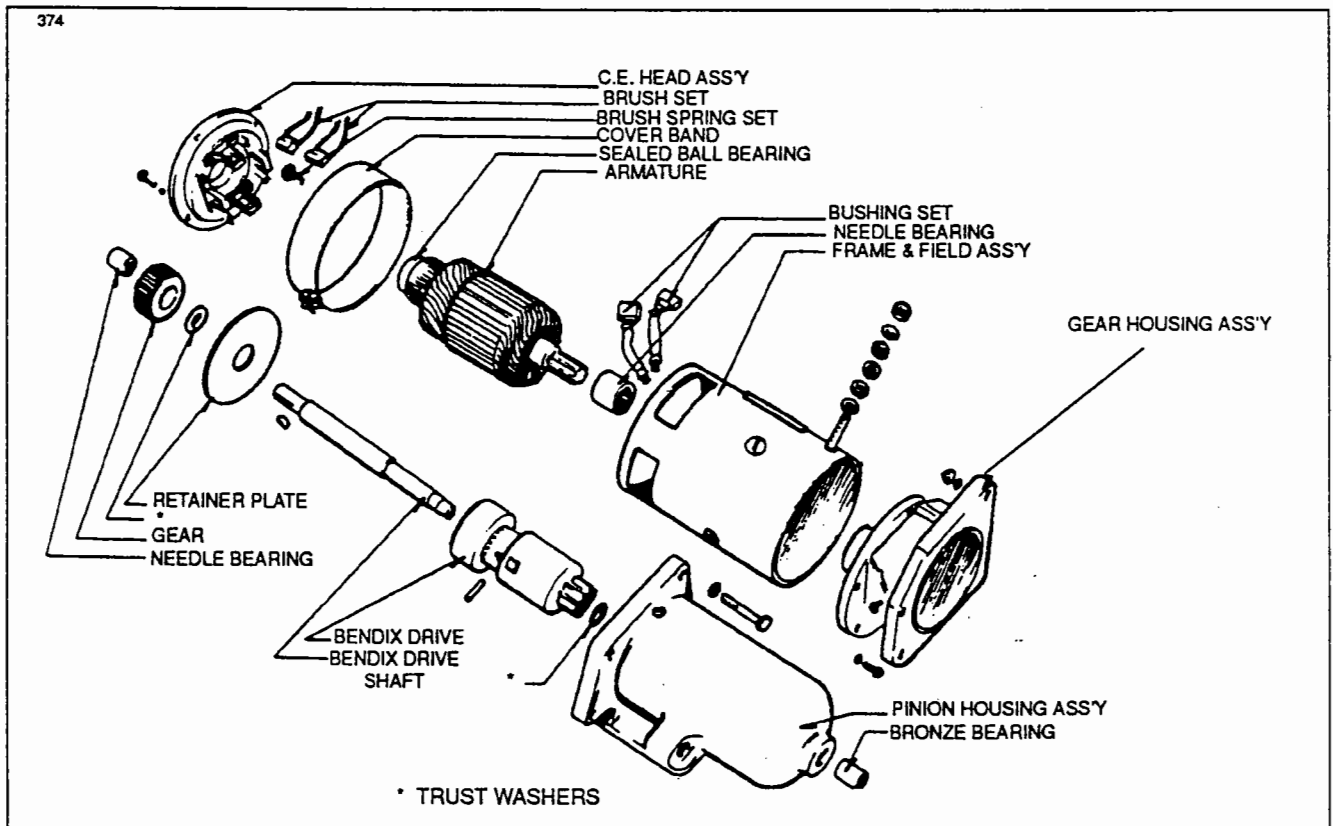


Figure 80-1. Exploded View of Gear Reduction Starter Motor

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

3. No lubrication is required on the starting motor except at the time of overhaul. Then lubricate the entire shaft under Bendix Drive, fill grooves in armature shaft at drive end and pack gear box with 1.3 to 2.0 ounces of Lithium Soap Base Grease 1925 Molytex "O" or equivalent.
4. The starting motor should be operated for a few seconds with the ignition switch off to make sure that the pinion engages properly and that it turns freely without binding or excessive noise. Then the engine should be started two or three times to see that the pinion disengages properly when the engine is turned off.

OVERHAUL OF STARTING MOTOR.

If during the above inspection any indication of starting motor difficulty is noted, the starting motor should be removed from the engine for cleaning and repair.

REMOVAL OF STARTING MOTOR.

To remove the starting motor from the engine, first disconnect the ground cable from the battery post to prevent short circuiting. Disconnect the lead from the starting motor terminal, then take out the mounting bolts. The motor can then be lifted off and taken to the bench for overhaul.

DISASSEMBLY OF STARTING MOTOR.

1. Remove the frame screws from the commutator end head and pull end head and armature from frame. Lift brushes and lock in elevated position with brush springs. Use a puller to remove the end head from the armature. Use a special bearing puller to remove the sealed ball bearing from the armature shaft.
2. Remove the frame screws that secure the gear housing to the frame. Remove bolts and nuts holding the gear housing to the pinion housing and separate the two units. Pull the Bendix shaft from the pinion housing. Do not lose the steel spacer that is located on the pinion end of the shaft. Remove the reduction gear, woodruff key and spacer from shaft.
3. Turn the Bendix pinion until it locks in the extended position. Locate "spiral" pin and use a punch to remove. Slide drive assembly off the shaft. Do not attempt to disassemble the drive and do not dip it in cleaning solvent.
4. To remove the roller bearings from the gear housing, use an arbor press and the correct bearing arbor. DO NOT HAMMER OUT. Each part should be cleaned and inspected for excessive wear or damage. Bearings should be checked for proper clearance and evidence of roughness or galling. Oil and dirt should be removed from insulation and the condition of the insulation checked.

BRUSHES.

Check the brushes to see that they slide freely in their holders and make full contact on the commutator. If worn to half their original length or less, they should be replaced.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

ARMATURE.

1. Check the commutator for uneven wear, excessive glazing or evidence of excessive arcing. If only slightly dirty, glazed or discolored, the commutator can be cleaned with 00 or 000 sandpaper. If the commutator is rough or worn, it should be turned in a lathe. Refer to Figure 80-2. The armature shaft should be inspected for rough bearing surfaces and rough or damaged splines.
2. To test the armature for grounds, a set of test probes connected in series with a 110 volt light should be used. Touch one probe to the commutator segment and the other to the armature core. If the test lamp lights, the armature is grounded and should be replaced.
3. To test for shorted armature coils, a growler is used. Refer to Figure 80-3. The armature is placed on the growler and slowly rotated by hand while a steel strip is held over the core so that it passes over each armature core slot. If a coil is shorted, the steel strip will vibrate.
4. A quick check for opens can be made by inspecting the trailing edge (in direction of rotation) of the commutator segments for excessive discoloration. This condition indicates an open circuit.

FIELD COILS. (See Figure 80-4.)

1. Check the field coils for grounds by placing one test probe on the frame and the other on the starter terminal. Be sure the brushes are not accidentally touching the frame. If the lamp lights, the fields are grounded. Repair or replace.
2. Inspect all connections to make sure they are clean and tight and inspect insulation for deterioration.

BRUSH HOLDERS.

1. To test brush holders, touch one test probe to the brush plate and the other to each brush holder.
2. The test lamp should light when the grounded brush holders are touched and should not light when the insulated brush holders are touched.

GEAR AND PINION HOUSING.

Inspect the housing for cracks and bearings for excessive wear. Remove rust, paint or grease from mounting surfaces.

BENDIX DRIVE.

The Bendix Drive should be wiped clean with a dry cloth. The pinion should turn smoothly in one direction and should lock in the other direction. Replace drive if it fails to check as above or if the pinion teeth are excessively worn or damaged.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

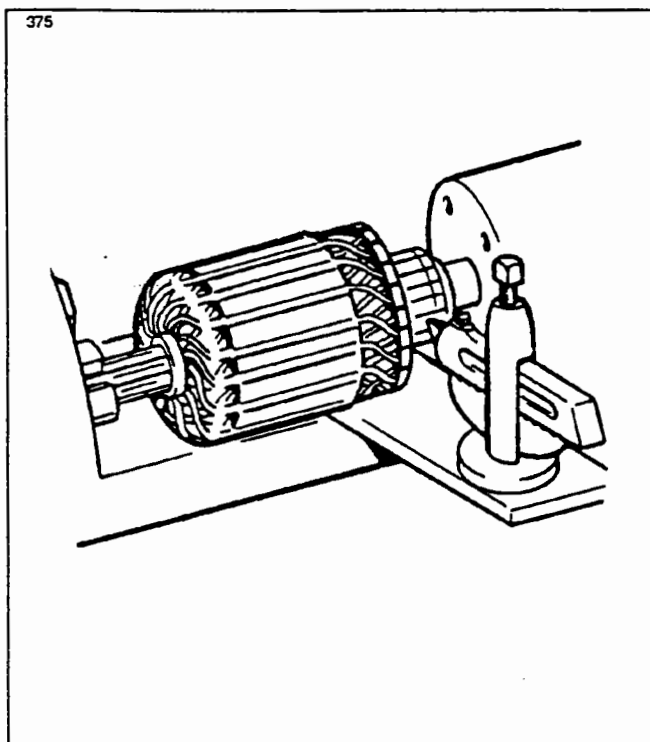


Figure 80-2. Turning Motor Commutator

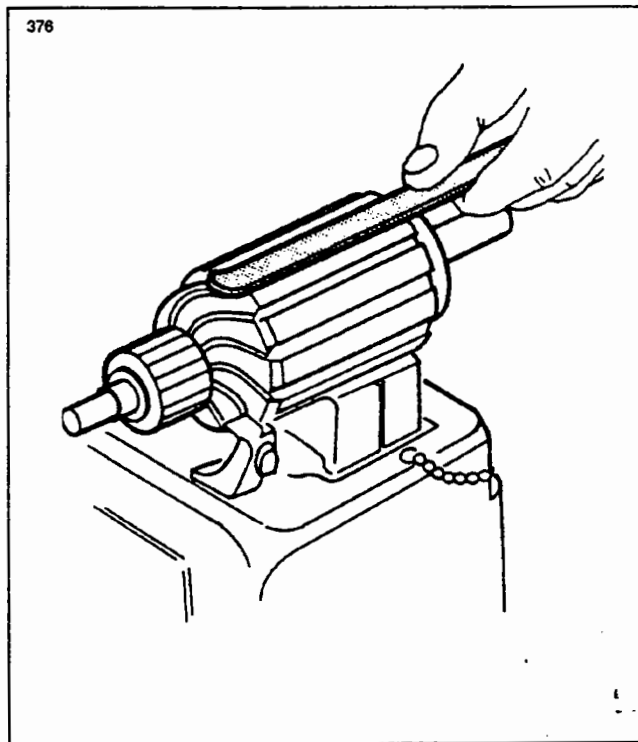


Figure 80-3. Testing Motor Armature for Shorts

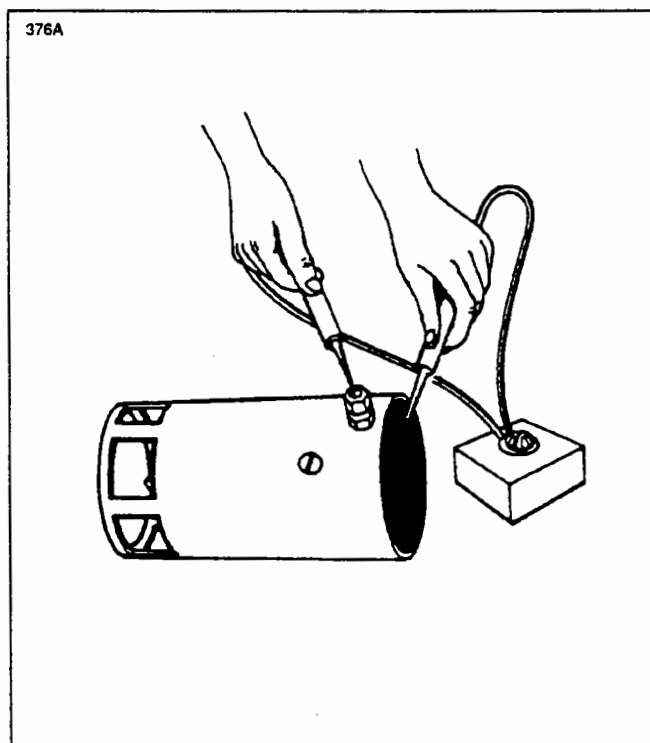


Figure 80-4. Testing Motor Fields for Grounds

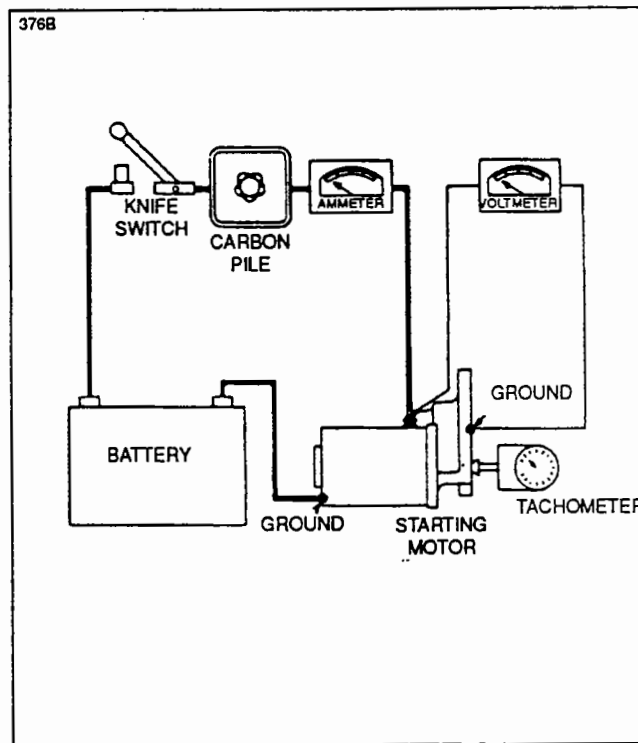


Figure 80-5. No Load Test Hookup

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

ASSEMBLY OF STARTING MOTOR.

1. When assembling the starting motor, always use an arbor press and the proper bearing arbor for installing graphitized bronze and roller bearings. The Bendix shaft should have a thin film of Lubriplate #777 or equivalent on the Bendix portion of the shaft. End play should be .005 to .050 of an inch.
2. New brushes should be properly seated when installing by wrapping a strip of 00 sandpaper around the commutator, with sanding side out, 1 1/4 to 1 1/2 times maximum. Drop brushes on sandpaper covered commutator and turn the armature slowly in the direction of rotation. Dust should be blown out of the motor after sanding.

— Note —

The spring tension is 32 to 40 ounces with new brushes. This tension is measured with a spring scale hooked under the brush spring near the brush and the reading is taken at right angles to the line of force exerted by the brush spring.

3. Check the position of the pinion to be sure the unit will mesh properly with the flywheel ring gear. See Chart 8002 for specifications.

BENCH TESTS.

1. After the starting motor is reassembled, it should be tested to see that no load current at a certain voltage is within specification as given in Chart 8002. To make this test, connect as shown in Figure 80-5. If current is too high, check the bearing alignment and end play to make sure there is no binding or interference. Two or three sharp raps on the frame with a rawhide hammer will often help to align the bearings and free the armature.
2. If no difficulty is indicated in the above test, a stall torque test may be made to see if the starting motor is producing its rated cranking power. Make test connections as shown in Figure 80-6.
3. If torque and current are not within specifications, check the seating of the brushes and internal connections for high resistance. If these checks are made and found to be in good order, replace frame and field assembly and retest starter.

STARTING MOTOR CONTROL CIRCUIT.

1. Inspect the control circuit wiring between the battery, solenoid and manual starting switch for breaks, poor connections and faulty insulation. Tighten all ground connections and make sure solenoid is firmly mounted and makes a good ground connection.
2. Check the voltage loss across the switch contacts during normal starting. If loss is in excess of 0.2 volts per 100 amps, the solenoid should be replaced.
3. If solenoid fails to operate when the manual starting switch is turned on, or if it fails to release when the manual starting switch is released, it should be replaced.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

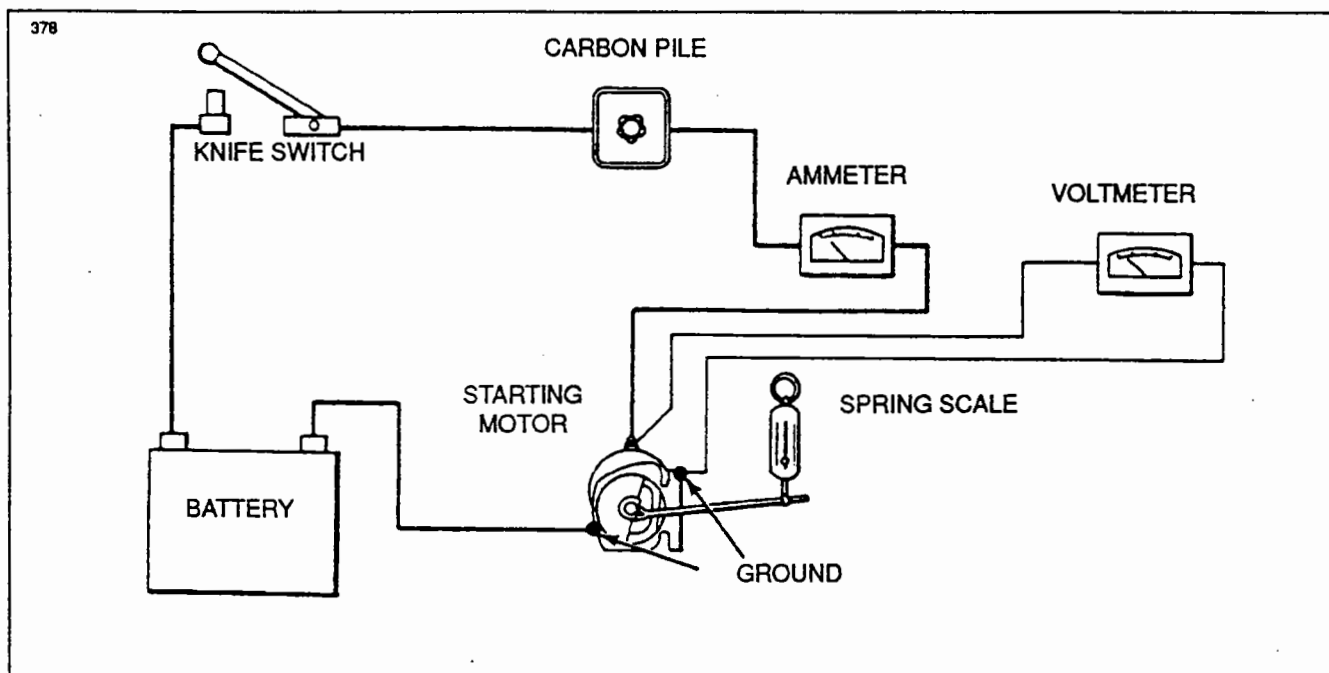


Figure 80-6. Stall Torque Hookup

STARTING MOTOR SERVICE TEST SPECIFICATIONS.

Prestolite specifications for 12 volt starting motors installed as standard equipment on PA 44-180 series airplanes are as follows:

CHART 8002. STARTING MOTOR SPECIFICATIONS

Motor Model	MZ-4220
Min. Brush Tension	32 oz.
Max. Brush Tension	40 oz.
No-Load Test (77° F)	
Volt	10
Max. Amps	75
Min. R.P.M.	2000
Stall Torque	
Amps	560
Min. Torque, Ft. Lbs.	38.0
Approx. Volts	4.0
Pinion Position*	
Drive at rest	1.748 in. - 1.855 in.
Drive extended	2.388 in. - 2.495 in.

*This dimension is measured from the centerline of the mounting hole nearest the drive end head to the edge of the pinion.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3I22 THROUGH 3I24
INTENTIONALLY LEFT BLANK**

CHAPTER

81

TURBINES

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 81 - TURBINES

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
81-00-00	GENERAL	3J3	
81-01-00	Description and Operation	3J3	
81-02-00	Troubleshooting	3J3	
81-03-00	Turbocharger Nomenclature	3J3	
81-20-00	TURBOCHARGER	3J9	
81-21-00	Removal of Turbocharger	3J9	
81-22-00	Installation of Turbocharger	3J9	
81-23-00	Prelubrication of Turbocharger	3J11	
81-24-00	Initial Run-In Procedure Precautions	3J13	
81-25-00	Routine Turbocharger Maintenance	3J13	
81-25-01	Periodic Inspection	3J13	
81-26~0	Absolute Pressure Relief Valve	3J13	
81-26-01	Removal of Absolute Pressure Relief Valve	3J14	
81-26~2	Installation of Absolute Pressure Relief Valve	3J14	
81-27~0	Exhaust Bypass Valve	3J14	8 - 82
81-27-01	Adjustment of Exhaust Bypass Valve	3J14	8 - 82

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

GENERAL.

DESCRIPTION AND OPERATION.

The turbocharger system (Figure 81-1) consists of a turbine and compressor assembly, ground adjustable exhaust bypass screw and the necessary hose and engine air intake ducts. The ground adjustable exhaust bypass screw allows some exhaust gas to bypass the turbine and flow directly overboard. The turbocharger requires little attention between overhauls. However, it is recommended that the items outlined in the Inspection Report be checked periodically.

— CAUTION —

EXTREME CARE SHOULD BE EXERCISED AT ALL TIMES WHILE SERVICING OPERATING TURBOCHARGERS. KEEP FINGERS AND FOREIGN OBJECTS AWAY FROM OPENINGS. AVOID CONTACT WITH HOT SURFACES.

OPERATION OF THE ENGINE AT ANY SPEED FASTER THAN IDLE IMMEDIATELY AFTER START-UP CAN RESULT IN "OIL LAG" FAILURE OF TURBOCHARGER BEARINGS, ESPECIALLY IN COLD WEATHER OR AFTER A PROLONGED NON-OPERATIVE PERIOD.

TROUBLESHOOTING.

CHART 8101. TROUBLESHOOTING (TURBOCHARGER)

Trouble	Cause	Remedy
Manifold pressure low or fluctuating.	Restriction in duct between air cleaner and turbocharger.	Remove restriction.
Aircraft cannot reach critical altitude.	Restriction in duct between compressor and engine intake manifold .	Remove restriction.
	Restriction in engine exhaust system after turbocharger.	Remove restriction.
	Restriction in engine intake or exhaust manifold.	Refer to appropriate engine manufacturers maintenance manual.
	Pressure relief valve opens at too low of a pressure.	Recalibrate or replace relief valve.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Oil leakage.	At too slow idle, turbocharger won't turn. Turbine seal leaks oil seen as blue smoke.	Increase idle speed.
	Engine oil wrong type or viscosity or unauthorized oil additives used.	Refer to engine manufacturer's maintenance manual.
	Restriction in duct between air cleaner and turbocharger.	Remove restriction.
	Restriction or faulty check valve in turbocharger oil lines.	Remove restriction or replace defective check valve.
	Engine malfunction allowing oil to enter exhaust (rings, pistons, valves, etc.)	Refer to engine manufacturer's maintenance manual.
Engine overboosts.	Pressure relief valve fails to open.	Recalibrate, overhaul or replace relief valve.
	Exhaust bypass valve improperly adjusted.	Adjust bypass valve.
Turbocharger output low or operates sluggishly.	Restriction in duct between compressor and engine intake manifold.	Remove restriction.
	Restriction in duct between air cleaner and turbocharger.	Remove restriction.
	Restriction in engine exhaust system after turbocharger.	Remove restriction.
	Restriction in engine intake or exhaust manifold.	Refer to engine manufacturer's maintenance manual.
	Heavy carbon build-up behind turbine wheel.	Overhaul turbocharger as needed.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Turbocharger output low or operates sluggishly (cont.)	Heavy sludge or coking in center housing.	Overhaul turbocharger as needed. Service engine lubrication system.
Turbocharger rotating assembly binding or dragging.	Compressor wheel damaged by foreign object.	Clean and repair air induction system. Overhaul turbocharger.
	Turbine wheel damaged by foreign object.	Clean and repair exhaust system. Overhaul turbocharger.
	Heavy carbon buildup behind turbine wheel.	Overhaul turbocharger as needed.
	Heavy sludge or coking in center housing.	Overhaul turbocharger. Service engine lubrication system.
Turbocharger seal leakage at turbine end.	Excessive prelube of turbo-charger.	Perform correct prelube of turbocharger.
	Restriction in engine crankcase breather.	Remove restriction,
	Restriction or faulty check valve in turbocharger oil drain line.	Remove restrictions or replace faulty check valve.
	Malfunction in oil scavenge pump or drain sump.	Refer to engine manufacturer's maintenance manual.
	Worn or damaged turbine wheel.	Clean and repair exhaust system as needed. Overhaul turbo-charger.
	Heavy sludge or coking in center housing.	Overhaul turbocharger-service engine lubrication system.
	Engine malfunction (Piston blowby or high internal crank-case pressure.	Refer to engine manufacturer's maintenance manual.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Turbocharger seal leakage at compressor end.	Air cleaner element clogged.	Service air cleaner.
	Restriction or faulty check valve in turbocharger oil drain line.	Remove restriction or replace faulty check valve.
	Restriction in duct between air cleaner and turbocharger.	Remove restriction.
	Malfunction in oil scavenge pump or drain pump.	Refer to engine manufacturer's maintenance manual.
	Restriction in engine crankcase breather.	Remove restriction.
	Worn or damaged compressor wheel.	Clean and repair induction system. Overhaul turbocharger.
	Engine malfunction (Piston blowby or high internal crankcase pressure.)	Refer to engine manufacturer's maintenance manual.
Pressure relief valve fails to open.	Relief valve aneroid bellows failed.	Overhaul or replace relief valve.
	Relief valve out of calibration.	Recalibrate or replace relief valve.
Excessive noise or vibration.	Improper bearing lubrication.	Supply required oil pressure, clean or replace oil line, clean oil screen. If trouble persists, overhaul turbocharger.
	Leak in engine intake or exhaust system.	Tighten loose connections or replace manifold exhaust gaskets as necessary.
	Dirty impeller blades.	Disassemble and clean turbocharger.
Engine will not deliver rated power.	Clogged induction system.	Clean all ducting and filter.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Engine will not deliver rated power. (cont)	Foreign material lodged in compressor, impeller or turbine.	Disassemble and clean.
	Excessive dirt build-up in compressor.	Clean compressor assembly. Service air cleaner and check for leakage .
	Leak in engine intake or exhaust.	Tighten loose connections or replace exhaust manifold gaskets as necessary.
	Turbocharger impeller binding, frozen or fouling housing.	Check bearing. Replace turbocharger as necessary.
	Rotating assembly bearing seizure.	Overhaul turbocharger.
— Note —		
Due to the critical tolerances and the high standards of workmanship involved, it is recommended that only qualified personnel attempt the overhaul of the turbochargers.		

TURBOCHARGER NOMENCLATURE.

Many unfamiliar terms may appear on the following pages of this manual. An understanding of these will be helpful in performing maintenance and troubleshooting. The following is a list of commonly used terms and a brief description of each.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

TURBOCHARGER NOMENCLATURE

TERM	MEANING
Absolute Pressure	Pressure measured above a vacuum rather than above ambient pressure.
Bootstrapping	This is a term used in conjunction with turbo machinery. If you were to take all the air coming from a turbocharger compressor and duct it directly back into the turbine of the turbocharger, it would be called a bootstrap system and if no losses were encountered, it would theoretically run continuously. It would also be very unstable because if for some reason the turbo speed would change, the compressor would pump more air to drive the turbine faster, etc. A turbo-charged engine above critical altitude is similar to the example mentioned above, except now there is an engine placed between the compressor discharge and turbine inlet. Slight system changes cause the exhaust gas to change slightly, which causes the turbine speed to change slightly, which causes the compressor air to the engine to change slightly, which in turn again affects the exhaust gas, etc.
Centrifugal	Acting in a direction away from a center or axis, as in the centrifugal, radial outflow of air in the turbocharger compressor.
Centripetal	Acting in a direction toward a center or axis, as in the centripetal, radial inflow of air in the turbocharger turbine.
Coking	Common term for the process in which oil is carbonized by overheating.
Compressor	That portion of the turbocharger which directs ambient air to the compressor wheel which compresses the air and discharges it to the engine throttle for mixing with fuel.
Critical Altitude	Altitude at which the engine can no longer maintain rated horsepower.
Deck Pressure	Pressure measured between the compressor discharge and the engine throttle valve (not to be confused with "manifold pressure").
Exhaust Bypass Valve	Valve in the exhaust system which can be adjusted to bypass some of the exhaust gas away from the turbocharger turbine thus reducing turbocharger speed and the degree of compression of air.
Intake Manifold	That part of the engine air intake system downstream of the throttle valve.
Manifold Pressure	Pressure measured downstream of the engine throttle valve. This pressure is almost directly proportional to engine power output.
Overboost	Condition detrimental to engine life and performance in which manifold pressure exceeds the limits at which the engine was tested and FAA certified.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

TURBOCHARGER NOMENCLATURE

TERM	MEANING
Prelubrication	Coating of all interior surfaces of the turbocharger with engine oil. Performed before storage of the turbocharger, at installation on an engine at each engine oil and filter change and after prolonged non-operation.
Static Pressure	Pressure measured in a housing or duct through a hole in the wall parallel to the direction of flow.
Turbine	That portion of the turbocharger which directs hot exhaust gas through the turbine wheel thus driving the shaft on which the compressor wheel is also mounted .
Turbocharger	Device which compresses air for the engine combustion chamber and in some cases for cabin pressurization, using a compressor driven by an exhaust-gas turbine.

TURBOCHARGER.

REMOVAL OF TURBOCHARGER.

1. Remove the upper cowling.
2. Disconnect the oil supply and return lines from the center housing of the turbocharger.
3. Disconnect the air ducts from the compressor inlet and outlet and the exhaust system from the turbine inlet and outlet.
4. Remove the bolts which secure the turbocharger to the mounting bracket and remove the turbo charger assembly.
5. Install protective covers on all openings on the turbocharger and the engine.

INSTALLATION OF TURBOCHARGER.

— CAUTION —

INSTALLATION OF THE TURBOCHARGER WITH THE CENTERLINE OF THE OIL DRAIN MORE THAN 35 DEGREES FROM VERTICAL CAN RESULT IN DAMAGE FROM INADEQUATE LUBRICATION.

1. Remove the protective covers from the turbocharger and the engine.
2. Check to ensure that the turbocharger compressor and turbine housings are properly oriented to the center housing and locked. (Refer to Airesearch Overhaul Manual TP20-0120-1 for proper orientation.)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

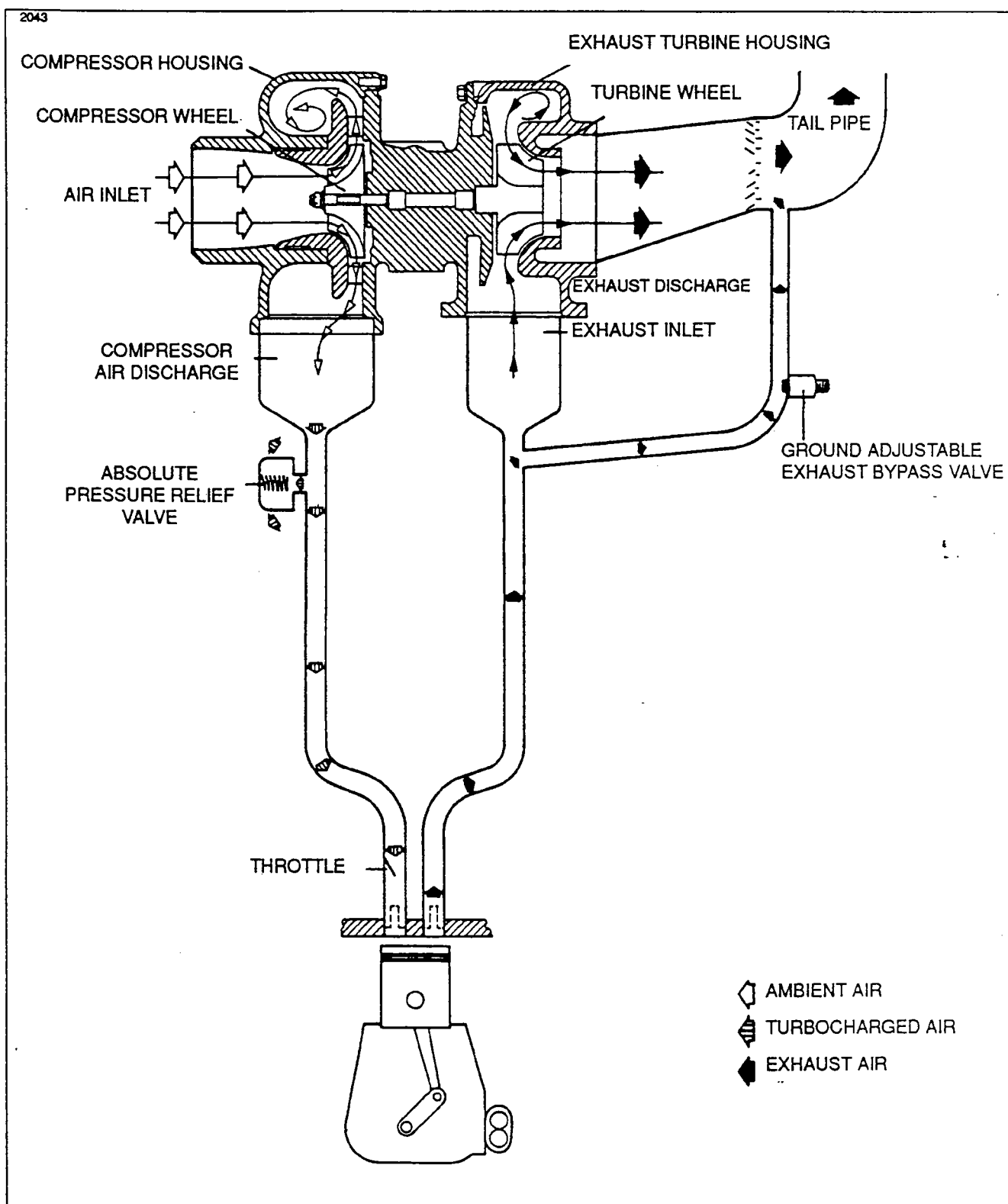


Figure 81-1. Schematic Diagram of Typical Turbocharger System

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

3. Position the turbocharger on the engine mounting flange, secure with three bolts and torque to 360 in. lbs. Safety with .032 safety wire.
4. Mate the turbine housing inlet to the exhaust system mounting flange. Coat the threads of the mounting bolts with Fel-Pro high temperature compound (or equivalent). Install and tighten the hardware to 360 in. lbs.
5. After installing new gaskets, connect the engine oil supply line to the turbocharger oil inlet port and connect the engine oil return line to the oil drain port.
6. Align the exhaust system mounting flange to the turbine housing outlet and secure.
7. Perform the prelubrication procedure as described in "Prelubrication of Turbocharger".
8. Align the carburetor inlet duct with the compressor housing outlet and secure.
9. Align the duct from the engine air cleaner to the turbocharger compressor inlet. Before tightening the duct connection, check whether bending loads are imposed upon the turbocharger by the ducting or other engine components.

— Note —

Bending loads imposed upon the turbocharger can add stress and reduce service life.

Should bending loads be present, perform the necessary repairs to alleviate the loads and then tighten the duct connection.

PRELUBRICATION OF TURBOCHARGER.

Upon completion of engine oil and filter change and following any prolonged period of non-operation, prelubrication of the turbocharger should be completed as follows:

1. Temporarily disconnect the engine oil supply line from the turbocharger oil inlet port and the engine air duct from the compressor housing inlet.
2. Fill the turbocharger oil inlet port with clean engine oil and manually turn the compressor wheel several revolutions to coat all journal and bearing surfaces with oil. Reconnect the air duct.
3. Place a suitable container under the disconnected engine oil supply line to avoid spilling oil on the engine.
4. Check that engine oil is at the 6 quart level. Remove the lower spark plugs, place the magneto switches "OFF", mixture control in "IDLE CUT-OFF" and the fuel selector in "OFF".
5. Using a 12 to 15 volt external power source, crank the engine until a steady flow of oil is obtained from the supply line indicating that air has been purged from the system. Reconnect the oil supply line.
6. If the turbocharger is being installed on a new or newly overhauled engine which has not completed its initial run-in period, refer to "Initial Run-in Procedure Precautions."

