

AIRPLANE MAINTENANCE MANUAL

CARD 1 OF 7

PA-44-180



(S/N's 4496001 & UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-892

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1A1

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THE NEW PIPER AIRCRAFT, INC.
PA-44-180, SEMINOLE
MAINTENANCE MANUAL

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-882) originally published March 1, 1998 are as follows:

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ORG970401	April 1, 1997	1, 2, 3, and 4
PR020228	February 28, 2002	1, 3, and 4
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CR060315 *	March 15, 2006	1, 2, 3, 4, 5, 6 and 7

*** COMPLETE REVISION OF MAINTENANCE MANUAL 761-892**

Revisions appear in all seven Aerofiche Cards. Accordingly, discard your entire existing Aerofiche Card set and replace it with this one dated 03/15/06.

Consult the Piper Customer Service Information Aerofiche (P/N 1753-755) for current revision dates for this manual.

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INTRODUCTION

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INTRODUCTION

1. Instructions for Continued Airworthiness

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

The PIPER PA-44-180 Seminole Maintenance Manual constitutes the Instructions for Continued Airworthiness in accordance with Federal Aviation Regulations (FAR) Part 23, Appendix G. Chapter 4 contains the Airworthiness Limitations section (4-00-00) and the Inspection Program is in Chapter 5 (5-20-00).

2. General

This publication is prepared in accordance with the General Aviation Manufacturers Association (GAMA) Specification No. 2, with respect to the arrangement and content of the System/Chapters within the designated Chapter/Section-numbering system.

WARNING: USE ONLY GENUINE PIPER AIRCRAFT PARTS OR PIPER AIRCRAFT APPROVED PARTS OBTAINED FROM PIPER APPROVED SOURCES, IN CONNECTION WITH THE MAINTENANCE AND REPAIR OF PIPER AIRPLANES.

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-44-180 Parts Catalog P/N 761-891, and FAR 43 for proper utilization.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

THE NEW PIPER AIRCRAFT, INC. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: THE NEW PIPER AIRCRAFT, INC. expressly reserves the right to supersede, cancel and/or declare obsolete any part, part numbers, kits or publication that may be referenced in this manual without prior notice.

In any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence.

3. Effectivity

This maintenance manual is effective for PA-44-180 Seminole airplanes serial numbers 4496001 and up.

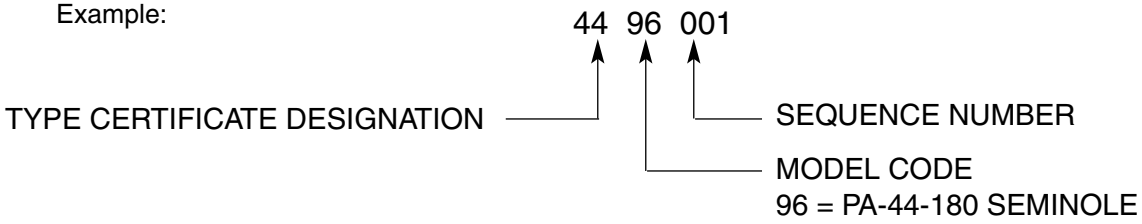
This encompasses the following model years:

NOTE: The following is provided as a general reference only.

Model Year	Serial Numbers
1995	4496001 thru 4496005
1996	4496006 thru 4496013
1997	4496014 thru 4496023; less 4496020
1999	4496024 thru 4496030; and 4496020
2000	4496031 thru 4496042
2001	4496043 thru 4496108
2002	4496109 thru 4496168
2003	4496169 thru 4496179
2004	4496180 thru 4496190
2005	4496191 thru 4496219
2006	4494220 and up

4. Serial Number Explanation

Example:



5. Assignment of Subject Material

This publication is divided into industry standard, three element, numeric subject groupings as follows:

A. System/Chapter - The various groups are broken down into major systems such as Environmental Systems, Electrical Power, Landing Gear, etc. They are assigned a number, which becomes the first element of the standardized numbering system. Thus, the element “28” of the number 28-40-01 refers to the chapter “Fuel”. Everything concerning the fuel system will be covered in this chapter.

B. Sub-System/Section - The major systems/chapters of an airplane are broken down into subsystems. These sub-systems are identified by the second element of the standard numbering system. The element “40” of the number 28-40-01 concerns itself with the indicating section of the fuel system.

C. Unit/Subject - The individual units within a sub-system/section may be identified by the third element of the standard numbering system. The element “01” of the number 28-40-01 is a subject designator. This element is assigned at the option of the manufacturer and is normally zeroed out by PIPER.

Refer to paragraph 14, Chapter/Section Index Guide, for a complete breakdown and list. The material is arranged in ascending numerical sequence.

6. Pagination

The Chapter - Section (i.e. - 28-40-00) numbering system (explained above) forms the primary page numbering system for this manual. Within each Section, pages are numbered consecutively beginning with Page 1 (i.e. - 28-40-00, Page 1). Additionally, the aerofiche grid numbering system (explained below) is also used to indicate location within the manual.

7. Aerofiche Effectivity

A. The General Aviation Manufacturers Association (GAMA) have developed specifications for microfiche reproduction of aircraft publications. 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. The “Aerofiche Effectivity” page at the front of this manual lists the current revision for each card in this set.

B. Conversion of Aerofiche alpha/numeric grid code numbers:

First number is the Aerofiche card number.
Letter is the horizontal row reference per card
Second number is the vertical column reference per card.

Example: 2J16 = Aerofiche card number two, row J, column 16.

C. To aid in locating information, the following is provided at the beginning of each aerofiche card:

(1) A complete Introduction containing the Chapter/Section Index Guide for all fiche in this set.

(2) A complete subject Index for all fiche in this set.

8. Identifying Revised Material

A revision to a page is defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a vertical line (i. e. - change bar) along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A change bar in the left-hand margin opposite the footer (i.e. - chapter/section/subject, page number and date), indicates that the text was unchanged but the material was relocated to a different page.

Example.

NOTE: Change bars are not used in the title pages, list of effective pages, or index. Likewise, all change bars are removed when a publication is completely revised (i.e. - reissued).

9. Indexing

An alphabetically arranged subject Index follows this introduction to assist the user in locating desired information. In addition, each System/Chapter begins with an individual Table of Contents.

10. List of Effective Pages

Each System/Chapter has a List of Effective Pages preceding the Table of Contents to identify the effective revision date for each page in that chapter.

11. Warnings, Cautions and Notes

These adjuncts to the text are used to highlight or emphasize important points when necessary. Warnings call attention to use of materials, processes, methods, procedures or limits which must be followed precisely to avoid injury or death to persons. Cautions call attention to methods and procedures which must be followed to avoid damage to equipment. Notes call attention to methods which make the job easier. Warnings and Cautions shall be located directly above and Notes directly beneath the text and be in line with the paragraphs to which they apply.

12. Accident/Incident Reporting

To improve our Service and Reliability system and aid in Piper's compliance with FAR 21.3, knowledge of all incidents and/or accidents must be reported to Piper immediately. To expedite and assist in reporting all incidents and accidents, Piper Form 420-01 has been created. See Service Letter 1041 for latest revision. This procedure is to be used by all Dealers, Service Centers and Repair Facilities.

13. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-44-180 airplane and its various components. Use them to supplement this manual.

A. Piper Publications:

	Piper P/N
(1) Parts Catalog:	761-892
(2) Periodic Inspection Report:	230-1963
(3) Progressive Inspection Manual (pending):	767-014

B. Vendor Publications:

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY.

(1) ALTERNATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

(2) AUTOFLIGHT:

Vendor Address: Honeywell (or) S-TEC Corporation
One Technology Center One S-TEC Way
23500 W. 105th St., M/D #45 Mineral Wells, Texas 76067
Olathe, Kansas 66061-1950 PH - (940) 325-9406
http://www.bendixking.com/ www.s-tec.com

(3) BATTERY:

Vendor Address: GILL Batteries PH: - (800) 456-0070
A Division of Teledyne Continental Motors
http://www.gillbatteries.com

(4) BRAKES AND WHEELS:

Vendor Address: Parker Hannifin Corp PH: - (800) 272-5464
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
http://www.parker.com/cleveland/Universe/book.pdf

(5) ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS):

Vendor Address: Avidyne Corporation PH - (800) 284-3963
55 Old Bedford Road
Lincoln, MA 01773
http://www.avidyne.com/index.htm

Instructions for Continued Airworthiness

Primary Flight Display and Magnetometer/OAT:	Document No. AVPFD-174
Multifuntion Display:	Document No. AVMFD-167
Data Acquisition Unit:	Document No. AVSIU-011

(6) EMERGENCY LOCATOR TRANSMITTER:

Vendor Address: Artex Airccraft Supplies PH: - (800) 547-8901
14405 Keil Road NE
Aurora, Oregon 97002
http://www.artex.net/

(7) ENGINE:

Vendor Address: Textron Lycoming PH - (717) 323-6181
652 Oliver Street FAX - (717) 327-7101
Williamsport, PA 17701
http://www.lycoming.textron.com/main.html

Overhaul Manual:	DIRECT DRIVE MODELS	- P/N 60294-7
Parts Catalog:	O, LO-360 A1H6 ENGINES	- P/N PC306-5
Operators Handbook:	O, HO, IO, AIO, HIO, TIO-360 SERIES	- P/N 60297-12

NOTE: The above Lycoming publications can be ordered as a set on CD-ROM from Avantext. See www.avantext.com or PH - (800) 998-8857.

(8) FIRE EXTINGUISHER (PORTABLE):

Vendor Address: H3R Inc. PH: - (800) 249-4289
43 Magnolia Ave # 4
San Francisco, California 94123-2911
http://www.h3r.com/index.htm

(9) FUEL CELLS:

Vendor Address: Engineered Fabrics Corporation PH - 770-684-7855
669 Goodyear Street FAX - 770-684-7438
Rockmart, Georgia 30153-0548
http://www.kfefc.com/index.htm

(10) HEATER

Vendor Address:	Kelly Aerospace Power Systems Airport Complex, PO Box 273 Fort Deposit, AL 36032 http://www.kellyaerospace.com/ts_heaters.html	PH: - (888) 461-6077 FAX - (334) 227-8596
Maintenance and Overhaul Manual:	Janitrol Maintenance and Overhaul Manual - 24E25-1	

(11) LIGHTS - NAVIGATION, STROBE, AND MAP LIGHTS:

Vendor Address:	Whelen Engineering Co. Inc. Route 145, Winthrop Rd. Chester, Conneticut 06412 http://www.whelen.com/	PH: - (860) 526-9504 FAX - (860) 526-2009

(12) MAGNETOS:

Vendor Address:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104 http://www.unisonindustries.com/index4.html	PH - (815) 965-4700 FAX - (815) 965-2457
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363	

(13) NAVIGATION, COMMUNICATIONS, AND GPS (NAV/COM/GPS):

Vendor Address:	Garmin International 1200 East 151ST Street Olathe, KS 66062 http://www.garmin.com	PH: (913) 397-8200

(14) PROPELLER:

Vendor Address:	Sensenich Corporation 14 Citation Lane Lititz, PA 17543 http://www.sensenich.com/	PH - (717) 569-0435 FAX - (717) 560-3725
Repair Manual:	METAL PROPELLER REPAIR MANUAL - SPRM 590	

(15) STARTER:

Vendor Address:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252
or	Electro Systems, Inc. (see “Voltage Regulator,” below)	

(16) VACUUM PUMP:

Vendor Address: Aero Accessories, Inc. PH - (800) 822-3200
1240 Springwood Avenue
Gibsonville, NC 27249
http://www.aeroaccessories.com/index.html

(17) VACUUM REGULATOR:

Vendor Address: Parker Hannifin Corp. PH: - (800) 382-8422
Airborne Division
711 Taylor Street
Elyria, Ohio 44035
http://www.parker.com/cleveland/Universe/book.pdf

(18) VOLTAGE REGULATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

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14. Chapter/Section Index Guide

NOTE: The following GAMA Specification No. 2 standard chapters are not included in this Maintenance Manual: 23, 35, 36, 38, 49, 54, 60, 72, 75, 81, and 83. These chapters are omitted because the subject system is either: not installed in these airplanes; adequately covered in vendor or other manuals; or, for ease of use, has been combined with another chapter.

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4

AIRWORTHINESS LIMITATIONS

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AIRWORTHINESS LIMITATIONS

NOTE: The Airworthiness Limitations section is FAA approved and specifies maintenance required under §§ 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

1. Limitations (PIR-TCDS A19SO, Rev. 9.)

The following limitations related to fatigue life of the airplane and its components have been established for the PA-44-180 Seminole airplane:

A. See Chart 1 for safe life of airframe structure.

B. The safe life limit of the propeller blades is unlimited.

NOTE: Refer to the LIMITATIONS section in the Pilot's Operating Handbook for a detailed delineation of the flight limitations of the airplane.

2. Inspections

Refer to 5-20-00 for Piper's recommended Inspection Program.

3. Life Limited Parts Marking and Disposition

14 CFR Part 43.10, Disposition of Life-Limited Aircraft Parts requires that proper procedures are followed when removing life limited parts with time and/or cycles remaining on them as well as the disposition of life limited parts with no time and/or cycles left. Life limited parts defined by Type Certificate (TC) are listed in paragraph 1, above. Other parts which are replaced or rebuilt at specified intervals are listed in Chapter 5.

A. Parts that are removed prior to accumulating their life limit, are to be marked with indelible ink or marker with the part number, serial number and accumulated life status as defined in 14 CFR Part 43.10 in a manner that does not affect part structural integrity, i.e. - no surface deformation such as vibration/etching allowed.

B. Parts that have accumulated the life limit shall be disposed of in accordance with the applicable FARs. Piper recommends life limited parts with no time and/or cycles remaining be completely destroyed.

CHART 1
STRUCTURAL INSPECTION AND REPLACEMENT

Component	Service Life (Flight Hours)	Inspection Interval (Flight Hours)
Wing and Associated Structure	14,663	N/A

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CHAPTER

5

TIME LIMITS / MAINTENANCE CHECKS

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GENERAL

The New Piper Aircraft, Inc. (Piper) takes a continuing interest in having the owner get the most efficient use from his airplane, and keeping the airplane in the best mechanical condition. To that end, Piper publishes a recurring maintenance schedule which is supplemented with Service Bulletins, Service Letters and Service Spares Letters as required.

A. The recurring maintenance schedule for the PA-44-180 Seminole is provided in 5-20-00.

B. Piper Service Bulletins are of special importance and Piper considers compliance mandatory. These are sent to the latest U.S. registered owners and Piper Service Centers.

C. Service Letters deal with product improvements and service hints pertaining to the aircraft. They are sent to Piper Service Centers and sometimes directly to owners, so they can properly service the aircraft and keep it up to date with the latest changes. Owners should give careful attention to the service letter information.

D. Service Spares Letters, which are sent only to Piper Service Centers, offer improved parts, kits and optional equipment which were not available originally and which may be of interest to the owner.

NOTE: Piper mails Service Bulletins, Service Letters, and P.O.H. Revisions to the registered owner's name and address as shown on the Aircraft Registration Certificate. If the aircraft is based and/or operated at a different location (or locations) and/or by a person (or persons) other than those recorded on the aircraft registration, then the registered owner(s) is responsible for forwarding these Bulletins and Letters to the operating location(s) or person(s).

Changes in aircraft registration may take a substantial amount of time to be recorded by the Federal Aviation Administration and received by Piper to change the mailing address. Owners and operators should make arrangements to keep abreast of service releases during this interim period through their Piper Service Center.

The Federal Aviation Administration (FAA) publishes Airworthiness Directives (AD's) that apply to specific aircraft. They are mandatory changes and are to be complied with in a time limit set by the FAA. When an AD is issued, it is sent to the latest registered owner of the affected aircraft and also to subscribers of the service. The owner is solely responsible for being aware of and complying with airworthiness directives.

NOTE: A searchable database of AD's is available on the FAA website. See the "Airworthiness Directives" link at "www.faa.gov". Additionally, Avantext offers a free email notification service for new AD's as well as the last six weeks worth of ADs at "www.avantext.com".

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

The New Piper Aircraft, Inc. has a subscription service for the Service Bulletins, Service Letters, and Service Spares Letters. This service is offered to interested persons such as owners, pilots, and mechanics at a nominal fee and may be obtained through Piper Service Centers. Owners residing outside of the United States are urged to subscribe to this service since Piper cannot otherwise obtain the addresses of foreign owners. Maintenance Manuals and Illustrated Parts Catalogs are also available through Piper Service Centers and Dealers worldwide.

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TIME LIMITS

1. Refer to 4-00-00 for the FAA-approved airworthiness limitations section. It sets forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure required for type certification.
2. Refer to 5-20-00 for Piper's recommended Inspection Programs. They include the frequency and extent of the inspections required for the continued airworthiness of these airplanes.
3. Inspections required by Flight Hour or Calendar Year, if due, are included as part of the Annual / 100 Hour Inspection and/or the Progressive Inspection Event cycles, and are listed individually in 5-30-00.

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SCHEDULED MAINTENANCE

WARNING: GROUND THE APPROPRIATE MAGNETO PRIMARY CIRCUIT (P LEAD), BEFORE PERFORMING ANY MAINTENANCE OPERATION ON EITHER ENGINE.

1. Description

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

The recurring maintenance schedule for the PA-44-180 Seminole is provided herein as an Annual / 100 Hour Inspection. A Progressive Inspection Program will be available from Piper Dealers in a separate manual form.

Piper inspection programs comply with the Federal Aviation Regulations Parts 43, 91 and 135. The owner/operator is primarily responsible for maintaining the airplane in an airworthy condition, including compliance with all applicable Airworthiness Directives and conformity with the requirements in FAR 91.409, 91.411 and 91.413.

The first overhaul or replacement of components should be performed at the given periods. The condition of various components can then be used as criteria for determining subsequent periods applicable to the individual airplane, depending on usage, providing the owner/operator has an established Part 91 Progressive Inspection Program (see 91.409(d)) or Part 135 Approved Aircraft Inspection Program (see 135.419).

The time periods given for inspections of various components are based on average usage and environmental conditions.

NOTE: The listed inspection, overhaul and replacement schedules do not guarantee that a particular item or component will reach the listed time without malfunction. Unique operating conditions encountered by individual airplanes cannot be controlled by the manufacturer.

2. Definitions

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

(1) Routine Inspection - Consists of a visual examination or check of the aircraft and its components and systems without disassembly.

(2) Detailed Inspection - Consists of a thorough examination of the aircraft, appliance, component, or system; with disassembly as necessary to determine condition.

(3) Special Inspection - Involves those components, systems or structure which by their application or intended use require an inspection peculiar to, more extensive in scope or at a time period other than that which is normally accomplished during an event or annual inspection.

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

C. Approved Inspection - Means a continuing airworthiness inspection of an airplane and its various components and systems at scheduled intervals in accordance with procedures approved by the FAA under FAR Part 91.409(d) or Part 135.419.

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

(1) Operational Test - A task to determine that an item, is fulfilling its intended purpose.The task does not require quantitative tolerances. This is a fault finding task.

(2) Functional Test - A quantitative check to determine, if one or more functions of an item performs within specified limits. This test may require the use of supplemental bench test equipment.

(3) In addition, each of the above tests must be performed by an FAA Certified Repair Station with appropriate ratings or by a Certified Mechanic who is qualified on this aircraft. The recording of the above function must be made in the permanent aircraft records by the authorized individual performing the test.

E. Bench Test - Means removal of component from the aircraft to inspect for cleanliness, impending failure, need for lubrication, repair or replacement of parts and calibration to at least the manufacturers specifications using the manufacturers recommended test equipment or standards or the equivalent.

Each bench test will be performed by a Piper Service Center, FAA Certified Repair Station with appropriate rating or by a certified mechanic. This test will be performed at the scheduled interval regardless of any bench test performed on a particular component while being repaired/overhauled before scheduled interval bench test. After the component is installed into the aircraft, an operational test of the component and its related system should be performed to ensure proper function. Serviceable parts that were issued to the component will be filed in the aircraft permanent records. The person performing the check must make appropriate entries in the aircraft's permanent maintenance record.

F. Maintenance - The word maintenance as defined by FAR Part 1, means "inspection, overhaul, repair, preservation and the replacement of parts, but excludes preventive maintenance."

G. On Condition Maintenance - A primary maintenance process having repetitive inspections or tests to determine the condition of units, systems, or portions of structure with regard to continued serviceability (corrective action is taken when required by item condition.)

H. Time - as used in this manual.

(1) Time-in-service for aircraft components, unless otherwise specified, is a cumulative total of flight hours or calendar time calculated from the time a new or overhauled component was first installed in any aircraft, and including:

(a) the aircraft time that elapses from the initial installation to the first removal, if any; and,

(b) the aircraft time that elapses from each subsequent installation to each subsequent removal, if any; or,

(c) the calendar time elapsed since the installation.

NOTE: Dates stamped on individual components at the time of manufacture are typically applied to determine shelf life - i.e. the maximum time allowed from manufacture/assembly/cure until actually installed in an aircraft and are not relevant.

Do not, however; ignore markings applied to life-limited parts when removed with time and/or cycles remaining on them.

(2) Aircraft time, flight hours, or aircraft hours are the "Hobbs Time" shown on, or calculated from, the installed "Hour Meter."

3. Inspection Requirements

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

A. Annual / 100 Hour Inspection. (See paragraph 4.)

Owners/operators may maintain the airplane solely under FAR 91.409 (a) and (b) inspection requirements. The 100 hour inspection cycle is a complete inspection of the airplane and is identical in scope to an annual inspection. Inspections must be accomplished by persons authorized by the FAA.

B. Progressive Inspection.

The Progressive Inspection program is designed to permit the best utilization of the aircraft through the use of a planned inspection schedule. This schedule is prepared in a manual form, which will be available from Piper Dealers:

P/N 767-014 for the PA-44-180 Seminole

Refer to Piper's Customer Service Information Aerofiche P/N 1761-755 for a checklist to ensure obtaining latest issue.

NOTE: The 50 Hour Progressive Inspection Manual (P/N 767-014) referenced above will not be a stand-alone document. It will constitute a snapshot of the Airworthiness Limitations and Inspection sections of the Instructions for Continued Airworthiness (ICA) and will be current only at the time of printing. Use it as follows:

(1) Owners/operators desiring to establish a Part 91 Progressive Inspection Program (PIP) (see 91.409(d)) or a Part 135 Approved Aircraft Inspection Program (AAIP) (see 135.419) should use the appropriate Progressive Inspection Manual as a template for submission to their regional FAA office.

(2) Service centers conducting Event Cycle inspections under a FAA-approved PIP or AAIP can use the appropriate Progressive Inspection Manual as a working check-off list/form, provided they verify its currency against the FAA-approved PIP or AAIP.

C. Overlimits Inspection.

If the airplane has been operated so that any of its components have exceeded their maximum operational limits, special inspections may be required by Piper and/or the component manufacturer. See 5-50-00 and applicable vendor publications.

4. Annual / 100 Hour Inspection Procedure

A. Scheduled Maintenance (i.e. - paragraph 5.)

(1) The required periodic inspection procedure is listed in paragraph 5. This inspection procedure is broken down into major groups which include Propeller, Engine, Cabin and Cockpit, Fuselage and Empennage, Wing, Landing Gear, Special Inspection, Operational Inspection and General. The first column in each group lists the inspection or procedure to be performed. The second column is divided into two sub-columns indicating the required inspection interval of 50 hours or 100 hours. Each inspection or operation is required at each of the inspection intervals indicated by a circle (O). When vendor publications specify times other than those designated in the the various columns, it will be indicated as:

As required by "applicable vendor publication"	or	See Note "X"

in the inspection interval columns, or listed as a special inspection in 5-30-00, or both.

(2) Refer to the applicable chapter of this manual for instructions on how to gain access to remove any item that must be removed and is not completely accessible.

(3) Inspection Report Forms.

To help in the performance of periodic inspections, Inspection Report forms are available through Piper Dealers:

P/N 230-1963 for the PA-44-180 Seminole

NOTE: Service centers conducting Part 91 Annual / 100 Hour Inspections can use the Inspection Report Form (P/N 230-1963), as a working check-off list, provided they verify its currency against an up-to-date copy of the ICA (i.e. - this Maintenance Manual, see 4-00-00 and 5-20-00).

(4) In addition to inspection intervals required in scheduled maintenance (i.e. - paragraph 5), preflight inspection must also be performed.

(5) References to maintenance manual applicable areas are per the "chapter - system/sub-system" assignment of subject material numbering system.

B. Special Inspections (see 5-30-00.)

C. Unscheduled Maintenance (see 5-50-00.)

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5. Scheduled Maintenance

Refer to Notes 1, 2, 3, and 4 before performing inspections.

NATURE OF INSPECTION	Inspection Interval (Hrs) L	R	50	100
A. PROPELLER GROUP				
WARNING: USE EXTREME CAUTION WHEN ROTATING PROPELLERS BY HAND; PROPELLER MAY KICK BACK. PRIOR TO ROTATING PROPELLER, ENSURE BOTH MAGNETO SWITCHES ARE OFF.				
1. Inspect spinner and back plate for cracks	O	O	O	O
2. Inspect blades for nicks and cracks	O	O	O	O
3. Inspect for grease and oil leaks	O	O	O	O
4. Lubricate propeller per Lubrication Chart, 12-20-00	O	O	O	O
5. Inspect spinner mounting brackets for cracks. (See Note 12.)	O	O		O
6. Inspect propeller mounting bolts and safety (Check torque if safety is broken)	O	O		O
7. Inspect hub parts for cracks and corrosion	O	O		O
8. Rotate blades of constant speed propeller and check for tightness in hub pilot tube	O	O		O
9. Inspect complete propeller and spinner assembly, and propeller governor, and if installed, unfeathering accumulator, installation(s) for security, chafing, cracks, deterioration, wear and correct installation. (See Note 39.)	O	O		O
10. Check propeller air pressure	O	O	O	O
B. ENGINE GROUP				
WARNING: GROUND MAGNETO PRIMARY CIRCUIT BEFORE WORKING ON ENGINE.				
NOTE: Read Note 5 and 47 prior to completing this inspection group.				
1. Remove engine cowlings	O	O	O	O
2. Clean and check cowlings for cracks, distortion, and loose or missing fasteners	O	O		O
3. Drain oil sump. Drain while engine is warm. (See Note 6 and 12-10-00.)	O	O	O	O
NOTE: Lycoming recommends changing the oil and filter each 50 hours or every four months, whichever comes first.				
4. Clean suction oil strainer at oil change (Check strainer for foreign particles)	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
6. Inspect oil temperature sender unit for leaks and security	O	O		O
7. Inspect oil lines and fitting for leaks, security, chafing, dents and cracks	O	O	O	O
8. Clean and check oil radiator cooling fins	O	O	O	O
9. Fill engine with oil per information on cowling or the Lubrication Chart, 12-20-00. (See Note 6 and 12-10-00.)	O	O	O	O

5. Scheduled Maintenance (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) L	R	50	100
B. ENGINE GROUP (cont)				
CAUTION: DO NOT CONTAMINATE VACUUM PUMP, IF INSTALLED, WITH CLEANING FLUID. (REFER TO LATEST LYCOMING SERVICE LETTER NO. 1221.)				
10. Clean engine	O	O	O	O
11. Inspect condition of spark plugs. (Clean and adjust gap as required; adjust per latest Lycoming Service Instruction No. 1042.)	O	O		O
NOTE: If fouling of spark plugs has been apparent, rotate bottom plugs to upper plugs.				
12. Inspect spark plug cable leads and ceramics for corrosion and deposits	O	O	O	O
13. Check cylinder compression. (See latest revision of AC 43.13-1.)	O	O		O
14. Inspect cylinders for cracked or broken fins. (See Note 9.)	O	O	O	O
15. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds	O	O	O	O
16. Inspect ignition harness and insulators for high tension leakage and continuity	O	O		O
17. Check magneto points for proper clearance. (Use “E” Gap method, see 74-10-00.)	O	O		O
18. Inspect magneto for oil seal leakage	O	O		O
19. Inspect distributor block for cracks, burned areas or corrosion and height of contact springs	O	O		O
20. Check magnetos to engine timing. (See Note 7.)	O	O		O
21. Remove air filters, tap gently to remove dirt particles and inspect condition of seal and filter material. (Replace as required.)	O	O	O	O
22. Inspect condition of air filter housing	O	O	O	O
23. Inspect security of carburetor throttle arm	O	O		O
24. Drain carburetor and clean inlet line fuel strainer	O	O		O
25. Inspect condition of carburetor heat air door and box. (See Note 10.)	O	O	O	O
26. Inspect intake seals for leaks and clamps for tightness	O	O		O
27. Inspect all air inlet cut hoses and replace as required	O	O		O
28. Inspect condition of flexible fuel lines	O	O		O
29. Inspect primer lines	O	O		O
30. Inspect primer for condition and security	O	O		O
31. Clean screens in electric fuel pump	O	O	O	O
32. Inspect fuel system for leaks	O	O		O
33. Inspect engine driven and electric fuel pumps for operation. (See Note 15.)	O	O		O
34. If installed, inspect and operationally test vacuum pumps and lines. (See Notes 7 and 19 and Vacuum Pumps, Inspection, 37-10-00.)	O	O		O
35. Inspect throttle, carburetor heat, mixture and propeller governor controls for security, travel and operating condition	O	O		O

5. Scheduled Maintenance (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) L	R	50	100
B. ENGINE GROUP (cont)				
36. Inspect exhaust stacks, connections and gaskets for leakage, condition, and security per Exhaust System, 100 Hour Inspection, 78-00-00. Replace as required.	O	O		O
37. Check operation of alternate air door. (See Note 31.)	O	O		O
38. Inspect muffler heat exchanger and baffles	O	O		O
39. Inspect breather tubes for obstructions and security	O	O		O
40. Inspect crankcase for cracks, leaks and security of seam bolts	O	O		O
41. Inspect engine mounts for cracks and loose mountings. (See Notes 21, 24, and 35.)	O	O		O
42. Inspect engine baffles for cracks and loose mountings	O	O		O
43. Inspect rubber engine mount bushings for deterioration. (Replace as required.)	O	O		O
44. Inspect firewall seals	O	O		O
45. Inspect condition and tension of alternator drive belt	O	O		O
46. Inspect condition of mounting of alternator and starter	O	O		O
47. Inspect all lines, air ducts, electrical leads and engine attachments for security, proper routing, chafing, cracks, deterioration and correct installation	O	O	O	O
48. Lubricate all controls per Lubrication Chart, 12-20-00	O	O	O	O
49. Install engine cowlings	O	O	O	O
C. CABIN AND COCKPIT GROUP				
1. Remove inspection covers and panels				O
2. Inspect cabin entrance, doors and windows for damage and operation				O
3. Check operation of emergency exit window per Emergency Exit, Testing, 52-20-00				O
4. Inspect upholstery for tears				O
5. Inspect seats, seat belts, shoulder harnesses, security brackets, and bolts. (See Restraint System - Inspection, 25-10-00.) (See Note 25.)				O
6. Inspect trim operation				O
7. Inspect operation and condition of rudder pedals			O	O
8. Inspect parking brake valve and toe brakes for operation and cylinder leaks				O
9. Inspect control wheels, column, pulleys and cables. (See Notes 14, 22, and 34.)				O
10. Inspect condition of flap control cable and cable-to-lever attachment bolt. (See Note 14.)				O
11. Check landing, navigation, cabin and instrument lights			O	O
12. If installed, inspect portable fire extinguisher minimum weight as specified on nameplate				O
13. Inspect instruments, lines and attachments. (See Notes 33 and 41.)				O
14. If installed, inspect gyro operated instruments and electric turn and bank indicator. (Overhaul or replace as required.)				O
15. If installed, replace filters on gyro horizon and directional gyro or replace central air filter. (See Note 23.)				O

5. Scheduled Maintenance (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
C. CABIN AND COCKPIT GROUP (cont)		
16. If installed, clean or replace vacuum regulator filter		O
17. Inspect static system, altimeter, and transponder for installation/certification per latest revision of AC43.13-1 and current test/inspection per FARs 91.411 and 91.413, respectively		O
18. Inspect operation of fuel selector valves		O
19. Inspect operation of fuel drains		O
20. Inspect condition of heater controls and ducts		O
21. Inspect condition and operation of air vents		O
22. Inspect and test ELT per FAR 91.207. (See Testing ELT, 25-60-00.)		O
23. Replace filter elements in manifold pressure in-line filters. If none installed, see 77-10-00.		O
D. FUSELAGE AND EMPENNAGE GROUP		
1. Remove inspection plates and panels		O
2. Inspect baggage doors, latches and hinges		O
3. Inspect battery, box and cables. Flush box as required and fill battery per instructions on box	O	O
4. Check fluid in brake reservoir. (Fill as required.)	O	O
5. Inspect heater. (See Notes 8 and 11, and AD 2004-21-05.)		O
6. Inspect the heater fuel pressure regulator and shut off valve for signs of leakage per Fuel Pressure Regulator and Shutoff Valve, 100 Hour Inspection, 21-40-00. (See Note 37.)		O
7. Inspect electronic installation. (See Note 48.)		O
8. Inspect skins, bulkheads, frames, stringers, and longerons for damage. (See Note 43.)		O
9. Inspect antenna mounts and electric wiring.		O
10. Check hydraulic pump fluid level. (Fill as required.)	O	O
11. Inspect hydraulic pump lines for damage and leaks		O
12. Inspect fuel lines, valves and gauges for damage and operation		O
13. Remove, drain and clean left and right fuel filter bowls. Clean or replace filter discs as required.		O
14. Inspect security of all lines		O
15. Inspect vertical fin and rudder for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware.		O
16. Inspect rudder hinges, horn and attachments for damage and operation		O
17. Inspect rudder control stops to ensure stops have not loosened and locknuts are tight		O
18. Inspect vertical fin attachments		O
19. Inspect ELT battery for condition/date per FAR 91.207. (See Note 17.)		O

5. Scheduled Maintenance (continued)

Refer to Notes 1, 2, 3, and 4 before performing the following inspections.

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
D. FUSELAGE AND EMPENNAGE GROUP (cont)		
20. Inspect ELT installation and antenna for condition and security. Replace antenna if bent or damaged		O
21. Inspect rudder, tab hinge bolts for excess wear. (Replace as required.)		O
22. Inspect rudder trim mechanism. (See Note 32.)		O
23. Inspect stabilator for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware.		O
24. Inspect stabilator, tab hinges, horn and attachments for damage and operation.		O
25. Inspect stabilator control stops to ensure stops have not loosened and locknuts are tight.		O
26. Inspect stabilator attachments.		O
27. Inspect stabilator and tab hinge bolts and bearings for excess wear (Replace as required).		O
28. Inspect stabilator trim mechanism.	O	O
29. Inspect aileron, rudder, stabilator, and stabilator trim cables, terminals, turnbuckles, guides, fittings, and pulleys for safety, condition, and operation. (See Notes 14 and 42.)		O
30. Inspect wing rear attach fittings for corrosion, general condition and security. (See Aft Wing Attach Fittings 100 Hour Inspection, 53-20-00.)		O
31. Inspect all control cables, air ducts, electrical harnesses and leads and attaching parts for security, routing, chafing, deterioration, wear and correct installation and tension. (See Note 14 and 100 Hour Inspection, 51-80-00.)		O
32. Clean and lubricate stabilator trim drum screw.		O
33. Clean and lubricate all exterior needle bearings.		O
34. Lubricate per Lubrication Chart, 12-20-00.	O	O
35. Inspect rotating beacon for security and operation.		O
36. Inspect security of Autopilot bridle cable clamps.		O
37. Reinstall inspection plates and panels.		O
E. WING GROUP		
1. Remove inspection plates and fairings.		O
2. Inspect surfaces and tips for damage, loose rivets, and condition of walkway. (See Notes 16 and 46.)		O
3. Inspect ailerons for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware. (See Notes 20 and 30.)		O

5. Scheduled Maintenance (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
E. WING GROUP (cont)		
4. Inspect aileron control stops to ensure stops have not loosened and locknuts are tight.		O
5. Inspect aileron cables, terminals, turnbuckles, fittings, guides, pulleys, and bellcranks for safety, condition, and operation. (Inspect bellcrank bearing for freedom of movement.) (See Note 14.)		O
6. Inspect flaps for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware.		O
7. Inspect condition of bolts used with hinges. (Replace as required.)		O
8. Lubricate per Lubrication Chart, 12-20-00.	O	O
9. Inspect wing attachment bolts and brackets. (See Note 28.)		O
10. Inspect all control cables, air ducts, electrical leads and attaching parts for security, routing, chafing, deterioration, wear and correct installation. (See Note 14.)		O
11. Inspect fuel tanks and lines for leaks and water		O
12. Check that fuel tanks are marked for proper capacity.		O
13. Check that fuel tanks are marked for minimum octane rating.		O
14. Inspect fuel tank vents		O
15. Inspect fuel tank nipple fittings for damage and proper torque. (See 28-10-00.)		O
16. Inspect wing attachment bolts and brackets. (See Note 27.)		O
17. Reinstall inspection plates and fairings.		O
F. LANDING GEAR GROUP		
1. Check oleo struts for proper extension and evidence of fuel leakage. See Landing Gear, 12-10-00.	O	O
2. Inspect nose gear steering control and travel		O
3. Inspect wheel alignment		O
4. Put airplane on jacks per 7-10-00		O
5. Inspect tires for cuts, uneven or excessive wear and slippage		O
6 Remove wheels, clean, check and repack bearings		O
7. Inspect wheels for cracks, corrosion and broken bolts		O
8. Check tire pressure. (N = 50 psi / M = 55 psi.)	O	O
9. Inspect brake lining and disc		O
10. Inspect wearing surfaces of brake disc for "heat checks." (See 32-40-00.)		O
11. Inspect brake backing plates		O
12. Inspect brake lines and retaining clamps		O
13. Inspect condition of nose gear centering spring		O
14. Inspect gear forks for damage		O
15. Inspect oleo struts for fluid leaks and scoring		O
16. Inspect gear struts, attachments, actuators, torque links, retraction links and bolts for condition and security. Replace as required. (See Notes 18, 36, 38, and 44.)		O

5. Scheduled Maintenance (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
F. LANDING GEAR GROUP (cont)		
17. Inspect down locks for operation and adjustment		O
18. Inspect torque link bolts and bushings. (Rebush as required.)		O
19. Inspect drag end side brace link bolts. (Replace as required.)		O
20. Inspect gear doors and attachments		O
21. Inspect gear warning horn and light for operation. (See Note 29.)		O
22. Perform Landing Gear Retraction System Functional Test, 32-30-00		O
23. Retract gear — check doors for clearance and operation		O
24. Inspect operation of squat switch		O
25. Inspect down lock switches, up switches, and electrical leads for security, operation and condition		O
26. Lubricate per Lubrication Chart, 12-20-00	O	O
WARNING: VERIFY LANDING GEAR IS DOWN AND LOCKED BEFORE REMOVING JACKS.		
27. Remove airplane from jacks		O
G. SPECIAL INSPECTIONS		
See 5-30-00.		
H. OPERATIONAL INSPECTION		
NOTE: Refer to Note 13 before performing inspections.		
1. Check fuel pump and fuel tank selector and crossfeed operation	O	O
2. Check fuel quantity and pressure or flow gauges	O	O
3. Check oil pressure and temperatures	O	O
4. Check alternator output	O	O
5. Check carburetor heat	O	O
6. Check parking brake and toe brakes	O	O
7. If installed, check vacuum gauge	O	O
8. Check gyros for noise and roughness	O	O
9. Check cabin heater operation	O	O
10. Check magneto switch operation	O	O
11. Check magneto RPM variation	O	O
12. Check throttle and mixture operation	O	O
13. Check propeller smoothness	O	O
14. Check constant speed propeller action	O	O
15. Check engine idle	O	O
16. Check electronic equipment operation	O	O
17. Check operation of controls	O	O
18. Check operation of flaps	O	O
19. Check manifold pressure indicating	O	O
20. Check operation of cowl flaps	O	O
21. Check operation of manual electric trim	O	O
22. Check operation of autopilot. (See Note 28.)	O	O

5. Scheduled Maintenance (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
I. GENERAL		
1. Aircraft conforms to FAA specifications	O	O
2. All FAA Airworthiness Directives complied with	O	O
3. All Manufacturers Service Letters and Bulletins complied with. (See Note 45.)	O	O
4. Check for proper Pilot's Operating Handbook (POH)	O	O
5. Aircraft papers in proper order	O	O

5. Scheduled Maintenance (continued)

J. NOTES

1. Refer to Piper's Customer Service Information Aerofiche P/N 1753-755 for latest revision dates to Piper Inspection Reports/Manuals and this maintenance manual. References to Section are to the appropriate Section in this manual.

   WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

2. Inspections or operations are to be performed as indicated by a “O” at the 50 or 100 hour inspection interval. Inspections or operations (i.e. - component overhauls/replacements, etc.) required outside the 100 hour cycle are listed as special inspections in section 5-30-00. Inspections must be accomplished by persons authorized by the FAA.
   (a) The 50 hour inspection accomplishes preventive maintenance, lubrication and servicing as well as inspecting critical components.
   (b) The 100 hour inspection is a complete inspection of the airplane, identical to an annual inspection.

   NOTE: A log book entry should be made upon completion of any inspections.

3. Piper Service Bulletins are of special importance and Piper considers compliance mandatory. In all cases, see Service Bulletin/Service Letter Index P/N 762-332 or Service Bulletin/Service Letter Aerofiche Set P/N 1762-331 to verify latest revision.
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 shall supersede or supplement the inspections outlined in this report.
6. Add oil additive LW-16702 at each 50-hour oil change. The additive may be purchased through Lycoming or Piper distribution systems. Refer to latest revisions of Textron Lycoming Service Instruction No. 1409 and Service Bulletin No. 480.
7. Replace or overhaul, as required, or at engine overhaul. For magnetos, in no case may Slick 4300 series magnetos exceed engine TBO time in service.
8. For heaters with 500 heater operating hours or twenty-four (24) months time-in-service since new, or overhauled with a new combustion tube assembly, each 100 hours or twenty-four (24) months, whichever comes first, conduct the 100 Hour Inspection under Heater in 21-40-00.

5. Scheduled Maintenance (continued)

J. NOTES (cont)

9. 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.
10. Check carburetor throttle body attaching screws for tightness; the correct torque for these screws are 40 to 50 inch-pounds.
11. In S/N's 4496001 thru 4496190 only, verify compliance with Kelly Aerospace SIL A-110B per Piper Service Bulletin No. 1127B.

    NOTE: In S/N's 4496001 thru 4496037, verify number of heater fuel pumps installed before ordering service kits or replacement parts.

12. To change propeller spinner dome attaching locknuts, refer to Hartzell Propeller Manual 115N, Rev. 12 (or latest).
13. Refer to Pilot's Operating Handbook for preflight and flight check, for intended function in all modes.
14. Examine cables for broken strands by wiping the cable with a cloth for their entire length. Visually inspect the cable thoroughly for damage not detected by the cloth. Replace any damaged or frayed cables.
    (a) See Control Cable Inspection, 27-00-00, or the latest edition of FAA AC 43.13-1.
    (b) At fifteen (15) years time-in-service, begin Cable Fittings 100-Hour Special Inspection (27-00-00).
15. Replace (or overhaul, if applicable) at engine overhaul or 5 years time-in-service, whichever comes first.
16. In S/N's 4496001 thru 4496015 only, verify compliance with Piper Service Bulletin No. 1016.
17. In S/N's 4496001 thru 4496019 only, verify compliance with Piper Service Bulletin No. 1020.
18. In S/N's 4496001 thru 4496019 only, verify compliance with Parker Hannifin Cleveland Service Bulletin No. 7063 per Piper Service Bulletin No. 1023.
19. In S/N's 4496001 thru 4496020 only, verify compliance with Parker Hannifin Airborne Service Letter No. 48 per Piper Service Bulletin No. 1026.
20. In S/N's 4496001 thru 4496015 only, verify compliance with Piper Service Bulletin No. 1028.
21. In S/N's 4496001 thru 4496025 only, verify initial compliance with Piper Service Bulletin No. 1033. For airplanes which have not installed either new engine mounts (P/N 89361-002) or two gussets (P/N's 100558-004 and 100568-005) to each existing engine mount, conduct Engine Mount, 100 Hour Inspection, 71-20-00.
22. In S/N's 4496001 thru 4496028, and 4496031 only, verify compliance with Piper Service Bulletin No. 1040.
23. In S/N's 4496001 thru 4496036 only, verify compliance with Parker Hannifin Airborne Service Letter No. 56 per Piper Service Bulletin No. 1041.
24. For new airplanes, at the first 100-hour inspection, while the airplane is on jacks, retorque the engine mount-to-fuselage bolts.

5. Scheduled Maintenance (continued)

J. NOTES (cont)

25. In S/N 4496001 only, verify compliance per Piper Service Bulletin No. 990.
27. Check torque at aft wing spar to fuselage attachment per 57-40-00, Figure 1.
28. In S/N's 4496044, and 4496047 thru 4496051 only, verify compliance with Piper Service Bulletin No. 1083C.
29. In S/N's 4496001 thru 4496120 only, verify compliance with Piper Service Bulletin No. 1109.
30. In S/N's 4496001 thru 4496015 only, verify compliance with Piper Service Bulletin No. 725B.
31. In S/N's 4496001 thru 4496117 only, verify compliance with Piper Service Bulletin No. 1110.
32. In S/N's 4496001 thru 4496118 only, verify compliance with Piper Service Bulletin No. 1117.
33. In S/N's 4496014, and 4496030 thru 4496162 only, verify compliance with Piper Service Bulletin No. 1135.
34. In S/N's 4496020 thru 4496180 only, verify compliance with Piper Service Bulletin No. 1139A.
35. In S/N's 4496182 and 4496184 only, verify compliance with Piper Service Bulletin No. 1151E.
36. In S/N's 4496001 thru 4496130 only, verify compliance with Parker Hannifin Cleveland Service Bulletin No. 7073A per Piper Vendor Service Publication No. 137A.
37. In S/N's 4496001 and up, verify compliance with Kelly Aerospace (Janitrol) Service Bulletin No. A-107A per Piper Vendor Service Publication No. 149.
38. In S/N's 4496001 thru 4496173 only, verify compliance with Parker Hannifin Cleveland Service Bulletin No. 7076 per Piper Vendor Service Publication No. 155.
39. In S/N's 4496001 thru 4496119 only, verify compliance with McCauley Service Bulletin No. 241 per Piper Vendor Service Publication No. 138.
40. In S/N's 4496001 thru 4496026 only, verify compliance with Piper Service Letter No. 1027.
41. In S/N's 4496001 thru 4496061 only, verify compliance with Piper Service Letter No. 1034.
42. In S/N's 4496001 thru 4496163 only, verify compliance with Piper Service Letter No. 1063.
43. In S/N's 4496001 thru 4496007 only, verify compliance with Piper Service Bulletin No. 1143. For airplane which have not replaced the original nose cone spar assemblies (on both sides), conduct the 100-hour Nose Cone Spar Assembly Inspection, 53-10-00.
44. In S/N's 4496001 and up, for airplanes with at least 500 hours time-in-service, verify compliance with Piper Service Bulletin No. 1156.
45. In S/N's 4496191 and up, for new airplanes delivered from the factory without paint, verify compliance with Piper Service Letter No. 1089.
46. In S/N's 4496001 thru 4496219 only, verify compliance with Piper Service Bulletin No. 1161. For airplanes which have not installed Piper Kits No. 767-397 (LH) and 767-398 (RH) or do not have wing rib assemblies at W.S. 49.25 with date codes of 8313 or higher, conduct 100 Hour Wing Rib Inspection, 57-10-00.
47. For airplanes with any Lycoming O-360-A1H6 or LO-360-A1H6 engine manufactured, rebuilt, overhauled, or repaired after March 1, 1999, verify compliance with Lycoming Service Bulletin No. 566, Supplement 1, per Piper Vendor Service Publication No. 170A.
48. For airplanes equipped with Avidyne FlightMax Entegra EFIS, verify compliance with Avidyne Service Alert No. SA-05-001.

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SPECIAL INSPECTIONS

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

The following inspections are required in addition to those listed in 5-20-00. These inspections are required at intervals of:

A. Flight hours;

B. calendar year; or

C. the specific operation being conducted or the environment being operated in.

Unless otherwise indicated, these inspections are to be repeated at each occurance of the specified interval. Note that the items listed herein are guidelines based on past operating experience. Each operator should closely monitor his own unique operating conditions/environment and react accordingly to keep his aircraft airworthy.

NOTE: A log book entry should be made upon completion of any inspections.

1. Per Flight Hour

First 50 Hours

☐ Check security of injector nozzles.

Each 200 Hours

☐ For aircraft 10 years old or older, each 200 hours: inspect the interior of the wing flap for evidence of dissimilar metal corrosion where aluminum sheet metal is in contact with steel flap brackets. Use a borescope or other suitable tool. Installation of a new wing flap will relieve this inspection requirement until the replacement wing flap reaches 10 years time-in-service.

Each 400 Hours

☐ 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 keepers, springs, and spring seats. If any indications are found, the cylinder and all of its components must 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 Textron Lycoming Service Table of Limits SSP-1776.

Each 500 Hours

☐ For airplanes equipped with Aero Accessories (Tempest) Dry Air Pumps: beginning at 500 hours time-in-service, and each 100 hours thereafter, inspect vacuum pump vane wear per Vacuum Pump(s), Inspection, 37-10-00.

☐ Remove propeller; remove sludge from propeller and crankshaft.

☐ Replace engine air filter.

☐ Remove and flush oil radiator.

☐ Inspect magneto(s) distributor block for cracks, burned areas or corrosion.

☐ Clean and lubricate stabilator trim drum screw.

Each 500 Hours (cont.)

- ☐ In S/N's 4496001 thru 4496219 only, for airplanes which have not installed Piper Kits No. 767-397 (LH) and 767-398 (RH) or do not have wing rib assemblies at W.S. 49.25 with date codes of 8313 or higher, conduct 500 Hour Wing Rib Inspection, 57-10-00.
- ☐ Each 500 hours time-in-service inspect the nose gear drag links and replace the nose gear drag link bolt and cotter pin per 500 Hour Nose Gear Drag Link Inspection and Bolt Replacement, 32-20-00.

Each 1000 Hours

- ☐ Replace engine compartment flexible hoses (fuel, oil, etc.) as required; but not to exceed 1000 hours time-in-service, eight (8) years, or engine overhaul, whichever comes first.
- ☐ Replace fuel tank flexible hose interconnect couplings and fuel tank vent line flexible hose and hose couplings as required; but not to exceed 1000 hours, seven (7) years or fuel tank removal, whichever comes first.
- ☐ For airplanes equipped with Parker Hannifin Airborne Dry Air Pumps: overhaul or replace engine driven vacuum pumps.
- ☐ Overhaul or replace magnetos.
- ☐ Clean and lubricate all exterior needle bearings.

Each 1500 Hours

- ☐ Each 1500 hours time-in-service or whenever the combustion heater fails a Pressure Decay Test, overhaul the Janitrol combustion heater per the latest revision of Janitrol Maintenance and Overhaul Manual, P/N 24E25-1.

Each 2000 Hours

- ☐ Each 2000 hours or seven (7) years, whichever occurs first, remove interior panels and headliner and conduct detailed inspection of aircraft structure (skin, bulkheads, stringers, etc.) for condition and security. Inspection of structure concealed by headliner may be accomplished by alternate means (i.e. - through the use of a borescope) without removing the headliner, providing access is obtained to all concealed areas and borescope provides sufficient detail to adequately accomplish the inspection.
- ☐ Each 2000 hours, or as specified in the latest revision of Lycoming Service Instruction No. 1009, overhaul or replace engine.
- ☐ At engine overhaul or each 2000 hours, whichever comes first, overhaul or replace alternators.
- ☐ Overhaul or replace Hartzell propeller governors each 2000 hours or at engine overhaul. (Verify TBO in latest revision of Hartzell Service Letter No. 61.)
- ☐ Overhaul or replace Hartzell propellers each five (5) or six (6) years or each 2000 or 2400 hours. (See latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)

Each 2400 Hours

- ☐ Overhaul or replace Hartzell propellers each five (5) or six (6) years or each 2000 or 2400 hours. (Refer to latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)

2. Per Calendar Year

Each Thirty (30) Days

- ☐ If installed, check portable fire extinguisher for condition and charge. Verify nozzle is unobstructed and safety seal is intact. Determine charge by “hefting” extinguisher.
- ☐ Inspect battery, box and cables at least every 30 days. Flush box as required and fill battery per instructions on box.
- ☐ Check propeller air pressure.

Each Ninety (90) Days

- ☐ For airplanes equipped with the Avidyne Entegra Electronic Flight Instrument System: if the Standby Attitude Indicator has not been operated in the previous 90 days, charge the battery of the Standby Attitude Indicator. See Standby Attitude Indicator, 34-20-00.
- ☐ At least every 90 days, remove, drain and clean fuel filter bowls. Clean or replace filter discs as required.

Each Six (6) Months

- ☐ If annual usage is significantly less than 100 Hours, lubricate propeller each six (6) months. See Hartzell Standard Practices Manual No. 202A.

Each Twelve (12) Months

- ☐ Lubricate propeller every 100 hours or annually, whichever comes first. If annual usage is significantly less than 100 Hours, lubricate propeller each six (6) months. See Hartzell Standard Practices Manual No. 202A.
- ☐ Each 100 hours or annually, whichever comes first, perform Emergency Exit, Testing, 52-20-00.
- ☐ For airplanes equipped with the Avidyne Entegra Electronic Flight Instrument System: each twelve months, perform a full capacity test of the Standby Attitude Indicator battery. See Standby Attitude Indicator, 34-20-00.

Each Two (2) Years

- ☐ Test and inspect the static pressure system and altimeters. Ensure compliance with the requirements of FAR 43, Appendix E. (See FAR 91.411.)
- ☐ Test and inspect the transponder. Ensure compliance with the requirements of FAR 43, Appendix F. (See FAR 91.413.)
- ☐ Inspect combustion heater fuel regulator and shutoff valve for leaks every two (2) years or 100 hours, whichever comes first, per Fuel Pressure Regulator and Shutoff Valve, 100 Hour Inspection, 21-40-00.
- ☐ Inspect Janitrol combustion heater each 24 months or 100 hours, whichever comes first, per AD 2004-21-05 and the latest revision of Janitrol Maintenance and Overhaul Manual, P/N 24E25-1.
- ☐ For airplanes equipped with the Avidyne Entegra Electronic Flight Instrument System: swing the magnetic compass and recalibrate the magnetometer every two (2) years. See Magnetometer, 34-20-00.

Each Three (3) Years

- ☐ For airplanes equipped with the Avidyne Entegra Electronic Flight Instrument System: replace the Standby Attitude Indicator battery as required, but at least every three (3) years. See Standby Attitude Indicator, 34-20-00.

Each Five (5) Years

- ☐ Replace engine-driven and electric fuel pumps at engine overhaul or five (5) years, whichever comes first.
- ☐ Overhaul or replace Hartzell propellers each five (5) or six (6) years or each 2000 or 2400 hours. (See latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)

Each Six (6) Years

- ☐ Overhaul or replace Hartzell propellers each five (5) or six (6) years or each 2000 or 2400 hours. (See latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)

Each Seven (7) Years

- ☐ Replace fuel tank flexible hose interconnect couplings and fuel tank vent line flexible hose and hose couplings as required; but not to exceed 1000 hours, seven (7) years or fuel tank removal, whichever comes first.
- ☐ Each 2000 hours or seven (7) years, whichever occurs first, remove interior panels and headliner and conduct detailed inspection of aircraft structure (skin, bulkheads, stringers, etc.) for condition and security. Inspection of structure concealed by headliner may be accomplished by alternate means (i.e. - through the use of a borescope) without removing the headliner, providing access is obtained to all concealed areas and borescope provides sufficient detail to adequately accomplish the inspection.

Each Eight (8) Years

- ☐ Replace engine compartment flexible hoses (fuel, oil, etc.) as required; but not to exceed 1000 hours time-in-service, eight (8) years, or engine overhaul, whichever comes first.

Each Ten (10) Years

- ☐ Each ten years time-in-service, test fuselage and wing fluid hoses to system pressure. Visually inspect for leaks. Hoses that pass inspection may remain in service, but must be rechecked each five years additional time-in-service. No fluid hose may exceed 20 years total time-in-service.
- ☐ For airplanes equipped with the Avidyne Entegra Electronic Flight Instrument System: replace the CMOS battery in the multifunction display (MFD) as required, but at least each 10 years. See Multifunction Display (MFD), 34-20-00.

Each Twelve (12) Years

- ☐ Hydrostatically test the portable fire extinguisher each twelve (12) years.

Each Twenty (20) Years

- ☐ No fluid hose may exceed 20 years total time-in-service.

3. Per Specific Operation / Operating Environment

A. **Operation in High Dust or Industrial Pollution Environment**

CAUTION: DISCONNECT LINES FROM PITOT/STATIC SYSTEM BEFORE CONDUCTING THIS INSPECTION.

	Item	Inspection	Inspection Interval
☐	Engine Air Filter.	Clean and inspect.	Daily.
☐	Cabin Environmental and Instrument Air Filters.	Inspect and replace if necessary.	100 Hours.
☐	Pitot/Static system.	Check for obstruction. Reverse flow to lines.	100 Hours or as required.
☐	Landing Gear Down Lock Assemblies.	Clean, inspect and lubricate. (Refer to Lubrication Chart, 12-20-00.)	100 Hours.
☐	Landing Gear Oleos	Clean.	Before each flight.
		Inspect.	100 Hours.
☐	Landing Gear Wheel Bearings.	Clean, inspect and repack.	50 Hours.
☐	Windows.	Inspect for cracks, erosion, crazing, visibility, and cleanliness.	Daily.
☐	Structure drain holes.	Clean with pipe cleaner.	Before each flight.

B. **Operation in High Salt or High Humidity Environment**

	Item	Inspection	Inspection Interval
☐	Fuselage, Empennage, Wings, and Control Surfaces.	Remove floor panels and exterior access plates; inspect for corrosion using a borescope or other suitable tool.	200 Hours.
☐	Landing Gear.	Inspect for corrosion and lubrication.	200 Hours.

WARNING: ENSURE BOTH MAGNETO SWITCHES ARE OFF (GROUNDED), BEFORE TURNING PROPELLER. ENGINE MAY START IF BOTH SWITCHES ARE NOT OFF. USE EXTREME CAUTION WHEN ROTATING PROPELLER BY HAND; PROPELLER MAY KICK BACK.

☐	Engines with more than 50 hours total time.	Each five days, pull prop through five complete revolutions. Each 30 days, fly aircraft for 30 minutes, or, ground run until oil temperature is in the green arc. Avoid excessive ground run.	Each 5 days and each 30 days.
☐	Engines with less than 50 hours total time.	Each day, pull prop through five complete revolutions. Each 30 days, fly aircraft for 30 minutes, or, ground run until oil temperature is in the green arc. Avoid excessive ground run.	Daily and each 30 days.
☐	Instruments and Wiring.	Inspect for proper seal of cases and corrosion.	100 Hours.
☐	Interior.	Inspect upholstery, seat belts, seats and rugs for corrosion and integrity.	100 Hours.

NOTE: Do not use metallic tie downs (i.e. - chains, cables, etc.) in high salt or high humidity environments.

C. **Operation in Extreme Cold**

	Item	Inspection	Inspection Interval
☐	Hydraulic, Pneumatic and Environmental.	Check all fittings and attachments for security and leaks.	First 100 Hour, then as required.

D. **Operation from Soft or Unusual Terrain**

	Item	Inspection	Inspection Interval
☐	Landing Gear.	Inspect for cracks, attachment, damage, cleanliness and lubrication.	100 Hours.
☐	Wheels.	Inspect for cracks, damage, chipped rims; bearings for damage, corrosion and lubrication.	100 Hours.
☐	Tires.	Inspect for cuts, wear, inflation and deterioration.	Daily.
☐	Wheel Wells.	Inspect for foreign material, damage and corrosion.	100 Hours.
☐	Brakes.	Inspect for damage, foreign material, cracks and overheating.	Daily.
☐	Flaps, Lower Fuselage and Wing.	Inspect for damage, cracks and corrosion.	100 Hours.

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UNSCHEDULED MAINTENANCE CHECKS

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

The following inspections are required in response to specific anomalies encountered during aircraft operation. Note that the items listed herein are guidelines based on past operating experience. Each operator should closely monitor his own unique operating conditions/environment and react accordingly to keep his aircraft airworthy.

NOTE: A log book entry should be made upon completion of any inspections.

1. Lightning Strike

	Item	Inspection	Inspection Interval
☐	Propeller.	Refer to latest Hartzell Service Letter. Overhaul prior to return to service.	Each occurrence, before further flight.
☐	Engine.	See latest revisions of appropriate Textron-Lycoming Service Bulletins and Overhaul Manual.	Each occurrence, before further flight.
☐	Electrical and Avionics Systems.	Inspect and check harness, connections, and equipment for high voltage damage, burns and insulation degradation. Replace or overhaul as required. Consult with appropriate avionics vendor(s) for inspections and operational checks. Bench test alternator and voltage regulator(s) (see 24-30-00).	Each occurrence, before further flight.
☐	All exterior surfaces, skins, and structure.	Inspect for burns, evidence of arcing, and damage on surfaces and bearings. Check for correct material properties in the area of the strike path. Degauss engine mount. Replace or repair affected areas/parts.	Each occurrence, before further flight.
☐	System Components.	Inspect instrumentation, vacuum, pitot/static, and fuel systems, for damage and correct operation.	Each occurrence, before further flight.
☐	Static Wicks.	Replace.	Each occurrence, before further flight.
☐	Bearings.	Inspect all control surface hinges and bearings, and landing gear and wheel bearings for pitting and damage. Replace as required.	Each occurrence, before further flight.

2. Engine Overspeed, Overtemp, Loss of Oil, or Sudden Stoppage

	Item	Inspection	Inspection Interval
☐	Engine.	See latest revisions of appropriate Textron-Lycoming Service Bulletins and Overhaul Manual.	Each occurrence, before further flight.
☐	Propeller.	Propeller overspeed of more than 10%. Refer to latest Hartzell Service Letter. Remove and overhaul before return to service.	Each occurrence, before further flight.
☐	Engine Mount and Attachments.	Inspect for distortion and damage. Replace or repair as required.	Each occurrence, before further flight.

3. Severe Turbulence, Hard or Overweight Landing

CAUTION: MINOR OR APPARENTLY SUPERFICIAL DAMAGE MAY INDICATE A MORE SEVERE CONDITION SOMEWHERE ELSE IN THE STRUCTURE.

A. Place aircraft in a normal level attitude.

B. Make a preliminary inspection of checking alignment and out-of-track condition of engine, wings, tail, landing gear and doors.

C. Follow Piper and Textron-Lycoming Maintenance Manual procedures. If there are any questions regarding repairs or procedures, contact your Piper Dealer's Service Advisor (DSA).

D. Inspect the following items closely to determine the extent of damage:

	Item	Inspection	Inspection Interval
☐	Landing Gear Struts. (Not required for severe turbulence.)	Cracks, signs of overstress deformation, loose or damaged strut housings. Axles for cracks, bending or flat spots. Damaged oleos and seals, hydraulic leaks and landing gear alignment.	Each occurrence, before further flight.
☐	Wheels, Tires, Brakes. (Not required for severe turbulence.)	Cracks, chips, loose or cracked mounting bolts, alignment of slippage marks, sidewall distress, hydraulic or air leaks. Inspect the wheels (dye penetrant method) and wheel bolts (magnetic particle method).	Each occurrence, before further flight.
☐	Wheel Wells and Landing Gear attach points. (Not required for severe turbulence.)	Buckling, cracks, overstress, wing skin buckling, and side brace for damage and condition. Inspect landing gear attachment bolts (magnetic particle method).	Each occurrence, before further flight.

3. Severe Turbulence, Hard or Overweight Landing (cont)

	Item	Inspection	Inspection Interval
☐	Wings.	Wing attach bolts for slippage, damage and overstress. Upper and lower wing skins for wrinkles, cracks, popped or loose rivets. Remove access plates and inspect for internal damage to ribs, stringers and sparwebs; and fuel tanks for damage, attachment, and leaks.	Each occurrence, before further flight.
☐	Engine.	Engine mounts for distortion and damage to elastomeric parts. Propeller for evidence of ground strike (i.e. - hard or overweight landing).	Each occurrence, before further flight.
☐	Fuselage.	Loose or missing rivets, door alignment, windows and attachments for overstress, cracks or damage. Wing carry through member for overstress damage. Stringers, bulkheads, keel beams for buckling, cracks, or damage. Avionics, instruments and accessories installation for security and operation.	Each occurrence, before further flight.
☐	Empennage.	Skins for buckling wrinkles, loose or missing rivets. Stabilator, rudder, and vertical fin for security of attachment and overstress of bolts. Ribs, stringers for buckling, cracks and damage.	Each occurrence, before further flight.

4. Flaps Extended Above Maximum Flap Extension Speed (V_{FE})

	Item	Inspection	Inspection Interval
☐	Flap torque tube/pushrod.	Inspect for distortion. Replace as required. (See Flap Torque Tube/Pushrod Distortion Inspection, 27-50-00.)	Each occurrence, before further flight.
☐	Flaps.	Inspect for damage to the skin and attach points. Replace as required.	Each occurrence, before further flight.

5. Flood Damage, Immersion in Water

A. These guidelines are general in nature and should be applied or varied to fit the individual aircraft according to water level, length of time of exposure and other variables. Only those areas that might not be obvious to the mechanic are addressed.

CAUTION: MAKE ALL REPAIRS AND/OR ADJUSTMENTS IN ACCORDANCE WITH THE APPROPRIATE PIPER MAINTENANCE MANUAL, THE COMPONENT MANUFACTURER'S MAINTENANCE MANUAL, AND FAR PART 43. PAY PARTICULAR ATTENTION TO SILT, CORROSION AND CONTAMINANTS.

B. Follow Piper and Textron-Lycoming Maintenance Manual procedures. If there are any questions regarding repairs or procedures, contact your Piper Dealer's Service Advisor (DSA).

C. Determine the water level on the aircraft. Determine which operating and/or electrical components have been exposed to the water.

D. If the following items were immersed, inspect them closely to determine the extent of damage:

	Item	Inspection	Inspection Interval
☐	Airframe.	Clean silt and contaminants from airframe.	If immersed, each event, before further flight.
☐	Tubular Structures. (i.e. - Engine Mounts, etc.)	Check for internal corrosion. Clean and represerve as required. (See 71-20-00 - Engine Mount Corrosion Inspection, Immersion in Water.)	If immersed, each event, before further flight.
☐	Wings.	Inspect to ensure that contaminants are cleaned from fuel cell areas.	If immersed, each event, before further flight.
☐	Landing Gear and associated Bearings, Torque Links, Shimmey Dampeners, etc.	Jack airplane and cycle landing gear oleos and torque links to ensure proper operation.	If immersed, each event, before further flight.
☐	Control Surfaces.	Remove surface, clean and check all bearings - relube or replace as necessary. Rebalance before installation.	If immersed, each event, before further flight.
☐	Flight Control System.	Clean and inspect all cables, pulleys, and bearings for evidence of corrosion. Replace corroded cables. Re-preserve galvanized cable with MIL- C-11796 Class 2 (hot).	If immersed, each event, before further flight.
☐	Trim Control System.	Clean and inspect all trim system cables, pulleys, drums, bearings, jack screws, etc. Do not apply preservation to trim cables.	If immersed, each event, before further flight.
☐	Actuating Cables.	Inspect "push-pull" actuating cables for power plant, heating and ventilating system, fuel system, etc. for proper operation.	If immersed, each event, before further flight.

5. Flood Damage, Immersion in Water (cont)

	Item	Inspection	Inspection Interval
☐	Engine.	Remove, disassemble, and inspect. Examine all parts paying particular attention for evidence of corrosion, rust or contaminants imbedded on bearing surfaces, piston, mounting flanges or any aluminum, magnesium or bronze surface that may be porous. Remove evidence of rust, or corrosion. If pitting in stressed areas is found the part should not be reused. Silt imbedded in porous surfaces may be removed. Be certain oil passages, dowel holes and similar hidden openings and recesses are thoroughly free from contaminants. Test electrical components and fuel metering devices in accordance with manufacturer's instructions to determine fitness for future use. Reassemble engine using new seals, gaskets, stressed bolts nuts and crankshaft sludge tubes. All reused parts must conform with Lycoming Table of Limits No. SSP-2070 for fits and clearances. See latest revision of Lycoming Service Bulletin No. 357.	If immersed, each event, before further flight.
☐	Engine Accessories.	Inspect. Aircraft systems that supply either fuel or oil to the engine must be thoroughly cleaned, including oil cooler, lines, valves, etc. to prevent contamination of the engine after reinstallation.	If immersed, each event, before further flight.
☐	Propeller.	Inspect and repair as necessary in an authorized propeller shop.	If immersed, each event, before further flight.

5. Flood Damage, Immersion in Water (cont)

	Item	Inspection	Inspection Interval
☐	Electrical Systems.	Replace all circuit breakers and switches.	If immersed, each event, before further flight.
		Replace all solenoids, relays and master contactors.	
		Replace battery.	
		Disassemble all connectors; clean and inspect for corrosion. Replace all corroded or pitted connectors. Inspect for wire corrosion at connector.	
		Check all harness assemblies for entrapped contaminants. Clean and check for short circuits.	
		Remove electric motors and electric pumps.	
		Remove all potted solid state electrical equipment such as alternator inop. switches, low fuel warning switches, etc. Clean, dry and bench test per appropriate maintenance manual.	
		Clean and check voltage regulators and overvoltage relays. Replace as necessary	
		Clean and check all strobe light power supplies. Refer to appropriate maintenance manual.	
		Replace all fuel senders, etc.	
		Clean, inspect and check heated pitot systems.	
☐	Autopilot System. (If Installed.)	Bench test in accordance with appropriate maintenance manual. Pay particular attention to clutch settings.	If immersed, each event, before further flight.

5. Flood Damage, Immersion in Water (cont)

	Item	Inspection	Inspection Interval
☐	Vacuum (if installed) and Pitot-Static Systems.	Replace gyros. Replace filters. Clean and inspect all lines, and pitot and static vents. Clean and check all regulating valves. Remove and inspect engine driven and auxiliary vacuum pumps.	If immersed, each event, before further flight.
☐	Induction System.	Clean and inspect for silt and corrosion. Check all ducts and gaskets. Replace as necessary. Clean and inspect all heat shrouds and ducting.	If immersed, each event, before further flight.
☐	Fuel System.	Perform Fuel Tank/Wing Spar Corrosion Inspection, 28-10-00. Remove and clean fuel cells and fuel cells wing area. Clean all associated lines and pumps. Clean and inspect all fuel tank vents, cap vents and vent lines.	If immersed, each event, before further flight.
☐	Instruments.	Clean and inspect instruments. Bench check per appropriate maintenance manual.	If immersed, each event, before further flight.
☐	Heating and Ventilating Systems.	Replace blower. Clean and inspect all distribution boxes, ducting and valves. Inspect and check system control cables. Replace corroded or binding cables. If installed, clean and inspect air conditioning evaporator, condenser, and compressor.	If immersed, each event, before further flight.

5. Flood Damage, Immersion in Water (cont)

	Item	Inspection	Inspection Interval
☐	Avionics Systems.	Replace avionics. Clean and inspect antennas and connectors.	If immersed, each event, before further flight.
☐	Insulation and Upholstery.	Remove all wet insulation and upholstery. Thoroughly clean and dry (or replace) to ensure corrosion is not promoted in adjacent structures.	If immersed, each event, before further flight.

6. Hail Damage

	Item	Inspection	Inspection Interval
☐	Metallic skin of the wings, fuselage, or empennage; control surfaces; or composite components.	Classify and disposition per Hail Damage, 51-70-00.	Each occurrence, before further flight.

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CHAPTER

6

DIMENSIONS AND AREAS

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CHAPTER 6

LIST OF EFFECTIVE PAGES

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	10	Mar 15/06			

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CHAPTER 6 - DIMENSIONS AND AREAS

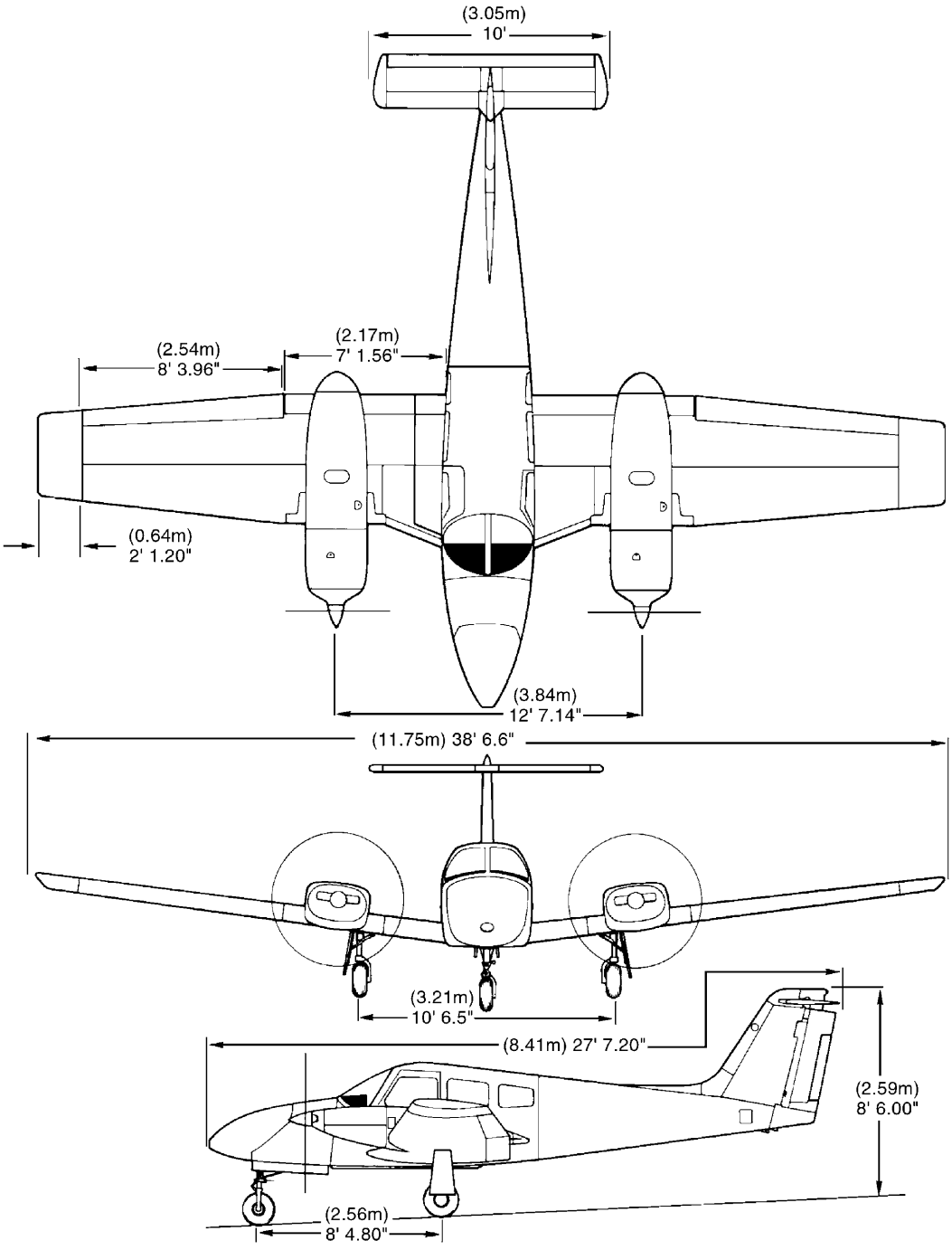
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GENERAL

The principal airplane dimensions are shown in Figure 1, and the leading particulars/principal dimensions are listed in Chart 1. The airplane serial number is on the aircraft data plate located on the bottom of the fuselage at station 235.125.



Three View
Figure 1

1. Leading Particulars and Principal Dimensions

CHART 1 (Sheet 1 of 3)
LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	**PA 44-180**	
ENGINE		
Manufacturer	Lycoming	
Model - Left	O-360-A1H6, (CW)	
Model - Right	LO-360-A1H6, (CCW)	
FAA Type Certificate	TC 286	
Rated Horsepower	180 HP at S. L.	
Rated Speed	2700 RPM	
Oil Pressure:		
Minimum Idling	25 psi	
Normal	55 to 95 psi	
Starting and Warmup	95 to 100 psi	
Maximum	115 psi	
Oil, SAE Number	See Lubrication Chart	
Oil Sump Capacity	8 U.S. Quarts	
Fuel, Aviation Grade, Minimum Octane	100/130	
	Direct	Impulse
Magnetos, Slick:	Drive	Coupled
O-360-A1H6	4370	4373
LO-360-A1H6	4302	4330
Magneto Timing	25° BTC	
Magneto Point Clearance	.010 ± .002	
Spark Plug Gap Setting	Refer to Latest Issue of Lycoming Service Instruction No. 1042	
Firing Order	1-3-2-4	
Starter — Prestolite (12volt):		
Left Engine	MZ - 4222	
Right Engine	MZ - 4220	
Alternator — Prestolite (70 amp)	ALX - 8421LS	
Alternator Voltage Regulator, Lamar	B-00392-1	

CHART 1 (Sheet 2 of 3)
LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	**PA 44-180**
PROPELLER	**TWO BLADE**
Manufacturer	Hartzell
Hub and Blade Model:	
Right Engine	HC-C2Y(K,R)-2CLEUF/FJC7666A-2R
Left Engine	HC-C2Y(K,R)-2CEUF/FC7666A-2R
Diameter	74 inches
Diameter, Minimum	72 inches
Blade Angle, Low Pitch[1]	12.4° ± 0.2°
Blade Angle, Feather[1]	79° - 81°
Governor Control	Hartzell
Left Engine	U-3-15
Right Engine	U-3-15L

NOTE: (1) Measurement taken at 30 inch station.

FUEL SYSTEM	
Electric Fuel Pump:	
Weldon (28 volt)	P/N 461-750
Fuel Tanks (1 per wing/2 total)	
Capacity	55 U.S. Gallons/Wing
Total Fuel On Board	110 U.S. Gallons
Total Usable Fuel	108 U.S. Gallons

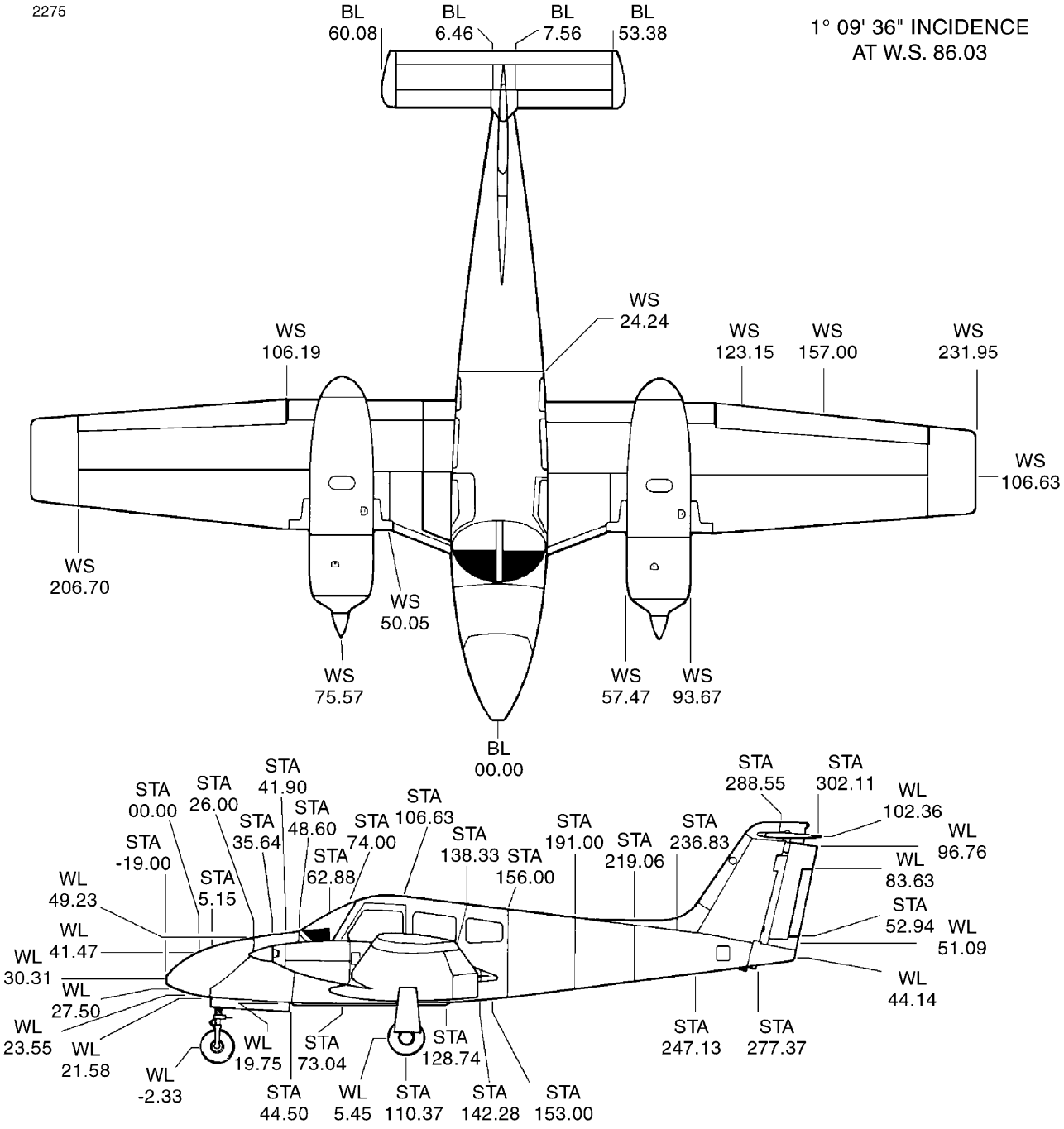
CHART 1 (Sheet 3 of 3)
LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	PA 44-180
LANDING GEAR	
Type	Fully Retractable
Shock Strut Type	Air - Oil Oleo
Fluid Required (Strut, Brakes & Hydraulic System)	MIL-H-5606
Wheel Tread	10.54 ft.
Wheel Base	8.40 ft.
Nose Wheel Travel	30° left, 30° 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 40-120C, 6.00 x 6
Brake, Type	Cleveland 30-83A
Tire, Nose	Type III, 5.00 x 5, 6 ply (Michelin Air, B.F. Goodrich, or McCreary)
Tires, Main	Type III, 6.00 x 6, 8 ply (Michelin Air, B.F. Goodrich, or McCreary)
Tire Pressure, Nose	50 psi @ Gross Weight
Tire Pressure, Main	55 psi @ Gross Weight
Nose Gear Strut Pressure	125 ± 12.5 psi
Nose Gear Visible Piston Extension (Under Static Load)[2]	2.7 ± .25 inches
Main Gear Strut Pressure	200 ± 20 psi
Main Gear Strut Visible Extension (Under Static Load)[2]	2.6 ± .25 inches

NOTE: (2) Static Load is the empty weight of the aircraft plus full fuel and oil.

2. Station Reference Lines

To locate various airplane components that require maintenance and servicing, a method utilizing fuselage station, wing station, buttock line and waterline designations is frequently employed in this manual. Fuselage stations (F.S.), wing stations, (W.S.) buttock lines (B.L.), and water lines (W.L.) are reference points measured by inches in the vertical or horizontal direction from a given reference line.

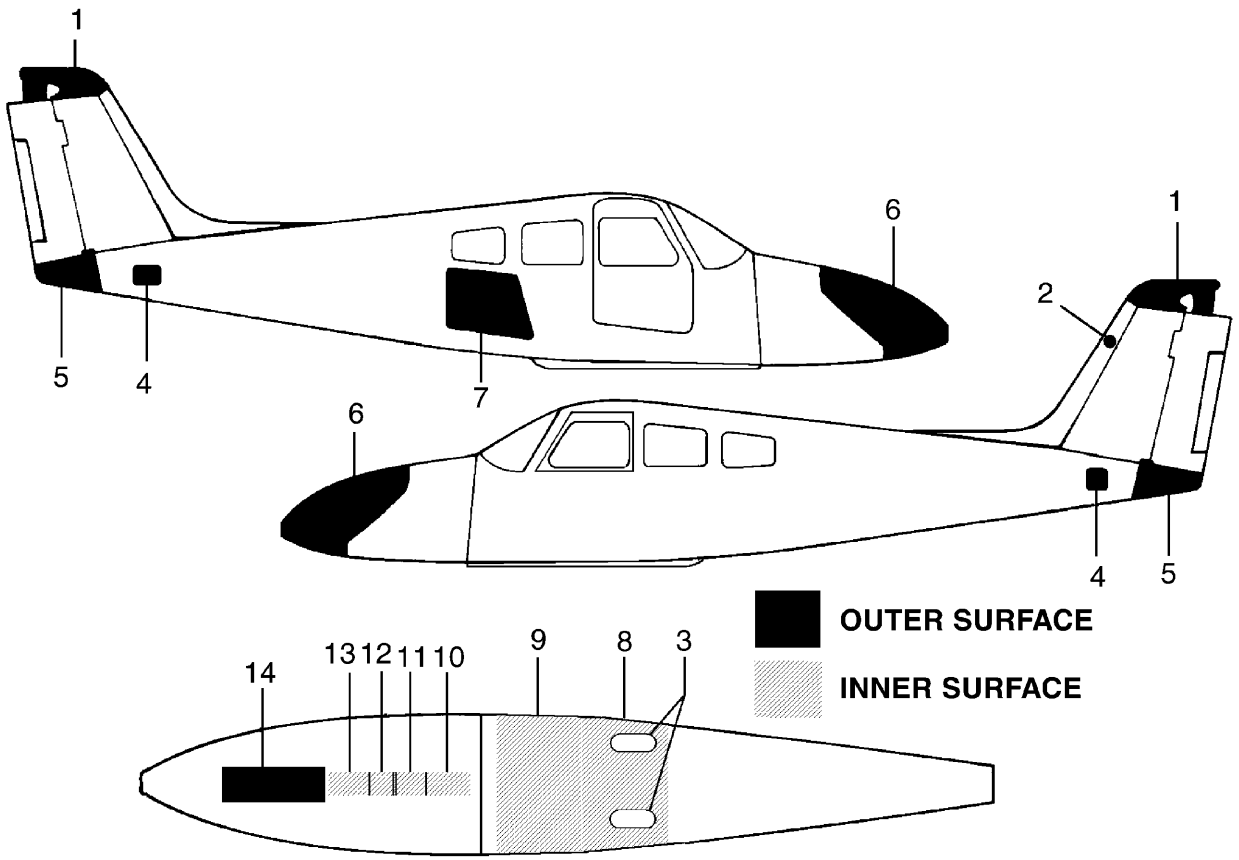


Station Reference Lines
Figure 2

3. Access And Inspection Provisions

CAUTION: BEFORE ENTERING THE AFT SECTION OF THE FUSELAGE, BE SURE THE AIRPLANE IS SUPPORTED AT THE TAIL SKID.

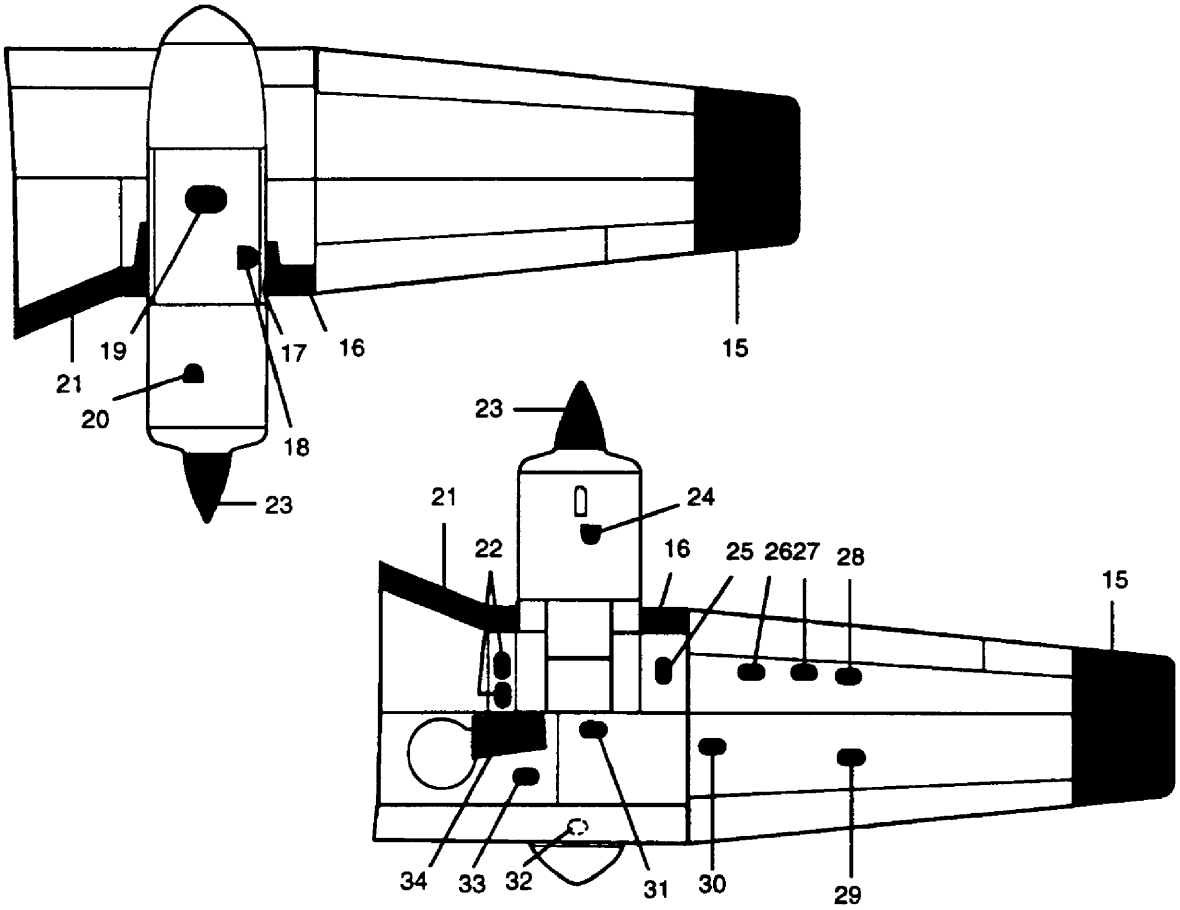
The access and inspection provisions for the airplane are shown in Figure 3. The component to be serviced or inspected through each opening is identified in the illustration. All access plates and panels are secured by either metal fasteners or screws. To enter the aft section of the fuselage, remove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



1. STABILATOR ATTACH.
   STABILATOR BALANCE WEIGHT
   STABILATOR TRIM DRIVE & LINKAGE
   STABILATOR PUSH ROD
2. NAV ANTENNA
3. CONTROL CABLE INSPECTION PANELS
4. ELT
   STABILATOR PUSH ROD & BELLCRANK
   RUDDER CONTROL CABLES
   STABILATOR CONTROL CABLES
   RUDDER TRIM CABLES
   STABILATOR TRIM CABLES
   CONTROL SYSTEM PULLEYS
5. LOWER RUDDER HINGE
   RUDDER SECTOR
6. COMBUSTION HEATER
   BATTERY & BATTERY BOX
   REGULATOR (2)
   DEFROSTERS
   BRAKE RESERVOIR
   FREE FALL VALVE
   NOSE GEAR STEERING
   AUTOPILOT
   STARTER RELAYS
   AUXILIARY POWER
7. HYD. PUMP
   AVIONICS
   AUTOPILOT TRIM SERVO
   ELECTRIC TRIM SERVO
8. SUMP DRAINS
9. FLAP TORQUE TUBE
   CONTROL SYSTEM PULLEY
   FUEL SYSTEM
   FUEL SYSTEM VALVES
   FUEL SYSTEM FILTER
   HYDRAULIC LINES
   FLAP RETURN SPRINGS
   AUTO PILOT ROLL SERVO
10. FUEL SYSTEM CONTROL CABLES & ANCHORS
    CONTROL SYSTEM CABLES & PULLEYS
11. FUEL SYSTEM CONTROL SELECTOR SLIDES
12. STABILATOR & RUDDER TRIM FLAP HANDLE.
    CONTROL SYSTEM PULLEYS
13. ENGINE CONTROL CABLES
    CARBURETOR HEAT CONTROL LEVERS
    COWL FLAP CONTROL LEVERS
14. NOSE GEAR
    NOSE GEAR ACTUATOR CYLINDER
    GEAR UP & GEAR DOWN SWITCHES

Access Plates and Panels
Figure 3 (Sheet 1 of 2)

2315



15. NAV LIGHT WIRING
    WING TIP LIGHTNING BONDING
    AILERON BALANCE WEIGHT
    PITOT STATIC HEAD
16. PITOT STATIC LINES
17. FUEL SYSTEM LINES
    VACUUM SYSTEM LINES
    SENDER FOR ANNUNCIATOR LIGHTS
    (VACUUM PRESS. & OIL PRESS.)
    ENGINE CONTROL CABLES
    FUEL SYSTEM VENT LINE
    ELECTRICAL SYSTEM
18. FUEL FILLER
19. FUEL QUANTITY SENDER
    BLADDER ACCESS HOLE
20. OIL DIPSTICK & FILLER
21. PRIMER LINES
    PITOT STATIC LINES
    VACUUM SYSTEM LINES
    ENGINE CONTROL CABLES
    ELECTRICAL SYSTEM
22. ELECTRIC FUEL PUMP
    FUEL LINES
    FINGER STRAINER
23. PROPELLER DOME PRESSURE
24. OIL SCREEN
25. FUEL FILLER CAVITY DRAIN
26. WING INTERIOR
27. WING INTERIOR
28. WING INTERIOR
29. AILERON BELLCRANK
    AILERON CONTROL CABLES
30. FUEL TANK VENT
31. WING / NACELLE INTERIOR
32. FUEL TANK VENT LINE
33. MAIN GEAR ATTACK BOLT
34. MAIN GEAR
    HYDRAULIC ACTUATOR CYLINDER
    GEAR LIMIT SWITCHES

Access Plates and Panels
Figure 3 (Sheet 2 of 2)

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CHAPTER

7

LIFTING AND SHORING

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CHAPTER 7

LIST OF EFFECTIVE PAGES

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7-List of Effective Pages	1	Mar 15/06			
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7-Table of Contents	1	Mar 15/06			
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CHAPTER 7 - LIFTING AND SHORING

TABLE OF CONTENTS

SUBJECT	SECTION	PAGE	GRID NO.
JACKING	**7-10-00**	1	1F9

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JACKING

Jacking the airplane is necessary to service the landing gear and other operations. The jacking operation is normally performed using tripod jacks. In other situations (i.e. - emergency, post-accident lifting, etc.), slings or air bags may be more appropriate.

If wing or fuselage shoring is required, make sure the support is contoured to conform to the surface it is supporting.

Jacking

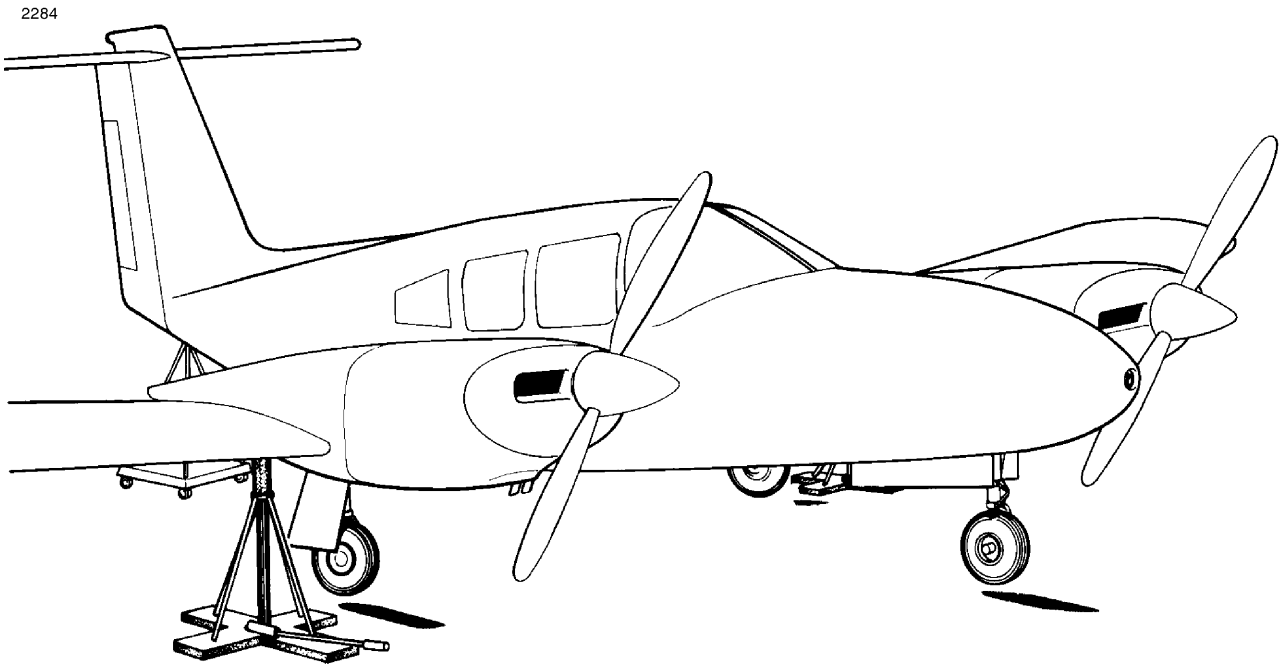
A. Align jacks under the wing respective pads on the wing front spar.

CAUTION: BE SURE TO APPLY SUFFICIENT TAIL SUPPORT BALLAST. OTHERWISE, THE AIRPLANE WILL SLIP FORWARD AND FALL ON THE FUSELAGE NOSE SECTION.

B. Attach a tail stand with approximately 600 pounds ballast to tail skid (See Figure 1).

CAUTION: PULL THE EMERGENCY GEAR EXTENSION KNOB FULL OUT FROM THE INSTRUMENT PANEL, IF THE HYDRAULIC SYSTEM WILL BE SERVICED. (SEE CHAPTERS 29 AND 32)

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



Jacking
Figure 1

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CHAPTER

8

LEVELING AND WEIGHING

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CHAPTER 8

LIST OF EFFECTIVE PAGES

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CHAPTER 8 - LEVELING AND WEIGHING

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SUBJECT	SECTION	PAGE	GRID NO.
WEIGHING	**8-10-00**	1	1F17
LEVELING	**8-20-00**	1	1F19

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WEIGHING

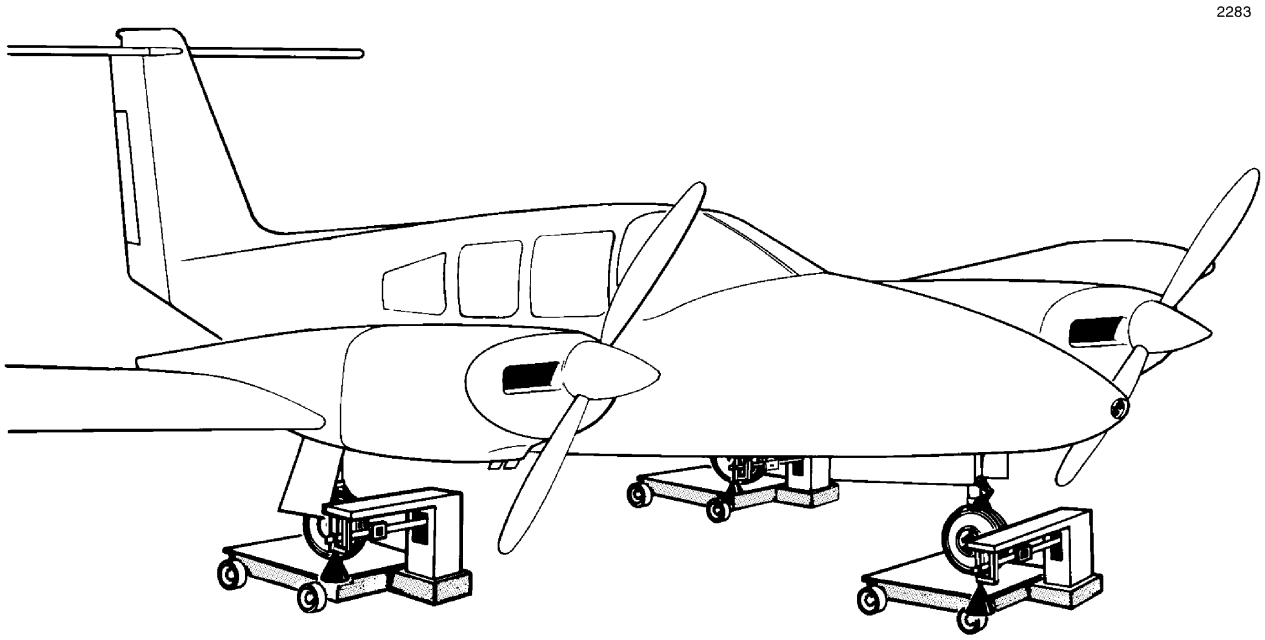
The airplane may be weighed by the following procedure (see Figure 1):

A. Position a scale and ramp in front of each of the three wheels.

B. Secure the scales from rolling forward and tow the airplane up onto the scales. (Refer to Towing, 9-10-00.)

C. Remove the ramp so as not to interfere with the scales.

D. If the airplane is to be weighed for weight and balance computations, level the airplane per 8-20-00.



Weighing Airplane
Figure 1

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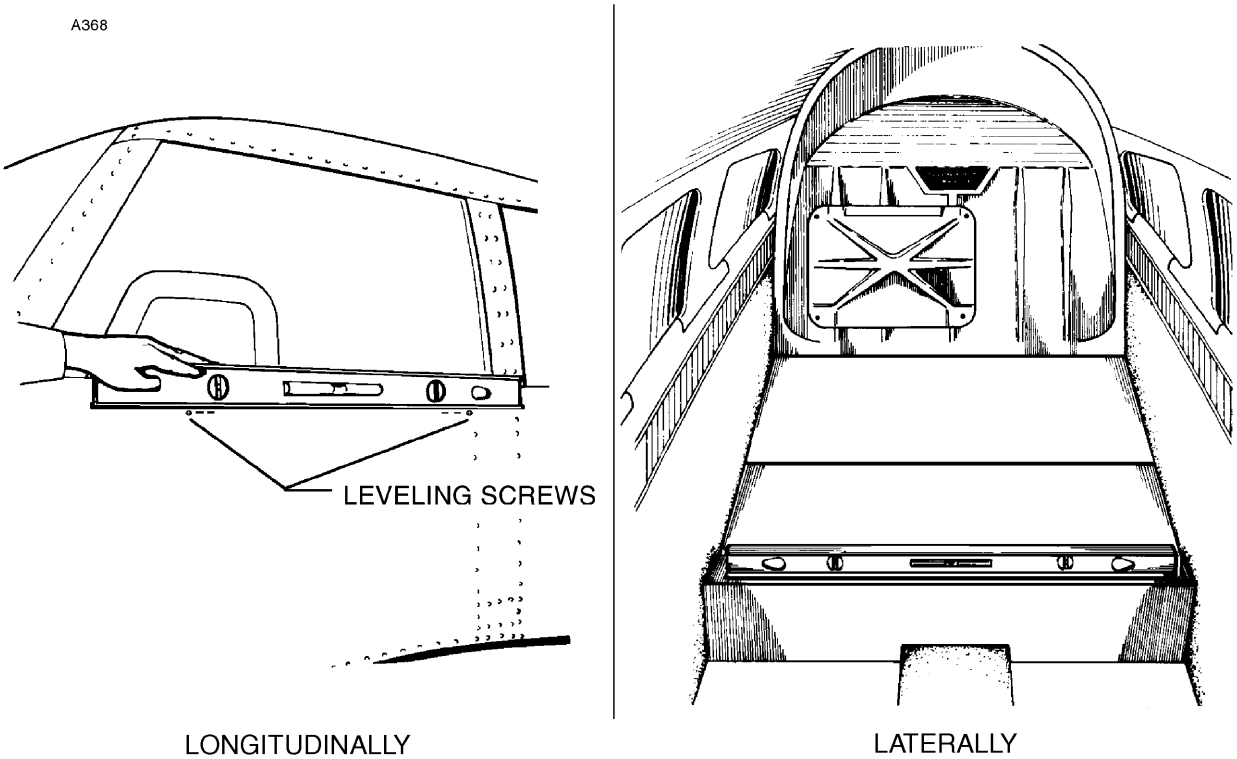
LEVELING

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:

NOTE: Level the airplane laterally first, then level it longitudinally.

A. To laterally level the airplane, place a spirit level across the baggage compartment floor along the rear bulkhead (refer to Figure 1) and deflate the tire on the high side of the airplane or adjust either jack until the bubble of the level is centered.

B. To longitudinally level the airplane, partially withdraw the two leveling screws located immediately below the left front side window. (Refer to Figure 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.



Leveling Airplane
Figure 1

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CHAPTER

9

TOWING AND TAXIING

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9-20-00	1	Mar 15/06			
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CHAPTER 9 - TOWING AND TAXIING

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SUBJECT	SECTION	PAGE	GRID NO.
TOWING	**9-10-00**	1	1G3
TAXIING	**9-20-00**	1	1G5

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TOWING

Before towing airplane, ground personnel must be informed by a qualified pilot or other qualified personnel about tow turning limits of nose gear and any other system functions required to properly and safely move the airplane.

CAUTION: DO NOT TURN THE NOSE GEAR BEYOND THE MARKED STEERING RADIUS LIMITS, WHEN TOWING WITH POWER EQUIPMENT. EXCEEDING THE NOSE GEAR STEERING LIMITS, IN EITHER DIRECTION, WILL DAMAGE THE NOSE GEAR AND STEERING MECHANISM.

CAUTION: DO NOT PUSH ON THE TRAILING EDGE OF THE AILERONS (OR ANY OTHER FLIGHT CONTROL SURFACE), WHEN MOVING THE AIRPLANE FORWARD BY HAND. THIS CAN CHANGE THE FLIGHT CONTROL SURFACE CONTOUR, RESULTING IN AN OUT-OF-TRIM CONDITION.

The airplane may be moved by using the nose wheel steering bar that is stowed in the forward baggage compartment or by using 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.

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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:

CAUTION: DO NOT OPERATE THE ENGINE AT HIGH RPM WHEN RUNNING UP OR TAXIING OVER GROUND CONTAINING LOOSE STONES, GRAVEL OR ANY LOOSE MATERIAL THAT MAY CAUSE DAMAGE TO THE PROPELLER BLADES.

CAUTION: OBSERVE WING CLEARANCES WHEN TAXIING NEAR BUILDINGS OR OTHER STATIONARY OBJECTS. IF POSSIBLE, STATION A GUIDE OUTSIDE THE AIRPLANE TO OBSERVE.

CAUTION: WHEN TAXIING ON UNEVEN GROUND, AVOID HOLES AND RUTS.

A. Taxi forward a few feet and apply brakes to determine their effectiveness.

B. Taxi with propeller set in low pitch, high rpm setting.

C. While taxiing, make slight turns to ascertain the effectiveness of steering.

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CHAPTER

10

PARKING AND MOORING

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CHAPTER 10

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CHAPTER 10 - PARKING AND MOORING

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PARKING	**10-10-00**	1	1G13
Parking		1	1G13
Locking Airplane		1	1G13
MOORING	**10-20-00**	1	1G15

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PARKING

1. Parking

When parking the airplane, ensure 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.

A. To park the airplane, head it into the wind, if possible.

B. Set the parking brake by pulling back the brake lever and depressing the knob attached to the left side of the handle.

C. To release the parking brakes, pull back on the brake lever to disengage the catch mechanism. Then allow the handle to swing forward.

NOTE: Take care when setting brakes that are overheated or during cold weather when accumulated moisture may freeze the brakes.

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

2. Locking Airplane

The passenger/crew door and the baggage compartment door (both on the right side of the aircraft) are provided with a key lock on the outside. All doors use the same key.

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MOORING

CAUTION: WHEN MOORING, USE SQUARE OR BOWLINE KNOTS. DO NOT USE SLIP KNOTS.

The airplane is moored to ensure its immovability, protection, and security under various weather conditions.

A. Head the airplane into the wind, if possible.

B. Block the wheels.

C. Lock the aileron and stabilator controls by looping the pilot's seat belt around wheel.

CAUTION: WHEN USING ROPE CONSTRUCTED OF NON-SYNTHETIC MATERIAL, LEAVE SUFFICIENT SLACK TO AVOID DAMAGE TO THE AIRPLANE WHEN THE ROPES CONTRACT DUE TO MOISTURE.

D. Secure tie-down ropes to the wing tie-down rings and the tail skid at approximately 45 degree angles to the ground.

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

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CHAPTER

11

PLACARDS AND MARKINGS

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CHAPTER 11

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11-Table of Contents	1	Mar 15/06			
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	4	Mar 15/06			
11-30-00	1	Mar 15/06			
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	3	Mar 15/06			
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CHAPTER 11 - PLACARDS AND MARKINGS

TABLE OF CONTENTS

SUBJECT	SECTION	PAGE	GRID NO.
GENERAL	**11-00-00**	1	1G23
Decals - Removal and Installation		5	1G23
EXTERIOR PLACARDS AND MARKINGS	**11-20-00**	1	1H1
INTERIOR PLACARDS	**11-30-00**	1	1H5
Meyercord Decals		5	1H9

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GENERAL

Decals - Removal and Installation

NOTE: Meyercord decals used on the instrument panel are addressed in 11-30-00.

For proper adhesion of decals, all surfaces must be clean and free of wax, oil, etc. Porous surfaces must be sealed. Sand and clean rough surfaces to remove any residue.

A. Paper Decals - Soak paper decals in water 1 to 3 minutes. Place one decal edge on receiving surface and slide decal off of paper backing. Blot water around decal with a soft absorbent cloth. Remove bubbles trapped beneath decal by wiping carefully towards nearest edge with a cloth. Coat decal with clear varnish to protect from deterioration and peeling. Remove paper decals by rubbing with cloth dampened with lacquer thinner. Use lacquer thinner sparingly if decals are applied over painted or doped surfaces.

B. Vinyl Film Decals - Separate paper backing from vinyl film. Remove paper adhering to film by rubbing with a clean water saturated cloth or a piece of masking tape. Apply cyclohexanone or equivalent, to adhesive side of film. Position and apply decal while adhesive is still tacky. Work a roller across decal until all air bubbles are removed. To remove a vinyl decal, place cloth saturated with cyclohexanone or methyl ethyl ketone on decal. Scrape with micarta scraper. Remove remaining adhesive with cloth dampened with dry cleaning solvent.

C. Metal Decals

(1) Cellophane backed.
   (a) Immerse in water 1 to 3 minutes.
   (b) Remove and dry.
   (c) Remove cellophane backing.
   (d) Position on receiving surface. (For large foil decals, position center or receiving surface and work outward from center.)
   (e) Roll with rubber roller and press all edges firmly.

(2) Paper backed.
   (a) Peel backing from decal.
   (b) Apply light coat of cyclohexanone.
   (c) Position and smooth per steps 4 and 5 of cellophane backed decals.

(3) Metal decals with no adhesive.
   (a) Apply cement MIL-A-5092 to decal and receiving surface.
   (b) Allow cement to dry until tacky.
   (c) Apply and smooth down decal.
   (d) Remove excess adhesive with aliphatic naphtha.

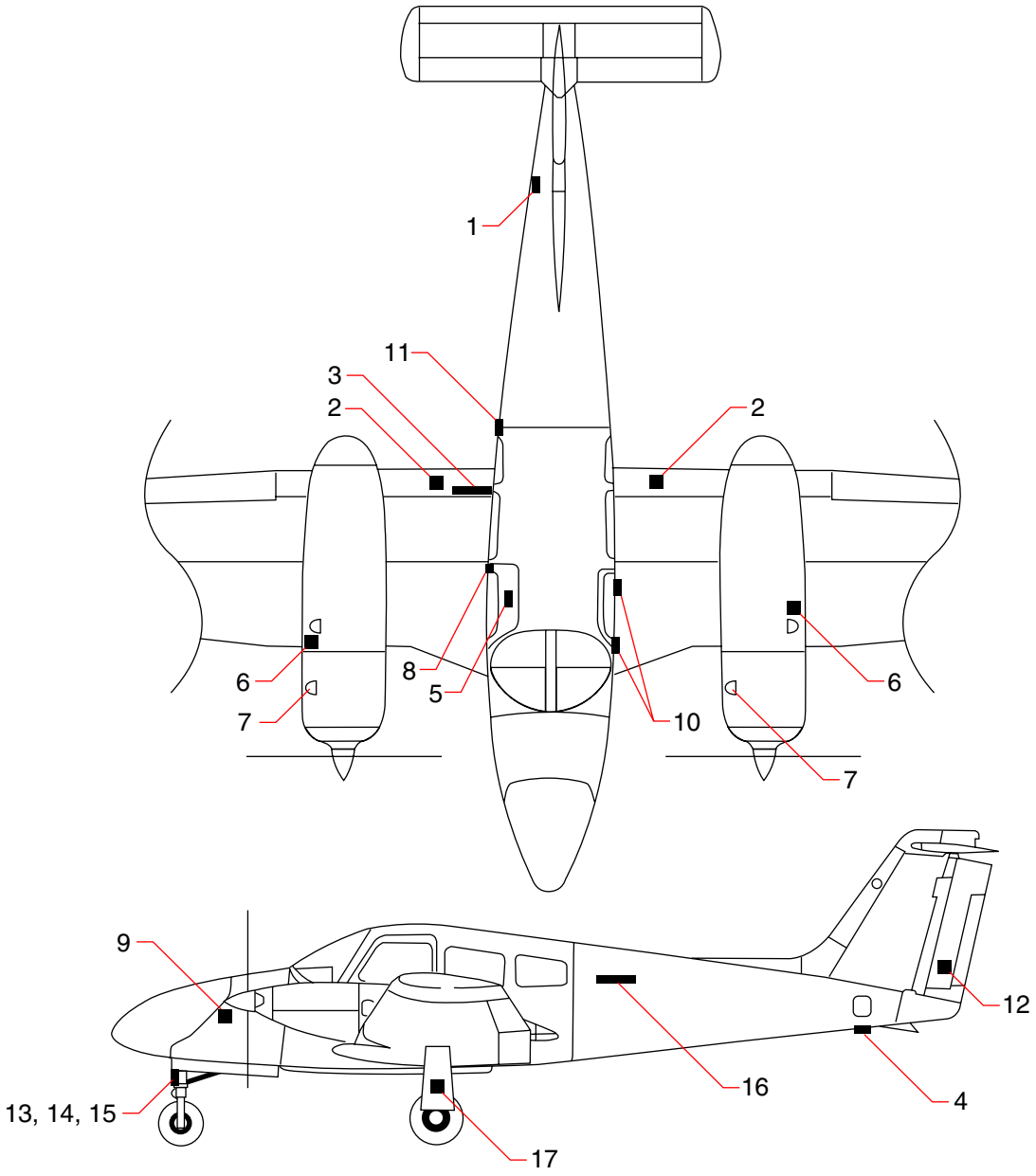
(4) To remove metal decals, moisten decal edge with aliphatic naphtha and peel off decal.

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EXTERIOR PLACARDS AND MARKINGS

The aircraft dataplate (Figure 1, Item 4) is located on the bottom of the fuselage at F.S. 235.125. The dataplate identifies the airplane by its model number and serial number. Should a question arise concerning the care of the airplane, it is important to include the airplane serial number in any correspondence to your Piper Dealer's Service Advisor (DSA).

NOTE: Any time an airplane is repainted or touched up, inspect all placards to ensure that they are not covered with paint, are legible, and securely attached.



1. PLACARD - ELT LOCATION
2. PLACARD - NO STEP
3. PLACARD - FLAP WARNING
4. PLATE - AIRCRAFT DATA
5. PLACARD - DOOR RELEASE
6. DECAL - AVGAS
7. PLACARD - OIL SPEC (INSIDE OIL DOOR)
8. PLACARD - DOOR OPEN
9. PLACARD - EXTERNAL POWER
10. PLACARD - LEVEL POINT
11. PLACARD - FUEL DRAINS
12. PLACARD - DO NOT PUSH (BOTH SIDES)
13. PLACARD - OLEO SERVICE INSTRUCTIONS
14. PLACARD - TURN LIMIT
15. PLACARD - TURN LIMIT CENTER MARK
16. STENCIL - AIRPLANE MODEL NAME
17. PLACARD - OLEO SERVICE INSTRUCTIONS (BOTH LEFT AND RIGHT STRUTS)

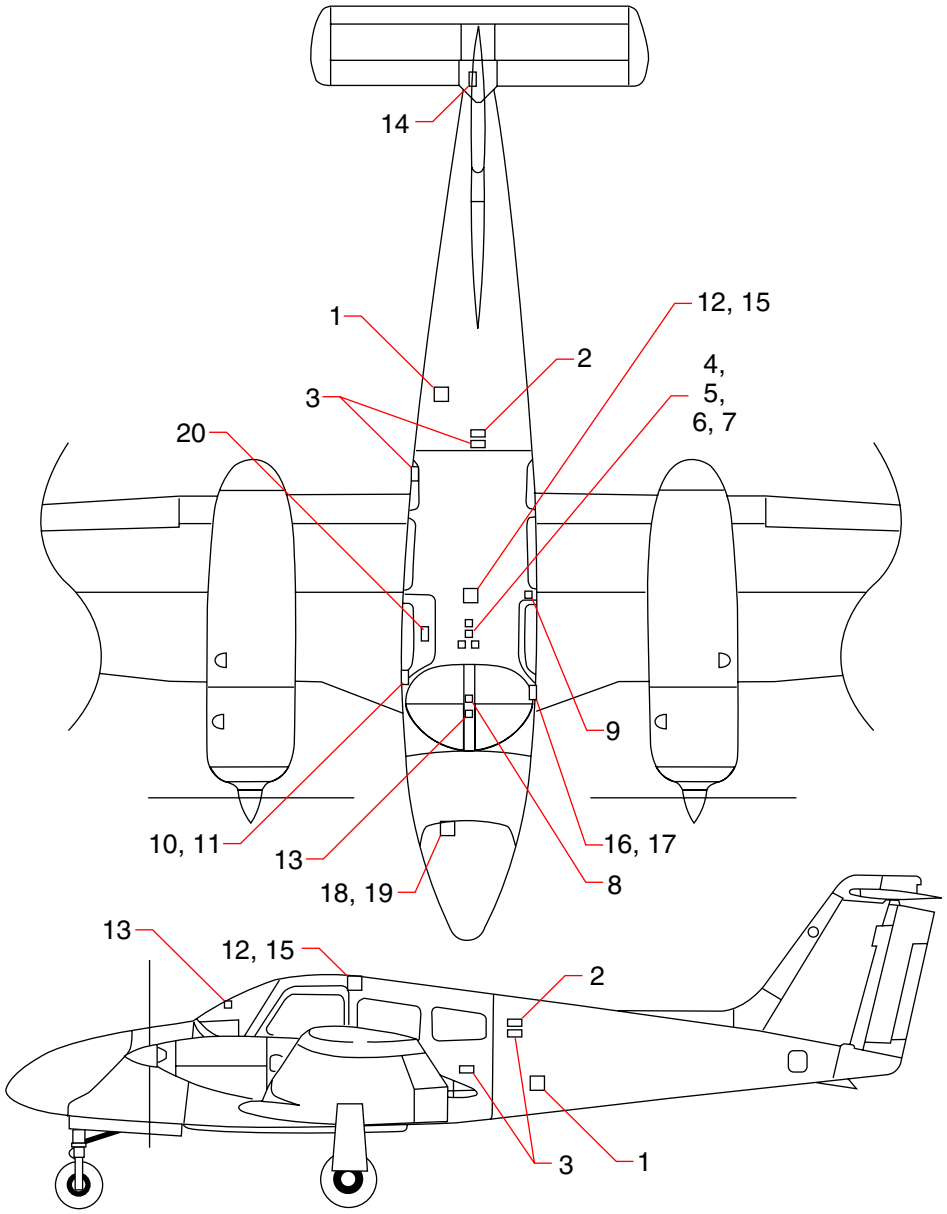
Exterior Placards and Markings
Figure 1

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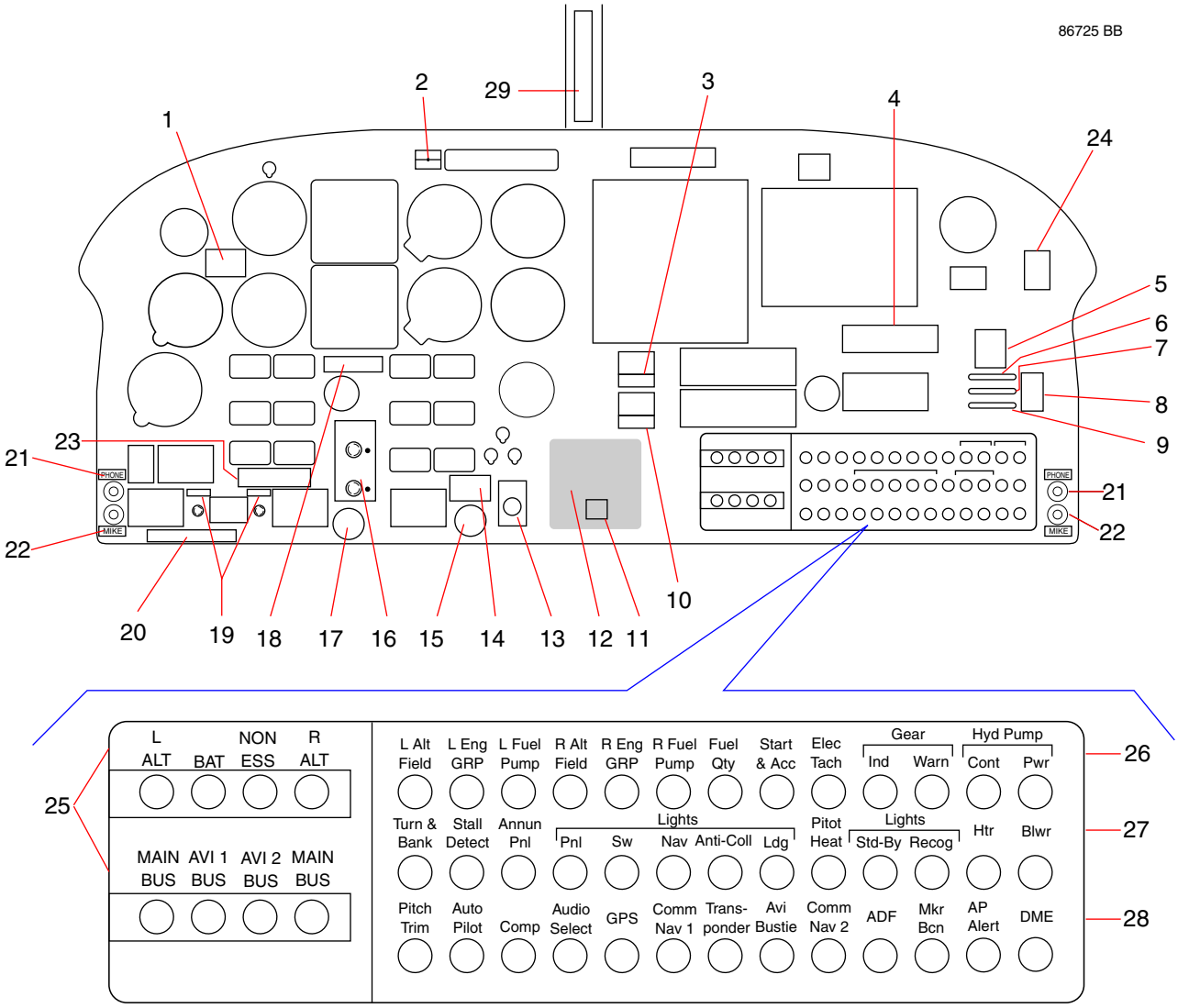
INTERIOR PLACARDS

86725 BB



1. PLACARD - HYDRAULIC FLUID SPECIFICATION
2. PLACARD - SOFT WEAR
3. PLACARD - BAGGAGE LIMITATIONS
4. PLACARD - FUEL SELECTOR
5. PLACARD - RUDDER TRIM
6. PLACARD - FLAPS
7. PLACARD - STABILATOR TRIM
8. PLACARD - COWL FLAPS
9. PLACARD - EMERGENCY EXIT
10. PLACARD - OPEN
11. PLACARD - LATCH
12. PLACARD - CABIN AIR - PULL OFF
13. PLACARD - COMPASS CAUTION
14. PLACARD - STABILATOR BALANCE WEIGHT (ALLOWABLE ON EITHER SIDE OF WEIGHT)
15. PLACARD - DOME LIGHT MAXIMUM
16. PLACARD - STORM WINDOW
17. PLACARD - OPERATING LIMITATIONS, ETC.
18. PLACARD - FLUID LEVEL
19. PLACARD - BRAKE RESERVOIR
20. PLACARD - DOOR OPEN - LOCK

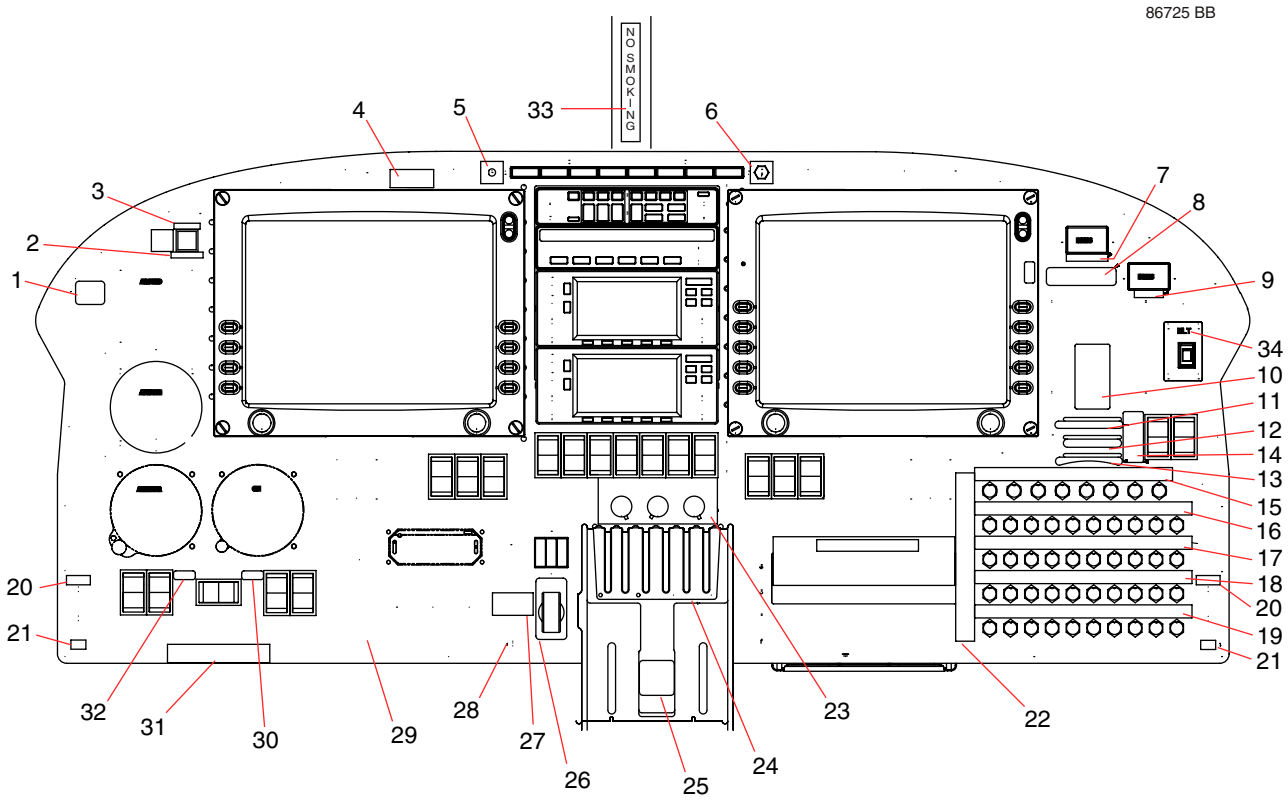
Interior Placards
Figure 1



1. PLACARD - AIR SPEEDS
2. PLACARD - PRESS TO TEST
3. PLACARD - MAINTENANCE
4. PLACARD - WINTERIZATION KIT
5. PLACARD - FLIGHT OPERATIONS (HEATER)
6. PLACARD - CLOSED - OPEN
7. PLACARD - WARMER (HEATER)
8. PLACARD - AIR TEMPERATURE (DEFROST)
9. PLACARD - OFF - ON DEFROST
10. PLACARD - HEATER
11. PLACARD - CARBURETOR HEAT
12. PLACARD - ENGINE CONTROL COVER
13. PLACARD - GEAR SWITCH
14. PLACARD - EMERGENCY GEAR RELEASE
15. PLACARD - EMERG. GEAR RELEASE KNOB
16. PLACARD - SWITCH AND PANEL LIGHTS
17. PLACARD - PARK BRAKE
18. PLACARD - REGISTRATION NUMBER
19. PLACARD - PRIMER
20. PLACARD - ALTERNATE STATIC
21. PLACARD - PHONE
22. PLACARD - MIKE
23. PLACARD - PARKING BRAKE
24. PLACARD - ELT WARNING
25. PLACARD - CIRCUIT BREAKER (Typical)
26. PLACARD - CIRCUIT BREAKER (Typical)
27. PLACARD - CIRCUIT BREAKER (Typical)
28. PLACARD - CIRCUIT BREAKER (Typical)
29. PLACARD - NO SMOKING

Effectivity
4496001 and up

Instrument Panel Placards
Figure 2 (Sheet 1 of 2)



1. PLACARD - AIR SPEEDS
2. PLACARD - PUSH ON - OFF
3. PLACARD - ELEVATOR TRIM
4. PLACARD - REGISTRATION
5. PLACARD - NIGHT - DAY
6. PLACARD - PRESS TO TEST
7. PLACARD - MAINTENANCE HOBBS
8. PLACARD - WINTERIZATION KIT
9. PLACARD - FLIGHT HOBBS
10. PLACARD - HEATER
11. PLACARD - AIR INTAKE SELECTOR
12. PLACARD - TEMPERATURE
13. PLACARD - DEFROST SELECTOR
14. PLACARD - TEMPERATURE DEFROST
15. PLACARD - CIRCUIT BREAKER
16. PLACARD - CIRCUIT BREAKER
17. PLACARD - CIRCUIT BREAKER
18. PLACARD - CIRCUIT BREAKER
19. PLACARD - CIRCUIT BREAKER
20. PLACARD - PHONE
21. PLACARD - MIC
22. PLACARD - CIRCUIT BREAKER
23. PLACARD - DIMMING
24. PLACARD - ENGINE CONTROL COVER
25. PLACARD - CARBURETOR HEAT
26. PLACARD - GEAR SELECTOR
27. PLACARD - EMERGENCY GEAR EXTEND
28. PLACARD - EMERGENCY GEAR RELEASE
29. PLACARD - PARK BRAKE
30. PLACARD - PRIMER SWITCH
31. PLACARD - ALTERNATE STATIC SOURCE
32. PLACARD - PRIMER SWITCH
33. PLACARD - NO SMOKING
34. PLACARD - ELT WARNING

Instrument Panel Placards
Figure 2 (Sheet 2 of 2)

Effectivity
4496174; 4496224 and up,
with Avidyne Entegra Option

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Meyercord Decals (PIR-PPS-65104, Rev. G.)

Decals installed on the instrument panel are Meyercord type manufacturered by Mark-It, 1055 Paramount Tarkway, Batavia. IL 60510. The following procedures should be followed in the event one or more of these decals must be replaced.

A. Removal

CAUTION: DO NOT USE LACQUER THINNER ON ANY PANEL THAT HAS BEEN PAINTED WITH ENAMEL OR LACQUER. INSTRUMENT PANELS ARE PAINTED AT THE FACTORY WITH POLYURETHANE PAINTS.

Remove placard to be replaced with a clean cloth ***dampened*** with lacquer thinner.

CAUTION: MARK-IT J-70 SOLVENT WILL REMOVE ENAMEL, LACQUER, AND POLYUTHERANE BASED PAINT PRODUCTS IF LIQUID IS DROPPED ONTO PAINTED SURFACE AND NOT REMOVED IMMEDIATELY.

If panel is painted with enamel or lacquer use a clean cloth ***dampened*** with Mark-It J-70 solvent to remove placard to be replaced.

B. Installation

(1) If required, clean surface to receive decal using alcohol. Newly painted surfaces need no preparation.
(2) Mix a solution consisting of six (6) parts water and one (1) part J-70 solvent (P/N 179-497).
(3) Submerge decal in the mixed J-70 solution for approximately 3 to 5 seconds.
(4) Remove decal from mixed solution and lay in position.
(5) Using a plastic squeegee, squeegee out from center to edges to remove excess solution.
(6) Wait approximately 30 to 60 seconds, then slide the backing paper off and wipe up the excess solution with a damp cloth.
(7) Wait at least 30 minutes at room temperature before wiping the face of the decal with a damp cloth to remove excess solvent residue.
(8) Allow the decal to dry thoroughly, (tack free in 2 hours at room temp) before handling.

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CHAPTER

12

SERVICING

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CHAPTER 12

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CHAPTER 12 - SERVICING

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GENERAL

This chapter covers all routine servicing of airplane, scheduled and non-scheduled, including replenishment of fuel, oil, brake fluid, tire pressure, lubrication requirements, servicing of oleo struts with air and oil, etc. Pay special attention to all WARNINGS and CAUTIONS.

1. Aircraft Finish Care

WARNING: DO NOT USE GASOLINE, ALCOHOL, BENZENE, CARBON TETRACHLORIDE, THINNER, ACETONE OR WINDOW CLEANING SPRAYS TO CLEAN AIRPLANE.

The entire airplane is carefully finished inside and out to assure maximum service life. The external surfaces are coated with durable polyurethane enamel.

A. Dupont Imron 6000 Paint System

CAUTION: FAILURE TO OBSERVE THE PROPER "FINISH CARE" GUIDELINES MAY RESULT IN DAMAGE OR LOSS OF SHINE OF THE AIRCRAFT PAINT. IMPROPER CARE MAY ALSO VOID THE WARRANTY REGARDING THE AIRCRAFT FINISH.

New Piper aircraft delivered in 1999 and later (i.e. - Seminole S/N 4496024 and up) use the new Dupont Imron 6000 paint system. The guidelines outlined below must be followed to prevent damage to the finish and ensure long paint life.

(1) For the first 30 days after painting:
   (a) Hand wash the aircraft often. Use fresh water only.
   (b) Avoid parking under trees or places where birds roost. If sap, bird droppings, or insect remains are discovered, rinse them off immediately. (Sap, bird droppings, or insect remains will damage the paint during this period.)

(2) For the first 120 days after painting:
   (a) To remove heavy soil, use mild liquid soap. Never use detergent.
   (b) DO NOT WAX THE AIRCRAFT WITHIN 120 DAYS OF PAINTING!

(3) For long term paint finish protection:
   (a) Park in a sheltered area whenever possible.
   (b) Never use a scraper to remove ice or snow from painted surfaces.
   (c) Never let avgas, oil, or hydraulic fluid stand on painted surfaces. (This will permanently damage the finish.)
   (d) Never wash the aircraft in the hot sun.
   (e) Never wipe the finish with a dry cloth, always use fresh water.
   (f) Avoid abrasive cleaners, chemicals, abrasive wax, or brushes.
   (g) Have paint nicks or scratches touched up as soon as possible to maintain the aircraft's corrosion protection.

To summarize, New Piper aircraft using the new Dupont paint system need special attention in the early days of ownership.

B. Cleaning

CAUTION: IF PAINT IS LESS THAN SIX MONTHS, SEE "DUPONT IMRON 6000 PAINT SYSTEM," ABOVE.

CAUTION: DO NOT DIRECT ANY STREAM OF WATER OR CLEANING SOLUTION AT THE OPENINGS IN THE PITOT HEAD, STATIC PORTS, ALTERNATE STATIC PORTS OR FUSELAGE DRAINS.

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 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.

2. Cleaning

A. Exterior Surfaces - see "Aircraft Finish Care," above, and "Windshield and Windows," below.

B. 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(S), AIR INTAKE AND ALTERNATE AIR INLETS.

(2) With the engine cowling removed, spray or brush the engine with solvent or a mixture of solvent and degreaser, as desired. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.
(3) Allow the solvent to remain on the engine from five to ten minutes; then rinse the engine clean with additional solvent 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,12-20-00.

C. Landing Gear

(1) Struts and Torque Links

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

(a) Place a pan under the gear to catch waste.

(b) Spray (low pressure only) or brush the gear area with solvent or a mixture of solvent and degreaser.

(c) Allow the solvent to remain on the gear for five to ten minutes. Rinse gear with additional solvent and allow to dry.

(d) Remove cover from wheel and remove the catch pan.

(e) Lubricate gear per Lubrication Chart, 12-20-00, if not proceeding to wheels and brakes, below.

(2) Wheels and Brakes

CAUTION: DO NOT USE HIGH PRESSURE SPRAY WASH EQUIPMENT. ITS USE CAN INJECT SOAP SOLUTION AND WATER INTO THE WHEEL BEARINGS AND OTHER INTERNAL CAVITIES RESULTING IN CORROSION AND REDUCED SERVICE LIFE.

(a) Hand wash wheels and brakes with a mild soap and water solution.

(b) Rinse with low-pressure spray.

(c) Lubricate gear per Lubrication Chart, 12-20-00, if not already done, above.

D. Windshield and Windows

WARNING: DO NOT USE GASOLINE, ALCOHOL, BENZENE, CARBON TETRACHLORIDE, THINNER, ACETONE OR WINDOW CLEANING SPRAYS.

(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.

(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 windshield and windows during flight through rain, a rain repellent such as REPCON should be applied to windshield and windows. The surfaces of the windshield and windows treated becomes so smooth that water beads up and readily flows off the surface. Apply this product in accordance with the manufacturer's instructions. (See 91-10-00, Consumable Materials and Vendor Contact Information.)

E. Interior

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

WARNING: 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.

F. Carpets

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

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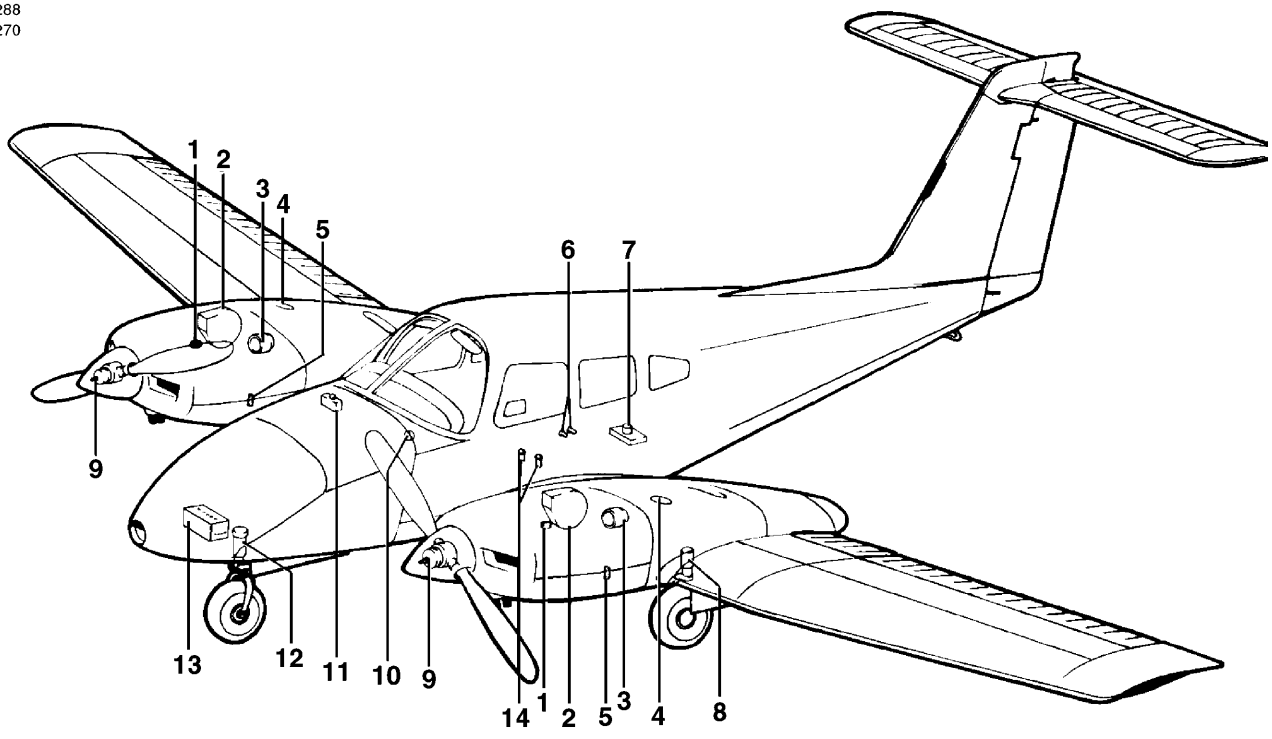
REPLENISHING

1. Fuel System

A. Fuel Filter

At intervals of 100 hours or 90 days, whichever comes first, clean the fuel filters. Remove and clean the filters in accordance with the instructions in 28-20-00. Inspection intervals of the various fuel system components are in Chapter 5.

2288
2270



1. ENGINE OIL FILL
2. INDUCTION AIR FILTER
3. ENGINE OIL FILTER
4. FUEL FILLER
5. ENGINE OIL SUCTION SCREEN
6. FUEL SYSTEM DRAINS
7. HYDRAULIC RESERVOIR AND PUMP
8. MAIN GEAR STRUT
9. PROPELLER AIR CHARGE
10. INSTRUMENT AIR FILTER
11. BRAKE RESERVOIR
12. NOSE GEAR STRUT
13. BATTERY
14. FUEL FILTERS

Service Points
Figure 1

B. Fuel Tanks

(1) Filling

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

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 0.15% by volume of the refueled quantity and to ensure its effectiveness should be blended at not less than 0.10% by volume. One and one-half liquid oz's. 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: ENSURE 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.

(2) Draining Moisture

CAUTION: WHEN DRAINING ANY AMOUNT OF FUEL, INSURE THAT NO FIRE HAZARD EXISTS BEFORE STARTING ENGINE.

The fuel system should be drained daily prior to first flight and after refueling to avoid the accumulation of water sediment. To facilitate draining the fuel system, fuel filters, lines and tanks of moisture and foreign matter, drains are incorporated in the starboard fuselage at a point just aft of the right flap trailing edge and just forward of the entrance step. Drain moisture as follows:

(a) Place a transparent container under the drain valve(s).

(b) Turn the fuel selector(s) ON for the side(s) being drained.

(c) Open each drain valve in turn, draining a small amount of fuel. Examine the fuel drained for water or other contaminants. If contaminants present, continue to drain until the fuel is free of contaminants.

(3) Draining Entirely

CAUTION: WHEN DRAINING ANY AMOUNT OF FUEL, INSURE THAT NO FIRE HAZARD EXISTS BEFORE STARTING ENGINE.

Fuel may be drained from the system by opening the valves at the right hand side of the fuselage 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 fuel filters. Either wing may be drained by closing the selector valve and then draining as desired.

C. Flushing Tanks and Selector Valves

(1) To flush the fuel tanks and selector valves, disconnect the fuel line at the injector.

(2) Select a fuel tank, turn on the electric fuel pump and flush fuel through the system until it is determined there is no dirt and foreign matter in the fuel valve or tank. During this operation, agitation of the fuel within the tank will help pick up and remove any dirt.

(3) Repeat this procedure for each tank.

(4) When all tanks are flushed, clean all filters.

2. Engine Lubrication

CAUTION: DO NOT INTRODUCE ANY TRADE ADDITIVE TO THE BASIC LUBRICANT UNLESS RECOMMENDED BY THE ENGINE MANUFACTURER IN THE LATEST REVISION OF LYCOMING SERVICE BULLETIN NO. 446.

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 oil and full flow cartridge filter should be changed every 50 hours or four months, whichever occurs first. Refer to the latest revision of Lycoming Service Bulletin 480. Should fuel other than the specified octane rating for the power plant be used, refer to the latest revision Lycoming Service Letter No. L185, for additional information and recommended service procedures. Use a quality brand Aviation Grade Oil of the proper season viscosity. For information on the use of detergent oil, refer to Recommendations for Changing Oil and/or the latest revision of Lycoming Service Instruction No. 1014.

A. Oil Sump

(1) Draining

To drain the oil sump, provide a suitable container with a minimum capacity of that required to fill the sump. Remove the upper engine cowl and open the oil quick drain located on the underside (inboard lower side) of the engine by placing a tube of the proper diameter on the quick drain and pushing 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.

(2) Filling

The oil sump should normally be filled with oil to the mark on the engine dipstick. The quantity of oil required for the engine may be found in 6-00-00, Chart 1. The specified grade(s) of oil may be found in 12-20-00, Figure 7; on the cowl panel access door of each engine; or in the appropriate vendor publication. To service the engine with oil, open the quick release oil filler access door on top of the cowl, and remove the oil filler cap.

(3) Oil Screen (Suction)

The oil suction screen, located on the bottom aft end of the engine sump, is 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. To avoid possible damage to the screen, after cleaning and inspection, place the screen inside the recess in the hex head plug and insert the screen into the housing. When certain that the screen is properly seated, tighten and safety the plug with MS-20995-C41 safety wire.

(4) Recommendations for Changing Oil

NOTE: Lycoming recommends changing the oil and filter each 50 hours of operation or every four months, whichever occurs first - for engines equipped with full flow cartridge filters. Refer to the latest revision of Lycoming Service Instruction No. 1014 and Lycoming Service Bulletins No. 446 and No. 480.

(a) A change to additive oil should be made with a degree of caution in engines that have been operating on straight mineral oil for several hundred hours, since the cleaning action of some additive oils will tend to loosen sludge deposits and cause plugged oil passages. On any engine that has been operating on straight mineral oil and is known to be in excessive dirty condition, do not switch to an additive or compounded oil until the engine has been overhauled.

(b) When changing from straight mineral oil to compounded oil, the following precautionary steps should be taken:

1 Except when using LW-16702 (Lycoming Service Bulletin No. 446), do not add ashless dispersant to straight mineral oil. Do not add additive oil to straight mineral oil. Drain the straight mineral oil from the engine and fill with additive oil.

2 Do not operate the engine longer than five hours before the first oil change.

3 Check all oil screens for evidence of sludge or plugging and change oil every ten (10) hours if sludge conditions are evident. Resume normal oil drain periods after sludge conditions improve.

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.

B. Oil Filter

(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 a 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 cartridge to 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. Use MS-20995-C41 safety wire.

3. Landing Gear (PIR-PPS50045, REV. K.)

The landing gear consists of tires, brakes and oleo strut assemblies. These should be inspected for scored piston tubes, possible hydraulic fluid leakage and security and condition of all connection points. Check the brake linings for wear and frayed edges, and brake discs for scoring. Replace if necessary. Minor servicing is described in the following paragraphs. For detailed services and overhaul instructions, refer to Chapter 32.

A. Servicing Oleo Struts

WARNING: DO NOT RELEASE AIR BY REMOVING THE STRUT VALVE CORE OR FILLER PLUG. DEPRESS THE VALVE CORE PIN UNTIL STRUT CHAMBER PRESSURE HAS DIMINISHED.

CAUTION: DIRT AND FOREIGN PARTICLES ACCUMULATE AROUND THE FILLER PLUGS OF THE LANDING GEAR STRUTS. THEREFORE, BEFORE ATTEMPTING TO REMOVE THESE PLUGS, THE TOPS OF THE STRUTS SHOULD BE CLEANED WITH COMPRESSED AIR AND/OR WITH A DRY SOLVENT.

CAUTION: DO NOT EXCEED SPECIFIED TUBE EXPOSURES.

Air-oil struts are incorporated in each landing gear oleo to absorb the shock resulting from the impact of the wheels on the runway during landing. To obtain proper oleo action, the nose gear oleo strut must have approximately 2.70 ± 0.25 inches of piston tube exposed, while the main gear struts require approximately 2.60 ± .25 inches of tube exposure.

These measurements are taken with the airplane setting on a level surface under normal static load (empty weight of airplane plus full fuel and oil). If the strut has less tube exposed than that prescribed, determine whether it needs air or oil by raising the airplane on jacks. With the strut extended, remove the cap from the air valve at the top of the housing and depress the valve core to allow air to escape from the strut piston until it is fully compressed. Allow the foam from the air-oil mixture to settle and then determine if oil is visible up to the bottom of the filler plug hole. If the oil is visible at the bottom of the hole, then all that is required is the valve be checked for unsatisfactory conditions and air added as described in Inflating Oleo Struts, below. Should fluid be at any level below the bottom of the filler plug hole, the oleo should be checked for leaks, etc, and oil added as described in Filling Nose Gear Oleo Strut, below; or, Filling Main Gear Oleo Strut, below, respectively. For repair procedures of the landing gear and/or oleo struts, refer to Chapter 32.

NOTE: Normal Static load is the empty weight of the airplane plus full fuel and oil.

B. Filling Nose Gear Oleo Strut

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

(1) Raise the airplane on jacks until the nose wheel is completely clear of the ground. (Refer to 7-10-00.)

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

(3) If not previously accomplished, relieve air from the strut housing chamber by removing the cap from the air valve and depressing the valve core.

(4) There are two methods by which the strut chamber may be filled as follows:

(a) Method I:

1 Remove valve core from filler plug at the top of strut housing. Do not remove plug.

2 Attach one end of a clear plastic hose to the valve stem of the filler plug and submerge the other end in a container of hydraulic fluid. Ascertain that the end of the hose on the valve stem is tight and the fluid container is approximately equal in height to the top of the strut housing.

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.

3 Fully compress and extend strut to draw fluid from the fluid container and expel air from strut chamber. By watching the fluid pass through the plastic hose, determine when the strut is full and no air is present in the chamber.

4 When air bubbles cease to flow through hose, compress strut fully and remove hose from the valve stem.

5 With strut compressed, remove filler plug to determine that the fluid level is visible up to the bottom of filler plug hole.

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

6 Install core in filler plug. Apply an appropriate thread lubricant to threads of filler plug and install plug in top of strut housing. Torque plug to 350 to 400 inch-pounds.

(b) Method II:

1 Remove filler plug from top of strut housing.

2 Raise strut piston until fully compressed.

3 Pour fluid from a clean container through filler opening until it reaches bottom of filler plug hole.

4 Install filler plug finger tight. Extend and compress the strut two or three times to remove any air that may be trapped in housing.

5 Remove filler plug. Raise strut to full compression and fill with fluid if needed.

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

6 Apply an appropriate thread lubricant threads of filler plug and install filler plug in the top of strut housing. Torque plug to 350 to 400 inch-pounds.

(5) With airplane raised, compress and extend the gear strut several times. Ensure strut actuates freely. The weight of the gear fork and wheel should extend strut.

(6) Clean off overflow of fluid, and inflate strut as described in Inflating Oleo Struts, below.

(7) Check that fluid is not leaking from around strut piston at bottom of housing.

(8) With the aircraft off the jacks, and the weight on the gear, visible strut extension should be as stated above under servicing.

C. Filling Main Gear Oleo Strut

Fill partly full or completely emptied main gear oleo strut with MIL-H-5606 fluid as follows:

(1) Raise the airplane on jacks until the main wheel is off the ground.

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

(3) If not previously accomplished, release air from strut housing chamber by removing cap from air valve and depressing valve core.

(4) Fill the main gear housing by one or two methods which are as follows:

(a) Method I:

1 Remove valve core from filler plug at top of strut housing. Do not remove plug.

2 Attach one end of a clear plastic hose to valve stem of filler plug and submerge the other end in 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 prolongs filling operation.

3 Fully compress and extend strut to draw fluid into the strut. By watching fluid pass through plastic hose, determine when the strut is full and no air is present.

4 When air bubbles cease to flow through hose, compress strut fully and remove hose from valve stem.

5 With strut fully compressed, remove filler plug to determine that fluid level is visible up to bottom of filler plug hole.

6 Install core in filler plug. Apply an appropriate thread lubricant to threads of filler plug and install plug in the top of strut housing. Torque plug to 350 to 400 inch-pounds.

(b) Method II:

1 Remove the filler plug from the top of the strut housing.

2 Raise the strut to full compression.

3 Pour fluid from a clean container through the filler opening until it is visible at the top of the strut chamber.

4 Lower the gear until the wheel touches the ground and then fully compress and extend the strut three or four times to remove any air from the housing.

5 Raise the strut to full compression and if needed, fill with fluid to the bottom of the filler plug.

6 Apply thread lubricant (Parker 6PB) to the threads of the filler plug. Reinstall the filler plug and torque to 350 to 400 inch-pounds.

(5) With airplane still on jacks, compress and extend gear strut several times to ascertain that the strut operates freely. The weight of gear fork and wheel should extend strut.

(6) Clean off overflow of fluid and inflate strut as described in Inflating Oleo Struts.

(7) Check that fluid is not leaking around the strut piston at the bottom of the housing.

(8) With the aircraft off the jacks, and the weight on the main gear, visible strut extension should be as stated above under Servicing.

D. Inflating Oleo Struts

(1) Airplane on jacks.

With the airplane on jacks (see 7-10-00), ensure that the torque links are properly connected and that the struts are filled with fluid (see Filling, above) and fully extended. Add air to the following pressures:

(a) Nose Gear: 125 psi.

(b) Main Gear: 200 psi.

(2) Airplane on ground.

Make certain that each oleo strut has sufficient fluid and that its torque link is properly connected. Attach a strut pump to air valve and inflate each oleo strut to proper visible piston extension as specified under Servicing, above.

When measuring extension, the aircraft should be fully serviced with fuel and engine oil and resting on its landing gear. Inflate strut until correct inches of piston is exposed. Rock aircraft several times to ascertain that gear settles back to the correct strut position. If a strut pump is not available, raise aircraft and use line pressure from a high pressure air system. Lower aircraft and, while rocking it, bring strut down to proper extension by releasing air from valve.

Check for valve core leakage before capping valve.

4. 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. Instructions for filling the reservoir are given in Filling Brake Cylinder Reservoir. When found necessary to accomplish repairs to any of the brake system components, or to bleed the system, these instructions may be found in 32-40-00.

A. Filling Brake Cylinder Reservior

The brake cylinder reservoir is located on the upper right hand side of the bulkhead in the nose compartment. It should be checked at every 50 hour inspection and replenished as necessary. Fill with MIL-H-5606 fluid to level marked on reservoir. No brake adjustment is necessary, though they should be checked periodically per instructions given in 32-40-00.

B. Draining Brake System

(1) Connect a hose to bleeder fitting on the bottom of the cylinder.

(2) Place other end of hose in a suitable container.

(3) Open bleeder fitting and slowly pump hand brake lever and appropriate brake pedal until fluid ceases to flow.

(4) Clean brake system by flushing with denatured alcohol.

5. Tires

The airplane may be equipped with either tubed or tubeless tires.

Tubeless tires are designed to permit any air or nitrogen that is trapped in the cords or that diffuses through the liner to escape through special sidewall vents. This venting prevents pressure build-up within the cord body which might cause tread, sidewall or ply separation. Discounting tire growth after initial inflation, once the tire has been inflated, the maximum permissible pressure drop due to diffusion is 5% in any 24 hour period.

Vent holes penetrate the sidewall rubber to, or into, the cord body and may vary in size, depth and angle. Therefore, the amount of diffusion through these holes will vary.

When water or a soap solution is brushed over the outside of an inflated tubeless tire, bubbles form. Some vents may emit a continuous stream of bubbles. Others may produce intermittent bubbles. And some may not bubble at all. This variety is normal and does not mean that there is anything wrong with the tire. In fact, as long as a tubeless tire is inflated, there will be some diffusion from the vents. When the loss rate exceeds 5% in 24 hours, recheck for possible injuries. Vents should remain open, so check periodically to make sure they have not been covered over or closed by tire paint or spilled solvent. And since vents may be covered during retreading, check for evidence that your retreads have been revented.

A. Several basic characteristics of tubeless aircraft tires may be mistaken for problems:

(1) Tire growth in the first 12 to 24 hours after inflation will result in a seemingly severe pressure drop. Simply inflate, wait for another 24 hours, then check pressure. It will probably be within specs.

(2) Make sure that initial inflation is to recommended operating pressure to ensure full tire growth.

(3) It is normal for tubeless tires to show a small amount of pressure leakage throughout the life of the tires.

B. Maintain tires at pressure specified in 6-00-00, Chart 1. When checking tire pressure, examine tires for wear, cuts, bruises and slippage on the wheel. Check that index mark on tire is aligned with index mark on wheel. Apply Age-Master #1 to tires to protect against ozone attack and weathering as follows:

(1) Clean oil and grease from all tire surfaces.

(2) Apply single heavy coat using brush at 0.4 - 0.5 fluid ounces per square foot. Cover surface completely and evenly; allow to dry for 5 - 10 minutes.

(3) Apply second coat per step 2; allow to dry for 20 - 30 minutes before handling.

(4) Remove agent on wheel assembly with cleaning solvent.

(5) Apply as conditions dictate.

6. 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. An inexpensive balancer can be made that will balance almost any tire for light aircraft. Balance the tire as follows:

A. Mount the tire and tube (if one is used) on the wheels, but do not install the securing bolts. Install the wheel bearings in the wheels; 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.

B. Release the tire. If it is out of balance it will rotate, coming to rest with the heaviest point on the bottom. Tape a ounce patch across the 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.

C. 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 centerline of the tire and aligned with the chalk marks on the sidewall. Burnish the patches to remove trapped air, etc.

D. 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 inflate the tire to the pressure specified in Chart 1, 6-00-00. and recheck the balance. The wheel should not be more than ounce out of balance.

E. Tire Balancer (See Figure 2.)

A useful tire balancing fixture can be built as follows:

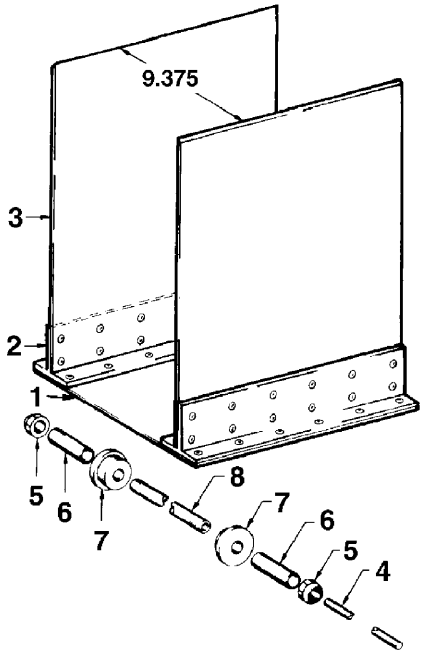
(1) Chamfer top edges of -3 sides, leaving 1/16 inch flat on top of the inboard edge. Rivet -2 tee's to -3 sides using AN 470-AD5 rivets, with 2 inch spacing, and using AN 426-AD5 rivets (2 inch center to center) to secure -2 tee's to -1 base. If tee extrusion is unavailable, heavy angle extrusion could be used. -3 sides must be vertical.

(2) The -4 axle must slide through the -8 pipe, the -5 nuts are made by reaming the existing threads in the AN 365-624 nuts with an R drill, then tapping them 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 and then 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, this will be thread 3 inches in from each end of the pipe.



USE THE FOLLOWING LIST OF MATERIALS TO MAKE THE BALANCER

- 1. 1 EA BASE	12 X 11	0.190 2024 T3 CLAD ALUMINUM ALLOY
- 2. 2 EA TEE	2.5 X 2 X 11	0.190 2024 T4 EXTRUDED ALUMINUM ALLOY
- 3. 2 EA SIDES	14 X 11	0128 2024 T3 CLAD ALUMINUM ALLOY
- 4. 2 EA AXLE	0.125 X 10.25	4130 STEEL, NOMALIZED
- 5. 2 EA NUTS	AN 365-624	
- 6. 2 EA SPACER	0.50 X 2.25	5052-0 ALUMINUM TUBING
2 EA SPACER	0.50 X 1.25	5052-0 ALUMINUM TUBING
- 7. 2 EA BUSHING	1.480 X 1.625 X 1.00	PHENOLIC OR ALUMINUM
2 EA BUSHING	2.240 X 1.37 X 1.00	PHENOLIC OR ALUMINUM
- 8. 1 EA PIPE	1/8 X 9.3	BLACK STEEL PIPE
* 2 EA BEARINGS	SAVE TWO OF EACH SIZE WORN WHEEL BEARINGS FROM PREVIOUS INSPECTIONS.	

Tire Balancer
Figure 2

7. 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. Maintenance procedures for the hydraulic pump and lines are addressed in Chapter 29, while the actuating cylinders and free-fall valve are in 32-30-00.

8. 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 observe the fluid level on the dipstick. Should fluid be below the hole or the recommended level on the stick, loosen the vent screw and add fluid (See Note), MIL-H-5606, through the filler hole until full. Reinstall the filler plug.

NOTE: The filler plug is a combination vent screw/filler plug. To install, tighten to full tight and loosen 1 1/2 turns. These instructions are also placarded on the pump reservoir.

9. Battery

The battery is in the nose and is serviced by opening the nose compartment. Check battery for proper fluid level. Do not fill battery above the baffle plates. Do not fill the battery with acid - use water only. A hydrometer check will determine the percent of charge in the battery.

Check for spilled electrolyte and corrosion at each 50 hour inspection or every 30 days, whichever comes first. Should corrosion or spillage be found on or around the battery, remove the battery and clean it and the surrounding area in accordance with the instructions in 24-30-00.

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SCHEDULED SERVICING

Routine cleaning and lubrication of the airplane and its component parts will significantly extend its service life and reduce the frequency of repairs.

1. Induction Air Filter

Inspect induction air filter each 50 hours. Clean or replace if found to be dirty. Replace the filter after one year, ten cleanings or 500 flight hours, whichever comes first. The induction air filter is located on the right rear side of the engine compartment. and may be removed by the following procedure:

A. Removing

(1) Remove the upper engine cowling.

(2) Release the fasteners, remove filter cover as applicable.

(3) Remove the air filter.

B. Installation

(1) Position air filter in the box assembly.

(2) Secure air filter using cover plate.

(3) Install upper engine cowling.

C. Inspection

(1) When returning existing filter to service, rap gently on a hard flat surface to remove embedded debris. Be careful not to damage sealing ends.

(2) Inspect filter housing for damage.

(3) The filter housing may be cleaned by wiping with a clean cloth soaked in a suitable quick-drying solvent.

2. Alternate Air Door

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:

A. Check that air door seals are tight and that the hinge is secure.

B. Check that when the cockpit control is in the closed position the door is properly seated in the closed position.

C. Actuate the door by operating the control lever in the cockpit to determine that it is not sticking or binding.

D. Check the cockpit control cable for free travel.

3. Propellers

Inspect spinner, back plate and propeller surfaces for nicks, scratches, corrosion and cracks. Remove minor nicks and scratches per instructions in 61-10-00. Paint face of each blade with a flat paint to retard glare. Wipe surfaces with a light oil or wax to prevent corrosion.