— CAUTION —

OPERATION OF THE ENGINE AT A SPEED GREATER THAN IDLE IMMEDIATELY AFTER START CAN RESULT IN "OIL LAG" FAILURE OF THE TURBOCHARGER BEARINGS. THIS IS ESPECIALLY TRUE DURING COLD WEATHER OR AFTER A PROLONGED NON-OPERATIONAL PERIOD

7. Ensure that all air and exhaust inlet ducts and filters are properly installed. Start the engine and idle for three or four minutes allowing engine oil pressure and flow to stabilize. Shut-down the engine and check for oil leaks. Tighten or repair as needed.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

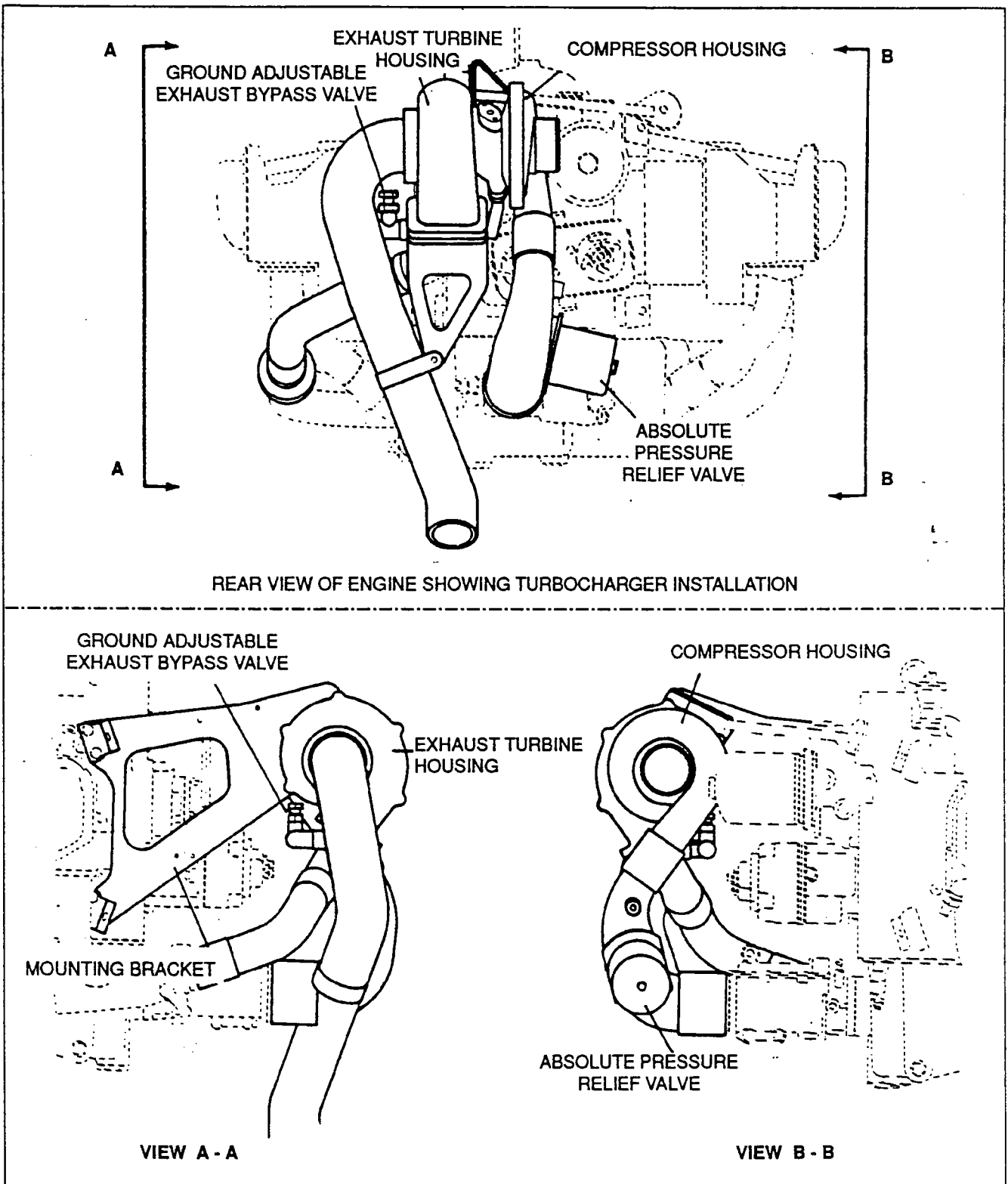


Figure 81-2. Turbocharger Installation

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

INITIAL RUN-IN PROCEDURE PRECAUTIONS.

To protect the turbocharger during engine initial run-in on new or newly overhauled engines, perform the following precautions:

1. TEMPORARILY install a screen of 100 mesh or finer in the oil supply line to the turbocharger to trap metal particles from the engine.

— CAUTION —

BECAUSE CLEANING OF THE EXTRA SCREEN IS NOT PROVIDED FOR IN THE PERIODIC INSPECTION GUIDE, THE SCREEN MUST NOT BE LEFT IN PLACE AFTER THE INITIAL RUN-IN PERIOD OPERATION OF THE TURBOCHARGER WITH A CLOGGED SCREEN WILL CAUSE TURBOCHARGER FAILURE DUE TO A LACK OF LUBRICATION.

2. Upon completion of the initial run-in period, remove the screen from the oil supply line.

ROUTINE TURBOCHARGER MAINTENANCE.

PERIODIC INSPECTION.

Whenever routine service of the engine is performed, inspect the turbocharger as follows:

1. Inspect all components of the air induction system for loose connections, cuts, cracks, punctures, corrosion or other evidence of deterioration.
2. Check the air duct connection between the compressor and the engine intake manifold and between the intake manifold and engine.
3. Ensure that the engine air cleaner has been inspected and serviced.
4. Inspect the exhaust system for leakage.
5. Disconnect the exhaust ducting from the turbine outlet and examine the turbine wheel blades for damage. Check for oil in the turbine wheel housing indicating seal leakage. Check for evidence of wheel rub on the housing.
6. Inspect for oil leakage at the turbocharger center housing oil inlet and drain port connections.
7. Check the engine crankcase breather for restrictions to air flow. Correct as required.

ABSOLUTE PRESSURE RELIEF VALVE.

The absolute pressure relief valve is mounted on the duct between the compressor outlet and the engine intake manifold. Deck pressure acting upon an aneroid bellows opens the valve at a predetermined value thereby limiting any possible damaging overboost.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

REMOVAL OF ABSOLUTE PRESSURE RELIEF VALVE.

1. Remove the four screws and washers which secure the relief valve to the duct.
2. Lift the relief valve assembly from the duct.
3. Remove the O-ring from the seating surface of the relief valve mounting flange on the duct.

INSTALLATION OF ABSOLUTE PRESSURE RELIEF VALVE.

1. Install a new O-ring and position the relief valve on the mounting flange of the duct.
2. Install the washers, screws and safety wire.

EXHAUST BYPASS VALVE.

The exhaust bypass valve is mounted on the crossover tube between the exhaust turbine inlet duct and the tailpipe. This ground adjustable unit is set to a predetermined value, thus bypassing a fixed amount of exhaust gas away from the turbocharger turbine limiting the turbocharger speed and the degree of compression of the air leaving the compressor.

ADJUSTMENT OF EXHAUST BYPASS VALVE.

— Note —

Before making any adjustments to the exhaust bypass valve, perform a complete inspection of the power plant system.

The exhaust bypass valve is preset at the factory so as to reach critical altitude at 12,000 feet density altitude, full throttle and 36.5 inches hg. manifold pressure. Adjustment should be accomplished only if the critical altitude cannot be reached and the powerplant system has been thoroughly checked.

1. After removing the upper cowling to gain access to the exhaust bypass valve, remove the safety wire from the valve.
2. Adjust the exhaust bypass valve initially so that there is 1/4 inch between the bolt head and the top of the jam nut.
3. If critical altitude is not obtainable at the initial setting, further adjustments should be made as follows:
 - a. To increase critical altitude turn bolt clockwise. To decrease turn bolt counterclockwise.
 - b. For each flat turned of the adjusting bolt head the critical altitude will change 200 feet.
4. Upon completion of adjustments, safety wire the adjusting bolt and reinstall the cowling.

— END —

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 3J15 THROUGH 3L24
INTENTIONALLY LEFT BLANK**



SEMINOLE
MAINTENANCE MANUAL

CARD 4 OF 4

PA-44-180 SEMINOLE

PA-44-180T TURBO SEMINOLE

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 664)

NOTE

PLEASE INSERT THE FOLDOUT PAGES, LOCATED AT THE END OF THIS MANUAL,
IN THEIR PROPER NUMERICAL SEQUENCE PRIOR TO USING THE MANUAL.

WARNING

The information contained in this manual is periodically revised. Piper Aircraft Corporation urges all users of this manual to keep it current. Contact your nearest Piper Aircraft Corporation distributor to arrange for a subscription to future revisions.

NOTE

Revision service is available in microfiche format only.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

INTRODUCTION.

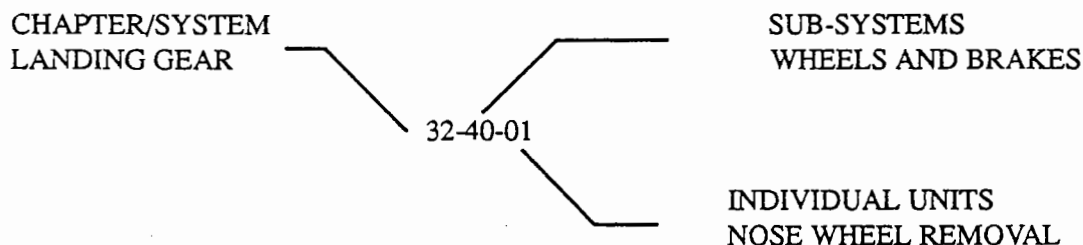
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

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

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

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

Example:



This manual does not contain hardware callouts for installation. Hardware callouts are only indicated where a special application is required. To confirm the correct hardware used, refer to the PA-44 Parts Catalog P/N 761 663, and FAR 43 for proper utilization.

WARNINGS, CAUTIONS, and NOTES are used throughout this manual to emphasize important information.

— WARNING —

***OPERATING PROCEDURES, PRACTICES, ETC., WHICH MAY RESULT IN
PERSONAL INJURY OR LOSS OF LIFE IF NOT CAREFULLY FOLLOWED.***

— CAUTION —

***OPERATING PROCEDURES, PRACTICES, ETC., WHICH IF NOT
STRICTLY OBSERVED MAY RESULT IN DAMAGE TO EQUIPMENT.***

— Note —

An operating procedure, condition, etc., which is essential to emphasize.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual = TEXTRON LYCOMING - OVERHAUL MANUAL
DIRECT DRIVE ENGINE - P/N 60294-7
Textron Lycoming Division
Williamsport, Pa 17701

Parts Catalog = TEXTRON LYCOMING — O-360 AND LO-360 E SERIES - P/N PC-123
TEXTRON LYCOMING — TO-360 AND LTO-360 E SERIES - P/N PC-124
TEXTRON LYCOMING — O-360 AND LO-360 A SERIES - P/N PC306-5
Textron Lycoming Division
Williamsport, Pa. 17701

Operators Handbook = TEXTRON LYCOMING O-360 AND LO-360 E SERIES - P/N 60297-25;
TEXTRON LYCOMING TO-360 AND LTO-360 E SERIES - P/N 60297-26;
TEXTRON LYCOMING O-360 AND LO-360 A SERIES - P/N 60297-12;
AIRCRAFT ENGINES
Textron Lycoming Division
Williamsport, Pa 17701

PROPELLER:

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

MAGNETOS:

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

4200 SERIES MAGNETOS
IGNITION, SYSTEM - P/N L-1199, L-1037
Slick Electro, Inc.
Rockford, Illinois 61104

TURBOCHARGERS:

Overhaul Manual = OVERHAUL MANUAL FOR
AIRCRAFT TURBOCHARGERS
VALVES AND CONTROLLERS
NUMBER TP20-0120-1
Airesearch Industrial Division
3201 Lomitor Blvd.
Torrance, Calif. 90505

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

VENDOR PUBLICATIONS. (cont)

RADAR ALTIMETER:

Maintenance
Instructions =

KING KRA-10 MAINTENANCE/OVERHAUL
MANUAL NUMBER 006-5152-00
King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061

Installation Manual =

BONZER MK 10X
Bonzer Incorporated
90th and Cody
Overland Park, Kansas 66214
INSTALLATION MANUAL
NUMBER 006-0152-00
King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061

AUTOFLIGHT:

Manufacturer =
KFC-150

EDO-AIRE MITCHELL	or	KING RADIO CORPORATION
P.O.Box 610		400 North Rogers Road
Mineral Wells, Texas 76067		Olathe, Kansas 66061

FUEL CELLS:

Maintenance=

LORAL, Engineered Fabrics (or)	Goodyear Aerospace Corp.
669 Goodyear Street	Engineered Fabrics Division
Rockmart, Georgia 30153-0548	Rockmart, Georgia 30153

PIPER PUBLICATIONS.

AUTOFLIGHT:

AutoControl IIIB
Service Manual =
AutoControl IIIC
Service Manual =

Piper P/N 761 502

Piper P/N 761 602

PA-44-180/180T

Parts Catalog =

Piper P/N 761 663

Inspection Reports =

Piper P/N 230 963

Programmed Inspection
Manual =

Piper P/N 761 733

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

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 given 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 illustration.
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, 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 Indication, (1R Month-Year)
Second Revision:	Revision Indication, (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 761 664 issued May 1, 1978 are as follows:

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

AEROFICHE EXPLANATION AND REVISION STATUS (cont)

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG791212	December 12, 1979	1, 2, and 3
PR800822	August 22, 1980	1, 2, and 3
PR810223	February 23, 1981	1, 2, and 3
PR810824	August 24, 1981	1, 2, and 3
PR820826	August 26, 1982	1, 2, and 3
PR820909	September 9, 1982	1, 2, and 3
PR830103	January 3, 1983	1, 2, and 3
PR840326	March 26, 1984	1, 2, and 3
IR860730	July 30, 1986 (Interim)	1
I PR890515	August 3, 1989	1, 2, 3 and 4

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

GAMA SYSTEM/CHAPTER INDEX GUIDE

SYST CHAP	SUB-SYST SECTION	TITLE	AEROFICHE GRID NO.
4		AIRWORTHINESS	1A18
5		TIME LIMITS/MAINT CHECKS	1A21
6		DIMENSIONS AND AREAS	1B14
7		LIFTING AND SHORING	1C1
8		LEVELING AND WEIGHING	1C5
9		TOWING AND TAXIING	1C10
10		PARKING AND MOORING	1C14
11		REQUIRED PLACARDS	1C17
12		SERVICING	1C22
20		STANDARD PRACT - AIRFRAME	1E2
21		ENVIRONMENTAL SYSTEM	1E12
22		AUTOFLIGHT	1H21
23		COMMUNICATIONS	1H24
24		ELECTRICAL POWER	1I10
25		EQUIPMENT / FURNISHINGS	1J12
26		FIRE PROTECTION	1J17
27		FLIGHT CONTROLS	1J24
28		FUEL	2A18
29		HYDRAULIC POWER	2B17
30		ICE AND RAIN PROTECTION	2D1
32		LANDING GEAR	2F13

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

SYST CHAP	SUB-SYST SECTION	TITLE	AEROFICHE GRID NO.
33	LIGHTS		2I6
34	NAVIGATION & PITOT/STATIC		2I16
35	OXYGEN		2J7
37	VACUUM		2K6
39	ELECTRICAL/ELECTRONIC PANELS AND MULTI-PURPOSE PARTS		2K19
51	STRUCTURES		2L7
52	DOORS		3A18
55	STABILIZERS		3B8
56	WINDOWS		3B22
57	WINGS		3C10
61	PROPELLER		3D1
71	POWER PLANT		3D21
73	ENGINE FUEL SYSTEM		3F1
74	IGNITION		3F16
77	ENGINE INDICATING		3H1
78	EXHAUST		3H19
79	OIL		3I1
80	STARTING		3I11
81	TURBINES		3J1
91	CHARTS AND WIRING DIAGRAMS		4A18

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS

FIGURE NO.	SUBJECT	GRID NO.
6-1.	Three View	1B19
6-2.	Station References	1B20
6-3.	Access Plates and Panels	1B22
7-1.	Jacking	1C4
8-1.	Leveling Airplane	1C8
8-2.	Weighing	1C9
11-1.	Placards and Decals	1C20
11-1A.	Placards and Decals	1C21
12-1.	Service Points	1D1
12-2.	Lubrication Chart - Landing Gear, Main	1D15
12-3.	Lubrication Chart - Landing Gear, Nose	1D17
12-4.	Lubrication Chart - Control System, Part 1	1D19
12-5.	Lubrication Chart - Cabin Door, Baggage Door and Seats	1D20
12-6.	Lubrication Chart - Control System, Part 2	1D22
12-7.	Lubrication Chart - Power Plant and Propeller	1D24
20-1.	Torque Wrench Formula	1E4
20-2.	Method of Installing Rod End Bearings	1E5
20-3.	Cherrylock Rivet Removal	1E6
20-4.	Identification of Aircraft Fluid Lines	1E8
21-1.	Cabin Environmental System Installation	1E24
21-2.	Heater and Combustion Air Blower Assembly	1F1
21-3.	Diagrammatic Cutaway of Heater to Show Whirling Flame Action	1F2
21-4.	Fuel Regulator and Shutoff Valve	1F3
21-5.	Top View - Duct Switch	1F3
21-6.	Intake Valve and Switches	1F4
21-7.	Wiring Diagram (Heater)	1F8
21-8.	Primary Power Circuit (Heater)	1F9
21-9.	Starting Power Circuit (Heater)	1F10
21-10.	Spark Plug Fixture (Heater)	1F12
21-11.	Wiring - Test Setup (Heater)	1F12
21-12.	Spark Plug Gap Adjustment (Heater)	1F13
21-13.	Ignition Unit Assembly (Heater)	1F17
21-14.	Test Setup for Fuel Regulator and Shutoff Valve (Heater)	1F20
21-15.	Heater Fuel Pump	1F21
21-16.	Suggested Design for Seal Plates, Plugs, and Caps for Combustion Tube leakage Test	1G1
21-17.	Test Setup for Combustion Air Pressure Switch	1G1
21-18.	Exploded View of Heater Assembly	1G6
21-19.	Exploded View - Combustion Air Blower and Motor Assembly	

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
21-20.	Suggested Setup of Heater Operation Test	1G10
21-21.	Wiring Connections for Heater Operation Test	1G10
21-22.	Spark Plug Gap Adjustment Tool	1G13
21-23.	Heater Hourmeter Installation	1G14
21-24.	Air Conditioning System Installation (PA-44 - 180T S/N 44-8107027 and up)	1G21
21-25.	Test Gauge and Manifold Set	1H2
21-26.	Manifold Set Operation	1H3
21-27.	Leak Test Hookup	1H4
21-28.	Evacuation Hookup	1H6
21-29.	Charging Stand	1H8
21-30.	Charging Hookup	1H9
21-31.	Top Dead Center Casting Mark (Sankyo Compressor)	1H12
21-32.	Rotation of Clutch Front Plate (Sankyo Compressor Oil Check)	1H12
21-33.	Condenser Installation	1H15
21-34.	Expansion Valve	1H17
21-35.	Components Installation	1H19
23-1.	Emergency Locator Transmitter Installation	1I3
23-2.	ELT Using Fixed Aircraft Antenna (Narco)	1I5
23-3.	ELT Portable Folding Antenna (Narco)	1I5
23-4.	Communications Components ELT Schematic	1I9
23-5.	Narco ELT Schematic	1I9
24-1.	Lamp Bank load	1I22
24-2.	Battery Box	1I24
24-3.	Electrical Component Location	1J3
24-4.	Regulator Diagram (LAMAR)	1J4
24-5.	Testing Regulator (LAMAR)	1J7
24-6.	Adjusting Regulator (LAMAR)	1J8
27-1.	Correct Method of Installing: Rod End Bearing	1K8
27-2.	Control Column Assembly	1K11
27-3.	Aileron Controls	1K13
27-4.	Bellcrank Rigging Tool	1K16
27-5.	Aileron Rigging	1K17
27-6.	Rudder Controls	1K20
27-7.	Rudder Rigging	1K21
27-8.	Clamping Rudder Pedals	1K21
27-9.	Rudder Travel Adjustments	1K22
27-10.	Rudder Trim Controls	1L1
27-11.	Rudder Pedal Assembly	1L4
27-12.	Stabilator Controls	1L6

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
27-13.	Stabilator Rigging	1L8
27-14.	Stabilator Travel Adjustments	1L10
27-15.	Methods of Securing Trim Cables	1L10
27-16.	Stabilator Trim Controls	1L12
27-17.	Wrapping Trim Barrels	1L15
27-18.	Stabilator Trim Screw Adjustment	1L15
27-19.	Flap Controls	1L17
27-20.	Flap Step Adjustment	1L19
27-21.	Flap Rigging Tool	1L22
28-1.	Fuel System Installation	2A22
28-2.	Fuel Cell Installation	2B2
28-3.	Locking Fuel Cap Assembly	2B9
28-4.	Gascolator Assembly	2B11
28-5.	Fuel Selector Valve	2B12
28-6.	Fuel Gauge	2B15
28-7.	Fuel Pressure Gauge and Calibration	2B16
28-7A.	Fuel Pressure Gauge and Calibration (S/N 44-95001 & up)	2B16
29-1.	Schematic Diagram of Hydraulic System	2B20
29-1A.	Schematic Diagram of Hydraulic System (S/N 44-95001 & up)	2B21
29-2.	Hydraulic System Installation	2B22
29-3.	Hydraulic Pump/Reservoir, Exploded View	2C8
29-3A.	Hydraulic Pump/Reservoir, Exploded View (Oildyne)	2C9
29-4.	Test and Adjustments of Hydraulic Pump	2C12
29-5.	Nose Gear Actuating Cylinder	2C15
29-6.	End Gland Locking Device (Main Gear)	2C17
29-7.	Main Gear Actuating Cylinder	2C17
30-1.	Pneumatic Deice System Installation	2D9
30-2.	Deice Control Panel Installation	2D16
30-3.	Electric Prop Deice System Installation	2E9
30-3.	Electric Prop Deice System Installation (cont)	2E10
30-4.	Suggested Use of Dial Indicator	2E13
30-5.	Centering of Brushes on Slip Rings	2E13
30-6.	Modular Brush Assembly Alignment	2E14
30-7.	Measuring Brush Assemblies	2E15
30-8.	Brush Module Assembly 3E2011	2E16
30-9.	Modular Brush Assembly 3E2090-1	2E16
30-10.	Installation of Deicer Boots	2E19
30-11.	Typical Deicer Boot Scaler Application	2E22
30-12.	Wrinkled Deicer	2E22
30-13.	Deicer Wiring Harness Installation (Typical)	2F1
30-14.	Wing Ice Lighting System	2F3

PIPER AIRCRAFT

PA-44-180/180T

AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
30-15.	Ice Detection System	2F6
30-16.	Heated Pitot and Heated Lift Detector Installation (PA-44-180T)	2F7
32-1.	Main Gear Oleo Strut Assembly	2G1
32-2.	Main Gear Service Tolerances	2G3
32-3.	Main Gear Installation	2G8
32-3.	Main Gear Installation (cont)	2G9
32-4.	Aligning Main Gear	2G13
32-5.	Nose Gear Oleo Strut Assembly	2G15
32-6.	Nose Gear Installation	2G17
32-7.	Nose Gear Service Tolerances	2G19
32-8.	Nose Gear Downlock and Eccentric Bushing Installation	2G24
32-9.	Nose Gear Adjustment	2H2
32-10.	Clamping Rudder Pedals in Neutral Position	2H4
32-11.	Rudder Pedals at Neutral Angle	2H4
32-12.	Mechanical Nose Gear Door Mechanism	2H6
32-13.	Nose Wheel Assemblies	2H8
32-14.	Main Wheel Assembly	2H10
32-15.	Wheel Brake Assembly	2H12
32-16.	Removal and Installation of Anchor Bolts	2H13
32-17.	Brake Installation	2H15
32-18.	Parking Brake Valve Assembly	2H16
32-19.	Brake Cylinder (1700)	2H17
32-20.	Brake Cylinder (10-27)	2H17
32-21.	Brake Cylinder (10-30) (Toe Brake)	2H18
32-22.	Toe Brake Installation	2H21
32-23.	Adjustment of Main Gear Down Limit Switch	2H23
32-24.	Adjustment of Nose Gear Down Limit Switch	2H23
32-25.	Throttle Warning Switches	2I1
34-1.	Pitot-Static System Installation	2I20
35-1.	Fixed - Oxygen System	2J10
35-2.	Portable - Oxygen System	2J11
35-3.	Test Apparatus for Testing Oxygen System	2J14
35-4.	Oxygen Tubing Installations	2J15
35-5.	Installation of Swageloc Fittings	2J18
37-1.	Vacuum System Installation	2K9
37-2.	Vacuum Regulator	2K11
39-1.	Annunciator Panel Installation	2K23
39-1A	Annunciator Panel Installation (PA-44-180, S/N 44-95001 and up)	2K24
39-2.	Electric Clock Installation	2L2
39-2.	Electric Clock Installation (cont)	2L3
51-1.	Skin Materials and Thickness	2L10
51-1.	Skin Materials and Thickness (cont)	2L11

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
51-2.	Surface Scratches or Ground-in-Dirt	2L15
51-3.	Deep Scratches. Shallow Nicks and Small Holes	2L16
51-4.	Mixing of Epoxy Patching Compound	2L16
51-5.	Welding Repair Method	2L17
51-6.	Repairing of Cracks	2L17
51-7.	Various Repairs	2L18
51-8.	Repair of Stress Lines	2L20
51-9.	Repair of Impacted Damage	2L20
52-1.	Door Installation	3A21
52-1a.	Door Snubber Installation	3A23
52-2.	Fabricated Tool for Baggage Door Lock	3A24
52-3.	Emergency Exit Installation	3B2
55-1.	Stabilator Installation	3B11
55-2.	Stabilator Balance Configuration	3B12
55-3.	Vertical Fin Installation	3B13
55-4.	Rudder Installation	3B15
55-5.	Rudder Balancing	3B16
56-1.	Windshield Installation	3C9
56-2.	Side Window Installation	3C3
57-1.	Wing Installation	3C14
57-2.	Aileron and Flap Installation	3C18
57-3.	Aileron Balancing	3C20
61-1.	Typical Nicks and Removal Method	3D4
61-2.	Propeller Installation	3D5
61-3.	Propeller Governor	3D7
61-4.	Adjustment of Propeller Control	3D7
61-5.	Synchrophaser System Installation	3D9
61-6.	Pulse Generator Assembly	3D11
61-7.	Backup Test of Pulse Generator	3D14
61-8.	Propeller Unfeathering System (PA-44-180, S/N 44-95001 and up)	3D17
71-1.	Engine and Shock Mount Installation	3E8
71-2.	Engine Cowling Installation	3E13
71-3.	Cowl Flap Installation	3E13
71-4.	PA-44-180 Induction System	3E15
71-5.	PA-44-180T Induction System	3E18
73-1.	Carburetor	3F3
73-2.	Engine Primer System (PA-44-180)	3F6
73-3.	Fuel System Schematic (PA-44-180T)	3F6
73-3a.	Electric Primer System (PA-44-180, S/N 44-95001 and up)	3F7
73-4.	Engine Primer System (PA-44-180T)	3F8

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
73-5.	Adjustment of Engine Controls	3F10
74-1.	Height of Spring in Distributor Block Tower	3F21
74-2.	Contact Points	3F21
74-3.	Engine Timing Marks	3F23
74-4.	Timing Light Connected to Magneto	3F23
74-5.	Timing Marks on Magneto Rotor	3F24
74-6.	Painted tooth Centered in Timing Window	3G1
74-7.	Timing Mark on Rotor Aligned with Pointer	3G1
74-8.	Timing Light Connected to Magneto and Breakers	3G4
74-9.	Cam End View of Magneto	3G5
74-10.	Removing Impulse Coupling	3G7
74-11.	Checking Flyweight to Stop Pin Clearance	3G7
74-12.	Stop Pin Installation Dimension	3G7
74-13.	Checking Flyweight Axial Wear with Drill Shank	3G8
74-14.	Checking Flyweight Radial Wear with Gauge	3G8
74-15.	Points of Coupling Body Wear	3G9
74-16.	Acceptable and Deformed Coupling Springs	3G9
74-17.	Checking Impulse Coupling for Magnetization	3G11
74-18.	Orientation of Spring in Coupling Body	3G11
74-19.	Lifting Inner End of Spring	3G11
74-20.	Checking Harness Leads Continuity	3G13
74-21.	Checking Harness Leads Insulation Resistance	3G13
74-22.	Modified Pliers	3G13
74-23.	Removing Spring From Lead Assembly	3G13
74-24.	Assembly Tool	3G15
74-25.	Using Assembly Tool	3G15
74-26.	Ferrule Positioned Under Braid	3G16
74-27.	Ferrule Seating Tool	3G16
74-28.	Position of 11-8627 Kit and Contact Spring at Start of Installation	3G17
74-29.	Position of 11-8627 Kit and Contact Spring After Installation	3G17
74-30.	Lubricating Sleeve	3G17
74-31.	Lubricating Ferrule Shoulder	3G17
74-32.	Removing Spark Plug Frozen to Bushing	3G19
74-33.	Magneto and Starter Switches	3G21
77-1.	Engine Instrument Lines Installation	3H3
77-2.	Electric Tachometer Installation	3H9
77-3.	Cylinder Head Temperature Gauge Calibration (S/N 44-95001 and up)	3H12
77-4.	EGT Probe Installation (PA-44-180T)	3H16
78-1.	Inspection of Mufflers	3H21
79-1.	Oil Pressure Gauge Calibration (PA-44-180, S/N 44-95001 and up)	3I6
79-2.	Oil Temperature Gauge Calibration (PA-44-180, S/N 44-95001 and up)	3I8

Introduction

Page -13

Revised: May 15, 1989

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

LIST OF ILLUSTRATIONS (cont)

FIGURE NO.	SUBJECT	GRID NO.
80-1.	Exploded View of Gear Reduction Starter Motor	3I16
80-2.	Turning Motor Commutator	3I19
80-3.	Testing Motor Armature for Shorts	3I19
80-4.	Testing Motor Fields for Grounds	3I19
80-5.	No Load Test Hookup	3I19
80-6.	Stall Torque Hookup	3I21
81-1.	Schematic Diagram of Typical Turbocharger System	3J10
81-2.	Turbocharger Installation	3J12
91-1.	Tire Balancer Fixture	4B1
91-2.	Control Surface Balancing Tool	4B11
91-3.	Fabricated Aileron Bellcrank Rigging Tool	4B12
91-4.	Fabricated Aileron and Flap Rigging Tool	4B13
91-5.	Fabricated Stabilator Rigging Tool	4B14
91-6.	Fabricated Rudder Rigging Tool	4B14

ELECTRICAL SCHEMATICS

— Note —

Refer to Card 4 Grid No. 4B19 for Electrical Schematic Index.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

LIST OF CHARTS

CHART NO.	SUBJECT	GRID NO.
601	Leading Particulars and Principal Dimensions	1B16
1201	Thread Lubricants	1E1
2001	Maximum Distance Between Supports for Fluid Tubing	1E7
2101	Troubleshooting (Janitrol Heater)	1E17
2102	Blower System Wire Color Codes	1E22
2101	Inspection (Ignition Unit)	1F18
2104	Troubleshooting (Air Conditioner)	1G16
2105	Temperature Pressure Chart	1G22
2106	Aluminum Tubing Torque	1H1
2107	Evaporator Blower Motor Wire Codes	1H19
2401	Troubleshooting (Alternator)	1I14
2402	Troubleshooting (Battery)	1I19
2403	Alternator Belt Tension	1I23
2404	Hydrometer Reading and Battery Charge Percent	1J1
2701	Troubleshooting (Surface Controls)	1K4
2702	Cable Tension Vs. Ambient Temperature	1K9
2801	Troubleshooting (Fuel System)	2A23
2802	Sender/Fuel Quantity Gauge Tolerances	2B15
2901	Troubleshooting (Hydraulic System)	2B24
2902	Leading Particulars, Hydraulic System	2C13
2903	Characteristics, Hydraulic Pump Motor	2C13
3001	Troubleshooting (Pneumatic Deice System)	2D7
3002	Operating Pressures	2D11
3003	Materials and Supplies for Cold Repair	2D18
3004	Troubleshooting (Propeller Deicer System)	2D19
3005	Required Materials for Repair of Propeller Deicer	2E20
3006	Mixing of Materials	2E23
3007	Electrical Resistance	2E23
3201	Troubleshooting (Landing Gear)	2F18
3202	Toe-In, Toe-Out Correction	2G11
3401	Troubleshooting (Rate of Climb Indicator)	2I21
3402	Troubleshooting (Altimeter)	2I22
3403	Troubleshooting (Airspeed Tubes and Indicator)	2I23
3404	Troubleshooting (Magnetic Compass)	2J1
3501	Troubleshooting (Oxygen System)	2J12
3502	Oxygen System Limits	2J19
3503	Filling Pressure for Certain Ambient Temperatures	2J24
3504	Portable Oxygen System Component Limits	2K2
3701	Troubleshooting (Vacuum System)	2K10
3901	Troubleshooting (Annunciator Panel)	2K22
5101	List of Materials (Thermoplastic Repair)	2L14

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

LIST OF CHARTS (cont)

CHART NO.	SUBJECT	GRID NO.
6101	Propeller Torque Limits	3D4
7101	Troubleshooting (Engine)	3D24
7301	Fuel Pressure Sender Test Specifications	3F11
7302	Troubleshooting (Fuel Pressure Gauge)	3F12
7401	Troubleshooting (Magnet)	3F18
7402	Coupling Torques	3G18
7701	Manifold Pressure Indicator (Troubleshooting)	3H6
7702	Tachometer (Troubleshooting)	3H7
7703	Cylinder Head Temperature (Troubleshooting)	3H11
7704	Exhaust Gas Temperature (Troubleshooting)	3H14
7901	Oil Pressure Sender Test Specifications	3I4
7902	Oil Pressure Gauge (Troubleshooting)	3I5
7903	Oil Temperature Indicators (Troubleshooting)	3I7
8001	Troubleshooting (Starter)	3I13
8002	Starting Motor Specifications	3I21
8101	Troubleshooting (Turbocharger)	3J3
9101	Flare Fitting Torques	4A20
9102	Recommended Nut Torques	4A21
9103	Decimal Conversions	4A23
9104	Decimal Equivalents of Drill Sizes	4A24
9105	List of Consumable Materials	4B2
9106	Metric Conversion Tables	4B7
9107	Electric Wire Coding	4B8
9108	Electric Symbols	4B15
9109	Electrical System Component Loads	4B16

CHAPTER

91

**CHARTS
AND
WIRING DIAGRAMS**

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHAPTER 91 - CHARTS AND WIRING DIAGRAMS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER SECTION SUBJECT	SUBJECT	GRID NO.	EFFECTIVITY
91-00-00	GENERAL	4A20	
91-01-00	Torque Requirements	4A20	
91-01-01	General Requirements	4A20	
91-01-00	Decimal Conversions	4A23	
91-03-00	Decimal Millimeter Equivalents of Drill Sizes	4A24	8 - 80
91-04-00	Tire Balancer Building Instructions	4B1	
91-05-00	List of Consumable Materials	4B2	
91-06-00	Metric Conversion Tables	4B7	A 8 - 80
91-10-00	SPECIAL TOOLS	4B11	
91-11-00	Control Surface Balancing Tool	4B11	2 - 81
91-12-00	Fabricated Aileron Bellcrank Rigging Tool	4B12	
91-13-00	Fabricated Aileron and Flap Rigging Tool	4B13	
91-14-00	Fabricated Stabilator Rigging Tool	4B14	
91-15-00	Fabricated Rudder Rigging Tool	4B14	
91-20-00	ELECTRICAL SCHEMATICS	4B15	
91-21-00	Electrical Wire Coding	4B15	
91-22-00	Electrical Symbols	4B16	
91-23-00	Electrical Schematic Index	4B17	8 - 82

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

TORQUE REQUIREMENTS.

The torque values given in Chart 9102 are derived from oil-free cadmium-plated threads and are recommended for all airframe installation procedures where torqueing is required, unless otherwise noted in sections where other values are stipulated. Propeller torque values are found in Chapter 61 of this manual. Chart 9101 lists the torque values for flared fittings of various sizes and material.

— CAUTION —

DO NOT OVERTORQUE FITTINGS

— Note —

When flared fittings are being installed, ascertain that the male threads are properly lubricated. Torque the fittings in accordance with Chart 9101.

CHART 9101. FLARE FITTING TORQUES

TORQUE—INCH-POUNDS						
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	---	---	---	---	---	---

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

CHART 9102. 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. The following procedures should be followed to assure that the correct torque is applied: 1. Self-Locking Fasteners - Add the friction torque from Chart "A" for sizes 8 through 7/16 to the recommended torque from Chart "B" to get the final torque. This would be the actual reading on the torque wrench. To determine friction drag torque for sizes 1/2 through 1 1/4, turn the nut fully on to the bolt and determine the torque required to turn the nut. Add this friction drag torque to the torque given in Chart "B". 2. Castellated and Non-Self Locking Nuts - Use only the torque given in Chart "B". Unless otherwise specified, when castellated nuts are used with a cotter pin on moving joints, do not torque the nut. Turn the nut onto the bolt until proper grip is established and alignment with the cotter pin hole is achieved. Then install the cotter pin. GENERAL REQUIREMENTS. 1. Calibrate the torque wrench periodically to assure accuracy. Recheck frequently. 2. Ascertain that the bolt and nut threads are clean and dry (unless otherwise specified by the manufacturers.) If the bolt or nut is required to be lubricated prior to tightening, the torque range should be reduced 50 percent. 3. Use a bolt long enough to prevent bearing loads on the threads. The complete chamfer or end radius of the bolt or screw must extend through the nut. 4. Unique torques specified in the text of this manual supercede the torques given in Charts "A" and "B". 5. Refer to the latest revision of Lycoming Service Table Limits, SSP1776, for torques on parts used on Lycoming engines. 6. A maximum of two AN960 washers may be added under bolt heads or nuts to correct for variations in material thickness within the tolerances permitted. 7. Self-Locking Fasteners - Limitations of the use of self-locking nuts, bolts and screws including fasteners with non-metallic inserts are as follows: A. Fasteners incorporating self-locking devices shall not be reused if they can be run-up using only fingers. They may be reused if hand tools are required to run them up providing there is no obvious damage to the self-locking device prior to installation. B. Bolts 5/16 inch diameter and over with cotter pin holes may be used with self-locking nuts. Nuts with non-metallic locking devices may be used in this application only if the bolts are free from burrs around the cotter pin hole. C. Do not use self-locking nuts at joints which subject either the nut or bolt to rotate. D. Never tap or rethread self-locking fasteners. Do not use nuts, bolts or screws with damaged threads or rough ends.		CHART B			
		COARSE THREAD SERIES			
		BOLTS Steel Tension			
		AN 3 THROUGH AN 20 AN 42 THROUGH AN 49 AN 73 THROUGH AN 81 AN 173 THROUGH AN 186 MS 20033 THROUGH MS 20046 MS 20073 MS 20074 AN 509 NK9 MS 24694 AN 525 NK525 MS 27039			
		NUTS			
		Steel Tension	Steel Shear		
		AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679	AN 320 AN 364 NAS 1022 MS 17826 MS 20364		
		Nut-bolt size	Torque Limits in-lbs.	Torque Limits in-lbs.	
			Min.	Max.	
		8-32	12	15	7 9
		10-24	20	25	12 15
		1/4-20	40	50	25 30
		5/16-18	80	90	48 55
		3/8-16	160	185	95 110
		7/16-14	235	255	140 155
		1/2-13	400	480	240 290
		9/16-12	500	700	300 420
		5/8-11	700	900	420 540
		3/4-10	1,150	1,600	700 950
		7/8-9	2,200	3,000	1,300 1,800
		1-8	3,700	5,000	2,200 3,000
		1-1/8-8	5,500	6,500	3,300 4,000
		1-1/4-8	6,500	8,000	4,000 5,000

CHART A	
BOLT SIZE	FRICTION DRAG TORQUE (IN. -LB.)
8 (course thread)	15
10	18
1/4	30
5/16	60
3/8	80
7/16	100

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9102. 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				AN 3DD THRU AN 20DD AN 173DD THRU AN 186DD AN 509DD AN 525D MS 27039D MS 24694DD			
NUTS Steel Tension Steel Shear				NUTS Steel Tension Steel Shear				NUTS 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

91-01-01

Page 91-03

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9103. DECIMAL CONVERSIONS

4THS	8THS	16THS	32DS	64THS	TO 3 PLACES	TO 2 PLACES	M.M. EQUIV.
			$\frac{1}{32}$	$\frac{1}{64}$	.016	.02	.397
			$\frac{2}{32}$	$\frac{2}{64}$	.031	.03	.794
		$\frac{1}{16}$	$\frac{3}{32}$	$\frac{3}{64}$	.047	.05	1.191
		$\frac{1}{16}$	$\frac{4}{32}$	$\frac{4}{64}$	.062	.06	1.587
			$\frac{5}{32}$	$\frac{5}{64}$	.078	.08	1.984
			$\frac{6}{32}$	$\frac{6}{64}$	.094	.09	2.381
	$\frac{1}{8}$		$\frac{7}{32}$	$\frac{7}{64}$	.109	.11	2.778
	$\frac{1}{8}$		$\frac{8}{32}$	$\frac{8}{64}$	.125	.12	3.175
			$\frac{9}{32}$	$\frac{9}{64}$	.141	.14	3.572
			$\frac{10}{32}$	$\frac{10}{64}$	.156	.16	3.969
		$\frac{3}{16}$	$\frac{11}{32}$	$\frac{11}{64}$	.172	.17	4.366
		$\frac{3}{16}$	$\frac{12}{32}$	$\frac{12}{64}$	.188	.19	4.762
			$\frac{13}{32}$	$\frac{13}{64}$	.203	.20	5.159
			$\frac{14}{32}$	$\frac{14}{64}$	.219	.22	5.556
	$\frac{1}{4}$		$\frac{15}{32}$	$\frac{15}{64}$	.234	.23	5.953
	$\frac{1}{4}$		$\frac{16}{32}$	$\frac{16}{64}$	.250	.25	6.350
			$\frac{17}{32}$	$\frac{17}{64}$	.266	.27	6.747
			$\frac{18}{32}$	$\frac{18}{64}$	.281	.28	7.144
		$\frac{5}{16}$	$\frac{19}{32}$	$\frac{19}{64}$	.297	.30	7.540
		$\frac{5}{16}$	$\frac{20}{32}$	$\frac{20}{64}$	.312	.31	7.937
			$\frac{21}{32}$	$\frac{21}{64}$	.328	.33	8.334
			$\frac{22}{32}$	$\frac{22}{64}$	.344	.34	8.731
	$\frac{3}{8}$		$\frac{23}{32}$	$\frac{23}{64}$	.359	.36	9.128
	$\frac{3}{8}$		$\frac{24}{32}$	$\frac{24}{64}$	.375	.38	9.525
			$\frac{25}{32}$	$\frac{25}{64}$	.391	.39	9.922
			$\frac{26}{32}$	$\frac{26}{64}$	.406	.41	10.319
		$\frac{7}{16}$	$\frac{27}{32}$	$\frac{27}{64}$	.422	.42	10.716
		$\frac{7}{16}$	$\frac{28}{32}$	$\frac{28}{64}$	.438	.44	11.112
			$\frac{29}{32}$	$\frac{29}{64}$	.453	.45	11.509
			$\frac{30}{32}$	$\frac{30}{64}$	.469	.47	11.906
			$\frac{31}{32}$	$\frac{31}{64}$	.484	.48	12.303
			$\frac{32}{32}$	$\frac{32}{64}$	.500	.50	12.700

4THS	8THS	16THS	32DS	64THS	TO 3 PLACES	TO 2 PLACES	M.M. EQUIV.
			$\frac{17}{32}$	$\frac{33}{64}$	.516	.52	13.097
			$\frac{18}{32}$	$\frac{34}{64}$	.531	.53	13.494
		$\frac{9}{16}$	$\frac{19}{32}$	$\frac{35}{64}$	.547	.55	13.891
		$\frac{9}{16}$	$\frac{20}{32}$	$\frac{36}{64}$	.562	.56	14.288
			$\frac{21}{32}$	$\frac{37}{64}$	.578	.58	14.684
			$\frac{22}{32}$	$\frac{38}{64}$	.594	.59	15.081
	$\frac{5}{8}$		$\frac{23}{32}$	$\frac{39}{64}$	.609	.61	15.478
	$\frac{5}{8}$		$\frac{24}{32}$	$\frac{40}{64}$	.625	.62	15.875
			$\frac{25}{32}$	$\frac{41}{64}$	.641	.64	16.272
			$\frac{26}{32}$	$\frac{42}{64}$	.656	.66	16.669
		$\frac{11}{16}$	$\frac{27}{32}$	$\frac{43}{64}$	.672	.67	17.065
		$\frac{11}{16}$	$\frac{28}{32}$	$\frac{44}{64}$	.688	.69	17.462
			$\frac{29}{32}$	$\frac{45}{64}$	.703	.70	17.859
			$\frac{30}{32}$	$\frac{46}{64}$	.719	.72	18.256
	$\frac{3}{4}$		$\frac{31}{32}$	$\frac{47}{64}$	.734	.73	18.653
	$\frac{3}{4}$		$\frac{32}{32}$	$\frac{48}{64}$	.750	.75	19.050
			$\frac{33}{32}$	$\frac{49}{64}$	.766	.77	19.447
			$\frac{34}{32}$	$\frac{50}{64}$	.781	.78	19.844
		$\frac{13}{16}$	$\frac{35}{32}$	$\frac{51}{64}$	.797	.80	20.241
		$\frac{13}{16}$	$\frac{36}{32}$	$\frac{52}{64}$	.812	.81	20.637
			$\frac{37}{32}$	$\frac{53}{64}$	.828	.83	21.034
			$\frac{38}{32}$	$\frac{54}{64}$	.844	.84	21.431
	$\frac{7}{8}$		$\frac{39}{32}$	$\frac{55}{64}$	.859	.86	21.828
	$\frac{7}{8}$		$\frac{40}{32}$	$\frac{56}{64}$	.875	.88	22.225
			$\frac{41}{32}$	$\frac{57}{64}$	.891	.89	22.622
			$\frac{42}{32}$	$\frac{58}{64}$	.906	.91	23.019
		$\frac{15}{16}$	$\frac{43}{32}$	$\frac{59}{64}$	.922	.92	23.416
		$\frac{15}{16}$	$\frac{44}{32}$	$\frac{60}{64}$	.938	.94	23.812
			$\frac{45}{32}$	$\frac{61}{64}$	.953	.95	24.209
			$\frac{46}{32}$	$\frac{62}{64}$	.969	.97	24.606
			$\frac{47}{32}$	$\frac{63}{64}$	.984	.98	25.003
			$\frac{48}{32}$	$\frac{64}{64}$	1.000	1.00	25.400

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9104. DECIMAL / MILLIMETER EQUIVALENTS OF DRILL SIZES

Decimal/Millimeter Equivalents of Drill Sizes From 1/2" to No. 80											
Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.
1/2	0.500	12.7000	G	0.261	6.6294	5/32	0.1562	3.9687	51	0.067	1.7018
31/64	0.4843	12.3031	F	0.257	6.5278	23	0.154	3.9116	52	0.0635	1.6129
15/32	0.4687	11.9062	E-1/4	0.250	6.3500	24	0.152	3.8608	1/16	0.0625	1.5875
29/64	0.4531	11.5094	D	0.246	6.2484	25	0.1495	3.7973	53	0.0595	1.5113
7/16	0.4375	11.1125	C	0.242	6.1468	26	0.147	3.7338	54	0.055	1.397
27/64	0.4218	10.7156	B	0.238	6.0452	27	0.144	3.6576	55	0.052	1.3208
Z	0.413	10.4902	15/64	0.2343	5.9531	9/64	0.1406	3.5719	3/64	0.0468	1.1906
13/32	0.4062	10.3187	A	0.234	5.9436	28	0.1405	3.5687	56	0.0465	1.1811
Y	0.404	10.2616	1	0.228	5.7912	29	0.136	3.4544	57	0.043	1.0922
X	0.397	10.0838	2	0.221	5.6134	30	0.01285	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.

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

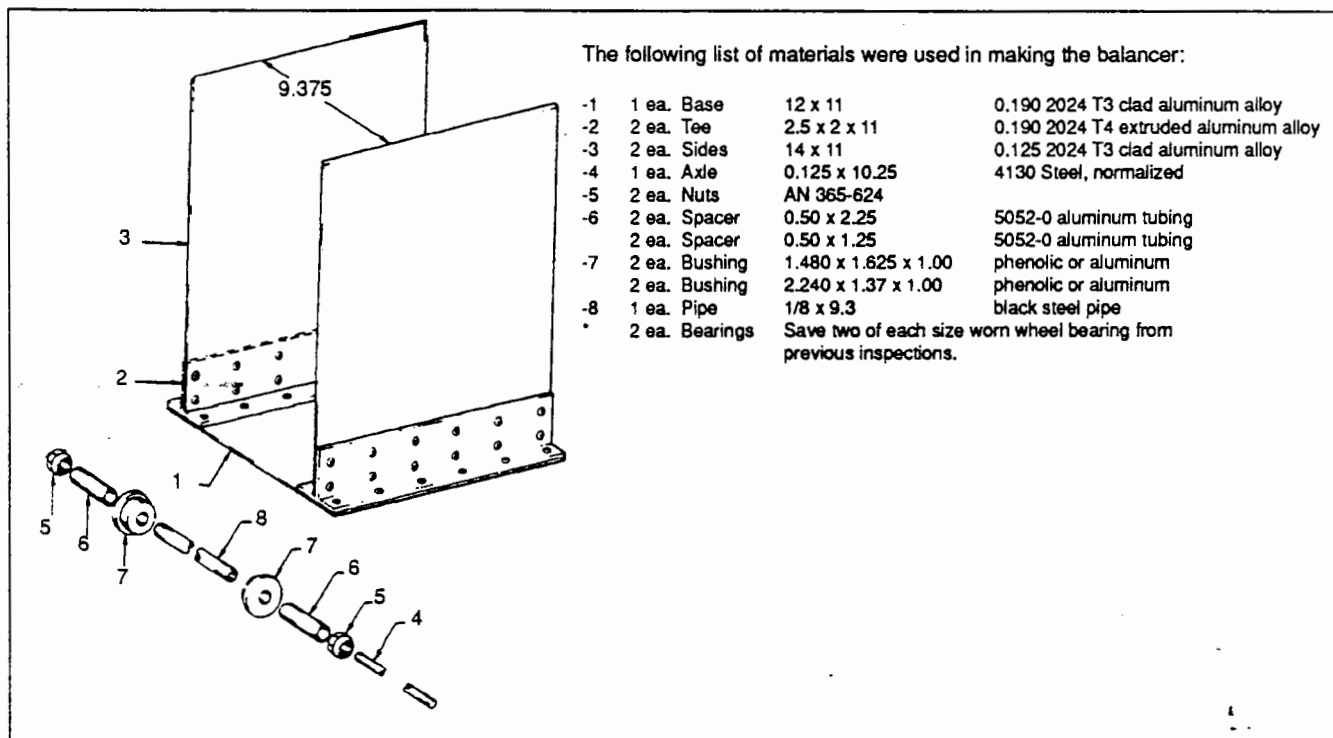


Figure 91-1. Tire Balancer Fixture

TIRE BALANCER BUILDING INSTRUCTIONS.

1. Chamfer top edges of -3 sides, leaving 1/16 inch flat on top inboard edge. Rivet -2 tee's to -3 sides using AN 470-ADS rivets 2" spacing. Use AN 426-ADS rivets 2" center to center to secure -2 tee's to -1 base. If tee extrusion is unavailable, heavy angle extrusion could be used. -3 sides must be vertical.
2. The -4 axle must slide through the -8 pipe. The -5 nuts were made by reaming the existing threads in the AN 365-624 nuts with an R drill, then tapping with a 1/8-27 pipe tap.
3. The -6 spacers were made from 1/2 inch aluminum tubing. The two lengths of spacers are suitable for balancing most any aircraft wheel.
4. The -7 bushings may be made from one inch phenolic or aluminum using a 1-1/2 inch hole saw to cut out the smaller bushing and a 1-3/4 hole saw to cut out the larger. By inserting a 1/4 inch long threaded bolt through the pilot hole and securing with a washer and nut, a drill press and file may be used to make the off-set on the bushing. The turned-down part should just slide inside the bearing race. Ream the pilot hole to slide over the -8 pipe threads.
5. The -8 pipe was made from a piece of 1/8 inch black pipe and threaded with a 1/8-27 pipe die. Thread 3 inches in from each end of the pipe.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 9105. LIST OF CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Fuel, Engine	(See Note 1)	100 octane green / blue	
Oil, Engine	MIL-L-6082 or MIL-L-2285 1 (See Note 3)		
Corrosion Preventive Compound and Broken Oil	MIL-C-6529 Type II Per latest revision Lycoming Service Letter L121		
Lubricating Oil (General Purpose Low Temperature)	MIL-L-7870		
Oil Filter			
Air Filter			
Dry Lubricant	MIL-L-60326		
Lubricating Oil		Aero Lubriplate or Mag 1 (Purch.)	Fiske Bros. Refining Co. 129 Lockwood St. Newark, N.J. 07105 (201)-589-9150
Lubricating Grease (General Purpose superseded by MIL-G-81322)	MIL-L-7711	Regal AFB2	Texaco Inc. 2000 Westchester Ave. White Plains, N.Y. 10650 (914)-253-4000
		Aeroshell Grease No. 6	Shell Oil Co. One Shell Plaza Houston, TX 77002 (713)-220-6697
		2242 International	Lubricants Co. New Orleans, La.
Lubricating Grease (High Temperature)	MIL-G-81322 (See Note 2)	Mobilgrease 28	Mobil Oil Corp. 150 E. 42nd St. New York, NY 10017 (212)-883-4242

91-05-00

Page 91-07

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9105. LIST OF CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Lubricating Grease (High Temperature) cont)		Aeroshell No. 22	Shell Oil Co. One Shell Plaza Houston, Texas 77002 (713)-220-6697
Lubricating Grease Aircraft and Instru-- ment. Low and High Temperature)	MIL-G-23827 (See Note 2)	Supermil Grease No. A72832	American Oil Co. 910 South Michigan Ave. Chicago, Ill. 60680
	Royco 27A	Royal Lubricants Co. River Road Hanover, N.J. 07936 (201)-887-3100	
	Shell 6249 Grease	Shell Oil Co. One Shell Plaza Houston, Texas 77002 (713)-220-6697	
Lubricating Grease (All Purpose)	Mobil Mobilgrease 77 or Mobilux EP2) Grease or Shell Alvania EP Grease 2	Texaco Marfak All Purpose Grease or	
Hydraulic Fluid	MIL-H-5606 Univis - 40	Brayco 756D	Bray Oil Co. 1925 Marianna Ave. Los Angeles, Cal. 98103 (213)-268-6171
		TL-5874	Texaco Inc. 2000 Westchester Ave. White Plains, N.Y. 10650 (914)-253-4000
		PED 3565	Standard Oil Co. of California, 225 Bush St. San Francisco, C.A 94120 (415)-434-7700
Sealer		PR 1321 B1/2	Products Research Co. 2919 Empire Avenue Burbank, Cal. 91504 (213)-849-3992

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9105. LIST OF CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Solvent	PD680		
Toluol	TT-T-548		
Buffing and Rubbing Compounds		Automotive Type DuPont #7	Dupont Company Finishes Division DuPont Bldg. Wilmington, Del. 19898 (302)-774-1000
		Ram Chemical #69 x 1	Ram Chemicals 210 E. Alondra Blvd. Gardena, CA 90248 (213)-321-0710
		Mirro Glaze #1	Mirro Bright Polish Co., Inc. Irvine Industrial Complex P.O. Box 17177 Irvine, CA. 92173 (714)-557-9200
Cleaners		Fantastic Spray Perchlorethylene VM&P Naphtha	Local Suppliers (Lighter Fluid)
ABS-Solvent Cements		Methylethyl Ketone Methylene Chloride Acetone	Local Suppliers
Epoxy Patching Compound		Solarite #400	Solar Compounds Corp. 1201 W. Blanke St. P.O. Box 227 Linden, N.J. 07036 (201)-862-2813
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. long		Sears Roebuck & Co. or Most Hardware Stores
Sealant		PRC5000	Behr-Manning Division Norton
Tapes, Vinyl Foam	1/8 in. x 1 in. 510 Series, Type II		Norton Tape Division Dept. 6610 Troy, NY 12181 (518)-273-0100

91-05-00

Page 91-09

Revised: May 15, 1989

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 9105. LIST OF CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Black Vinyl Plastic	2 in. x 9 mil. and or 11/7 in. x 9 mil.		Norton Tape Division Dept. 6610 Troy, NY 12181 (518)-273-0100
Vinyl Foam	1 in. x 1/8 in. 530 Series, Type I		Same as above.
Tenon Tape	.003" x .5" wide		Minnesota Mining and Mfg. 3M Center St. Paul, Minnesota 55101 (612)-733-1110
	.003 x .25 wide		Shamban W.S. and Co. 11543 W. Olympic Blvd. Los Angeles, CA 90064 (213)-879-2270
Leak Detector Solution For Oxygen	MIL-L-25567C	Alpha 73 Oxygen Leak Detector Type 1 Leak Tec #16-OX	Johnson and Johnson Inc. Permaceal Div. 501 George Street New Brunswick, N.J. 08903 (201)-524-0400 U.S. Gulf Corp. P.O. Box 233 Stoneybrook, N.Y. 11790 (212)-683-9221 American Gas and Chemical Co. Ltd. 220 Pegasus Avenue Northvale, N.J. 07647 (201)-767-7300
Neoprene Rubber	PMS-C1002-S	Scotch Grip 2210 Contact Adhesive B10161	Minnesota Mining and Mfg.; 3M Center St. Paul, Minnesota 55101 (612)-733-1110 Delta Laboratories, Inc. P.O. Box 1650 Ocala, FL 32670 (904)-629-8101

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9105. LIST OF CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Rain Repellent	FSCM 50159	Repcon	Unelko Corporation 727 E. 110th Street Chicago, Illinois 60628
Tube Fitting		Swageloc Fitting	Crawford Fitting Co. 29500 Solon Road Solon, Ohio 44139 (216)-248-4600

— Notes —

1. If 100 octane (green)fuel is not available, use 100 octane low lead (blue) fuel
2. Precautions should be taken when using MIL-G-23827 and MIL-G-81322, since these greases contain chemicals harmful to painted surfaces.
3. Refer to the latest revision of Lycoming Service Instruction No. 1014 for Lubricating Recommendations.

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 9106. METRIC 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 9106.)
 - 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 ($^{\circ}$ F) and Celsius ($^{\circ}$ C) (Centigrade) Temperature. (Refer to Chart 9106.)
 - A. Read number in middle column, if in degrees Celsius ($^{\circ}$ C), read Fahrenheit equivalent in right hand column. If in degrees Fahrenheit ($^{\circ}$ F), read Celsius equivalent in left-hand column.
 - (1) 70° F = 21.1° C.
 - (2) 30° C = 86.0° F.

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9106. METRIC CONVERSION TABLES (cont)

CENTIGRADE — FAHRENHEIT CONVERSION TABLE

Example: To convert 20°C, to Fahrenheit, find 20 in the center column headed (°F—°C); then read 68.0°F, in the column (°F) to the right. To convert 20°F, to Centigrade; find 20 in the center column and read -6.67°C, in the (°C) column to the left.

°C	°F—°C	°F	°C	°F—°C	°F
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
-45.6	-50	-58.0	115.56	240	464.0
-40.0	-40	-40.0	121.11	250	482.0
-34.0	-30	-22.0	126.67	260	500.0
-38.9	-20	-4.0	132.22	270	518.0
-23.3	-10	14.0	137.78	280	536.0
-17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
37.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
48.89	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	237.78	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

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

CHART 9106. METRIC CONVERSION TABLES (cont)

INCHES TO MILLIMETER										
INCHES	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
	MILLIMETER									
0.000		0.0025	0.0050	0.0076	0.0101	0.0127	0.0152	0.0177	0.0203	0.0228
0.001	0.0254	0.0279	0.0304	0.0330	0.0355	0.0381	0.0406	0.0431	0.0457	0.0482
0.002	0.0508	0.0533	0.0558	0.0584	0.0609	0.0635	0.0660	0.0685	0.0711	0.0736
0.003	0.0762	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	0.0965	0.0990
0.004	0.1016	0.1041	0.1066	0.1092	0.1117	0.1143	0.1168	0.1193	0.1219	0.1244
0.005	0.1270	0.1295	0.1320	0.1346	0.1371	0.1397	0.1422	0.1447	0.1447	0.1498
0.006	0.1524	0.1549	0.1574	0.1600	0.1625	0.1651	0.1676	0.1701	0.1727	0.1752
0.007	0.1778	0.1803	0.1828	0.1854	0.1879	0.1905	0.1930	0.1955	0.1981	0.2006
0.008	0.2032	0.2057	0.2082	0.2108	0.2133	0.2159	0.2184	0.2209	0.2235	0.2260
0.009	0.2286	0.2311	0.2336	0.2362	0.2387	0.2413	0.2438	0.2463	0.2489	0.2514
INCHES	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
	MILLIMETER									
0.00		0.025	0.050	0.076	0.101	0.127	0.152	0.177	0.203	0.228
0.01	0.254	0.279	0.304	0.330	0.355	0.381	0.406	0.431	0.457	0.482
0.02	0.508	0.533	0.558	0.584	0.609	0.635	0.660	0.685	0.711	0.736
0.03	0.762	0.787	0.812	0.838	0.863	0.889	0.914	0.939	0.965	0.990
0.04	1.016	1.041	1.066	1.092	1.117	1.143	1.168	1.193	1.219	1.244
0.05	1.270	1.295	1.320	1.346	1.371	1.397	1.422	1.447	1.473	1.498
0.06	1.524	1.549	1.574	1.600	1.625	1.651	1.676	1.701	1.727	1.752
0.07	1.778	1.803	1.828	1.854	1.879	1.905	1.930	1.955	1.981	2.006
0.08	2.032	2.057	2.082	2.108	2.133	2.159	2.184	2.209	2.235	2.260
0.09	2.286	2.311	2.336	2.362	2.387	2.413	2.438	2.463	2.489	2.514
INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	MILLIMETER									
0.0		0.254	0.508	0.762	0.016	1.270	1.524	1.778	2.032	2.286
0.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
0.2	5.080	5.334	5.588	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

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9106. METRIC CONVERSION TABLES (cont)

MULTIPLY	BY	TO OBTAIN	MULTIPLY	BY	TO OBTAIN
CENTIMETERS	0.3937 0.03281	IN. FT.	KILOGRAMS	2.205 35.27 1000	LB. OZ. GRAMS
CU. CENTIMETERS	0.001 0.06102 0.0002642	LITERS CU. IN. U.S. GAL.	LITERS	1000 61.03 0.03532 0.2642 0.22 1.057	CU. CM. CU. IN. CU. FT. U.S. GAL. IMPERIAL GAL. QUARTS
CU. FT.	28.320 1.728 7.481 28.32	CU. CM CU. IN. U.S. GAL. LITERS	METERS	39.37 3.281 1000	IN. FT. MM.
CU. IN.	16.39 0.01639 0.004329 0.01732	CU. CM LITERS U.S. GAL. QUARTS	METER-KILOGRAM	7.233 9.807	FT.-LB. JOULES
CU. METERS	1000000 35.314 61.023 264.17 999.97	CU. CM CU. FT. CU. IN. GAL. LITERS	OUNCES, AVDP	0.0625 28.35 437.5	LB., AVDP GRAMS GRAINS
FEET	0.3048 12.000 304.8 0.3333	METERS MILS MM. YARDS	OUNCES, FLUID	29.57 1.805	CU. CM. CU. IN.
FT.-LB.	0.1383 0.001285 0.000000376	M-KG BTU KW-HR	LB., AVDP	453.6 7000 16.0	GRAMS GRAINS OUNCES
FLUID OZ.	8 29.6	DRAM CU. CM	SQUARE INCH	6.4516	SQ. CM.
GAL., IMPERIAL	277.4 1.201 4.546	CU. IN. U.S. GAL. LITERS	POUND PER SQUARE INCH (PSI)	0.0703	KG.-CM SQUARED
GAL., U.S. DRY	268.8 0.1556 1.164 4.405	CU. IN. CU. FT. U.S. GAL., LIQ. LITERS	STATUTE MILE	1.609 0.8684	KILOMETER NAUTICAL MILE
GAL., U.S. LIQ.	231.0 0.1337 3.785 0.8327 128	CU. IN. CU. FT. LITERS IMPERIAL GAL. FLUID OZ.	NAUTICAL MILE	1.151	STATUTE MILE
IN.	2.540 .08333	CM. FT.	QUART	.9463	LITER
JOULES	0.000948 0.7376	FT. FT.-LB.	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

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

SPECIAL TOOLS.

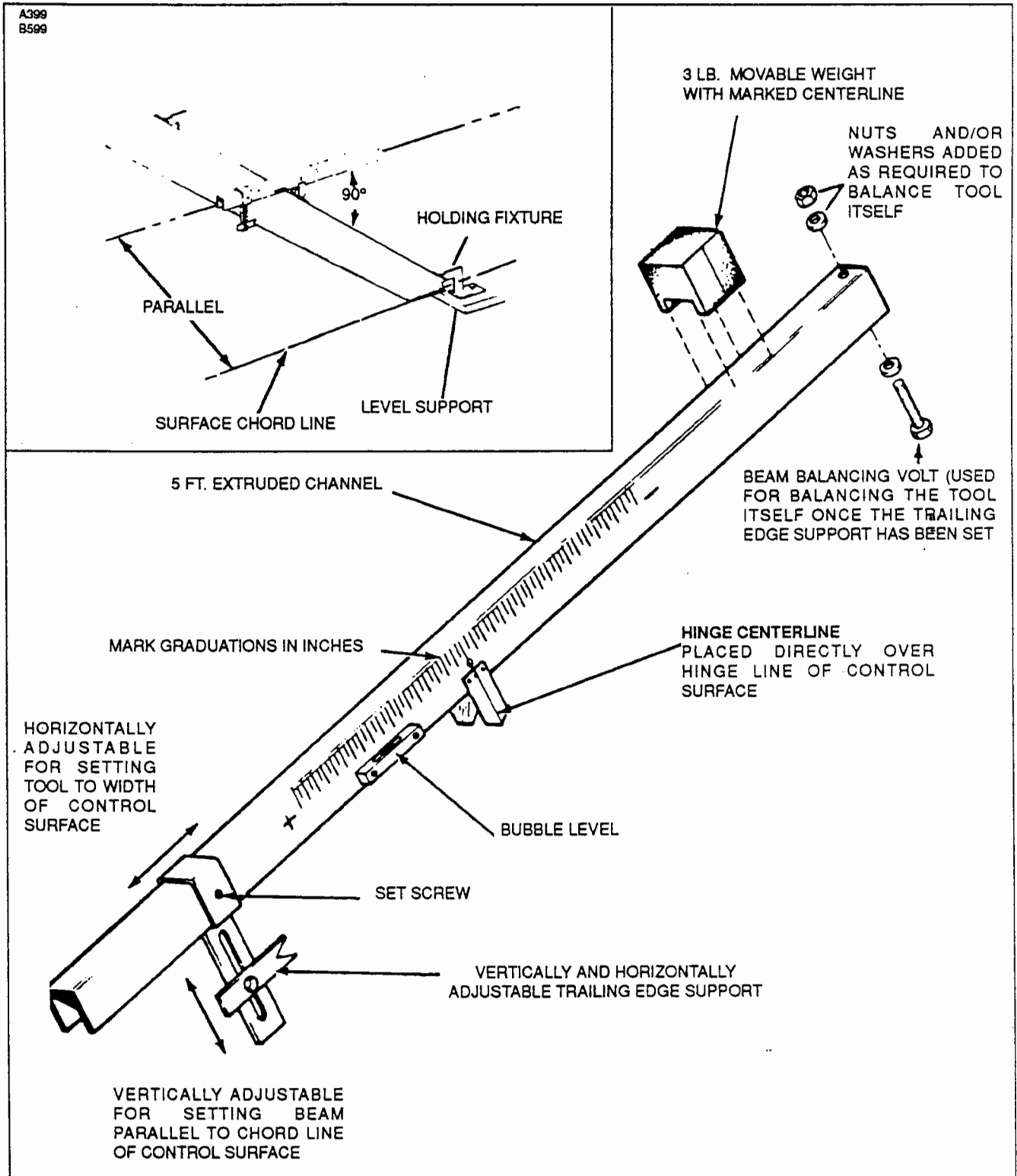


Figure 91-2. Control Surface Balancing Tool

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

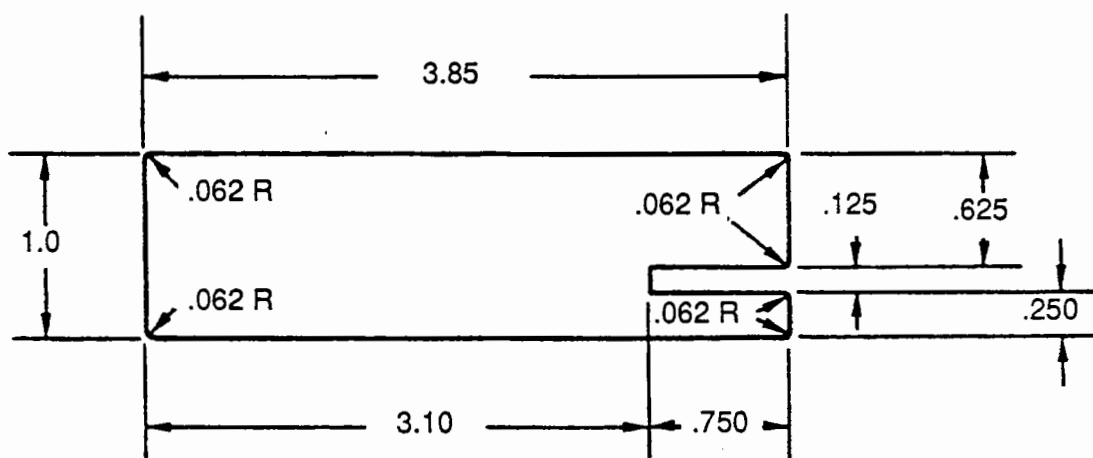


Figure 91-3. Fabricated Aileron Bellcrank Rigging Tool

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

A115

MATERIAL:

.750 X 31.50 X 4.00 ALUM. BAR OR
.750 X 31.50 X .750 SQ. ALUM.
BARSTOCK (MIN.)

NOTES

1. DRILL AND TAP TO 10-32 NF. AN-3 BOLT, JAM NUT AND INTERNAL STAR WASHER MAY BE USED FOR SPACER OR AN-3 BOLT WITH HEAD FILED TO REQUIRED LENGTH.
2. SPAR STOCK MAY BE USED IN PLACE OF ALUM. BAR STOCK.

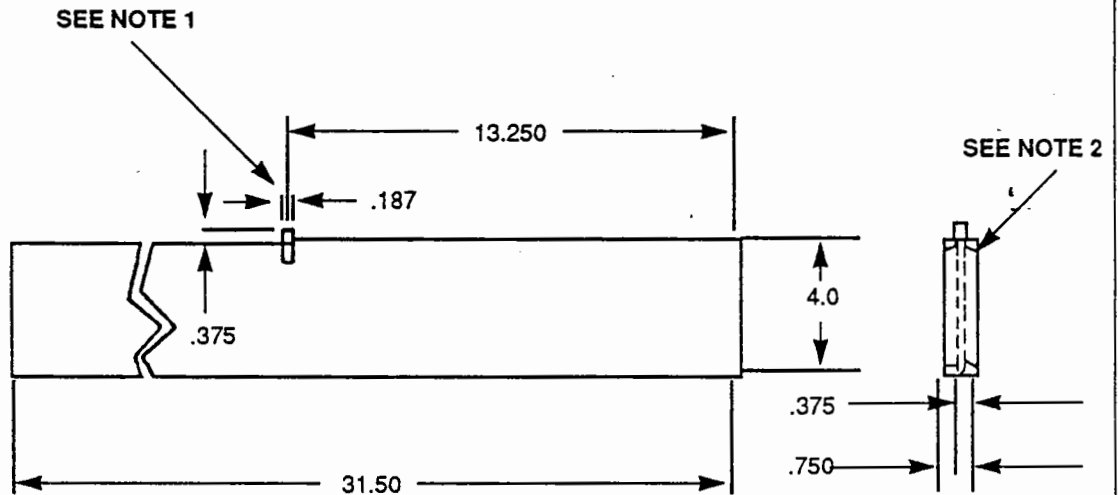


Figure 91-4. Fabricated Aileron and Flap Rigging Tool

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

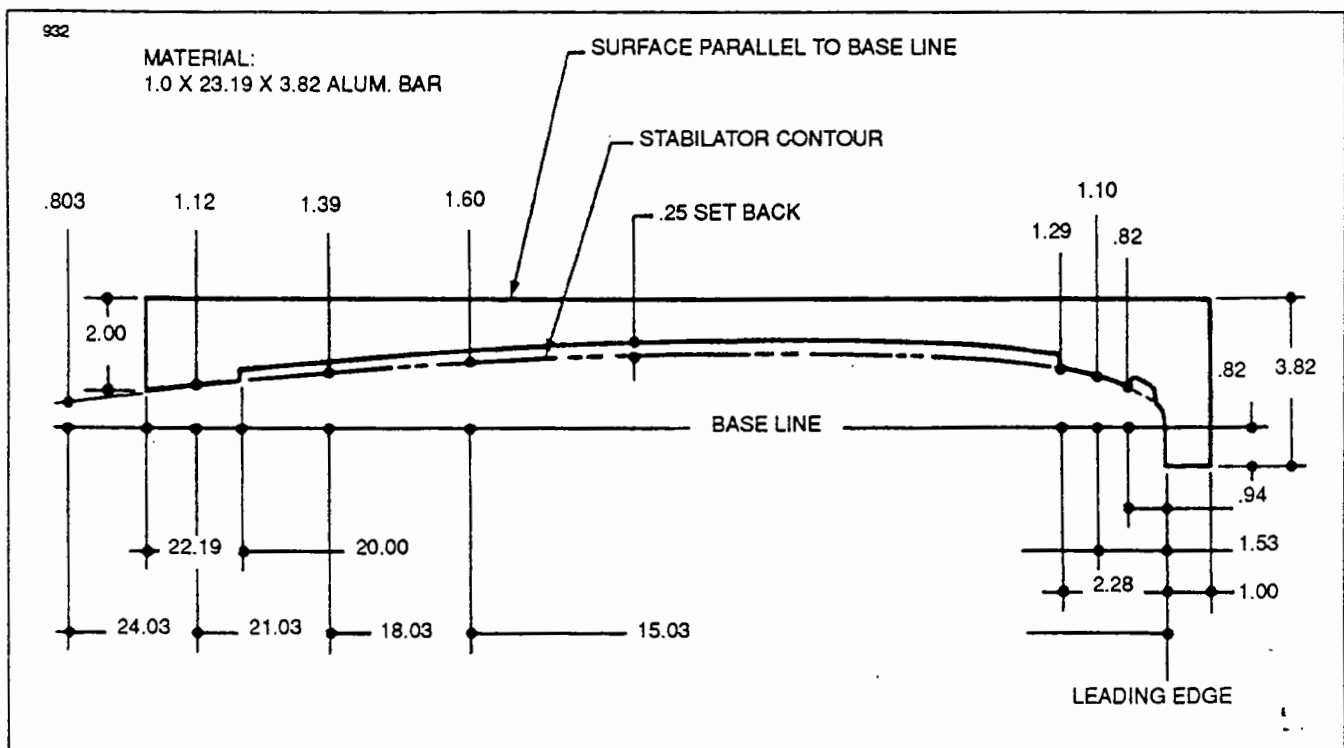


Figure 91-5. Fabricated Stabilator Rigging Tool

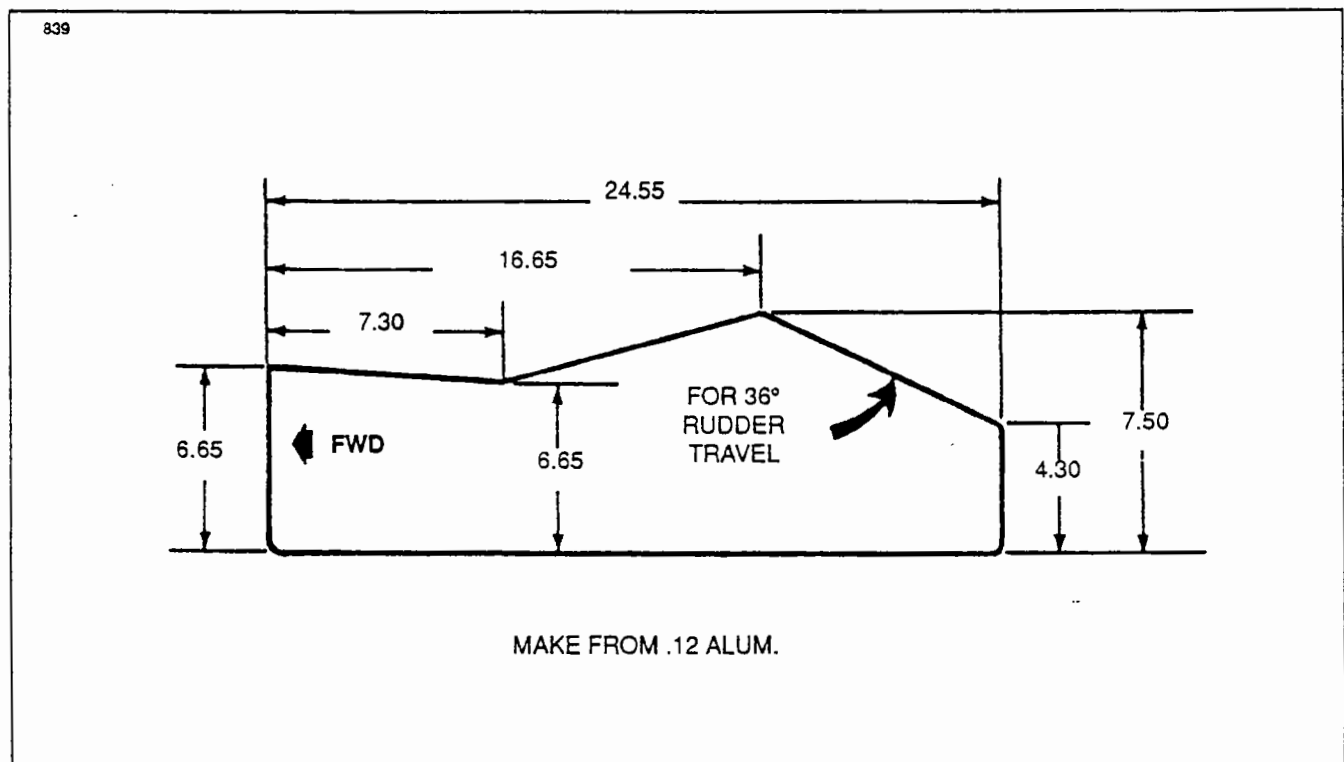
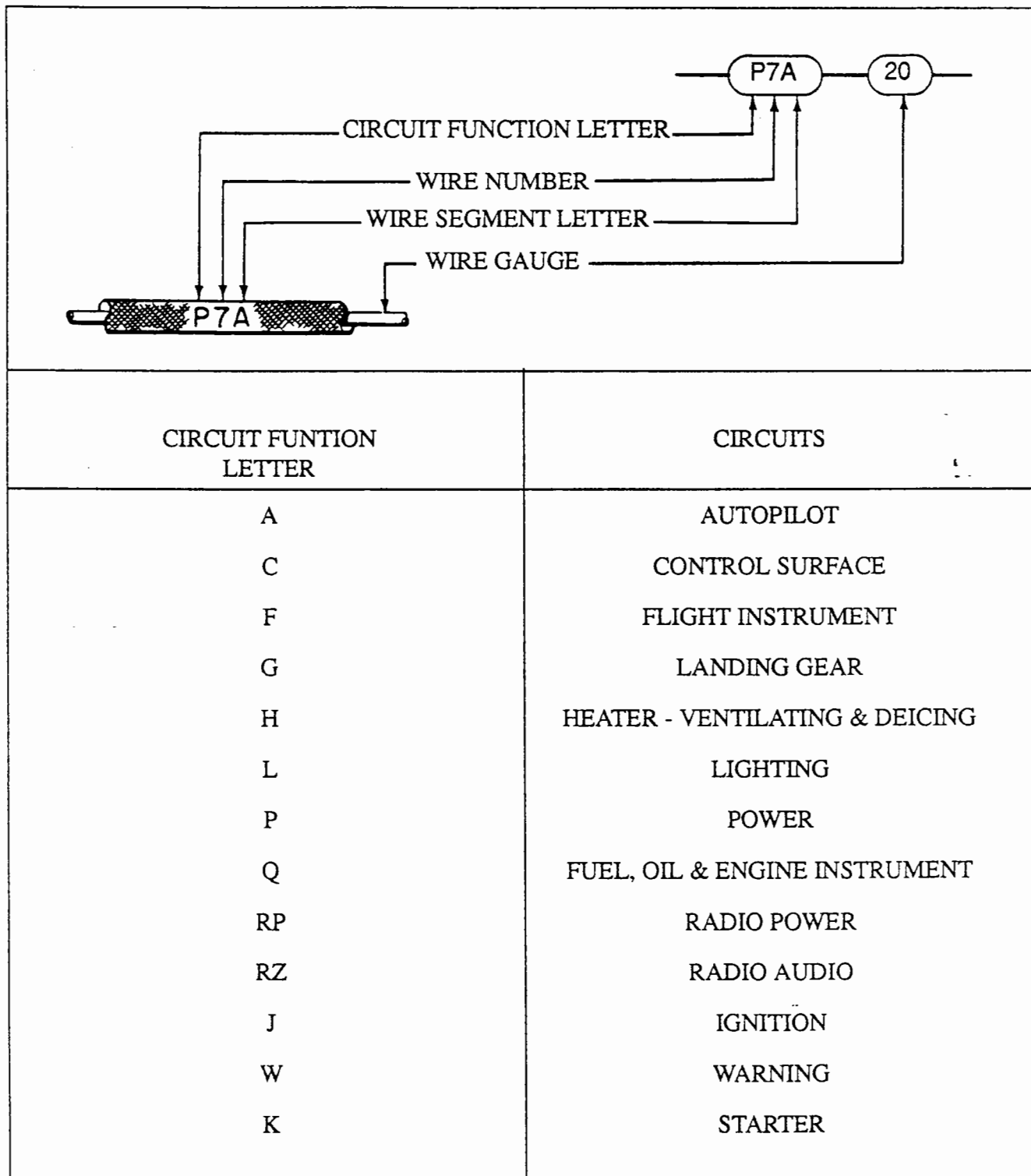