Inspect propellers for grease or oil leakage and freedom of rotation on the hub pilot tube. To check freedom of rotation, rock the blade back and forth through the slight freedom allowed by the pitch change mechanism. Lubricate the propeller in accordance with the Lubrication Chart.

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

4. Electrical System

Servicing the electrical system involves adding distilled water to the battery to maintain correct electrolyte level, and checking for any spilled electrolyte that would lead to corrosion. The security of all electrical connections should be checked as well as the operation of all lights, general condition of the generator or alternator and starter. All electrical wires should be inspected for chafing and bare wires. For detailed information on this system, refer to Chapter 24 of this manual.

5. 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. An inexpensive balancer can be made that will balance almost any tire for light aircraft. See 95-00-00, Figure 1 for balancer details. Balance the tire as follows:

A. Mount tire and tube (if one is used) on wheel, but do not install the securing bolts. Install wheel bearings in wheel; then, using the -7 bushings, -6 spacers, and -5 nuts, (refer to Figure 1) install the wheel-tire assembly on the -8 pipe. Secure the nuts finger-tight so that the wheel halves touch each other. Be sure the bolt holes are aligned. Insert the axle through the 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.

B. Release the tire. If it is out of balance it will rotate, coming to rest with the heaviest point on the bottom. Tape a one-half (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 one (1) ounce patch and again rotate the tire and release it. Continue this procedure until the tire is balanced.

C. 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.

D. 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 one-half (1/2) ounce out of balance.

6. Steering Bungee

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

A. Remove the tunnel cover located in the forward compartment.

B. Clamp the rudder pedals in the neutral position

C. Remove the nut, washers, and bolt that secures the steering bungee and the steering arm.

D. Disconnect the bungee from the idler arm by removing the nut, washer and bolt.

E. Remove the steering bungee from the aircraft.

F. Cut the safety wire from the bungee retainer.

G. Carefully remove the retainer and release the spring.

H. Apply Aero Lubriplate to the spring and mounting hardware as specified in the Lubrication Chart.

I. Compress the spring into the bungee tube and install the retainer securing with MIL-W-6713 Type 316 safety wire.

J. 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.

K. Install the bolt, washers and nut that secures the bungee to the steering arm.

L. Install the bolt, washer and nut that secures the bungee to the idler arm.

M. Align the nose gear per Alignment of Nose landing Gear.

N. Remove the rudder pedal clamps and check the operation of the steering bungee.

O. Install the tunnel cover in the forward compartment with the attachment hardware.

7. Lubrication

Proper lubrication procedures are valuable for 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, combined with cleanliness, as detailed in the following paragraphs, ensures maximum efficiency and utmost service of all moving parts. Lubrication instruction regarding the locations, time intervals, and type of lubricants used are found in proper lubrication charts.

A. To ensure the best possible results from the application of lubricants, observe the following precautions:

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

(1) Use only recommended lubricants. Where general purpose lubricating oil is specified, but unavailable, clean reciprocating engine oil may be used as a satisfactory substitute.

(2) Check components for evidence of excessive wear and replace as necessary.

(3) Remove all excess lubricants from components to prevent collecting dirt and sand in quantities capable of causing excessive wear or damage to bearing surfaces.

B. Application of Grease

When lubricating bearings and bearings surfaces with a grease gun, ensure gun is filled with new, clean grease of the grade specified for the particular application before applying lubricant to grease fittings.

(1) If a reservoir is not provided around a bearing, apply lubricant sparingly and wipe off excess.

(2) Remove wheel bearings from the wheel hub and clean thoroughly with a suitable solvent. When packing 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 propeller hub to avoid blowing clamp gaskets. Remove one grease fitting and apply grease to the other fitting until fresh grease appears at the hole of the removed fitting. Uneven greasing affects propeller balance.

C. Application of Oil

If specific lubrication instructions for certain components are not available, observe the following precautions:

CAUTION: AFTER THOROUGHLY WASHING AIRPLANE, ENSURE LANDING GEAR, FLIGHT CONTROLS, FLAP TRACKS, ELEVATOR TRIM SCREW, AND ENGINE COMPARTMENT ARE STILL PROPERLY LUBRICATED.

NOTE: Do not lubricate engine control cables.

(1) Apply oil sparingly. Never apply more than enough to coat the bearing surfaces.

(2) Do not oil flight control cables.

CHART 1
THREAD LUBRICANTS

Line	Lubricant
Brakes	MIL-H-5606
Fuel	MIL -T-5544, Anti-Seize, Graphite Petrolatum
Landing Gear Air Valve	6PB Parker
CAUTION: LUBRICATE ENGINE FITTINGS ONLY WITH THE FLUID CONTAINED IN THE PARTICULAR LINE.	
Oil	MIL-G-6032, Lubrication Grease (Gasoline and Oil Resistant)
Pitot and Static	TT-A-580 (JAN-A-669). Anti-Seize Compound (White Lead Base)

D. Lubrication Charts (PIR-89152, Rev. B.)

The lubrication charts consist of individual illustrations for the various aircraft systems. Each component to be lubricated is indicated by a number, the type of lubricant and the frequency of application. Special Instructions and Cautions, which are consistent throughout the charts, are listed at the beginning of the lubrication charts (below) and with the applicable component illustration.

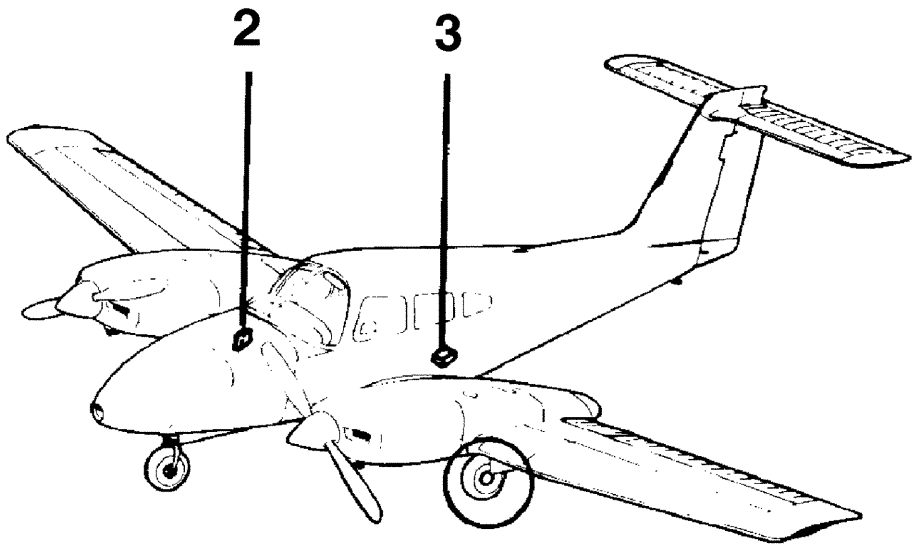
CAUTION: MIL-G-23827 AND MIL-G-81322, CONTAIN CHEMICALS WHICH MAY BE HARMFUL TO PAINTED SURFACES.

CAUTION: DRY LUBRICANT (I.E. - PTFE BASED MS-122DF) WILL ATTACK ANY ACRYLIC-BASED PLASTIC (LUCITE), POLYCARBONATES (LEXAN), POLYSTYRENE AND ITS COPOLYMERS (ABS), AND CELLULOSE ACETATE.

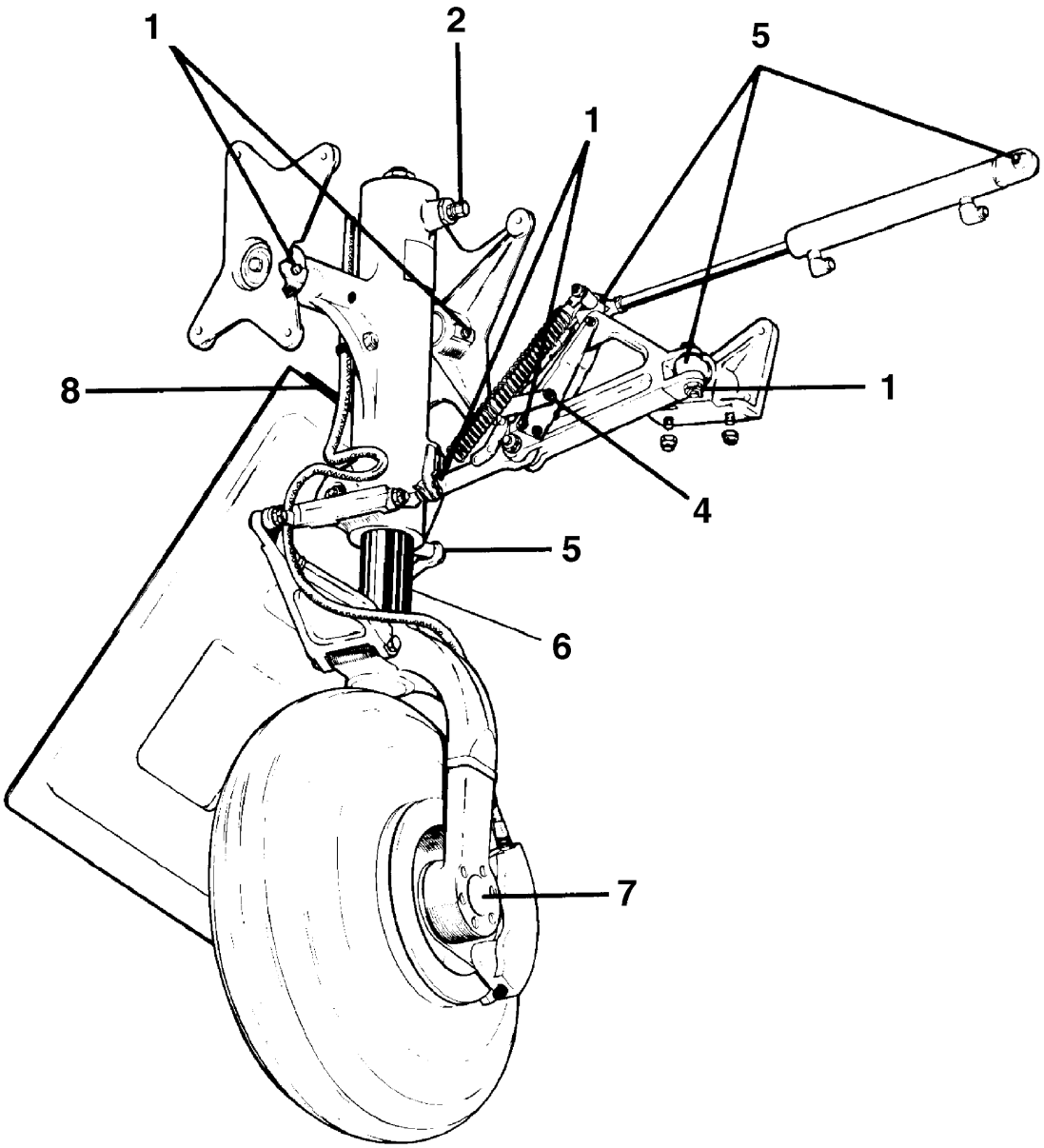
CHART 2
SPECIAL INSTRUCTIONS

1.	Air Filter - To clean filter, tap gently to remove dirt particles. Do not blow out with compressed air or use oil. Replace filter if punctured.or damaged.
2.	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. NOTE: Wheel bearings require cleaning and repacking after exposure to an abnormal quantity of water.
4.	Oleo Struts, Hydraulic Pump Reservoir and Brake Reservoir - Fill per instructions on unit or container.
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.
7.	Bungee - Lubricate springs if bungee is disassembled.
8.	Outer surface of inner spacer.
9.	Do not use hydraulic fluid with a castrol oil or ester base.
10.	Do not over-lubricate cockpit controls.
11.	Do not apply lubricant to rubber parts.
12.	Do not oil flight control cables. Grease flight control cables where they pass over a pulley or through a fairlead.
13.	Do not lubricate engine control cables.

	COMPONENT	LUBRICANT	FREQUENCY
1.	MAIN GEAR PIVOT POINTS, UPPER SIDE BRACE SWIVEL FITTING, MAIN GEAR SIDE BRACE LINK ASSY. (See Spec. Instr. 2)	MIL-G-23827	100 HRS
2.	OLEO STRUT FILLER POINT, BRAKE RESERVOIR (See Spec. Instr. 4 and 9)	MIL-H-5606	AS REQUIRED
3.	HYDRAULIC PUMP RESERVOIR (See Spec. Instr. 4 and 9)	MIL-H-5606	100 HRS
4.	MAIN GEAR DOWN LOCK ASSEMBLY (See Spec. Instr. 6)	MIL-G-7711	100 HRS
5.	RETRACTION FITTING AND CYLINDER ATTACHMENT POINTS, MAIN GEAR DOOR CONTROL ROD ENDS, MAIN GEAR TORQUE LINKS (See Spec. Instr. 6)	MIL-L-7870	100 HRS
6.	EXPOSED OLEO STRUT (See Spec. Instr. 2)	CARBON DIOXIDE RELEASE AGENT DRY LUBRICANT MS-122N/CO2	100 HRS
7.	MAIN GEAR WHEEL BEARINGS (See Spec. Instr. 3)	MIL-G-81322 MOBIL 28	100 HRS
8.	MAIN GEAR DOOR HINGE (See Spec. Instr. 6)	MIL-L-7870	100 HRS



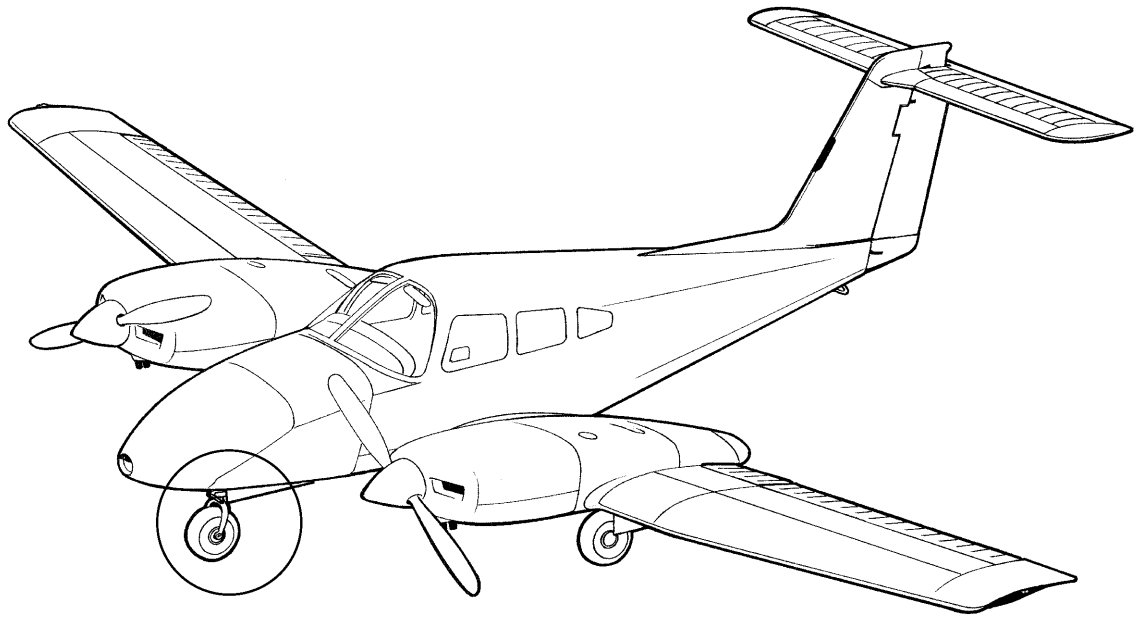
Lubrication Chart - Landing Gear, Main
Figure 1 (Sheet 1 of 2)



Lubrication Chart - Landing Gear, Main
Figure 1 (Sheet 2 of 2)

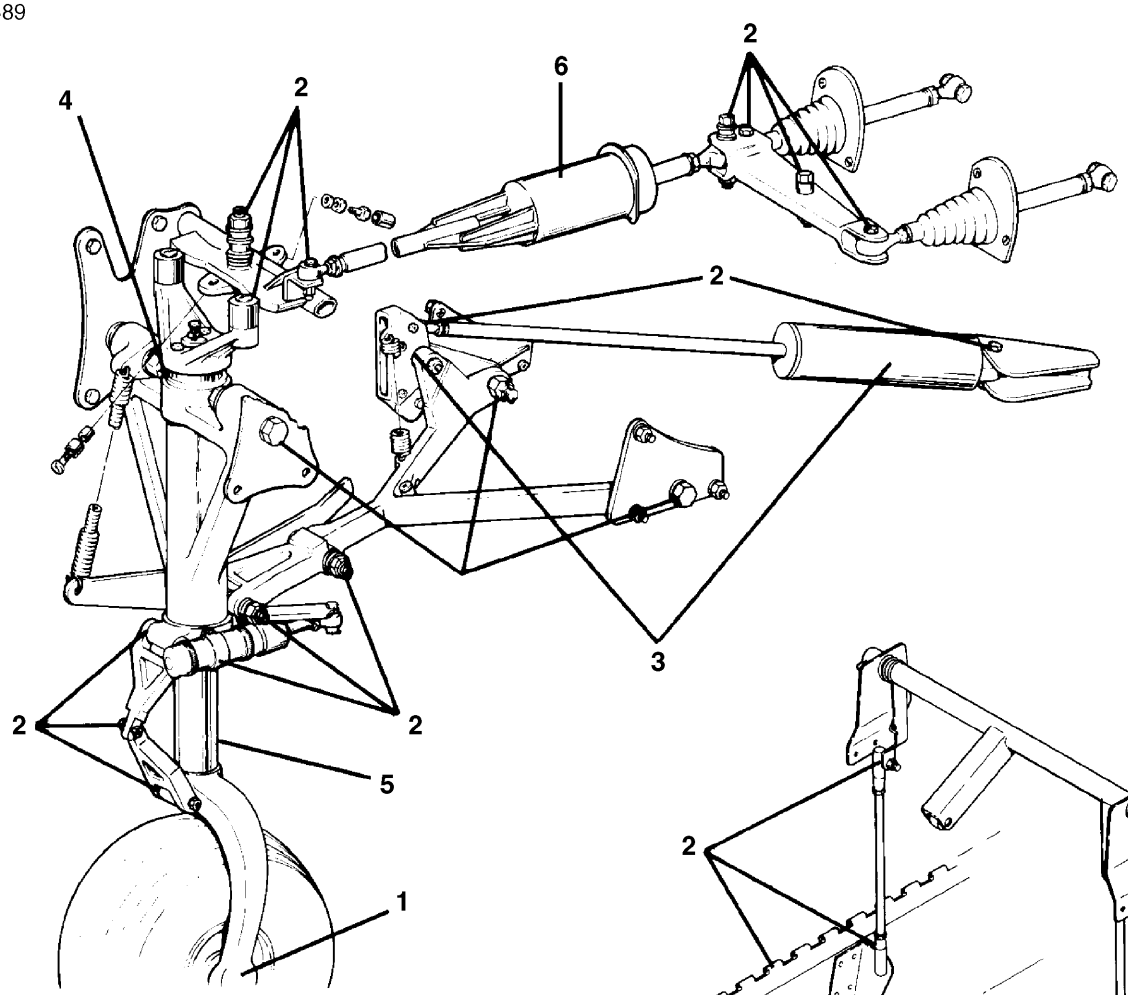
	COMPONENT	LUBRICANT	FREQUENCY
1.	NOSE WHEEL BEARINGS - (See Spec. Instr. 3)	MOBIL 28 MIL-G-81322	100 HRS
2.	NOSE GEAR TORQUE LINK ASSY, NOSE GEAR PIVOT POINT, NOSE GEAR DRAG LINK ASSY., STEERING BELLCRANK PIVOT POINTS, STEERING BELLCRANK ROD ENDS, NOSE GEAR STEERING ROLLERS, HYDRAULIC CYLINDER ROD END & MASTER CYLINDER ROD END, DOOR & RETRACTION MECHANISM, NOSE GEAR CENTERING SPRING PIVOT POINT (See Spec. Instr. 2)	MIL-L-7870	100 HRS
3.	NOSE GEAR DOWNLOCK AND CYLINDER (See Spec. Instr. 2)	MIL-L-7870	100 HRS
4.	NOSE GEAR STRUT HOUSING (See Spec. Instr. 2 & 6)	MIL-G-23827	100 HRS
5.	EXPOSED OLEO STRUT (See Spec. Instr. 2 & 4)	RELEASE AGENT/ DRY LUBRICANT MS-122N/CO2	100 HRS
6.	STEERING BUNGEES (See Spec. Instr. 7 & 11)	LUBRIPLATE #907 (PURCH) FISKE BROS. REFINNING CO.	AS REQUIRED

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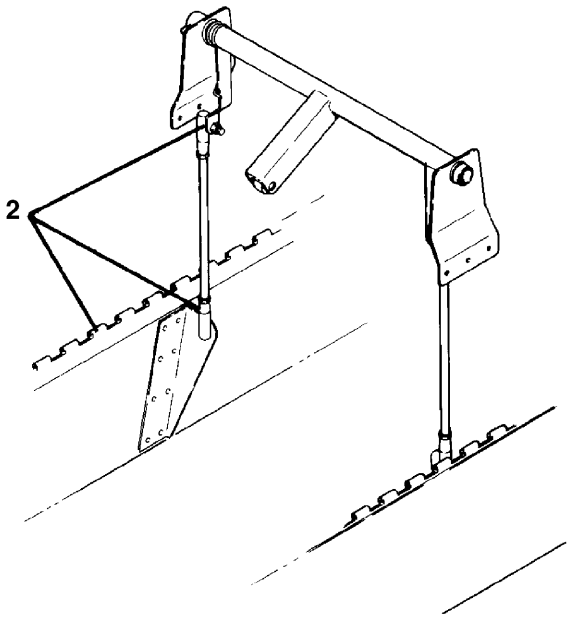


Lubrication Chart - Landing Gear, Nose
Figure 2 (Sheet 1 of 2)

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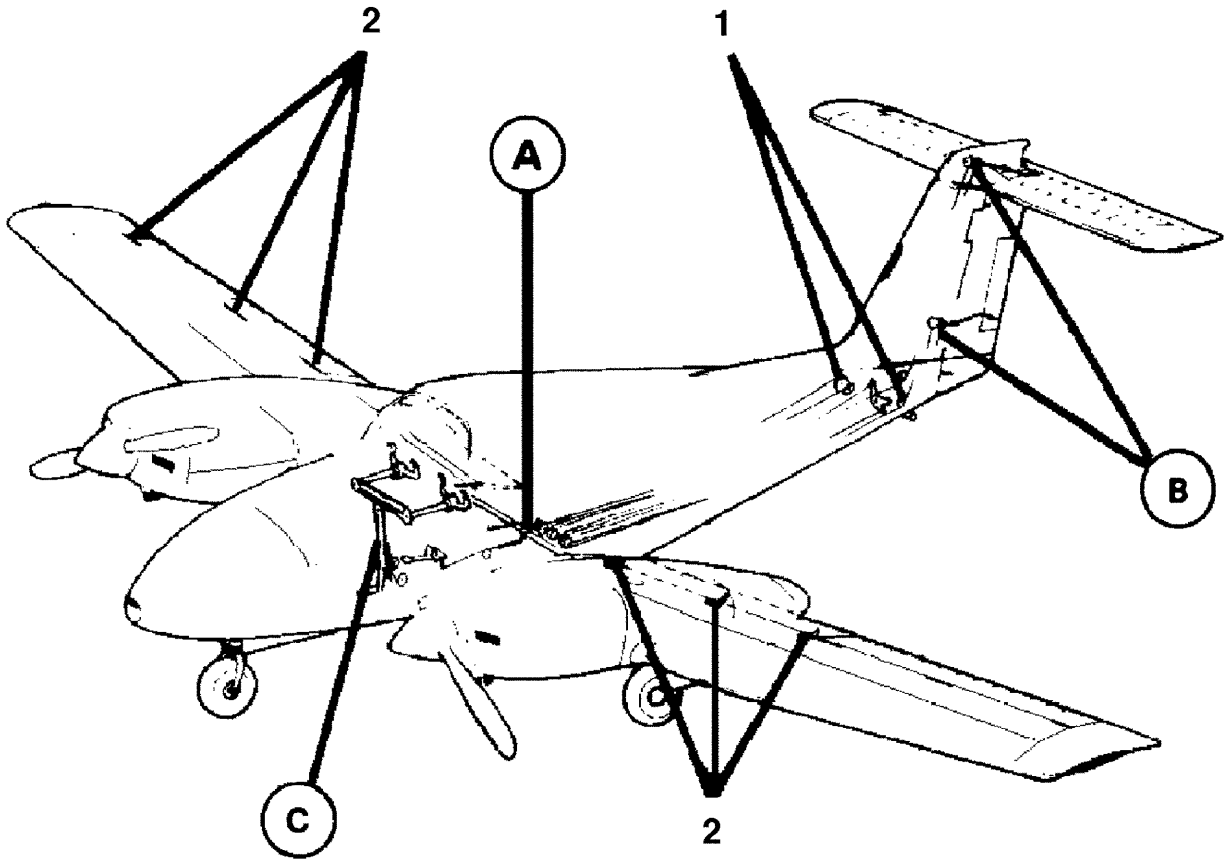
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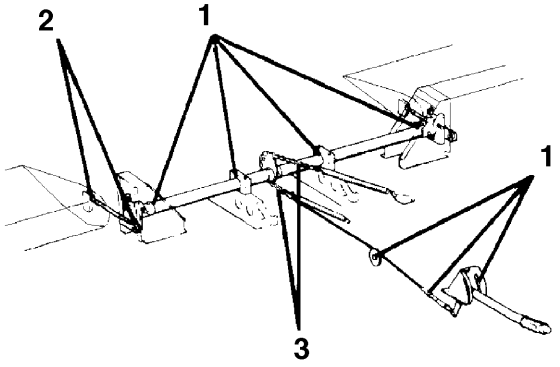
Lubrication Chart - Landing Gear, Nose
Figure 2 (Sheet 2 of 2)

	COMPONENT	LUBRICANT	FREQUENCY
1.	RUDDER AND STABILATOR HINGE PINS, RUDDER TAB AND STABILATOR TAB ROD END BEARINGS, STABILATOR TRIM TAB LINKS, STABILATOR CONTROL AND RUDDER CONTROL CABLE PULLEYS, FLAP TORQUE TUBE BEARING BLOCK, FLAP HANDLE PIVOT POINT, FLAP LOCK MECHANISM, TURN BUCKLE END AND TEE BAR PIVOT POINTS, CONTROL COLUMN FLEX JOINT, SPROCKET AND “O” RING, AILERON AND STABILATOR CONTROL PULLEYS, STABILATOR CONTROL ROD AND IDLER PULLEY. (See Spec. Instr. 2, 6, 10, & 12)	MIL-L-7870	100 HRS
1A.	AILERON, STABILATOR AND RUDDER CONTROL CABLES (See Spec. Instr. 6, 10, & 12)	AEROSHELL 33 MIL-G-23827	100 HRS
2.	AILERON HINGE BEARINGS, FLAP HINGE BEARINGS AND FLAP CONTROL ROD END BEARINGS (See Spec. Instr. 2 & 6)	MIL-L-7870	100 HRS
3.	FLAP RETURN & TENSION CHAINS, AND AILERON & STABILATOR CONTROL CHAIN. (See Spec. Instr. 2 & 6)	MIL-L-7870	500 HRS
4.	RUDDER & STABILATOR TRIM SCREW. (See Spec. Instr. 2 & 6)	MIL-S-8660B DOW #4 COMPOUND	500 HRS

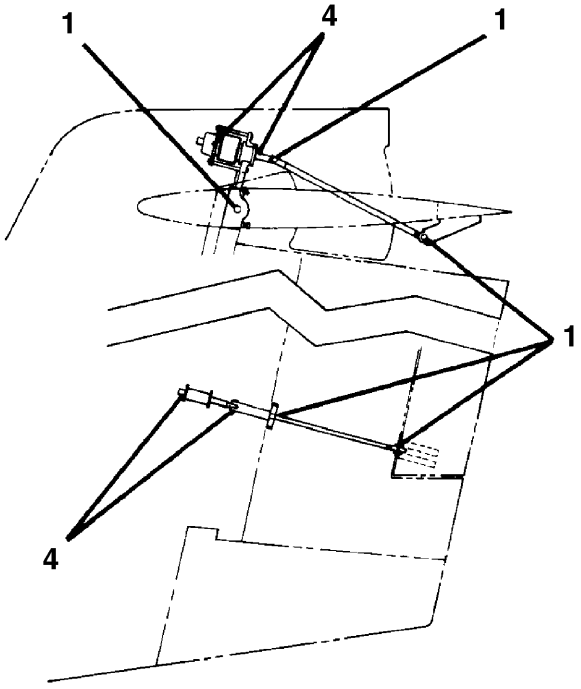
CAUTION: DO NOT LUBRICATE CONTROL WHEEL SHAFT OR BUSHING. CLEAN ONLY WITH ALCOHOL OR OTHER SUITABLE SOLVENT.



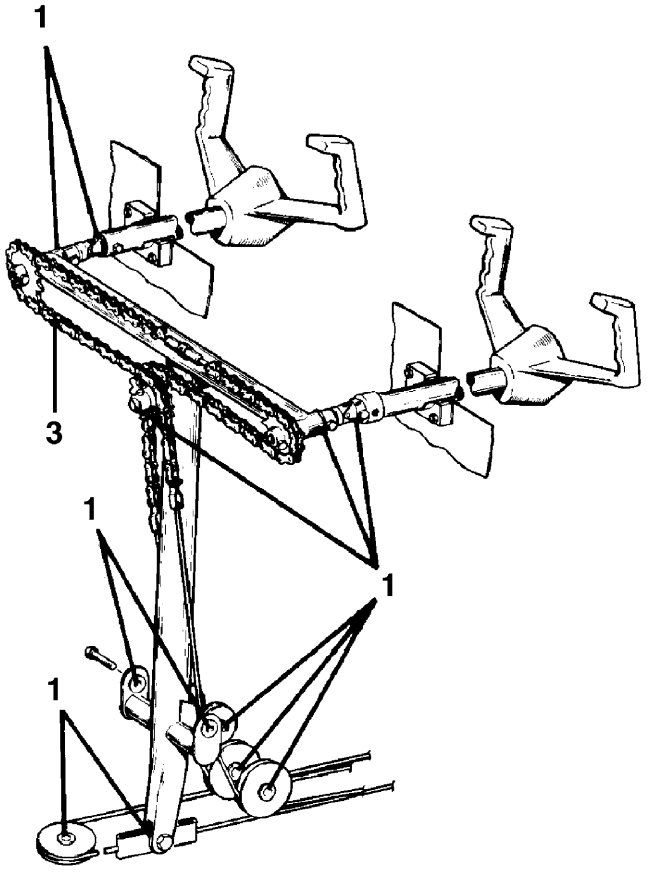
Lubrication Chart - Control System, Part 1
Figure 3 (Sheet 1 of 2)



SKETCH A



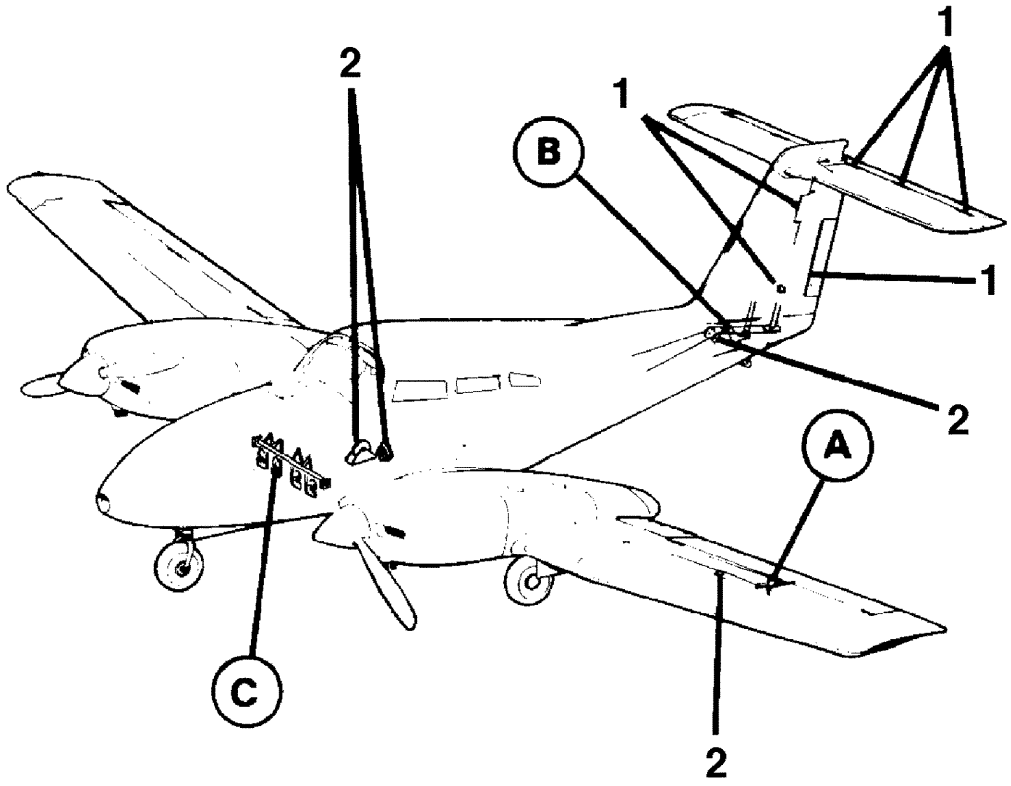
SKETCH B



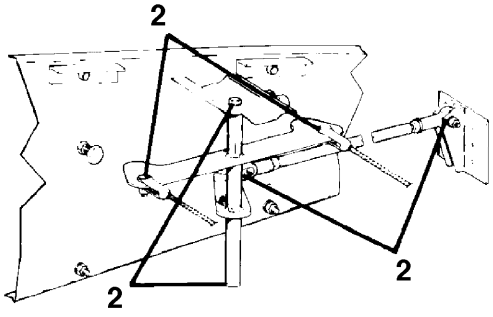
SKETCH C

Lubrication Chart - Control System, Part 1
Figure 3 (Sheet 2 of 2)

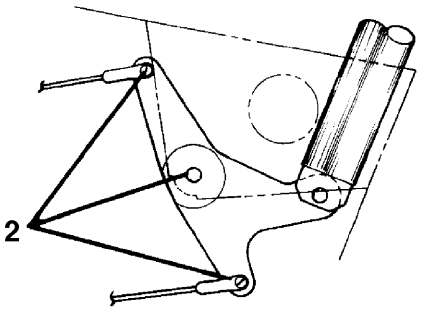
	COMPONENT	LUBRICANT	FREQUENCY
1.	RUDDER HINGE BEARINGS, RUDDER TAB STABILATOR TAB HINGE PINS. (See Spec. Instr. 2 & 6)	MIL-L-7870	100 HRS
2.	AILERON CONTROL ROD END BEARINGS, AILERON BELLCRANK PIVOT POINTS, AILERON BELLCRANK CABLE ENDS, AILERON CONTROL CABLE PULLEYS, RUDDER CONTROL CABLE PULLEYS, TRIM 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 AND CABLE ENDS. (See Spec. Instr. 6, 10, & 12)	MIL-L-7870	100 HRS
2A.	AILERON, STABILATOR, AND RUDDER CONTROL CABLES (See Spec. Instr. 6, 10, & 12)	AEROSHELL 33 MIL-G-23827	100 HRS
3.	TOE BRAKE BRACE (See Spec. Instr. 6)	MIL-G-7711	100 HRS



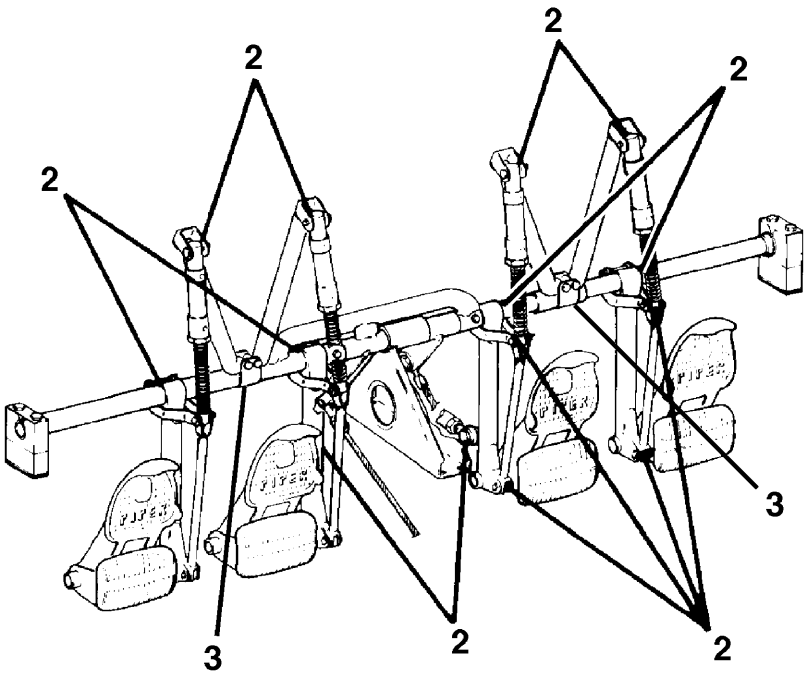
Lubrication Chart - Control System, Part 2
Figure 4 (Sheet 1 of 2)



SKETCH A



SKETCH B

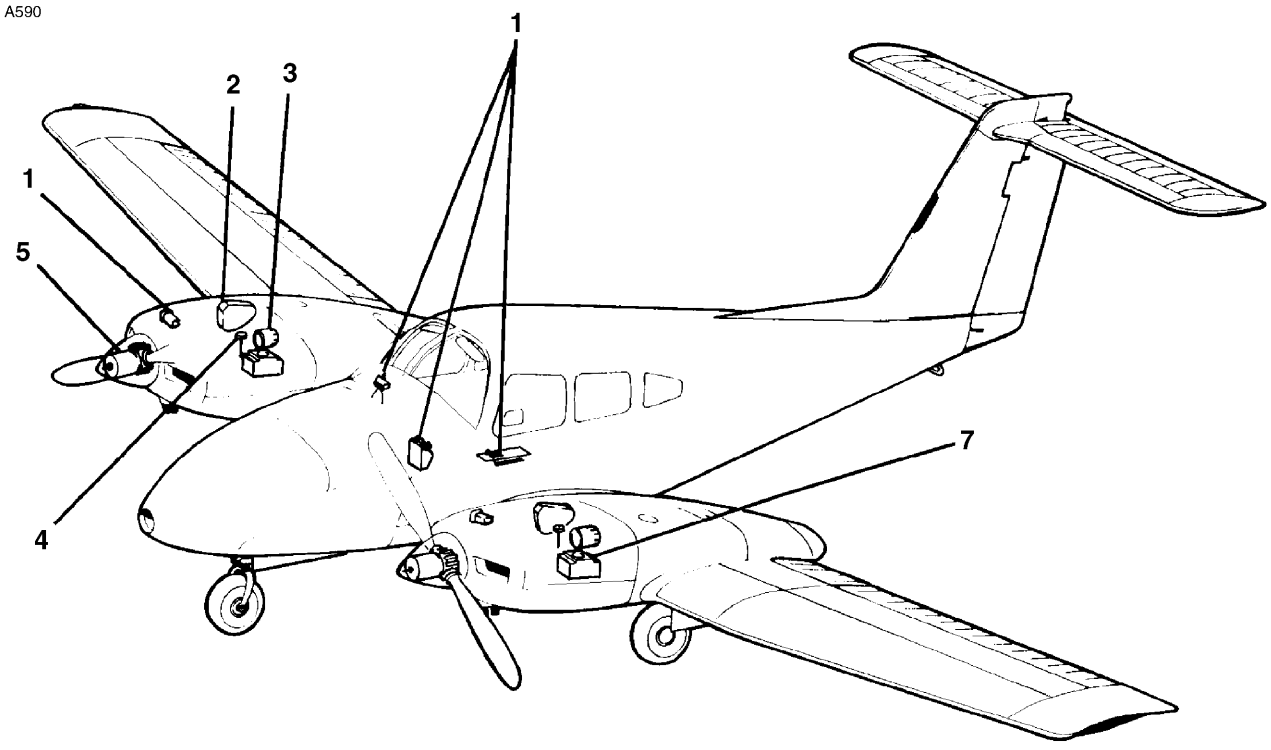


SKETCH C

Lubrication Chart - Control System, Part 2
Figure 4 (Sheet 2 of 2)

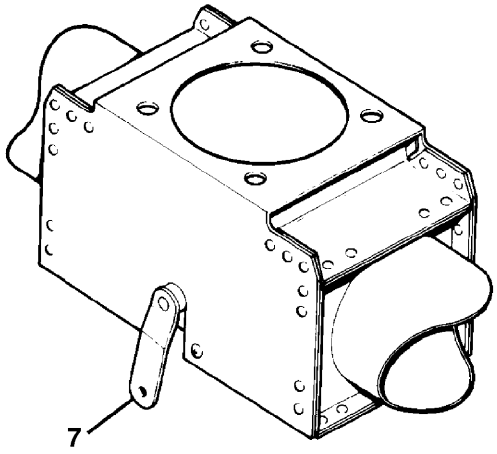
	COMPONENT		LUBRICANT		FREQUENCY
1.	COWL FLAP HINGE, GOVERNOR CONTROL, CONTROL QUADRANT CONTROLS, CABIN HEAT & DEFROST MECHANISMS, SELECTOR VALVE CONTROL (See Spec. Instr. 6 & 10)		MIL-L-7870		100 HRS
2.	AIR FILTER (See Spec. Instr. 1)				50 HRS
3.	CARTRIDGE TYPE OIL FILTERS		REPLACE		50 HRS
4.	ENGINE SUMP LUBRICATING OIL, RECIPROCATING ENGINE (PISTON)	AIR TEMPERATURE	MIL-L-6082B	MIL-L-22851 (Ashless Dispersant)	
		ALL	---	SAE 15W50, 20W50	
		ABOVE 80°F (26.67°C)	SAE 60	SAE 60	
		ABOVE 60°F (15.55°C)	SAE 50	SAE 40, SAE 50	
		30° TO 90°F (-1.11° TO 32.22°C)	SAE 40	SAE 40	
		0° TO 70°F (-17.77° TO 21.11°C)	SAE 30	SAE 30, 40, 20W40	
		0° TO 90°F (-17.77° TO 32.22°C)	SAE20W50	SAE20W50, 15W50	
		BELOW 10°F (-12.22°C)	SAE 20	SAE 30, 20W30	50 HRS
5.	PROPELLER ASSEMBLY (See Spec. Instr. 5)		MIL-G-23827		100 HRS
6.	COWL FLAP ACTUATING MECHANISM (See Spec. Instr. 8)		LUBRIPLATE No. 907		500 HRS
7.	CARBURETOR AIR BOX FLAPPER VALVE		LUBRIPLATE No. 907		100 HRS

NOTE: Use straight mineral oil during the first 50 hours of operation, or until oil consumption has stailized. For additional servicing information, refer to the latest revision of Textron Lycoming Service Bulletin No. 446 and Service Instruction No. 1014.

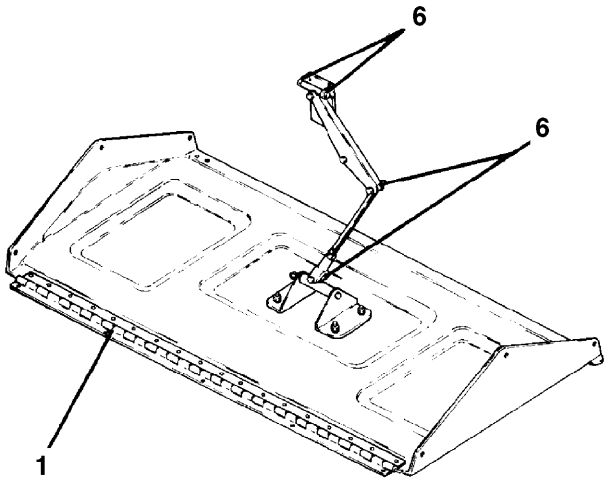


Lubrication Chart - Power Plant and Propeller
Figure 5 (Sheet 1 of 2)

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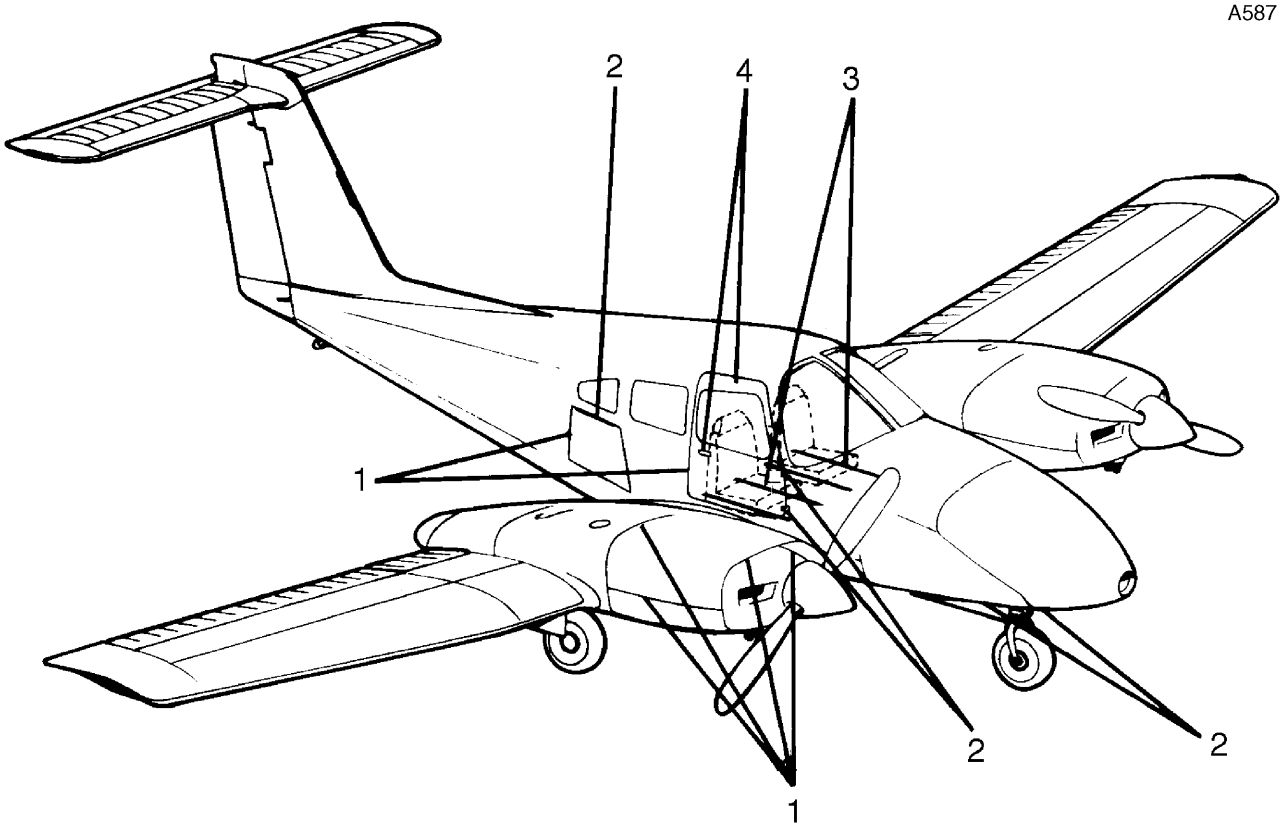
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Lubrication Chart - Power Plant and Propeller
Figure 5 (Sheet 2 of 2)

	COMPONENT	LUBRICANT	FREQUENCY
1.	DOOR & COWL SEALS (See Spec. Instr. 6)	CARBON DIOXIDE RELEASE AGENT DRY LUBRICANT MS-122N/CO_2	AS REQUIRED
2.	NOSE CONE & NOSE DOOR HINGES, BAGGAGE & MAIN DOOR HINGES (See Spec. Instr. 6)	MIL-L-7870	100 HRS
3.	PILOT & COPILOT SEAT ADJUSTMENT (See Spec. Instr. 6)	MIL-G-7711	500 HRS
	Pilot, Copilot, and Passenger Seat Track Rollers and Stop Pins (See Spec. Instr. 6)	MIL-L-7870	AS REQUIRED
4.	DOOR LATCH MECHANISM (See Spec. Instr. 6)	LUBRIPLATE No. 907	500 HRS

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Lubrication Chart - Cabin/Baggage Doors and Seats
Figure 6

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CHAPTER

20

STANDARD PRACTICES - AIRFRAME

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CHAPTER 20

LIST OF EFFECTIVE PAGES

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	2	Mar 15/06			
20-Table of Contents	1	Mar 15/06			
	2	Mar 15/06			
20-00-00	1	Mar 15/06			
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	3	Mar 15/06			
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	9	Mar 15/06			
	10	Mar 15/06			
20-20-00	1	Mar 15/06			
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	3	Mar 15/06			
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	6	Mar 15/06			

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CHAPTER 20 - STANDARD PRACTICES - AIRFRAME

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Installing Rod End Bearings		1	1J13
Removing Cherrylock Rivet		3	1J15
Identification of Fluid Lines		4	1J16
Inspection of Flexible Hoses		4	1J16
Flareless Tube Assemblies		6	1J18
Support Clamps		8	1J20
Dye Penetrant Inspection		8	1J20
PAINTING	**20-20-00**	1	1J23
Painting Safety		1	1J23
Polyurethane Paint Safety		1	1J23
Paint Application		2	1J24
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GENERAL

1. Description

This chapter contains general information pertaining to standard aircraft hardware installation and removal practices, as well as general information on corrosion control and painting issues.

For standard repair practices of a minor nature, see 51-70-00 and AC 43.13-1 (latest revision).

If non-destructive testing is needed after repair of 4130 steel, use a magnetic particle inspection method such as Magnaflux.

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

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

2. Torque Wrenches

Torque wrenches should be checked daily and calibrated by means of weights and a measured lever arm to ensure that inaccuracies are not present. Checking one torque wrench against another is not sufficient and is not recommended. Some wrenches are quite sensitive 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 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).

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

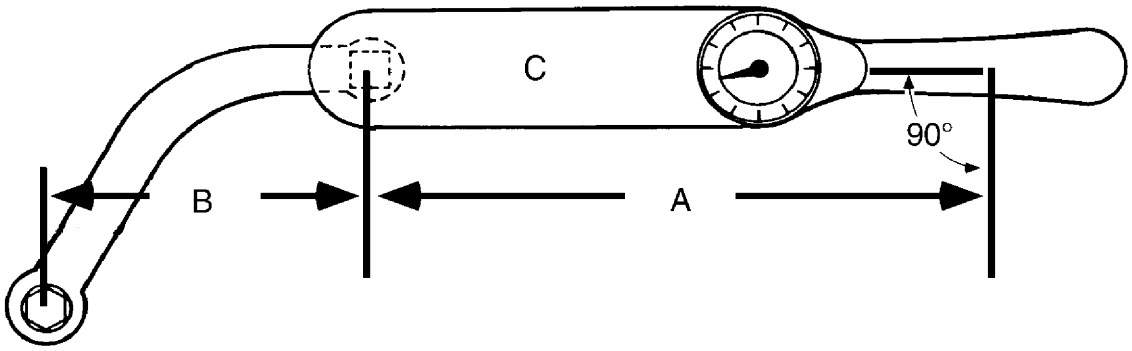
EXAMPLE: A bolt requires 30 foot pounds and a 3 inch adapter (one-quarter of a foot or 0.25') is needed to get at it. You want to know what scale reading it will take on a one-foot lever arm wrench to obtain the 30 foot pounds at the bolt.

$$C = \frac{1 \times 30}{1 + 0.25} \quad \text{or} \quad C = \frac{30}{1.25} = 24 \text{ ft.-lbs.}$$

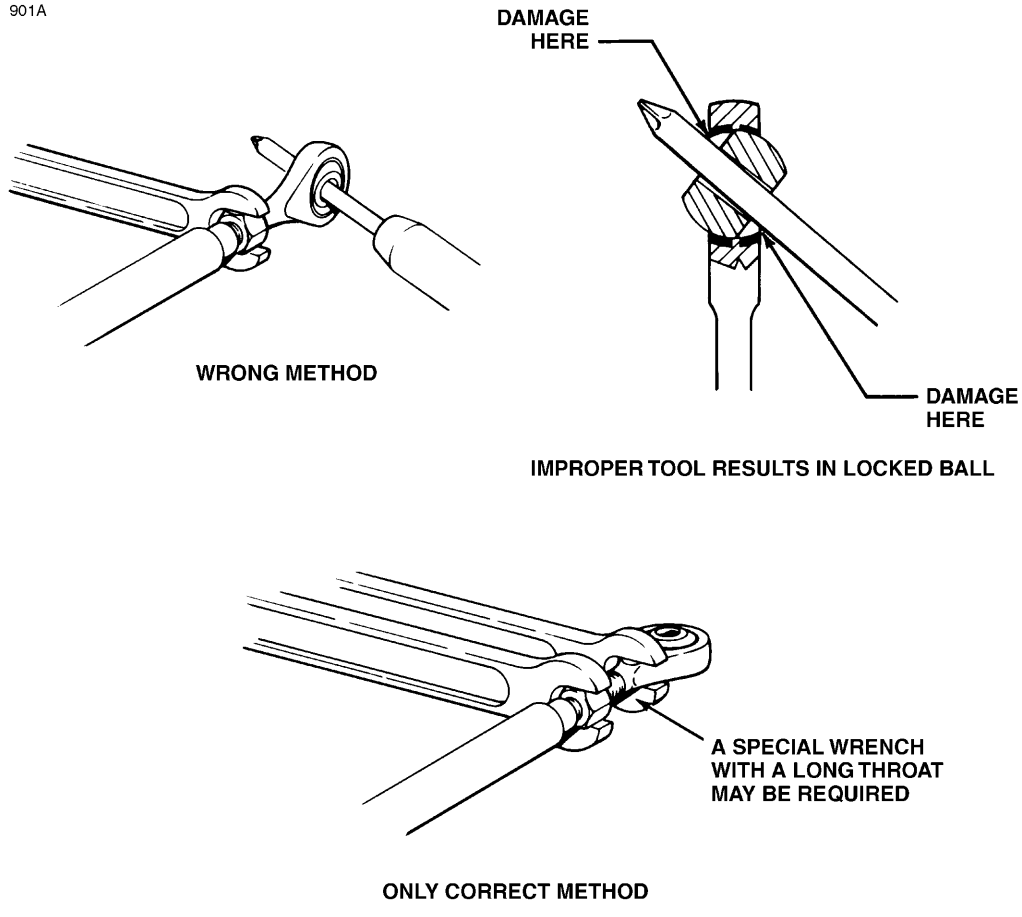
Remember, the 3-inch adapter must be projecting 3 inches straight along the wrench axis. In general, avoid all complex assemblages or adapters and extensions of flex joints.

3. Installing Rod End Bearings

Install rod end bearings as shown in Figure 2.



Torque Wrench Formula
Figure 1



Installing Rod End Bearings
Figure 2

4. Removing Cherrylock Rivets

Use following procedure to remove cherrylock rivets:

A. To remove from thick material, use a tapered steel drift pin to drive out rivet stem. (See Figure 3, View 1.)

CAUTION: DRIVING OUT THE LOCKED STEM OF RIVETS INSTALLED IN THIN MATERIAL MAY DAMAGE THE MATERIAL.

NOTE: Drilling completely through the rivet sleeve, when removing rivets, tends to enlarge hole.

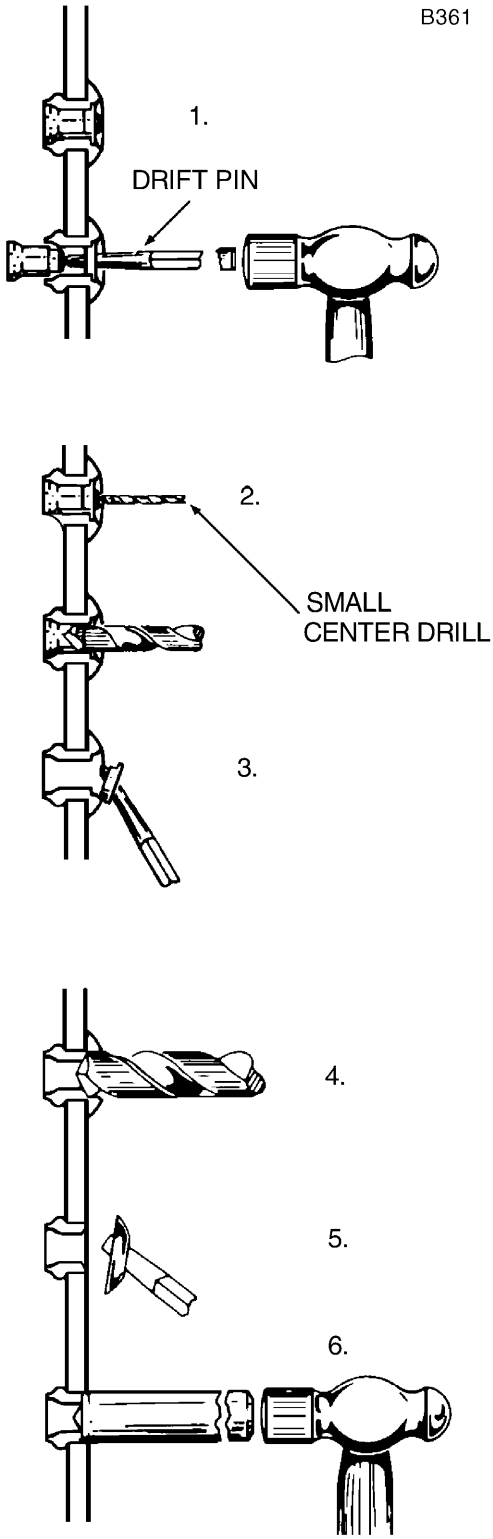
B. To remove from thin material, drill away tapered portion of stem to destroy the lock. Use a small center drill bit on top of the rivet stem to provide a guide for a larger bit. (See Figure 3, Views 2 and 3.)

C. Pry remainder of locking collar out of rivet head with a drift pin. (See Figure 3, View 3.)

D. Drill almost, but not completely, through head of rivet. Use a drill bit the same size as the rivet shank. (See Figure 3, View 4.)

E. Use a drift pin as a lever to break off rivet head. (See Figure 3, View 5.)

F. Drive out remaining rivet shank with a pin having same diameter as rivet shank. (See Figure 3, View 6.)



Removing Cherrylock Rivets
Figure 3

5. Identification of Fluid Lines (Refer to Figure 4.)

Aircraft fluid lines are identified by color code markers, words and geometric symbols. The markers identify each line`s function, content, primary hazard, and the direction of fluid flow.

Most fluid lines are marked with 1 inch tape or decals. Paint is used on lines in the engine induction system.

Certain lines may also be identified as to the 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. Line containing physically dangerous materials, such as oxygen, nitrogen, or freon, are marked PHDAN.

The aircraft and engine manufacturer is responsible for the original installation of identification markers, Aircraft maintenance personnel are responsible for their replacement when it becomes necessary.

Tapes, paint, tags and decals are placed on both ends of a line and at least once in each compartment through which the line runs. Identification markers are also placed immediately adjacent to each valve, regulator, filter or other accessory within a line.

6. Inspection of Flexible Hoses

NOTE: During the manufacturing process, a condition known as “rubber strike-through” occasionally occurs. This condition is such that rubber material protrudes through the wire braid cover. This condition has no effect on hose quality.

It is recommended that flexible hoses be inspected every 100 hours, especially those in the engine compartments. When inspecting hoses, look for the following conditions:

A. Check each installation to be sure the hose is not kinked, twisted, or distorted. Check for evidence of abrasion, cuts, and broken wires. Random broken wires are acceptable since wire breaks sometimes occur during manufacture. Discard hose if two or more broken wires are found per plait (braid) or more than six broken wires per lineal foot. Broken wires in an area where kinking is evident is also a cause for rejection.

CAUTION: PUNCTURING THE OUTER COVER OF THE HOSE MAY CAUSE DAMAGE TO THE HOSE.

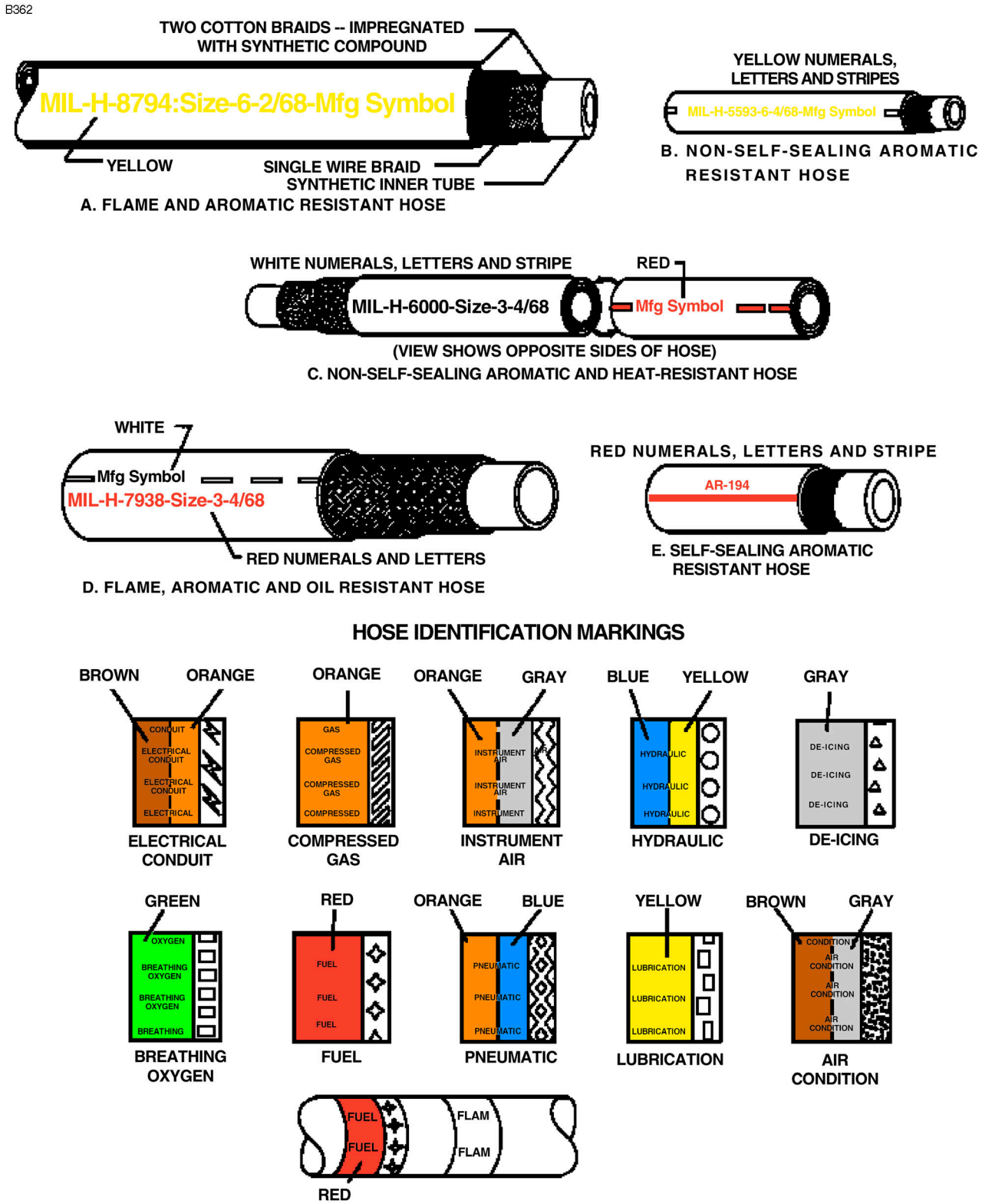
B. Check each assembly for deterioration, ply separation of cover or braid, cracks, weather checking, lack of flexibility, blisters or bulging, collapse, or sharp bending. Blisters on the outer synthetic cover do not necessarily indicate a faulty hose.

C. Remove hose from assembly if hose shows any visible wear. Inspect hose interior and check for signs of deterioration, tube collapse, cut rubber, wire braid puncture, or restriction. To inspect hoses with elbow fittings, use flexible inspection light and viewer, or inspection ball as described in Chart 1 Replace hose if any deterioration exists.

CHART 1
BALL DIAMETERS FOR TESTING HOSE RESTRICTIONS

Hose Size	Ball Size
- 4	5/64
- 5	9/65
- 6	13/64
- 8	9/32
- 10	3/8
- 12	1/2
- 16	47/64
- 20	61/64

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Hose, Tube, and Line Markings
Figure 4

7. Flareless Tube Assemblies (Refer to Figure 5.)

Flareless tube fittings eliminates all tube flaring, but presetting is necessary prior to installation of a new flareless tube assembly. Perform presetting as follows:

A. Cut tube to correct length, with ends perfectly square. Deburr inside and outside of tube. Slip nut, then sleeve, over tube (Step 1, Figure 5).

B. Lubricate threads. See Figure 5 and Chart 2 for proper lubricant. When applying thread lubricants, proceed as follows:

(1) Thoroughly clean threads before applying lubricant.

(2) Use thread lubricant sparingly.

(3) Apply thread lubricant to male threads only.

(4) Lubricate first three threads only on straight fittings.

(5) Do not lubricate first two threads on tapered fittings; apply lubricant to next three threads only.

(6) Ensure lubricant does not enter fittings or flared areas.

(7) Lubricate any fittings going to engine with same fluid going through lines.

C. Place fitting in vise (Step 2), and hold tubing firmly and squarely on seat in fitting. Tube must bottom firmly in fitting. Tighten nut until cutting edge of sleeve grips tube. This point is determined by slowly turning tube back and forth while tightening nut. When tube no longer turns, nut is ready for final tightening.

D. Final tightening depends upon tubing. For aluminum alloy tubing up to and including 1/2 inch outside diameter, tighten nut from 1 to 1-1/6 sixth turns. For steel tubing and aluminum alloy tubing over 1/2 inch outside diameter, tighten from 1-1/6 to 1-1/2 turns.

E. After presetting sleeve, disconnect tubing from fitting. Check following points per Step 3, Figure 5:

(1) Tube must extend 3/32 to 1/8 inch beyond sleeve pilot; otherwise blowoff may occur.

(2) Sleeve pilot must contact tube or have a maximum clearance of 0.005 inch for aluminum alloy tubing or 0.015 inch for steel tubing.

(3) A slight collapse of tube at sleeve cut is permissible. No movement of the sleeve pilot, except rotation, is permissible.

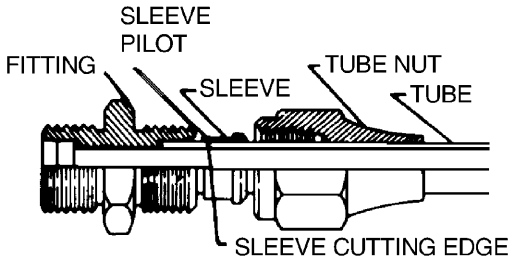
CHART 2
THREAD LUBRICANTS

Line	Lubricant
Brakes	MIL-H-5606
Fuel	MIL -T-5544, Anti-Seize, Graphite Petrolatum
Landing Gear Air Valve	6PB Parker
CAUTION: LUBRICATE ENGINE FITTINGS ONLY WITH THE FLUID CONTAINED IN THE PARTICULAR LINE.	
Oil	MIL-G-6032, Lubrication Grease (Gasoline and Oil Resistant)
Pitot and Static	TT-A-580 (JAN-A-669). Anti-Seize Compound (White Lead Base)

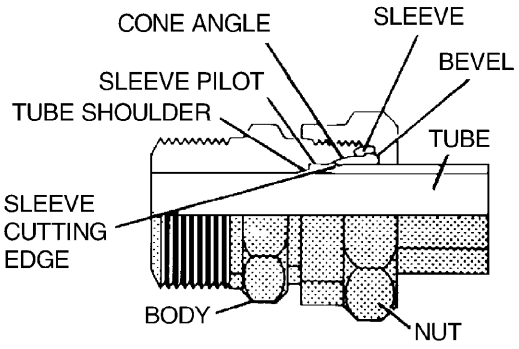
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TUBING AND HOSE LUBRICANTS

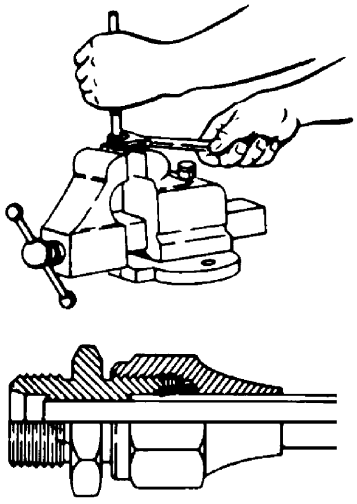
TUBING SYSTEM	LUBRICANT
HYDRAULIC	MIL-H-5606
FUEL	MIL-H-5656
OIL	SYSTEM OIL
PNEUMATIC	MIL-L-4343



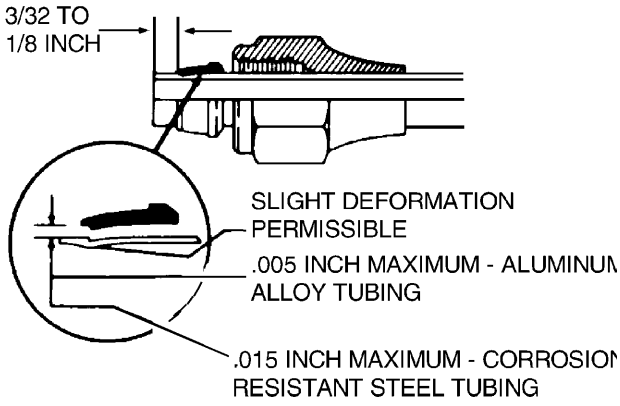
STEP 1



FLARELESS-TUBE FITTING



STEP 2



STEP 3

Flareless Tube Fittings
Figure 5

8. Support Clamps

CAUTION: MAKE CERTAIN THAT CLAMPS ARE OF THE CORRECT SIZE. CLAMPS OR SUPPORTING CLIPS SMALLER THAN THE OUTSIDE DIAMETER OF THE HOSE MAY RESTRICT THE FLOW OF FLUID THROUGH THE HOSE.

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

A teflon cushioned clamp is used in areas where the deteriorating effects of hydraulic fluid or fuel is expected, however, because it is less resilient, it does not provide as good a vibration damping effect as other cushion materials.

Use bonded clamps to secure metal hydraulic, fuel and oil lines in place. Unbonded clamps should be used only for securing wiring. Remove any paint or anodizing from the portion of the tube at the bonding clap location.

All plumbing lines must be secured at specified intervals. The maximum distance between supports for rigid fluid tubing is shown in Chart 3.

CHART 3
MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

Tube O.D. (IN.)	Distance Between Supports (IN.) Aluminum Alloy	Steel
1/8	9-1/2	11-1/2
3/16	12	14
1/4	13-1/2	16
5/16	15	18
3/8	16-1/2	20
1/2	19	23
5/8	22	25-1/2
3/4	24	27-1/2
1	26-1/2	30

9. Dye Penetrant Inspections

NOTE: The following procedure is general in nature. See manufacturer's instructions, included with dye penetrant kit, for specifics.

A. Using a volatile cleaner, thoroughly remove dirt, loose scale, oil and grease from surface to be inspected.

B. Heat surface to at least 70°F (21°C), but not exceeding 130°F (54°C).

C. Apply penetrant by brushing, spraying, or dipping. Let stand 2 to 15 minutes, depending on temperature.

D. Remove surplus penetrant by applying special cleaner recommended by penetrant manufacturer, or by rinsing with water. Allow housing to dry.

E. Apply a light, even coat of developer by spraying, brushing, or dipping. Cracks or other opening in surface being inspected will appear as bright red. An indication of size of the defect may be obtained by watching the size and rate of growth of red indication.

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PAINTING

1. Painting Safety

WARNING: OVERSPRAY FROM CERTAIN ENAMELS, IF PUT IN WATER, IS FLAMMABLE. STORE ALL OVERSPRAY IN COVERED CONTAINERS AWAY FROM BUILDINGS WHERE SPRAYING OPERATIONS ARE CONDUCTED.

WARNING: WASH ALL RAGS AND SPONGES USED TO APPLY ANY PHOSPHORIC ACID CONVERSION COATINGS (ALODINE) BEFORE DISPOSAL. IF MATERIAL DRIES ON RAG, THERE IS DANGER OF SPONTANEOUS COMBUSTION.

WARNING: MIX DOPES AND LACQUERS WITH AIR DRILL. DO NOT USE ELECTRIC DRILL. ARCING ELECTRIC DRILL MOTOR WILL IGNITE FUMES.

WARNING: VERIFY SPRAY ROOM IS WELL VENTILATED. A CONCENTRATION OF FUMES WILL CAUSE A DANGEROUS FIRE HAZARD OR INSUFFICIENT OXYGEN FOR THE OPERATOR.

CAUTION: DO NOT ALLOW PAINT STRIPPER TO CONTACT FIBERGLASS REINFORCED PARTS SUCH AS RADOMES, RADIO ANTENNAS, WING PARTS, OR WING TIPS. FIBERGLASS STRUCTURES MAY BE FINISHED WITH ACRYLIC LACQUER OR POLYURETHANE ENAMEL AND ARE DAMAGED BY THE STRIPPER.

2. Polyurethane Paint Safety

WARNING: POLYURETHANE PAINT MAY BE DANGEROUS TO YOUR HEALTH. SERIOUS INJURY WILL RESULT IF SAFETY PRECAUTIONS ARE NOT FOLLOWED.

WARNING: DURING TRANSIT AND STORAGE CHECK FOR SIGNS OF A BULGING CAN, OTHER THAN NORMAL ODOR, OR A CHANGE IN RESIN FROM A CLEAR TO A CLOUDY STATE. A SLOW CARBON DIOXIDE BUILDUP WILL CAUSE CAN TO BURST. REMOVE AND PROPERLY DISPOSE ANY DEFECTIVE CANS.

WARNING: ENSURE ADEQUATE VENTILATION AND WEAR APPROPRIATE BREATHING PROTECTION FACE MASK WHEN PAINTING.

WARNING: POLYURETHANE PAINTS CAN PRODUCE IRRITATION OF THE SKIN, EYES, AND RESPIRATORY TRACT DURING MIXING AND APPLICATION. EXPOSURE TO SPRAY VAPORS AND MISTS DURING SPRAY APPLICATION MAY CAUSE BREATHING DIFFICULTY, SHORTNESS OF BREATH, AND DRY COUGH. INDIVIDUAL SUSCEPTIBILITY IS A CONTROLLING FACTOR. ONCE SENSITIZED, MANY PEOPLE CANNOT TOLERATE ANY EXPOSURE AND MUST THEREAFTER AVOID EXPOSED WORK AREAS.

WARNING: PRODUCTION TYPE MIXING AND SPRAY PAINTING OPERATIONS MUST BE IN SPECIALLY DESIGNED, EXHAUST-VENTILATED AREAS.

WARNING: PAINTERS MUST BE FULLY CLOTHED WITH COLLARS BUTTONED AND SLEEVES TAPED AT THE WRIST. PAINTERS MUST WEAR FITTED, DOUBLE CARTRIDGE ORGANIC VAPOR RESPIRATOR WITH FRESH CARTRIDGE INSERTED DAILY, SOLVENT-RESISTANT GAUNTLET STYLE GLOVES, AND SAFETY GOGGLES.

3. Paint Application

WARNING: GROUND AIRCRAFT BEFORE PAINTING SO NO STATIC ELECTRICITY CHARGES BUILD UP AND DISCHARGE.

CAUTION: PROTECT WINDSHIELD WHEN MASKING AIRCRAFT. PAINT STRIPPERS, METAL BRIGHTENERS, AND SOLVENTS WILL DAMAGE WINDSHIELD.

CAUTION: BALANCE MOVABLE CONTROL SURFACES AFTER PAINTING. REFER TO APPROPRIATE MAINTENANCE MANUAL SECTIONS.

CAUTION: BEFORE FORCE DRYING AT ELEVATED TEMPERATURES, VERIFY THAT ALL FUEL TANK VENTS ARE UNOBSTRUCTED AND WILL NOT RESULT IN EXPANDED FUEL SPILLING ON NEWLY PAINTED SURFACES OR PAINT BOOTH FLOOR.

CAUTION: DO NOT PAINT PITOT TUBES, GAS CAPS, OR ANTENNA COVERS THAT WERE NOT FACTORY PAINTED.

CAUTION: DO NOT USE METALLIC PAINTS ON RADAR CONES OR ANTENNA COVERS.

CAUTION: DO NOT ALLOW SILICONE LUBRICANTS TO CONTACT ANY SURFACES TO BE PAINTED. SILICONE LUBRICANT IS VERY DIFFICULT TO REMOVE COMPLETELY.

4. Painting Sequence

For primer, tack, finish coats, and lacquer application:

A. Position airplane so airflow is from tail toward nose and overspray ahead of you.

B. To minimize overspray problems, have two painters work simultaneously on opposite sides of airplane.

C. Paint difficult areas such as landing gear, and wheel wells before flat surfaces. Paint the ends and leading edges of ailerons and flaps. Paint flap and aileron wells, wing tips, and leading and trailing edges.

D. Paint the bottom of the airplane first including bottom of horizontal tail surfaces. Starting at the root and working outward, spray chordwise. Work up fuselage and allow spray to cover sides. Work up to engine. Spray wing bottom. Start each painter at the root and work toward tip, spraying chordwise.

E. Lower airplane tail enough to reach fin top. When spraying fuselage top, tilt spray gun so overspray is ahead of area being painted and new paint will wipe out overspray. Spray primer across fuselage, vertical and horizontal tail surfaces, and wing.

5. Color Matching

See aircraft logbooks for color codes.

6. Trim and Registration Numbers

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

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

Apply registration numbers by painting or affixing self-adhering plastic figures. They must be solid color lines contrasting with background. Location and size of identification numbers vary, per aircraft size. Location and size is found in Federal Aviation Regulations.

7. Paint System Compatibility

Before applying new paint, find what type finish was used previously. Refer to the Piper parts catalog for correct paint number and color.

Identify paint finishes by applying engine oil to a small surface area. Old nitrocellulose finishes will soften in a few minutes. Acrylics, urethanes, and epoxy finishes show no effects.

If not identified, wipe down a small area with rag wet with methy ethyl ketone. MEK picks up pigments from acrylic finishes, but not from epoxy or cured urethane coatings. Wipe surface, do not rub. Heavy rubbing picks up epoxy and urethane pigments from coatings not fully cured.

The use of different types of paint, with several coatings, make repair of damaged and deteriorated areas difficult. Paint finishes are not always compatible. The following are general rules for compatibility and are not necessarily listed in order of importance.

A. Old type zinc chromate primer may be used directly for touchup of bare metal surfaces and on interior finishes. It may be overcoated with wash primers if in good condition. Acrylic lacquer finishes will not adhere to this material.

B. Modified zinc chromate primer will not adhere to bare metal. Never use it over a dried film of acrylic nitrocellulose lacquer.

C. Nitrocellulose coatings will adhere to acrylic finishes, but reverse is not true. Do not use acrylic nitrocellulose lacquers over old nitrocellulose finishes.

D. Acrylic nitrocellulose lacquers will not adhere to nitrocellulose and epoxy finishes and to bare metal. For best results, apply lacquers over fresh, successive coatings of wash primer and modified zinc chromate. They also adhere to freshly applied epoxy coatings (dried less than 6 hours).

E. Epoxy topcoats adhere to all paint systems in good condition. Use epoxy for general touch touchup, including touchup of defects in baked enamel coatings.

F. Old wash primer coats may be overcoated directly with epoxy finishes. Apply a new second coat of wash primer if an acrylic finish is to be applied.

G. Old acrylic finishes may be refinished with new acrylic provided old coating is thoroughly softened using acrylic nitrocellulose thinner before paint touchup.

H. Repair damage to epoxy finishes by using more epoxy. Neither lacquer finish will stick to epoxy surfaces. In some instances, air drying enamels may be used for touchup of epoxy coatings if edges of damaged areas are roughened with abrasive paper.

8. Common Paint Troubles

A. Poor Adhesion - Paint properly applied to correctly pretreated surfaces will adhere satisfactorily. When thoroughly dry, paint must not be easily removed. Poor adhesion can result from:

(1) Inadequate cleaning and pretreatment.
(2) Inadequate stirring of paint or primer.
(3) Coating at incorrect time intervals.
(4) Application under adverse conditions.
(5) Bad application.

B. Spray Dust - Spray dust caused by atomized particles drying before reaching surface being painted fail to flow as a continuous film. Usual causes are incorrect air pressure or distance gun is held from work.

C. Sags and Runs - Excess paint causes wet paint film to move by gravity and presents a sagging appearance. Incorrect viscosity, air pressure, and gun handling, or inadequate surface preparation are frequent causes.

D. Spray Mottle - Sometimes known as orange peel or pebble, is caused by incorrect paint viscosity, air pressure, spray gun setting, or the distance the gun is held from work.

E. Blushing is one of the most common troubles. It appears as clouding or blooming of paint film. It is more common with cellulose than synthetic materials. It may be caused by moisture in air supply line, adverse humidity, drafts, or sudden temperature changes.

9. Storage

A. Store paint, enamel, and other finishing material in dry storage away from direct sunlight and heat. Mark each container with a code for identification.

B. Storage facilities must comply to Occupational Safety and Health Act (OSHA) requirements regarding air circulation, lighting, and fire protection. Lock storage facilities to prevent children and unauthorized personnel entry.

C. Invert pigmented materials every inventory so pigments will not pack to can bottom. Properly dispose of empty containers.

D. Use older materials first. Useful life of some finishes is limited.

E. Storage area temperatures must be approximately 50-90°F. If finishes are stored in temperature extremes, allow them to return to room temperature before using.

10. Painting Facility

WARNING: DO NOT BREATHE PAINT FUMES. FUMES DEPLETE THE OXYGEN SUPPLY REQUIRED BY THE BODY.

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

B. Provide sufficient air movement in painting area so there is only a slight finishing material odor. Exhaust fans must be belt-driven and located near floor level. Locate fan's motor away from fumes.

C. All spraying area personnel must wear approved respiration safety equipment.

11. Aircraft Finish Care

See Aircraft Finish Care, 12-00-00.

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GRIDS 1K4 THRU 1L24
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AIRPLANE MAINTENANCE MANUAL

CARD 2 OF 7

PA-44-180



(S/N's 4496001 & UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-892

March 15, 2006

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© The New Piper Aircraft, Inc.
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Member
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Manufacturers Association

THE NEW PIPER AIRCRAFT, INC.
PA-44-180, SEMINOLE
MAINTENANCE MANUAL

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-882) originally published March 1, 1998 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG970401	April 1, 1997	1, 2, 3, and 4
PR020228	February 28, 2002	1, 3, and 4
PR021206	December 6, 2002	2
CR060315 *	March 15, 2006	1, 2, 3, 4, 5, 6 and 7

*** COMPLETE REVISION OF MAINTENANCE MANUAL 761-892**

Revisions appear in all seven Aerofiche Cards. Accordingly, discard your entire existing Aerofiche Card set and replace it with this one dated 03/15/06.

Consult the Piper Customer Service Information Aerofiche (P/N 1753-755) for current revision dates for this manual.

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INTRODUCTION

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
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	2	Mar 15/06			
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INTRODUCTION

1. Instructions for Continued Airworthiness

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

The PIPER PA-44-180 Seminole Maintenance Manual constitutes the Instructions for Continued Airworthiness in accordance with Federal Aviation Regulations (FAR) Part 23, Appendix G. Chapter 4 contains the Airworthiness Limitations section (4-00-00) and the Inspection Program is in Chapter 5 (5-20-00).

2. General

This publication is prepared in accordance with the General Aviation Manufacturers Association (GAMA) Specification No. 2, with respect to the arrangement and content of the System/Chapters within the designated Chapter/Section-numbering system.

WARNING: USE ONLY GENUINE PIPER AIRCRAFT PARTS OR PIPER AIRCRAFT APPROVED PARTS OBTAINED FROM PIPER APPROVED SOURCES, IN CONNECTION WITH THE MAINTENANCE AND REPAIR OF PIPER AIRPLANES.

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-44-180 Parts Catalog P/N 761-891, and FAR 43 for proper utilization.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

THE NEW PIPER AIRCRAFT, INC. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: THE NEW PIPER AIRCRAFT, INC. expressly reserves the right to supersede, cancel and/or declare obsolete any part, part numbers, kits or publication that may be referenced in this manual without prior notice.

In any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence.

3. Effectivity

This maintenance manual is effective for PA-44-180 Seminole airplanes serial numbers 4496001 and up.

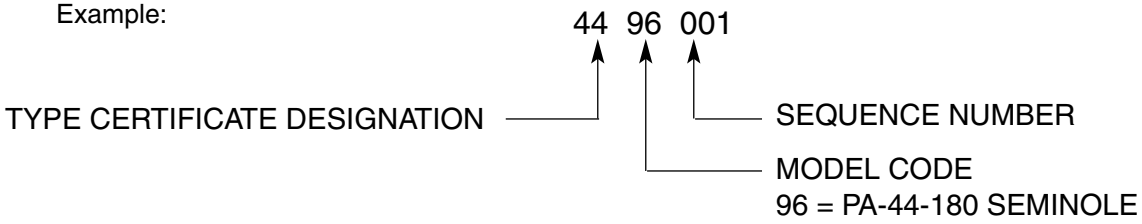
This encompasses the following model years:

NOTE: The following is provided as a general reference only.

Model Year	Serial Numbers
1995	4496001 thru 4496005
1996	4496006 thru 4496013
1997	4496014 thru 4496023; less 4496020
1999	4496024 thru 4496030; and 4496020
2000	4496031 thru 4496042
2001	4496043 thru 4496108
2002	4496109 thru 4496168
2003	4496169 thru 4496179
2004	4496180 thru 4496190
2005	4496191 thru 4496219
2006	4494220 and up

4. Serial Number Explanation

Example:



5. Assignment of Subject Material

This publication is divided into industry standard, three element, numeric subject groupings as follows:

A. System/Chapter - The various groups are broken down into major systems such as Environmental Systems, Electrical Power, Landing Gear, etc. They are assigned a number, which becomes the first element of the standardized numbering system. Thus, the element “28” of the number 28-40-01 refers to the chapter “Fuel”. Everything concerning the fuel system will be covered in this chapter.

B. Sub-System/Section - The major systems/chapters of an airplane are broken down into subsystems. These sub-systems are identified by the second element of the standard numbering system. The element “40” of the number 28-40-01 concerns itself with the indicating section of the fuel system.

C. Unit/Subject - The individual units within a sub-system/section may be identified by the third element of the standard numbering system. The element “01” of the number 28-40-01 is a subject designator. This element is assigned at the option of the manufacturer and is normally zeroed out by PIPER.

Refer to paragraph 14, Chapter/Section Index Guide, for a complete breakdown and list. The material is arranged in ascending numerical sequence.

6. Pagination

The Chapter - Section (i.e. - 28-40-00) numbering system (explained above) forms the primary page numbering system for this manual. Within each Section, pages are numbered consecutively beginning with Page 1 (i.e. - 28-40-00, Page 1). Additionally, the aerofiche grid numbering system (explained below) is also used to indicate location within the manual.

7. Aerofiche Effectivity

A. The General Aviation Manufacturers Association (GAMA) have developed specifications for microfiche reproduction of aircraft publications. 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. The “Aerofiche Effectivity” page at the front of this manual lists the current revision for each card in this set.

B. Conversion of Aerofiche alpha/numeric grid code numbers:

First number is the Aerofiche card number.
Letter is the horizontal row reference per card
Second number is the vertical column reference per card.

Example: 2J16 = Aerofiche card number two, row J, column 16.

C. To aid in locating information, the following is provided at the beginning of each aerofiche card:

(1) A complete Introduction containing the Chapter/Section Index Guide for all fiche in this set.

(2) A complete subject Index for all fiche in this set.

8. Identifying Revised Material

A revision to a page is defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a vertical line (i. e. - change bar) along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A change bar in the left-hand margin opposite the footer (i.e. - chapter/section/subject, page number and date), indicates that the text was unchanged but the material was relocated to a different page.



Example.

NOTE: Change bars are not used in the title pages, list of effective pages, or index. Likewise, all change bars are removed when a publication is completely revised (i.e. - reissued).

9. Indexing

An alphabetically arranged subject Index follows this introduction to assist the user in locating desired information. In addition, each System/Chapter begins with an individual Table of Contents.

10. List of Effective Pages

Each System/Chapter has a List of Effective Pages preceding the Table of Contents to identify the effective revision date for each page in that chapter.

11. Warnings, Cautions and Notes

These adjuncts to the text are used to highlight or emphasize important points when necessary. Warnings call attention to use of materials, processes, methods, procedures or limits which must be followed precisely to avoid injury or death to persons. Cautions call attention to methods and procedures which must be followed to avoid damage to equipment. Notes call attention to methods which make the job easier. Warnings and Cautions shall be located directly above and Notes directly beneath the text and be in line with the paragraphs to which they apply.

12. Accident/Incident Reporting

To improve our Service and Reliability system and aid in Piper's compliance with FAR 21.3, knowledge of all incidents and/or accidents must be reported to Piper immediately. To expedite and assist in reporting all incidents and accidents, Piper Form 420-01 has been created. See Service Letter 1041 for latest revision. This procedure is to be used by all Dealers, Service Centers and Repair Facilities.

13. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-44-180 airplane and its various components. Use them to supplement this manual.

A. Piper Publications:

	Piper P/N
(1) Parts Catalog:	761-892
(2) Periodic Inspection Report:	230-1963
(3) Progressive Inspection Manual (pending):	767-014

B. Vendor Publications:

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY.

(1) ALTERNATOR:

Vendor Address: Electro Systems, Inc.
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/
PH: - (888) 461-6077

(2) AUTOFLIGHT:

Vendor Address: Honeywell
One Technology Center
23500 W. 105th St., M/D #45
Olathe, Kansas 66061-1950
http://www.bendixking.com/

(or) S-TEC Corporation
One S-TEC Way
Mineral Wells, Texas 76067
PH - (940) 325-9406
www.s-tec.com

(3) BATTERY:

Vendor Address: GILL Batteries
A Division of Teledyne Continental Motors
http://www.gillbatteries.com
PH: - (800) 456-0070

(4) BRAKES AND WHEELS:

Vendor Address: Parker Hannifin Corp
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
http://www.parker.com/cleveland/Universe/book.pdf
PH: - (800) 272-5464

(5) ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS):

Vendor Address: Avidyne Corporation PH - (800) 284-3963
55 Old Bedford Road
Lincoln, MA 01773
http://www.avidyne.com/index.htm

Instructions for Continued Airworthiness

Primary Flight Display and Magnetometer/OAT:	Document No. AVPFD-174
Multifuntion Display:	Document No. AVMFD-167
Data Acquisition Unit:	Document No. AVSIU-011

(6) EMERGENCY LOCATOR TRANSMITTER:

Vendor Address: Artex Airccraft Supplies PH: - (800) 547-8901
14405 Keil Road NE
Aurora, Oregon 97002
http://www.artex.net/

(7) ENGINE:

Vendor Address: Textron Lycoming PH - (717) 323-6181
652 Oliver Street FAX - (717) 327-7101
Williamsport, PA 17701
http://www.lycoming.textron.com/main.html

Overhaul Manual:	DIRECT DRIVE MODELS	- P/N 60294-7
Parts Catalog:	O, LO-360 A1H6 ENGINES	- P/N PC306-5
Operators Handbook:	O, HO, IO, AIO, HIO, TIO-360 SERIES	- P/N 60297-12

NOTE: The above Lycoming publications can be ordered as a set on CD-ROM from Avantext. See www.avantext.com or PH - (800) 998-8857.

(8) FIRE EXTINGUISHER (PORTABLE):

Vendor Address: H3R Inc. PH: - (800) 249-4289
43 Magnolia Ave # 4
San Francisco, California 94123-2911
http://www.h3r.com/index.htm

(9) FUEL CELLS:

Vendor Address: Engineered Fabrics Corporation PH - 770-684-7855
669 Goodyear Street FAX - 770-684-7438
Rockmart, Georgia 30153-0548
http://www.kfefc.com/index.htm

(10) HEATER

Vendor Address:	Kelly Aerospace Power Systems Airport Complex, PO Box 273 Fort Deposit, AL 36032 http://www.kellyaerospace.com/ts_heaters.html	PH: - (888) 461-6077 FAX - (334) 227-8596
Maintenance and Overhaul Manual:	Janitrol Maintenance and Overhaul Manual - 24E25-1	

(11) LIGHTS - NAVIGATION, STROBE, AND MAP LIGHTS:

Vendor Address:	Whelen Engineering Co. Inc. Route 145, Winthrop Rd. Chester, Conneticut 06412 http://www.whelen.com/	PH: - (860) 526-9504 FAX - (860) 526-2009

(12) MAGNETOS:

Vendor Address:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104 http://www.unisonindustries.com/index4.html	PH - (815) 965-4700 FAX - (815) 965-2457
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363	

(13) NAVIGATION, COMMUNICATIONS, AND GPS (NAV/COM/GPS):

Vendor Address:	Garmin International 1200 East 151ST Street Olathe, KS 66062 http://www.garmin.com	PH: (913) 397-8200

(14) PROPELLER:

Vendor Address:	Sensenich Corporation 14 Citation Lane Lititz, PA 17543 http://www.sensenich.com/	PH - (717) 569-0435 FAX - (717) 560-3725
Repair Manual:	METAL PROPELLER REPAIR MANUAL - SPRM 590	

(15) STARTER:

Vendor Address:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252
or	Electro Systems, Inc. (see “Voltage Regulator,” below)	

(16) VACUUM PUMP:

Vendor Address: Aero Accessories, Inc. PH - (800) 822-3200
1240 Springwood Avenue
Gibsonville, NC 27249
http://www.aeroaccessories.com/index.html

(17) VACUUM REGULATOR:

Vendor Address: Parker Hannifin Corp. PH: - (800) 382-8422
Airborne Division
711 Taylor Street
Elyria, Ohio 44035
http://www.parker.com/cleveland/Universe/book.pdf

(18) VOLTAGE REGULATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

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14. Chapter/Section Index Guide

NOTE: The following GAMA Specification No. 2 standard chapters are not included in this Maintenance Manual: 23, 35, 36, 38, 49, 54, 60, 72, 75, 81, and 83. These chapters are omitted because the subject system is either: not installed in these airplanes; adequately covered in vendor or other manuals; or, for ease of use, has been combined with another chapter.

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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 Operation

A. 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 or through the inlet located on the left side of the aft fuselage, depending on serial number.

B. 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 of 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.

C. 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 (See 21-40-00, Figure 5) 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.

D. 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.

E. 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.

F. 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, or a “HTR OVER TEMP” lamp located in the annunciator panel lights, upper center 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.

G. There are four overhead fresh air vents which are supplied by a separate inlet in the dorsal fin or through the inlet located on the left side of the aft fuselage, depending on serial number.

H. The system can be supplemented by an optional blower.

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DISTRIBUTION

1. Overhead Vent System

Overhead Vent Blower

Cabin ventilation and cooling is provided solely by fresh air through the overhead vent system (see 21-40-00, Figure 1). The overhead vent blower is mounted aft of the rear cabin close-out panel underneath the top of the fuselage and is connected to the overhead vent system. The vent blower draws in air either from the dorsal fin or from a louver on the left rear side of the fuselage and forces it through the ducting. A three-position blower switch on the instrument panel controls the two-speed blower.

(1) Removal

(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.

(2) Installation

(1) Position blower assembly in hangers and retainer. Install washers and screws.

(2) Secure blower assembly to hanger braces nuts, washers, and screws.

(3) Seal all hose joints with 3M 390 Duct Tape.

(4) Install inlet and outlet hoses. Secure with clamps.

(5) Ensure master switch is OFF. Connect plug and receptacles to blower.

(6) Check blower for proper operation.

(7) Install access door to aft wall of baggage area. Secure with attaching hardware.

NOTE: Pin number 1 is at pointed side of plug and receptacle.

(3) Disassembly

(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) Remove the motor as follows:

1 Separate the plate from the motor cover by carefully drilling out the connecting rivets.

2 Cut the motor wires at the edge of the receptacle and plug and remove the wire ends from the blocks.

3 Remove the motor from the mounting plate by removing the nuts, washers and bolts.

(4) Assembly

(1) Mount motor on plate and secure with bolts, washers, and nuts. Check that motor nuts are snug and shaft spins freely.

(2) Position cover over motor plate with motor wires protruding through cover grommet.

(3) With the holes in the cover matching the holes in motor plate, secure the two parts together with rivets.

CHART 1
BLOWER SYSTEM WIRE COLOR CODES

		Motor Wires		Aircraft Wires		
		Pin Nos.	YY75062 ESB - Universal Electric Co.	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

(4) Where wires are passed through the cover grommet, fill any opening with Sealant, Airframe and Window (See 91-10-00, Chart 8).

(5) Install wires in plug and receptacle.

(6) Position blower fan on motor shaft and secure with set screw.

(7) Position hose duct on blower assembly and secure with screws, washers, and nuts. Install screws with heads inside duct.

(8) Clean old sealant from all surfaces where duct attaches to blower assembly.

(9) Seal all surfaces where duct attaches to blower assembly with Sealant, Airframe and Window (See 91-10-00, Chart 8).

2. Avionics Cooling Blower (See Figure 1.)

In S/N's 4496043 and up, the avionics cooling blower is installed on the back of the instrument panel below the pilot's control wheel tube. The cooling air is directed through hoses to standard and optional avionics equipment.

NOTE: Actual equipment will vary depending on optional equipment installed in an aircraft. Figure 1 shows two examples of cooling blower installations.

A. Removal

(1) Remove hoses from blower. Hoses are tied together with a strap and secured to blower with Ty-Raps. If GNS 430(s) are installed, clamps secure the hose to them; remove the clamps.

(2) Disconnect blower motor wires at connector.

(3) Remove blower assembly from its mounting bracket.

B. Installation

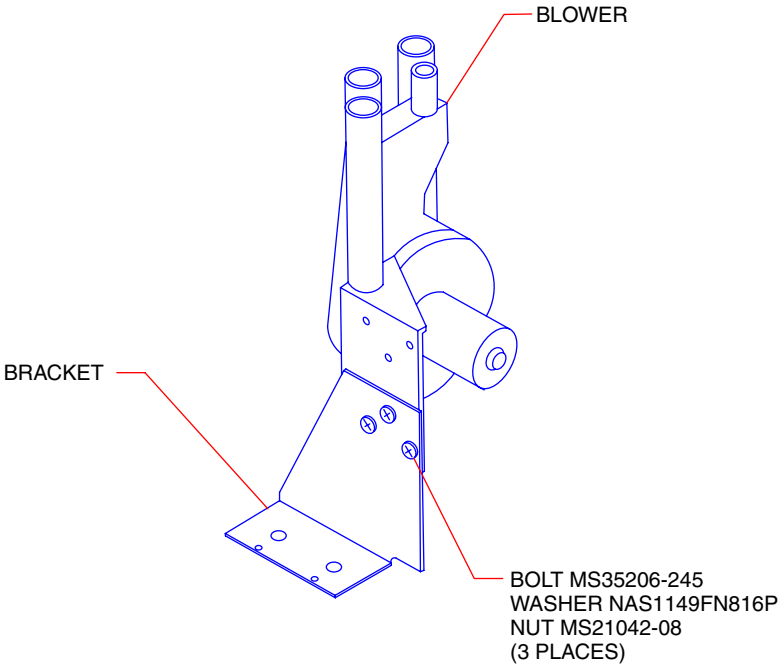
(1) Attach the blower assembly to its mounting bracket with bolts, washers and nuts.

(2) Reconnect the blower motor wiring to the connector.

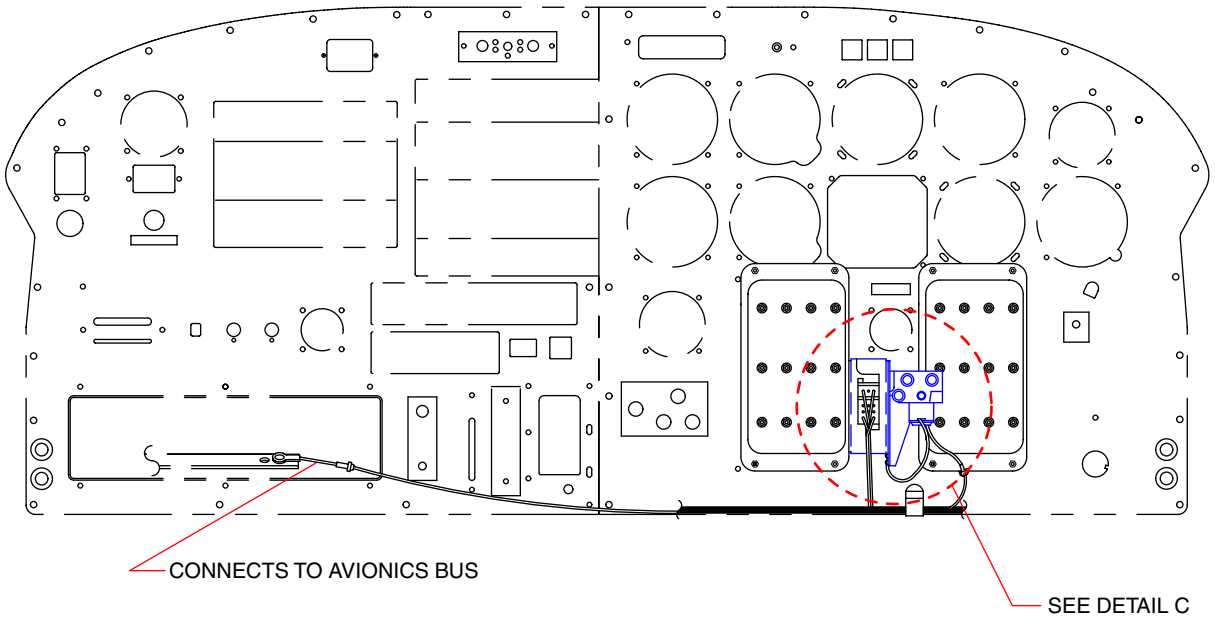
(3) Attach the hoses to the blower. Tie hoses together with strap and secure the hoses to the blower with Ty-Raps. (If GNS 430(S) installed, hose to be secured to it with hose clamp.)

(4) Cap any unused ports on the blower.

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DETAIL C

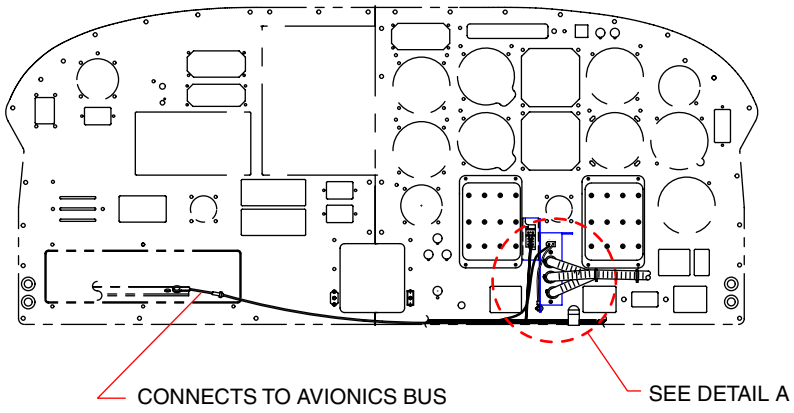


LOOKING AFT

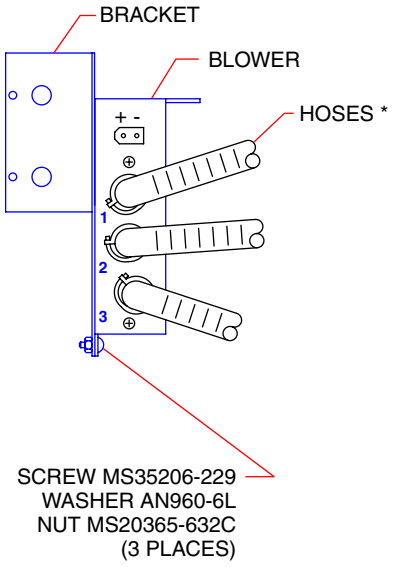
Avionics Cooling
Figure 1 (Sheet 1 of 2)

Effectivity
4496001 thru 4496030,
less 4496014

104084 E



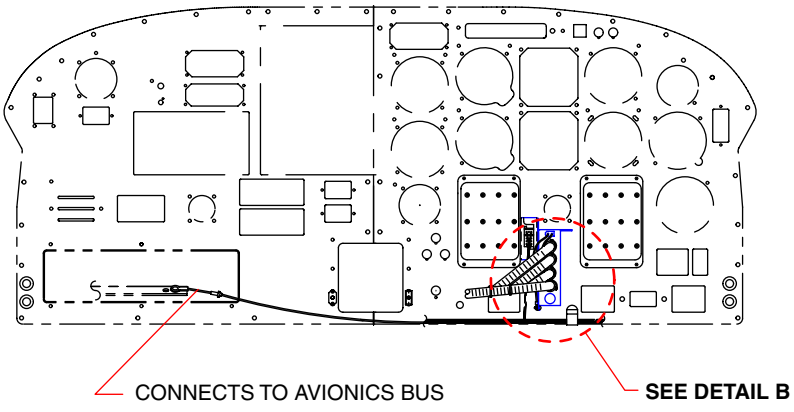
LOOKING AFT



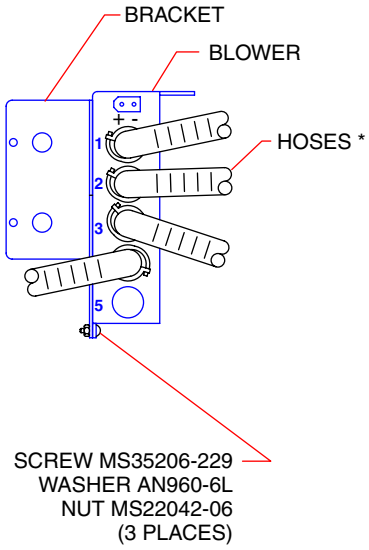
DETAIL A

S/N'S 4496014, AND 4496031 THRU 4496042

*** ACTUAL HOSE CONNECTIONS WILL VARY DEPENDING ON OPTIONAL EQUIPMENT INSTALLED.**



LOOKING AFT



DETAIL B

S/N'S 4496043 AND UP

Effectivity
4496014, and
4496031 and up

Avionics Cooling
Figure 1 (Sheet 2 of 2)

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HEATING

1. Description (See Figure 1.)

CAUTION: WHEN CABIN HEAT IS OPERATED, HEAT DUCT SURFACE BECOMES HOT. THIS COULD RESULT IN BURNS IF ARMS OR LEGS ARE PLACED TOO CLOSE TO HEAT DUCT OUTLETS OR SURFACE.

A Janitrol Model B3500 (90D38-Z) Combustion Heater is installed as standard equipment.

A. Spark - Spray Ignition

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 (Figure 3) that is stable and sustains combustion under the most adverse conditions, because it is circulated about 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.

B. Basic Components are shown in Figure 2.

(1) Fuel Regulator and Shutoff Valve (See Figure 13.)

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 ± 0.5 psi. The shutoff valve is operated by a solenoid.

(2) Intake Valve and Switches

The intake valve is located at the front of the combustion heater and controls air flow into the heater unit. Adust the valve as shown in Figure 4.

(3) Duct Switch

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°F ± 10° downward through a range of 146°F ± 6°. The switch has a differential of 15°F ± 5° at any given setting. Adjust as shown in Figure 5.

(4) Combustion Air Blower

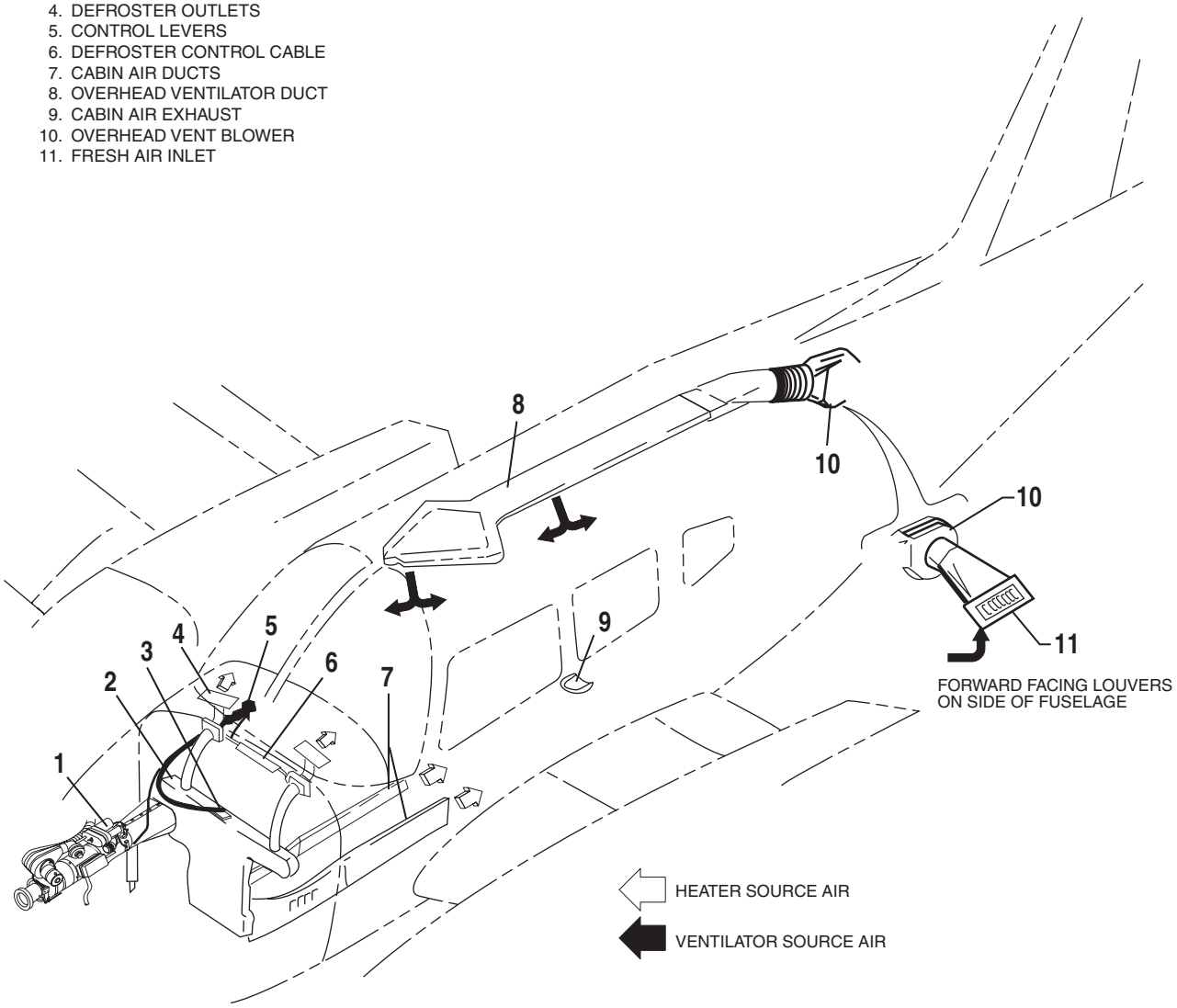
This centrifugal type blower supplies combustion air to the combustion chamber of the heater.

(5) 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.

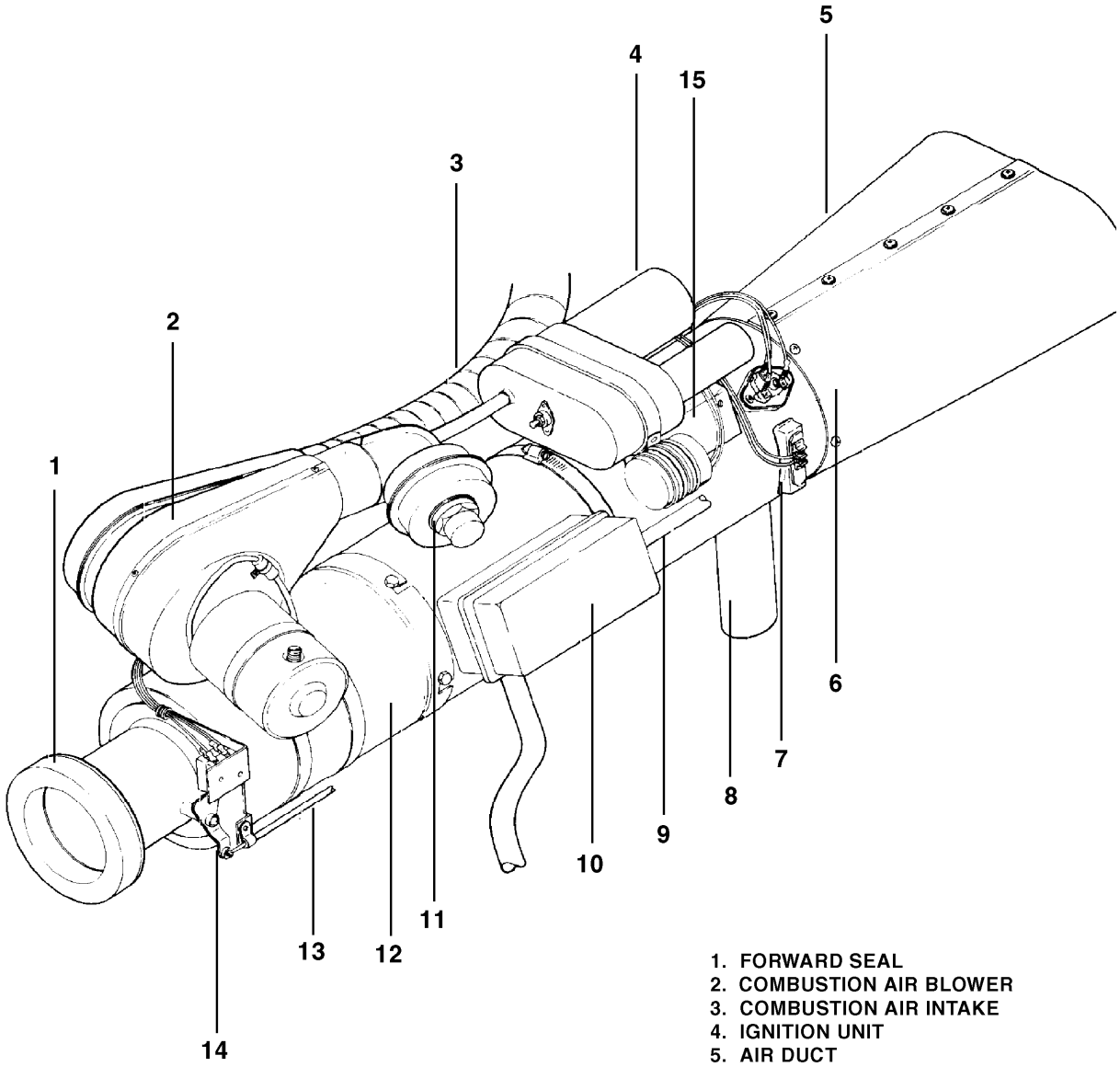
2311-A

1. COMBUSTION HEATER
2. AIR DISTRIBUTION MANIFOLD
3. AIR DISTRIBUTION VALVE
4. DEFROSTER OUTLETS
5. CONTROL LEVERS
6. DEFROSTER CONTROL CABLE
7. CABIN AIR DUCTS
8. OVERHEAD VENTILATOR DUCT
9. CABIN AIR EXHAUST
10. OVERHEAD VENT BLOWER
11. FRESH AIR INLET



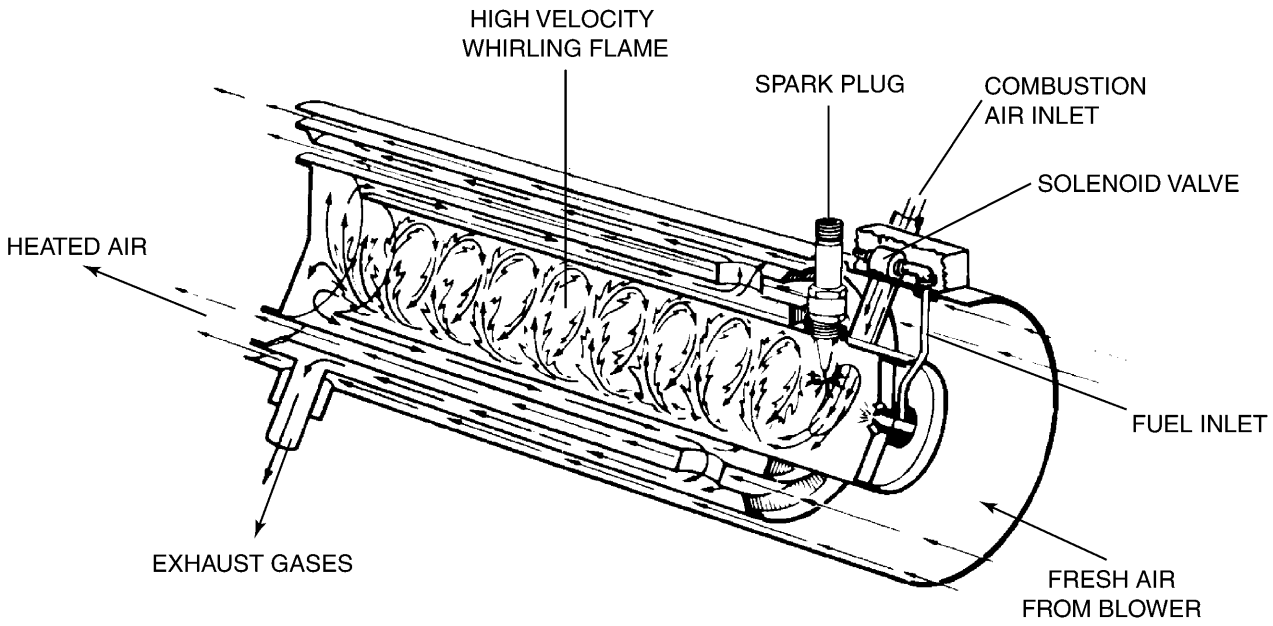
Cabin Environmental System Installation
Figure 1

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

Heater and Combustion Air Blower Assembly
Figure 2



Diagramatic Cutaway of Heater to Show Whirling Flame Action
Figure 3

(6) Operating Controls

NOTE: The schematic diagram (Figure 6) shows the heater circuit including the electrical wiring in the airplane. See also 91-21-40.

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.

2. Troubleshooting

See Chart 1.

CHART 1 (Sheet 1 of 3)
TROUBLESHOOTING - JANITROL HEATER

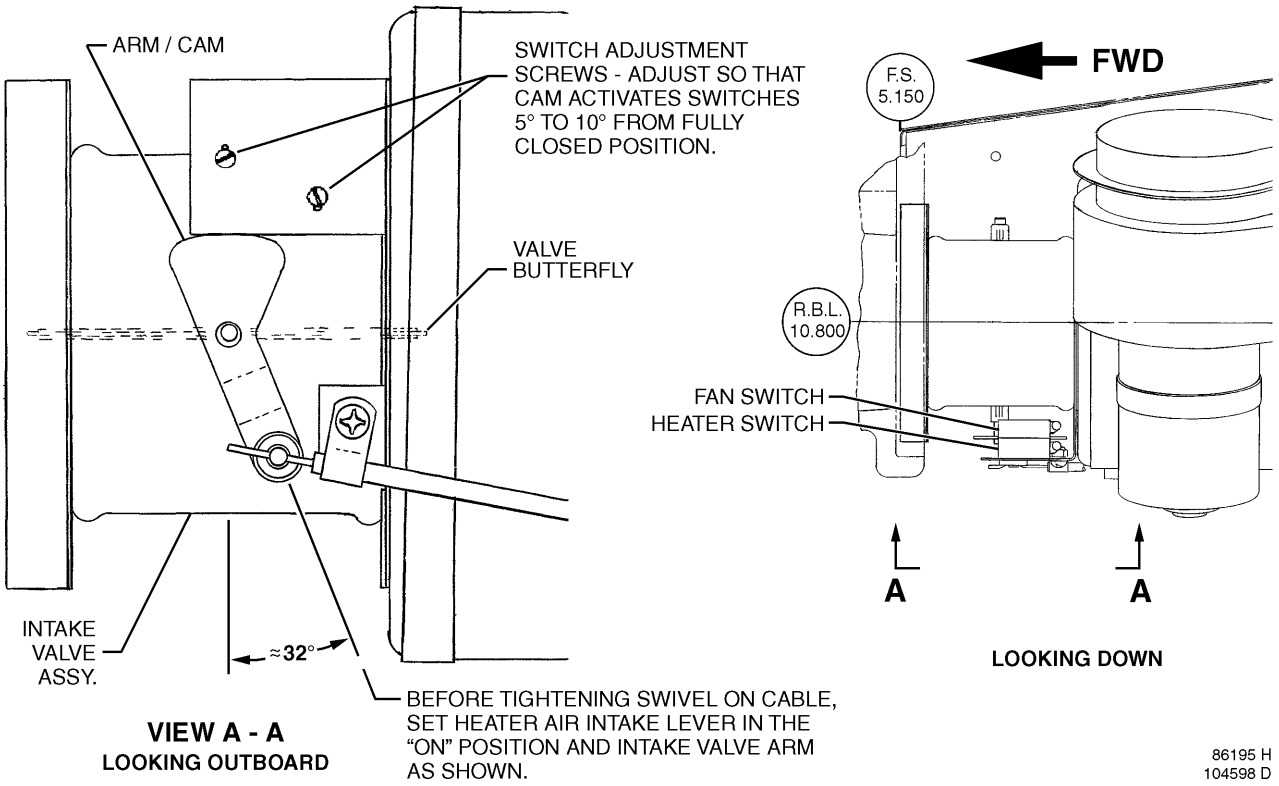
Trouble	Cause	Remedy
Heater fails to light.	Heater switch or circuit breaker off.	Turn on heater switch or close circuit breaker.
	Low voltage supply.	Apply external power supply. Attempt to start heater.
	Fuel cut off from tank.	Turn on heater switch.
	Regulator not operating	Check for low pressure or replace regulator.
NOTE: 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 feel pressure and counterclockwise to decrease it. (See Figure 13.)		
	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.
	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.

CHART 1 (Sheet 2 of 3)
TROUBLESHOOTING - JANITROL HEATER

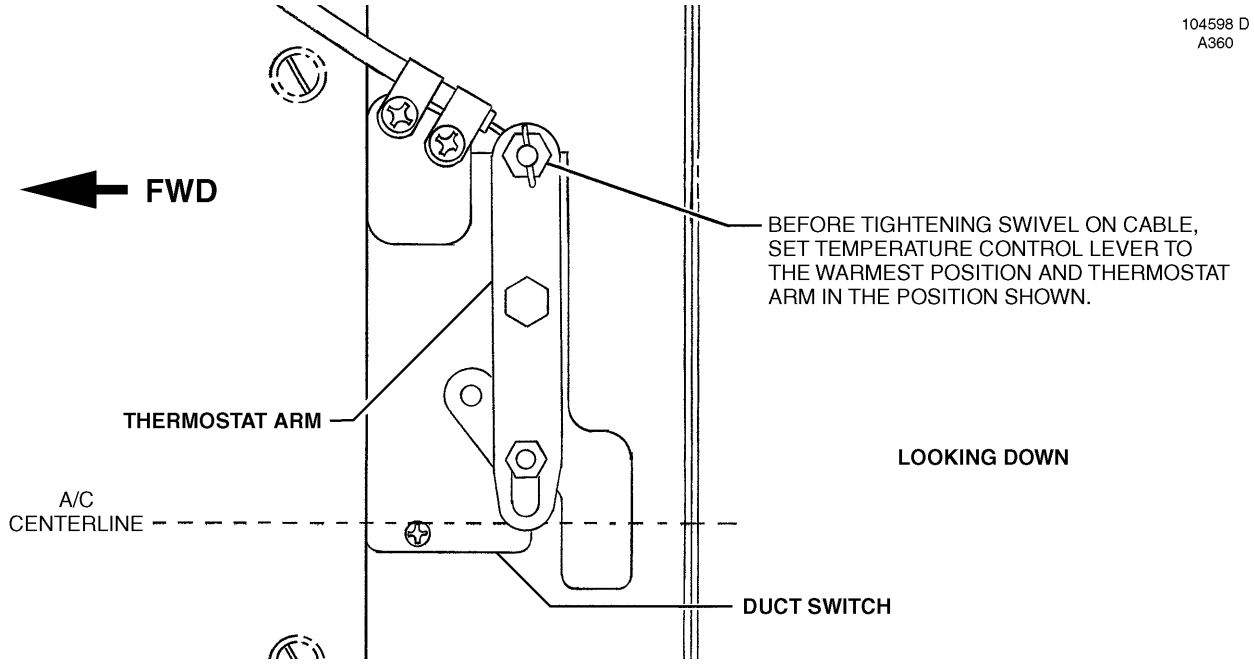
Trouble	Cause	Remedy
Ventilating air blower fails to run.	Heater switch "OFF." Broken or loose wiring to motor.	Energize the heater switch. Check and repair wiring.
	Circuit breaker open.	Close circuit breaker.
	Worn motor brushes.	Replace motor brushes.
	Blower wheel jammed.	Remove and check the ventilating 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.
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.
CAUTION: 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.		
	Spark plug partially fouled.	Replace spark plug.
	Loose primary connection at ignition assembly.	Tighten the connection.
	Faulty vibrator.	Replace the vibrator.

CHART 1 (Sheet 3 of 3)
TROUBLESHOOTING - JANITROL HEATER

Trouble	Cause	Remedy
Heater fires but burns unsteadily. (cont.)	Combustion air blower speed fluctuates. (Can be caused by low voltage, loose blower wheel, worn brushes or motor.)	Remove and overhaul the combustion air blower assembly as required or correct low voltage condition.
	High voltage leak in lead between ignition assembly and spark plug.	Replace ignition assembly.
	Inoperative ignition assembly.	If vibrator is in good condition, replace ignition assembly only.
	Restriction in fuel nozzle orifice.	Remove nozzle for cleaning or replacement.
	Nozzle loose in retainer or improper spray angle.	Tighten or replace the nozzle as required.
Heater starts then goes out.	Lack of fuel at heater.	Check fuel supply through all components from the tank to the heater. Make necessary corrections.
	Inoperative or chattering combustion air pressure switch.	Adjust or replace switch.
	Inoperative overheat switch.	Replace switch.
	Inoperative cycling switch.	Adjust or replace the switch.
	Low voltage.	Attach external power.
Heater fails to shut off.	Fuel solenoid valve in heater stuck open.	Remove and replace solenoid assembly.
	Inoperative duct and cycling switch.	Check and repair.
	Defective heater switch.	Replace the heater switch.



Intake Valve and Switches
Figure 4



Duct Switch
Figure 5

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3. Heater

Instructions contained in this section consist of periodic inspection, adjustment, 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.

A. Inspection

(1) Preflight and/or Daily Inspection

(a) 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.

(b) 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 to Operating Procedure, below, and verify heater system basic operation.

(2) 100-Hour Inspection

For heaters with 500 heater operating hours or twenty-four (24) months time-in-service since new, or overhauled with a new combustion tube assembly, each 100 hours or twenty-four (24) months, whichever occurs first, conduct the following inspection.

NOTE: 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.

(a) Inspect the ventilating air and combustion air inlets and exhaust outlet for restrictions and security at the airplane skin line.

(b) Inspect the drain line to make sure it is free of obstructions. Run a wire through it if necessary to clear obstructions.

(c) 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.

(d) Inspect electrical wiring at the heater terminal block and components for loose connections, possible chafing of insulation and security of attachment points.

(e) Inspect the high voltage cable connection at the spark plug to make sure it is tight. Examine the cable sheath for any possible indications of arcing, which would be evidenced by burning or discoloration of the sheath.

(f) Inspect the combustion air blower assembly for security of mounting, connecting tubing and wiring. Tighten any loose electrical terminals and air tube connections.

(g) Operate both the combustion and ventilating air blowers and check for unusual noise or vibrations.

(h) Check the condition and operation of the spark plug as described in Spark Plugs, below.

(i) 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 (latest revision).

(j) Following the 100 hour inspection, perform the “Preflight and/or Daily Inspection.”

B. Operating Procedure

Heater operating procedure is described below. This can also be used as a basic heater system operational check.

(a) 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.

(b) 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.

(c) 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.

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

C. Operational Test (PIR-PPS60055, Rev. F.)

(1) On Ground

(a) Check all fittings and connections for condition and security of mounting.

(b) Check that all ducts, inlets, and outlets are free from obstruction.

(c) Disconnect wire (H4F) from the heater terminal strip to remove electrical power from the heater fuel pump.

(d) 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 confirm airflow. The heater should not ignite.

(e) Simulate the landing gear in the up position by momentarily inserting a wedge under the leaf of the main gear squat switch. The ventilation blower should stop operating.

(f) Press the overheat indicator light. The lamp should illuminate.

(g) Place the air intake lever in the OPEN position and place the HEATER switch in the FAN position for two (2) minutes. Then place the HEATER switch in the OFF position.

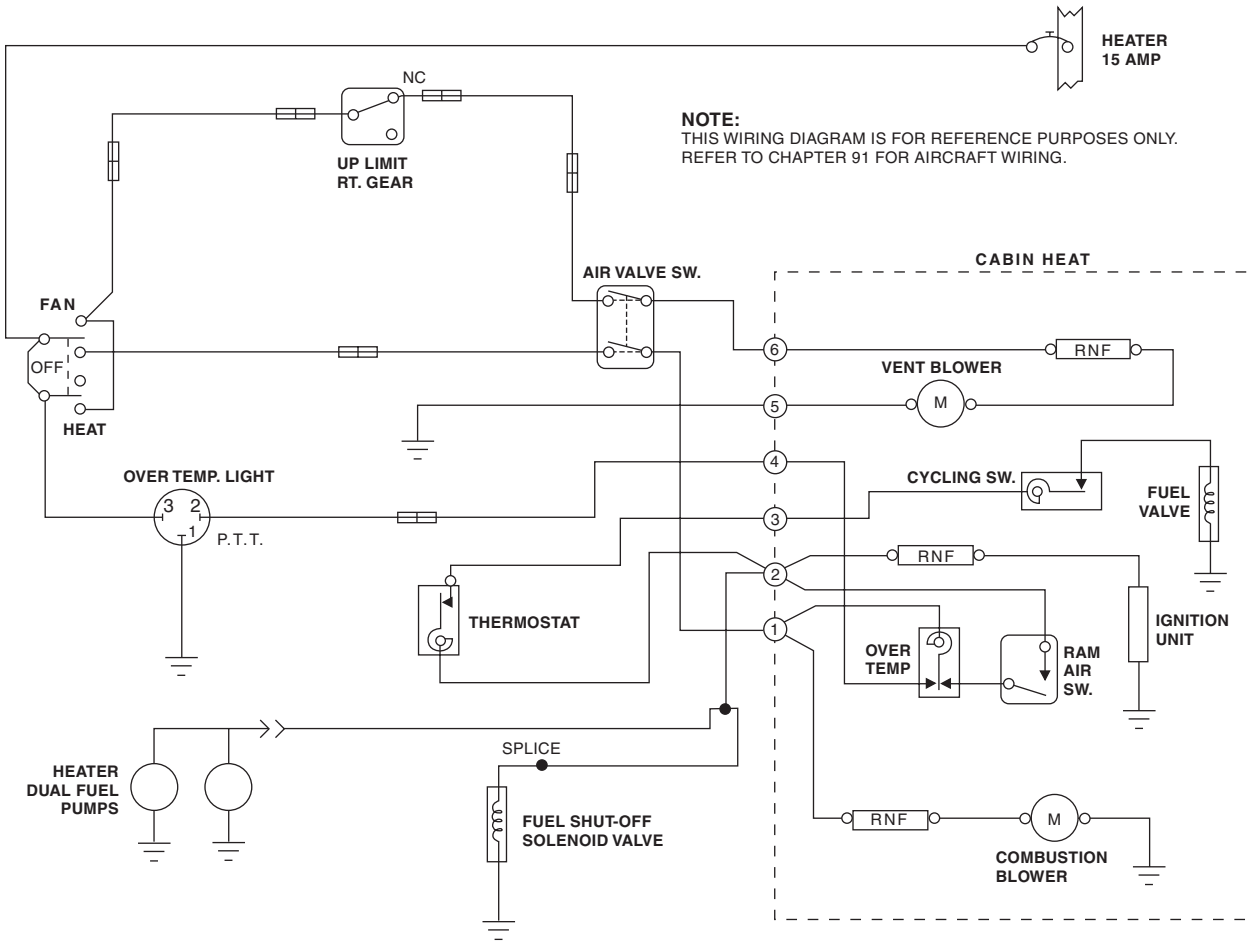
NOTE: This procedure should be followed after every shutdown to cool down the burn chamber.

(h) Set the master switch OFF.

(i) Install a 0 to 15 psi pressure gauge at the fuel drain aft of the heater fuel pump by installing a “T” fitting in the line from the fuel pump.

(j) Reconnect the wire (H4F) to the heater terminal strip.

(k) Place the air intake lever in the “OPEN” position and the temperature control lever in the center of its travel.



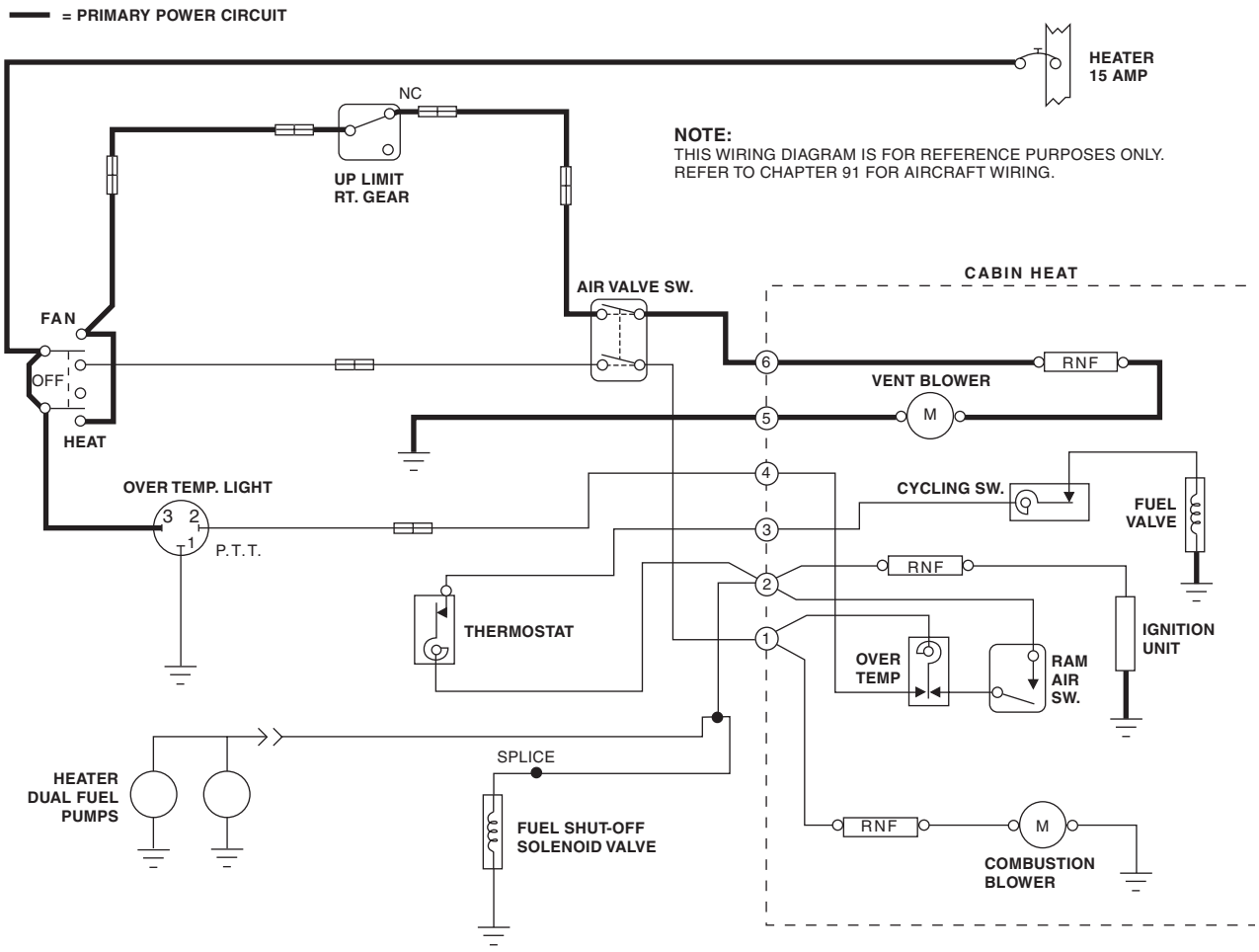
Wiring Diagram
Figure 6

(l) Turn the master switch and the HEATER switch ON. 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.

NOTE: 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.

(m) Place the heater switch in the FAN position. The heater should stop operating 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 stop operating.

(n) With the air intake CLOSED, turn ON the HEATER switch. The heater should not ignite and the blower should not operate.



Primary Power Circuit
Figure 7

(o) Turn OFF the HEATER switch and master switch.

(p) Remove the pressure gauge and “T” fitting and reconnect the fuel line.

(2) In Flight

(a) Check that while climbing out, the ventilation blower does not operate.

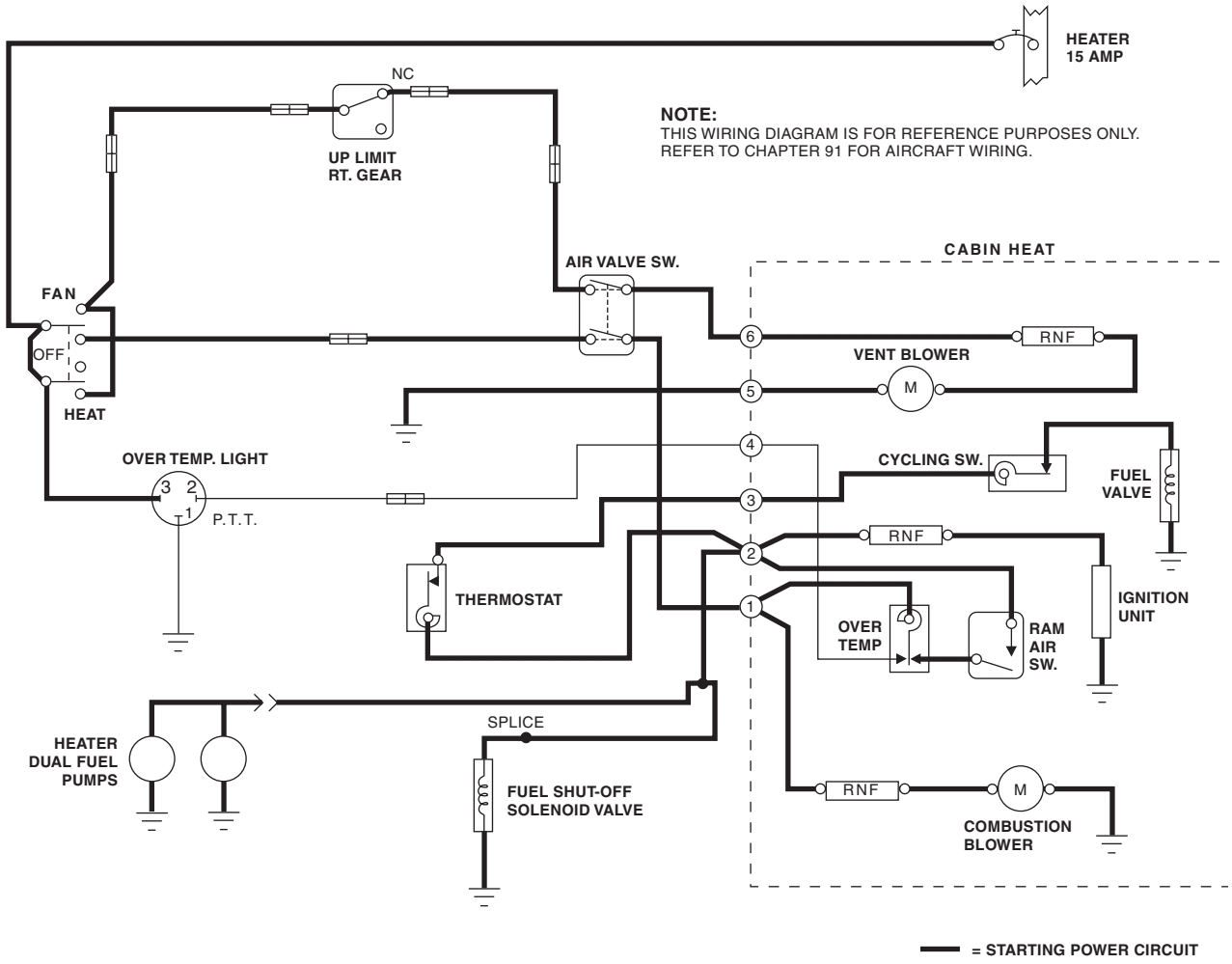
(b) Place the defroster blower switch ON. Air should flow from the defroster vent openings.

D. Electrical System Checks

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

NOTE: The schematic wiring diagrams (Figures 6, 7 and 8) show, in addition to the heater circuitry, the aircraft control circuit. For the purposes of this manual, the circuitry shown in these illustrations will be used 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.



Starting Power Circuit
Figure 8

In the event that voltage is not present at one or more of the following 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.

(1) Vent Blower Power Circuit

With the HEATER SWITCH in the FAN position, voltage (14 volts nominal) should be present at the following locations: (See Figure 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.

(2) Heater Power Circuit

With the HEATER SWITCH in the HEAT position, voltage should be present at the following locations: (See Figure 8.)

NOTE: Power for the ventilating air blower is the same as described, 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 terminal strip through the cycling switch to the fuel solenoid valve.

E. Removal (See Figure 2.)

(1) Ascertain that all heater controls are off.

(2) Remove the screw in the nose, lower nose cone to gain access to heater.

(c) Disconnect the heater outlet duct from the heater manifold by removing the attachment screws.

(d) Remove the clamp from the intake valve control cable and disconnect the control cable from the intake valve.

(e) Note the hookup of the electrical leads to facilitate reinstallation. Disconnect the leads from the heater terminal block.

(f) 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.

(g) Disconnect the fuel and water drains from the bottom of the heater and allow them to slide down.

(h) Disconnect the combustion air blower inlet hose from the blower assembly by removing the cotter key and clevis pin at the blower.

(i) Loosen the clamps from around the heater and remove the heater from the airplane. The exhaust shroud should remain in the airplane.

(j) With the heater removed, the necessary maintenance may be performed as required.

F. Installation (See Figure 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.

(c) 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.

(d) 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.

(e) Connect the fuel and water drain lines to the bottom of the heater.

(f) Connect the fuel supply line to the heater and cover over the fuel shroud and secure with two screws.

(g) Attach the intake valve control cable to the intake valve and install the clamp.

(h) Connect the electrical leads to the heater terminal block on the heater as shown in Figure 2.

(i) Check the operation of the heater.

(j) Lift the nose cone up and secure with appropriate screws.

4. Components

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.

A. 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.

(2) 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.

(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.

(3) Replacing Motor Brushes

(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.

B. Spark Plug

(1) Removal (See Figure 16.)

(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.

(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) Installation (See Figure 9.)

(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 (No. 39 in Figure 16) in the heater jacket opening.

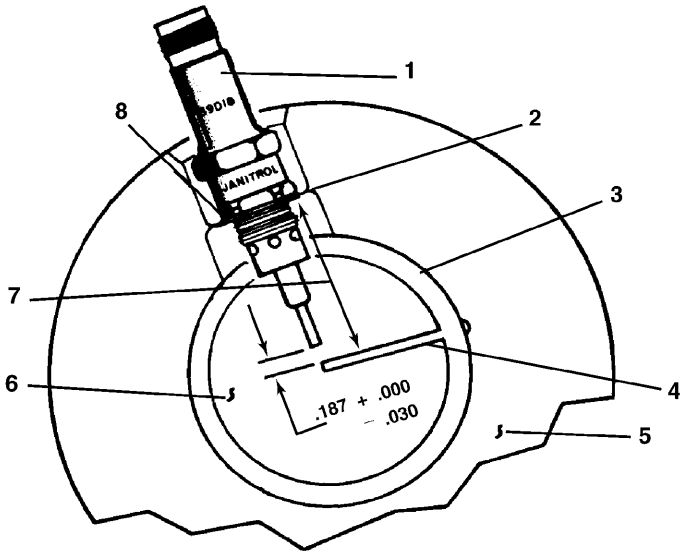
(e) Carefully insert the spring connector on the high voltage lead into the spark plug shell, press down gently and start the nut on the threads. Tighten the nut to 20 foot-pounds.

(f) Operate the heater to check dependability and close all access openings.

(3) Inspection and Servicing

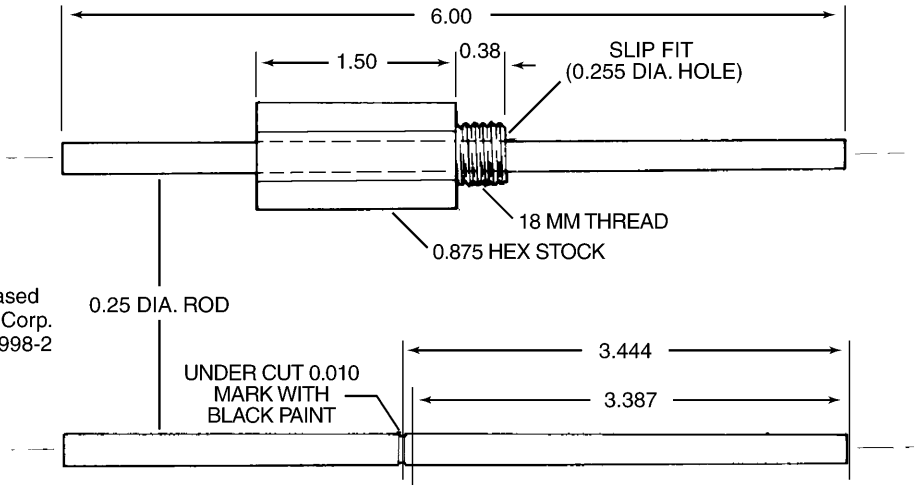
If the spark plug appears to be in good condition, except for a mild coating of oxide on the porcelain and electrodes, it may be cleaned and reused. Cleaning is accomplished on a conventional airplane type spark plug cleaner, except that it will be necessary to use two or more adapters in order to raise 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.



1. SPARK PLUG
2. SEATING SURFACE
3. COMBUSTION TUBE ASSY
4. GROUND ELECTRODE
5. JACKET ASSEMBLY
6. COMBUSTION HEAD ASSY
7. MEASURE
8. GASKET

GAUGE FOR LOCATING GROUND ELECTRODE IN JANITROL HEATERS



NOTE
This tool can be purchased from New Piper Aircraft Corp. under Piper Part No. 55998-2

Material Can Be SAE TYPE 303, 321, or 347 STAINLESS STEEL or ALUMINUM - Case Hardened

Spark Plug Gap Adjustment
Figure 9

(4) Spark Gap Check and Adjustment (See Figure 9.)

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.

(a) Method I

1 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.)

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

3 Recheck the gap after repositioning of the ground electrode.

(b) Method II

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

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

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

(c) Method III

1 Fabricate or purchase from Piper the special tool from dimensions given in Figure 9.

2 Install the threaded end of the tool into the spark plug hole.

3 Slide the rod of the tool into the combustion head until it contacts the ground electrode.

4 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. Heliarc tack weld the rivet head to hold it in place.
4. Check spark gap as noted in Methods I or II.

C. 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.

(1) Removal (See Figure 16.)

NOTE: Make sure heater electrical circuits are de-energized.

(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 (See Figure 16.)

(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.

(3) Inspection

Inspect components as follows.

(a) 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 the above conditions.

(b) Ignition Coil - Inspect for broken bakelite, carbon tracks, oil leaks, and dents in coil cover. Replace for any of the above conditions..

(4) Testing

(a) Set-up

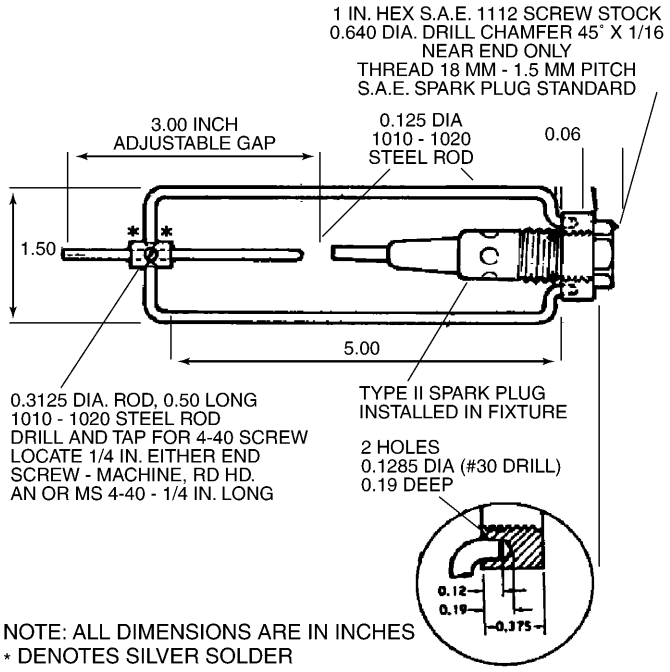
The following test will indicate whether or not the unit is operational and whether the vibrator should be replaced before reinstallation in the aircraft. The following equipment is required to test the components:

1 A battery that will supply power at approximately 14 volts DC.

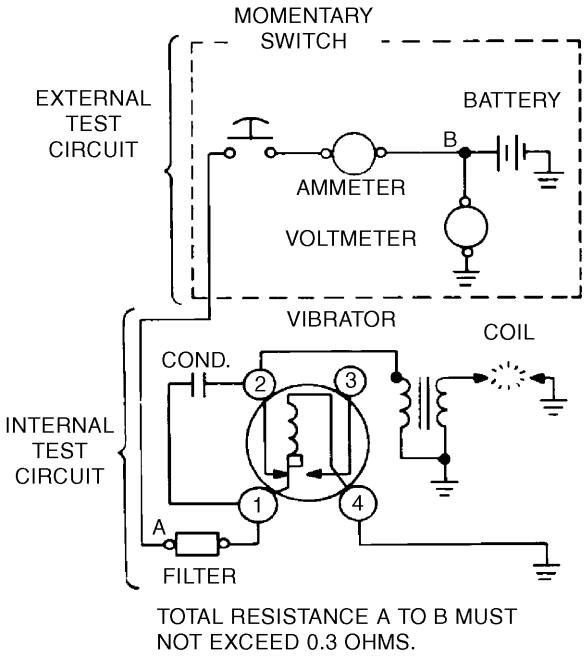
2 A voltmeter with a range of 0-15 volts.

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.



Spark Plug Fixture
Figure 10



Wiring - Test Setup
Figure 11

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. (See Figure 10 to fabricate this fixture.)

NOTE: Any one of several spark plugs may be used with the spark plug fixture detailed in Figure 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 11.

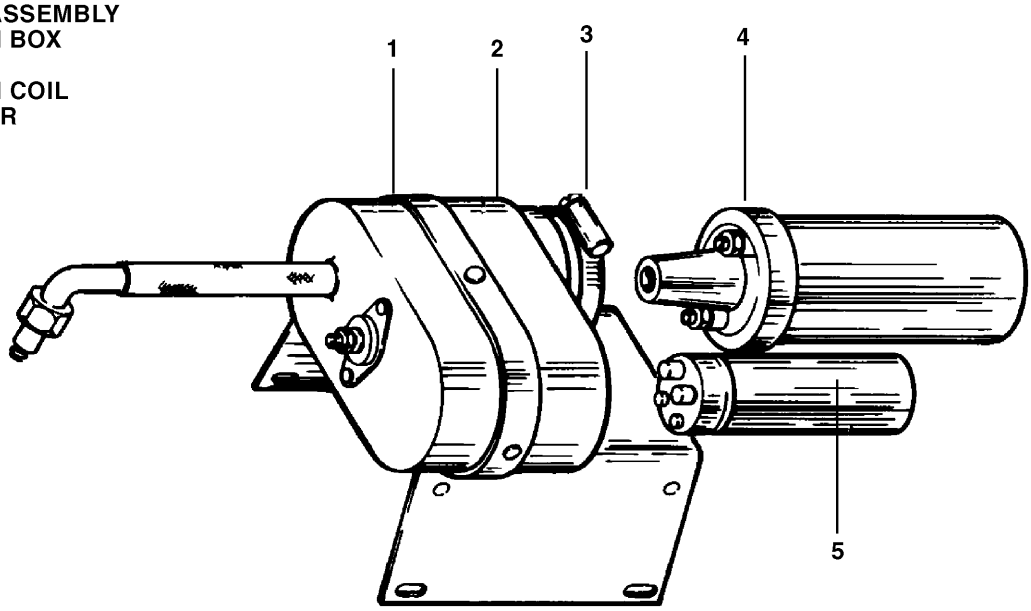
(b) Procedure

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.

A269

1. COVER ASSEMBLY
2. IGNITION BOX
3. CLAMP
4. IGNITION COIL
5. VIBRATOR



Ignition Unit Assembly
Figure 12

(4) Vibrator (See Figure 12.)

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.

(a) Removal

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.

(b) Installation

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

2 Secure with the clamp.

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

D. Cycling Switch and Limit (Overheat) Switch (See Figure 16.)

(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

(a) Install the limit switch and spacers (gaskets) by placing them in position in the heater jacket pening and installing two screws.

(b) Tighten screws securely; then reconnect the electrical leads in accordance with markings made during disassembly. (See wiring diagram, Figure 6.)

(c) Install the cycling switch (see Figure 16) 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. (See wiring diagram, Figure 6.)

E. Combustion Air Pressure Switch (See Figure 16.)

(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.)

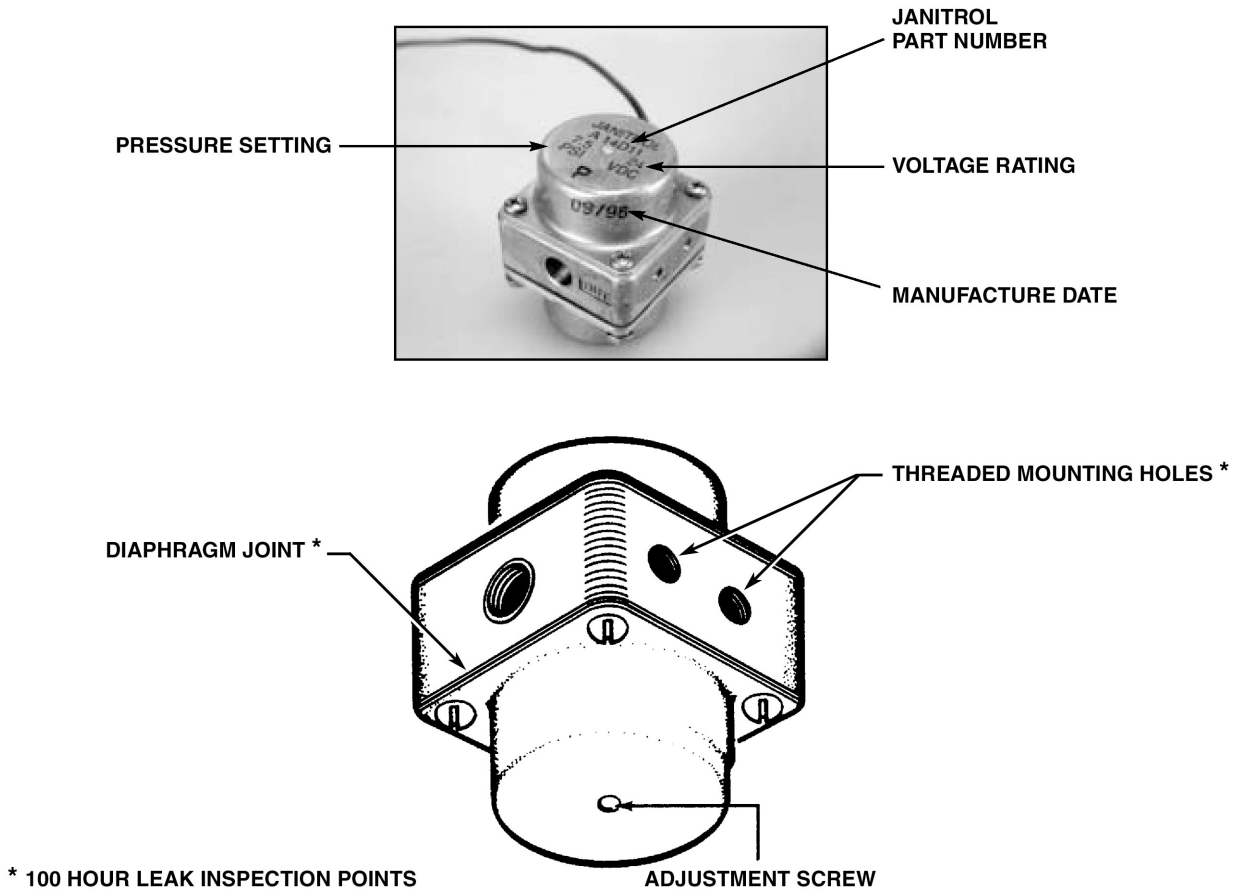
(b) Unscrew and remove the combustion air pressure switch from the fitting on the combustion air inlet tube.

(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 6. Connect the tube to the switch cap.

(c) Check for proper heater operation.



Fuel Regulator and Shutoff Valve
Figure 13

F. Fuel Regulator and Shutoff Valve (See Figure 13.)

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

(1) 100-Hour Inspection

Visually inspect the valve body for signs of fuel stains, paying careful attention to the diaphragm joint and the threaded mounting holes located in sides of the valve body (See Figure 3). Fuel leakage may appear as a greenish blue stain or residue in the area of the diaphragm joint or threaded mount hole. Use supplemental lighting, if needed, to facilitate visual inspection. Visual inspection must include all four sides of the regulator valve body. If signs of fuel leakage are found, then replace the valve with a new valve of the appropriate part number with a manufacture date code of 02/02 or later. Record valve replacement in the logbook.

(2) Removal

(a) Ascertain that the left fuel tanks are empty and the fuel selector controls are in the OFF position.

(b) Gain access to the regulator and disconnect the electrical leads from regulator and shutoff valve.

(c) 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.

(3) Installation

(a) 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.

(b) Connect the regulator to the pump and the heater fuel line to the regulator outlet port.

(c) Connect the electrical leads from the regulator.

(d) Operate the heater to make sure the unit is functioning properly.

(4) Adjustment

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:

(a) Install the regulator in a test stand similar to that shown in Figure 14.

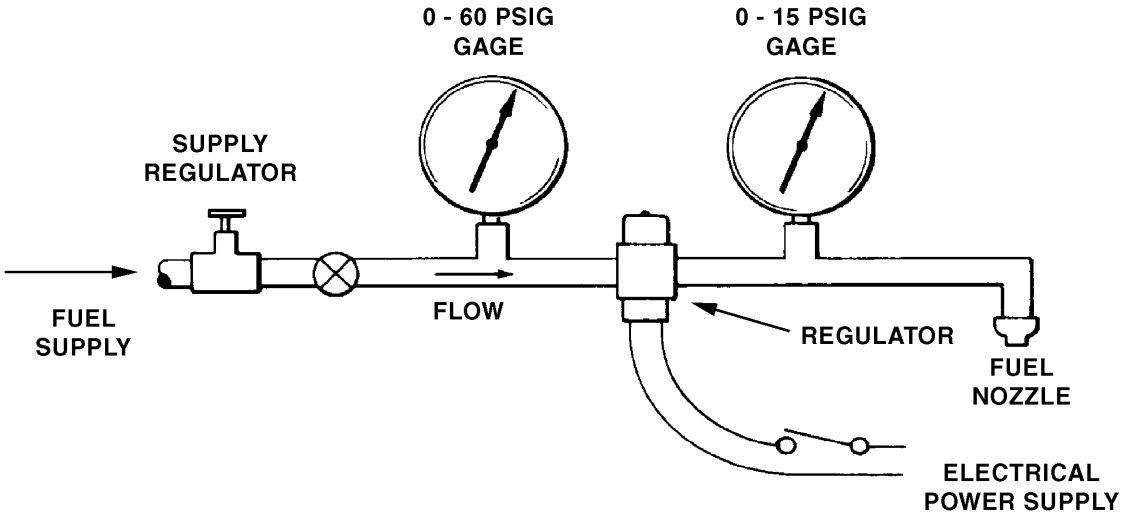
(b) Install a 2.0 gph nozzle (Janitrol Part No. C08D09). Gasoline or Stoddard solvent can be used for testing.

(c) Apply fluid pressure from fuel pump and energize the solenoid. Outlet pressure should be 7.0 ± .5 psi, if not, correct accordingly.

(d) Using a screwdriver, break the seal over the adjustment screw and adjust the regulated outlet pressure to 7.0 ± .5 psi. (Turn clockwise to increase pressure or counterclockwise to decrease pressure.)

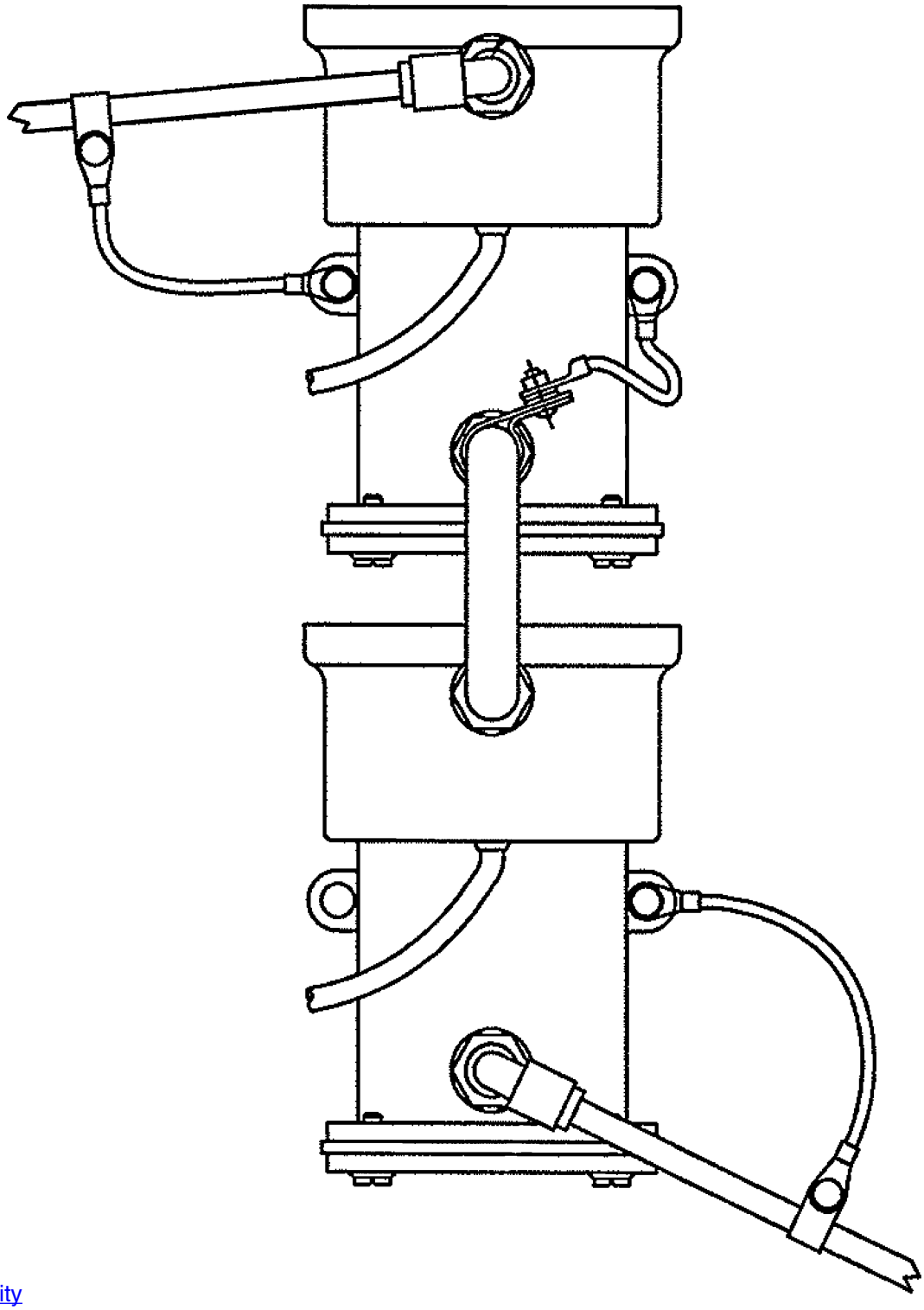
(e) De-energize and energize the solenoid at least twice. The outlet pressure should be 6.5 to 7.5 psi with the solenoid energized. When the solenoid is de-energized, the pressure should drop to zero and the fuel now from the nozzle should stop.

(f) 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.



Test Setup for Fuel Regulator and Shutoff Valve
Figure 14

TOP



Effectivity
4496038 & up; and,
4496001 thru 4496037 with
Kit No. 766-686 installed

Heater Dual Fuel Pumps
Figure 15

G. Heater Fuel Pumps

(1) Single Fuel Pump (S/N's 4496001 - 4496037 only.)

Maintenance required for the factory-installed single fuel pump, in S/N's 4496001 through 4496037 only, consists of inspecting the pump for worn or broken parts. Retaining the single pump is acceptable as long as it is serviceable. If parts are worn or broken, replacement with Piper Kit No. 766-686 (dual fuel pumps) is required.

(a) Removal

The fuel pump is located on the upper left side of the forward bulkhead assembly. Access is achieved by lowering the nose cowl.

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.

(b) Installation

NOTE: In S/N's 4496001 through 4496037 only, the original equipment single fuel pump is no longer available. If replacement is required, install new dual fuel pumps with Kit No. 766-686.

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 the nose cowl and secure it.

(2) Dual Fuel Pumps (See Figure 15.)

(S/N's 4496038 and up; and, 4496001 thru 4496037 with Kit No. 766-686 installed.)

Maintenance required for the dual fuel pumps consists of a visual inspection for worn or broken parts. Replace dual fuel pumps if worn or broken parts are found.

(a) Removal

The combustion heater dual fuel pumps are located on the upper left side of the forward bulkhead assembly. Access is achieved by lowering the nose cowl.

1 Ascertain that the left fuel tanks are empty and the fuel selector controls are in the OFF position.

2 Disconnect the electrical leads from the pumps.

3 Disconnect the fuel line from the inlet end of the lower pump and the regulator from the upper pump outlet. Cap all open fuel lines to prevent contamination.

4 Remove the bolts which secure the pumps to their mounting bracket; remove the ground wires from the bolts.

(b) Installation

1 Position the dual fuel pumps on the forward bulkhead assembly and secure in place with bolts.

2 Connect the regulator to the upper pump outlet and the fuel line to the lower pump inlet.

3 Connect the electrical leads from both pumps; connect the three ground wires.

4 Turn on the heater to verify that both pumps are functioning properly.

5 Check all of the combustion heater fuel lines and fittings for any leaks.

6 Replace the nose cowl and secure it.

H. Duct Switch (See Figure 5.)

(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:

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.

5. Overhaul

Each 1500 hours or whenever the pressure decay test is failed, overhaul the heater assembly. See Janitrol Maintenance and Overhaul Manual, P/N 24E25-1.

6. Heater Hourmeter (See Figure 17.)

A. Removal

(1) Remove thes 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.

(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.

B. Installation

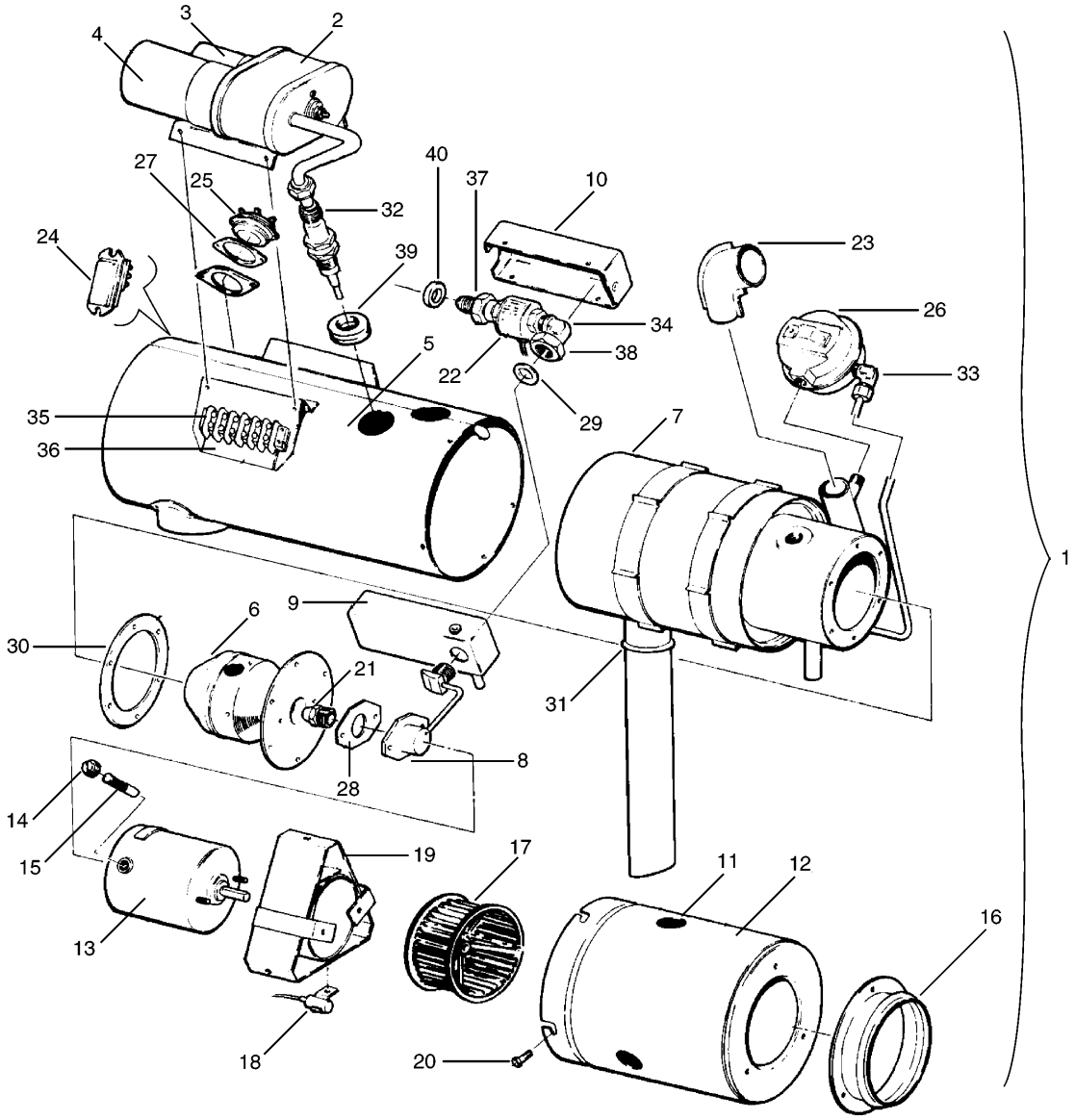
(1) Position clamps on hourmeter as indicated in Figure 17.

(2) Secure first clamp to ignition assembly bracket using screw MS35206-242.

(3) Secure second clamp to ignition assembly using remaining screws.

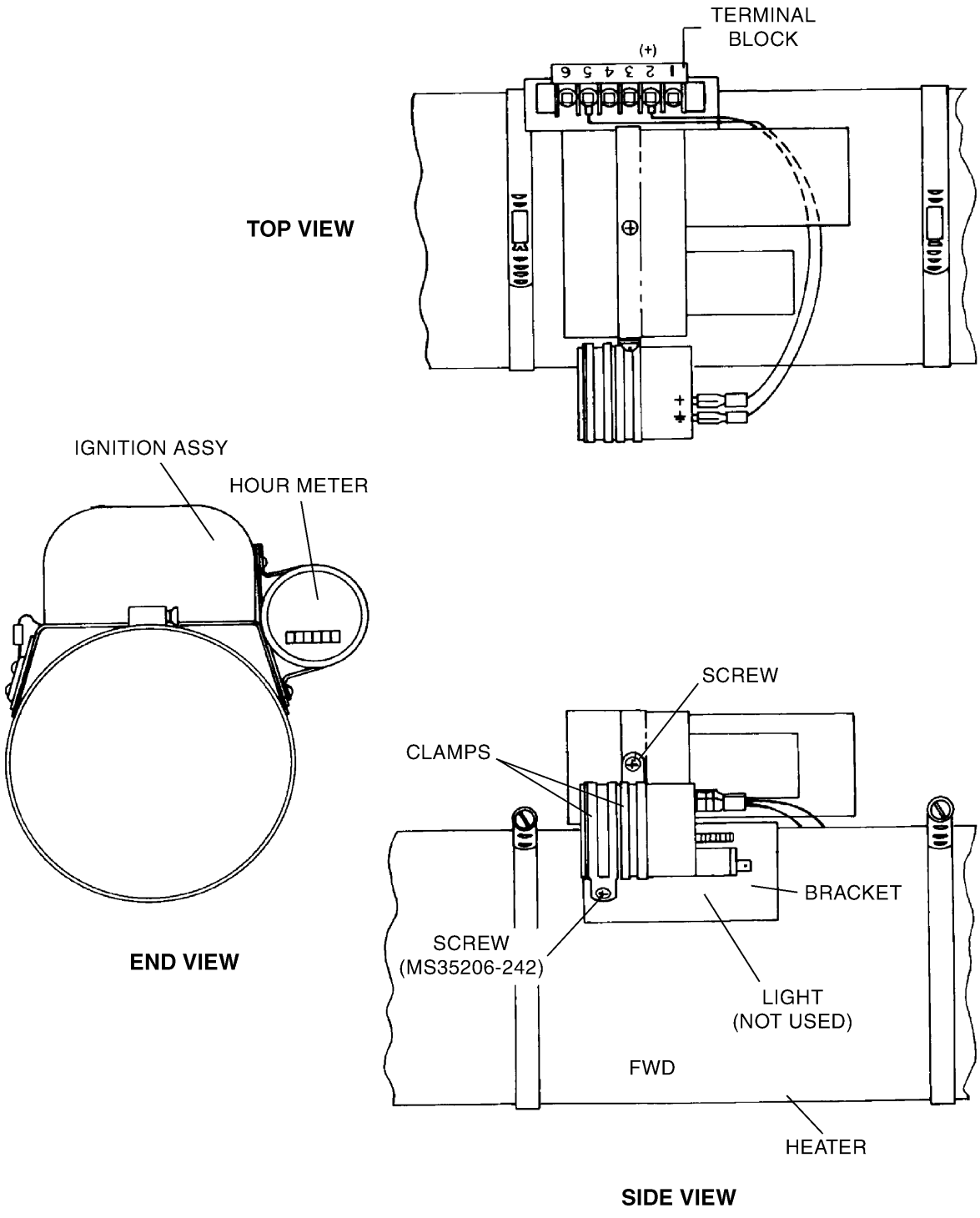
(4) Attach wire assemblies to rear of gauge.

(5) Raise nose cone into position and secure.



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

Exploded View of Heater Assembly
Figure 16



Heater Hourmeter Installation
Figure 17

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CHAPTER

22

AUTOFLIGHT

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CHAPTER 22

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CHAPTER 22 - AUTOFLIGHT

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AUTOPILOT

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. SEE INTRODUCTION, SUPPLEMENTARY PUBLICATIONS.

1. General

An Autopilot/Flight Director (APFD) system is installed as optional equipment in PA-44-180 Seminoles.

A. S/N's 4496001 thru 4496029 (1995 - 1998)

A Bendix/King Autopilot/Flight Director (APFD), manufactured by then Allied Signal (now Honeywell), was installed these airplanes. Maintenance information for those systems is not included in this manual. Follow the service literature published by the AP/FD equipement manufacturer. This includes mechanical service such as: adjusting bridle cable tension, servo removal and installation, servo clutch adjustments, etc.

King/Allied Signal technical support, parts support, and service literature can be obtained from:

Honeywell
One Technology Center
23500 W. 105th St., M/D #45
Olathe, Kansas 66061-1950
http://www.bendixking.com/

B. S/N's 4496030 and up (1999 and up)

The S-TEC System 55/55X is installed in these airplanes. Maintenance information for these systems only is provided herein.

2. S-TEC System 55/55X (1999 and up)

A. S-TEC System 55 (1999 - 2000)

This system is installed as optional equipment in S/N's 4496030 through 4496042 only.

B. S-TEC System 55X (2001 and up)

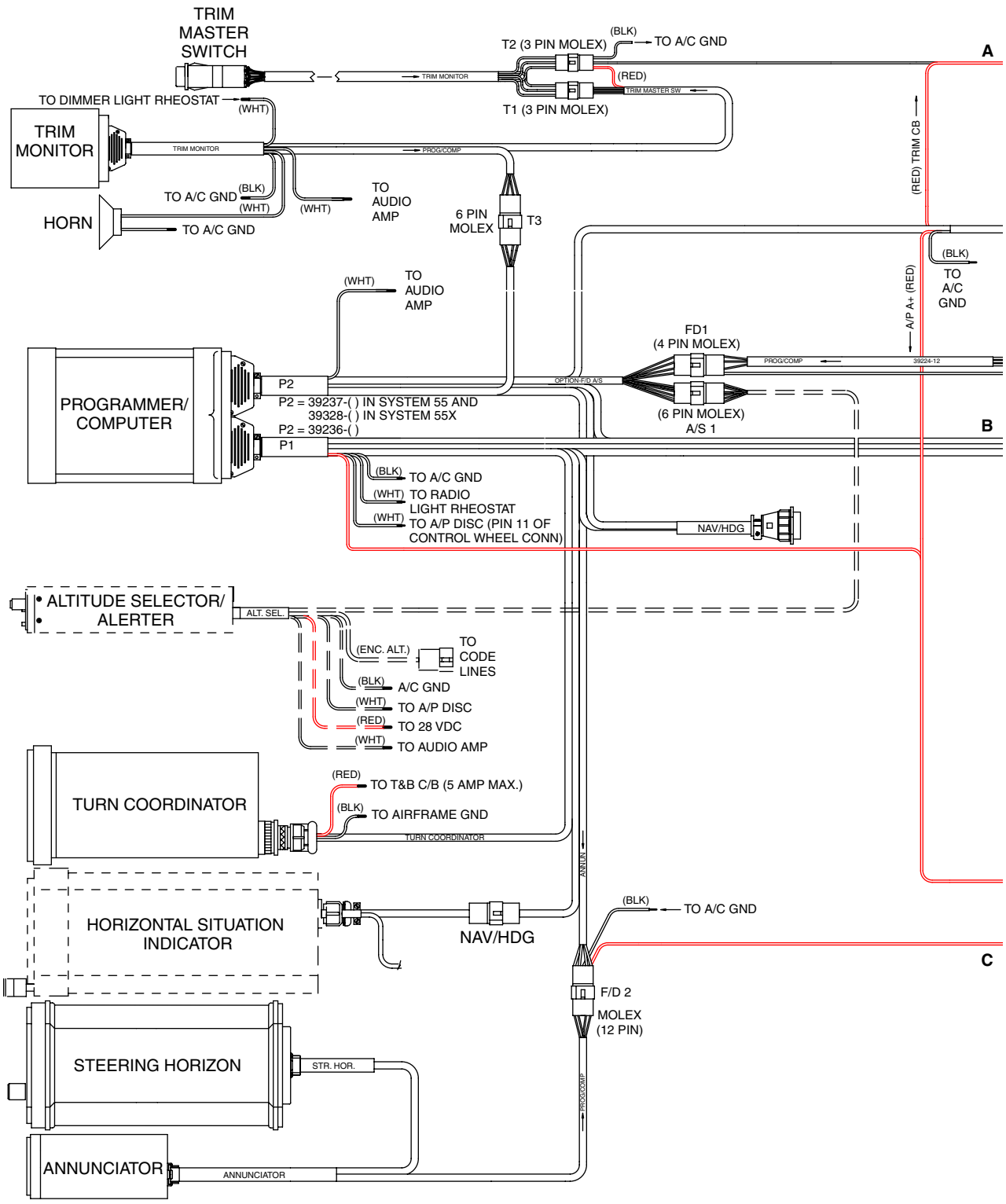
This system is installed as optional equipment in S/N's 4496043 and up.

C. Description (See Figure 1.)

NOTE: In S/N's 4496174; and, 4496224 and up, for airplanes equipped with the Avidyne Entegra EFIS (see 34-20-00); many of the individual components listed below (i.e. - HSI, Deviation Indicators, etc.) are replaced by the Primary Flight Display (PFD). See Figure 1 and the Avidyne AFM Supplement.

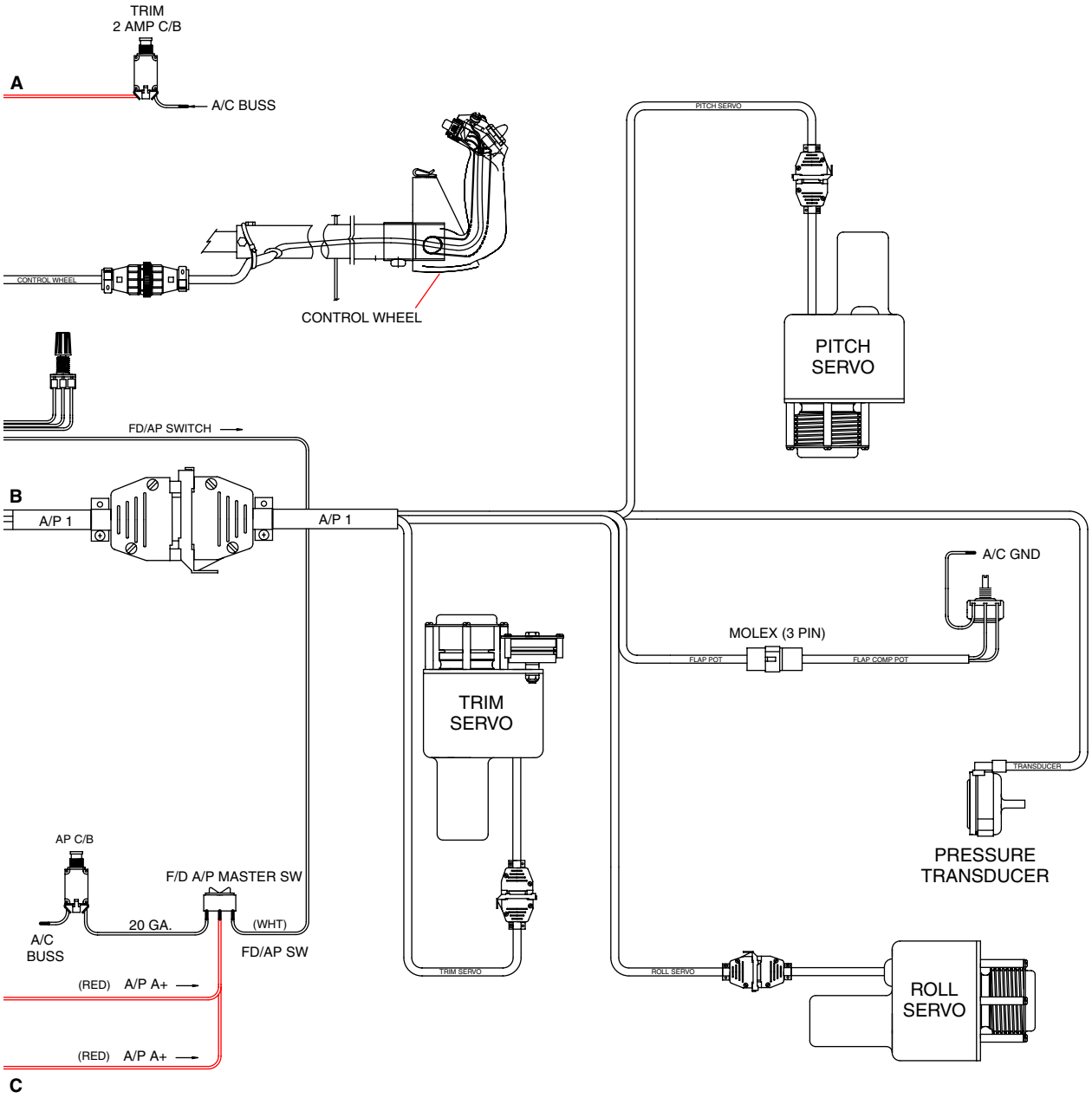
The S-TEC System 55/55X is a rate based autopilot that controls the roll and pitch axis of the aircraft. The autopilot's main function is to convert pilot commands to logic signals for the roll and pitch computers. As the pilot enters the desired mode by pressing the appropriate mode selector switch, the computer acknowledges the mode, causing the appropriate annunciator to illuminate.

The Roll Computer receives select input signals from the Directional Gyro (DG) or Horizontal Situation Indicator (HSI), VHF Omnidirectional Radio (VOR), Localizer (LOC) or Global Positioning System (GPS), Deviation Indicators, and the Turn Coordinator. It then computes roll servo commands for stabilization, turns, navigation intercepts, and tracking.



S-TEC System 55/55X
Autopilot/Flight Director Installation
Figure 1 (Sheet 1 of 5)

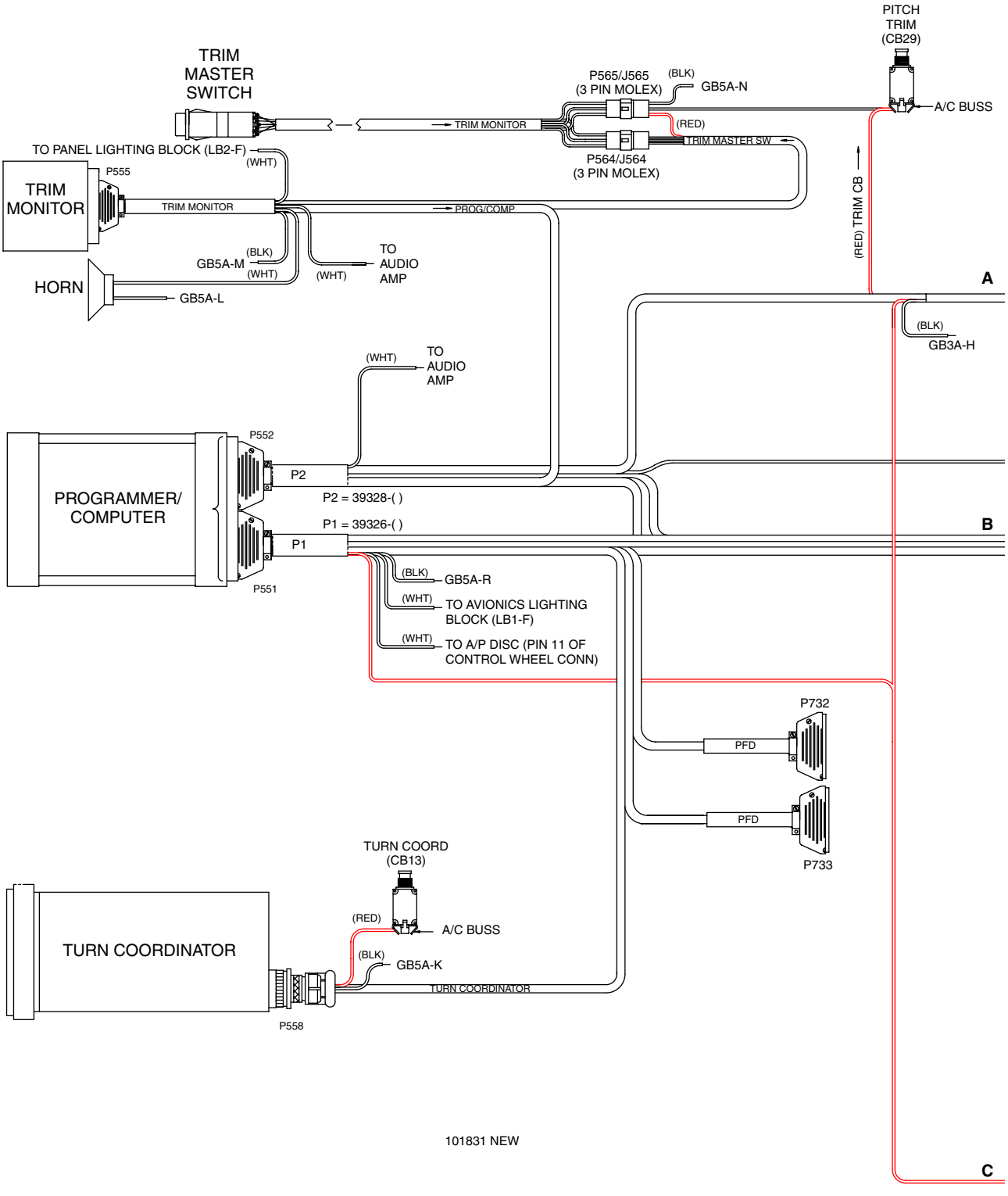
Effectivity
4496030 and up



104085C
104582 K

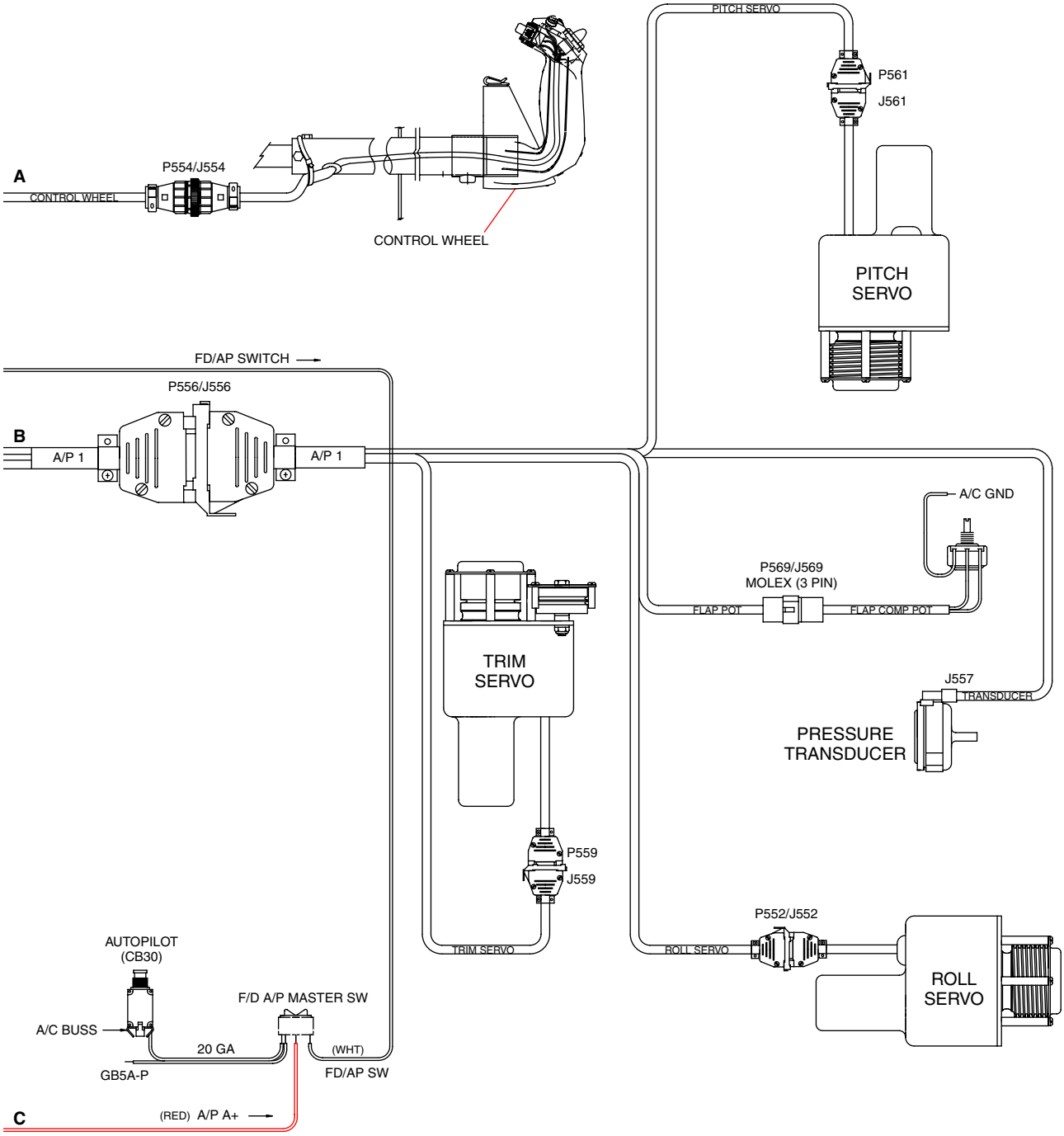
S-TEC System 55/55X
Autopilot/Flight Director Installation
Figure 1 (Sheet 2 of 5)

Effectivity
4496030 and up



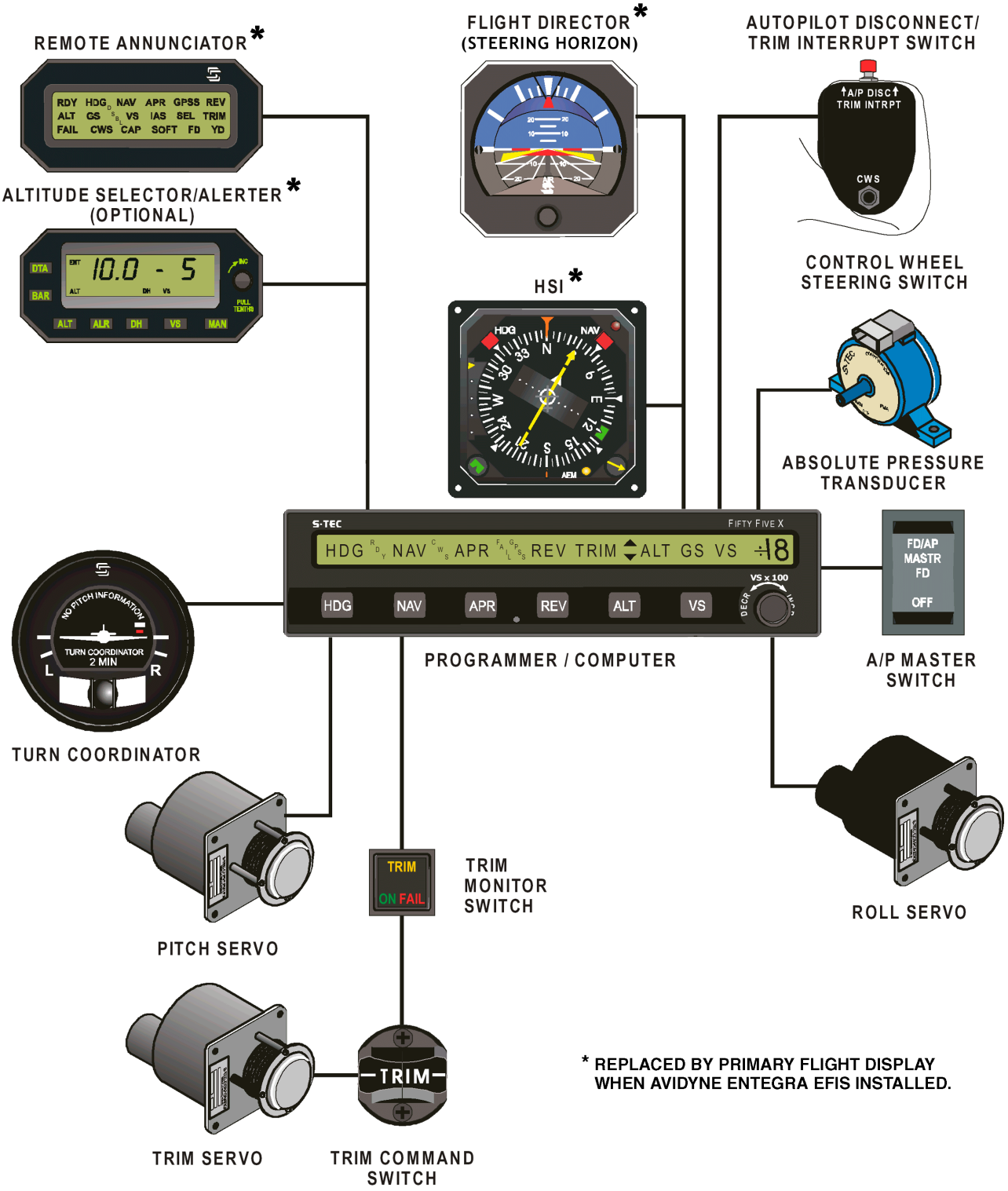
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

S-TEC System 55/55X
Autopilot/Flight Director Installation
Figure 1 (Sheet 3 of 5)



S-TEC System 55/55X
Autopilot/Flight Director Installation
Figure 1 (Sheet 4 of 5)

Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option



S-TEC System 55/55X Autopilot/Flight Director Installation
Figure 1 (Sheet 5 of 5)

The Pitch Computer receives select input signals from the Altitude Pressure Transducer, Accelerometer, Glideslope Deviation Indicator and Altitude Selector/Alerter (if installed). It then computes pitch servo commands for vertical speed, altitude hold and glideslope intercept and tracking. Sensing for trim annunciation or automatic stabilator trim is provided by the pitch servo. Drive for the stabilator trim servo is provided by the pitch computer.

A typical S-TEC System 55/55X Autopilot installation includes the following:

(1) Panel Mounted:

Programmer/Computer, Turn Coordinator, Annunciator, D.G. or HSI, altitude selector/alerter, and Steering Horizon.

(2) Remote Mounted:

Roll Servo, Pitch Servo, Trim Servo, Trim Monitor, A/P Disconnect switch, and Altitude (Pressure) Transducer.

Servo installations use aluminum brackets to secure the servos to the airframe. Attachment to the airplane's primary flight control and trim systems is accomplished with bridle cables and extension attachments.

D. Troubleshooting

System functionality can be determined using functional checks descibed in the AFM Supplement and autopilot Pilot's Operating Handbook. More detailed troubleshooting should be accomplished by authorized S-TEC Dealers, holding the appropriate FAA certification, with required test equipment and service data.

E. GPSS (System 55X only)

The Global Positioning System Steering (GPSS) is a function of the 55X autopilot only. In the GPSS mode, the converter receives ground speed and bank angle digital signals that are calculated and converted to a commanded turn rate. The turn rate is then scaled and converted to a DC heading error signal that is compatible with S-TEC autopilots. The end result is an autopilot that can be directly coupled to the roll steering commands produced by the GPS Navigator, eliminating the need for the pilot to make any further adjustments to the HSI course arrow or the DG's heading bug.

F. System Operation

Operation of the autopilot and other systems is described in the FAA-approved Airplane Flight Manual Supplement (AFMS) - see airplane Pilot's Operating Handbook (POH), Section 9. Specialized controls, annunciation, operation and interpretation are covered in this supplement and in the S-TEC Autopilot POH that supplements the approved AFMS.

G. Maintenance

Except as provided in 5-20-00, servicing and/or maintenance of the autopilot system is On-Condition.

NOTE: Servicing of S-TEC System 55/55X Autopilot installations is best accomplished by approved S-TEC dealers holding the appropriate FAA-certification. Locations of and access to the components installed are described and depicted individually below. Removal and replacement of components is generally indicated by functional checks provided in the AFM Supplement, S-TEC Autopilot POH and/or below.

H. Post-Maintenance Operational Checkout

Complete the following checkout procedure after any maintenance to the system is performed.

NOTE: The System 55X incorporates a SELF-TEST that requires a 100 percent pass rate before the autopilot can be engaged.

NOTE: For airplanes equipped with the optional Avidyne Entegra EFIS (see 34-20-00), references below to the remote annunciator, flight director and HSI are to those functions in the Primary Flight Display (PFD).

(1) Apply aircraft power.

(2) Avionics Master Switch . . . . . ON

(3) Autopilot Master Switch . . . . . Set to FD / AP

NOTE: Observe that all segments of the Programmer/Computer display and annunciators illuminate for five (5) seconds during test. Satisfactory completion of the SELF-TEST is indicated when the Ready (RDY) annunciator remains on at the end of the five (5) second self-test. Should a fault be detected, the FAIL annunciator will remain on at the conclusion of the self-test and the autopilot will not operate.

(4) Trim Master (ON / OFF) Switch . . . . . ON

(5) HDG and VS switches . . . . . PRESS / RELEASE

Ensure that HDG and VS illuminate on the 55X annunciator.

(6) VS Knob . . . . . ROTATE CW

Pitch control (i.e. - the control yoke) should move slowly out (pilot may have to assist a heavy yoke).

(7) VS Knob . . . . . ROTATE CCW

Pitch control should move slowly in.

(8) A/P DISC Trim Interrupt Switch (on control yoke) . . . . . PRESS

Verify the autopilot disconnects.

(9) HDG Mode . . . . . ENGAGE

(10) DG or HSI HDG bug . . . . . MOVE LT / RT

Roll control should follow the HDG bug.

NOTE: If HSI equipped, center the course arrow under the lubber line and push the NAV button. Move the course arrow on the HSI left then right. Roll control should follow the course arrow. Channel a valid VOR signal and move course arrow just enough to deflect the left/right needle one (1) or two (2) dots. Roll control should follow the Course Deviation Indicator (CDI) left/right needle during the test. (This test is only valid if the left/right needle is centered with the course arrow under the lubber line.)

NOTE: If DG equipped, center the HDG bug under the lubber line. Channel a valid VOR signal. Move the OBS to cause left/right CDI needle deflection. The roll control should follow the left/right needle movement.

(11) REV Mode button . . . . . PUSH

Roll control should respond opposite to the course arrow and CDI left/right needle inputs.

(12) Altitude Hold (ALT) button . . . . . PUSH

Slowly pull out (nose up) on the pitch control (i.e. - control yoke). Autotrim should run nose down with TRIM flashing on the remote annunciator and the autopilot computer/programmer after approximately 3 seconds. Slowly move control yoke forward (nose down). After 3 seconds, autotrim should move nose up with TRIM flashing on the remote annunciator and the autopilot computer/programmer after approximately 3 seconds.

(13) Trim Master (ON / OFF) Switch . . . . . OFF

(14) Manual Electric Trim Test:

(a) Trim Master (ON / OFF) Switch . . . . . ON

1 Move the Manual Electric Trim Command Switch FWD and AFT.

Trim should not run.

2 Move both segments of the Trim Command switch FWD.

Trim should run nose down.

3 Move both segments of the Trim Command switch AFT.

Trim should run nose up.

(b) Re-trim aircraft for takeoff and check controls for freedom of movement. Be sure the autopilot and trim servos are disengaged.

(15) Flight Director Test:

(a) Autopilot Master Switch . . . . . SELECT FD

Note that the roll, pitch and trim servos are disengaged. The steering bar should be in view on the attitude indicator.

(b) HDG Mode . . . . . ENGAGE

MOVE HDG bug 45 degrees left. The roll steering bar should slowly indicate a left steering command. Repeat the same test for the right side.

(c) VS Mode . . . . . ENGAGE

SELECT 1500 FPM rate of climb. Note the pitch steering bar moves slowly up. Repeat the same test for the down direction.

(d) Autopilot Master Switch . . . . . SELECT FD / AP

The servos should re-engage.

(e) Trim Master ON / OFF Switch . . . . . ON

(f) Manual Electric Trim Command Switch . . . MOVE FWD or AFT

The autopilot should disconnect.

NOTE: The manual electric trim command switch will disconnect the autopilot only if there is a pitch mode engaged.

I. Components

(1) Panel-Mounted Components

The flight director, HSI, autopilot programmer/computer, altitude selector/alerter (if installed), remote annunciator, and turn coordinator are either face-mounted or rack-mounted in the instrument panel. See 39-10-00 for removal and installation instructions.

For airplanes equipped with the Avidyne Entegra EFIS, the steering horizon, altitude selector and horizontal situation selector components are replaced by the Primary Flight Display (PFD).

(2) Component Locator

See Figure 2.

(3) Trim Monitor

The trim monitor is mounted on brackets to the left side of the fuselage, underneath the instrument panel, see Figure 2.

(a) Removal

1 Remove wiring harness and cables from trim monitor.

2 Remove the four (4) screws and washers that attach the trim monitor to the bracket; remove the trim monitor.

(b) Installation

1 Place trim monitor in position on the bracket and secure with washers and screws (4).

2 Connect cables and wiring harness.

3 Check system operation - perform Manual Electric Trim Test under Post-Maintenance Operational Checkout, above.

(4) Roll Servo (See Figure 3.)

The roll servo is mounted at the far right side of the aircraft under the floor panel below the passenger seat. Access it from the baggage door.

(a) Removal

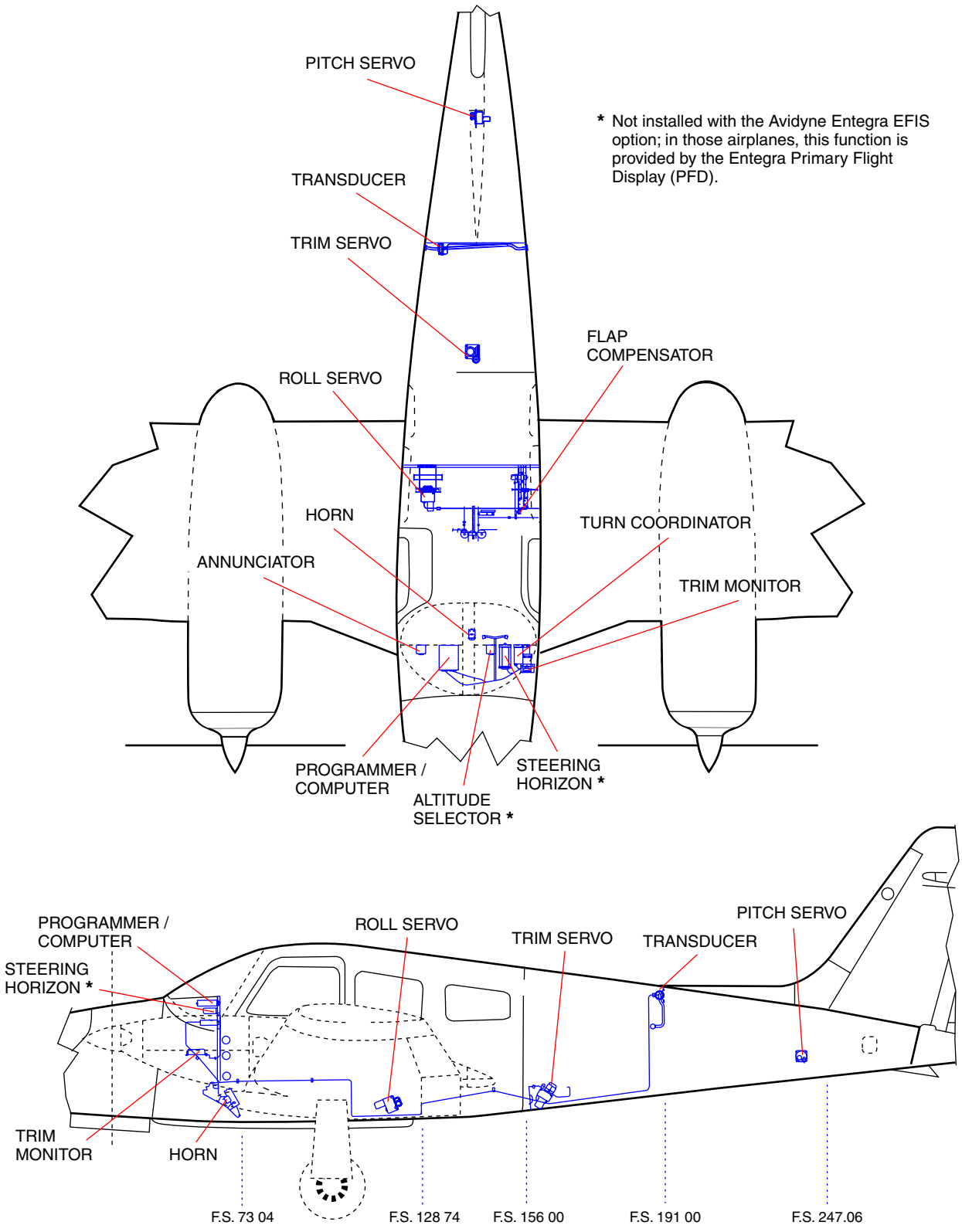
1 Remove the passenger seats.

2 Remove underlying carpet and floor panel.

3 Disconnect wiring harness and cables from the roll servo.

4 Remove nuts and bolts (2 ea.) securing each cable clamp (2) and remove cable clamps from aileron balance and autopilot bridle cables.

5 Remove nuts, washers, and bolts (4 each) securing roll servo to mounting bracket and remove roll servo with attached bridle cable.



Component Locator
Figure 2

(b) Installation

1 Rig ailerons per Aileron Control Rigging and Adjustment, 27-10-00.

2 Place the control column tee bar in full forward position, maintaining that position using a suitable tool or by placing weights on the aft side of the stabilator (if stabilator cables have been previously tensioned).

3 Lock the ailerons in neutral (i.e. - aligned with flaps) position using a suitable contour fixture at the inboard ends of the ailerons and the outboard ends of the flaps. Verify control wheels are centered and secure in that position.

4 Remove screws (4) and remove capstan cover and cable guards from servo.

5 Adjust roll servo clutch torque per Servo Clutch Torque Adjustment, below.

6 Wrap autopilot bridle cable, align capstan, and and tighten centerball setscrew as shown in Figure 3.

7 Replace cable guards and capstan cover, secure with screws (4).

8 Position servo on the mounting bracket as shown in Figure 3 and secure it with bolts (4 ea.), washers (8 ea.), and nuts (4 ea.).

9 Position cable clamps as shown in Figure 3 and tighten nuts and bolts (2 ea.). Adjust cable clamps in or out along the aileron balance cable to obtain a bridle cable tension of 15 ± 2 lbs. Torque cable clamp bolts as specified in Figure 3.

10 Remove the locking fixtures at the inboard ends of the airlerons. Aileron neutral (i.e. - aligned with flaps) position should be maintained with the control wheels in neutral. A droop of 1/8 inch is allowable.

11 Remove the control wheel/tee bar locks. Check to insure that the left aileron up and right aileron down stops are contacted simultaneously and vice versa. Adjust stops as required.

12 Rotate the left (pilot's) control wheel in each direction until the bellcranks contact the stops. The sprocket stops on the tee bar shall not be contacted until additional “override" movement (cushion) of the wheel occurs. A "cushion" on 0.030 to 0.040 inches is to be maintained as measured between the sprocket pin and adjustable control wheel stop bolts.

13 Place the ailerons in the neutral (aligned with the flaps) position. For each aileron, from the neutral position, check that the "up" travel and the "down" travel are within the limits shown in Figure 6, 27-00-00:

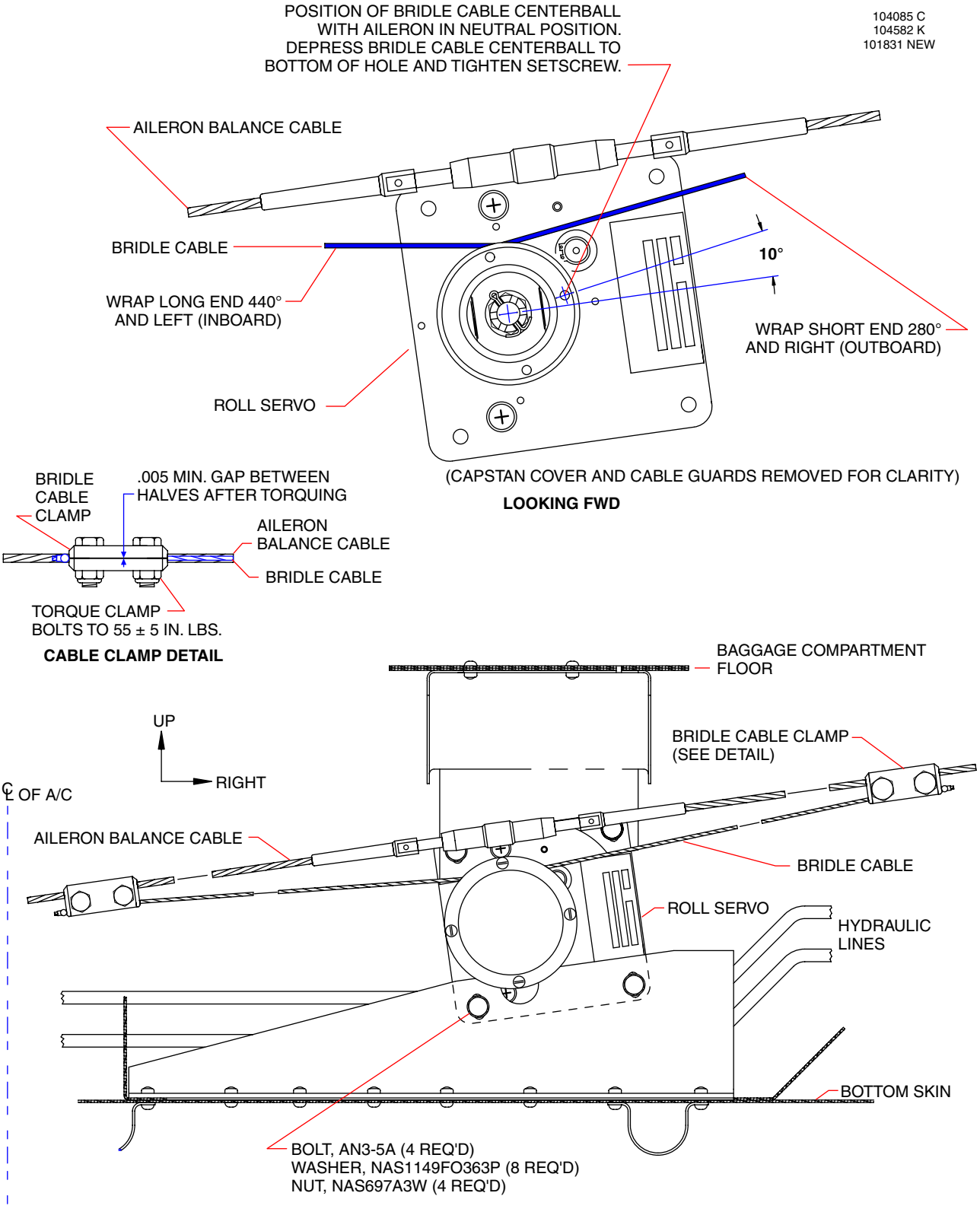
a Center bubble of a protractor over surface of aileron at neutral position. Note reading.

b Move aileron full up and down. Check degree of travel in each direction. Degree of travel on protractor is determined by taking the difference between protractor reading at neutral and up, and neutral and down. Bubble must be centered at each reading.

When measuring "down" travel from the neutral position, a light "up" pressure shall be maintained at the center of the aft edge of the aileron. When measuring "up" travel from the neutral position, a light "down" pressure shall be maintained at the center of the aft edge of the aileron (at the "up" position only), just sufficient to remove the slack between the bellcrank and the aileron. Total free play measured at the aileron trailing edges shall not exceed 0.120 inches.

14 If steps 10 thru 13 reveal the aileron controls out of rig, repeat steps 1 thru 9.

15 Connect autopilot harness.



Roll Servo Installation
Figure 3

16 Check aileron controls for free and correct movement.

17 Perform Post-Maintenance Operational Checkout, above.

18 Replace floor panel and secure with screws.

19 Replace carpeting.

20 Replace the passenger seats.

(5) Pressure Transducer

The pressure transducer is mounted on the upper right forward side of the bulkhead at F.S. 191.00. Access is throught the cabin rear closeout panel.

(a) Removal

1 Disconnect the transducer from the static-system by removing the Ty-rap and pulling the static hose off of the transducer hose barb.

2 Disconnect the autopilot harness.

3 Remove screws (2), washers (4), and nuts (2) and remove transducer.

(b) Installation

1 Place transducer in position. Secure with screws, washers, and nuts.

2 Slide the static hose over the transducer hose barb and secure with a Ty-rap .

3 Connect the autopilot harness.

(6) Trim Servo (See Figure 4.)

The trim servo is located at the airplane centerline just aft of F.S. 156.00, behind the cabin rear closeout panel. The left stabilator trim cable wraps around the servo ilder pulley and the servo capstan.

(a) Removal

1 Remove the closeout panel at the back of the passenger cabin.

2 Remove the baggage compartment carpet and control cable inspection access covers.

3 Tie a pull rope to the left stabilator trim cable exposed beneath the floor panel and fasten the pull rope to structure aft.

4 Tie a pull rope to the left stabilator trim cable aft of the turnbuckle in the rear fuselage aft of the trim servo and fasten the pull rope to structure forward.

NOTE: The pull ropes apply tension to the trim cables to prevent the cables from unwrapping from the trim wheel drum or the trim barrel, and to prevent the cables from fouling at any of the pulleys.

5 Slack-off the turnbuckle in the left stabilator trim cable segment aft of the trim servo sufficient to relieve tension on the left stabilator trim cable as it wraps around the trim servo idler pulley and capstan.

6 Disconnect the autopilot harness.

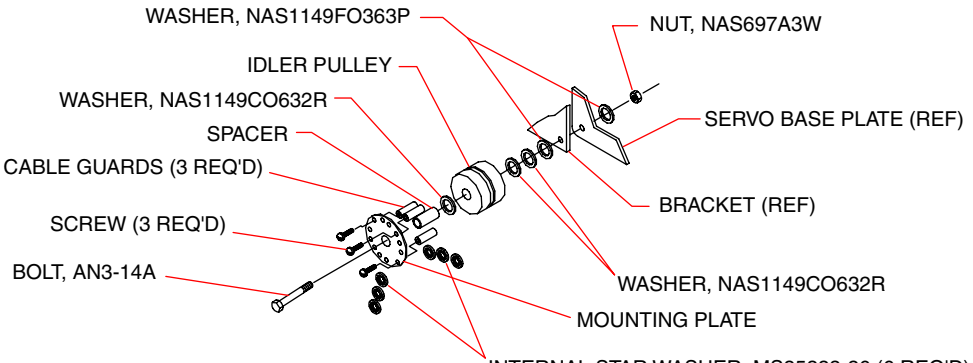
7 Remove the capstan cover and cable guards (4) by removing the retaining screws (4).

8 Remove the bolt, nut, and washer securing the idler pulley to the trim servo baseplate and mounting bracket and remove the idler pulley components.

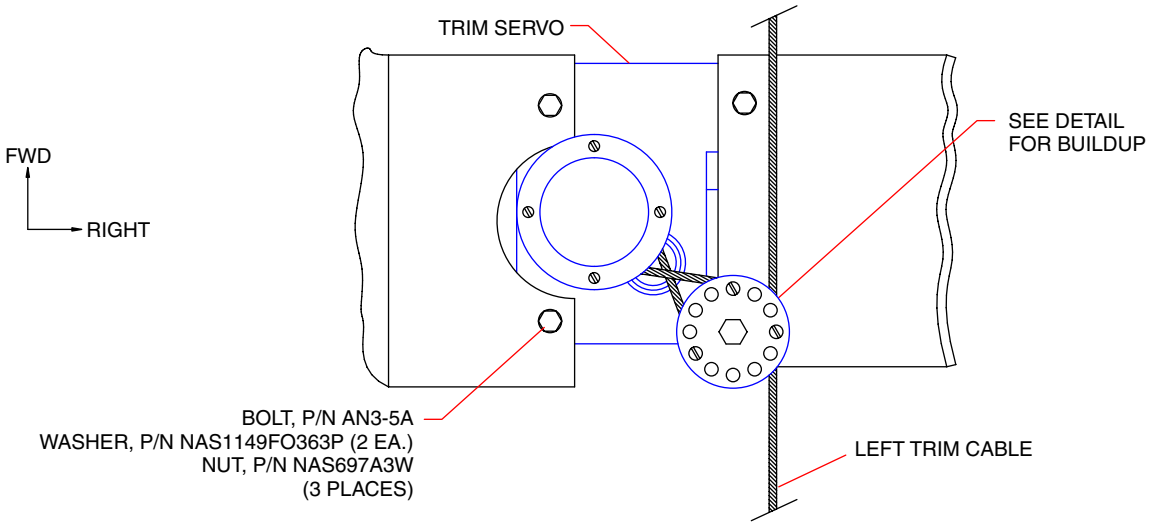
NOTE: The idler pulley breaks down into the following components upon removal of the bolt, above: mounting plate/cable guard assembly, idler pulley, and two washers.

9 Remove the remaining bolts, nuts, and washers (3 ea.) securing the trim servo to its mounting bracket and remove the trim servo.

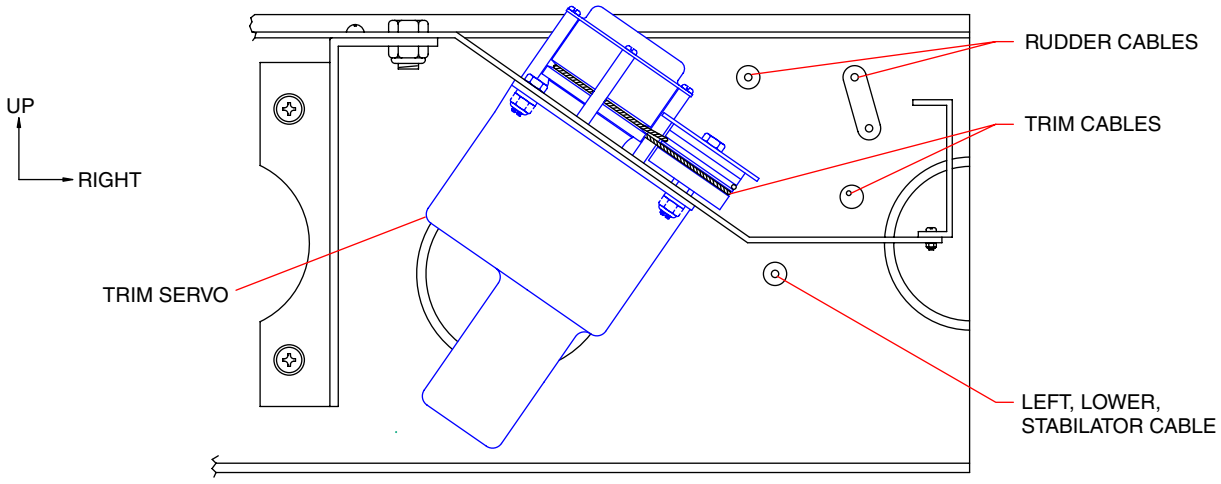
104085 C
104582 K
101831 NEW



IDLER PULLEY BUILDUP DETAIL



LOOKING DOWN AND OUTBOARD



LOOKING FORWARD, AFT OF F.S. 156.00

Trim Servo Installation
Figure 4

(b) Installation

1 Adjust trim servo clutch torque per Servo Clutch Torque Adjustment, below.

2 With the capstan cover and cable guards removed, place the trim servo onto brackets as shown in Figure 4. Secure with bolts, nuts, and two washers (3 places - two forward and aft left).

3 Assemble the idler pulley cable guards (3) to the mounting plate with screws (1 ea.) and star washers (2 ea.). Place the center bolt through the mounting plate/cable guard assembly and slide a washer over the threaded end and up against the mounting plate. Set aside the assembly.

4 Drape the slack left stabilator trim cable over the servo capstan.

CAUTION: IN STEPS 5 THRU 12 BELOW, THE TERMS “LEFT” AND “RIGHT” ARE FROM THE VIEW OF THE TECHNICIAN IN THE CABIN BAGGAGE AREA LOOKING AFT, EXCEPT WHERE AIRPLANE COMPONENT PARTS ARE SPECIFICALLY NAMED.

5 Place thumb and forefinger on top of the capstan over the trim cable in its groove. Pressing the trim cable into its groove, slide thumb and forefinger down around opposite sides of the servo capstan and pull the trim cable slack away from you and to your left.

6 Holding the trim cable in that position, install the capstan cover and cable guards as shown in Figure 4.

7 Hold the idler pulley forward and above the trim servo and to the right of the airplane’s left stabilator trim cable. Move the idler pulley left and down to the forward segment of the left stabilator trim cable and capture the trim cable underneath the idler pulley in the cable groove on the right.

8 Keeping the trim cable in the groove, slide the idler pulley aft along the trim cable, below and left of the servo capstan, and bring it approximately to its installed position (see Figure 4). At this point, the forward portion of the trim cable should be: routed left, around the rear, to the right of the idler pulley; to the left, around the front, and to the right of the capstan.

9 Holding the idler pulley in this position, reach down and pull the aft portion of the trim cable over the idler pulley and seat it in the cable groove. The left trim cable should now be routed as shown in Figure 4.

10 Place the spacer inside the idler pulley.

11 Position the mounting plate/cable guard/bolt assembly as shown in Figure 4 and slide the bolt through the spacer inside the idler pulley.

12 Place a washer over the bolt end and put the bolt through the trim servo mounting bracket and baseplate. Secure with a nut and washer, taking care to ensure that the cable guards are positioned, and the left trim cable is routed, as shown in Figure 4.

13 Rig stabilator trim per Rigging and Adjustment, Stabilator Trim Controls, 27-30-00.

14 Connect the autopilot harness.

15 Perform Post-Maintenance Operational Checkout, above.

16 Check stabilator trim controls for free and correct movement.

17 Replace cabin closeout panel.

18 Replace control cable inspection access covers in baggage compartment floor and replace baggage compartment carpet.

19 Replace rear seats.

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(7) Pitch Servo (See Figure 5.)

The pitch servo is located at the centerline in the aft fuselage, between bulkheads F.S. 219.06 and F.S. 247.19. Access is through the cabin rear closeout panel.

(a) Removal

1 Attach a tail stand under the tail skid.

2 Remove the cabin rear closeout panel.

3 Crawl into the tailcone to the pitch servo.

4 Disconnect the autopilot harness.

5 Remove nuts and bolts (2 ea.) securing each cable clamp (2) and remove cable clamps from upper and lower stabilator cables and autopilot bridle cable.

6 Remove cotter pin from bridle cable pulley and pull upper portion of bridle cable free of the pulley.

7 Remove nuts and bolts (4 ea.) and washers (8 ea.), securing pitch servo to mounting bracket and remove pitch servo with attached bridle cable.

(b) Installation

1 Rig stabilator controls per Rigging and Adjustment, Stabilator Controls, 27-30-00.

2 Remove screws (4), and remove capstan cover and cable guards from servo.

3 Adjust pitch servo clutch torque per Servo Clutch Torque Adjustment, below.

4 Wrap autopilot bridle cable, align capstan, and tighten centerball setscrew as shown in Figure 5, Sheet 2.

5 Replace cable guards and capstan cover, secure with screws (4).

6 Position pitch servo as shown in Figure 5 and secure to bracket with bolts, nuts, and washers (4 ea.).

7 Lead upper portion of bridle cable through pulley as shown in Figure 5. Reinstall cotter pin.

8 Position cable clamps (2) as shown in Figure 5, and tighten nuts and bolts (2 ea.). Adjust cable clamps in or out along the stabilator cables to obtain a bridle cable tension of 15 ± 2 lbs. Torque cable clamp bolts as shown in Figure 3.

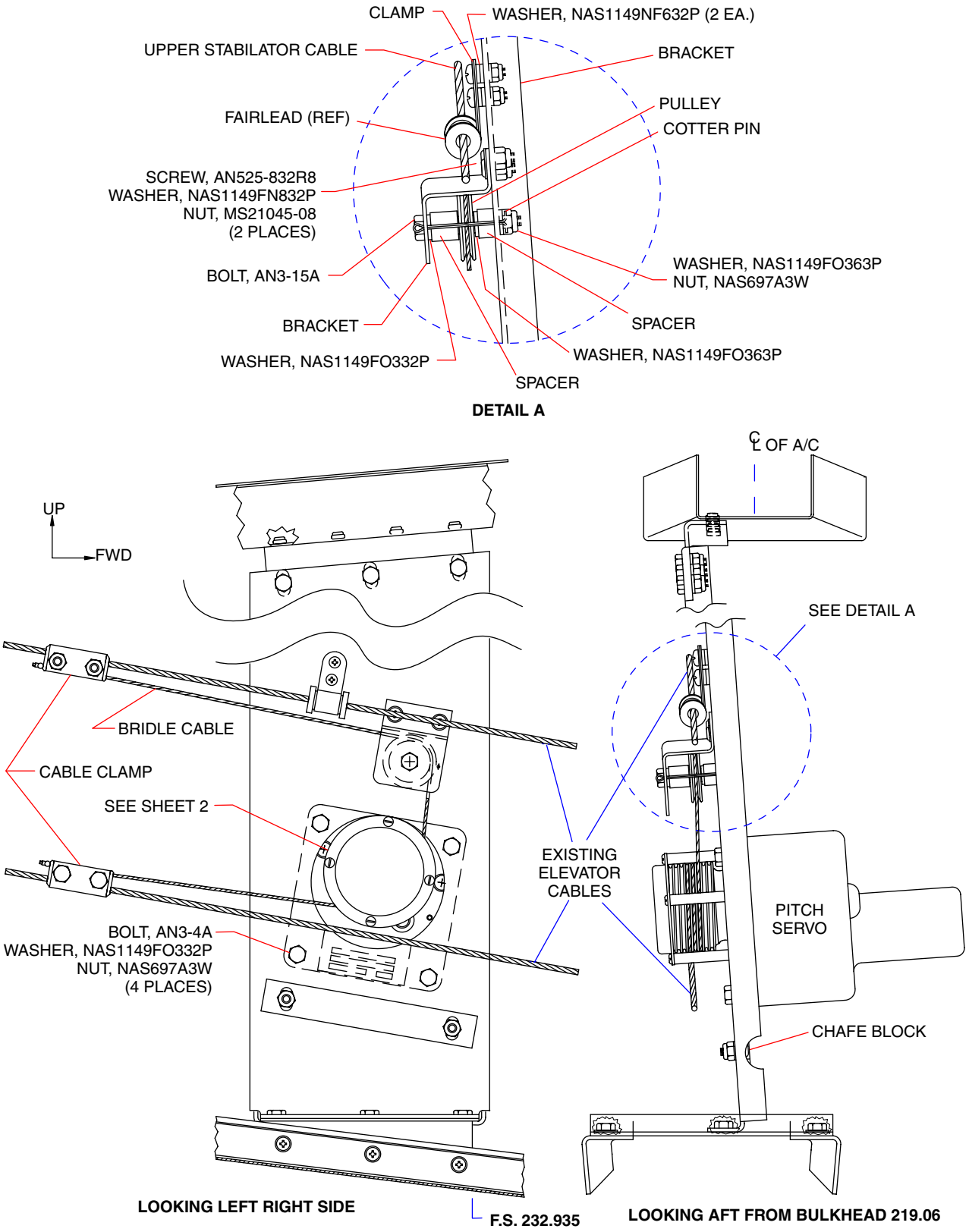
9 Connect autopilot harness.

10 Perform Post-Maintenance Operational Checkout, above.

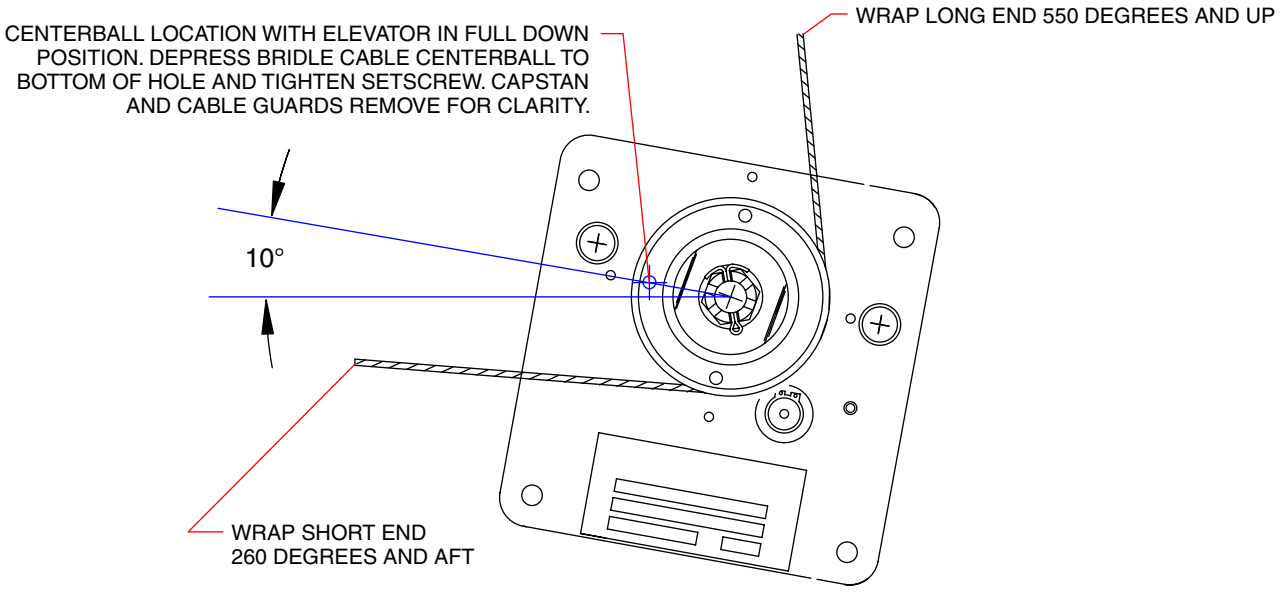
11 Check stabilator controls for free and correct movement.

12 Reinstall and secure the cabin rear closeout panel.

13 Remove tail stand.



Pitch Servo Installation
Figure 5 (Sheet 1 of 2)



PITCH SERVO CAPSTAN WRAPPING
(CAPSTAN COVER AND CABLE GUARDS REMOVED FOR CLARITY)

Pitch Servo Installation
Figure 5 (Sheet 2 of 2)

(8) Servo Clutch Torque Adjustment (See Figure 6.)

(a) Remove servo per instructions under specific servo, above.

(b) Place servo in a holding fixture (i.e. - vice) with capstan up.

(c) Remove capstan cover, cable guards, and cable.

(d) Check capstan torque by attaching the capstan adjusting tool (special tool - see parts catalog) to the capstan and using a currently calibrated torque wrench as shown in Figure 6.

1 Acceptable torque is specified in Chart 1.

2 If adjustment is required, proceed as follows.

(e) Remove cotter pin from end of servo shaft and remove castle nut, shim washers, and tension washers.

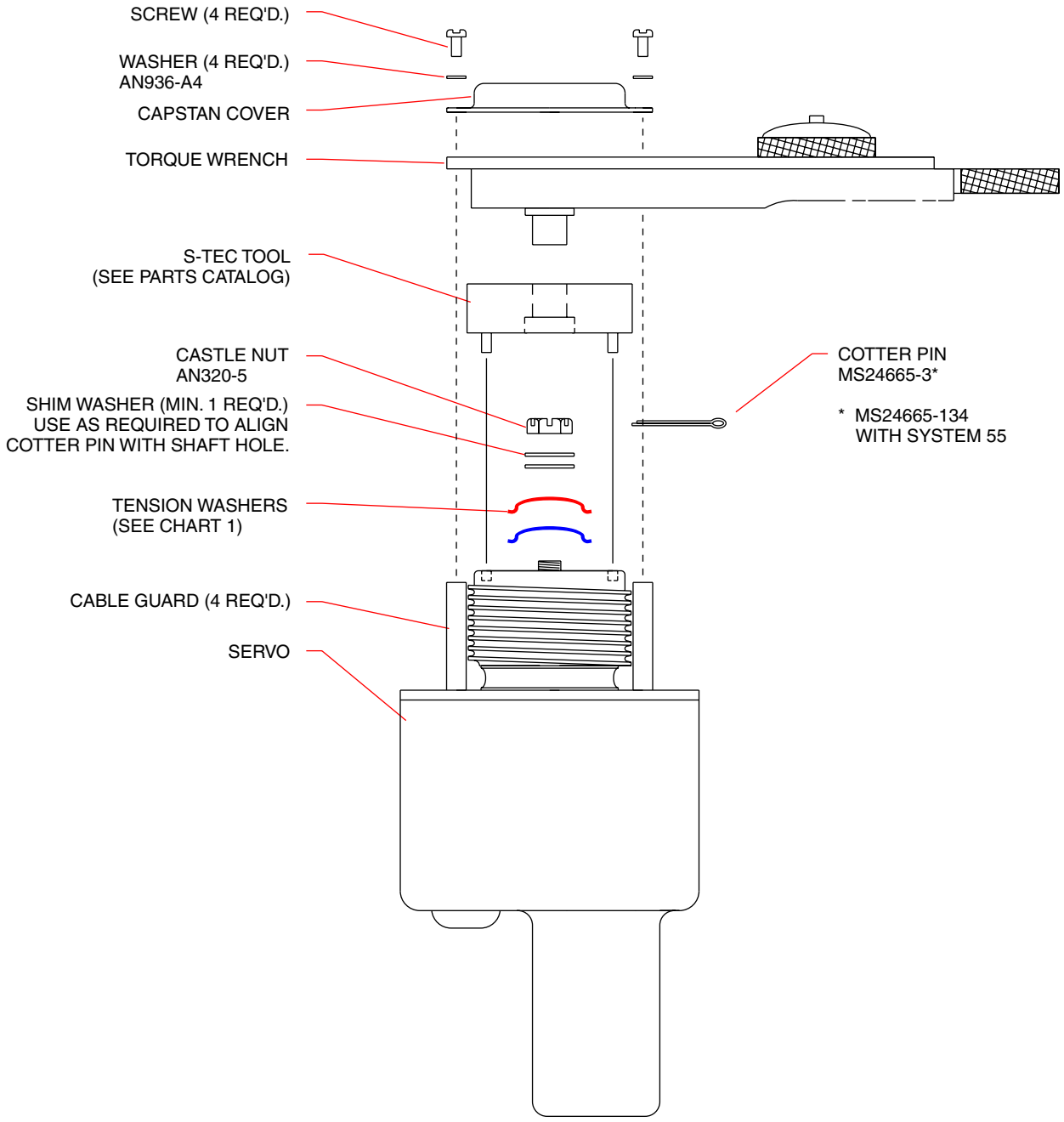
(f) Replace tension washers as required (see Chart 1).

(g) Replace shim washers and castle nut.

(h) Tension castle nut so that capstan torque is as specified in Chart 1.

CHART 1
AUTOPILOT SERVO CLUTCH TORQUE

SERVO	TORQUE (In. Lbs.) System 55/55X	WASHERS System 55	WASHERS System 55X
Roll	34 ± 2	Three (3) ea., .040	Three (3) ea., .032
Pitch	37 ± 2	Three (3) ea., .040	Three (3) ea., .032
Trim	28 ± 2	One (1) ea., .032; Two (2) ea., .040	Three (3) ea., .032



Servo Clutch Torque Adjustment
Figure 6

(9) Flap Compensator (See Figure 7.)

A flap compensator potentiometer is mounted underneath the left passenger seat, mounted on a bracket close to the left outboard just forward of bulkhead F.S. 128.74. The arm of the potentiometer (pot) is linked to the flap torque tube by a cushion clamp.

Adjustment

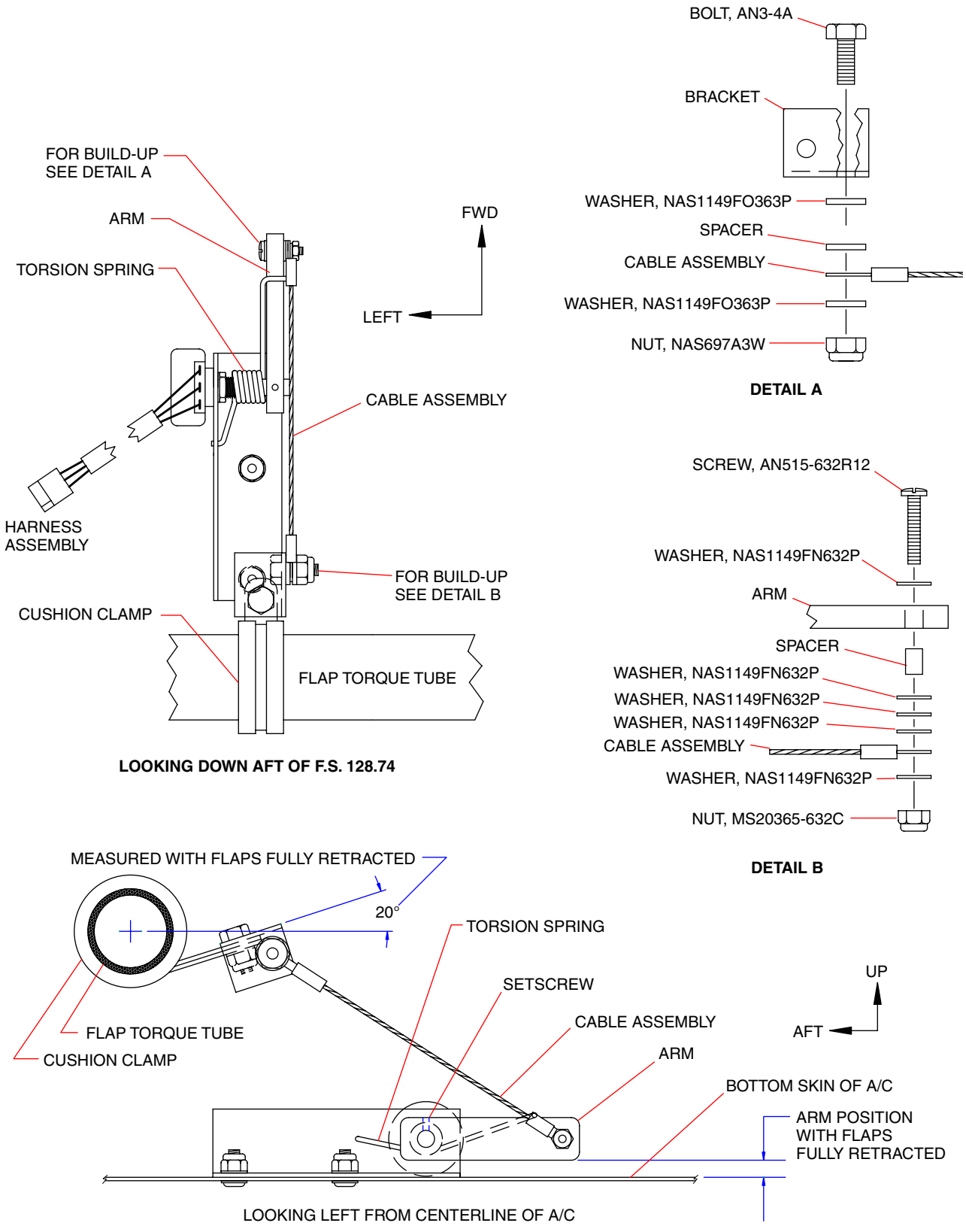
(a) With flaps in the full up position and set screw loose, turn A/P master switch ON.

(b) Connect a digital voltmeter (3 1/2 digit) between airframe ground and center terminal (wiper) of pot.

(c) Turn pot shaft clockwise to stop. Voltmeter should read 5.00 vdc.

(d) Turn pot shaft slowly counter-clockwise until voltage just starts to decrease from 5.00 volts.

(e) Tighten set screw and recheck wiper voltage for 4.95 to 5.00 vdc.



Flap Compensator Installation
Figure 7

GRIDS 2F8 THRU 2F24
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CHAPTER

24

ELECTRICAL POWER

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CHAPTER 24

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CHAPTER 24 - ELECTRICAL POWER

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GENERAL

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

This chapter deals with the complete electrical system and provides service procedures and a trouble-shooting guide.

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 70 ampere alternator and stored in a 12 volt, 35 amp-hour battery. The system is DC and has a negative ground.

Each alternator is protected by an alternator control unit which incorporates a voltage regulator and an overvoltage relay. This relay protects the electrical and avionics equipment from regulator malfunction. The overvoltage relay will take its respective alternator offline if the alternator's output exceeds 17 volts. The ALT light on the annunciator panel will illuminate simultaneously. The individual circuits are protected from overloads and shorts by resettable circuit breakers located on the right side of the instrument panel.

The battery is used for starting and as a reserve power supply in case of alternator failure. Access to the battery is gained by opening the hinged fiberglass nose which tips forward and down.

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

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D.C. GENERATION

1. Precautions

Since the alternator and regulator are designed for use on only one polarity system, the following precautions must be observed when testing or servicing the electrical system. Failure to observe these precautions will result in serious damage to the electrical equipment.

CAUTION: 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.

CAUTION: THE OUTPUT LEAD MUST NOT BE REMOVED FROM ALTERNATOR WHILE ROTOR WINDING IS ENERGIZED AND ALTERNATOR IS OPERATING.

CAUTION: ALTERNATOR MUST NOT BE OPERATED ON OPEN CIRCUIT WITH ROTOR WINDING ENERGIZED.

CAUTION: DO NOT ATTEMPT TO POLARIZE THE ALTERNATOR. NO POLARIZATION IS REQUIRED. ANY ATTEMPT TO DO SO COULD DAMAGE ALTERNATOR, REGULATOR OR CIRCUITS.

CAUTION: GROUNDING OF THE ALTERNATOR OUTPUT TERMINAL WILL DAMAGE THE ALTERNATOR AND/OR CIRCUIT AND COMPONENTS.

CAUTION: REVERSED BATTERY CONNECTIONS WILL DAMAGE THE RECTIFIERS, WIRING OR OTHER COMPONENTS OF THE CHARGING SYSTEM. BATTERY POLARITY MUST BE CHECKED WITH A VOLTMETER BEFORE CONNECTING. THIS AIRCRAFT IS NEGATIVE GROUND.

CAUTION: IF A BOOSTER BATTERY OR FAST CHARGER IS USED, BE SURE TO CONNECT NEGATIVE TO NEGATIVE AND POSITIVE TO POSITIVE.

2. Alternator System

A. Description

Each 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.

Each alternator system has an independent ON-OFF rocker switch and a solid state voltage regulator that automatically regulates alternator field current. When selected ON, the positive output of each alternator is fed through individual shunts to the main tie bus. Overcurrent protection is provided by the L ALT and R ALT 70-amp main tie bus circuit breakers. Additionally, each alternator field is protected by a 5-amp circuit breaker marked L ALT FIELD or R ALT FIELD, as appropriate. If this breaker trips, it will result in a complete shutdown of power from the respective generating system. After a one or two minute cool down period, the breaker can be reset manually. If tripping occurs again, this indicates a short in the respective alternator circuit.

Two annunciator lights are located at the upper right of the pilots panel. When either alternator fails, or is selected OFF, the amber ALT annunciator light will illuminate. A low voltage monitor, also connected to the tie bus will illuminate the red LO BUS annunciator light when the system drops from bus voltage (14 Vdc) to battery voltage (approx. 12 Vdc). A fuse provides overvoltage protection for the low voltage monitor.The dual ammeters do not indicate battery discharge, but display the load in amperes placed on the individual generating systems. With all electrical equipment off, except the master switch, the ammeters 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 (2) amperes. The amount of current shown on the ammeters 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 arrive at a current of eight (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 (Figure 1) can be made by connecting eight (8) landing lights wired in parallel from the main bus to airframe ground or fourteen three-ohm, 100-watt resistors.

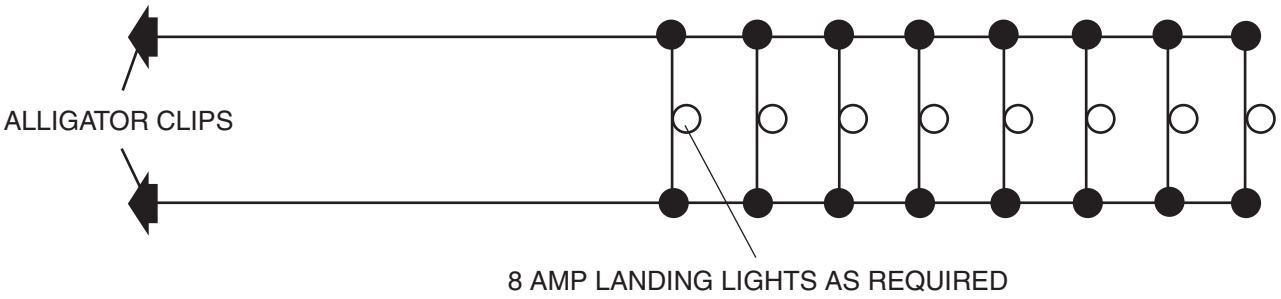
B. Troubleshooting

WARNING: ALL CHECKS AND ADJUSTMENTS OF THE ALTERNATOR AND/OR ITS COMPONENTS MUST BE MADE WITH THE ENGINE STOPPED. ACCORDINGLY, TO COMPLETE SOME CHECKS OR ADJUSTMENTS, IT WILL BE NECESSARY TO REMOVE THESE UNITS FROM THE AIRPLANE AND PLACE ON A TEST STAND.

Troubles peculiar to the alternator are listed in Chart 1 along with their probable causes and suggested remedies. The wiring diagrams included at the end of this section will give physical breakdown of the different electrical circuits used in these airplanes.

After the trouble has been corrected, check the entire system for security and operation of its components.

2612



Lamp Bank Load
Figure 1

CHART 1 (Sheet 1 of 5)
TROUBLESHOOTING ALTERNATOR

Trouble	Cause	Remedy
Zero output indicated on ammeter regardless of RPM voltage (refer to alternator system test procedure).	Open field circuit.	With master switch turned on, check for battery 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 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.)

CHART 1 (Sheet 2 of 5)
TROUBLESHOOTING ALTERNATOR

Trouble	Cause	Remedy
Zero output indicated on ammeter regardless of RPM (refer to alternator system from test procedure). (continued)	Open field winding in alternator	Disconnect field terminal of alternator from field wiring and check for continuity field terminal to ground with ohmmeter (20-100 ohms) depending on brush contact resistance.
		WARNING: TURN MAGNETO SWITCH TO OFF BEFORE TURNING PROP.
		(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 check out 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 checkpoint, 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.
	High resistance connections in field or output circuit.	Check visually for loose binding posts at the various junction points in system, alternator battery post, lugs on ammeter, connections at voltage regulator, circuit breaker, etc., (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.

CHART 1 (Sheet 3 of 5)
TROUBLESHOOTING ALTERNATOR

Trouble	Cause	Remedy
Output indicated on ammeter does not meet minimum values specified in alternator system test procedure. (continued)	Open rectifier.	If any of the six rectifiers pressed into the rear bell housing of the alternator open up internally, it will result in a definite limitation on the current that can be drawn from the alternator. After having checked the previous causes of low output it can be assumed that a faulty rectifier exists.
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.)
	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 it self. 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.

WARNING: TURN MAGNETO SWITCH TO OFF BEFORE TURNING PROPELLER.

CHART 1 (Sheet 4 of 5)
TROUBLESHOOTING ALTERNATOR

Trouble	Cause	Remedy
Field circuit breaker trips. (continued)	Short circuit in field circuit. (continued)	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.	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 or wire which component was was isolated as defective. (See schematic.)
	Battery installed with reversed	Remove battery and reinstall polarity. with correct polarity.
	Battery charged backwards.	Remove battery. Connect load such as landing light lamp or similar load and discharge battery. Recharge with correct polarity and test each cell for signs of damage due to reversed charging.

NOTE: This type of condition can only occur in a case where a discharged battery has been removed from the airplane and put on a charger with the polarity reversed. This reversal in polarity cannot occur in the airplane due to any fault in the alternator system.

CHART 1 (Sheet 5 of 5)
TROUBLESHOOTING ALTERNATOR

Trouble	Cause	Remedy
Excessive ammeter fluctuation.	Excessive resistance in field circuit.	Check all connections and wire terminals in field circuit for deterioration such as loose binding posts, broken wire strands at terminals, etc. Tighten all connections and replace faulty terminals.
	High field circuit resistance.	If problem persists, jump across terminals of the following components one at a time until the faulty unit is isolated. a. Field 5 amp (alternator) circuit protector. b. Alternator half of master switch. c. Overvoltage relay.
	Defective voltage regulator.	Replace voltage regulator.

C. Belt Tension

If properly installed, tensioned and periodically checked, an alternator drive belt will provide ample 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 installation, after 25 hours of operation and, thereafter, at each 100-hour inspection.

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 Chart 2. 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.

D. Testing

With electrical equipment off (except master switch) the ammeter will read amount of charging current demanded by battery. The amount will vary, depending on percentage of battery charge. As battery is charged, current displayed on ammeter will reduce to approximately two amperes. Current reading on ammeter will show if alternator system is operating normally.

NOTE: Current reading on ammeter is the load in amperes demanded by the electrical system from alternator. Check, for example, a condition where battery is demanding 10 amperes charging current, then switch on landing light. Note value in amperes placarded on circuit breaker panel for landing light circuit breaker (10 amps) and multiply by 80 percent. You will arrive at a current of 8 amperes. This is approximate current drawn by the light. When light is switched on, there will be an increase of current from 10 to 18 amperes on ammeter. As each unit of electrical equipment is switched on, current will add up and the total, including battery, will read on ammeter.

(1) Start engine and set throttle for 1000 to 1200 rpm.

(2) Switch on the following loads and observe the ammeter output increase as indicated:

(a) Rotating beacon - 3 to 6 amps.

(b) Navigation and instrument lights (bright) - 4 to 6 amps.

(c) Landing light - 7 to 9 amps.

(d) VHF radio(s) - 4 to 6 amps (each).

(3) If alternator does not meet above indications, refer to Chart 2.

(4) On airplanes without night flying equipment, load required by test can be simulated by connecting a lamp-bank load consisting of eight (8) landing lights wired in parallel from main bus (+) to airframe ground (-) (see Figure 1) or 14, 3-ohm, 100-watt resistors.

CHART 2
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

E. Service Test Specifications

Refer to Figure 2 for test circuit used. See Chart 3 for specifications.

2. 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. (See Figure 3.)

A. Precautions

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.

CAUTION: WHEN INSTALLING A BATTERY, ALWAYS MAKE SURE THE GROUND POLARITY OF THE BATTERY AND THE GROUND POLARITY OF THE ALTERNATOR ARE THE SAME.

CAUTION: WHEN CONNECTING A BOOSTER BATTERY, MAKE CERTAIN TO CONNECT THE NEGATIVE BATTERY TERMINALS TOGETHER AND THE POSITIVE BATTERY TERMINALS TOGETHER.

CAUTION: 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.

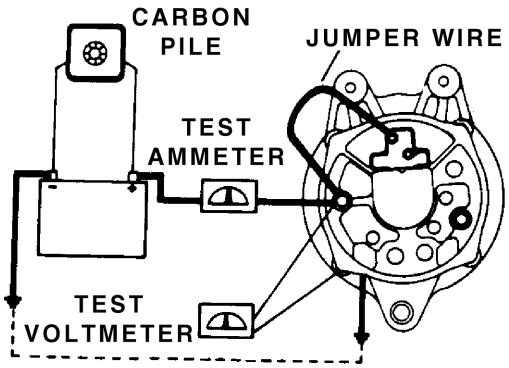
CAUTION: NEVER OPERATE THE ALTERNATOR ON AN OPEN CIRCUIT. MAKE ABSOLUTELY CERTAIN ALL CONNECTIONS IN THE CIRCUIT ARE SECURE.

CAUTION: DO NOT SHORT ACROSS OR GROUND ANY OF THE TERMINALS ON THE ALTERNATOR OR REGULATOR.

CAUTION: DO NOT ATTEMPT TO POLARIZE THE ALTERNATOR.

CHART 3
ALTERNATOR SERVICE TEST SPECIFICATIONS

Voltage	12-volts
Rated Output	70 amperes
Ground Polarity	Negative
Rotation	Bi-Directional
Rotor	
Current Draw (77°F)	2.4 to 4.0 amps @ 12.0-volts
Resistance (77°F)	3.5 to 5.0 ohm
Output Test (77°F)	
Volts	14.0
Amperes Output	33.0
Field Amperes	--
Alternator RPM	3000



Testing Alternator
Figure 2

B. Servicing

See Battery, 12-10-00.

C. Removal

(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.

D. Installation

(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.

E. Testing

The specific gravity check method is listed in Chart 4. If the alternator output is known to be correct, the question of battery capability can be more accurately determined with a load type tester.

F. Charging

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.

CHART 4 (Sheet 1 of 2)
TROUBLESHOOTING BATTERY

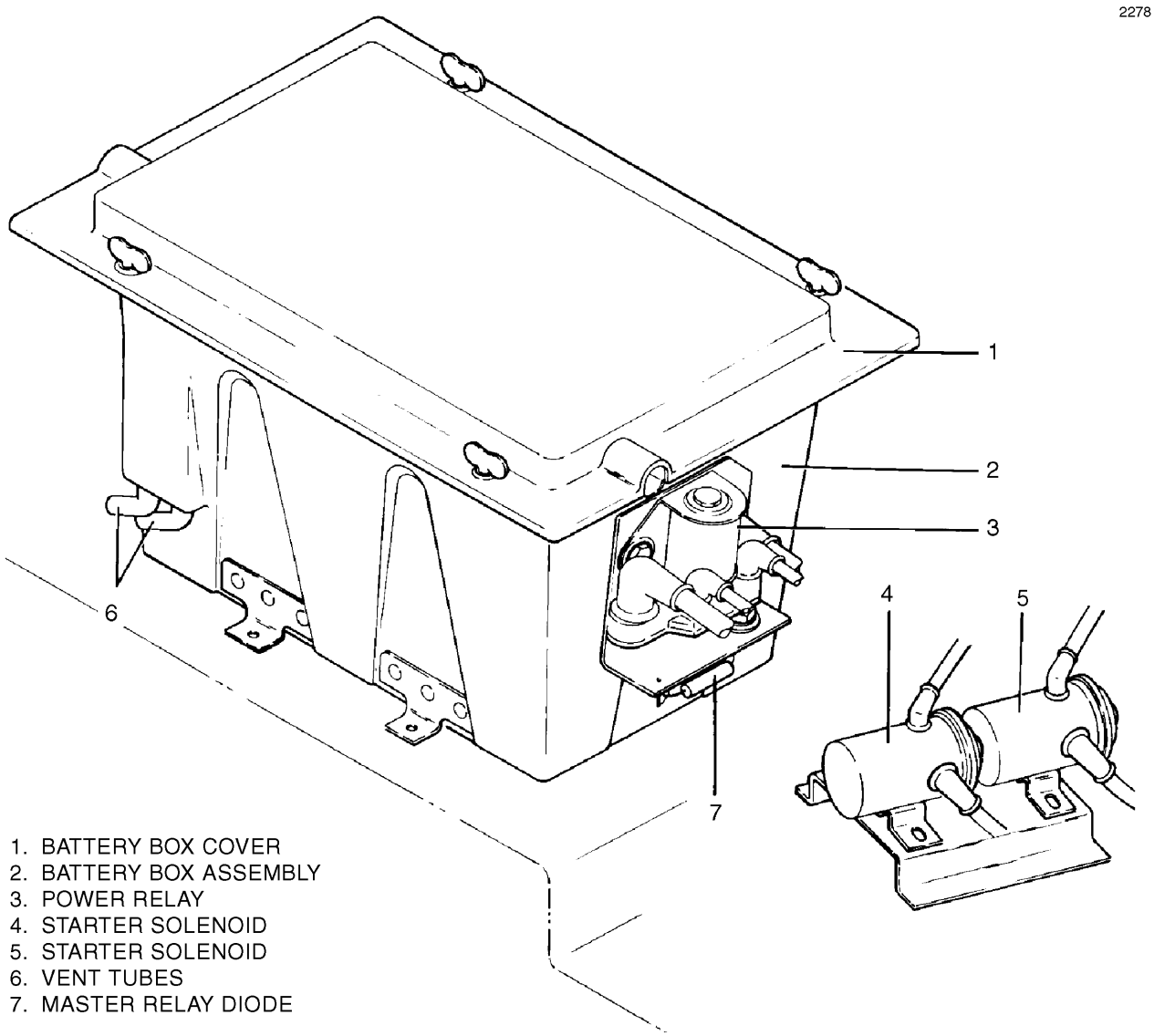
Trouble	Cause	Remedy
Discharged battery.	Battery worn out.	Replace battery.
	Low electrical system voltage.	Check voltage regulator voltage.
	Standing too long.	Remove and recharge battery if left in unused airplane three weeks or more.
	Equipment left on accidentally.	Remove and recharge.
	Impurities in electrolyte.	Replace.
	Short circuit (ground) in wiring.	Check wiring.
	Broken cell partitions.	Replace.

CHART 4 (Sheet 2 of 2)
TROUBLESHOOTING BATTERY

Trouble	Cause	Remedy
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.
Excessive corrosion inside container.	Spillage from overfilling.	Use care in adding water.
	Vent lines leaking or clogged.	Repair or clean.
	Charging rate too high.	Adjust voltage regulator 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.

CHART 5
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



Battery Box
Figure 3

G. Battery Box

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.

(1) Removal (Refer to Figure 3.)

(a) Remove the battery from the box as described under Removal, above.

(b) 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.

(c) Remove the six mounting bolts securing the box and remove the box.

(2) Installation (Refer to Figure 3.)

(a) Position the battery box in place and secure with six bolts previously removed.

(b) 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.

(c) Install the battery per Installation, above.

(3) Corrosion Prevention

Check the battery for spilled electrolyte or corrosion at least every 30 days, but not later than each 50 hour inspection, whichever comes first. Remove the battery and remove any corrosion found in the box, on the terminals, on or around the battery by the following procedure:

(a) 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.

(b) Clean the battery and the box. Neutralize corrosion effects by applying a solution of baking soda and water mixed to the consistency of thin cream. Continue application until bubbling action has ceased.

(c) Rinse the battery and box with clean water and dry.

(d) Place the cap over the battery box drain.

(e) Install battery. (Refer to battery installation.)

3. Voltage Regulators and Overvoltage Relays

A. Lamar Model No. B-00392-1 Alternator Voltage Regulator

The voltage regulators and shunts are mounted on a panel that is secured to the left bulkhead at F.S. 35.00 (see Figure 4). They are 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.

B. Lamar Model No. B-00392-1 Voltage Regulator Operation

(1) The Lamar No. B-00392-1 voltage regulator delivers a pulse width modulated field control output, as required, to maintain the alternator output voltage.

(2) An overvoltage protection is incorporated, which latches off regulator output following an overvoltage event.

(3) The regulator is protected against damage due to output (field) short to ground. A short will latch off the output until reset.

(4) Momentarily turn OFF 14-volt power supply to reset latch off caused by either an overvoltage or shorted output.

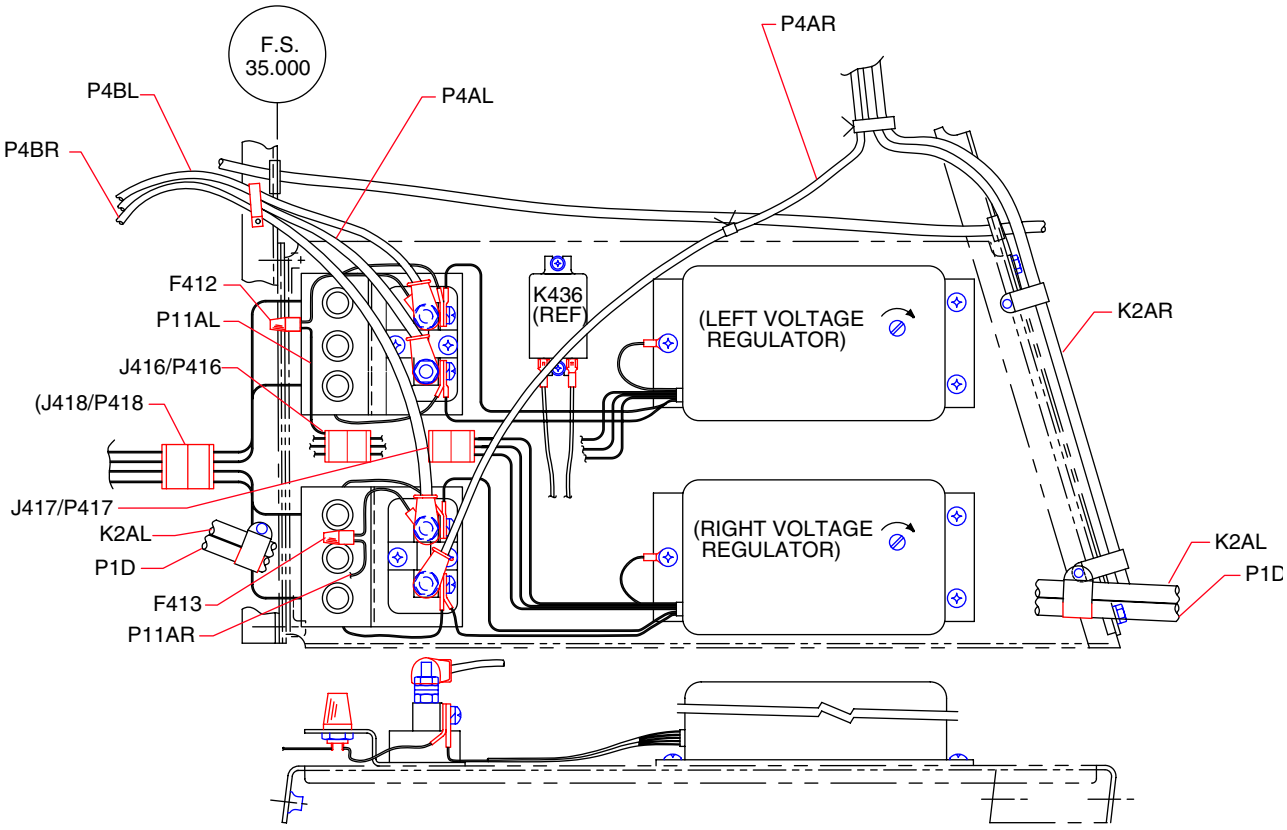
(5) Field pulse rise and fall times are slowed to be more that 50 microseconds.

(6) Refer to Figure 5 to check overvoltage operation. Temporary indicator will be activated when overvoltage circuit locks out.

(7) In an operating system (2 units with equalizer connection), an excess current in one shunt, due to an overvoltage condition in that side, will cause the opposite side overvoltage sensing to be desensitized. The side causing the overvoltage will be selectively tripped. Excess shunt current will then fall to zero, which permits the normal side overvoltage sensitivity to restore to its calibrated value.

(8) Except for the equalizer connection, the left and right alternator systems are independent of each other. The equalizer connection WILL NOT cause a failure in one system to disable the other normal operating system.

(9) The equalizer circuit may be faulted to either ground or the bus with no damage to either system. Balancing action and selectivity of the overvoltage trip protection will be lost. If the equalizer faulted to the bus, system voltage will increase to the limit of balancing circuit control authority (less than 1 volt). The overvoltage operating point of both systems will be elevated to the value provided for selective trip action (approximately 2 volts above the normal overvoltage trip calibration point).



NOSE CONE COMPARTMENT FORWARD OF F.S. 35.000, LEFT SIDE, LOOKING OUTBOARD

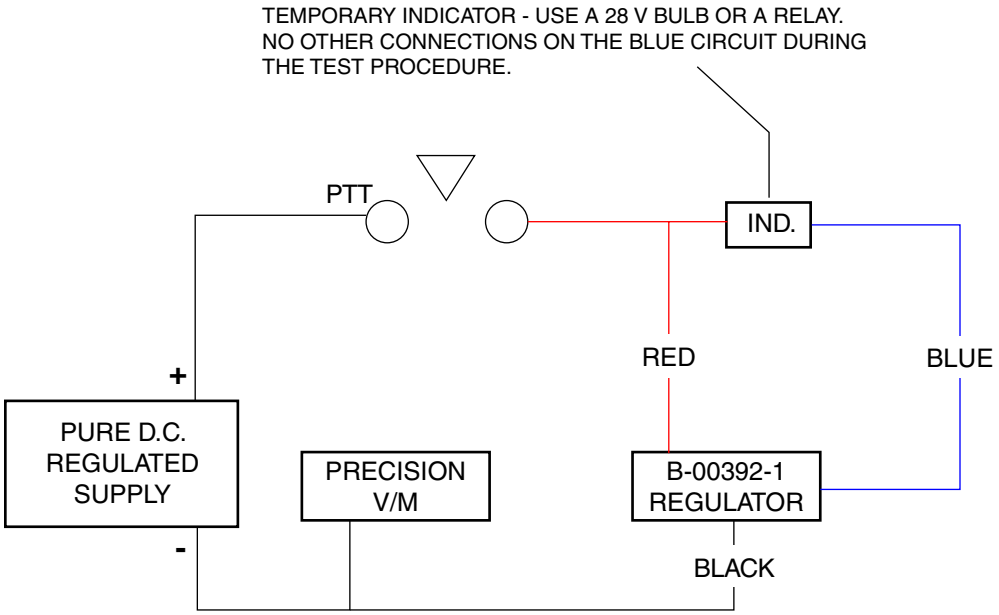
Voltage Regulator Installation
Figure 4

C. Adjusting Voltage Regulator Unit (Lamar Model No. B-00392-1)

The only adjustment necessary to maintain the alternator system is the adjustment of the voltage control on the voltage control unit. A level of 14 volts DC is automatically maintained. All other adjustments are made at the time of installation and need not be reset.

4. Ammeter

The ammeters are mounted in the instrument panel. Each instrument measures, in amperes, the output of its respective alternator into the entire electrical system, including the battery charging demand.



CAUTION: IN-AIRCRAFT TESTING WITH ALTERNATOR RUNNING IS NOT RECOMMENDED. DO NOT BYPASS REGULATOR BUS TO FIELD AS A MEANS OF CHECKING ALTERNATOR WITH ALTERNATOR RUNNING.

Lamar 00392-1 Regulator Overvoltage Test Method
Figure 5

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EXTERNAL POWER

CAUTION: EXTERNAL POWER IS SUPPLIED DIRECTLY TO THE ELECTRICAL BUS. TURN OFF ALL ELECTRICAL EQUIPMENT BEFORE APPLYING OR REMOVING EXTERNAL POWER.

1. Description

The external power receptacle is located on the right side of the nose section.

2. Operation

A. Ground Power

When using external power for operation of any of the airplane's equipment, the master switch must be ON.

B. Starting

To start the engine with external power proceed as follows:

WARNING: DO NOT ATTEMPT ANY FLIGHT IF THERE IS NO INDICATION OF ALTERNATOR OUTPUT.

CAUTION: WHEN USING AN AUXILIARY POWER UNIT, ENSURE THE VOLTAGE AND POLARITY ARE SET TO CORRESPOND WITH THE AIRCRAFT SYSTEM VOLTAGE AND POLARITY.

CAUTION: IF AIRCRAFT BATTERY IS WEAK, CHARGING CURRENT WILL BE HIGH. DO NOT TAKE OFF UNTIL CHARGING CURRENT FALLS BELOW 20 AMPS. DO NOT TAKE OFF WITH A COMPLETELY DISCHARGED BATTERY AS THREE VOLTS IS NEEDED TO EXCITE THE ALTERNATOR.

NOTE: Should the hydrometer reading indicate less than 1190, the aircraft battery should be removed and recharged or replaced.

NOTE: For all normal operations using the external power 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.

(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:

CAUTION: 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.

(a) Start engines with the standard technique.

(b) 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.

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ELECTRICAL LOAD DISTRIBUTION

Electrical System Component Loads (PIR-VB1514, Rev. New.)

See Chart 1.

CHART 1
ELECTRICAL SYSTEM COMPONENT LOADS

Duty Cycle Cont.	Duty Cycle Inter.	Circuit / Equipment	Circuit Breaker Amps	Load Amps
X		Alternator Control Unit (2)		0.14
X		Alternator Field (2)	5	1.5
X		Avionics Contactor (2)	25	0.7
X		Avionics Cooling Blower		2
	X	Combustion Heater	15	12.14
X		Elec. Turn & Bank	3	0.6
X		Engine Gauges Cluster	5 (2)	0.8
	X	External Power Contactor	60	0.64
	X	Fresh Air Blower	20	15
	X	Fuel Pump (2)	10 (2)	6
	X	Gear Horn	3	0.1
X		Hour Meter (3)		0.15
	X	Hydraulic Pump	25	25
X		Lights - Annunciator	5	0.56
X		Lights - Avionics	5	2.3
	X	Lights - Cockpit Flood	5	2.14
X		Lights - Gear Safe	3	0.24
	X	Lights - Landing Light	15	14.25
X		Lights - Navigation / Position	10	7.14
X		Lights - Panel	5	0.8
X		Lights - Recognition	10	2.5
X		Lights - Strobe	10	7
X		Lights - Switch	5	2.9
X		Master Contactor	60	0.72
X		Pitot Heat	15	12.14
	X	Stall Horn	5	0.1
	X	Starter		175
	X	Starter Contactor	5	1.5
X		Tachometer	3	0.7

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CHAPTER

25

EQUIPMENT / FURNISHINGS

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CHAPTER 25

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CHAPTER 25 - EQUIPMENT / FURNISHINGS

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Description		2	2H16
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FLIGHT COMPARTMENT

1. Description

The Seminole has the capacity of seating up to 4 (passengers and crew) in a forward facing seat arrangement. Information on seat installations and other options are included in this chapter.

Two fully adjustable forward facing seats are installed for the pilot and co-pilot. They adjust vertically, recline, and adjust fore and aft with a storage pocket on the back of each seat. Two forward facing reclining seats are installed for the passengers. A worktable attaches to either the pilot or co-pilots seat back. It is stored along the left side in the baggage area and secured with a strap.

2. Pilot's Seat Lock and Release Rigging (Refer to Figure 1.)

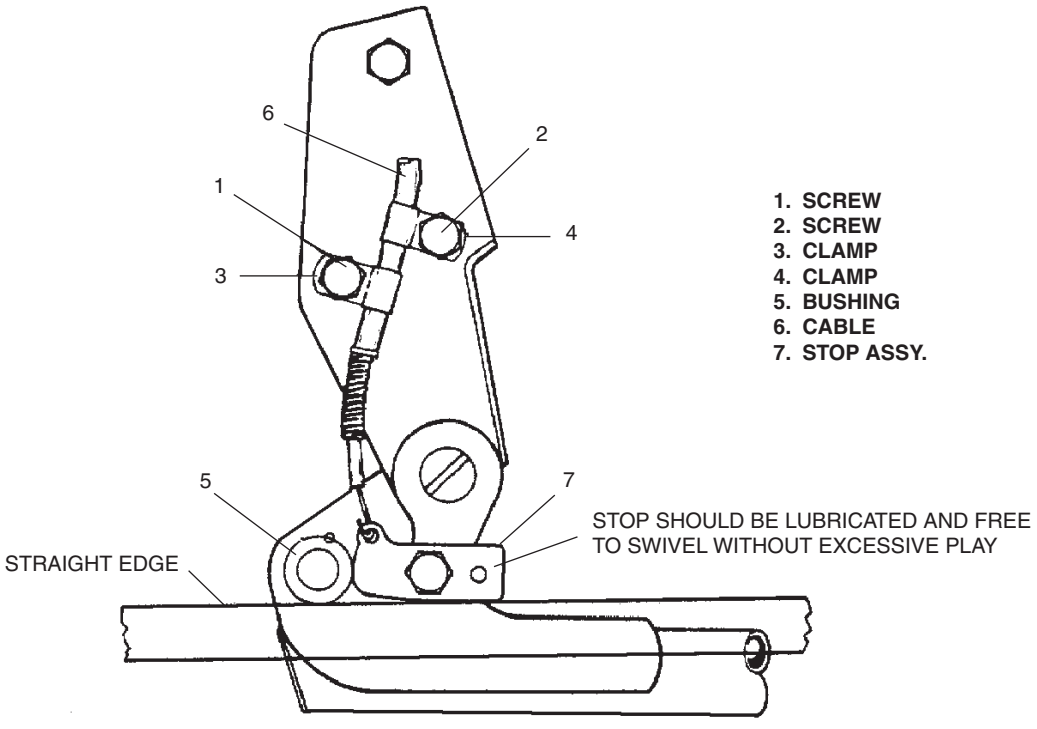
A. Loosen screws and loosen clamps to allow push-pull cable to move within the clamps.

B. Place a straightedge along lower surface of seat back release bushing.

C. Adjust push-pull cable by raising or lowering until lower surface of the stop assembly is parallel to straightedge.

D. Secure push-pull cable in position by tightening screws on clamps. The stop must be lubricated and free to swivel without excessive play.

E. Push on seat back to check stop assembly engagement. Rotate seat back release handle and check for seat back disengagement.



Seat Back Lock
Figure 1

3. Lumbar Support (Refer to Figure 2.)

A. Description

In the optional interior, the pilot and co-pilot seats incorporate a lumbar support feature. The installation consists of an inflatable bladder attached to the seat back filler and an inflation bulb located under and on the inboard side of each pilot and co-pilot seat.

B. Removal

(1) Remove seat from airplane.
(2) Loosen velcro securing seat back filler cover.
(3) Remove only enough of seat back filer cover to expose lumbar bladder.

NOTE: Inflation tube may be removed before or after bladder is removed from seat back filler. Tube is not glued to nipple attachment; it can be removed by carefully pulling on tube.

(4) Remove inflation tube from bladder.

CAUTION: DO NOT USE A CHEMICAL SOLVENT TO REMOVE BLADDER. SOLVENT MAY DAMAGE SEAT BACK FILLER

CAUTION: TO AVOID OR MINIMIZE DAMAGE TO SEAT BACK FILLER DURING REMOVAL, USE ONE HAND TO RETAIN SEAT BACK FILLER IN PLACE, WHILE GENTLY REMOVING BLADDER WITH OTHER HAND.

(5) Starting at either right or left edge of bladder, carefully and slowly pull bladder and pad assembly from seat back filler.

C. Assembly

(1) Apply a layer of 3M 847 cement to smooth side of bladder pad.
(2) Apply a layer of 3M 847 cement to back side of bladder (side away from inflation tube nipple).
(3) Attach bladder pad to bladder.

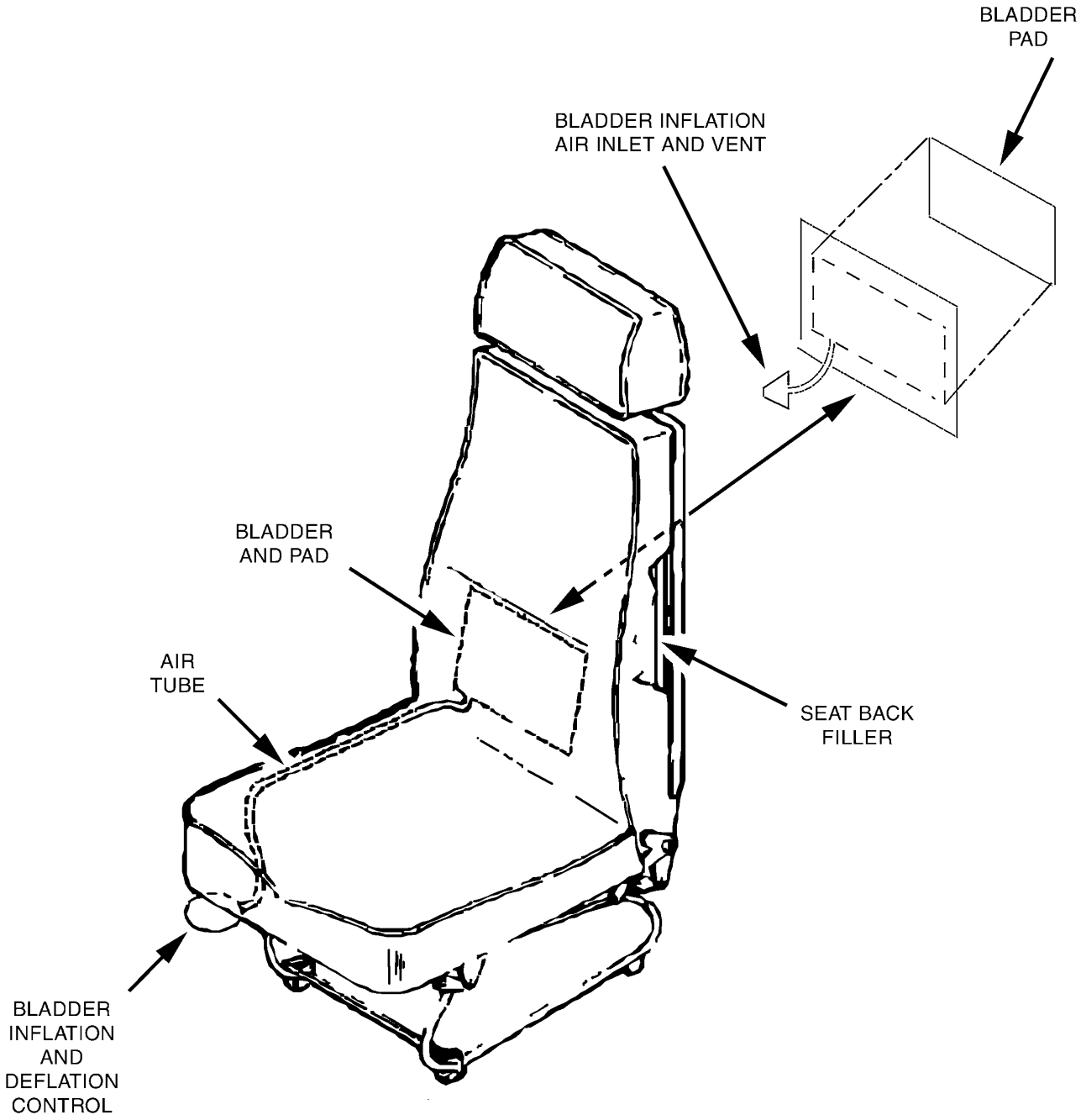
NOTE: While cement does not set immediately, there is no need to wait before attaching bladder and pad to seat back filler.

D. Installation

(1) Apply a layer of 3M 847 cement to rough side of bladder pad.
(2) Apply a layer of 3M 847 cement to seat back filler where bladder is to be located.
(3) Attach bladder and pad assembly to seat back filler. Depending on temperature and humidity, allow 30 minutes to one (1) hour for cement to set.
(4) Install seat back filler cover and secure velcro fastenings.
(5) Install seat in airplane.

4. Carpets

The carpets are individually fastened to the floor with Velcro fasteners and adhesive (Hysol EA9309 NA).



Lumbar Seat Bladder Installation
Figure 2

5. Restraint System

A. Inspection

(1) In S/Ns 4496001 thru 4496035 only:

(a) Shoulder Harness

1 Inspect ends and attachment points for condition and security.

2 Inspect harness web material for condition and wear over its entire length. Particularly look for wear and fraying where harness web passes in and out of inertial reel. If excessively worn, replace.

(b) Lap Belt

1 Inspect ends and attachment points for condition and security.

2 Inspect harness web material for condition and wear over its entire length. Particularly look for wear and fraying where harness web passes in and out of adjustable buckle end. If excessively worn, replace.

3 Inspect shoulder harness keeper nylon bushing. If excessively worn or missing, replacement of that half of the lap belt is required.

(c) In S/N 4496001 only:

1 If Piper Service Bulletin No. 990 has been complied with, no further action is required. If not, then inspect seat belts at each position.

2 Replace all belts manufactured by Pacific Scientific and the seat belt has a date stamp of 6/94 thru 8/95, if the seat belt buckle end has an old Piper logo (large stylized “P”) or no logo, and if the seat belt fitting end I.D. tag has a date stamp of 6/94 thru 8/95.

3 Replacement belts, fitting end and buckle end, should be ordered under the same part number(s) found on the suspect seat belts as no new part numbers were issued. Order the appropriate quantity of: Seat Belt, Fitting End - P/N 564-867; Buckle End (short) - P/N 564-868; Buckle End (medium) - P/N 564-889; and/or, Buckle End (long) - P/N 564-862.

4 Check the new seat belts for operation and security, after installation.

5 Make an appropriate logbook entry of compliance with Service Bulletin No. 990.

6 Pending replacement of the suspect seat belts, the aircraft may be flown, provided the Pilot-In-Command inspects each seat belt being used for secure positive latching and that the seat belts are free of any anomalies prior to each flight and during each use.

(2) In S/N’s 4496036 & up:

An integrated shoulder harness / lap belt restraint system (Schroth) is installed.

(a) Inspect ends and attachment points for condition and security.

(b) Inspect harness web material for condition and wear over its entire length. Particularly look for wear and fraying where harness web passes in and out of inertial reel and in and out of the adjusting buckle. If excessively worn, replace.

(c) Check inertia reel mechanism by pulling sharply on strap. Verify reel will lock in place under sudden stress.

B. Inertial Reel Adjustment

The inertial reel locking feature prevents the shoulder strap from extending and holds occupant in place. For normal movement strap will extend and retract as required. If required, adust inertial reel as follows:

(1) Allow harness to wind up on reel as much as possible.

(2) On end of reel, pry off plastic cover over spring. Make sure spring does not come out of plastic cover. Set aside plastic cover.

(3) Unwind the harness completely. Measure and mark the harness 24 inches from the reel center.

(4) Wind harness onto reel until the 24-inch mark is reached. Hold reel and place cap with spring over reel shaft end.

(5) Align slot in shaft with spring tang. Wind spring 6-1/2 turns and snap plastic cover into holes in reel end shaft.

(6) Release harness and allow harness to wind up. Extend harness several times to check reel for smooth operation.

(7) Hold inertia reel with reel completely wound and inertia mechanism end up. Pry off plastic cover over mechanism and set reel aside.

(8) Install nut in plastic cover so that stud in cover is flush with nut surface. Position cover over reel and snap cover into place. Extend harness several times to ensure reel operates smoothly.

6. Electric Clock

The standard electric clock receives its power from the aircraft battery. The clock is mounted in the upper left corner of the instrument panel. For electrical schematic, refer to Chapter 91.

A. Removal

(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.

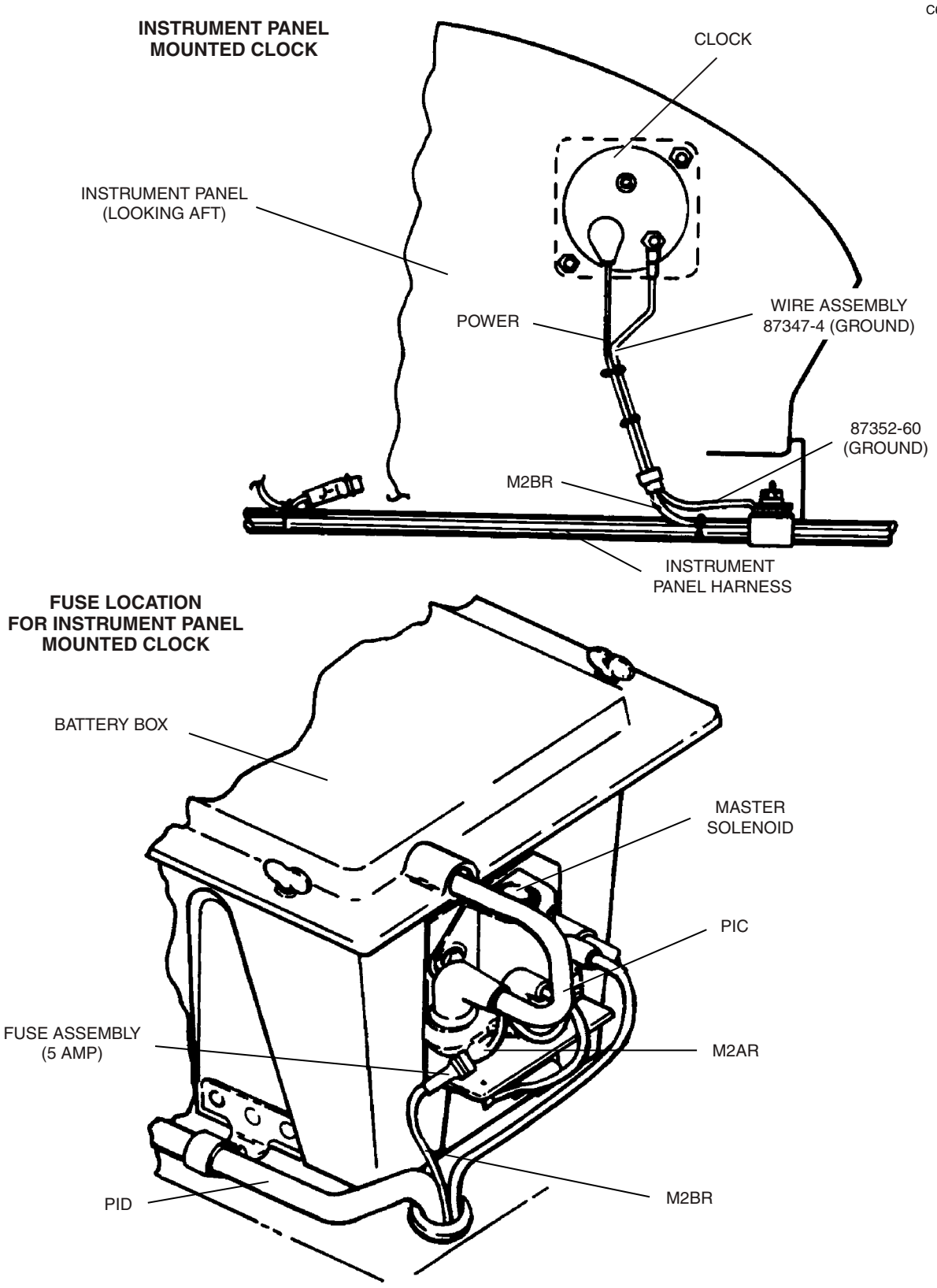
B. Installation

(1) Attach wires to back of clock.

(2) Position clock in panel and secure with two screws previously removed.

(3) Re-apply power to circuit.

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Electric Clock Installation
Figure 3

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EMERGENCY

Artex ELT 110-4 Emergency Locator Transmitter (ELT)

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

A. Description

The Artex ELT 110-4 transmits on 121.5 mHz and 243.0 mHz, and is designed to meet or exceed the requirements of TSO C91a and FAR Part 91. Electrical power for the ELT transmissions is totally supplied by its own self-contained battery. The battery must be replaced if the transmitter has been used in an emergency situation or if accumulated test time exceeds one hour, or no later than the replacement date marked on the transmitter label, whichever comes first.

The Artex 110 cannot be accidentally activated by dropping the unit, handling it roughly, or during shipping. However, when properly mounted, and locked into its mounting tray, the ELT will activate in a crash, regardless of the cockpit remote switch and ELT. switch position. The normal position of the ELT switch is in the down or OFF position. The normal position of the remote cockpit switch is in down or ARM position.

Whenever the ELT is activated, a red light located just above the remote cockpit switch will blink to alert the pilot or maintenance personnel. Should the ELT be activated accidentally, it must be reset. To reset:

(1) Position the remote cockpit switch to ON, then immediately reposition it to ARM, or;
(2) Position the switch on the ELT to ON, then immediately reposition it to OFF.

B. Battery (Refer to Figure 1)

(1) Removal
  (a) Remove nose top cowl.
  (b) Disconnect and remove positive cable from aircraft battery.
  (c) At right side of empenage, remove four (4) screws and remove ELT access panel.
  (d) Remove ELT from the airplane by:
    1 Loosening the two screws on the front of the mounting tray and pull mounting tray cap off.
    2 Disconnecting coax (antenna) cable.
    3 Disconnecting the Molex cable from the ELT unit.
    4 Remove unit from airplane.
  (e) Remove the four screws on the bottom of the ELT securing the battery pack.
  (f) Disconnect battery pack connector from main unit.
  (g) Remove battery pack from unit.

(2) Installation
  (a) Securely plug in new battery pack connector to main unit.
  (b) Immediately reset unit by positioning unit switch to ON, then to OFF.
  (c) Fit new battery pack into place. Ensure all gaskets are properly aligned.
  (d) Replace the four (4) screws. Dress wires away from standoffs to avoid pinching wires between standoffs and the battery pack.

(e) Install unit into mounting tray:

1 Connect Molex and coax cables to ELT unit.

2 Install mounting tray cap and secure to front of mounting tray with the two screws.

(f) Replace ELT access panel and secure with four (4) screws.

(g) Reconnect positive cable to the aircraft battery.

(h) Secure the top nose cowl.

(i) Test transmitter.

C. Testing

The transmitter operates on the emergency frequencies of 121.5 and 243.0 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:

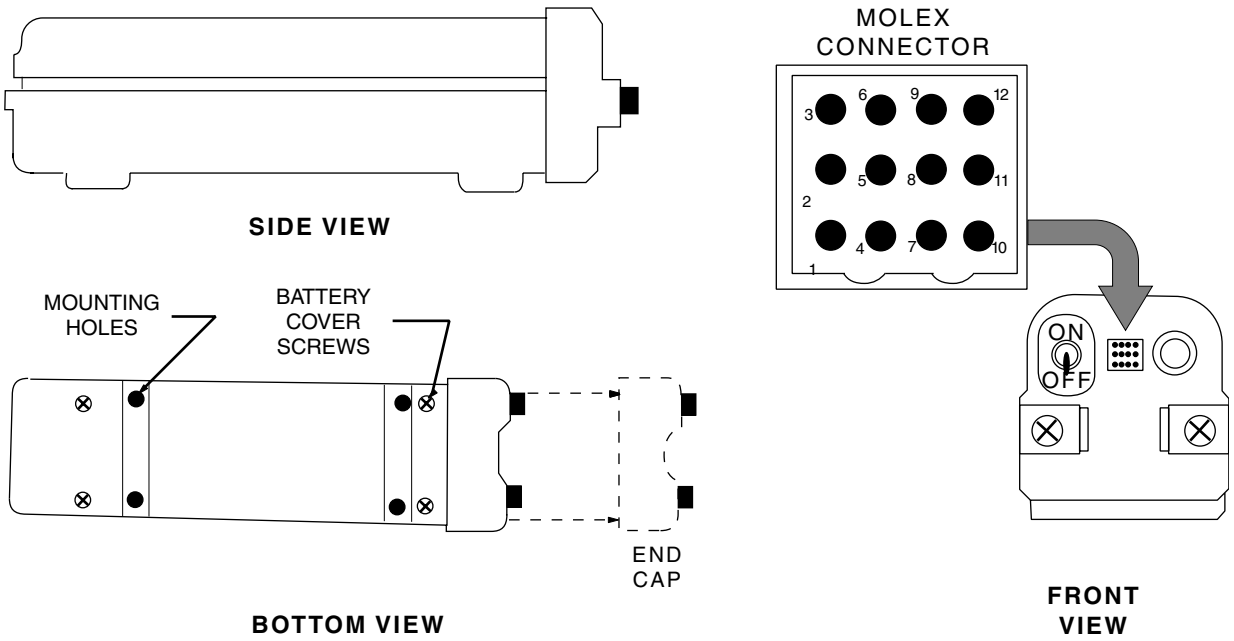
CAUTION: TESTING OF AN ELT SHOULD BE CONDUCTED IN A SCREEN ROOM OR METAL ENCLOSURE TO ENSURE THAT ELECTROMAGNETIC ENERGY IS NOT RADIATED DURING TESTING. IF A SHIELDED ENCLOSURE IS NOT AVAILABLE, TESTING MAY BE PERFORMED IN ACCORDANCE WITH THE FOLLOWING PROCEDURES:

(1) Test should be no longer than three audio sweeps.

(2) Test should be conducted only within the time period made up of the first five minutes after any hour.

(3) If the operational tests must be made at a time not included within the first five minutes after the hour, the test should be coordinated with the closest FAA Tower or Flight Service Station.

CAUTION: CONSULT FAA ADVISORY CIRCULAR AC 20-81 FOR DETAILED INFORMATION CONCERNING UNSHIELDED TESTING.



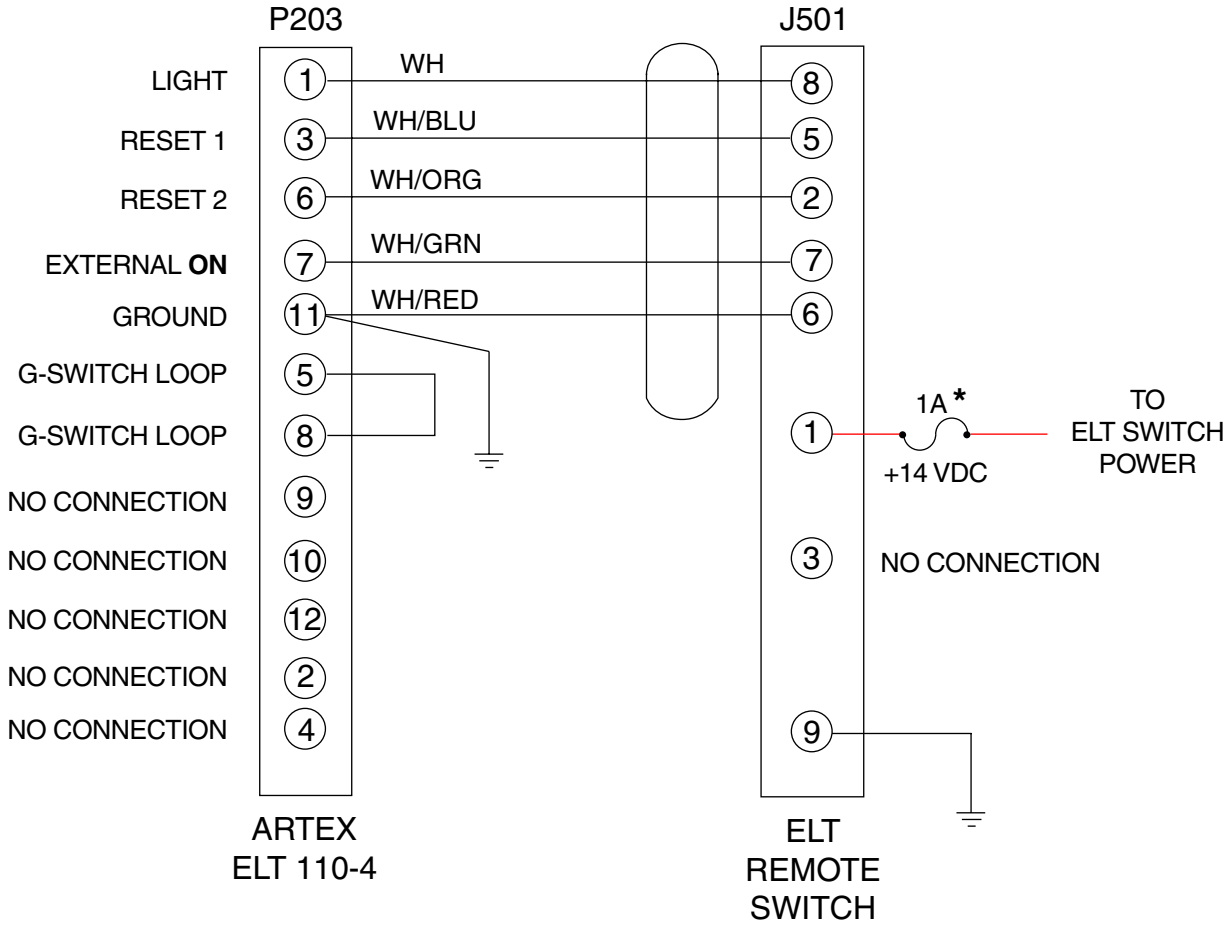
Artex ELT 110-4
Figure 1

(4) Turn both the airplane master switch and the radio master switch ON.

(5) Tune airplane communications receiver to 121.5 mHz and select SPKR on the audio panel.

(6) Position ELT cockpit switch to ON. The ELT should immediately begin signaling and the panel light should immediately come ON. Although the light may illuminate after a few seconds, failure of the light to immediately come ON indicates trouble with the G-Switch circuit, pins 5 and 8 on tray connector, and that the unit is not working properly. Repairs should be done only by a licensed aviation radio repair shop.

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* Not installed with Avidyne Entregra EFIS.

Artex ELT 110-4 Wiring Schematic
Figure 2

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CHAPTER

26

FIRE PROTECTION

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CHAPTER 26

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EXTINGUISHING

Portable Fire Extinguisher

A. Description

A portable, disposable, Class 2B:C fire extinguisher (Model No. A600) is installed as standard equipment. Containing 1.2 lbs. (550 grams) of Halon 1211/1301 blend, the extinguisher is located on the top of the tunnel cover between the two forward seats. (See Figure 1.)

To operate the extinguisher, remove it from the quick-release bracket, hold it upright in either hand by the handgrip, with the spray nozzle pointing forward. Remove the safety pin, direct the nozzle towards the base of the fire source, depress the lever. Maximum extinguishing effect is obtained if the fire fighter uses side to side motion and keeps moving in towards the base of the fire source as it is extinguished. Releasing the lever closes a secondary seal inside the operating head. This interrupts the flow of extinguishant, thus retaining part of the charge, for dealing with a flash back or re-ignition should they occur, without waste or leakage. A partly or totally discharged extinguisher should be replaced immediately after use.

B. Inspection

Disposable type fire extinguishers should be maintained and inspected in accordance with the nameplate instructions.

(1) Monthly

Inspect monthly or more frequently. Ensure nozzle is not obstructed and safety seal is intact. Inspection is a "quick check" that an extinguisher is available and will operate. It is intended to give reasonable assurance that the extinguisher is fully charged and operable. This is done by seeing that it is in its designated place, that it has not been actuated (discharged) or tampered with, and that there is no obvious physical damage or condition to prevent operation. Determine fullness by weighing or "hefting."

(2) 100 Hour/Annual

Each 100 hours or annually, whichever comes first, weigh the extinguisher. Replace and return to manufacturer if gross weight is below the minimum specified on the nameplate.

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GRIDS 2I16 THRU 2L24
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AIRPLANE MAINTENANCE MANUAL

CARD 3 OF 7

PA-44-180



(S/N's 4496001 & UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-892

March 15, 2006

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Technical Publications

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2926 Piper Drive
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U.S.A.



Member
General Aviation
Manufacturers Association

THE NEW PIPER AIRCRAFT, INC.
PA-44-180, SEMINOLE
MAINTENANCE MANUAL

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-882) originally published March 1, 1998 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG970401	April 1, 1997	1, 2, 3, and 4
PR020228	February 28, 2002	1, 3, and 4
PR021206	December 6, 2002	2
CR060315 *	March 15, 2006	1, 2, 3, 4, 5, 6 and 7

*** COMPLETE REVISION OF MAINTENANCE MANUAL 761-892**

Revisions appear in all seven Aerofiche Cards. Accordingly, discard your entire existing Aerofiche Card set and replace it with this one dated 03/15/06.

Consult the Piper Customer Service Information Aerofiche (P/N 1753-755) for current revision dates for this manual.

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INTRODUCTION

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	2	Mar 15/06			
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	2	Mar 15/06			
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INTRODUCTION

1. Instructions for Continued Airworthiness

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

The PIPER PA-44-180 Seminole Maintenance Manual constitutes the Instructions for Continued Airworthiness in accordance with Federal Aviation Regulations (FAR) Part 23, Appendix G. Chapter 4 contains the Airworthiness Limitations section (4-00-00) and the Inspection Program is in Chapter 5 (5-20-00).

2. General

This publication is prepared in accordance with the General Aviation Manufacturers Association (GAMA) Specification No. 2, with respect to the arrangement and content of the System/Chapters within the designated Chapter/Section-numbering system.

WARNING: USE ONLY GENUINE PIPER AIRCRAFT PARTS OR PIPER AIRCRAFT APPROVED PARTS OBTAINED FROM PIPER APPROVED SOURCES, IN CONNECTION WITH THE MAINTENANCE AND REPAIR OF PIPER AIRPLANES.

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-44-180 Parts Catalog P/N 761-891, and FAR 43 for proper utilization.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

THE NEW PIPER AIRCRAFT, INC. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: THE NEW PIPER AIRCRAFT, INC. expressly reserves the right to supersede, cancel and/or declare obsolete any part, part numbers, kits or publication that may be referenced in this manual without prior notice.

In any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence.

3. Effectivity

This maintenance manual is effective for PA-44-180 Seminole airplanes serial numbers 4496001 and up.

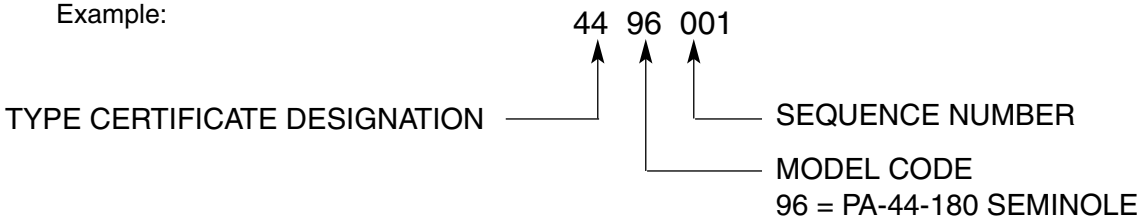
This encompasses the following model years:

NOTE: The following is provided as a general reference only.

Model Year	Serial Numbers
1995	4496001 thru 4496005
1996	4496006 thru 4496013
1997	4496014 thru 4496023; less 4496020
1999	4496024 thru 4496030; and 4496020
2000	4496031 thru 4496042
2001	4496043 thru 4496108
2002	4496109 thru 4496168
2003	4496169 thru 4496179
2004	4496180 thru 4496190
2005	4496191 thru 4496219
2006	4494220 and up

4. Serial Number Explanation

Example:



5. Assignment of Subject Material

This publication is divided into industry standard, three element, numeric subject groupings as follows:

A. System/Chapter - The various groups are broken down into major systems such as Environmental Systems, Electrical Power, Landing Gear, etc. They are assigned a number, which becomes the first element of the standardized numbering system. Thus, the element “28” of the number 28-40-01 refers to the chapter “Fuel”. Everything concerning the fuel system will be covered in this chapter.

B. Sub-System/Section - The major systems/chapters of an airplane are broken down into subsystems. These sub-systems are identified by the second element of the standard numbering system. The element “40” of the number 28-40-01 concerns itself with the indicating section of the fuel system.

C. Unit/Subject - The individual units within a sub-system/section may be identified by the third element of the standard numbering system. The element “01” of the number 28-40-01 is a subject designator. This element is assigned at the option of the manufacturer and is normally zeroed out by PIPER.

Refer to paragraph 14, Chapter/Section Index Guide, for a complete breakdown and list. The material is arranged in ascending numerical sequence.

6. Pagination

The Chapter - Section (i.e. - 28-40-00) numbering system (explained above) forms the primary page numbering system for this manual. Within each Section, pages are numbered consecutively beginning with Page 1 (i.e. - 28-40-00, Page 1). Additionally, the aerofiche grid numbering system (explained below) is also used to indicate location within the manual.

7. Aerofiche Effectivity

A. The General Aviation Manufacturers Association (GAMA) have developed specifications for microfiche reproduction of aircraft publications. 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. The “Aerofiche Effectivity” page at the front of this manual lists the current revision for each card in this set.

B. Conversion of Aerofiche alpha/numeric grid code numbers:

First number is the Aerofiche card number.
Letter is the horizontal row reference per card
Second number is the vertical column reference per card.

Example: 2J16 = Aerofiche card number two, row J, column 16.

C. To aid in locating information, the following is provided at the beginning of each aerofiche card:

(1) A complete Introduction containing the Chapter/Section Index Guide for all fiche in this set.

(2) A complete subject Index for all fiche in this set.

8. Identifying Revised Material

A revision to a page is defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a vertical line (i. e. - change bar) along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A change bar in the left-hand margin opposite the footer (i.e. - chapter/section/subject, page number and date), indicates that the text was unchanged but the material was relocated to a different page.

Example.

NOTE: Change bars are not used in the title pages, list of effective pages, or index. Likewise, all change bars are removed when a publication is completely revised (i.e. - reissued).

9. Indexing

An alphabetically arranged subject Index follows this introduction to assist the user in locating desired information. In addition, each System/Chapter begins with an individual Table of Contents.

10. List of Effective Pages

Each System/Chapter has a List of Effective Pages preceding the Table of Contents to identify the effective revision date for each page in that chapter.

11. Warnings, Cautions and Notes

These adjuncts to the text are used to highlight or emphasize important points when necessary. Warnings call attention to use of materials, processes, methods, procedures or limits which must be followed precisely to avoid injury or death to persons. Cautions call attention to methods and procedures which must be followed to avoid damage to equipment. Notes call attention to methods which make the job easier. Warnings and Cautions shall be located directly above and Notes directly beneath the text and be in line with the paragraphs to which they apply.

12. Accident/Incident Reporting

To improve our Service and Reliability system and aid in Piper's compliance with FAR 21.3, knowledge of all incidents and/or accidents must be reported to Piper immediately. To expedite and assist in reporting all incidents and accidents, Piper Form 420-01 has been created. See Service Letter 1041 for latest revision. This procedure is to be used by all Dealers, Service Centers and Repair Facilities.

13. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-44-180 airplane and its various components. Use them to supplement this manual.

A. Piper Publications:

		Piper P/N
(1)	Parts Catalog:	761-892
(2)	Periodic Inspection Report:	230-1963
(3)	Progressive Inspection Manual (pending):	767-014

B. Vendor Publications:

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY.

(1) ALTERNATOR:

Vendor Address: Electro Systems, Inc.
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/
PH: - (888) 461-6077

(2) AUTOFLIGHT:

Vendor Address: Honeywell
One Technology Center
23500 W. 105th St., M/D #45
Olathe, Kansas 66061-1950
http://www.bendixking.com/

(or) S-TEC Corporation
One S-TEC Way
Mineral Wells, Texas 76067
PH - (940) 325-9406
www.s-tec.com

(3) BATTERY:

Vendor Address: GILL Batteries
A Division of Teledyne Continental Motors
http://www.gillbatteries.com
PH: - (800) 456-0070

(4) BRAKES AND WHEELS:

Vendor Address: Parker Hannifin Corp
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
http://www.parker.com/cleveland/Universe/book.pdf
PH: - (800) 272-5464

(5) ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS):

Vendor Address: Avidyne Corporation PH - (800) 284-3963
55 Old Bedford Road
Lincoln, MA 01773
http://www.avidyne.com/index.htm

Instructions for Continued Airworthiness

Primary Flight Display and Magnetometer/OAT:	Document No. AVPFD-174
Multifuntion Display:	Document No. AVMFD-167
Data Acquisition Unit:	Document No. AVSIU-011

(6) EMERGENCY LOCATOR TRANSMITTER:

Vendor Address: Artex Airccraft Supplies PH: - (800) 547-8901
14405 Keil Road NE
Aurora, Oregon 97002
http://www.artex.net/

(7) ENGINE:

Vendor Address: Textron Lycoming PH - (717) 323-6181
652 Oliver Street FAX - (717) 327-7101
Williamsport, PA 17701
http://www.lycoming.textron.com/main.html

Overhaul Manual:	DIRECT DRIVE MODELS	- P/N 60294-7
Parts Catalog:	O, LO-360 A1H6 ENGINES	- P/N PC306-5
Operators Handbook:	O, HO, IO, AIO, HIO, TIO-360 SERIES	- P/N 60297-12

NOTE: The above Lycoming publications can be ordered as a set on CD-ROM from Avantext. See www.avantext.com or PH - (800) 998-8857.

(8) FIRE EXTINGUISHER (PORTABLE):

Vendor Address: H3R Inc. PH: - (800) 249-4289
43 Magnolia Ave # 4
San Francisco, California 94123-2911
http://www.h3r.com/index.htm

(9) FUEL CELLS:

Vendor Address: Engineered Fabrics Corporation PH - 770-684-7855
669 Goodyear Street FAX - 770-684-7438
Rockmart, Georgia 30153-0548
http://www.kfefc.com/index.htm

(10) HEATER

Vendor Address:	Kelly Aerospace Power Systems Airport Complex, PO Box 273 Fort Deposit, AL 36032 http://www.kellyaerospace.com/ts_heaters.html	PH: - (888) 461-6077 FAX - (334) 227-8596
Maintenance and Overhaul Manual:	Janitrol Maintenance and Overhaul Manual - 24E25-1	

(11) LIGHTS - NAVIGATION, STROBE, AND MAP LIGHTS:

Vendor Address:	Whelen Engineering Co. Inc. Route 145, Winthrop Rd. Chester, Conneticut 06412 http://www.whelen.com/	PH: - (860) 526-9504 FAX - (860) 526-2009

(12) MAGNETOS:

Vendor Address:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104 http://www.unisonindustries.com/index4.html	PH - (815) 965-4700 FAX - (815) 965-2457
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363	

(13) NAVIGATION, COMMUNICATIONS, AND GPS (NAV/COM/GPS):

Vendor Address:	Garmin International 1200 East 151ST Street Olathe, KS 66062 http://www.garmin.com	PH: (913) 397-8200

(14) PROPELLER:

Vendor Address:	Sensenich Corporation 14 Citation Lane Lititz, PA 17543 http://www.sensenich.com/	PH - (717) 569-0435 FAX - (717) 560-3725
Repair Manual:	METAL PROPELLER REPAIR MANUAL - SPRM 590	

(15) STARTER:

Vendor Address:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252
or	Electro Systems, Inc. (see “Voltage Regulator,” below)	

(16) VACUUM PUMP:

Vendor Address: Aero Accessories, Inc. PH - (800) 822-3200
1240 Springwood Avenue
Gibsonville, NC 27249
http://www.aeroaccessories.com/index.html

(17) VACUUM REGULATOR:

Vendor Address: Parker Hannifin Corp. PH: - (800) 382-8422
Airborne Division
711 Taylor Street
Elyria, Ohio 44035
http://www.parker.com/cleveland/Universe/book.pdf

(18) VOLTAGE REGULATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

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14. Chapter/Section Index Guide

NOTE: The following GAMA Specification No. 2 standard chapters are not included in this Maintenance Manual: 23, 35, 36, 38, 49, 54, 60, 72, 75, 81, and 83. These chapters are omitted because the subject system is either: not installed in these airplanes; adequately covered in vendor or other manuals; or, for ease of use, has been combined with another chapter.

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CHAPTER 27

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GENERAL

1. Description and Operation

The airplane is controlled in flight by standard three-axis control surfaces: ailerons (roll), stabilator (pitch) and rudder (yaw). These controls are operated by movement of the control wheel(s), control column-tee bar assembly and rudder pedals.

On the forward end of each control wheel tube is a sprocket assembly. A chain is wrapped around the sprockets to connect the right and left control wheels and then back to idler sprockets on the column's tee bar, which 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 pushrod connected to the balance arm of the stabilator. Cables also connect the rudder pedals with the rudder horn.

Pitch and yaw trim control is provided by separate adjustable trim mechanisms for both the stabilator and the rudder. Stabilator trim is controlled by a wheel and drum mounted on the floor tunnel between the front seats or, in an optional installation, by an S-TEC Manual Electric Trim Control mounted on the control yoke. Cables are routed aft from the drum to a screw assembly mounted above the stabilator attachment point. This screw assembly in turn moves the pushrod 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.

The flaps are manually operated.

2. Standard Procedures

The following tips may be helpful in the removal, installation, and rigging of individual control system assemblies.

A. It is recommended, though not always necessary, to level and place the airplane on jacks during rigging and adjustment.

B. Remove turnbuckle barrels from cable ends before withdrawing the cables through the structures.

C. Tie a cord to the cable end before withdrawing the cable through the structures to facilitate installation of cable.

D. Mark cable ends, etc., before disconnecting, using a felt tip marking pen.

E. Assemble and adjust the turnbuckles so that each terminal is screwed an approximately equal distance into the barrel. Do not turn the terminals in such a manner that will put a permanent "twist" into the cables.

F. Cable tensions should be taken with the appropriate control surface in its neutral position.

NOTE: Cable rigging tensions specified must be corrected to ambient temperature where the tension is being checked, using Chart 1. When installing new cables, initially tension them 20 to 30% over nominal tension, then loosen them to the "high side" of the tolerance. This will aid in maintaining specified tension after flight testing.

G. Check all cable ball ends for proper seating in retainers after setting cable tension.

H. After completion of each adjustment, check the turnbuckles to be sure not more than three terminal threads are visible outside the barrel. Install the locking clips, and check for proper installation by trying to remove the clips using fingers only. Both locking clips may be installed in opposite holes. Locking clips which have been installed and removed must be scrapped and not reused.

I. Turnbuckles may be safetied in accordance with Advisory Circular 43.13-1, latest revision.

J. When pushrods or rod ends are provided with an inspection hole, the screw must be screwed in far enough to pass the inspection hole. This can be determined visually or by feel, inserting a piece of wire into the inspection hole. If no hole is provided, there must be a minimum thread engagement of .375 (3/8) inch .

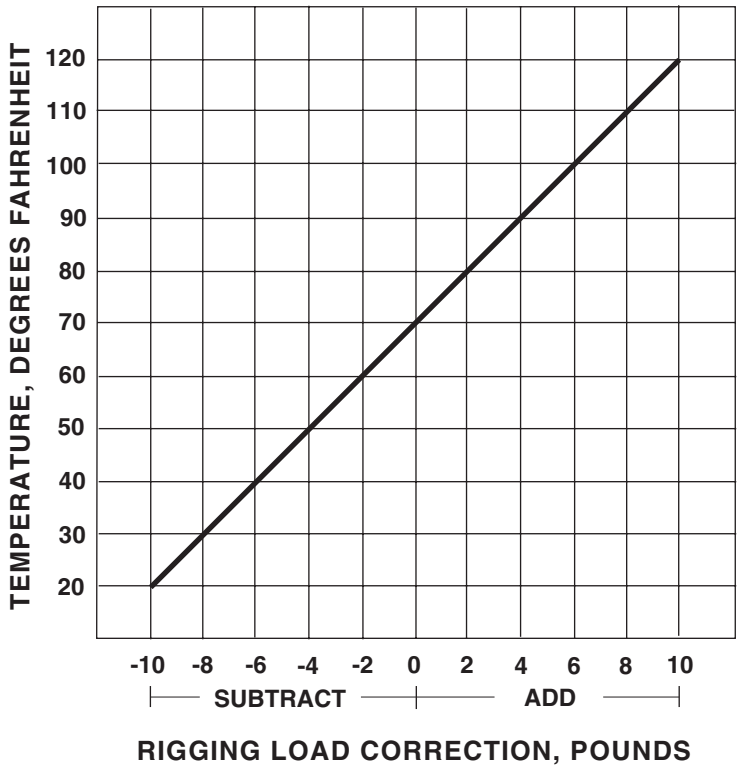
K. When installing/adjusting rod end jamnuts, refer to Figure 1 for proper method.

L. After completion of adjustments, each jam nut must be tightened securely and inspected.

NOTE: Torque all nuts in the flight control system (including nose wheel steering) as specified in 91-10-00, Chart 2.

M. Ensure all pulley guard pins are properly installed and secured.

CHART 1
CABLE TENSION VS. AMBIENT TEMPERATURE



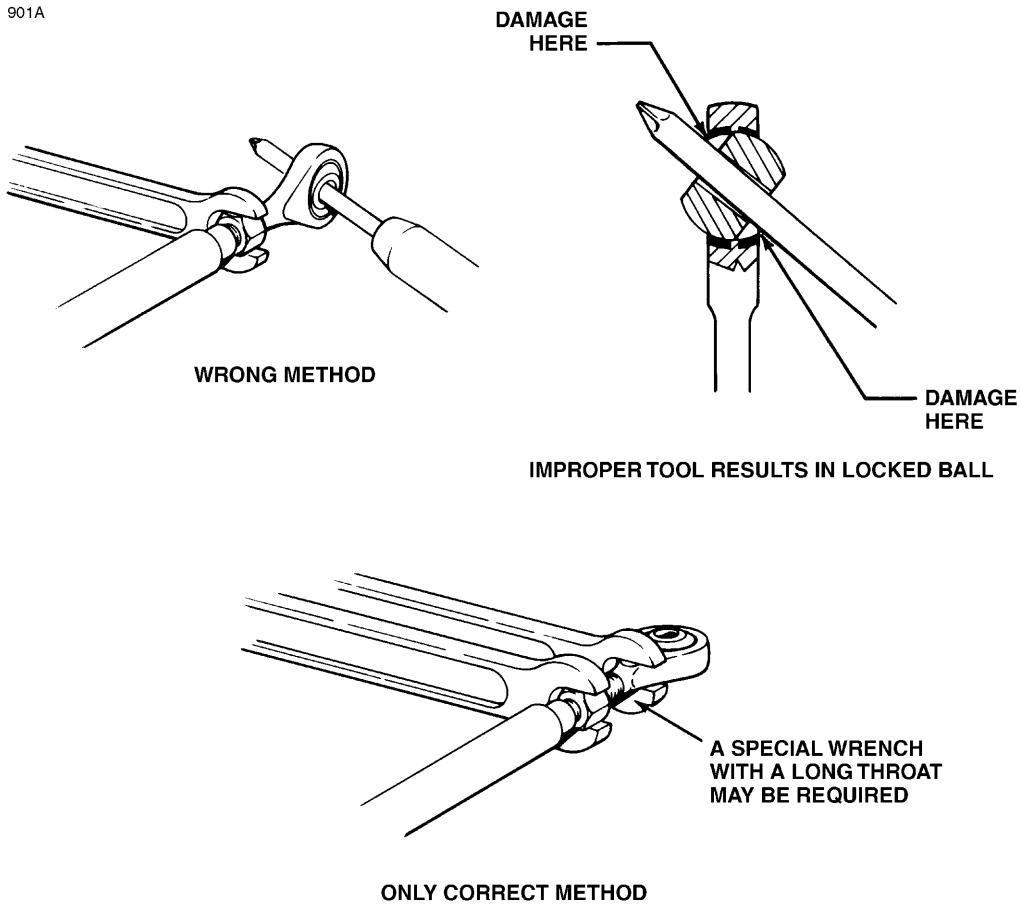
3. Control Cable Inspection

Aircraft control cable systems are subject to a variety of environmental conditions and forms of deterioration that, with time, may be easy to recognize as wire/strand breakage or the not-so-readily visible types of wear, corrosion, and/or distortion. The following data may help in detecting the presence of these conditions:

A. Cable Damage

Critical areas for wire breakage are sections of the cable which pass through fairleads and around pulleys. To inspect each section which passes over a pulley or through a fairlead, remove cable from aircraft to the extent necessary to expose that particular section. Examine cables for broken wires by passing a cloth along length of cable. This will clean the cable for a visual inspection, and detect broken wires, if the cloth snags on cable. When snags are found, closely examine cable to determine full extent of damage.

The absence of snags is not positive evidence that broken wires do not exist. Figure 2, View A, shows a cable with broken wires that were not detected by wiping, but were found during a visual inspection. The damage became readily apparent (View B) when the cable was removed and bent using the techniques depicted in View C.



Rod End Installation Method
Figure 1

B. External Wear Patterns

Wear will normally extend along cable equal to the distance cable moves at that location. Wear may occur on one side of the cable only or on its entire circumference. Replace flexible and non-flexible cables when individual wires in each strand appear to blend together (outer wires worn 40-50 percent) as depicted in Figure 3.

C. Internal Cable Wear

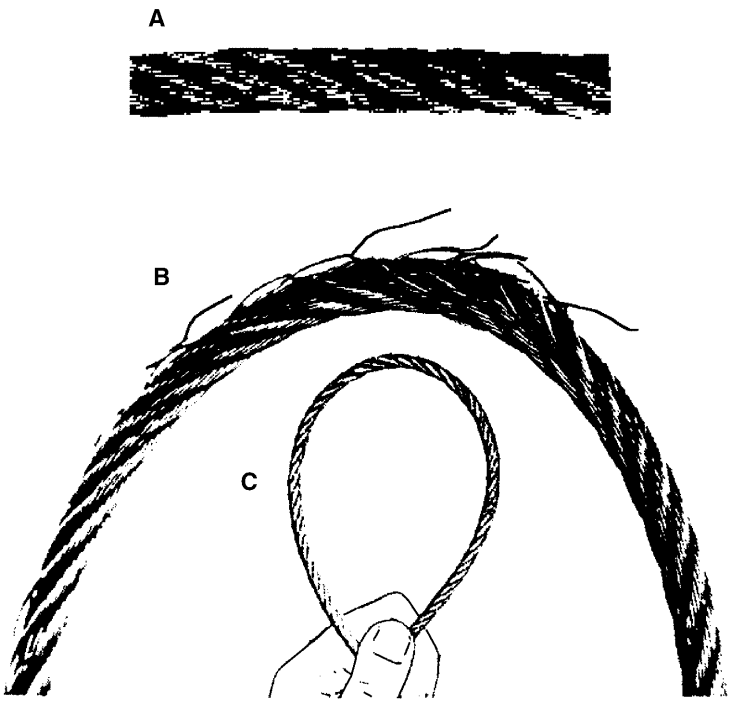
As wear is taking place on the exterior surface of a cable, the same condition is taking place internally, particularly in the sections of the cable which pass over pulleys and quadrants. This condition, shown in Figure 4, is not easily detected unless the strands of the cable are separated. Wear of this type is a result of the relative motion between inner wire surfaces. Under certain conditions the rate of this type wear can be greater than that occurring on the surface.

D. Corrosion

Carefully examine any cable for corrosion that has a broken wire in a section not in contact with wear producing airframe components such as pulleys, fairleads, etc. It may be necessary to remove and bend the cable to properly inspect it for internal strand corrosion as this condition is usually not evident on the outer surface of the cable. Replace cable segments if internal strand rust or corrosion is found.

Areas especially conducive to cable corrosion are battery compartments, lavatories, wheel wells, etc., where concentrations of corrosive fumes, vapors, and liquids can accumulate.

NOTE: Check all exposed sections of cable for corrosion after a cleaning and/or metal-brightening operation has been accomplished in that area.