Figure 91-6. Fabricated Rudder Rigging Tool

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

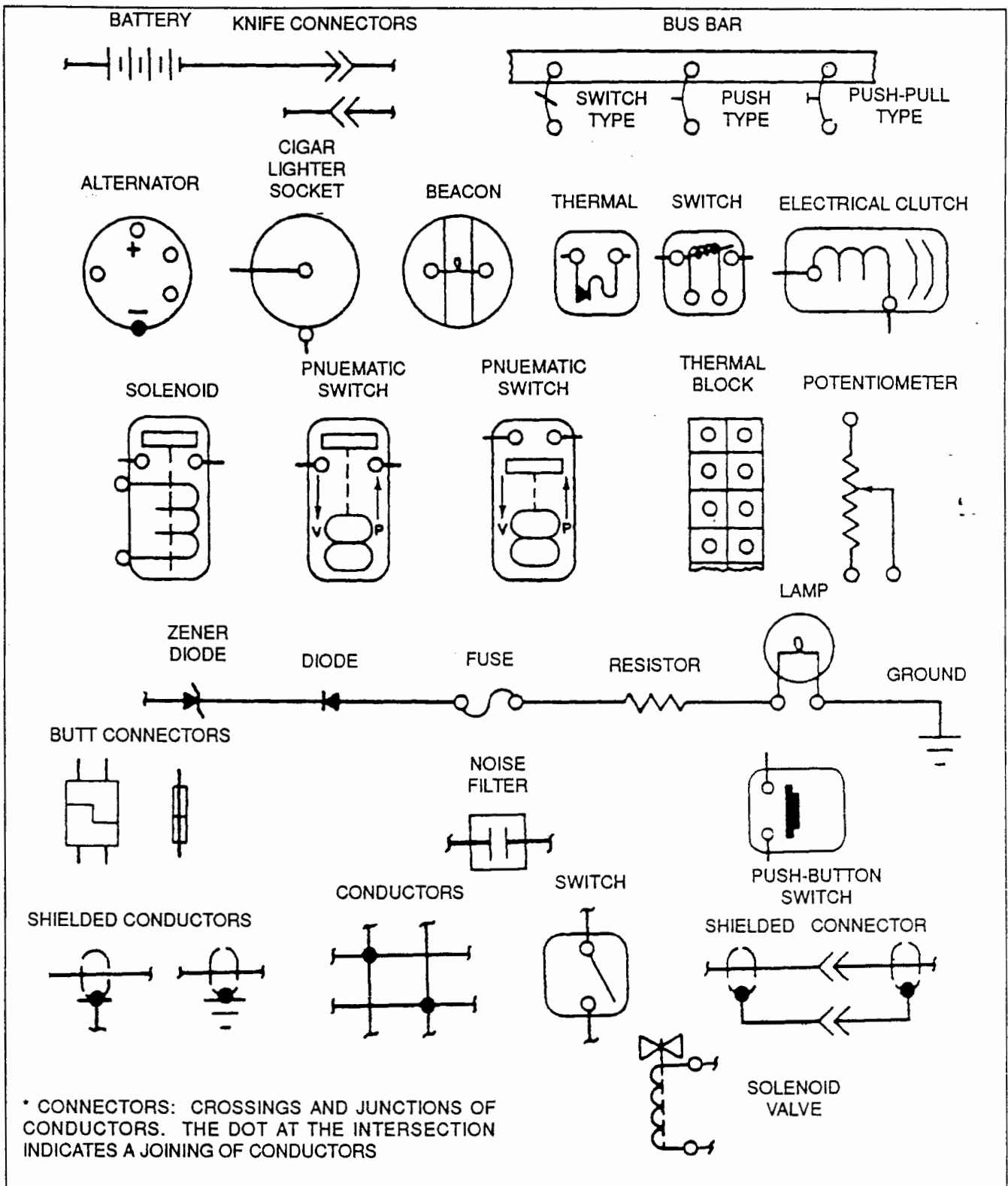
ELECTRICAL SCHEMATICS.

CHART 9107. ELECTRICAL WIRE CODING



PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9108. ELECTRICAL SYMBOLS



PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9109. ELECTRICAL SYSTEM COMPONENT LOADS

DUTY ¹	CYCLE ²	EQUIPMENT	CKT.-BKR.	(AMPS)	OPT.
X	X	ALTERNATOR FIELD (2)	5	5.0 EA	
		STARTER SOLENOID (LEFT AND RIGHT)	10	10.0	
		CIGAR LIGHTER (ACCESSORY)	—	8.0	
		STARTER	—	175.0	
		FUEL PUMP (LEFT)	8	0.5	
	X	FUEL PUMP (RIGHT)	8	0.5	
X		ENGINE GAGES (LEFT)	5		appx. 1.0
X		ENGINE GAGES (RIGHT)	5		appx. 1.0
	X	HYDRAULIC PUMP	25	25.0	
	X	LANDING GEAR CONT. & WARN.	5	—	
	X	LANDING GEAR SOLENOID	—	0.8	
	X	GEAR DOWN LIGHTS (3)	—		Total 0.3
	X	GEAR UNSAFE LIGHT	—	0.08	
	X	GEAR WARN HORN	—	0.4	
X		MASTER CONTACTOR	—	0.6	
	X	COMBUSTION HEATER	15	13.0	
	X	PITOT HEAT	15	13.2	
	X	STALL WARNING HORN	5	0.4	
X		ELECTRIC TURN & BANK	5	0.5	
	X	PITCH TRIM	5	5.0	
	X	LANDING LIGHT	10	8.0	
		AVIONICS LIGHTS	5		Varies on Avionics Instls.
X		INSTRUMENT PNL. LIGHTS	10	2.5	
		FLOOD LIGHTS	5		
X		RED FLOOD	—	1.0	
	X	DOME LIGHT	—	0.6	
X		POSITION LIGHTS	10	7.3	

¹ CONTINUOUS

² INTERMITTENT

91-23-00

Page 91-22

Revised: May 15, 1989

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

CHART 9109. ELECTRICAL SYSTEM COMPONENT LOADS (cont)

DUTY ¹	CYCLE ²	EQUIPMENT	CKT.-BKR.	(AMPS)	OPT.
X		ANTI-COLLISION LIGHT (WING TIP STROBES)	10	7.0	
	X	AUTOPILOT	5	—	X
	X	PITOT HEAT	15	13.2	X
X		HOUR METER	Fuse 5	0.25	X
		AVIONICS (SEE MFG. INSTL. MANUAL)		—	X
¹ CONTINUOUS ² INTERMITTENT					

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

ELECTRICAL SCHEMATIC INDEX

FIGURE NO.	SCHEMATIC	GRID NO.
ANNUNCIATOR		
	Annunciator Panel	
91-7.	PA-44-180	4B22
91-8.	PA-44-180T	4B23
DEICE SYSTEMS		
91-10.	Pitot Heat	4C1
91-9.	Propeller Deice (2 and 3 Blade)	4B24
91-12.	Surface Deice	4C1
91-11.	Heated Windshield	4C1
91-13.	Heated Lift Detector	4C2
ELECTRICAL POWER		
91-15.	Alternator/Starters - Early Models - 180/180T	4C3
	Alternator	
91-16.	PA-44-180 S/N: 8195001 and up	4C4
91-16.	PA-44-180T S/N: 8107076 and up	4C4
	Starters	
91-17.	PA-44-180 S/N: 8195001 and up	4C5
91-170.	PA-44-180T S/N: 8107076 and up	4C5
	Ground Clearance - Option	
91-18.	PA-44-180T S/N: 8307001 and up	4C6
	Avionics Bus Power Distribution	
91-21.	PA-44-180/180T Early Models	4C7
91-22.	PA-44-180T S/N: 8207001 and up	4C7
91-19.	Avionics Master Switch - Option	4C6
ENGINE SYSTEMS		
	Engine Gauges	
91-24.	PA-44-180 S/N: 7995001 to 8095037	4C9
91-25.	PA-44-180 S/N: 8175001 and up	4C10
91-25.	PA-44-180T S/N: 8107001 to 8207031	4C10
91-26.	PA-44-180T S/N: 8307001 and up	4C11
91-22.	Magnetos (Left/Right)	4C7
91-27.	Primer Solenoids - PA-44-180T	4C12
91-28.	Tachometer (Electric) PA-44-180T	4C12
91-20.	Fuel Pumps	4C6
ENVIRONMENTAL SYSTEMS		
	Air Conditioning	
91-31.	PA-44-180 S/N: 8195001 to 8195040	4C13
91-31.	PA-44-180T S/N: 8107001 and up	4C13
91-32.	Heater	4C14
91-29.	Blower Motor PA-44-180T (Option)	4C12

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

ELECTRICAL SCHEMATIC INDEX (cont)

FIGURE NO.	SCHEMATIC	GRID NO.
FUEL SYSTEM		
91-20.	Fuel Pumps	4C6
INDICATORS		
	Clock	
91-33.	Panel Mounted	4C15
91-34.	Control Wheel Mounted	4C15
	Turn and Bank	
91-30.	PA-44-180 S/N: 8095001 and up	4C12
91-30.	PA-44-180T S/N: 8107001 and up	4C12
91-35.	Turn and Bank (Optional)	4C15
	Engine Gauges	
91-24.	PA-44-180 S/N: 7995001 to 8095037	4C9
91-25.	PA-4-180 S/N: 8195001 and up	4C10
91-25.	PA-44-180T S/N: 8107001 to 8207031	4C10
91-26.	PA-44-180T S/N: 8307001 and up	4C11
LANDING GEAR		
91-36.	Landing Gear/Hydraulic Pump	4C16
LIGHTING EXTERNAL		
91-37.	Anti-Collision Strobes	4C17
91-38.	Landing Light - Early Models	4C17
	Landing Lights - Dual (Option)	
91-39.	PA-44-180 S/N: 8195001 and up	4C22
91-39.	PA-44-180T S/N: 8107001 and up	4C22
91-40.	Position	4C18
91-43.	Wing Inspection	4C19
LIGHTING INTERNAL		
	Overhead Flood	
91-41.	PA-44-180 S/N: 7995001 to 8095006	4C18
91-42.	PA-44-180 S/N: 8095007 and up	4C18
91-42.	PA-44-180T S/N: 8107001 and up	4C18
91--.	Panel Lighting	4C20
PROPELLER SYSTEMS		
91-45.	Propeller Synchrophaser	4C21
91-9.	Propeller Deice (Two and Three Blade)	4B24
WARNING SYSTEMS		
	Annunciator (See Annunciator Systems)	
91-36.	Landing Gear Warning	4C16
91-14.	Stall Warning	4C2

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

ELECTRICAL SCHEMATIC INDEX (cont)

FIGURE NO.	SCHEMATIC	GRID NO.
FOR PA-44-180 (S/N 44-95001 AND UP)		
91-47.	Power Distribution and Control	4D1
91-48.	Power Monitor and Control	4D3
91-49.	Starter and Ignition Control	4D5
91-50.	Fuel Pumps	4D7
91-51.	Fuel and Ampere Indicators	4D9
91-52.	CHT and Oil Indicators	4D11
91-53.	Electric Tachometer	4D13
91-54.	Engine Hour Meter	4D15
91-55.	Hydraulic Pump	4D17
91-56.	Landing Gear Position Indicators	4D19
91-57.	Landing Gear Warning	4D21
91-58.	Annunciator	4D23
91-59.	Stall Detection	4E1
91-60.	Landing Lights	4E3
91-61.	Position Lights	4E5
91-62.	Recognition Lights	4E7
91-63.	Strobe Lights	4E9
91-64.	Panel and Switch Lighting	4E11
91-65.	Pitot Heat	4E13
91-66.	Turn and Bank	4E15
91-67.	Cabin Heat	4E17
91-68.	Cockpit Flood Lights	4E19
91-69.	Vent Blower	4E21

**SCHEMATIC DRAWING LIST WITH LAST REVISION INCORPORATED
(FOR PIPER INTER-OFFICE USE ONLY)**

DWG-REV.	DWG-REV.	DWG-REV.	DWG-REV.	DWG-REV.
86372-S	86912 New	86959-C	89295-C	
86861-H	86909-E	86960-A		
36889-F	86666-B	86831-AM		
39708-A	86908-E			
	86911 New			

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

EL803
86861

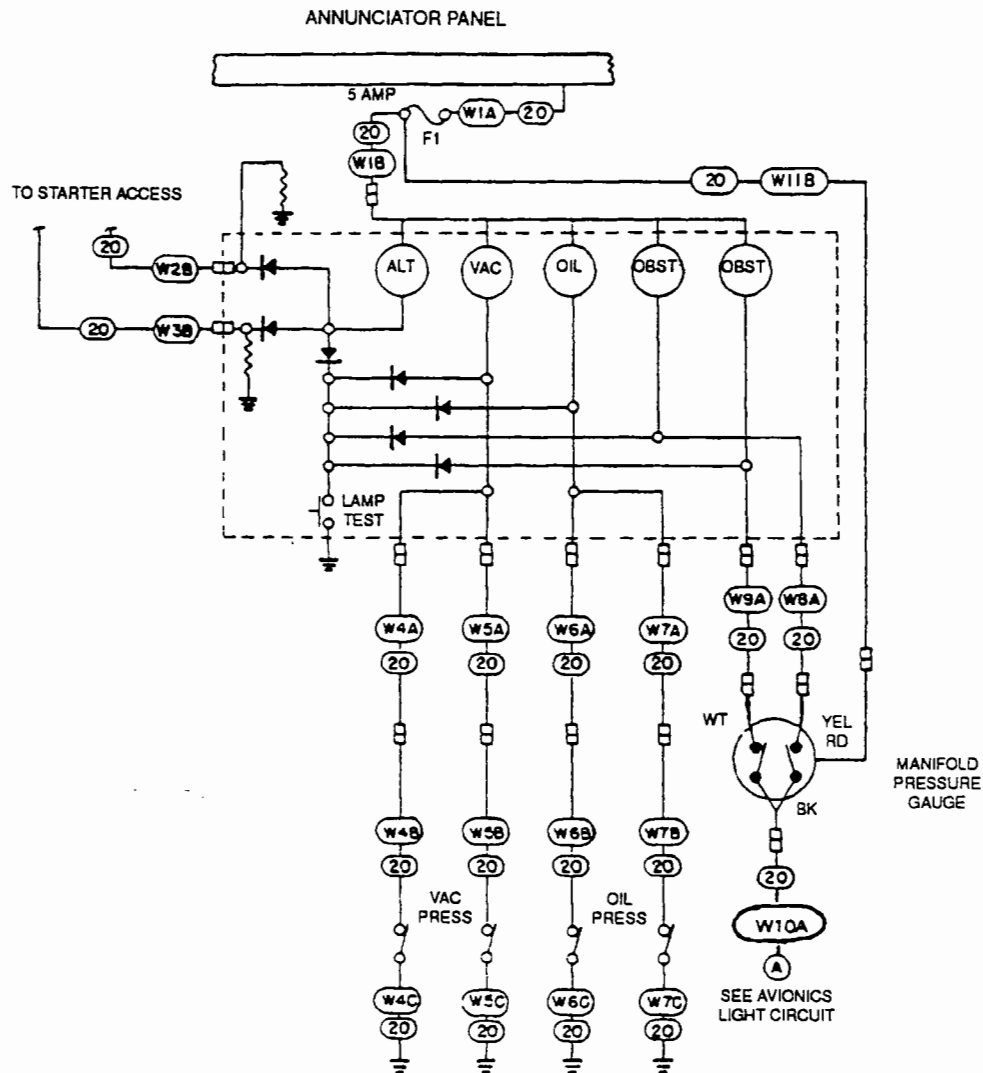
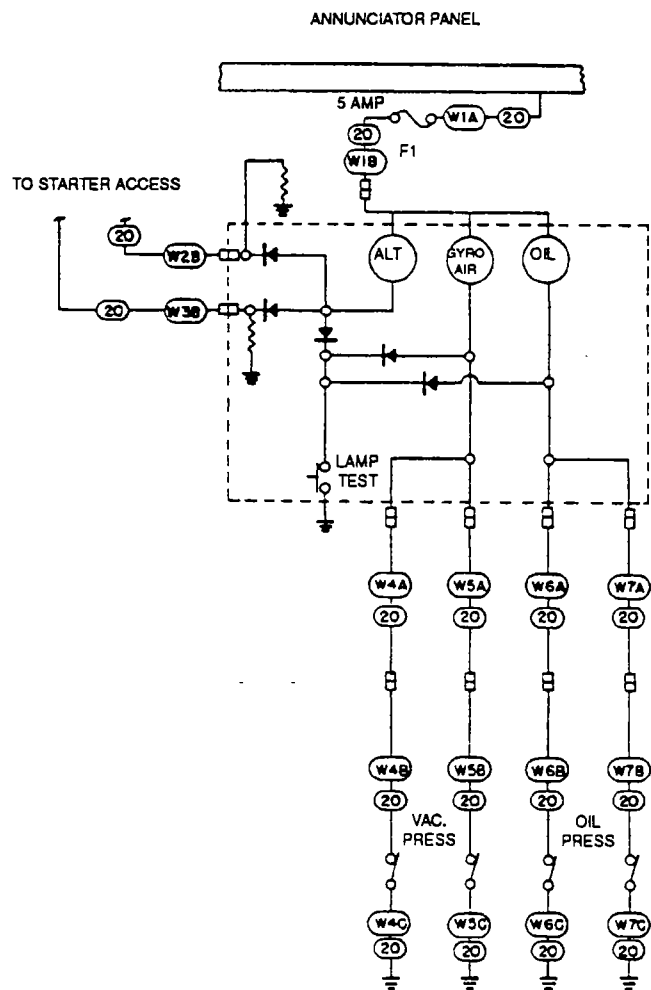


Figure 91-7. Annunciator Panel (180T)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

EL802
86372



PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

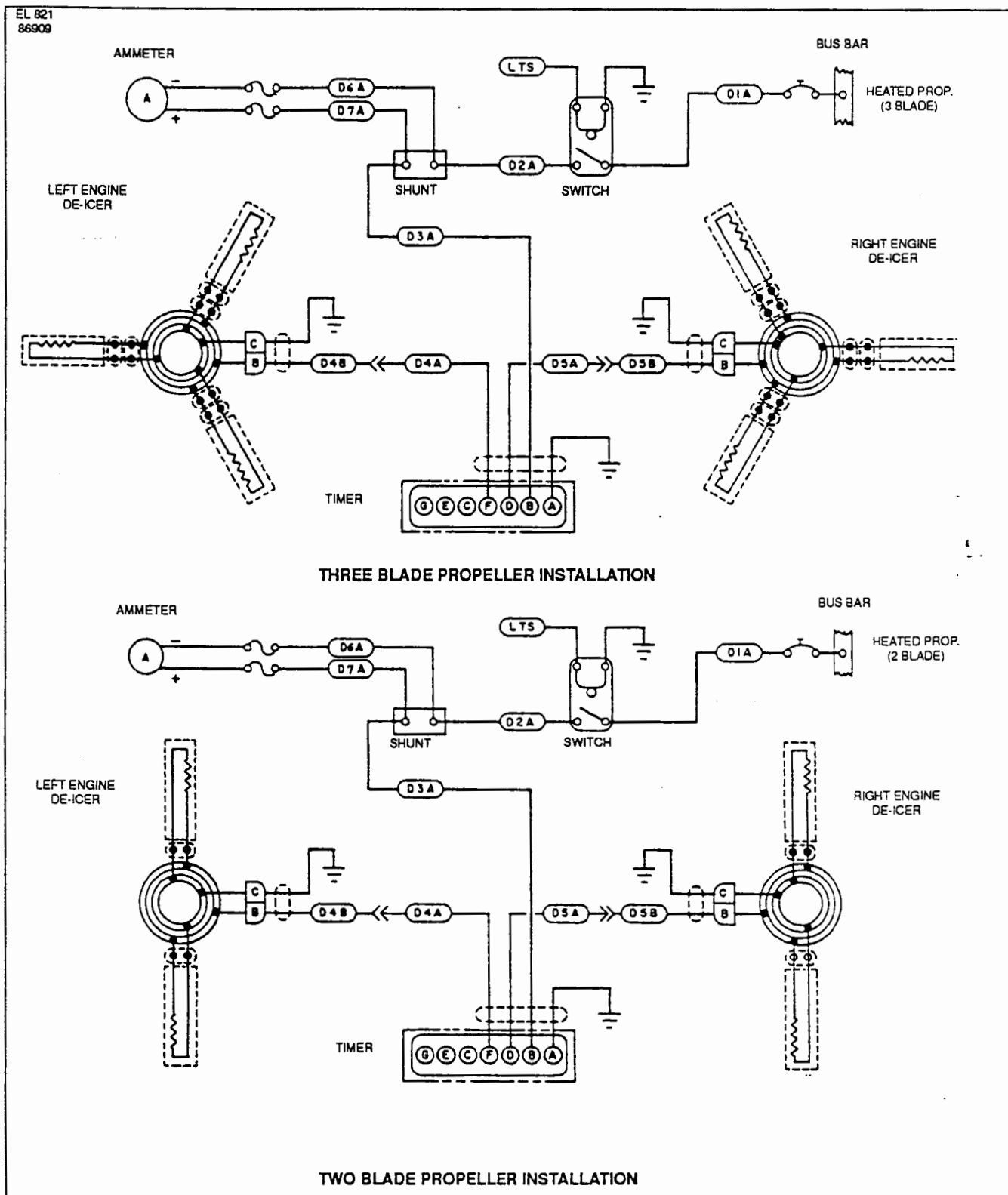


Figure 91-9. Electrical Prop Deicing System

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

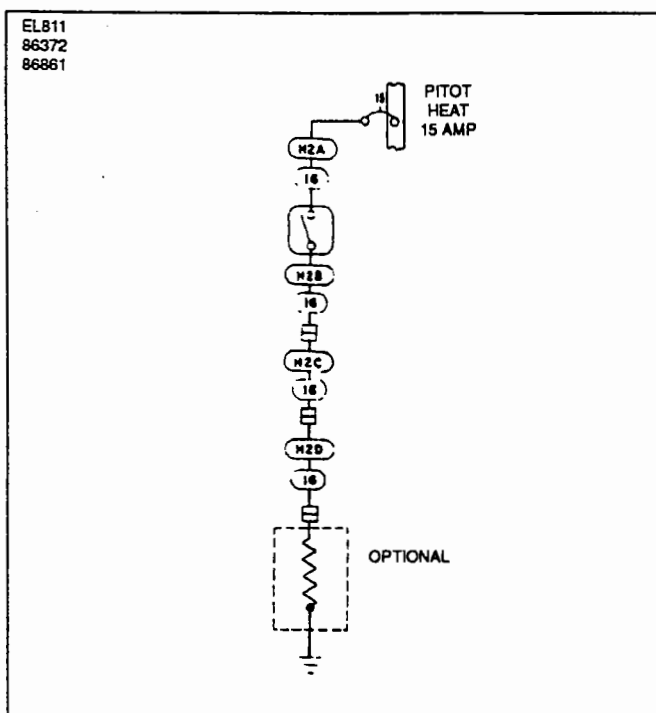


Figure 91-10. Pitot Heat

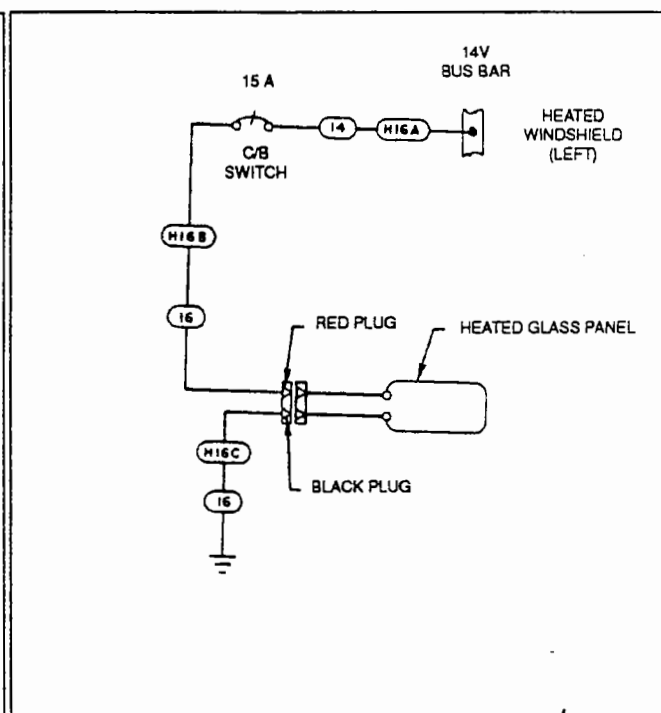


Figure 91-11. Windshield Heat

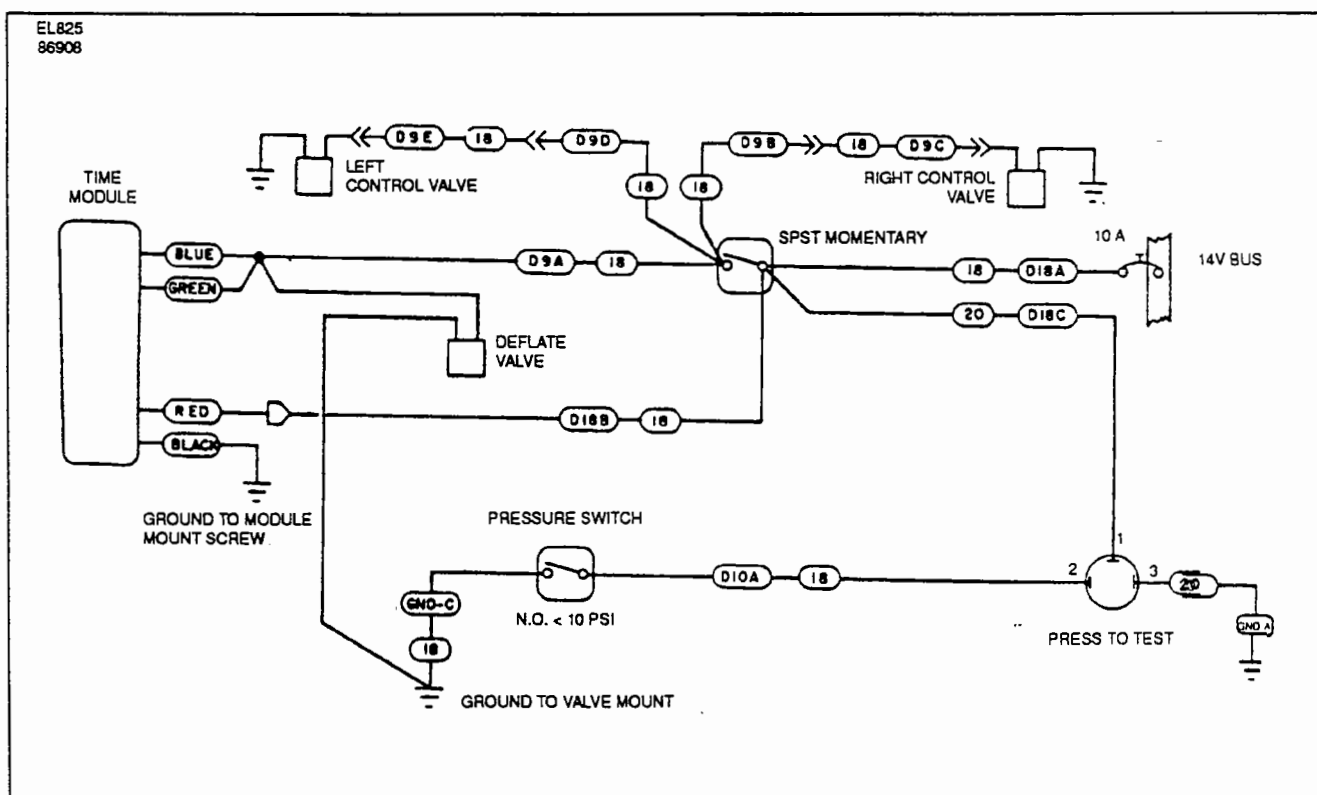


Figure 91-12. Surface Deice

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

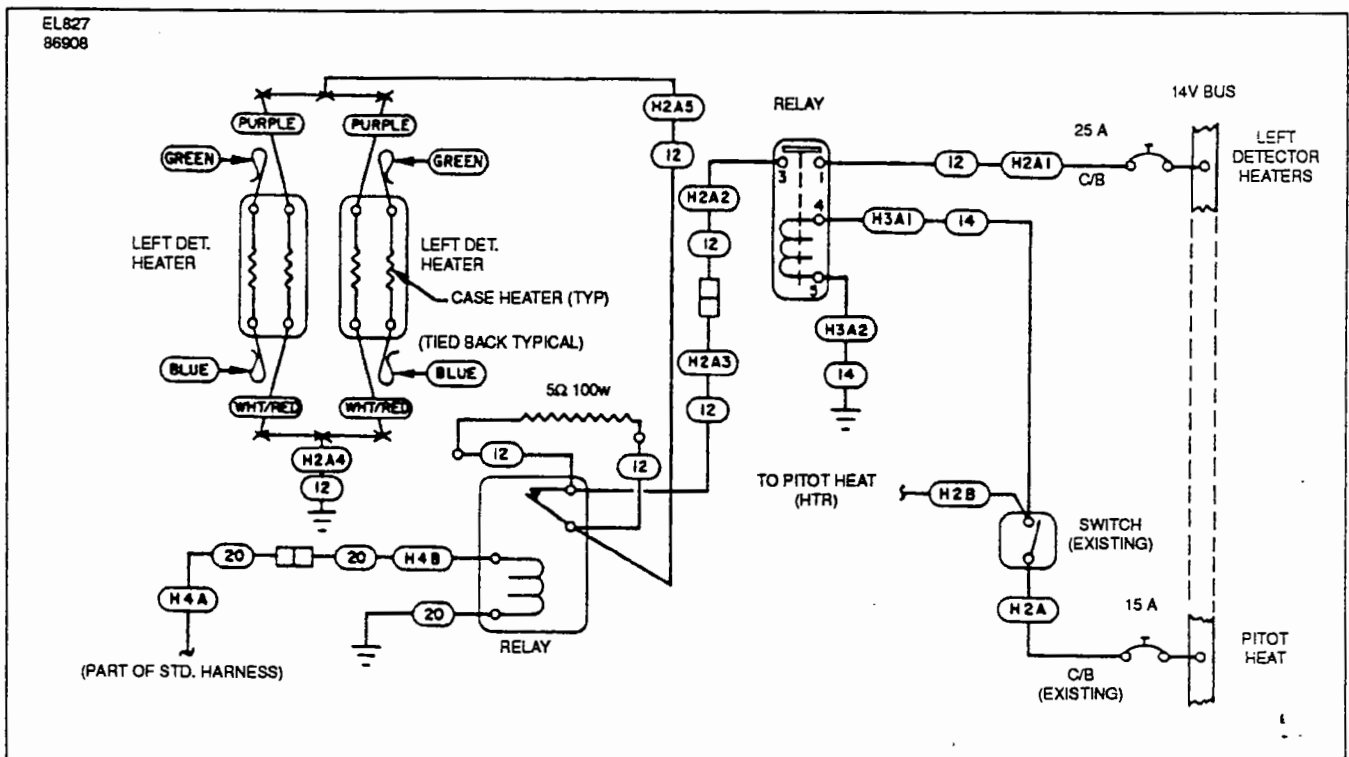


Figure 91-13. Heated Left Detector

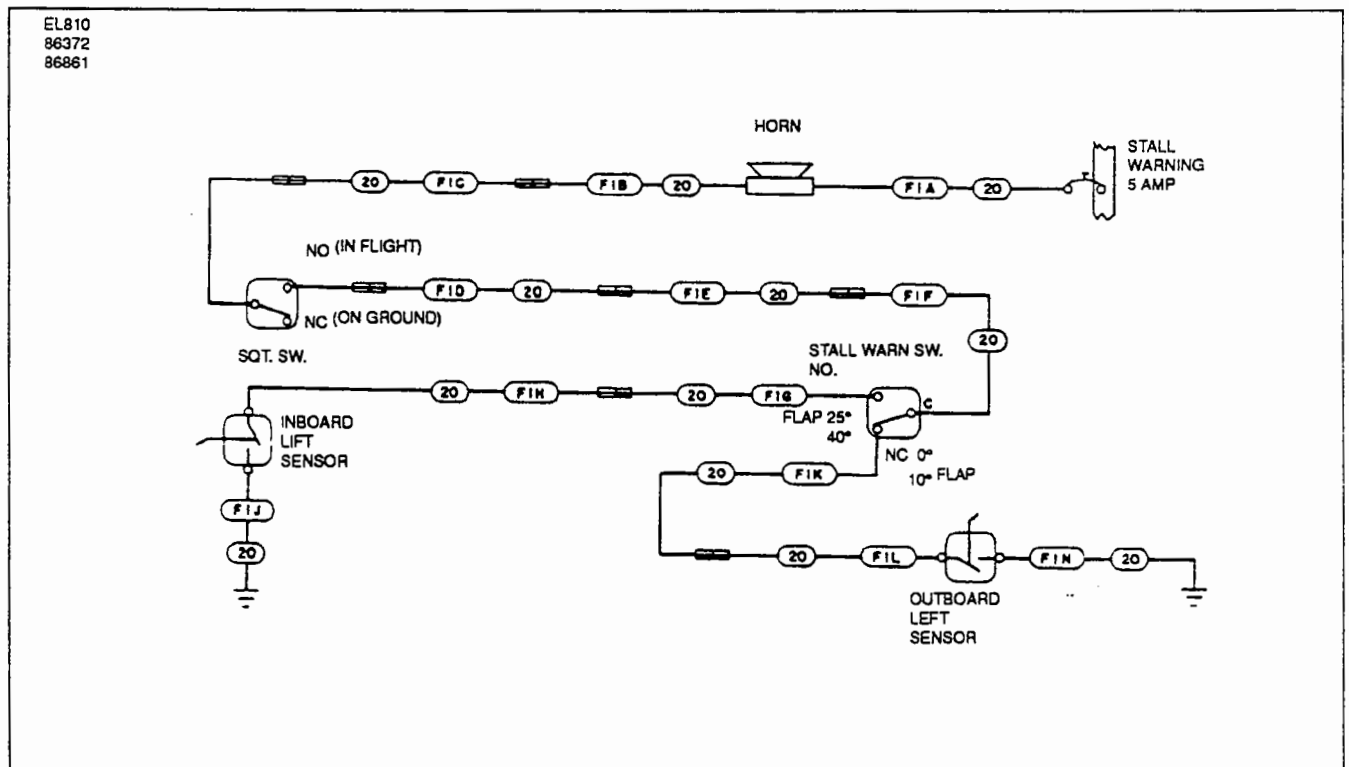


Figure 91-14. Stall Warning

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

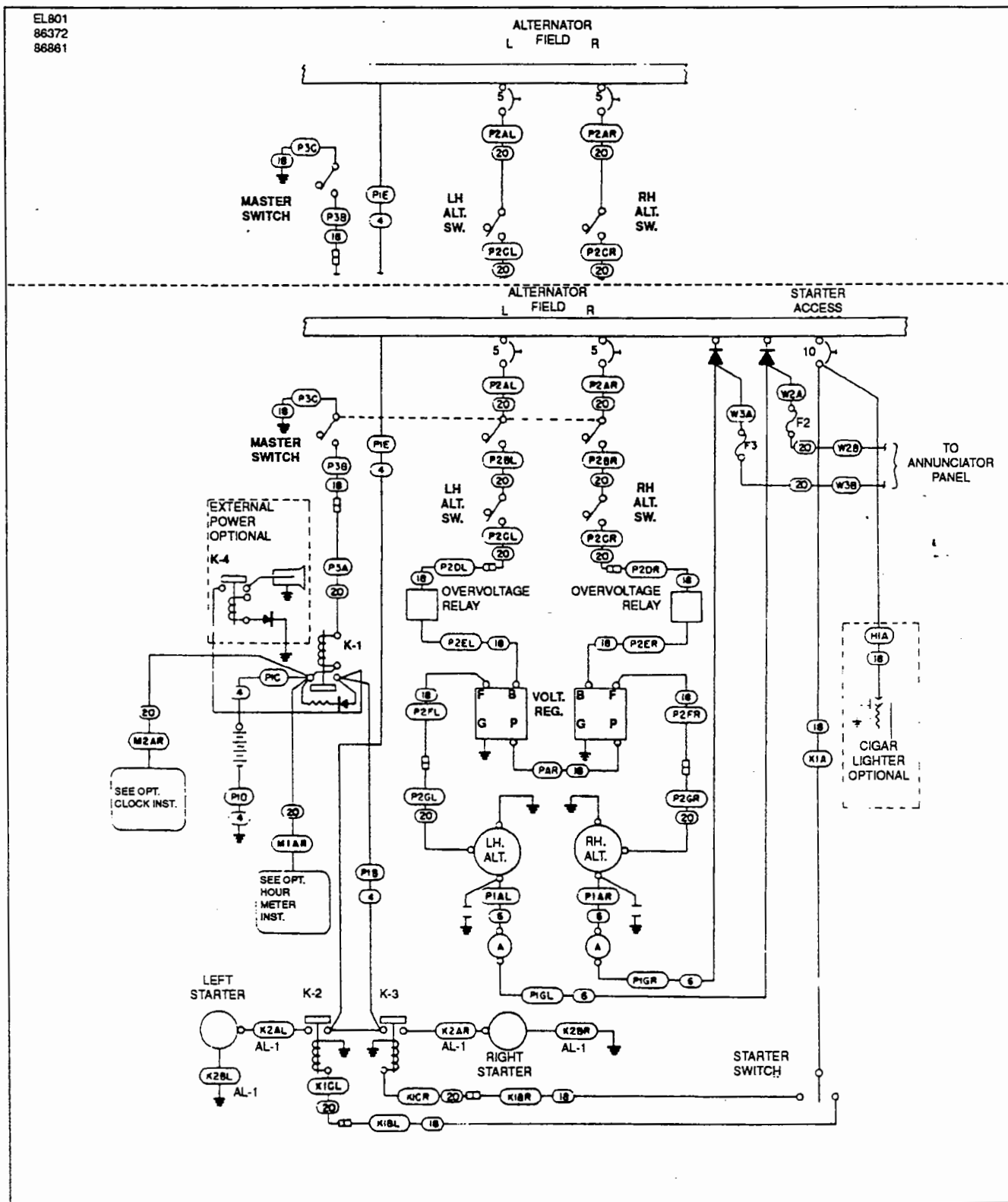


Figure 91-15. Alternator and Starter (Early Models)