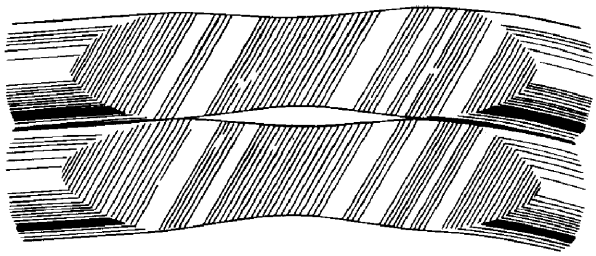
Control Cable Inspection Technique
Figure 2

E. Cable Maintenance

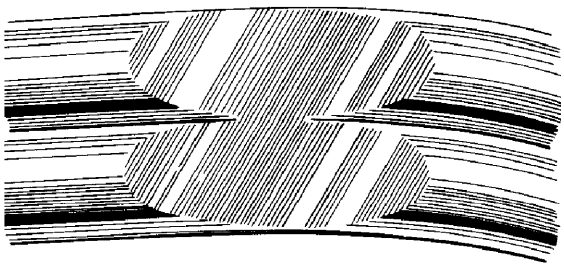
CAUTION: TO AVOID REMOVAL OF CORROSION-PREVENTATIVE COMPOUNDS AND CABLE INTERNAL LUBRICANT, DO NOT USE VAPOR DEGREASING, STEAM CLEANING, METHYLETHYLKETONE (MEK) OR OTHER SOLVENTS.

CAUTION: DO NOT OIL CONTROL CABLES.

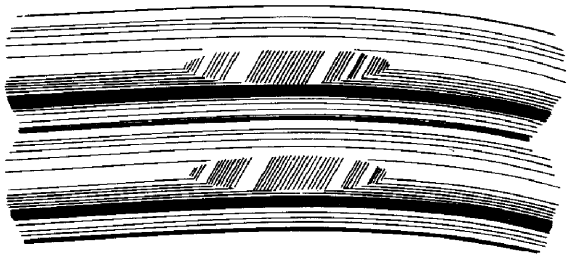
Frequent inspections and preservation measures such as rust prevention treatments for bare cable areas will help to extend cable service life. Where cables pass through fairleads, pressure seals, or over pulleys, remove accumulated heavy coatings of corrosion prevention compound. Provide corrosion protection for these cable sections by lubricating as specified in the Lubrication Chart, 12-20-00.



INDIVIDUAL OUTER WIRES
WORN MORE THAN 50%

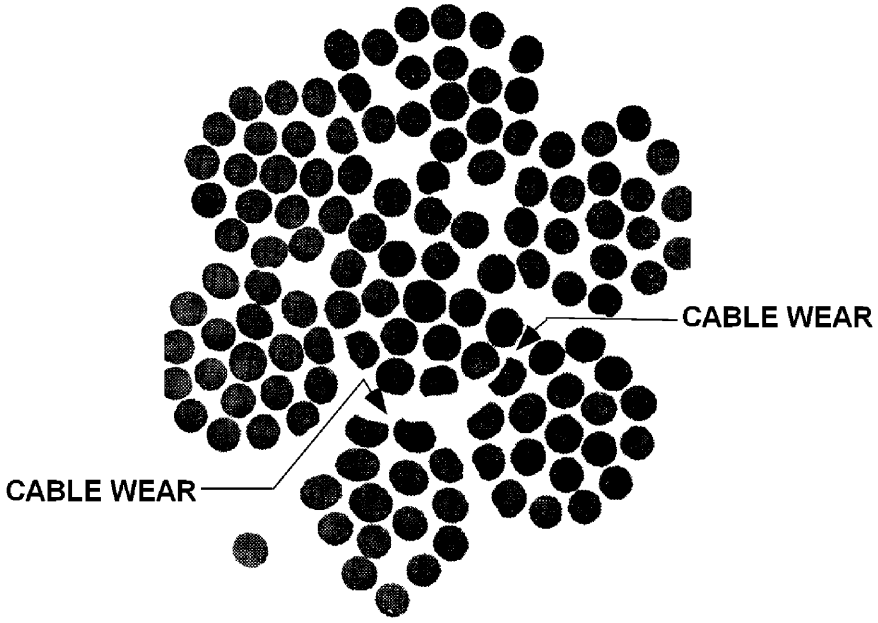


INDIVIDUAL OUTER WIRES WORN
MORE THAN 40 - 50 %
(NOTE BLENDING OF WORN AREAS)



INDIVIDUAL OUTER WIRES WORN LESS THAN 40%
(WORN AREAS INDIVIDUALLY DISTINGUISHABLE)

External Cable Wear
Figure 3



Internal Cable Wear
Figure 4

F. Cable Fittings

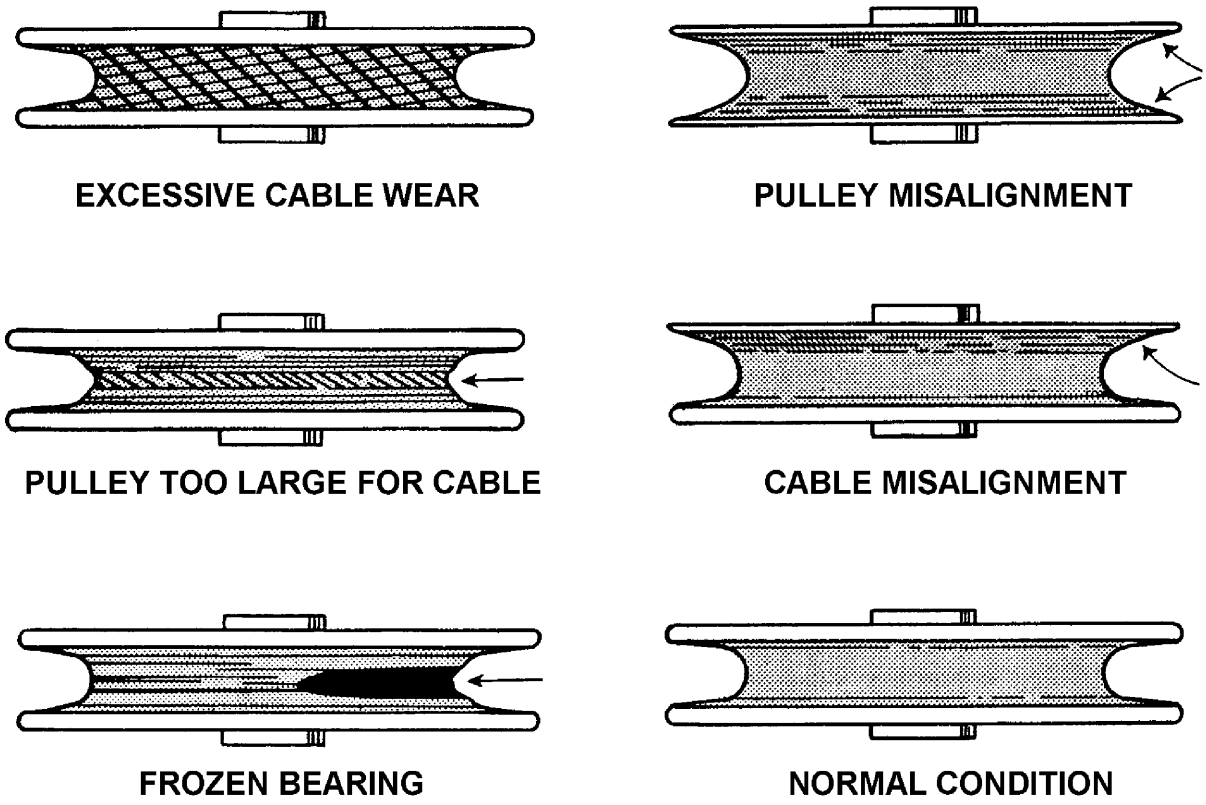
(1) 100 Hour Standard Inspection

Check swaged terminal reference marks for any indication of cable slippage within fitting. Inspect fitting assembly for distortion and/or broken strands at the terminal. Check that all bearings and swivel fittings (bolted or pinned) pivot freely to prevent binding and subsequent failure. Check turnbuckles for proper thread exposure and broken or missing safety wires/clips.

Pay particular attention to corrosion and “pitting” on cable terminals, turnbuckles and cable fittings. Any corrosion or pitting found requires replacement of the corroded fitting and/or cable.

(2) 100 Hour Special Inspection

For airplanes 15 years old or older, using a 10X magnifier, visually inspect the entire surface of each cable terminal, turnbuckle, or other cable fitting for corrosion or cracking. Inspect under safety wire or clips wrapped around the cable or fitting. Any evidence of corrosion or cracking, however minute, is cause for replacement. A logbook entry documenting the replacement of a cable terminal, turnbuckle, or other cable fitting relieves the inspection requirement for that fitting only, until such time as that fitting has been in service for 15 years.



Pulley Wear Patterns
Figure 5

G. Pulleys

Inspect pulleys for roughness, sharp edges, and presence of foreign material embedded in the grooves. Examine pulley bearings to assure proper lubrication, smooth rotation, freedom from flat spots, dirt, and paint spray. Periodically rotate pulleys, which turn through a small arc, to provide a new bearing surface for the cable. Maintain pulley alignment to prevent the cable from riding on flanges and chafing against guards, covers, or adjacent structure. Check all pulley brackets and guards for damage, alignment, and security.

H. Pulley Wear Patterns

Various cable system malfunctions may be detected by analyzing pulley conditions. These include such discrepancies as too much tension, misalignment, pulley bearing problems, and size mismatches between cables and pulleys. Examples of these conditions are shown in Figure 5.

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AILERON

1. Description and Operation

The ailerons are operated by movement of the control wheel(s).

On the forward end of each control wheel tube is a sprocket assembly. A chain is wrapped around the sprockets to connect the right and left control wheels and then back to idler sprockets on the column's tee bar, which connect to the aileron primary control cables. The cables operate the aileron bellcrank and push-pull rods.

NOTE: Adjust and rig flap controls completely before adjusting and rigging aileron controls.

2. Troubleshooting

See Chart 1.

3. Control Column Assembly

NOTE: To remove/install the control wheel from/to the control wheel tube, see Control Wheel, below.

A. Removal (Refer to Figure 1)

(1) To remove either control wheel and tube assembly, do the following:

(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 and tube assembly from the instrument panel.

(2) To remove tee bar with assembled parts:

(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 and tube 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.

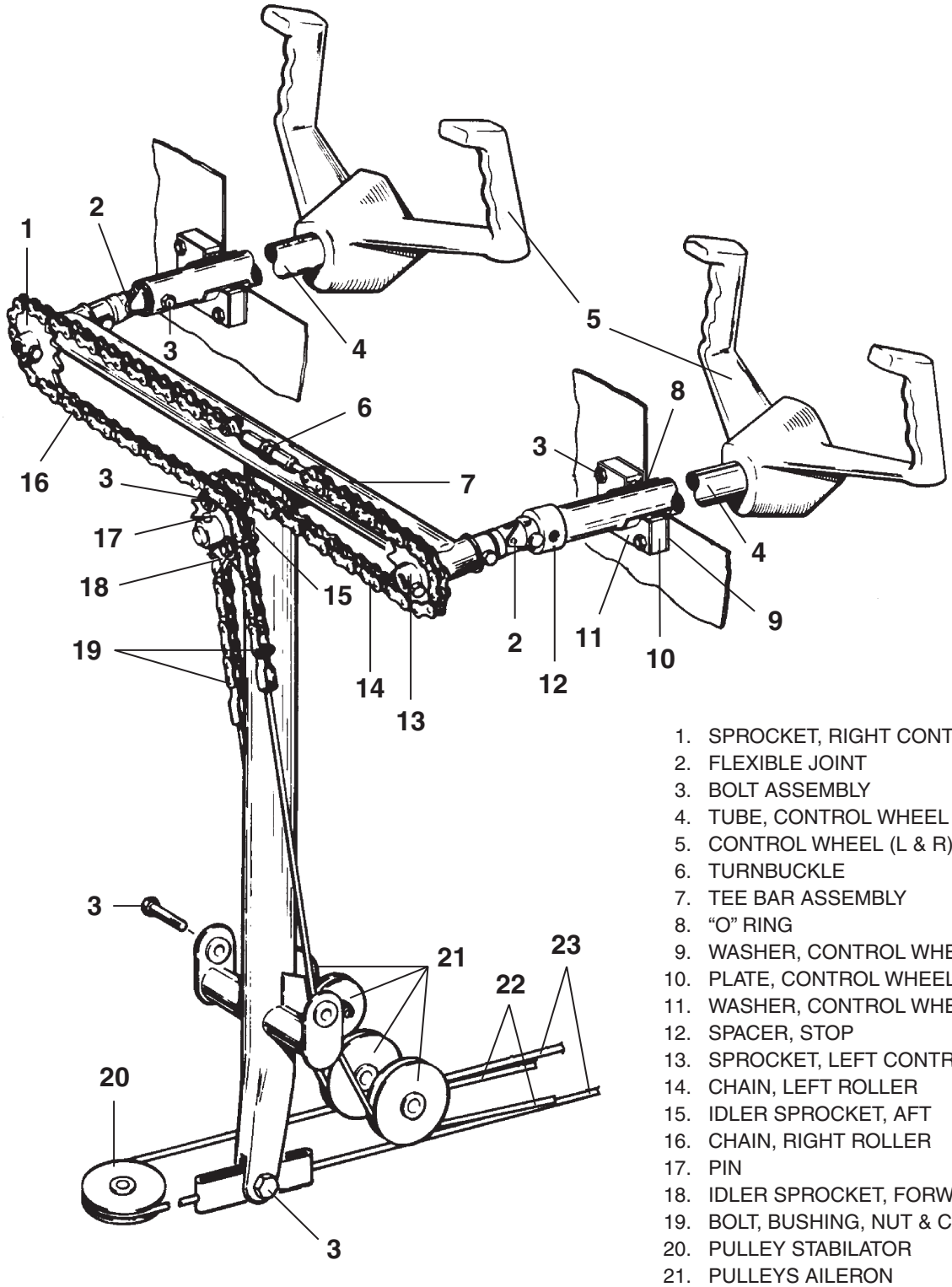
(h) Disconnect the stabilator control cables from the lower end of the tee bar assembly.

(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 arc through each side of the floor tunnel, and lifting it up and out through the right side of the cabin.

CHART 1
TROUBLESHOOTING AILERON CONTROL SYSTEM

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



1. SPROCKET, RIGHT CONTROL WHEEL
2. FLEXIBLE JOINT
3. BOLT ASSEMBLY
4. TUBE, CONTROL WHEEL
5. CONTROL WHEEL (L & R)
6. TURNBUCKLE
7. TEE BAR ASSEMBLY
8. “O” RING
9. WASHER, CONTROL WHEEL
10. PLATE, CONTROL WHEEL
11. WASHER, CONTROL WHEEL
12. SPACER, STOP
13. SPROCKET, LEFT CONTROL WHEEL
14. CHAIN, LEFT ROLLER
15. IDLER SPROCKET, AFT
16. CHAIN, RIGHT ROLLER
17. PIN
18. IDLER SPROCKET, FORWARD
19. BOLT, BUSHING, NUT & COTTER PIN
20. PULLEY STABILATOR
21. PULLEYS AILERON
22. CABLES, AILERON CONTROL
23. CABLES, STABILATOR CONTROL

Control Column Assembly
Figure 1

B. Installation (Refer to Figure 1)

(1) To install tee bar assembly:

(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 Control Wheel, below.

(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.

(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 6. 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, torque to 45 ± 5 in.-lbs.

(k) Install the floor tunnel plate and secure with screws. Fasten the tunnel carpet in place.

(2) To install either control wheel and tube assembly:

(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 of the tube ahead of the control wheel. Position the rubber grommet in the hole in the side of the tube to protect wires.

(c) On the left control tube, install the stop.

(d) Connect the control wheel tube to the flexible joint of the tee bar assembly. If the control cables and/or chains have not been removed or loosened, place the ailerons in neutral and install the control tube on the flexible joint to allow the control wheel to be neutral. Install bolt, washer and nut and tighten.

(3) Installation of Flex Joint Replacement (Refer to Figures 1 and 2.)

(a) Carefully lay out location for hole to be drilled in flex joint tube to match hole in control column shaft.

(b) Using a #5 (0.2055) drill bit, drill hole through flex joint tube at location determined above.

(c) Ream drilled hole, in steps, with a #1 reamer, checking to insure proper depth for taper pin and sufficient pin thread protrusion for proper installation.

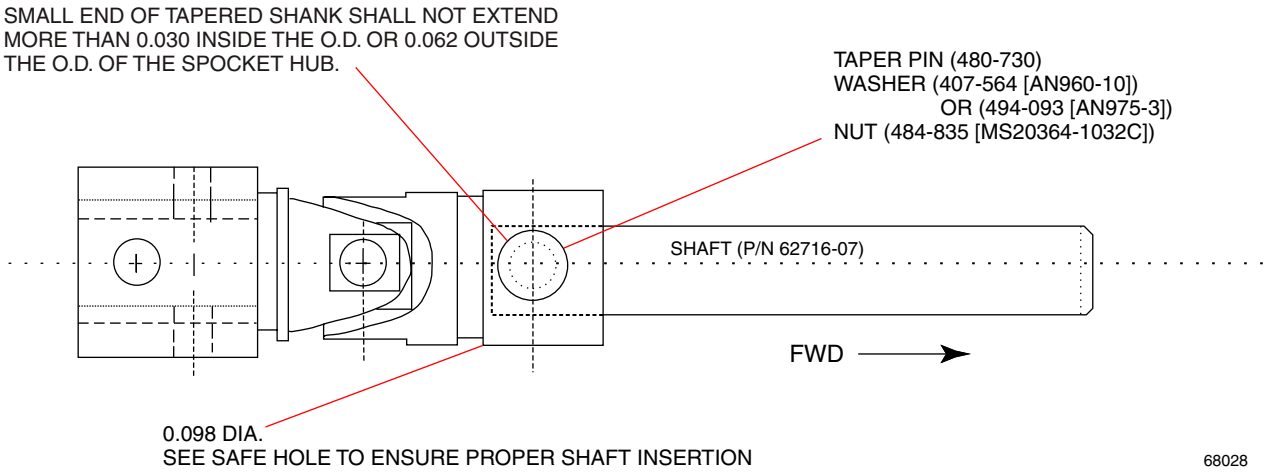
NOTE: Reamer may be purchased from Enstice Tool Co., Palm Bay, Florida.

(d) Install pin through tube and shaft.

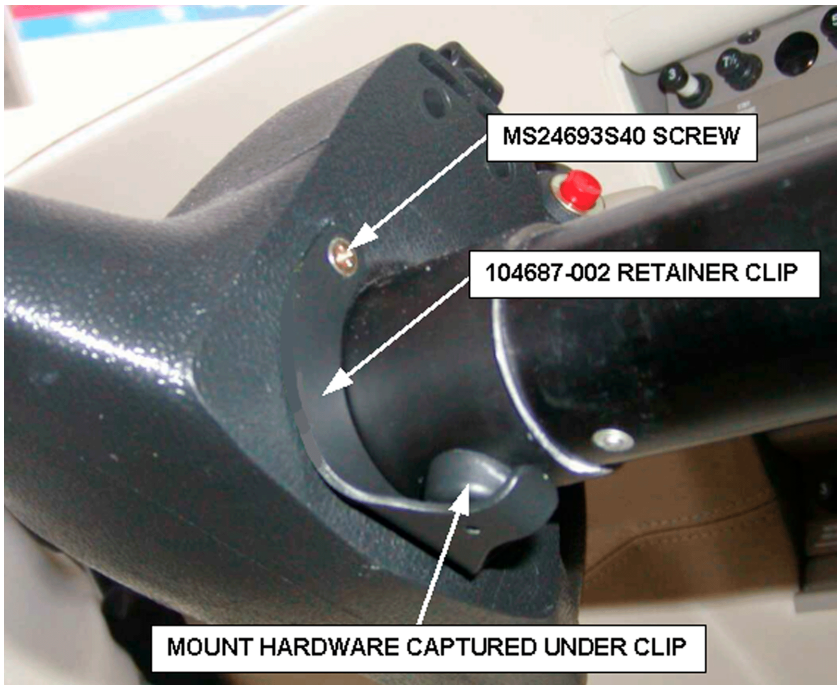
1 If pin shoulder does not protruded past sprocket hub, install an AN960-10 washer

2 If pin shoulder does protruded past sprocket hub, install an AN975-3 washer

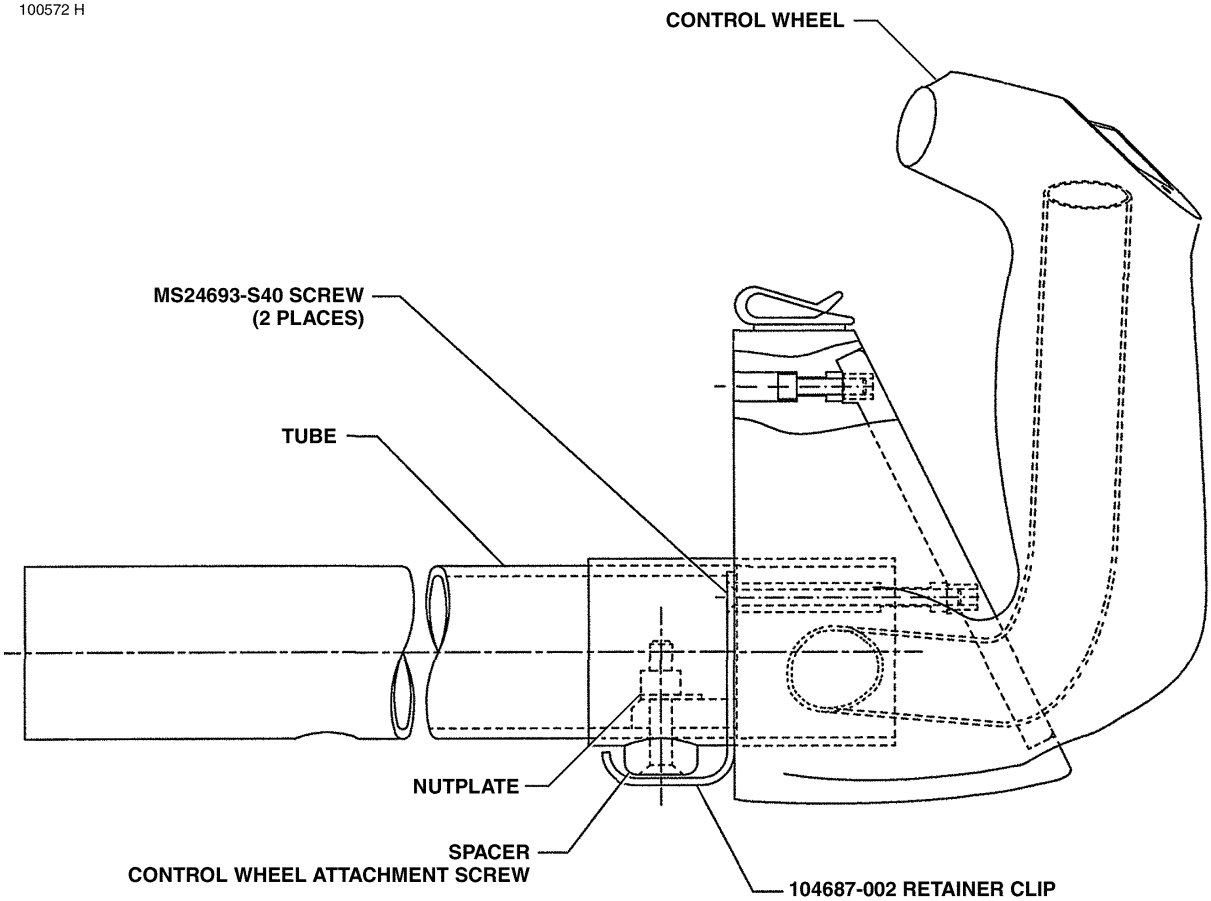
3 Install nut. Torque 35 - 40 inch-pounds.



Flex (Universal) Joint Assembly
Figure 2

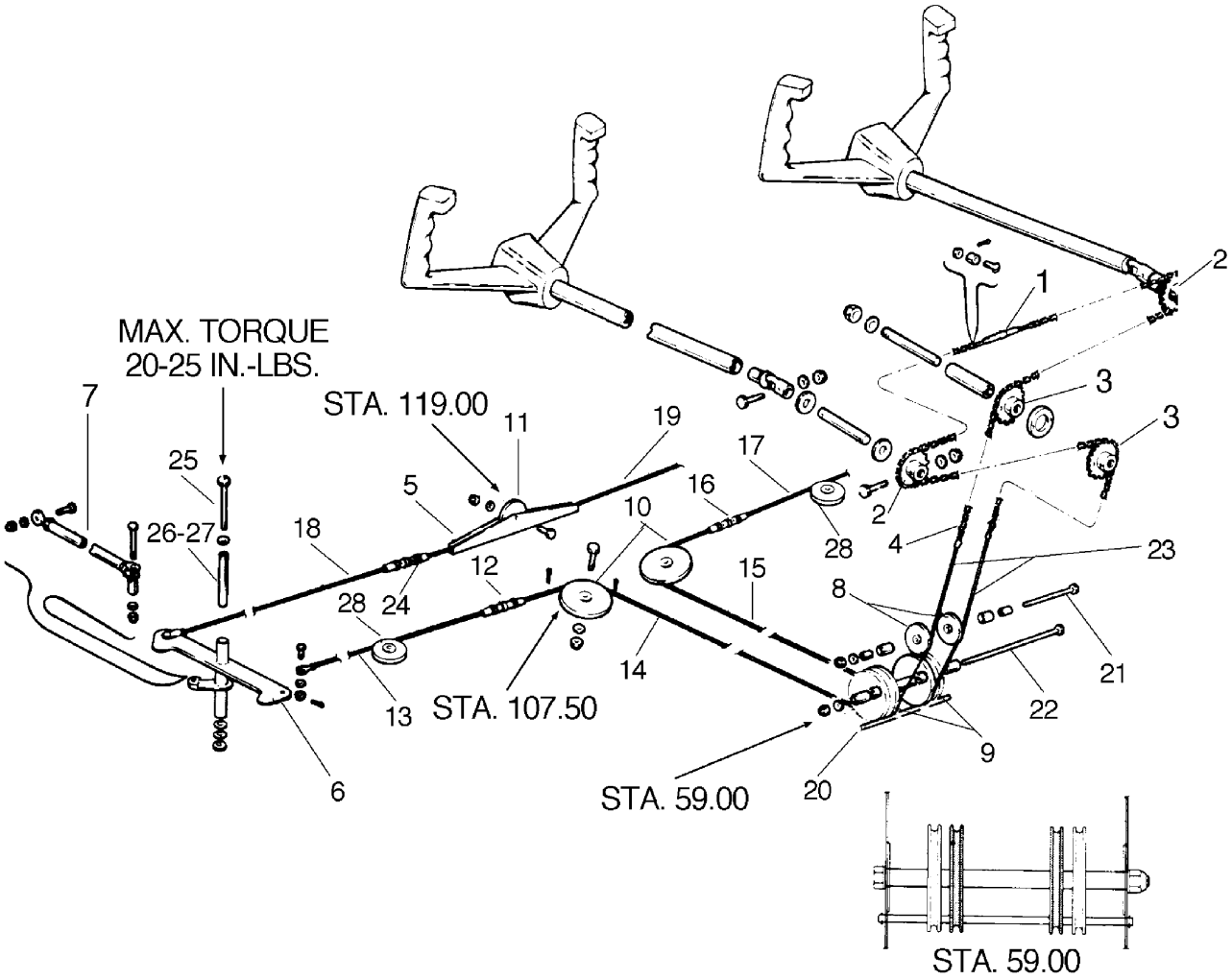


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Effectivity
4496020 and up

Control Wheel Installation
Figure 3



1. TURNBUCKLE, CONTROL CHAINS
2. SPROCKET, CONTROL WHEEL
3. SPROCKET, IDLER
4. CHAIN, AILERON CONTROL
5. BRACKET, PULLEY
6. BELLCRANK, AILERON
7. ROD, AILERON CONTROL
8. PULLEY, TEE BAR
9. PULLEY, FORWARD CLUSTER
10. PULLEY, PRIMARY CONTROL CABLE
11. PULLEY, BALANCE CABLE
12. TURNBUCKLE, RIGHT PRIMARY
13. CABLE, RIGHT WING PRIMARY
14. CABLE, RIGHT FUSELAGE PRIMARY
15. CABLE, LEFT FUSELAGE PRIMARY
16. TURNBUCKLE, LEFT PRIMARY
17. CABLE, LEFT WING PRIMARY
18. CABLE, RIGHT BALANCE
19. CABLE, LEFT BALANCE
20. ROD, CABLE GUARD
21. BOLT, WASHER & NUT
22. BOLT, WASHER & NUT
23. BOLT, NUT, BUSHING & COTTER PIN
24. TURNBUCKLE, BALANCE CABLE
25. BOLT, BELLCRANK PIVOT
26. BUSHING, BELLCRANK
27. TEFLON TUBE
28. PULLEY, PRIMARY CONTROL CABLE
(W.S. 106.190, TORQUE TO 25 ± 5 IN. LBS.)

Aileron Controls
Figure 4

4. Control Wheel (S/N's 4496020 and up.) (See Figure 3.)

NOTE: Refer to Control Column Assemby, above, for control column assembly installation and removal.

The retainer clip (P/N 104687-002) and MS24693-S40 screw (2 ea.) are factory installed in S/N's 4496181 and up. For S/N's 4496020 through 4496180 the retainer clips and screws must be individually procured and retrofitted.

A. Removal

(1) Remove two (2) screws and retainer clip.
(2) Remove control wheel attachment screw and spacer.
(3) Slide control wheel off of tube.

B. Installation

(1) Degrease aft end of tube and inside of control wheel using acetone or naptha. Allow to dry.
(2) Degrease control wheel attachment screw, the spacer, and the nutplate (inside the tube) using acetone or naptha. Allow to dry.
(3) Prime inside of control wheel with Loctite 7649 (Piper P/N 279-073). Allow to dry.
(4) Install control wheel onto tube using Loctite 271 (Piper P/N 279-128). Take care to ensure screw hole in control wheel aligns with screw hole in tube.

NOTE: This step must be accomplished promptly due to short cure time.

(5) Prime threads of control wheel attachment screw with Loctite 7649 (Piper P/N 279-073). Allow to dry.
(6) Install control wheel attachment screw (with spacer) into nutplate using Loctite 271 (Piper P/N 279-128).

NOTE: This step must be accomplished promptly due to short cure time.

(7) Position retainer clip to capture spacer and control wheel attachment screw. Secure with screws (2), being careful not to over tighten the screws and damage the logo medallion.

5. Aileron Control Cables

A. Removal (Refer to Figure 4.)

(1) To remove any of the control cables in the fuselage or either wing:
(a) Remove the the center seats and seat belt attachments.
(b) Remove screws securing the floor panel located directly aft of the main spar. Lift the panel and remove from the airplane.
(2) To remove either the right or left primary cables located in the fuselage:
(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 the 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.

(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.

(k) Draw the cable back through the floor tunnel.

(3) To remove the primary control cable in either wing:

(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) To remove either balance cable:

(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.

B. Installation (Refer to Figure 4.)

(1) To install either the right or left primary control cable located in the fuselage:

(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 per Rigging and Adjustment, below.

(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.

(2) To install the primary control cable in the left or right wing:

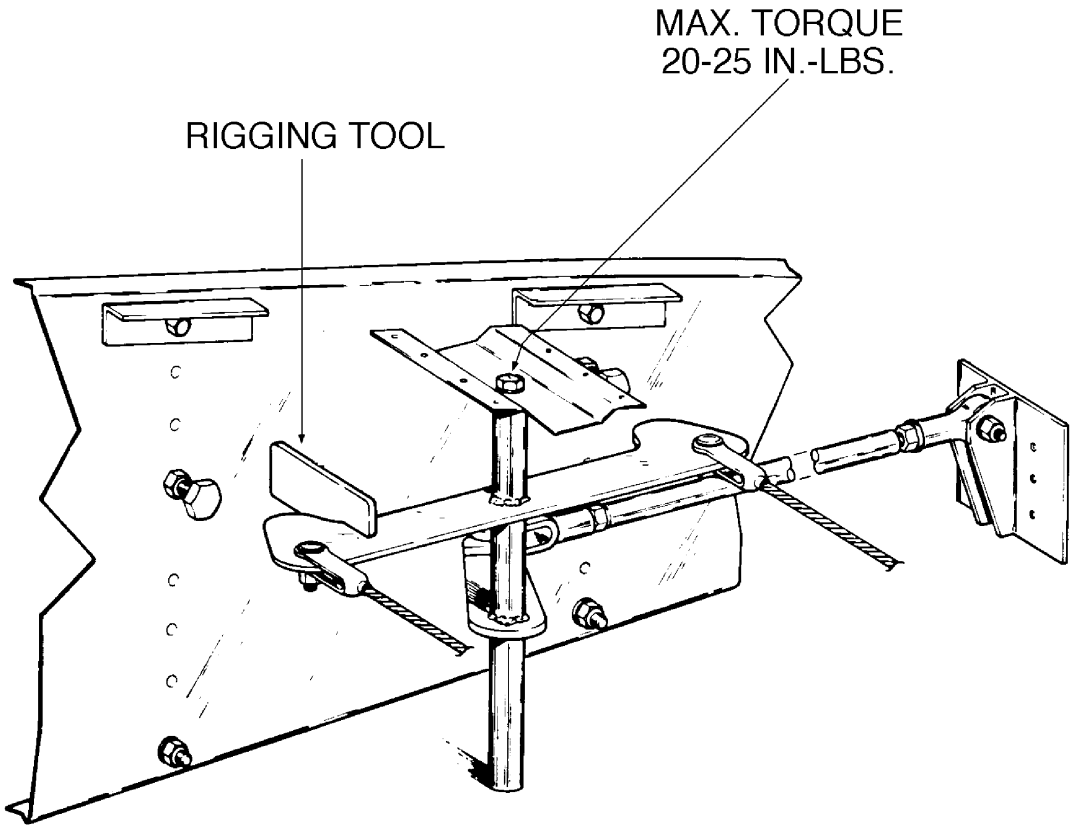
(a) Draw the control cable into the wing.

(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 per Rigging and Adjustment, below.

(e) Install the access plate on the underside of the wing.



Aileron Bellcrank Rigging
Figure 5

(3) To install either balance cable:

(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 per Rigging and Adjustment, below.

(f) Install the access plate on the underside of the wing.

(g) Install the floor panel, seat belt attachments and seats.

6. Aileron Bellcrank

A. Removal (Refer to Figure 5.)

(1) Remove the the center seats, seat belt attachments.

(2) Remove the screws securing the floor panel located directly aft of the main spar. Lift the panel and remove from the airplane.

(3) Remove the access plate to the aileron bellcrank located on the underside of the wing, forward of the inboard end of the aileron.

(4) Relieve tension from the aileron control cables by loosening the balance cable turnbuckle located in the floor opening aft of the main spar.

(5) Disconnect the primary and balance control cables from the bellcrank assembly by removing cotter pins, nuts, washers and bolts.

(6) Disconnect the aileron control rod at the aft or forward end, as desired.

(7) Remove the nut, pivot bolt and washers that secure the bellcrank. The nut is visible from the underside of the wing.

(8) Remove the bellcrank from within the wing.

B. Installation (Refer to Figure 5.)

(1) Ensure 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.

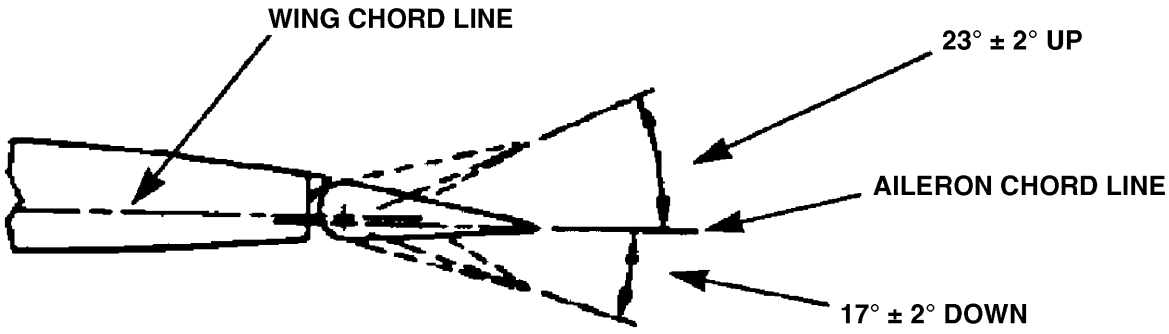
(3) Install the bellcrank pivot bolt with the head up. Install tapered washers and nut on the bolt and torque nut as specified in Figure 5. Check that the bellcrank rotates freely with little up-down play.

(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.

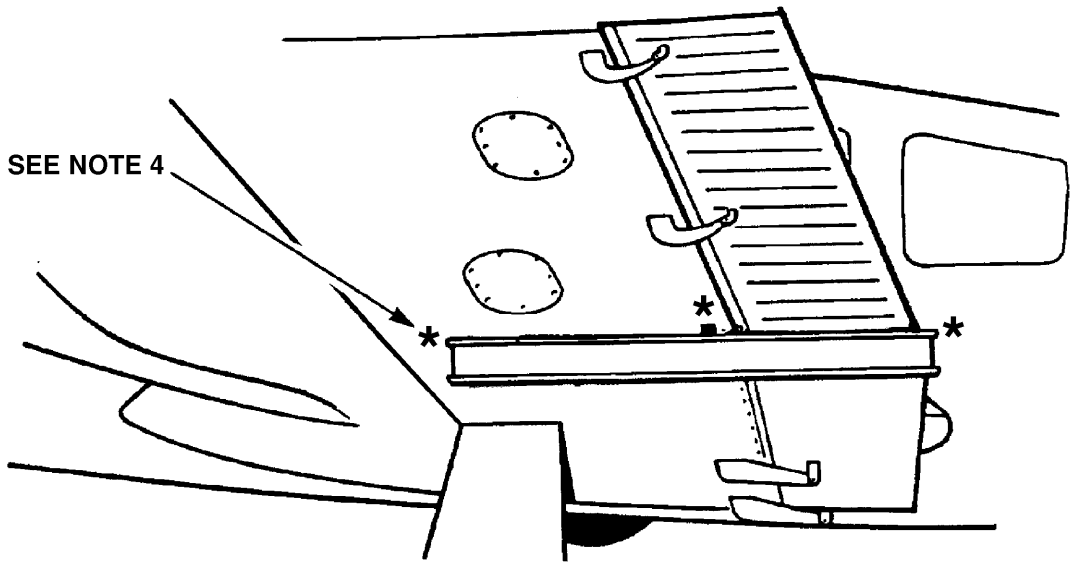
(7) Install the access plate on the underside of the wing, the floor panel aft of the main spar, seat belt attachments and seats.



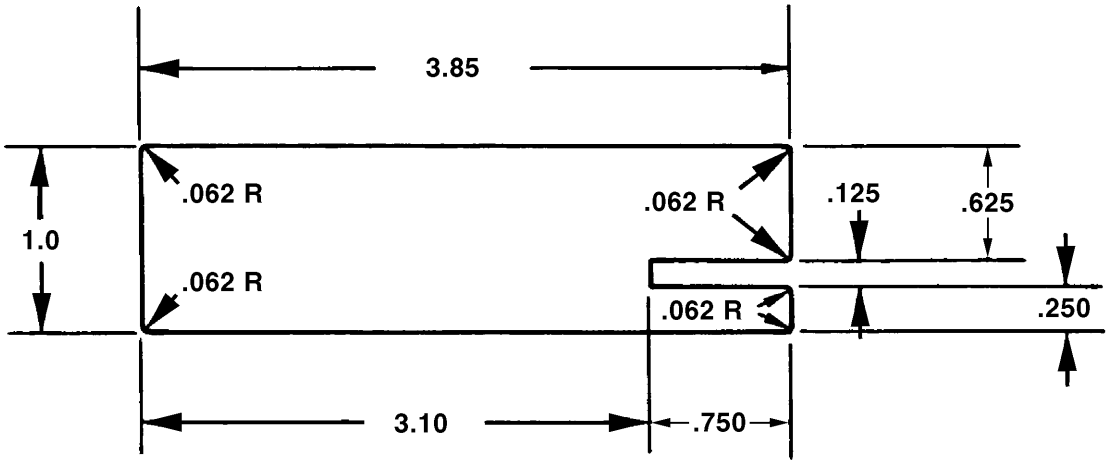
CABLE TENSION (See Note 3)

AILERON	40 LBS ± 5 LBS

NOTES:
1. Maximum free play for aileron is 0.12 inch measured at trailing edge.
2. Maximum end play for aileron is 0.035 inch measured spanwise (inboard/outboard).
3. Cable tension applies only to airplanes without autopilot bridle cables attached, unless autopilot rigging instructions specify otherwise. See 22-10-00 or appropriate Autopilot Manufacturer's Service Manual.
4. Aileron neutral is achieved when these three points on the fabricated rigging tool contact wing and aileron skin at the same time.
   Align 0.375 inch height spacer with aft spar rivet line, but do not allow it to contact any rivets.
   See 27-50-00, Figure 4, to fabricate Aileron and Flap Rigging Tool shown.



Aileron Rigging
Figure 6



Aileron Bellcrank Rigging Tool
Figure 7

7. Rigging and Adjustment (Refer to Figure 6.) (PIR-PPS50033, Rev. I)

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF AILERONS. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF AILERON RIGGING AND ADJUSTMENT, VERIFY THAT THE RIGHT AILERON MOVES UP AND THE LEFT AILERON MOVES DOWN WHEN THE CONTROL WHEEL IS TURNED RIGHT; AND THAT THE LEFT AILERON MOVES UP AND THE RIGHT AILERON MOVES DOWN WHEN THE CONTROL WHEEL IS TURNED LEFT.

NOTE: Adjust and rig flap controls completely before adjusting and rigging aileron controls.

Check and adjust the rigging of the aileron controls, and aileron travel, as follows:

A. Place the tee bar in the full forward position and maintain in this position by use of a suitable tool. Alternately, place weights on the aft side of the stabilator if stabilator cables tension is already set.

B. Check that both aileron bellcranks are in the neutral position. Bellcrank neutral position is when the forward and aft cable connection holes are an equal distance from the adjacent inboard wing rib. A rigging tool, as shown in Figure 5, may be fabricated to hold the bellcranks in the neutral position. (See Figure 7.) A snug fit of the tool is required between the bellcrank arms and ribs, which may necessitate loosening a primary or balance cable.

C. Check and set aileron neutral

Aileron neutral is when the inboard ends of the ailerons are aligned with the outboard ends of the flaps.

Should the ailerons and flaps not be aligned, adjust the aileron control pushrods by loosening the jam nuts at each pushrod end. Rotate the rods until they are aligned. Apply a slight up pressure against the trailing edge of the aileron while making this adjustment. After adjustment, retighten the jam nuts.

The ailerons may be allowed to droop by approximately 0.125 (1/8) inch at this point.

D. Adjust the primary (or, drive) and balance cable tension by the following procedure:

(1) Remove the two front seats if desired, and the rear seat floor panel.

(2) Lock the control wheels in the centered, neutral, position.

(3) Confirm that both bellcranks are in the neutral position.

(4) Adjust tension of the primary and balance cables at the turnbuckles (located in the opening just aft of the main spar), to meet the specifications in Figure 6. Primary cable tension will be slightly less than balance cable tension, but should be within the tension specified (in Figure 6). Adjust the cables in such a manner that when the specified tension is attained, the inboard ends of the ailerons are visually aligned with the outboard ends of the flaps. Apply a light up pressure, with the palm of a hand, against the middle of the underside of the aileron while making this determination, to take slack out of the hinge and linkage.

(5) Maintain neutral position of the control wheels. To do so, it may be necessary to adjust the roller chain turnbuckle located between the control wheel sprockets: Loosen the connecting bolts of the idler cross-over sprockets at the control tee bar to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets. Tighten the bolts to secure the idler cross-over sprockets, torque as specified in Control Column Assembly, Installation, To install tee bar assembly, above.

(6) Finish the adjustment with even tension on all cables, then remove all rigging tools.

E. Remove the control wheel locks. Using the control wheel, confirm that the left aileron up and right aileron down stops are contacted simultaneously and vice versa. Adjust the stops where necessary.

F. 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 (or, a “cushion”) of 0.030 to 0.040 inch is obtained between the sprocket pin and adjustable stop bolts. (Refer to Figure 1.)

G. To measure and adjust aileron travel:

(1) Place the ailerons in the neutral position (aligned with flaps).

(2) Check that the up and down travel of each aileron from neutral position is as specified in Figure 6. While measuring the travel, maintain light pressure up (while measuring the down travel) or down (while measuring the up travel) at the center of the aft edge of the aileron, to remove the slack between the bellcrank and aileron.

(3) Confirm that total free play at the aileron trailing edge does not exceed 0.120 inch.

H. 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, causing an out-of-rig condition which may require aileron replacement.

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RUDDER

1. Description and Operation

   The rudder is operated by movement of the rudder pedals. Cables connect the rudder pedals with the rudder horn.

   Yaw trim control is provided by an adjustable trim mechanism for the rudder. 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.

2. Troubleshooting

   See Charts 1 and 2.

CHART 1
TROUBLESHOOTING RUDDER CONTROL SYSTEM

Trouble	Cause	Remedy
Lost motion between rudder pedals and rudder.	Cable tension too low.	Adjust cable tension.
	Linkage loose or worn.	Check linkage and tighten or replace.
Excessive resistance to rudder pedal movement.	Broken pulley.	Replace pulley.
	Bolts attaching rudder to bellcrank are loose.	Tighten bellcrank bolts.
	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.
Rudder pedals not neutral when rudder is streamlined.	Rudder cables incorrectly rigged.	Rig rudder cables.
Incorrect rudder travel.	Rudder sector stop incorrectly adjusted.	Check sector stops rigging.
	Nose wheel contacts stops before rudder.	Adjust nose wheel stops.

CHART 2
TROUBLESHOOTING RUDDER TRIM CONTROL SYSTEM

Trouble	Cause	Remedy
Trim control knob moves with excessive resistance.	System not lubricated properly.	Lubricate system.

3. Rudder Control Cables

A. Removal (Refer to Figure 1.)

(1) To remove either the forward or aft rudder cables:

(a) Remove the access panel to the aft section of the fuselage.

(b) Disconnect the desired cable at the turnbuckle in the aft section of the fuselage.

(2) To remove either forward rudder cable

(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.

(3) To remove aft rudder control cables:

(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.

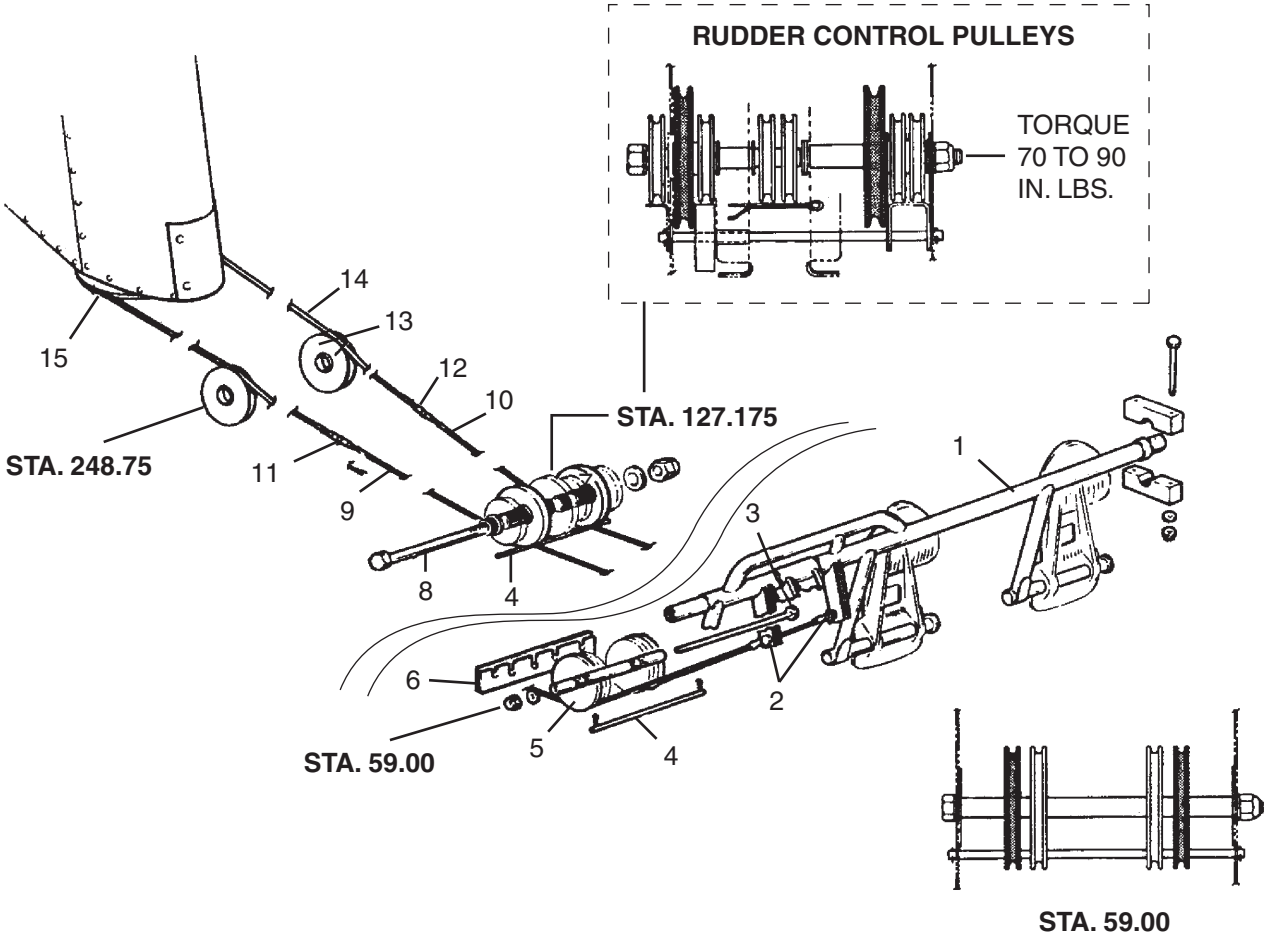
B. Installation (Refer to Figure 1.)

(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 now as described, below. Ascertain that each cable is in the groove of its pulley.



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

Rudder Controls
Figure 1

(d) Move the cable guard that is located in the forward tunnel, at the pulley cluster, into position, and secure with cotter pin.

(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 per Rigging and Adjustment, below.

(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 per Rigging and Adjustment, below.

(e) Install fairing and secure with screws.

(3) Install the access panel to the aft section of the fuselage.

C. Rigging and Adjustment (PIR-PPS50033, Rev. I)

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF RUDDER. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF RUDDER RIGGING AND ADJUSTMENT, VERIFY THAT THE RUDDER MOVES RIGHT WHEN THE RIGHT PEDAL IS DEPRESSED; AND, THAT THE RUDDER MOVES LEFT WHEN THE LEFT PEDAL IS DEPRESSED.

(1) Check and set the correct degree of rudder travel as follows:

(a) Using a rigging tool (refer to Figure 3), set the rudder stops so that rudder travel right and left from neutral position (rudder streamlined with the vertical stabilizer) is as specified in Figure 4. (Fabrication of a rigging tool can be done using dimensions in Figure 6.)

(b) With the rudder against the left stop, place a rigging tool against the side of the rudder and vertical stabilizer as shown in Figure 3. (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 left rudder stop is correct.

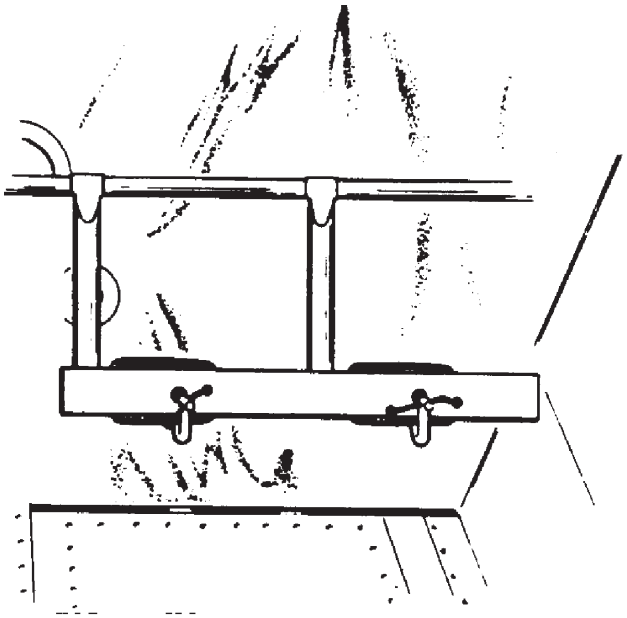
(c) Swing the rudder in the other direction (right) and check travel as described above.

(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 5.)

(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 32-20-00, Nose Landing Gear, Alignment.
   (c) Clamp the rudder pedals to align in a lateral position as shown in Figure 2.
   (d) Adjust the turnbuckles to obtain the main cable tension given in Figure 4. Adjust the cables evenly, to avoid uneven strain on aircraft components.
   (e) Check safety of turnbuckles.

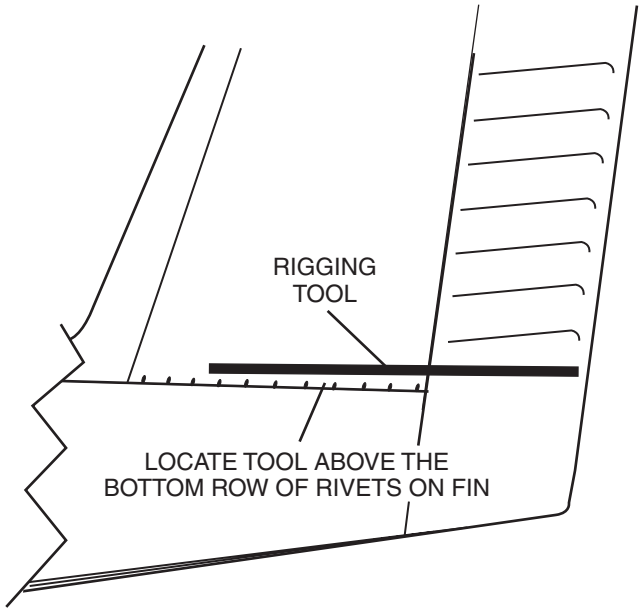
(3) Check that when the rudder contacts its stops, the clearance between the nose wheel stops and the nose wheel horn is between 0.06 and 0.12 of an inch. A more accurate check can be made with weight off of the nose wheel. Adjust the stops according to 32-20-00, Nose Landing Gear, Alignment.

(4) Install the fairing and the access panel to the aft section of the fuselage.



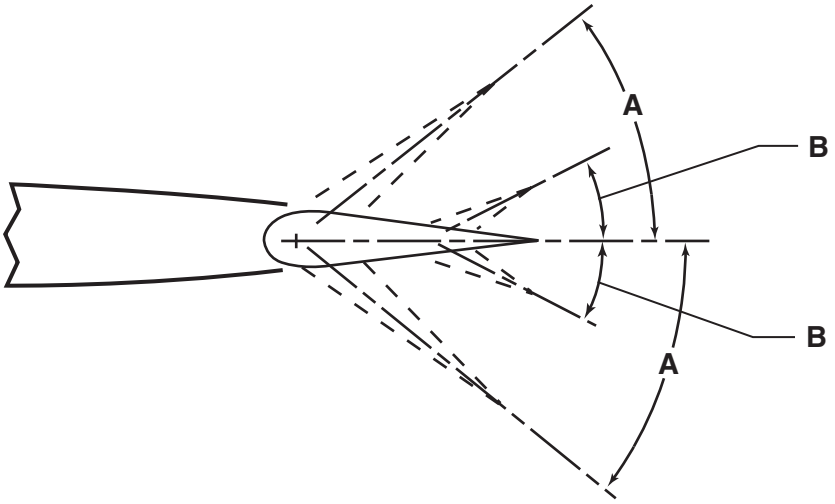
RUDDER PEDAL NEUTRAL POSITION
AFT OF VERTICAL 19º+ 1º, - 0º

Clamping Rudder Pedals
Figure 2



NOTE: SEE 95-10-00, FIGURE 5, FOR RIGGING TOOL SPECIFICATIONS

Rudder Rigging Location
Figure 3



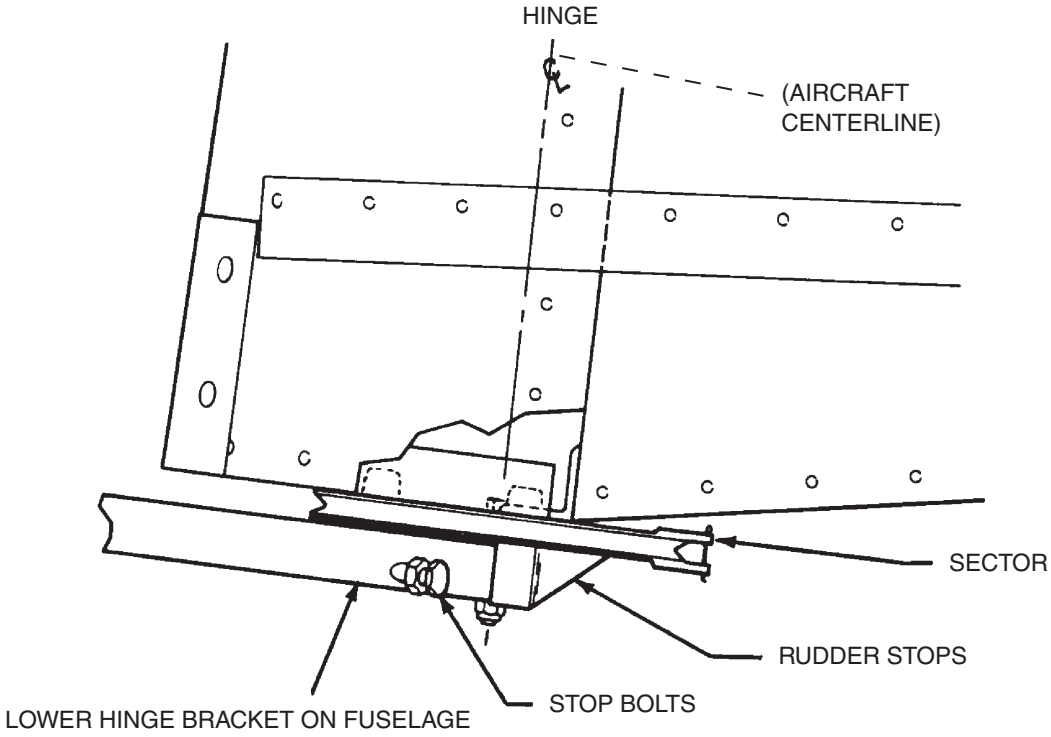
CABLE TENSION (See Note)
MAIN = 40 LBS. ± 5 LBS.
TRIM = 10 LBS. ± 1 LB.

RUDDER TRAVELS
A = 37° + 1° - 0°

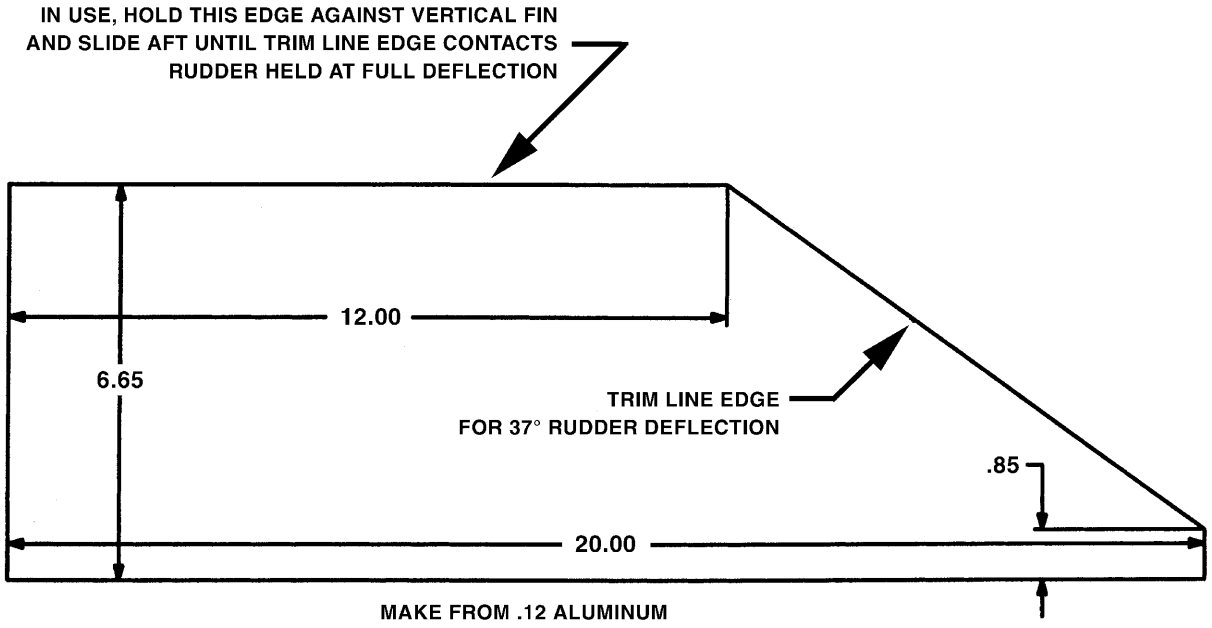
RUDDER TAB TRAVELS
B = 26° ± 2°

NOTE: CABLE TENSION APPLIES ONLY TO AIRPLANES WITHOUT AUTOPILOT BRIDLE CABLES ATTACHED, UNLESS AUTOPILOT RIGGING INSTRUCTIONS SPECIFY OTHERWISE. SEE 22-10-00 OR APPROPRIATE AUTOPILOT MANUFACTURER'S SERVICE MANUAL.

Rudder Rigging
Figure 4



Rudder Travel Adjustments
Figure 5



Rudder Rigging Tool
Figure 6

4. Rudder Trim Control

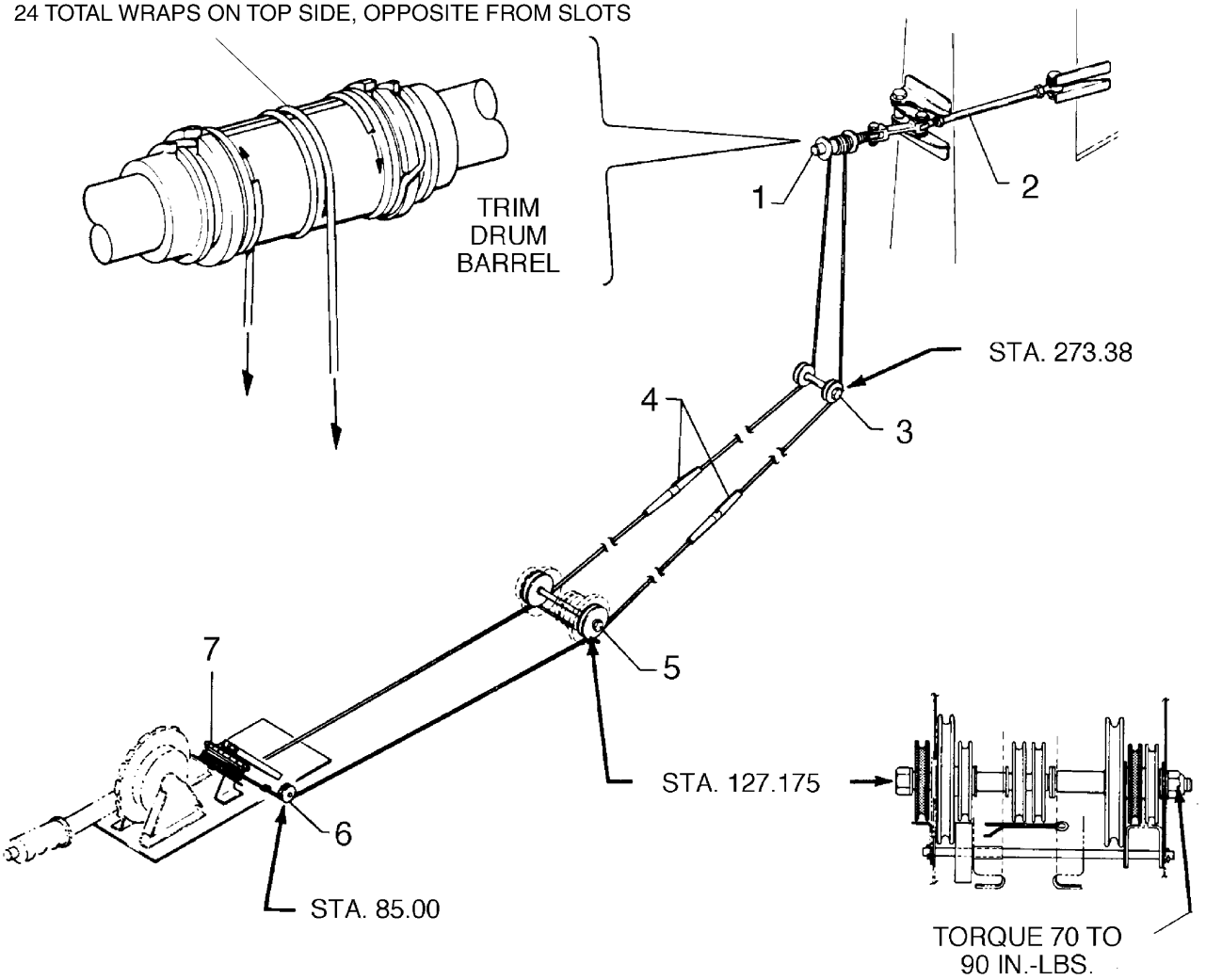
A. Forward Rudder Trim Control

(1) Removal (Refer to Figure 6.)

(a) To remove the trim control wheel assembly and/ or trim control cables:

1 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 6 and 27-30-00, Figure 4.)



1. TRIM SCREW
2. PUSH ROD
3. PULLEY CLUSTER
4. TURNBUCKLES
5. PULLEY CLUSTER
6. PULLEY CLUSTER
7. RUDDER TRIM CONTROL

Rudder Trim Controls
Figure 7

(b) To remove the trim control wheel:

1 Loosen the cables at the turnbuckle.

2 Remove the trim cover assembly by removing the cover attaching screws.

3 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.

4 Unwrap the lower cable from the drum.

5 The wheel and drum are joined by three screws. Remove screws and separate these two items and unwrap the upper cable.

6 Tie the cables forward to prevent them from slipping back into the floor tunnel.

(c) To remove trim control wheel and forward cables:

1 Block the aft cables aft of the turnbuckles.

2 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.

3 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.

4 Remove the trim cover assembly to gain access to the trim wheel mounting hardware.

5 Disconnect the turnbuckles and remove the guard plate/pin at the pulley cluster.

6 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.

(2) Installation (Refer to Figure 7.)

(a) To install the trim control wheel with drum:

1 Wrap the left cable on the trim drum by inserting the swaged 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 eleven turns of cable in a clockwise direction.

2 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.

3 Wrap the right cable on the drum by inserting the swaged 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.

4 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.

5 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.

6 Install the cover assembly over the trim control wheel and secure with screws unless the control cables have yet to be installed.

(b) To install the forward trim control cables:

1 Draw the cables through the floor tunnel and route them through the pulley clusters at station 127.175 and 85.0.

2 Wrap the cable drum and install the trim control wheel as given above.

3 Position the cables over the proper pulleys.

4 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 the installation instructions under “Aft Rudder Trim Controls,” below.

5 Remove the blocks securing the aft cables and check that the cables are seated on the pulleys. Install the guard plates/pins at the pulley clusters.

6 Set trim cable tension in accordance with specifications in Figure 4 and check rigging and adjustment per Rigging and Adjustment, below. Safety both turnbuckles.

7 Install the tunnel cover on the forward tunnel and secure with screws.

8 Install the carpet over the floor tunnel.

9 Install the cover assembly over the trim control wheels and flap handle and secure with screws.

10 Install the seat belts removed from the top of the floor tunnel and secure with bolt, washer and nut.

11 Install the aft floor tunnel cover, heater duct and carpet.

12 Install the carpet over the aft floor plate.

(c) Install the panel to the aft section of the fuselage and the seats.

B. Aft Rudder Trim Control (Refer to Figure 7.)

(1) Removal

(a) If the forward trim mechanism is not being removed, block the cables forward of the turnbuckles to prevent the cables from unwrapping at the forward trim drum. (Refer to Figure 7 and 27-30-00, Figure 4.)

(b) Secure the trim cables at the aft trim drum barrel.

(c) Disconnect the trim cable turnbuckles in the aft section of the fuselage.

(d) Remove the cable guards from the pulley bracket located at station 273.38.

(e) Disconnect the trim screw link assembly from the screw.

(f) Remove the cotter pin from the aft end of the screw.

(g) Remove the two bolt assemblies securing the forward support to the mounting bracket.

(h) Remove the screw and barrel assembly along with the aft cables from the airplane.

(2) Installation

(a) Insert the complete trim screw and barrel assembly into the fin. Route the trim cable ends around the pulleys at station 273.38.

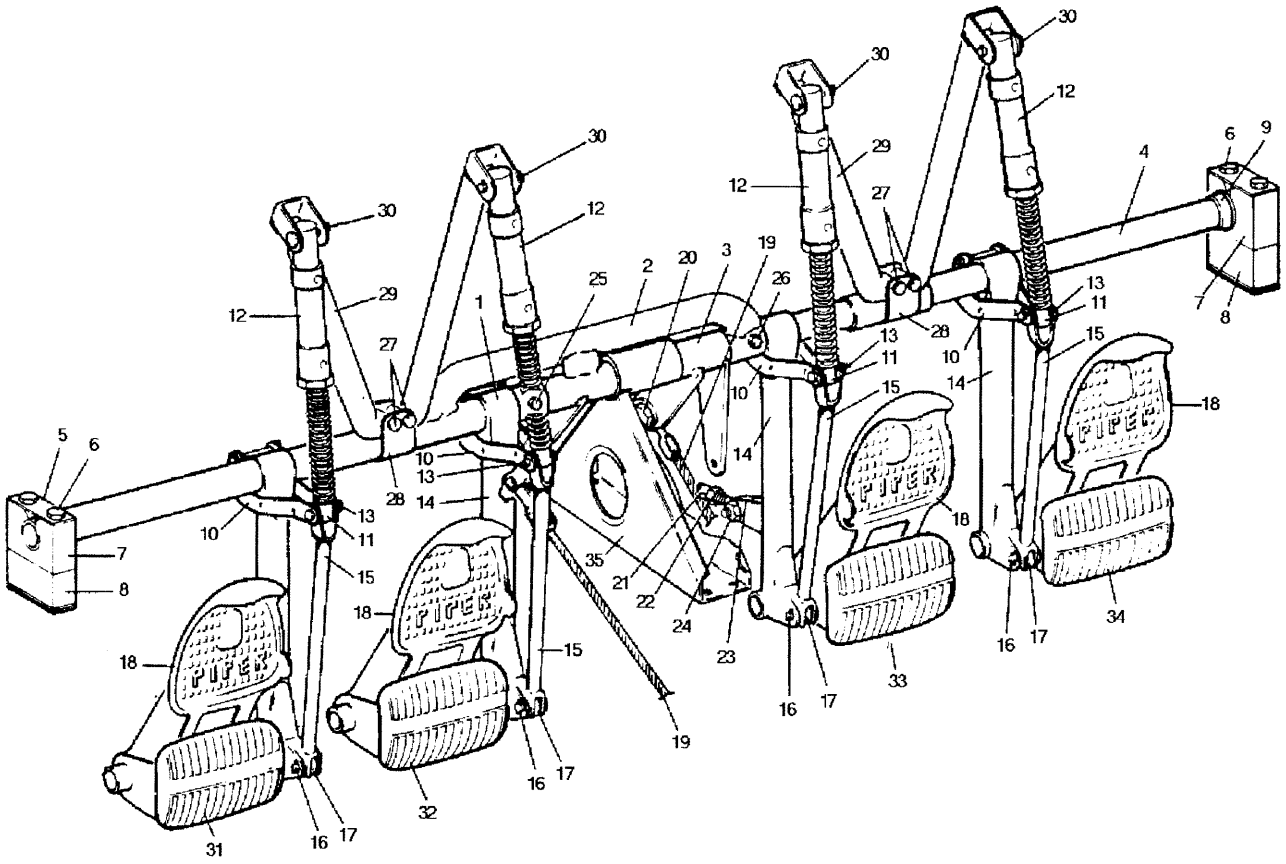
(b) Insert the trim screw and barrel assembly into the mounting bracket. Place the washer on the forward end of the barrel and install the support assembly in the mounting bracket.

(c) Install the cotter pin in the aft end of the shaft.

(d) Adjust the screw assembly to obtain the neutral position. (Refer Figure 7.)

(e) Connect the link assembly to the trim screw.

(f) Connect the aft trim cables to the forward cables with turnbuckles. Check to insure the cables are properly routed around the pulleys.



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

Rudder and Steering Pedal Assembly
Figure 8

(g) Install the cable guards at the pulley bracket in the fuselage at station 273.38.

(h) Remove the clamp securing the forward trim cables and proceed to rig the system per Rigging and Adjustment, below.

(i) Lubricate the assembly per Lubrication Chart, 12-20-00.

C. Rigging and Adjustment (Refer to Figure 7.) (PIR-PPS50033, Rev. I)

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF RUDDER TAB. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF RUDDER TRIM RIGGING AND ADJUSTMENT, VERIFY THAT THE RUDDER TAB MOVES RIGHT WHEN THE RUDDER TRIM WHEEL IS TRIMMED LEFT; AND, THAT THE RUDDER TAB MOVES LEFT WHEN THE RUDDER TRIM WHEEL IS TRIMMED RIGHT.

(1) Check that the following items have been completed before proceeding with the rigging and adjustment of the tab. If these items were accomplished during the installation, proceed with step (2).

(a) Check that the cable is wrapped 11 turns around the barrel from each end with space at the center as shown in Figure 7.

(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 cockpit rudder trim control wheel is centered and cable tension is set as specified in Figure 4.

(e) The nose wheel is off the ground before continuing.

(2) With the rudder still centered, rotate the trim control wheel in the cockpit to full left. Adjust the trim tab actuating pushrod as required to obtain the trim tab travel to the right as specified in Figure 4, measured with a suitable tool.

(3) With the rudder still centered, rotate the trim control wheel in the cockpit to full right. Adjust the trim tab actuating pushrod as required to obtain the trim tab travel to the left as specified in Figure 4, measured with a suitable tool.

(4) At this point, repeat step (2), above. If proper travel cannot now be obtained by adjusting the pushrod, the trim barrel screw must be repositioned by adding or removing shim washers, as follows:

(a) To adjust the trim tab travel to the left:

1 Add shim washers at the forward end of the trim barrel screw to reduce the travel.

2 Remove shim washers at the forward end of the trim barrel to increase the travel.

(b) To adjust the trim tab travel to the right:

1 Add shim washers at the aft end of the shaft to reduce the trim travel.

2 Remove shim washers at the aft end of the shaft to increase the trim travel.

(5) Remove the rudder centering tools.

(6) Check the rudder and rudder trim travels by swinging the rudder full left with full right trim and full right rudder with full left trim.

(7) Confirm all travels meet the specifications given in Figure 4.

(8) Determine the free play of the rudder tab:

(a) Method I:

Securely hold the rudder against either stop. Total free travel measured at the tab trailing edge must not exceed 0.06 inch.

(b) Method II:

1 Place rudder and rudder tab in neutral position. Using a dial indicator, determine the amount of free play motion between the rudder trailing edge and rudder tab trailing edge, allowing 0.06 maximum play.

2 With the cockpit trim control wheel in the in neutral, apply pressure to the left rudder pedal until the rudder stop is contacted. Using a suitable tool, measure the amount of tab travel to the left of the center line of the rudder. Repeat the precedure for the right rudder pedal, measuring travel to the right of centerline of the rudder. Travel must meet the specifications given in Figure 4.

3 If any adjustment is required, it must be made at the trim barrel screw engagement and in the length of the pushrod. If either of these are adjusted, Steps (2), (3) and (4) above must be repeated (adjustment of the trim tab travel to meet Figure 4 specifications).

(c) If the free play 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.

5. Rudder Pedal Assembly

A. Removal (Refer to Figure 8.)

(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.

B. Installation (Refer to Figure 8.)

(1) Assemble the torque tube assembly as shown in Figure 8. Do not install the two bolts through the center of the tube assembly at this time.

(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.

(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.

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STABILATOR

1. Description and Operation

   The stabilator is operated by movement of the control column-tee bar assembly.

   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 pushrod connected to the balance arm of the stabilator.

   Pitch trim control is provided by an adjustable trim mechanism for the stabilator. Stabilator trim is controlled by a wheel and drum mounted on the floor tunnel between the front seats or, in an optional installation, by an S-TEC Manual Electric Trim Control mounted on the control yoke. Cables are routed aft from the drum to a screw assembly mounted above the stabilator attachment point. This screw assembly in turn moves the pushrod which controls the stabilator trim tab.

2. Troubleshooting

   See Charts 1 and 2.

3. Stabilator Control Cables

   A. Removal (Refer to Figure 1.)

      (1) To remove either the forward or aft stabilator cables 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) To remove either FORWARD stabilator cable:

         (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.

         (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) To remove either AFT stabilator cable:

         (a) Disconnect the assist springs from the bulkhead at sta. 156. (See Figure 1.)

         (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.

CHART 1
TROUBLESHOOTING STABILATOR CONTROL SYSTEM

Trouble	Cause	Remedy
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 control movement.	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.
Incorrect stabilator travel.	Stabilator stops incorrectly adjusted.	Adjust stop screws.
Correct stabilator travel cannot be obtained by adjusting stops.	Stabilator cables incorrectly rigged.	Rig stabilator cables.

CHART 2
TROUBLESHOOTING STABILATOR TRIM CONTROL SYSTEM

Trouble	Cause	Remedy
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.
	Cables crossed or routed incorrectly.	Check routing of control cables
	Electric trim servo clutch binding, or incorrectly rigged.	Check servo clutch for free and correct operation. Adjust rigging as necessary.
Trim tab fails to reach full travel.	System incorrectly rigged.	Check and/or adjust rigging.
	Trim drum incorrectly wrapped.	Check and/or adjust rigging.
Trim indicator fails to indicate correct trim position.	Trim indicator unit not adjusted properly.	Readjust trim indicator.

B. Installation (See Figure 1.)

(1) To install the FORWARD stabilator cables:

(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 now as described below.

(d) Place the stabilator in the neutral position and lock it with a suitable tool.

(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 per Rigging and Adjustment, below.

(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) To install either AFT stabilator control cable:

(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.)

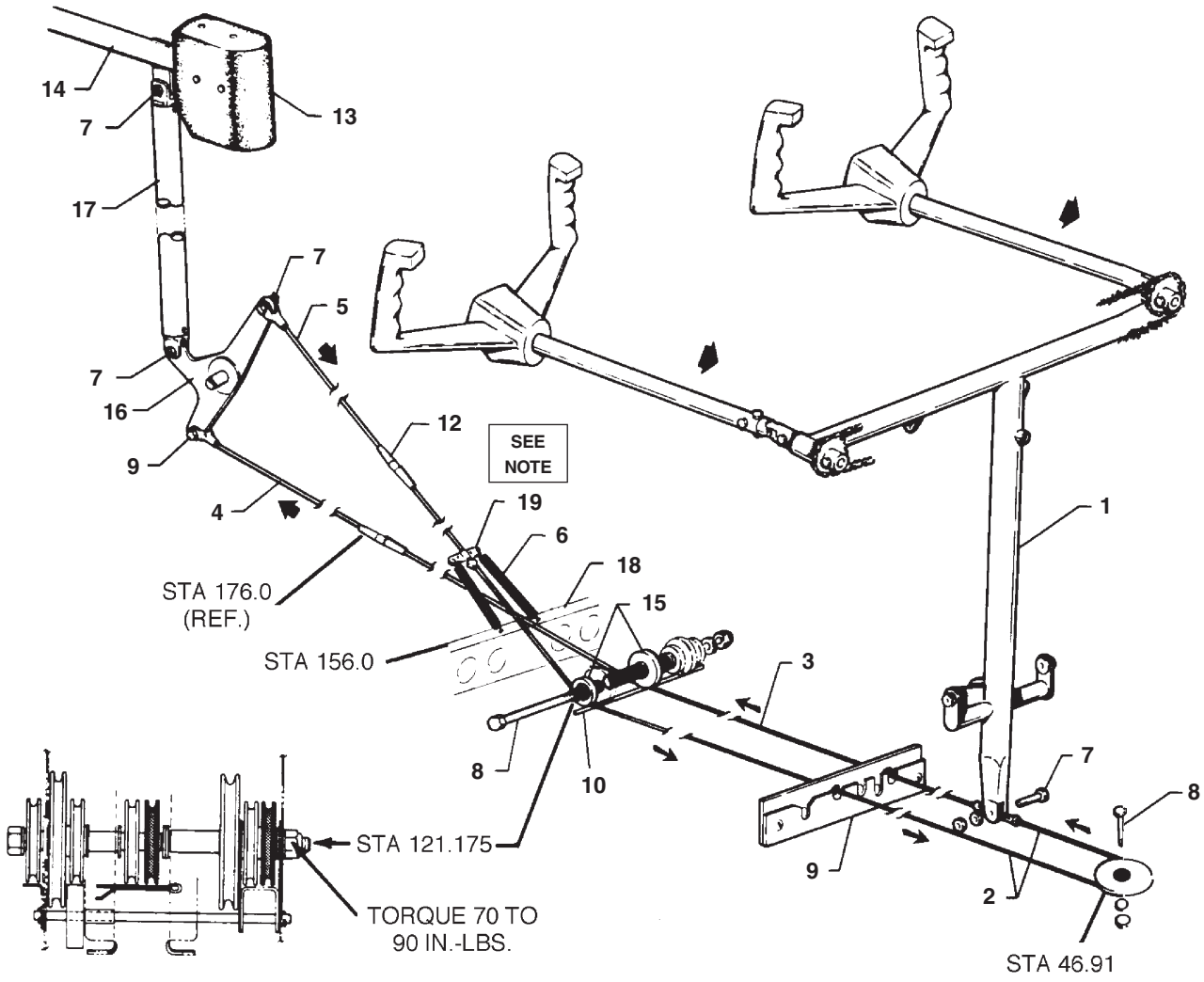
(c) Connect the cable to the forward cable at the turnbuckle in the aft section of the fuselage. The upper aft cable connects to the right forward cable and the lower cable to the left cable.

(d) Connect assist springs to the bulkhead at F.S. 156.00 and orient cable plates so that they align with horizontal plane ± 10°. (Refer to Figure 1.)

(e) Install the cable guard pin at the pulley.

(f) Set cable tension and check rigging and adjustment per Rigging and Adjustment, below.

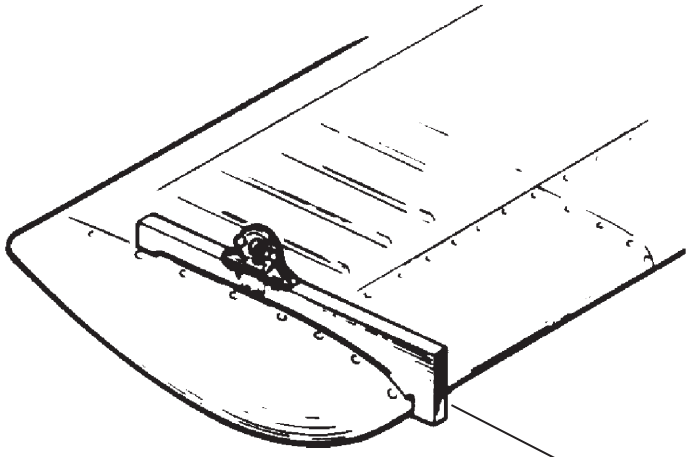
(3) Install the rear cabin access panel to the aft section of the fuselage.



NOTE: ALIGN CABLE PLATES WITH HORIZONTAL PLANE TO WITHIN ±10°

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

Stabilator Controls
Figure 1

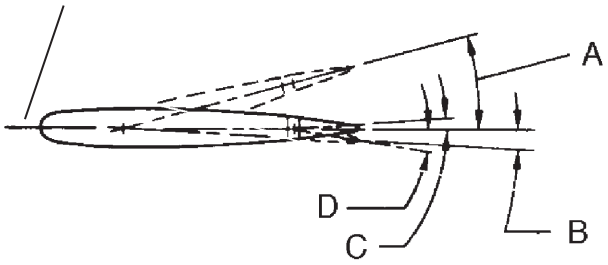


CABLE TENSION
(SEE NOTE 1)

STABILATOR	**40 LBS. ± 5 LBS.**
STABILATOR TRIM TAB	**14 LBS. ± 1 LB.**

RIGGING TOOL
(SEE 95-00-00, FIGURE 7.)

STABILATOR CHORD LINE
(NEUTRAL POSITION. SEE NOTE 3.)



STABILATOR TRAVELS
A = 15° ± 1° UP
B = 3° ± 1° DOWN

STABILATOR TAB TRAVELS
C = 4° ± 1° UP
D = 9° ± 1° DOWN
(SEE NOTE 2)

NOTES:
1. CABLE TENSION APPLIES ONLY TO AIRPLANES WITHOUT AUTOPILOT BRIDLE CABLES ATTACHED, UNLESS AUTOPILOT RIGGING INSTRUCTIONS SPECIFY OTHERWISE. SEE 22-10-00 OR APPROPRIATE AUTOPILOT MANUFACTURER'S SERVICE MANUAL.
2. MAXIMUM FREE PLAY FOR CONTROL SURFACE TAB IS 0.06 OF AN INCH MEASURED AT TAB TRAILING EDGE.
3. NEUTRAL POSITION OF THE STABILATOR IS WHEN THE STABILATOR CHORD LINE IS PARALLEL TO THE FRONT SEAT TRACKS.

Stabilator and Stabilator Trim Tab Rigging Limits
Figure 2

C. Rigging and Adjustment (PIR-PPS50033, Rev. I)

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF STABILATOR. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF STABILATOR RIGGING AND ADJUSTMENT, VERIFY THAT THE REAR EDGE OF THE STABILATOR MOVES UP WHEN THE WHEEL IS PULLED BACK; AND, THAT THE REAR EDGE OF THE STABILATOR MOVES DOWN WHEN THE WHEEL IS PUSHED FORWARD.

(1) Stabilator Travel

The stabilator, tab and cables must be installed in order to rig and adjust stabilator. Check and set the correct degree of stabilator travel as follows:

(a) Level the airplane. (Refer to Leveling, 8-20-00.)

(b) Place the stabilator in neutral position as specified in Figure 2.

NOTE: This can be accomplished by placing a bubble protractor on the front seat tracks and another bubble protractor on the fabricated stabilator rigging tool as shown in Figure 2. Then adjust the stabilator until the readings on the two bubble protractors match.

(c) Check the stabilator travel by placing a rigging tool (see Figure 2) on the upper surface of the stabilator, as shown in Figure 2. (A rigging tool may be fabricated from the dimensions given in Figure 3.)

(d) Adjust the stabilator stops to obtain the travel limits specified in Figure 2. Use a bubble protractor to measure the travel.

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

1 On protractor, set the number of degrees up travel given in Figure 2. Place the protractor on the rigging tool. Raise the trailing edge of the stabilator until it contacts its stop. Accurate stabilator travel is obtained when the bubble of the protractor is centered.

2 Set the number of degrees down travel and place the protractor 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.

3 Should the stabilator travel be incorrect in either position, adjust the stabilator stops (see Figure 4).

a Remove the fin tip

b Using the rigging tool and bubble protractor, turn the stops at the stabilator hinge in or out to obtain the correct degree of travel.

c Ascertain that the locknuts of the stop screws are secure; reinstall the fin tip.

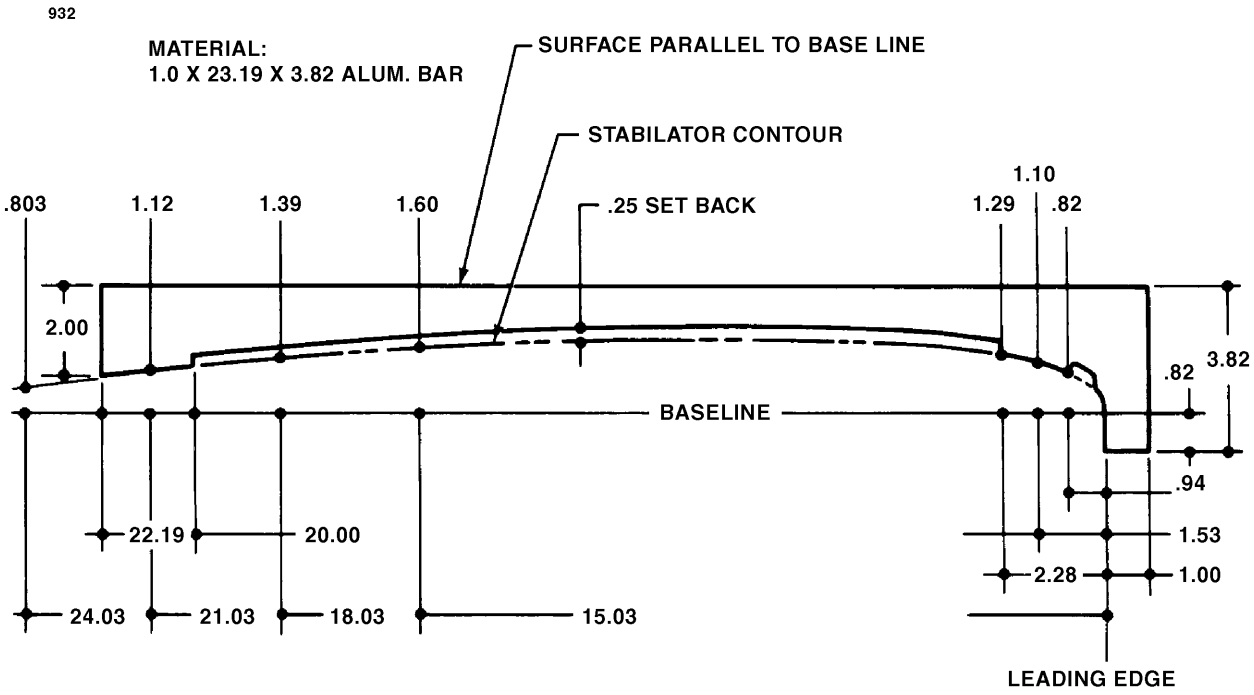
(2) Stabilator Control Cable Tension

Check and set stabilator control cable tension as follows:

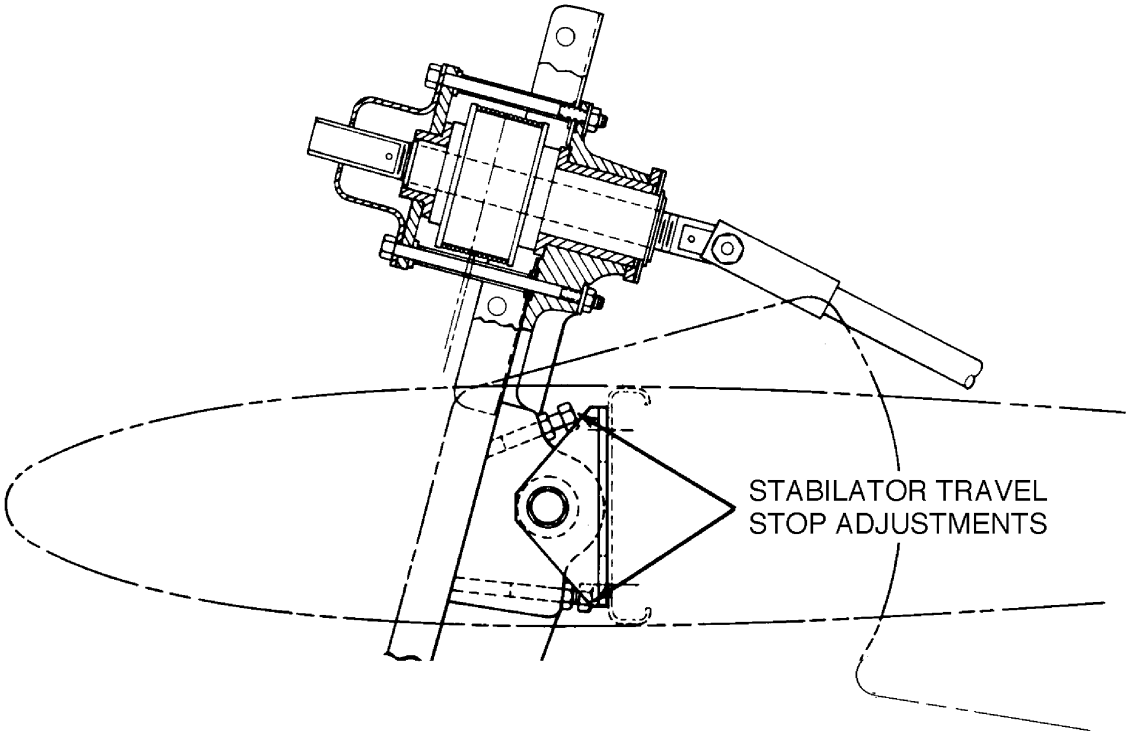
(a) Ascertain that the stabilator travel is correct (see above).

(b) Remove the cabin rear closeout panel and fin tip and disconnect the assist springs from the bulkhead at F.S. 156.00.

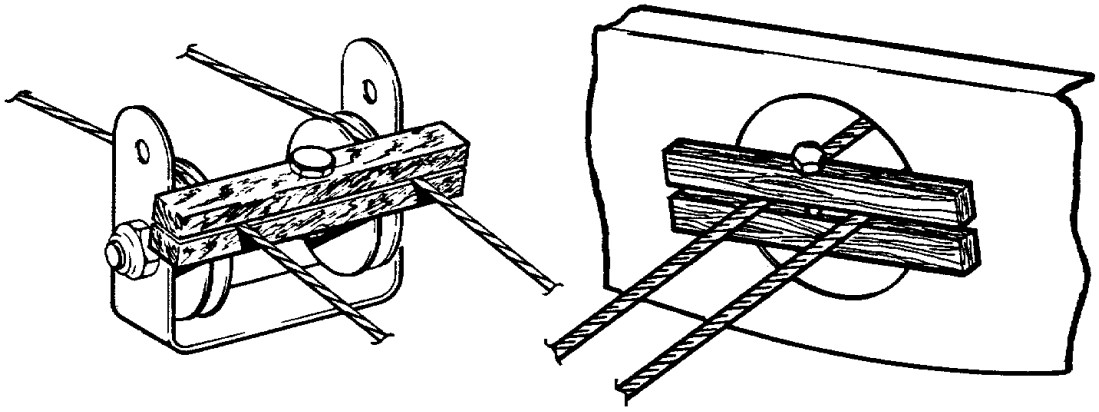
(c) Secure the control column in the near forward position. Set the tee bar to a position 0.25 ± 0.031 inch off the forward tee bar stop in the cockpit.



Stabilator Rigging Tool
Figure 3



Stabilator Travel Adjustments
Figure 4



Methods of Securing Trim Cables
Figure 5

(d) Check and adjust stabilator cable tension as specified in Figure 2.

1 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.

2 With the tension of the upper cable correct and the control wheel still secured in the near forward position described above, adjust the turnbuckle of the lower cable to obtain correct tension.

(e) 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.

1 Check to insure that stabilator up and down stops are contacted before the tee bar stops are contacted.

2 The travel distance from where the stabilator reaches its stop and the control wheel contacts its stop should be approximately equal in both the fore and aft positions. Readjust the turnbuckles if the travel distances are not in accord.

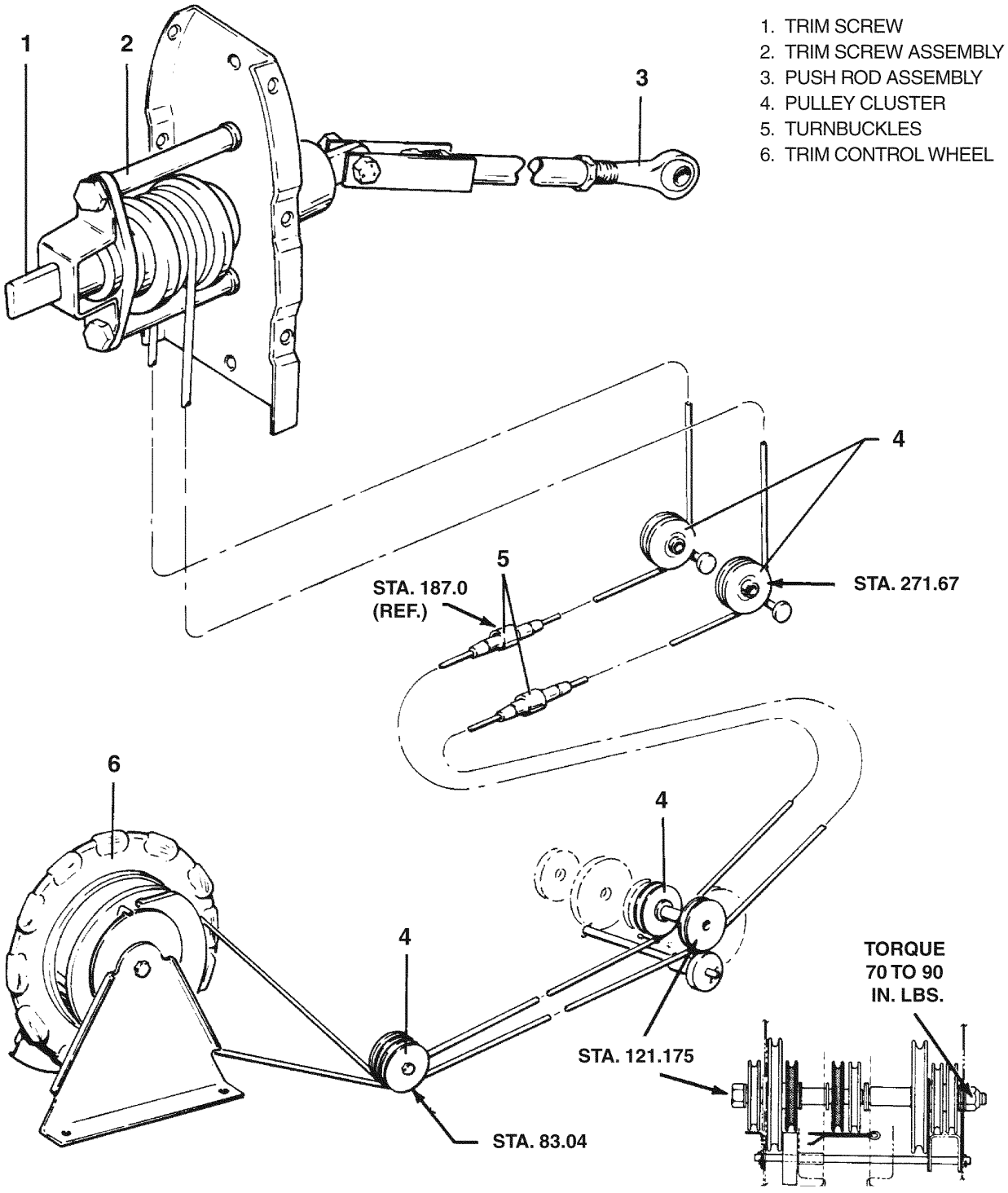
(f) With the stabilator and trim in all extremes of travel, check to insure that there is no interference between turnbuckles and pulleys.

(g) Check safety of all turnbuckles and bolts.

(h) Connect the assist springs to the bulkhead at F.S. 156.00.

(i) Install cabin rear closeout panel and fin tip.

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Stabilator Trim Controls
Figure 6

4. Stabilator Trim Controls

A. Forward Assembly

(1) Removal (Refer to Figure 6.)

(a) To remove the trim control wheel assembly and/or the trim control cables, remove the panel to the aft section of the airplane.

(b) 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 6.)

(c) If the trim control wheel and cables are to be removed, loosen or disconnect the cables at the trim cable turnbuckles in the aft section of the fuselage.

(d) To remove the control wheel with drum:

1 Remove the control wheel cover by removing the cover attaching screws.

2 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.

3 Unwrap the left cable from the drum.

4 The wheel and drum are joined by a push fit, separate these two items with their center bushing and unwrap the right cable.

5 Tie the cables forward to prevent them from slipping back into the floor tunnel.

(e) To remove the trim control cables:

1 Remove the pilot and rear seats if desired.

2 Remove the seat belts attached to the forward floor tunnel by removing attachment nuts, washers and bolts.

3 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.

4 Unfasten the carpet from the aft portion of the forward floor tunnel and lay it forward.

5 Remove the tunnel cover located between the trim control wheel and the spar cover by removing the selector knobs and cover attachment screws.

6 Remove the cable pulleys located in the forward tunnel by removing the cotter pin, washer and clevis pin.

7 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.

8 Remove the cable rub blocks located in the floor opening on the aft side of the main spar by removing the block attachment screws.

9 Remove the trim plate located on top of the forward end of the aft floor tunnel.

10 Remove the carpet from the aft floor tunnel.

11 Remove the cover plate from the top of the aft floor tunnel by removing attachment screws.

12 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.

13 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.

14 Remove the cable guard from the cable pulleys in the aft lower section of the fuselage forward of the cable turnbuckles.

15 With the cables disconnected from the trim control wheel, draw the cable(s) through the floor tunnel.

(2) Installation (Refer to Figure 6.)

(a) The trim control wheel with drum may be installed as follows:

1 Wrap the right trim cable on the trim drum by inserting the swaged ball of the cable in the slot provided in the side (right side) of the drum that mates with the control wheel, and looking at this side, wrap the drum with three wraps of the cable in a clockwise direction.

2 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.

3 Wrap the left trim cable on the drum by inserting the swaged ball of the cable in the slot provided in the flanged side (left side) of the drum and looking at this side, wrap the drum with three wraps of the cable in a clockwise direction.

4 Lubricate and install the bushing in the control wheel and drum.

5 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.

6 Install the cover over the control wheel and secure with screws, unless the control cables have yet to be installed.

(b) The trim control cables may be installed as follows:

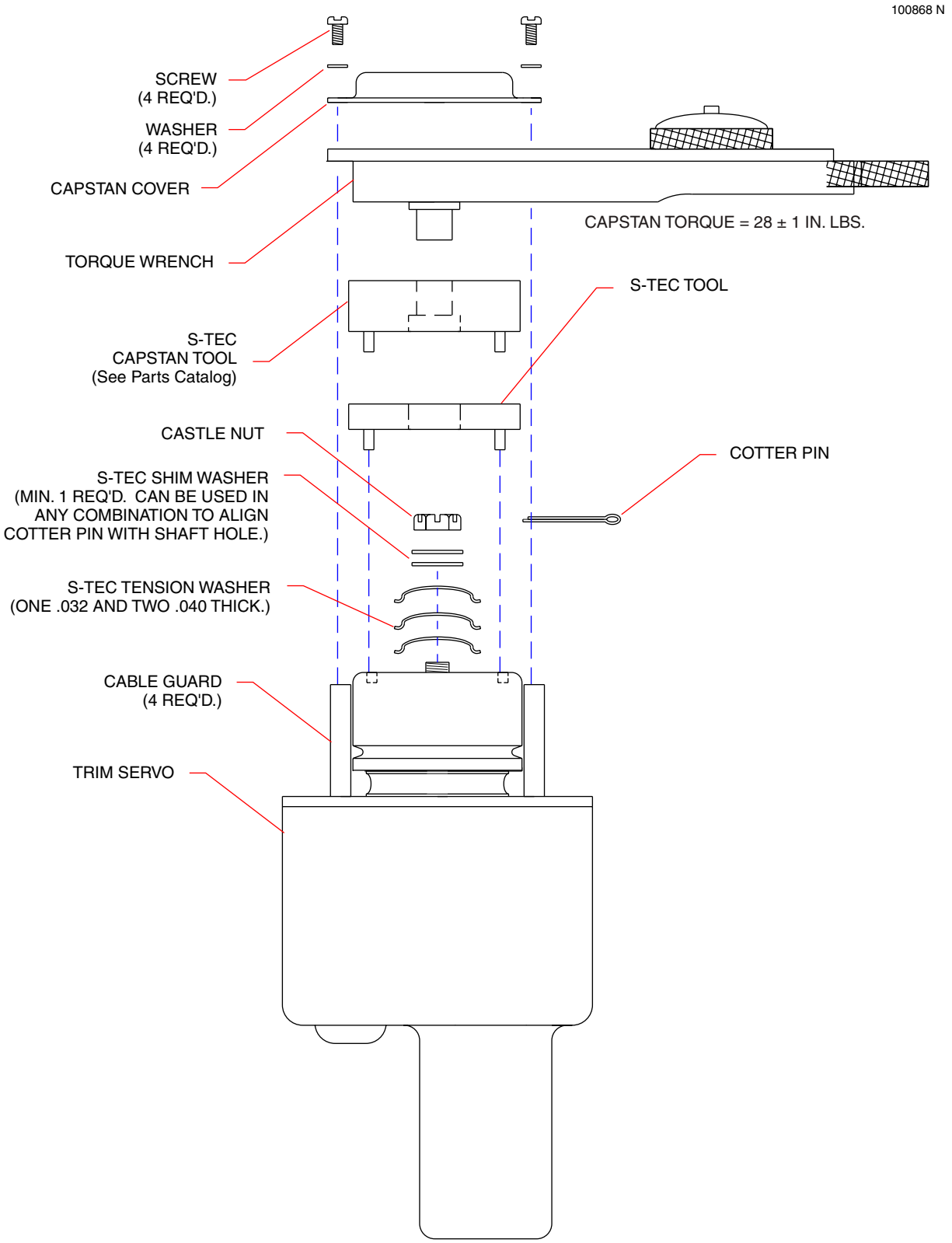
1 Draw the cable(s) through the floor tunnel.

2 Wrap the cable drum and install the trim control wheel described above.

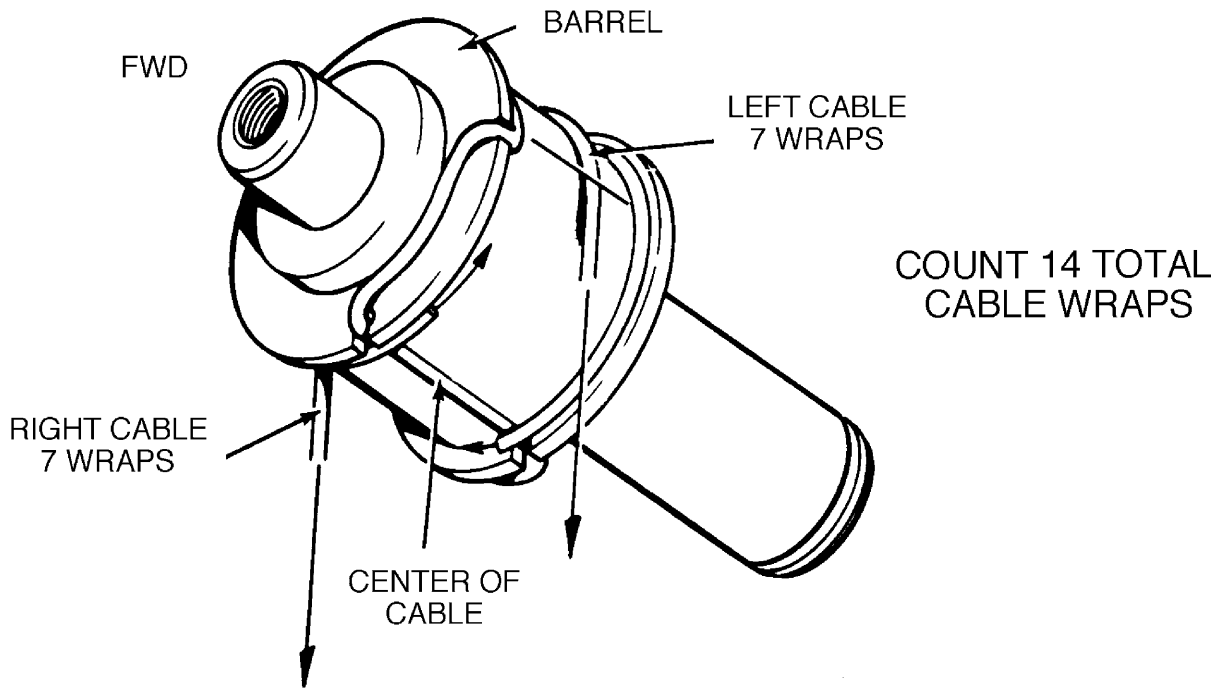
3 Position the cable pulleys on their mounting bracket and install the clevis pin, washer and cotter pin.

4 Connect the cable to the aft cable at the turnbuckle in the aft section of the fuselage. Install aft cable if not installed.

5 Install the cable guard at the cable pulleys in the aft lower section of the fuselage forward of the cable turnbuckles.

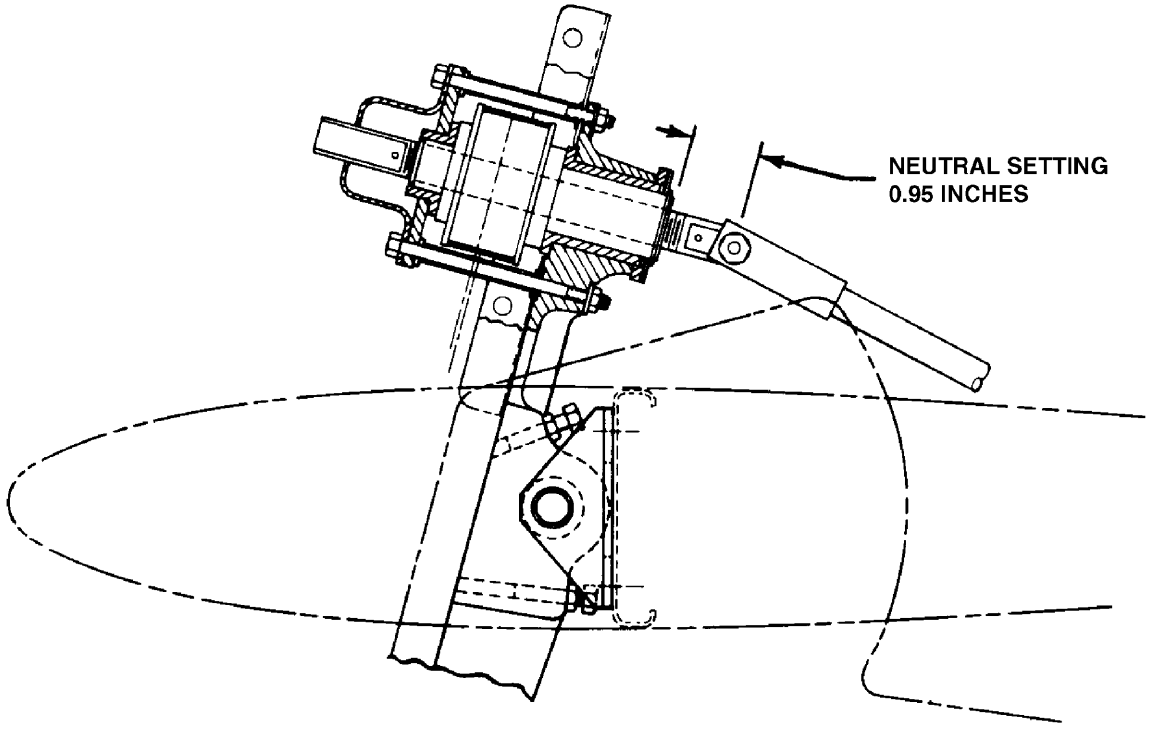


S-TEC Manual Electric Trim Clutch Adjustment
Figure 7



Wrapping Trim Barrels
Figure 8

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Stabilator Trim Screw Adjustment
Figure 9

6 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.

7 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.

8 Install the cable rub blocks located on the aft side of the main spar housing and secure with screws.

9 Remove the blocks that secure the aft trim cable and check that the cables are seated on their pulleys.

10 Set cable tension and check rigging and adjustment per Rigging and Adjustment, below. Check safety of all turnbuckles.

11 Install the tunnel cover on the forward tunnel and secure with screws.

12 Install the carpet over the floor tunnel.

13 Install the heat deflectors on each side of the floor tunnel.

14 Install the cover over the trim control wheel and secure with screws and special washers.

15 Install the fuel selector knobs and secure with set screws.

16 Install the seat belts removed from the top of the floor tunnel and secure with bolt, washer and nut.

17 Install the floor panel and seat belt attachments aft of the main spar, and secure panel with screws.

18 Install the aft floor tunnel and secure with screws.

19 Install the carpet over the aft floor tunnel.

20 Install the trim plate on top of the forward end of the aft floor tunnel.

(c) Install the panel to the aft section of the airplane and the seats.

(3) S-TEC Manual Electric Trim (Refer to Figure 7.)

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

(a) S-TEC Manual Electric Trim is an optional system. When installed, a servo motor, capstan, and idler pulley assembly are attached to the left stabilator trim cable just aft of F.S. 156.00.

(b) Check and adjust the servo clutch as follows:

1 Remove the trim cable guards and trim cable from capstan. Remove the capstan cover. Check capstan torque by attaching the capstan adjusting tool (special tool) to the capstan and using a currently calibrated torque wrench as shown in Figure 6. If adjustment is required, proceed as follows.

2 Remove servo motor and capstan. Place servo motor and capstan in a holding fixture (vice) with capstan up. Remove capstan cover. Remove cotter pin from end of servo shaft and remove castle nut, shim washers, and tension washers.

3 Replace tension washers as required in quantities shown in Figure 7. Replace shim washers and castle nut. Tension castle nut so that capstan torque is as specified in Figure 7.

4 Reinstall servo motor and capstan. Adjust stabilator trim cable tension as specified in Figure 2.

B. Aft Stabilator Trim Controls

(1) Removal (Refer to Figure 5.)

(a) Remove the access panel to the aft section of the fuselage.

(b) 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 5.

(c) Disconnect the cable at the turnbuckles in the aft section of the fuselage.

(d) Remove cable guard from pulley cluster and cable guards from pulley cluster.

(e) Remove the fin tip by removing attachment screws.

(f) Disconnect the pushrod by removing the attaching hardware securing pushrod to screw.

(g) Remove bolts, washers, bushings and nuts securing forward end of barrel. Remove snap ring to free aft end of barrel.

(h) Draw the trim cable from the fuselage and up the fin.

(2) Installation (Refer to Figure 6.)

(a) Wrap the trim barrel by first laying the center of the trim cable (as measured equally from each end to the center of the 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 seven (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 seven (7) wraps to the center of barrel. (Refer to Figure 8.)

(b) 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.

(c) Lubricate the bearings and install barrel as shown in Figures 6 and 8. Install the barrel using any combination of AN960-10, AN960-10L and AN960PD 10L washers to achieve free barrel rotation with trim cable rigged and tensioned.

(d) Rotate the cables down the fin into the fuselage through the two pulley clusters and attach the ends to the forward trim cables.

(e) Install all cable guards.

(f) Remove the blocks that are holding the forward cables tight and aft cables at the barrel.

(g) Set cable tension and check rigging and adjustment as described below. Check safety of all turnbuckles.

(h) Install fin tip and secure with screws.

(i) Install the access panel to the aft section of the fuselage.

C. Rigging and Adjustment

The stabilator, tab and cables must be installed in order to rig and adjust stabilator trim. Check and set the correct degree of stabilator travel as follows:

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF STABILATOR TAB. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF STABILATOR TRIM RIGGING AND ADJUSTMENT, VERIFY THAT THE STABILATOR TAB MOVES UP WHEN THE TRIM WHEEL IS TRIMMED DOWN; AND, THAT THE STABILATOR TAB MOVES DOWN WHEN THE TRIM WHEEL IS TRIMMED UP.

(1) Level the airplane. (Refer to Leveling, 8-20-00.)

(2) Check for proper stabilator trim cable tension as given in Figure 2. If cables were disconnected, rotate the control wheel several times to allow the cables to seat and recheck tension.

(3) Place the stabilator in the neutral position and lock it with a suitable tool (see Figure 2, Note 3).

(4) Place the stabilator trim control wheel in neutral position.

(5) Adjust the stabilator trim tab pushrod to streamline the trim tab with the stabilator to achieve the trim tab neutral position.

(6) Turn the trim control to its full up and full down position. Trim tab travel must be as specified in Figure 2.

(7) If trim tab travel is not as specified, correct as follows:

(a) First, try adjusting travel by disconnecting the trim tab pushrod (Item 3, Figure 6) and turning the pushrod rod end in or out as required.

(b) Travel adjustments which cannot be corrected by adjusting the rod end require repositioning the trim screw (Item 1, Figure 6) in the barrel. With the trim tab pushrod disconnected, rotate the trim screw in or out to achieve a preliminary neutral setting as shown in Figure 8.

(c) Repeat steps (5), (6), and (7) (a), above.

(8) 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.

(9) Check to insure that the stabilator up and down stops are contacted before the tee bar stops are contacted.

(10) 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 that given in Figure 2, Note 2.

5. Stall Warning

A. Description and Operation

The system consists of two lift detectors, located on the left wing, which are electrically connected to the flap position switch and the stall warning horn. Each lift detector functions in a separate flap setting range: 0° to 10° for the outboard detector; and, 25° to 40° for the inboard detector.

B. Ground Check

Perform the following ground check to determine that the lift detectors are functioning properly:

(1) With the master switch ON gently lift the tabs on both lift detectors; the stall warning horn should not sound.

(2) With the master switch still ON, activate the main gear squat switch to simulate inflight conditions; extend the flaps to the 10-degree (10°) flap position.

(3) Gently lift the outboard sensor; the stall warning horn should sound. Lifting the inboard sensor should not sound the horn.

(4) 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.

(5) 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.

C. Lift Detectors

NOTE: The master switch must be off prior to performing any work on the lift detector(s).

(1) Removal

NOTE: Place reference marks on holding plate and wing skin for use when reinstalling.

(a) Remove four screws holding the plate around the tab. The lift detector is fastened to this plate; remove the unit from wing.

(b) Mark the electrical wires and terminals to facilitate installation. Remove electrical wires from lift detector: Remove lift detector from aircraft.

(2) Installation

(a) Attach the electrical leads to the appropriate terminals of the lift detector.

(b) 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.

(3) Adjustment (See Stall Warning Flight Test Procedure, below.)

CAUTION: NEVER TRY TO ADJUST THE SWITCH BY BENDING THE VANE.

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 Philip's 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. Tighten the screws after making any adjustments.

D. Stall Warning Flight Test Procedure (PIR-FTP2001-7, Rev. D.)

NOTE: Required whenever a “replacement” wing is installed.

Flying at a rate of 1 KT/SEC maximum obtain the following POWER OFF / GEAR DOWN warning and stall speeds:

		TRIM KIAS	RECORD:	WARNING KIAS	STALL KIAS
0° FLAPS	=	87		_____	_____
FULL FLAPS	=	77		_____	_____

(1) Verify that the stall warning system performs within the following limits:

(a) Maximum: stall warning begins at 5 to 10 KIAS prior to stall and continues until stall occurs.

(b) Desired: stall warning begins at 7 to 9 KIAS prior to stall and continues until stall occurs.

(2) If the stall warning system fails to perform within the limits above, adjust the system and re-fly the test.

(3) If not able to adjust the stall warning system sufficient to achieve the limits above, recheck the “replacement” wing installation to ensure it is installed and rigged correctly.

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FLAPS

1. Description and Operation

   The flaps are manually operated. A lever in the cockpit is cnnected by cable to a chain and sprocket on a torque tube. Motion of the torque tube actuates pushrods attached to the flaps.

2. Troubleshooting

   See Chart 1.

3. Wing Flap Controls

   A. Removal (Refer to Figure 1.)

      (1) To remove the flap torque tube assembly:

         (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 rear seats, seat belt attachments and the screws securing the panel. Lift the panel and remove from aircraft.

         (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) Fully extend the flaps with the flap handle. Disconnect the flap tension spring at the spar or the aft end of the control cable, as desired.

            CAUTION: FORWARD PRESSURE IS ON THE FLAP HANDLE ONCE THE TENSION SPRING IS DISCONNECTED.

         (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.

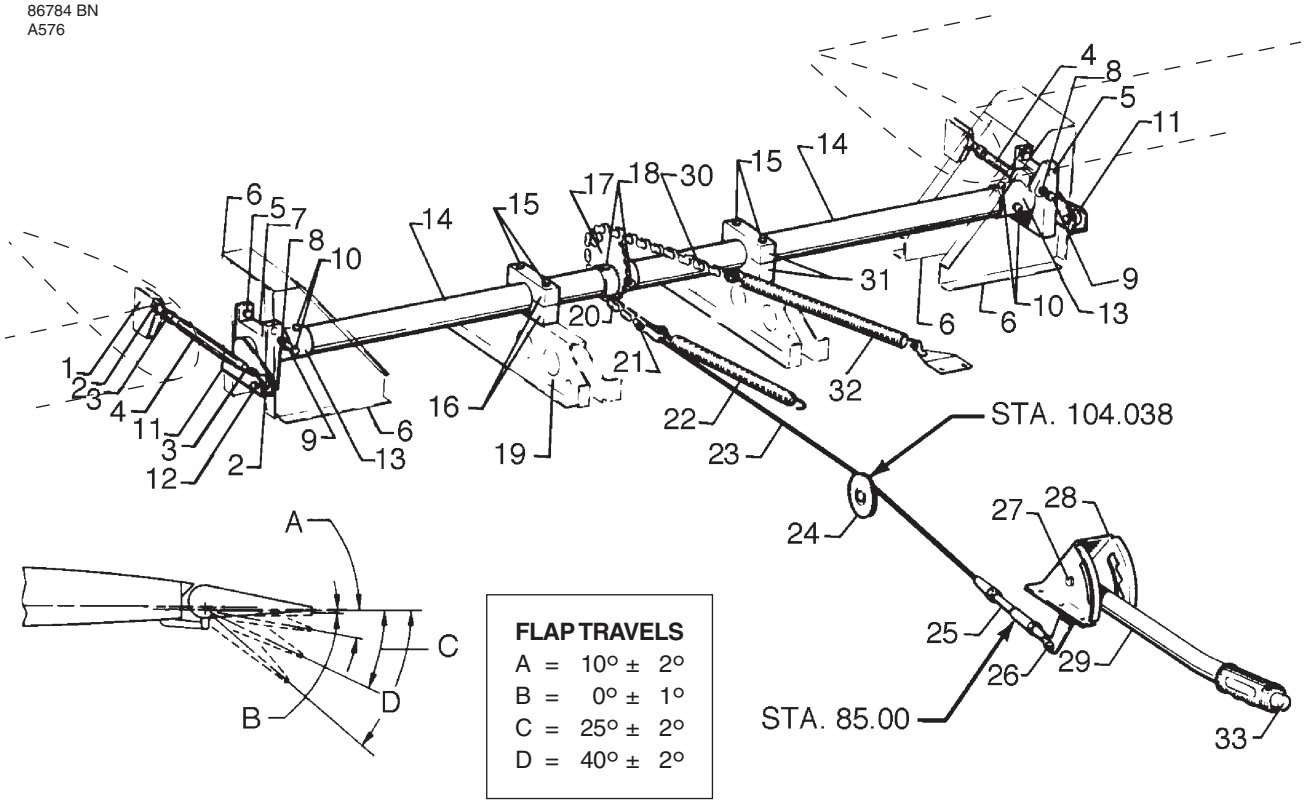
         (k) Disconnect one bearing block from its mounting brackets by removing nuts, washers and bolts.

         (l) Slide the tube from the bearing block still attached to its brackets, raise the end and lift it from the floor opening.

CHART 1
TROUBLESHOOTING FLAP CONTROL SYSTEM

Trouble	Cause	Remedy
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.	Adjust flaps.

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

* TORQUE BOLT HEAD 100-110 IN. LBS. - INCL. FRICTION DRAG AND NO LUBRICANT ON THREADS

Flap Controls and Rigging
Figure 1

(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.

CAUTION: FORWARD PRESSURE IS ON THE HANDLE ONCE THE FLAP TENSION SPRING IS DISCONNECTED.

(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.

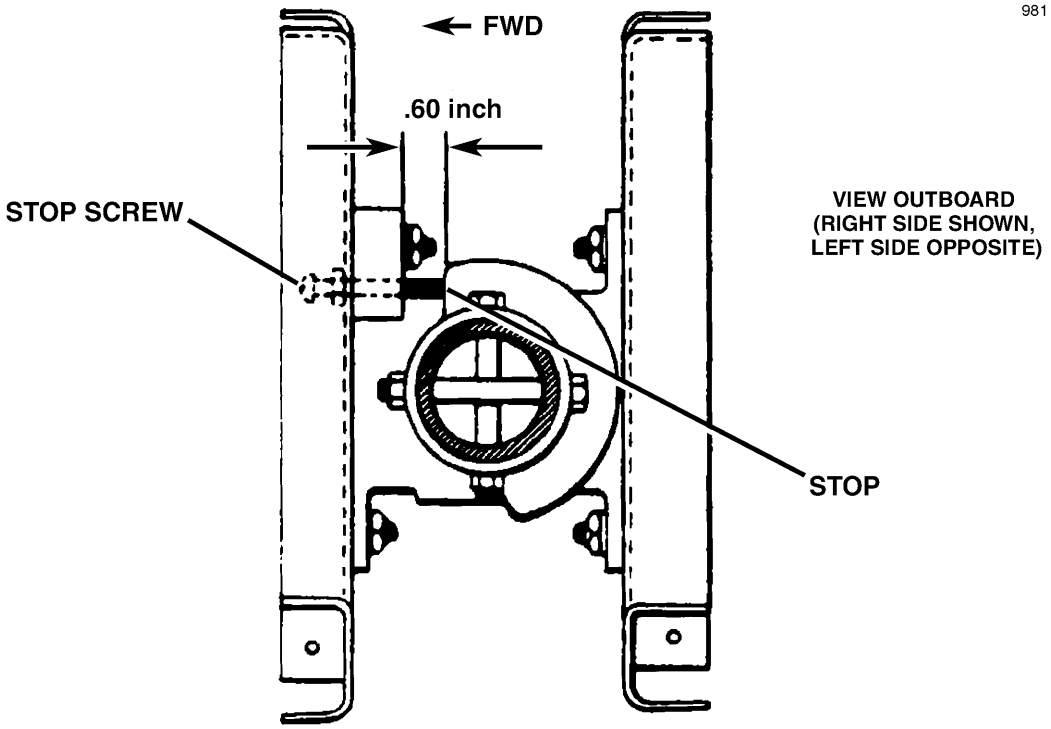
(g) Lift the aft section of the tunnel carpet far enough to remove the screws securing the tunnel cover that is between the flap handle and the spar cover. Remove the cover.

(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.



Stop Screw Adjustment
Figure 2

B. Installation (Refer to Figure 1)

(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 (depending on what was disconnected).

(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 described above.

(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.

C. Rigging and Adjustment (PIR-PPS50033, Rev. I)

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF FLAPS. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF FLAP RIGGING AND ADJUSTMENT, VERIFY THAT THE FLAPS MOVE UP WHEN THE FLAP HANDLE IS PUSHED DOWN; AND, THAT THE FLAPS MOVE DOWN WHEN THE FLAP HANDLE IS PULLED UP.

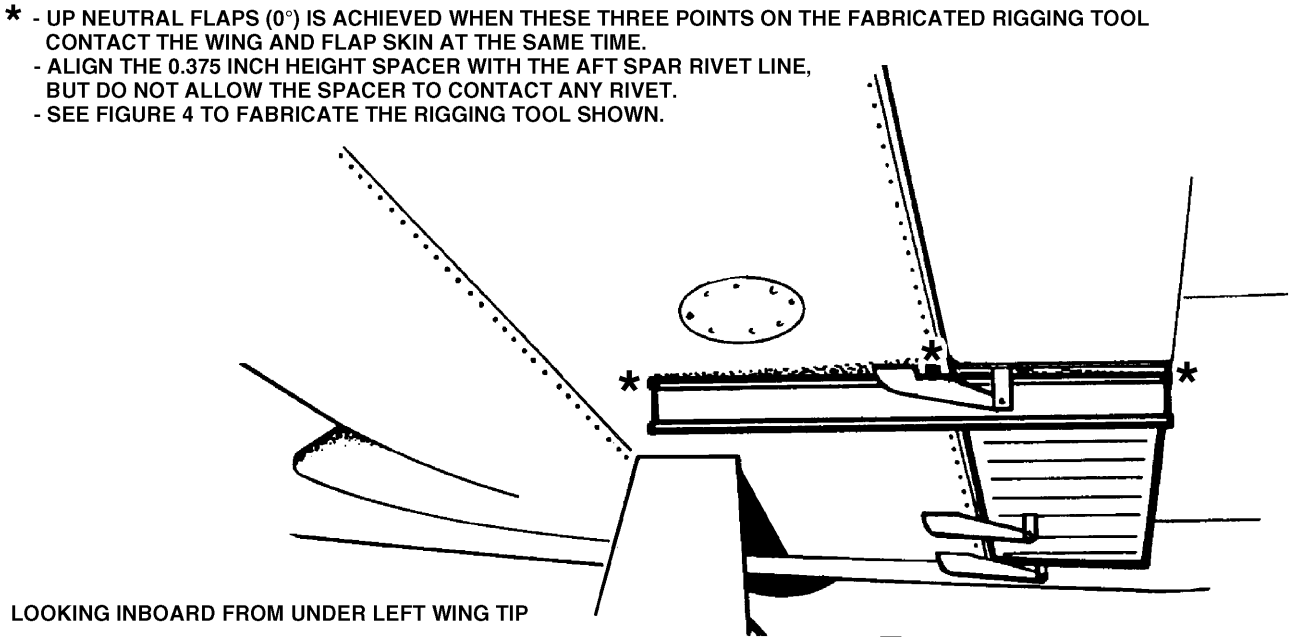
(1) Place the flap handle in the full forward, flap retracted position.

(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. Back off the left torque tube stop screw. 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 adjust the right stop screw as shown in Figure 2. With the right stop screw against the stop, adjust the left stop screw to contact the stop.

(4) If not already done, install the upper tension spring, chain and cable. Check cable tension and, if required, adjust turnbuckle with the flap handle in flaps up position, to remove all slack. Do not tighten cable to the point that the stop screw comes off the stop. Similarly install the lower tension spring, with the flap handle in flaps full down position.

(5) Place a 0.125-inch thick spacer between the right hand stop screw and the stop fitting. With the right hand flap installed and flap control rod connected, determine that down pressure on the top of the flap will not cause the flap to come down. If the flap does extend (comes down under pressure), turn the stop screw out until down pressure will not cause the flap to come down. Do the same procedure for the left hand stop screw to match. After adjustment of both stop screws, tighten jam nuts and remove the spacer blocks.



Flap Rigging
Figure 3

(6) Flap Neutral Position

NOTE: To remedy wing heaviness during flight, adjust the flap on the side of the heavy wing down from neutral by lengthening the control rod. Check the inspection hole in each rod end to ensure that there are sufficient threads remaining and a wire cannot be inserted through the holes. Do not raise the flap of the other wing above neutral.

(a) Method I

To check the up-neutral position of the flaps place a flap rigging tool as shown in Figure 3 against the underside of the wing and flap as close as possible to the outboard end of the flap without contacting any rivets. (See Figure 4 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.

Maintain a light up pressure on the underside of the flap to remove slack in the linkage while making this check.

(b) Method II

With the flap handle in the flaps up position, adjust each flap pushrod so that the chord line of the flap forms a zero degree ± 1° angle with the wing chord at the outboard end of the flap. This is the neutral position. Maintain a light up pressure on the underside of the flap, sufficient to take the slack out of the linkage, while making this measurement.

(7) Measuring from the flaps up position attained above, maintaining light up pressure on the underside of the flap as described above, check flap travel. Travel should be as shwon in Figure 1.

Adjust the torque tube stop screw in or out as required. After any screw adjustment, it is necessary to review steps (3) through (7).

(8) Check complete operation of the flaps, and handle and ratchet mechanism. Install all access covers removed.

4. Torque Tube/Pushrod Distortion Inspection.

If flaps have been extended at or above V_{FE}, inspect the flap torque tube arms and pushrods for evidence of distortion.

(1) If the paint is cracked or peeling anywhere along the torque tube arm or pushrod, torsional movement has occurred.

(2) Remove the paint and inspect for cracks:

(a) In the welds at the arm on the torque tube end.

(b) In the rod ends and pushrod tube.

(c) Use a dye penetrant method of inspection.

(3) If cracks are not found, repaint the part(s) and reinstall.

(4) If cracked, replace the affected part(s).

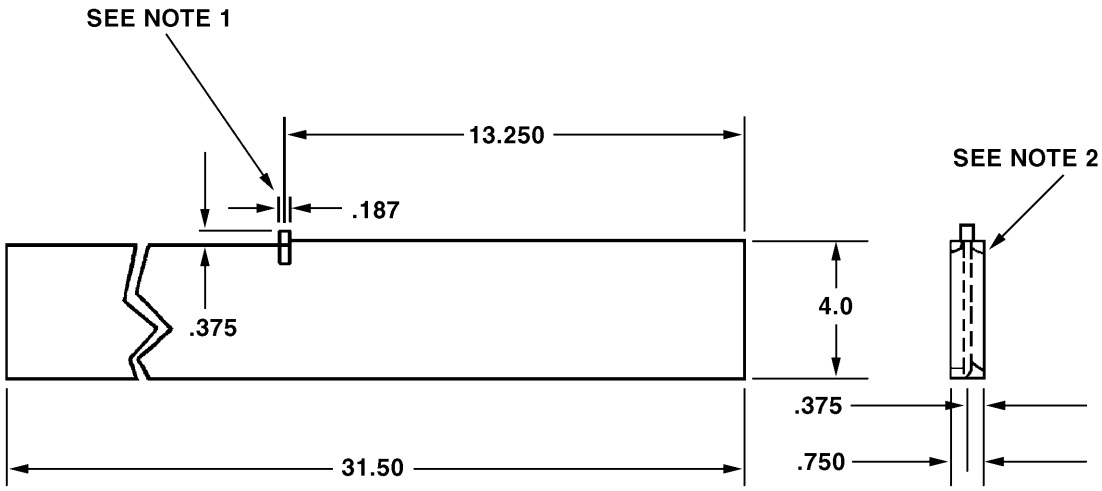
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MATERIAL:

.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 AMY BE USED IN PLACE OF ALUM. BAR STOCK.



Aileron and Flap Rigging Tool
Figure 4

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CHAPTER

28

FUEL

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CHAPTER 28

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CHAPTER 28 - FUEL

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GENERAL

The fuel system components covered in this section consist of fuel cells. fuel selector valves, fuel filters and electric fuel pumps. Each wing nacelle contains a fuel cell, having a capacity of 55 U.S. gallons, for a total capacity of 110 U.S. gallons.

1. 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 wing to be drawn by the opposite engine in the event of an emergency.

Fuel cells are installed in the aft nacelles and consist of bladder type tanks.

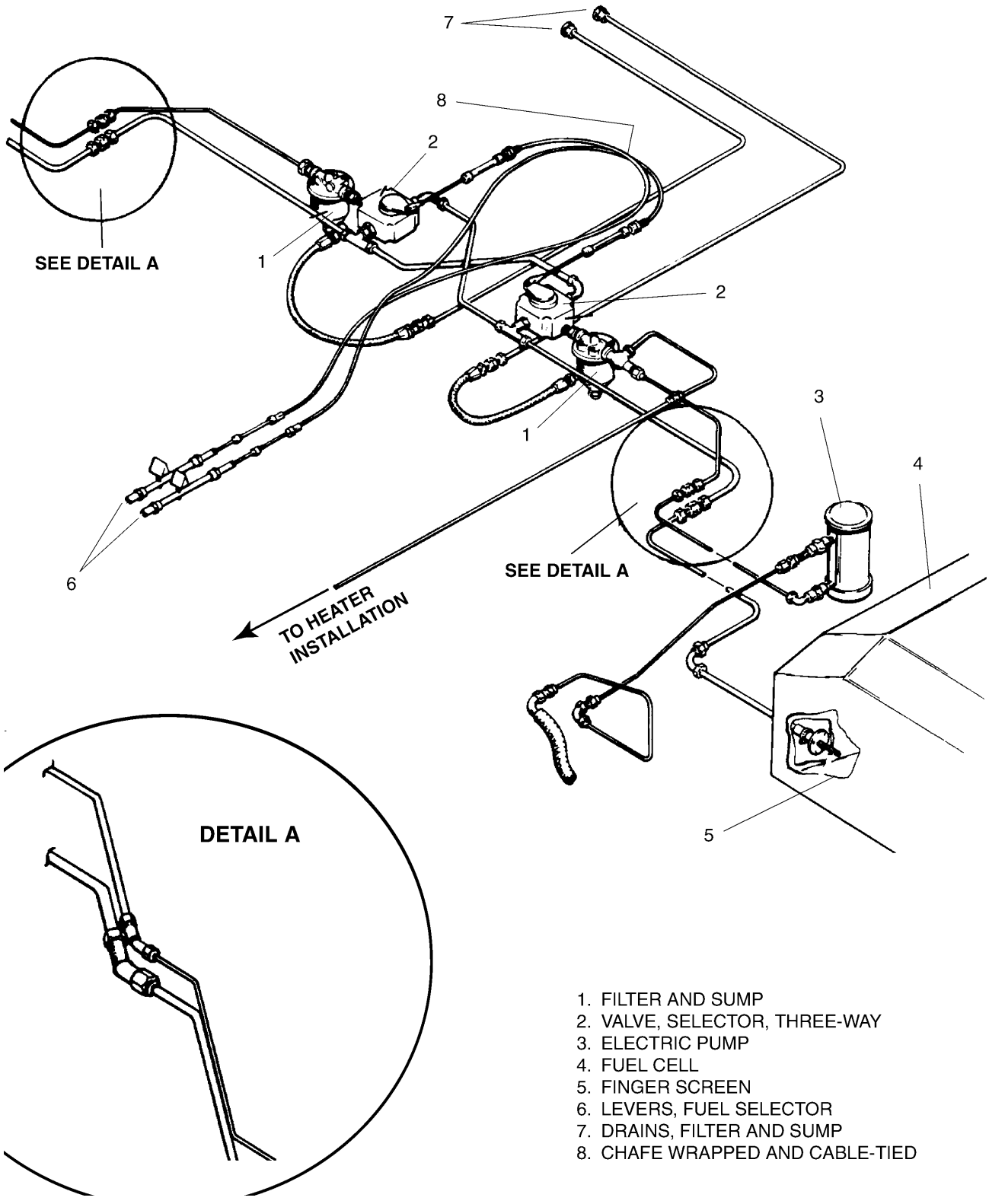
Fuel pressure and fuel flow for each system are indicated on their respective indicators located in the instrument panel. A fuel quantity gauge for each system, also located in the instrument panel, indicates the amount of fuel remaining as transmitted by electric fuel quantity sending units located 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 fuel filter to the electric pump and into the engine driven pump which forces the fuel to the carburetor.

2. Troubleshooting

Chart 1 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.

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1. FILTER AND SUMP
2. VALVE, SELECTOR, THREE-WAY
3. ELECTRIC PUMP
4. FUEL CELL
5. FINGER SCREEN
6. LEVERS, FUEL SELECTOR
7. DRAINS, FILTER AND SUMP
8. CHAFE WRAPPED AND CABLE-TIED

Fuel System Installation
Figure 1

CHART 1
TROUBLESHOOTING FUEL SYSTEM

Trouble	Cause	Remedy
Failure of fuel to flow.	Fuel line blocked.	Flush fuel system.
	Fuel vent cap blocked.	Check and clean vent hole in cap.
	Mechanical or electrical fuel pump failure.	Check and replace if necessary.
	Fuel selector valve in improper position.	Reposition as required.
		Check for obstructions in the fuel selector leverage mechanism.
		Check fuel selector cable for freedom of movement.
	Damaged fuel selector valve.	Replace fuel selector valve.
Fuel Quantity gauge fails to operate.	Broken wire.	Check and repair.
	Gauge inoperative.	Replace gauge.
	Fuel sender float partially or completely filled with fuel.	Replace sender.
	Circuit breaker open.	Check and reset.
	Float and arm assembly of fuel sender sticking.	Check.
	Bad ground.	Check for good contact at ground lip or rear of gauge.
No fuel pressure indication.	Fuel selector valve stuck.	Check fuel selector valve.
	Fuel tanks empty.	Check fuel tanks and fill.
	Defective gauge.	Replace gauge.
	Fuel selector valve in improper position.	Reposition fuel selector valve lever.
Low pressure or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty diaphragm in pump.	Rebuild or replace pump.
	Air in line to pressure gauge.	Bleed line.

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STORAGE

1. Fuel Cells

WARNING: DO NOT PERMIT SMOKING OR OPEN FLAME NEAR FUEL CELLS.

A. Removal (Refer to Figure 1.)

(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.

B. Installation (Refer to Figure 1.)

(1) With protective material around the cell access opening, install folded fuel cell through access hole and then orient it correctly. Finally, 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 in.-lbs., wait 30 minutes and retorque to 25 ± 5 in.-lbs.

(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 in.-lbs.

(5) Reaching through the side access panel connect the fitting at the vent line and tighten the clamps to 15 in.-lbs.

(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.

C. Fuel Cell Compartment

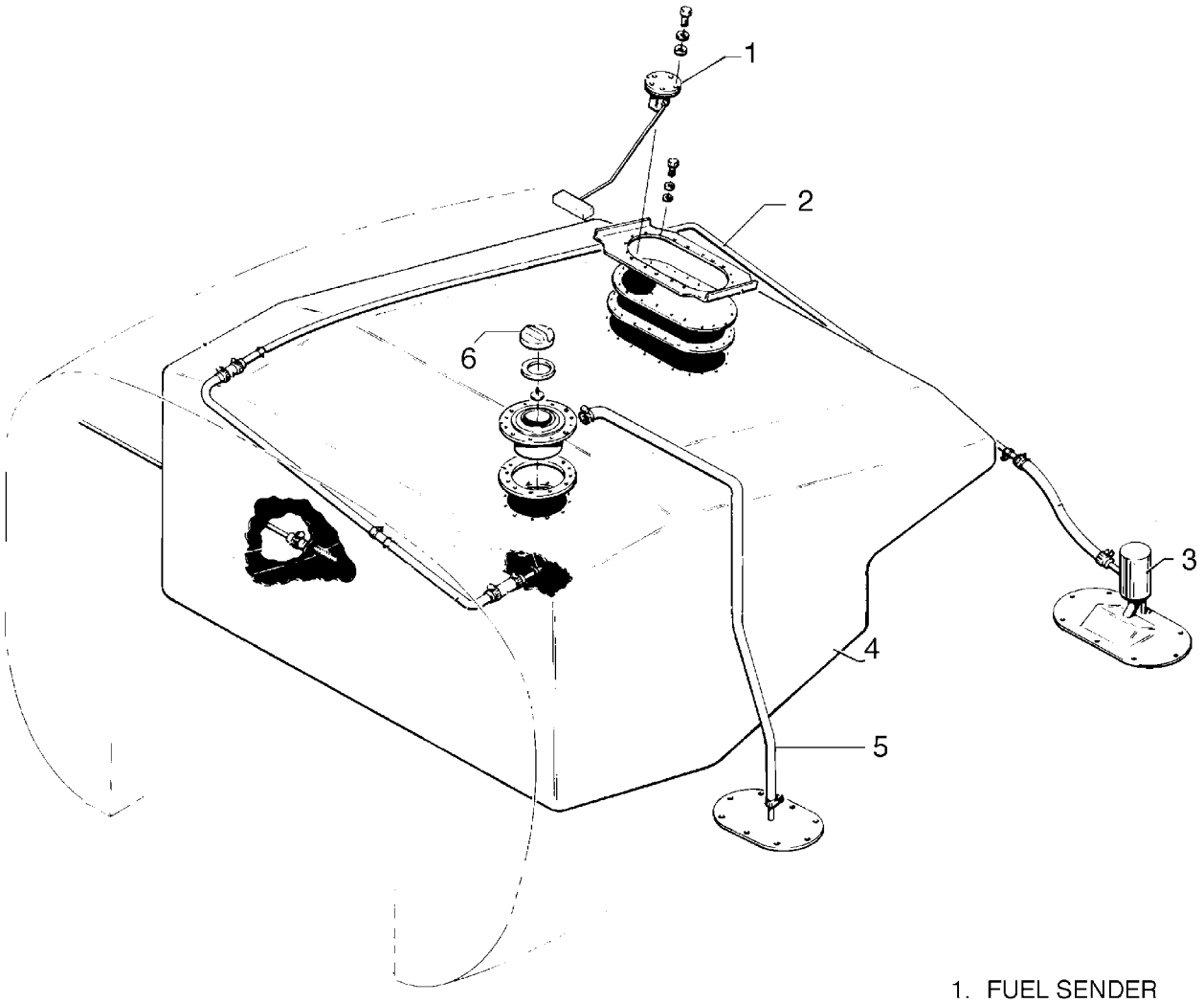
Anytime a fuel cell is removed:

(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.



1. FUEL SENDER
2. VENT LINE
3. VENT CAN
4. FUEL CELL
5. OVERFLOW LINE
6 FILLER CAP

Fuel Cell Installation
Figure 1

D. Molded Nipple Fittings

The molded nipple fitting is a lightweight fitting developed for ease in installation in certain locations in the aircraft. In order to get the best service from this type of 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 0.25 inch where possible.

(4) Locate the hose clamp on the fabric-reinforced area of the nipple.

(5) Torque the hose clamp 15 to 20 in.-lbs. 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.

E. Handling and Storage

WARNING: DO NOT PERMIT SMOKING OR OPEN FLAME NEAR FUEL CELLS.

(1) Prevent needless damage by exercising common sense in the care and handling of fuel cells:

(a) Folding or collapsing of cells is necessary to place them in containers for storage, installing in airframe cavities and carrying from place to place.

(b) Protect fitting seal surface from contact with cavities during removal or installation. Use protective covers over fitting seal when practical.

(c) Protect cell from tools, hot lights, etc., when working around them.

(d) Avoid stepping on folds or creases in cells.

(e) Do not carry cells by fittings.

(f) Maintain original cell contours or folds when refolding for boxing, rolling to insert in airframe cavities or handling in the repair area.

(g) Cells that are 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.

F. Cleaning and Inspection

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

WARNING: USE A VAPOR-PROOF LIGHT FOR INSPECTION.

(1) Fuel cells may be cleaned by the following procedure:

(a) New Cells

It should not be necessary to clean new cells upon removing them from their containers, if they are installed in the airframe cavities promptly. If for any reason the cells are not installed immediately, and become dirty, they should be cleaned with soap and warm water to remove foreign material prior to installation in a clean cavity.

(b) Used Cells

Prior to removal, the cells are to be drained of fuel, purged with fresh air and swabbed out to remove all traces of fuel. Following removal, the cells are to be cleaned inside and out with soap and warm water.

(2) Fuel cells may be inspected as follows:

WARNING: USE A VAPOR-PROOF LIGHT FOR INSPECTION.

(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 inspecting and repair, or cells being returned to service from storage, should be inspected as outlined above.

(c) 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.

G. Repairing and Testing

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

WARNING: DO NOT PERMIT SMOKING OR OPEN FLAME NEAR REPAIR AREA OR CELLS.

(1) Repairing

For procedures for the maintenance, repair and “quick cure” repair of fuel cells constructed of LORAL or GOODYEAR VITHANE® material, reference the applicable vendor publication from Engineered Fabrics Corp.

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. 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.

(2) Testing Fuel Cells

Either of the following test procedures may be used to detect leaks in the bladder cells:

NOTE: The chemical test is more sensitive and the preferred test.

(a) Soap Suds Test

1 Attach test plates to all fittings.

2 Inflate the cell with air to a pressure of 1/4 psi MAXIMUM.

3 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.

4 After test, remove all plates and wipe soap residue from the exterior of the cell.

(b) Chemical Test

1 Attach test plates to all fitting openings except one.

2 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.

3 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.

4 Inflate the cell with air to a pressure of 1/4 psi MAXIMUM, and maintain pressure for 15 minutes.

5 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.

6 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 re-soaking the cloth in the solution.

7 The solution and test cloth are satisfactory only as long as they remain clean. Indicator solution that is not used immediately should be stored in a closed rustproof container to prevent evaporation and deterioration.

(c) 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.

2. Locking Fuel Cap

A. Disassembly

(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.

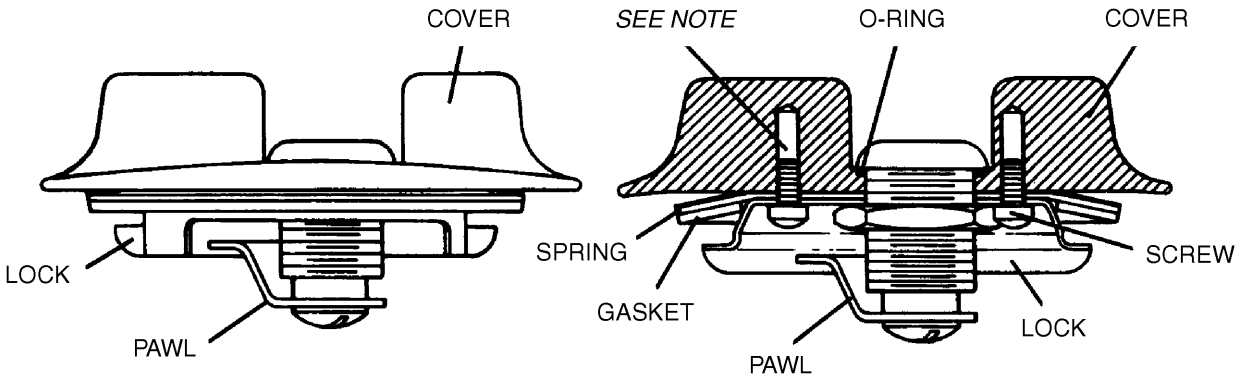
B. Assembly

(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.
(3) Reinstall nut which secures key lock to cover.
(4) Attach pawl to back of lock assembly with screw previously removed.

NOTE: Apply Loctite 271 to the thread of the two screws previously removed from the back of the fuel cap.

(5) Install screws in back of fuel cap.

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NOTE: INSTALL WITH LOCTITE 271.

Locking Fuel Cap Assembly
Figure 2

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DISTRIBUTION

1. Fuel Filter (Refer to Figure 1.)

NOTE: The fuel filter should be inspected at periodic intervals as explained in 12-10-00.

A. Removal

(1) Determine that the fuel selector valve lever is in the off position. Remove scoop and screen from bottom of fuselage to gain access to the fuel filter.

(2) Drain remaining fuel from fuel filter 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 filter disc/cartridge assembly.

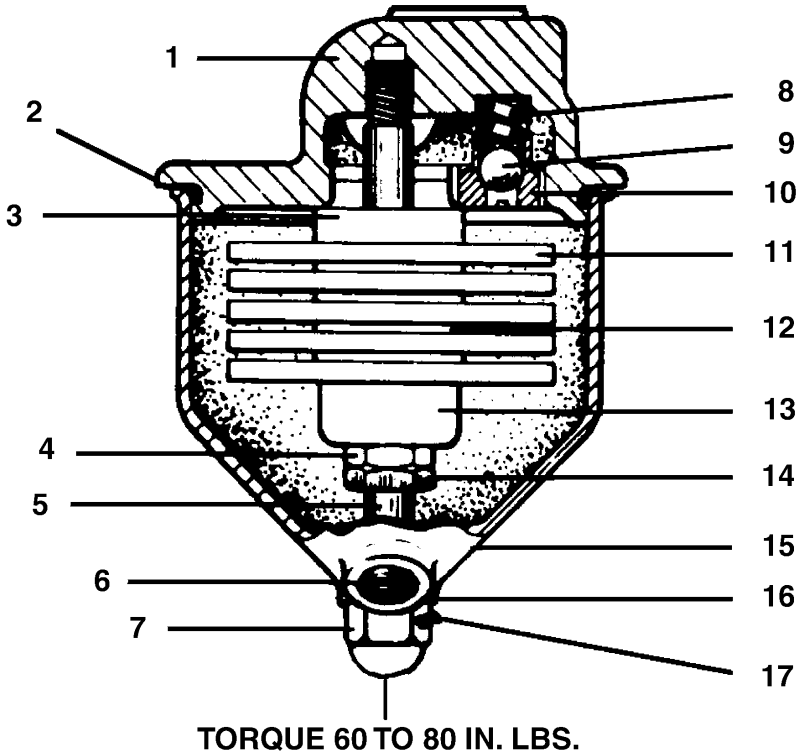
B. Installation

(1) Install filter discs/cartridge assembly onto stud and secure with nuts. Install new gasket on top of bowl assembly, place bowl in position on filter body and stud. Secure with washer and nut. Torque as specified in Figure 1 and safety.

(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.

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1. BODY FILTER
2. O-RING SEAL
3. TUBE, OUTER
4. NUT
5. STUD
6. DRAIN, FILTER, FITTING
7. NUT
8. SPRING
9. BALL, RELIEF
10. SEAT, RELIEF
11. DISCS, FILTER
12. WASHERS
13. CUP, RETAINER
14. NUT, CHECK
15. BOWL, FILTER
16. WASHER
17. SAFETY WIRE

Fuel Filter Assembly
Figure 1

C. Cleaning

(1) Clean filter discs/cartridge 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.

2. Fuel Selector Valve

CAUTION: NO FIELD DISASSEMBLY OR REPAIR OF FUEL SELECTOR VALVES IS AUTHORIZED. MAINTENANCE IS LIMITED TO REMOVAL AND REPLACEMENT OF THE WHOLE UNIT.

A. Removal

(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) To remove the fuel selector valve, remove rear seat and floor.

(3) Drain appropriate fuel tank. (Refer to 12-10-00, Fuel Tanks.)

(4) Disconnect control cable from valve selector lever. Disconnect fuel lines and mounting hardware and remove fuel selector valve.

B. Installation

(1) Place fuel selector valve and attach it with the mounting hardware.

(2) Connect the fuel lines; connect control cable to the valve selector lever.

(3) Install the rear seat and floor.

(4) Be sure to refill the emptied fuel tank before returning aircraft to flight.

C. Leak Test

Remove fuel selector valve as described above.

(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.

3. Cleaning Fuel System

A. To flush fuel cell and selector valve, disconnect the fuel line from the carburetor.

B. 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.

C. Repeat this procedure for each fuel cell.

D. When both cells are flushed, clean fuel filter and fuel tank finger screens.

4. Electric Fuel Pump

CAUTION: DO NOT RUN PUMP DRY.

A. Removal

There is one electric fuel pump for each engine. The pump is mounted in the inboard side of each 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.

B. Installation

(1) Insert pump through access opening.
(2) Position pump and attach using bolts.
(3) Connect electrical wiring and fuel lines.
(4) Replace access cover.

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INDICATING

1. Standard Installation (PIR-PPS60032-1, Rev. D)

A. Fuel Quantity Sender Unit

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 the fuel quantity gauges in the instrument panel. A dipstick in the side pocket of the cabin can also be used to manually check the indicating system.

B. Fuel Quantity Sender/Gauge Check (Installed)

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

(1) Put the fuel selector levers in the “ON” position. Completely drain fuel cell that relates to the fuel quantity sender and gauge to be checked. (Refer to Draining Fuel System, 12-10-00.)

(2) Level airplane laterally. (Refer to Leveling, 8-20-00.)

NOTE: An external power supply providing 14 ± 0.2 volts should be utilized for the fuel Quantity Sender/Gauge Check.

(3) With the master switch in the “OFF” position, 14 ± 0.2 volts DC 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 guage should be replaced.

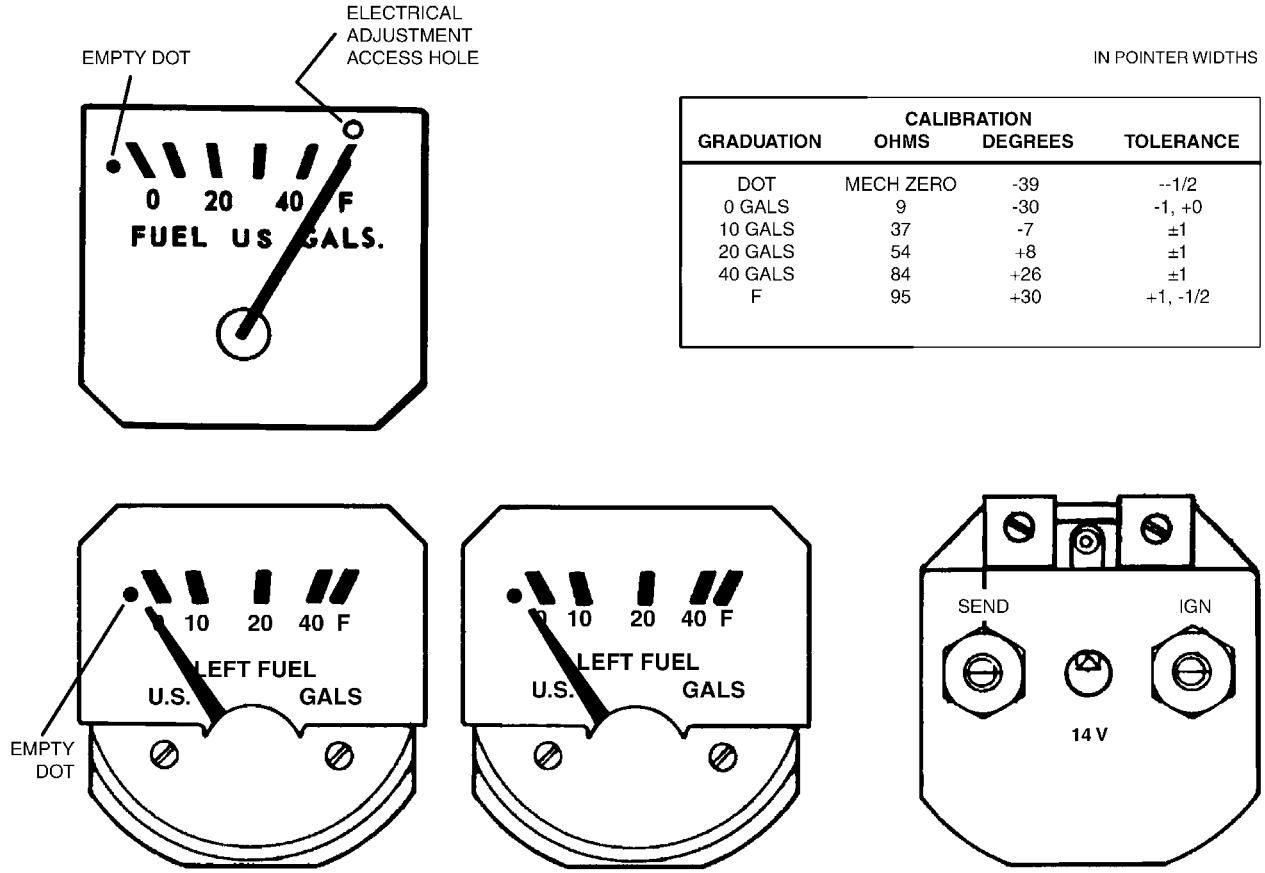
(4) Add fuel to the tanks in accordance with the information given in Chart 1, until tanks are full. Observe the gauge reading at each 10 gallon increment. To reduce internal gauge friction tap the gauge.

(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 1), just sufficiently to bring it within tolerance – do not center the needle.

CHART 1
FUEL QUANTITY ANALOG GAUGE / SENDER TOLERANCES

Total Fuel in Tanks [Side Being Tested] Gallons	Required Gauge Reading	Tolerance (Plus or Minus) Needle Widths*	Resistance (Ohms) Both Senders
FUEL QUANTITY ADDED (GALLONS)	SENDER RESISTANCE (OHMS)(REF.)	GAUGE INDICATION	TOLERANCE (NEEDLE WIDTHS)
1.5*	9	0	-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.

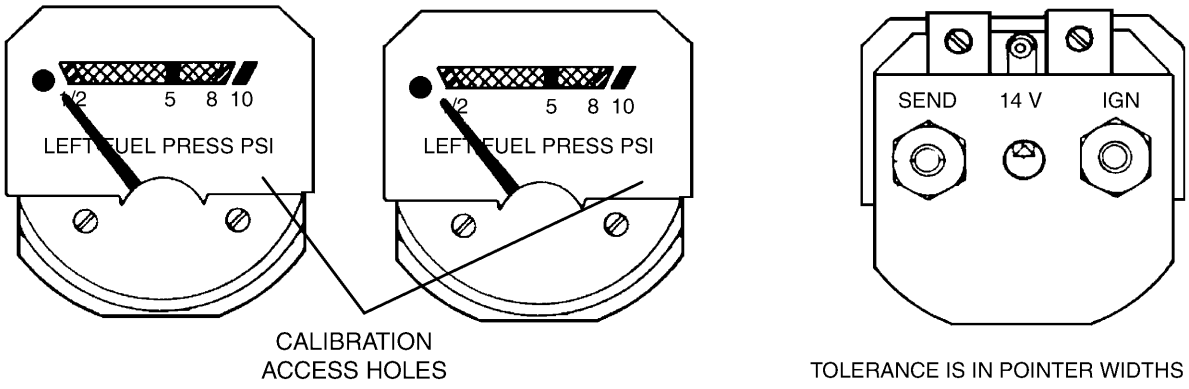


IN POINTER WIDTHS

GRADUATION	CALIBRATION OHMS	DEGREES	TOLERANCE
DOT	MECH ZERO	-39	--1/2
0 GALS	9	-30	-1, +0
10 GALS	37	-7	±1
20 GALS	54	+8	±1
40 GALS	84	+26	±1
F	95	+30	+1, -1/2

Fuel Gauge
Figure 1

	CALIBRATION		
GRADUATION	OHMS	DEGREES	TOLERANCE
DOT	MECH ZERO	-39	1/2
1/2	11.50	-28	-1, +0
5	42.0	+10	±1
8	60.0	+25	-0, +1
10	72.0	+32	±1



Fuel Pressure Gauge and Calibration
Figure 2

C. Fuel Pressure Gauge Check

(1) With electrical power off, the fuel pressure gauge shall indicate the dot ± 1/2 needle width.

(2) Apply positive 14V DC to the electrical buss. Each needle should move to a position below the red line at 1/2 lb. per sq. in.

(3) Place the electrical fuel pump switches in the “ON” position. With fuel in the tanks, the gauge should indicate between the 1/2 and 8 PSI radial lines.

2. Optional Installation (PIR-PPS60224)

Fuel Quantity Calibration

In S/N's 4496174; 4496224 and up, with the optional Avidyne FlightMax Entegra EFIS installed, fuel quantity information is collected by the DAU and displayed on the MFD. Whenever the MFD, DAU or any fuel sender is replaced, calibrate the Fuel Quantity Indicator as follows:

(1) This process requires that the aircraft be placed in a leveled condition per the appropriate aircraft leveling instructions, 8-20-00.

(2) From the MFD maintenance page, depress the line select key (L4) to access the Engine Setup Page.

(3) Depress the Fuel Cal button (L1) to enter the Fuel Calibration Page.

(4) Depress "Begin Cal" button (R3) and follow the on-screen calibration procedure for left & right tank zero fuel and full fuel calibration points. (See Chart 2.)

(5) Use the Left Knob to select the current calibration point, The selected calibration point is highlighted and the value displayed is the current reported fuel quantity from the DAU. A message at the bottom of the screen prompts the operator to add the appropriate amount of fuel and then to select "Accept Value" once the value reported from the DAU has stabilized. If the DAU reported value is not within 2.5 gallons of the test point value, a message "DAU Reported Fuel Value Out of Tolerance" will be presented and the value will not be accepted.

(6) Once all points have been calibrated, the operator presses "Calibration Complete" to cause the calibration factors to be computed and applied to the DAU reported fuel quantity.

(7) Other options from the Calibration Underway state are to "Restore Last Cal" and "Clear Cal."

(a) Pressing "Restore Last Cal" causes the calibration values from the last completed calibration to be restored and the state to change to Calibrated.

(b) Pressing "Clear Cal" causes all calibration values to be cleared and the state to change to "Not Calibrated." An "Are You Sure?" prompt will give the operator a chance to reconsider the decision to either "Restore Last Cal" or "Clear Cal."

(8) When the calibration procedure has been completed, press the Save button. If you decide not to save the changes, pressing the Cancel button from the Underway state causes the current calibration session to be aborted with any unsaved interim calibration values being discarded. Changes will not take effect until the MFD has been restarted.

NOTE: The "empty" and "full" fuel readings on this set-up page will NOT display zero (0) or fifty-four (54) gallons usable fuel for the respective empty and full calibration points. However, the appropriate zero and full will be displayed on the MFD in normal operation mode (not maintenance set-up).

(9) Verify DAU Status Box reads: DAU(s) configured for Piper PA-44-180 (Seminole).

(10) Verify Calibration Status Box reads:

"Left Fuel Tank: Calibrated"

"Right Fuel Tank: Calibrated"

CHART 2
FUEL CALIBRATION

Quantity	Unusable Fuel
ZERO FUEL	1.0 + .1; -0 Gallon unusable fuel
FULL FUEL	54 + 0; -1 gallon unusable fuel

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CHAPTER

29

HYDRAULIC POWER

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CHAPTER 29

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	2	Mar 15/06			
29-Table of Contents	1	Mar 15/06			
	2	Mar 15/06			
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	2	Mar 15/06			
	3	Mar 15/06			
	4	Mar 15/06			
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CHAPTER 29 - HYDRAULIC POWER

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Installation		1	3G19
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Servicing Hydraulic Pump/Reservoir		5	3G23

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GENERAL

The airplane is equipped with an Oildyne hydraulic pump.

The hydraulic components covered in this chapter consist of the combination hydraulic pump and reservoir, and hydraulic lines. See 32-30-00 for the landing gear free fall valve and actuating cylinders. 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 32-40-00 for information on the brake system.

CAUTION: PRIOR TO STARTING ANY INVESTIGATION OF THE HYDRAULIC SYSTEM, PLACE THE AIRPLANE ON JACKS (REFER TO JACKING, 7-10-00).

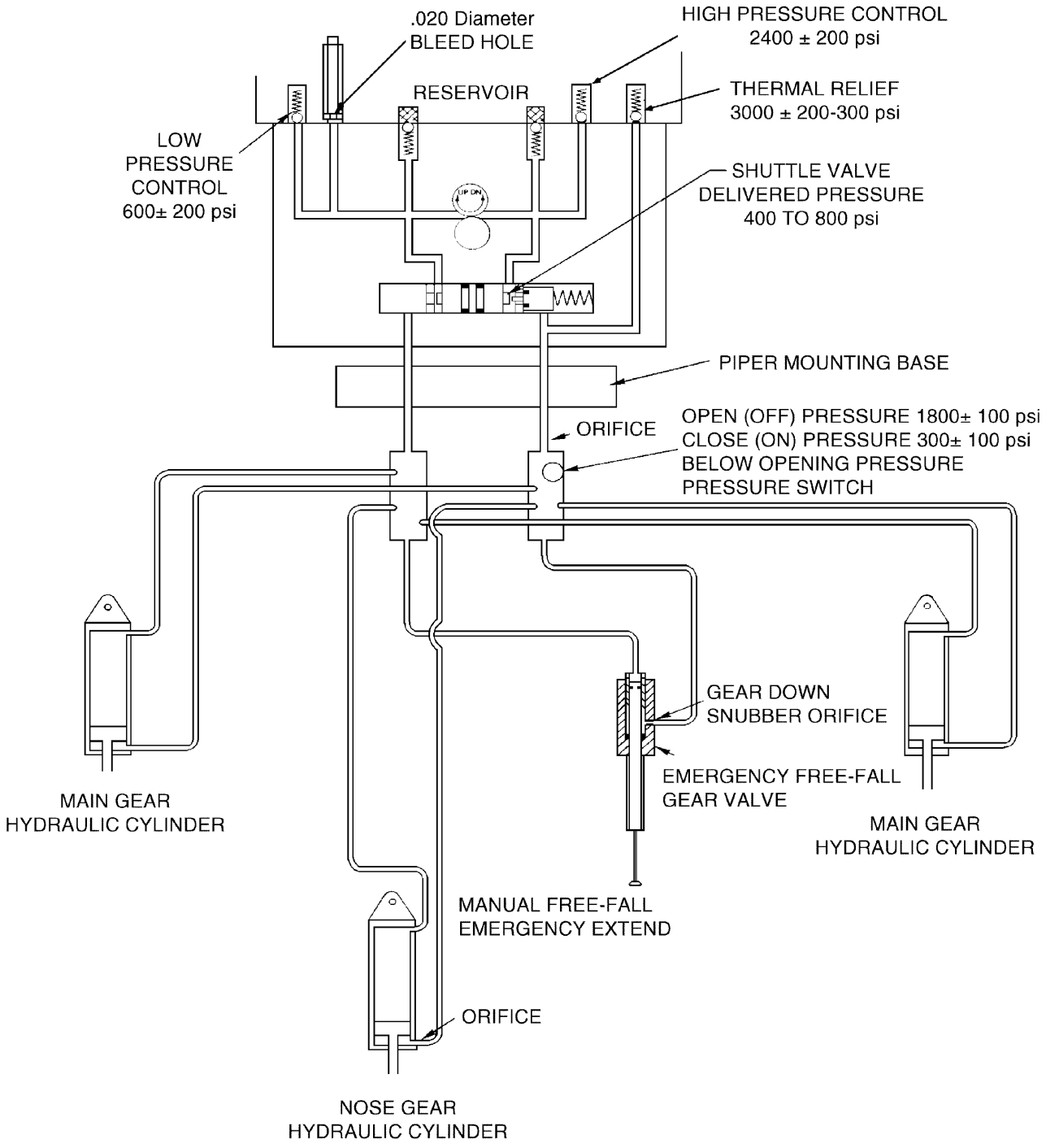
1. Description

Hydraulic fluid to the landing gear actuating cylinders (see 32-30-00) is supplied by an electrically powered reversible pump located in the aft fuselage on a 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. (Refer to Figure 1.)

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 to 1800 ± 100 psi. The switch will continue to hold the circuit open until pressure in the system drops to 200 to 400 psi. 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 1.)

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 1. To prevent excessive buildup of pressure in the hydraulic system due to expansion, a thermal relief valve is incorporated in the pump. The pump's relief valve opens at 3,000 ± 200 to 300 psi. 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 1.)

Also in the system is a bypass or free-fall valve (see 32-20-00), operated by the emergency gear release knob, that releases hydraulic pressure to permit the gear to free fall, with spring assistance on the nose gear, should a malfunction in the pump system occur. The knob must be pulled out for emergency extension. To prevent the gear from extending too fast, there is a special restriction elbow on the nose gear retraction line. The knob must be pushed in when the hydraulic system operational checks are being conducted. The emergency gear knob is located on the instrument panel to the left of the control quadrants.



Schematic Diagram of Hydraulic System
Figure 1

2. Troubleshooting

CAUTION: TO PREVENT THE BUILDUP OF UNNECESSARY PRESSURE ON THE ACTUATING CYLINDERS AND CONNECTING HYDRAULIC LINES, WHEN THE GEAR IS RAISED OR LOWERED MANUALLY WITH THE AIRPLANE ON JACKS, PULL THE EMERGENCY GEAR RELEASE KNOB OUT. FAILURE TO COMPLY WITH THIS PROCEDURE COULD RESULT IN THE BUILDUP OF SUFFICIENT PRESSURE TO UNLOCK THE DOWN LOCK, 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 THE MASTER SWITCH ON, AND SELECT GEAR DOWN. OBSERVE THAT ALL THREE GREEN LIGHTS ARE ENERGIZED, INDICATING THAT THE LANDING GEARS ARE DOWN AND LOCKED. TURN THE MASTER SWITCH OFF.

If trouble develops in the landing gear, place the airplane on jacks (refer to Jacking, 7-10-00), and proceed to find the cause of the trouble. A hydraulic system operational check may be conducted using Figures 1 or 2 and the Landing Gear Retraction System Functional Test, 32-30-00. When the trouble has been recognized, the first step is to isolate the cause. After isolation of a particular cause or problem, refer to the individual Chapter pertaining to that subject matter, i.e., for Landing Gear, see 32-30-00.

Hydraulic system troubles are not always traceable to one cause. A malfunction may be the result of more than one trouble in the system. Start with the most obvious and most probable reasons for the trouble, check each possibility and, by process of elimination, isolate the fault.

CHART 1
LEADING PARTICULARS, HYDRAULIC SYSTEM

Hydraulic Pump	**Piper P/N 481-879 - Oildyne Pump**
High Pressure	2400 ± 200 psi
Low Pressure	600 ± 200 psi
Flow Rate @ 1000 psi	60 cu. in. per min.
Hydraulic Fluid	MIL-H-5606
Thermal Relief Valve	3000 + 300 / -200 psi
Shuttle Valve Delivered Pressure	400 - 800 psi
Pressure Switch	
Open (OFF) Pressure	1800 ± 100 psi
Close (ON) Pressure	300 ± 100 psi
Electrical Characteristics	
Voltage	14 VDC
Rotation	Reversible
Polarity	Negative ground
Operating Current	18 amps, max at 14 volts(both rotations)
Operating Time	5 - 10 sec. (current load = 100 amps @ 77° F)
Overload Protection	Thermal circuit breaker
Automatic Reset Time	12 seconds, max.
Location, Automatic Reset	Commutator end head of motor

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WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

1. Hydraulic Pump

NOTE: No field repair of Oildyne hydraulic pumps is authorized. Any faulty hydraulic pump must be replaced, or returned to Piper via the local Piper distributor for repairs.

A. Removal (Refer to Figure 1, Sheet 1.)

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) Remove the cabin rear access cover.

(2) Disconnect the three knife connectors that attach the black, blue, and green forward and reverse harness wires.

(3) Disconnect and plug the UP and DOWN pressure hydraulic lines from pump mount. Cap the lines.

(4) Remove the three each mounting bolts and washers securing pump mount to deck.

(5) Lift assembly from airplane.

B. Installation (Refer to Figure 1, Sheet 1.)

(1) Position assembled pump, bracket, and pump mount on pump deck in airplane.

(2) Secure pump assembly to deck by installing the three AN3-10 bolts with one MS35489-64 washer under each bolt head and three No. 5712-45 (Piper P/N 494-192) washers between Piper mount assembly and pump deck.

NOTE: Before positioning the complete hydraulic pump assembly on the mounting bracket, ensure that the cushion pad is secured in place on the reservoir base.

(3) Install the UP and DOWN pressure hydraulic lines to pump mount.

(4) Connect the three knife connectors that attach the black, blue, and green forward and reverse harness wires.

(5) Install the cabin rear access cover.

C. Field Service

NOTE: No field repair of Oildyne hydraulic pumps is authorized. Any faulty hydraulic pump must be replaced, or returned to Piper via the local Piper distributor for repairs.

Field service of the hydraulic pump is limited to removal, cleaning and inspecting the hydraulic fluid reservoir.

Oildyne pump includes a dipstick to check the quantity of hydraulic fluid in the reservoir. Replenish only with MIL-H-5606 petroleum base hydraulic fluid.

(1) Hydraulic Pump and Bracket/Pump Mount (Refer to Figure 1.)

(a) Disassembly

1 Remove safety wire securing two bolts that attach bracket to pump.

2 Remove the two bolts and washers.

3 Separate pump assembly from bracket.

(b) Assembly

1 If bracket was removed from was removed from pump mount, install bracket to Piper pump mount with four MS24693-S298 screws.

2 Position pump assembly on bracket so that tapped holes in adapter align with bolt holes on bracket.

3 Install two AN960-616 washers and two MS20074-06-05 bolts to secure pump assembly to bracket.

4 Safety bolts with MS20995-C41 wire.

(2) Motor Assembly and Pump-Adapter (Refer to Figure 1.)

(a) Disassembly

1 Remove two each mounting bolts on flange of motor assembly and separate the motor assembly from the pump.

2 Remove coupling and O-ring and discard.

NOTE: New O-ring and coupling are included in replacement motor assembly.

(b) Assembly

1 Locate the replacement O-ring and coupling.

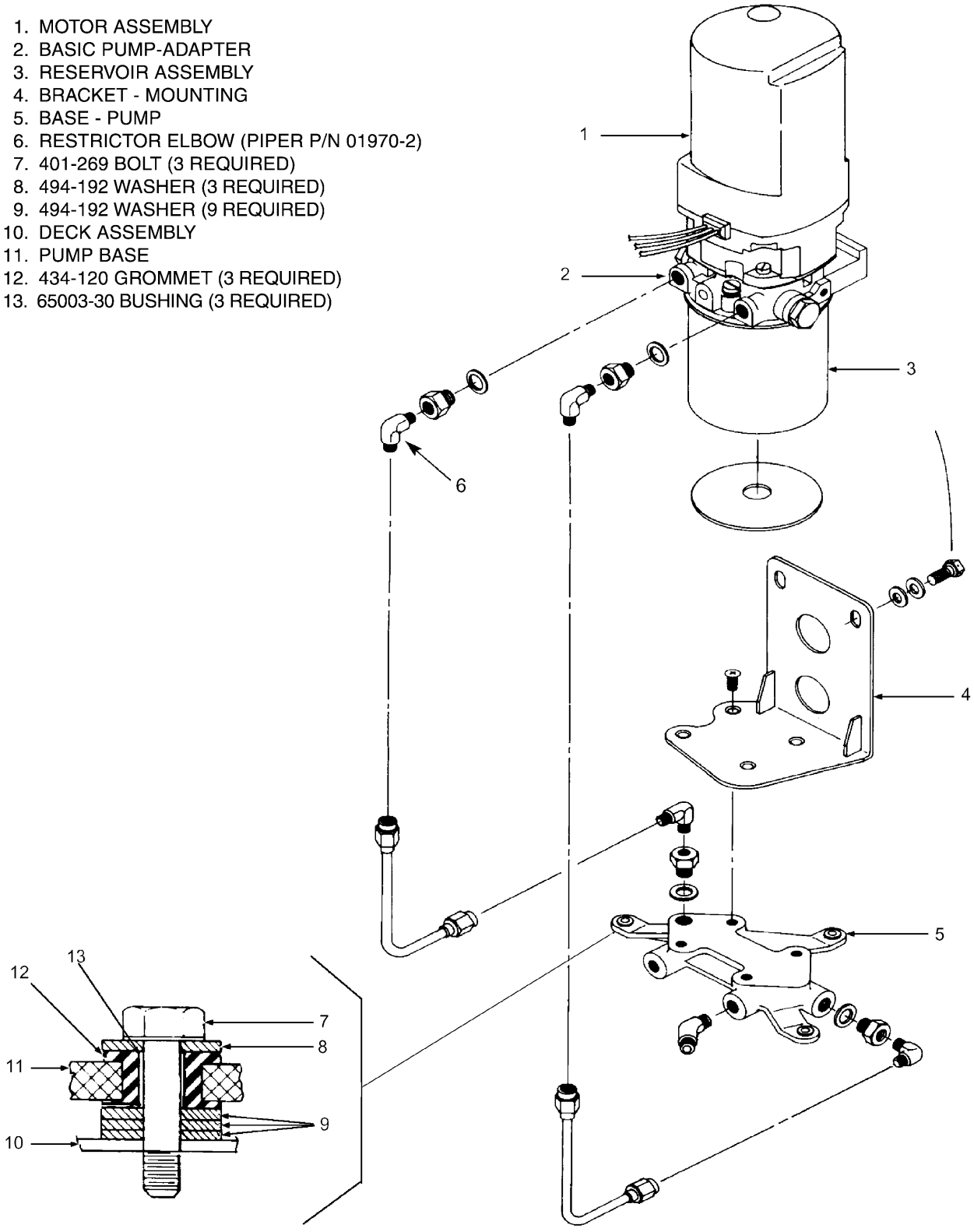
2 Place the coupling and O-ring into position between the motor assembly and pump-adapter assembly.

3 Apply light coating of Titeseal No. 3 in back of the first two threads of mounting bolts.

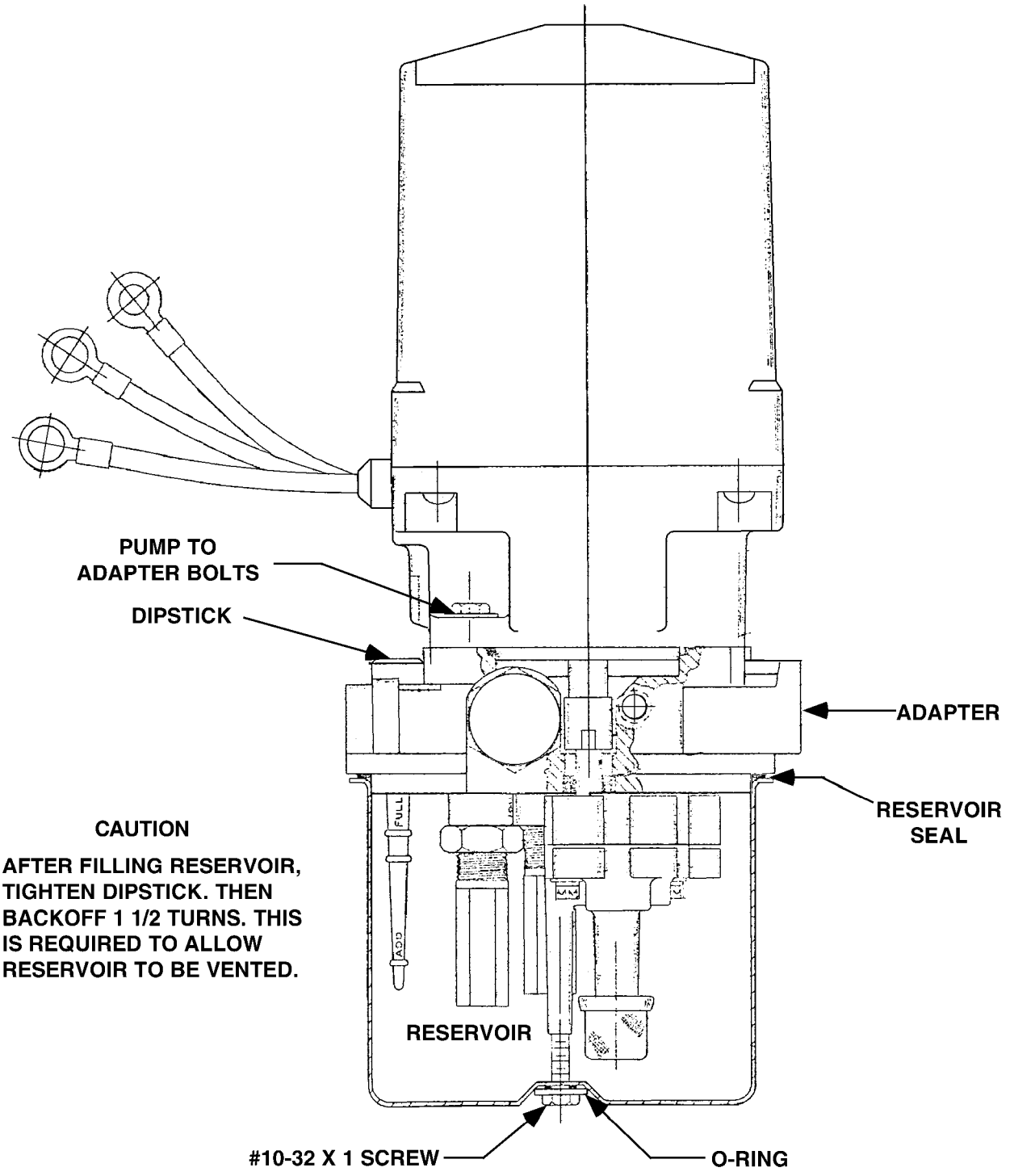
4 Positioning the two units in place, install two each mounting bolts through the flange of the motor assembly and into the pump-assembly housing.

5 Torque bolts to 15-20 in. lbs.

1. MOTOR ASSEMBLY
2. BASIC PUMP-ADAPTER
3. RESERVOIR ASSEMBLY
4. BRACKET - MOUNTING
5. BASE - PUMP
6. RESTRICTOR ELBOW (PIPER P/N 01970-2)
7. 401-269 BOLT (3 REQUIRED)
8. 494-192 WASHER (3 REQUIRED)
9. 494-192 WASHER (9 REQUIRED)
10. DECK ASSEMBLY
11. PUMP BASE
12. 434-120 GROMMET (3 REQUIRED)
13. 65003-30 BUSHING (3 REQUIRED)



Hydraulic Pump
Figure 1 (Sheet 1 of 2)



Hydraulic Pump
Figure 1 (Sheet 2 of 2)

(3) Reservoir and Pump-Adapter (Refer to Figure 1.)

(a) Disassembly

CAUTION: DO NOT DISASSEMBLE PUMP ASSEMBLY FROM ADAPTER ASSEMBLY. DAMAGE TO VALVES AND PRESSURE SETTINGS, WHICH ARE NON-ADJUSTABLE, WILL OCCUR.

1 Remove screw and O-ring securing the reservoir to the adapter assembly.

2 Remove reservoir and reservoir seal.

3 When replacing reservoir, remove the cushion pad. It will have to be bonded to the new reservoir base using Scotch Grip 2210 or Contact Adhesive B-10161 rubber cement.

(b) Assembly

1 Locate the cushion pad and bond it to the bottom surface of the reservoir using Scotch Grip 2210, or Contact Adhesive B-10161 rubber cement.

2 Position the reservoir seal between the reservoir and the adapter assembly.

3 Locate the O-ring and bolt that secures the reservoir to the pump-adapter assembly and apply a light coating of Titeseal No. 3 in back of first two bolt threads.

4 Position the O-ring on the bolt, and install it through the reservoir and into the pump-adapter securing the reservoir.

5 Tighten this bolt to a torque value of 40 - 50 inch-pounds.

2. Hydraulic Lines

Removal and Installation

Remove a damaged hydraulic line by disconnecting the fitting at each end and by disconnecting where secured by brackets. Refer to Figure 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.

3. Testing Hydraulic System

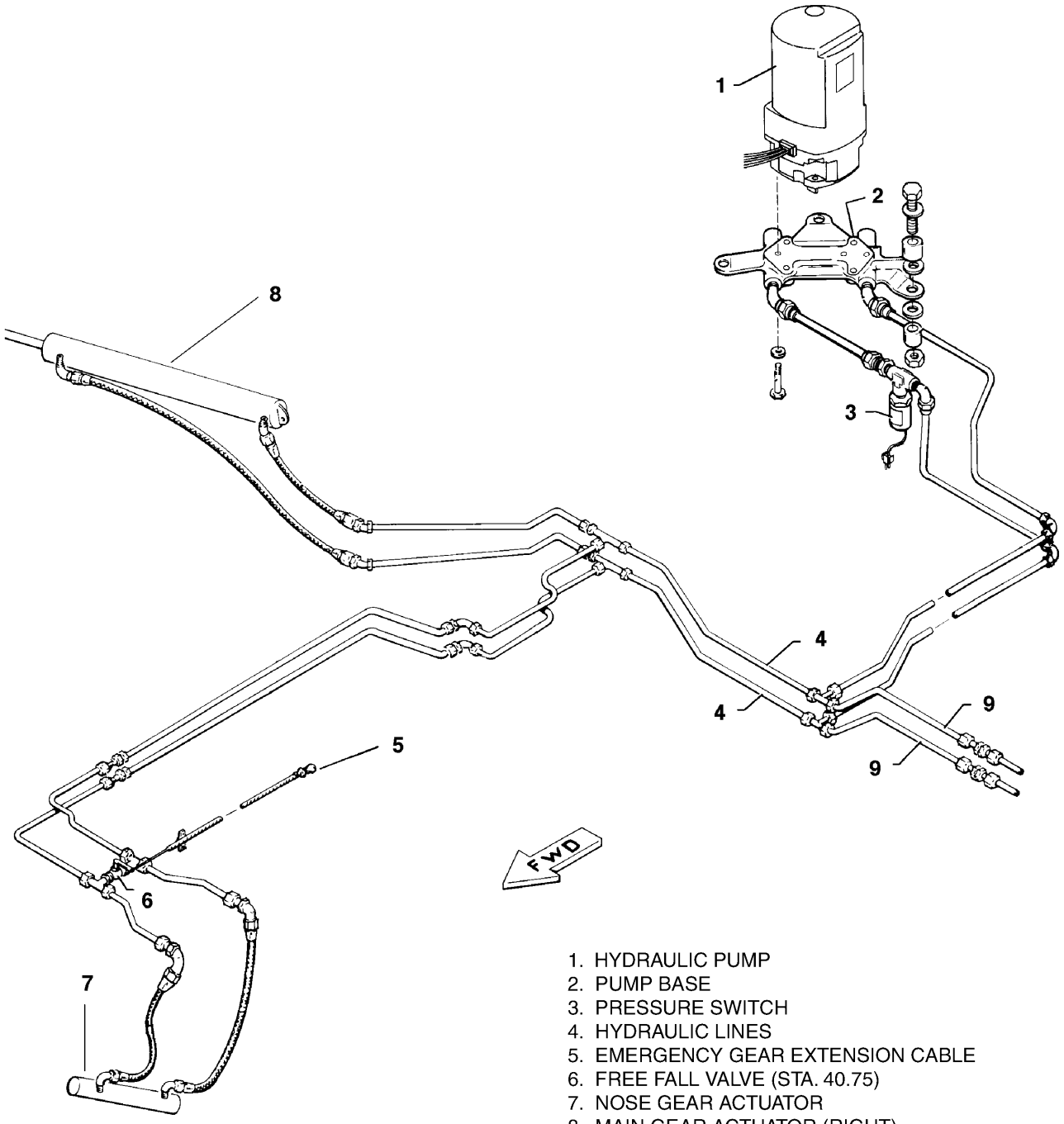
After performing any service on the hydraulic system, test the system to assure its proper function. See Gear Retraction System - Functional Test, 32-30-00.

4. Servicing Hydraulic Pump/Reservoir

CAUTION: THE PUMP MUST HAVE THE DIPSTICK LOOSENED 1 1/2 TURNS TO PROPERLY VENT IT.

The fluid level of the reservoir of the combination pump and reservoir should be checked every 50 hours by checking the dipstick indication. Access to the pump is through the access panel in the aft wall of the baggage compartment.

Should the fluid level be low, add fluid, MIL-H-5605A, and return the dipstick. After tightening the dipstick, loosen it 1 1/2 turns to allow the reservoir to vent.



1. HYDRAULIC PUMP
2. PUMP BASE
3. PRESSURE SWITCH
4. HYDRAULIC LINES
5. EMERGENCY GEAR EXTENSION CABLE
6. FREE FALL VALVE (STA. 40.75)
7. NOSE GEAR ACTUATOR
8. MAIN GEAR ACTUATOR (RIGHT)
9. LINES TO MAIN GEAR ACTUATOR (LEFT)

Hydraulic Lines Installation
Figure 2

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CHAPTER

30

ICE AND RAIN PROTECTION

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CHAPTER 30

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	4	Mar 15/06			

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CHAPTER 30 - ICE AND RAIN PROTECTION

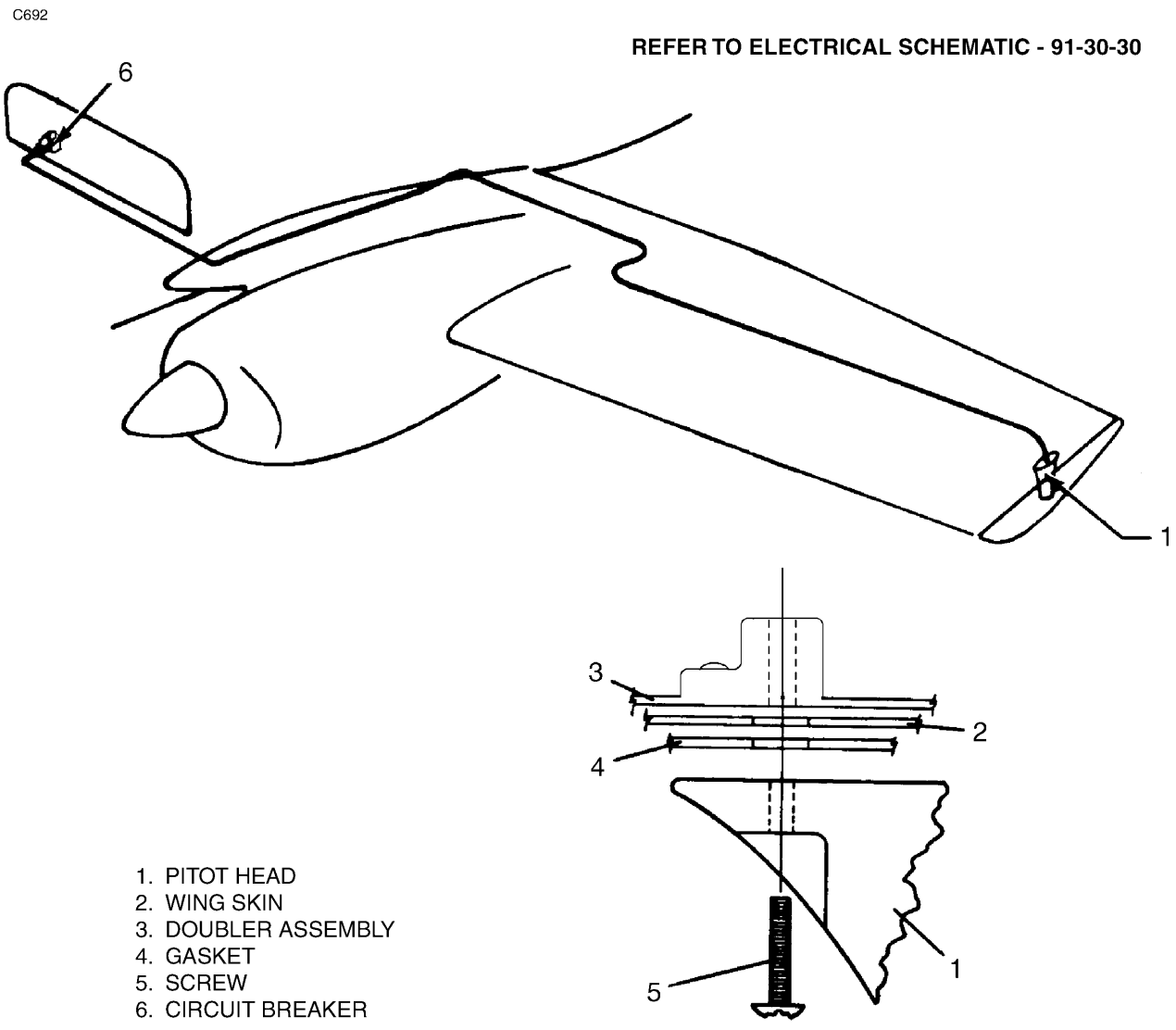
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SUBJECT	SECTION	PAGE	GRID NO.
PITOT AND STATIC	**30-30-00**	1	3H9

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PITOT AND STATIC

The 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 1.)



Heated Pitot Installation
Figure 1

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CHAPTER

31

INDICATING / RECORDING SYSTEMS

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CHAPTER 31

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	4	Mar 15/06			

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CHAPTER 31 - INDICATING / RECORDING SYSTEMS

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Annunciator Panel		1	3H19
Description and Operation		1	3H19
Troubleshooting		1	3H19
Light Bulbs Replacement		1	3H19

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CENTRAL WARNING SYSTEM

Annunciator Panel

A. Description and Operation

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.

(1) Standard (See Figure 1.)

There are five (5) annunciator lights (ALT, OIL, VAC, LO BUS, and HTR OVERTEMP).

NOTE: With the battery master switch on, a press-to-test button adjacent to the annunciator lights will check the operation of the lights.

(a) The amber/yellow VAC warning light 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 ± .25 in. Hg.

(b) The amber/yellow 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 (15 psi) and decreasing.

(c) The amber/yellow 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 (0). 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.

(d) The red LO BUS light illuminates when bus voltage (14 volts) drops to battery voltage (approx. 12 volts).

(e) The red HTR OVERTEMP light activates when the overheat limit switch energizes, indicating an overtemperature condition in the heater vent jacket and rendering the heater inoperative.

(2) Optional (See Figure 1.)

In S/N's 4496174; and, 4496224 and up, equipped with the optional Avidyne Entegra EFIS, there are six (6) lights. The ALT, OIL, LO BUS and HTR OVERTEMP lights are explained in (b) through (e), above; in addition, there are the following lights:

(a) The amber PITOT HEAT OFF/INOP light illuminates when the pitot heat either fails or is set to OFF.

(b) The red STARTER ENGAGE light notifies that the engine starter is engaged.

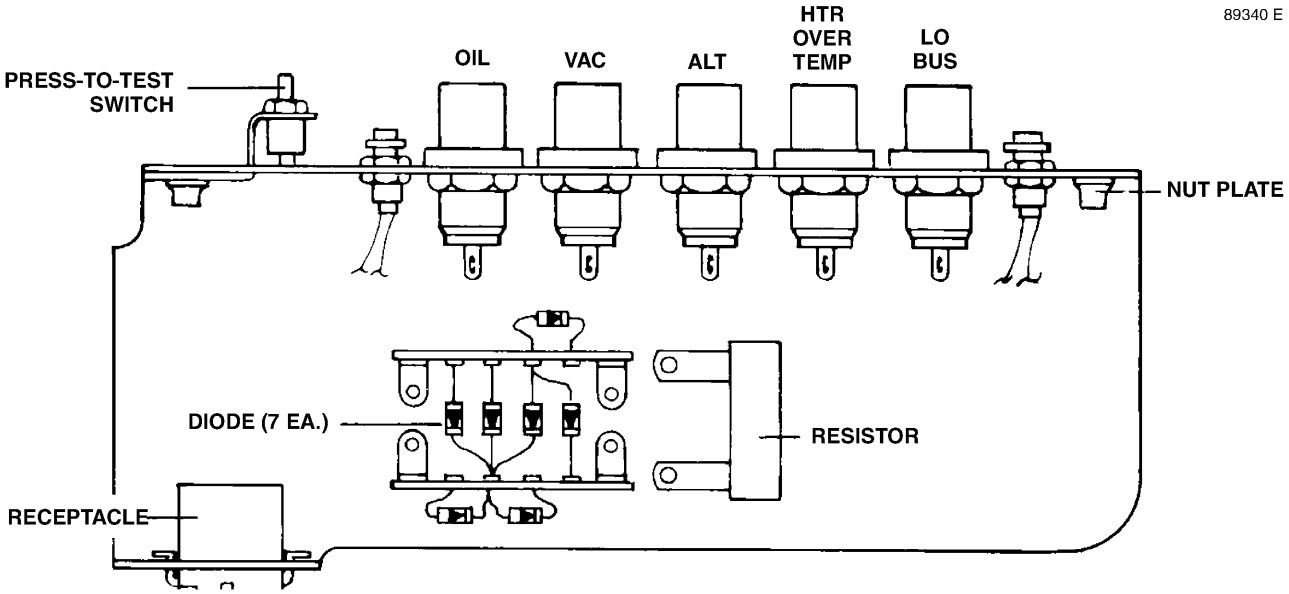
B. Troubleshooting

See Chart 1.

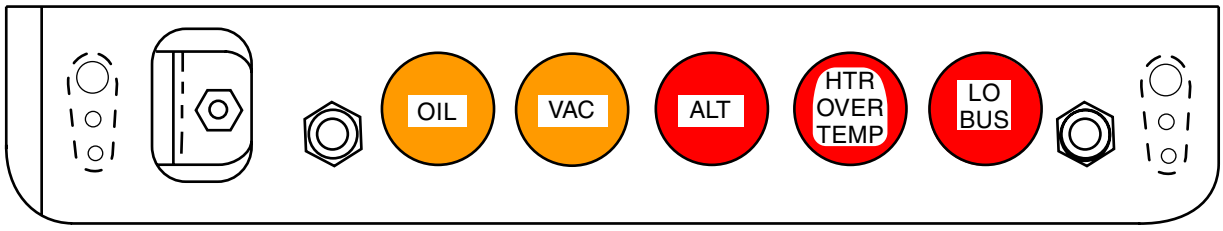
C. Light Bulb Replacement

See Annunciator Panel, 33-10-00.

89340 E

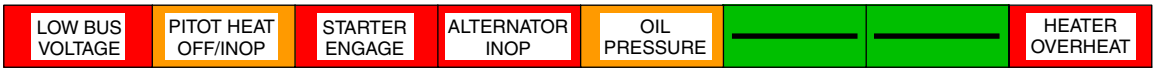


VIEW FROM BELOW



STANDARD

85372 L



OPTIONAL

(INSTALLED WITH AVIDYNE ENTEGRA EFIS IN S/N'S 4496174; AND, 4496224 AND UP.)

Annunciator Panel Installation
Figure 1

CHART 1
TROUBLESHOOTING ANNUNCIATOR

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 VAC 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 VAC warning light fails to operate.	Lamp burned out.	Replace.
	Sensor activates at too low a setting.	Replace.
	Defective sensor.	Replace.
ALT warning light fails to operate.	Lamp burned out.	Replace.
ALT warning light fails to extinguish.	Circuit breaker tripped.	Reset, if it trips a second time, check circuit breaker, replace if defective.
	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.
LO BUS warning light fails to illuminate.	Lamp burned out.	Replace lamp.
HTR OVERTEMP light fails to illuminate.	Lamp burned out.	Replace lamp.
HTR OVERTEMP light fails to extinguish.	Temperature in heater vent jacket to high.	Press reset button in nose, then activate FAN only for a minimum of two minutes.

GRIDS 3H22 THRU 3L24
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AIRPLANE MAINTENANCE MANUAL

CARD 4 OF 7

PA-44-180



(S/N's 4496001 & UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-892

March 15, 2006

Published by
Technical Publications

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2926 Piper Drive
Vero Beach, Florida 32960
U.S.A.



Member
General Aviation
Manufacturers Association

THE NEW PIPER AIRCRAFT, INC.
PA-44-180, SEMINOLE
MAINTENANCE MANUAL

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-882) originally published March 1, 1998 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG970401	April 1, 1997	1, 2, 3, and 4
PR020228	February 28, 2002	1, 3, and 4
PR021206	December 6, 2002	2
CR060315 *	March 15, 2006	1, 2, 3, 4, 5, 6 and 7

*** COMPLETE REVISION OF MAINTENANCE MANUAL 761-892**

Revisions appear in all seven Aerofiche Cards. Accordingly, discard your entire existing Aerofiche Card set and replace it with this one dated 03/15/06.

Consult the Piper Customer Service Information Aerofiche (P/N 1753-755) for current revision dates for this manual.

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INTRODUCTION

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INTRODUCTION

1. Instructions for Continued Airworthiness

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

The PIPER PA-44-180 Seminole Maintenance Manual constitutes the Instructions for Continued Airworthiness in accordance with Federal Aviation Regulations (FAR) Part 23, Appendix G. Chapter 4 contains the Airworthiness Limitations section (4-00-00) and the Inspection Program is in Chapter 5 (5-20-00).

2. General

This publication is prepared in accordance with the General Aviation Manufacturers Association (GAMA) Specification No. 2, with respect to the arrangement and content of the System/Chapters within the designated Chapter/Section-numbering system.

WARNING: USE ONLY GENUINE PIPER AIRCRAFT PARTS OR PIPER AIRCRAFT APPROVED PARTS OBTAINED FROM PIPER APPROVED SOURCES, IN CONNECTION WITH THE MAINTENANCE AND REPAIR OF PIPER AIRPLANES.

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-44-180 Parts Catalog P/N 761-891, and FAR 43 for proper utilization.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

THE NEW PIPER AIRCRAFT, INC. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: THE NEW PIPER AIRCRAFT, INC. expressly reserves the right to supersede, cancel and/or declare obsolete any part, part numbers, kits or publication that may be referenced in this manual without prior notice.

In any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence.

3. Effectivity

This maintenance manual is effective for PA-44-180 Seminole airplanes serial numbers 4496001 and up.

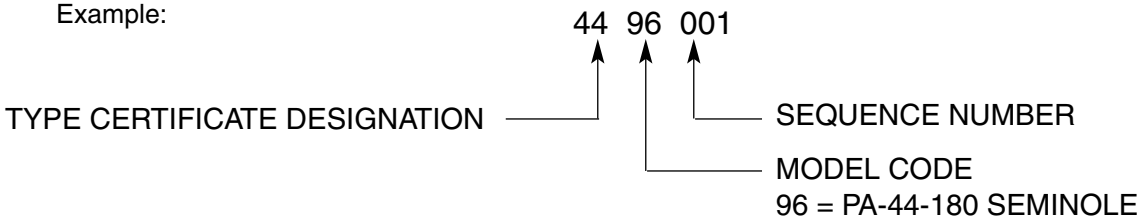
This encompasses the following model years:

NOTE: The following is provided as a general reference only.

Model Year	Serial Numbers
1995	4496001 thru 4496005
1996	4496006 thru 4496013
1997	4496014 thru 4496023; less 4496020
1999	4496024 thru 4496030; and 4496020
2000	4496031 thru 4496042
2001	4496043 thru 4496108
2002	4496109 thru 4496168
2003	4496169 thru 4496179
2004	4496180 thru 4496190
2005	4496191 thru 4496219
2006	4494220 and up

4. Serial Number Explanation

Example:



5. Assignment of Subject Material

This publication is divided into industry standard, three element, numeric subject groupings as follows:

A. System/Chapter - The various groups are broken down into major systems such as Environmental Systems, Electrical Power, Landing Gear, etc. They are assigned a number, which becomes the first element of the standardized numbering system. Thus, the element “28” of the number 28-40-01 refers to the chapter “Fuel”. Everything concerning the fuel system will be covered in this chapter.

B. Sub-System/Section - The major systems/chapters of an airplane are broken down into subsystems. These sub-systems are identified by the second element of the standard numbering system. The element “40” of the number 28-40-01 concerns itself with the indicating section of the fuel system.

C. Unit/Subject - The individual units within a sub-system/section may be identified by the third element of the standard numbering system. The element “01” of the number 28-40-01 is a subject designator. This element is assigned at the option of the manufacturer and is normally zeroed out by PIPER.

Refer to paragraph 14, Chapter/Section Index Guide, for a complete breakdown and list. The material is arranged in ascending numerical sequence.

6. Pagination

The Chapter - Section (i.e. - 28-40-00) numbering system (explained above) forms the primary page numbering system for this manual. Within each Section, pages are numbered consecutively beginning with Page 1 (i.e. - 28-40-00, Page 1). Additionally, the aerofiche grid numbering system (explained below) is also used to indicate location within the manual.

7. Aerofiche Effectivity

A. The General Aviation Manufacturers Association (GAMA) have developed specifications for microfiche reproduction of aircraft publications. 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. The “Aerofiche Effectivity” page at the front of this manual lists the current revision for each card in this set.

B. Conversion of Aerofiche alpha/numeric grid code numbers:

First number is the Aerofiche card number.
Letter is the horizontal row reference per card
Second number is the vertical column reference per card.

Example: 2J16 = Aerofiche card number two, row J, column 16.

C. To aid in locating information, the following is provided at the beginning of each aerofiche card:

(1) A complete Introduction containing the Chapter/Section Index Guide for all fiche in this set.

(2) A complete subject Index for all fiche in this set.

8. Identifying Revised Material

A revision to a page is defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a vertical line (i. e. - change bar) along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A change bar in the left-hand margin opposite the footer (i.e. - chapter/section/subject, page number and date), indicates that the text was unchanged but the material was relocated to a different page.

Example.

NOTE: Change bars are not used in the title pages, list of effective pages, or index. Likewise, all change bars are removed when a publication is completely revised (i.e. - reissued).

9. Indexing

An alphabetically arranged subject Index follows this introduction to assist the user in locating desired information. In addition, each System/Chapter begins with an individual Table of Contents.

10. List of Effective Pages

Each System/Chapter has a List of Effective Pages preceding the Table of Contents to identify the effective revision date for each page in that chapter.

11. Warnings, Cautions and Notes

These adjuncts to the text are used to highlight or emphasize important points when necessary. Warnings call attention to use of materials, processes, methods, procedures or limits which must be followed precisely to avoid injury or death to persons. Cautions call attention to methods and procedures which must be followed to avoid damage to equipment. Notes call attention to methods which make the job easier. Warnings and Cautions shall be located directly above and Notes directly beneath the text and be in line with the paragraphs to which they apply.

12. Accident/Incident Reporting

To improve our Service and Reliability system and aid in Piper's compliance with FAR 21.3, knowledge of all incidents and/or accidents must be reported to Piper immediately. To expedite and assist in reporting all incidents and accidents, Piper Form 420-01 has been created. See Service Letter 1041 for latest revision. This procedure is to be used by all Dealers, Service Centers and Repair Facilities.

13. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-44-180 airplane and its various components. Use them to supplement this manual.

A. Piper Publications:

	Piper P/N
(1) Parts Catalog:	761-892
(2) Periodic Inspection Report:	230-1963
(3) Progressive Inspection Manual (pending):	767-014

B. Vendor Publications:

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY.

(1) ALTERNATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

(2) AUTOFLIGHT:

Vendor Address: Honeywell (or) S-TEC Corporation
One Technology Center One S-TEC Way
23500 W. 105th St., M/D #45 Mineral Wells, Texas 76067
Olathe, Kansas 66061-1950 PH - (940) 325-9406
http://www.bendixking.com/ www.s-tec.com

(3) BATTERY:

Vendor Address: GILL Batteries PH: - (800) 456-0070
A Division of Teledyne Continental Motors
http://www.gillbatteries.com

(4) BRAKES AND WHEELS:

Vendor Address: Parker Hannifin Corp PH: - (800) 272-5464
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
http://www.parker.com/cleveland/Universe/book.pdf

(5) ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS):

Vendor Address: Avidyne Corporation PH - (800) 284-3963
55 Old Bedford Road
Lincoln, MA 01773
http://www.avidyne.com/index.htm

Instructions for Continued Airworthiness

Primary Flight Display and Magnetometer/OAT:	Document No. AVPFD-174
Multifuntion Display:	Document No. AVMFD-167
Data Acquisition Unit:	Document No. AVSIU-011

(6) EMERGENCY LOCATOR TRANSMITTER:

Vendor Address: Artex Airccraft Supplies PH: - (800) 547-8901
14405 Keil Road NE
Aurora, Oregon 97002
http://www.artex.net/

(7) ENGINE:

Vendor Address: Textron Lycoming PH - (717) 323-6181
652 Oliver Street FAX - (717) 327-7101
Williamsport, PA 17701
http://www.lycoming.textron.com/main.html

Overhaul Manual:	DIRECT DRIVE MODELS	- P/N 60294-7
Parts Catalog:	O, LO-360 A1H6 ENGINES	- P/N PC306-5
Operators Handbook:	O, HO, IO, AIO, HIO, TIO-360 SERIES	- P/N 60297-12

NOTE: The above Lycoming publications can be ordered as a set on CD-ROM from Avantext. See www.avantext.com or PH - (800) 998-8857.

(8) FIRE EXTINGUISHER (PORTABLE):

Vendor Address: H3R Inc. PH: - (800) 249-4289
43 Magnolia Ave # 4
San Francisco, California 94123-2911
http://www.h3r.com/index.htm

(9) FUEL CELLS:

Vendor Address: Engineered Fabrics Corporation PH - 770-684-7855
669 Goodyear Street FAX - 770-684-7438
Rockmart, Georgia 30153-0548
http://www.kfefc.com/index.htm

(10) HEATER

Vendor Address:	Kelly Aerospace Power Systems Airport Complex, PO Box 273 Fort Deposit, AL 36032 http://www.kellyaerospace.com/ts_heaters.html	PH: - (888) 461-6077 FAX - (334) 227-8596
Maintenance and Overhaul Manual:	Janitrol Maintenance and Overhaul Manual - 24E25-1	

(11) LIGHTS - NAVIGATION, STROBE, AND MAP LIGHTS:

Vendor Address:	Whelen Engineering Co. Inc. Route 145, Winthrop Rd. Chester, Conneticut 06412 http://www.whelen.com/	PH: - (860) 526-9504 FAX - (860) 526-2009

(12) MAGNETOS:

Vendor Address:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104 http://www.unisonindustries.com/index4.html	PH - (815) 965-4700 FAX - (815) 965-2457
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363	

(13) NAVIGATION, COMMUNICATIONS, AND GPS (NAV/COM/GPS):

Vendor Address:	Garmin International 1200 East 151ST Street Olathe, KS 66062 http://www.garmin.com	PH: (913) 397-8200

(14) PROPELLER:

Vendor Address:	Sensenich Corporation 14 Citation Lane Lititz, PA 17543 http://www.sensenich.com/	PH - (717) 569-0435 FAX - (717) 560-3725
Repair Manual:	METAL PROPELLER REPAIR MANUAL - SPRM 590	

(15) STARTER:

Vendor Address:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252
or	Electro Systems, Inc. (see “Voltage Regulator,” below)	

(16) VACUUM PUMP:

Vendor Address: Aero Accessories, Inc. PH - (800) 822-3200
1240 Springwood Avenue
Gibsonville, NC 27249
http://www.aeroaccessories.com/index.html

(17) VACUUM REGULATOR:

Vendor Address: Parker Hannifin Corp. PH: - (800) 382-8422
Airborne Division
711 Taylor Street
Elyria, Ohio 44035
http://www.parker.com/cleveland/Universe/book.pdf

(18) VOLTAGE REGULATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

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14. Chapter/Section Index Guide

NOTE: The following GAMA Specification No. 2 standard chapters are not included in this Maintenance Manual: 23, 35, 36, 38, 49, 54, 60, 72, 75, 81, and 83. These chapters are omitted because the subject system is either: not installed in these airplanes; adequately covered in vendor or other manuals; or, for ease of use, has been combined with another chapter.

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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. Adjustment and testing of the landing gear retracting system is also covered, as well as removal and installation of the landing gear actuators and the free-fall valve. See 29-10-00 for the hydraulic pump.

1. 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 above or below the selector lever for gear down and locked, and a red light located at the top of the instrument panel (pilot's side) 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 free fall 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 nose gear extension under these conditions, two springs, one inside the other, are 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.

2. Troubleshooting

Mechanical and electrical switch troubles peculiar to the landing gear system are listed in Chart 1. 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. See 32-30-00, Chart 1, to troubleshoot the extension and retraction system.

CHART 1 (Sheet 1 of 5)
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.		
Red gear unsafe light operates on and off after Far 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.

CHART 1 (Sheet 2 of 5)
TROUBLESHOOTING LANDING GEAR

Trouble	Cause	Remedy
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: Ascertain navigation lights are off (daytime).		
Red gear unsafe light and an green lights out.	Indicator lights circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Light circuit wire broken.	Check wiring.
NOTE: Ascertain navigation lights are off (daytime).		
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.
	Diode in circuit between throttle switch “A” and light/ horn open.	Replace diode.
NOTE: When replacing diode connect banded end (cathode) to terminal ends of wires G2Q and G2K on mounting block.		
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.

CHART 1 (Sheet 3 of 5)
TROUBLESHOOTING LANDING GEAR

Trouble	Cause	Remedy
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” or manifold pressure transducer failed.	Replace switch or transducer.
Hydraulic pump shuts off, but red gear unsafe light remains on.	Gear not fully retracted.	Determine cause and 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.	Replace shimmy dampener.
	Shimmy dampener or bracket loose at mounting.	Replace necessary parts and bolts.
	Tire out of balance. tire if necessary.	Check balance and replace
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/ or bushings.	Replace bolts and/or bushings.

CHART 1 (Sheet 4 of 5)
TROUBLESHOOTING LANDING GEAR

Trouble	Cause	Remedy
Excessive or uneven wear on nose tire.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wear resulting from shimmy.	Refer to proceedings for correction.
Nose gear fails to steer properly.	Oleo cylinder binding in strut housing.	Lubricate strut housing (refer to Lubrication Chart).
		Cylinder and/or strut housing bushings damaged.
	One brake dragging.	Determine cause and correct.
	Steering arm roller sheared at top of strut.	Replace defective roller.
	Steering bellcrank loose on attachment plate.	Readjust and tighten.
	Steering bellcrank bearing and/or bolt worn.	Replace bearing and/or bolt.
	Shimmy dampener galling or binding.	Replace.
Nose gear fails to straighten when landing gear extends.	Steering arm roller sheared at top of strut.	Replace defective roller.
	Incorrect rigging of nose gear steering.	Check nose gear steering adjustment.
Nose gear fails to straighten when landing gear retracts.	Centering guide roller sheared.	Replace roller.
	Damaged guide.	Replace guide.
Main landing gear shimmies during fast taxi, takeoff or landing.	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/or bushings.	Replace bolts and/or bushings.

CHART 1 (Sheet 5 of 5)
TROUBLESHOOTING LANDING GEAR

Trouble	Cause	Remedy
Excessive or uneven wear on main tires.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wheel out of alignment (toe in or out).	Check wheel adjustment.
	Lower side brace link out of adjustment, allowing gear to slant in or out.	Check gear adjustment.
Strut bottoms on normal landing or taxiing on rough ground.	Insufficient air and/or fluid in strut.	Service strut with air and/or fluid.
	Defective internal parts in strut.	Replace defective parts.
Landing gear doors fail to completely close.	Landing gear not retracting completely.	Check adjustment of Landing gear.
	Door retraction mechanism out of adjustment.	Check adjustment.

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MAIN GEAR AND DOORS

1. Main Gear Oleo

A. Disassembly (See Figure 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. (See 7-10-00.)

(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 reading 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.

B. Assembly (See Figure 1.)

(1) Determine that all parts are cleaned and inspected per Inspection, below.

(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 mined 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.

(10) Only the left strut assembly only, 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. (See Lubrication Charts, 12-20-00.)

(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. (See 12-20-00.)

(16) Check main gear alignment and gear operation. Ascertain that gear is down and locked.

(17) Remove the airplane from jacks.

C. Inspection

(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.

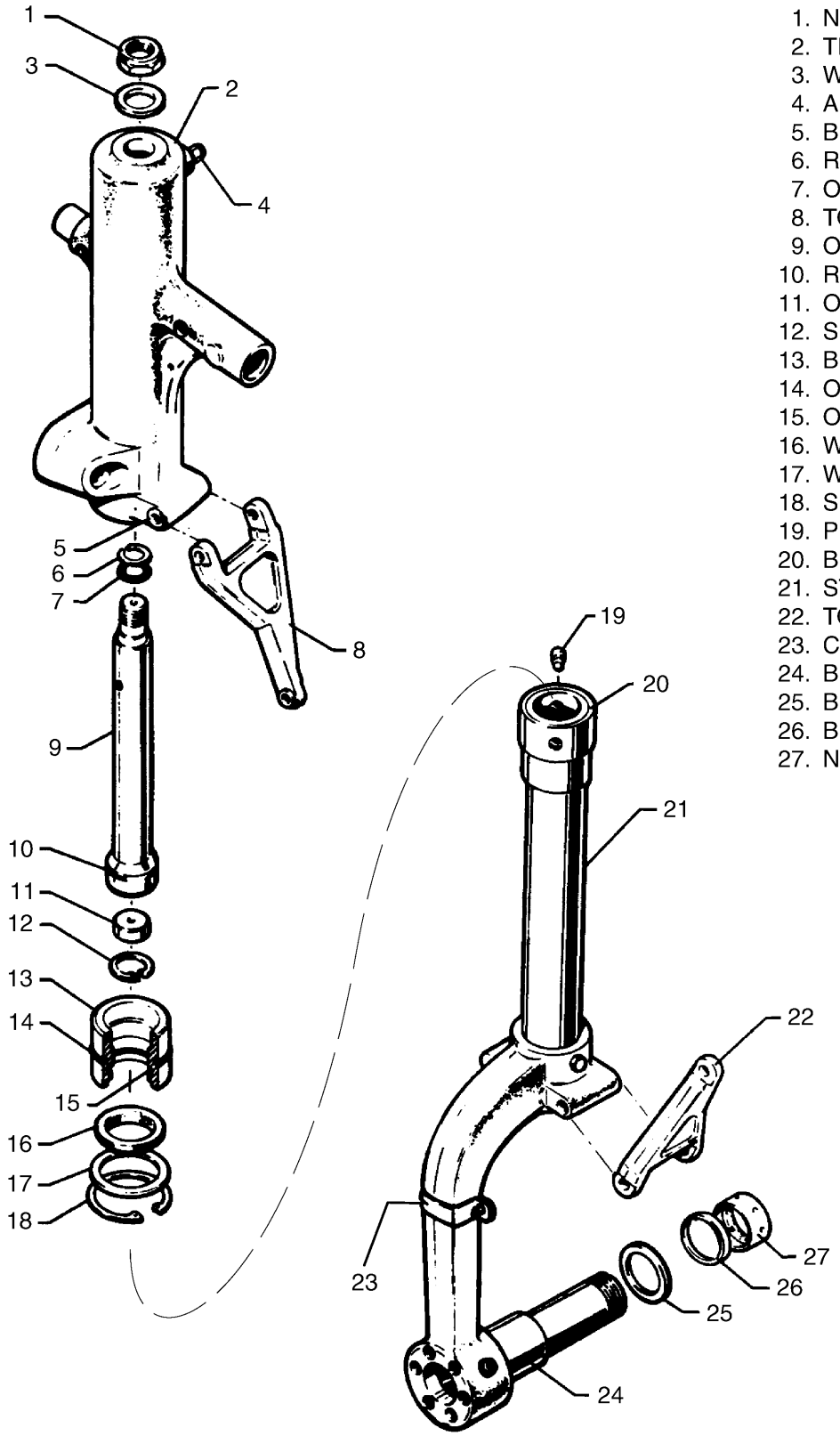
(e) Orifice plate for hole restriction.

(f) Fork tube for corrosion, scratches, nicks, dents and misalignment.

(g) Air valve general condition.

D. Repair

Repair of the oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.



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

Main Gear Oleo Strut Assembly
Figure 1

2. Main Landing Gear

A. Removal (See Figure 3.)

(1) Place the airplane on jacks. (See 7-10-00.)

(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 fining. Remove the tube from the wing.

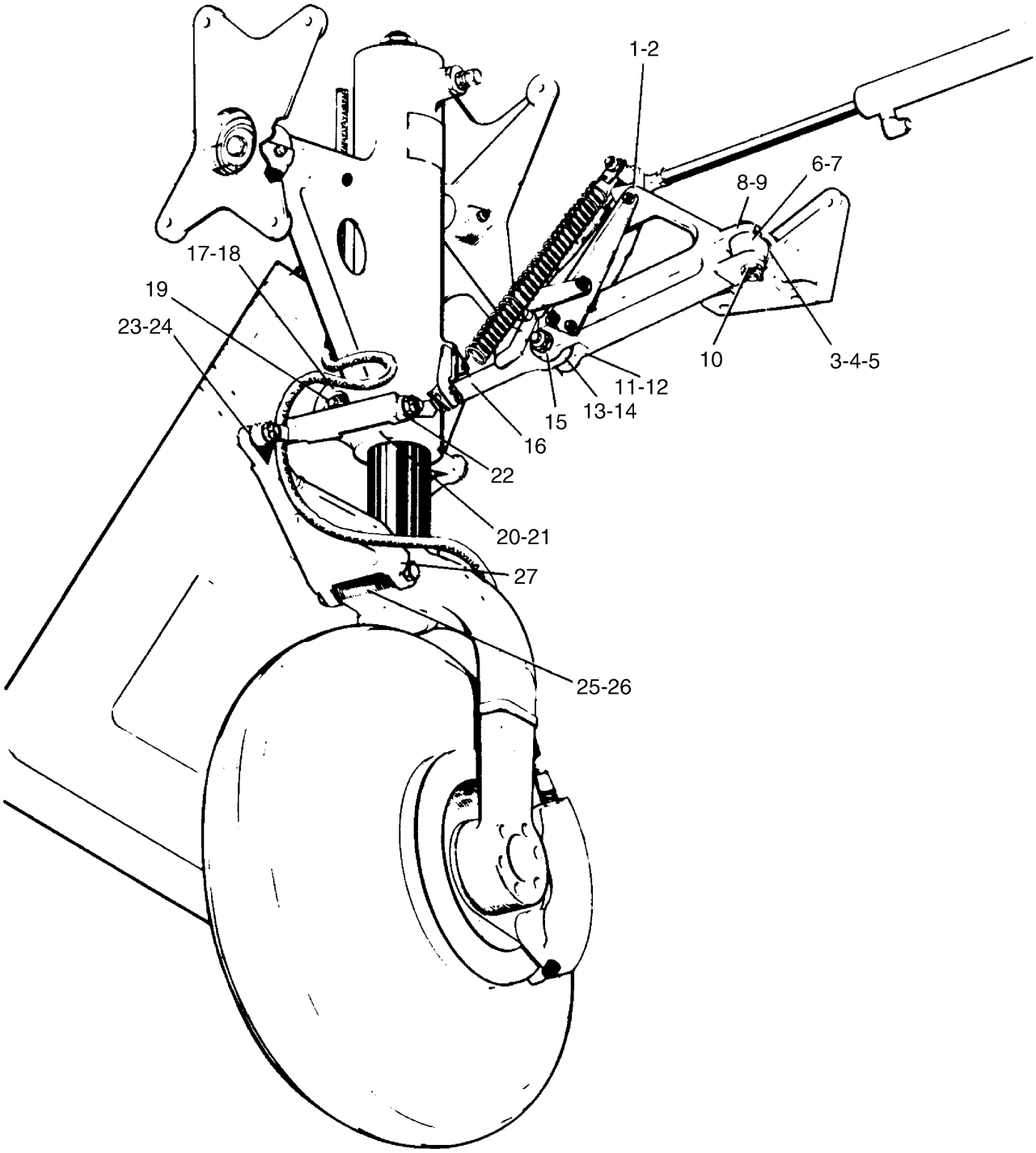
(g) Allow the gear to drop free from the wing.

(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.

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Main Gear Service Tolerances
Figure 2 (Sheet 1 of 3)

ITEM NO.	PART NO.	NOMENCLATURE	MANUFACTURERS DIMENSION	SERVICE DIMENSION	SERVICE TOL.	REMARKS
1	67514-002	Link upperside brace	ID .3645 .3625			
2	63900-089	Bushing, upperside brace link	**ID .249 .251	ID .248 .252	.004	Press fit.
3	95642-006 95642-007	Bracket, side brace support	ID .7495 .7505	ID .7490 .7510	.002	Shrink ft.
4	67026-012	Bushing, support bracket	ID .624 .625	ID .624 .626		Shrink fit.
5	78717-002	Stud, side brace support	OD .6235 .6225	OD .6220		
6	78717-002	Stud, side brace support	ID .4365 .4385	ID .4355 .4395	.004	
7	65003-041	Bushing, side brace support stud	ID .375 .376		.004	
8	67514-002	Link, upperside brace	ID .4945 .4935	ID .4925		
9	14843-016 (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	67514-002	Link, upperside brace	ID .4945 .4935	ID .4925		
12	14843-016 (2)	Bushing, side brace link	**ID .3745 .3755	ID .374		Install using Loctite 601.
13	78720-005 78720-006	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		
16	78722-002	Bearing Assembly, Rod End	ID .562 .564			
17	67926-026 67926-027	Trunnion housing, side brace attachment	ID .7530 .7550	ID .7530 .7550		4496001 - 4496161.
	67926-036 67926-037	Trunnion housing, side brace attachment	ID .7530 .7550	ID .7530 .7550		4496162 and up.
	67926-042 67926-043	Trunnion housing, side brace attachment	ID .7530 .7550	ID .7530 .7550		Service for 4496001 and up.

** Line ream to this dimension after installation of new part.

Main Gear Service Tolerances
Figure 2 (Sheet 2 of 3)

ITEM NO.	PART NO.	NOMENCLATURE	MANUFACTURERS DIMENSION	SERVICE DIMENSION	SERVICE TOL.	REMARKS
18 ***	67026-010	Bushing, trunnion	ID .5645 .5625	ID .5605 .5585	.004	4496001 - 4496161.
	67026-018	Bushing, trunnion	ID .5645 .5625	ID .5605 .5585	.004	4496162 and up; and service for 4496001 and up.
		*** Install using Loctite 601.				
19	402-974 (NAS 464 P9A-46)	Bolt, trunnion/side brace attaching	OD .5616 +.0000 -.0009			
20	67926-026 67926-027	Trunnion housing, torquelink attachment	ID .4410 .4430	ID .4410 .4440		4496001 - 4496161.
	67926-036 67926-037	Trunnion housing, torquelink attachment	ID .4410 .4430	ID .4410 .4440		4496162 and up.
	67926-042 67926-043	Trunnion housing, torquelink attachment	ID .4410 .4430	ID .4410 .4440		Service for 4496001 and up.
21	67026-007 (2)	Bearing, trunnion	**ID .314 .313	ID .315		Press fit. Install using Loctite 601.
22	67012-000	Torquelink	ID .312 + .001 - .000	ID .312 + .002 - .000	.002	Line ream.
23	67012-000	Torquelink	ID .3760 .3745	ID .3770 .3745	.0025	
24	31796-000 (2)	Bushing, Torquelink	**ID .252 .251	ID .253 .251	.002	Press fit.
25	67037-004	Strut Assembly	ID .4385 .4370	ID .4395 .4370	.0025	
26	67026-007 (2)	Bearing, strut	**ID .314 .313	ID .315 .313	.002	Press fit.
27	67012-000	Torquelink	ID .312 + .001 - .000	ID .312 + .002 - .000	.002	Line ream.

** Line ream to this dimension after installation of new part.

Main Gear Service Tolerances
Figure 2 (Sheet 3 of 3)

B. Installation (See Figure 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 62833-044).

(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 12-20-00.

(5) Check adjustment of landing gear per Adjustment, below.

(6) Check alignment of the wheel per Adjustment, below.

(7) Install the access plate on the underside of the wing and remove the airplane from jacks.

C. Adjustment

(1) Place the airplane on jacks. (See 7-10-00.)

(2) Level the airplane laterally and longitudinally. (See 8-20-00.)

(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, see 32-60-00.

(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, only steps (b) and (f) thru (h) need 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.

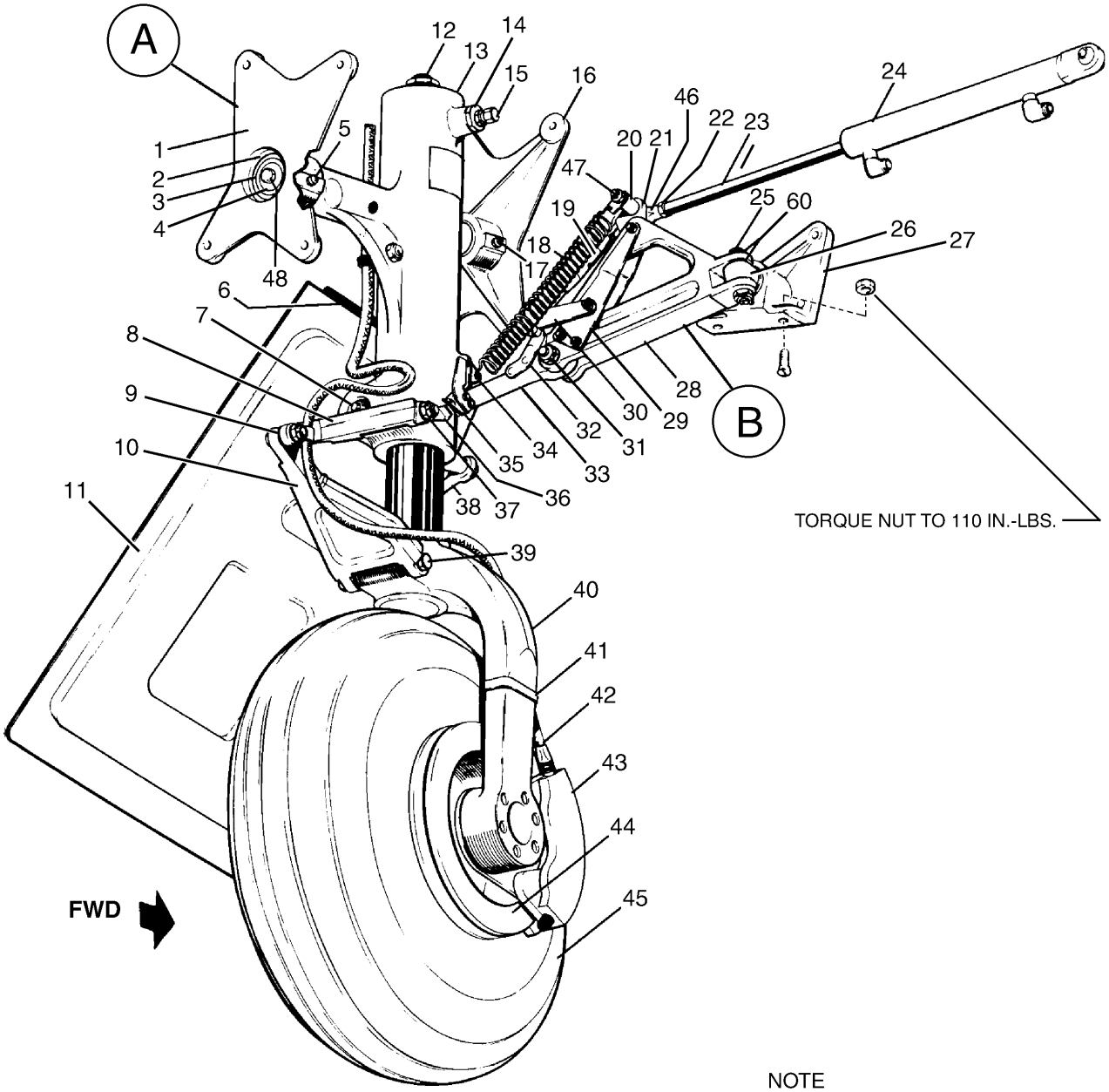
NOTE: When adjusting rod end be sure to allow at least a 0.03 inch cushion prior to bottoming with the downlock in the up position.

(f) When the gear is to within 0.125 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.

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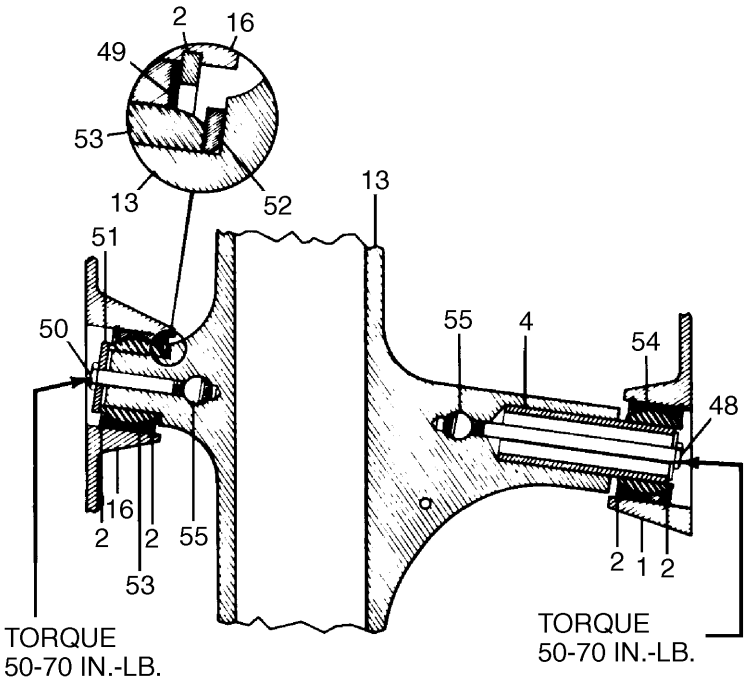
NOTE

Special landing gear attachment hardware may have been used during assembly of the aircraft due to manufacturing tolerances. Therefore, special attention should be given when removing hardware to inspect and insure the same diameter hardware is used upon reassembly. Standard AN4 or AN5 bolts are replaced by alternate oversized bolts NAS 3004 or NAS 3005, also NAS3005, and standard flush head bolts MS24694-S105 are replaced by alternate oversize bolts NAS1604-9R respectively when oversized hardware is required.

Main Gear Installation
Figure 3 (Sheet 1 of 2)

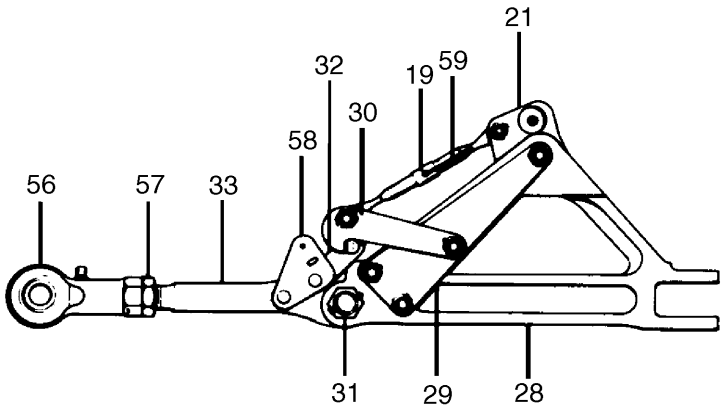
1. SUPPORT FITTING, AFT
2. SNAP RING
3. BEARING
4. RETAINER, TUBE ASSEMBLY
5. FITTING, GREASE
6. HINGE, GEAR DOOR
7. BOLT, WASHERS AND NUT
8. TORQUE LINK, UPPER
9. WASHER, SPACER
10. TORQUE LINK, LOWER
11. DOOR, GEAR
12. NUT
13. HOUSING, STRUT
14. PLUG, HYDRAULIC FLUID
15. VALVE ASSEMBLY
16. SUPPORT FITTING, FORWARD
17. FITTING, GREASE
18. SPRING, DOWNLOCK
19. TURNBUCKLE
20. SWIVEL ASSEMBLY
21. RETRACTION FITTING
22. JAM NUT
23. ROD, PISTON
24. CYLINDER, HYDRAULIC ACTUATING
25. BOLT, WASHERS, NUT AND COTTER PIN
26. STUD, SIDE BRACE SUPPORT
27. SUPPORT BRACKET
28. LINK, UPPER SIDE BRACE
29. PLATE
30. HOOK, DOWNLOCK
31. BOLT, WASHERS, NUT AND COTTER PIN
32. PIN, DOWNLOCK
33. LINK, LOWER SIDE BRACE
34. BRACKET, SPRING
35. SWITCH, SAFETY
36. ACTUATOR, SAFETY SWITCH
37. BOLT, WASHERS, NUT AND COTTER PIN
38. ROD, GEAR DOOR
39. BOLT, WASHERS, NUT AND COTTER PIN
40. FORK GEAR
41. CLAMP
42. HOSE, BRAKE
43. BRAKE HOUSING
44. BRAKE DISC
45. TIRE
46. ROD END BEARING
47. BOLT, WASHER, NUT AND BUSHING
48. BOLT
49. SHIM WASHER
50. BOLT
51. WASHER
52. WASHER
53. BEARING, FORWARD SUPPORT
54. BEARING, AFT SUPPORT
55. SNAP RING
56. ROD END BEARING
57. JAM NUT
58. BRACKET, SWITCH
59. CLIP, SAFETY
60. BUSHING, TAPERED

1763



DETAIL A

1734



DETAIL B

Main Gear Installation
Figure 3 (Sheet 2 of 2)

D. Alignment (See Figure 4.)

(1) Place a straightedge no less than 12 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. See Chart 1.

(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.

CHART 1
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 0.031 Thick

AN960-416 Washers 0.062 Thick

(7) If a new top torque link had to be installed on either side or it had to be reversed during the alignment check, it will be necessary to check the squat switch bracket on that side 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. (See Sketch A, Figure 4.) This hole should be aligned with centerline of the link and a 0.096 inch hole drilled 0.150 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. (See Sketch B, Figure 4.)

(8) Check adjustment of the squat switch. (See 32-60-00.)

E. Inspection

(1) Clean all parts with a suitable type cleaning solvent.

(2) Inspect the gear components for the following unfavorable and conditions.

(a) Bolts, bearing and bushings for excess wear, corrosion and damage.

(b) Gear housing, 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 in. Measurement is taken from the inner side of each hook.

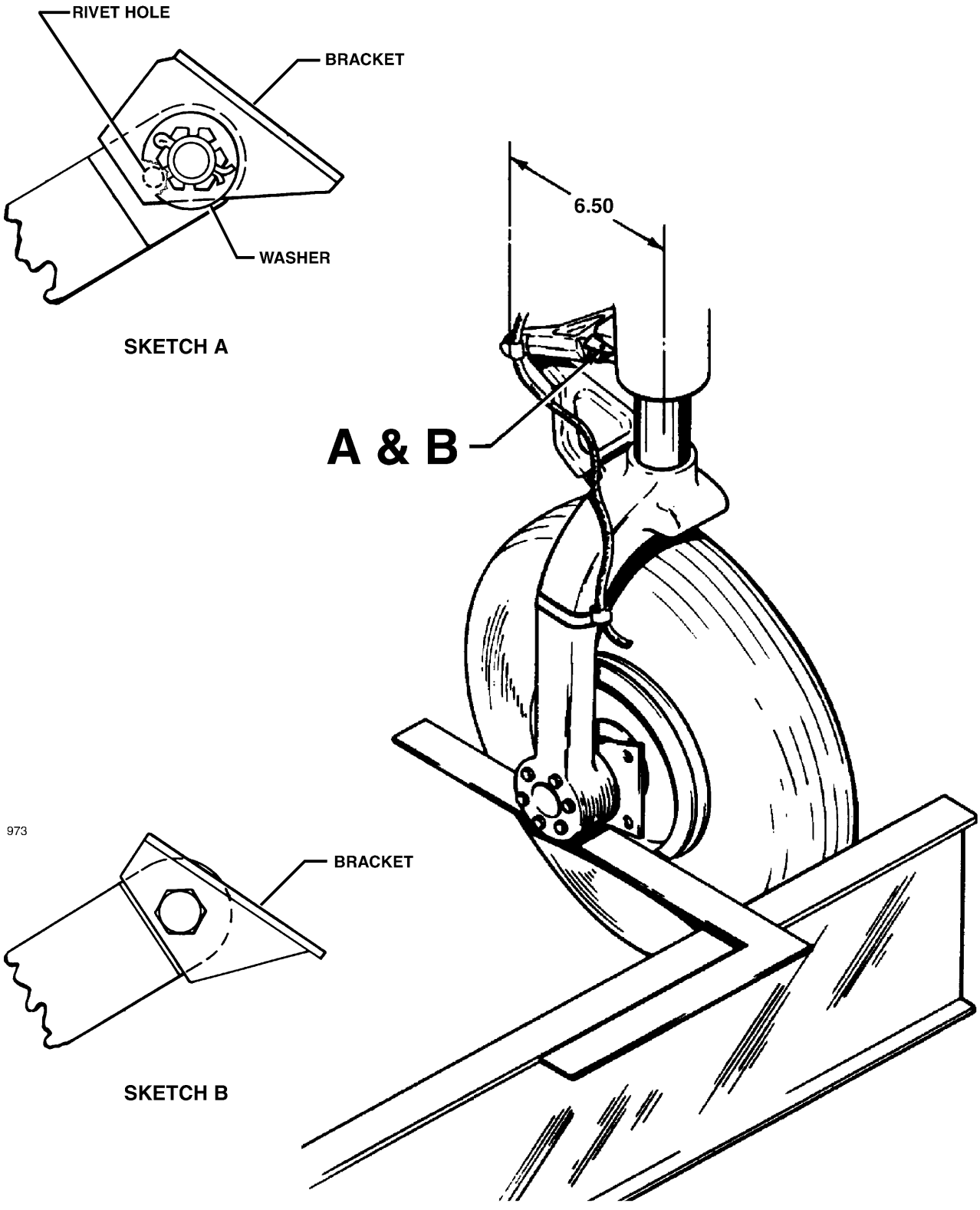
(4) Check the general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

(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.

F. Repair

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.



Aligning Main Gear
Figure 4

3. Main Gear Door

A. Removal

(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.

B. Installation

(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 0.12 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 0.20 of an inch.

C. Inspection

(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.

D. Repair

Repairs to a door may be replacement of hinge, repair of fiberglass and painting.

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NOSE GEAR AND DOOR

1. Nose Gear Oleo

A. Disassembly (See Figure 1.)

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. (See 7-10-00.)

(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.

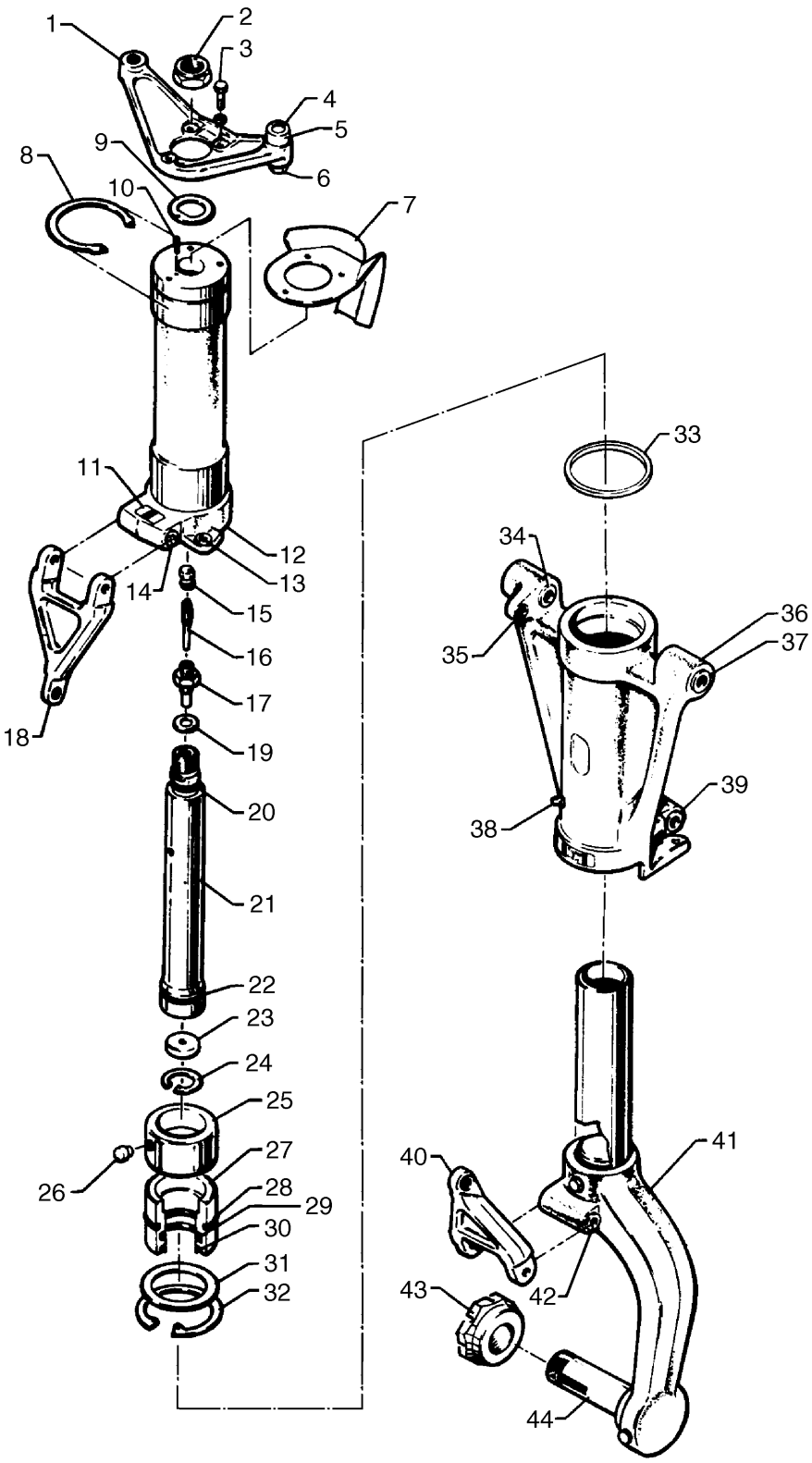
(9) Pull the piston tube with components parts from the cylinder.

(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 parts 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.



1. ARM ASSEMBLY - STEERING
2. NUT
3. BOLT
4. BOLT
5. BUSHING
6. NUT
7. BRACKET - ALIGNER
8. SNAP RING
9. WASHER
10. ROLL PIN
11. PLACARD - TURN LIMIT
12. STRUT TUBE ASSEMBLY
13. BUSHING
14. BUSHING
15. CAP - AIR VALVE
16. CORE - AIR VALVE
17. BODY - AIR VALVE
18. TORQUE LINK - UPPER
19. GASKET - AIR VALVE
20. O-RING
21. ORIFICE TUBE
22. RING - COMPRESSION
23. ORIFICE PLATE
24. SNAP RING
25. BEARING
26. PIN
27. BEARING
28. O-RING
30. WIPER STRIP
31. WASHER
32. SNAP RING
33. SPACER
34. BEARING
35. BUSHING
36. TRUNNION ASSEMBLY
37. BEARING
38. GREASE FITTING
39. BEARING
40. TORQUE LINK - LOWER
41. STRUT ASSEMBLY - LOWER
42. BUSHING
43. AXLE NUT
44. AXLE

Nose Gear Oleo Strut
Figure 1

B. Assembly (See Figure 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.) in. lbs.

(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 in. lbs. torque and safety with MS33540 wire.

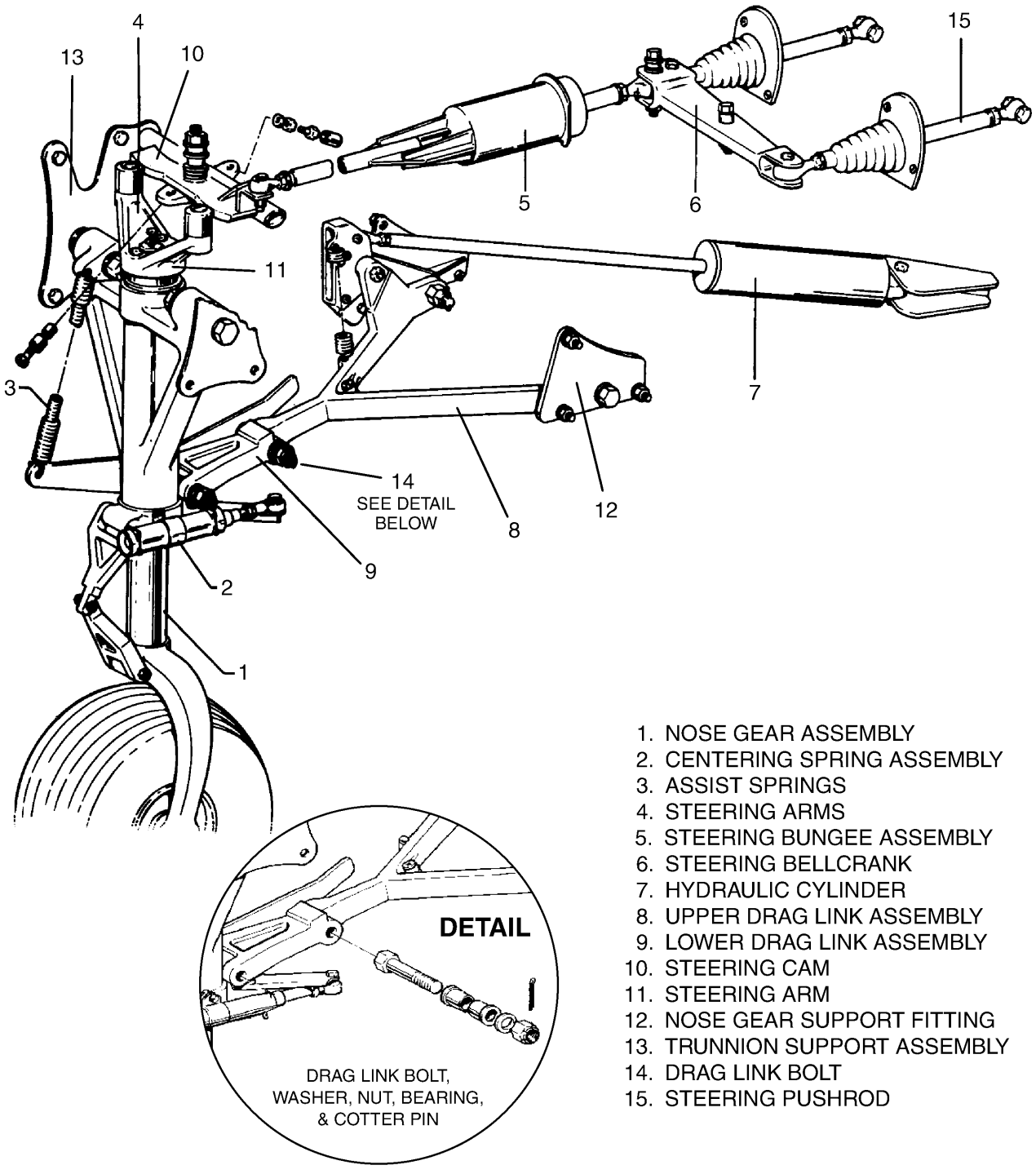
(12) Install the shimmy dampener and safety.

(13) Lubricate the gear assembly. (See Lubrication Charts, 12-20-00.)

(14) Compress and extend the strut several times to ascertain that the strut will operate freely. Weight of the gear wheel and fork should allow the strut to extend.

(15) Service the oleo strut with fluid and air. (See 12-10-00.)

(16) Check nose gear for alignment and gear operation.



1. NOSE GEAR ASSEMBLY
2. CENTERING SPRING ASSEMBLY
3. ASSIST SPRINGS
4. STEERING ARMS
5. STEERING BUNGEE ASSEMBLY
6. STEERING BELLCRANK
7. HYDRAULIC CYLINDER
8. UPPER DRAG LINK ASSEMBLY
9. LOWER DRAG LINK ASSEMBLY
10. STEERING CAM
11. STEERING ARM
12. NOSE GEAR SUPPORT FITTING
13. TRUNNION SUPPORT ASSEMBLY
14. DRAG LINK BOLT
15. STEERING PUSHROD

Nose Gear Installation
Figure 2

C. Inspection

(1) Clean all parts with a suitable dry type cleaning solvent.

(2) Inspect the landing gear oleo assembly components for the following:

(a) Bearings and bushings for excess wear, corrosion, scratches and overall damage.

(b) Retaining pins for wear and damage.

(c) Lock rings for cracks, burrs, etc.

(d) Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.

(e) 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.

D. Repair

Repair of the oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.

2. Nose Landing Gear Assembly

A. Removal (See Figure 2.)

CAUTION: WHENEVER THE AIRCRAFT IS PLACED ON JACKS FOR THE PURPOSE OF MANUALLY RETRACTING THE NOSE GEAR ASSEMBLY, INSURE THAT THE NOSE GEAR DOWNLOCK IS FULLY DISENGAGED BEFORE RELEASING THE NOSE GEAR DRAG LINKS. DAMAGE COULD OCCUR TO THE DOWN LOCK IF NOT FULLY DISENGAGED.

(1) Place the airplane on jacks. (See 7-10-00.)

(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, above.)

(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.

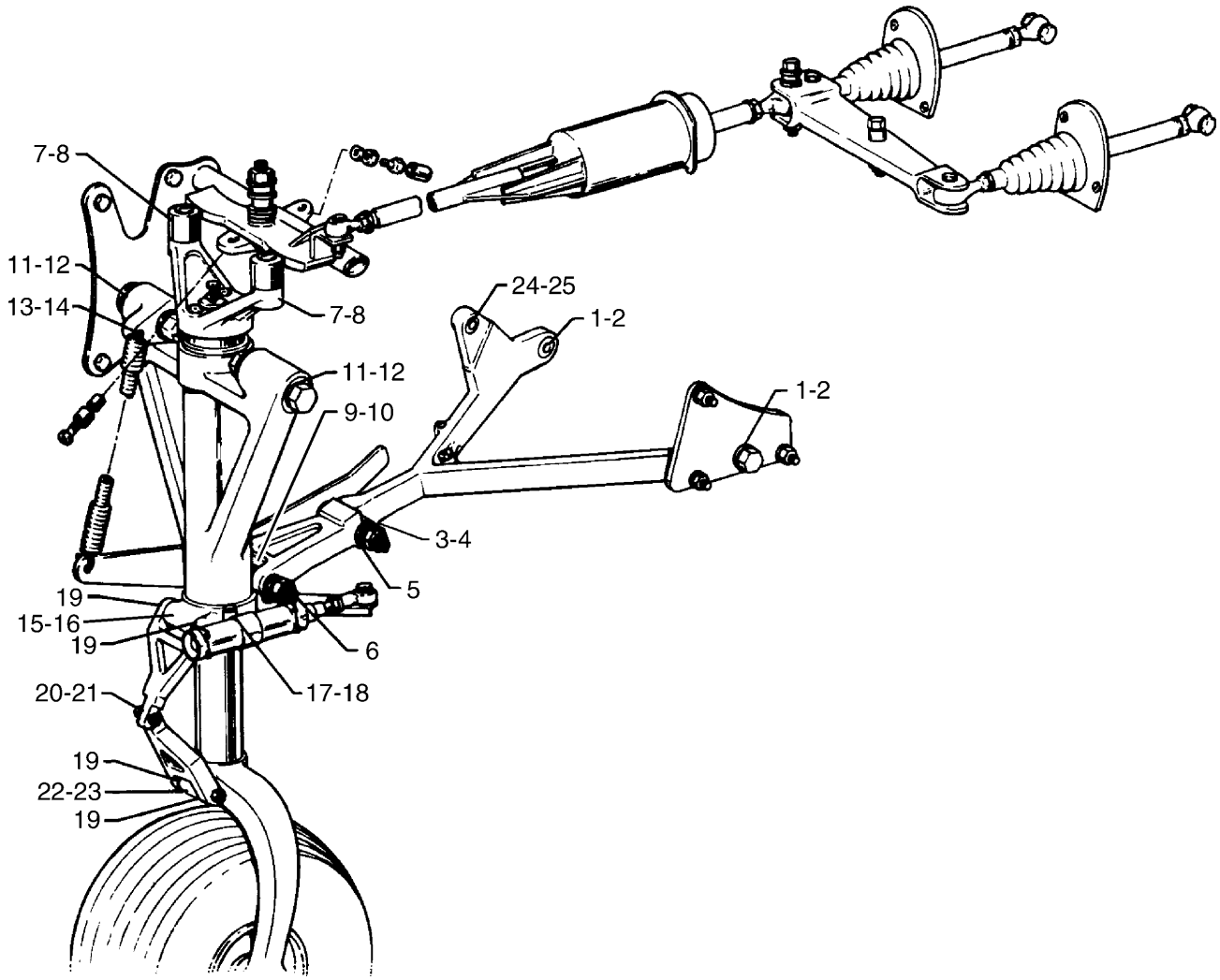
(c) Remove the gear tension spring arm from the right side of the oleo housing and lower drag link by removing the cotter pin, nut and washer from the bolt that connects the drag link to the housing. Slide the arm and spacer washer from the bolt.

CAUTION: THE NUMBER OF WASHERS, IF ANY, BETWEEN THE UPPER DRAG LINK AND THE NOSE GEAR SUPPORTS IS DETERMINED AT THE FACTORY TO ENSURE CORRECT CENTERING OF THE NOSE GEAR. WHEN REMOVING THE UPPER DRAG LINK, BE SURE TO CAREFULLY TAKE NOTE OF THE POSITION, NUMBER, AND TYPE OF THESE WASHERS, IF ANY, TO FACILITATE THEIR CORRECT REINSTALLATION.

(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.

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Nose Gear Service Tolerances
Figure 3 (Sheet 1 of 3)

ITEM NO.	PART NO.	NOMENCLATURE	MANUFACTURERS DIMENSION	SERVICE DIMENSION	SERVICE TOL.	REMARKS
1	67146-004	Draglink, upper	ID 0.6235 0.6245	ID 0.6230 0.6250	0.002	
2	87319-003 (F632-1)	Bearing, upper drag link	**ID 0.4385 0.4375	ID 0.4395 0.4375	0.002	
2	65003-045*	Bushing				
3	67146-004	Drag link upper	ID 0.378 0.379	ID 0.3775 0.3795	0.002	
4	87319-002 (FF310-5)	Bearing, upper drag link	**ID 0.2495 0.2505	ID 0.2495 0.2515	0.002	
5	67144-002	Drag link lower	ID 0.2495 0.2505	ID 0.2495 0.2515	0.002	
6	67144-002	Drag link lower	ID 0.3120 0.3130	ID 0.3120 0.3140	0.002	
7	44386-003	Steering arm	ID 0.4370 0.4385	ID .4370 .4385	0.0015	
8	14976-011	Bushing, steering arm	**ID 0.312 0.313	ID 0.312 0.314	0.002	Press fit.
9	67054-003	Trunnion housing, drag link attachment	ID 0.4415 0.4425	ID 0.4415 0.4425	0.0015	
10	67026-007	Bushing, trunnion housing drag link attachment	ID 0.312 0.313	ID 0.312 0.314	0.002	Press fit. Install using Loctite 601.
11	67054-003	Trunnion assembly, main attachment fitting	ID 0.6285 0.6295	ID 0.6285 0.6295	0.001	
12	67026-011	Bushing, trunnion assembly attachment	ID 0.4385 0.4375	ID 0.4415 0.4405	0.003	Install using Loctite 601.
13	67054-003	Trunnion assembly, assist spring fitting	ID 0.302 0.303	ID 0.302 0.3035	0.0015	
14	95061-144	Bearing, assist spring fitting	ID 0.249 0.250	ID 0.249 0.259	0.010	Install using Loctite 601.
15	67148-000	Tube assembly, torque link fitting	ID 0.4370 0.4385	ID 0.4370 0.4385	0.0015	

* Used with 87319-03 bearing.
** Line ream to this dimension after installation of new part.

Nose Gear Service Tolerances
Figure 3 (Sheet 2 of 3)

ITEM NO.	PART NO.	NOMENCLATURE	MANUFACTURERS DIMENSION	SERVICE DIMENSION	SERVICE TOL.	REMARKS
16	67026-007	Bushing, tube assembly, torquelink fitting	**ID 0.314 0.313	ID 0.3155 0.3130	0.0025	Press fit. Install using Loctite 601.
17	67148-000	Shimmy damper fitting	ID 0.3745 0.3760	ID 0.3745 0.3760	0.0017	
18	21831-004	Bearing, Shimmy damper fitting	**ID 0.249 0.251	ID 0.249 0.252	0.003	
19	20735-005	Torquelink	ID .312 0.313	ID 0.312 0.314	0.002	
20	20735-005	Torquelink	ID 0.377 0.3785	ID 0.377 0.3790	0.002	
21	452-366 (#F-310-5)	Bearing, torquelink	**ID 0.2495 0.2505	ID 0.2495 0.2515	0.002	Coat bearing with zinc chromate and install while still wet. Press fit.
22	67099-000	Strut assembly, torquelink fitting	ID 0.4370 0.4385	ID 0.4370 0.4385	0.0015	
23	67026-007	Bushing, Strut assembly torquelink fitting (FF411-4)	**ID 0.312 0.313	ID 0.312 0.314	0.002	Press fit.
24	67146-004	Draglink, upper	ID 0.372 0.373			
25	63900-120	Bushing, upper draglink	ID 0.2495 0.2500			

* Used with 87319-03 bearing.
** Line ream to this dimension after installation of new part.

Nose Gear Service Tolerances
Figure 3 (Sheet 2 of 3)

(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 cam may be removed by removing the nut and bolt at the steering bungee assembly rod, and the bolt assembly with bushing at the steering cam pivot point.

B. Installation (See Figure 2.)

CAUTION: WHENEVER THE 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.

NOTE: When assembling any units of the landing gear; lubricate bearings, bushings, and friction surfaces with the proper lubricant as described in 12-20-00.

(1) Attach the steering cam with bushing to its mounting plate on the trunnion support assembly securing it with bolt, washers, nut and cotter pin. Align the top surface of the steering cam and the top surface of the steering arm bushings by positioning the spacer washers as shown in Figure 2. Connect the steering bungee assembly rod to the cam and install bolt, washer and nut. The adjustment, fore and aft of the cam may be made after the gear has been installed and rigged and adjusted.

(2) To install the nose gear assembly, position the gear so that the bolt attachment points on the trunnion assembly 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.

CAUTION: THE NUMBER OF WASHERS, IF ANY, BETWEEN THE UPPER DRAG LINK AND THE NOSE GEAR SUPPORTS IS DETERMINED AT THE FACTORY TO ENSURE CORRECT CENTERING OF THE NOSE GEAR. WHEN REINSTALLING THE UPPER DRAG LINK, BE SURE TO REINSTALL THESE WASHERS, IF ANY, IN THE POSITION, NUMBER, AND TYPE THAT WERE REMOVED.

(d) Install nuts and washers on the upper link attachment bolts. Tighten the nut to allow to links to rotate freely and safely.

(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, above.)

(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 12-20-00.

(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.

C. Inspection

(1) General

(a) Clean all parts with a suitable dry type cleaning solvent.

(b) Inspect the gear components for the following unfavorable conditions:

1 Bolts, bearings and bushings for excess wear, corrosion and damage.

2 Gear housing, drag links, torque links, and tension spring arm for cracks, bends or misalignment.

3 Downlock hook for excess wear of the hook and bearing surfaces.

4 Downlock roller bearing for freedom of movement and excessive wobble.

(c) Inspect the gear tension and downlock hook springs for the following:

1 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.

2 Check the gear tension springs for load tensions below minimum allowable tolerances. The minimum allowable tension of the inner spring is 46 lbs. pull at 13.75 in. and the outer is 75 lbs. pull at 13.75 in. Measurement is taken from the inner side of each hook. If it is found that either spring should be rejected, replace both springs.

3 Check the gear downlock hook spring for load tension below minimum allowable tolerance. The minimum tension of the spring is 10.5 lbs. pull at 4.5 in. Measurement is also taken from the inner side of each hook.

(d) Check the general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

(e) 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 0.062 to 0.125 nor more than 0.125 to 0.250 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.

(f) The shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, the dampener should be replaced rather than repaired.

(2) 500-Hour Drag Link Inspection and Bolt Replacement

Each 500 hours time-in-service, inspect the nose gear drag links as described below and replace the drag link bolt and cotter pin (Item 14, Figure 2).

(a) Lift the aircraft on jacks. (See 7-10-00.)

(b) Disassemble the upper drag link (Item 8, Figure 2) from the lower drag link (Item 9, Figure 2) by removing the bolt (NAS464P4-27) that serves as a hinge pin for the two parts. Discard the bolt and cotter pin, regardless of condition. Nut and washers may be reused, depending on condition.

(c) Inspect bushings for excessive wear and verify that bushing IDs are within service dimension range of 0.2515 to 0.2495 in., replacing as necessary.

(d) Reassemble upper and lower drag links per installation, below. Install a new NAS464P4-27 bolt, taking care to reposition washers retained in Step 2. Reinstall castellated nut retained in Step 2 and secure with a new MS24665-134 cotter pin.

(e) Lubricate per 12-20-00.

(f) Verify proper operation of the nose gear.

(g) Remove aircraft from jacks and return to service.

D. Repair

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.

3. Downlock and Eccentric Bushing

A. Removal (See Figure 4.)

(1) Place the aircraft on jacks as described in 7-10-00.

(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.

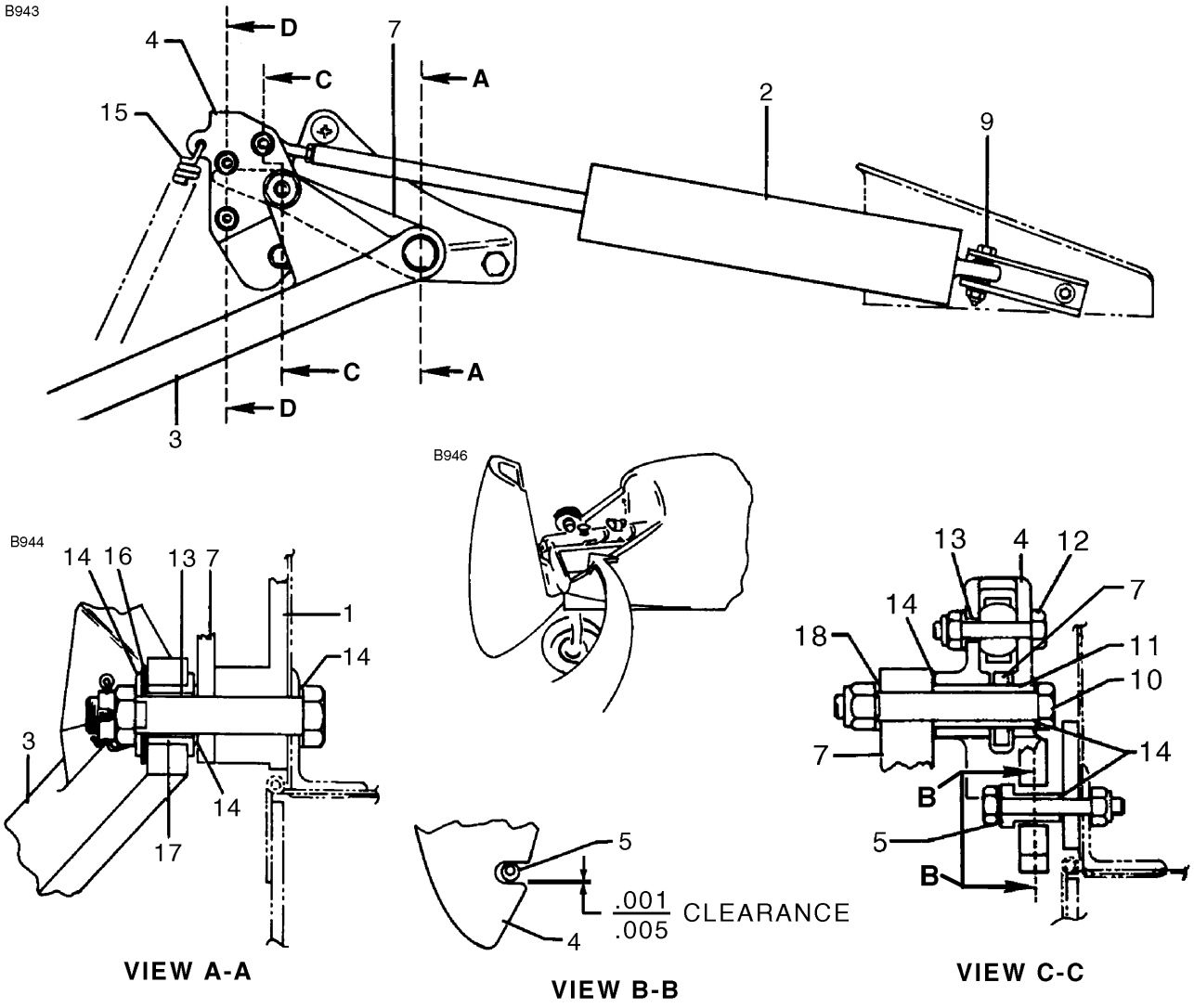
(7) Remove the cotter pins, nuts and washers from the drag brace/wheel well attach points and push the bolts back into the wheel well far enough to allow the drag brace to be lowered.

(8) Remove the bolt which secures the hydraulic retract cylinder forward rod end to the nose gear downlock.

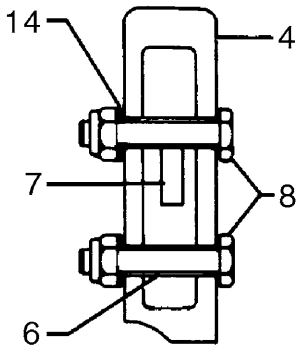
NOTE: Do not lose the bushing located on the inboard (nut) side of the downlock hook.

(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.



1. NOSE GEAR SUPPORT FITTING
2. HYDRAULIC ACTUATOR
3. UPPER DRAG LINK ASSEMBLY
4. DOWNLOCK HOOK
5. ECCENTRIC BUSHING
6. STOP BOLT BUSHING
7. DOWNLOCK ARM
8. STOP BOLT
9. AFT MOUNTING BOLT, HYDRAULIC ACTUATOR
10. PIVOT BOLT
11. PIVOT BOLT BUSHING
12. FORWARD MOUNTING BOLT, HYDRAULIC ACTUATOR
13. BUSHING
14. WASHER
15. SPRING
16. TEFLON WASHER
17. BEARING
18. WASHERS (2)



VIEW D-D

Nose Gear Downlock and Eccentric Bushing Installation
Figure 4

B. Installation (See Figure 4.)

(1) Install the new eccentric bushing. (See Figure 4 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 0.003 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. (See 32-60-00.) 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.

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C. Adjustment (See Figure 5.)

The gear up stop is located on the steering cam.

(1) Place the airplane on jacks. (See 7-10-00.)

CAUTION: FULLY DISENGAGE THE NOSE GEAR DOWNLOCK BEFORE RELEASING THE NOSE GEAR DRAG LINKS. WHENEVER AIRCRAFT IS PLACED ON JACKS TO MANUALLY RETRACT THE NOSE GEAR ASSEMBLY, 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 the Free Fall Control (i.e. - Emergency Gear Extension Knob).

(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 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 carpenters 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 in., 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 in. of travel remains to full extension.

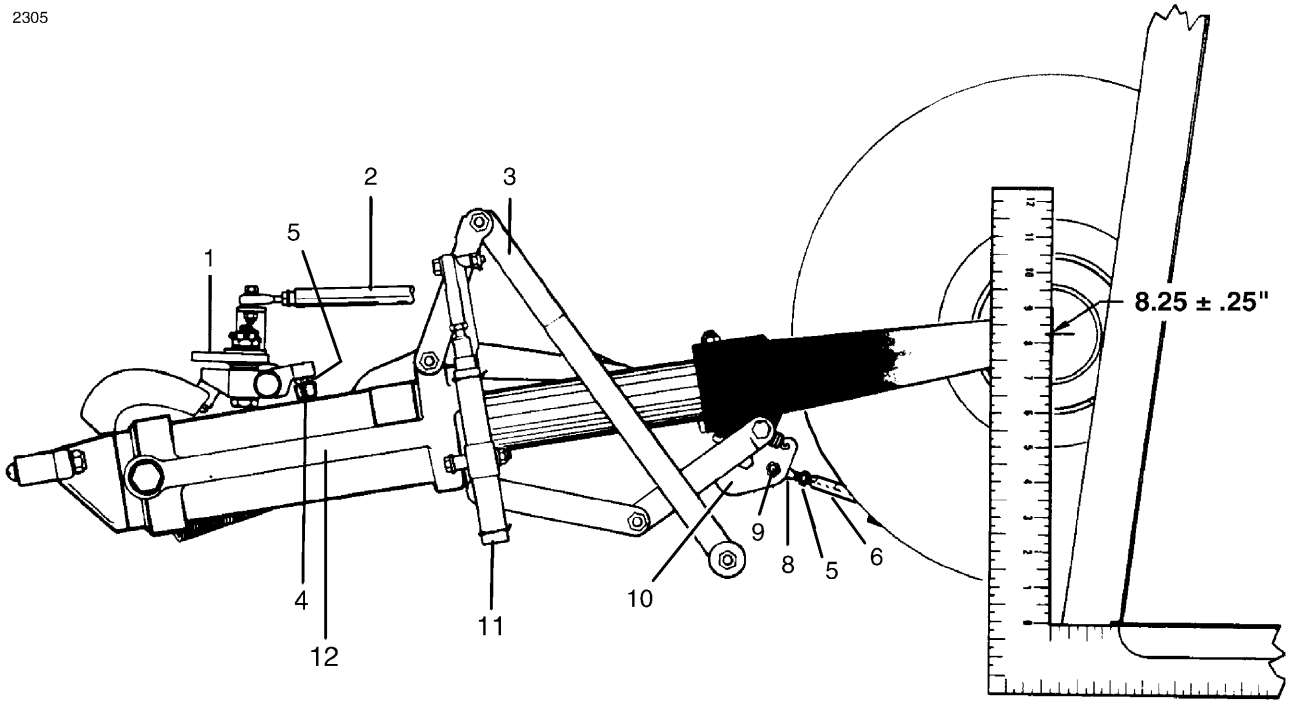
(12) Adjust shimmy dampener by turning nose wheel stops and adjusting the rod ends of the dampener for 30° travel to both extremes.

(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.

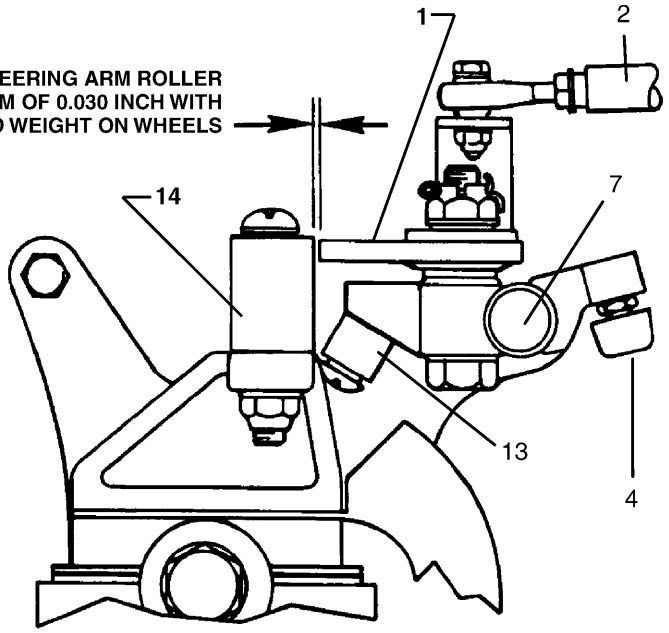
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NOSE GEAR RETRACTED

ADJUST STEERING CAM TO STEERING ARM ROLLER CLEARANCE TO A MAXIMUM OF 0.030 INCH WITH GEAR DOWN AND LOCKED AND WEIGHT ON WHEELS

1. STEERING CAM
2. STEERING BUNGEE ASSEMBLY ROD
3. UPPER DRAG LINK
4. GEAR UP STOP
5. JAM NUT
6. ACTUATOR ROD, CYLINDER
7. TRUNNION SUPPORT ASSEMBLY
8. ROD END BEARING
9. BOLT ASSEMBLY
10. DOWNLOCK HOOK
11. SHIMMY DAMPENER
12. STRUT HOUSING
13. NOSE GEAR ALIGNER GUIDE
14. STEERING ARM ROLLER

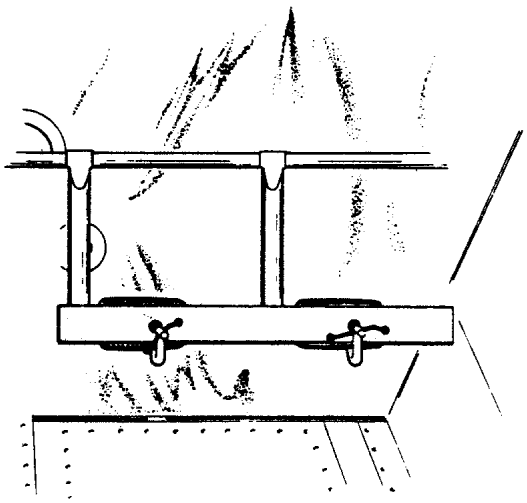


NOSE GEAR DOWN AND LOCKED WITH WEIGHT ON WHEELS

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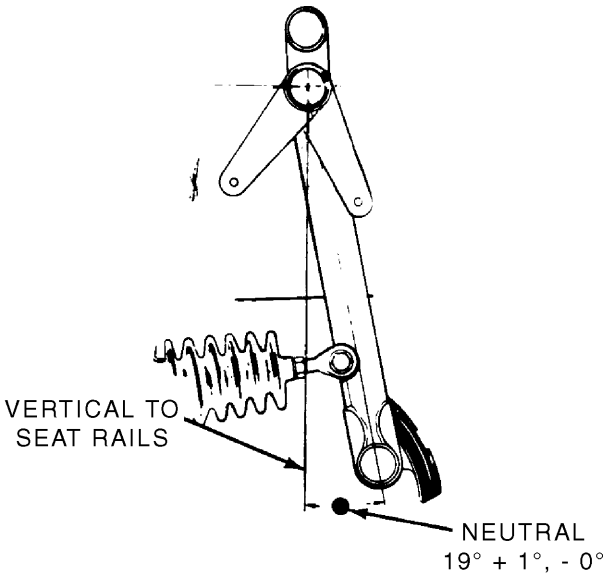
Nose Gear Adjustment
Figure 5

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Clamping Rudder Pedals in Neutral Position
Figure 6

1641



Rudder Pedals at Neutral Angle
Figure 7

D. Alignment (See Figures 5, 6, and 7.) (PIR-PPS50033, Rev. I)

(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. (See “Adjustment,” above.)

(3) Install a suitable tool which will lock the rudder pedals together and in alignment with each other, in the neutral position. In neutral, the rudder pedals are tilted 19 degrees aft as shown in Figure 6.

(4) Locate the steering cam fore or aft until it clears the steering arm rollers by 0.030 inch maximum with the gear down and locked, and aircraft weight on the nose gear.

(5) The cam may be adjusted by loosening its attachment bolt and sliding the cam fore and aft until it clears each steering arm roller by 0.030 in. Torque attach bolt 160 to 190 in. lbs.

(6) Place the airplane on jacks. (See 7-10-00.)

(7) Level the airplane laterally and longitudinally. (See 8-20-00.)

(8) From the center point of the tail skid, extend a plumb bob and mark the center point on the floor.

(9) 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.

(10) Install the nose wheel steering bungee in the neutral position (no load on springs). Adjust the rod ends as necessary.

(11) 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.

(12) 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.

(13) Place a bubble protractor against a rudder pedal steering tube to check the neutral angle as shown in Figure 7.

(14) One end of each steering pushrod 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) Remove rudder pedal locking tool.

(16) Turn nose wheel to the left until the stop located on the nose gear trunnion makes contact. Nose wheel travel must be 30° + 1°. Repeat this procedure turning the nose wheel to the right.

(17) If travel limit is exceeded in one direction and not enough in the other direction, check for possible damage to the gear fork or torque links.

4. Nose Gear Door

A. Removal (See Figure 8.)

(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.

B. Installation (See Figure 8.)

(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.

C. Inspection

(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.

D. Repair

Repair to the door assembly is limited to replacing hinge bearings or rivets and mechanism parts, minor skin repairs and repainting.

E. Adjustment (See Figure 8.)

(1) Place the airplane on jacks. (See 7-10-00.)

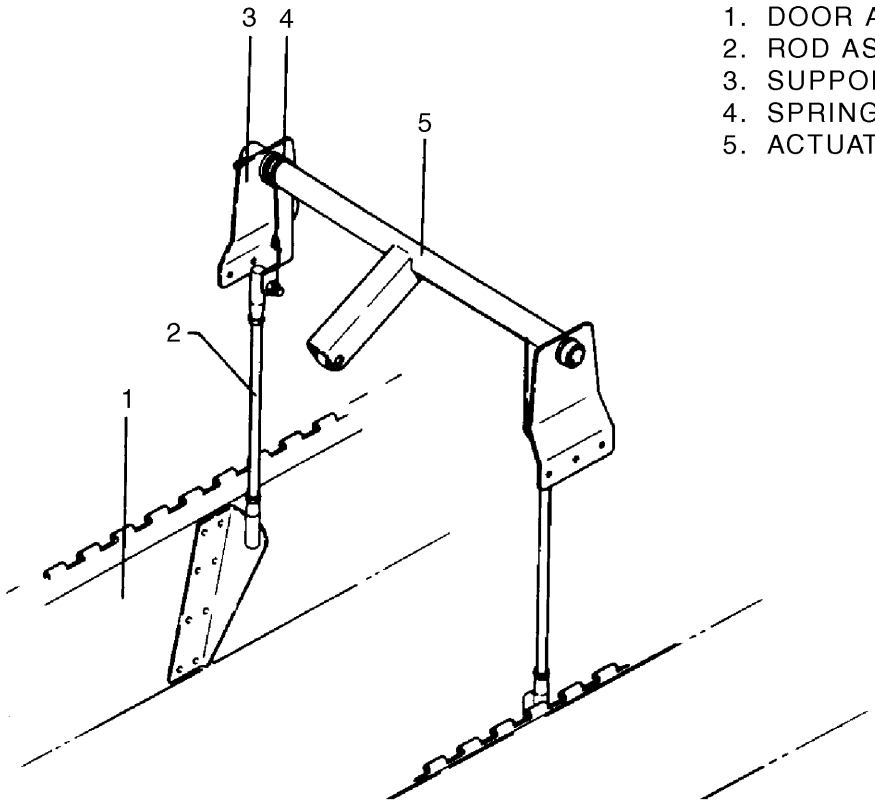
(2) Disconnect the nose gear door retraction rods, if not previously disconnected.

(3) Adjust doors one at a time. Close the door to the stop and adjust the retraction rod.

(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.

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1. DOOR ASSEMBLY
2. ROD ASSEMBLY
3. SUPPORT BRACKET
4. SPRING
5. ACTUATOR

Nose Gear Door Mechanism
Figure 8

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EXTENSION AND RETRACTION

1. Troubleshooting

See Chart 1.

CHART 1 (Sheet 1 of 5)
TROUBLESHOOTING EXTENSION & RETRACTION

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. (See Adjustment of Safety Switch.)
	Squat switch inoperative.	Replace switch.
	Pressure switch inoperative.	Replace switch.
	Pump retraction solenoid in operative (upper solenoid).	Replace solenoid.
NOTE: 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.		
	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.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Battery low or dead.	Check condition of battery.

CHART 1 (Sheet 2 of 5)
TROUBLESHOOTING EXTENSION & RETRACTION

Trouble	Cause	Remedy
Landing gear extension system fails to operate.	Landing gear actuator circuit breaker open.	Reset circuit breaker and determine cause for open circuit for open circuit breaker.
	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit for open circuit breaker.
	Landing gear actuator circuit wires broken.	Check wiring.
	Landing gear selector circuit wires broken.	Check wiring.
	Pump extension outboard solenoid inoperative.	Replace solenoid.
NOTE: 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.		
	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.
	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.

CHART 1 (Sheet 3 of 5)
TROUBLESHOOTING EXTENSION & RETRACTION

Trouble	Cause	Remedy
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, readjust or replace switch.
NOTE: When seen in Oildyne pump, pump may require overhaul.		
	Mechanical restriction or obstruction in hydraulic system to allow pressure to 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.
	Pump retraction inboard solenoid sticking.	Replace solenoid.
	Internal leakage of system.	Check free fall valve for internal leakage.
		Check gear actuating cylinders for internal leakage.
		Replace pump or return pump to Piper via local Piper distributor for overhaul.

CHART 1 (Sheet 4 of 5)
TROUBLESHOOTING EXTENSION & RETRACTION

Trouble	Cause	Remedy
Pump fails to shut off though gear has fully retracted. (cont.)	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 lower solenoid sticking.	Replace solenoid.
	Nose gear down limit switch actuator out of adjustment.	Adjust switch actuator. (See 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. (See Adjustment of Main Gear Down Limit Switch.)
	Main gear down limit switch failed.	Replace switch.
Pump running intermittently after gear has retracted.	Leakage of high pressure check valve.	Replace pump or return pump to Piper via local Piper distributor for overhaul.
	Internal leakage of system.	Check free fall valve for internal leakage.
		Check gear actuating cylinders for internal leakage.
	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.

CHART 1 (Sheet 5 of 5)
TROUBLESHOOTING EXTENSION & RETRACTION

Trouble	Cause	Remedy
Gear stops part way up, but pump continues to run.	Pump high pressure relief valve out of adjustment.	Replace pump.
	Internal leakage of system.	Check free fall valve for internal leakage.
		Check gear actuating cylinders for internal leakage.
		Check for broken or damaged hydraulic lines.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
All gears fail to free fall.	Free fall valve fails to open.	Check valve and cables connections. Replace valve or connect cables.
With gear selector down and three green lights on, gear unsafe light comes on intermittently or continuously.	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.

2. Landing Gear Retraction System Functional Test (PIR-PPS60033-3, Rev. G. / PPS60033-12, Rev. New.)

A. Set-up

Before proceeding with the test:

(1) Check that the tires and struts are inflated as required.
(2) Check that the squat and limit switches are at their proper adjustment.
(3) Raise airplane on jacks as explained in 7-10-00.
(4) Connect a 12 to 14-Vdc, 60 amperes, power source to the aircraft electrical system.

B. Procedure

Two different landing gear up/power reduced warning systems are installed. In S/N's 4496001 thru 4496216, microswitches are installed in the throttle quadrant to detect the power levers being retarded; in S/N's 4496217 and up, a transducer in the manifold pressure line detects reduced power: the following procedure is annotated accordingly when the procedure varies due to these differences.

NOTE: Carry out the following procedures in the sequence designated, because 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) Keep hydraulic reservoir full of fluid. Make provisions to add fluid to the reservoir as necessary. Allow the reservoir to be vented.
(2) Make sure all switches are OFF and that the gear selector is in the down position.
(3) Throttles in closed position:
  (a) In S/N's 4496001 thru 4496216, be sure throttles are in the closed position.
  (b) In S/N's 4496217 and up, simulate reduced power as follows:
    1 At LEFT gear warning manifold pressure switch jump wires G11X and G11Y together.
    2 At RIGHT gear warning manifold pressure switch jump wires G11V and G11W together.
(4) Position the BATT Master switch ON. Ensure the hydraulic pump power (HYD PUMP PWR) circuit breaker is IN (ON).

  For all aircraft, confirm the following:

  (a) The three (3) green safe lights at the bottom center of the panel are ON.
  (b) Red gear unsafe warning light at the top of the panel is OUT.
  (c) The gear warning horn does not sound.

    NOTE: Confirm that the GEAR WARN MUTE annunciator light is OUT.

  (d) The hydraulic pump does not operate.
(5) Fully extend struts. Measure strut up from top of gear fork, putting a mark at eight (8) inches. Place a second mark 0.25 in. below first mark. With throttle levers closed, compress strut slowly. Horn should sound between the marks.
(6) Turn cabin heat ON. Move air intake lever to OPEN position. Confirm that combustion air blower is operational.

(7) With gear selector switch UP, confirm the following:
  (a) The green safe lights are OUT.
  (b) The red gear unsafe warning light is ON.
  (c) The gear warning horn sounds.
  (d) All gear retract fully and nose gear doors close fully.
  (e) Both the pump motor and the combustion air blower stop operating.

(8) Throttles singly and simultaneously at mid-travel position:
  (a) In S/N's 4496001 thru 4496216:
    1 Move the LEFT throttle to the mid-travel position (with gear fully retracted).
      a The gear warning horn should sound.
      b Red unsafe light ON.
    2 Close LEFT throttle.
    3 Move RIGHT throttle to mid-travel position. The gear warning horn and the red unsafe light should remain ON.
    4 Move both throttles to the mid-travel position. Confirm that:
      a The warning horn STOPS sounding.
      b The red unsafe light remains ON.
      c The mute light goes OUT.
    5 Depress gear warning mute switch. Repeat Steps 1 through 4, above.
      a Red unsafe light will be OUT.
      b Warning horn will not sound.
  (b) In S/N's 4496217 and up, simulate throttle positions as follows:
    1 Remove jumper on LEFT manifold pressure switch. Confirm that:
      a Gear warning horn still sounds.
      b Red unsafe light remains ON.
    2 Replace jumper on LEFT manifold pressure switch. Remove jumper on RIGHT manifold pressure switch. Confirm that:
      a Gear warning horn still sounds.
      b Red unsafe light remains ON.
    3 Remove the jumpers on both the LEFT and RIGHT manifold pressure switches. Confirm that:
      a Gear warning horn stops sounding.
      b Red unsafe light goes OUT.
    4 Reinstall jumpers and repeat Steps 1 through 3, above. Confirm that:
      a Red unsafe light is OFF.
      b Warning horn is silent.
    5 Remove RIGHT jumper and replace LEFT jumper. Confirm that horn sounds and red unsafe light is ON.
    6 Push mute. Confirm that horn does not sound and red unsafe light is OFF.
    7 Remove LEFT jumper and reinstall RIGHT jumper. Confirm that horn sounds and red unsafe light is ON.
    8 Push mute. Confirm that horn does not sound and red unsafe light is OFF.
    9 Remove both jumpers. Confirm that horn does not sound.

10 Reinstall both jumpers. Confirm that:

a Mute light is OFF.

b Red unsafe light is ON.

c Horn sounds.

11 Remove both jumpers.

(9) Extend the flaps to the second notch. Confirm that:

(a) The warning horn sounds.

(b) The red unsafe light comes ON.

(10) Press gear warning mute light. Confirm that the gear warning horn still sounds.

(11) Retract the flaps. Horn will stop sounding; red unsafe light and mute light will be OFF.

(12) Leave the gear up for five (5) minutes. The pump motor should not operate at any time.

NOTE: If the pump should operate during the five-minute period, search for a leak in the “up” line or a malfunctioning component in the system.

NOTE: One momentary pump operation is allowable during the five-minute period, provided that the gear unsafe light is OFF and there is no repeated pump operation for a subsequent 15-minute period.

(13) Pull hydraulic pump circuit breaker OUT (OFF). Turn OFF cabin heat switch. Set air intake lever to CLOSED.

(14) Pull the emergency gear release (or free-fall) knob. Confirm that all gear return to the down and locked position, with the down latches engaged.

(15) Set the gear selector switch to DOWN.

(16) Push in the emergency gear release knob. Push IN (ON) hydraulic pump circuit breaker. Confirm that:

(a) The three green safe lights come ON.

(b) The red unsafe light is OFF.

(c) The warning horn does not sound.

(d) Pump does not operate.

(17) Verify that the FLAPS are fully retracted. Confirm that:

(a) The inboard stall vane, when lifted, does not activate the stall warning horn.

(b) The outboard stall vane, when lifted, ACTIVATES the stall warning horn.

(18) Lower flaps to 10-degree position. Confirm that:

(a) The inboard stall vane, when lifted, does not activate the stall warning horn.

(b) The outboard stall vane, when lifted, ACTIVATES the stall warning horn.

(19) Set the gear selector switch to UP. When the gear are fully up, check the following:

(a) 0° Flaps, Outboard Stall Vane ON, Inboard Stall Vane OFF

(b) 10° Flaps, Outboard Stall Vane ON, Inboard Stall Vane OFF

(c) 25° Flaps, Inboard Stall Vane ON, Outboard Stall Vane OFF

(d) 40° Flaps, Inboard Stall Vane ON,Outboard Stall Vane OFF

(20) Set the gear selector switch to DOWN.

Proceed with the next step when the gear are in the fully down and locked position, with the down latches engaged.

(21) Lower flaps to 25-degree position. Confirm that:
  (a) The inboard stall vane, when lifted, ACTIVATES the stall warning horn.
  (b) The outboard stall vane, when lifted, does not activate the stall warning horn.

(22) Lower flaps to the 40-degree position. Confirm that:
  (a) The inboard stall vane, when lifted, ACTIVATES the stall warning horn.
  (b) The outboard stall vane, when lifted, does not activate the stall warning horn.

(23) Retract flaps.

(24) Insert a suitable tool under the leaf of squat switch on left main gear (see 32-60-00, Figure 2).

NOTE: If no suitable tool is available, the following alternative methods are acceptable:
- remove the torque link connecting bolt and rotate the upper torque link so that the switch tang is free;
- loosen the squat switch adjustment screws and rotate the squat switch until the tang is free;
- partially compress the left main gear oleo until the squat switch operating tang is free.

If any of these methods are used, at the completion of the test, be sure to reinstall and adjust any components disassembled.

  (a) In S/N's 4496217 and up only, reinstall the jumpers on the manifold pressure switches in both engine nacelles.
  (b) In all S/N's, with the gear select switch UP, confirm that:
    1 Pump does not run.
    2 Three green safe lights remain ON.
    3 Red unsafe light ON.
    4 Gear warning horns sounds.
  (c) Throttles at mid-travel position:
    1 In S/N's 4496001 thru 4496216 only, move the throttles to their mid-travel position.
    2 In S/N's 4496217 and up, simulate mid-power settings by removing the jumpers on both manifold pressure switches.

  Confirm that the red unsafe light and warning horn both remain ON.

(25) Put the gear selector switch DOWN. Confirm that:
  (a) Red warning light goes OUT.
  (b) Warning horn goes silent.

(26) Remove the tool from the left main gear squat switch.

(27) Manually disengage (i.e. - break) the LEFT main gear downlock. Confirm that:
  (a) The pump motor operates with the appropriate green safe light OUT
  (b) The red unsafe light is ON.
  (c) The gear warning horn does not sound.

(28) Repeat the above step on the RIGHT main gear downlock.

(29) Put the gear selector switch UP. Confirm that:
  (a) The pump motor operates.
  (b) The three green safe lights are OUT.
  (c) The red unsafe light is ON until all gear are UP; then OFF.
  (d) The gear retract fully in less than 10 seconds.
  (e) The pump motor shuts off when all gear are UP.
  (f) The warning horn does not sound.

(30) Set the gear selector switch DOWN.

(a) The pump motor operates until all gear are down and locked.

(b) All gear return to “down and locked” position in 15 seconds or less.

(c) The three green safe lights come ON in less than 15 seconds.

(c) The red unsafe light is OFF.

(d) The warning horn does not sound.

NOTE: Any momentary blinking of the red and/or green gear lights after the downlocks are engaged indicates an improperly adjusted microswitch.

(31) Day/Night dimming test

(a) In airplanes without a day/night dim switch:

1 Set the NAV LIGHTS switch to ON.

2 Confirm that the three green safe lights remain ON, but become DIM.

(b) In airplanes with a day/night dim switch:

1 Set the day/night dim switch to NIGHT.

2 Confirm that the three green safe lights remain ON, but become DIM.

(c) Set/check the NAV LIGHTS switch to OFF, day/night dim switch to DAY.

(32) Set Master switch to OFF.

(33) Verify gear are down and locked and remove the airplane from jacks.

3. Main Gear Actuating Cylinder

A. Removal

(1) Place the airplane on jacks. (See Jacking, 7-10-00.)

(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.

B. Installation

(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. (See 32-10-00, Main Landing Gear, Adjustment.)

(5) Operate pump to purge system of air and check fluid level in reservoir.

(6) Turn master switch ON. Ensure the three green GEAR DOWN and LOCKED lights are ON. Turn master switch OFF.

(7) Verify gear are down and locked and remove the airplane from jacks.

NOTE: The following instructions apply to actuators P/N 96860-000 (i.e. - SFA232-3 and SFA232-4) only. Disassembly, Assembly, and Cleaning, Inspection and Repair instructions for later model actuators P/N 96860-002 and 96860-003 (i.e. - SFA232-5) are found in Cleveland Wheel and Brakes publication: Component Maintenance Manual - CMSFA232-5 (011-00504) available from the vendor. See Vendor Publications in the Introduction.

C. Disassembly (See Figure 1.)

(1) With the cylinder removed from the airplane, push the piston rod (by hand) toward the clevis to remove oil from the unit.

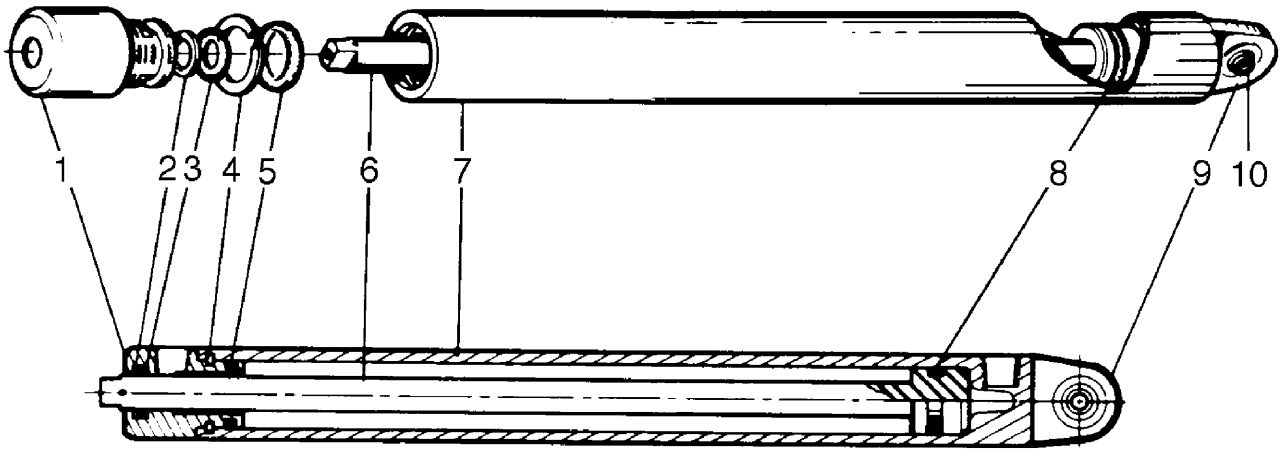
(2) Put clevis in a soft jaw vise and clamp against the clevis bearing.

(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.

(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, as shown in Figure 2. (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.)

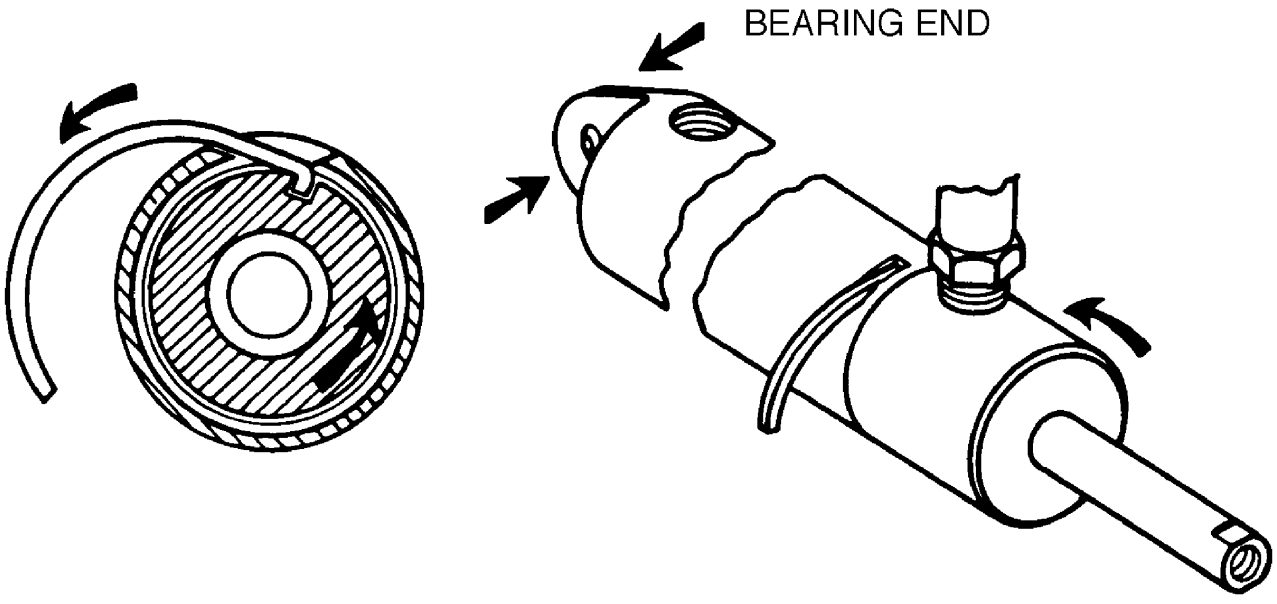
(5) Pull the piston and end gland from the cylinder.

(6) Remove O-rings as desired.



1. END GLAND
2. BACK-UP RING
3. O-RING
4. RETAINER RING
5. O-RING
6. PISTON
7. CYLINDER BODY
8. O-RING
9. CLEVIS
10. BEARING

Main Gear Actuating Cylinder
Figure 1



Main Gear End Gland Locking Device
Figure 2

D. Inspection

(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.

E. Repairs

Repairs to the cylinder are limited to polishing out small scratches, burrs, etc., and replacing components. (See Parts Catalog for replacement part numbers.)

F. Assembly (See Figure 1.)

(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.

4. Nose Gear Actuating Cylinder

A. Removal

(1) Place the airplane on jacks. (See Jacking, 7-10-00.)

CAUTION: WHEN 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 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.

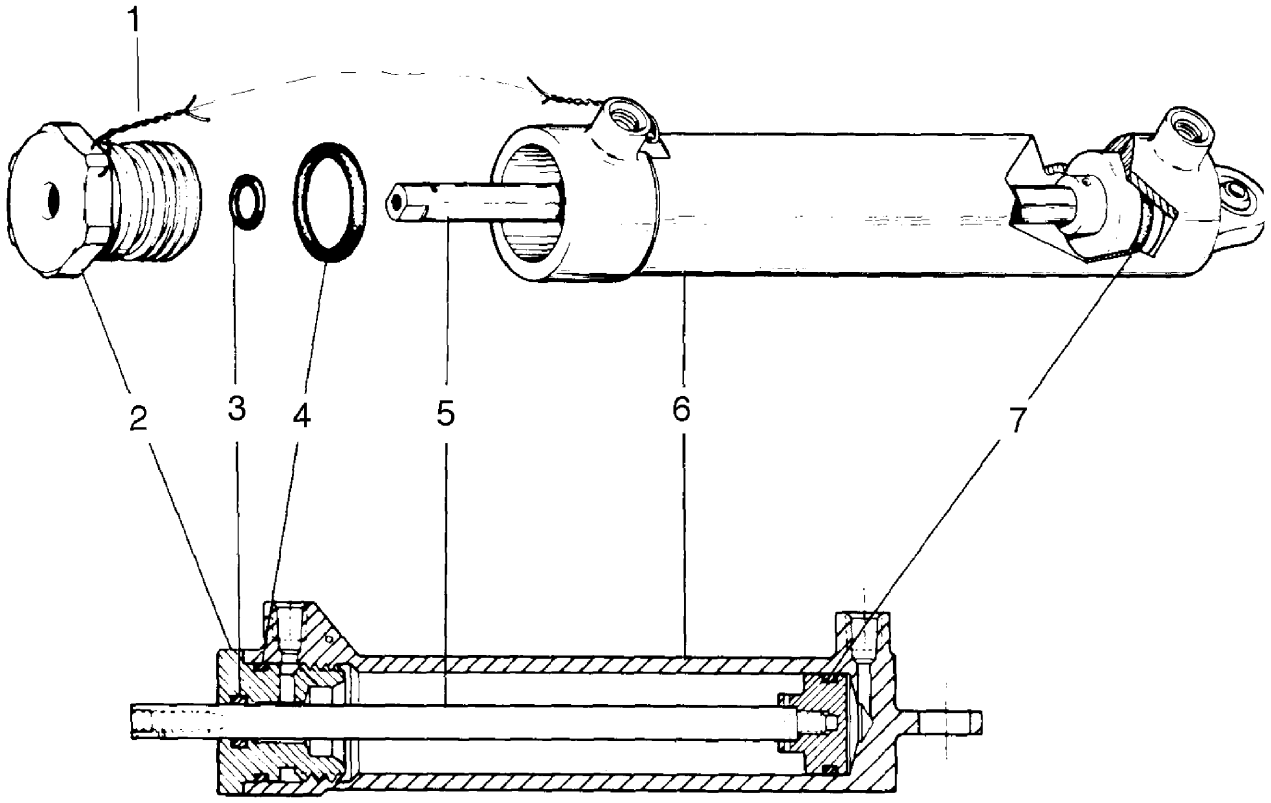
(5) Disconnect the aft end of the cylinder from its attachment fitting.

(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.



1. SAFETY WIRE
2. END PLUG
3. O-RING
4. O-RING
5. PISTON SHAFT
6. CYLINDER BODY
7. O-RING

Nose Gear Actuating Cylinder
Figure 3

(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.

B. Installation

(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 (AN96-516L) 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 adjustment of the cylinder rod end. (See 32-20-00, Nose Landing Gear, Adjustment.)

CAUTION: WHEN 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.

(10) Operate pump to purge system of air and check fluid level in reservoir.

(11) Turn master switch ON. Ensure the three green GEAR DOWN and LOCKED lights are ON. Turn master switch OFF.

(12) Verify gear are down and locked and remove the airplane from jacks.

NOTE: The following instructions apply to actuators P/N 96860-000 (i.e. - SFA232-3 and SFA232-4) only. Disassembly, Assembly, and Cleaning, Inspection and Repair instructions for later model actuators P/N 96860-002 and 96860-003 (i.e. - SFA232-5) are found in Cleveland Wheel and Brakes publication: Component Maintenance Manual - CMSFA232-5 (011-00504) available from the vendor. See Vendor Publications in the Introduction.

C. Disassembly (See Figure 3.)

(1) With the cylinder removed from the airplane, mark the position of the end gland to facilitate installation.

(2) Remove safety wire and unscrew the end gland.

(3) Complete disassembly of piston and O-rings.

D. Inspection (See Figure 3.)

(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.

E. Repairs

Repairs to the cylinder are limited to polishing out small scratches, burrs, etc., and replacing parts.

F. Assembly (See Figure 3.)

(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.

5. Landing Gear Free-fall Valve Assembly

This valve is located on the right side of the forward bulkhead at station 40.75.

A. Removal

(1) Loosen cable set screw securing cable to free-fall valve. Remove cable from valve.

(2) Disconnect hydraulic lines connected to the valve. Place a rag in position to absorb any hydraulic fluid spillage that may result. Cap the lines to avoid contamination.

(3) Remove the two (2) each MS35207-264 screws, MS20365-1032C nuts, AN960-10L washers, 80700-006 spacers, and PS10017-2-10 clamps securing the valve to the frame.

(4) Remove the assembly from the airplane.

B. Installation

(1) Position valve assembly in proper location in airplane.

(2) Secure valve assembly to frame with two (2) each PS10017-2-10 clamps, 80700-006 spacers, MS35207-264 screws, AN960-10L washers, and MS20365-1032C nuts.

(3) Apply Titeseal No. 3 in back of the male threads of elbows fittings. Insert fittings into valve an tighten. Titeseal should be applied sparingly to prevent it entering the hydraulic system.

(4) Push arm assembly to the fully closed position. Pull cable full forward and insert loose end of cable through hole in bushing of the arm assembly. Tighten set screw on cable so that a twenty (20) in.-lb. pull on cable will not pull cable from valve.

(5) Rig cable with valve in closed position. Rig cable so that valve will hit its internal stop without being limited by the console in cockpit. (0.03 to 0.06 inch clearance)

C. Inspection

Inspection is limited to determining if any signs of hydraulic fluid leakage are evident around the seam between the end fitting and valve body, and around the periphery of the piston assembly shaft. If leaks appear, the valve assembly should be replaced since it is impractical to repair the valve.

D. Repairs

No repairs are authorized. If leaking or otherwise defective, replace the valve.

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WHEELS AND BRAKES

1. Wheels

A. Main Wheels

(1) Removal and Disassembly (See Figure 1.)

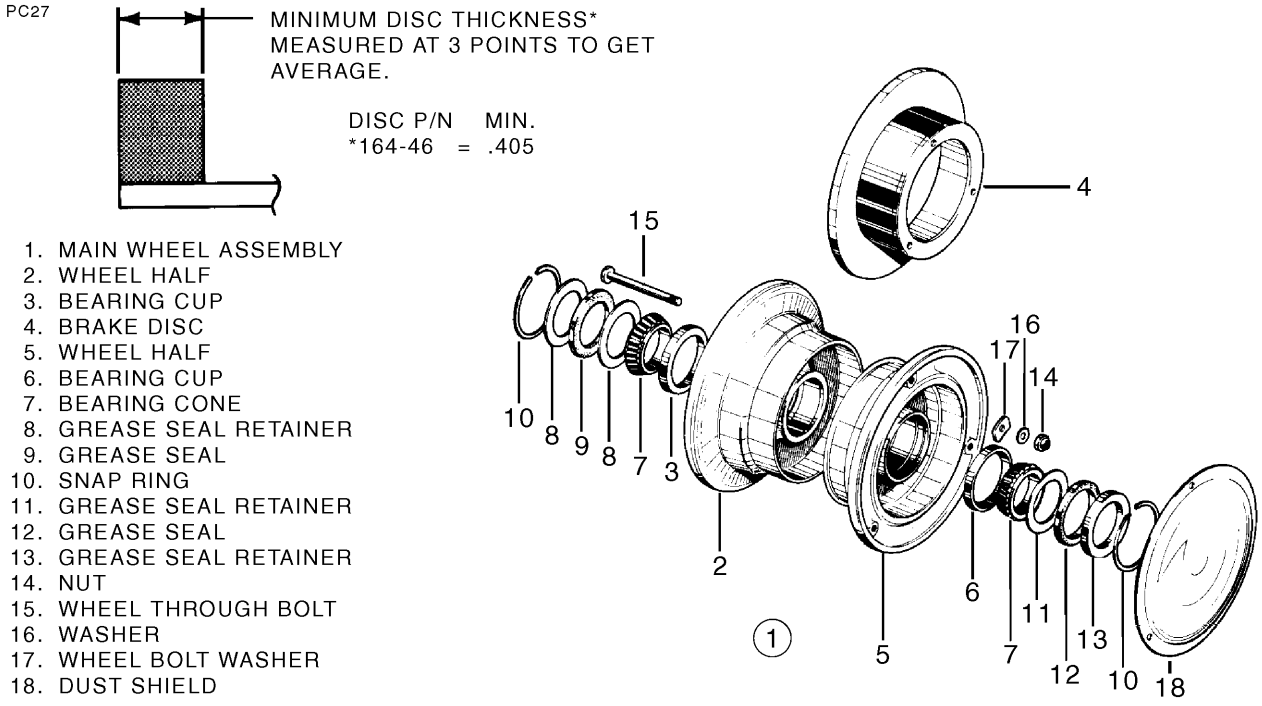
(a) Place the airplane on jacks. (See 7-10-00.)

(b) 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.

(c) Remove the dust cover and the cotter pin that safeties the wheel nut, remove the wheel nut and slide the wheel from the axle.

(d) 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.

(e) 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.



Main Wheel Assembly
Figure 1

(2) Assembly and Installation (See Figure 1.)

(a) 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.

(b) 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.

(c) Lubricate the bearing cones and install the cones, grease seals~ seal retainer rings and felt rings. Secure with snap rings.

(d) 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.

(e) 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.

(3) Inspection

(a) 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.

(b) Visually check all parts for cracks, distortion, defects and excess wear.

(c) Check tie bolts for looseness or failure.

(d) 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.)

(e) Check tire for cuts, internal bruises and deterioration.

(f) Check bearing cones and cups for wear and pitting and relubricate.

(g) Replace any wheel casting having visible cracks.

B. Nose Wheel

(1) Removal and Disassembly (See Figure 2.)

(a) Jack the airplane enough to raise the nose wheel clear of the ground. (See 7-10-00.)

(b) Remove wheel by the following procedure:

1 Remove the nut and washer from one end of the axle rod and slide out the rod and axle plugs.

2 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.

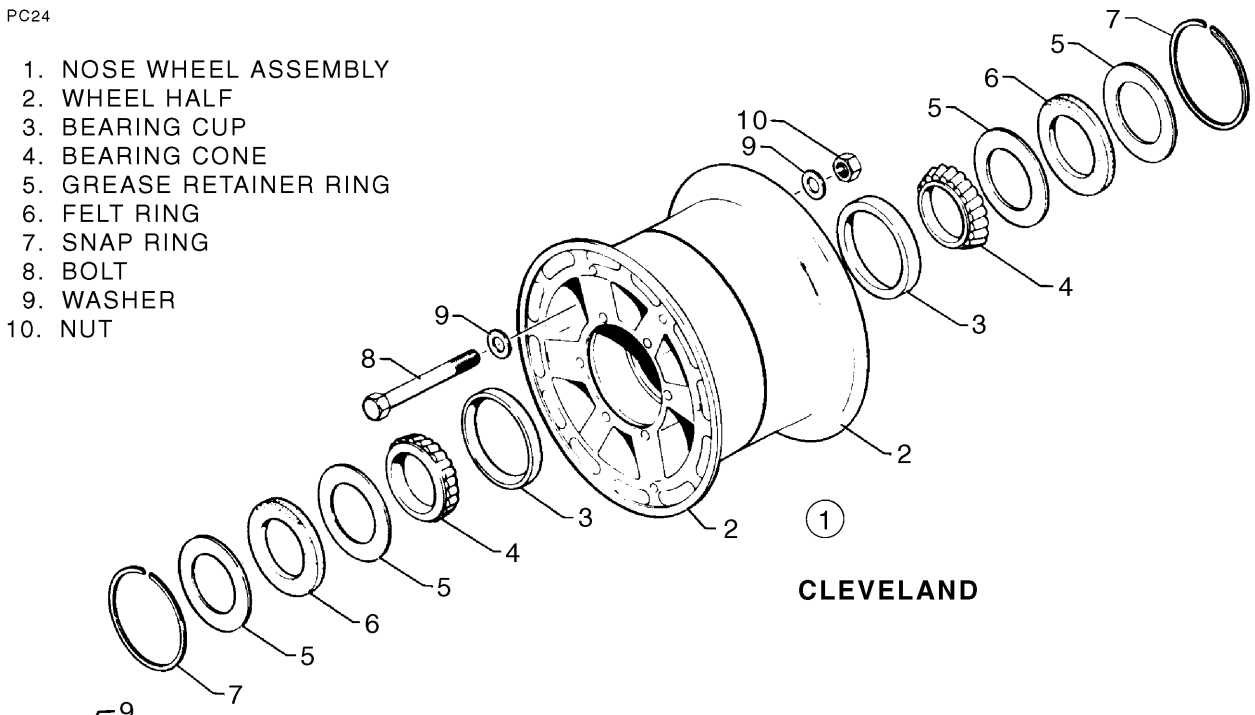
3 Remove the spacer tubes and the wheel assembly.

(c) 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.

(d) 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.

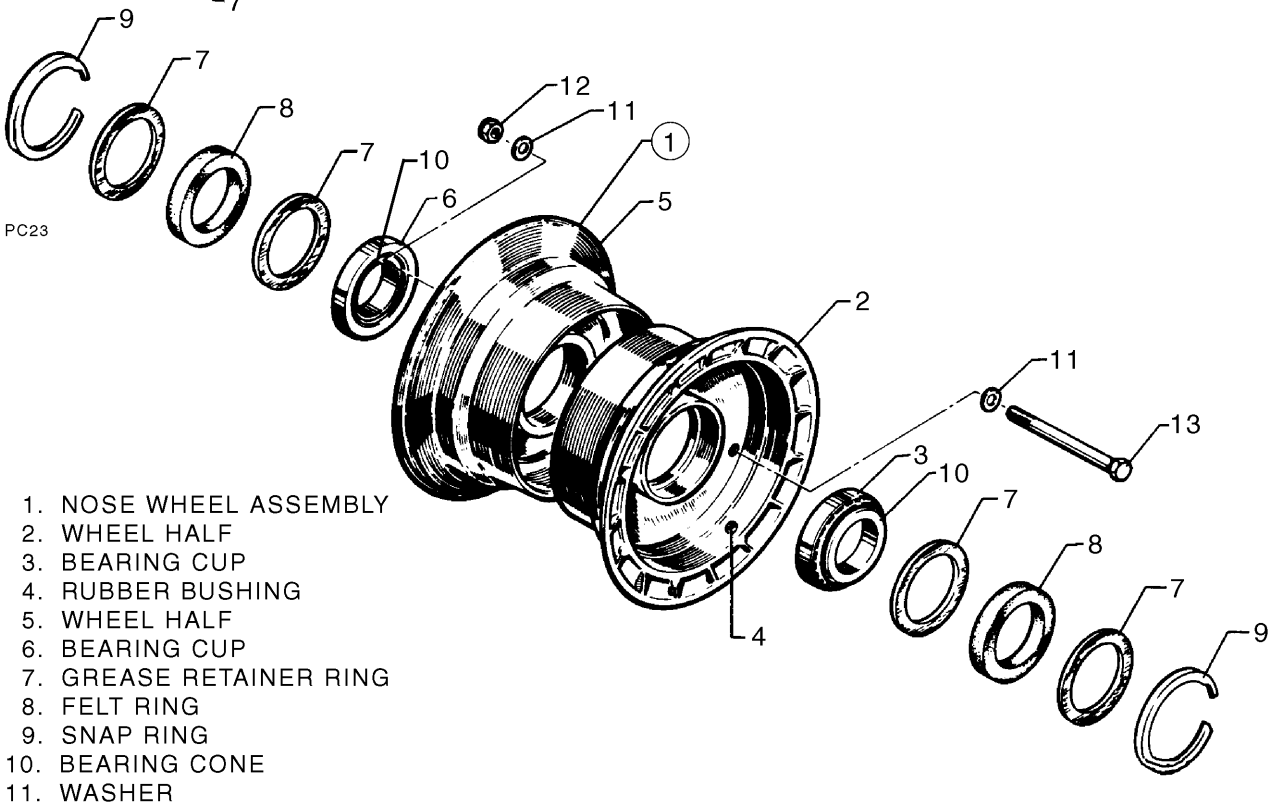
PC24

1. NOSE WHEEL ASSEMBLY
2. WHEEL HALF
3. BEARING CUP
4. BEARING CONE
5. GREASE RETAINER RING
6. FELT RING
7. SNAP RING
8. BOLT
9. WASHER
10. NUT



CLEVELAND

PC23



1. NOSE WHEEL ASSEMBLY
2. WHEEL HALF
3. BEARING CUP
4. RUBBER BUSHING
5. WHEEL HALF
6. BEARING CUP
7. GREASE RETAINER RING
8. FELT RING
9. SNAP RING
10. BEARING CONE
11. WASHER
12. NUT
13. BOLT

McCAULEY

Nose Wheel Assemblies
Figure 2

(2) Assembly and Installation (See Figure 2.)

(a) 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.

NOTE: Torque nuts as follows:
Cleveland Wheel Assemblies - 90 in.-lbs;
McCauley Wheel Assemblies - 140-150 in.-lbs.

On McCauley Nose Wheel Assemblies only, bushing is required to prevent tube movement.

(b) 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 6-00-00, Chart 1.

(c) Lubricate the bearing cones and install the cones, grease seals, felt rings and seal retainer rings. Secure with snap rings.

(d) 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.

(3) Inspection

(a) Visually check all parts for cracks, distortion, defects and excess wear.

(b) Check tie bolts for looseness or failure.

(c) 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.)

(d) Check tire for cuts, internal bruises and deterioration.

(e) Check bearing cones and cups for wear and pitting and relubricate.

(f) Replace any wheel casting having visible cracks.

C. Repair - Main and Nose Wheel Assemblies

(1) General

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 equivilent primer and one coat of aluminum lacquer.

NOTE: Never paint working surfaces of the bearing cups.

(2) 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.

2. Brakes

A. 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.

B. Wheel Brake Assembly

(1) Removal and Disassembly (See Figure 3.)

(a) To remove the brake assembly, first disconnect the brake line from the brake cylinder at the tube fitting.

(b) 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.

(c) Slide the brake cylinder housing from the torque plate.

(d) Remove the pressure plate by sliding it off the anchor bolts of the housing.

(e) The piston(s) may be removed by injecting low air pressure in the cylinder fluid inlet and forcing the piston from the housing.

(f) Check anchor bolt for wear.

(g) Remove anchor bolt by the following procedure:

1 Position cylinder assembly on a holding fixture. (See Figure 4, Removal.)

2 Use a suitable arbor press to remove the anchor bolt from the cylinder body.

(h) Install anchor bolt by the following procedure:

1 Support anchor bolt in a holding fixture. (See Figure 4, Step A.)

2 Align cylinder body over anchor bolt. (See Figure 4, Step B.)

3 Use a suitable arbor press and apply pressure on the spot face directly over the anchor bolt hole. (See Figure 4, Step C.)

(2) Assembly and Installation (See Figure 3.)

(a) 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.

(b) Slide the lining pressure plate onto the anchor bolts of the housing.

(c) Slide the cylinder housing assembly on the torque plate of the gear.

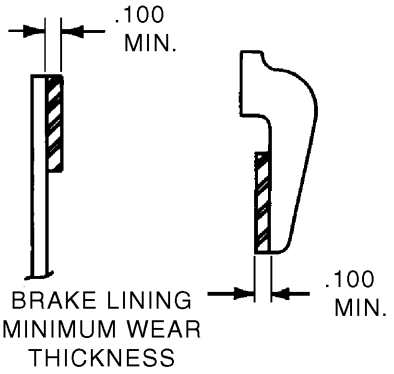
(d) Position the lining back plate between the wheel and brake disc. Install the bolts and torque to 40 inch-pounds to secure the assembly.

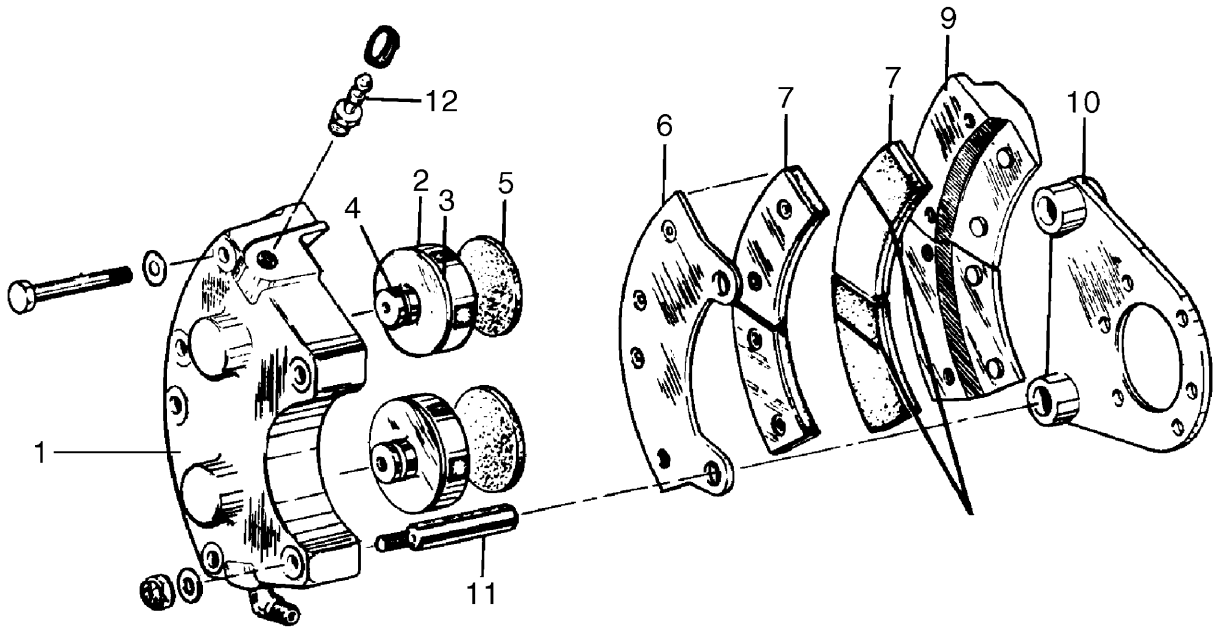
(e) Connect the brake line to the brake cylinder housing.

(f) Bleed the brake system.