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

EL819

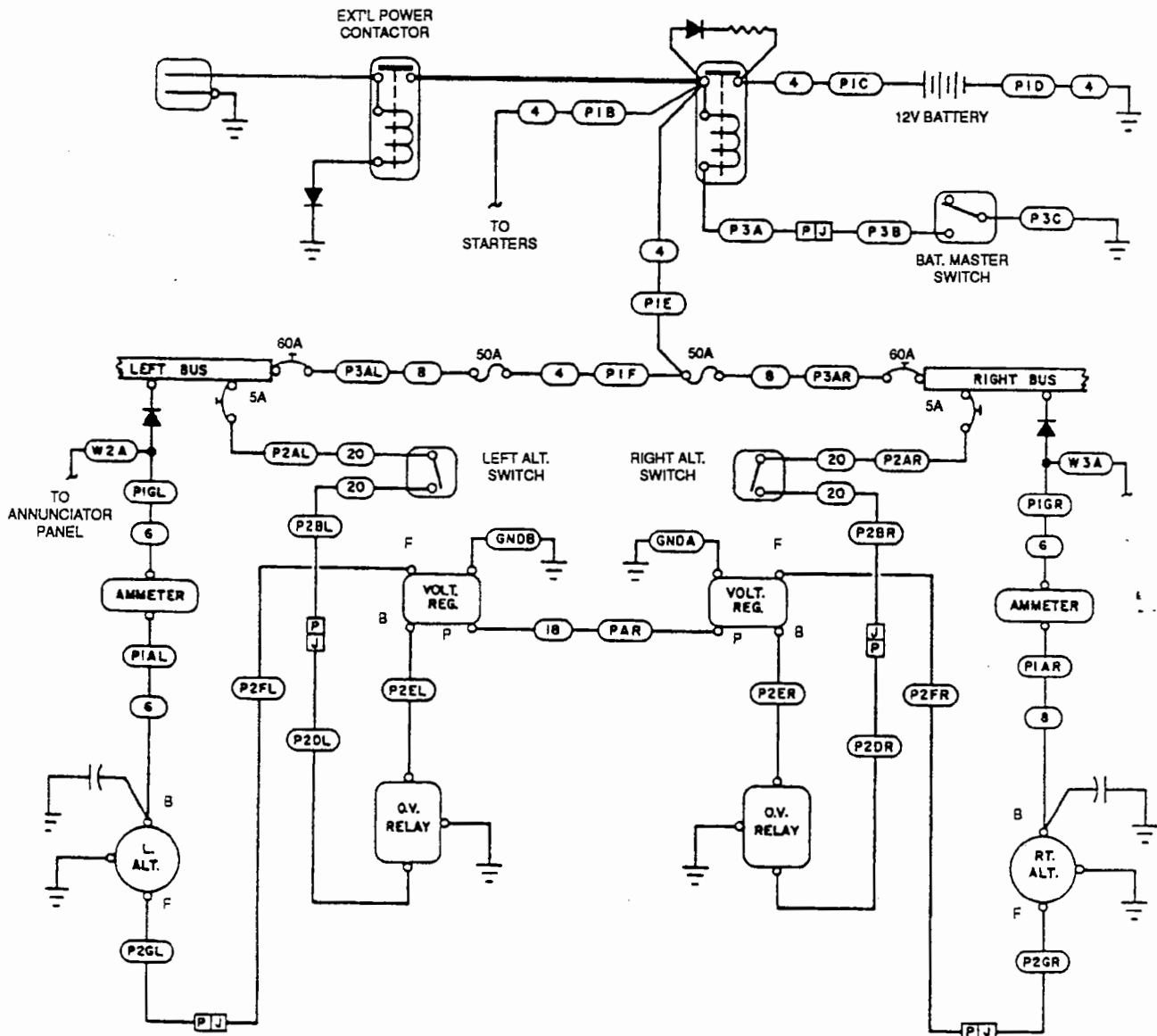


Figure 91-16. Alternators PA-44-180 S/N 8195001 and up
PA-44-180T S/N 8107076 and up

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

EL820

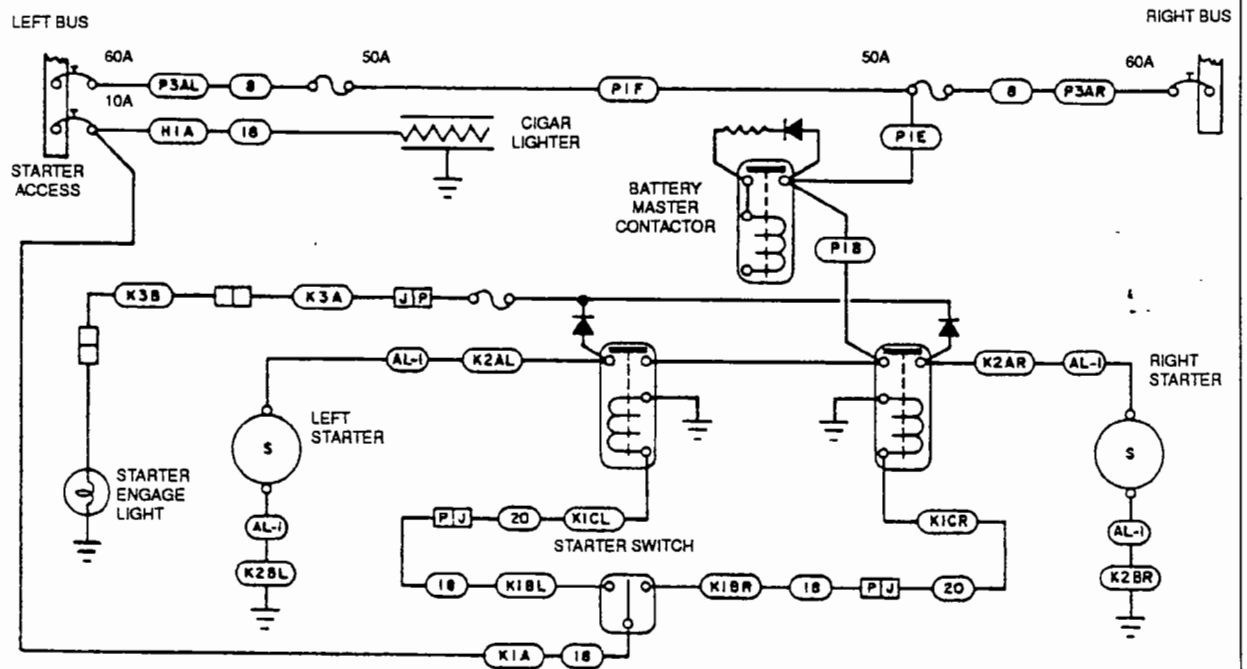


Figure 91-17. Starters PA-44-180, S/N 8195001 and up
PA-44-180T, S/N 8107076 and up

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

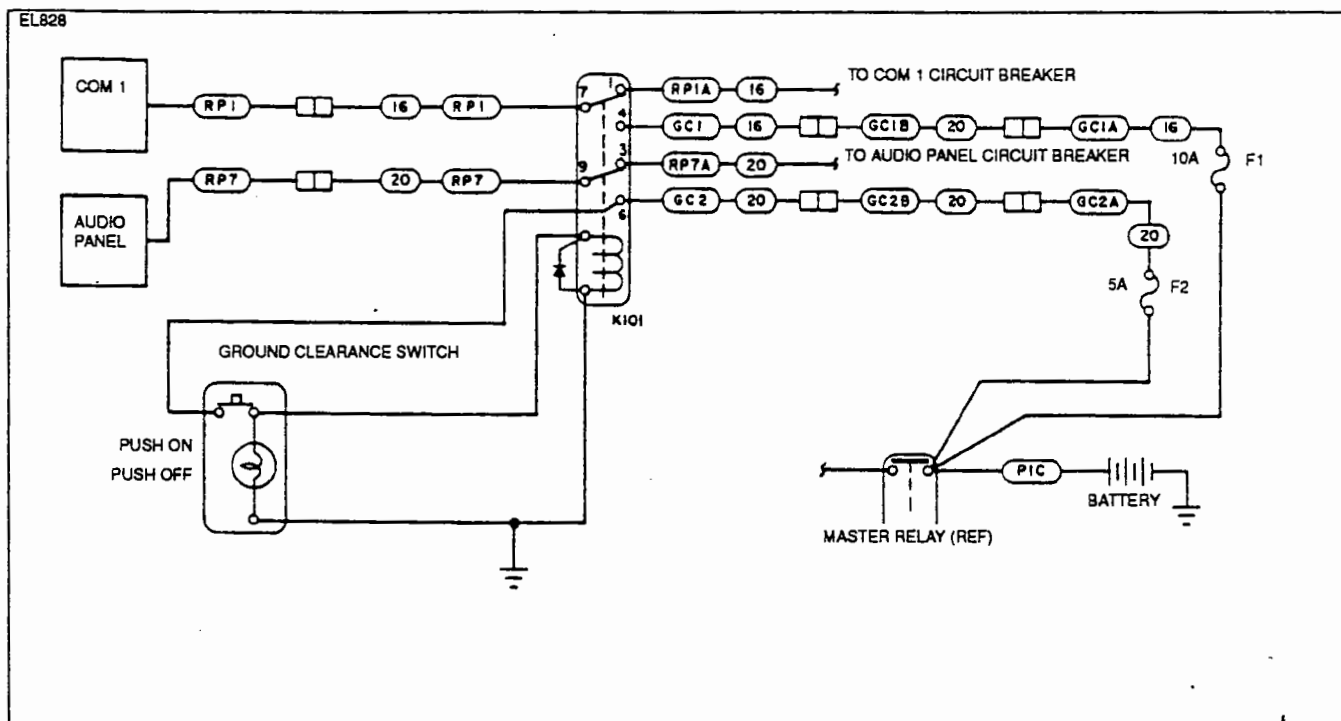


Figure 91-18. Ground Clearance Switch, PA-44-180T (Optional)
S/N 44-8307001 and up

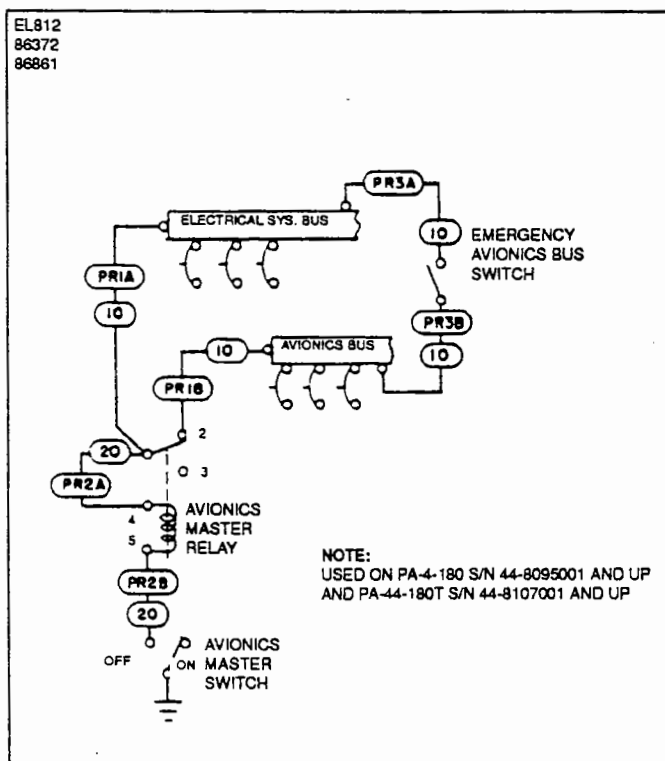


Figure 91-19. Optional Avionics Master Switch

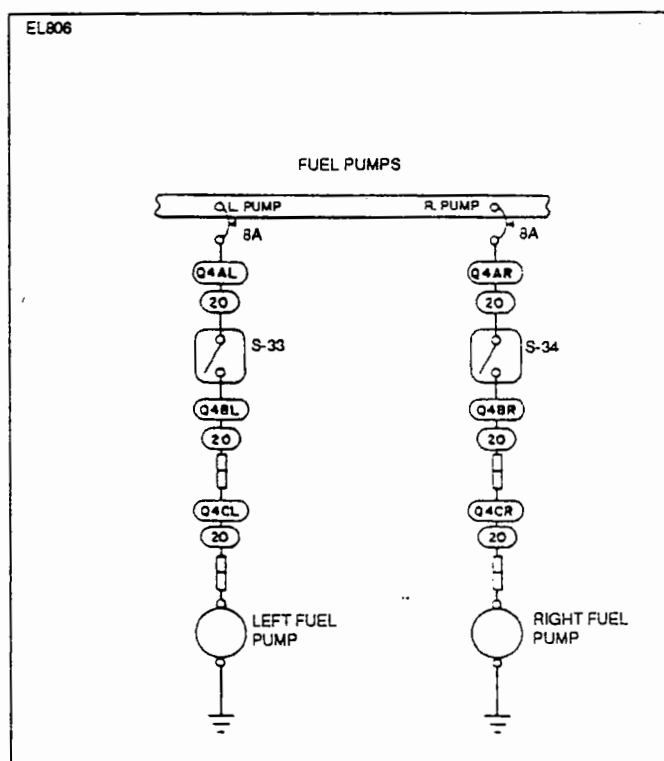


Figure 91-20. Fuel Pumps

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

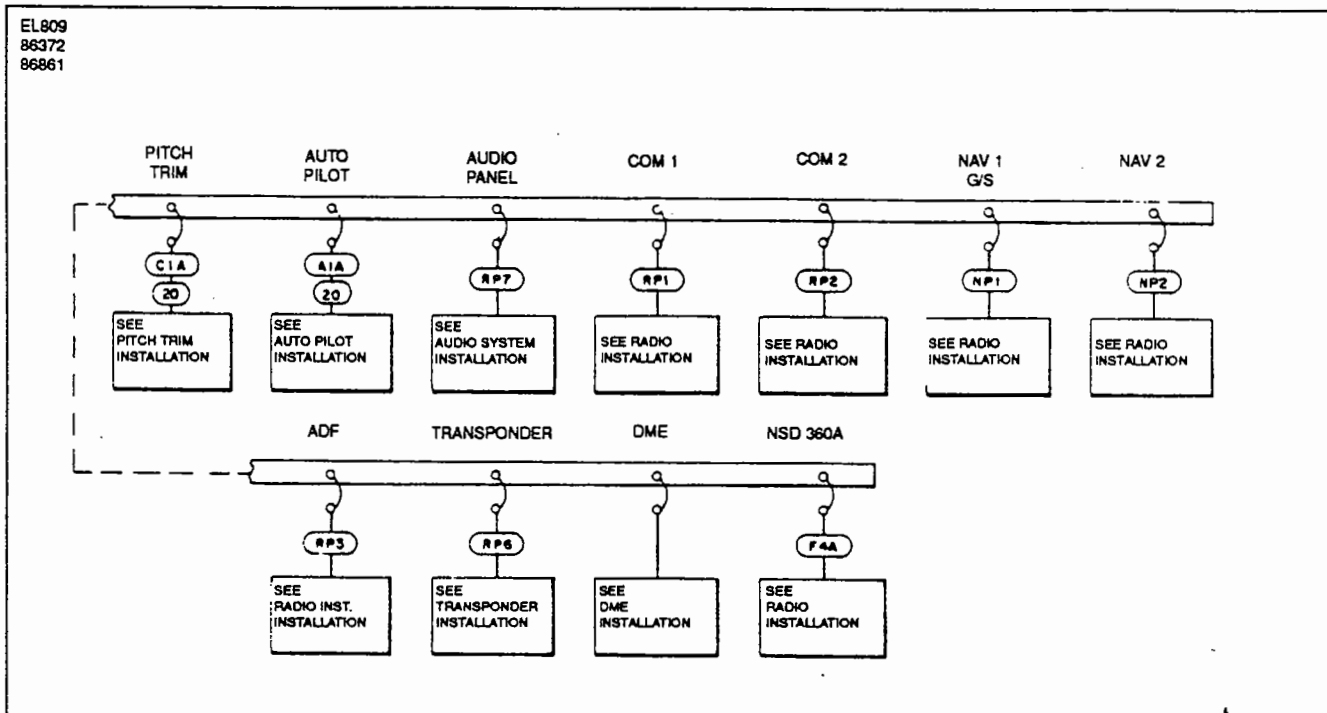


Figure 91-21. Avionics Bus Power (Early Models 180/180T)

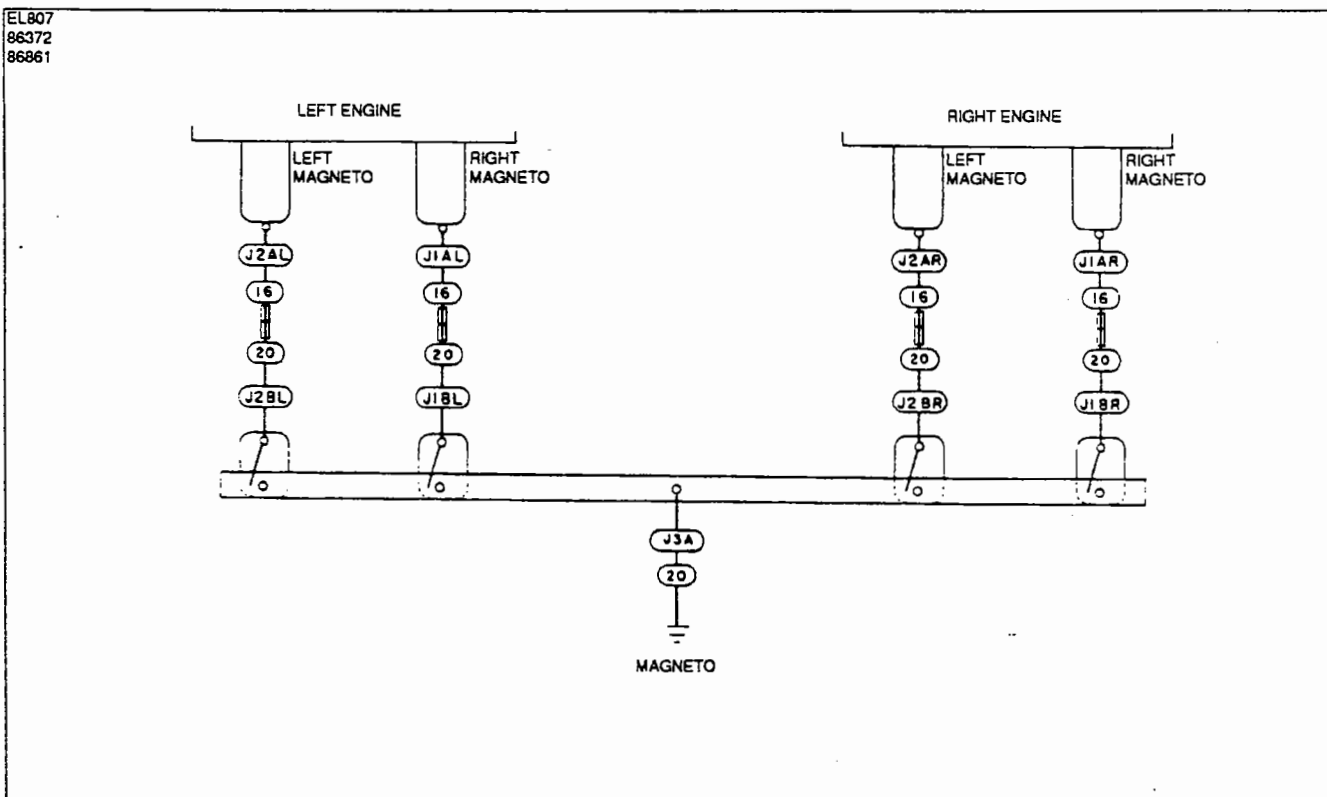


Figure 91-22. Left and Right Engine Magnetos

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

EL823
86959

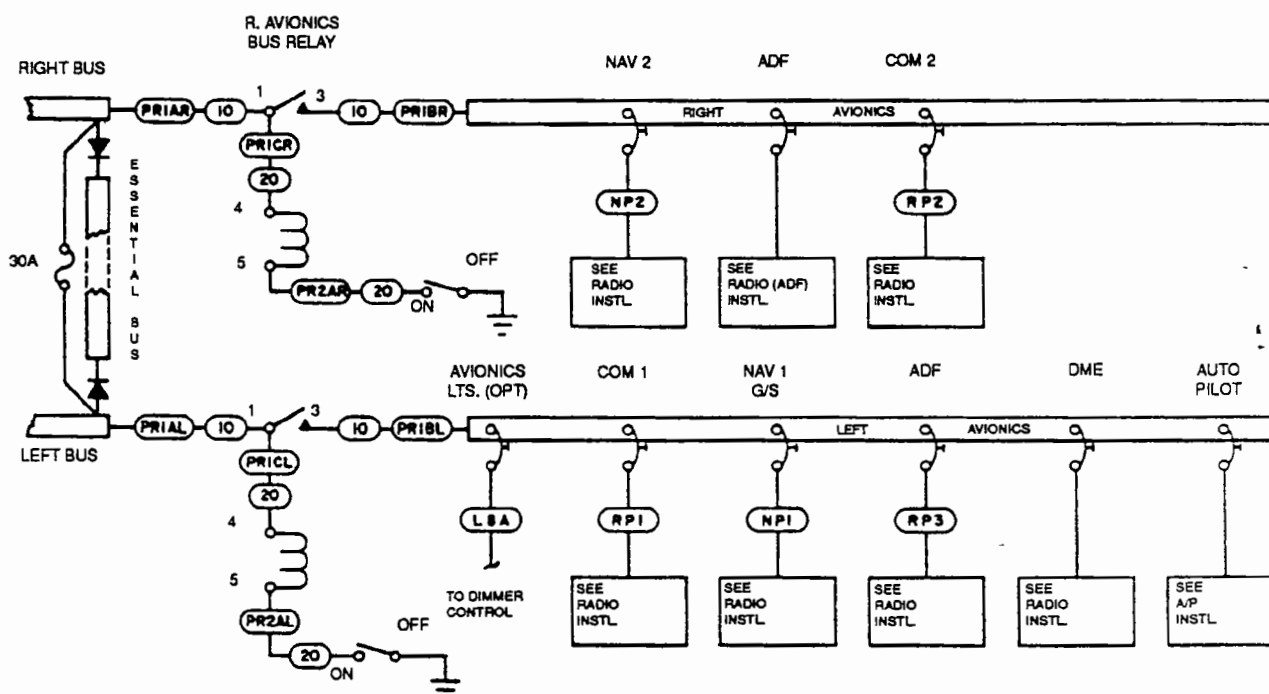


Figure 91-23. Avionics Bus Power PA-44-180T, S/N 82007001 and up

91-23-00

Page 91-34

Revised: May 15, 1989

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

EL805
86372
86861

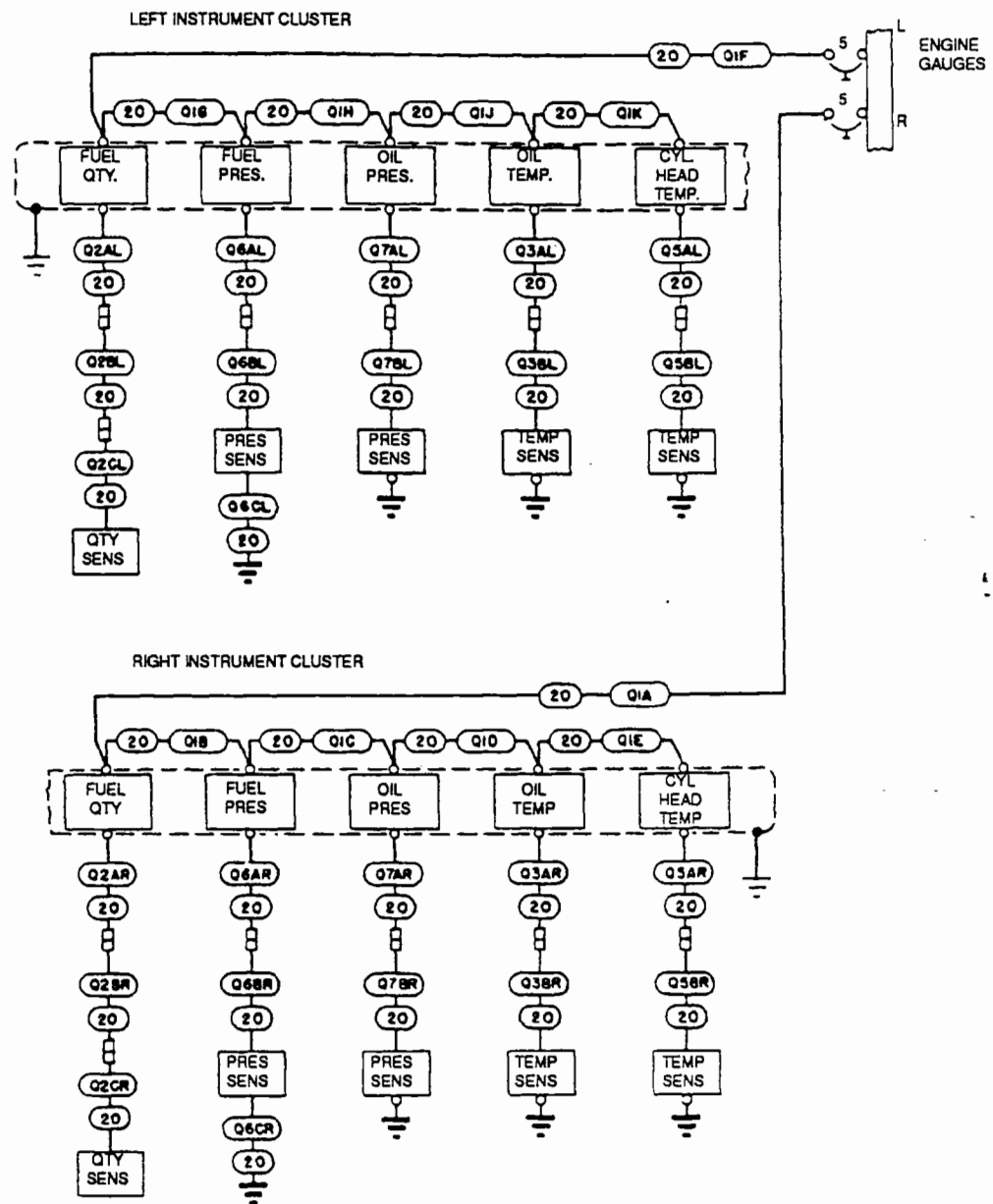


Figure 91-24. Engine Gauges PA-44-180, S/N 7995001 to 8095037

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

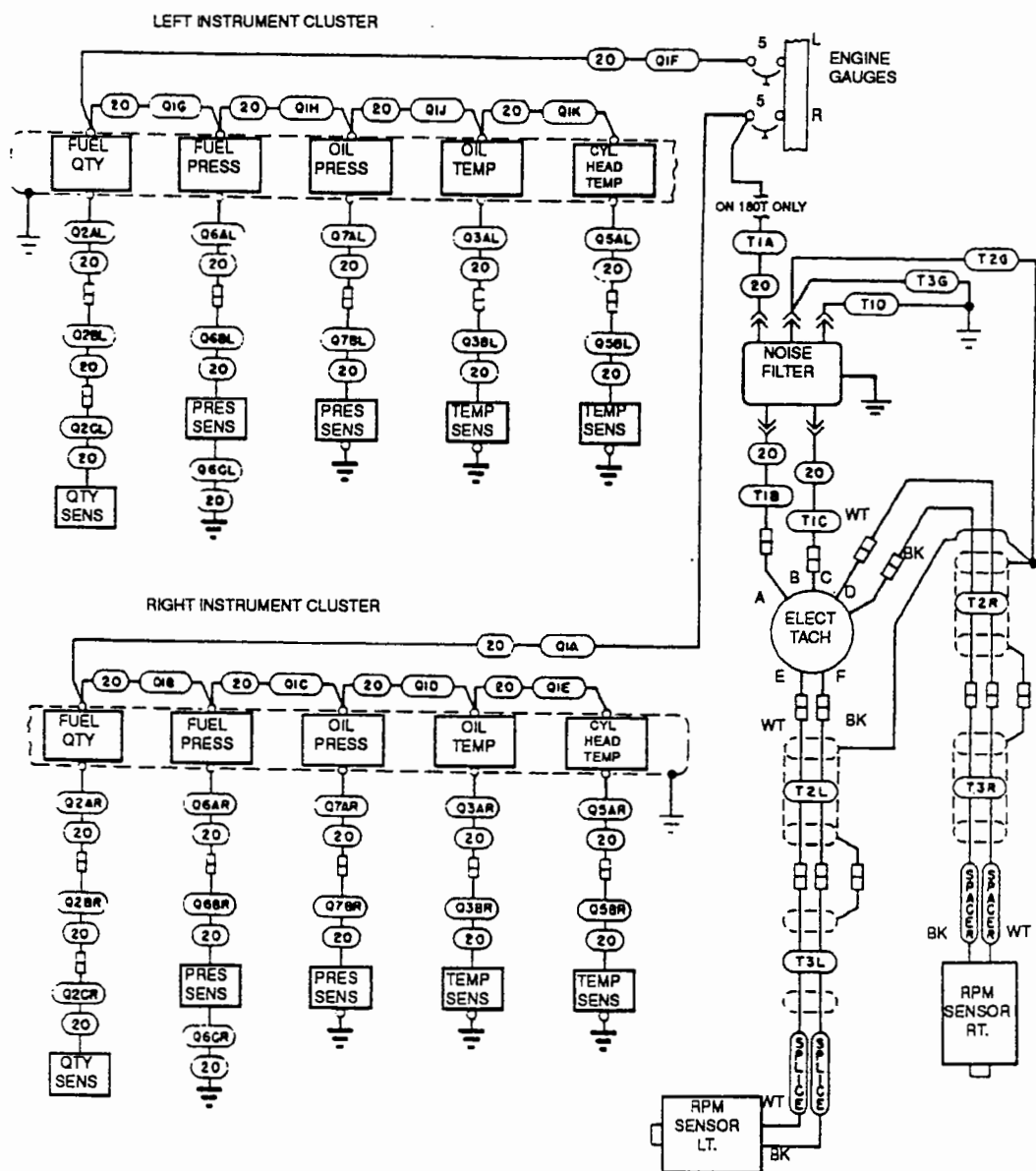


Figure 91-25. Engine Gauges PA-44-180, S/N 8195001 and up
PA-44-180T, S/N 8107001 to 8207031

EL830



PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

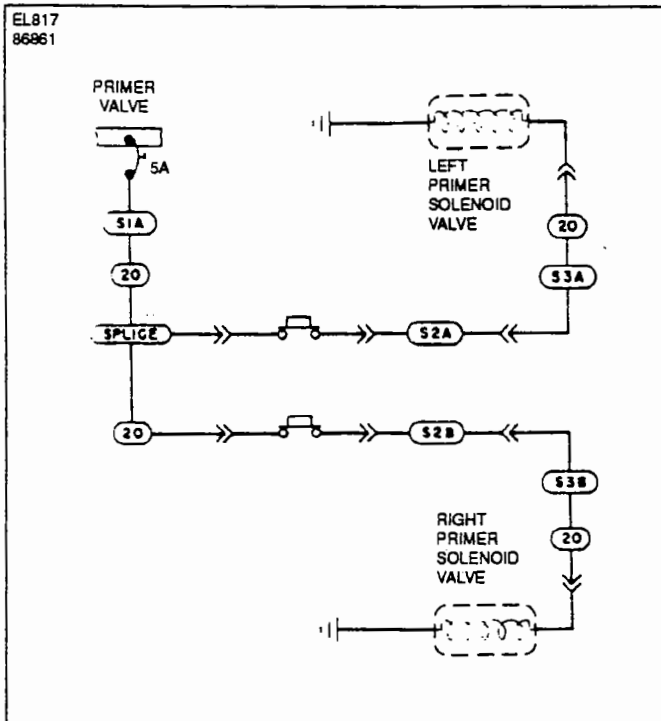


Figure 91-27. Primer Solenoids

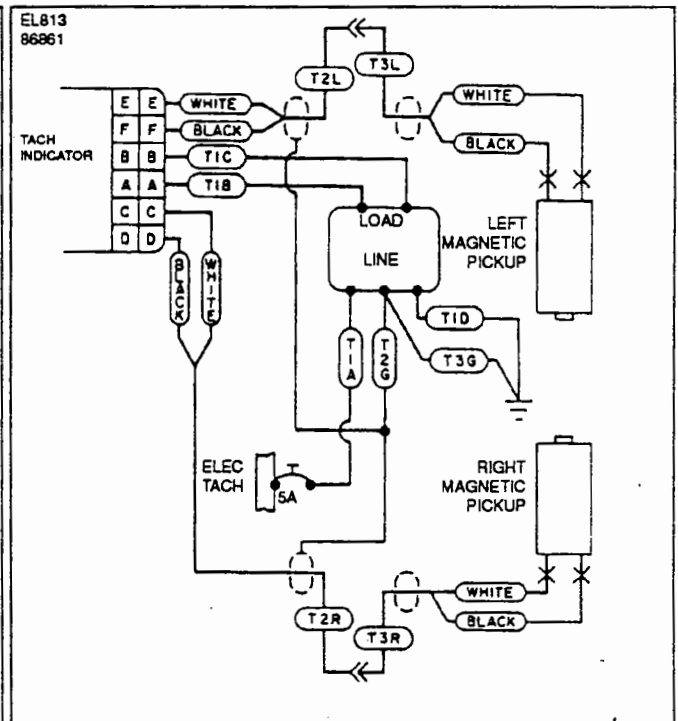


Figure 91-28. Electric Tach Installation (180T)