BRAKE ASSEMBLY

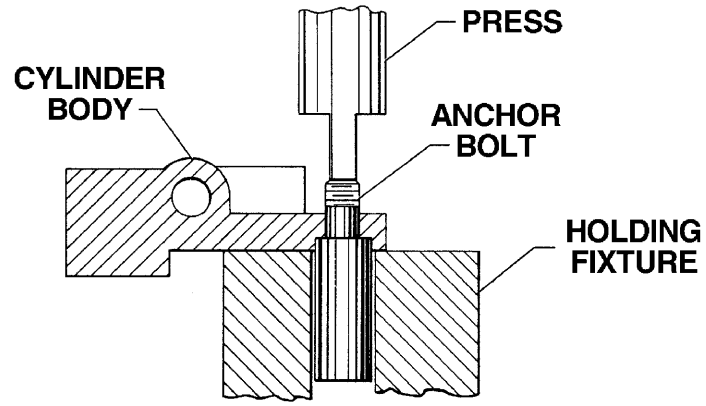
1. BRAKE CYLINDER
2. PISTON
3. O-RING
4. FRICTION SPRING
5. INSULATOR
6. PRESSURE PLATE
7. BRAKE LINING
8. RIVET
9. BACK PLATE
10. TORQUE PLATE ASSEMBLY
11. ANCHOR BOLT
12. BLEEDER SCREW ASSEMBLY



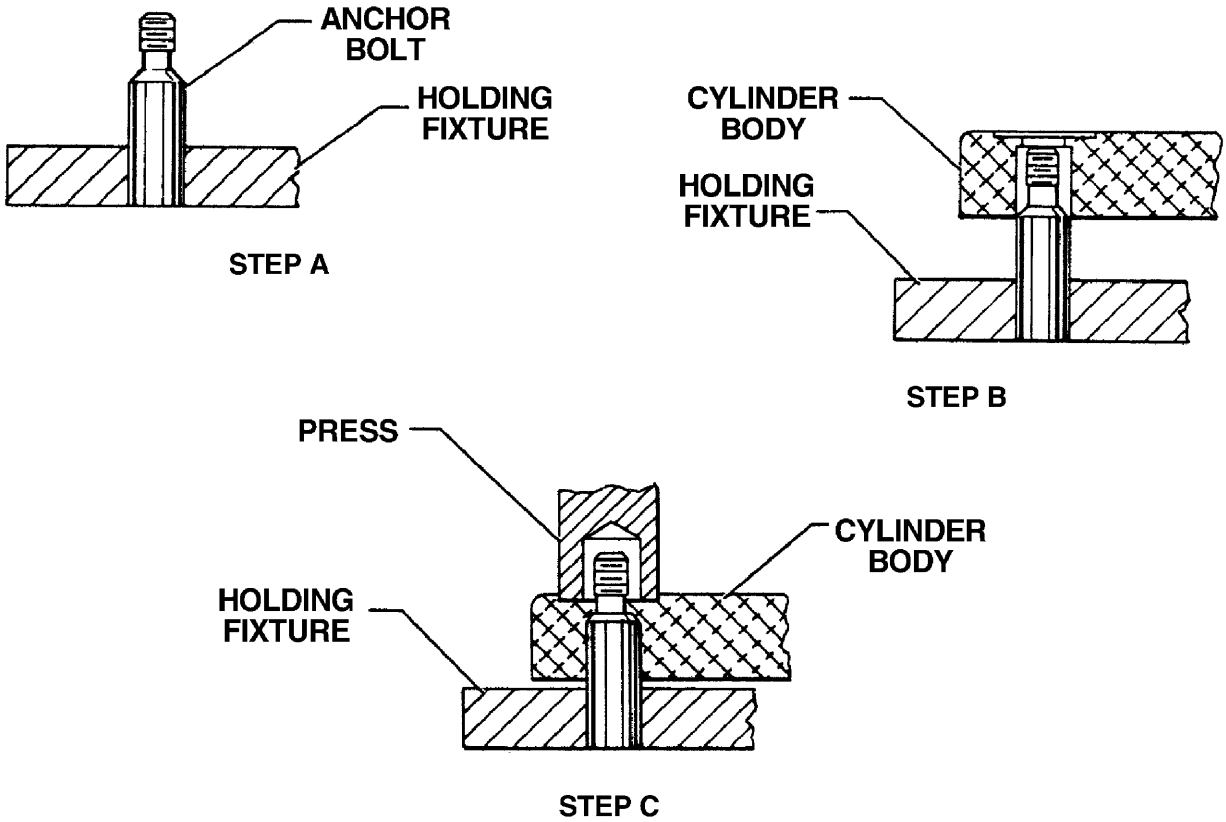


Wheel Brake Assembly
Figure 3

REMOVAL



INSTALLATION



Removal and Installation of Anchor Bolts
Figure 4

(3) Inspection

(a) Clean the assembly with a suitable solvent and dry thoroughly.

(b) Check the wall of the cylinder housing and piston for scratches, burrs, corrosion, etc., that may damage O-rings.

(c) Check the general condition of the brake bleeder screw and lines.

(d) Check the brake disc for wear, grooves, scratches or pits. The minimum disc thickness of Disc 164-46 used on heavy duty Wheel Assembly 40-120 is 0.405. A single groove or isolated grooves up to 0.030 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 0.210 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 0.400 inch. The disc should be immediately replaced if any crack extends into the welded seam between the flange and cup.

(e) 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.

C. Parking Brake Valve

(1) Removal

(a) Disconnect the parking brake cable from the valve actuating arm.

(b) Disconnect the fluid lines from the valve.

(c) Remove the screws that attach the valve to its mounting bracket.

(d) Place a protective material over the line openings to prevent contamination of the system.

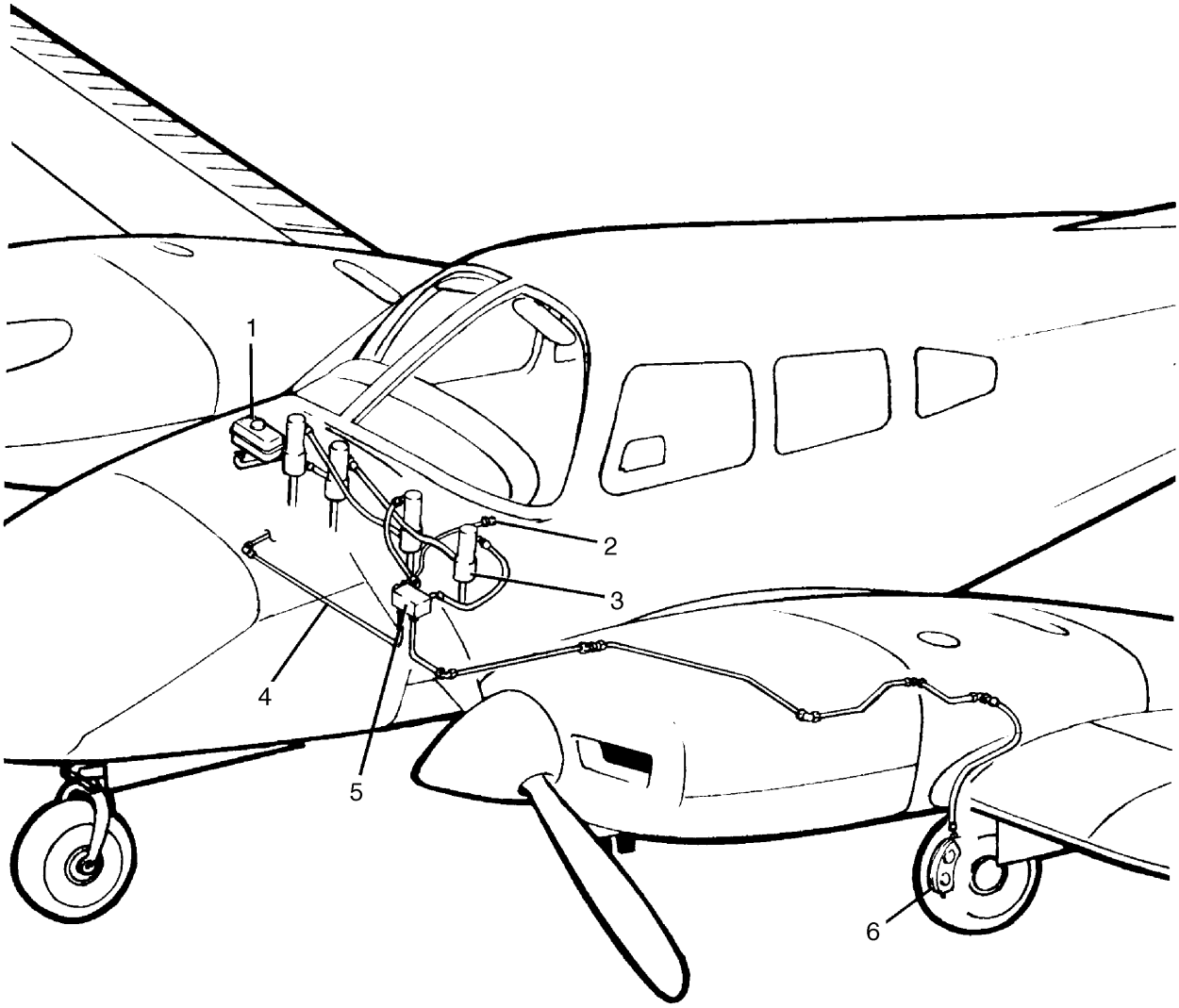
(2) Installation

(a) Attach the valve to the bulkhead mounting bracket with screws.

(b) Connect the fluid lines to the valve.

(c) Connect the control cable to valve lever and determine that when valve lever fits in the closed detent, parking brake handle is 0.03 to 0.06 inch of being full in against stop.

2312



1. RESERVOIR
2. KNOB, PARKING BRAKE
3. MASTER CYLINDERS
4. FLUID LINE
5. VALVE, PARKING BRAKE
6. BRAKE ASSEMBLY

Brake Installation
Figure 5

(3) Disassembly (See Figure 6.)

(a) 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.

(b) From the valve body, remove the valve spring and valve.

(c) To remove the valve cam, remove the nut, washer, bushing and spring and pull the cam from the valve body.

(4) Inspection

(a) Clean the valve parts with a suitable solvent and dry thoroughly.

(b) Inspect valve and seat surfaces of valve body for excessive wear and corrosion.

(c) Inspect the cam assembly for burrs, scratches, excess wear, loose operating lever, etc.

(d) Check general condition of valves and springs.

(e) Repair to the valve is largely limited to smoothing burred or scratched surfaces and replacing O-rings.

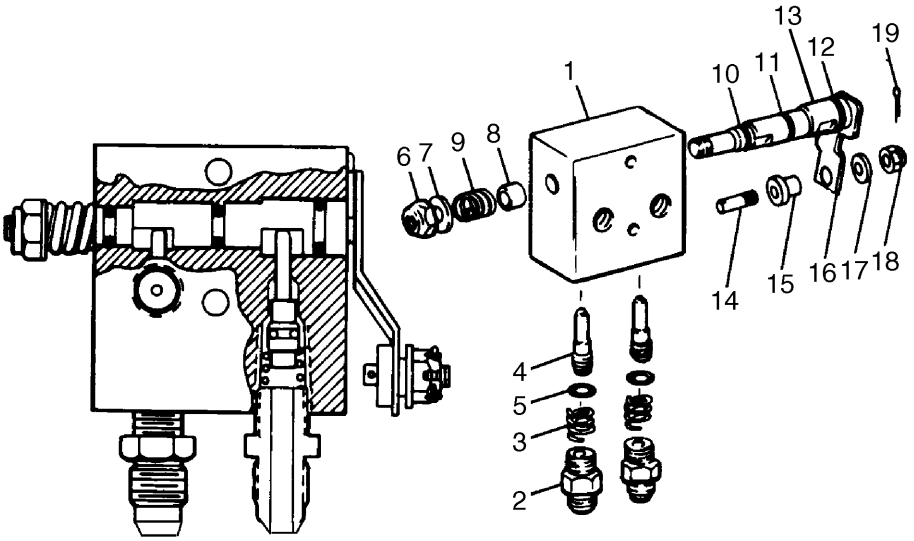
(5) Assembly (See Figure 6.)

(a) Install O-rings on valve cam.

(b) Lubricate O-rings with fluid (MIL-H-5606), insert cam into valve body and secure with spring, bushing, washer and self-locking nut.

(c) Install O-ring on the valve, insert valve in hole of out port, install valve spring and secure with outlet fitting.

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1. VALVE BODY
2. FITTING
3. SPRING
4. VALVE
5. “O” RING
6. NUT
7. WASHER
8. BUSHING
9. SPRING
10. “O” RING
11. “O” RING
12. “O” RING
13. CAM
14. STUD
15. SWIVEL
16. LEVER
17. WASHER
18. NUT
19. COTTER PIN

Parking Brake Valve Assembly
Figure 6

D. Toe Brake Master Cylinder (See Figure 7.)

(1) Removal

(a) 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.

(b) Remove cotter pins and clevis pins securing brake cylinder in position, then remove brake cylinder.

(2) Installation

(a) Position brake master cylinder at its mounting points and secure in position with clevis pin. Safety clevis pins with cotter pins.

(b) Connect brake lines to master cylinder fittings. Bleed brakes.

(3) Disassembly

(a) Gar-Kenyon master cylinder number 17000. (See Figure 8.)

1 Remove the master cylinder from its mounting bracket.

2 To disassemble the master cylinder, first remove the piston rod assembly by unscrewing the fitting from the master cylinder.

3 The piston rod assembly may be disassembled by first removing the retaining ring securing the sleeve and then removing the spring, piston, seal, fitting, and, if desired, the large return spring.

4 Remove the O-rings from the piston and fitting.

(b) Cleveland master cylinder number 10-30. (See Figure 9.)

1 Install new O-rings on the inside and outside of the packing gland and on the outside of the piston.

2 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.

3 Insert the piston rod assembly in the master cylinder and secure with the retaining ring.

4 Install the master cylinder.

(4) Inspection

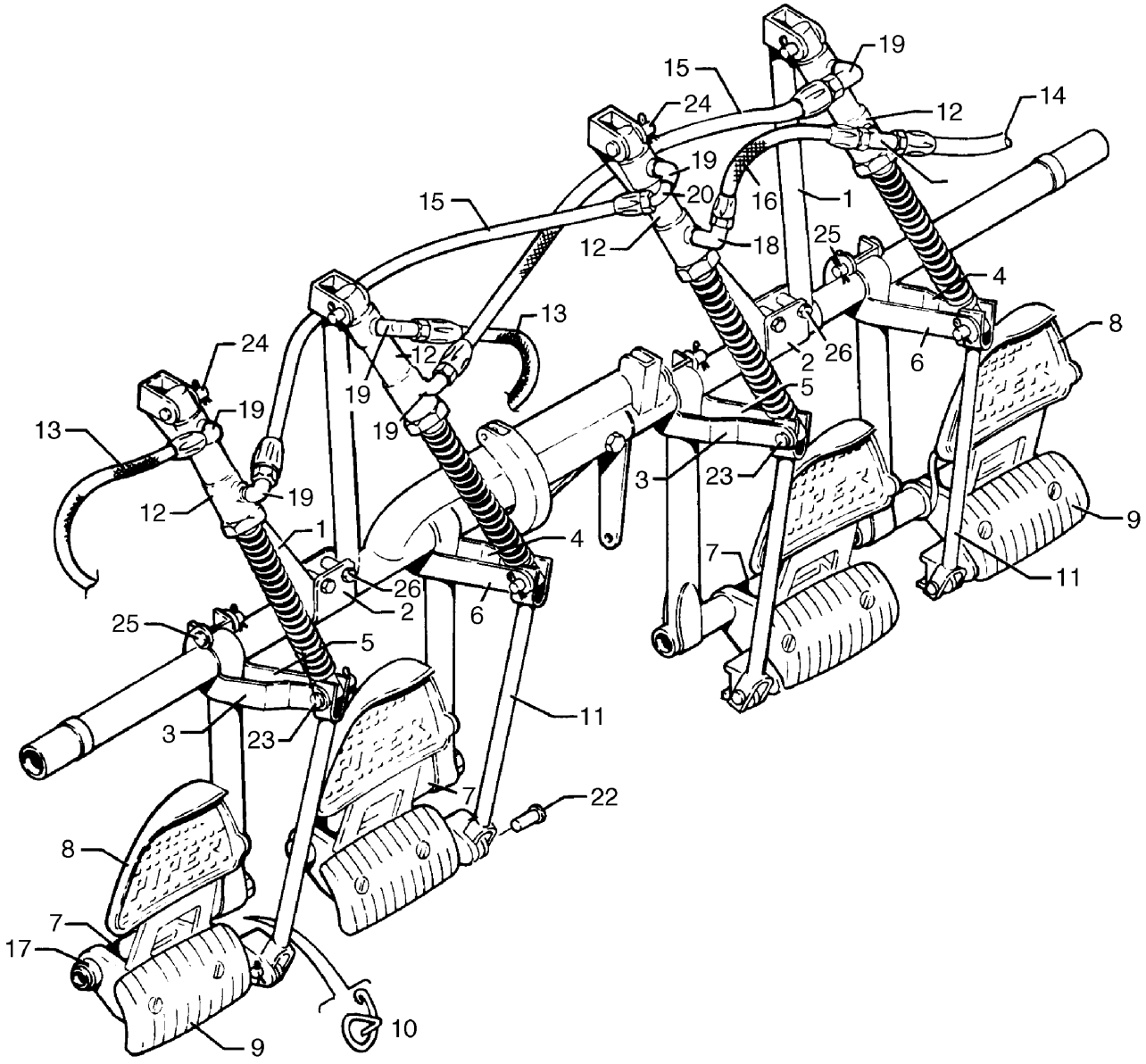
(a) Clean master cylinder components with a suitable solvent and dry thoroughly.

(b) Inspect interior walls of master cylinder for scratches, burrs, corrosion, etc.

(c) Inspect general condition of fitting threads.

(d) Inspect piston for scratches, burrs, corrosion, etc.

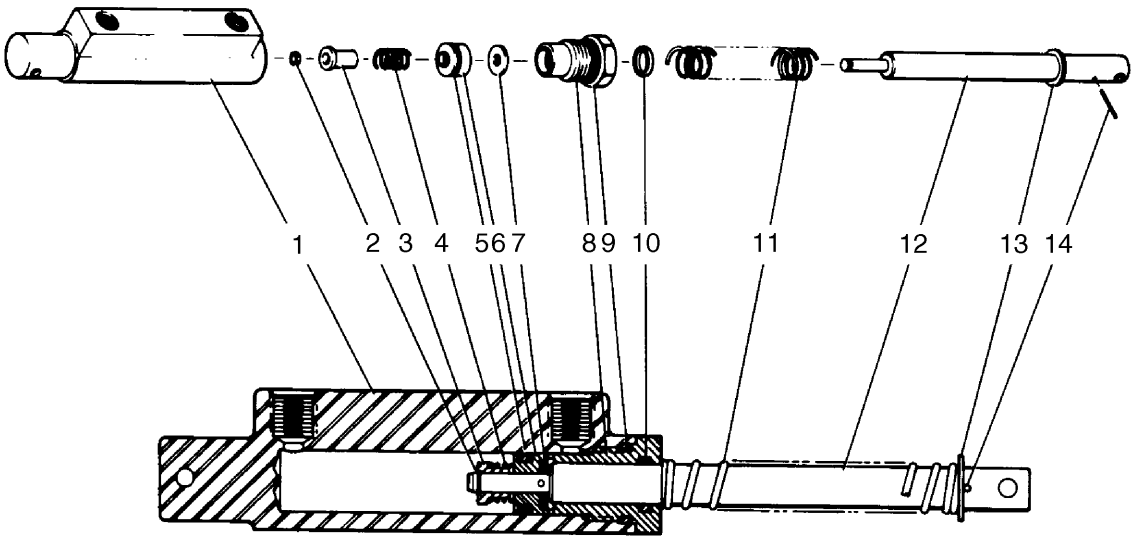
(e) Repairs to the master cylinder are limited to polishing out small scratches and burrs, and replacing seal and O-rings.



1. BRACKET ASSEMBLY
2. BRACKET
3. ARM
4. ARM
5. ARM
6. ARM
7. SPACER
8. TOE BRAKE PEDALS
9. PEDAL PADS
10. CLIP
11. CLEVIS ASSEMBLY
12. MASTER CYLINDER ASSEMBLY
13. HOSE ASSEMBLY
14. HOSE ASSEMBLY
15. HOSE ASSEMBLY
16. HOSE ASSEMBLY
17. BEARING
18. ELBOW
19. ELBOW
20. ELBOW
21. TEE
22. PIN
23. PIN
24. PIN
25. PIN
26. BOLT, WASHER AND NUT ASSY

Toe Brake Assembly
Figure 7

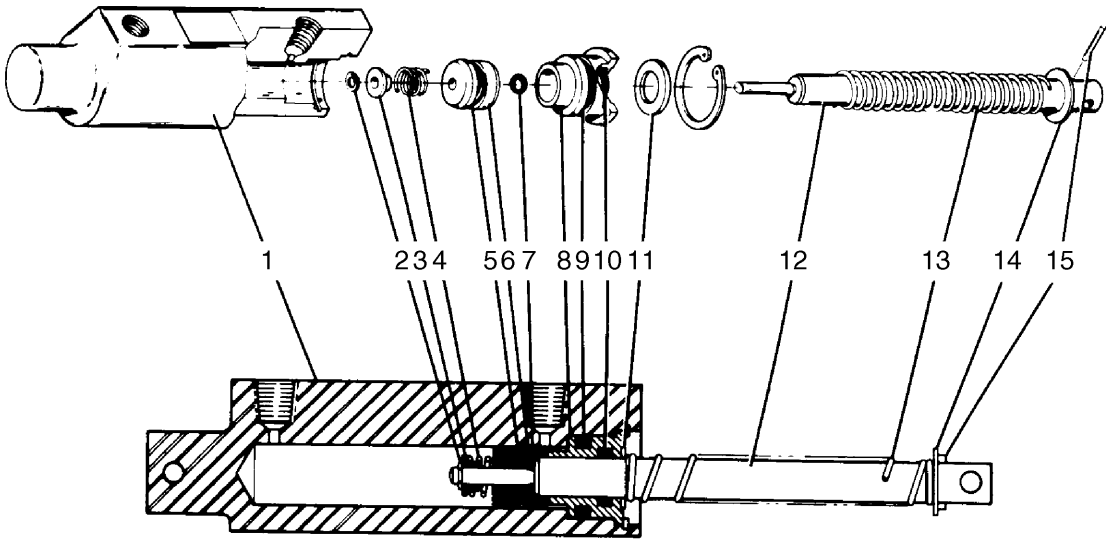
C578



1. HOUSING
2. RETAINING RING
3. SLEEVE
4. SPRING
5. O-RING
6. PISTON
7. SEAL
8. FITTING
9. O-RING
10. O-RING
11. SPRING
12. PISTON ROD
13. WASHER
14. ROLL PIN

Gar-Kenyon Toe Brake Master Cylinder (17000)
Figure 8

2637



1. HOUSING
2. RETAINING RING
3. SLEEVE
4. SPRING
5. O-RING
6. PISTON
7. O-RING
8. GLAND
9. O-RING
10. O-RING
11. WASHER WIPER
12. ROD
13. SPRING
14. WASHER
15. ROLL PIN

Cleveland Toe Brake Master Cylinder (10-30)
Figure 9

(5) Assembly (See Figures 8 and 9.)

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.

(a) Gar-Kenyon master cylinder number 17000. (See Figure 8.)

1 Install new O-rings on the inside and outside of the fitting and on the outside of the piston.

2 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.

3 Insert the piston rod assembly in the master cylinder and secure fitting.

4 Install the master cylinder.

(b) Cleveland master cylinder number 10-30. (See Figure 9.)

1 Remove the master cylinder from its mounting bracket.

2 To disassemble the master cylinder, first remove the piston rod assembly by removing the retaining ring from the annular slot in the master cylinder housing. Draw the piston rod assembly from the master cylinder.

3 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.

4 Remove the O-rings from the piston and packing gland.

E. Bleeding Brakes

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.

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POSITION AND WARNING

1. Landing Gear Limit Switches

NOTE: All adjustments of the limit switches should be made with the airplane on jacks. When adjustments are complete, safety wire each limit and squat switch.

A. Main Gear Limit Switches

(1) Up Limit Switch Adjustment

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 0.88 of an inch of full up. Switch operation turns the red gear unsafe light out.

(2) Down Limit Switch Adjustment (See Figure 1.)

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 0.025 to 0.035 of an inch of contacting the downlock pin. (See Down Lock Rigging, Figure 1.)

Adjust as follows:

(a) Ascertain that the main gear downlock is properly adjusted.

(b) Raise the airplane on jacks. (See 7-10-00.)

(c) Ascertain that the landing gear is down and pressure is relieved from the hydraulic system. To relieve pressure, hold down the emergency extender lever.

(d) Raise the downlock hook assembly and place a .030 of an inch feeler gauge between the horizontal surface of the hook (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.

(e) Loosen the locking nuts of the switch and, while pushing up on the center of the link assembly, screw the switch toward the hook until it is heard to actuate. Retighten the locking nuts of the switch.

(f) 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 0.025 to 0.035 of an inch of full lock.

(g) 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.

B. Nose Gear Limit Switches (See Figure 2.)

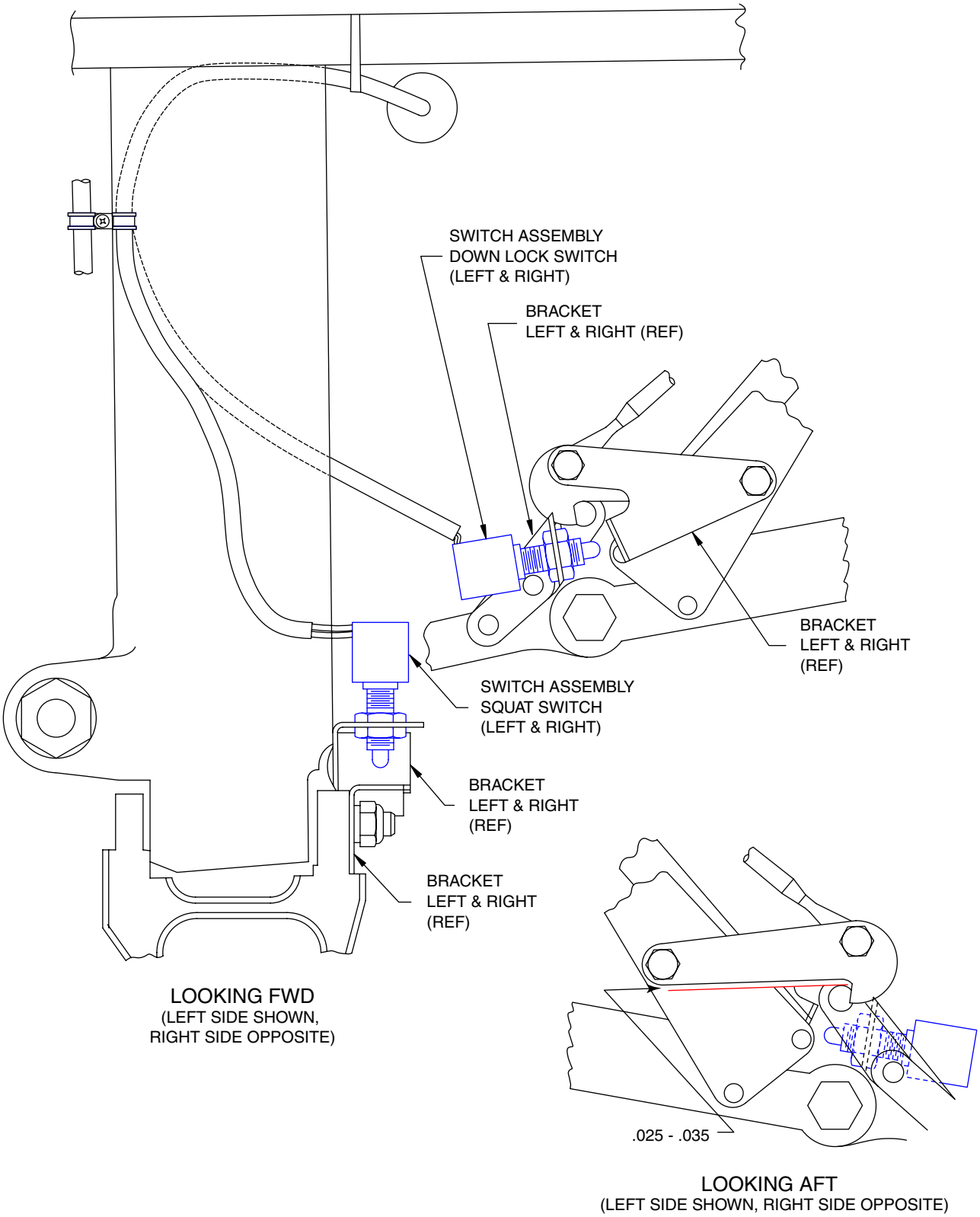
The nose gear up and down limit switches are located on the right nose cone spar assembly and are mounted either side of fuselage station 24.00.

(1) To facilitate adjustment of the switches, disconnect the gear doors.

(2) With the aircraft placed on jacks (see 7-10-00), 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.

(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 nose gear 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.



Main Gear Down Limit and Squat Switches
Figure 1

(5) Turn the master switch on and raise the nose gear and remove the block from under the nose gear.

(6) Cycle the gear and determine that the gear lights function properly.

2. Landing Gear Safety Squat Switch Adjustment

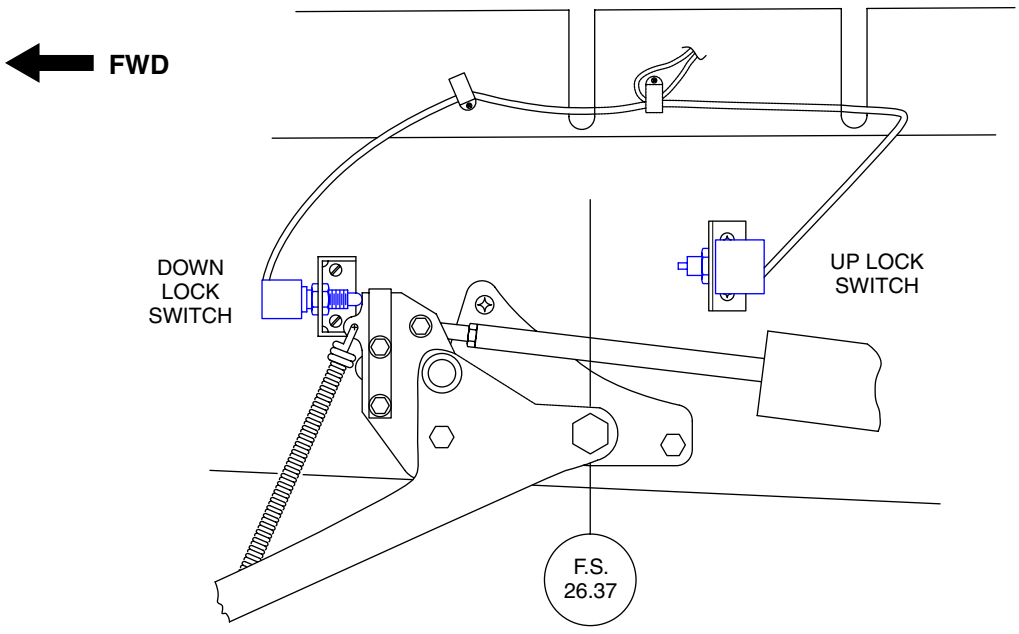
The landing gear safety squat switch, located on the left main gear housing, is adjusted so that the switch is actuated within the last quarter of an inch of gear extension.

NOTE: The squat switch on the right main gear is connected to the flight hour meter and is rigged / adjusted the same as the landing gear safety squat switch.

A. Compress the strut until 7.875 in. is obtained between the top of the gear fork and the bottom of the gear housing. Hold the gear at this measurement.

B. Adjust the switch down until it actuates at this point. Secure the switch.

C. Extend and then compress the strut to ascertain that the switch will actuate within the last quarter of an inch of oleo extension.



LOOKING OUTBOARD FROM A/C CENTERLINE

Nose Gear Limit Switches
Figure 2

3. Gear Up/Power Reduced Warning Switches (PIR-FTP2001-7, Rev. D)

Two different landing gear up/power reduced warning systems are installed. In S/N's 4496001 thru 4496216, microswitches are installed in the throttle quadrant to detect the power levers being retarded; in S/N's 4496217 and up, transducers in both manifold pressure lines detect reduced power.

In either case, a warning horn is activated when the landing gear are up and power is reduced below approximately 14 in.-hg. manifold pressure.

A. S/N's 4496001 thru 4496216. (See Figure 3.)

(1) Switch Location

The landing gear up power reduced warning switch is located in the control quadrant behind the throttle stop plate.

(2) Adjustment

When adjusting switch fly the airplane at approach speed 1000 ft. AGL. (See the Pilot's Operating Handbook.)

Use the following procedure:

(a) With the aid of a qualified pilot, fly the airplane to an elevation of 1000 ft. above the ground and come to approach speed with propellers set for high rpm. Retard the throttles to 14 ± 2 in.-hg. 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.

(b) Place the airplane on jacks and retract the landing gear.

(c) Position the throttle levers at the location marked during the flight (i.e. - 14 ± 2 in.-hg. of manifold pressure).

(d) 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 gear warning annunciator light illuminate. Tighten the mounting screws.

(e) With the warning horn operating, depress GEAR WARN MUTE switch. Check that the warning horn stops sounding and that the GEAR WARN MUTE light illuminates.

(f) Advance throttles to a power setting in excess of 14 ± 2 in.-hg. of manifold pressure. Check that MUTE light extinguishes. Check that warning system is rearmed by retarding throttle levers to 14 ± 2 in.-hg. of manifold pressure, activating alarm horn.

(g) With the warning horn sounding, lower the landing gear. Check that the horn ceases to operate when the gear are down and locked.

(h) Advance throttles levers beyond the position which gave the 14 ± 2 in.-hg. of manifold pressure. Retract the landing gear.

(i) Reposition the throttle levers at the location marked during the flight (i.e. - 14 ± 2 in.-hg. of manifold pressure). Check that the warning horn sounds.

(j) With the warning horn operating, depress GEAR WARN MUTE switch. Check that the warning horn stops sounding and that the GEAR WARN MUTE light illuminates.

(k) Extend the landing gear. Check that the GEAR WARN MUTE light extinguishes. Remove airplane from jacks.

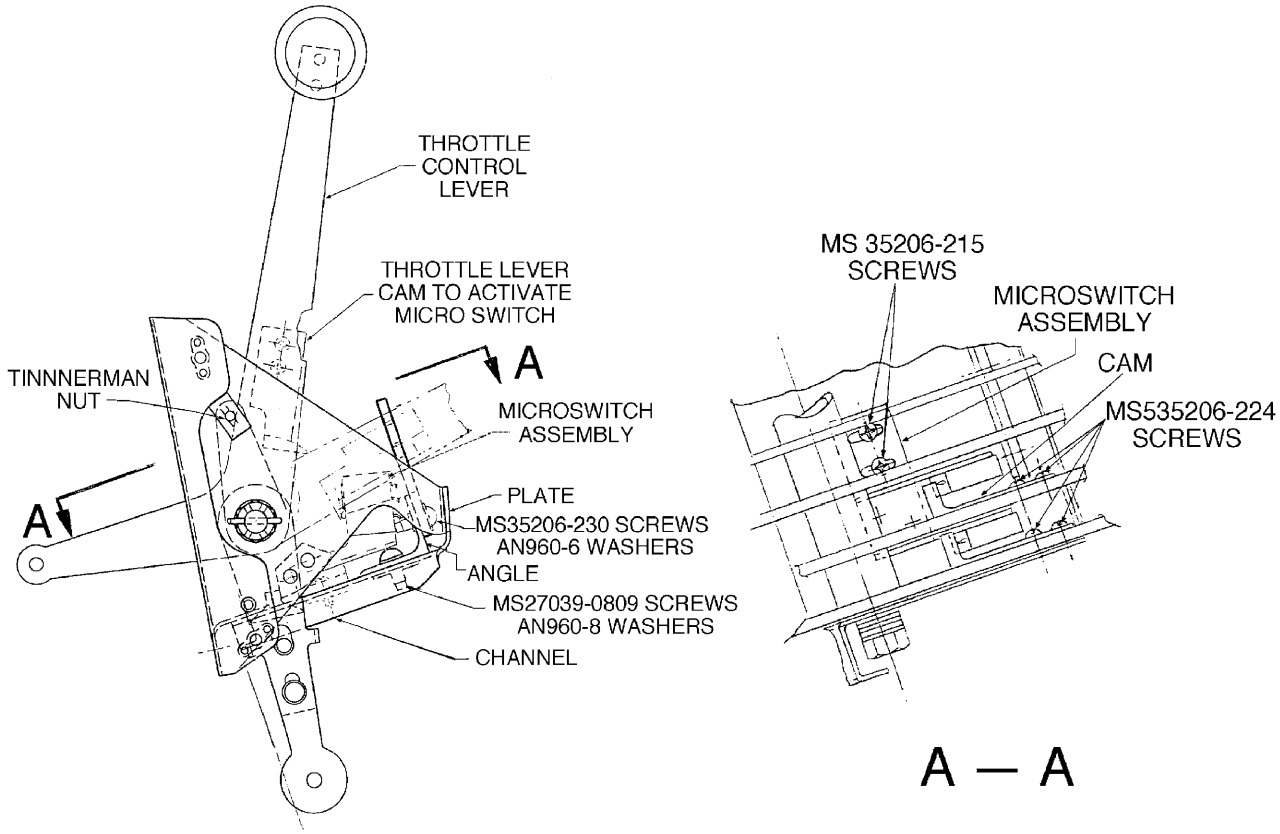
(l) Flight test the airplane to insure proper operation of the gear warning horn with the gear up and power reduced below 14 ± 2 in.-hg. of manifold pressure.

(3) Replacement

When replacing the microswitch assembly, determine how many washers are positioned between the microswitch and the bracket so that an equal amount are used during installation. The switch, when properly positioned, should be in the middle of the cams located on each throttle control lever.

B. S/N's 4496217 and up.

A manifold pressure switch, located on the inboard aft side of the firewall in each engine nacelle, activates the warning horn when power in either engine is reduced below 14 ± 2 in. manifold pressure. No adjustment required.



Throttle Warning Switches
Figure 3

Effectivity
4496001 thru 4496216

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CHAPTER

33

LIGHTS

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CHAPTER 33

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CHAPTER 33 - LIGHTS

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GENERAL

1. Description and Operation

   Interior lighting consists of post lights and internally lighted avionics and switches. Radio, panel and switch lights are controlled by rheostat switches located below the pilot's control column. A floodlight, mounted in the overhead panel, provides additional instrument and cockpit lighting for night flying. The light is controlled by a rheostat switch located adjacent to the light. A map light window in the lens is actuated by an adjacent switch.

   Exterior lighting systems include white landing/taxi lights in the nose cone, red and green navigation lights in the wing tips, white strobe/anti-collision lights, and recognition lights. The wing tip recognition light system consists of two white lights; one in each wing tip.

2. Troubleshooting

   When checking the lighting system, the MASTER SWITCH must be ON for the lights to operate. For the light circuit being checked, confirm that the circuit breaker protecting that light is pushed IN. If the light still fails to operate, replace the bulb.

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FLIGHT COMPARTMENT

Flight compartment lighting comprises instrument panel post and case lighting with a dimmer control, overhead flood light, compass light, and a cabin light.

Instrument and Panel Lights

A. Annunciator Panel - Bulb Replacement

(1) Standard

Bulb replacement 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, do the following:

(a) Pull the lens out of the annunciator panel.

(b) Withdraw the defective bulb from the lens and replace with a new bulb.

(c) Align the key on the lens with the key way on the annunciator panel socket

(d) Press the lens into position.

(2) Optional

In S/N's 4496174; and 4496224 and up, with the optional Avidyne Entegra EFIS installed, without removing the annunciator panel, simply push in on the function light until it "clicks," then release pressure. The cover assembly will be partially ejected from the lamp base assembly. Pull the cover from the base and rotate to expose the lamp bulb. Replace defective bulb and reverse removal procedure. Depress "test" function to verify lamp function.

B. Dimmer Control Unit

(1) Removal

Access to the dimmer control assembly is from beneath the instrument panel.

(a) Master Switch off.

(b) Disconnect the electrical connector from the assembly.

(c) Remove the two screws securing the assembly to the instrument panel.

(d) Remove the assembly from the airplane.

(2) Installation

(a) Master switch off.

(b) Position the assembly in the instrument panel (with the control knobs inserted into their appropriate slots).

(c) Secure assembly with the two screws.

(d) Connect the electrical harness connector to dimmer assembly.

(e) Master switch on.

(f) Check operation of dimmer control assembly.

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EXTERIOR

1. General

The exterior lighting consists of recognition lights, navigation lights, anti-collision strobe lights, and nose cone landing taxi lights.

2. Landing/Taxi Lights

NOTE: Check and make sure that the ends of the bonding strap are securely attached: both to the light mounting bracket in the nose cone; and, to the fuselage.

A. Removal

(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.

B. Installation

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.

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.

3. Recognition Lights

A recognition light is installed in the outboard leading edge of each wing, between W. S. 209.72 and W. S. 215.48. To replace the lamp assembly:

A. Remove the 10 screws and washers securing the clear acrylic lens to the wing. Note that the two inboard screws also secure the shield in place.

B. Remove the Socket Head Cap Screw and washer located in the bottom center of the lamp assembly.

C. Remove lamp assembly far enough to gain access to plug connector P119 (left wing) or P219 (right wing)

D. Disconnect plug connector and remove lamp assembly.

NOTE: Do not permit bulb to come in contact with skin as oil from skin will shorten bulb life. Should accidental contact be made, wipe bulb with a clean, soft cloth prior to first illumination.

E. Connect new lamp assembly to plug connector.

F. Position lamp lamp assembly in appropriate location. Align screw hole on bottom of lamp assembly with Tinnerman nut in bracket.

G. Secure lamp with the Socket Head Cap Screw and washer.

CAUTION: DO NOT OVER TORQUE SCREWS. OVER TORQUING WILL CAUSE CRACKING AROUND HOLES IN ACRYLIC LENS.

H. Position acrylic lens and shield in place. Secure with the 10 screws and washers.

4. Anti-Collision Strobe Lights

These lights are located in the wing tips and are part of the same assembly as the red and green navigation lights. The anti-collision strobe lights are rated to flash at approximately 45 to 50 times a minute and are both supplied by one power supply.

A. Removal

WARNING: HIGH VOLTAGE – MAKE CERTAIN THE MASTER SWITCH IS OFF WHEN WORKING ON THE STROBE LIGHTS.

(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.

B. Installation

(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 schematics 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.

C. Troubleshooting

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, then discharges across the xenon flash tube at intervals of approximately 45 to 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, determined if the trouble is in the flash tube or the power supply. Replacement of the flash tube will confirm if the tube is defective. A normally operating power supply will emit a 1 to 1.5 kHz audible tone. If there is no sound emitted, check the system according to the following instructions. When troubleshooting the system, utilize the appropriate schematics in Chapter 91. The power supply is accessible through the access panel in the baggage compartment, aft of F.S. 191.000.

CAUTION: WHEN CONNECTING THE POWER SUPPLY INPUT, DO NOT REVERSE CONNECTIONS. REVERSED POLARITY OF THE INPUT VOLTAGE, FOR JUST AN INSTANT, WILL DESTROY A PROTECTIVE DIODE IN THE POWER SUPPLY, CAUSING IT TO SELF-DESTRUCT FROM OVERHEATING. THIS DAMAGE IS SOMETIMES NOT IMMEDIATELY APPARENT, BUT WILL CAUSE FAILURE OF THE SYSTEM IN TIME.

(1) Ensure the input voltage at the power supply is 14 V.

(2) Check for malfunction in interconnecting cables.

NOTE: A short of the type described in Steps 3 and 4 will not cause permanent damage to the power supply, but will render the system inoperative.

(3) Check that pins 1 and 3 of interconnecting cable are not reversed.

(4) Using an ohmmeter, check for a short between Pin 1 and 3 of interconnecting cable. If a reading is obtained on the meter, the cable is shorted and must be replaced.

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) Use an ohmmeter to make the following continuity checks:

(a) 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. If no continuity exists, the cable is broken and must be replaced.

CAUTION: ANY CONNECTION BETWEEN PINS 1 AND 2 OF THE INTERCONNECTING CABLE WILL DISCHARGE THE CONDENSER IN THE POWER SUPPLY AND DESTROY THE TRIGGER CIRCUITS.

(b) 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 must be replaced.

(8) Check the tube socket assembly for shorts.

(9) Disconnect the tube socket assembly of the anti-collision light from the interconnecting cable.

(10) Using an ohmmeter, 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.

D. Strobe Power Supply

(1) Removal

(a) Remove the access panel in the baggage compartment to gain access to the power supply.

(b) Disconnect the electrical plugs and make note of their placement to facilitate reinstallation.

(c) Disconnect the other electrical leads and label them to facilitate reinstallation.

(d) Remove the four screws securing the power supply to the plate and remove the supply.

(2) Installation

(a) Secure the power supply to the plate with the four screws previously removed.

CAUTION: BEFORE APPLYING POWER, MAKE CERTAIN ALL ELECTRICAL CONNECTIONS ARE CORRECTLY MADE WITHOUT INTERCHANGING ANY LEADS .

(b) Connect the electrical leads to the proper terminals. (Refer to the strobe power supply schematics in Chapter 91.)

(c) Connect the electrical plugs (left wing, right wing) to corresponding receptacles.

(d) Replace access panel on the fuselage in the baggage compartment.

(e) Turn on master switch and strobe lights to ensure proper operation.

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CHAPTER

34

NAVIGATION

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CHAPTER 34

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GENERAL

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.

Description and Operation

A. Standard

(1) Pitot and static air sources supply both pitot and static pressure for the airspeed indicator; and static pressure for the altimeter and vertical speed indicator.

(2) A vacuum system consisting of an engine driven vacuum pump supplies negative air pressure to operate the:

(a) Attitude Deviation Indicator (ADI) (i.e. - Artificial Horizon), and

(b) Directional Gyro (DG) or Horizontal Situation Indicator (HSI).

NOTE: Both the ADI and DG require 4.8 to 5.2 in. HG. negative pressure for proper rotor speed. An annunciator (VACUUM INOP) will illuminate should the negative pressure decrease to 3.5 in. HG. The annunciator will extinguish when the electric auxiliary vacuum pump is turned on and the negative pressure increases to more than 3.5 in. HG.

(3) A windshield mounted outside air temperature (OAT) gauge.

(4) A Magnetic Compass.

(5) An electrically operated Turn Coordinator.

B. Optional

In S/N's 4496174; and, 4496224 and up, the Avidyne Entegra Electronic Flight Instrument System (EFIS) is available as an option.

(1) A fully-integrated, solid-state Air Data and Attitude/Heading Reference System (ADAHRS) is contained within the EFIS Primary Flight Display (PFD). The ADAHRS uses a 3-axis solid state gyro and accelerometer system to provide Roll, Pitch, and Heading data to the PFD's Electronic Atitude Deviation Indicator (EADI) and Electronic Horizontal Situation Indicator (EHSI) display modes.

(2) Standard pitot and static air sources supply both pitot and static pressure to the ADAHRS which then displays airspeed, altitude, and vertical speed data on the PFD.

(3) A magnetometer / OAT assembly provides magnetic heading and outside air temperature data.

(4) Standby electro-mechanical flight instruments (i.e. - airspeed, altimeter, and electric attitude indicator) provide redundancy. (See 34-20-00, Figure 2.)

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FLIGHT ENVIRONMENT DATA

1. Pitot/Static System (See Figure 1.)

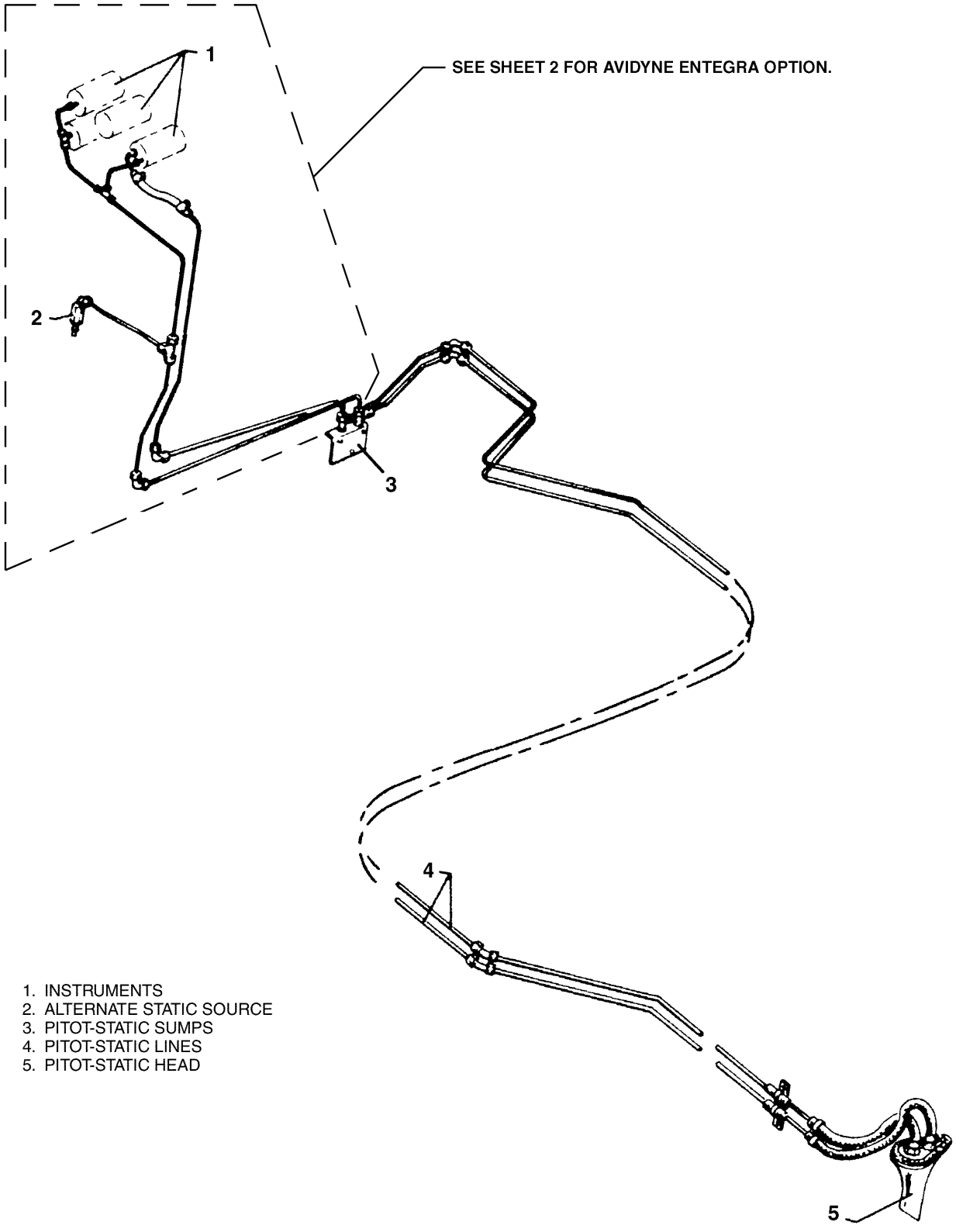
   A. The pitot air system consists of a pitot mast on the underside of the left wing with its related plumbing. Impact air pressure entering the pitot is transmitted from the pitot inlet through hose and tubing routed through the wing to the airspeed indicator (and Avidyne Entegra PFD, if installed) on the instrument panel. A partially or completely blocked pitot head will result in erratic or zero instrument readings.

   B. The static air system consists of a static port on the underside of the pitot static mast. The port is connected to the airspeed indicator, altimeter, and vertical speed indicator (and Avidyne Entegra PFD, if installed) by hose and tubing routed through the wing.

   C. An alternate static air source is located below the instrument panel in front of the pitot. It incorporates a shutoff valve to close the port when not needed.

   D. Pitot and static lines are drained through separate drain valves on the left lower side of the fuselage interior.

      NOTE: If any connections in static system are opened for maintenance, the entire system must be rechecked per FAR 23.1325.

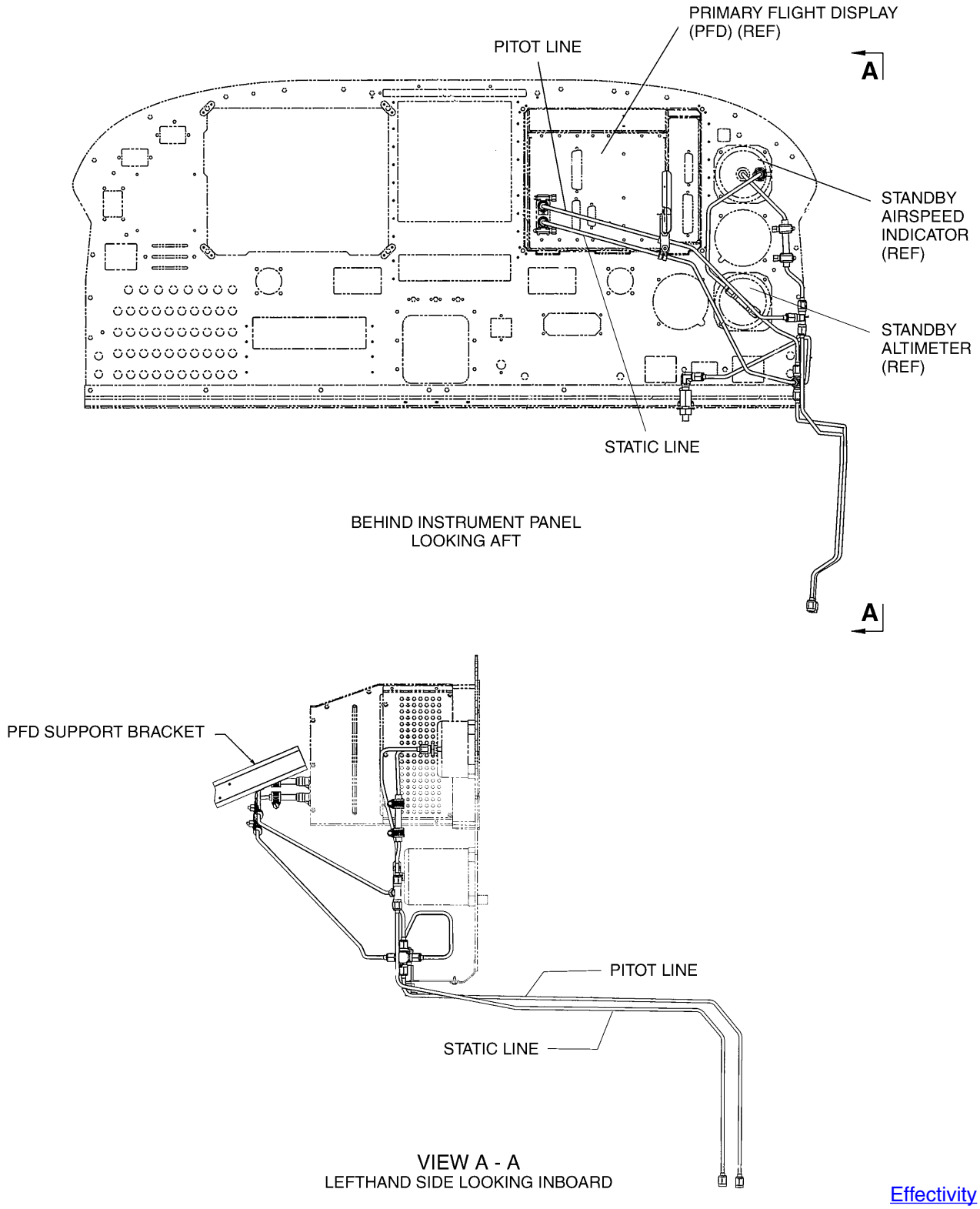


1. INSTRUMENTS
2. ALTERNATE STATIC SOURCE
3. PITOT-STATIC SUMPS
4. PITOT-STATIC LINES
5. PITOT-STATIC HEAD

Effectivity
4496001 and up

Pitot Static System
Figure 1 (Sheet 1 of 2)

86194 AA



VIEW A - A
LEFTHAND SIDE LOOKING INBOARD

Pitot Static System
Figure 1 (Sheet 2 of 2)

Effectivity
4496174; and,
4496224 and up
with Avidyne Entegra Option

2. Vertical Speed Indicator

NOTE: In S/N's 4496174; and, 4496224 and up, when the optional Avidyne Entegra EFIS is installed, this function is provided in the Primary Flight Display (PFD).

A. Description and Operation

The vertical speed indicator measures rate of change in static pressure when the airplane is established in a climb or descent. A pointer and dial will show the airplane's rate of climb or descent in feet per minute. Due to instrument lag, the airplane will be climbing or descending before the instrument starts to indicate. The instrument will continue to indicate a climb or descent after the airplane is level. Thus, the instrument is unreliable in rough air. This lag is not considered a malfunction.

B. Troubleshooting

See Chart 1.

NOTE: If any connections in static system are opened for maintenance, the entire system must be rechecked per FAR 23.1325.

CHART 1
TROUBLESHOOTING VERTICAL SPEED 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 head frozen over. Water in static line.	Check individual instruments for obstruction in lines.
	Obstruction in pitot head.	Clean lines and head.
Pointer oscillates.	Leaks in static lines.	Disconnect all instruments connected to the static line. Check individual instruments for leaks. Reconnect instruments to static line and test installation for leaks.
	Defective mechanism.	Replace instrument.
Rate of climb indicates when aircraft is banked.	Water in static line.	Disconnect static lines and blow out lines from cockpit out to pitot head.
Pointer cannot be reset to zero.	Diaphragm distorted.	Replace instrument.
Instrument reads very low during climb or descent.	Case of instrument broken or leaking.	Replace instrument.

3. Altimeter

A. Description and Operation

The altimeter indicates pressure altitude in feet above sea level. The indicator has three pointers and dial scale, the long pointer is read in hundreds of feet. the middle pointer in thousands of feet and the short pointer in ten thousands 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 comer 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.

B. Troubleshooting

See Chart 2.

NOTE: If any connections in static system are opened for maintenance, the entire system must be rechecked per FAR 23.1325.

CHART 2 (Sheet 1 of 2)
TROUBLESHOOTING ALTIMETER

Trouble	Cause	Remedy
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism.	Replace instrument.
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 pitot head.
Altimeter changes reading as aircraft is banked.	Water in static line.	Remove static lines from all instruments, and blow line clear from cockpit to pitot head.
High or low reading.	Improper venting.	Eliminate leak in static pressure system and check alignment of airspeed tube.
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 when reset.	Tighten instrument screw, if loose. Replace instrument, if screw is missing.
Cracked or loose cover glass.	Case gasket hardened.	Replace instrument.

CHART 2 (Sheet 2 of 2)
TROUBLESHOOTING ALTIMETER

Trouble	Cause	Remedy
Dull or discolored markings.	Age.	Replace Instrument
Barometric scale and reference markers out of synchronism.	Slippage mating parts.	Replace Instrument.
Barometric scale and reference markers out of synchronism with pointers.	Drift in mechanism.	See latest revision of AC43.13-1.

4. Airspeed Indicator

A. Description and Operation

The airspeed indicator provides a means of indicating the speed of the airplane passing through the air. The airspeed indication is the differential pressure reading between pitot air to 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.

B. Troubleshooting

See Chart 3.

NOTE: If any connections in static system are opened for maintenance, the entire system must be rechecked per FAR 23.1325.

CHART 3
TROUBLESHOOTING AIRSPEED INDICATOR

Trouble	Cause	Remedy
Pointers of static instruments do not indicate properly.	Leak in instrument case or in pitot lines.	Check for leak and seal.
Pointer of instrument oscillates.	Defective mechanism.	Replace instrument.
Instrument reads high.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
Instrument reads low.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
	Pitot head not aligned correctly.	Realign pitot head.
Airspeed changes as aircraft is banked.	Water in pitot line.	Remove lines from static instruments and blow out lines from cockpit to pitot head.

5. Outside Air Temperature (OAT) Gauge

A. Standard (See Figure 2.)

(1) Description and Operation

An OAT inicator is mounted in the pilot's windshield and is a simple direct measuring thermometer. Although unlit internally, the dial is finished in flourescent luminescent paint.

(2) Removing and Installing

CAUTION: DURING INSTALLATION OF ALL OAT'S, ONLY FINGER TIGHTEN GAUGE AND EXTERNAL THREADED HEX TUBE (SUNSHIELD). OVER-TORQUING WILL DAMAGE INSTRUMENT.

(a) Remove external sunshield by turning it counterclockwise. Turn by hand only.

(b) Remove bushing on outside of windshield by sliding it off of threaded shaft. Note position of any washers or spacers.

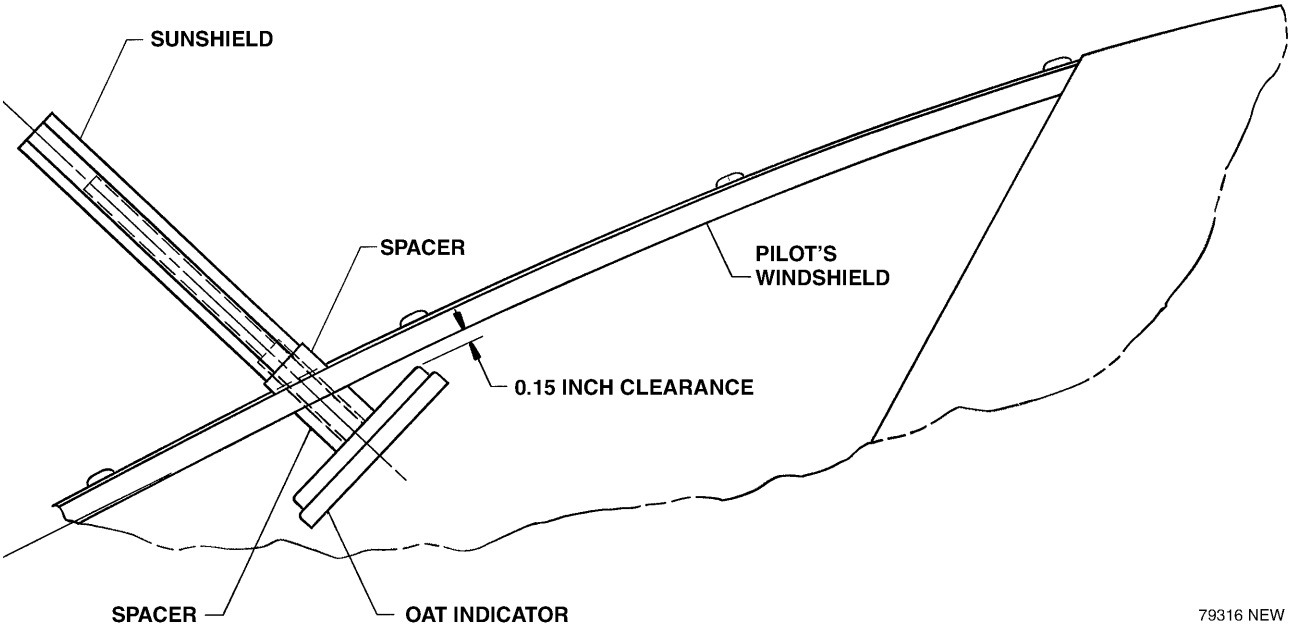
(c) Remove gauge and inner bushing by pulling gauge through windsield from inside the airplane.

(d) Install new gauge in reverse sequence. Check that tapered face on inner and outer bushings are positioned properly against windshield. Check gauge position before hand tightening sunshield.

B. Optional

In S/N's 4496174; and, 4496224 & up, with the optional Avidyne Entegra EFIS installed; OAT is provided by the Magnetometer / OAT Sensor Assembly (Mag/OAT) mounted in the underside of the outboard left wing, which feeds temperature data to the Primary Flight Display (PFD) and Multifunction Display (MFD).

See Electronic Flight Instrument System and Magnetometer in 34-20-00 for additional information.



OAT Installation - Standard
Figure 2

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ATTITUDE AND DIRECTION

1. Attitude Deviation Indicator (ADI)

A. Description and Operation

The gyro horizon is essentially an air driven gyroscope rotating in a horizontal plane and is operated by the same principal as the directional gyro. Due to the gyroscopic inertia, the spin axis continues to point in the vertical direction, providing a constant visual reference to the attitude of the airplane relative to pitch and roll axis. A bar across the face of the indicator represents the horizon and aligning the miniature airplane to the horizon bar simulates the alignment of the airplane to the actual horizon. Any deviation simulates the deviation of the airplane from the true horizon. The gyro horizon is marked for different degrees of bank.

B. Troubleshooting

See Chart 1.

CHART 1
TROUBLESHOOTING ATTITUDE DEVIATION INDICATOR

Trouble	Cause	Remedy
Bar fails to respond.	Insufficient vacuum.	Check pump and tubing.
	Filter dirty.	Clean or replace filter.
Bar does not settle.	Insufficient vacuum.	Check line and pump. Adjust valve.
	Incorrect instrument.	Check part number.
	Defective instrument.	Replace.
Bar oscillates or shimmies continuously.	Instrument loose in panel.	Tighten mounting screws.
	Vacuum too high.	Adjust valve.
	Defective mechanism.	Replace instrument.
Instrument tumbles in flight.	Low vacuum.	Reset regulator.
	Dirty filter.	Clean or replace filter.
	Line to filter restricted.	Replace line.
	Plug missing or loose in instrument	Replace or tighten plug.
Instrument does not indicate level flight.	Instrument not level in panel.	Loosen screws and level instrument.
	Aircraft out of trim.	Trim aircraft.
Bar high after 180° turn.	Normal, if it does not exceed 1/16 inch.	

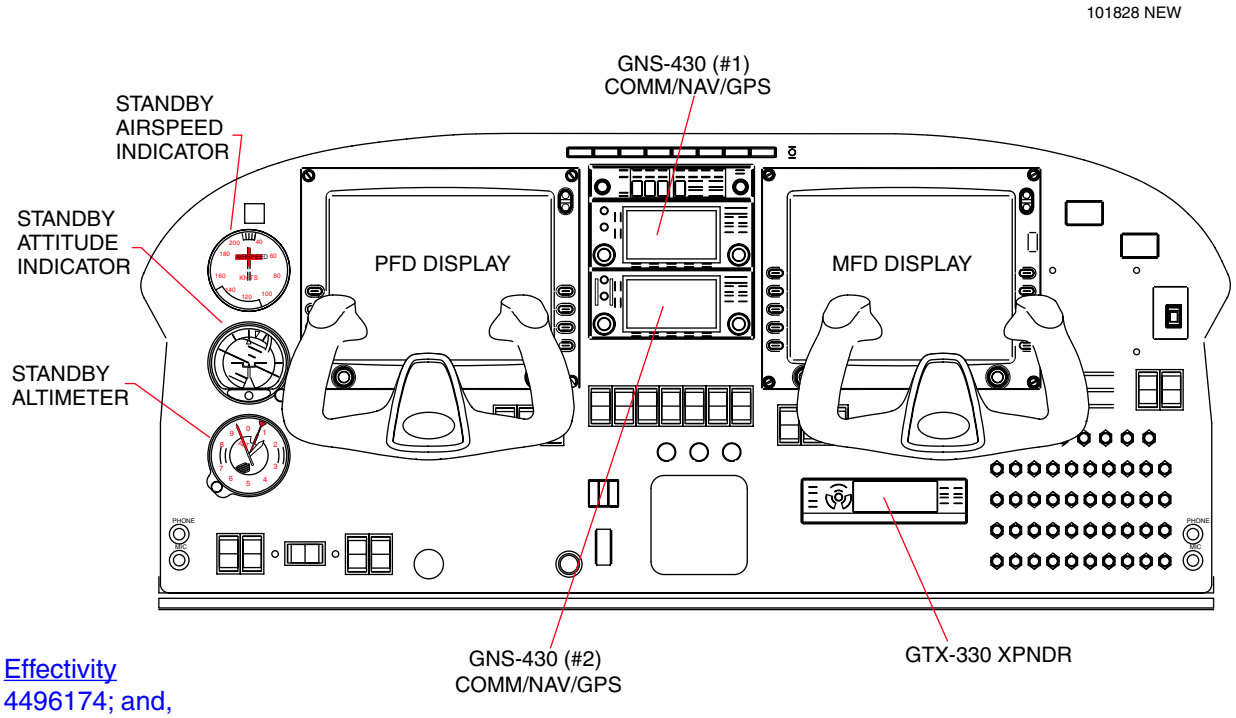
2. Standby Attitude Indicator

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

In S/N's 4496174; and, 4496224 and up, with the optional Avidyne Entegra Electronic Flight Instrument System installed; an electric standby attitude indicator is installed to the left of the Primary Flight Display (PFD).

Other than removing and replacing the unit itself (see 39-10-00), the only line replaceable part is the emergency power battery which is located in the rear of the instrument's case. See Figure 2.

Required periodic maintenance is listed in 5-20-00 and 5-30-00. Checkout and test procedures and Instructions for Continued Airworhiness are provided in Mid-Continent Instruments Manual No. 9015762.



Effectivity
4496174; and,
4496224 and up
with Avidyne Entegra Option

EFIS Instrument Panel (Optional)
Figure 1

3. Electronic Flight Instrument System (EFIS)

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.

The Avidyne Entegra Electronic Flight Instrument System (EFIS) is available as an option in S/N's 4496174; and, 4496224 and up.

A. Description (See Figures 1, 2, 3 and 4.)

This system uses two large 10.4-inch diagonal, high-resolution, sunlight-readable full color displays (PFD and MFD), to provide primary flight and engine information as well as a wide variety of other data. Standby electromechanical flight instruments (i.e. - airspeed, electric attitude indicator, and altimeter) provide redundancy.

The EFIS installation consists of the following components: Primary Flight Display (PFD), Multifunction Display (MFD), Data Acquisition Unit (DAU) and associated sensors, and Magnetometer/OAT Sensor Assembly.

B. Maintenance

The Instructions for Continued Airworthiness (ICA) published by Avidyne provide the necessary information for maintaining this system as installed in Piper airplanes, except as noted below.

(1) Primary Flight Display (PFD) (PIR-PPS60223)

Use 700-00006-0XX PFD & 700-00011-000 Mag/OAT ICA, Avidyne Document No. AVPFD-174, Revision 00-C, or latest revision, with the following exceptions:

(a) Replace paragraph 7.5.3, Aircraft Model Setup, with the following:

1 Depress the "Aircraft Model" Line Select Key (R4) until the aircraft selection displays "44-180" in the "A/C Model" LSK Label Window.

2 Verify the System Steup indicates the following:

Aircraft Make:	Piper
Model:	PA44-180 (Seminole)
Pitch Offset:	0.0

(b) Replace paragraph 7.5.2.1, GNS 430 Nav/Com Setup, PFD Unit, with the following:

1 Select the Avionics Setup page by highlighting the "Avionics" tab at the bottom of the screen by rotating the lower left control knob.

2 Depress the "NAV 1" LSK (R1) until the NAV 1 LSK Label Window displays "430/530."

3 Depress the "NAV 2" LSK (R2) until the NAV 2 LSK Label Window displays "430/530."

4 Depress the "A/P Type" LSK (R3) until the A/P Type LSK Label Window displays "STEC 55X."

5 Depress the "ADF" LSK (R3) until the ADF LSK Label Display Window displays "NONE."

(c) Next, Complete the following procedures:

1 Select the Display Setup page by highlighting the “Display” tab at the bottom of the screen by rotating the lower left control knob.

2 Depress the “Trim Ann” LSK (L1) until the Trim Ann LSK Label Window displays “SHOW.”

3 Depress the “A/P Annun” LSK (L2) until the A/P Ann LSK Label Window displays “SHOW.”

4 Depress the “V-Speeds” LSK (L3) until the V-Speeds LSK Label Window displays “SHOW.”

5 Depress the “Horiz Marks” LSK (R1) until the Horiz Marks LSK Label Window displays “SHOW.”

6 Depress the “ARS” (Aircraft Reference Symbol) LSK (R4) until the ARS LSK Label Window displays “Delta.”

7 Depress the “Baro-Unit” LSK (R1) until the Baro-Unit LSK Label Window Displays “In Hg” for U.S. registered aircraft. Depress the “Baro-Unit” LSK (R1) until “hPa” or “Mb” appears in the window for foreign registered aircraft if other than “In Hg” is required for the aircraft APO.

(d) Disregard paragraph 7.5.5.1, Barometric Units Setting, as it is covered in step 7, above.

(2) Multifunction Display (MFD) (PIR-PPS60223)

Use 700-00004-0XX-() Multifunction Display ICA, Avidyne Document No. AVMFD-167, with the following exceptions:

(a) Replace items 3 and 4 in paragraph 7.3.1, Maitnenance Mode Access with the following:

1 At the prompt “Press any bezel key to continue”, press any LSK. This places the screen at the exceedance page. Press O.K. to acknowledge exceedances and to continue to the Intitial Usable Fuel page. Depress the “Fuel Done” LSK (R4).

2 Rotate the right outer concentric knob clockwise until the AUX page is displayed.

(b) Replace paragraph 7.3.2.1, GAMA 429 Graphics Setup (EX5000 only), with the following:

1 From the Maintenance page, depress the LSK (L1) to access the GPS/FMS Setup page.

2 Using the right outer concentric knob to select the configuration field and the right inner concentric knob to select the desired configuration; configure the GPS/FMS Setup page for the following conditions:

Receiver 1:	GAMA 429 FORMAT
Port:	ARINC 429 RX 1
Speed:	LOW
Receiver 2:	GAMA 429 FORMAT
Port:	ARINC 429 RX 2
Speed:	LOW

3 Press the SAVE button.

(c) Replace paragraph 7.3.5.1, TAS (SkyWatch & Bendix King) Setup, with the following:

1 If equipped with SKY-497, configure the Traffic Setup page for the following conditions (otherwise not installed):

Sensor:	TAS
Port:	ARINC 429 TX 3
TAS Type:	SKYWATCH
External Controller Box:	NOT CHECKED

2 Press the SAVE button.

(d) Replace paragraph 7.3.4, Lightning Sensor Interface and Setup, with the following:

1 From the Maintenance Setup page depress the LSK (L3) to access the Lightning Setup page.

2 Using the right outer concentric knob to select the configuration field and the right inner concentric knob to select the desired configuration. Configure the Lighting Setup page for the following condition:

Sensor	WX-500
Operating Mode:	Weather
Port:	RS232-3-(Lightning Default)
Stabilization Type:	Use Map Heading/Track
Enable Lightning Ahead:	Box CHECKED
Antenna on Top:	Box NOT CHECKED

3 Press the SAVE button.

(e) Replace paragraph 7.3.10.1, Engine Sensor Setup, with the following:

1 From the Maintenance Page, depress the LSK (L4) to access the Traffic Setup page.

2 Using the right outer concentric know to select the configuration field and the right inner concentric knob to select the desired configuration. Configure the Engine Setup page for the following conditions:

Aircraft Model:	PA-44-180 (Seminole)
Left Engine Serial Port:	RS232 4
Right Engine Serial Port:	RS232 2
Vacuum System Installed:	Box CHECKED if aircraft is deice equipped, NOT CHECKED if aircraft is not deice equipped

3 Press the SAVE button.

4 When configuring a MFD for the first time only, the following setup box appears: “Select ACFT Model and Port(s).” Select “Resync.”

(f) Replace paragraph 7.3.8, Map Setup, with the following:

1 From the Maintenance Setup page, depress the LSK (R1) to access the MAP Setup page.

2 Using the right outer concentric knob to select the configuration field and the right inner concentric knob to select the desired configuration; configure the Map Heading Setup page for the following conditions:

Map Heading:	FMS/GPS

3 Press the SAVE button.

(g) After completing the previous procedures, complete the Aircraft Seup procedure as follows:

1 From the Maintenance page, depress the LSK (R2) to access the AIRCRAFT Setup page.

2 Using the right outer concentric knob to select the configuration field and the right inner concentric knob to select the desired configuration; configure the AIRCRAFT Setup page for the following conditions:

Narrowcast:	Quake SC
Port:	RS232 6 (Datalink Default)
Broadcast:	XM Radio
Port:	ARINC 429 RX 4
Dimming Bus Voltage:	No setting required
Brightest Dimming Voltage:	24.0 Volts
Darkest Dimming Voltage:	5.0 Volts

3 Press the SAVE button.

(h) See 28-40-00 for Fuel Quantity Indicator calibration.

(3) Data Acquisition Unit (DAU)

(a) Use 200-00041-000 DAU ICA, Avidyne Document No. AVSIU-011, with the following exceptions:

1 In para 6, in “Table 2 - DAU Pinout,” pins J1-2 and J1-21 have “No Connection” in the Piper installation.

2 In para 6, in “Table 4 - DAU Sensor Compatibility,” parameter “VAC” is not used in the Piper installation.

(b) Removal and Installation

The DAU’s are mounted on the forward side of the nacelle bulkhead assembly for each engine. Maintenance is on condition. (See Figure 2, Sheet 3.)

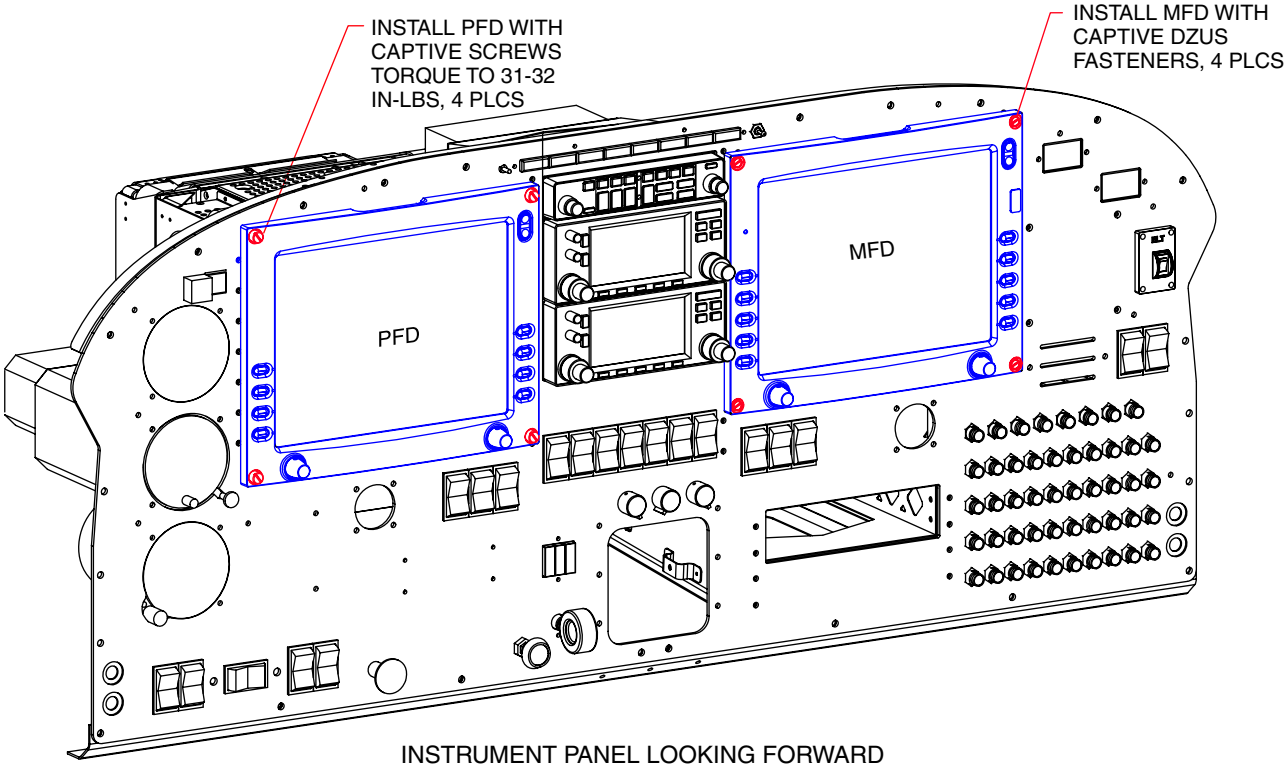
(4) Magnetometer/OAT Sensor Assembly

See information under Primary Flight Display, above. Removal and installation instructions are provided under “Magnetometer/OAT Sensor Assembly,” below.

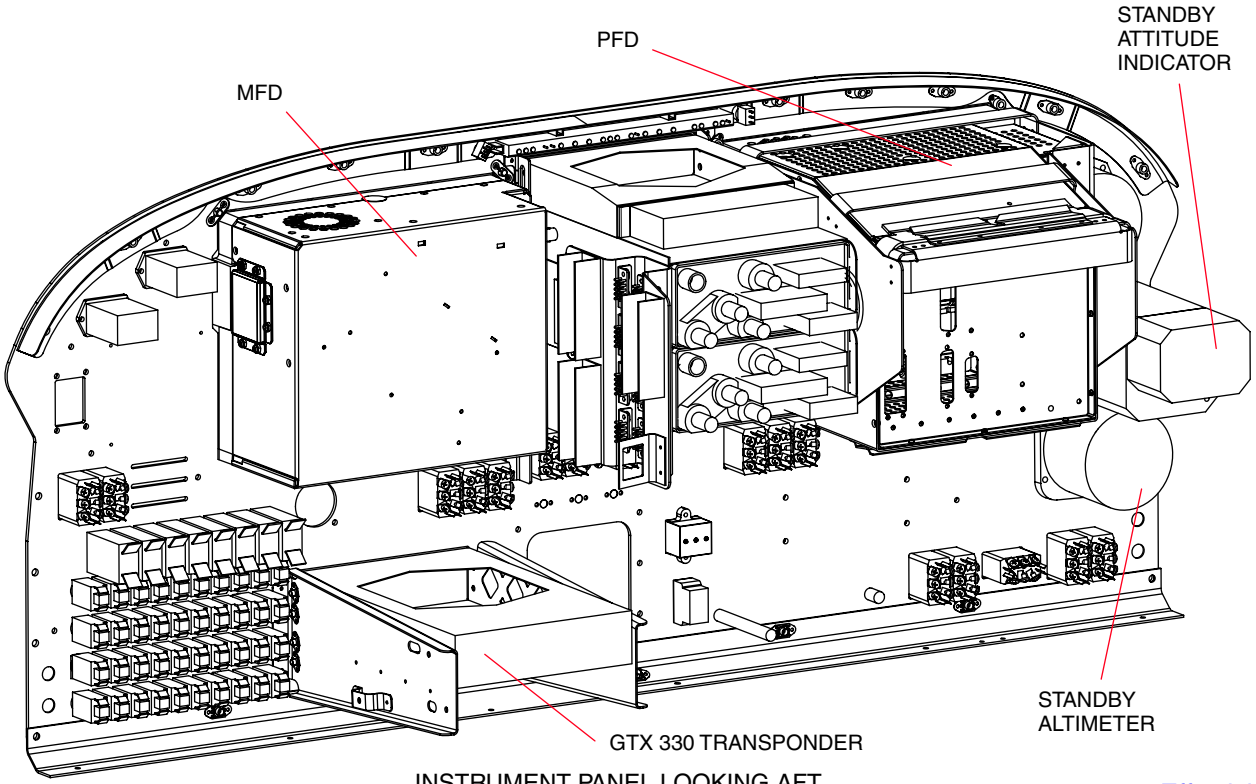
C. Component Locator

See Figure 2.

101828 NEW



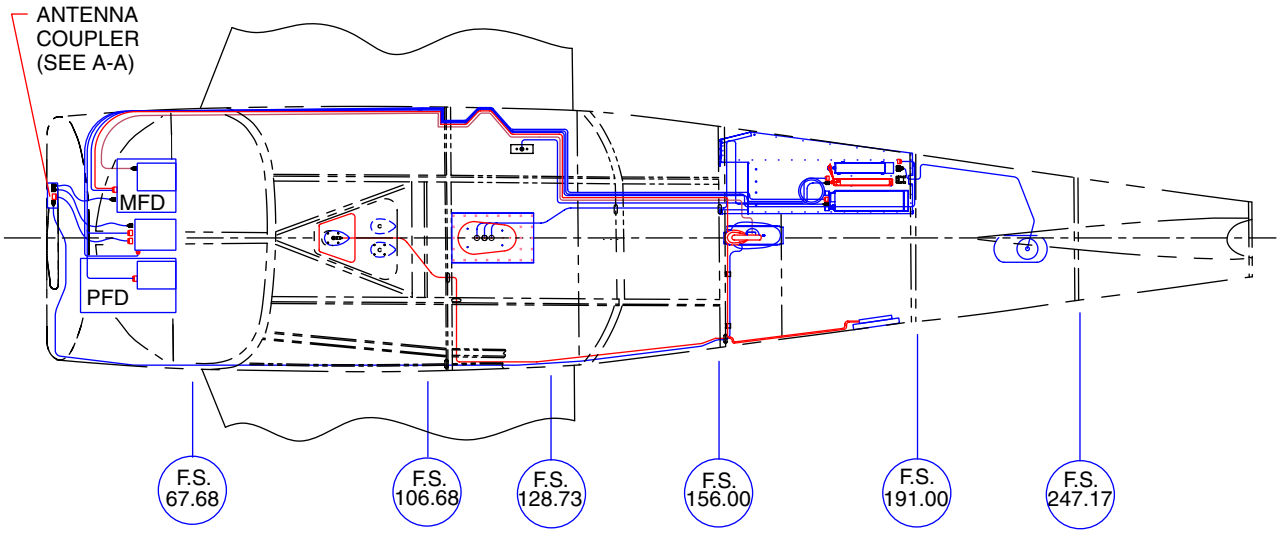
INSTRUMENT PANEL LOOKING FORWARD

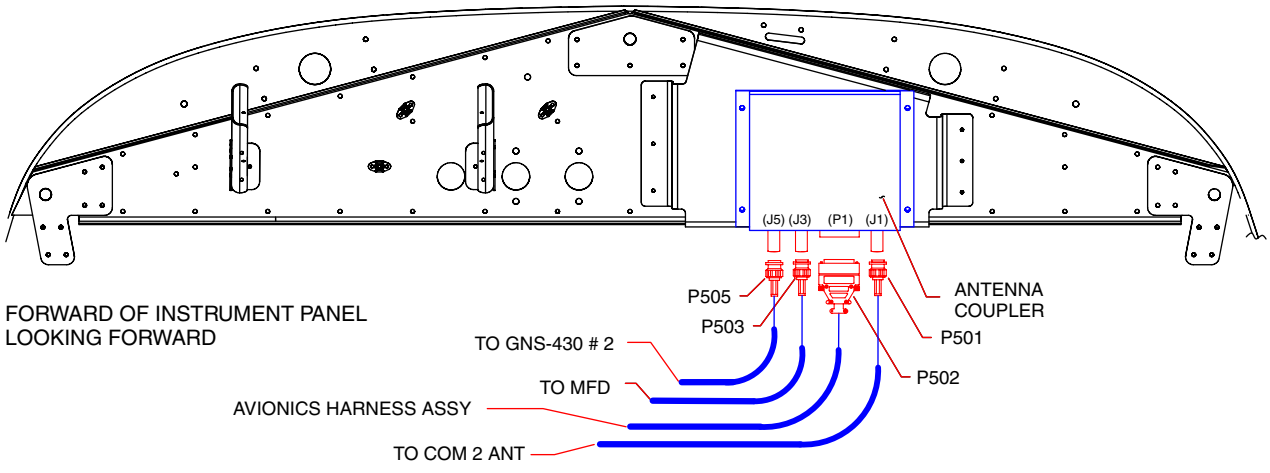


INSTRUMENT PANEL LOOKING AFT

EFIS Component Locator
Figure 2 (Sheet 1 of 3)

Effectivity
4496174; and,
4496224 and up
with Avidyne Entegra Option



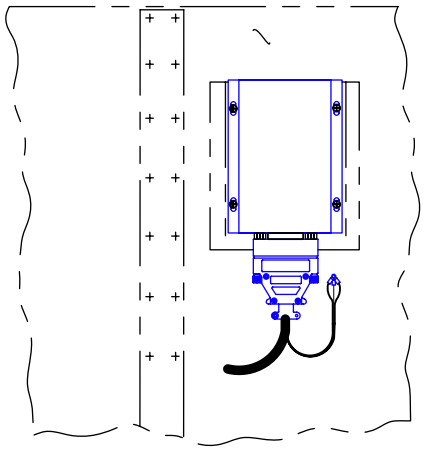


VIEW A - A

Effectivity
4496174; and,
4496224 and up
with Avidyne Entegra Option

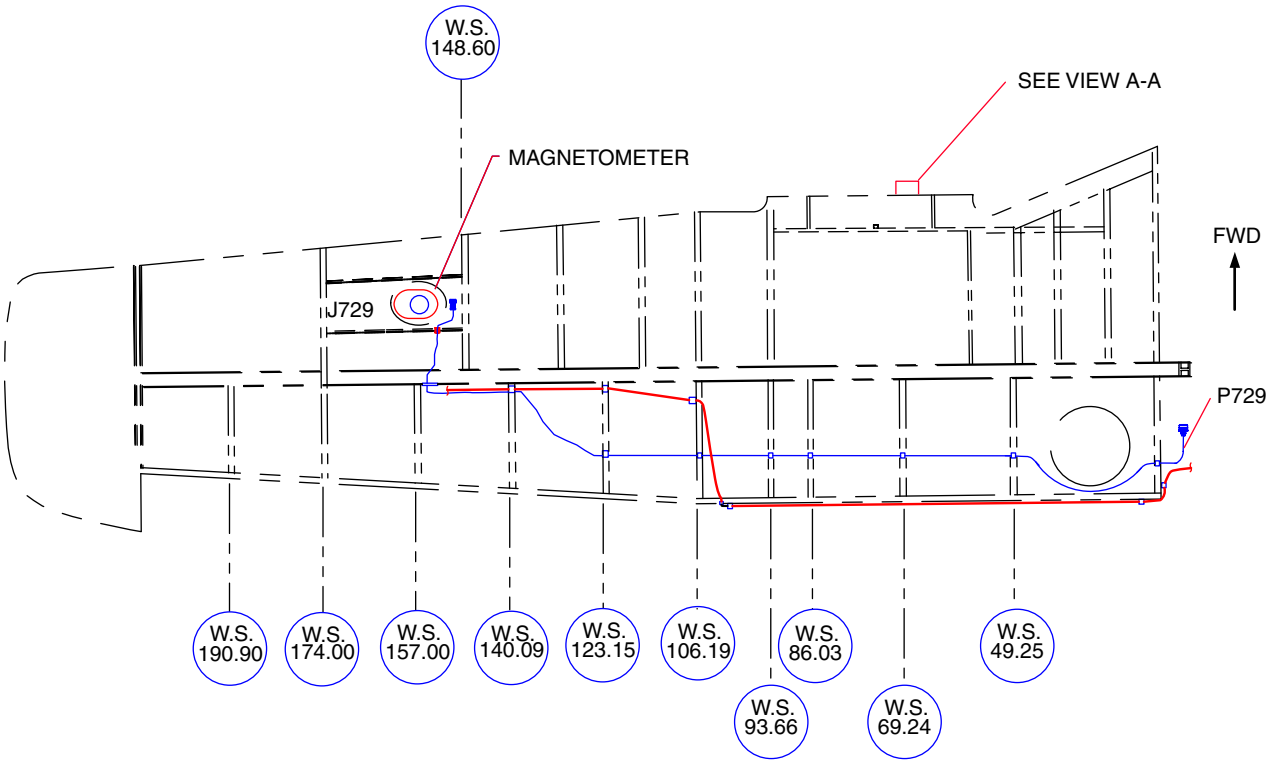
EFIS Component Locator
Figure 2 (Sheet 2 of 3)

101828 NEW



VIEW A-A

DAU INSTALLATION
(LEFT SIDE SHOWN, RIGHT SIDE OPPOSITE)
NACELLE BULKHEAD ASSEMBLY, LOOKING AFT



Effectivity
4496174; and,
4496224 and up
with Avidyne Entegra Option

EFIS Component Locator
Figure 2 (Sheet 3 of 3)

4. Directional Gyro

A. Description and Operation

The directional gyro is a flight instrument incorporating an air driven gyro stabilized in the vertical plane. The gyro is rotated at high speed by lowering the pressure in the air tight case and simultaneously allowing atmospheric air pressure to enter the instrument against the gyro buckets. Due to gyroscopic inertia, the spin axis continues to point in the same direction even though the aircraft yaws to the right or left. This relative motion between the gyro and the instrument case is shown on the instrument dial which is similar to a compass card. The dial, when set to agree with the airplane magnetic compass provides a positive indication free from swing and turning error. However, the directional gyro has no sense of direction and must be set to the magnetic compass, since the magnetic compass is subject to errors due to magnetic fields, electric instruments, etc., the directional gyro is only accurate for the heading it has been set for. If the gyro is set on 270°, for instance, and the aircraft is turned to some other heading, there can be a large error between the gyro and the magnetic compass due to the error in compass compensation, the will appear as gyro precession. The gyro should only be checked on the heading on which it was first set, also due to internal friction, spin axis error, air turbulence and airflow, the gyro should be set at least every 15 minutes for accurate operation, whether it has drifted or not.

B. Troubleshooting

See Chart 2.

CHART 2
TROUBLESHOOTING DIRECTIONAL GYRO

Trouble	Cause	Remedy
Excess drift in either direction.	Setting error.	Reset per paragraph A.
	Defective instrument.	Replace instrument.
	High or low vacuum. If vacuum is not correct, check for the following:	
	a. Relief valve properly adjusted.	a. Adjust.
	b. Incorrect Instrument reading.	b. Replace Instrumente.
	c. Pump failure.	c. Repair or replace.
	d. Vacuum line kinked of leaking.	d. Check and repair. Check for collapsed inner wall or hose.
Dial spins during turn.	Limits (55° bank) of gimbal exceeded.	Recage gyro in level flight.
Dial spins continuously.	Defective mechanism.	Replace Instrument.

5. Magnetic Heading System (See Figure 3.)

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.

The Avidyne Entegra Electronic Flight Instrument System (EFIS), of which the magnetic heading system is part, is available as an option in S/N's 4496174; and, 4496224 and up.

A. Magnetometer/OAT Sensor Assembly

The Magnetometer/OAT Sensor Assembly (Mag/OAT) is mounted on a wing access cover plate in the underside of the outboard left wing and supplies magnetic heading information to the Primary Flight Display (PFD). The cover plate - Mag/OAT sensor assembly is removed and installed as a unit.

(1) Removal

(a) Remove eight (8) screws and support cover plate with your hand.

(b) Drop cover plate down sufficient to reach inside and disconnect the wiring harness.

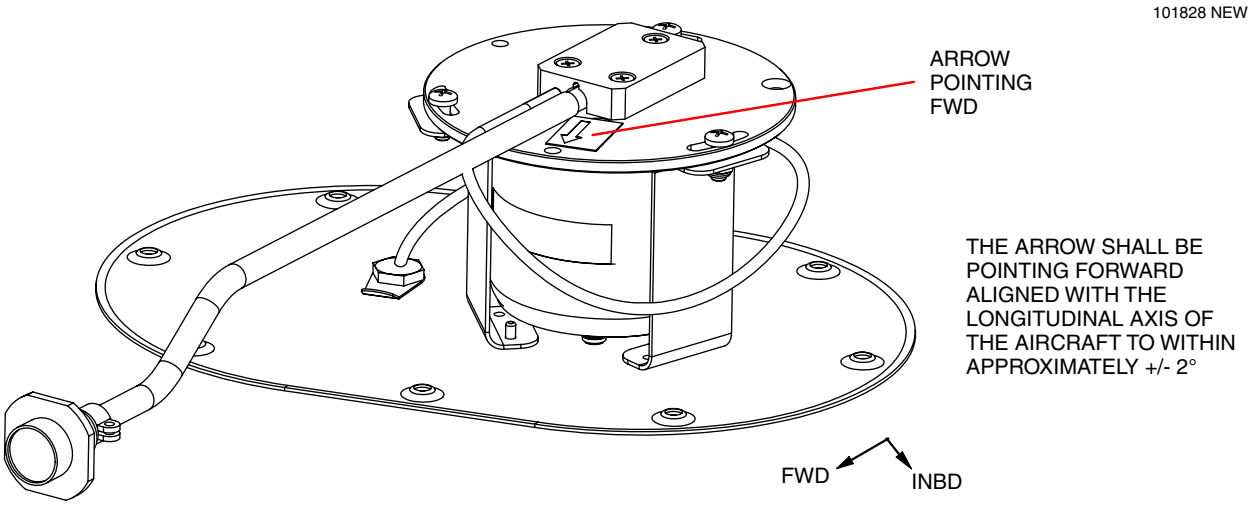
(c) Remove cover plate - Mag/OAT sensor assembly.

(2) Installation

(a) Connect the Mag/OAT sensor assembly wiring harness.

(b) Position the cover plate - Mag/OAT sensor assembly in the access hole with the arrow on the magnetometer pointing forward.

(c) Secure with screws (8).



Magnetometer/OAT Installation
Figure 3

Effectivity
4496174; and,
4496224 and up
with Avidyne Entegra Option

B. Calibration (PIR-PPS60227, Rev. NEW.)

Calibration can be accomplished using either of the following two methods.

NOTE: LSK L1 “Perform IRU Mx” and LSK L3 “Perform ADU Cal” are to be performed by Avidyne Service Technicians only. These functions are for bench test only.

(1) Bore sight reference compass (2 technicians)

NOTE: A hand-held bore sight reference compass is required for this procedure.

(a) Apply external power to the aircraft to allow the PFD’s to align while conserving the battery for the remaining calibration procedure.

(b) Allow 3 minutes for the PFD’s to align, until the ADAHRS countdown timer expires and the Gyro Warm-up box is removed from view Aircraft in “level flight attitude.”

NOTE: The PFD countdown timer might automatically restart its count before the countdown expires. This is a normal operation and does not indicate a problem with the PFD.

(c) Allow an additional 10 minutes in the aligned state to ensure complete stability.

(d) Place Battery Master Switch “ON”.

(e) Remove external power from the aircraft.

(f) Position the aircraft in an area located away from metal structures and magnetic interference such as that caused by underground power lines, etc.

(g) Using the bore sight compass, align the aircraft to a heading of 360° +/- 1°.

(h) Enter the System Setup mode on the pilot and copilot PFD’s.

(i) Press the “Perform Mag Cal” Line Select Key (L2).

(j) Follow the directions on the “Magnetometer Calibration Page” and press the “Calibrate Heading” button and wait until “Done” is displayed.

(k) Align the aircraft to each of the remaining 11 consecutive 30° headings using steps (g) through (j) and press the “Calibrate Heading” LSK (R4) at each of these alignment points after satisfactory alignment is achieved.

(l) At the final alignment point (330°), remain stationary until “Done” is displayed. This could take up to one minute as data from the 12 calibration points is loaded onto the PFD’s.

(m) When complete, the following message appears:

MAG CAL COMPLETE - YOU MUST CYCLE POWER ON THE PFD IN ORDER FOR THE MAGNETOMETER CALIBRATION TO TAKE EFFECT.

(n) Cycle power by pulling the following circuit breakers.

1	Main bus:	Pilot PFD and Copilot PFD
2	Non Essential Bus:	PFD/MFD Power Converter
3	Avionics 1 Bus:	Pilot PFD
4	Avionics 2 Bus:	Copilot PFD

NOTE: Wait 20 seconds before applying power.

(o) Verify the calibration by aligning the aircraft with consecutive 90° headings, starting with 360°. Use the same alignment procedure as before and view the digital heading display on the pilot and copilot PFD’s at each of these headings.

(2) Magnetometer Calibration Using Compass and Engine Run

(a) Perform normal engine start and turn on Avionics Master if needed for taxi communications.

(b) Remain stationary and allow the pilot and copilot PFD's to align for approximately 3 minutes until the ADAHRS coundown timer expires and the Gyro Warm-up box is removed from the PFD screen.

NOTE: The PFD countdown timer might automatically restart its count before the countdown expires. This is a normal operation and does not indicate a problem with the PFD.

(c) Allow an additional 10 minutes in the aligned state to ensure complete stability.

(d) Taxi to the compass rose with a technician to act as a spotter to aid in the alignment.

(e) Enter the System Setup mode on the pilot and copilot PFD's.

(f) Press the "Perform Mag Cal" Line Select Key (L2).

(g) Align the aircraft with magnetic north on the compass roase with the assistant to within +/- 1°.

(h) Follow the directions on the "Magnetometer Calibration Page" and press the "Calibrate Heading" button and wait until "Done" is displayed.

(i) Align the aircraft to each of the remaining 11 consecutive 30° headings using steps (g) through (h) and press the "Calibrate Heading" LSK (R4) at each of these alignment points after satisfactory alignment is achieved.

(j) At the final alignment point (330°), remain stationary until "Done" is displayed. This could take up to one minute as data from the 12 calibration points is loaded onto the PFD's.

(k) When complete, the following message appears:

MAG CAL COMPLETE - YOU MUST CYCLE POWER ON THE PFD IN ORDER FOR THE MAGNETOMETER CALIBRATION TO TAKE EFFECT.

(l) Cycle power by pulling the following circuit breakers.

1	Main bus:	Pilot PFD and Copilot PFD
2	Non Essential Bus:	PFD/MFD Power Converter
3	Avionics 1 Bus:	Pilot PFD
4	Avionics 2 Bus:	Copilot PFD

NOTE: Wait 20 seconds before applying power.

(m) Verify the calibration by aligning the aircraft with consecutive 90° headings, starting with 360°. Use the same alignment procedure as before and view the digital heading display on the pilot and copilot PFD's at each of these headings.

6. Magnetic Compass

A. Description and Operation

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.

B. Troubleshooting

See Chart 3.

C. Adjustment

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, engine running, throttle set at cruise position and aircraft in level flight attitude. Aircraft master switch, alternator switch and all radio switches should be in the ON position. 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 a magnetic South heading and note resulting South error. Adjust N-S adjusting screw until one-half of this error has been removed.

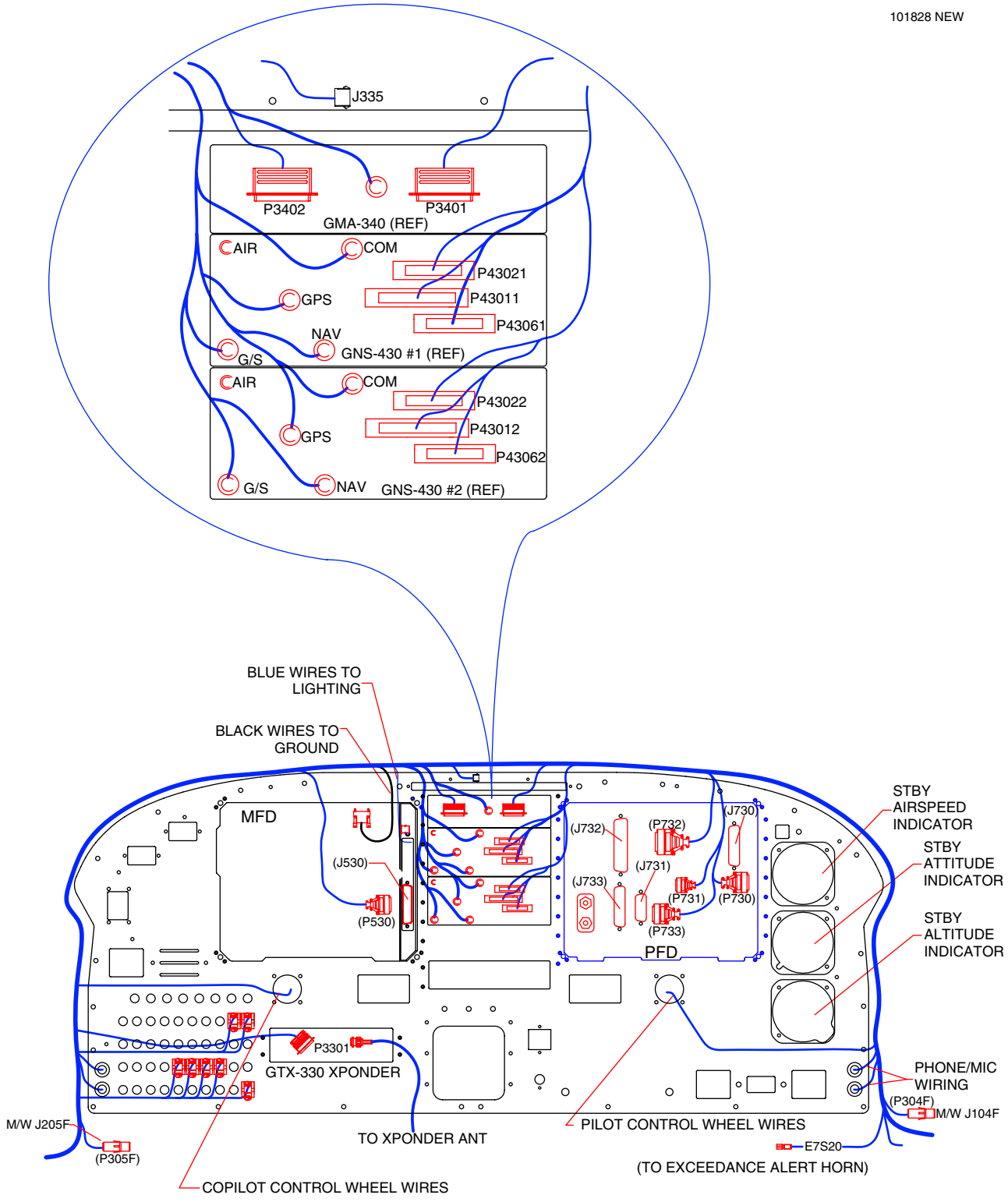
(5) Head aircraft on magnetic West and do same as step (4), adjusting E-W adjusting screw.

(6) Head aircraft in successive magnetic 30° headings and record compass readings on appropriate deviation card. Deviations must not exceed ± 10° on any heading.

CHART 3
TROUBLESHOOTING MAGNETIC COMPASS

Trouble	Cause	Remedy
Excessive card error.	Compass not properly compensated.	Compensate instrument. (See Magnetic Compass, Adjustment.)
	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Insufficient liquid.	Replace instrument.
Card sluggish.	Wear card magnet.	Replace instrument.
	Excessive pivot friction or broken jewel.	Replace instrument.
Liquid leakage.	Loose bezel screws.	Replace instrument.
	Broken cover glass.	Replace instrument.
	Defective sealing gaskets.	Replace instrument.
Discolored markings.	Age.	Replace instrument.
Defective light.	Burned out lamp or broken circuit.	Check lamp or continuity or wiring.
Card sticks.	Altitude compensating diaphragm collapsed.	Replace instrument.
Card does not move when compensating screws are turned.	The gears that turn compensating magnets are stripped.	Replace instrument.
Compass swings erratically when radio transmitter is keyed.	Normal.	

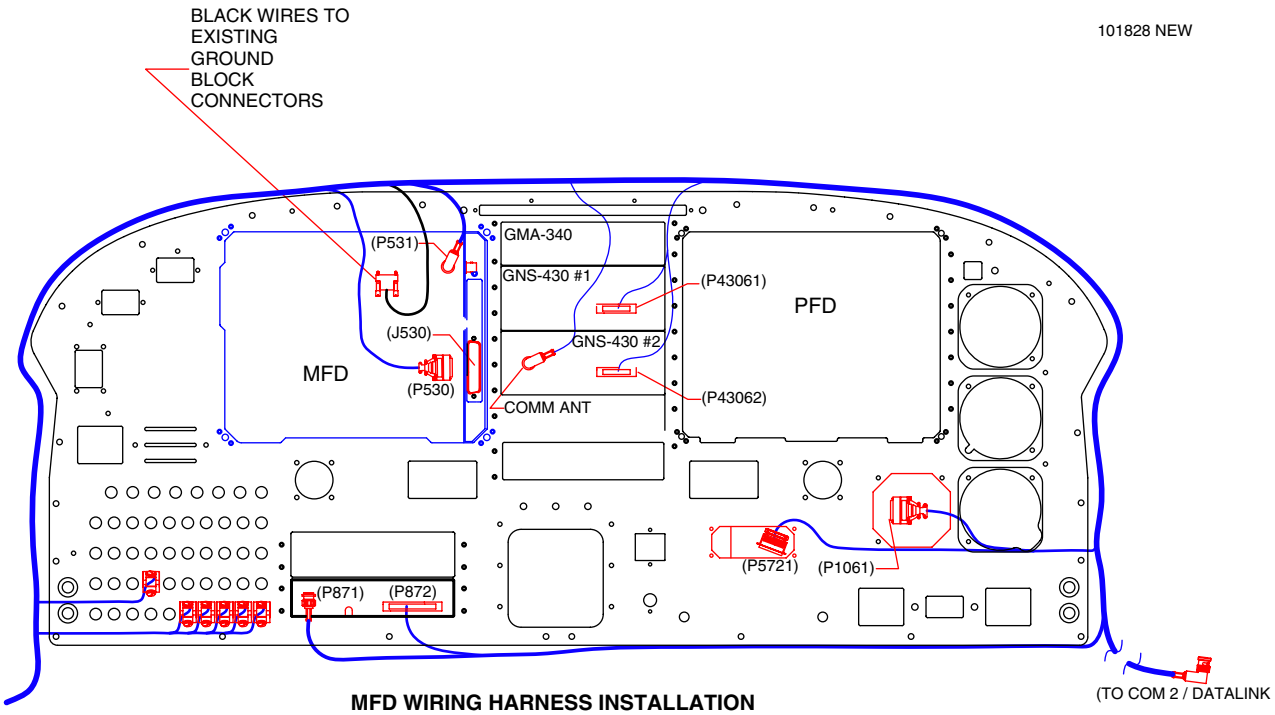
101828 NEW



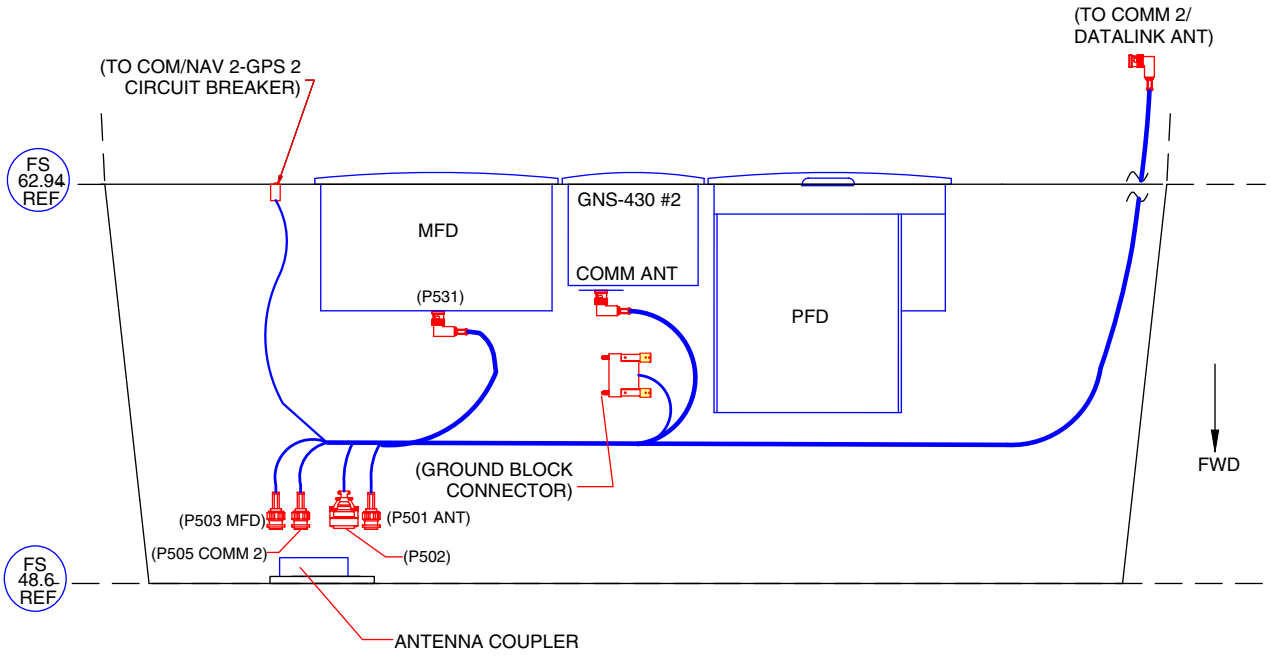
PFD WIRING HARNESS INSTALLATION (LOOKING AFT)

Effectivity
4496174; and,
4496224 and up
with Avidyne Entegra Option

EFIS Wiring Harness Installation
Figure 4 (Sheet 1 of 2)



MFD WIRING HARNESS INSTALLATION (LOOKING AFT)



ANTENNA COUPLER WIRING HARNESS INSTALLATION (LOOKING DOWN)

EFIS Wiring Harness Installation
Figure 4 (Sheet 2 of 2)

Effectivity
4496174; and,
4496224 and up
with Avidyne Entegra Option

7. Turn Coordinator

A. Description and Operation

Unlike the conventional turn and slip indicator, the electrically operated gyroscope in the turn coordinator is canted. However, like conventional turn and slip indicator, it works on the principal of precession. By canting the gyro, the instrument not only measures rate of turn, but also measures rate of roll. With this indicator, if the aircraft is rolled right and left rapidly, the indicator will move, measuring the rate at which the airplane is rolled by indicating a turn in the direction of the roll. If the aircraft is held in a bank, and rudder is applied (such as when slipping), the needle indicator will come back to neutral, indicating no turn.The slip/skid portion of the indicator is a ball sealed in a curved glass tube filled with damping fluid. In the previous example, It would indicate the airplane is slipping. By utilizing rudder and aileron to establish the airplane in a desired rate of turn will eventually establish the airplane in a coordinated turn at the desired rate.

B. Troubleshooting

See Chart 4.

CHART 4
TROUBLESHOOTING TURN COORDINATOR

Trouble	Cause	Remedy
Instrument fails to respond when power is being applied to instrument.	Foreign matter lodged in instrument.	Replace instrument.
Incorrect sensitivity.	Out of calibration.	Replace instrument.
Incorrect turn rate.	Out of calibration.	Replace instrument.
Ball sticky.	Flat spot on ball.	Replace instrument.
Ball not in center when aircraft is correctly trimmed in wings level flight.	Instrument not level in panel.	Level instrument.
Instrument will not run	No power to instrument.	Check appropriate circuit breaker on pilot's circuit breaker panel.
		Check circuit and repair.
	Instrument malfunction.	Replace instrument.

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DEPENDENT POSITION DETERMINING

1. COM/NAV/GPS

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

A. S/N's 4496031 and up. (PIR-PPS60199-2, Rev. G.)

Single Garmin GNS-430 COM/NAV/GPS systems are installed as standard equipment and dual GNS 430 systems are optional. Each installation consists of the GNS-430 transceiver/display unit, associated wiring, and antennas.

Maintenance of the GNS-430 is "on condition" only and, with the exception of swapping complete units, should be performed only by a qualified avionics shop in accordance with the GARMIN Series 400 Maintenance Manual (Garmin P/N - 190-00140-05).

Information provided in this manual is intended solely to aid the removal and installation of the GNS-430 transceiver/display units, their associated wiring and antennas.

Removal and Installation

See 39-10-00.

B. Post Installation Setup Procedure (PIR-PPS60199-2, Rev. G/PPS60119, NEW.)

(1) Aircraft Preparation and Configuration

Setup and prelliminary checks may be made using the aircraft battery or external power supplied by an external power cart. Final checks (OBS/CDI or HSI accuracy) should be made with the engine running and the aircraft configured as in Chart 1.

(2) Configuration Setup Procedure

Access the Configuration Mode of the unit by depressing and holding the ENT key while applying power to the unit. Release the ENT key when the display activates. After the database pages, press the ENT key twice to display the MAIN ARINC 429 CONFIG page. Pages may be selected by ensuring the cursor is off and rotating the inner concentric knob on the right side of the unit.

CHART 1
FINAL CHECK CONFIGURATION

Engine running, alternators	On	Avionics	On
Instrument Panel Lights	Full Bright	Day/Night Switch	Day
Navigation Lights	On	Strobe Lights	On
Pitot Heat	Off	Air Conditioning	Off
Cabin Blower Fan	Low	Vent Blower	Off

To change data on the displayed Configuration Page, the cursor must be selected. Press the inner concentric knob on the right side of the unit to activate the cursor. Rotating the outer concentric knob on the right side of the unit changes the selected data field. Rotating the inner concentric knob changes the data within the selected field. To accept entry of the desired selection, press the ENT key.

(a) Configure the MAIN ARINC 429 Page on both GNS #1 and #2 as follows:

	SPEED	DATA
IN 1	HIGH	OFF, or TRAFFIC ADVISORY (if Skywatch is installed)
IN 2	HIGH	OFF
OUT	HIGH	GAMA 429 GRAPHICS W/INT
SDI	LNAV 1 (GNS Unit #1) LNAV 2 (GNS Unit #2)	

(b) Deslect the cursor and rotate the inner concentric knob on the right side of the unit to display the MAIN RS232 CONFIG page. Configure both the GNS #1 and #2 as follows:

	INPUT	OUTPUT
CHNL 1	OFF	AVIATION NO ALT
CHNL 2	OFF	OFF
CHNL 3	CROSSFILL*	CROSSFILL*
CHNL 4	OFF or WX500	OFF or WX500 (if Stormscope is installed)
CHNL 5	OFF	OFF
CHNL 6	OFF	OFF
FUEL TYPE		AV Gas

* If there is only one (1) GNS unit, CHNL 3 INPUT and OUTPUT are OFF.

(c) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the MAIN LIGHTING page. Change only the “SOURCE” setting to display an output of “PHOTO” and key of “14V DC”.

(d) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the MAIN CDI/OBS CONFIG page. Setup is only required for selected course calibration.

Adjust the OBS or HSI course needle to indicate a selected course of 150 degrees. The SELECTED COURSE field on the GNS unit should indicate very close to 150 degrees. Select the “Calibrate to 150?” field and press ENT. Verify the OBS (or HSI course) operation by checking that the course displayed on the GNS unit is within 2° of the selected course. Verify the accuracy at cardinal headings around the OBS card.

(e) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the COM SETUP page. Change only the “SPACING” setting to display “Select 25.0 KHz”.

(f) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the VOR/LOC/GS/CDI page. Change only the “DME CHNL MODE” setting to display “Parallel 2x5”.

(g) VOR/LOC/GS ARING 429 CONFIG Page

1 For aircraft with Avidyne Entegra EFIS:

#1 GNS	RX	TX
SPEED	LOW	LOW
SDI	VOR/ILS 1	
DME MODE	DIRECTED FREQ 1	
#2 GNS	RX	TX
SPEED	LOW	LOW
SDI	VOR/ILS 2	
DME MODE	DIRECTED FREQ 2	

2 For aircraft without EFIS, there is no settings required on this CONFIG page.

2. Transponder

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

A. S/N's 4496001 thru 4496042

A Bendix/King KT76A transponder, manufactured by then Allied Signal (now Honeywell), was installed in these airplanes. Maintenance information for those systems is not included in this manual. Follow the service literature published by the AP/FD equipment manufacturer. King/Allied Signal technical support, parts support, and service literature can be obtained from:

Honeywell
One Technology Center
23500 W. 105th St., M/D #45
Olathe, Kansas 66061-1950
http://www.bendixking.com/

B. S/N's 4496043 thru 4496179 (PIR-PPS60199, Rev. G.)

A Garmin GTX-327 Transponder is installed as standard equipment. Maintenance of the GTX-327 is "on condition" only and, with the exception of swapping complete units, should be performed only by a qualified avionics shop in accordance with the GARMIN GTX-327 Maintenance Manual (Garmin P/N - 190-00187-05).

Information provided in this manual is intended solely to aid the removal and installation of the GTX-327 transceiver/display unit, its associated wiring and antenna.

Removal and Installation

See 39-10-00.

C. S/N's 4496180 and up

A Garmin GTX-330 Transponder is installed as standard equipment. Maintenance of the GTX-330 is "on condition" only and, with the exception of swapping complete units, should be performed only by a qualified avionics shop in accordance with the GARMIN GTX-330 Maintenance Manual (Garmin P/N - 190-00207-02).

Information provided in this manual is intended solely to aid the removal and installation of the GTX-330 transceiver/display unit, its associated wiring and antenna.

Removal and Installation

See 39-10-00.

D. Post Installation Setup Procedure (PIR-PPS60206, Rev. G.)

Access the Configuration Mode of the unit by depressing and holding the FUNC key while applying power to the unit. Release the FUNC key when the display activates. The FUNC key sequences forward through the configuration pages. The START/STOP key reverses through the pages, stopping at the Menu page. The CRSR key highlights selectable fields on each page. When a field is highlighted, the 0-9 keys enter numeric data and the 8 or 9 keys move through list selections. Press the CRSR key to accept changes. When a field is highlighted, pressing the FUNC key moves to the next configuration page without saving the changes. To exit the configuration pages, turn the power off and then turn the unit on again without holding the FUNC key for normal operation.

NOTE: When the unit it turned on for the first time, or an invalid address is recognized, the unit will prompt the user to enter a valid aircraft address. See Mode S Address paragraph, below.

CHART 2
VOICE AND VOLUME

Function	Selection	Description
VOLUME	MAX	
VOICE	MALE	
MESSAGE (0-5)		Selected Audio Tones and Messages 0= Toggle a continuous tone on and off 1= Attention Tone, preceeds voice messages to attract the pilot's attention. 2= "Leaving Altitude", when altitude monitor is active and the altitude deviation is exceeded. 3= "Traffic", when a TIS traffic alert is received. 4= "Time Expired", when the countdown expires. 5= "Traffic Not Available", when TIS service is not available or out or range of an operating TIS MODE S site. 6-9 are not used.
ALTITUDE MONITOR	OFF TONE	When Altitude Pre-Select is installed. When Altitude Pre-Select is not installed.
PAGE CHANGE	ENABLE	
COUNTDOWN TIMER	TONE	

CHART 3
DISPLAY MODE AND KEY LIGHTING

DISPLAY MODE	AUTO
LEVEL	75
BKLT	AUTO
LVL	Not Selectable
RSP TIME	4
MIN	8
BKLT SRCE	PHOTO
SLOPE	50
OFFSET	50
KEY	AUTO
LVL	Not Selectable
RSP TIME	4
MIN	5
KEY SRCE	14V
SLOPE	20
OFFSET	30
CONTRAST MODE	AUTO

CHART 4
ARINC 429 CONFIGURATION PAGE

	GTX 330	
429 INPUT	SPEED	DATA
CHANNEL 1	HIGH	GPS/FMS
CHANNEL 2	HIGH	OFF
CHANNEL 3	LOW	OFF
CHANNEL 4		OFF
429 OUTPUT		DATA
CHANNEL 1		OFF
CHANNEL 2		GARMIN W/TIS GARMIN W/SKYWATCH

CHART 5
RS-232 INPUT AND OUTPUT

RS-232 CONFIG	GTX	
232 INPUT	INPUT	OUPUT
CHANNEL 1	OFF	OFF
CHANNEL 2	OFF	OFF

CHART 6
OPERATION CONFIGURATION

VS RATE	500
FORMAT	FEET
VFR ID	1200
ALTITUDE ALERT DEVIATION	200
SQUAT SWITCH	“YES”
“SENSE”	“LOW”
DELAY TIME	24
AUTO FLIGHT TIMER	MANUAL

(1) Configuration Menu

The JUMP TO menu page provides the capability to select a configuration mode starting page without having to step through all of the pages. Press the CRSR key and sequence through to the desired section with the 8 and 9 keys. Jump to the selection vy pressing the CRSSR key again with the desired selection highlighted. The FUNC key steps to the next configuration page, after which the START/STOP key reverses until stopping at the JUMP TO menu page. Following is a list of selections and their descriptions

SELECTION	DESCRIPTION
DIAGNOSTICS	Jumps to Gray Code Input Page
DISPLAY/AUDIO	Jumps to Audio Volume Page
I/O CONFIG	Jumps to ARINC INPUt #1 Page
ACFT CONFIG	Jumps to Operation Configuration #1 Page

(2) See Charts 2 thru 6 for required settings on the configuration pages.

(3) On the TEMPERATURE Page, select “NO” for SENSOR INSTALLED.

(4) MODE S Address (ICAO Aircraft Address Code) and FLIGHT ID Entry Page

When the unit is turned on for the first time, or an invalid address is recognized, the unit will prompt the user to enter a valid aircraft address.

NOTE: U.S. registered aircraft ICAO Aircraft Address Code (ADDRESS HEX) is the “N number” and is displayed as such on the ATC-601. On Non-U.S. registered aircraft, verify only that the hexadecimal code displayed on ATC-601 matches the “ADDRESS HEX” code programmed on the GTX-330.

(a) U.S. Registered Aircraft

1 To highlight the “U.S. Tail #” address field, press the CRSR key one time.

2 Enter the registration number using the number keys. Press the CRSR key to select the numeric entry field. Press a key repeatedly to scroll through the digit/alpha characters for that entry field.

3 Repeat step 2 until the complete number is entered.

4 When finished, press the CRSR key to accept the number entry.

5 For entering the Flight ID number, press the CRSR key one time.

6 Repeat steps 2 and 3.

7 When finished, press the CRSR key to accept the number entry.

(b) Non-US Registered Aircraft

1 For entering Non-U.S. Aircraft Registration, press the CRSR key one time, then 8 or 9 to select ADDRESS HEX.

2 Non-U.S. Aircraft Registry normally supplies a 24 bit binary code, known as the ICAO Aircraft Code for the Mode S address in lieu of directly entering the N# for U.S. registered aircraft.

3 The GTX 330 only accepts a hexadecimal format for the Non-U.S. Registered Aircraft, so the 24 bit binary code must be converted to a hexadecimal format.

4 Convert the 24 bit binary code to hexadecimal as follows:

a 24 bit binary code: 111001000111111101101101

b Seperate for hex conversion: 1110/0100/0111/1110/1110/1101

c Apply the hexadecimal values found in Chart 7.

E	4	7	E	E	D
1110/	0100/	0111/	1110/	1110/	1101

5 Enter the hexadecimal address using the number keys. Press the CRSR key to select the numeric entry field. Press a key repeatedly to scroll through the digit/alpha characters for that entry field.

6 Repeat step 5 until the complete number is entered.

7 for FLIGHT ID select “CONFIG ENTRY” and enter the Hex code or select “POWER UP ENTRY”.

8 When finished, press the CRSR key to accept the number entry.

(5) On the “MODE S Aircraft Type” Page, select “<15.5k Lb” for AC TYPE, and “<=300 kt” for MAX AIRSPEED.

(6) When entries are complete, cycle unit power and check for entries.

CHART 7
Hexadecimal Conversion

Binary	Hexadecimal	Decimal	Binary	Hexadecimal	Decimal
/0000	0	0	/1000	8	8
/0001	1	1	/1001	9	9
/0010	2	2	/1010	A	10
/0011	3	3	/1011	B	11
/0100	4	4	/1100	C	12
/0101	5	5	/1101	D	13
/0110	6	6	/1110	E	14
/0111	7	7	/1111	F	15

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CHAPTER

37

VACUUM

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CHAPTER 37

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
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	2	Mar 15/06			
37-Table of Contents	1	Mar 15/06			
	2	Mar 15/06			
37-00-00	1	Mar 15/06			
	2	Mar 15/06			
	3	Mar 15/06			
	4	Mar 15/06			
	5	Mar 15/06			
	6	Mar 15/06			
37-10-00	1	Mar 15/06			
	2	Mar 15/06			
	3	Mar 15/06			
	4	Mar 15/06			
	5	Mar 15/06			
	6	Mar 15/06			
	7	Mar 15/06			
	8	Mar 15/06			
37-20-00	1	Mar 15/06			
	2	Mar 15/06			

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CHAPTER 37 - VACUUM

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Gyro Filters		1	4J9
Engine Driven Vacuum Pump		2	4J10
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Vacuum Regulator Valve		4	4J12
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GENERAL

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

NOTE: In S/N's 4496174; and, 4496224 and up, for airplanes equipped with the optional Avidyne Entegra EFIS: no vacuum system is installed.

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.

If aircraft is equipped with a pneumatic deicing system, refer also to 30-10-00.

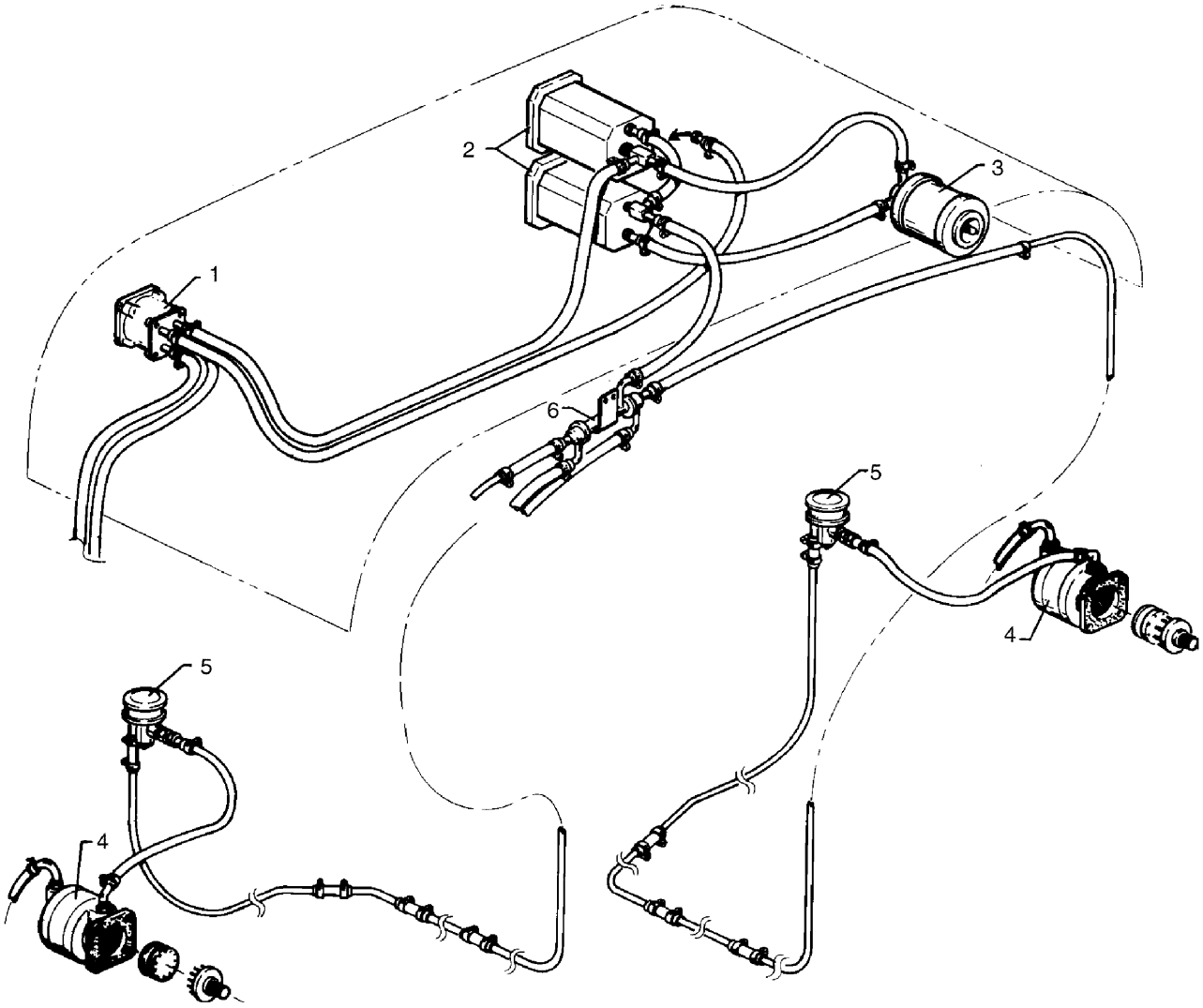
Troubleshooting

See Chart 1.

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1. VACUUM GAUGE
2. INSTRUMENTS
3. FILTER
4. PUMPS (AIRBORNE SHOWN)
5. REGULATORS
6. MANIFOLD

NOTE: WHEN INSTALLING FITTINGS INTO INSTRUMENT CASES, DO NOT EXCEED PLACARDED TORQUE LIMITATIONS.



RIGHT ENGINE

LEFT ENGINE

Vacuum System Installation
Figure 1

CHART 1 (Sheet 1 of 2)
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.
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.

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DISTRIBUTION

1. Hoses and Clamps

   A. Hoses and clamps should be examined periodically and inspected carefully when engine maintenance activities cause hose disconnections to be made at the pump(s), regulating valve, gyro instruments, or vacuum gauge.

      NOTE: Immediately plug holes with shipping plugs after removing any component, opening any line, or removing any gyro.

   B. Examine the ends of the hoses for rubber separation and slivers on the inside diameter. The slivers can detach, enter the vacuum pump, filter, and cause premature pump failure.

   C. Replace old, hard, cracked or brittle hose. Sections of the inner layers may seperate, causing pump failure.

   D. Ensure hoses are clear and clean by blowing them out with shop air. Remove from aircraft as required.

      CAUTION: DO NOT WIGGLE HOSE FROM SIDE TO SIDE DURING INSTALLATION. WIGGLING COULD CAUSE PARTICLES TO BE CUT FROM INNER WALL OF HOSE WHICH WOULD DAMAGE THE PUMP.

   E. Where hose clearance is tight, making it difficult to reinstall it onto a fitting or barb, spray the fitting or barb with silicone. Let dry, then install hose by pushing it straight on.

      CAUTION: WHEN REPLACING ANY OF THE THREADED FITTINGS, DO NOT USE PIPE DOPE, THREADLUBE, OR TAPE. PIPE DOPE / TAPE PARTICLES INGESTED BY THE VACUUM PUMP COULD CAUSE THE PUMP TO FAIL. USE ONLY SILICONE SPRAY, LETTING IT DRY BEFORE ASSEMBLY.

   F. Hose clamps and fittings should be replaced when broken, damaged or corroded.

2. Gyro Filters

   A. Gyro filter must be serviced on a scheduled basis, not to exceed 100 hours, and on condition.

      NOTE: Operations in dusty conditions may warrant more frequent inspections.

      NOTE: Filters should be replaced when gauge indication declines below the recommended adjustment setting; DO NOT adjust the regulator because accurate adjustment can only be obtained with clean system filters.

   B. The vacuum system has a large central filter and a differential vacuum gauge that monitors the filter condition while gaining vacuum indication.

3. Engine Driven Vacuum Pump

NOTE: In S/N's 4496174; and, 4496224 and up, for airplanes equipped with the optional Avidyne Entegra EFIS: no vacuum system is installed.

A single engine-driven dry-air pump is mounted on the accessory section at the rear of each engine. The vacuum pump is a rotary vane, positive displacement type. These units consist of an aluminum housing, a carbon rotor and carbon vanes. They are driven by means of a coupling mated to an engine-driven gear assembly.

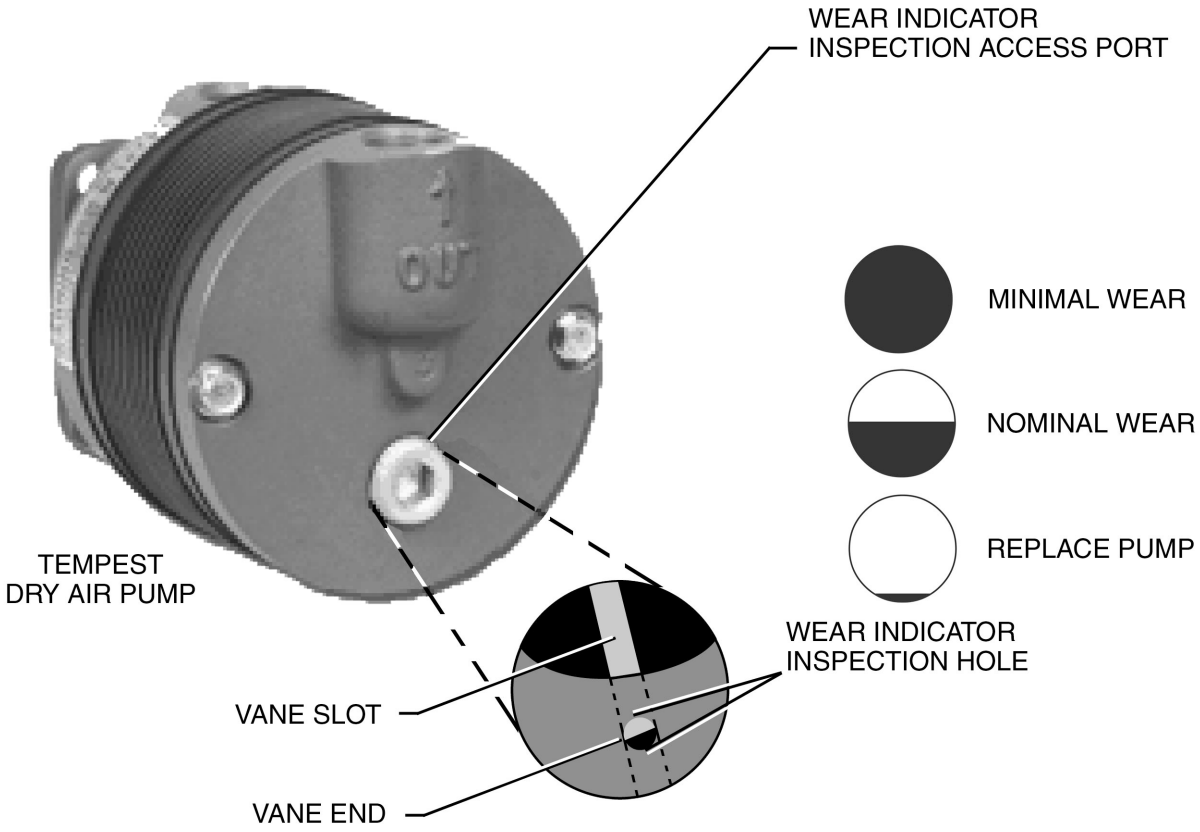
Parker-Hannifin Airborne pumps were original equipment in S/N's 4496001 thru 4496157. Beginning with S/N's 4496158 & later, and for all service replacement requirements, Aero Accessories Tempest pumps are installed.

A. Inspection - Aero Accessories Tempest Pumps Only (See Figure 1.)

The vacuum pump(s) feature a wear indicator inspection port on the back cover which allows direct observation of pump vane wear. Beginning at 500 hours time-in-service, and each 100 hours thereafter, remove the inspection port plug and observe vane wear as shown in Figure 1.

(1) As vanes wear, they slide outboard in the vane slots in the rotor.

(2) When the portion of the vane that can be observed in the inspection hole covers approximately 1/8th of the inspection hole, replace the pump.



Vacuum Pump Vane Wear Inspection
Figure 1

B. Removal

(1) Remove top engine cowling.

(2) Loosen hose clamp and remove hose from pump fitting.

(3) Remove the four retainer nuts, lockwashers, plain washers that secure the pump to the accessory section of the engine.

(4) Remove the pump, plug the open hose and cap the open pump line.

C. Installation

CAUTION: A PUMP THAT HAS BEEN DAMAGED OR DROPPED SHOULD NOT BE INSTALLED.

NOTE: Change the vacuum system filter when installing a new pump.

(1) If required, install fittings on pump per Replacing Pump Fittings, below.

CAUTION: ONLY PUMP MOUNTING GASKET AUTHORIZED AND APPROVED FOR USE ON AIRBORNE VACUUM PUMP IS AIRBORNE GASKET B3-1-2, PIPER PART NUMBER 751-859. USE OF ANY OTHER GASKET MAY RESULT IN OIL SEEPAGE OR LEAKAGE AT MOUNTING SURFACE.

(2) Place pump gasket in its proper place and align spline on pump drive with spline on engine drive assembly.

(3) Secure pump to engine with four plain washers, lock washers and retaining nuts. Torque nuts 50 to 70 inch-pounds.

(4) Connect hoses to pump and secure with hose clamps.

(5) Reinstall engine cowling.

D. Replacing Pump Fittings

CAUTION: WHEN REPLACING ANY OF THE THREADED FITTINGS, DO NOT USE PIPE DOPE, THREADLUBE, OR TAPE. PIPE DOPE / TAPE PARTICLES INGESTED BY THE VACUUM PUMP COULD CAUSE THE PUMP TO FAIL. USE ONLY SILCONE SPRAY, LETTING IT DRY BEFORE ASSEMBLY.

CAUTION: A PUMP THAT HAS BEEN DAMAGED OR DROPPED SHOULD NOT BE INSTALLED.

(1) Before installing any fittings on pump, check for any external damage.

CAUTION: DO NOT APPLY VISE PRESSURE TO OUTSIDE DIAMETER OR OVERALL LENGTH OF PUMP.

(2) When a vise is used to hold pump while installing fittings, suitable caution must be exercised to avoid pump damage. Square mounting flange must be held between soft wood blocks and only at right angles to vise jaws. Use only enough vise pressure to hold pump firmly.

(3) The ports of AIRBORNE pumps have been treated with a dry film lubricant and AIRBORNE fittings are cadmium plated thus eliminating any need for thread lubricants. If thread lubricant is required, use only a silicone spray. Apply sparingly to external threads of fittings only and let dry before assembly.

(4) Firmly hand tighten fittings into pump ports. Then, using a wrench, tighten each fitting 1/2 to 2 turns only. Do not over tighten.

4. Vacuum Regulator Valve (See Figure 2.)

A. Description and Operation

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.

(1) The regulator valves are located within the nacelles covering each engine.

NOTE: If the gauge is found to be accurate, all filters clean, and the vacuum gauge still does not indicate within 4.8 to 5.2 inches of mercury range, the regulator valve must be replaced.

(2) Symptoms that indicate regulator replacement are:

(a) Rapid fluctuation of the vacuum gauge indication pointer.

(b) Audible sound or chatter with fluctuation indication.

(c) Non-repeatability of vacuum gauge indication when gauge is not suspect.

NOTE: Regulator malfunctions tend to increase vacuum power to the gyro instruments. Although this excess of vacuum is applied, a loss of vacuum does occur. Gyro instruments themselves act as limiting devices to keep vacuum power from exceeding safe limits.

B. Adjustment

WARNING: DO NOT ATTEMPT ADJUSTMENT OF THIS VALVE WITH ENGINE IN OPERATION. THIS PROCEDURE MAY BE DONE WITH THE ENGINE RUNNING PROVIDED A QUALIFIED PILOT OR MAINTENANCE PERSON IS AT THE CONTROLS, BUT IS CONSIDERED DANGEROUS AND NOT RECOMMENDED.

CAUTION: BEFORE ANY ADJUSTMENTS ARE MADE TO THE VACUUM REGULATOR, VERIFY THAT THE SYSTEM FILTERS AND LINES ARE CLEAN.

(1) Bend locking tabs up (if applicable) then loosen locking nut or remove protective cap from valve per type installed.

(2) Start the engine and allow for engine warm-up at a medium rpm setting.

(3) With the engine running at medium rpm, the suction gauge should indicate 5.0 ± 0.2 inches of mercury. If the indication is not within this range, shut down the engine and adjust regulator (clockwise to increase pressure or counterclockwise to decrease pressure).

(4) Again, start the engine and repeat this procedure until an indication of 5.0 ± 0.2 inches of mercury is obtained at a medium power setting.

NOTE: If airplane is not equipped with a vacuum gauge, or the one installed is suspect, connect a temporary gauge of known accuracy by removing the plug from the back of the artificial horizon and attaching it there.

(5) After satisfied that pressure is adjusted correctly to 5.0 ± 0.2 inches of mercury, remove gauge and install plug; replace protective cap and tighten locknut per type valve installed.

C. Removal and Replacement

(1) Remove nacelle cover(s).

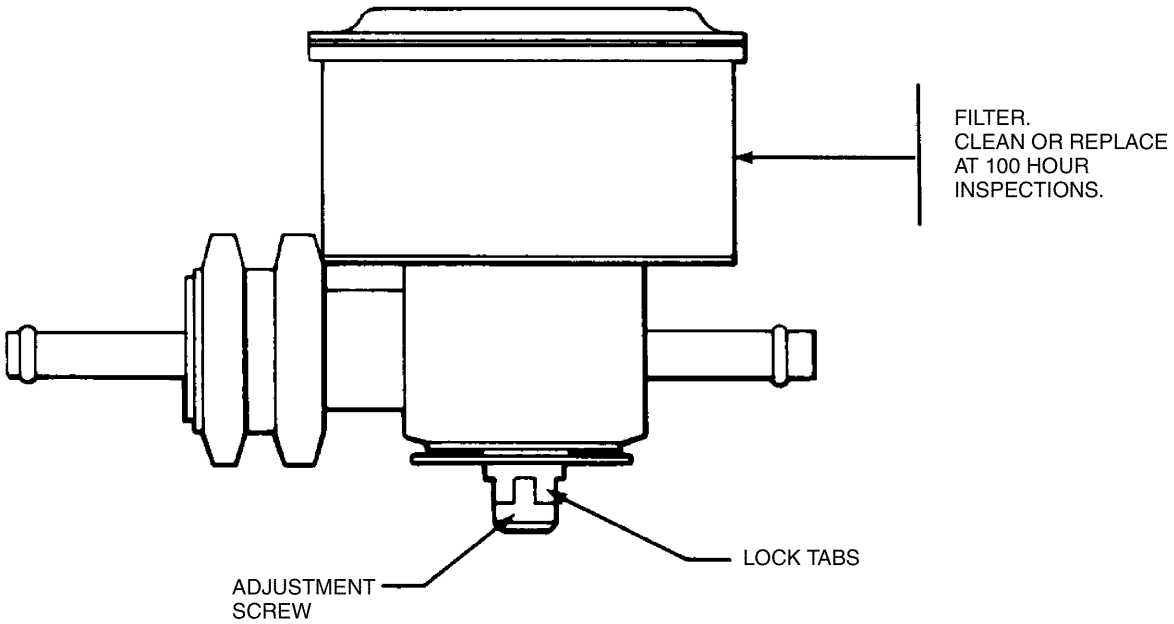
(2) Disconnect the two lines and remove mounting nuts, lockwashers and washers.

(3) Remove valve from airplane.

(4) Install regulator in reverse order of removal.

(5) Verify that complete vacuum system is operational.

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Vacuum Regulator
Figure 2

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INDICATING

Vacuum Gauge

A. Description and Operation

The vacuum gauge is mounted in the right side of the instrument panel. This gauge is calibrated in inches of mercury and has a direct pressure line and vent line. Therefore, the gauge indicates the differential pressure or actual pressure being applied to the gyro instruments. As the system filter becomes clogged or lines obstructed, the gauge will show a decrease in pressure. Do not reset the regulator until the filter and lines have been checked.

NOTE: Vacuum gauges are replaced when malfunctions occur. The failure of the gauge does not impair safety of flight.

If the vacuum gauge malfunctions in a manner to cause an incorrect reading in normal cruise power conditions, the gauge must be checked by comparing the reading with a gauge of known accuracy. If the gauge is indicating correct and the system vacuum level is not in accordance with the specific vacuum; then and only then should the regulator be adjusted.

B. Performance

(1) When the engine is not operating and no vacuum is applied to the gauge, the pointer on the indicator should rest against the internal stop in the 9 o'clock position. If the pointer appears in any other position, the indicator is faulty and requires replacement.

(2) A slight overshoot during engine startup, not to exceed one half inch of mercury is normal and is not cause for replacement.

(3) With the engine running at normal cruise power rpm, the indication should read 4.8 to 5.2 inches of mercury.

(4) At 1200 rpm, the vacuum indication should read in excess of four inches of mercury.

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CHAPTER

39

ELECTRICAL / ELECTRONIC PANELS

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CHAPTER 39

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CHAPTER 39 - ELECTRICAL / ELECTRONIC PANELS

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INSTRUMENT AND CONTROL PANELS

1. General

A. Face-Mounted Instruments

Most instruments are face-mounted and secured to the instrument panel by screws from the front of the panel. The instrument panel consists of two all-metal panels without a face panel. Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide. Most instruments are removed out the back of the panel, but a few are removed through the front of the panel. Take special care when any operation pertaining to the instruments is performed.

(1) Removal

(a) Disconnect the plumbing and/or electrical connectors from the back of the instrument. Where two or more lines connect to an instrument, identify and tag each line to facilitate installation. Attach a dust cap to each fitting.

NOTE: For those instruments which remove through the front of the panel, disconnecting and tagging plumbing and/or electrical connectors can be done after the instrument retaining screws are removed and the instrument is slid gently forward to expose the connections at the rear.

(b) Remove the screws that secure the instrument in the panel cutout.

(c) Remove the instrument from the panel.

(2) Installation

(a) Place the instrument in its proper panel cutout and secure with screws.

NOTE: For those instruments which install through the front of the panel, connecting plumbing and/or electrical connectors can be done from the front of the panel before the instrument retaining screws are installed. After the connections are secure, slide the instrument into place and install the retaining screws.

(b) Connect the plumbing and/or electrical connectors to back of instrument.

(c) Check instrument operation.

B. Rack-Mounted Avionics

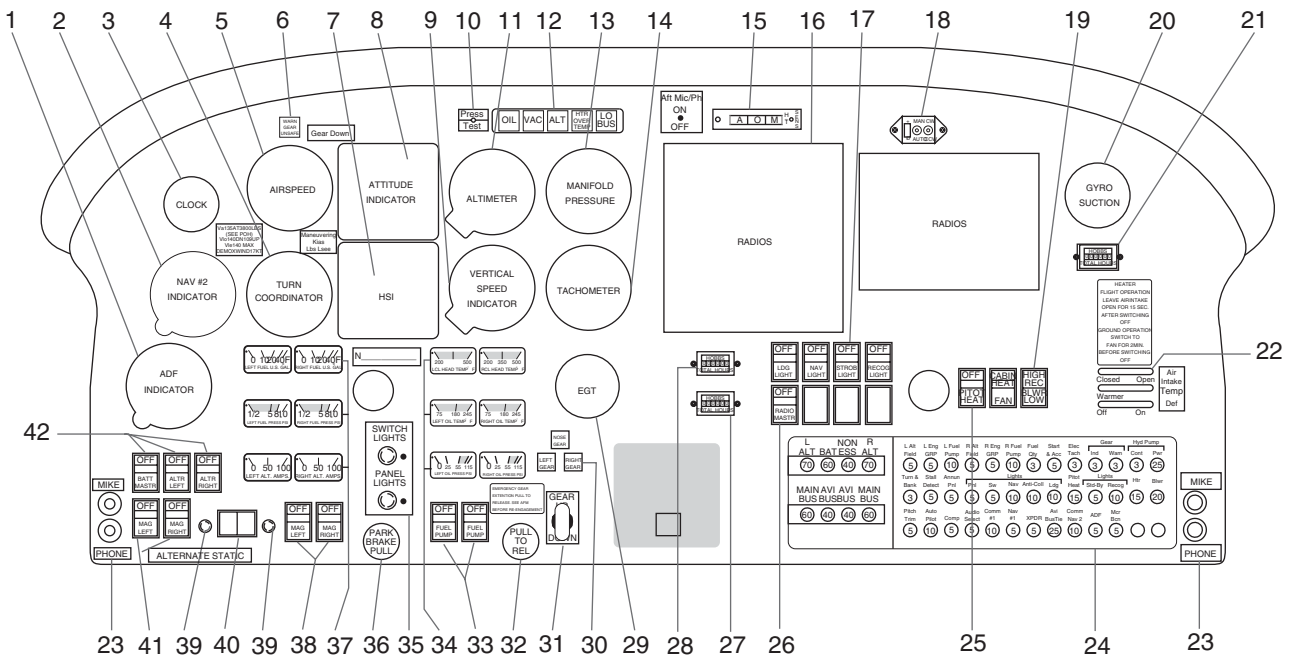
Most avionics are rack-mounted front-removable units generally secured to the instrument panel tray/rack by a single jackscrew located in the center of their faceplate.

(1) Removal

(a) Insert an appropriate size (generally 3/32 inch) allen wrench into the jackscrew access hole in the faceplate.

(b) Unscrew the jackscrew in a counterclockwise direction.

(c) Slide the avionics unit aft and out of the instrument panel tray/rack.



1. ADF INDICATOR
2. NAV #2 INDICATOR
3. CLOCK
4. TURN COORDINATOR
5. AIRSPEED INDICATOR
6. GEAR UNSAFE WARNING LIGHT
7. HORIZONTAL SITUATION INDICATOR
8. ATTITUDE INDICATOR
9. VERTICAL SPEED INDICATOR
10. ANNUNCIATOR TEST SWITCH
11. ALTIMETER
12. ANNUNCIATORL DISPLAY
13. DUAL MANIFOLD PRESSURE
14. DUAL TACHOMETER
15. MARKET BEACON
16. AVIONICS
17. EXTERIOR LIGHT SWITCHES
18. GYRO SLAVING CONTROL
19. ENVIRONMENTAL CONTROL SWITCHES
20. GYRO SUCTION
21. ENGINE HOURMETER
22. CABIN TEMP CONTROLS
23. MIC/PHONE JACKS
24. CIRCUIT BREAKER PANEL
25. PITOT HEAT SWITCH
26. RADIO MASTER SWITCH
27. HEATER HOURMETER
28. FLIGHT HOURMETER
29. EXHAUST GAS TEMPERATURE
30. GEAR POSITION INDICATOR
31. LANDING GEAR SELECTOR
32. EMERGENCY GEAR EXTENSION HANDLE
33. FUEL PUMP SWITCHES
34. INSTRUMENT CLUSTER
    - L & R CYL HEAD TEMPERATURE
    - L & R OIL TEMPERATURE
    - L & R OIL PRESSURE
35. INTERIOR LIGHTS
36. PARKING BREAK HANDLE
37. INSTRUMENT CLUSTER
    - L & R FUEL QUANTITY
    - L & R FUEL PRESSURE
    - L & R ALTERNATOR AMMETERS
38. RIGHT ENGINE MAGNETO SWITCHES
39. PRIMER SWITCHES
40. L & R START SWITCHES
41. LEFT ENGINE MAGNETO SWITCHES
42. BATTERY & ALTERNATOR SWITCHES
43. DAY/NIGHT DIMMER SWITCH

Instrument Panel (Typical)
Figure 1

(2) Installation

NOTE: Inspect the front of the panel-mounted avionics tray/rack to verify it is not significantly inset from the panel. If so, correct the tray/rack installation before proceeding.

NOTE: The high insertion forces required to seat a unit with “high density” connectors tend to limit the effectiveness of the first seating attempt. Accordingly, the following procedure requires sequential applications of force, and subsequent tightening of the jackscrew, to ensure all connectors seat properly.

(a) Slide the avionics unit into the instrument panel rack and forward applying a moderate insertion force.

(b) Insert an appropriate size (generally 3/32 inch) allen wrench into the jackscrew access hole in the faceplate and tighten to remove any slack, but do not try to “pull” unit into place with the jackscrew.

(c) Apply additional insertion force to front of unit.

(d) Tighten jackscrew again.

(e) Apply additional insertion force to front of unit.

(f) Finish tightening jackscrew.

(g) Ensure that unit bezel is “tight” against panel.

2. Circuit Breaker Panel

Circuit breakers are installed in the lower right instrument panel and are of the single hole mounting, pushbutton type, with manual reset.

Should a circuit breaker be replaced or added, exercise extreme caution ensuring the breakers are in proper mechanical alignment, any insulators that are called out are installed correctly, and all electrical wiring and connections meet aviation standards. Do not deviate from the parts manual requirements when replacing circuit breakers.

NOTE: This type of circuit breaker can be used as a method of turning a system on and off.

A. Removal

(1) Disconnect positive battery cable.

(2) Remove knurled nut from circuit breaker face plate on front of instrument panel.

(3) From behind instrument panel, disconnect electric bus bar from circuit breaker.

(4) From behind instrument panel, remove circuit protector from instrument panel.

NOTE: Record placement of electrical leads to aid installation.

(5) Disconnect electrical connections fastened with screws to circuit breaker.

B. Installation

(1) Check circuit breaker amperage is correct.

(2) Connect electrical leads to their proper screws on new breaker and secure.

(3) From behind instrument panel, insert circuit protector into its proper hole on instrument panel.

(4) From behind instrument panel, install electric bus bar to circuit breakers.

(5) Reconnect positive battery cable.

3. Switches

All switches are rocker-type and are located centrally in the instrument panel.

CAUTION: ALTHOUGH SMALL SWITCH ASSEMBLIES ARE EASIER TO REMOVE IF WIRING IS FIRST DISCONNECTED, THE LIMITED WORK SPACE BEHIND THE PANEL CAN RESULT IN BURNED WIRE INSULATION. DO NOT ATTEMPT TO UNSOLDER THESE SMALL ELECTRICAL CONNECTIONS BEHIND THE INSTRUMENT PANEL UNDER ANY CONDITIONS. IF NECESSARY, CUT WIRES AT POINT OF CONNECTION. IN ANY CASE, IT'S BETTER TO DAMAGE THE SWITCH AND REPLACE IT, RATHER THAN DAMAGE THE WIRING HARNESS LEADS.

A. Removal

(1) Disconnect positive battery cable.
(2) Gain access to the switch from behind the instrument panel.
(3) Squeeze retainer blades on top and bottom of the switch together and push switch from the panel.
(4) Make note of the placement of, and/or tag, wires on the switch to facilitate installation.
(5) Disconnect wires from the switch. Remove switch.

B. Installation

(1) Connect wires to the switch.
(2) Squeeze retainer blades on top and bottom of the switch together and push switch into panel until retainer blades engage the panel.
(3) Reconnect positive battery cable.

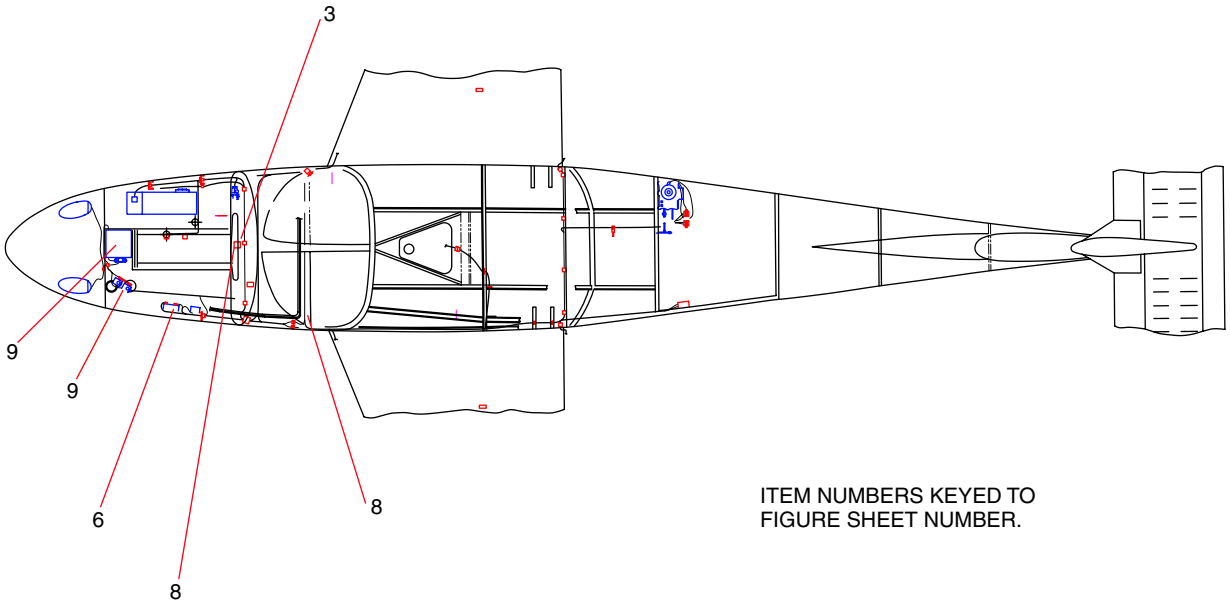
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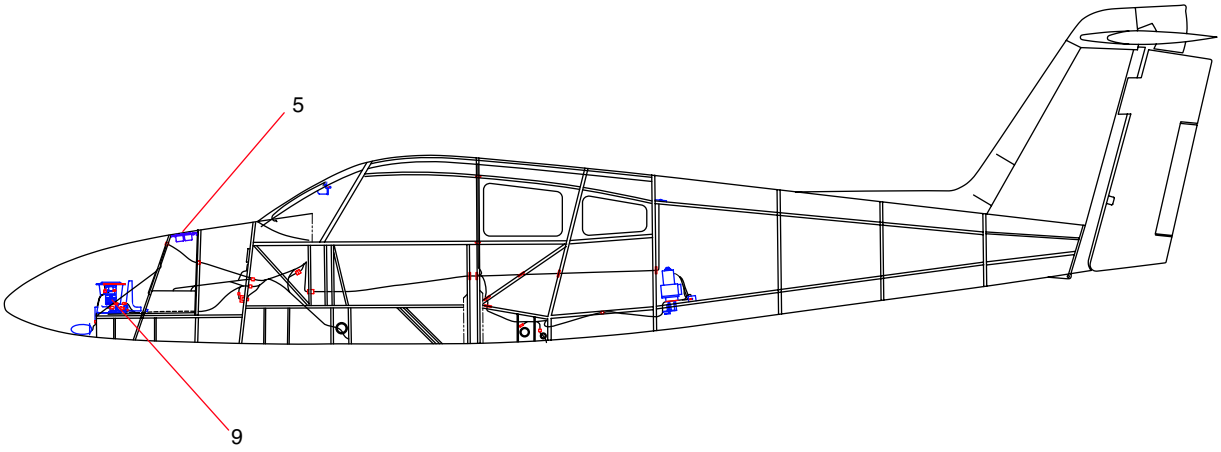
ELECTRICAL & ELECTRONIC EQUIPMENT

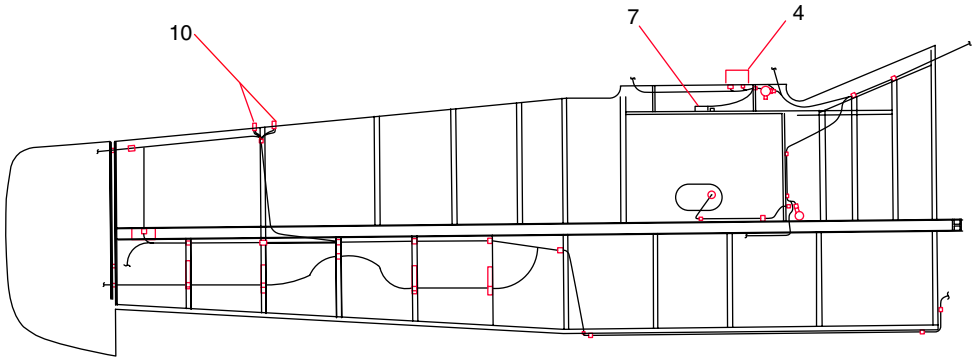
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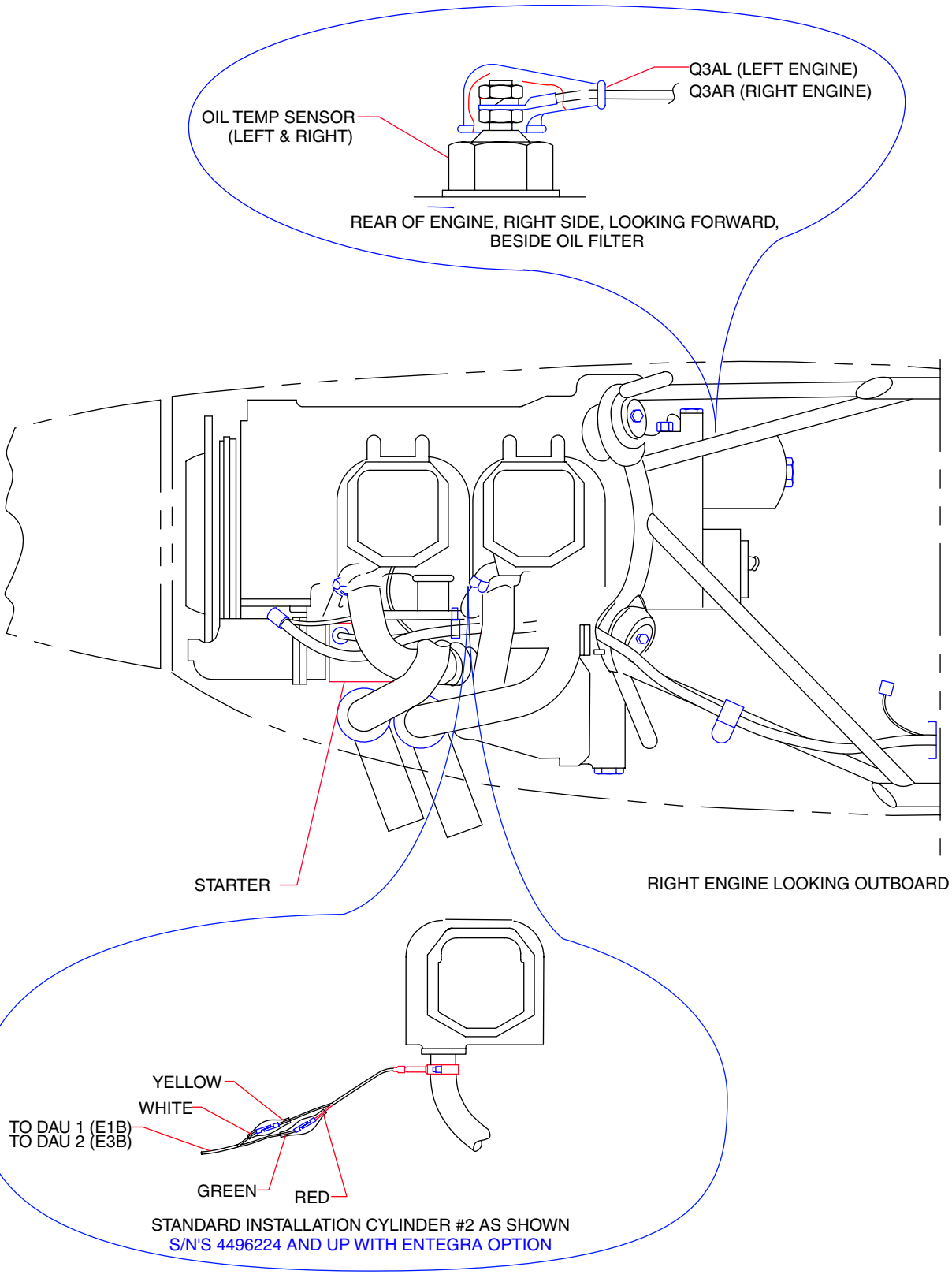


ITEM NUMBERS KEYED TO
FIGURE SHEET NUMBER.