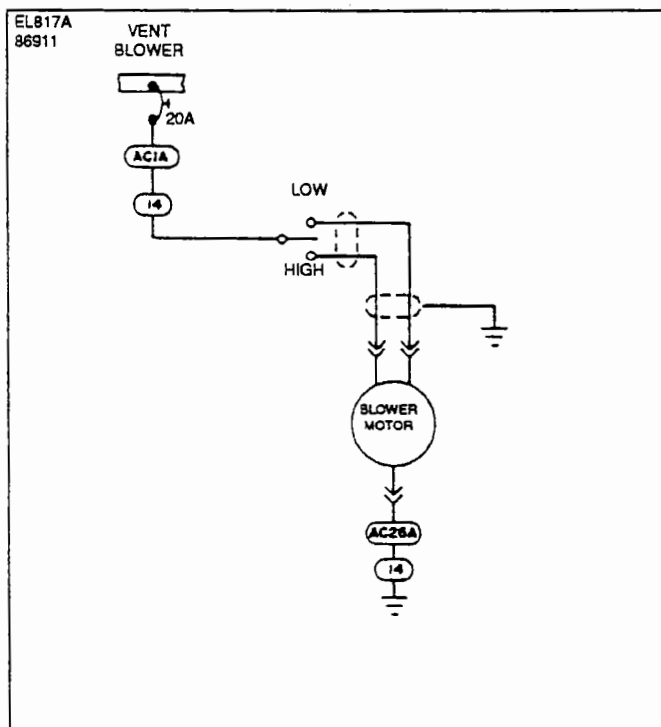


Figure 91-29. Blower Motor

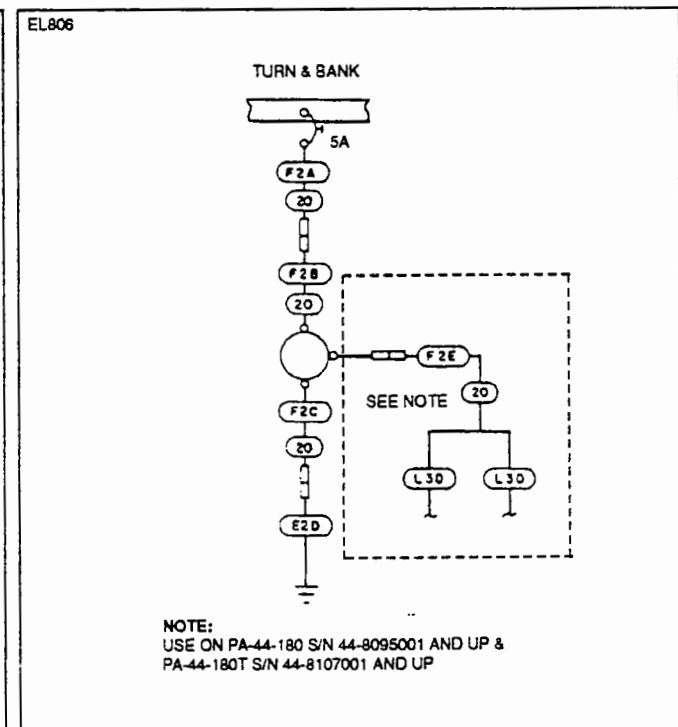


Figure 91-30. Turn and Bank

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

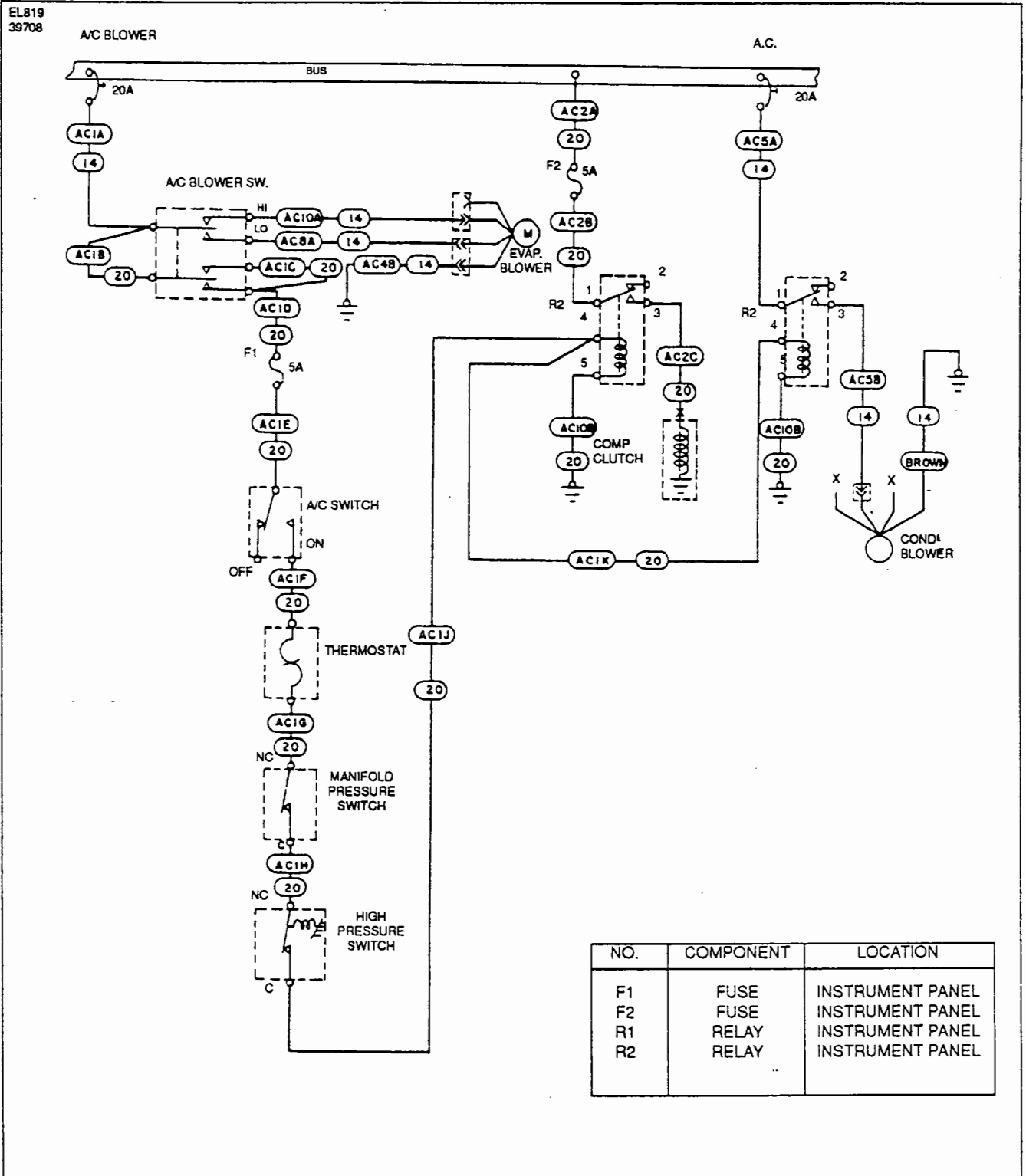
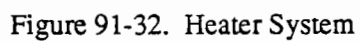


Figure 91-31. Air Conditioning System PA-44-180, S/N 8195001 to 8195040
PA-44-180T S/N 8107001 and up

EL815
86372
86861



PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

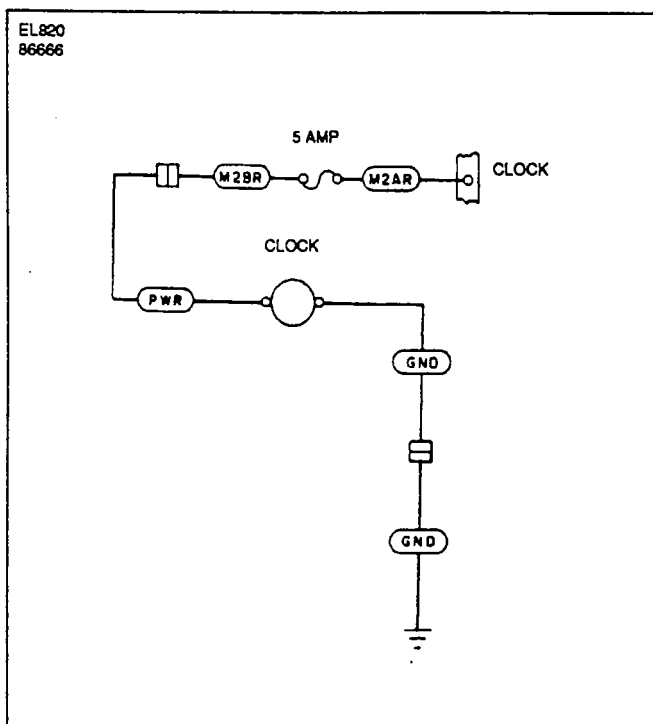


Figure 91-33. Clock (Instrument Panel Mounted)

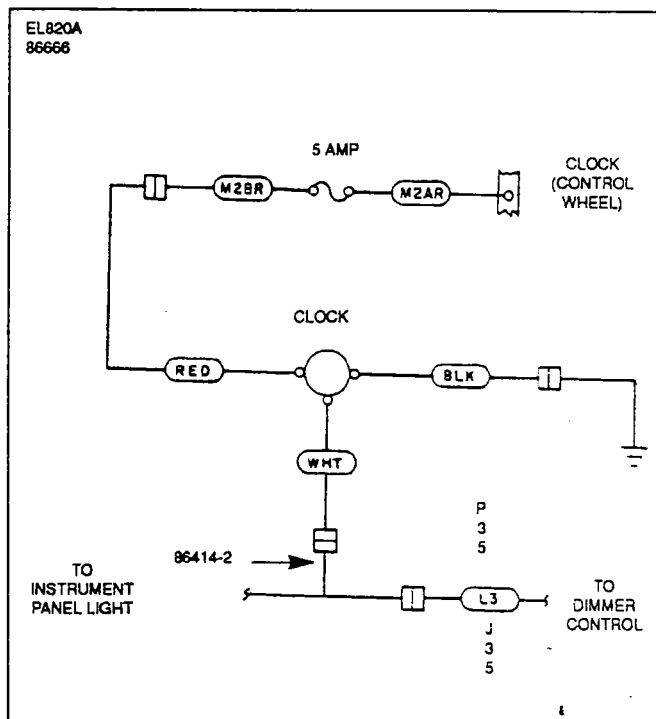


Figure 91-34. Clock (Control Wheel Mounted)

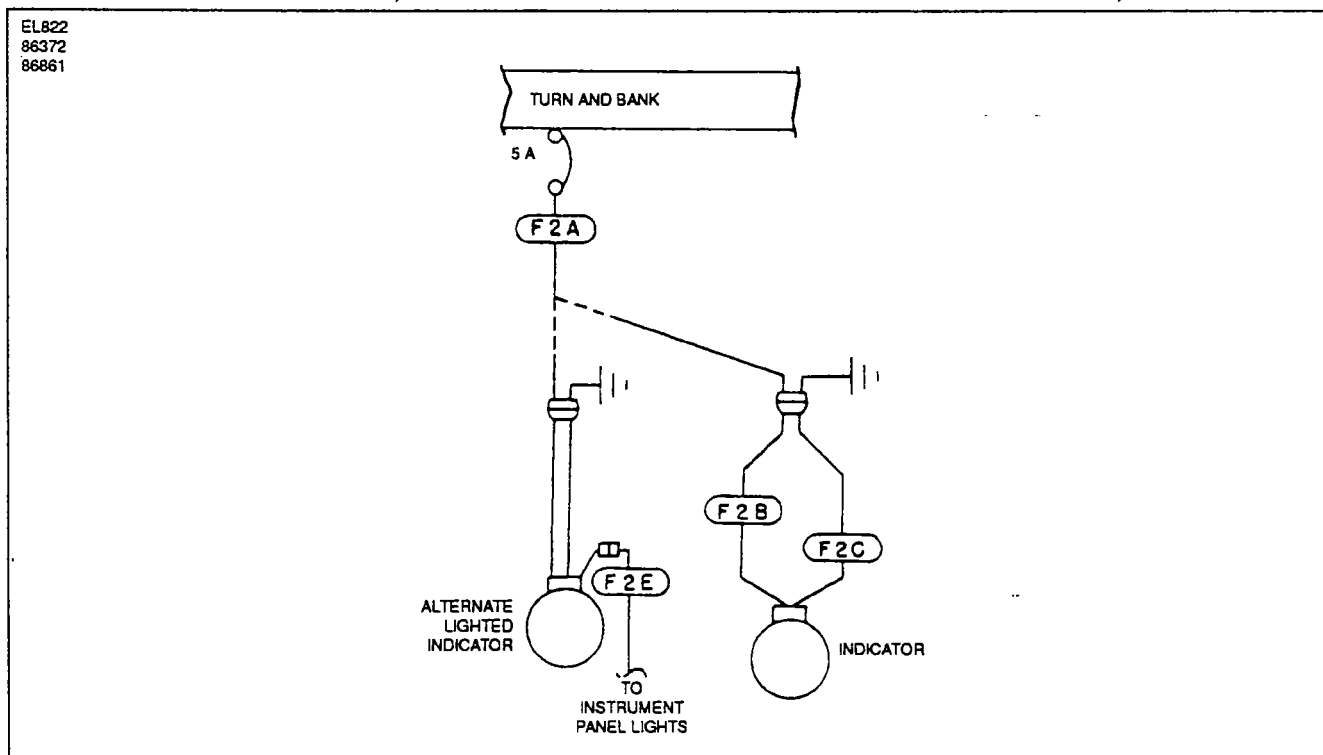
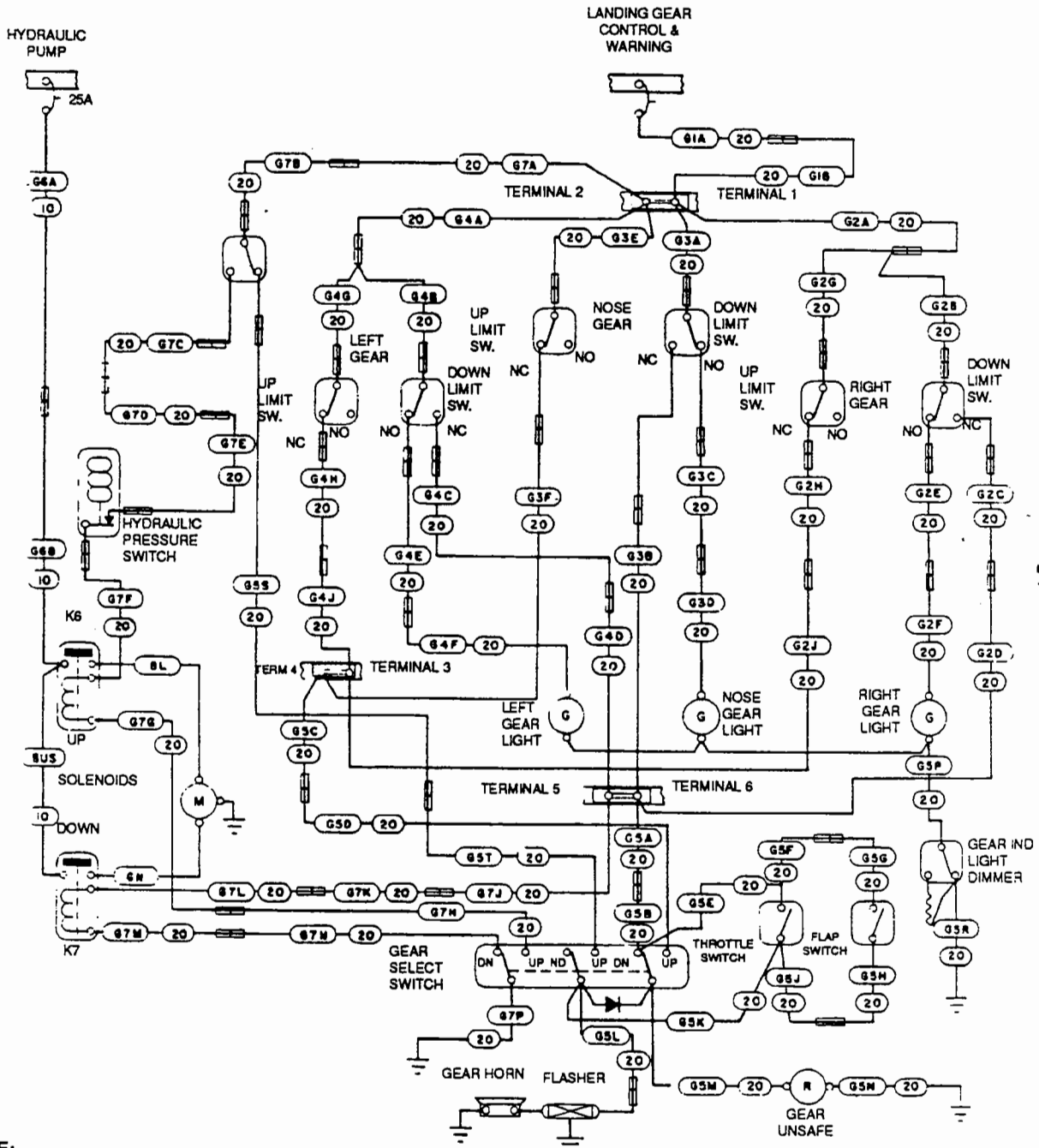


Figure 91-35. Turn and Bank (Optional)

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

EL804
86861
86372



NOTE:
GEAR SHOWN IN DOWNLOCK
POSITION WITH STRUTS
COMPRESSED AND THROTTLE
SELECT SWITCHES OPEN AND FLAPS
UP.

Figure 91-36. Hydraulic Pump and Landing Gear Control and Warning

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

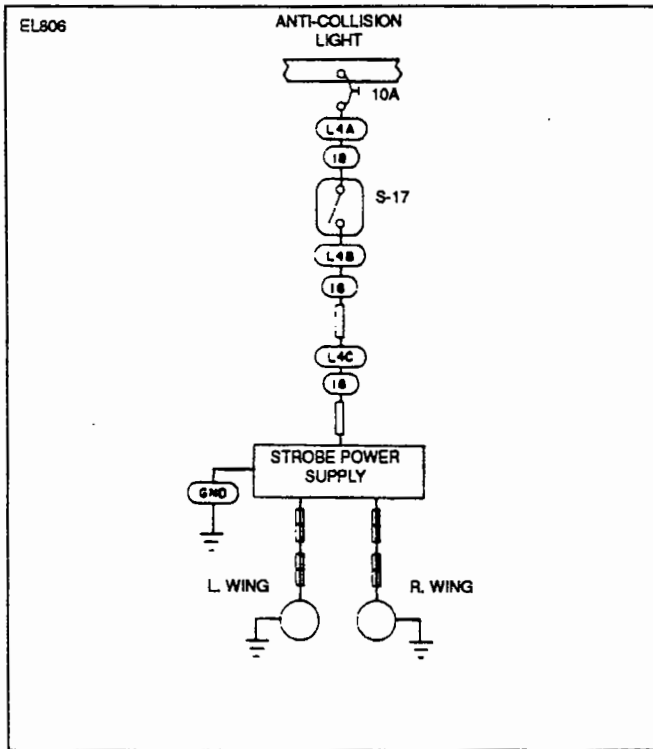


Figure 91-37. Anti-Collision Light

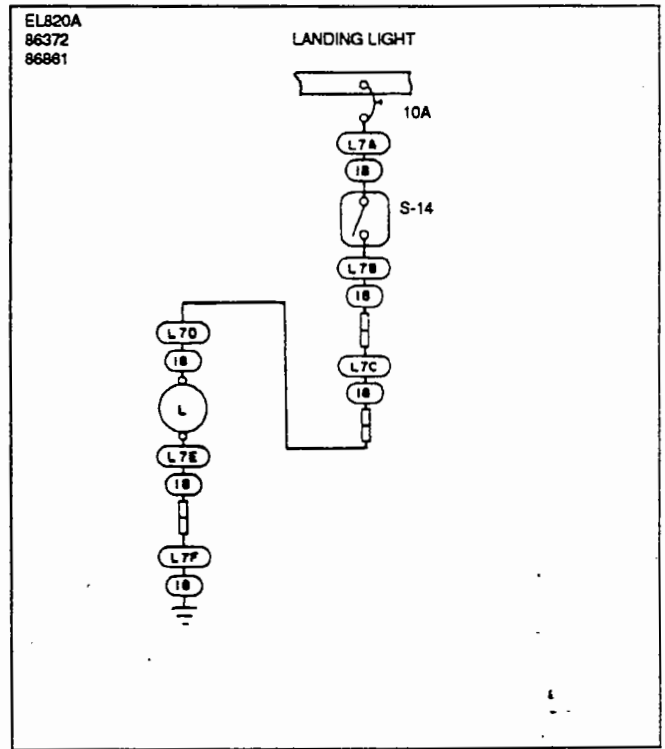


Figure 91-38. Landing Light

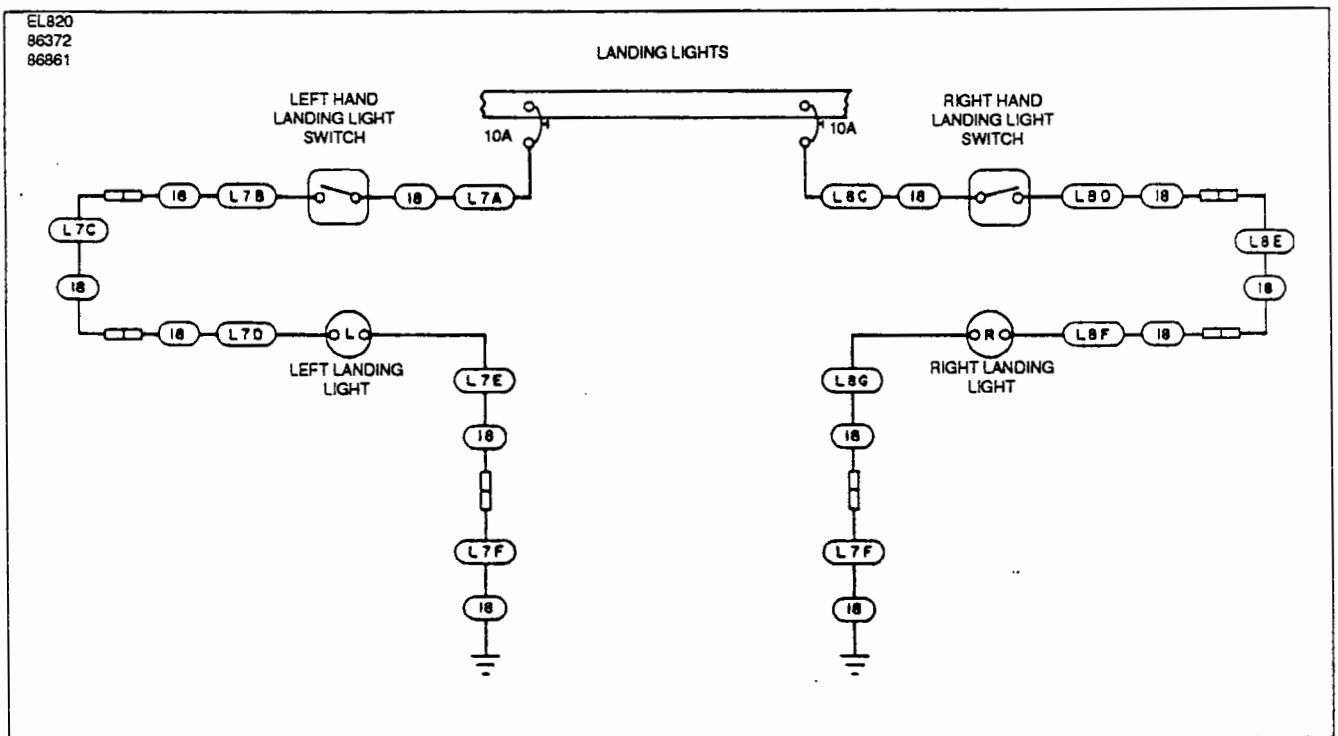


Figure 91-39. Dual Landing Lights

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

EL820
86912

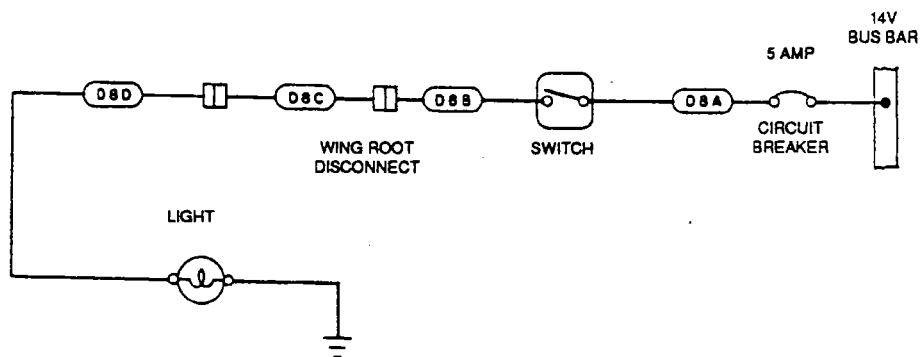


Figure 91-43. Wing Inspection Light

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

EL814
86372
86861

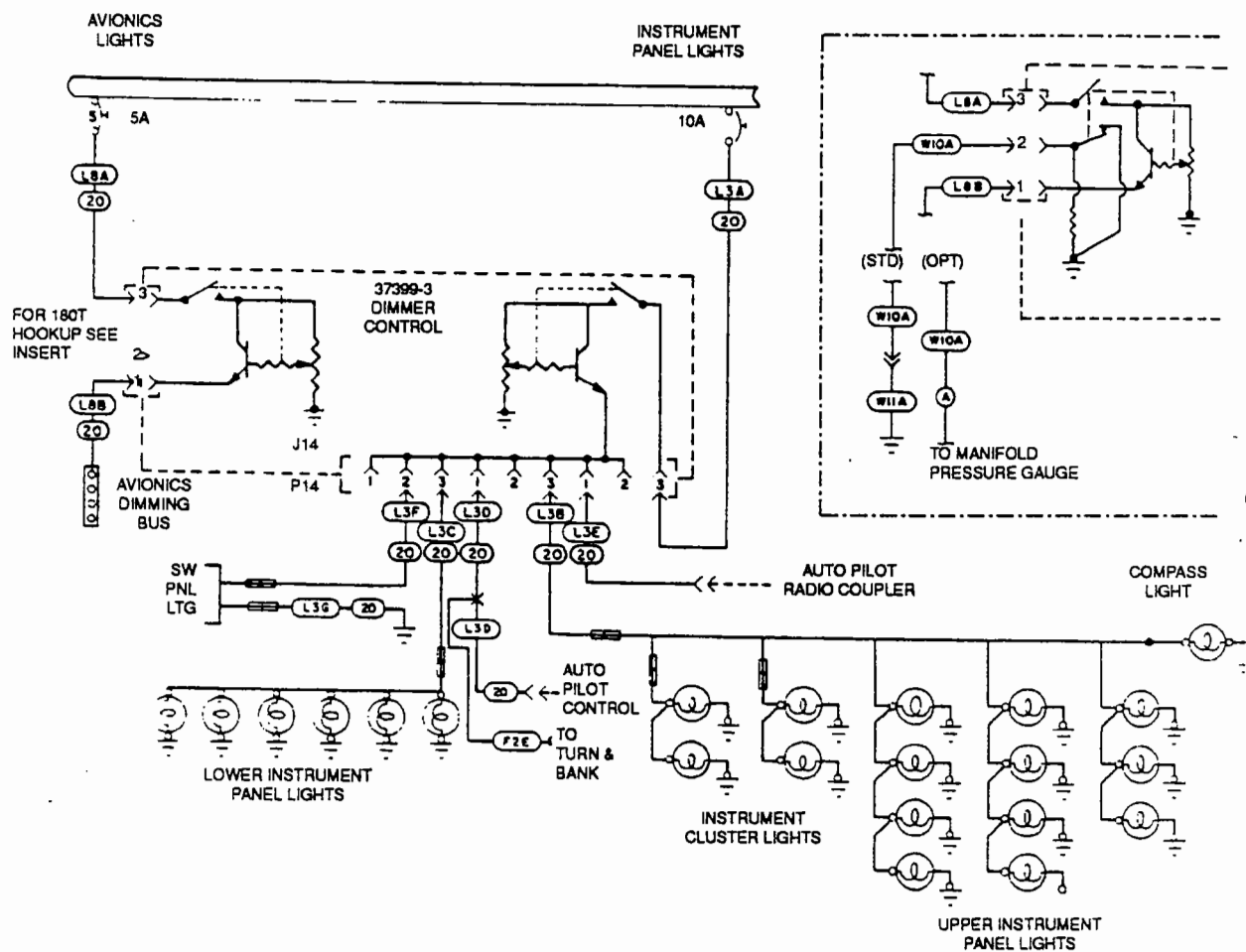


Figure 91-44. Avionics and Instrument Panel Lights

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

EL816
36889

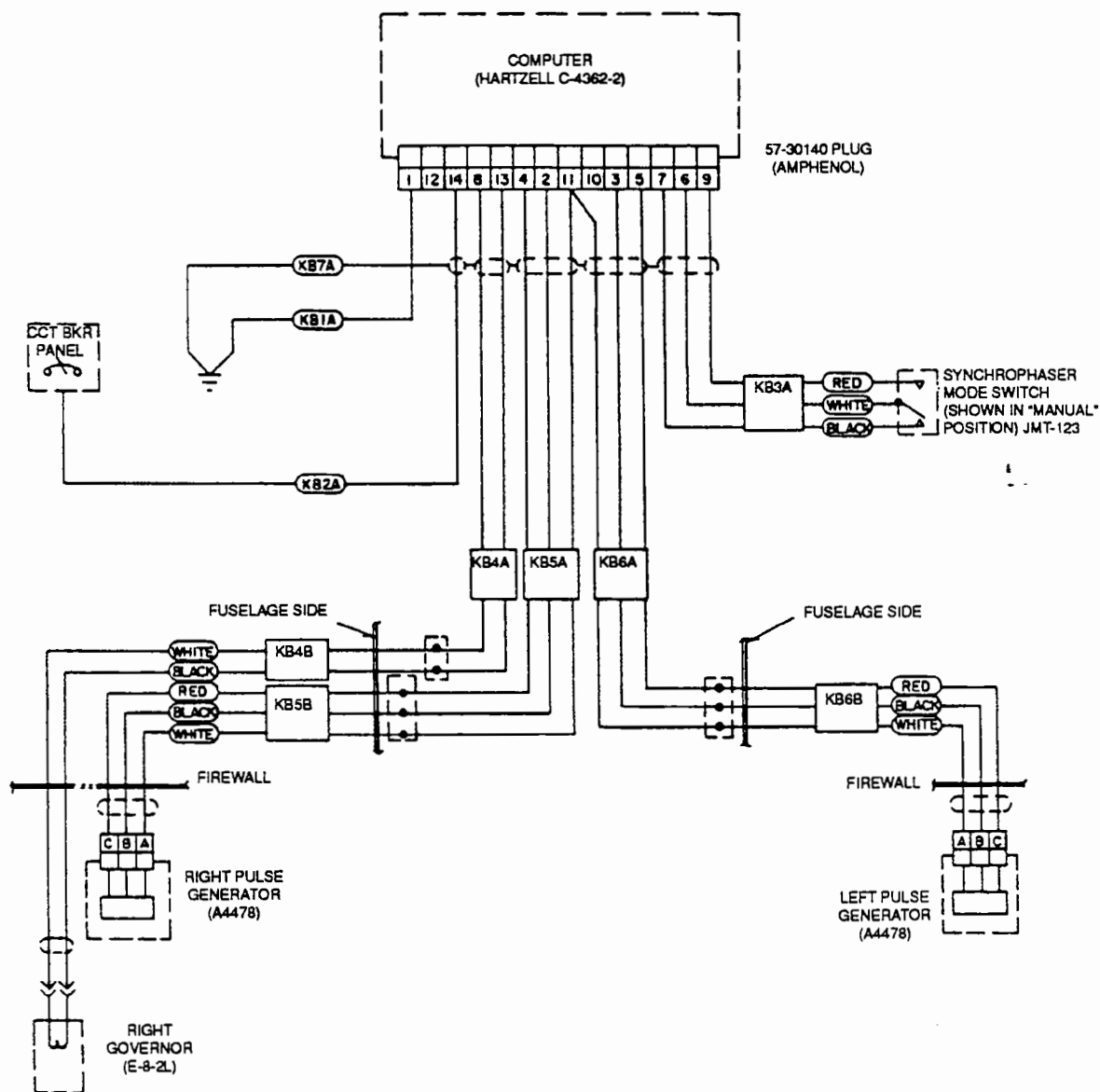


Figure 91-45. Synchrophaser System

PIPER AIRCRAFT PA-44-180/180T AIRPLANE MAINTENANCE MANUAL

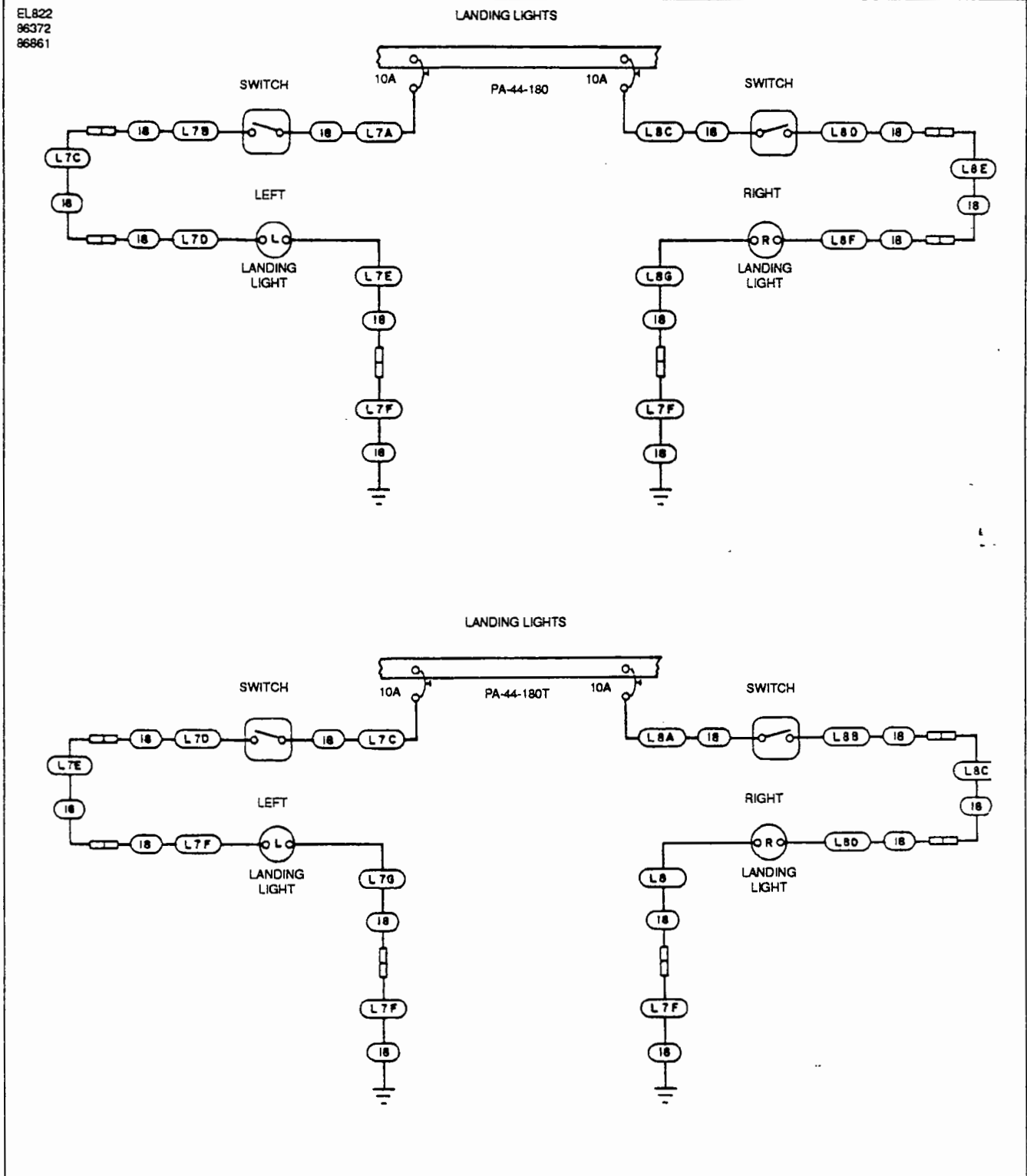


Figure 91-46. Dual Landing Lights PA-44-180, S/N 8195001 and up
PA-44-180T, S/N 8107001 and up