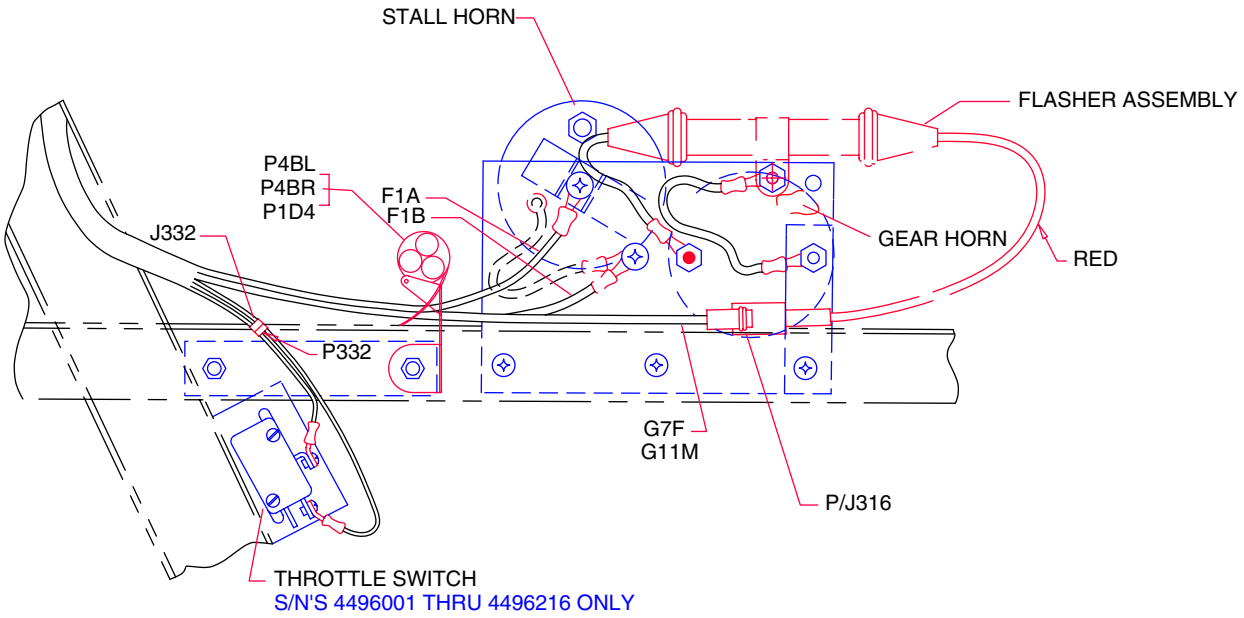




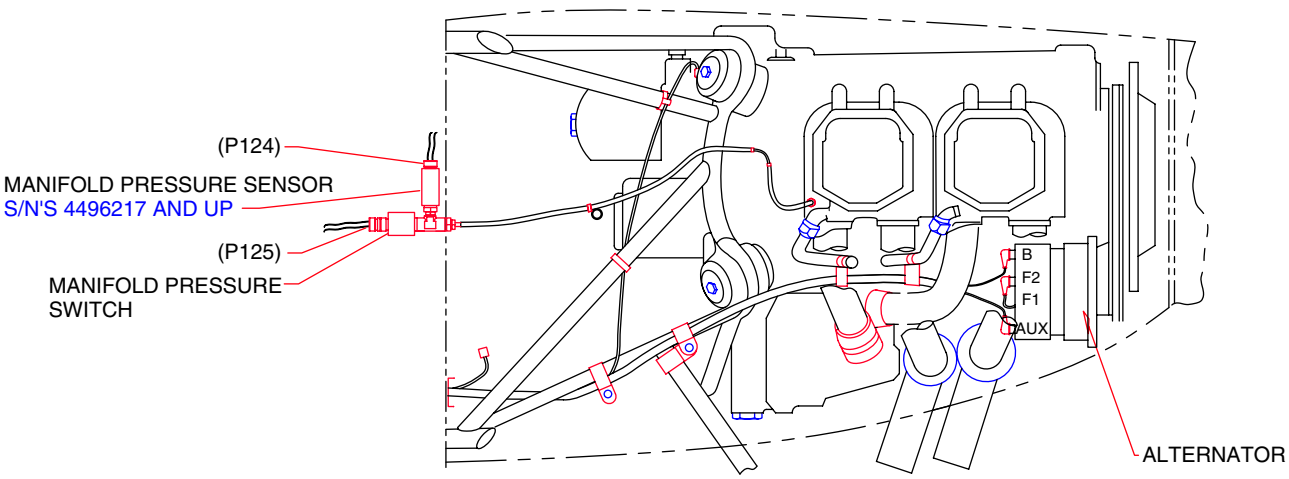
Electrical/Electronic Component Locator
Figure 1 (Sheet 1 of 10)



Electrical/Electronic Component Locator
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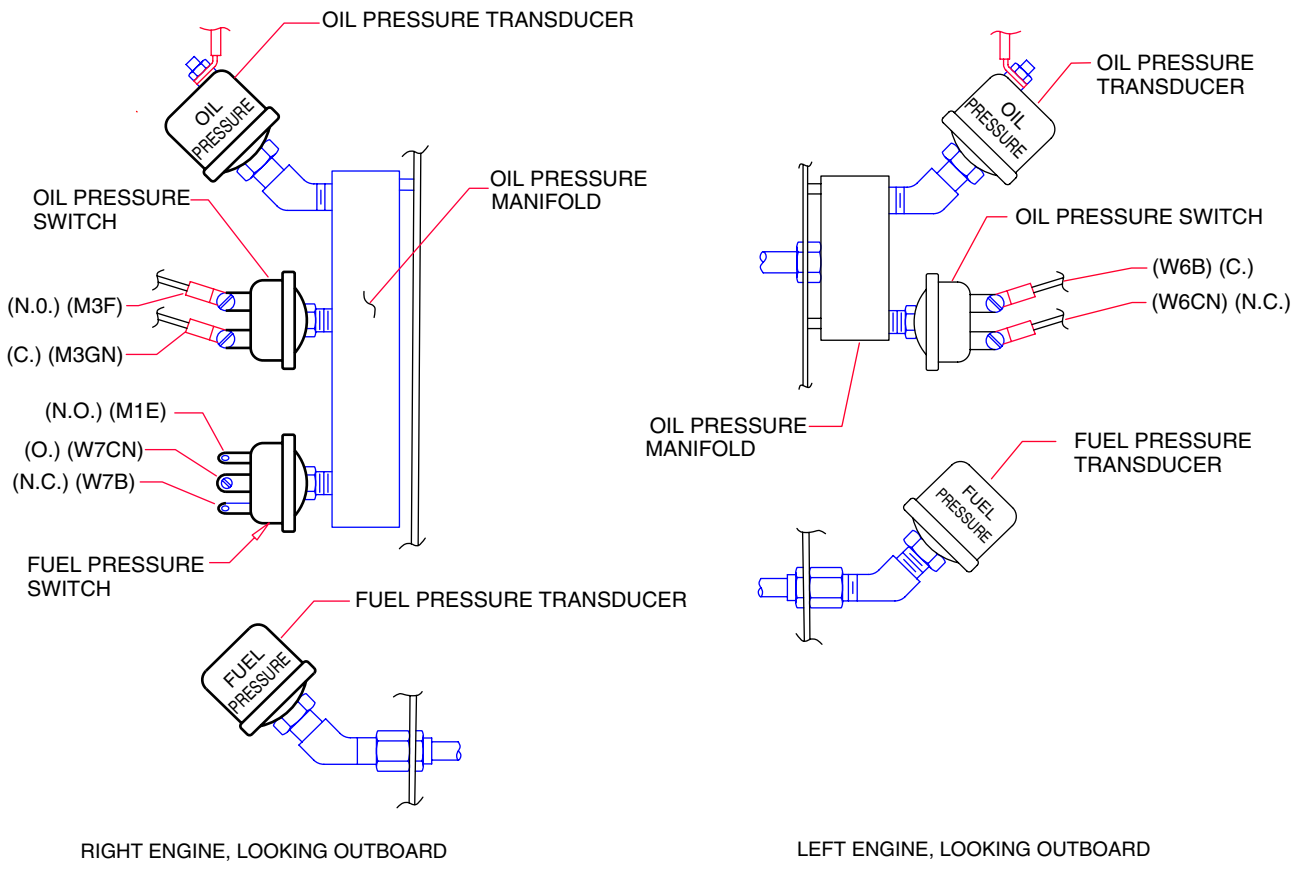


STALL HORN AND GEAR WARN HORN ASSEMBLY
BEHIND INSTRUMENT PANEL, LOOKING LEFT FROM AIRCRAFT CENTERLINE

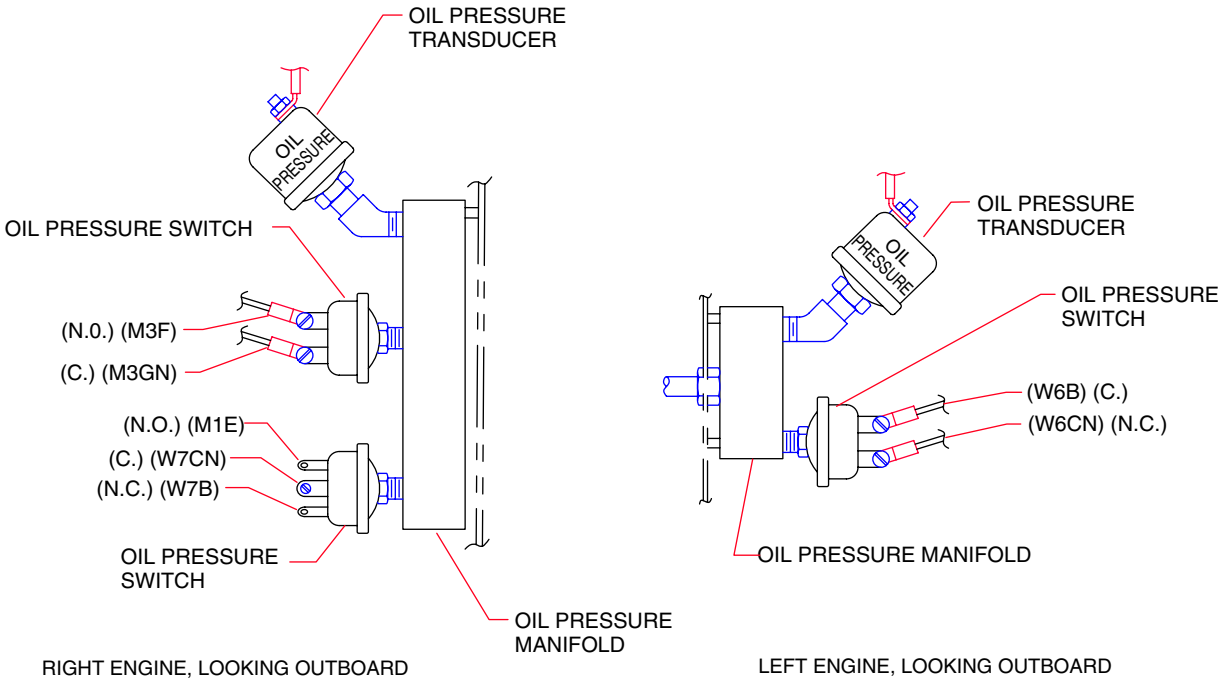


LEFT ENGINE LOOKING OUTBOARD
RIGHT ENGINE LOOKING INBOARD

Electrical/Electronic Component Locator
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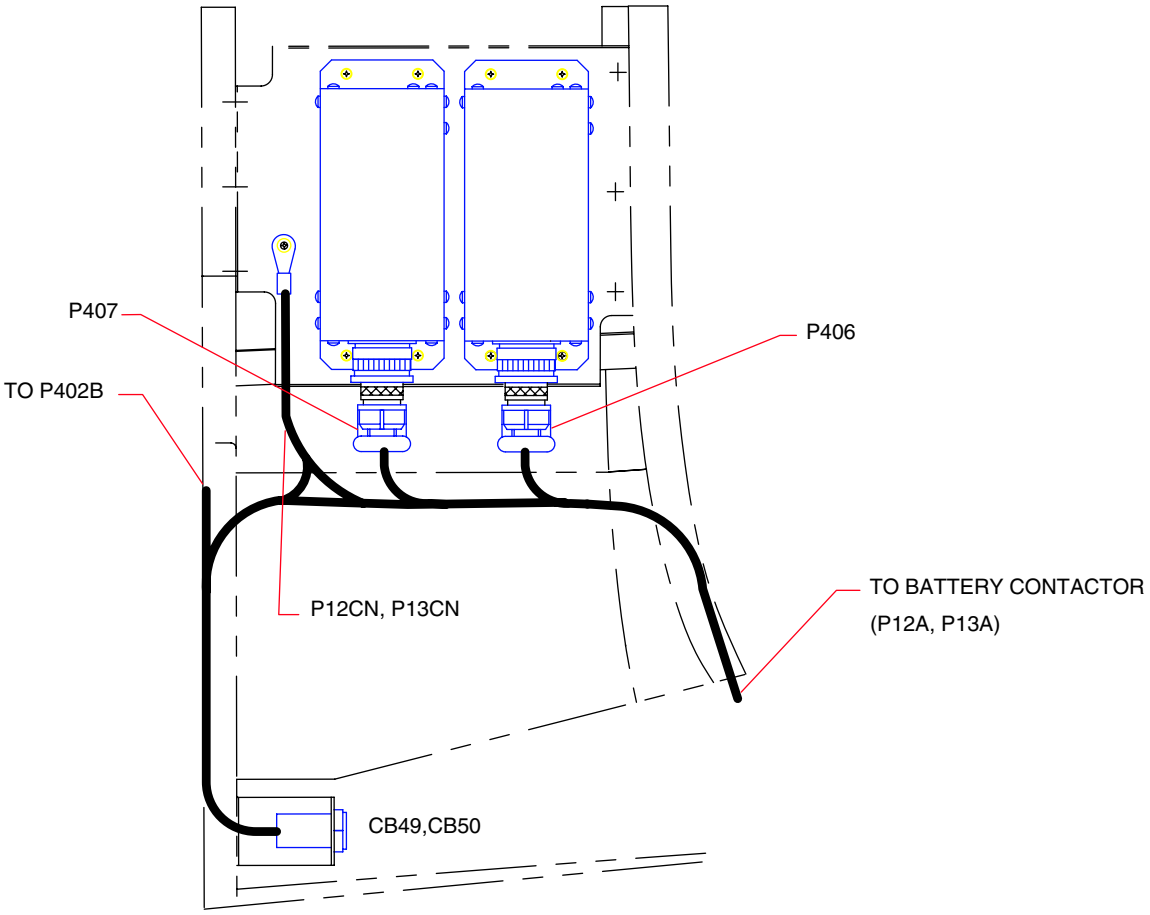


S/N'S 4496001 AND UP



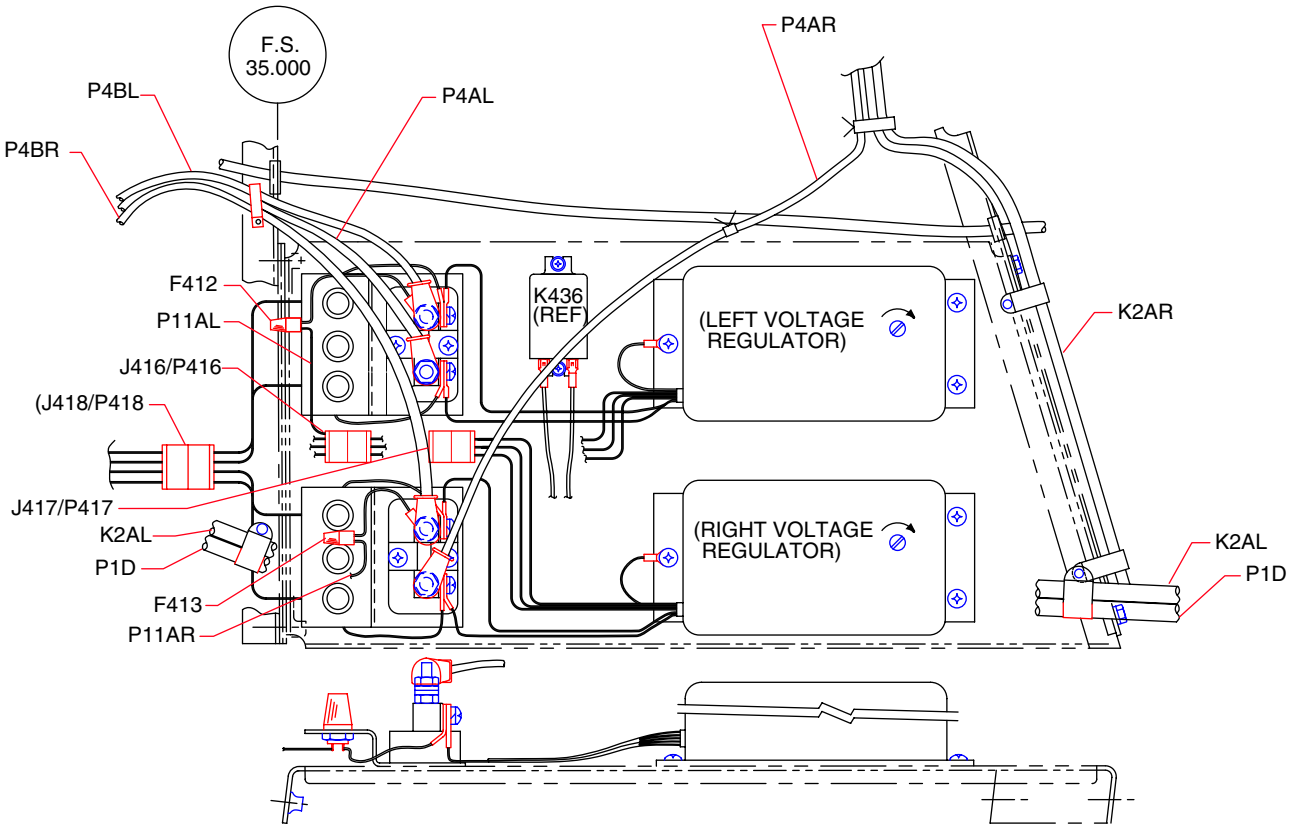
S/N'S 4496174; AND, 4496224 AND UP WITH ENTEGRA OPTION

Electrical/Electronic Component Locator
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VOLTAGE CONVERTER ASSEMBLY
NOSE COMPARTMENT, OVERHEAD LOOKING FORWARD
S/N'S 4496224 AND UP WITH ENTEGRA OPTION

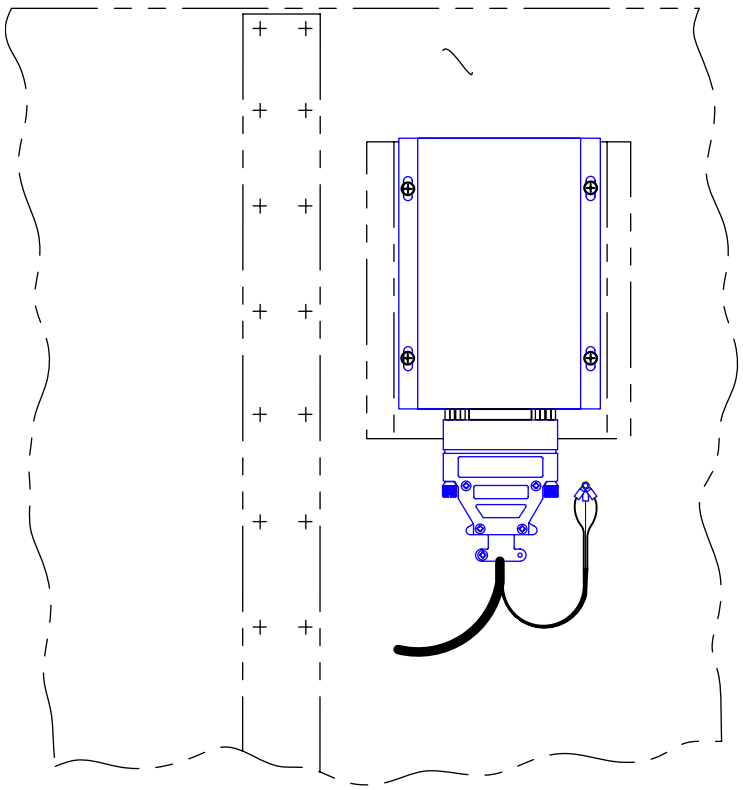
Electrical/Electronic Component Locator
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VOLTAGE REGULATOR ASSEMBLY

NOSE CONE COMPARTMENT FORWARD OF F.S. 35.000, LEFT SIDE, LOOKING OUTBOARD

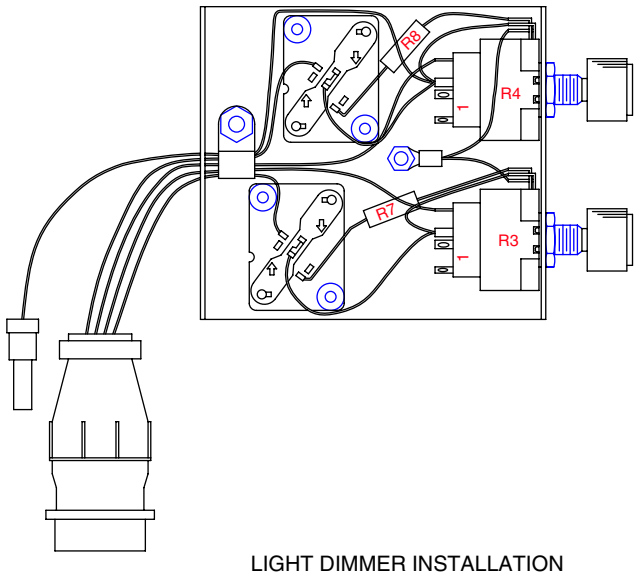
Electrical/Electronic Component Locator
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DAU INSTALLATION
(LEFT SIDE SHOWN, RIGHT SIDE OPPOSITE)
NACELLE BULKHEAD ASSEMBLY, LOOKING AFT

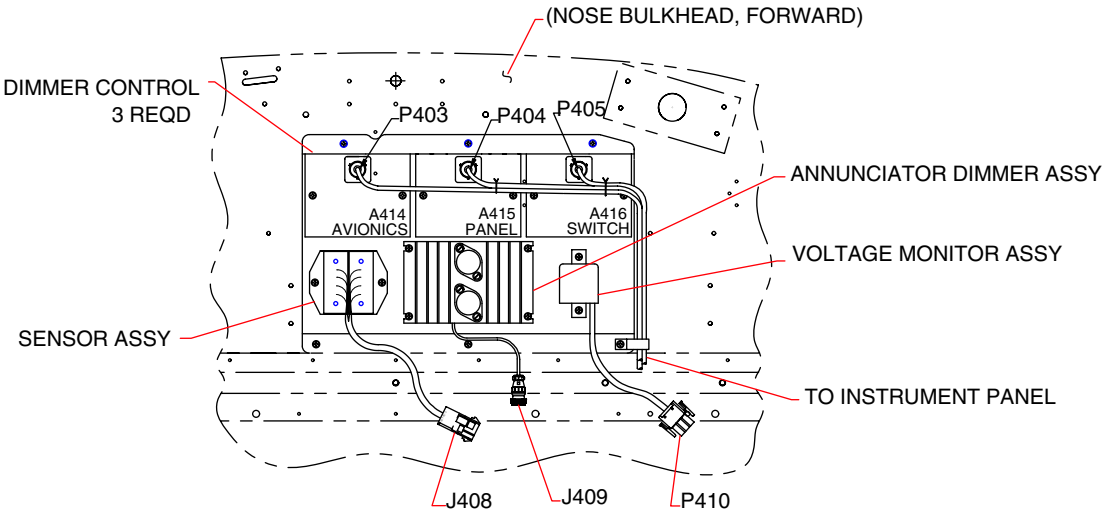
S/N'S 4496174; AND, 4496224 AND UP WITH ENTEGRA OPTION

Electrical/Electronic Component Locator
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LIGHT DIMMER INSTALLATION
S/N'S 4496001 AND UP

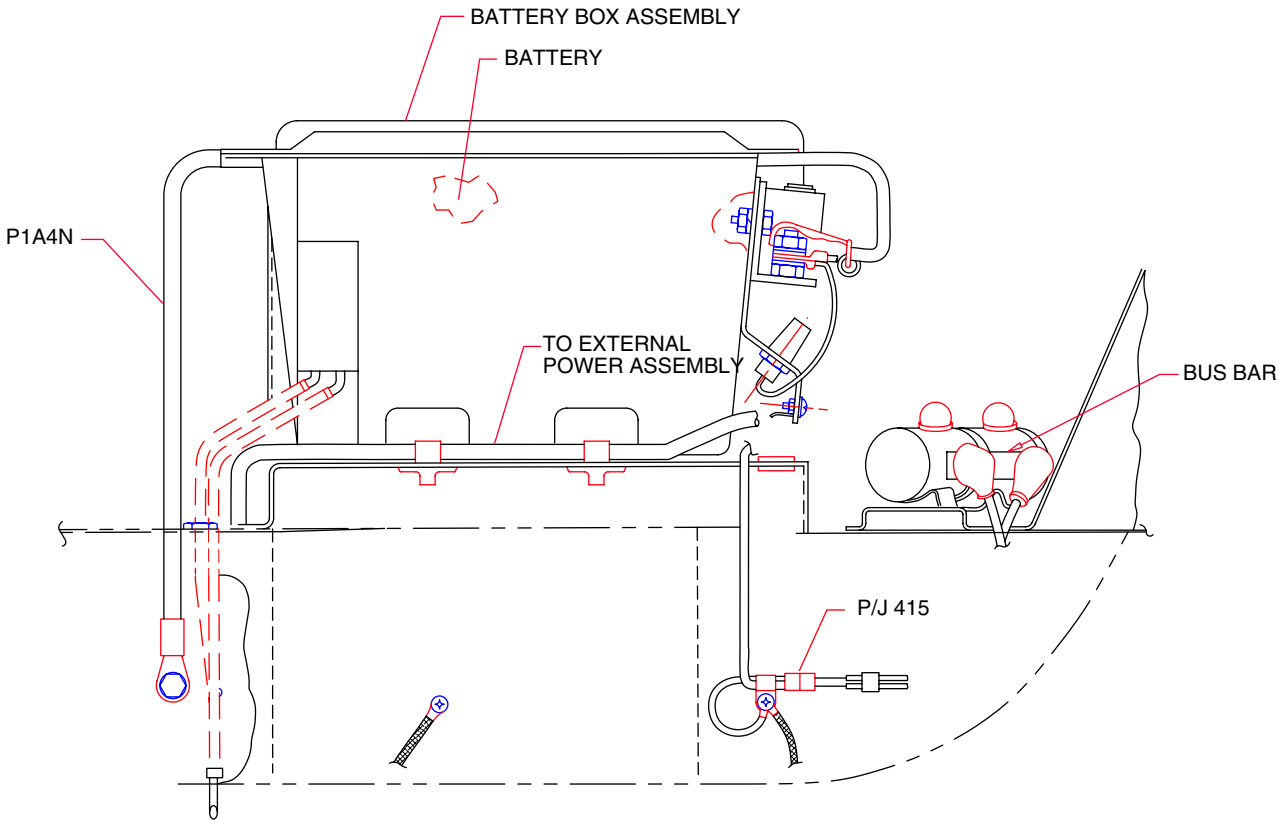
BEHIND INSTRUMENT PANEL, LEFT SIDE, LOOKING INBOARD



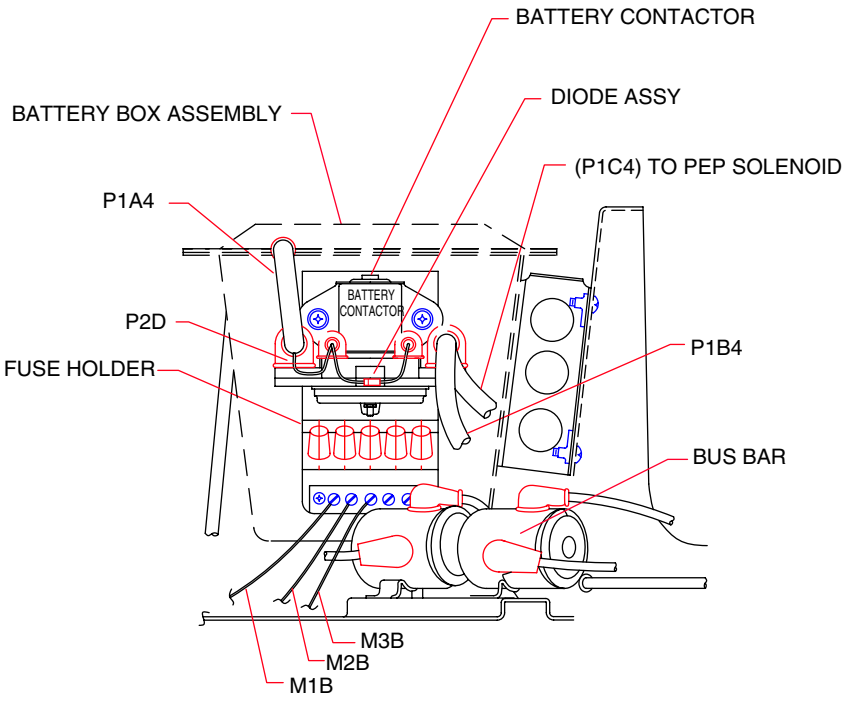
LIGHT DIMMER INSTALLATION
S/N'S 4496174; AND, 4496224 AND UP WITH AVIDYNE ENTEGRA OPTION

REAR OF NOSE CONE COMPARTMENT, LOOKING AFT

Electrical/Electronic Component Locator
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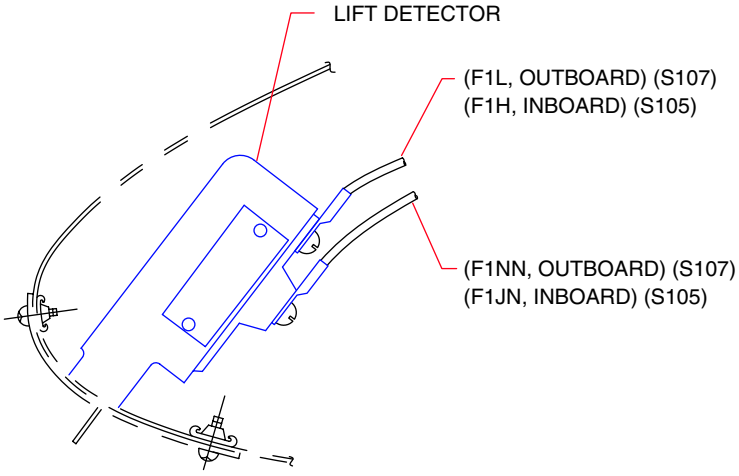


FORWARD NOSE CONE COMPARTMENT, LOOKING AFT



FORWARD NOSE CONE COMPARTMENT, LEFT SIDE, LOOKING RIGHT

Electrical/Electronic Component Locator
Figure 1 (Sheet 9 of 10)



LEFT WING ONLY
2 PLACES

Electrical/Electronic Component Locator
Figure 1 (Sheet 10 of 10)

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AIRPLANE MAINTENANCE MANUAL

CARD 5 OF 7

PA-44-180



(S/N's 4496001 & UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-892

March 15, 2006

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Manufacturers Association

THE NEW PIPER AIRCRAFT, INC.
PA-44-180, SEMINOLE
MAINTENANCE MANUAL

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-882) originally published March 1, 1998 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG970401	April 1, 1997	1, 2, 3, and 4
PR020228	February 28, 2002	1, 3, and 4
PR021206	December 6, 2002	2
CR060315 *	March 15, 2006	1, 2, 3, 4, 5, 6 and 7

*** COMPLETE REVISION OF MAINTENANCE MANUAL 761-892**

Revisions appear in all seven Aerofiche Cards. Accordingly, discard your entire existing Aerofiche Card set and replace it with this one dated 03/15/06.

Consult the Piper Customer Service Information Aerofiche (P/N 1753-755) for current revision dates for this manual.

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INTRODUCTION

1. Instructions for Continued Airworthiness

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

The PIPER PA-44-180 Seminole Maintenance Manual constitutes the Instructions for Continued Airworthiness in accordance with Federal Aviation Regulations (FAR) Part 23, Appendix G. Chapter 4 contains the Airworthiness Limitations section (4-00-00) and the Inspection Program is in Chapter 5 (5-20-00).

2. General

This publication is prepared in accordance with the General Aviation Manufacturers Association (GAMA) Specification No. 2, with respect to the arrangement and content of the System/Chapters within the designated Chapter/Section-numbering system.

WARNING: USE ONLY GENUINE PIPER AIRCRAFT PARTS OR PIPER AIRCRAFT APPROVED PARTS OBTAINED FROM PIPER APPROVED SOURCES, IN CONNECTION WITH THE MAINTENANCE AND REPAIR OF PIPER AIRPLANES.

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-44-180 Parts Catalog P/N 761-891, and FAR 43 for proper utilization.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

THE NEW PIPER AIRCRAFT, INC. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: THE NEW PIPER AIRCRAFT, INC. expressly reserves the right to supersede, cancel and/or declare obsolete any part, part numbers, kits or publication that may be referenced in this manual without prior notice.

In any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence.

3. Effectivity

This maintenance manual is effective for PA-44-180 Seminole airplanes serial numbers 4496001 and up.

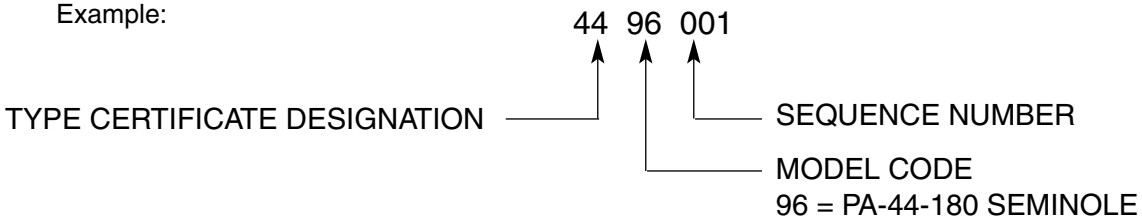
This encompasses the following model years:

NOTE: The following is provided as a general reference only.

Model Year	Serial Numbers
1995	4496001 thru 4496005
1996	4496006 thru 4496013
1997	4496014 thru 4496023; less 4496020
1999	4496024 thru 4496030; and 4496020
2000	4496031 thru 4496042
2001	4496043 thru 4496108
2002	4496109 thru 4496168
2003	4496169 thru 4496179
2004	4496180 thru 4496190
2005	4496191 thru 4496219
2006	4494220 and up

4. Serial Number Explanation

Example:



5. Assignment of Subject Material

This publication is divided into industry standard, three element, numeric subject groupings as follows:

A. System/Chapter - The various groups are broken down into major systems such as Environmental Systems, Electrical Power, Landing Gear, etc. They are assigned a number, which becomes the first element of the standardized numbering system. Thus, the element “28” of the number 28-40-01 refers to the chapter “Fuel”. Everything concerning the fuel system will be covered in this chapter.

B. Sub-System/Section - The major systems/chapters of an airplane are broken down into subsystems. These sub-systems are identified by the second element of the standard numbering system. The element “40” of the number 28-40-01 concerns itself with the indicating section of the fuel system.

C. Unit/Subject - The individual units within a sub-system/section may be identified by the third element of the standard numbering system. The element “01” of the number 28-40-01 is a subject designator. This element is assigned at the option of the manufacturer and is normally zeroed out by PIPER.

Refer to paragraph 14, Chapter/Section Index Guide, for a complete breakdown and list. The material is arranged in ascending numerical sequence.

6. Pagination

The Chapter - Section (i.e. - 28-40-00) numbering system (explained above) forms the primary page numbering system for this manual. Within each Section, pages are numbered consecutively beginning with Page 1 (i.e. - 28-40-00, Page 1). Additionally, the aerofiche grid numbering system (explained below) is also used to indicate location within the manual.

7. Aerofiche Effectivity

A. The General Aviation Manufacturers Association (GAMA) have developed specifications for microfiche reproduction of aircraft publications. 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. The “Aerofiche Effectivity” page at the front of this manual lists the current revision for each card in this set.

B. Conversion of Aerofiche alpha/numeric grid code numbers:

First number is the Aerofiche card number.
Letter is the horizontal row reference per card
Second number is the vertical column reference per card.

Example: 2J16 = Aerofiche card number two, row J, column 16.

C. To aid in locating information, the following is provided at the beginning of each aerofiche card:

(1) A complete Introduction containing the Chapter/Section Index Guide for all fiche in this set.

(2) A complete subject Index for all fiche in this set.

8. Identifying Revised Material

A revision to a page is defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a vertical line (i. e. - change bar) along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A change bar in the left-hand margin opposite the footer (i.e. - chapter/section/subject, page number and date), indicates that the text was unchanged but the material was relocated to a different page.

Example.

NOTE: Change bars are not used in the title pages, list of effective pages, or index. Likewise, all change bars are removed when a publication is completely revised (i.e. - reissued).

9. Indexing

An alphabetically arranged subject Index follows this introduction to assist the user in locating desired information. In addition, each System/Chapter begins with an individual Table of Contents.

10. List of Effective Pages

Each System/Chapter has a List of Effective Pages preceding the Table of Contents to identify the effective revision date for each page in that chapter.

11. Warnings, Cautions and Notes

These adjuncts to the text are used to highlight or emphasize important points when necessary. Warnings call attention to use of materials, processes, methods, procedures or limits which must be followed precisely to avoid injury or death to persons. Cautions call attention to methods and procedures which must be followed to avoid damage to equipment. Notes call attention to methods which make the job easier. Warnings and Cautions shall be located directly above and Notes directly beneath the text and be in line with the paragraphs to which they apply.

12. Accident/Incident Reporting

To improve our Service and Reliability system and aid in Piper's compliance with FAR 21.3, knowledge of all incidents and/or accidents must be reported to Piper immediately. To expedite and assist in reporting all incidents and accidents, Piper Form 420-01 has been created. See Service Letter 1041 for latest revision. This procedure is to be used by all Dealers, Service Centers and Repair Facilities.

13. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-44-180 airplane and its various components. Use them to supplement this manual.

A. Piper Publications:

	Piper P/N
(1) Parts Catalog:	761-892
(2) Periodic Inspection Report:	230-1963
(3) Progressive Inspection Manual (pending):	767-014

B. Vendor Publications:

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY.

(1) ALTERNATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

(2) AUTOFLIGHT:

Vendor Address: Honeywell (or) S-TEC Corporation
One Technology Center One S-TEC Way
23500 W. 105th St., M/D #45 Mineral Wells, Texas 76067
Olathe, Kansas 66061-1950 PH - (940) 325-9406
http://www.bendixking.com/ www.s-tec.com

(3) BATTERY:

Vendor Address: GILL Batteries PH: - (800) 456-0070
A Division of Teledyne Continental Motors
http://www.gillbatteries.com

(4) BRAKES AND WHEELS:

Vendor Address: Parker Hannifin Corp PH: - (800) 272-5464
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
http://www.parker.com/cleveland/Universe/book.pdf

(5) ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS):

Vendor Address: Avidyne Corporation PH - (800) 284-3963
55 Old Bedford Road
Lincoln, MA 01773
http://www.avidyne.com/index.htm

Instructions for Continued Airworthiness

Primary Flight Display and Magnetometer/OAT:	Document No. AVPFD-174
Multifuntion Display:	Document No. AVMFD-167
Data Acquisition Unit:	Document No. AVSIU-011

(6) EMERGENCY LOCATOR TRANSMITTER:

Vendor Address: Artex Airccraft Supplies PH: - (800) 547-8901
14405 Keil Road NE
Aurora, Oregon 97002
http://www.artex.net/

(7) ENGINE:

Vendor Address: Textron Lycoming PH - (717) 323-6181
652 Oliver Street FAX - (717) 327-7101
Williamsport, PA 17701
http://www.lycoming.textron.com/main.html

Overhaul Manual:	DIRECT DRIVE MODELS	- P/N 60294-7
Parts Catalog:	O, LO-360 A1H6 ENGINES	- P/N PC306-5
Operators Handbook:	O, HO, IO, AIO, HIO, TIO-360 SERIES	- P/N 60297-12

NOTE: The above Lycoming publications can be ordered as a set on CD-ROM from Avantext. See www.avantext.com or PH - (800) 998-8857.

(8) FIRE EXTINGUISHER (PORTABLE):

Vendor Address: H3R Inc. PH: - (800) 249-4289
43 Magnolia Ave # 4
San Francisco, California 94123-2911
http://www.h3r.com/index.htm

(9) FUEL CELLS:

Vendor Address: Engineered Fabrics Corporation PH - 770-684-7855
669 Goodyear Street FAX - 770-684-7438
Rockmart, Georgia 30153-0548
http://www.kfefc.com/index.htm

(10) HEATER

Vendor Address:	Kelly Aerospace Power Systems Airport Complex, PO Box 273 Fort Deposit, AL 36032 http://www.kellyaerospace.com/ts_heaters.html	PH: - (888) 461-6077 FAX - (334) 227-8596
Maintenance and Overhaul Manual:	Janitrol Maintenance and Overhaul Manual - 24E25-1	

(11) LIGHTS - NAVIGATION, STROBE, AND MAP LIGHTS:

Vendor Address:	Whelen Engineering Co. Inc. Route 145, Winthrop Rd. Chester, Conneticut 06412 http://www.whelen.com/	PH: - (860) 526-9504 FAX - (860) 526-2009

(12) MAGNETOS:

Vendor Address:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104 http://www.unisonindustries.com/index4.html	PH - (815) 965-4700 FAX - (815) 965-2457
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363	

(13) NAVIGATION, COMMUNICATIONS, AND GPS (NAV/COM/GPS):

Vendor Address:	Garmin International 1200 East 151ST Street Olathe, KS 66062 http://www.garmin.com	PH: (913) 397-8200

(14) PROPELLER:

Vendor Address:	Sensenich Corporation 14 Citation Lane Lititz, PA 17543 http://www.sensenich.com/	PH - (717) 569-0435 FAX - (717) 560-3725
Repair Manual:	METAL PROPELLER REPAIR MANUAL - SPRM 590	

(15) STARTER:

Vendor Address:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252
or	Electro Systems, Inc. (see “Voltage Regulator,” below)	

(16) VACUUM PUMP:

Vendor Address: Aero Accessories, Inc. PH - (800) 822-3200
1240 Springwood Avenue
Gibsonville, NC 27249
http://www.aeroaccessories.com/index.html

(17) VACUUM REGULATOR:

Vendor Address: Parker Hannifin Corp. PH: - (800) 382-8422
Airborne Division
711 Taylor Street
Elyria, Ohio 44035
http://www.parker.com/cleveland/Universe/book.pdf

(18) VOLTAGE REGULATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

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14. Chapter/Section Index Guide

NOTE: The following GAMA Specification No. 2 standard chapters are not included in this Maintenance Manual: 23, 35, 36, 38, 49, 54, 60, 72, 75, 81, and 83. These chapters are omitted because the subject system is either: not installed in these airplanes; adequately covered in vendor or other manuals; or, for ease of use, has been combined with another chapter.

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CHAPTER

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STRUCTURES

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CHAPTER 51

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CHAPTER 51 - STRUCTURES

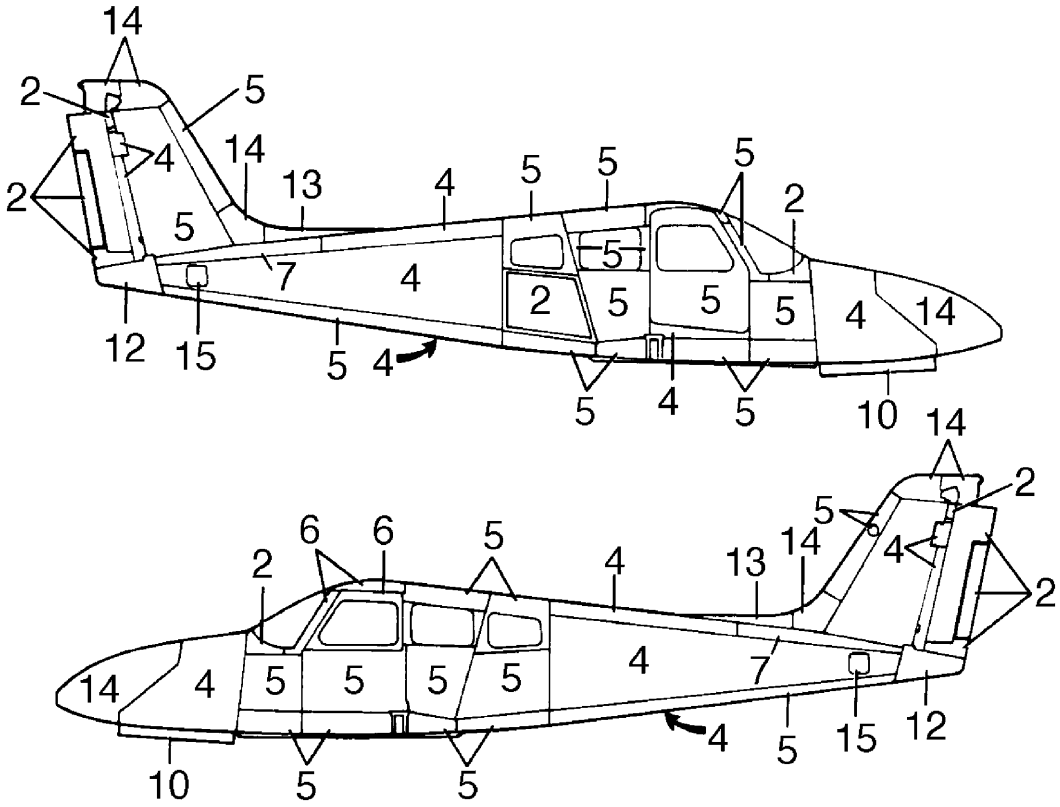
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GENERAL

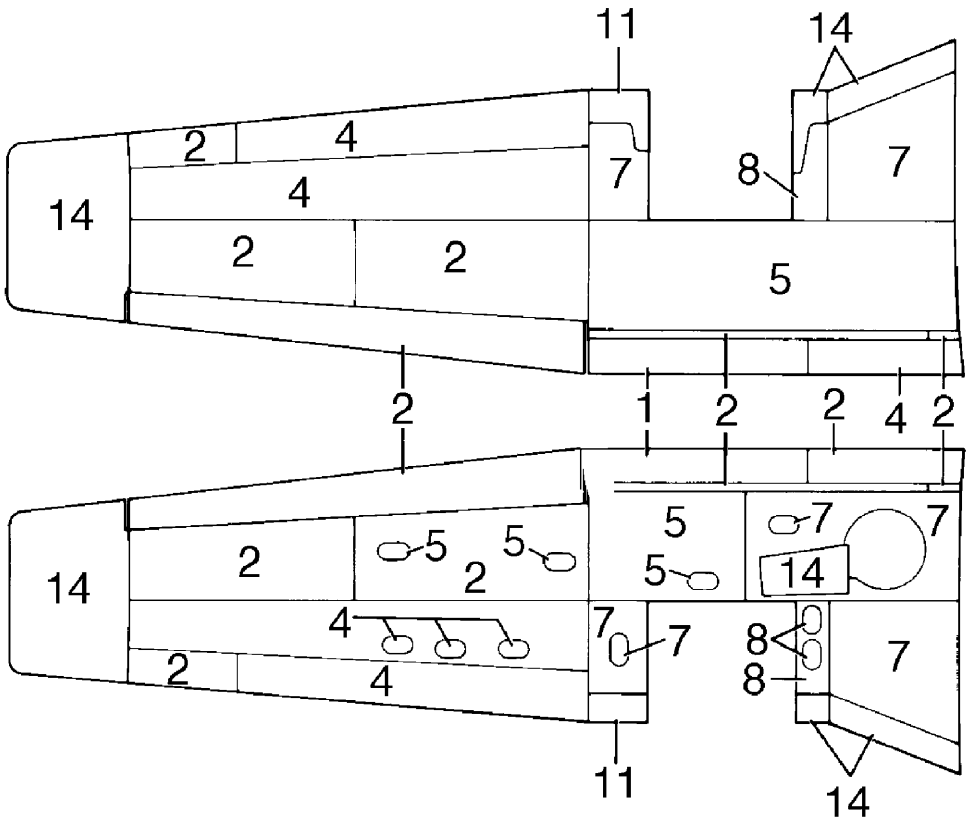
The airplane is an all metal semi-monocoque structure. The fuselage is constructed of bulkheads, stringers and stiffeners, to which all of the outer skin is riveted. The cabin entrance door is located on the right side of the fuselage above the wing. An emergency exit is provided on the left side of 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.



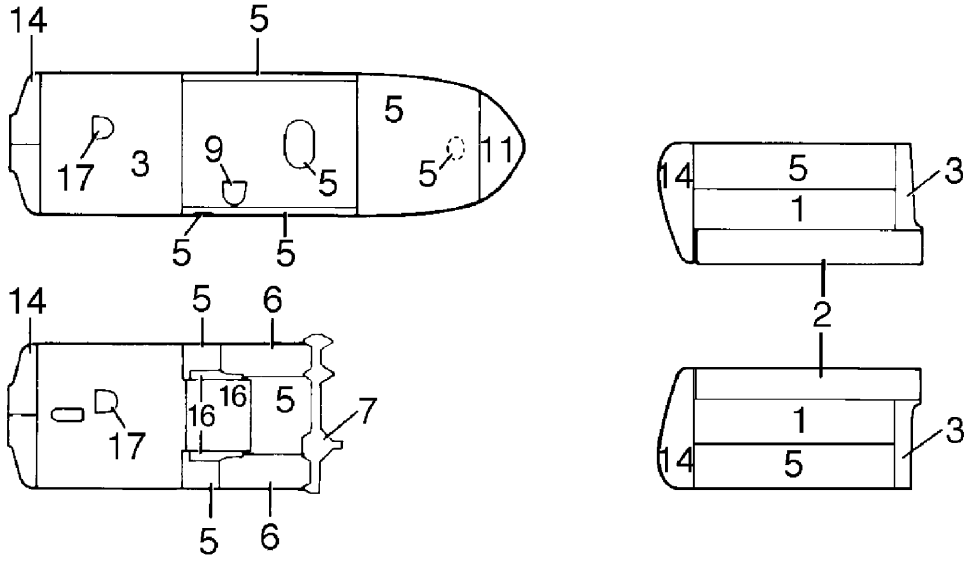
SKIN	MATERIAL	THICKNESS
1	2024-T3	0.016
2	2024-T3	0.020
3	2024-T3 *	0.020
4	2024-T3	0.025
5	2024-T3	0.032
6	2024-T3 *	0.032
7	2024-T3	0.040
8	2024-T3	0.051
9	5052-H34	0.040
10	BONDOLITE Z-3A	0.125
11	THERMOPLASTIC	0.125
12	THERMOPLASTIC	0.93
13	THERMOPLASTIC	0.062
14	FIBERGLASS	
15	2024-T3	0.050
16	GALVANIZED STEEL	0.018
17	5052-H34	0.032

*** HEAT TREAT TO 2024-T42 AFTER FORMING.**

Skin Materials and Thickness
Figure 1 (Sheet 1 of 2)



LEFT WING AND NACELLE SHOWN, RIGHT WING OPPOSITE



Skin Materials and Thickness
Figure 1 (Sheet 2 of 2)

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INVESTIGATION, CLEANUP AND AERODYNAMIC SMOOTHNESS

Corrosion Control

Corrosion is the deterioration of metal by chemical or electrochemical attack. Water which is allowed to remain on the aircraft and industrial pollution are the major causes of corrosion in aircraft. The two general types of corrosion are:

-- Direct chemical attack (i.e. spilled battery acid).

-- Electrochemical attack which requires a medium (usually water).

The latter is the most common and is responsible for most forms of aircraft corrosion.

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

A. Forms of Corrosion (See Chart 1.)

The following are the most common forms of corrosion:

(1) Surface Corrosion appears as a general roughening or pitting on the surface usually accompanied by a powdery deposit of corrosion products. It may spread under the surface and not be recognized until the paint or plating is lifted off the surface in small blisters.

(2) Dissimilar Metal Corrosion may occur when two dissimilar metals are contacting each other. This type may be serious because it usually takes place out of sight. The only way to find it before structural failure is by disassembly and inspection. Insulating is necessary between two contacting dissimilar surfaces (2 to 3 coats of zinc chromate on each surface; plus, if one of the surfaces is magnesium, a 0.003 inch thick piece of vinyl tape).

(3) Intergranular Corrosion is difficult to detect in its early stages. When severe, it causes the surface of the metal to exfoliate (flake or lift).

(4) Stress Corrosion is the result of sustained tensile stresses and corrosive environment. It usually occurs in assemblies such as aluminum alloy bellcranks with pressed in bushings; landing gear shock struts with pipe thread grease fittings, clevis pin joints and shrink fit parts.

(5) Fretting Corrosion takes place when two parts rub together, constantly exposing fresh active metal to the corrosive effects of the atmosphere.

(6) Filiform Corrosion is the appearance of numerous meandering thread like filaments of corrosion on the surface of various types of metal.

B. Conditions Affecting Corrosion

Some conditions which affect the occurrence of corrosion are:

(1) Heat and humidity increase corrosion.

(2) Different (i.e. - dissimilar) metals and their relative sizes affect resistance or susceptibility to corrosion.

(3) Frequent contributing factors to corrosion:

(a) Soil and atmosphere dust.

(b) Oil, grease, and exhaust residues.

(c) Salt water and salt moisture condensation.

(d) Spilled battery acids and caustic cleaning solution.

(e) Welding, brazing, and soldering flux residue.

CHART 1
TYPES OF METAL CORROSION

Type of Material	Type of Corrosion	Remedy (2)
Steel.	Rust (1).	Complete removal of corrosion by mechanical means.
Aluminum.	White to grey powdery material.	Mechanical polishing or brushing with material softer than aluminum.
Magnesium (highly susceptible to corrosion).	White powdery snow-like mounds and white spots.	Mechanical polishing or brushing for a smooth finish.
Cadmium (plating).	White to brown to black mottling of surface (plating is still protecting until iron appears).	Mechanical removal of corrosion is limited to metal surfaces from which cadmium has been depleted.
Chromium (plating).	May pit in chloride environment.	Polishing and buffing.

— NOTES —

(1) Red rust generally shows on bolts, nuts, and other aircraft hardware. Rust in these areas is generally not dangerous, however, it shows a need for maintenance and the possibility of corrosive attack in more critical areas. Any surface corrosion on highly stressed steel parts is potentially dangerous. A careful removal of corrosion using mild abrasives (rouge or fine grit aluminum oxide paper) is necessary. Do not overheat metal when removing corrosion.

(2) For abrasion, do not use dissimilar material (for example steel wool on aluminum). Remove only material required to clean affected area.

(4) A clean aircraft will resist corrosion better than a dirty one. Cleaning frequency depends on several factors, including geographical location, type of operation, etc. Remove soil as soon as possible, especially when in a high temperature area.

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

C. Inspection

CAUTION: INSPECTION FOR CORROSION MUST BE PERFORMED BY PERSONS FAMILIAR WITH CORROSIVE PROBLEMS AND REMEDIES.

NOTE: Some areas of the airplane have been treated with a corrosion inhibiting compound which requires re-treatment at five (5) year intervals. See Each Five (5) Years, Per Calendar Year, 5-30-00.

Check for corrosion at every inspection. In trouble areas, inspection frequency must be increased. In addition to routine inspections:

(1) Aircraft operating around a marine environment must be given special inspections on a weekly basis. See Per Specific Operation / Operating Environment, 5-30-00.

(2) Aircraft operating in semi-acid conditions must be inspected monthly. Semi-acid conditions are likely to occur in industrialized areas where sulphur-bearing particles in dust, smoke, and smog will attack painted surfaces. See Per Specific Operation / Operating Environment, 5-30-00.

(3) Inspection for corrosion must be performed by personnel familiar with corrosive problems and remedies.

(a) Daily and preflight inspection must include engine frontal areas, all intake vents, engine compartments, gaps, seams, and faying surfaces in exterior skins, wheel and wheel well areas, battery compartment, fuel cell, all other drains, and any bilge areas not requiring extensive removal of inspection access covers.

(b) Detailed inspection must include above referenced areas along with areas requiring removal of inspection plates and panels to thoroughly inspect internal cavities of aircraft.

(4) Paint tends to hide corrosion in its initial stages. The results of corrosion can sometimes be seen as blisters, flakes, chips, and other irregularities in paint.

D. Corrosion Removal and Control

CAUTION: THE DEPTH OF MATERIAL REMOVED MUST NOT EXCEED SAFE LIMITS.

CAUTION: REMOVAL OF SEVERE CORROSION MAY BE CONSIDERED A MAJOR REPAIR. ANY REPAIR OF THIS TYPE MUST BE APPROVED BY THE FAA BEFORE THE AIRPLANE CAN BE RETURNED TO SERVICE.

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

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

(1) Before beginning any rework:

(a) Position airplane in a wash rack or provide some type of washing apparatus for rapid rinsing of all surfaces.

(b) Connect static ground line to airplane.

(c) Remove airplane battery if required.

(d) Protect pitot-static ports, engine openings, airscoops, louvers, wheels, tires, and other portions of airplane from moisture and chemical brightening agents.

(e) Protect surfaces next to rework areas from chemical paint strippers, corrosion removal agents, and surface treatment materials.

(2) Evaluate corrosion damage to determine type and extent of repairs required. Proceed as follows:

(a) Light Corrosion: discoloration or pitting. Remove by light hand sanding or a small amount of chemical treatment.

(b) Moderate Corrosion: similar to light corrosion except there is blistering or evidence of scaling and flaking. Remove by extensive hand or mechanical sanding.

(c) Severe Corrosion: similar to moderate corrosion with severe blistering, exfoliation, scaling, or flaking. Remove by extensive mechanical sanding or grinding.

E. Corrosion Prone Areas

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

(1) Areas around steel fasteners are susceptible to corrosion. The paint on these areas cracks which allows moisture to seep in and corrode the underlying metal. Each time the fastener is removed, it should be coated with zinc chromate (or equivilent) before reinstallation. The paint should be wet when the fastener is installed.

(2) Fluids tend to seep into faying surfaces, seams and joints due to capillary action. The effect of this type of intrusion is usually detectable by irregularities in the skin's surface.

(3) Spot welded assemblies are particularly prone to corrosion. The only means to prevent this type of corrosion is by keeping potential moisture entry points in the spot weld filled with a sealant or preservative compound. On an aluminum spot welded assembly, a chromate conversion coating before paint is applied will help prevent corrosion.

(4) Areas exposed to exhaust gases may have their finish damaged by deposits. These deposits may result in an aggressive attack on the metal by corrosion. Heat from the exhaust may also blister or otherwise damage the paint. Gaps, seams, hinges and fairings are some places where exhaust gas deposits may be trapped and not reached by normal cleaning methods.

(5) The wheel well and landing gear are the most exposed parts of the aircraft. Due to the complexity of its shape, assemblies and fittings, maintaining a protective coverage is difficult. The especially troublesome areas are:

(a) Magnesium wheels: around bolt heads, lugs and wheel well areas:

(b) Exposed rigid tubing, B-nuts, ferrules, under clamps and tubing identification tape:

(c) Exposed position indicator switches and other electrical equipment:

(d) Crevices between stiffeners, ribs and lower skin surfaces.

(6) Flaps, flight control slots and equipment installed in these areas may corrode unnoticed unless a careful surveillance is maintained.

(7) Engine frontal areas, air inlet ducts and the leading edge of wings, because they are constantly exposed to abrasion by dirt, dust, gravel and rain, should be checked frequently for the beginning of corrosion.

(8) Hinges (piano hinges especially) are extremely vulnerable to corrosion. Their protective coatings wear away and they naturally trap dirt, salt and moisture.

(9) Control cables may have bare spots in their preservative coating which will lead to corrosion. Cables having external corrosion must be checked for internal corrosion. If internal corrosion is present, replace the cable. If only external corrosion is present, remove corrosion with wire brush and recoat cable with preservative.

(10) Check and clean drain holes regularly.

(11) Battery compartment and vent openings are especially prone to corrosion due to spilled electrolyte. Fumes from overheated battery electrolyte will spread to adjacent areas and cause rapid corrosion of unprotected surfaces. Frequent cleaning and neutralization of deposits will minimize corrosion in this area.

(12) Magnesium parts are prone to corrosion. Special attention must be given to their surface treatment, proper insulation (due to dissimilar metal corrosion), and paint coatings.

(13) Electrical components and connectors must be checked. Inspection frequency is based on operational environment and past trouble.

(14) Skin joints and lap-overs are two areas that can trap and hold moisture. Corrosion in these areas may go unnoticed unless particular attention is paid to them during inspection.

(15) Hoses, having an internal wire braid, which are located in a position where they are frequently water soaked, need a protective treatment.

(16) Drilled holes and trimmed ends of sandwich panels must be protected. Use an inhibitor solution or sealant application. Any gaps or cavities which allow dirt or moisture to enter must be filled with sealant.

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REPAIRS

Structural repair methods used must be in accordance with regulations set forth in FAA Advisory Circular 43.13-1, latest revision. To assist in making repairs and/or replacements, Figure 1, 51-00-00, identifies type and thickness of various skin material used.

WARNING: NO ACCESS HOLES ARE PERMITTED IN ANY CONTROL SURFACE. USE OF PATCH PLATES FOR REPAIRS OF ALL MOVABLE TAIL SURFACES IS PROHIBITED. USE OF ANY FILLER MATERIAL NORMALLY USED FOR REPAIR OF MINOR DENTS AND/OR MATERIALS USED FOR FILLING INSIDE OF SURFACES IS ALSO PROHIBITED ON ALL MOVABLE TAIL SURFACES.

Never make a skin replacement or patch plate from material other than type of original skin, or of a different thickness than original skin. Repair must be as strong as original skin. However, flexibility must be retained so surrounding areas will not receive extra stress.

1. Fiberglass Repairs

The repair procedure in this section will describe the methods for the repair of fiberglass reinforced structures. This section describes Touch-up and Surface Repairs such as blisters, open seams, delaminations, cavities, small holes and minor damages that have not harmed the fiberglass cloth material. Also covered are Fracture and Patch Repairs such as puncture, breaks and holes that have penetrated through the structure and damaged the fiberglass cloth. A repair kit, Piper P/N 766-222, that contains the necessary material for such repairs, is available through Piper Distributors.

NOTE: Very carefully follow resin and catalyst mixing instructions furnished with repair kit.

A. Touch-up and Surface Repairs

(1) Remove wax, oil and dirt from around the damaged area with acetone. Methylethylketone or equivalent and remove paint to gel coat.

(2) The damaged area may be scraped with a fine blade knife or a power drill with a burr attachment to roughen the bottom and sides of the damaged area. Feather the edge surrounding the scratch or cavity. Do not undercut the edge. (If the scratch or cavity is shallow and penetrates only the surface coat, continue to step (8)

(3) Pour a small amount of resin into a jar lid or on a piece of cardboard, just enough to fill the area being worked on. Mix an equal amount of milled fiberglass with the resin, using a putty knife or stick. Add catalyst, according to kit instruction, to the resin and mix thoroughly. A hypodermic needle may be used to inject gel into small cavities not requiring fiberglass millings mixed with the gel.

(4) Work the mixture of resin, fibers and catalyst into the damaged area, using the sharp point of a putty knife or stick to press it into the bottom of the hole and to puncture any air bubbles which may be present. Fill the scratch or hole above the surrounding undamaged area about .062 of an inch.

(5) Lay a piece of cellophane or waxed paper over the repair to cut off air and start the cure of gel mixture.

(6) Allow the gel to cure 10 to 15 minutes until it feels rubbery to the touch. Remove the cellophane and trim flush with the surface, using a sharp razor blade or knife. Replace the cellophane and allow to cure completely for 30 minutes to an hour. The patch will shrink slightly below the structure surface as it cures. (If wax paper is used, make sure the wax is removed from surface.)

(7) Rough up the bottom and edges of the hole with the electric burr attachment or rough sandpaper. Feather hole into surrounding gel coat, do not undercut.

(8) Pour out a small amount of resin, add catalyst and mix thoroughly, using a cutting motion rather than stirring. Use no fibers.

(9) Using the tip of a putty knife or fingertips, fill the hole to about .062 of an inch above the surrounding surface with the gel coat mixture.

(10) Lay a piece of cellophane over the patch to start the curing process. Repeat step (6), trimming patch when partially cured.

(11) After trimming the patch, immediately place another small amount of gel coat on one edge of the patch and cover with cellophane. Then, using a squeegee or the back of a razor blade, level with area surrounding the patch; leave the cellophane on patch for one to two hours or overnight, for complete cure.

(12) After repair has cured for 24 hours, sand patched area, using a sanding block with fine wet sandpaper. Finish by priming, again sanding and applying color coat.

B. Fracture and Patch Repairs

(1) Remove wax, oil and dirt from around the damaged area with acetone, methylethylketone or equivalent.

(2) Using a key hole saw, electric saber saw, or sharp knife cut away ragged edges. Cut back to sound material.

(3) Remove paint three inches back from around damaged area.

(4) Working inside the structure, bevel the edges to approximately a 30 degree angle and rough-sand the hole and the area around it, using 80 grit dry paper. Feather back for about two inches all around the hole. This roughens the surface for strong bond with patch.

(5) Cover a piece of cardboard or metal with cellophane. Tape it to the outside of the structure, covering the hole completely. The cellophane should face toward the inside of the structure. If the repair is on a sharp contour or shaped area, a sheet of aluminum formed to a similar contour may be placed over the area. The aluminum should also be covered with cellophane.

(6) Prepare a patch of fiberglass mat and cloth to cover an area two inches larger than the hole.

(7) Mix a small amount of resin and catalyst; enough to be used for one step at a time, according to kit instructions.

(8) Thoroughly wet mat and cloth with catalyzed resin. Daub resin on mat first, and then on cloth. Mat should be applied against structures surface with cloth on top. Both pieces may be wet out on cellophane and applied as a sandwich. Enough fiberglass cloth and mat reinforcements should be used to at least replace the amount of reinforcements removed in order to maintain the original strength. If damage occurred as a stress crack, an extra layer or two of cloth may be used to strengthen area.

(9) Lay patch over hole on inside of structure, cover with cellophane, and squeegee from center to edges to remove all air bubbles and assure adhesion around edge of hole. Air bubbles will show white in the patch and they should all be worked out to the edge. Remove excess resin before it gels on the part. Allow patch to cure completely.

(10) Remove cardboard or aluminum sheet from outside of hole and rough-sand the patch and edge of hole. Feather edge of hole about two inches into undamaged area.

(11) Mask area around hole with tape and paper to protect surface. Cut a piece of fiberglass mat about one inch larger than the hole and one or more pieces of fiberglass cloth two inches larger than the hole. Brush catalyzed resin over hole, lay mat over hole and wet out with catalyzed resin. Use a daubing action with brush. Then apply additional layer or layers of fiberglass cloth to build up patch to the surface of structure. Wet out each layer thoroughly with resin.

(12) With a squeegee or broad knife, work out all air bubbles in the patch. Work from center to edge pressing patch firmly against the structure. Allow patch to cure for 15 to 20 minutes.

(13) As soon as the patch begins to set up, but while still rubbery, take a sharp knife and cut away extra cloth and mat. Cut on outside edge of feathering. Strip cut edges of structure. Do this before cure is complete, to save extra sanding. Allow patch to cure overnight.

(14) Using dry 80 grit sandpaper on a power sander or sanding block, smooth patch and blend with surrounding surface. Should air pockets appear while sanding, puncture and fill with catalyzed resin. A hypodermic needle may be used to fill cavities. Let cure and resand.

(15) Mix catalyzed resin and work into patch with fingers. Smooth carefully and work into any crevices.

(16) Cover with cellophane and squeegee smooth. Allow to cure completely before removing cellophane. Let cure and resand.

(17) Brush or spray a coat of catalyzed resin to seal patch. Sand patch, finish by priming, again sanding and applying color coat.

NOTE: Brush and hands may be cleaned in solvents such as acetone or methylethylketone. If solvents are not available, a strong solution of detergent and water may be used.

2. Thermoplastic Repairs

The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane. Chart 1 lists materials needed to perform these repairs along with suggested suppliers. Common safety precautions should be observed when handling some of the materials and tools used while making these repairs. Refer to Vendor Information, Chapter 91, for supplier addresses.

A. Surface Preparation

(1) Surface dirt and paint if applied must be removed from the item being repaired. Household cleaners have proven most effective in removing surface dirt.

(2) Preliminary cleaning of the damaged area with perchlorethylene or V M & P Naphtha will generally ensure a good bond between epoxy compounds and thermoplastic.

B. Surface Scratches, Abrasion or Ground-in-Dirt (See Figure 1.)

(1) Shallow scratches and abraded surfaces are usually repaired by following directions on containers of conventional automotive buffing and rubbing compounds.

(2) 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.

(3) The thermoplastic will return to its original shape upon cooling.

C. Deep Scratches, Shallow Nicks and Small Holes - Less than 1 inch in diameter (See Figure 2.)

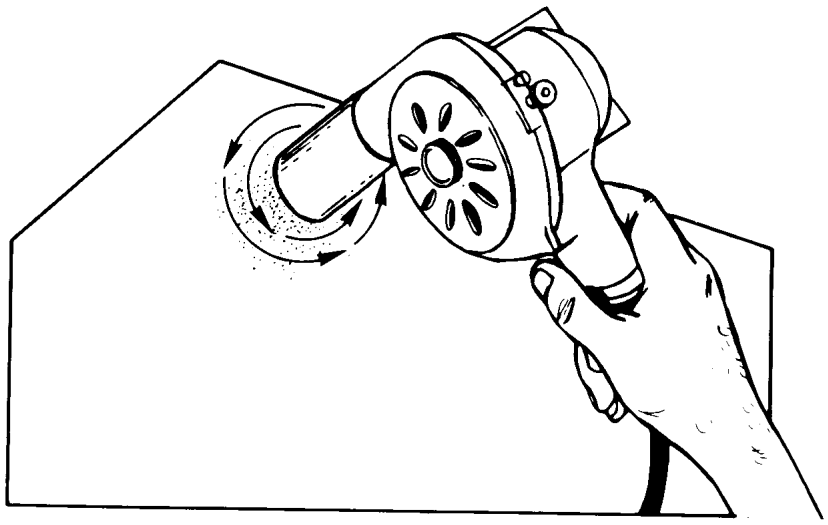
(1) Solvent cements will fit virtually any of these applications. If the area to be repaired is very small, it may be quicker to make a satisfactory cement by dissolving thermoplastic material of the same type being repaired in solvent until the desired paste like consistency is achieved.

(2) 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.

(3) Solvent adhesives are not recommended for highly stressed areas, or thin walled parts or for patching holes greater than 1/4 inch in diameter.

(4) For larger damages, an epoxy patching compound is recommended. This type material is a two part, fast curing, easy sanding commercially available compound.

(5) Adhesion can be increased by roughing the bonding surface with sandpaper and by utilizing as much surface area for the bond as possible.



Surface Scratches - Abrasions or Ground in Dirt
Figure 1



Deep Scratches, Shallow Nicks and Small Holes
Figure 2

CHART 1
LIST OF MATERIALS (THERMOPLASTIC REPAIRS)

Items	Descriptions	Suppliers
Buffing and Rubbing Compounds	Automotive Type - DuPont #7	DuPont Company
	Ram Chemical #69 x 1	Ram Chemicals
	Mirror Glaze #1	Mirror Bright Polish Co., Inc.
Cleaners	Fantastic Spray	Obtain From Local Suppliers
	Perchlorethylene	
	V M & P Naphtha (Lighter Fluid)	
ABS-Solvent Cements	Solarite #11 Series	Solar Compounds Corp.
Solvents	Methylethylketone	Obtain From Local Suppliers
	Methylene Chloride	
	Acetone	
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp.
Hot Melt Adhesives	Stick Form 1/2 in. dia.	Sears Roebuck & Co. or
Polyamids and Hot Melt Gun	3 in. long	Most Hardware Stores
Hot Air Gun	Temp. Range 300° to 400° F	Local Suppliers

(6) 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 V M & P Naphtha prior to applying the compound (see Figure 3).

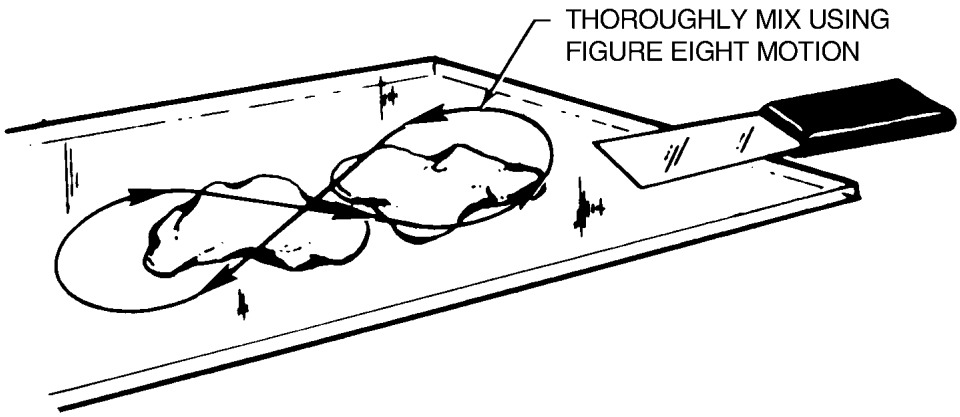
(7) A mechanical sander can be used after the compound is cured, providing the sander is kept in constant motion to prevent heat buildup.

(8) 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.

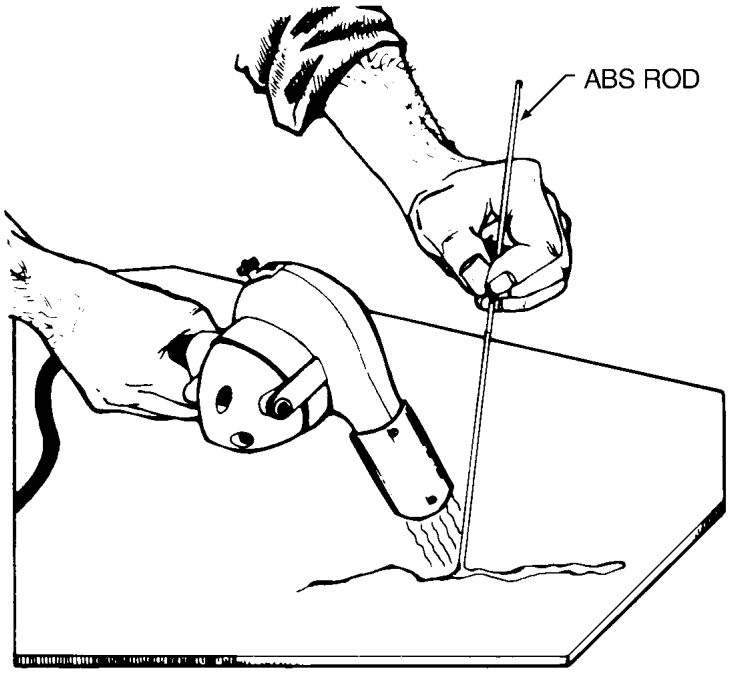
(9) For repairs in areas involving small holes, indentations or cracks in the material where high stress is apparent or where thin walled sections are used, the welding method is suggested.

(10) 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 (see Figure 4).

(11) After the repair is completed, sanding is allowed to obtain a surface finish of acceptable appearance.



Mixing of Epoxy Patching Compound
Figure 3



Welding Repair Method
Figure 4

D. Cracks (See Figure 5.)

(1) Before repairing a crack in the thermoplastic part, first determine what caused the crack and alleviate that condition to prevent it from recurring after the repair is made.

(2) Drill small stop holes at each end of the crack.

(3) If possible, a double plate should be bonded to the reverse side of the crack to provide extra strength to the part.

(4) The crack should be “V” grooved and filled with repair material, such as solvent cement, hot melt adhesive, epoxy patching compound or it should be hot air welded, whichever is preferred.

(5) After the repair has cured, it may be sanded to match the surrounding finish.

E. Repairing Major Damage - Larger than 1 inch in diameter (See Figure 6.)

(1) If possible, a patch should be made of the same material, and cut slightly larger than the section being repaired.

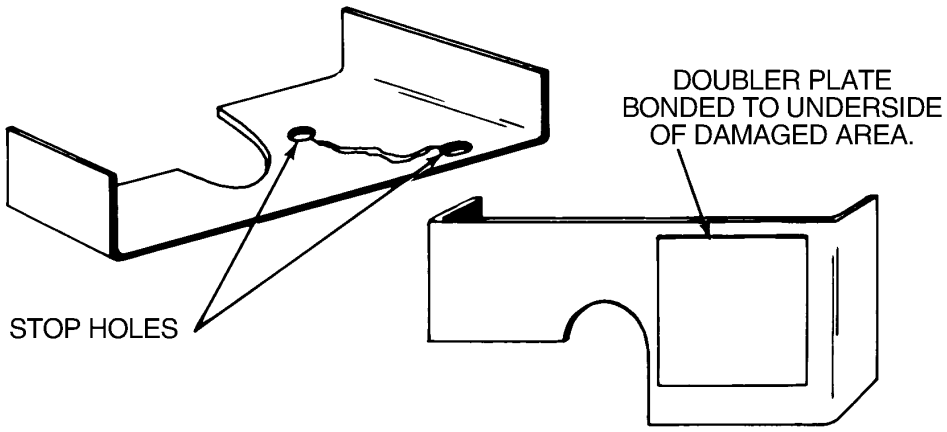
(2) When appearances are important, large holes, cracks, tears, etc, should be repaired by cutting out the damaged area and replacing it with a piece of similar material.

(3) 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 ensure a good fit.

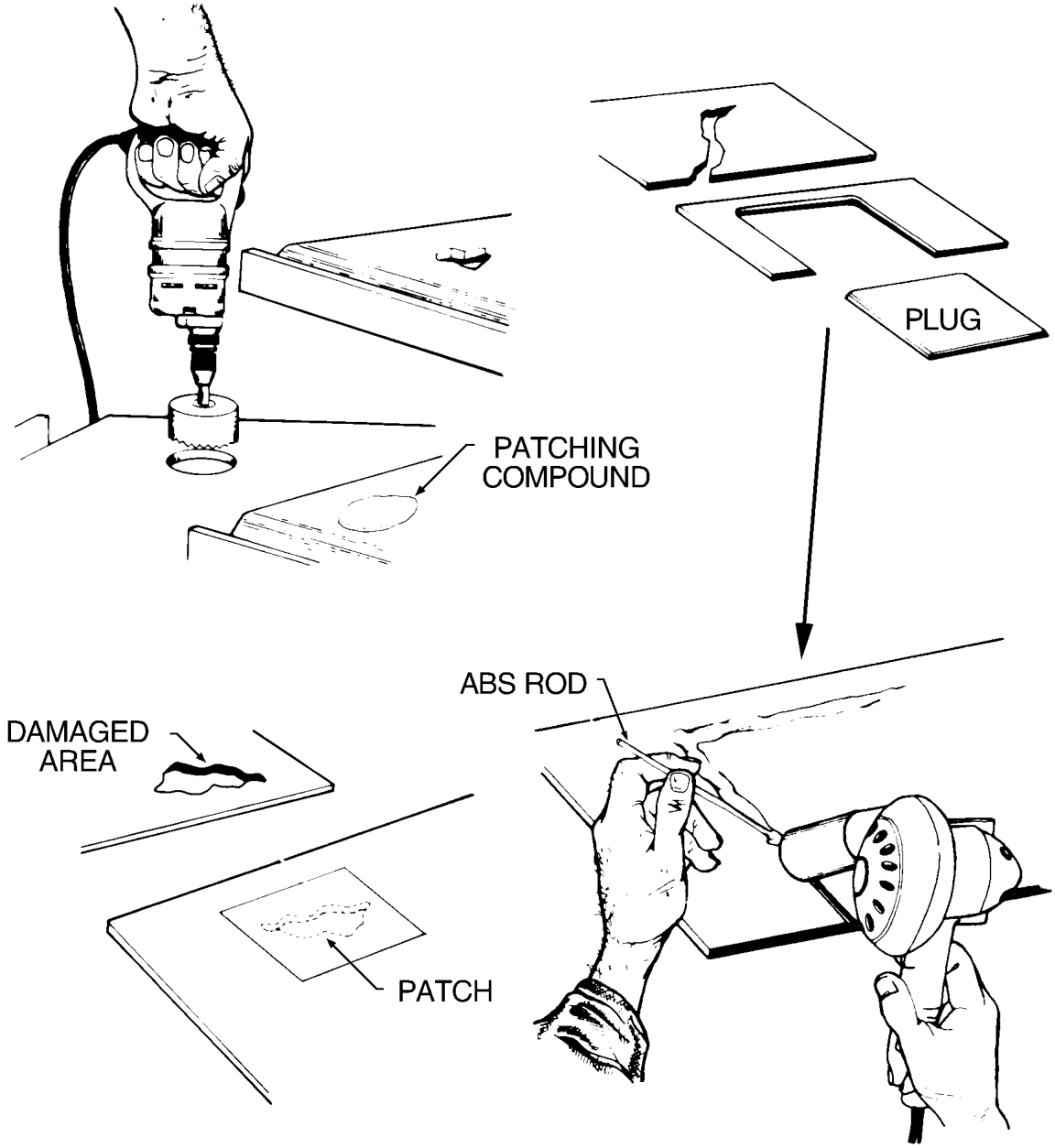
(4) Coat the patch with solvent adhesive and firmly attach it over the damaged area.

(5) Let the patch dry for approximately one hour before any additional work is performed.

(6) The hole, etc, is then filled with the repair material. A slight overfill of the repair material is suggested to allow for sanding and finishing after the repair has cured. If patching compound is used, the repair should be made in layers, not exceeding a 1/2 inch thickness at a time. This will allow the compound to cure and ensure a good solid buildup of successive layers as required.



Repairing of Cracks
Figure 5



Various Repairs
Figure 6

F. Stress Lines (See Figure 7.)

(1) Stress lines produce a whitened appearance in a localized area and generally emanate from the severe bending or impacting of the material (see Figure 8).

(2) 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.

G. Painting the Repair

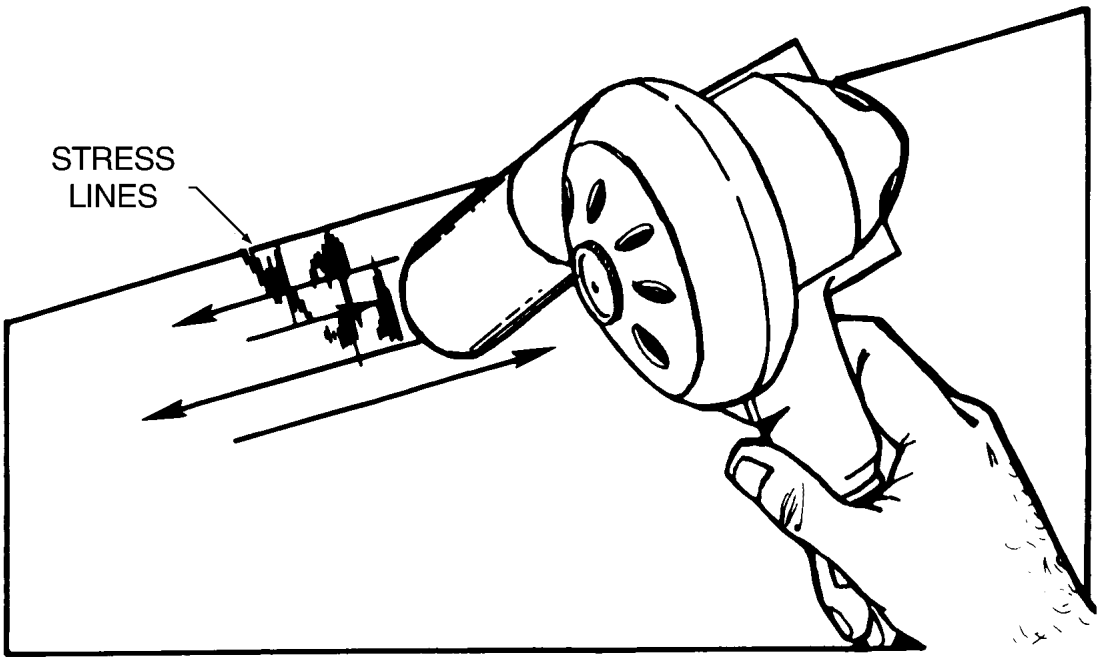
(1) An important factor in obtaining a quality paint finish is the proper preparation of the repair and surrounding area before applying any paint.

(2) 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.

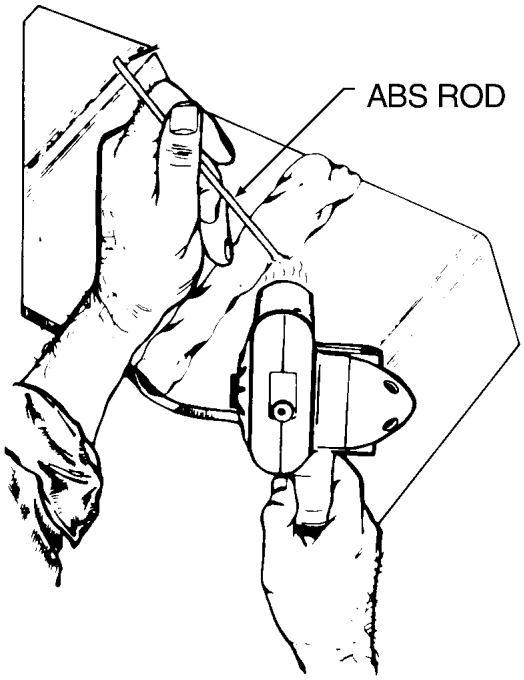
(3) The paint used for coating thermoplastic can be either lacquers or enamels, depending on which is preferred by the repair facility or customer.

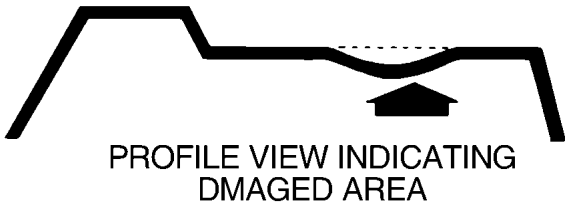
NOTE: It is extremely important that solvent formulations be considered when selecting a paint, because not an lacquers or enamels can be used satisfactorily on thermoplastic. Some solvents used in the paints can significantly affect and degrade the plastic properties

(4) 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.



Repair of Stress Lines
Figure 7





Repair of Impacted Damage
Figure 8

3. Pressure Sensitive Safety Walk Installation (PIR-PPS45010, Rev. F.)

Pressure sensitive safety walk (i.e. - non-skid) is installed on the right wing root, right inboard flap end, and the top of the boarding step to provide a secure non-slip path to the cabin door.

A. Surface Preparation

(1) Allow newly painted surfaces to dry a minimum of 2 hours prior to applying the safety walk.

(2) If the paint becomes contaminated, remove the contamination with clean dry rags or paper wipers moistened with MIL-S-18718 Safety Solvent.

(3) Prior to applying the safety walk, wipe the applicable surface with a clean dry cloth, ensuring that no moisture remains on the surface.

B. Application Procedure

(1) Do not apply when surface temperature is below 500°F.

(2) Peel back the full width of the protective liner leading edge approximately two inches.

(3) Adhere the leading edge of the safety walk to the forward edge of the area being covered.

(4) Remove the remaining protective liner as the safety walk is being adhered from front to back.

(5) Roll firmly with a long handled cylindrical brush in both lengthwise directions.

(6) Seal all edges of the safety walk with “3M Company Safety Walk Edge Sealing Compound” (P/N 914-055) or “Flex-Tred Edge Sealer” (P/N 688-440). Position the bead with half the bead on the safety walk and half on the surface on which the safety walk is mounted.

4. Metal / Wire Stitching Repair (See Figure 9.) (PIR-PPS20024, Rev. A.)

CAUTION: METAL/WIRE STITCHING (AND THE ALTERNATE METHOD OF JOINING DESCRIBED BELOW) SHALL ONLY BE USED FOR NON-STRUCTURAL, NON-LOAD CARRYING APPLICATIONS.

A metal/wire stitching process is used to staple fabric and rubber seal materials to engine baffles and some composite materials. The following alternate method of joining is approved for field use when replacing these fabric and rubber seal materials.

Alternate (Rivet) Method of Joining.

(1) Substitute two rivets in lieu of each staple where stitching was previoiusly used or is specified. Maintain a minimum of .75 inch spacing between rivets.

(2) When materials being joined include Stainless Steel, Galvanized Steel or Steel, use:

(a) MS20615M4 Rivet (Monel) and NAS1149CN432R Washer (See Figure 9.)

(b) Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.

(3) When materials being joined include only aluminum and nonmetallic materials use:

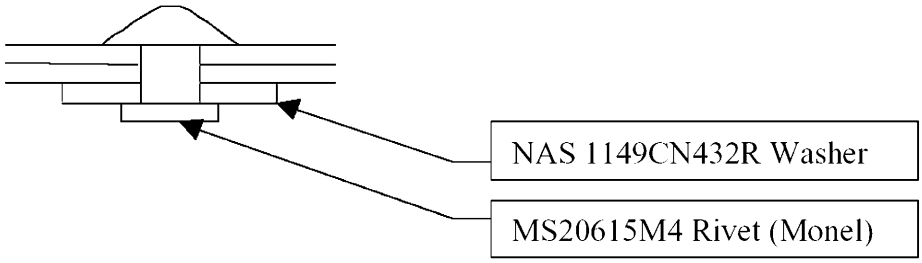
(a) MS20470A4 Rivet and NAS1149DN432H Washer (See Figure 9.)

(b) Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.

When materials being joined include Stainless Steel, Galvanized Steel or Steel, use:

MS20615M4 Rivet (Monel)
NAS1149CN432R Washer

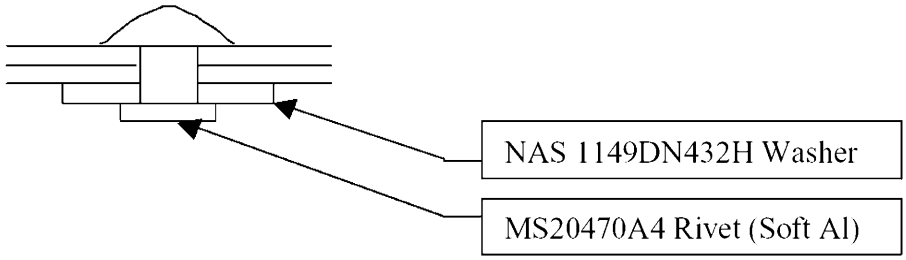
Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.



When materials being joined include only aluminum and nonmetallic materials use:

MS20470A4 Rivet
NAS1149DN432H Washer

Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.



Metal / Wire Stitching Repair
Figure 9

5. Hail Damage (PIR-SL1095, Orig.)

Classification and disposition of hail damage can be accomplished as follows.

A. Inspection of Dents

(1) Determine in which of the following locations the dents are present:
   (a) Metallic skin of the fuselage, wings, or empennage.
   (b) Control surfaces.
   (c) Composite components.

(2) Measure the maximum depth and circumscribable diameter of the dents from the aircraft exterior. For depth measurements on curved surfaces, measure the maximum depth of the dent from the general contour. The dent diameter is measured to the point where the skin material rejoins the general contour. See Figure 10.

(3) Measure the distance from the above circumscribable diameter to the nearest fastener. Note the diameter of the fastener.

(4) Visually inspect the dent area for cracks, abrasions, creases, or abrupt changes in contour within an area encompassing two times the circumscribable diameter. Use a 10-power magnifier or an equivalent inspection method.

(5) Visually inspect interior adjacent structural members for deformation.

B. Classification of Dents

(1) Negligible Dents:
   (a) Limited to metallic skin of the fuselage, wings and empennage.
   (b) Depth no greater than 0.030 inches and a circumscribable diameter no greater than 2.0 inches.
   (c) A minimum distance of two times the applicable fastener diameter from the circumscribable diameter to the nearest fastener.
   (d) No cracks, abrasions, or creases within an area encompassing two times the circumscribable diameter.
   (e) Control Surface Dents: Do not meet negligible dent limitation (a).

(2) Minor Dents: Must meet all the limitations of negligible dents, except the dents are less than two times the applicible fastener diameter from the nearest fastener (dent limitation (c)).

(3) Major Dents: Exceed one of the above negligible dent limitations (b), (d), or (e).

(4) Composite Components.

(5) Control Surface Dents: Do not meet negligible dent limitation (a).

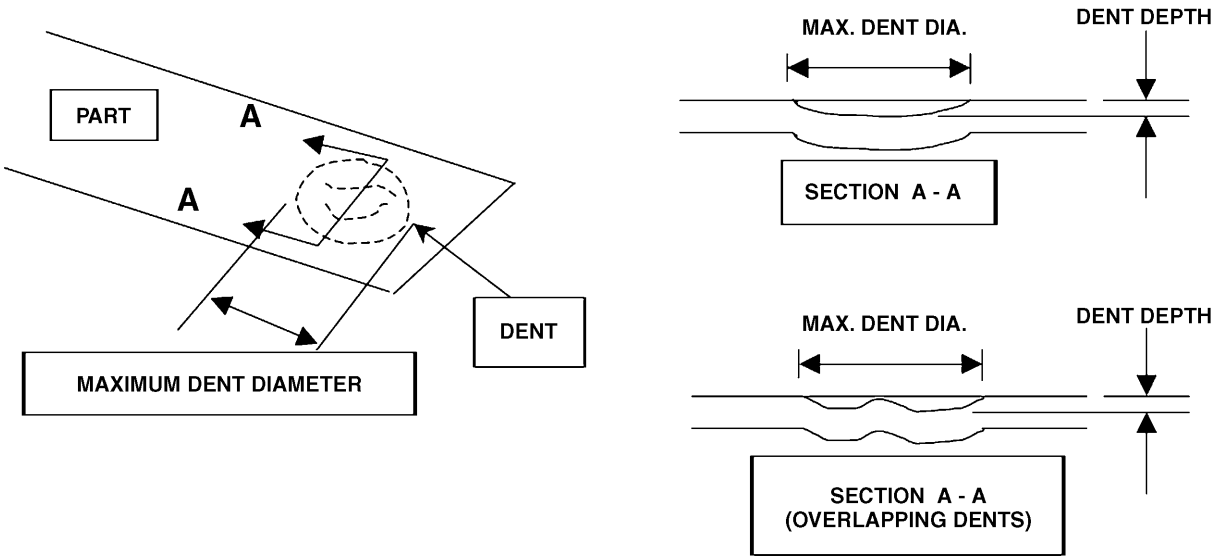
C. Disposition of Dents

(1) Negligible Dents: Acceptable as is.

(2) Minor Dents: Replace affected part or repair as follows:

For each fastener that is within an area encompassing 2 times the applicable fastener diameter from any dent edge, install one adjacent midspace fastener of the same type. Midspace fasteners shall be located a minimum of 2 times the fastener diameter from the dent, a minimum of 3 times the fastener diameter from existing fasteners, and a minimum of 2 times the fastener diameter from component edges.

(3) Major Dents: Replace affected part or repair (using FAA approved data).



Hail Profile Definitions
Figure 10

(4) Composite Components: Evaluate and disposition per the lastest revision of AC43.13-1, “Chapter 3, Fiberglass and Plastics” prior to returning to service.

(5) Control Surface Dents:

(a) Replace control surface if dents exceed any one of the negligible limits (b), (d), or (e).

(b) Replace surface if dents disturb the trailing edge contour or any formed radius.

NOTE: Movable control surfaces must remain free of body filler, or any other modifcation that could affect weight and balance.

D. Continued Inspection Requirements

For any airplane where dents were acceptable or repaired, make a logbook entry containing the following:

“Visually inspect all dents for cracks every 250 hours, or annually, whichever comes first. Paint cracking around the area of the dent may indicate cracking of the skin and requires further inspection.”

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ELECTRICAL BONDING

1. General (See also 23-60-00.) (PIR-PPS55006, Rev. T.)

All electrical and electronic equipment and specified components shall be installed in such a manner as to provide a continuous low resistance path (bonds) from the equipment enclosure/component to the airplane structure. Bonds must be installed to ensure that the structure and equipment are electrically stable and free from the hazards of lightning, static discharge, electrical shock, etc.

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

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

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

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

2. 100 Hour Inspection (PIR-AC 43.13-1, Rev. B.)

Each 100 hours, visually inspect shield and shield terminations of each electrical harness for integrity, condition, and security. If electrical arcing is evident, check for intermittant contact between conducting surfaces. Arcing can be prevented by bonding or insulation, as appropriate.

Inspect the components listed in Chart 1 as follows:

A. Bond connections shall be secure and free from corrosion.

B. Bonding jumpers installed so as not to interfere in any way with the operation of moveable components of the aircraft.

C. No self-tapping screws used for bonding purposes.

D. Exposed conducting frames or parts of electrical or electronic equipment should have a low resistance bond of less than 2.5 millohms to structure. If the equipment design includes a ground terminal or pin, which is internally connected to such exposed parts, a ground wire connection to such terminal will satisfy this requirement.

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

F. Where aluminum or copper is bonded to dissimilar metallic structures, ensure installed hardware (typically washers) is as called out in the parts catalog to minimize electrolytic corrosion and ensure the hardware should corrode first.

3. On Condition Inspection

Whenever any electrically bonded component (see Chart 1) is removed and reinstalled, or visual inspection reveals the electrical bonding to be suspect, measure resistance between component and aircraft structure.

To ensure proper operation and suppression of radio interference from hazards, electrical bonding of equipment must not exceed the maximum allowable resistance values specified in Chart 1.

A. Measurements should be performed after the grounding and bonding mechanical connections are complete to determine if the measured resistance values meet the basic requirements.

B. A high quality test instrument (AN/USM-21A or equivalent) will accurately measure the very low resistance values specified.

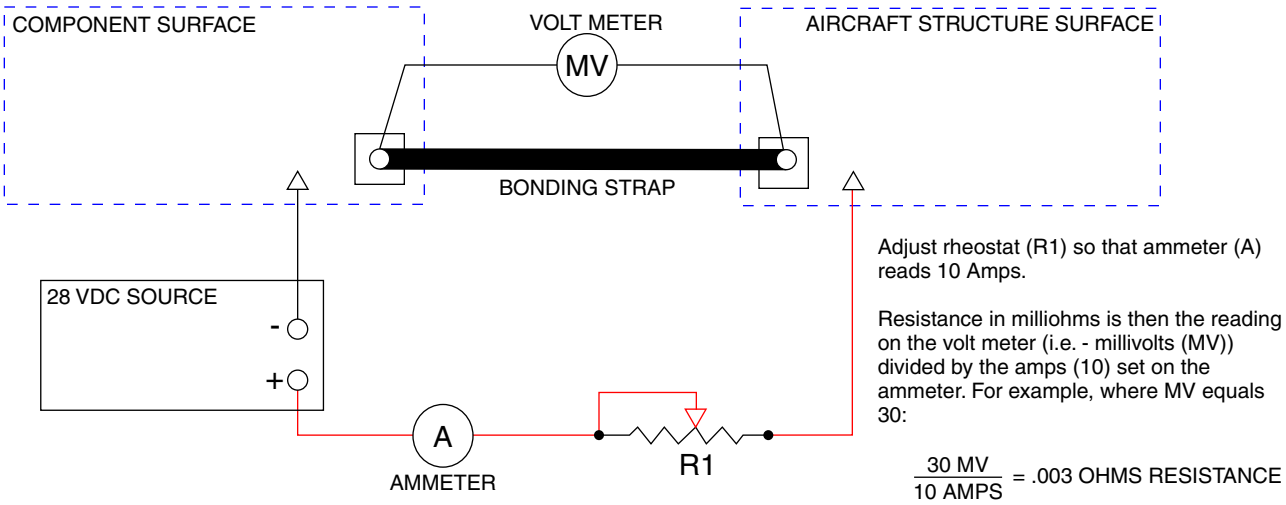
C. Another method of measurement is the millivolt drop test as shown in Figure 1.

CHART 1
ELECTRICAL BONDING RESISTANCE INDEX

Component	Maximum Allowable Resistance Value in Ohms
Engine Mount(s)	.003
Generator(s)	.010
Ailerons	.003
Elevator / Stabliator	.003
Rudder	.003
Alternator(s)	.010
Trim Tab(s)	
Conventional Hinge	.003
Piano Hinge	.010
Instrument Panel Inserts	.010
Exterior Lights Mounted on Non-Conductive Material	.003
Avionics 'Black Boxes'	.003
NOTE: Harnesses should be installed and connected for this check, internal chassis wiring through the connector to ground is permissible for this grounding.	
Battery Ground Point	.010
Static wick mounting plates (TCO Model B-4) P/N 452-094	1.00

NOTE: Where jumper wires or cables are used to accomplish a proper bond, resistance between the jumper terminal and the component or structure shall not exceed .001 ohms. The controlling points for measuring resistance will be within the limits of the cleaned area to be bonded and within 1/4 inch of the exterior limits of the bonding jumper terminal or material called for in the bill of materials of the drawing.

Resistance to ground will be measured from wire terminal to structure for electrical / electronic equipment not internally grounded and from mounting flange to structure for equipment that is internally grounded.



Millivolt Drop Test
Figure 1

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CHAPTER

52

DOORS

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CHAPTER 52

LIST OF EFFECTIVE PAGES

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	2	Mar 15/06			
	3	Mar 15/06			
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	5	Mar 15/06			
	6	Mar 15/06			
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CHAPTER 52 - DOORS

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Cabin Doors		1	5E1
Removal		1	5E1
Installation		1	5E1
Adjustment		1	5E1
Door Locks		1	5E1
Removal		1	5E1
Installation		1	5E1
Door Latch Mechanism		1	5E1
Removal		1	5E1
Installation		1	5E1
Adjustment		1	5E1
Door Auxilliary Latch		3	5E3
Removal		3	5E3
Installation		3	5E3
Adjustment		3	5E3
EMERGENCY EXIT	**52-20-00**	1	5E5
Removal		1	5E5
Installation		1	5E5
Testing		1	5E5
CARGO	**52-30-00**	1	5E9
Baggage Doors		1	5E9
Removal		1	5E9
Installation		1	5E9
Forward Baggage Door Lock		1	5E9
Removal		1	5E9
Installation		1	5E9
Baggage Door Hinges		1	5E9
Removal		1	5E9
Installation		1	5E9

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GENERAL

1. Description

This airplane is configured with a single passenger/crew door on the right side of the fuselage, over the wing. Access to the baggage compartment is through a small door also on the right side, just aft of the wing. Emergency egress is assisted by an emergency exit incorporated into the pilot's left window.

2. Door Snubber Seals - Replacement

Door snubber seals are incorporated into the door jamb to improve door sealing.

NOTE: If existing seal is torn or badly deteriorated, it should be replaced. If seal is loose or bond is "marginal", it should be rebonded. Adhesives listed below are recommended for rebonding:

3M EC 1300L (Preferred)
Proco Adhesive 6205-1
Scotch Grip 2210

A. Replacement

(1) Remove windlace retainers, "roll" back windlace (tape to secure) out of way, remove all scuff plates and disconnect door holder.
(2) Remove all striker plates except where shown in Figure 1.
(3) With a plastic scraper or other appropriate instrument, scrape off snubber while applying mineral spirits as necessary to loosen strip and wipe off excess adhesive with a clean cloth.

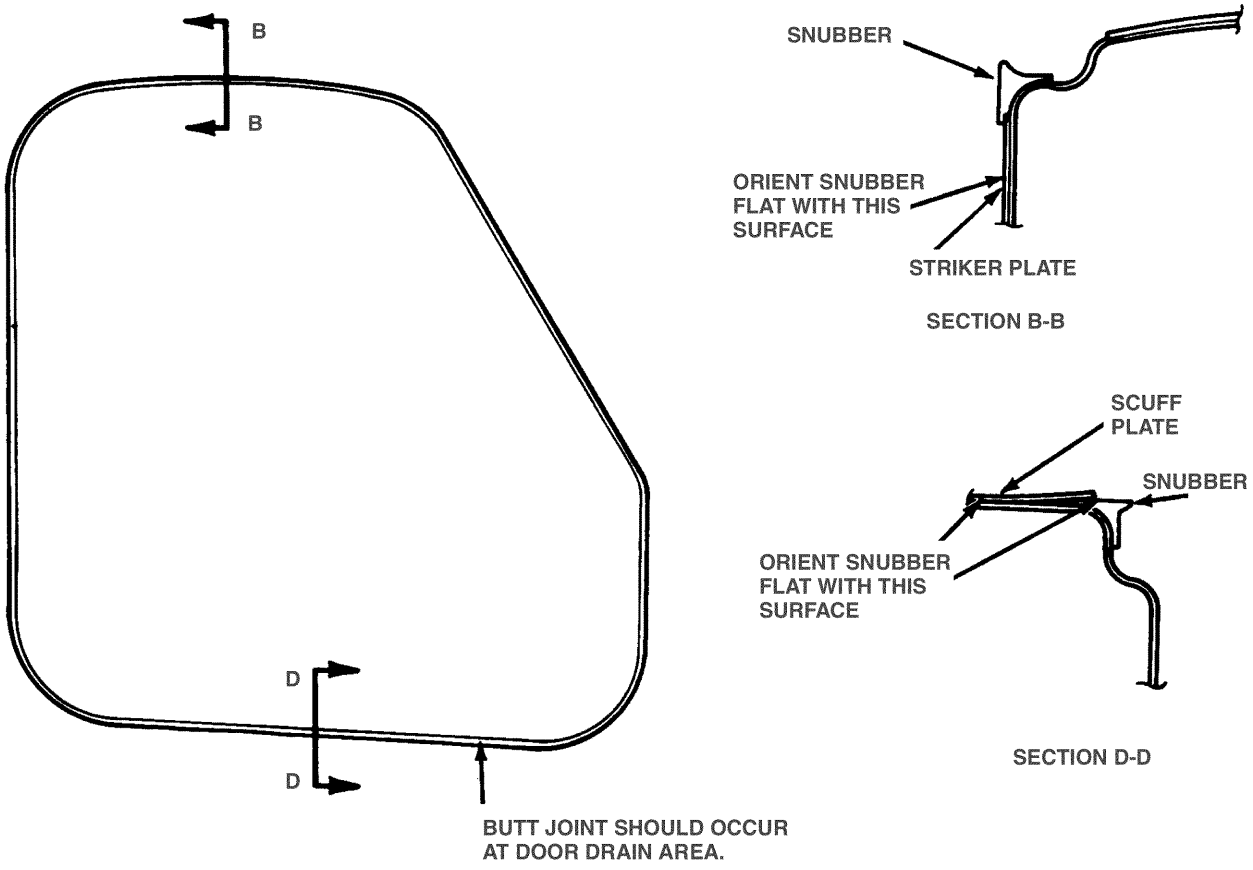
B. Installation

(1) If door jamb is flaking or excessively scuffed, rub down with wet and dry emery cloth. Clean surface using Prep-Sol or equivalent cleaner which will not leave an oily residue.
(2) Mask jamb as shown in View E of Figure 1.
(3) Apply adhesive to door jamb as shown in View E of Figure 1.
(4) Apply adhesive to inside surface of snubber.
(5) Position snubber with protruding leg facing outboard beginning at lower center of door jamb and work progressively around jamb applying pressure to snubber to remove any trapped air and to ensure a proper bond. Do not prestretch snubber as this can induce cracks.

NOTE: Normal tack time for 3M EC 1300L is 30-45 minutes at 75°F. However, adhesive that has "set" may be reactivated by a clean rag moistened with Toluol or MEK.

(6) It takes approximately 1 day for bond to cure. Do Not allow door to close during this period. It is recommended that door be left open as long as possible to effect curing.
(7) Remove masking tape if used and clean off excessive adhesive smears using Mineral Spirits or Toluol and a clean cloth. Install striker plates and windlacing. Cut snubber for aft cabin door as shown in Figure 1.
(8) Check that doors close properly and readjust as necessary to achieve a flush fit. Latching effort must not have increased.
(9) With all hardware and plates installed, coat snubbers with silicone.

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Door Snubber Seal Installation
Figure 1

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PASSENGER / CREW

1. Door (See Figure 1.)

   A. Removal

      (1) Remove the clevis bolt, washer and bushing from the door holder assembly.

      (2) Remove cotter pins, clevis pins and washers from door hinges.

      (3) Remove the door from the airplane.

   B. Installation

      (1) Insert the door into position and install the washers, clevis bolts and cotter pins on the door hinges.

      (2) For adjustment of door, refer to Adjustment, below.

      (3) Hook up and install the clevis bolt, bushing and washer into the door holder assembly.

   C. Adjustment

      (1) To acquire the proper vertical adjustment of the door, insert the necessary washer combination between the cabin door hinge and fuselage bracket assembly.

      (2) Additional adjustments may be made by tapping out the serrated door hinge bushings and rotating them to obtain the hinge centerline location that will provide proper door fit.

      (3) To ensure long life of door seals and improve sealing characteristics, lubricate with a dry lubricant in a spray can.

2. Door Lock Assembly

   A. Removal

      (1) Remove the door trim upholstery by removing the attachment screws.

      (2) Loose the nut on the lock assembly and remove the lock by turning it sideways.

   B. Installation

      (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.

3. Door Latch Mechanism

   A. Removal

      (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.

   B. Installation

      (1) Place the latch assembly into position on the door.

      (2) Connect the latch pull rod to the inside door handle.

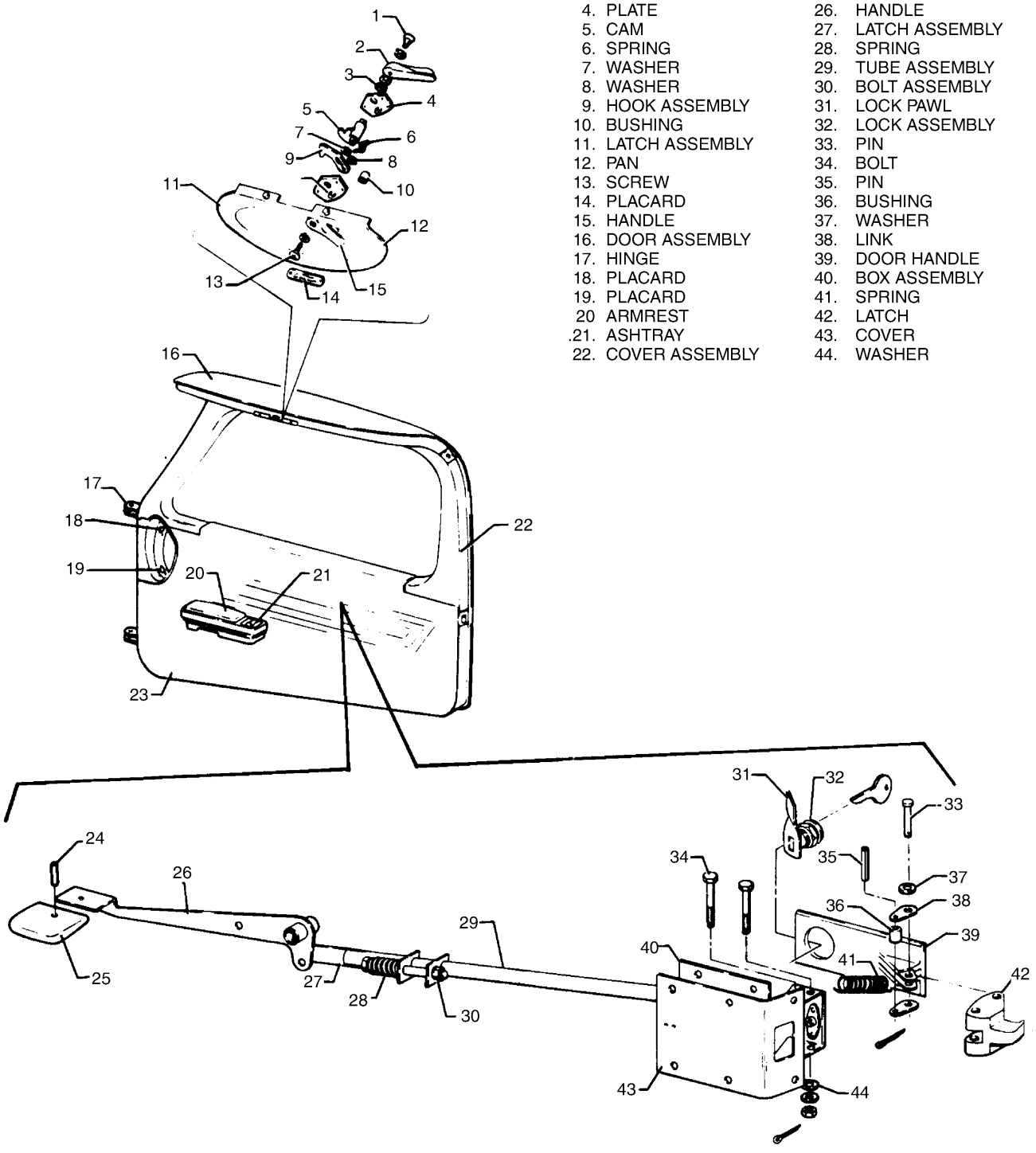
      (3) Replace the screws that attach the latch plate and mechanism to the door. Install the door trim upholstery and secure with screws.

   C. Adjustment

      To adjust the door latch, loosen the screws on the striker plate, make necessary adjustment, and retighten the screws.

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1. SCREW
2. HANDLE
3. WASHER
4. PLATE
5. CAM
6. SPRING
7. WASHER
8. WASHER
9. HOOK ASSEMBLY
10. BUSHING
11. LATCH ASSEMBLY
12. PAN
13. SCREW
14. PLACARD
15. HANDLE
16. DOOR ASSEMBLY
17. HINGE
18. PLACARD
19. PLACARD
20 ARMREST
.21. ASHTRAY
22. COVER ASSEMBLY
23. PANEL ASSEMBLY
24. SCREW
25. KNOB
26. HANDLE
27. LATCH ASSEMBLY
28. SPRING
29. TUBE ASSEMBLY
30. BOLT ASSEMBLY
31. LOCK PAWL
32. LOCK ASSEMBLY
33. PIN
34. BOLT
35. PIN
36. BUSHING
37. WASHER
38. LINK
39. DOOR HANDLE
40. BOX ASSEMBLY
41. SPRING
42. LATCH
43. COVER
44. WASHER



Cabin Door Installation
Figure 1

4. Door Auxiliary Latch

A. Removal

(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.

B. Installation

(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.

C. Adjustment

(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.

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EMERGENCY EXIT

1. Emergency Exit

   A. Removal (Refer to Figure 1.)

      (1) Remove the safety wire securing the lock handle and push the handle forward to unlock the exit.

      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.

      (2) Carefully push outward along the bottom of the door (see CAUTION, Testing) 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.

   B. Installation (Refer to Figure 1.)

      (1) Inside the door frame apply lubriplate around both fore and aft latch tubes.

      (2) Insure that all gaps and holes between the sills and longeron are filled with polyurethane, urethane, acrylic, or polysulfide sealant (see Sealant - Window and Airframe, Chart 10, 91-10-00).

      (3) Insure that neoprene seal is securely bonded to the emergency exit assembly.

      (4) Cover the contacting surfaces of the assembly with vinyl film. (See Note 3, Figure 1.)

      (5) 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.

      (6) When exit is secured in place additional sealant around perimeter of door and trim any excess vinyl film from inside and outside of the unit.

      (7) Test the latch mechanism, as explained in the next section, for operation prior to applying any sealant around the door.

      (8) Fill all gaps around the outside of the emergency exit and fuselage with sealant.

      (9) Check for water leaks by spraying water over the emergency exit and window assembly.

2. Testing

   A. Remove the side panel access cover to the emergency release handle.

   B. Attach a calibrated spring scale 1.0 inch from the top of the handle.

   C. 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.

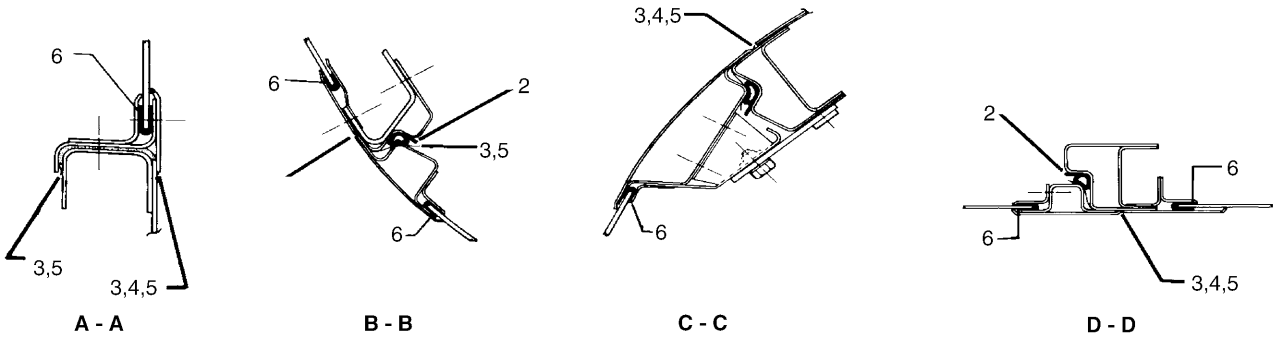
   D. Remove the spring scale and rotate the handle sufficiently to completely disengage the latch mechanism.

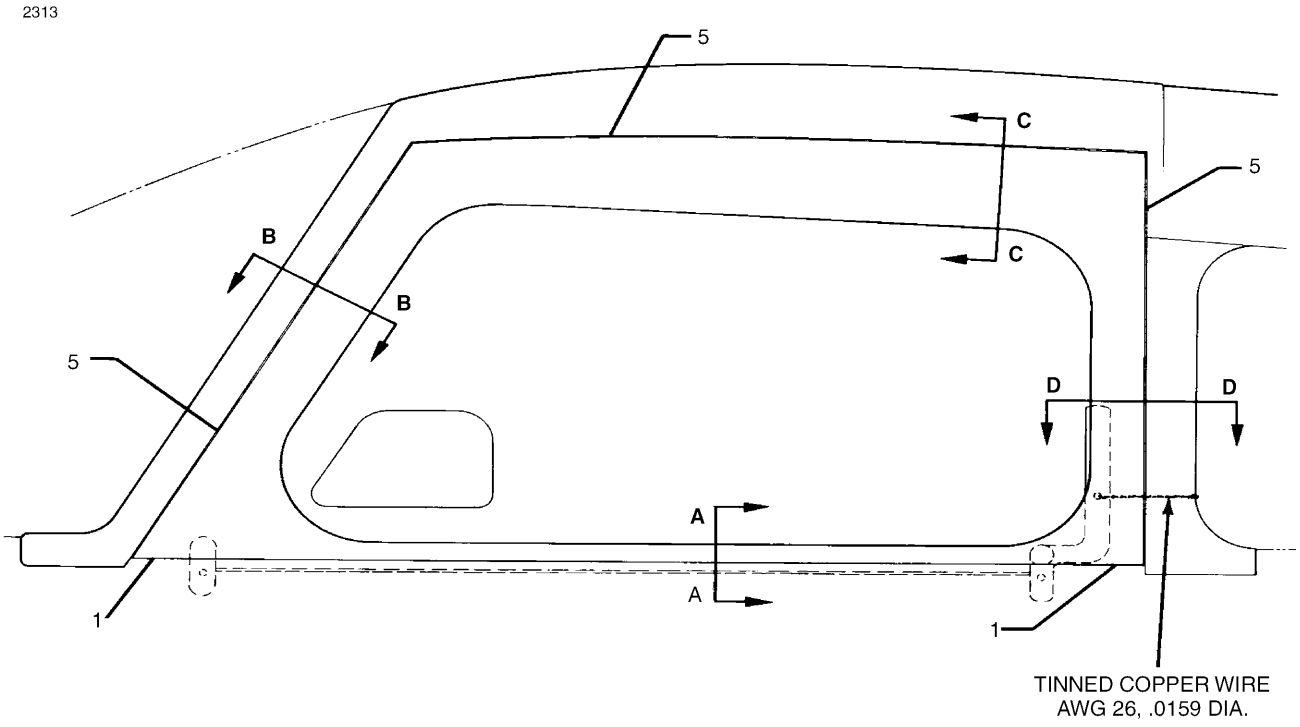
      CAUTION: DO NOT PUSH DOOR OPEN MORE THAN FOUR INCHES BEYOND THE BOTTOM DOOR SILL OR THE TOP REAR SKIN OVER THE DOOR WILL BE DAMAGED.

   E. 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.

   F. Push the door just clear of the door sill and wiggle it down out of the overlapping top skin.

   G. After inspection of door reinstall as previously directed.





NOTES:
1. FILL ALL GAPS AND HOLES BETWEEN SILLS AND LONGERON WITH SEALANT, WINDOWS AND AIRFRAME, SEE 91-10-00 CHART 10.
2. NEOPRENE SEAL BONDED TO DOOR SILLS WITH ADHESIVE - NEOPRENE RUBBER, SEE 91-10-00, CHART 10.
3. COVER CONTACTING SURFACE WITH VINYL CHLORIDE COPOLYMER FILM (SARAN-48 GAUGE TYPE B) MIL-P-6264B.
4. WHEN THE ADJUSTMENT OF DOOR IS COMPLETED, TRIM THE EXCESS POLYMER FILM FROM THE INSIDE AND OUTSIDE OF THE INSTALLATION.
5. FILL EXTERIOR GAPS BETWEEN THE DOOR AND FUSELAGE WITH SEALANT, WINDOWS AND AIRFRAME, SEE 91-10-00, CHART 10.
6. FOR WINDOW SEALING AND INSTALLATION INFORMATION, REFER TO CHAPTER 56.

Emergency Exit Installation
Figure 1

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CARGO

1. Baggage Door

   A. Removal

      With the door open remove the hinge pin from the hinge and remove the door.

   B. Installation

      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.

2. Baggage Door Lock Assembly

   A. Removal

      (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 1.)

      (3) Remove the lock assembly through the front of the door.

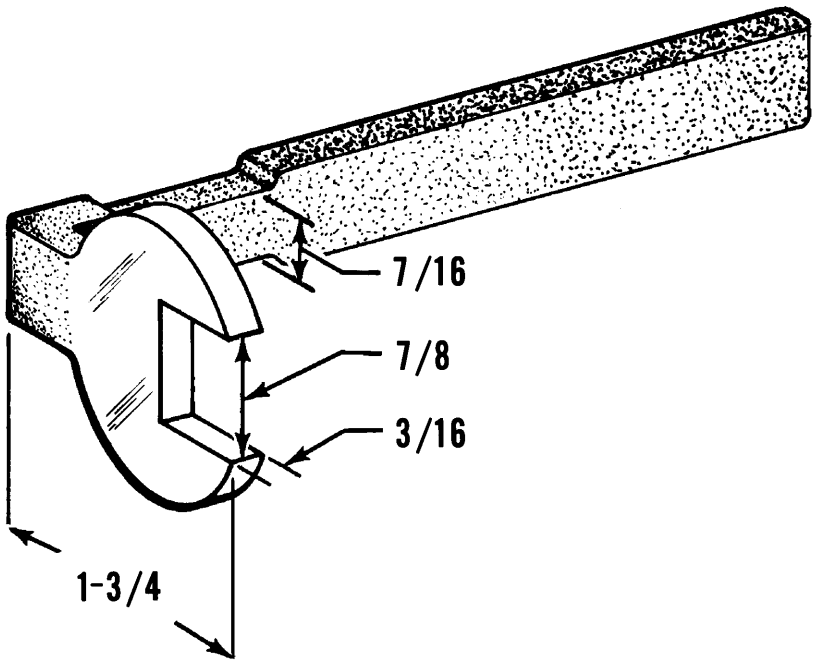
   B. Installation

      (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.

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Fabricated Tool for Baggage Door Lock
Figure 1

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CHAPTER

53

FUSELAGE

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CHAPTER 53

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CHAPTER 53 - FUSELAGE

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NOSE

Nose Cone

A. General

The nose cone assembly is comprised of an outer skin, ribs, spars, attachment hardware. The combustion heater, battery, brake reservoir and other items are mounted within the nose cone.

B. 100-Hour Nose Cone Spar Assembly Inspection

In S/N's 4496001 through 4496007, for airplanes with the original left and right nose cone spar assemblies still installed, each 100 hours time-in-service conduct the following inspection.

NOTE: Installation of both of the improved nose cone spar assemblies, P/N 86444-800 (LEFT) and 86444-802 (RIGHT), relieves this 100-hour repetitive inspection requirement.

(1) Place the aircraft on jacks per 7-10-00.

(2) Remove necessary hardware to open nose cone.

(3) Remove nose wheel cover.

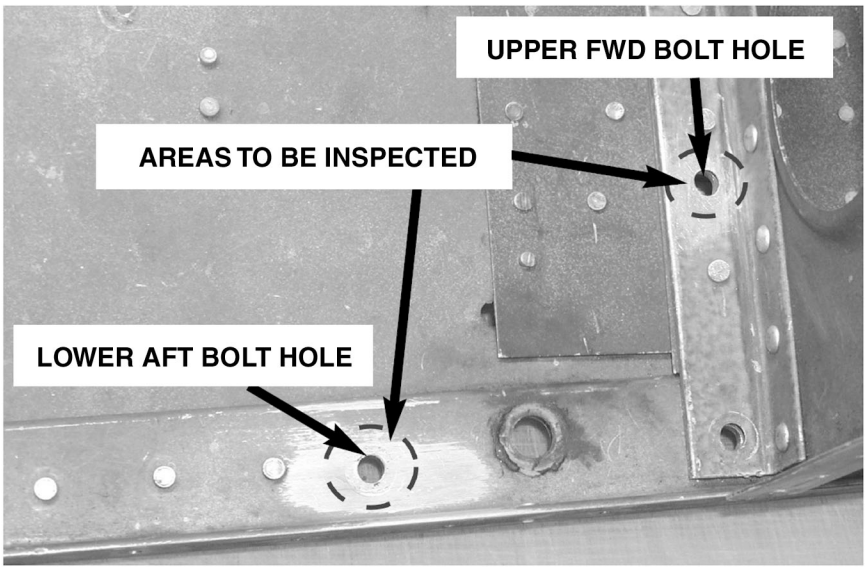
NOTE: Inspection of the outboard side of the right spar assembly will require the partial removal of the heater assembly. See 21-40-00.

(4) For both the right and left nose gear support fittings (Item 12, Figure 2, 32-20-00):

(a) remove the lower aft AN4-6A bolts and related hardware; and,

(b) remove the upper forward MS24694-010 bolts and related hardware.

(5) Through the access opening in the floorboard, remove the primer and clean the surface in the area surrounding the bolt attachment holes in the reinforcing angles as shown in Figure 1.



Nose Cone Spar Assembly Inspection
Figure 1

(7) Using a borescope with a minimum 3X magnification, inspect the area around the attachment holes for cracks; specifically, at the bottom outside edge of the washer that is installed under the self-locking nut.

(8) If cracks are present, then a complete replacement of the nose cone spar assembly is required.

(9) Install improved nose cone spar assemblies P/N 86444-800 (LEFT) and/or 86444-802 (RIGHT) as required.

NOTE: Installation of both of the improved nose cone spar assemblies, above, relieves this 100-hour repetitive inspection requirement.

(10) If no cracks are detected:

(a) Clean all bare metal areas with isopropyl alcohol per Federal Specification TT-I-735 or equivalent, or acetone per ASTM Specification D-329 or equivalent.

(b) Prime with zinc chromate primer per Federal Specification TT-P-1757 or equivalent and allow primer to dry.

(c) Reinstall the attachment hardware, heater assembly, nose wheel cover and close the nose cone.

(11) Verify gear are down and locked and remove the aircraft from the jacks.

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MAIN

Aft Wing Attach Fittings 100 Hour Inspection

A. Background

Should the seals for the windows and doors not be maintained, leaks may develop which, if not corrected, will allow an ingress of water. This water contamination will wet the insulation around the aft wing attach fittings creating a highly corrosive environment.

B. Procedure

Each 100 hours, inspect to determine condition of the aircraft window and door seals, the condition of the aft wing attach fittings, the insulation material around the affected area, and the drain holes in the bottom fuselage skin at the aft attach fittings area.

(1) Gain access to the left and right aft wing attach fittings.
  (a) Remove rear seats and the rear floorboard.
  (b) Remove interior mouldings and carpet as necessary.
  (c) Remove the carpet from the baggage area floor and remove the two access panels in the baggage area floor.

(2) Inspect thoroughly the left and right aft wing attach fittings for evidence of flaking paint and/or corrosion. (Flaking paint may be a symptom of hidden corrosion.) If no corrosion exists, continue with these instructions.
  (a) If corrosion is superficial and there is no metal flaking and/or pitting, clean and paint fittings, using a good quality aircraft primer.
  (b) If serious corrosion is found, consult the Piper Illustrated Parts Catalog (P/N 761-891) for replacement part numbers and obtain and install new parts before next flight.

(3) Upon completion of the inspection and after replacement or refurbishment of fittings, treat the aft attach fittings area using DINOL AV 8 corrosion compound (P/N 89500-800). The treatment may be brushed or sprayed.

(4) Inspect insulation in and around the rear fittings.
  (a) If insulation is wet or matted down where it has been wet, it will be necessary to replace this insulation and it will be necessary to inspect all windows, doors, and exterior panels leading to the cabin.
    1 Check door seals for deterioration, cracks, and voids in adhesive.
    2 Check window seals for voids, cracks, and deterioration.
    3 Perform a leak check with water to determine where the water is entering. Cure all leak paths before continuing these instructions.
    4 Consult the Piper Illustrated Parts Catalog (P/N 761-891) for replacement part numbers and obtain and install new parts before continued operation.
    5 If sealing windows, use P/N 279-058 Sealant (Bostik 1100 FS) or equivalent.
    6 If using insulation other than Piper original material, be sure that the insulation is flame resistant and conforms to FAR part 23.853.
  (b) If the insulation material has not been wet, or if new material is being installed, ensure a six (6) inch clearance in the insulation has been cut out in all directions around each attach fitting.

(5) Locate the two 0.191 inch drain holes, one beneath each rear attach fitting, in the bottom fuselage skin and ensure each is clean and free of obstruction.

(6) Re-install floorboards, seats, interior panels, and other articles previously removed. Perform a functional test of any system or component that may have been interrupted or removed.

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CHAPTER

55

STABILIZERS

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CHAPTER 55

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CHAPTER 55 - STABILIZERS

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Removal		1	5F17
Installation		1	5F17
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STABILATOR AND TAB

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS. LIMITED REPAIRS TO CONTROL SURFACE SKINS ARE AUTHORIZED ONLY AS PROVIDED IN THIS MANUAL.

1. Stabilator (See Figure 1.)

   A. Removal

      CAUTION: AT EACH REMOVAL OF THE STABILATOR, CONDUCT ATTACH BRACKETS CORROSION CONTROL INSPECTION, 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.

   B. Installation

      WARNING: ALL CONTROL SURFACES THAT HAVE BEEN REPLACED OR REPAINTED MUST BE BALANCED BEFORE INSTALLATION PER INSTRUCTIONS IN BALANCING, BELOW.

      (1) Insert the stabilator in position and insert the two hinge bolts at the pivot points.
      (2) Attach balance weight arm to stabilator by inserting attachment bolt at the forward and aft arm mounting fitting.
      (3) Connect trim push rod and push rod attached to stabilator balance weight arm.
      (4) Insert the fin tip attachment screws and connect the light at quick connect then attach tip assembly.
      (5) Check attaching hardware for proper installation.

2. Balancing (See Figure 2.)

   A. Balancing Equipment

      Balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the centerline of the control surface hinge pin. See the tool configuration in Figure 3. Other tool configurations may be used if accuracy is maintained and recalibration capability is provided.

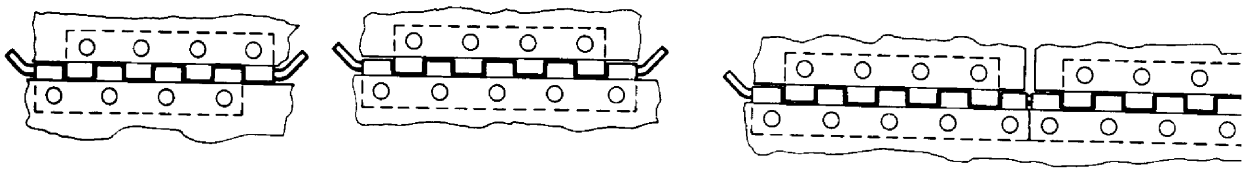
      (A) To use this tool:

         (a) 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.

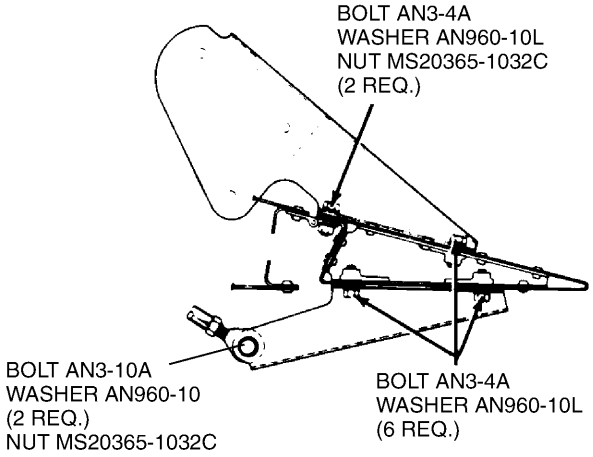
            NOTE: Because paint is a considerable balance factor, it is recommended that existing paint be removed prior to repainting a control surface.

         (b) Place hinge bolts through control surfaces and place control surface on a holding fixture.

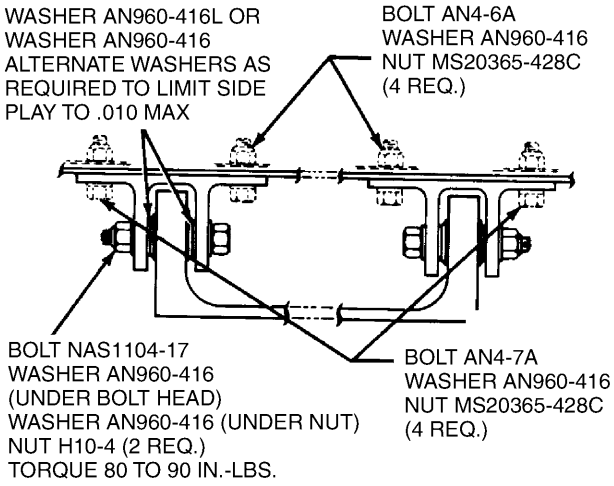
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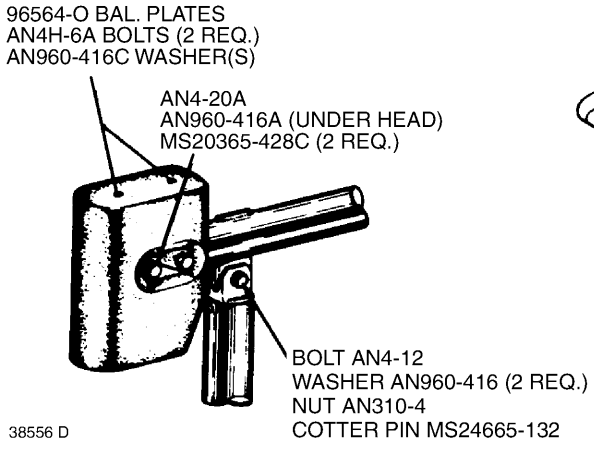
SKETCH A **SKETCH B** **SKETCH C**



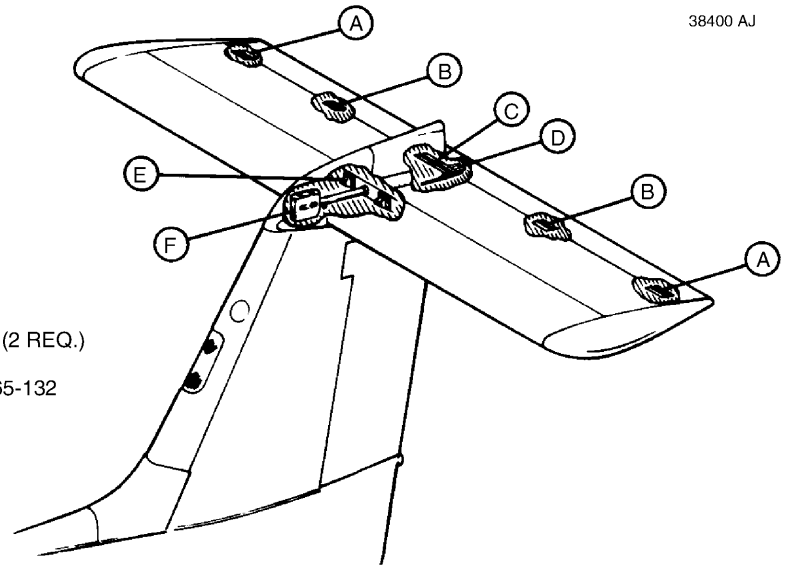
SKETCH D



SKETCH E



SKETCH F



Stabilator Installation
Figure 1

(c) Calibrate the tool.

1 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.

2 Adjust the movable trailing edge support to fit the width of the control surface. Tighten the set screw on the trailing edge support.

3 Adjust the trailing edge support vertically until the beam is parallel with the control surface chord line.

4 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.

(d) After balancing the tool, reattach it to the control surface per Figure 2. Keep the beam positioned 90° from the control surface hinge line.

(e) Determine balance of control surface by sliding movable weight along the balance beam.

(f) Read the scale when the bubble level has been centered. Multiply by three to determine inch-lbs. (I.E. - Since the movable weight weighs three pounds, every inch it is moved from the center of the beam equals three inch-lbs of force.)

B. Balancing Stabilator (See Figure 2.)

1) Position the aileron on the balancing fixture in a draft free area and in a manner which allows unrestricted movement of the aileron.

(2) Place the tool on the stabilator, avoiding rivets, and keep the beam perpendicular to the hinge centerline.

(3) Read the scale when the bubble level has been centered by adjustment of the movable weight and determine the static balance.

(4) If the static balance is not within the limits specified in Figure 2, proceed as follows:

(a) If the stabilator is out of limits on the leading edge heavy side, remove balance plates from the mass balance weight until the static balance is within limits.

(b) If stabilator is out of limits on trailing edge heavy side, add balance plates (4 Maximum) to mass balance weight until static balance is within limits.

3. Stabilator Trim Tab (See Figure 1.)

A. Removal

(1) Disconnect the trim push rod from the trim horn.

(2) Remove the hinge pins and remove the trim tab.

B. Installation

(1) Using new hinge pins, insert the trim tab in position and insert the hinge pins.

(2) Connect the trim push rod to the trim horn.

5. Repairs

A. General

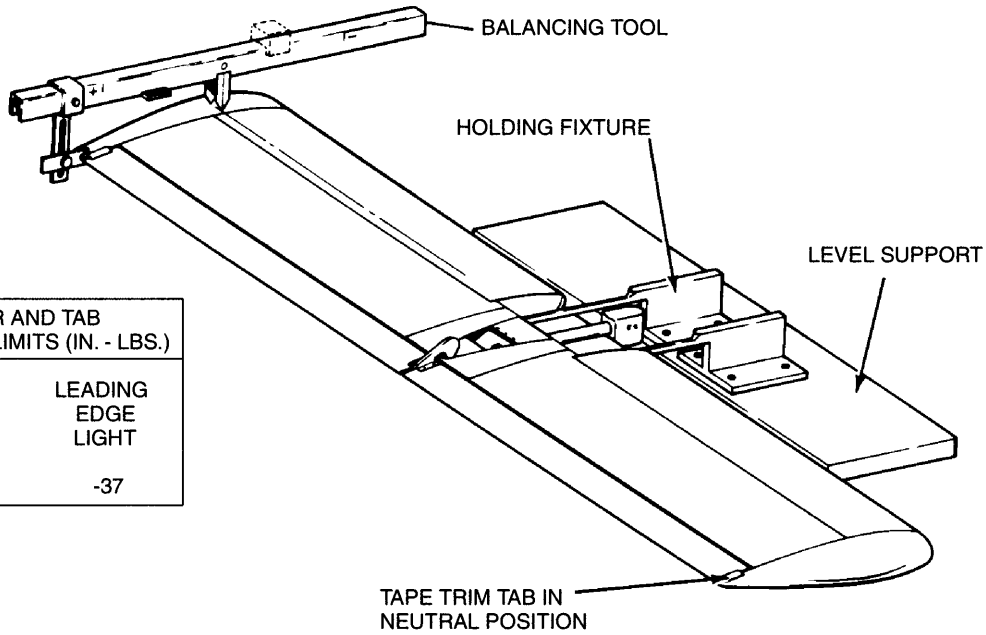
WARNING: NO ACCESS HOLES ARE PERMITTED IN ANY CONTROL SURFACES.

WARNING: 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.

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS. LIMITED REPAIRS TO CONTROL SURFACE SKINS ARE AUTHORIZED ONLY AS PROVIDED IN THIS MANUAL.

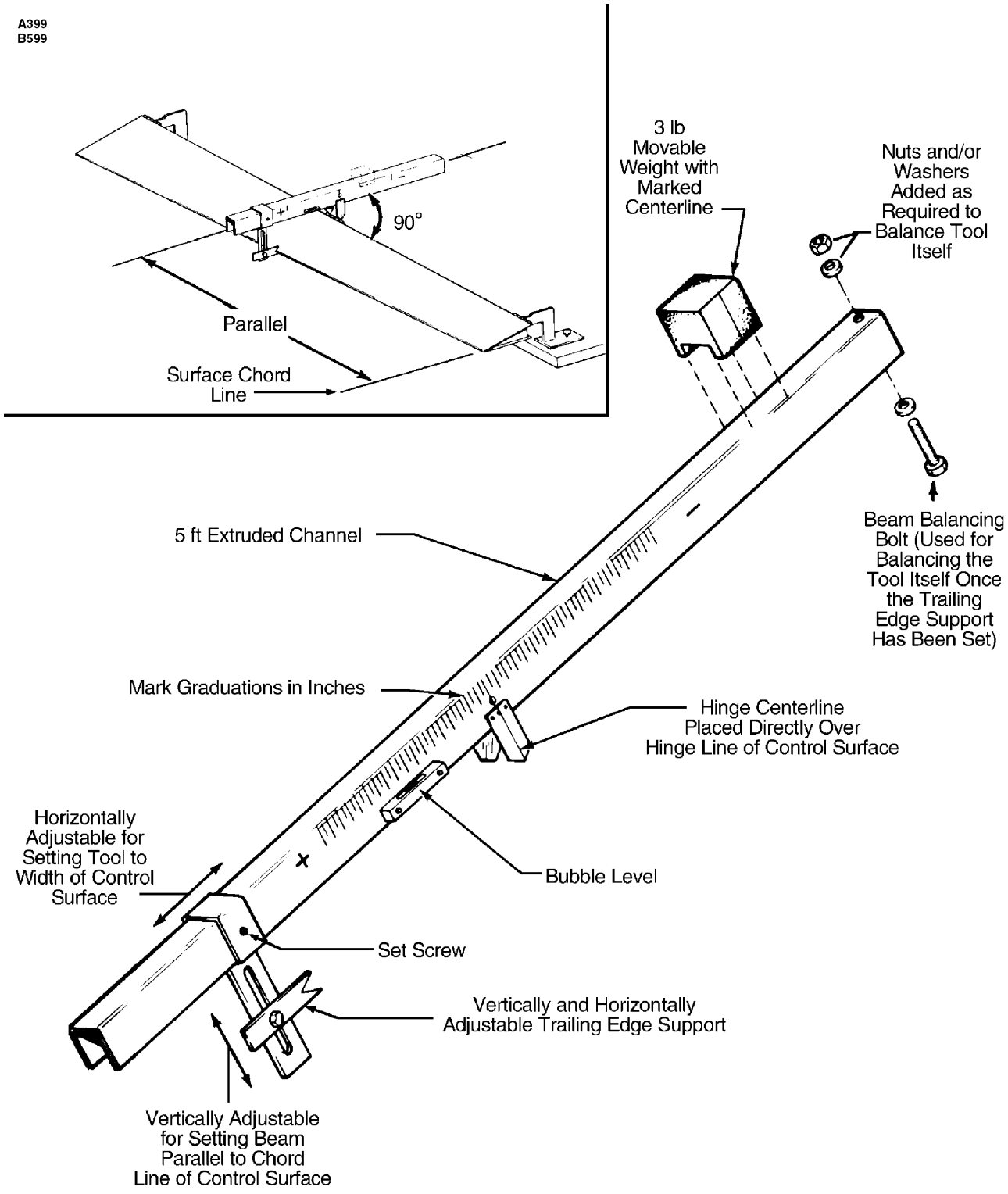
Structural repairs must be made in accordance with the latest revision of FAA Advisory Circular 43.13-1. See also 51-70-00.

850



STABILATOR AND TAB STATIC BALANCE LIMITS (IN. - LBS.)	
LEADING EDGE HEAVY	LEADING EDGE LIGHT
-12	-37

Balancing Stabilator
Figure 2



Control Surface Balancing Tool
Figure 3

B. Skin Bead Repair (Refer to Figure 4.)

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS. LIMITED REPAIRS TO CONTROL SURFACE SKINS ARE AUTHORIZED ONLY AS PROVIDED IN THIS MANUAL.

(1) Limitations

NOTE: These repairs are authorized only as a temporary measure until replacement parts (i.e. - skins) can be obtained and installed.

Repair of minor cracks in stabilator control surface skins only is authorized, but limited as follows:

(a) Cracks of no more that 0.5 inch at the ends of the skin stiffening beads;

(b) No more than two cracks per surface side.

(c) Cracks are limited to either end of a bead (See Figure 4), but not on the same bead;

(d) For wrap-around skins, two crack repairs are acceptable per side, but repairs may not be opposite to one another on opposite sides (i.e. - top and bottom or left and right).

(e) Bead crack repairs on top surface stabilator skins are not authorized.

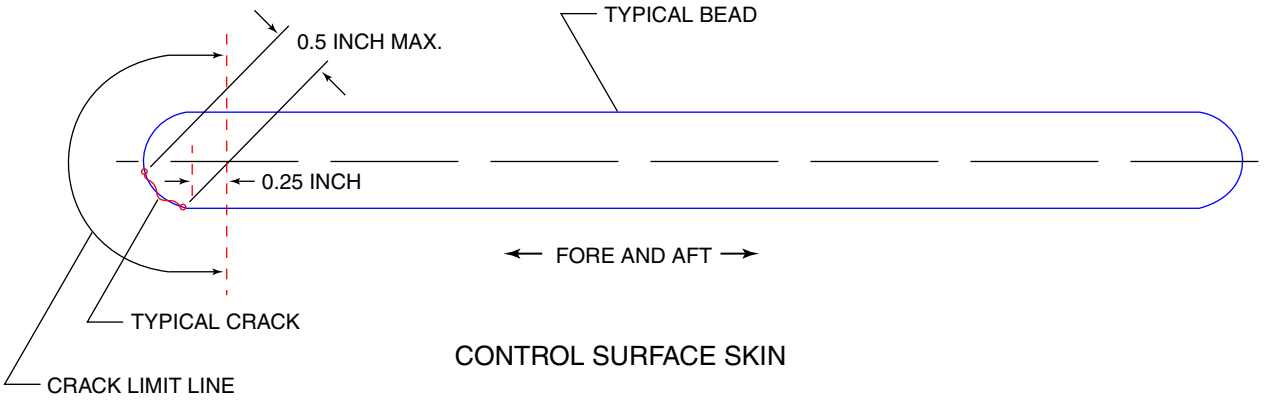
(2) Procedure

Only cracks confined to the bead end area shown in Figure 4 may be repaired.

(1) Cracks 0.5 inch long or less may be repaired by stop drilling;

(2) Stop drill the extreme ends of the crack with a #50 (0.070) drill.

NOTE: Cracks stop drilled once cannot be stop drilled again, should crack growth continue.



Skin Bead Repair
Figure 4

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VERTICAL STABILIZER

Vertical Fin (Refer to Figure 1.)

A. Removal

(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.

B. Installation

(1) place the fin in position and insert the bolts which secure the fin spar to the aft bulkhead.

(2) Attach the two bolts at the leading edge of the fin.

(3) Attach stabilator control push rod to the fin by connecting attachment hardware at the balance weight arm and at bellcrank.

(4) Connect the antenna wire from the antenna assembly, remove the fishing line to the antenna cable after attaching it to the fin conduit.

(5) Attach the stabilator per Stabilator - Installation, 55-20-00.

(6) Install the stabilator trim assembly and aft trim cable per instructions given in Stabilator Trim Controls - Aft Assembly - Installation, 27-30-00.

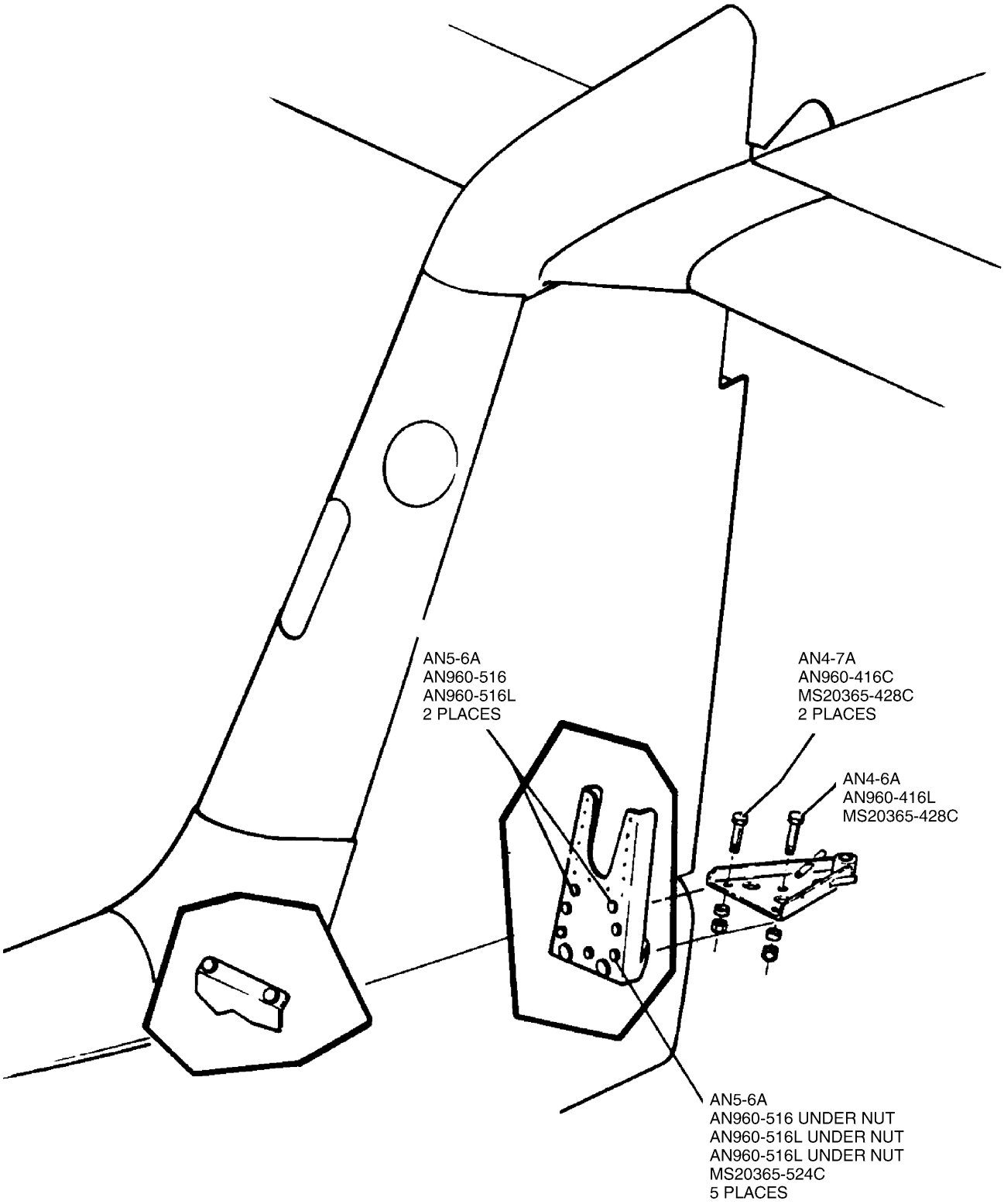
(7) Attach the rudder per Rudder - Installation, 55-40-00.

(8) Rig and adjust the rudder and trim control cables as specified in 27-20-00 and 27-30-00, respectively.

(9) Install the fin tip, tail fairing, dorsal fin at the forward edge of the fin. Connect upper and lower tail lights at the quick disconnects.

(10) Check the operation of the radios and electrical lights.

(11) Check all bolts for safety.



Vertical Stabilizer Installation
Figure 1

RUDDER AND TAB

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

1. Rudder (See Figure 1.)

   A. Removal

      (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.

   B. Installation

      WARNING: ALL CONTROL SURFACES THAT HAVE BEEN REPLACED OR REPAINTED MUST BE BALANCED BEFORE INSTALLATION PER INSTRUCTIONS IN BALANCING, BELOW.

      (1) While supporting the rudder, install the hinge bolts and attach the rudder to the fin.
      (2) Connect the rudder cables at the turnbuckles within the fuselage tail section and connect the cable to the rudder sector in accordance with Rudder - Rigging and Adjustment, 27-20-00.
      (3) Connect the trim push rod by inserting one bolt from the push rod.
      (4) Install the fairing.
      (5) Check cable tension if disturbed.

2. Balancing (See Figure 2.)

   A. Balancing Equipment

      Balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the centerline of the control surface hinge pin. See the tool configuration in 55-20-00, Figure 3. Other tool configurations may be used if accuracy is maintained and recalibration capability is provided.

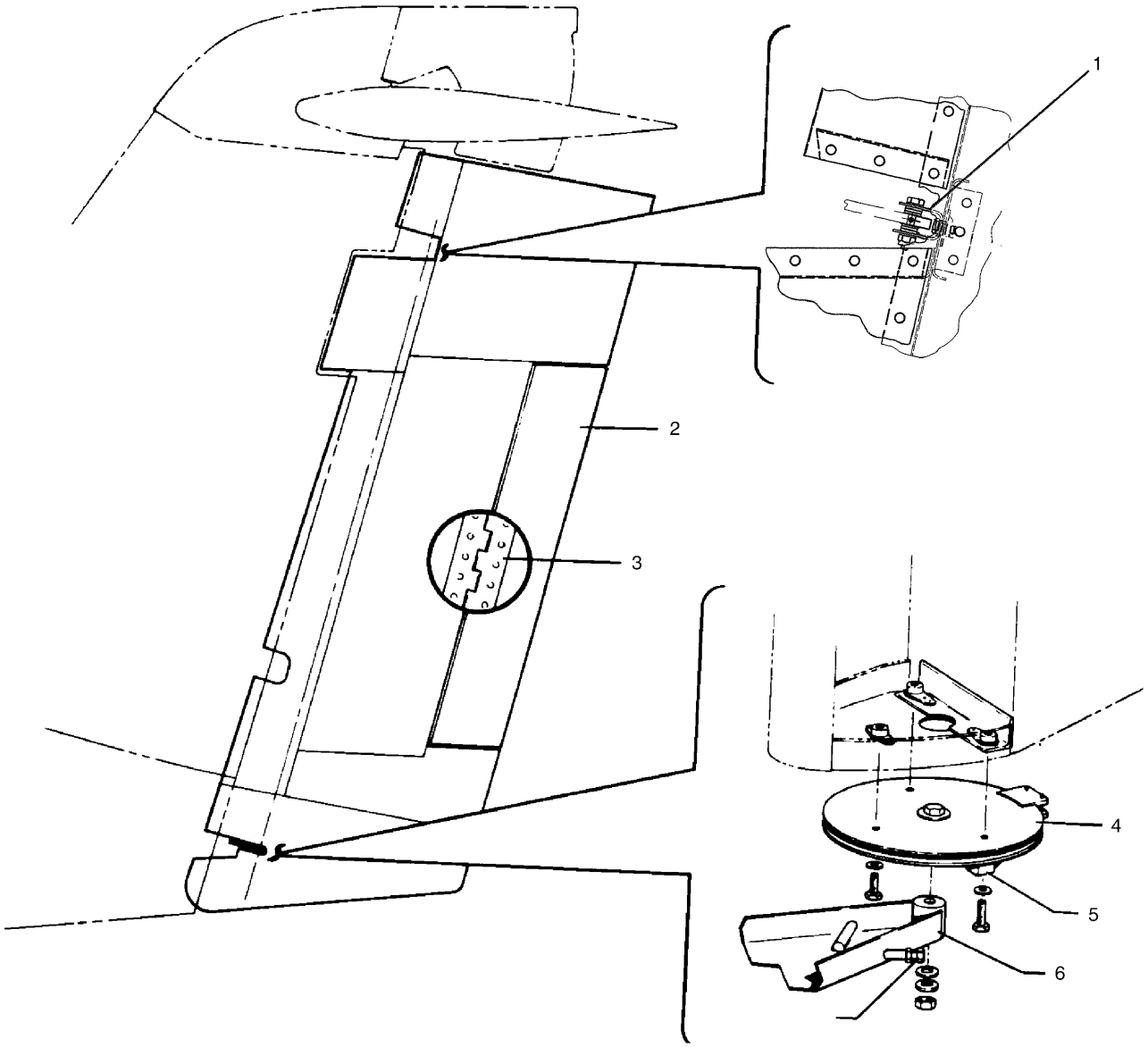
      (A) To use this tool:

         (a) 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.

         (b) Place hinge bolts through control surfaces and place control surface on a holding fixture.

2303

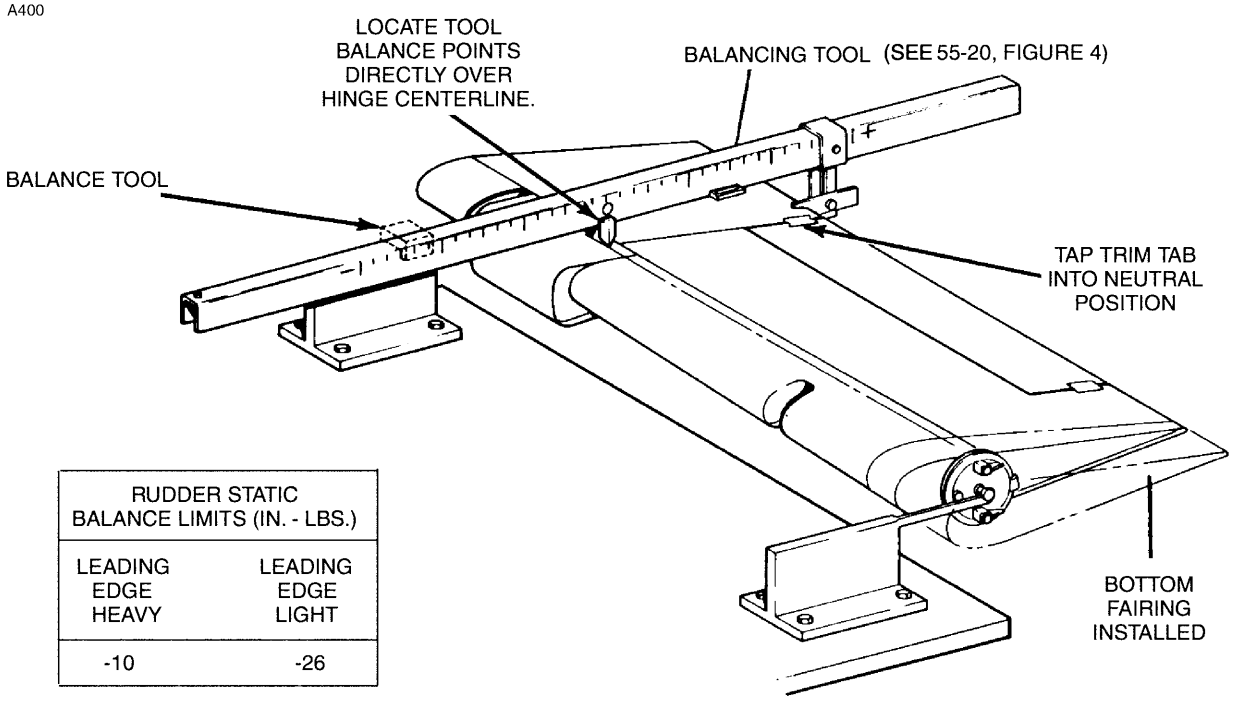


1. UPPER RUDDER HINGE
2. RUDDER TRIM TAB
3. TRIM TAB HINGE
4. RUDDER SECTOR
5. RUDDER SECTOR STOP
6. LOWER RUDDER HINGE
7. RUDDER STOP ADJUSTMENT BOLT

86498 K

Rudder Installation
Figure 1

A400



RUDDER STATIC BALANCE LIMITS (IN. - LBS.)	
LEADING EDGE HEAVY	LEADING EDGE LIGHT
-10	-26

Balancing Rudder
Figure 2

(c) Calibrate the tool.