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

INTENTIONALLY LEFT BLANK

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

INTENTIONALLY LEFT BLANK

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

**GRIDS 4E23 THROUGH 4L24
INTENTIONALLY LEFT BLANK**



PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

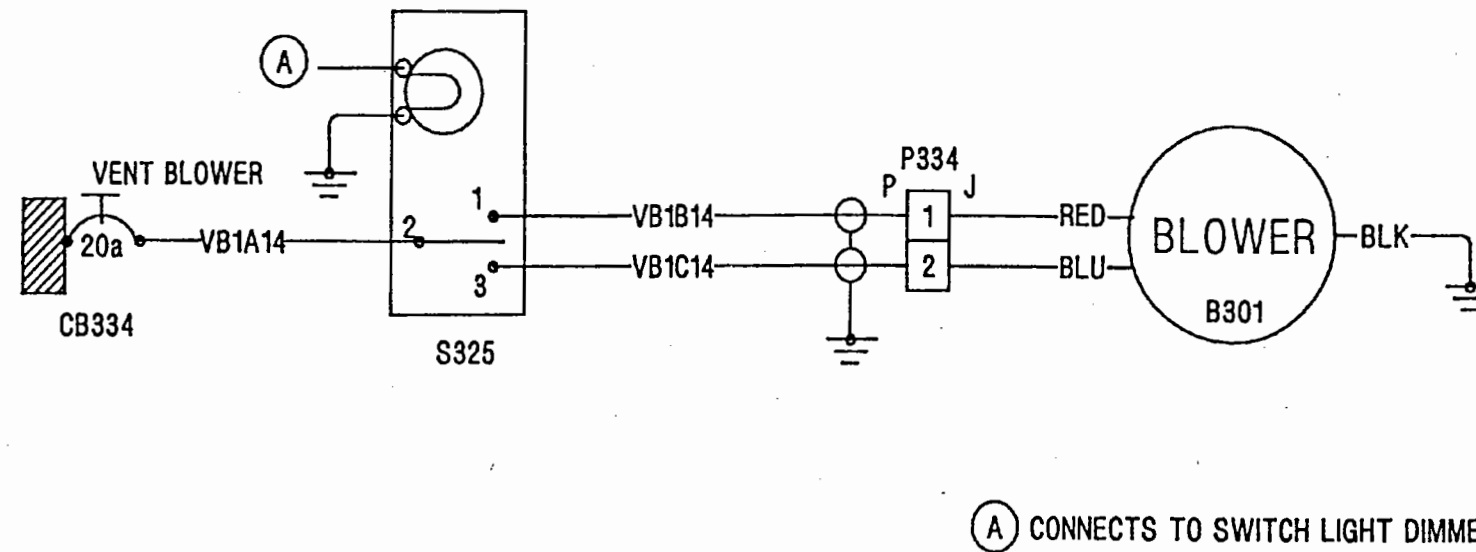


Figure 91-69. Vent Blower (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

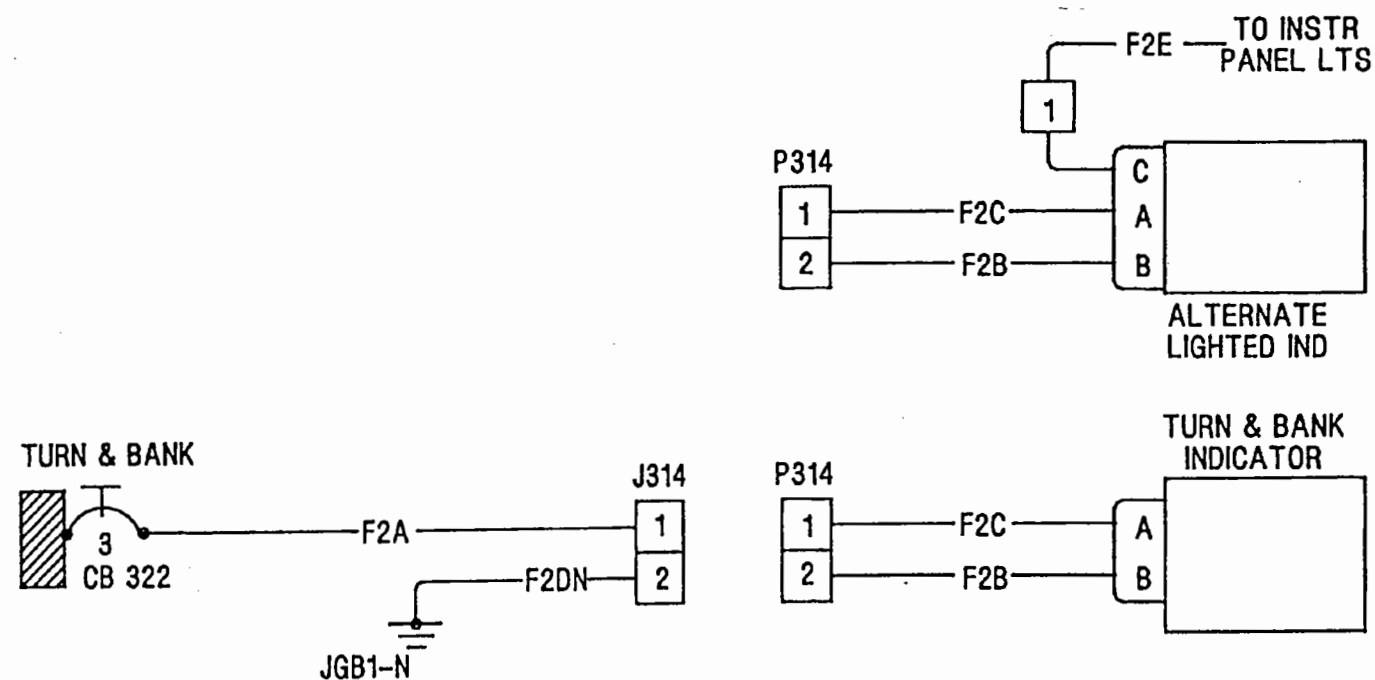


Figure 91-68. Cockpit Flood Lights (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

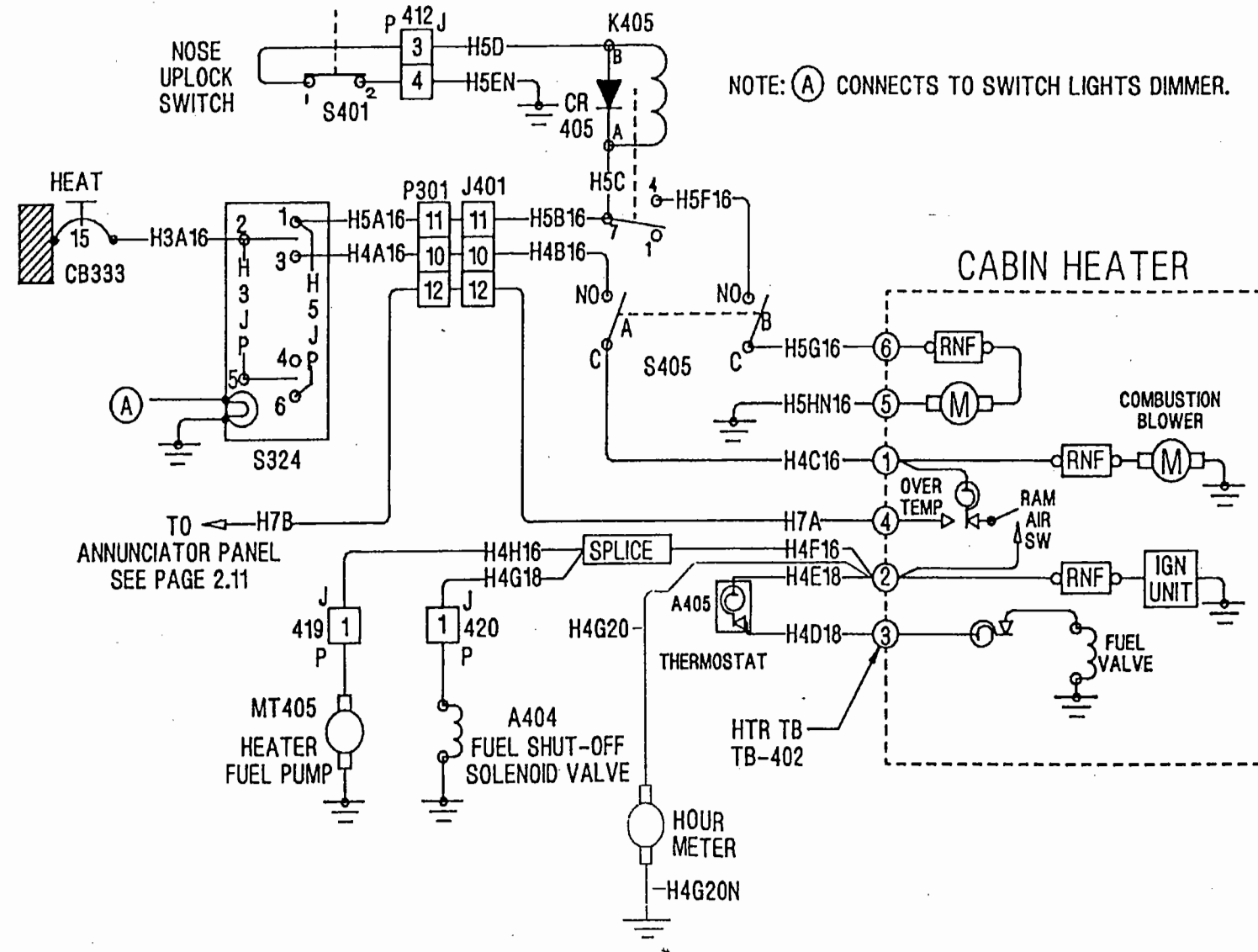


Figure 91-67. Cabin Heat (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

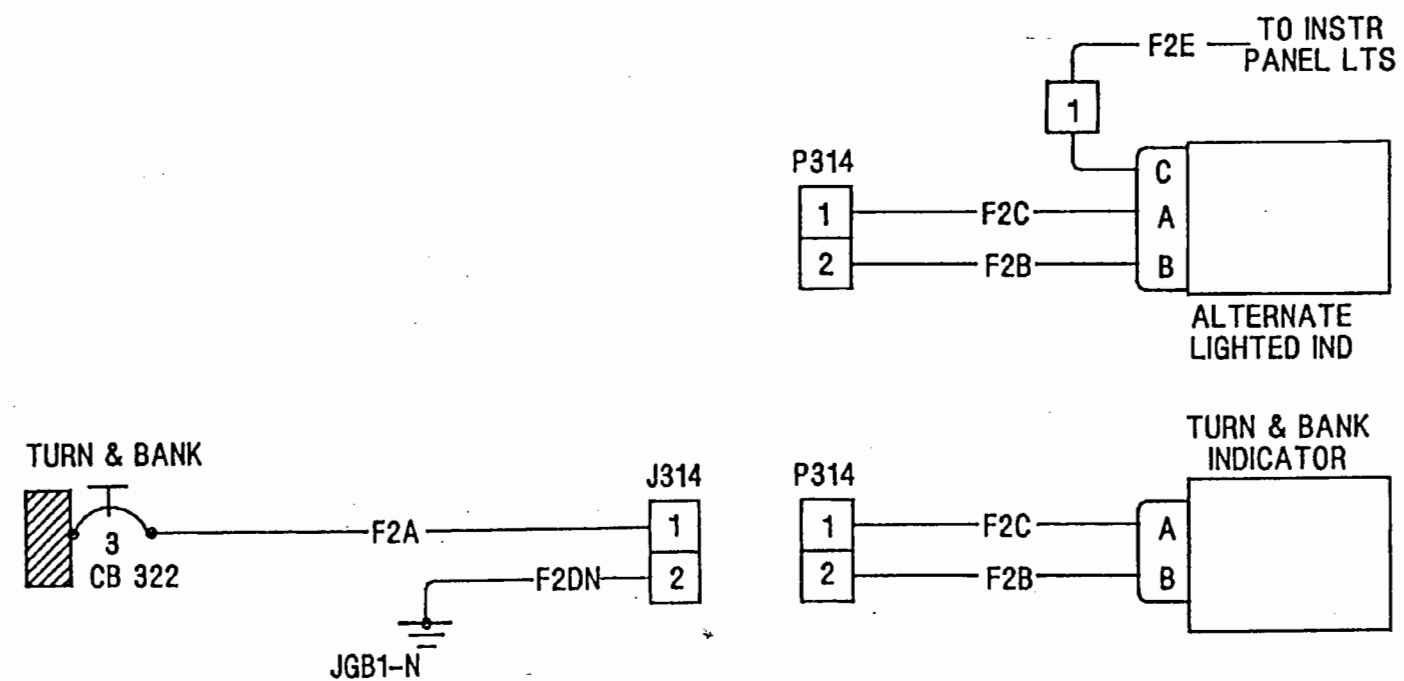
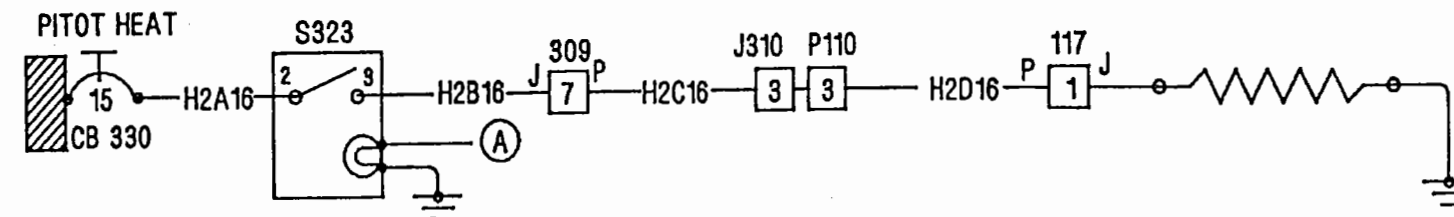


Figure 91-66. Turn and Bank (S/N 44-95001 and up)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**



NOTE: (A) CONNECTS TO SWITCH LIGHTS DIMMER.

Figure 91-65. Pitot Heat (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

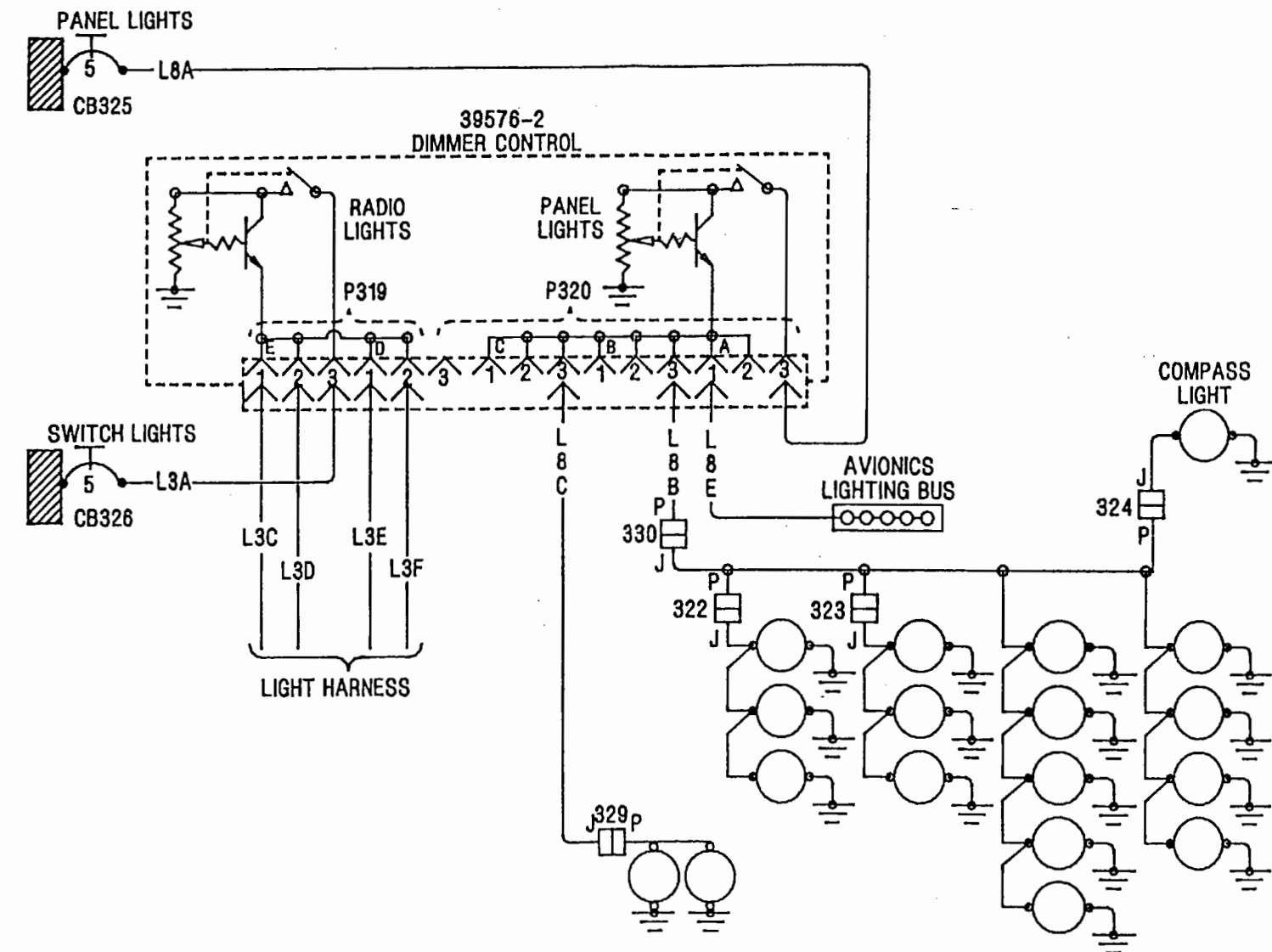


Figure 91-64. Panel and Switch Lighting (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

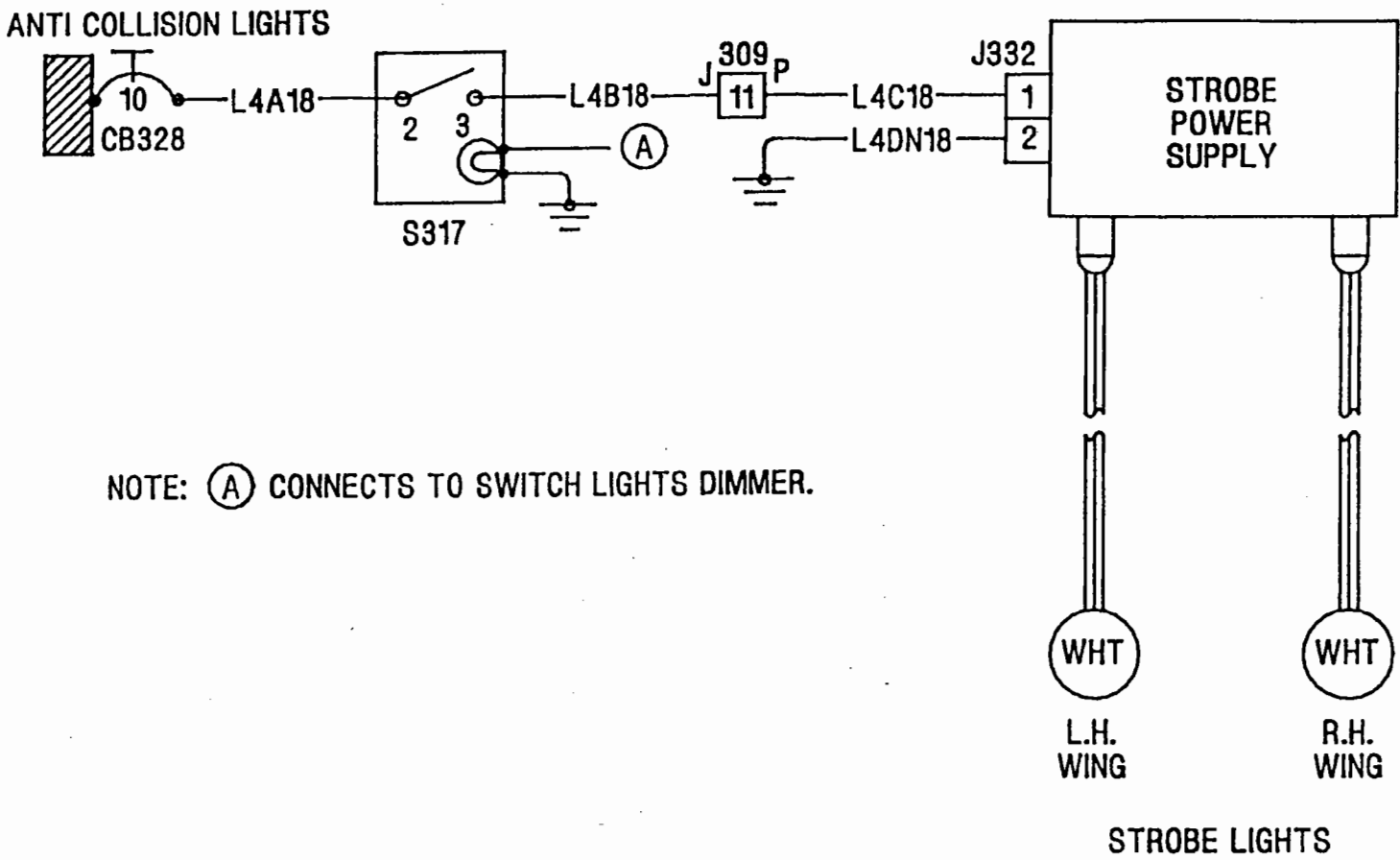
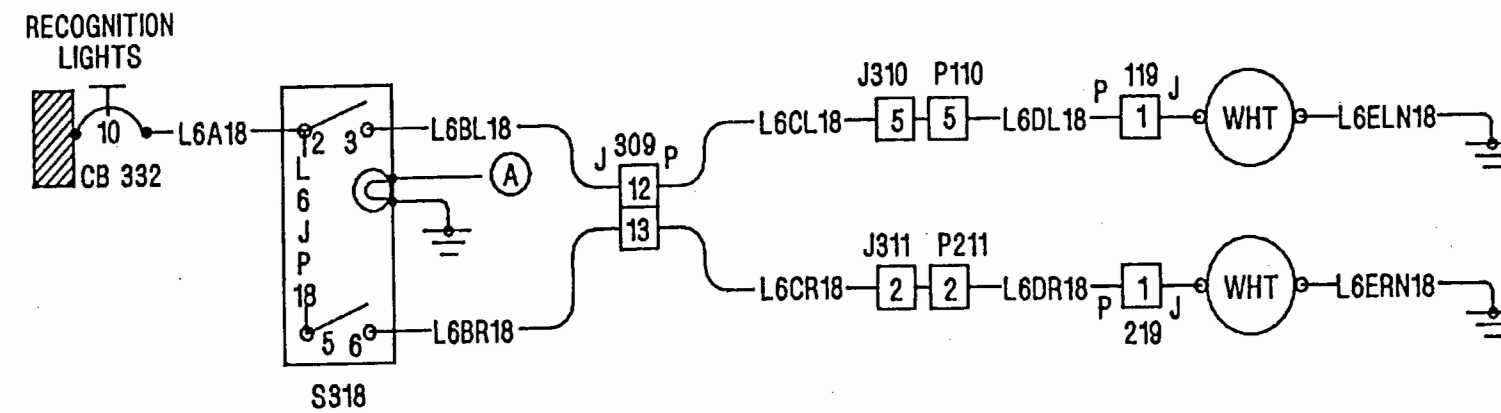


Figure 91-63. Strobe Lights (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL



NOTE: (A) CONNECTS TO SWITCH LIGHTS DIMMER.

Figure 91-62. Recognition Lights (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

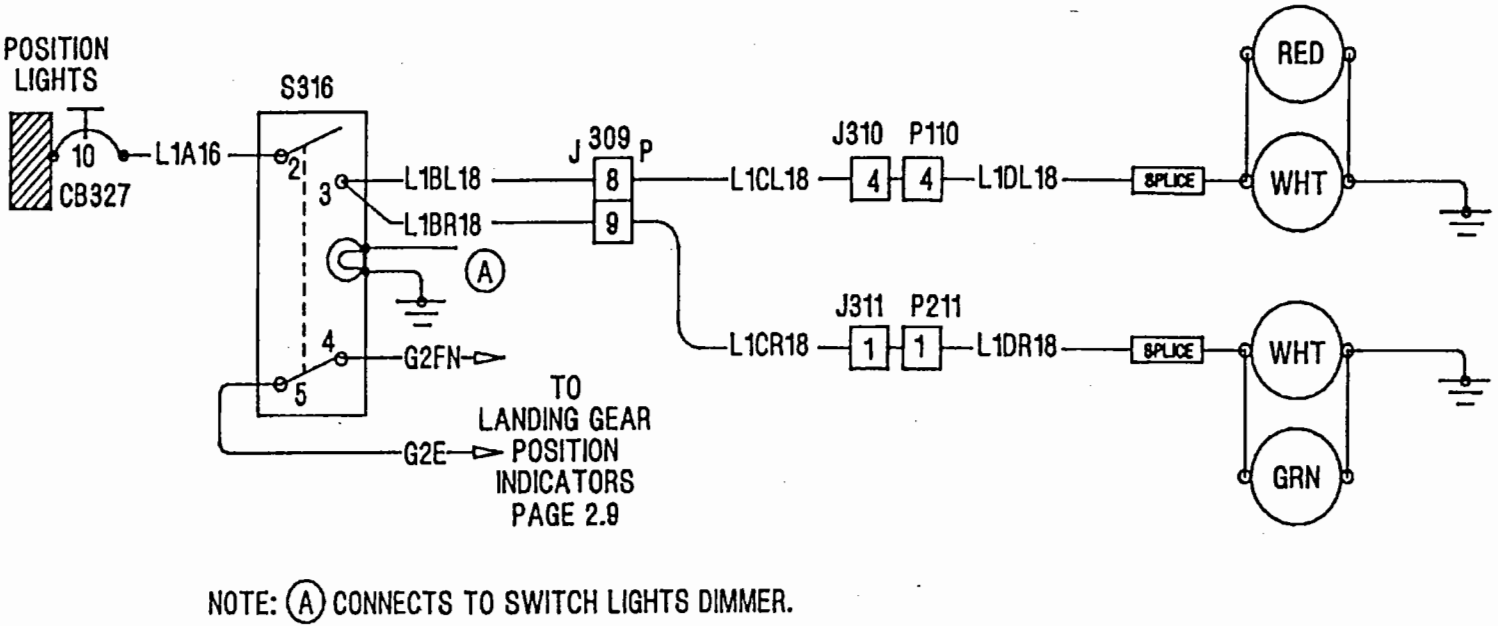


Figure91-61. Position Lights (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

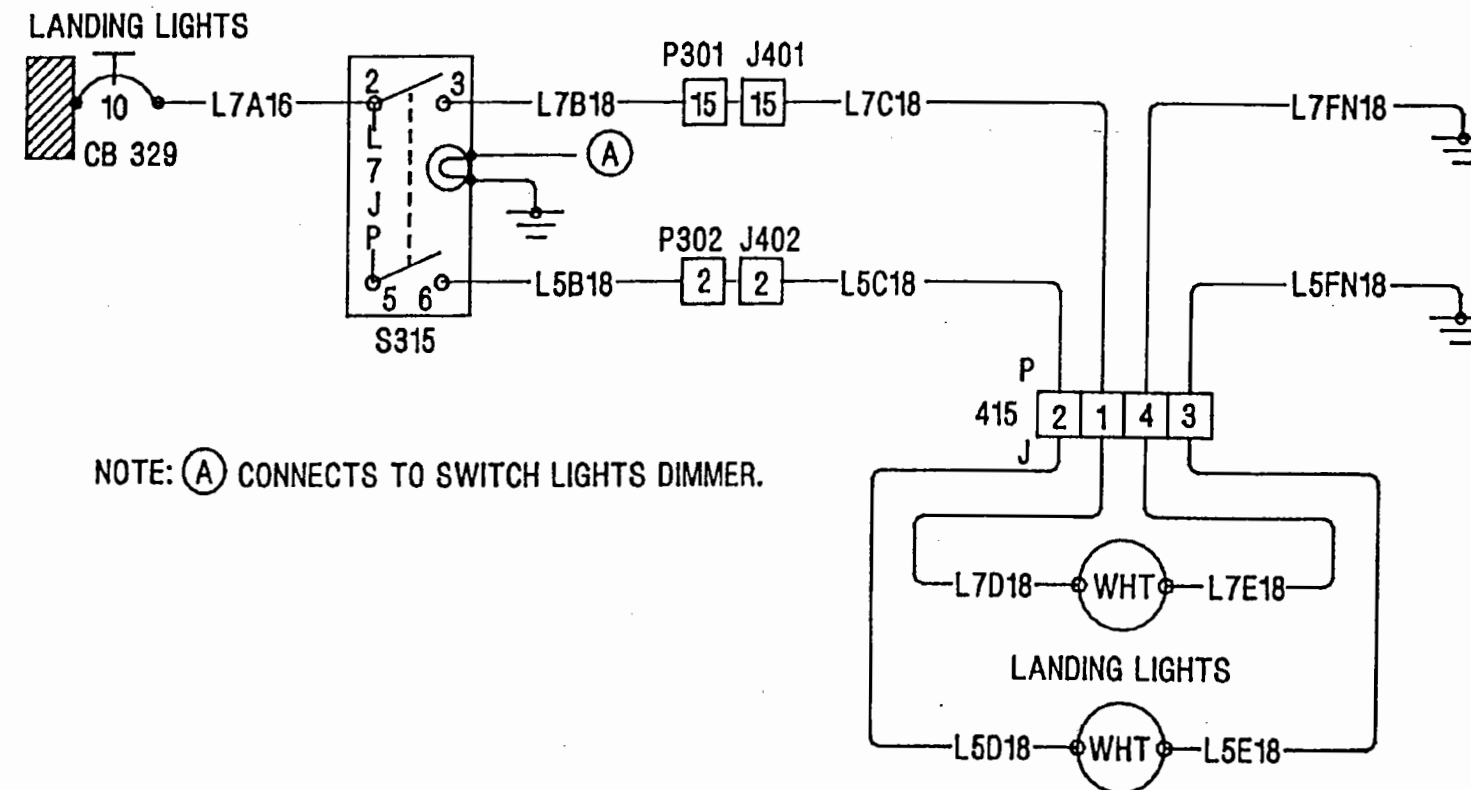


Figure 91-60. Landing Lights (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

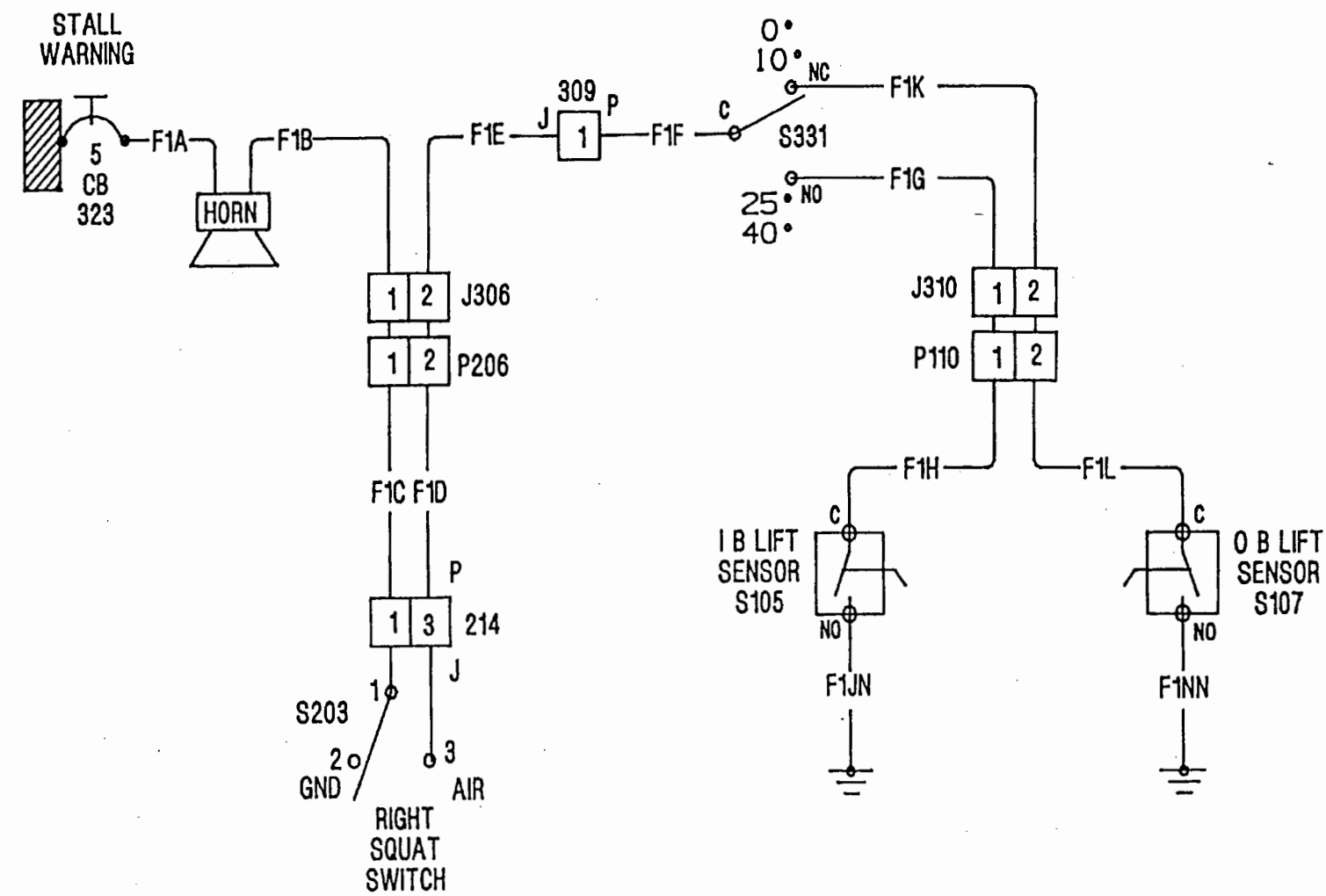


Figure 91-59. Stall Detection (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

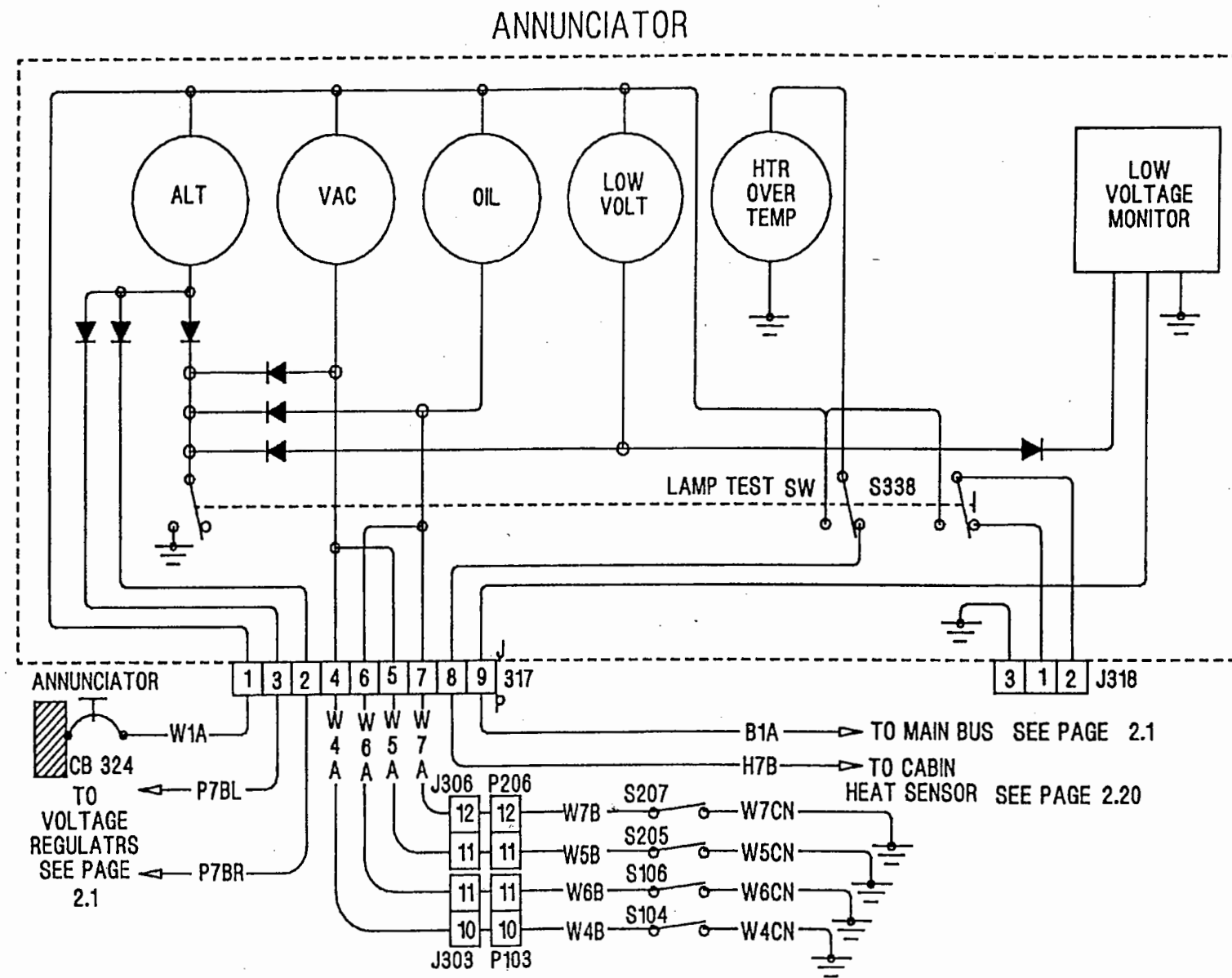


Figure 91-58. Annunciator (S/N 44-95001 and up)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

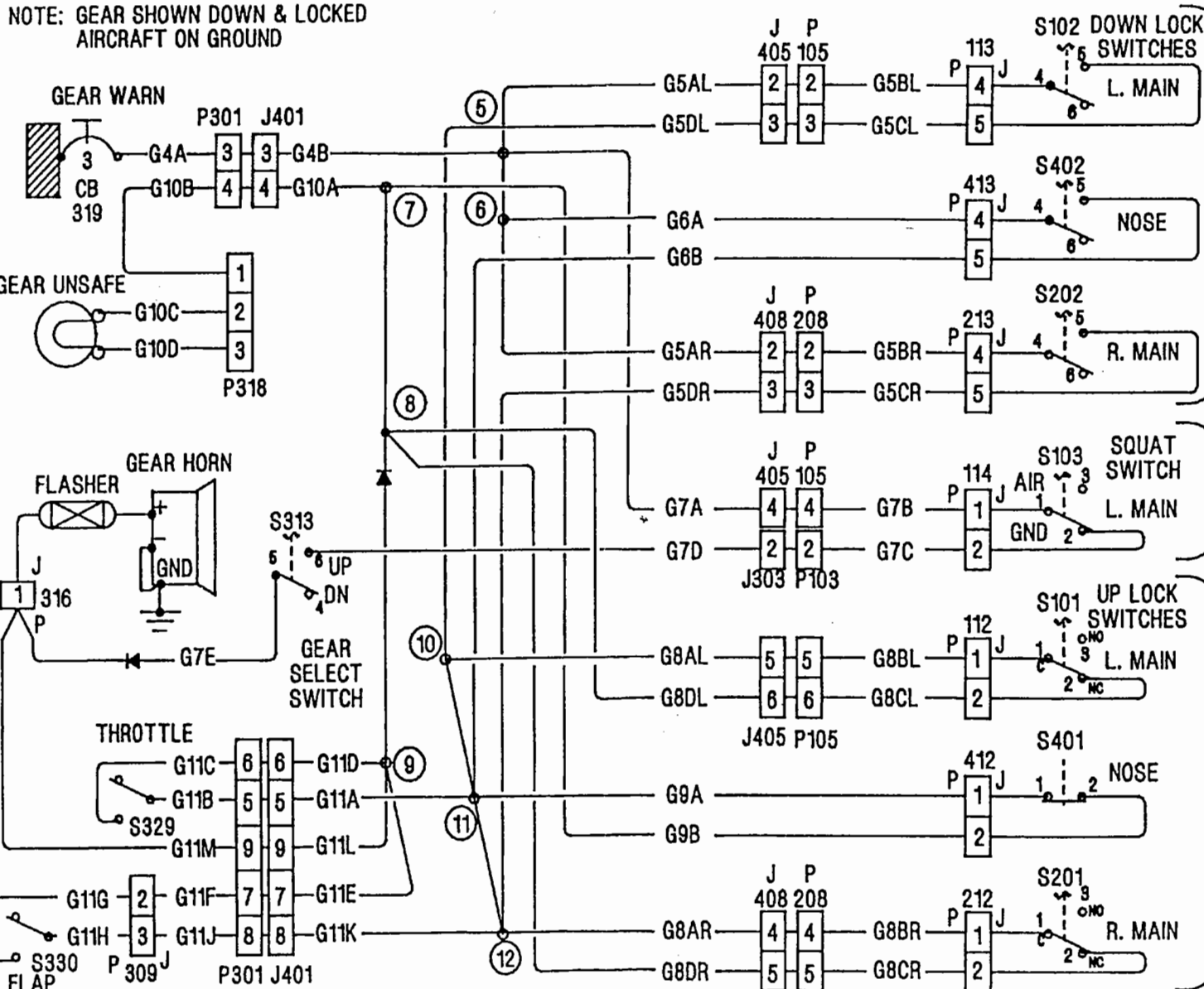


Figure 91-57. Landing Gear Warning (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

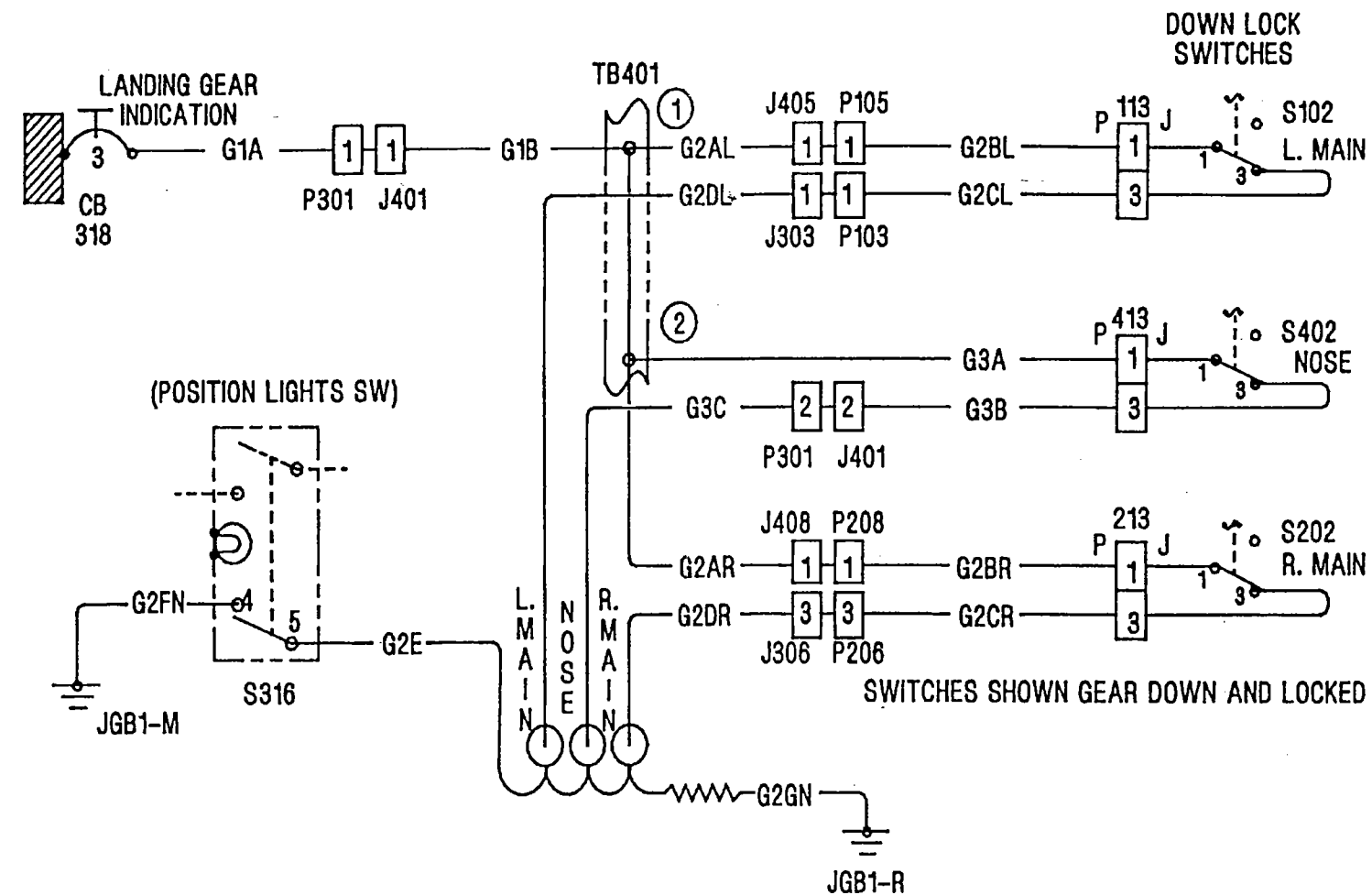


Figure 91-56. Landing Gear Position Indicators (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

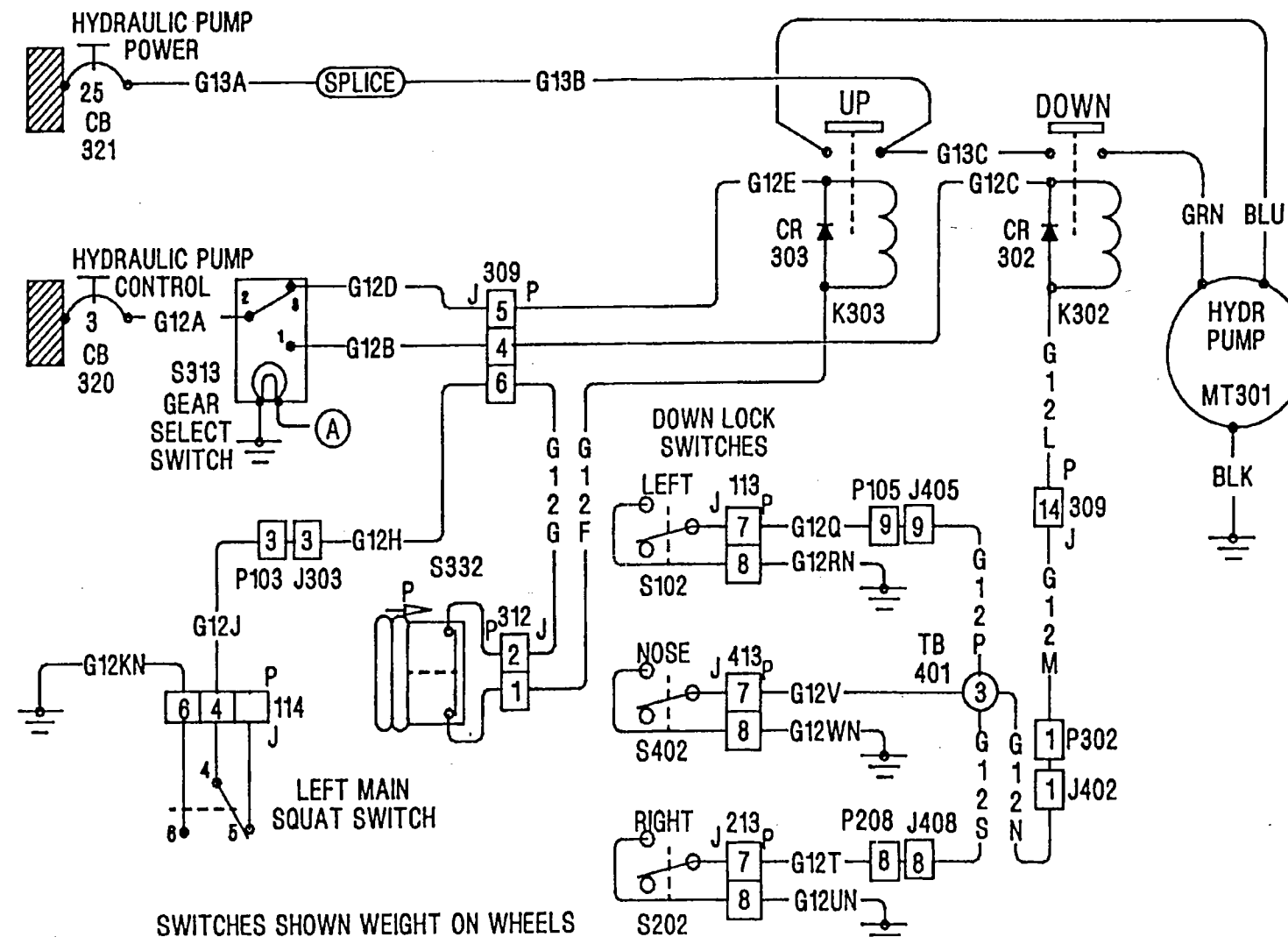


Figure 91-55. Hydraulic Pump (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

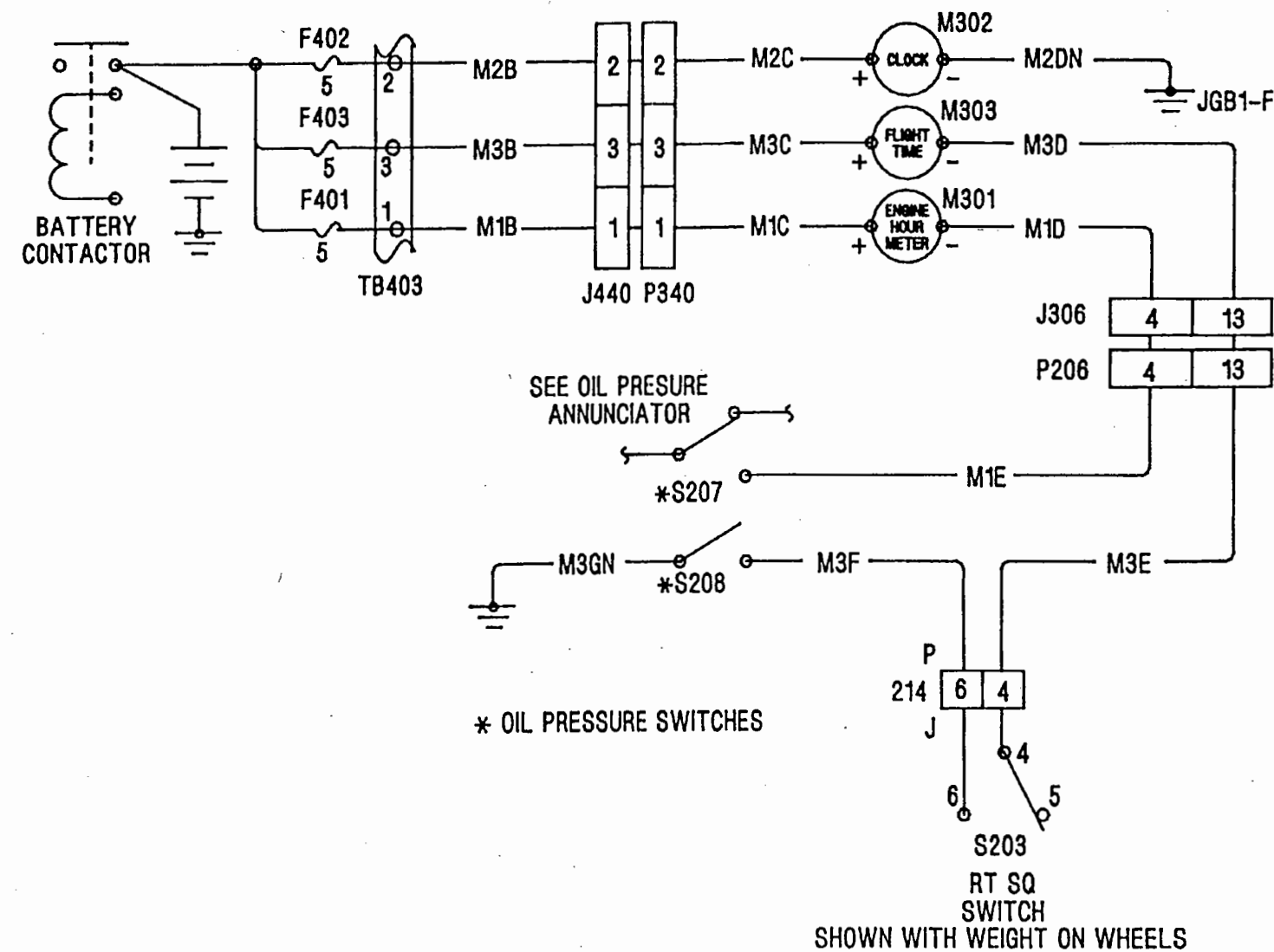


Figure 91-54. Engine Hour Meter (S/N 44-95001 and up)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

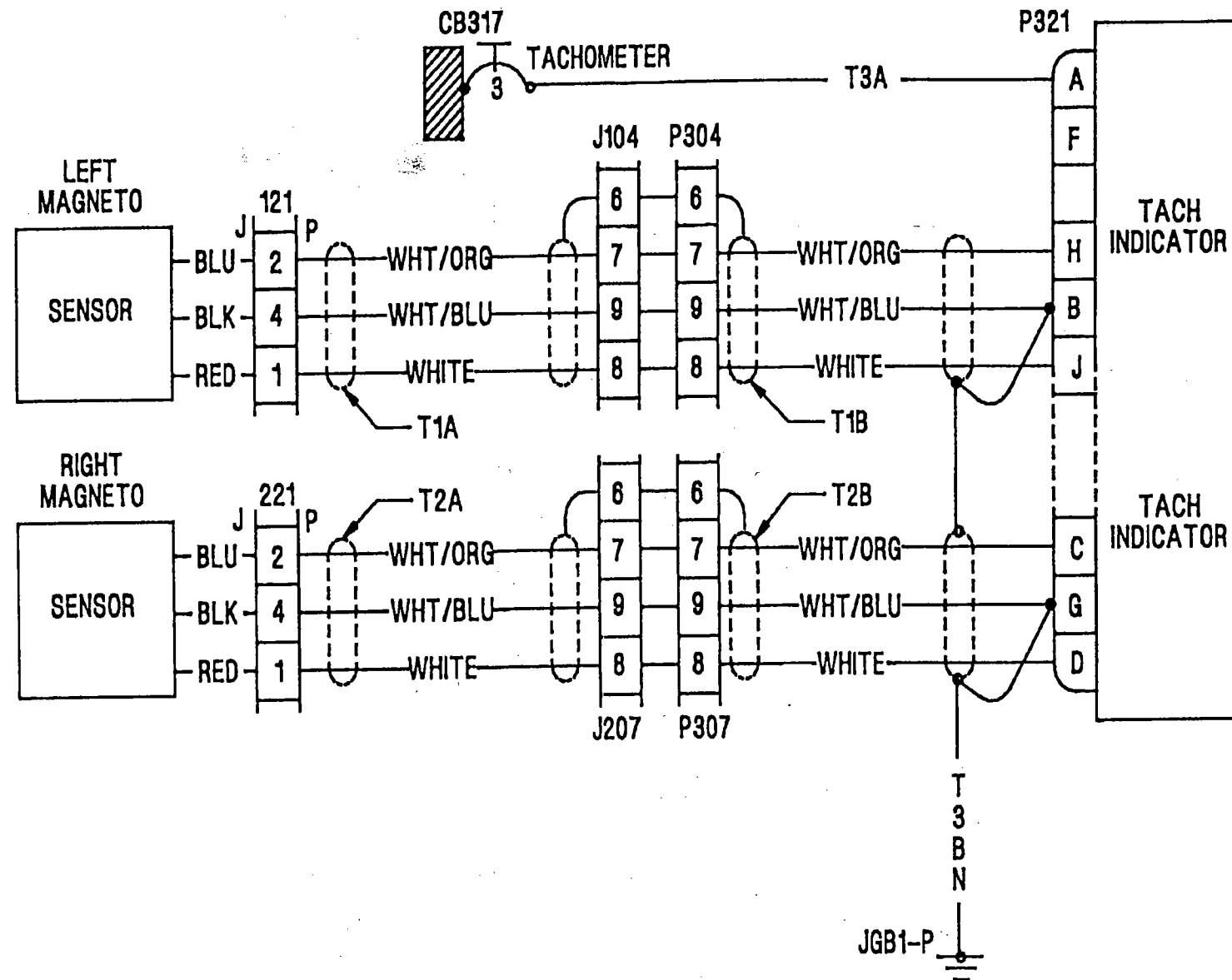


Figure 91-53. Electric Tachometer (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

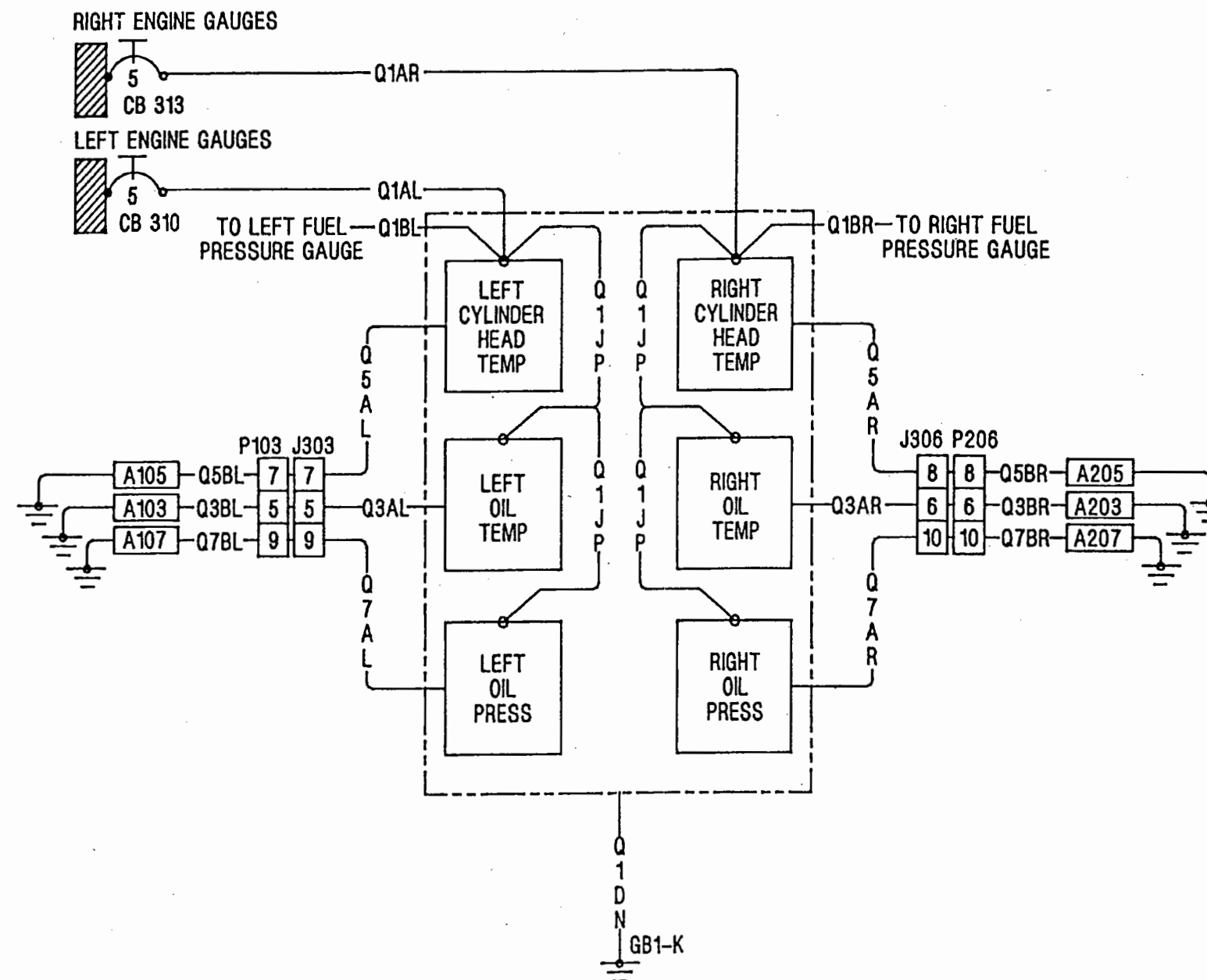


Figure 91-52. CHT and Oil Indicators (S/N 44-95001 and up)

**PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL**

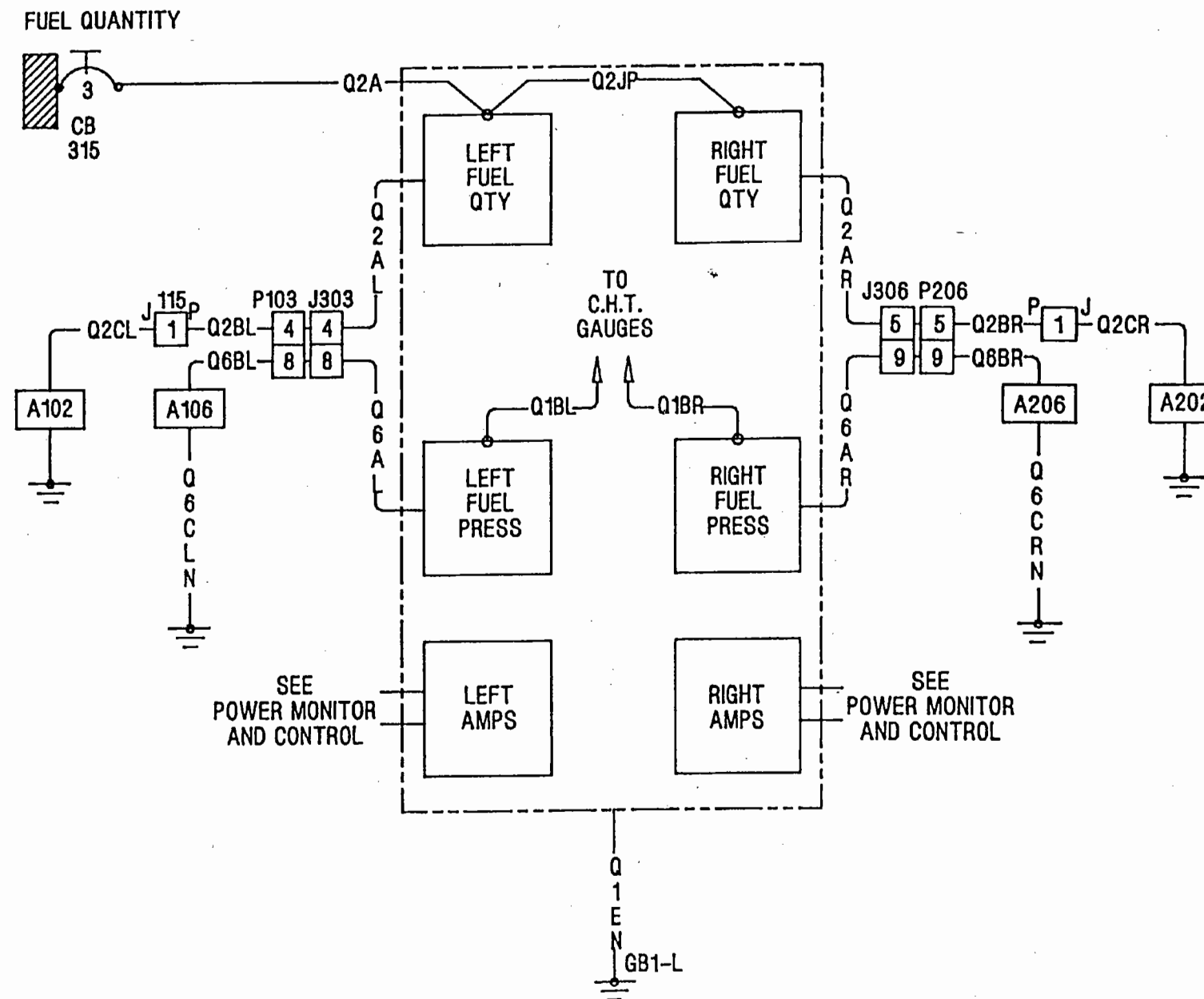


Figure 91-51. Fuel and Ampere Indicators (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

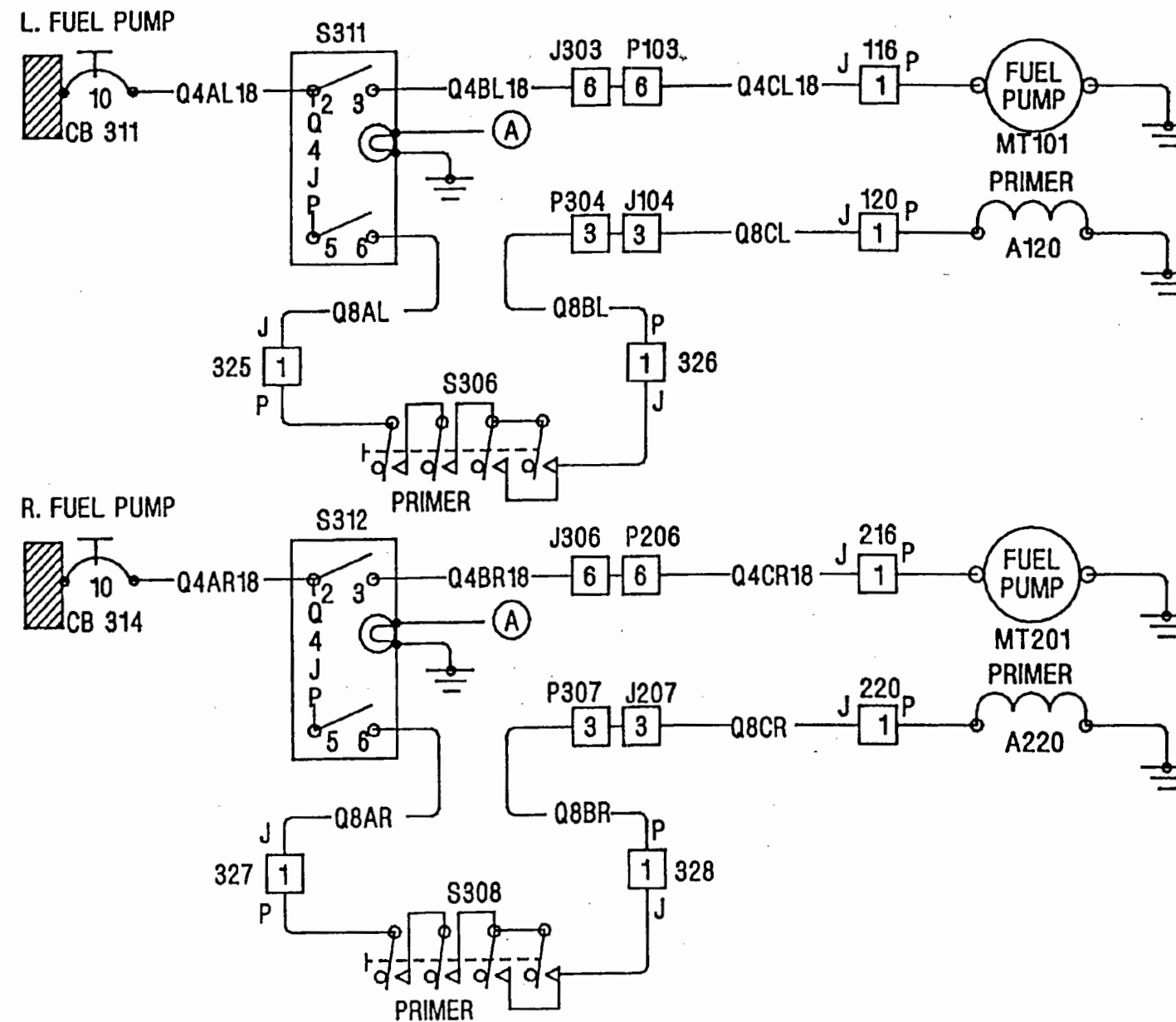


Figure 91-50. Fuel Pumps (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

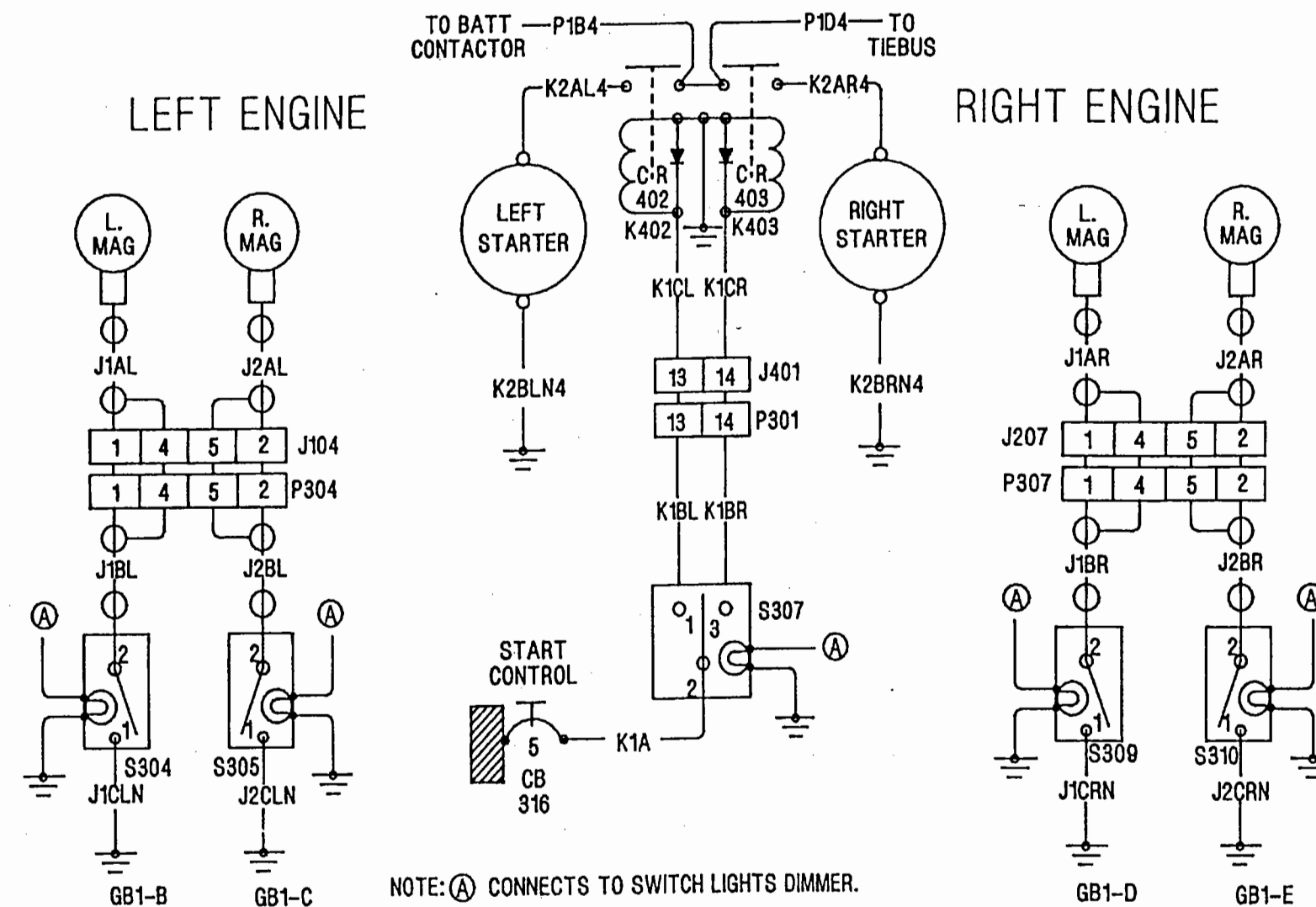


Figure 91-49. Starter and Ignition Control (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

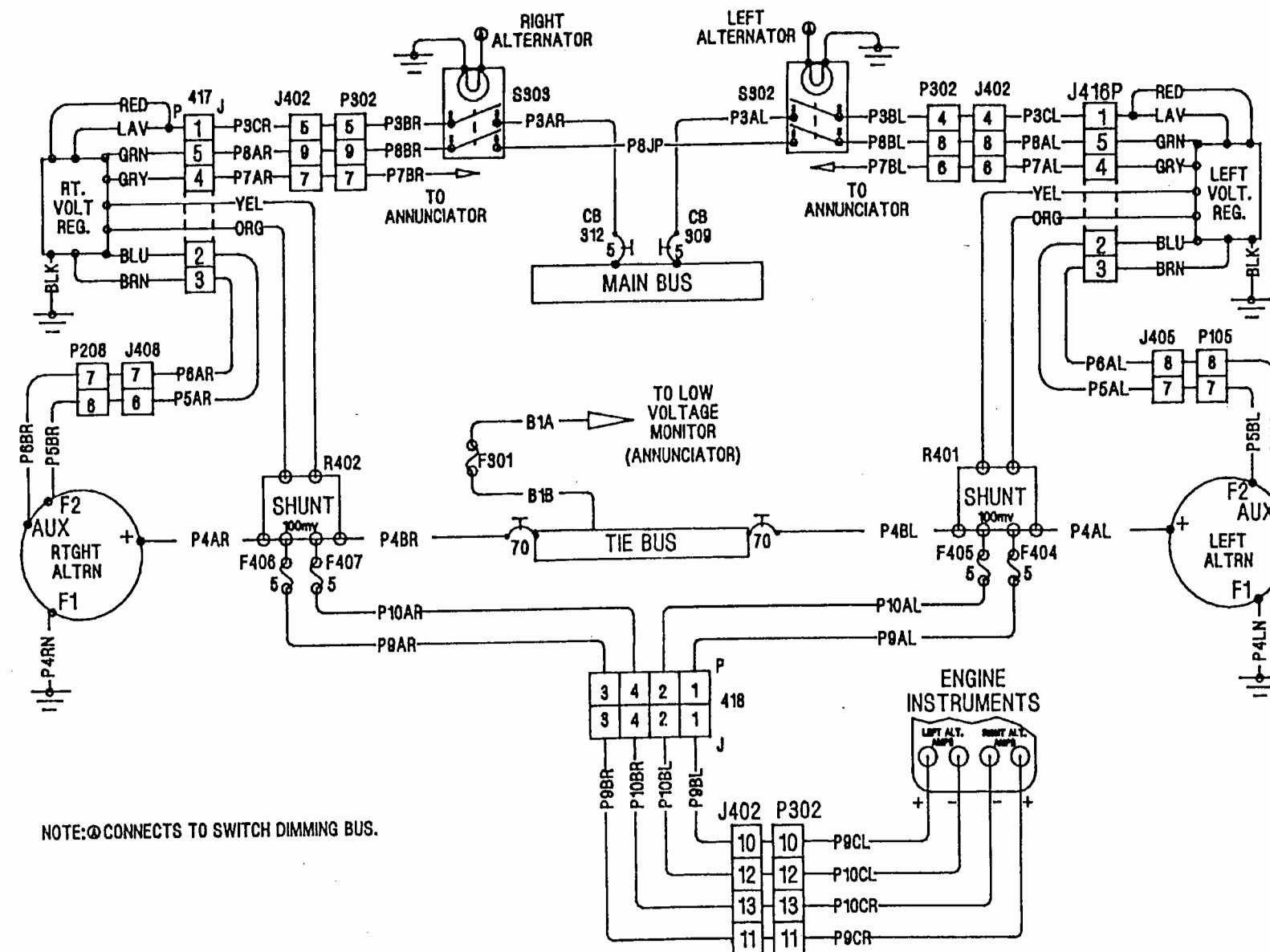


Figure 91-48. Power Monitor and Control (S/N 44-95001 and up)

PIPER AIRCRAFT
PA-44-180/180T
AIRPLANE MAINTENANCE MANUAL

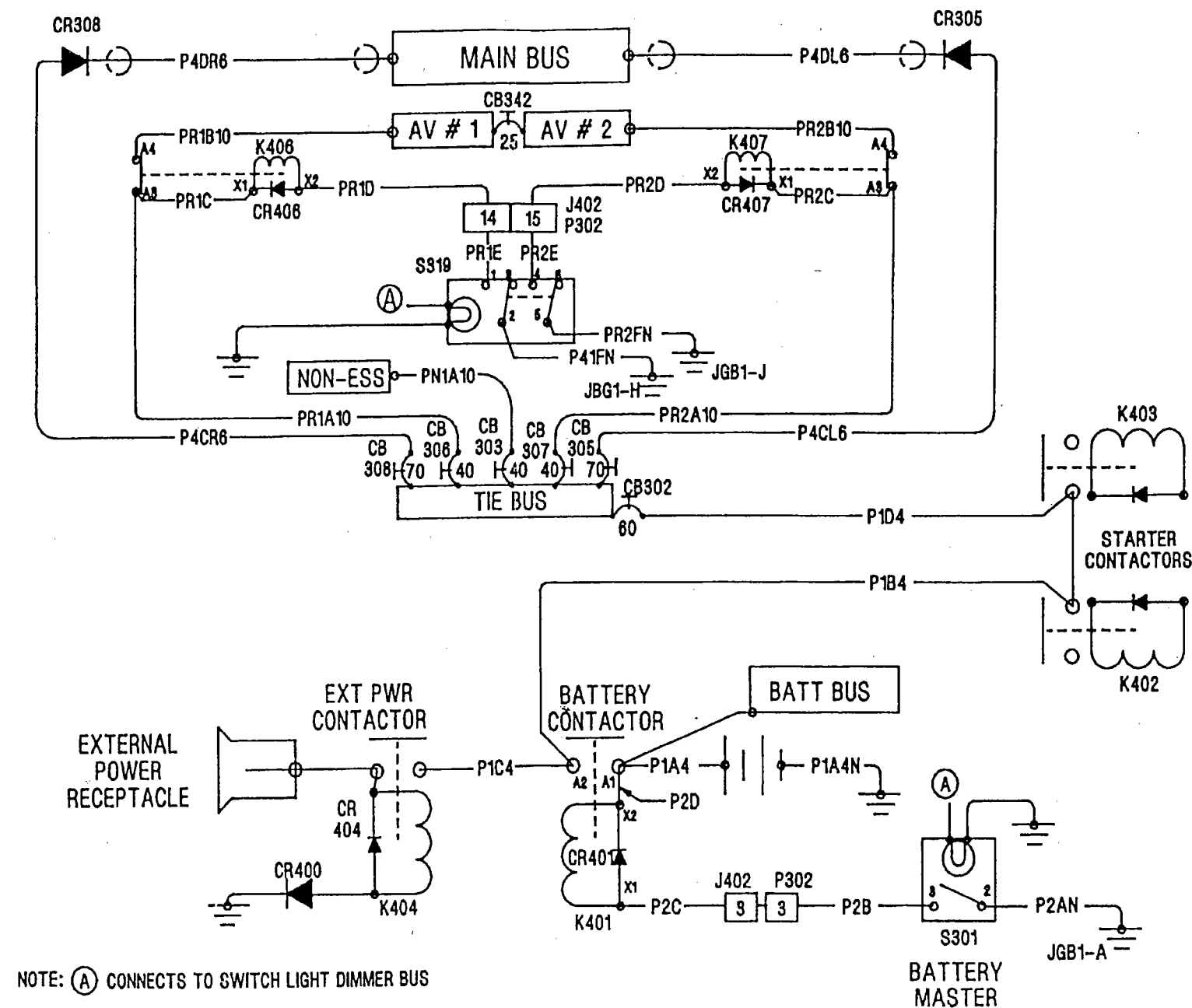


Figure 91-47. Power Distribution and Control (S/N 44-95001 and up)