1 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.

2 Adjust the movable trailing edge support to fit the width of the control surface. Tighten the set screw on the trailing edge support.

3 Adjust the trailing edge support vertically until the beam is parallel with the control surface chord line.

4 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.

(d) After balancing the tool, reattach it to the control surface per Figure 2. Keep the beam positioned 90° from the control surface hinge line.

(e) Determine balance of control surface by sliding movable weight along the balance beam.

(f) Read the scale when the bubble level has been centered. Multiply by three to determine inch-lbs. (I.E. - Since the movable weight weighs three pounds, every inch it is moved from the center of the beam equals three inch-lbs of force.)

B. Balancing Rudder (See Figure 2.)

To balance rudder, assembly must be complete including sector assembly. Place complete assembly horizontally on knife edge support in a draft-free area in a manner that allows unrestricted movement. Place tool on rudder with beam perpendicular to hinge centerline. Calibrate tool as described in Control Surface Balancing Equipment, above. Read scale when bubble level has been centered by adjustment of moveable weight and determine static balance limit. If static balance is not within limits given proceed as follows:

(1) Nose Heavy: This condition is highly improbable; recheck calculations and measurements.

(2) Nose Light: In this case, the mass balance weight is too light or the rudder is too heavy because of painting; it will be necessary to strip the paint and repaint. If the rudder is too heavy as a result of repairs, the repair must be removed and the damaged parts replaced.

3. Rudder Trim Tab (See Figure 1.)

A. Removal

(1) Discconect the trim push rod.

(2) Remove the inge pin and remove the trim tab.

B. Installation

(1) Place the trim tab in position and install a new hinge pin.

(2) Connect the trim push rod.

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GRIDS 5F22 THRU 5F24
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CHAPTER

56

WINDOWS

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CHAPTER 56

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	4	Mar 15/06			

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CHAPTER 56 - WINDOWS

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FLIGHT COMPARTMENT.

1. Windshield (See Figure 1.)

   A. Removal

      (1) Remove the collars 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) Clean old tape and sealer off the affected mating surfaces.

   B. Installation

      (1) Match new winshield to old. If necessary, cut or grind the new windshield to matching dimensions.

      (2) Apply 1/8 in. by 1 in. vinyl foam tape, Norton V510 or equivilent (i.e. - Tape - Vinyl Foam, Type 2; 91-10-00, Consumable Materials), around entire edge of windshield.

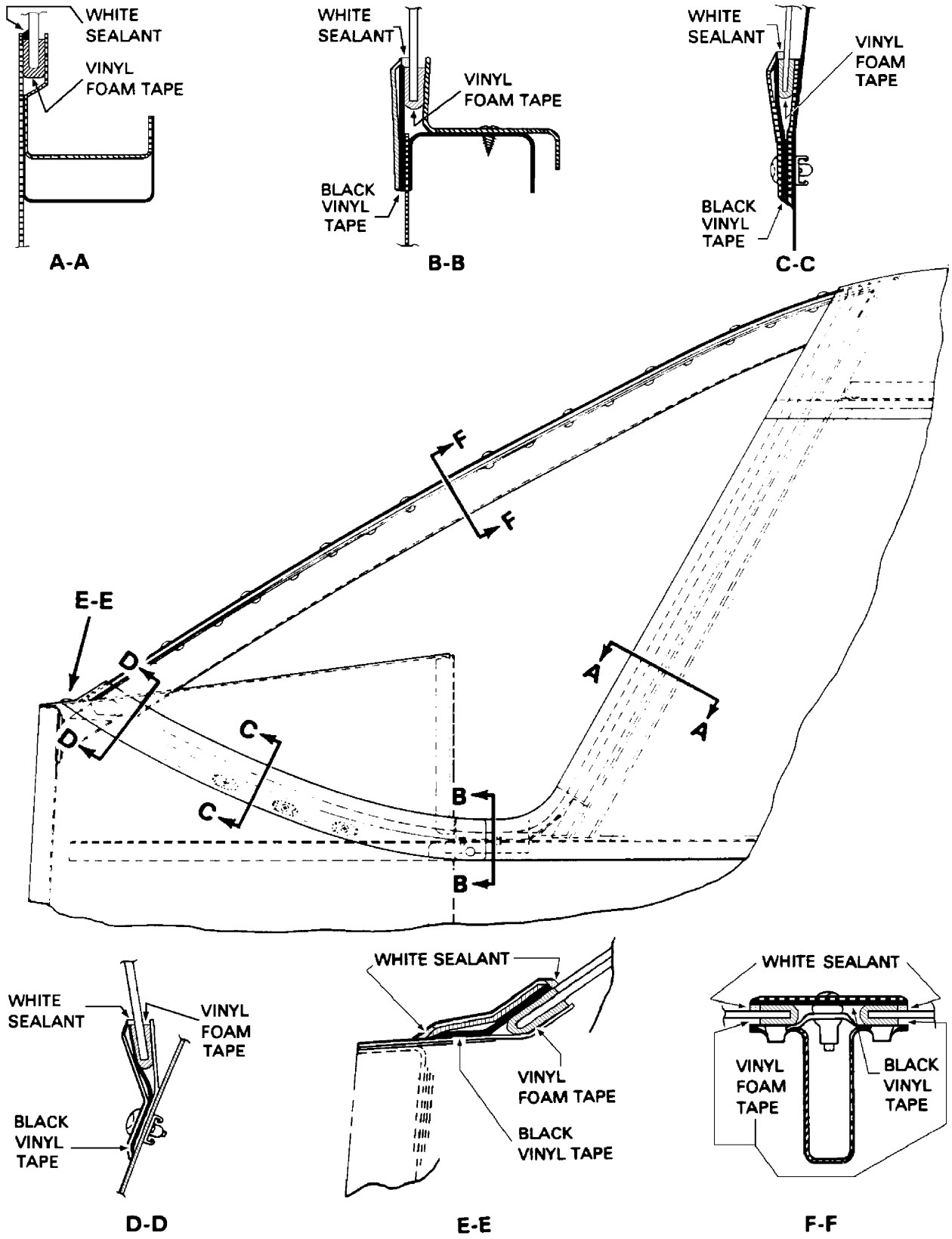
      (3) Place windshield into position, sliding aft and up into place. Take care not to dislocate vinyl foam tape. Allow clearance for expansion between the two windshield sections at the center post.

      (4) Apply 1.5 in., 9 mil, black vinyl tape covering the previously applied vinyl foam tape and sealing the joint between the windshield and airframe as indicated in Figure 1.

      (5) Apply polyurethane, urethane, acrylic, or polysulfide sealant (i.e. - Sealant - Window and Airframe; 91-10-00, Consumable Materials), to seal the forward edge of the vinyl tape at the bottom of the center post, as indicated in Figure 1, View E-E.

      (6) Reinstall collars and trim strip. Apply sealant as indicated in Figure 1 by forcing the sealant between the mating parts. Mating parts may be separated slightly using a soft wooden wedge or a tongue depressor. Force sealant deep into the gap. Take care to avoid bending or scratching aluminum or windshield surfaces. Joints should be completely filled, and blended smoothly with adjacent surfaces after clean-up.

      (7) Remove excess sealant and exposed tape. Sealant may be cleaned from window areas using rags, disposable wipers or plastic scrapers. A tool made of acrylic sheet with a wedged end (.25 in. thick and 1.5 in. wide) can be fabricated and used. Tirpolene solvent or Apperson solvent No. 120 may be used to clean polysulfide sealants.



Windshield Installation (Typical)
Figure 1

2. Emergency Exit Window

A. Removal. (See Figure 1.)

The airplane is 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 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.

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 window frame and molding.

B. Installation

1. Match new window to old. If necessary, cut or grind the new window to the same dimensions.
2. Apply 1/8 in. by 1 in. vinyl foam tape, Norton V510 or equivilent (see 91-10-00, Chart 10, Tape - Vinyl Foam, Type 2), around entire edge of window.
3. Insert the window into the frame, install the retainer moldings and attachement screws, but do not tighten. Take care not to damage or dislocate the vinyl foam tape.
4. Apply polyurethane, urethane, acrylic, or polysulfide sealant (see 91-10-00, Chart 10, Sealant - Window and Airframe) completely around the outer surface of the window at all attachment flanges as indicated in Figure 1. Force the sealant between the mating parts, which may be separated slightly using a soft wooden wedge or a tongue depressor. Force sealant deep into the gap. Take care to avoid bending or scratching aluminum or window surfaces. Joints should be completely filled, and blended smoothly with adjacent surfaces after clean-up.
5. Tighten attachment screws until vinyl foam tape is compressed approximately 25 percent. Reinstall rivets.
6. Remove excess sealant from window areas using rags, disposable wipers or plastic scrapers. A tool made of acrylic sheet with a wedged end (.25 inch thick and 1.5 inch wide) can be fabricated and used. Tirpolene solvent or Apperson solvent No. 120 may be used.to clean polysulfide sealants.

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PASSENGER COMPARTMENT

Side Windows (See Figure 1.)

These airplanes are equipped with single-pane side windows.

A. Removal

(1) Remove the molding and retainer from around the window by removing attaching screws.

(2) Carefully remove the damaged window from the frame.

(3) Remove old tape and sealer from window frame and molding.

NOTE: A damaged window should be saved to provide a pattern for shaping the new window.

B. Installation

(1) Match new window to old. If necessary, cut or grind the new window to the same dimensions.

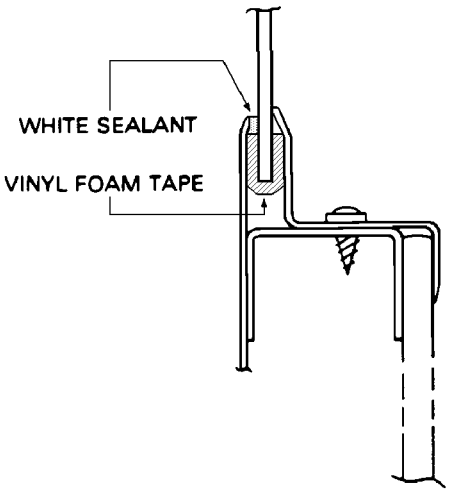
(2) Apply 1/8 in. by 1 in. vinyl foam tape, Norton V510 or equivilent (i.e. - Tape - Vinyl Foam, Type 2; 91-10-00, Consumable Materials), around entire edge of window.

(3) Insert the window into the frame, install the retainer moldings and attachement screws, but do not tighten. Take care not to damage or dislocate the vinyl foam tape.

(4) Apply polyurethane, urethane, acrylic, or polysulfide sealant (i.e. - Sealant - Window and Airframe; 91-10-00, Consumable Materials), completely around the outer surface of the window at all attachment flanges as indicated in Figure 1. Force the sealant between the mating parts, which may be separated slightly using a soft wooden wedge or a tongue depressor. Force sealant deep into the gap. Take care to avoid bending or scratching aluminum or window surfaces. Joints should be completely filled, and blended smoothly with adjacent surfaces after clean-up.

(5) Tighten attachment screws until vinyl foam tape is compressed approximately 25 percent.

(6) Remove excess sealant from window areas using rags, disposable wipers or plastic scrapers. A tool made of acrylic sheet with a wedged end (.25 inch thick and 1.5 inch wide) can be fabricated and used. Tirpolene solvent or Apperson solvent No. 120 may be used.to clean polysulfide sealants.



Side Window Installation
Figure 1

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CHAPTER

57

WINGS

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CHAPTER 57

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GENERAL

1. 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.

2. Repairs

A. General

WARNING: NO ACCESS HOLES ARE PERMITTED IN ANY CONTROL SURFACES.

WARNING: 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.

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS. LIMITED REPAIRS TO CONTROL SURFACE SKINS ARE AUTHORIZED ONLY AS PROVIDED IN THIS MANUAL.

Structural repairs must be made in accordance with the latest revision of FAA Advisory Circular 43.13-1. See also 51-70-00.

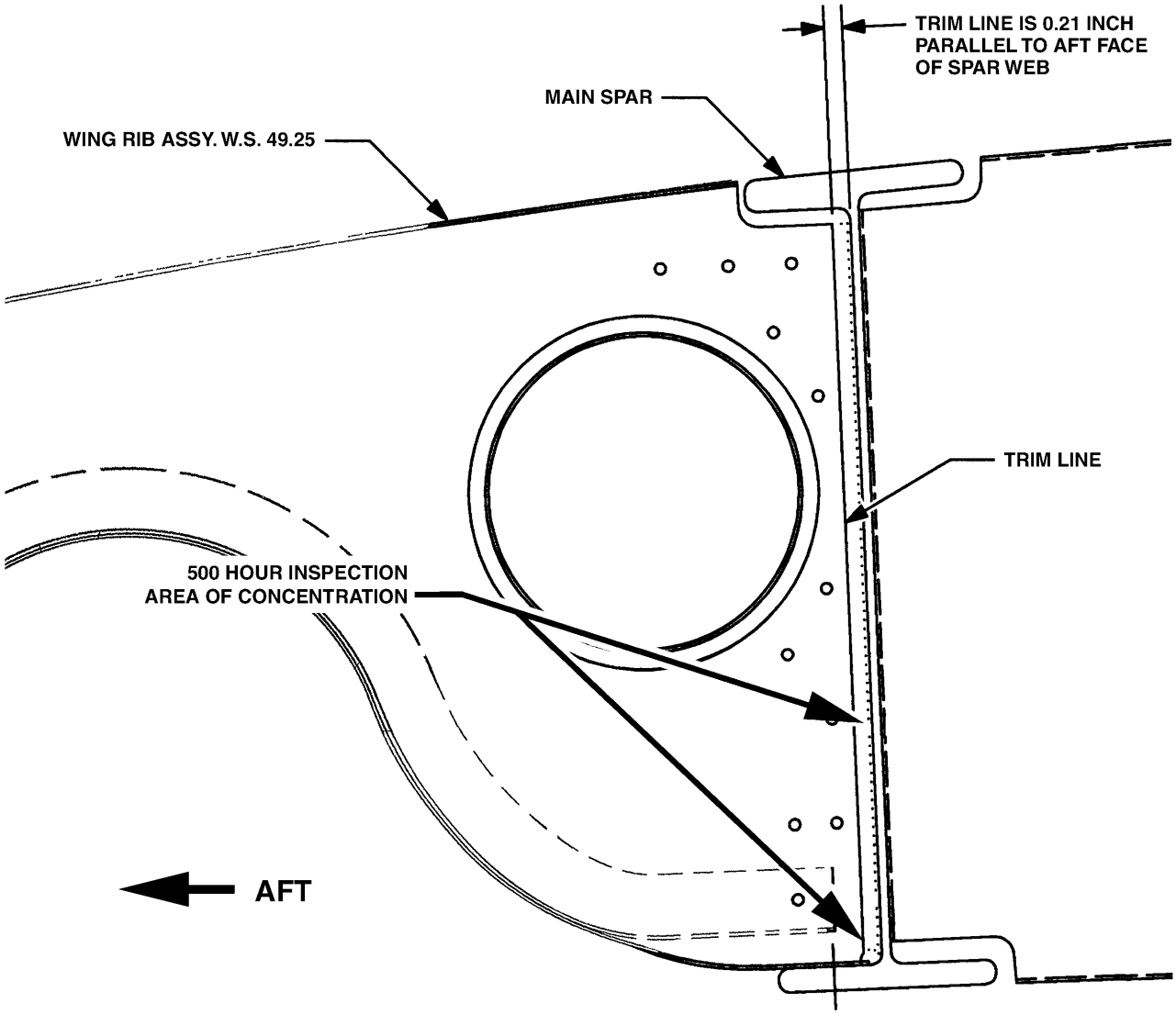
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MAIN FRAME

Wing Rib Assembly W.S. 49.25

The left and right rib assemblies, factory installed in S/N's 4496001 thru 4496219, aft of the main spar at W.S. 49.25 can, under certain conditions, crack. The cracking is typically observed vertically along the bend radius of the flange common to the main spar and the main landing gear side brace attach fitting (see Figure 1). Accordingly, in S/N's 4496001 thru 4496219 only, perform the following inspections at the intervals indicated:

NOTE: Installation of Kits No. 767-397 (LH) and 767-398 (RH), confirmation of existing rib assemblies stamped with Date Code 8313 (see Figure 2) or higher, installation of new rib assemblies with Date Code 8313 or higher, or any combination of the above will eliminate the following 100 hour and 500 hour repetitive inspection requirements.



Wing Rib Inspection (W.S. 49.25)
Figure 1

A. 100 Hour Wing Rib Inspection

In S/N's 4496001 thru 4496219 only, for airplanes which have not installed Kits No. 767-397 (LH) and 767-398 (RH), or do not have rib assemblies at W.S. 49.25 stamped with Date Code 8313 (see Figure 2) or higher,.each 100 hours time-in-service:

(1) Place the airplane on jacks per 7-10-00.

(2) In both the right and left wings:

(a) Inspect the Aft Rib Assembly at W.S. 49.25 for any evidence of cracks (see Figure 1.)

(b) Inspection shall be limited to a visual examination.

(c) Inspect the exposed (upper half) portion of the bend radius of the flange common to the Aft Rib Assembly and the Main Spar Web.

(3) If any crack is detected visually, proceed to a more detailed examination.

(a) Remove the Main Landing Gear Side Brace, by removing the five (5) bolts that fasten it to the wing structure. Retain hardware for reassembly.

(b) Inspect the cracked Rib Assembly in the bend radius of the flange common to the Main Spar Web, using dye penetrant inspection techniques, to determine the full extent of crack propagation.

(c) Determine if trimming, as shown in Figure 1, will remove all the material affected by the crack.

1 If so, install the appropriate kit (see above).

2 If this cannot be accomplished, replace the cracked Rib Assembly.

(4) If no cracks are detected, reassemble/reinstall any parts or components previously removed.

(5) Verify proper functioning of landing gear.

(6) Verify gear are down and locked and remove airplane from jacks.

(7) Make an appropriate logbook entry.

B. 500 Hour Wing Rib Inspection

In S/N's 4496001 thru 4496219 only, for airplanes which have not installed Kits No. 767-397 (LH) and 767-398 (RH), or do not have rib assemblies at W.S. 49.25 stamped with Date Code 8313 (see Figure 2) or higher,.each 500 hours time-in-service:

(1) Place the airplane on jacks per 7-10-00.

(2) In both the right and left wings:

(a) Remove the Main Landing Gear Side Brace, by removing the five (5) bolts that fasten it to the wing structure. Retain hardware for reassembly.

(b) Inspect the Rib Assembly for evidence of cracks in the bend radius of the flange common to the Main Spar Web (as show in Figure 1), using dye penetrant inspection techniques.

(3) If a crack is detected, identify the path of the propagation, and determine if trimming, as shown in Figure 2, will remove all the material affected by the crack.

(a) If so, install the appropriate kit.

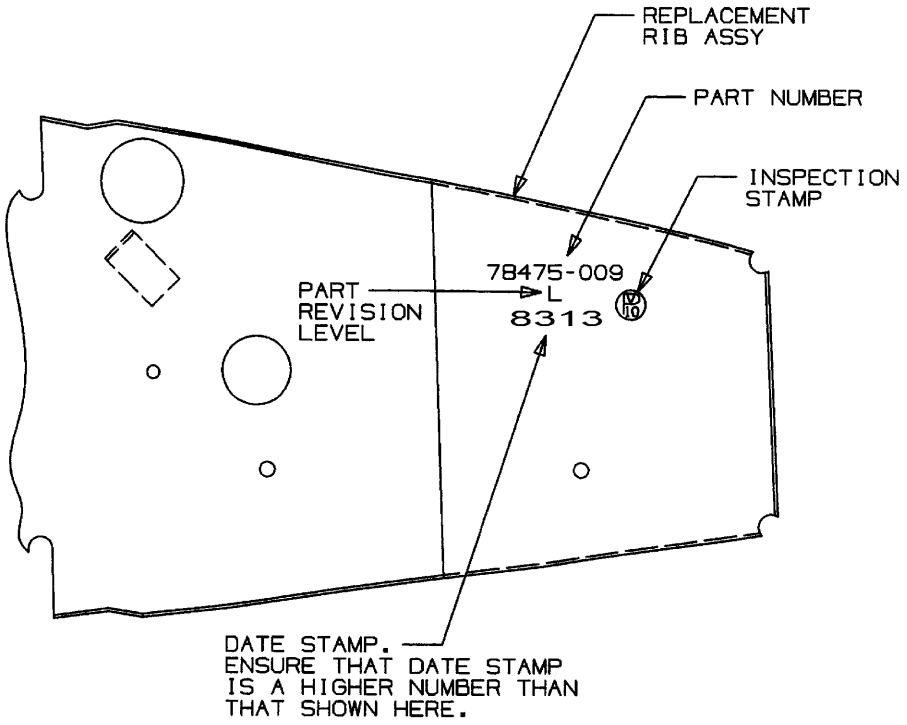
(b) If this cannot be accomplished, replace the cracked Rib Assembly.

(4) If no cracks are detected, reassemble/reinstall any parts or components previously removed.

(5) Verify proper functioning of landing gear.

(6) Verify gear are down and locked and remove airplane from jacks.

(7) Make an appropriate logbook entry.



Wing Rib Assembly Marking
Figure 2

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AXUILIARY STRUCTURE

Wing Tip

A. Removal

(a) Remove the screws holding the wing tip to the wing, being careful not to damage the wing or wing tip.

(b) Pull off the wing tip far enough to disconnect the landing light and navigation and strobe light wire assemblies. Be sure to unscrew the ground lead at the wing rib.

(c) Inspect the wing tip to ascertain that it is free of cracks, severe nicks and minor damage. If repair is required, refer to Repair, below.

B. Installation

(a) Place the wing tip in a position that the landing light and navigation and strobe light leads may be connected. Be sure to connect the navigation/strobe ground lead to the wing rib by use of a screw and nut. Ensure that the ground lead is free of dirt and film to insure a good connection.

(b) Insert the wing tip into position and install the screws round the tip. Take care to refrain from damaging the wing tip or wing. Check operation of the lights.

C. Repair

See 51-70-00.

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ATTACH FITTINGS

1. WING

NOTE: The major subassemblies of the wing may be removed individually or the wing may be removedas a unit. To remove a wing, a fuselage supporting cradle is required

A. Removal (Refer to Figure 1.)

(1) Disconnect the battery.

(2) Close the fuel valve and drain the fuel from the wing to be removed. (Refer to Draining Fuel System, 12-10-00.)

(3) Drain the brake lines and reservoir. (Refer to Draining Brake System, 12-10-00.)

(4) Remove the engine from the wing to be removed. (Refer to Removal of Engine, 71-10-00.)

(5) Drain the hydraulic lines of the landing gear of the wing to be removed by separating the lines and elbows at the actuating cylinder.

(6) Remove the seal at the wing root and adjacent access plates and inspection panels. (See Access Plates and Panels, 6-00-00).

(7) Remove the front and back seats from the airplane.

(8) Expose the spar box and remove the side trim cockpit panel assembly that corresponds with the wing being removed.

(9) Place the airplane on jacks. (Refer to Jacking, 7-10-00.)

(10) Disconnect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar.

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.

(11) 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.

(12) 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.

(13) 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.

(14) 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.

(15) 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.

(16) Disconnect the landing gear hydraulic lines at the fittings aft of the spar and within the fuselage.

(17) 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.

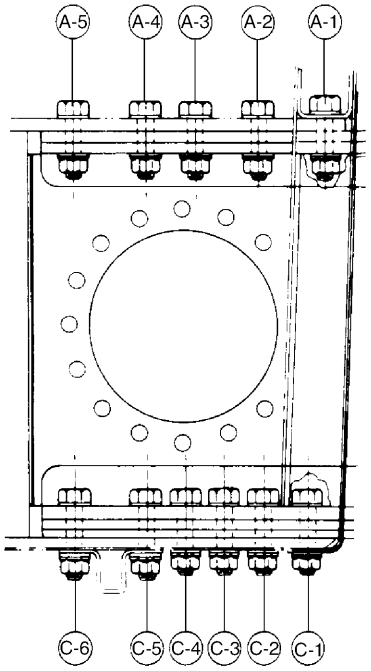
(18) Arrange and put in place a suitable fuselage cradle and supports for both wings.

(19) Remove the wing jacks.

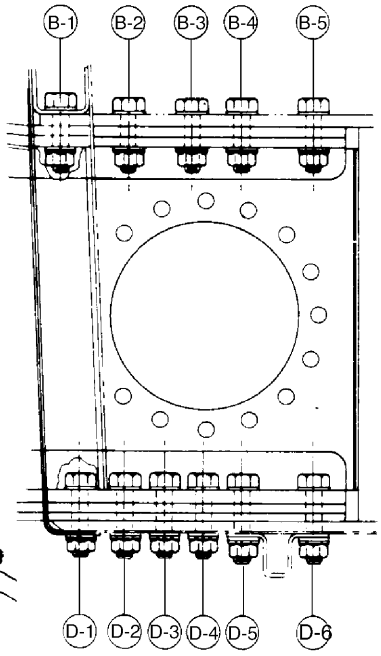
BOLT LEGEND			WASHER	
POS	BOLT	NUT [1]	UNDER HEAD	UNDER NUT
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A-2	NAS464P6LA16	MS21042-6	(1)NAS1149F0663P	(2)NAS1149F0663P
A-3	NAS464P6LA16	MS21042-6	(1)NAS1149F0663P	(2)NAS1149F0663P
A-4	NAS464P6LA16	MS21042-6	(1)NAS1149F0663P	(2)NAS1149F0663P
A-5	NAS464P6LA16	MS21042-6	(1)NAS1149F0663P	(2)NAS1149F0663P
B-1	NAS464P6LA15	H19300-6	(1)NAS1149F0632P	(1)K19301-6 [2]
B-2	NAS464P6LA14	H19300-6	(1)NAS1149F0663P	(1)K19301-6 [2]
B-3	NAS464P6LA14	H19300-6	(1)NAS1149F0663P	(1)K19301-6 [2]
B-4	NAS464P6LA14	H19300-6	(1)NAS1149F0663P	(1)K19301-6 [2]
B-5	NAS464P6LA14	H19300-6	(1)NAS1149F0663P	(1)K19301-6 [2]
C-1	NAS464P5LA20	MS21042-5	(1)NAS1149F0532P	(2)NAS1149F0563P
C-2	NAS464P6LA20	MS21042-6	(1)NAS1149F0632P	(2)NAS1149F0663P
C-3	NAS464P6LA20	MS21042-6	(1)NAS1149F0632P	(2)NAS1149F0663P
C-4	NAS464P6LA20	MS21042-6	(1)NAS1149F0632P	(2)NAS1149F0663P
C-5	NAS464P6LA21	MS21042-6	(1)NAS1149F0632P	(1)96352-3 [2]
C-6	NAS464P5LA21	MS21042-5	(1)NAS1149F0532P	(1)96352-2 [2]
D-1	NAS464P5LA20	MS21042-5	(1)NAS1149F0532P	(2)NAS1149F0563P
D-2	NAS464P6LA20	MS21042-6	(1)NAS1149F0632P	(2)NAS1149F0663P
D-3	NAS464P6LA20	MS21042-6	(1)NAS1149F0632P	(2)NAS1149F0663P
D-4	NAS464P6LA20	MS21042-6	(1)NAS1149F0632P	(2)NAS1149F0663P
D-5	NAS464P6LA21	MS21042-6	(1)NAS1149F0632P	(1)96352-3 [2]
D-6	NAS464P5LA21	MS21042-5	(1)NAS1149F0532P	(1)96352-2 [2]

NOTES:

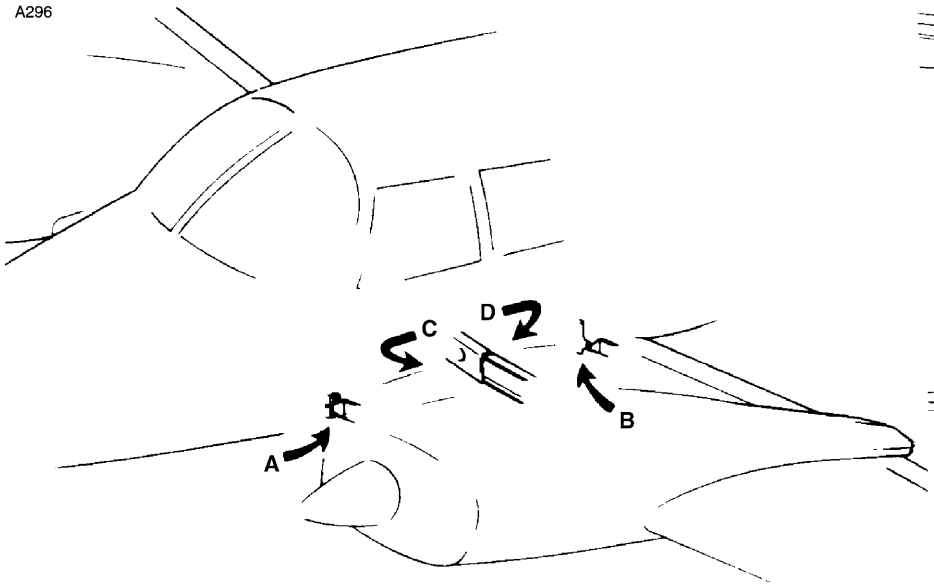
1. TORQUE BOLT HEAD ON UPPER SPAR CAP AND NUT ON LOWER SPAR CAP AS FOLLOWS:
   FOR A 5/16 BOLT - 205-225 IN-LBS
   FOR A 3/8 BOLT - 360-390 IN-LBS
2. A MAXIMUM OF TWO NAS1149F06663P OR TWO NAS1149F0563P ON THE APPROPRIATE BOLT ARE ALLOWED UNDER THE SPECIAL WASHER.
3. IT IS PERMISSIBLE TO TRIM FLAP ON INSTALLATION TO OBTAIN PROPER CLEARANCE.



SKETCH C



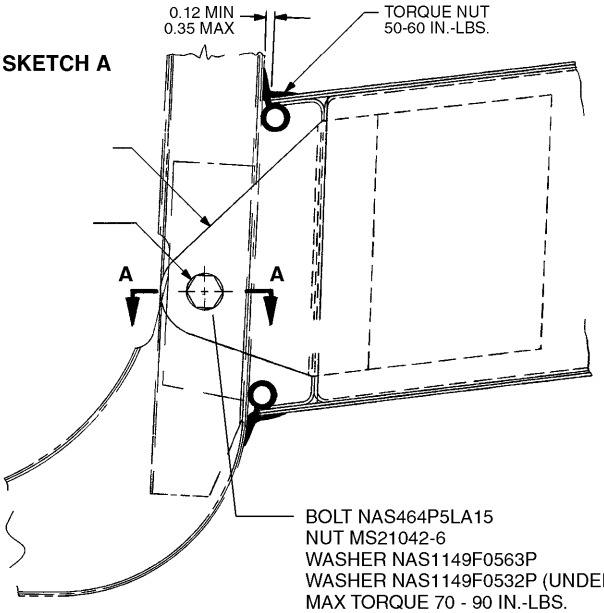
SKETCH D

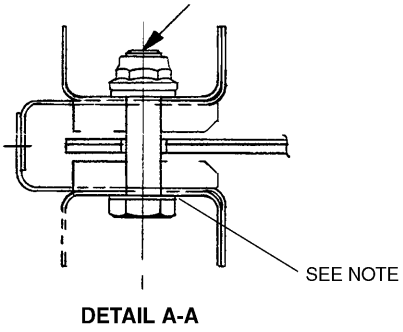


Wing Installation
Figure 1 (Sheet 1 of 2)

FORWARD SPAR ATTACHMENT
(LOOKING AFT, LEFT SIDE)

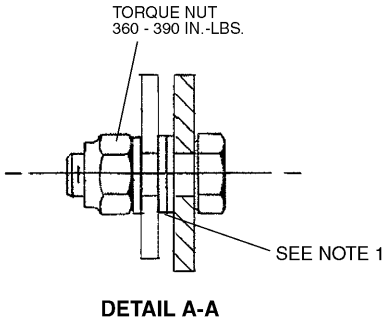
86504 AF

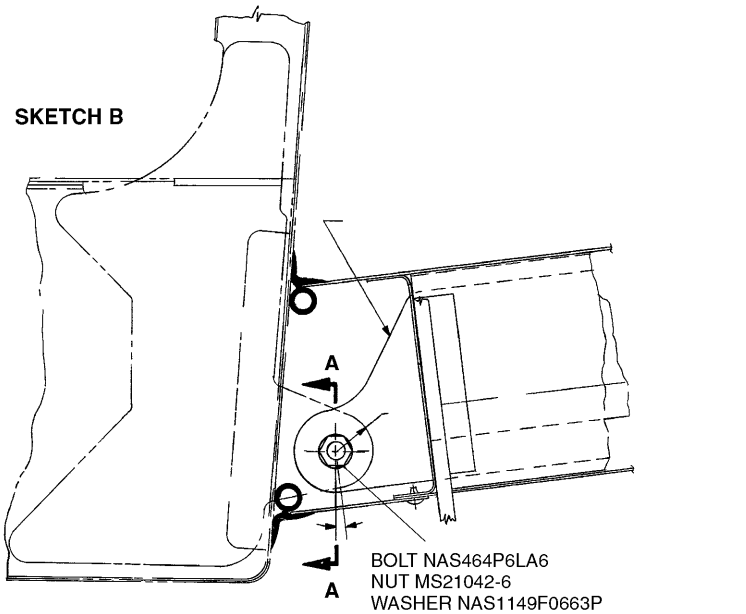




NOTE
MINIMUM OF ONE WASHER UNDER NUT, THEN AS REQUIRED TO LEAVE A MAXIMUM OF 1 1/2 VISIBLE THREADS OR MINIMUM OF BOLT CHAMFER EXPOSED.

REAR SPAR ATTACHMENT
(LOOKING AFT, LEFT SIDE)





NOTES
1. MAXIMUM NUMBER OF WASHERS ALLOWED BETWEEN FORWARD FACE OF WING FITTING AND AFT FACE OF FUSELAGE FITTING IS ONE NAS1149F0632P AND ONE NAS1149F0633P. (ALL THREE WASHERS ALWAYS REQUIRED WITH ONLY THE NAS1149F0632P WASHER ALLOWED UNDER THE BOLT HEAD.
2. NEW SERVICE WINGS ARE NOT DRILLED FOR THE REAR SPAR ATTACHMENT BOLT. ACCORDINGLY, WHEN INSTALLING A NEW SERVICE WING, DRILL A 0.3745 - 0.3765 INCH HOLE IN THE REAR SPAR ATTACHMENT POINT.

Wing Installation
Figure 1 (Sheet 2 of 2)

(20) Remove the front and rear wing spar to fuselage attach nuts, washers and bolts. Discard nuts.

NOTE: Note the number and placement of washers at each attach point to facilitate reinstallation.

WARNING: DO NOT DRIVE OUT SPAR TO FUSELAGE ATTACH BOLTS. TAKE EXTREME CARE NOT TO DAMAGE BOLTS OR BOLT HOLES. NUMBER BOLTS AND BOLT HOLES TO ENSURE THAT, IF REUSED, THE SAME BOLTS ARE REINSTALLED IN THE SAME HOLES.

(21) For the wing(s) being removed, remove the twenty-two (22) main spar to fuselage (i.e. - spar carrythrough) attachment bolts. Discard nuts.

(22) Slowly remove the wing being certain that all electrical leads, cables and lines are disconnected. Ensure that no undue up or down pressure is exerted on the inboard spar within the spar carrythrough.

B. Installation (See Figure 1.)

NOTE: When installing a “replacement” wing, perform Stall Warning Flight Test Procedure, 27-30-00, upon completion of wing installation.

NOTE: If a factory replacement wing is being installed, the wing aft spar fitting must have a .3745 / .3765 diameter hole installed in line with the existing hole in the fuselage fitting, using suitable tooling to ensure alignment of the holes.

(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. Ensure that the lines, cable, and electrical leads are carefully fed into place.

WARNING: DO NOT DRIVE SPAR TO FUSELAGE ATTACH BOLTS IN. TAKE EXTREME CARE NOT TO DAMAGE BOLTS OR BOLT HOLES. IF REUSING BOLTS, ENSURE THE SAME BOLTS ARE REINSTALLED IN THE SAME HOLES.

(5) Install the twenty-two (22) main spar to fuselage (i.e. - spar carrythrough) attachment bolts in accordance with the bolt legend in Figure 1. Use twenty-two (22) new nuts (see bolt legend, Figure 1).

(6) Install the main spar bolts in accordance with the information given in Figure 1, Sketches C and D.

(7) 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 1.)

(8) Insert the number of washers required at the rear wing spar between the forward face of the wing fitting and aft face of the fuselage fitting, as specified in Sketch B, Figure 1, to fill the gap. A true “no-gap” condition with the faces of the fittings against each other is also acceptable. After the required washers are inserted between the plates, install the bolt and check to insure that no threads are bearing on the forward plate prior to installing the nut. Add washers, as specified in Sketch B, Figure 1, as required (minimum of one), to leave a maximum of one and one-half usable threads exposed.

CAUTION: BE CERTAIN THAT ALL BOLTS, NUTS AND WASHERS ARE INSTALLED INACCORDANCE WITH FIGURE 1 (I.E. - THE BOLT LEGEND AND SKETCHES A, B, C, AND D).

(9) Torque the bolt heads on the upper main spar cap and the nuts on the lower main spar cap as specified in Figure 1, bolt legend. Torque the forward wing spar to fuselage attach nut as specified in Figure 1, Sketch A. Torque the rear wing spar to fuselage attach nut as specified in Figure 1, Sketch B.

(10) 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.

(11) 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.

(12) 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.

(13) Connect the leads to the appropriate posts on the terminal strip and install the washers and nuts. (For assistance in connecting the electrical leads, refer to the electrical schematics in Chapter 91.) Place the clamps along the electrical harness to secure it in position and install the terminal strip dust cover.

(14) Connect the fuel line at the fitting located inside the wing, by reaching through the access panel on the forward inboard portion of the wheel well.

(15) Connect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar. After the left balance cable has been inserted through the bracket assembly and connected, install a cotter pin cable guard into the hole that is provided in the bracket assembly.

(16) Connect the flap by placing the flap handle in the full flap position; place the bushing on the outside of the rod end bearing and insert and tighten bolt.

(17) Service and refill the brake system with hydraulic fluid in accordance with Brake System - Servicing Reservoir, 12-10-00. Bleed the system per Bleeding Brakes, 32-40-00 and check for fluid leaks.

(18) Check the fluid level of the landing gear hydraulic system and fill in accordance with Hydraulic System Servicing, 12-10-00. Conduct Landing Gear Retraction System Functional Test, 32-30-00. If required, bleed the hydraulic system using techniques described in Bleeding Brakes, 32-40-00.

(19) Service and fill the fuel system in accordance with Fuel System - Filling Fuel Tanks, 12-10-00. Open the fuel valve and check for leaks and flow.

(20) Check the operation of all electrical equipment and pitot systems.

(21) Service and fill the fuel system in accordance with Servicing Fuel System, Chapter 12-10-00. Open the fuel valve and check for leaks and fuel flow.

(22) Check the operation of all electrical equipment, pitot and static systems.

(23) Remove the airplane from jacks.

(24) Install cockpit trim panel assembly, spar box carpet, the front and back seats. Check operation of pilot and co-pilot seats.

(25) Replace all the wing root seal and all access plates and panels on the wing involved.

(26) Connect battery.

(27) Ground run airplane to verify proper operation of fuel and brake systems.

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FLIGHT SURFACES

1. Ailerons (See Figure 1.)

   CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

   A. Removal

      (1) Disconnect the aileron control rod at the aileron attachment point by removing the nut, washers and bolt from the rod end bearing. To simplify installation note location of washers removed.

      (2) Remove the attaching nuts, bolts and washers from the hinges at the leading edge of the aileron, and remove the aileron.

   B. Installation

      WARNING: ALL CONTROL SURFACES THAT HAVE BEEN REPLACED OR REPAINTED MUST BE BALANCED BEFORE INSTALLATION PER INSTRUCTIONS IN BALANCING, BELOW.

      (1) Move the aileron into place and install attaching bolts, washers and nuts. Ascertain that the aileron is free to move with no interference.

      (2) Attach the aileron control rod with bolts, washers and nut, dividing the washers so that the aileron is free to rotate from stop to stop without the control rod binding or rubbing on the opening in the aft spar. Be certain that the rod end bearing has no side play when tightening the bolt and that the rod does not contact the side of the bracket.

      (3) Rig and adjsut ailerons per Rigging and Adjustment, 27-10-00.

2. Balancing

   A. Balancing Equipment

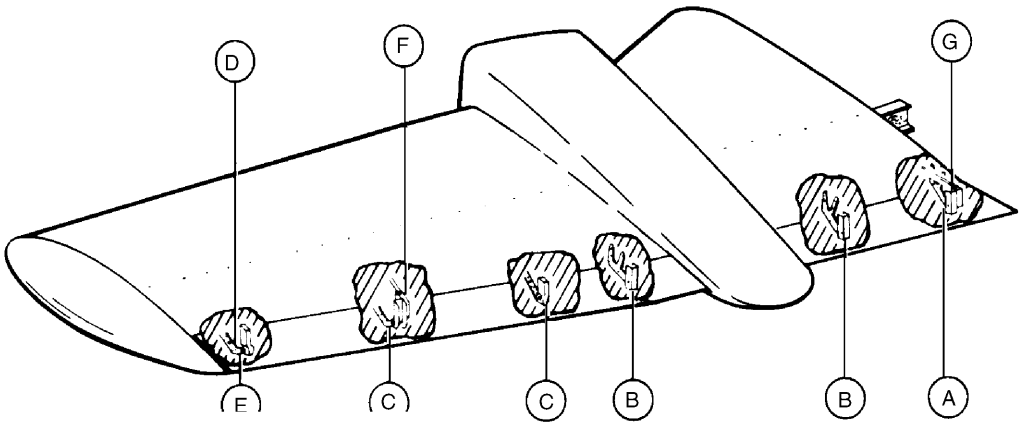
      Balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the centerline of the control surface hinge pin. See the tool configuration in 55-20-00, Figure 3. Other tool configurations may be used if accuracy is maintained and recalibration capability is provided.

      (A) To use this tool:

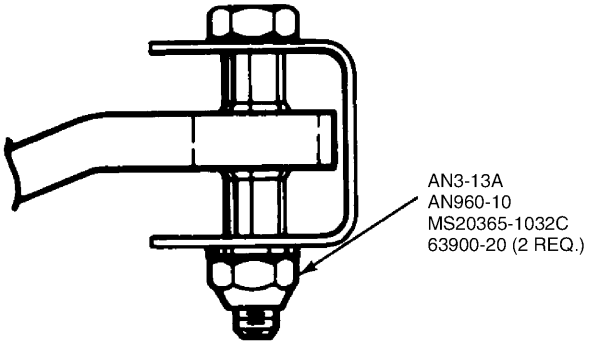
         (a) Insure that the control surface is in its final Flight configuration, static wicks, trim tabs, trim tab push pull rod and control surface tip (as applicable) should be installed. The surface should be painted and trim/servo tabs should be in the neutral position.

            NOTE: Because paint is a considerable balance factor, it is recommended that existing paint be removed prior to repainting a control surface.

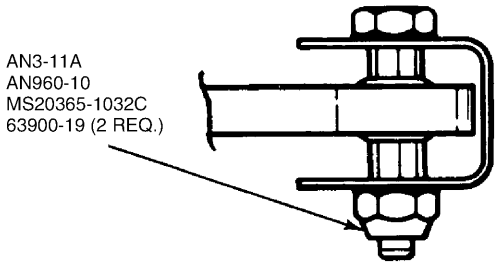
         (b) Place hinge bolts through control surfaces and place control surface on a holding fixture.



A322

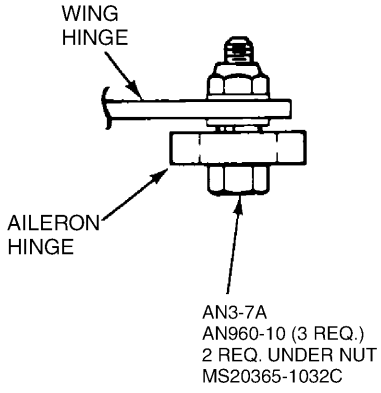


SKETCH A

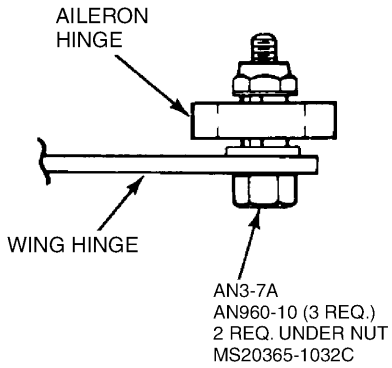


SKETCH B

A288



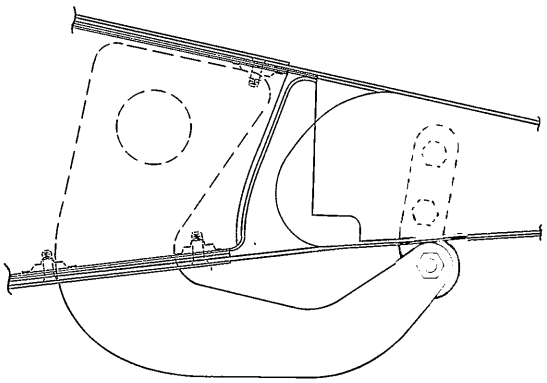
SKETCH C



SKETCH D

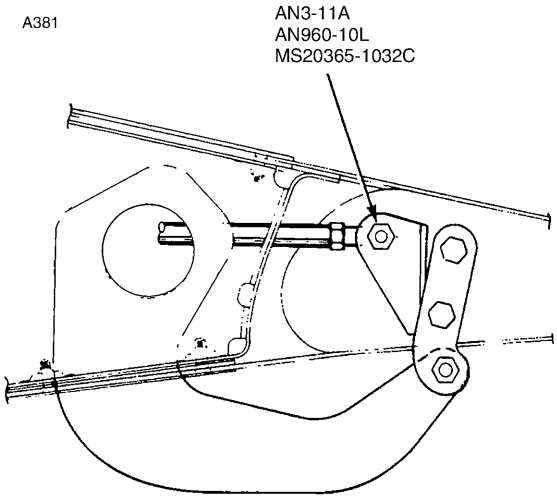
Aileron and Flap Installation
Figure 1 (Sheet 1 of 2)

A380



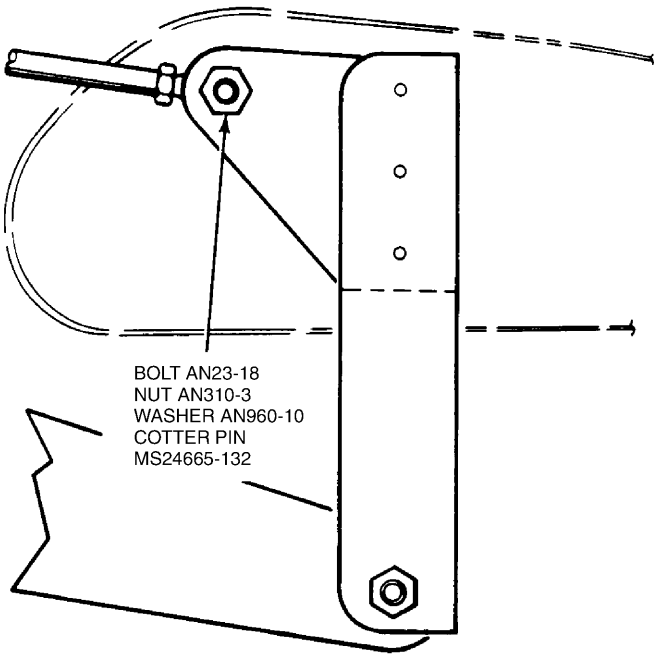
SKETCH E

A381



SKETCH F

A313



SKETCH G

Aileron and Flap Installation
Figure 1 (Sheet 2 of 2)

(c) Calibrate the tool.

1 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.

2 Adjust the movable trailing edge support to fit the width of the control surface. Tighten the set screw on the trailing edge support.

3 Adjust the trailing edge support vertically until the beam is parallel with the control surface chord line.

4 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.

(d) After balancing the tool, reattach it to the control surface per Figure 2. Keep the beam positioned 90° from the control surface hinge line.

(e) Determine balance of control surface by sliding movable weight along the balance beam.

(f) Read the scale when the bubble level has been centered. Multiply by three to determine inch-lbs. (I.E. - Since the movable weight weighs three pounds, every inch it is moved from the center of the beam equals three inch-lbs of force.)

B. Balancing Aileron (See Figure 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 2. If the ailerons are not to be painted, the balance weight will probably require adjustment. All replacement.

(1) Position the aileron on the balancing fixture in a draft free area and in a manner which allows unrestricted movement of the aileron.

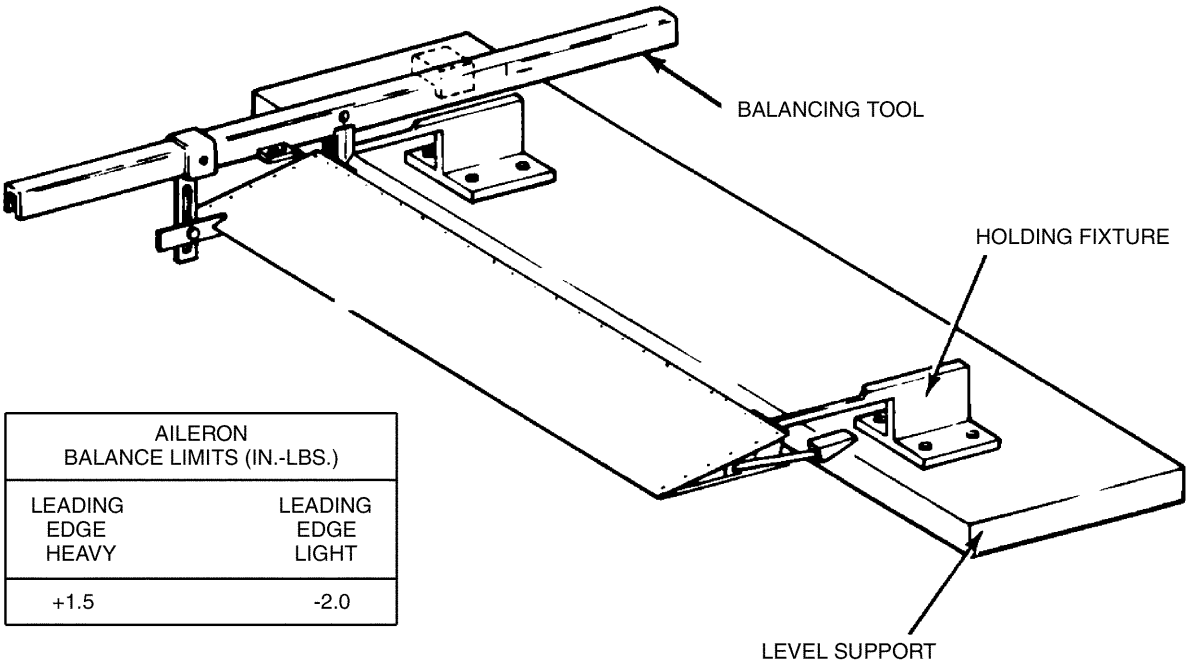
(2) Place the tool on the aileron, avoiding rivets, and keep the beam perpendicular to the hinge centerline.

(3) Read the scale when the bubble level has been centered by adjustment of the movable weight and determine the static balance.

(4) If the static balance is not within the limits specified in Figure 2, proceed as follows:

(a) Leading edge heavy: This condition is highly improbable; recheck measurements and calculations.

(b) 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.



AILERON BALANCE LIMITS (IN.-LBS.)	
LEADING EDGE HEAVY	LEADING EDGE LIGHT
+1.5	-2.0

Balancing Aileron
Figure 2

C. Skin Bead Repair (See Figure 3.)

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS. LIMITED REPAIRS TO CONTROL SURFACE SKINS ARE AUTHORIZED ONLY AS PROVIDED IN THIS MANUAL.

(1) Limitations

NOTE: These repairs are authorized only as a temporary measure until replacement parts (i.e. - skins) can be obtained and installed.

Repair of minor cracks in aileron surface skins only is authorized, but limited as follows:

(a) Cracks of no more that 0.5 inch at the ends of the skin stiffening beads;

(b) No more than two cracks per surface side.

(c) Cracks are limited to either end of a bead (see Figure 3), but not on the same bead;

(d) For wrap-around skins, two crack repairs are acceptable per side, but repairs may not be opposite to one another on opposite sides (i.e. - top and bottom or left and right).

(2) Procedure

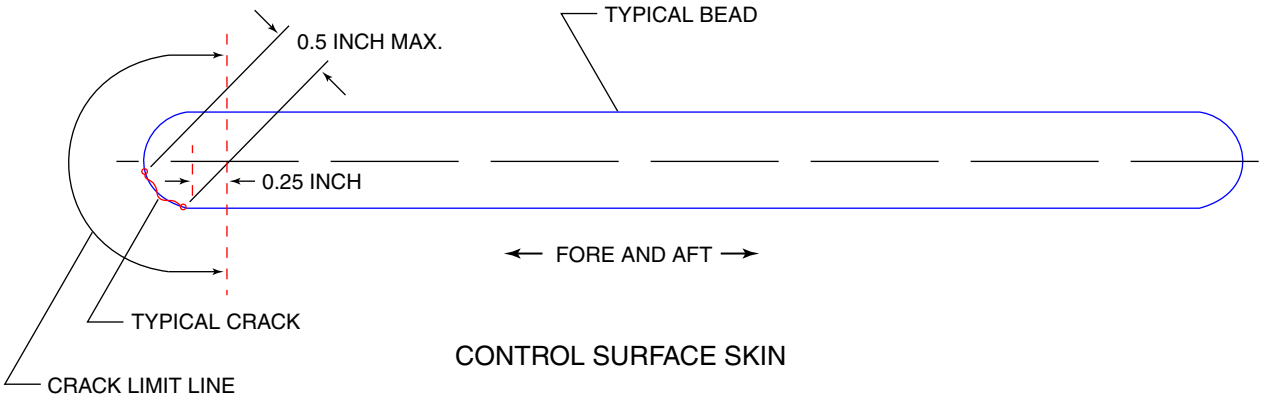
Only cracks confined to the bead end area shown in Figure 3 may be repaired.

(1) Cracks 0.5 inch long or less may be repaired by stop drilling;

(2) Stop drill the extreme ends of the crack with a #50 (0.070) drill.

NOTE: Cracks stop drilled once cannot be stop drilled again, should crack growth continue.

3. Wing Flap (See Figure 1.)



Skin Bead Repair
Figure 3

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBT CRACKS.

A. Removal

(1) Extend the flaps to their fullest degree and remove the bolt and bushing from the rod end bearing.

(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.

B. Installation

(1) Replace the wing flap by placing the flap onto 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 is operating freely. (Refer to 27-50-00, Wing Flap Controls, Rigging and Adjustment.)

GRIDS 5H22 THRU 5H24
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CHAPTER

61

PROPELLERS

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CHAPTER 61

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	2	Mar 15/06			
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	3	Mar 15/06			
	4	Mar 15/06			
	5	Mar 15/06			
	6	Mar 15/06			
61-20-00	1	Mar 15/06			
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CHAPTER 61 - PROPELLERS

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Governor		1	5I13
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PROPELLER ASSEMBLY.

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

Propeller

A. Removal

(1) Insure that the master and magneto switches are off.

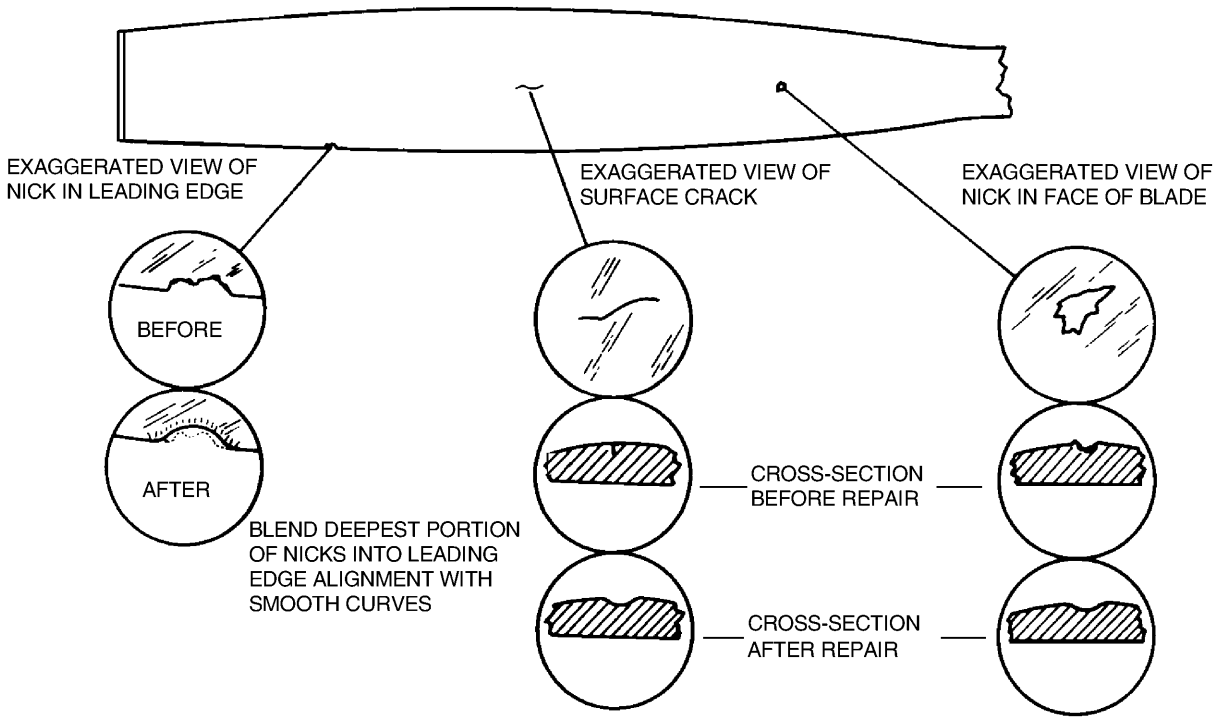
(2) Move fuel selector to off position.

(3) Place the mixture control in idle cut-off.

(4) Note position of each component to facilitate reinstallation.

NOTE: Before removing spinner components, reference each mating part to facilitate in alignment for reassembly.

(5) Remove the screws from around the spinner assembly and remove spinner. (Refer to latest revision of Hartzell Service Instructions No. 118.)



NOTE: RECOMMENDED METHOD FOR REMOVING NICKS, CRACKS, AND SCRATCHES IS BY USING A RIFFLE FILE OR CROCUS CLOTH.

Typical Nicks and Removal Methods
Figure 1

(6) Remove the safety wire from the six propeller nuts on studs and remove studs.

NOTE: Nuts with studs will have to be backed out evenly so that propeller may be pulled forward (approximately 1/4-inch at a time) until all studs are disengaged from the engine crankshaft flange.

(7) Place a drip pan under the propeller to catch oil spillage, then remove the propeller.

B. Installation

(1) Insure master and magneto switches are off.

(2) Place fuel selector to off position.

(3) Place mixture control in idle cut-off.

(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.

(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.

C. Cleaning, Inspection, And Repair

(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 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.

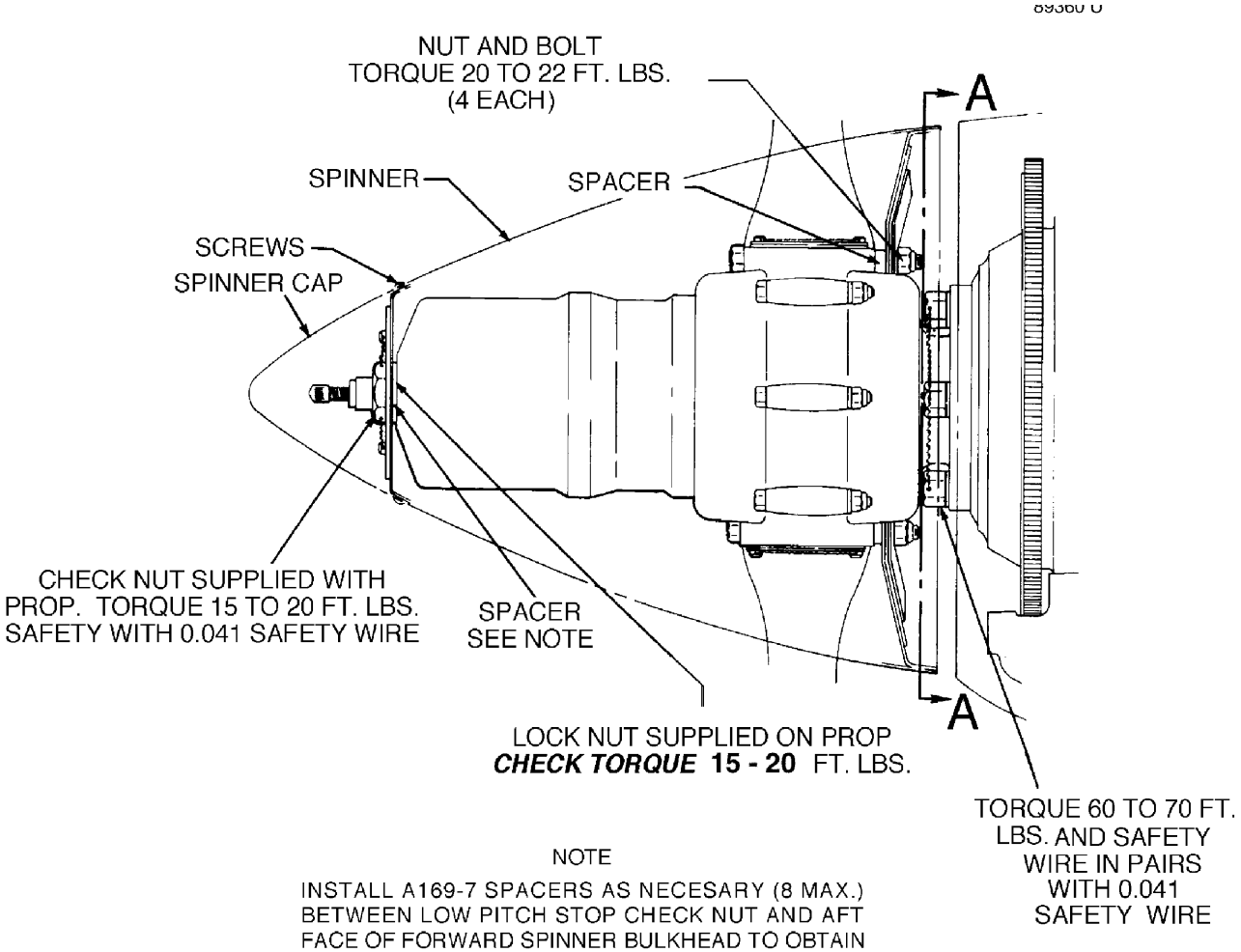
(8) It is recommended that for severe damage, internal repairs and replacement of parts, the propeller should be referred to the Hartzell Factory or an authorized Service Station.

(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.

CHART 1
PROPELLER TORQUE LIMITS

Description	Required Torque (Dry)
Propeller Mounting Nuts	60 - 70 Foot-Pounds
Forward Bulkhead Attachment Bolts	20 - 22 Foot-Pounds
Spinner Attachment Screws	20 - 25 Inch-Pounds



NOTE

INSTALL A169-7 SPACERS AS NECESARY (8 MAX.) BETWEEN LOW PITCH STOP CHECK NUT AND AFT FACE OF FORWARD SPINNER BULKHEAD TO OBTAIN ALIGNMENT OF AFT ATTACHMENT HOLES IN SPINNER WITH HOLES IN AFT SPINNER BULKHEAD.

FOR INFORMATION DEALING WITH THE CHANGING OF THE SPINNER DOME ATTACHING LOCK NUTS, REFER TO THE LATEST REVISION OF HARTZELL SERVICE INSTRUCTIONS NO. 118.

Propeller Installation
Figure 2

C. 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.

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CONTROLLING

1. Propeller Governor

A. Removal

(1) Remove the upper engine cowl.

(2) Disconnect the control rod rod end bearing from the governor control arm.

NOTE: Have a means available to catch oil that will drip from governor when the oil line is disconnected.

(3) Disconnect the governor oil line from the governor.

(4) 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.

(5) Remove the mounting gasket. If another unit not substituted, and the governor is to be removed for a considerable length of time cover, the mounting pad to prevent foreign matter.damage.

B. Installation

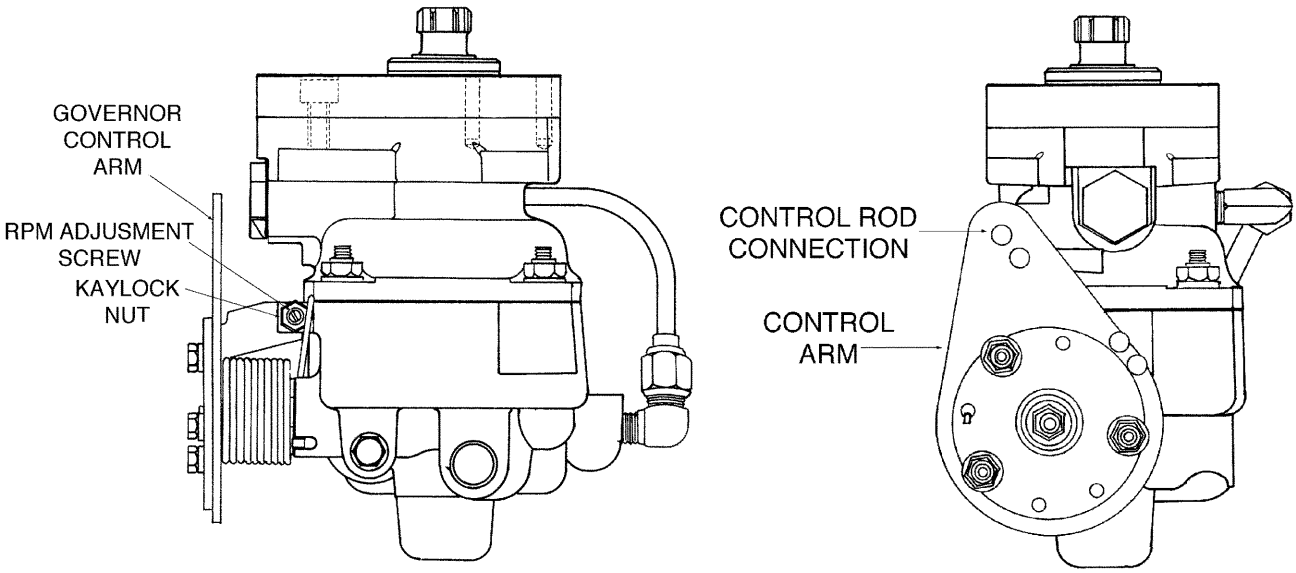
(1) Clean the mounting pad thoroughly. Ensure that there are no foreign particles in the recess around the drive shaft.

(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 rod rod end bearing to the governor control arm.



Propeller Governor
Figure 1

(6) Adjust governor control per the following paragraph.

(7) Install engine cowl.

C. Rigging and Adjustment (See Figure 1.) (PIR-FTP2001-7, Rev. D)

(1) Start engine. Park 90° to wind direction and warm in normal manner.

(2) To check the high rpm, low pitch setting, move the propeller control all the way forward. The governor (speed) control arm should be against the high rpm (fine) adjusting screw. (Refer to Figure 1). With the throttle full forward, engine rpm should be 2650 - 2700 rpm. If not, adjust the high rpm setting as follows:

(a) Shut down the engine. Remove the upper engine cowl.

NOTE: One revolution of the fine adjustment screw will increase or decrease the engine speed approximately 20 rpm.

(b) Using the (fine) adjustment screw, adjust the governor to 2650 - 2700 rpm. Loosen the high rpm (fine adjustment screw) locknut. Turn the screw clockwise to decrease engine speed or counterclockwise to increase engine speed.

(c) Install upper engine cowl. Repeat step b to ensure proper rpm setting.

(d) After completing the high rpm adjustment, run the self-locking nut on the fine adjustment screw against the base projection to lock.

(e) Check that the governor control arm is adjusted to the proper angle on the control wheel as shown in Figure 1.

(f). After completion of the high rpm adjustment, adjust the control system 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. 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. Connect the cable end and tighten jam nut.

(g) It is only necessary to adjust the governor control system high rpm setting. This action automatically satisfies the positive high pitch setting.

2. Propeller Unfeathering System

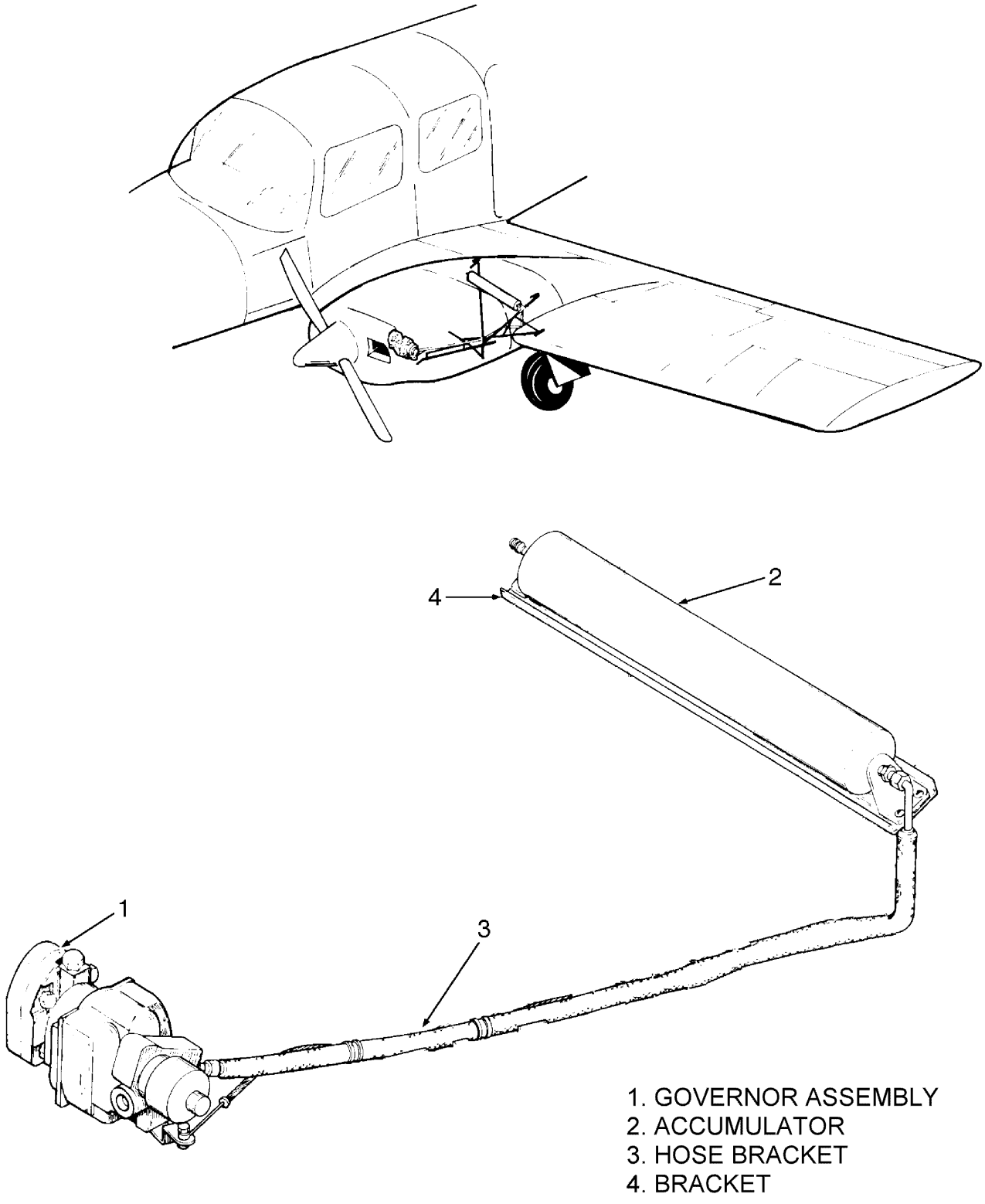
The optional propeller unfeathering system provides a means for storing air and oil pressure in an accumulator so that the propeller may be moved out of the feathered position when so desired. Refer to the Pilot's Operating Handbook for proper operating procedures.

3. Accumulator Service

WARNING: WHEN REMOVING THE UNIT FROM THE AIRPLANE, COMPLETELY DISCHARGE ALL NITROGEN PRESSURE BEFORE DISCONNECTING THE OIL LINE.

This is a free piston type accumulator that 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. Refer to the Pilot's Operating Handbook for proper operational check procedure.



Propeller Unfeathering System
Figure 2

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STANDARD PRACTICES - ENGINE

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CHAPTER 70

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CHAPTER 70 - STANDARD PRACTICES - ENGINE

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GENERAL

Standard Practices

Review the following suggestions before working on the power plant.

A. To insure proper reinstallation and/or assembly, tag and mark all parts, clips, and brackets as to their location prior to their removal and/or disassembly.

NOTE: Use tags or temporary marking methods which are durable enough to ensure identification during ordinary handling, storage and final assembly of parts.

B. During removal of various tubes or engine parts, inspect them for indications of scoring, burning or other undesirable conditions. To facilitate reinstallation, observe the location of each part during removal. Tag any unserviceable part and/or units for investigation and possible repair.

C. Extreme care must be taken to prevent foreign matter from entering the engine, such as lockwire, washers, nuts, dirt, dust, etc. This precaution applies whenever work is done on the engine, either on or off the aircraft. Suitable protective caps, plugs, and covers must be used to protect all openings as they are exposed.

NOTE: Dust caps used to protect open lines must always be installed OVER the tube ends and NOT IN the tube ends. Flow through the lines may be blocked off if lines are inadvertently installed with dust caps in the tube ends.

D. Should any items be dropped into the engine, the assembly process must stop and the item removed, even though this may require considerable time and labor. Insure that all parts are thoroughly clean before assembling.

E. Never reuse any lockwire, lockwashers, tablocks, tabwashers or cotter pins. All lockwire and cotter pins must fit snugly in holes drilled in studs and bolts for locking purposes. Cotter pins should be installed so the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Use only corrosion resistant steel lockwire and/or cotter pins. Bushing plugs shall be lockwired to the assembly base or case. Do not lockwire the plug to the bushing.

F. All gaskets, packings and rubber parts must be replaced with new items of the same type at reassembly. Insure the new nonmetallic parts being installed show no sign of having deteriorated in storage.

G. When installing engine parts which require the use of a hammer to facilitate assembly or installation, use only a plastic or rawhide hammer.

CAUTION: ENSURE THAT ANTI-SEIZE COMPOUNDS ARE APPLIED IN THIN EVEN COATS, AND THAT EXCESS COMPOUND IS COMPLETELY REMOVED TO AVOID CONTAMINATION OF ADJACENT PARTS.

H. Anti-seize lubrication should be applied to all loose-fit spline drives which are external to the engine and have no other means of lubrication. For certain assembly procedures, molybdenum disulfide in either paste or powdered form mixed with engine oil or grease may be used.

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CHAPTER

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POWER PLANT

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CHAPTER 71 - POWER PLANT

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GENERAL

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

1. Description

O-360-A1H6 (left) and LO-360-A1H6 (right) Textron Lycoming four cylinder, horizontally opposed, engines rated at 180 horsepower each are installed. See Chapter 6, Leading Particulars, for engine operating limits.

CAUTION: TO ENSURE ADEQUATE OUTFLOW THROUGH OIL BREATHER TUBE ON -AIH6 ENGINES, DO NOT PERMIT CUTOUT IN SHROUD AROUND BREATHER VENT HOLES TO BECOME BLOCKED.

The A1H6 model engines have the oil breather pipe wrapped in a sheath to decrease the probability of condensation freezing and blocking the pipe during winter operations. (Refer to Figure 1.)

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.

The magnetos are Slick 4300 Series. These are installed two per engine as left and right magnetos with individual drives. The left magneto on each engine incorporates an impulse coupling to provide ignition at engine cranking speed. (Refer to 74-10-00 for detailed information.)

2. Troubleshooting

WARNING: GROUND THE MAGNETO PRIMARY CIRCUIT BEFORE PERFORMING ANY CHECKS OF THE ENGINE.

Troubles peculiar to the power plant are listed in Chart 1 along with their probable causes and suggested remedies.

CHART 1 (Sheet 1 of 4)
TROUBLESHOOTING POWERPLANT

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.
	Insufficient fuel pressure.	Adjust fuel pressure.
	Fouled spark plugs.	Clean or replace plugs.

CHART 1 (Sheet 2 of 4)
TROUBLESHOOTING POWERPLANT

Trouble	Cause	Remedy
Failure of engine to idle properly (cont.)	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.
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.
Failure of engine to develop full power.	Leak in the induction system.	Tighten all connections and replace defective parts.
	Throttle lever out of adjustment	Adjust throttle lever.
	Improper fuel flow.	Check strainer, gauge and flow at the fuel inlet.
	Restriction in air induction.	Examine air intakes and remove restrictions.
	Improper fuel.	Drain and refill tank with recommended fuel.

CHART 1 (Sheet 3 of 4)
TROUBLESHOOTING POWERPLANT

Trouble	Cause	Remedy
Failure of engine to develop full power.	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.
Rough engine.	Cracked engine mount. Defective mounting bushings.	Replace or repair mount. Install new mounting bushings.
	Uneven compression.	Check compression.
Low oil pressure.	Insufficient oil.	Fill sump with recommended oil.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line	Check gasket between accessory housing and crankcase.
	Dirty oil strainers.	Remove and clean oil strainers.
	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	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
	Failing or failed bearing.	Examine sump for metal particles. If found, overhaul engine.
	Defective temperature gauge.	Replace gauge.
	Defective oil cooler lines.	Check inside of oil lines for obstruction flush out lines and oil cooler.

CHART 1 (Sheet 4 of 4)
TROUBLESHOOTING POWERPLANT

Trouble	Cause	Remedy
Excessive oil consumption.	Low grade of oil.	Fill with oil conforming to specifications.
	Failing or failed bearings.	Check sump for metal particles.
	Worn piston rings.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.
	Failure of rings to seat (new nitrided cylinders)	Use mineral base oil. Climb to cruise altitude at full power and operate at 75% cruise power setting with high oil temperature until oil consumption stabilizes.
	Leaking or damaged oil lines.	Replace item.
Poor acceleration.	Idle mixture too lean.	Readjust mixture.
	Incorrect fuel air mixture.	Service carburetor.
	Worn control linkage or restricted air cleaner.	Tighten loose connections; and/or service air cleaner.
	Ignition defective.	Check ignition cables, plugs, timing and magnetos.
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.

3. Powerplant

A. Removal (See Figure 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 cowlings. (See 71-10-00.)

(4) Remove the propellers per Propeller, Removal, 61-10-00. 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.

(6) Remove the engine 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 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.

(8) Remove the "P" leads at the magnetos. Install a cap or protective cover over each of the distributor blocks openings.

(9) Disconnect the oil temperature lead at the top aft end of the engine and make sure it is clear of the engine at removal.

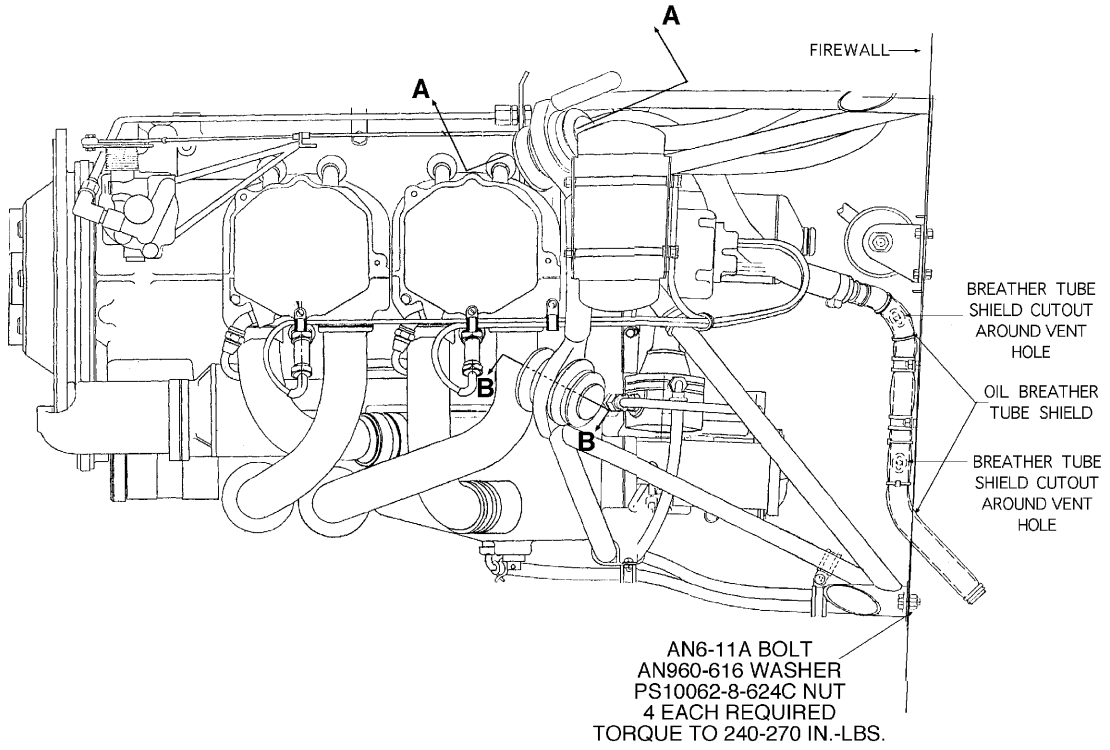
(10) Unscrew the tachometer cable out of the back of the engine and move clear for removal.

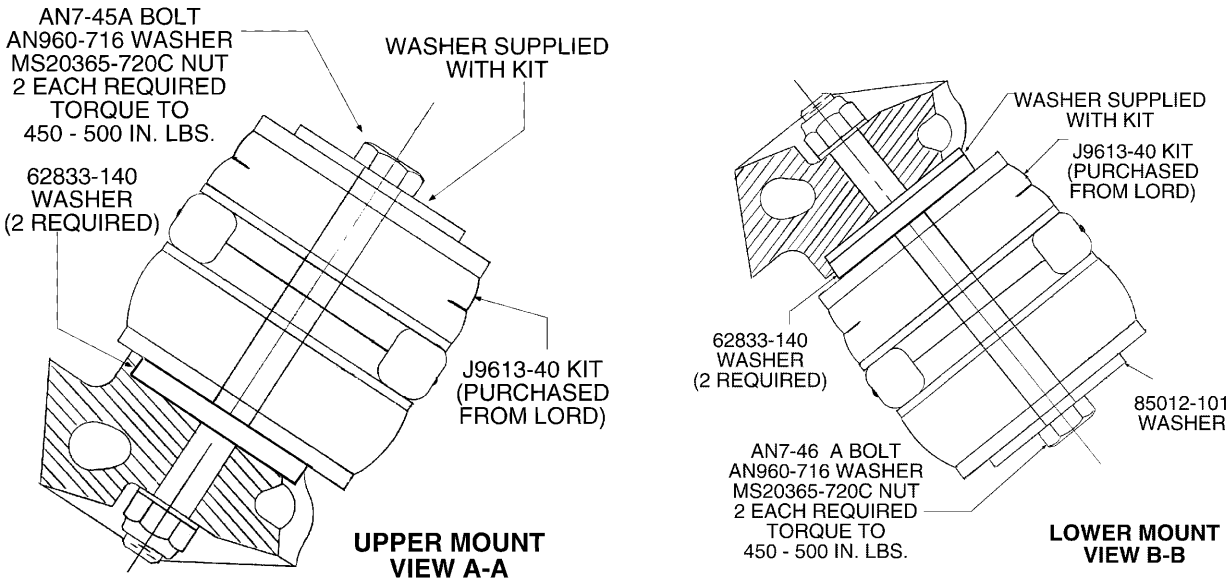
(11) Disconnect the vacuum lines from the pump. and if tied to any item being removed with the engine release the line.

(12) Disconnect the oil breather tube from the back of the engine and make sure it is held clear of the engine.

(13) Disconnect the alternator leads, their cable attachments and move them clear of the engine.

(14) If desired, drain the oil from the engine.





Engine Installation
Figure 1

(15) Remove the lifting lugs from the left side of the nose gear well, just aft of the starter solenoids.

(16) Attach a half ton (minimum) hoist to the lifting lugs using a strap arrangement.

(17) 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.

(18) Up-load the hoist just enough to take the weight off the mounts and remove the four engine mount assemblies.

(19) 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. Be careful not to damage any attached assemblies.

B. Installation (See Figure 1.)

(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 as specified in 71-20-00.

(3) Connect the alternator leads and secure cables with clamps.

(4) Connect the oil pressure line, tachometer drive cable, oil temperature lead and the oil breather 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 prop control cable to the governor.

(11) Connect the throttle, mixture and carburetor heat cable. Reinstall the carburetor, if previously removed.

(12) Connect the primer system hose to the tee fitting at the rear of the engine.

(13) Connect the starter positive and ground leads at the starter and secure with attachment clamps.

(14) Be certain that the magneto switches are OFF and install the propeller. See Propeller, Installation, 61-10-00.

(15) Install the proper grade and amount of engine oil. See 12-10-00.

(16) Connect the battery ground wire at the battery.

(17) Open the throttle and fuel valve completely. Turn on the electric fuel pump and check the fuel line for leaks.

(18) Install the engine cowlings and remove the tail stand. Make sure the appropriate drains are installed.

NOTE: To avoid possible high speed bearing failure resulting from a lack of lubrication during initial starts, the engine should be pre-oiled in accordance with the latest revision of Lycoming Service Instruction No. 1241.

NOTE: Do not lubricate engine control cables.

(19) Install the proper grade and amount of engine oil.

(20) Turn on the fuel valve; open the throttle full and turn on the electric fuel pump. Check the fuel lines for leaks.

(20) Perform an engine operational check.

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COWLING

1. Cowling

The cowling consists of an upper and lower section and a nose section. A cowling flap is an integral part of the lower cowling.

A. Removal (See Figure 1.)

(1) Remove the fasteners securing the top cowling and remove the cowling.

(2) Disconnect the cowling flap control.

(3) Support the bottom cowling and remove the screws that attach the cowling to nose cowling, engine mount and nacelle.

(4) The nose cowling may be removed by removing the attaching screws and separating the two cowling halves.

B. Installation (See Figure 2.)

(1) Install the nose cowling by placing the two halves in position and inserting the attaching screws.

(2) Position the bottom cowling and support it while inserting the screws that attach the cowling to nose cowling, engine mount and nacelle.

(3) Connect the cowling flap control.

(4) Position the top cowling and install the fasteners.

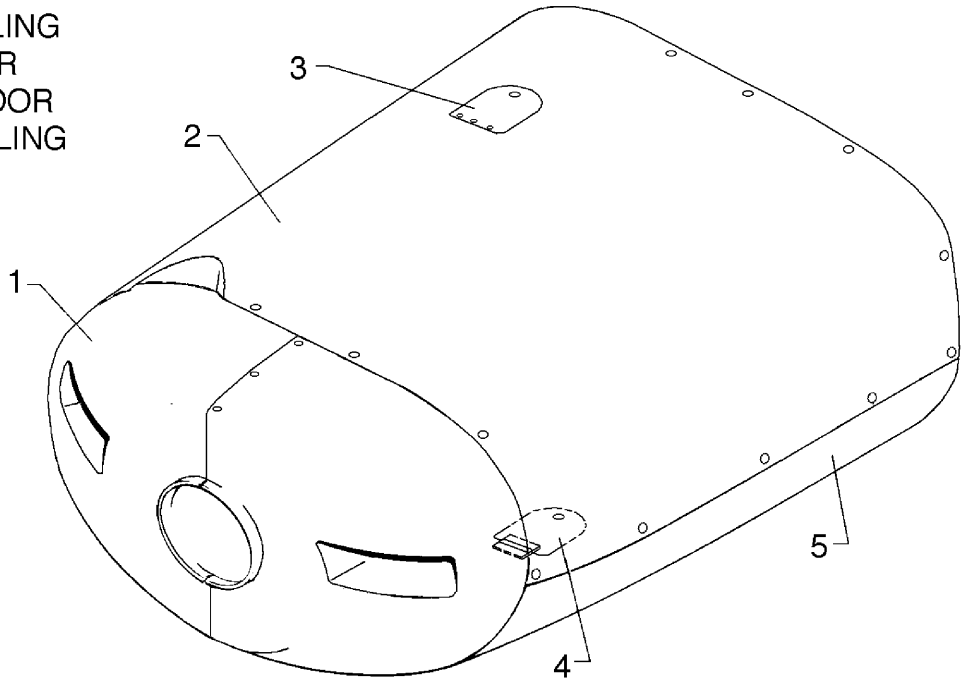
C. Cleaning, Inspection and Repair

(1) The cowling should be cleaned with a suitable solvent then wiped with a clean cloth.

(2) Inspect the cowlinging for dents, cracks, loose rivets, damaged or missing fasteners and damaged fiberglass areas.

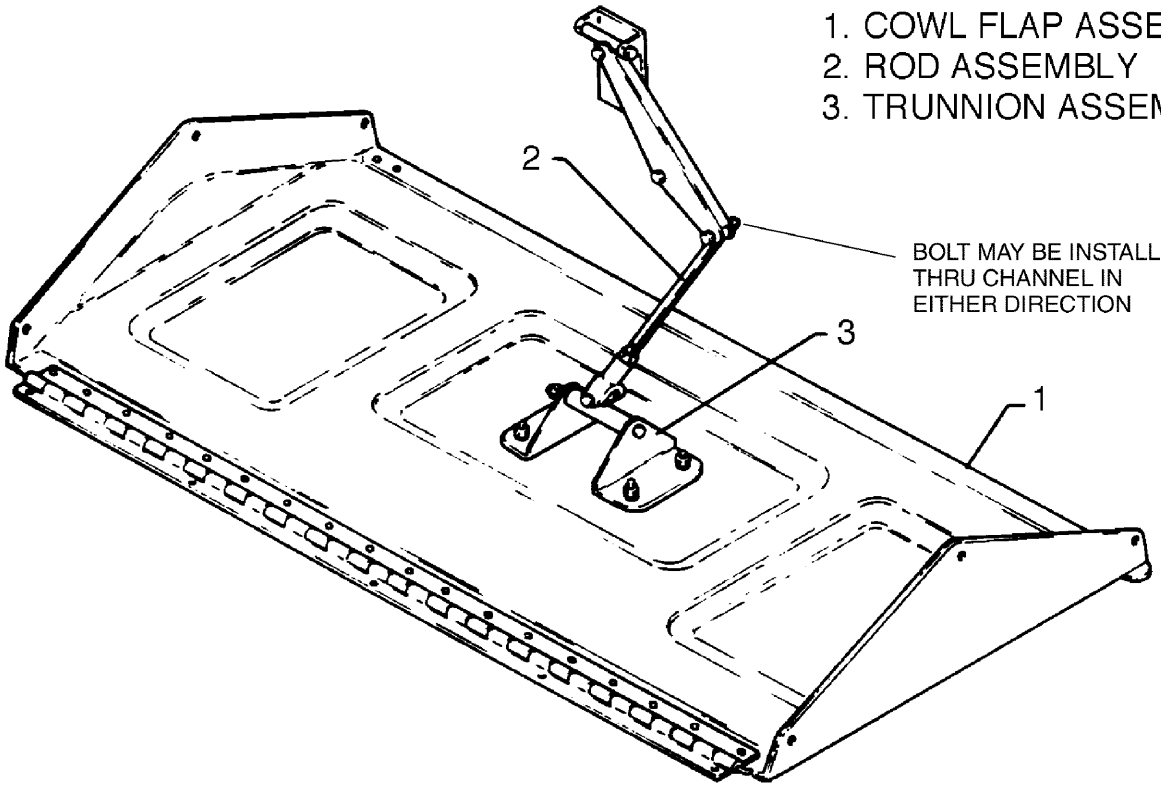
(3) Repair all defects to prevent further damage. Fiberglass repair procedures are in 51-70-00.

1. NOSE BOWL
2. UPPER COWLING
3. OIL FILL DOOR
4. OIL DRAIN DOOR
5. LOWER COWLING



Engine Cowling Installation
Figure 1

1. COWL FLAP ASSEMBLY
2. ROD ASSEMBLY
3. TRUNNION ASSEMBLY



Cowl Flap Installation
Figure 2

2. Engine Cowl Flaps (See Figure 2.)

The cowl flaps are all metal flaps located on the rear of the bottom cowls. The flaps are manually operated through a push-pull control from the cockpit. The cowl flaps are connected to the engine cowls with full length piano type hinges.

Operation and Adjustment

The cowl flaps are all metal flaps located on the rear of the bottom cowls. 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.

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MOUNTS

1. Engine Shock Mounts

   Installation (See 71-00-00, Figure 1.)

   (1) Assemble the engine shock mounts on the engine mount as shown in 71-00-00, Figure 1. Note the position of each mount carefully.

   (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.

2. Engine Mount 100 Hour Inspection

   In S/N's 4496001 thru 4496025, for airplanes which have not installed new engine mounts P/N 89361-002 or engine mount gussets P/N's 100558-004 and 100558-005, each 100 hours inspect the engine mounts as follows:

   A. Remove left and right engine upper cowlings per 71-10-00, and locate the upper left hand engine mount flexible isolator.

   B. Inspect the left and right engine mounts at a point just aft of the flexible isolator along the mount tube. Use a 10x power magnifying glass and examine all around the tube for evidence of cracks. If paint is chipped or peeling in this area, remove the paint and perform a dye penetrant inspection. (See Figure 1.)

   C. If a crack appears in the tube at any point, the engine mount must be replaced before further flight.

   D. If no cracks are found, reinstall components removed, repaint any area cleaned for dye penetrant inspection, and return airplane to service.

   E. At any engine removal, install engine mount gussets as described below or replace engine mount.

      NOTE: Installing new engine mounts P/N 89361-002 or engine mount gussets P/N's 100558-004 and 100558-005 will relieve the repetitive inspection requirement.

   F. Make an appropriate logbook entry.

3. Engine Mount Gusset Installation

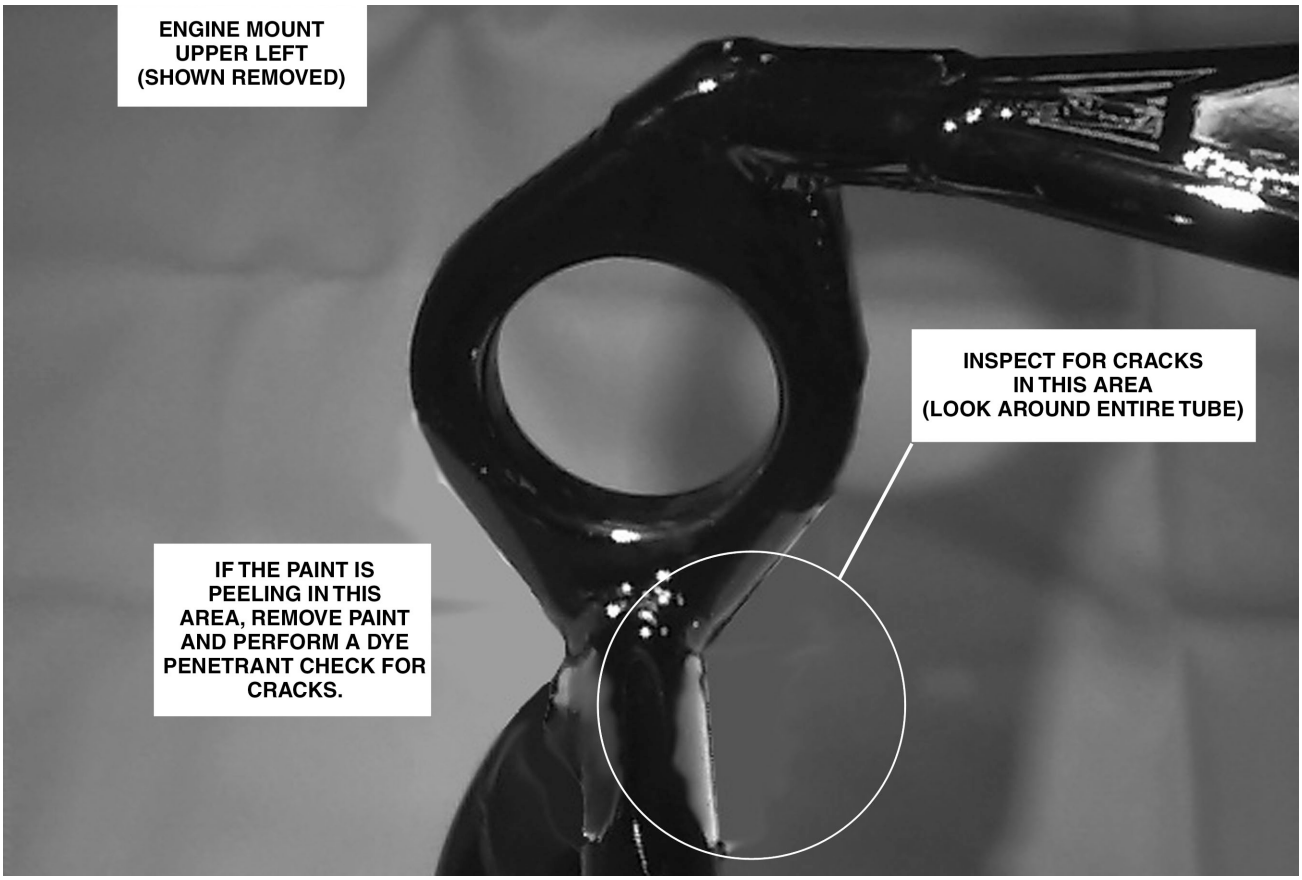
   In S/N's 4496001 thru 4496025, for airplanes which have not installed new engine mounts P/N 89361-002 or engine mount gussets P/N's 100558-004 and 100558-005, engine mount gussets can be installed as follows:

   A. If either the right or left engine is removed from the aircraft for any reason including overhaul, installation of additional gussets are required prior to returning aircraft to service. Do not modify or install engine mounts that have cracks or that are unairworthy in any other manner. Refer to Figures 2, 3, 4 and 5 for the installation of these gussets.

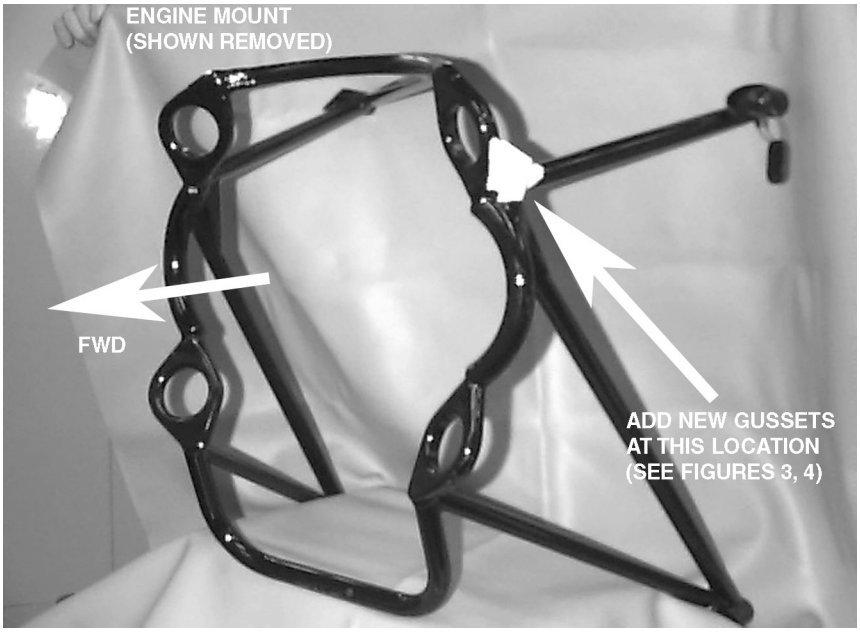
      NOTE: It is permissible to do one engine mount at a time should a single engine be removed prior to the other. If engines are being overhauled both engine mounts must be done.

   B. Prepare the engine mount for welding in the affected area by cleaning throughly and removing paint.

      NOTE: Do one last dye penetrant check for cracks prior to welding in the new gussets.



Engine Mount Inspection
Figure 1



Engine Mount Modification Location
Figure 2

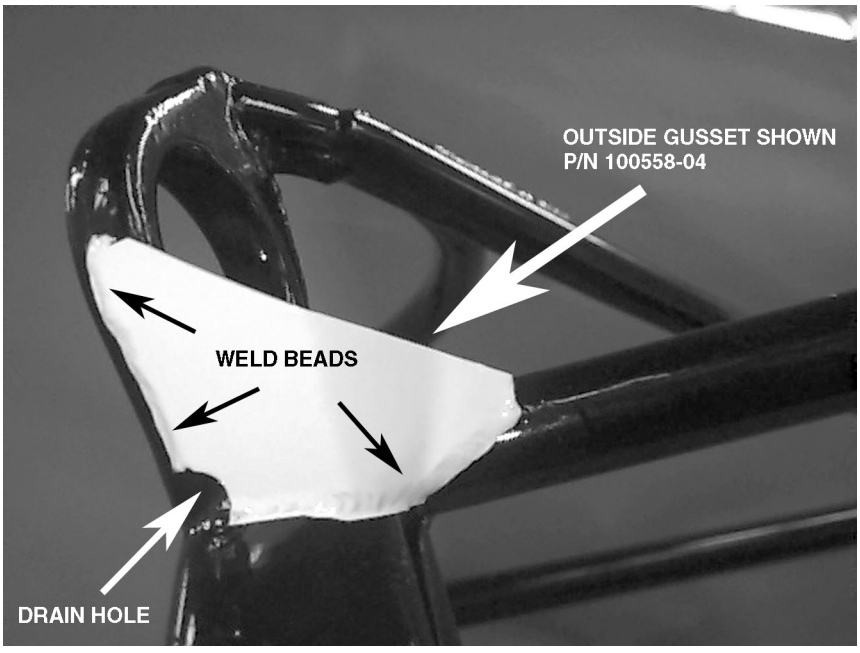
C. Utilizing qualified technical personnel and standard welding techniques, install the outside gusset. P/N 100558-04, as shown in Figure 2. Install the inside gusset, P/N 100558-05, as shown in Figure 3. The gussets will fit approximately as shown and does not need an exact measurement. Weld bead should extend to the cut out for the drain. Do not weld drain cut out area closed.

NOTE: Degauss the engine mount after welding to assure no residual magnetism is retained.

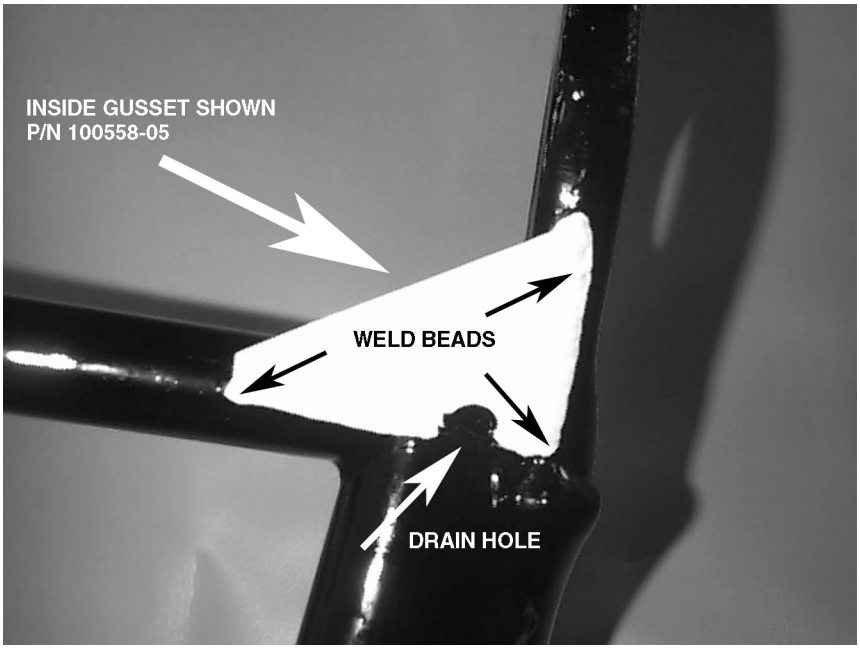
D. Clean, prime and paint the mount and gussets as required. The engine mount may not be returned to service.

CAUTION: AS THE ENGINE MAY HAVE BEEN REMOVED FOR A NUMBER OF REASONS, IT IS THE RESPONSIBILITY OF THE INSTALLATION AGENT TO ASSURE THE PROPER RE-INSTALLATION, FUNCTIONAL CHECKS, AND OPERATIONAL SUITABILITY OF THE ENGINE PRIOR TO RETURNING THE AIRCRAFT TO SERVICE. REFER TO THE APPLICABLE ENGINE MANUFACTURER'S MAINTENANCE MANUALS AS WELL AS THE PIPER MAINTENANCE MANUAL IN THE APPROPRIATE CHAPTERS AS REQUIRED.

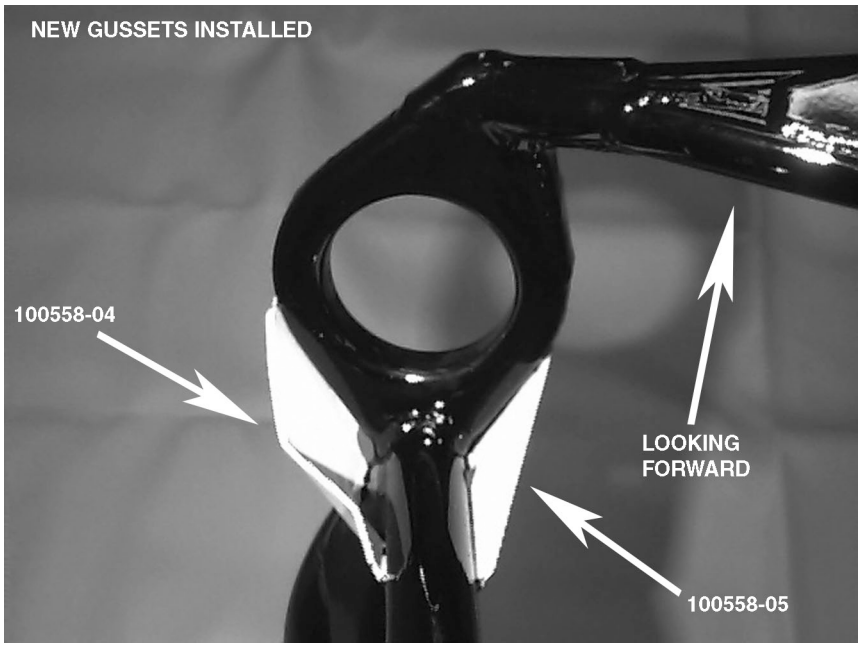
E. Make the appropriate logbook entry.



Outside Gusset Installation
Figure 3



Inside Gusset Installation
Figure 4



Completed Gusset Installation
Figure 5

4. Engine Mount Corrosion Inspection, Immersion in Water

The following guidance is general in nature and should be applied or varied to fit the individual situation based on water level during immersion, length of time immersed, length of time since exposure, etc. Proceed as follows:

A. Inspection

(1) Level the aircraft in accordance with 8-20-00.

(2) In the two lower, larger tubes; drill a 3/16 inch hole in each tube, at the approximate mid-point.

(3) Visually inspect the interior surface of each tube through the 3/16 inch hole for evidence of internal corrosion.

(4) Should evidence of corrosion be detected in step (3), above, replace the engine mount. If no corrosion is detected, proceed with corrosion prevention, below.

B. Corrosion Prevention

If no evidence of corrosion is detected above, proceed as follows:

(1) Place a drip pan below the inspection holes in each engine mount tube.

(2) Insert a plastic tube thru each inspection hole and feed it up to the high point of the engine mount tube.

(3) Using a syringe inserted into the end of the plastic tube, pump linseed oil into the upper end of the engine mount tube while rotating the syringe/plastic tube assembly to assure maximum coverage. Continue pumping until the lower end of the engine mount tube is filled with linseed oil to the level of the inspection hole.

(4) Now, draw the plastic tube out of the upper end of the engine mount tube and reinsert it in the opposite direction, feeding it to the lower end of the engine mount tube.

(5) Suck excess linseed oil out of the engine mount tube with the syringe/plastic tube assembly.

(6) When linseed oil can no longer be picked up by the syringe/plastic tube assembly, remove it and allow the engine mount tube to drain into drip pans for approximately two hours.

(7) Purge excess oil from tubes by applying air pressure to each 3/16 inch inspection hole, one at a time.

(8) Insure that roughly the same amount of linseed oil that was pumped in is retrieved in the drip pans.

(9) Apply a liberal coating of an approved fuel tank sealant (see List of Consumables, 91-00-00) to each inspection hole and seal the hole with an appropriate blind rivet. After installing the rivet, apply a liberal coating of the approved fuel tank sealant over the head of the rivet.

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AIR INTAKES

1. Induction System (See Figure 1.)

   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.

2. Air Filter Housing

   A. Removal

      (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.

   B. Installation

      (1) With the housing upheld, install the bolts to the housing support bracket that attaches it to the engine mount.

      (2) Install the bolts and washer that mount the housing to the firewall.

      (3) Move the clamps retaining the ducts to the filter housing into place and tighten.

      (4) Install the air filter and position the cover of the filter housing.

      (5) Install both the top and bottom cowlings per 71-10-00.

3. Carburetor Air Box

   A. Removal

      (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.

   B. Installation

      (1) Install the four bolts securing the assembly to the carburetor and secure with safety wire.

      (2) Install the back of the air box and flapper valve assembly.

      (3) Insert 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) Move the clamps on the duct tubes over the air box inlets and tighten.

      (5) Replace the bottom cowl per 71-10-00. Connect the cable to the flutter valve arm.

C. Inspection

(1) Remove the back of the air box and flapper valve assembly. Lubricate the shaft with lubriplate as necessary.

(2) 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.

(3) Remove the safety wire and follow with the four bolts securing the assembly to the carburetor.

(4) With the assembly removed inspect the box for cracks and proper sealing.

D. Control Adjustment

Adjust the carburetor heat control as follows:

(1) Position the air box valve in the full cold position and the cockpit control 0.16 inch below the cold detent.

(2) The air box valve must be in the full heat position when the cockpit control is in the hot position.

NOTE: Do not lubricate engine control cables.

4. Carburetor Heat Shroud

Carburetor heat is supplied by a duct interconnected with a shroud mounted to the cylinder No. 4 exhaust manifold.

A. Removal

(1) Remove the bottom cowl per 71-10-00.

(2) 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.

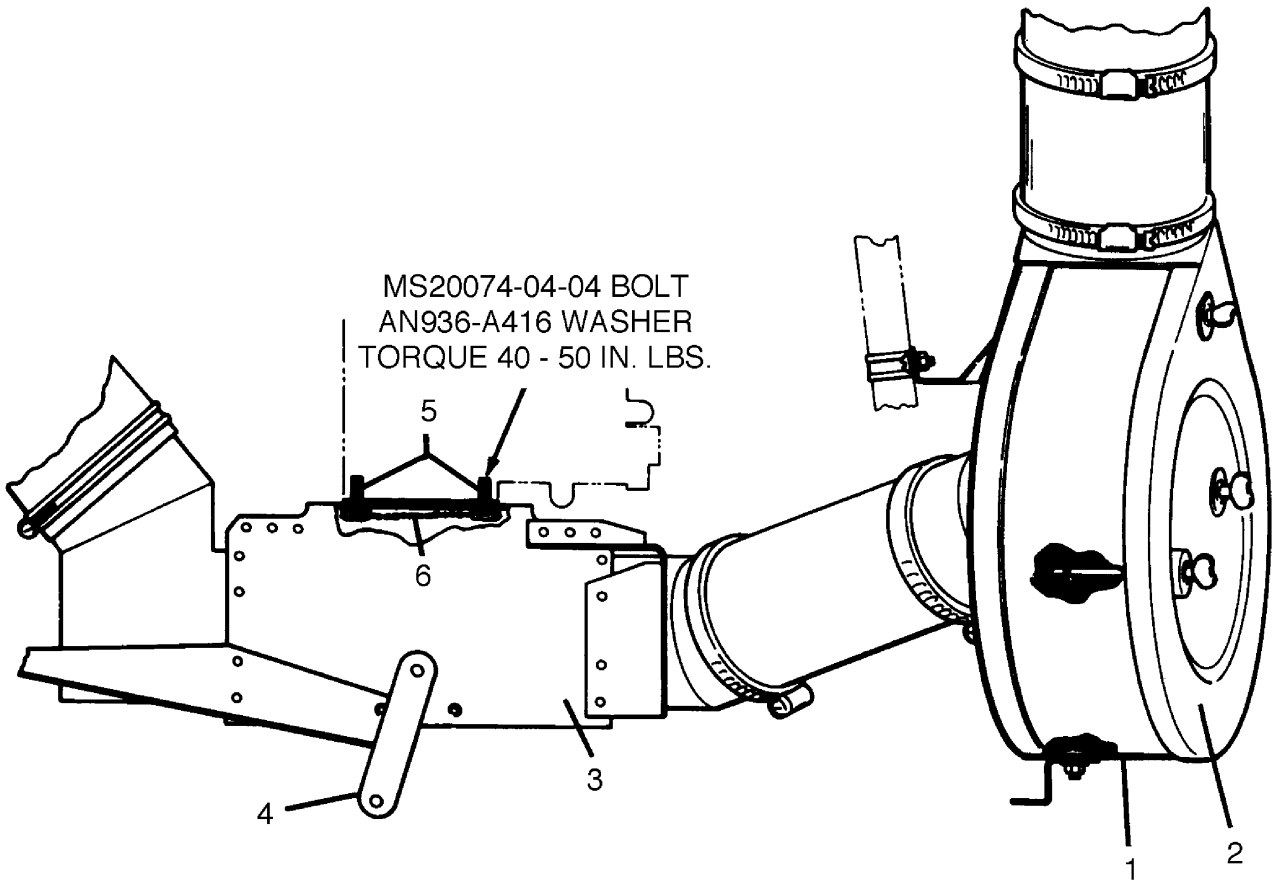
B. Installation

(1) Attach the bolts securing the shroud to the exhaust stack.

(2) Place the outboard shell of the shroud on the main shroud support and attach with screws.

(3) Install the clamps retaining it to the air box and shroud fixtures.

(4) Install the bottom cowl per 71-10-00.



1. AIR FILTER BOX
2. AIR FILTER
3. CARBURETOR AIR BOX
4. AIR CONTROL ARM
5. MOUNTING BOLTS
6 . 0.032 DIA. SAFETY WIRE

Induction System
Figure 1

GRIDS 5K8 THRU 5L24
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AIRPLANE MAINTENANCE MANUAL

CARD 6 OF 7

PA-44-180



(S/N's 4496001 & UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-892

March 15, 2006

Published by
Technical Publications

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Member
General Aviation
Manufacturers Association

THE NEW PIPER AIRCRAFT, INC.
PA-44-180, SEMINOLE
MAINTENANCE MANUAL

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-882) originally published March 1, 1998 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG970401	April 1, 1997	1, 2, 3, and 4
PR020228	February 28, 2002	1, 3, and 4
PR021206	December 6, 2002	2
CR060315 *	March 15, 2006	1, 2, 3, 4, 5, 6 and 7

*** COMPLETE REVISION OF MAINTENANCE MANUAL 761-892**

Revisions appear in all seven Aerofiche Cards. Accordingly, discard your entire existing Aerofiche Card set and replace it with this one dated 03/15/06.

Consult the Piper Customer Service Information Aerofiche (P/N 1753-755) for current revision dates for this manual.

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INTRODUCTION

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
Intro-List of Effective Pages	1	Mar 15/06			
	2	Mar 15/06			
Intro-Table of Contents	1	Mar 15/06			
	2	Mar 15/06			
Introduction	1	Mar 15/06			
	2	Mar 15/06			
	3	Mar 15/06			
	4	Mar 15/06			
	5	Mar 15/06			
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	7	Mar 15/06			
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INTRODUCTION

1. Instructions for Continued Airworthiness

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

The PIPER PA-44-180 Seminole Maintenance Manual constitutes the Instructions for Continued Airworthiness in accordance with Federal Aviation Regulations (FAR) Part 23, Appendix G. Chapter 4 contains the Airworthiness Limitations section (4-00-00) and the Inspection Program is in Chapter 5 (5-20-00).

2. General

This publication is prepared in accordance with the General Aviation Manufacturers Association (GAMA) Specification No. 2, with respect to the arrangement and content of the System/Chapters within the designated Chapter/Section-numbering system.

WARNING: USE ONLY GENUINE PIPER AIRCRAFT PARTS OR PIPER AIRCRAFT APPROVED PARTS OBTAINED FROM PIPER APPROVED SOURCES, IN CONNECTION WITH THE MAINTENANCE AND REPAIR OF PIPER AIRPLANES.

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-44-180 Parts Catalog P/N 761-891, and FAR 43 for proper utilization.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

THE NEW PIPER AIRCRAFT, INC. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: THE NEW PIPER AIRCRAFT, INC. expressly reserves the right to supersede, cancel and/or declare obsolete any part, part numbers, kits or publication that may be referenced in this manual without prior notice.

In any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence.

3. Effectivity

This maintenance manual is effective for PA-44-180 Seminole airplanes serial numbers 4496001 and up.

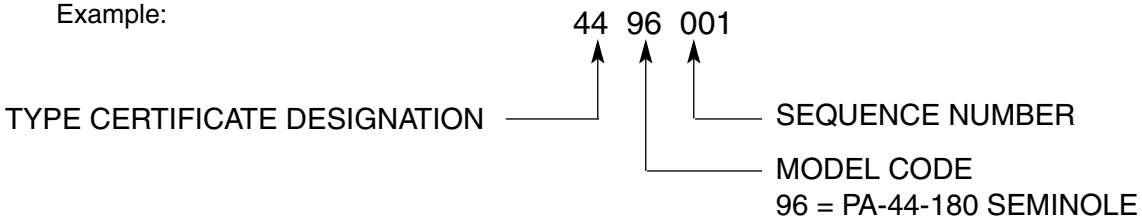
This encompasses the following model years:

NOTE: The following is provided as a general reference only.

Model Year	Serial Numbers
1995	4496001 thru 4496005
1996	4496006 thru 4496013
1997	4496014 thru 4496023; less 4496020
1999	4496024 thru 4496030; and 4496020
2000	4496031 thru 4496042
2001	4496043 thru 4496108
2002	4496109 thru 4496168
2003	4496169 thru 4496179
2004	4496180 thru 4496190
2005	4496191 thru 4496219
2006	4494220 and up

4. Serial Number Explanation

Example:



5. Assignment of Subject Material

This publication is divided into industry standard, three element, numeric subject groupings as follows:

A. System/Chapter - The various groups are broken down into major systems such as Environmental Systems, Electrical Power, Landing Gear, etc. They are assigned a number, which becomes the first element of the standardized numbering system. Thus, the element “28” of the number 28-40-01 refers to the chapter “Fuel”. Everything concerning the fuel system will be covered in this chapter.

B. Sub-System/Section - The major systems/chapters of an airplane are broken down into subsystems. These sub-systems are identified by the second element of the standard numbering system. The element “40” of the number 28-40-01 concerns itself with the indicating section of the fuel system.

C. Unit/Subject - The individual units within a sub-system/section may be identified by the third element of the standard numbering system. The element “01” of the number 28-40-01 is a subject designator. This element is assigned at the option of the manufacturer and is normally zeroed out by PIPER.

Refer to paragraph 14, Chapter/Section Index Guide, for a complete breakdown and list. The material is arranged in ascending numerical sequence.

6. Pagination

The Chapter - Section (i.e. - 28-40-00) numbering system (explained above) forms the primary page numbering system for this manual. Within each Section, pages are numbered consecutively beginning with Page 1 (i.e. - 28-40-00, Page 1). Additionally, the aerofiche grid numbering system (explained below) is also used to indicate location within the manual.

7. Aerofiche Effectivity

A. The General Aviation Manufacturers Association (GAMA) have developed specifications for microfiche reproduction of aircraft publications. 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. The “Aerofiche Effectivity” page at the front of this manual lists the current revision for each card in this set.

B. Conversion of Aerofiche alpha/numeric grid code numbers:

First number is the Aerofiche card number.
Letter is the horizontal row reference per card
Second number is the vertical column reference per card.

Example: 2J16 = Aerofiche card number two, row J, column 16.

C. To aid in locating information, the following is provided at the beginning of each aerofiche card:

(1) A complete Introduction containing the Chapter/Section Index Guide for all fiche in this set.

(2) A complete subject Index for all fiche in this set.

8. Identifying Revised Material

A revision to a page is defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a vertical line (i. e. - change bar) along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A change bar in the left-hand margin opposite the footer (i.e. - chapter/section/subject, page number and date), indicates that the text was unchanged but the material was relocated to a different page.



Example.

NOTE: Change bars are not used in the title pages, list of effective pages, or index. Likewise, all change bars are removed when a publication is completely revised (i.e. - reissued).

9. Indexing

An alphabetically arranged subject Index follows this introduction to assist the user in locating desired information. In addition, each System/Chapter begins with an individual Table of Contents.

10. List of Effective Pages

Each System/Chapter has a List of Effective Pages preceding the Table of Contents to identify the effective revision date for each page in that chapter.

11. Warnings, Cautions and Notes

These adjuncts to the text are used to highlight or emphasize important points when necessary. Warnings call attention to use of materials, processes, methods, procedures or limits which must be followed precisely to avoid injury or death to persons. Cautions call attention to methods and procedures which must be followed to avoid damage to equipment. Notes call attention to methods which make the job easier. Warnings and Cautions shall be located directly above and Notes directly beneath the text and be in line with the paragraphs to which they apply.

12. Accident/Incident Reporting

To improve our Service and Reliability system and aid in Piper's compliance with FAR 21.3, knowledge of all incidents and/or accidents must be reported to Piper immediately. To expedite and assist in reporting all incidents and accidents, Piper Form 420-01 has been created. See Service Letter 1041 for latest revision. This procedure is to be used by all Dealers, Service Centers and Repair Facilities.

13. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-44-180 airplane and its various components. Use them to supplement this manual.

A. Piper Publications:

	Piper P/N
(1) Parts Catalog:	761-892
(2) Periodic Inspection Report:	230-1963
(3) Progressive Inspection Manual (pending):	767-014

B. Vendor Publications:

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY.

(1) ALTERNATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

(2) AUTOFLIGHT:

Vendor Address: Honeywell (or) S-TEC Corporation
One Technology Center One S-TEC Way
23500 W. 105th St., M/D #45 Mineral Wells, Texas 76067
Olathe, Kansas 66061-1950 PH - (940) 325-9406
http://www.bendixking.com/ www.s-tec.com

(3) BATTERY:

Vendor Address: GILL Batteries PH: - (800) 456-0070
A Division of Teledyne Continental Motors
http://www.gillbatteries.com

(4) BRAKES AND WHEELS:

Vendor Address: Parker Hannifin Corp PH: - (800) 272-5464
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
http://www.parker.com/cleveland/Universe/book.pdf

(5) ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS):

Vendor Address:	Avidyne Corporation 55 Old Bedford Road Lincoln, MA 01773 http://www.avidyne.com/index.htm	PH - (800) 284-3963

Instructions for Continued Airworthiness

Primary Flight Display and Magnetometer/OAT:	Document No. AVPFD-174
Multifuntion Display:	Document No. AVMFD-167
Data Acquisition Unit:	Document No. AVSIU-011

(6) EMERGENCY LOCATOR TRANSMITTER:

Vendor Address:	Artex Airccraft Supplies 14405 Keil Road NE Aurora, Oregon 97002 http://www.artex.net/	PH: - (800) 547-8901

(7) ENGINE:

Vendor Address:	Textron Lycoming 652 Oliver Street Williamsport, PA 17701 http://www.lycoming.textron.com/main.html	PH - (717) 323-6181 FAX - (717) 327-7101

Overhaul Manual:	DIRECT DRIVE MODELS	- P/N 60294-7
Parts Catalog:	O, LO-360 A1H6 ENGINES	- P/N PC306-5
Operators Handbook:	O, HO, IO, AIO, HIO, TIO-360 SERIES	- P/N 60297-12

NOTE: The above Lycoming publications can be ordered as a set on CD-ROM from Avantext. See www.avantext.com or PH - (800) 998-8857.

(8) FIRE EXTINGUISHER (PORTABLE):

Vendor Address:	H3R Inc. 43 Magnolia Ave # 4 San Francisco, California 94123-2911 http://www.h3r.com/index.htm	PH: - (800) 249-4289

(9) FUEL CELLS:

Vendor Address:	Engineered Fabrics Corporation 669 Goodyear Street Rockmart, Georgia 30153-0548 http://www.kfefc.com/index.htm	PH - 770-684-7855 FAX - 770-684-7438

(10) HEATER

Vendor Address:	Kelly Aerospace Power Systems Airport Complex, PO Box 273 Fort Deposit, AL 36032 http://www.kellyaerospace.com/ts_heaters.html	PH: - (888) 461-6077 FAX - (334) 227-8596
Maintenance and Overhaul Manual:	Janitrol Maintenance and Overhaul Manual - 24E25-1	

(11) LIGHTS - NAVIGATION, STROBE, AND MAP LIGHTS:

Vendor Address:	Whelen Engineering Co. Inc. Route 145, Winthrop Rd. Chester, Conneticut 06412 http://www.whelen.com/	PH: - (860) 526-9504 FAX - (860) 526-2009

(12) MAGNETOS:

Vendor Address:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104 http://www.unisonindustries.com/index4.html	PH - (815) 965-4700 FAX - (815) 965-2457
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363	

(13) NAVIGATION, COMMUNICATIONS, AND GPS (NAV/COM/GPS):

Vendor Address:	Garmin International 1200 East 151ST Street Olathe, KS 66062 http://www.garmin.com	PH: (913) 397-8200

(14) PROPELLER:

Vendor Address:	Sensenich Corporation 14 Citation Lane Lititz, PA 17543 http://www.sensenich.com/	PH - (717) 569-0435 FAX - (717) 560-3725
Repair Manual:	METAL PROPELLER REPAIR MANUAL - SPRM 590	

(15) STARTER:

Vendor Address:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252
or	Electro Systems, Inc. (see “Voltage Regulator,” below)	

(16) VACUUM PUMP:

Vendor Address: Aero Accessories, Inc. PH - (800) 822-3200
1240 Springwood Avenue
Gibsonville, NC 27249
http://www.aeroaccessories.com/index.html

(17) VACUUM REGULATOR:

Vendor Address: Parker Hannifin Corp. PH: - (800) 382-8422
Airborne Division
711 Taylor Street
Elyria, Ohio 44035
http://www.parker.com/cleveland/Universe/book.pdf

(18) VOLTAGE REGULATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

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14. Chapter/Section Index Guide

NOTE: The following GAMA Specification No. 2 standard chapters are not included in this Maintenance Manual: 23, 35, 36, 38, 49, 54, 60, 72, 75, 81, and 83. These chapters are omitted because the subject system is either: not installed in these airplanes; adequately covered in vendor or other manuals; or, for ease of use, has been combined with another chapter.

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CHAPTER 73 - ENGINE FUEL SYSTEMS

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DISTRIBUTION

1. Carburetor

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

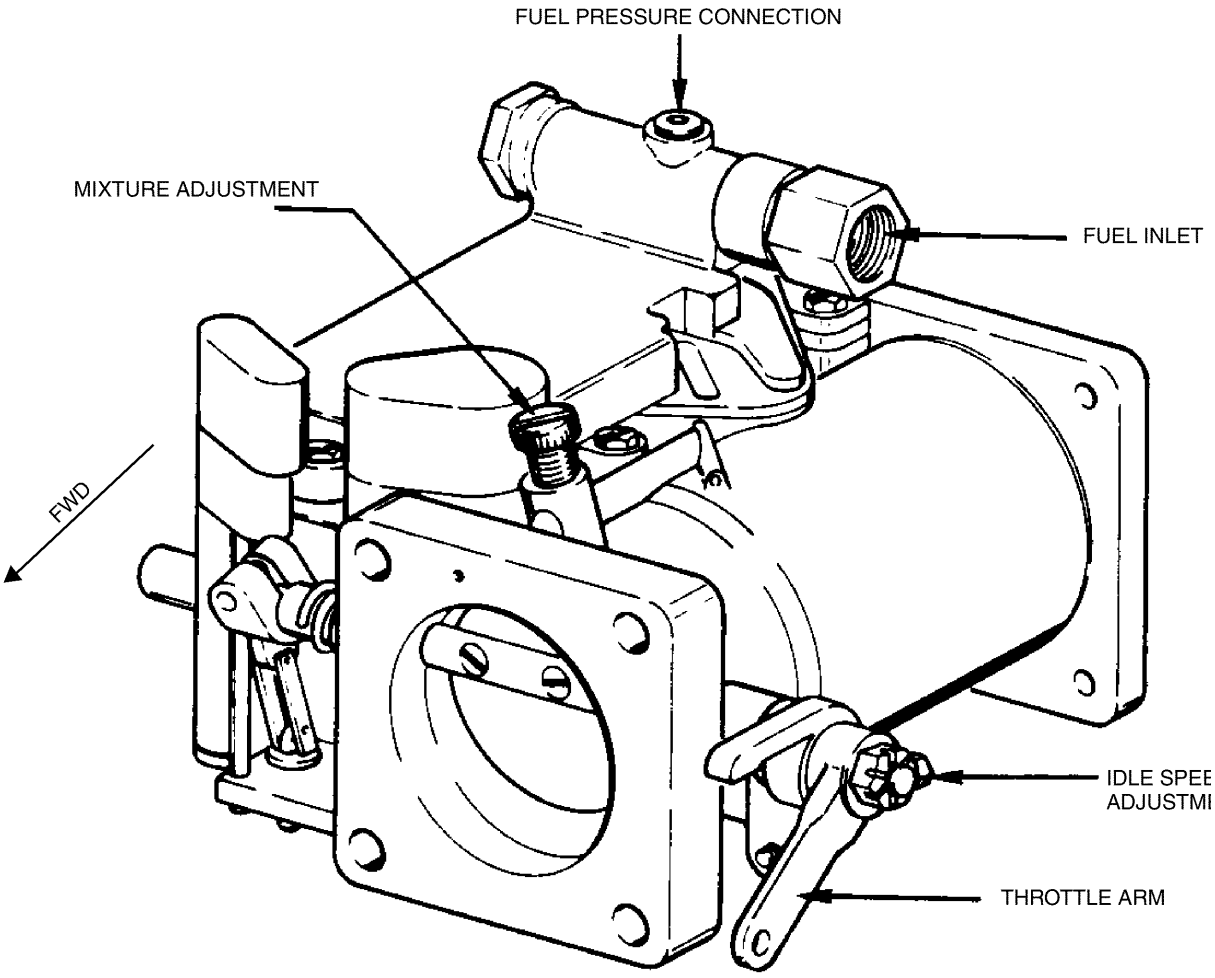
In general, little attention is required between carburetor overhauls. However, it is recommended that the following items be checked during recommended inspection periods of the engine.

A. Maintenance

CAUTION: GROUND RUNNING WITH THE COWLING REMOVED: MAXIMUM POWER GROUND RUNNING IS LIMITED TO FIVE 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.

(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. (See Figure 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.
(7) Check the adjustment of the idle mixture and idle speed.

A570



Carburetor
Figure 1

B. Adjustment

(1) Mixture (See Figure 1.)

WARNING: WHEN PERORMING ENGINE WARM-UP INDOORS, PROVIDE A BARRIER ABOUT THE ENGINE TO PREVENT SERIOUS INJURY. ALSO PROVIDE ADEQUATE MEANS OF VENTILATING THE WORK AREA.

(a) 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.

(b) 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.

(c) 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.

(d) 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.

(e) Should these steps reveal that the idle mixture is not correct make the following adjustments and perform Steps 2 thru 4 again.

1 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.

2 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.

3 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.

(f) After adjusting the idle mixture, recheck it several times to insure its remaining consistent from high power settings back to idle.

(2) Idle Speed. (See Figure 1.)

(a) Pull back the cockpit throttle control lever until it is completely aft and in the closed position. Observe the engine speed on the tachometer.

(b) 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.

2. Engine Primer Installation (See Figure 2.)

High pressure electric pumps are used for engine priming.

A. Electric Primer

NOTE: The electric fuel pumps must be ON to operate the electric primers.

The priming system uses 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 three cylinders in each engine. (See Figure 2.)

B. Primer Jets

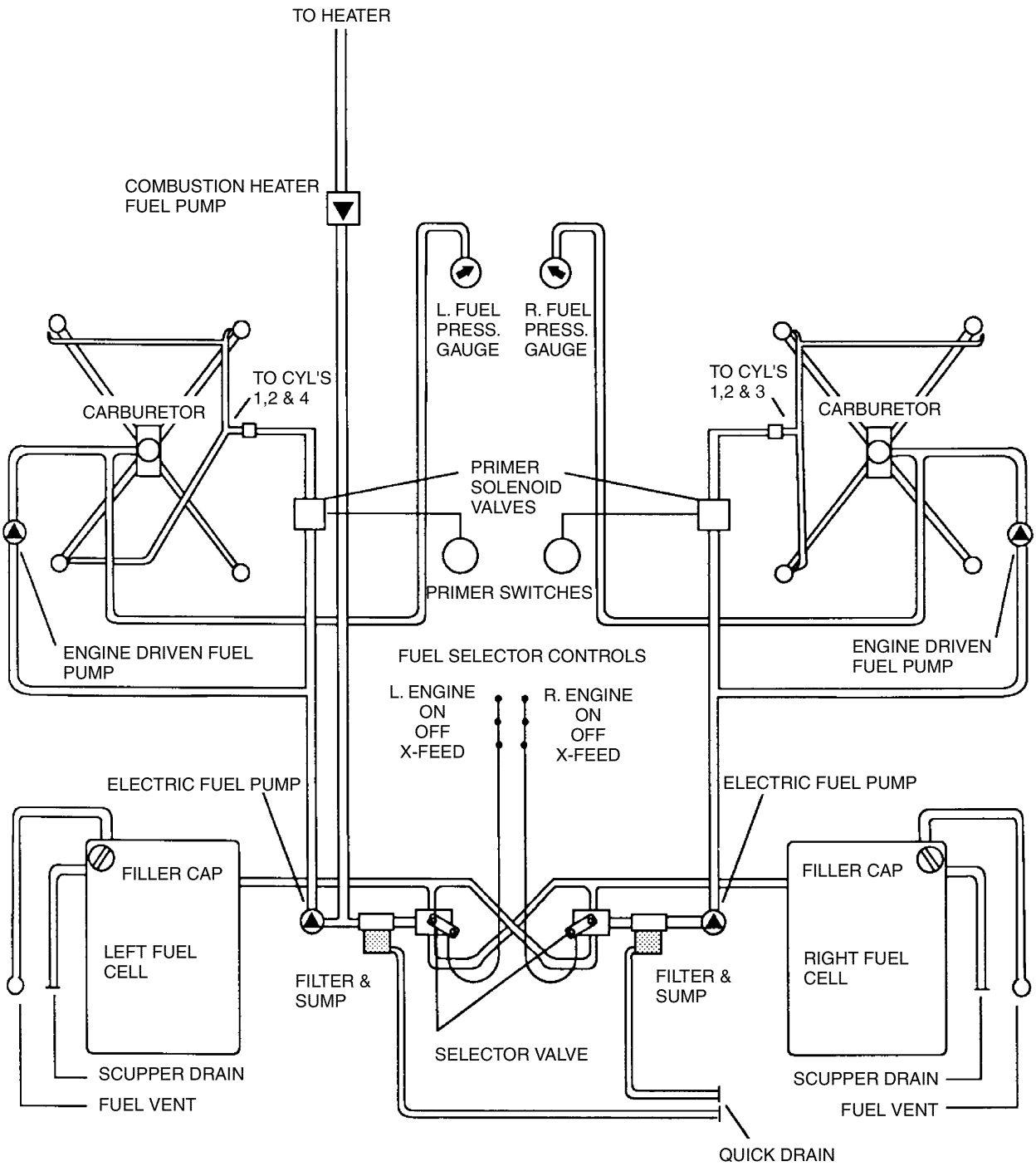
(1) To remove the primer jets, disconnect the supply line from each jet. With a deep socket and light pressure, remove the jet from the cylinder.

(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: If fuel stoppage continues after the primer jets are cleaned, check for blocked supply lines and bent or collapsed walls.

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Fuel System Schematic
Figure 2

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INDICATING

Fuel Pressure Gauge

NOTE: In S/N's 4496174; and, 4496224 and up, with the Avidyne Entegra EFIS option, this function is in the MFD.

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.

A. Puel Pressure Sender Testing (See Chart 1.)

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.

(a) 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 1.

(4) 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 8.0 psi.

(c) Reduce the pressure to 0.5 psi. The gauge should indicate 0.5, +1, - 0 needle widths.

NOTE: The sender and gauge are nonadjustable, therefore that which does not meet specifications should be replaced.

(5) Reinstall the gauge and sender.

B. Troubleshooting

See Chart 2.

Chart 1
FUEL PRESSURE SENDER TEST SPECIFICATION

Pressure (PSI)	Resistance (Ohms)	Tolerance (Ohms)
0	10	-
0.5	11.5	+1, -0
5	42	±1/2, -0
8	60	+1/2, -0
10	72	±1
The gauge (Piper P/N 86750-2) should indicate 8 psi +1/2, - 0 needle widths.		

CHART 2
TROUBLESHOOTING FUEL PRESSURE GAUGE

Trouble	Cause	Remedy
No fuel pressure indication	Fuel valve stuck.	Check valve.
	No fuel in tanks.	Check fuel, fill.
	Defective fuel pump.	Check pump for pressure build up. check diaphragm and relief valves in engine pump. Check for obstruction in electric pump. Check bypass valve. Air leak in intake lines.
Pressure low or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty bypass valve.	Replace.
	Faulty diaphragm.	Replace or rebuild pump.
Needle Fluctuation.	Surge dome or pump filled with fuel.	Remove and empty.
	Air in line.	Lossen 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 cowling.	Normal.

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IGNITION

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CHAPTER 74 - IGNITION

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ELECTRICAL POWER SUPPLY

1. Ignition System

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

A. Description

Ignition of the fuel charge in each cylinder is accomplished by two spark plugs independently excited by one of two Slick 4300 series magnetos. Two magnetos are installed on each engine for redundancy. Each magneto separately generates, times and distributes high tension (voltage) through leads to each cylinder.

The magnetos are controlled by switches at the lower left of the instrument panel (Refer to 74-30-00, Figure 1). With its switch OFF, the magneto is grounded and will not produce spark. The right magneto fires all the lower spark plugs. The left magneto fires all the upper spark plugs.

On each engine, the right magneto is standard and the left magneto is an impulse-coupled type installed to retard magneto ignition timing (see lag angle on magneto dataplate) and provide spark for engine starting. As the engine is cranked, a spring in the impulse coupling is wound. When the engine crankshaft reaches the proper position for starting, the spring in the impulse coupling is released to spin the rotating magnet and produce the spark required to fire the engine. After the engine starts, the impulse coupling flyweights disengage the coupling due to centrifugal action. The coupling then acts as a straight drive and the magneto fires at the normal firing position of the engine.

NOTE: Check the magneto data plate to verify the specific model number and series of the magneto being worked on.

B. Troubleshooting

WARNING: ENSURE THAT THE PRIMARY CIRCUITS OF BOTH ENGINES ARE GROUNDED AND THE IGNITION SWITCH IS OFF, BEFORE WORKING ON EITHER ENGINE.

WARNING: REMOVE HARNESS ASSEMBLIES FIRST AND INSTALL THEM LAST TO MINIMIZE DANGER OF STARTING ENGINE INADVERTANTLY WHEN GROUND LEAD IS REMOVED FROM MAGNETO. I.E. - THESE MAGNETOS ARE NOT INTERNALLY GROUNDED AND MAGNETO IS HOT WHEN GROUND LEAD IS DISCONNECTED.

See Chart 1.

C. Replacement Magnetos

An alternative to overhaul is complete magneto replacement with a new Slick magneto. New Slick magnetos incorporate all the latest design features and may be a cost effective alternative to overhaul.

NOTE: Check the magneto data plate to verify the specific model number and series of the magneto being worked on.

CHART 1
TROUBLESHOOTING MAGNETOS

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.
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.

D. Overhaul

Overhaul is required as conditions indicate, but in no case may Slick 4300 series magnetos time-in-service exceed the TBO for the engine. Magnetos must also be overhauled after a lightning strike or following a sudden engine stoppage.

Information provided in this section is intended to support magneto removal, cleaning, inspection, replacement and timing. For magneto overhaul procedures, see Slick's F-1100 Master Service Manual available from:

Slick Aircraft Products PH: 904-739-4000
Unison Industries
Attn: Subscription Dept.
7575 Baymeadows Way
Jacksonville, FL 32256
http://www.unisonindustries.com/news/service_documents.html

2. Magnetos

A. 100 Hour Inspection

Every 100 hours or at annual inspection, whichever comes first, perform the following checks.

WARNING: BE SURE IGNITION SWITCH IS IN THE "OFF" POSITION AND THE CONDENSER P-LEAD IS GROUNDED.

(1) Adjust timing to engine. (See Figure 1.)

(a) Turn the engine crankshaft in the normal direction of rotation until the No. 1 cylinder is in the full-advance firing position.

1 Cover spark plug hole of number one cylinder with thumb. Rotate crankshaft until pressure is felt on thumb.

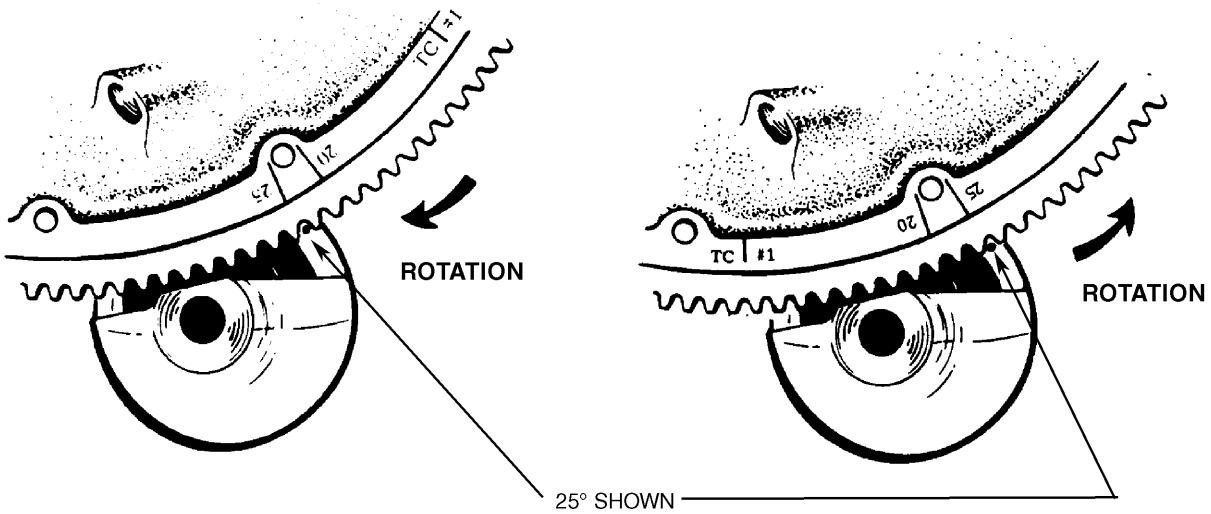
2 Rotate crankshaft slowly until the advance timing mark on the starter ring gear is in alignment with the small hole located at the two (2) o'clock position on the front face of the starter housing. When the 20° mark on the gear is aligned with the small hole, number one piston is at 20° BTC.

NOTE: Always verify correct BTC on the engine data plate.

(b) Scribe a reference mark on the magneto mounting flange and engine accessory case.

(c) Loosen the magneto mounting bolts, and connect a standard timing light between engine ground and the magneto condenser terminal.

WARNING: DO NOT ROTATE PROPELLER WHEN IGNITION SWITCH IS IN THE "ON" POSITION. THE MAGNETOS WILL FIRE THE SPARK PLUGS IF THE PROPELLER IS ROTATED - FATAL INJURY IS POSSIBLE.



Engine Timing Marks
Figure 1

(d) Turn ignition switch ON.

(e) Rotate the magneto, in its mounting, in the direction of normal operating rotation until the timing light indicates the contact breaker points are open.

(f) Slowly rotate the magneto opposite normal rotation of the magneto on the engine mounting until the timing light (or audible signal) goes out.

(g) Measure the distance from the reference mark previously scribed on the accessory case and the corresponding reference mark on the magneto. If this measurement is more than 1/8 inch, remove the magneto (paragraph B) and inspect/adjust the contact breaker points per paragraphs C (4) & (5) and E (9) & (10), respectively. A 1/8 inch change corresponds to an approximate 5° change in internal magneto timing.

(h) Secure the magneto in this position, alternately tightening the magneto mounting clamps - first to 8 ft-lbs. and finally to 17 ft-lbs. of torque.

(i) Turn ignition switch OFF.

(2) Inspect harness. See Section 74-20-00.

(3) Inspect vent holes. Ensure vent holes are clean and clear of any obstruction.

(4) Inspect P-lead attachment. The P-lead connects the magneto primary circuit to the ignition switch. If the P-lead is disconnected, the magneto will be “HOT” and will fire the spark plug if the propeller is rotated. Verify that the P-lead is attached to the condenser stud. Torque to 13 to 15 in-lbs.

B. Removal

Before removing the magnetos, make sure the magneto switches are OFF.

CAUTION: ASCERTAIN THAT THE PRIMARY CIRCUIT OF THE ENGINE IS GROUNDED BEFORE WORKING ON THE ENGINE.

WARNING: THE MAGNETO IS NOT INTERNALLY GROUNDED, WHEN THE GROUND LEAD IS DISCONNECTED THE MAGNETO IS HOT. REMOVING THE HARNESS ASSEMBLY FIRST AND INSTALLING THEM LAST MINIMIZES THE DANGER OF STARTING THE ENGINE ACCIDENTALLY WHEN THE GROUND LEAD IS REMOVED FROM THE MAGNETO.

(1) Turn the engine crankshaft in the normal direction of rotation until the No. 1 cylinder is in the full-advance firing position.

(2) Remove the harness cap from the magneto. Before doing this, place an index mark on the harness cap and distributor housing to ensure proper alignment upon reassembly.

(3) Disconnect the P-lead and pressurization tube from magneto.

(4) Remove the nuts, washers and clamps, and remove the magnetos from the engine.

(5) Cover the magneto accessory opening with suitable material to prevent internal engine contamination.

C. 500 Hour Inspection and Cleaning

Each 500 hours, remove magneto per paragraph B, above, and disassemble magneto, as necessary, per procedures in paragraph D, below. Inspect and clean magneto as follows:

(1) Inspect ball bearing assembly by rotating rotor shaft. Shaft should rotate freely without binding or sticking, but should not appear loose. If not, replace bearings.

(2) Inspect rotor for damage or worn keyway. Check rotor surfaces for wear.

(a) Inspect oil seal location on shaft.

(b) Assemble bearings and rotor per paragraph E (1) & (2), below.

(c) In the left magnetos only (i.e. - impulse coupled), inspect magneto rotor shaft at impulse coupling (see Figure 2). If the heel of the pawl has struck the shaft and caused the shaft to dimple in excess of .006 inch per side, the rotor shaft must be replaced.

(3) In the left magnetos only (i.e. - impulse coupled), clean and inspect the impulse coupling:

(a) Clean to bare metal to ensure a reliable inspection. Use a suitable degreasing solvent to remove all oil or sludge buildups.

(b) Inspect impulse coupling shell and hub for cracks, rust or corrosion. Replace impulse coupling, if found.

(c) Inspect hub shaft and keyway for deformation or damage. Replace impulse coupling, if found.

(d) Inspect impulse coupling pawl latching ends (see Figure 4). If rounded, peened, or excessively worn, replace impulse coupling.

NOTE: Stringers, inclusions, and heat checks may appear on the surfaces of impulse coupling components. These conditions are normal and, by themselves, generally do not require impulse coupling replacement.

(e) Inspect pawl retaining rivets. If loose or, if they show indications of movement, replace impulse coupling.

(f) Measure the clearance between the boss on the underside of each impulse pawl and the pawl plate using a feeler gauge. Position the latching end of the impulse pawl over the pawl plate as shown in Figure 4.

(g) Maximum clearance for pawls with one boss is .150 inch (see Figure 5). Maximum clearance for pawls with two bosses is .150 inch for left-hand rotation couplings and .140 inch for right-hand rotation couplings. If the feeler gauge passes between the full width of the boss(es) and the pawl plate, replace the impulse coupling.

(4) In the left magnetos only (i.e. - impulse coupled), reassemble and install the impulse coupling:

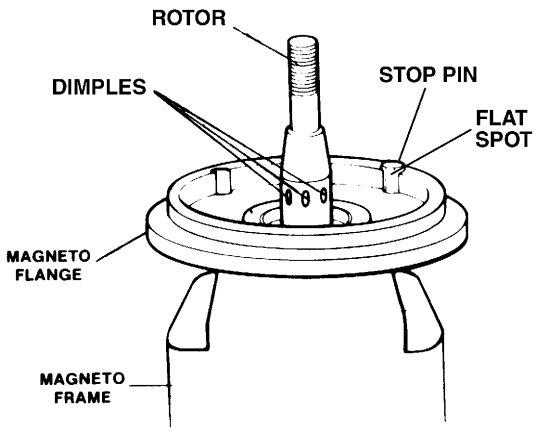
(a) Lubricate the pawl assembly, hub and spring with aircraft engine oil. Verify that pawls move freely.

(b) Reassemble impulse coupling per paragraph E (5), below.

(c) Inspect stop pin for looseness, cracks or corrosion (see Figure 2). Replace magneto frame, if found.

(d) Inspect stop pin for flat spots. These are a normal sign of wear and do not, of themselves, mandate component replacement. However, if the flat spots allow the impulse coupling pawls to slip past the stop pin, then either or both the impulse coupling and the magneto frame must be replaced.

(e) Install impulse coupling per paragraph E (6), below.



Rotor and Stop Pin
Figure 2

(5) Inspect coil for visible radial cracks. Replace coil if cracks evident. Inspect coil for primary and secondary circuit resistance and continuity, as follows: primary coil - .50 to 1.2 ohms; secondary coil - 13,000 to 20,500 ohms. Replace, if required.

(6) Inspect primary contact points for signs of pitting and discoloration. If points are not discolored and have a white, frosty surface around the edges, points are functioning properly and can be reused. If points are blue (indicating excessive arcing) or pitted, they should be discarded. Replace primary contact point assembly, condenser and cam.

(7) Clean and inspect condenser.

(a) If the external surfaces of the condenser are dirty, clean with light soapy water. Rinse thoroughly with clear water and pat dry before reinstalling into the magneto housing.

(b) Using a magnifying lens, examine the glass bead end seals of the capacitor for broken glass or for glass separation from the retaining steel rings. Replace, if required.

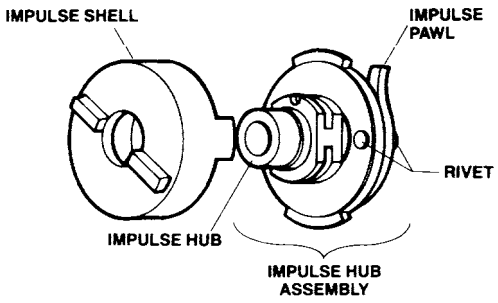
(c) Inspect the condenser for signs of corrosion. Replace, if required.

(d) Inspect the condenser P-lead stud for twisting or "pulled" condition. Replace, if required.

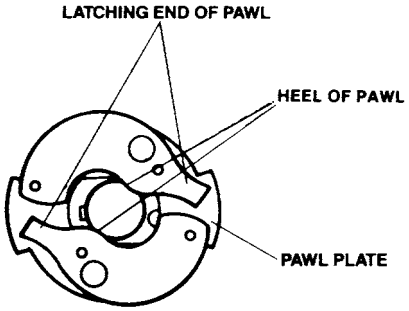
(e) Test the electrical properties of the condenser using appropriate calibrated test equipment. Test for capacitance value with condenser charged to 400 volts DC. Service limit: .35 microfarad + 10 percent. Test for resistance, measured between condenser lead wire and condenser shell. Resistance should be greater than 10 megaohms.

NOTE: No field repairs of any type to the condenser are approved.

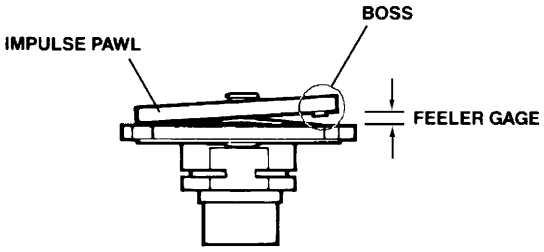
(f) Install condenser per paragraph E (12), below.



Impulse Coupling
Figure 3



Impulse Coupling Pawls
Figure 4



Measuring Pawl Clearance
Figure 5

(8) Clean and inspect distributor block

CAUTION: DO NOT PUT CLEANER IN EITHER BRONZE OILITE BUSHING. THESE BUSHINGS ARE IMPREGNATED AT THE FACTORY AND CLEANER WILL DRAW THE LUBRICANT OUT OF THE BUSHING.

(a) Disassemble and clean the distributor block bearing bar. Use standard non-filming non-conductive cleaner. Clean distributor gear with soapy water and rinse with clean water.

(b) Clean all surfaces free of dirt, oil, carbon dust and other contaminants using a cotton swab or "Q-Tip".

(c) Inspect the distributor block for cracks or other physical damage. Replace, as required.

(d) Inspect the brass electrode posts for signs of physical wear. Replace block assembly, as required, but note that during normal operation, the post will experience an electrical-metal transfer with the distributor gear electrode.

(e) Inspect oilite bushing for gumming oil. The bushing should be free of contamination and the gear should turn freely in the distributor block with no appreciable drag. If the bushing is gummed, wipe the bushing with MEK and lubricate with one drop of Exxon Teresstic 100 or Slick P/N M-3306. No other oils should be placed in these bushings.

(f) Ensure the distributor block surfaces are free of all oil and carbon dust prior to reassembly.

(g) Inspect distributor gear teeth for wear and general integrity. Replace block assembly as required.

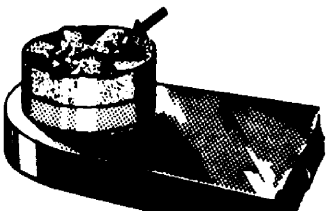
(h) Inspect the electrode finger for looseness. The electrode should be held securely to the shaft when tested with light finger pressure. If loose, replace block and gear.

(i) Clean the end of the electrode to remove electrical deposits.

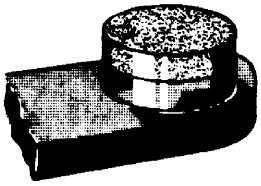
(j) Inspect bearing bar for cracks or other physical damage. Replace as required.

(k) Ensure the bearing bar is free of all and carbon dust prior to reassembly.

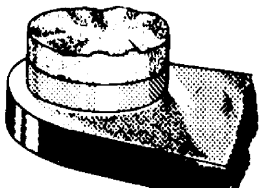
236 **WELL DEFINED MOUND EXTENDING NOTICEABLY ABOVE SURROUNDING SURFACE, REJECT POINTS.**



NORMAL POINT IS SMOOTH AND FLAT. SURFACE HAS DULL GRAY "SANDBLASTED" APPEARANCE



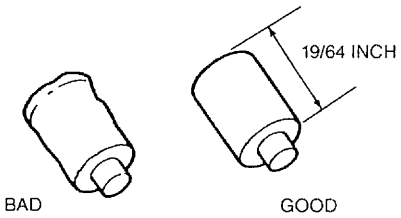
MINOR IRREGULARITIES - SMOOTH ROLLING HILLS AND DALES WITHOUT ANY DEEP PITS OR HIGH PEAKS. THIS IS A NORMAL CONDITION OF POINT WEAR.



Contact Points
Figure 6

(9) Inspect the carbon brush. Overall length must be greater than 19/64 (.297) inch and the outside diameter must be uniform (see Figure 6). Replace as required.

(10) Inspect the loading spring. Overall free standing length should be greater than 19/32 (.594) inch. Springs that appear worn, that have flat spots or are too short must be replaced.



Carbon Brush Assembly
Figure 7

D. Disassembly (see Figures 7 and 8.)

NOTE: Use of the Slick T-100 Assembly and Timing Kit (Figure 7) is strongly recommended. The tools contained in this kit will greatly facilitate magneto disassembly/assembly and help prevent damage to parts.

(1) Remove impulse coupling:

CAUTION: THE SHELL OF THE IMPULSE COUPLING ASSEMBLY IS UNDER CONSIDERABLE SPRING TENSION.

(a) Remove cotter pin, nut, washer and bushing; and drive gear, where applicable.

(b) Firmly holding the shell of the impulse coupling assembly, gently pull shell of impulse coupling assembly out enough to clear the latching ears of the impulse hub assembly.

(c) Turn shell to release spring tension. Remove shell and attached impulse spring.

(d) Engage T-106 hub puller into grooves in the hub assembly. Tighten T-106 puller bolt to remove impluse coupling hub assembly.

(2) Remove Woodruff key by prying key from rotor shaft using pliers.

(3) Remove distributor housing assembly

(a) Remove three long screws and single short screw from distributor housing.

(b) Separate distributor housing from magneto frame.

(c) Disconnect condenser lead from contact breaker assembly.

(4) Remove the distributor block assembly by removing two screws and remove distributor bearing bar, distributor gear and distributor block from the housing.

(5) Remove condenser. When removing the condenser from the distributor housing, carefully rotate the condenser wire counterclockwise in the same direction as the condenser to eliminate twisting the condenser lead.

(6) Remove rotor gear by prying it out of the end of the rotor assembly using two flat-blade screwdrivers.

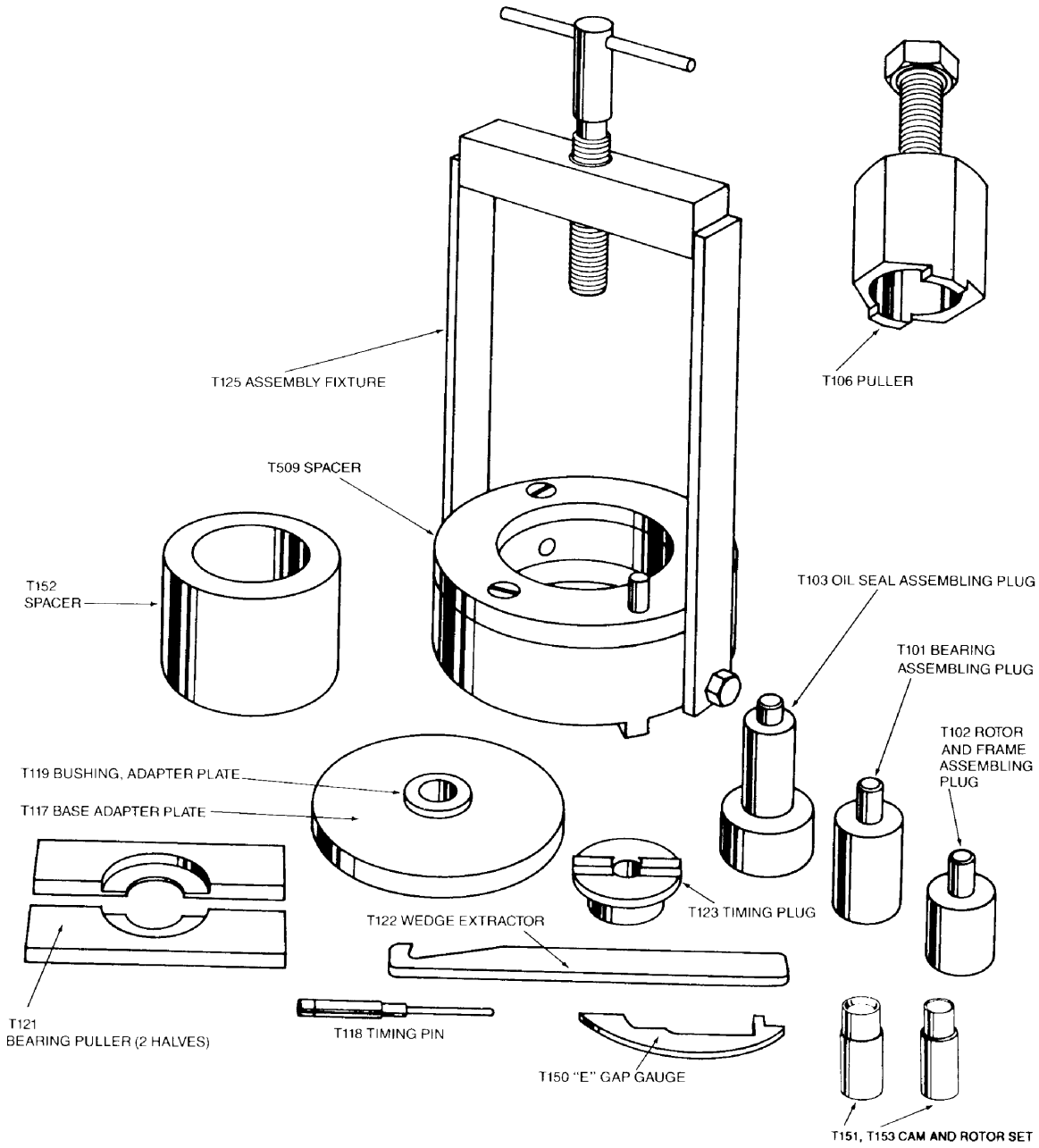
(7) Remove contact breaker assembly - Impulse Coupled and Direct Drive Magnetos

(a) Disconnect coil lead wire from contact breaker assembly.

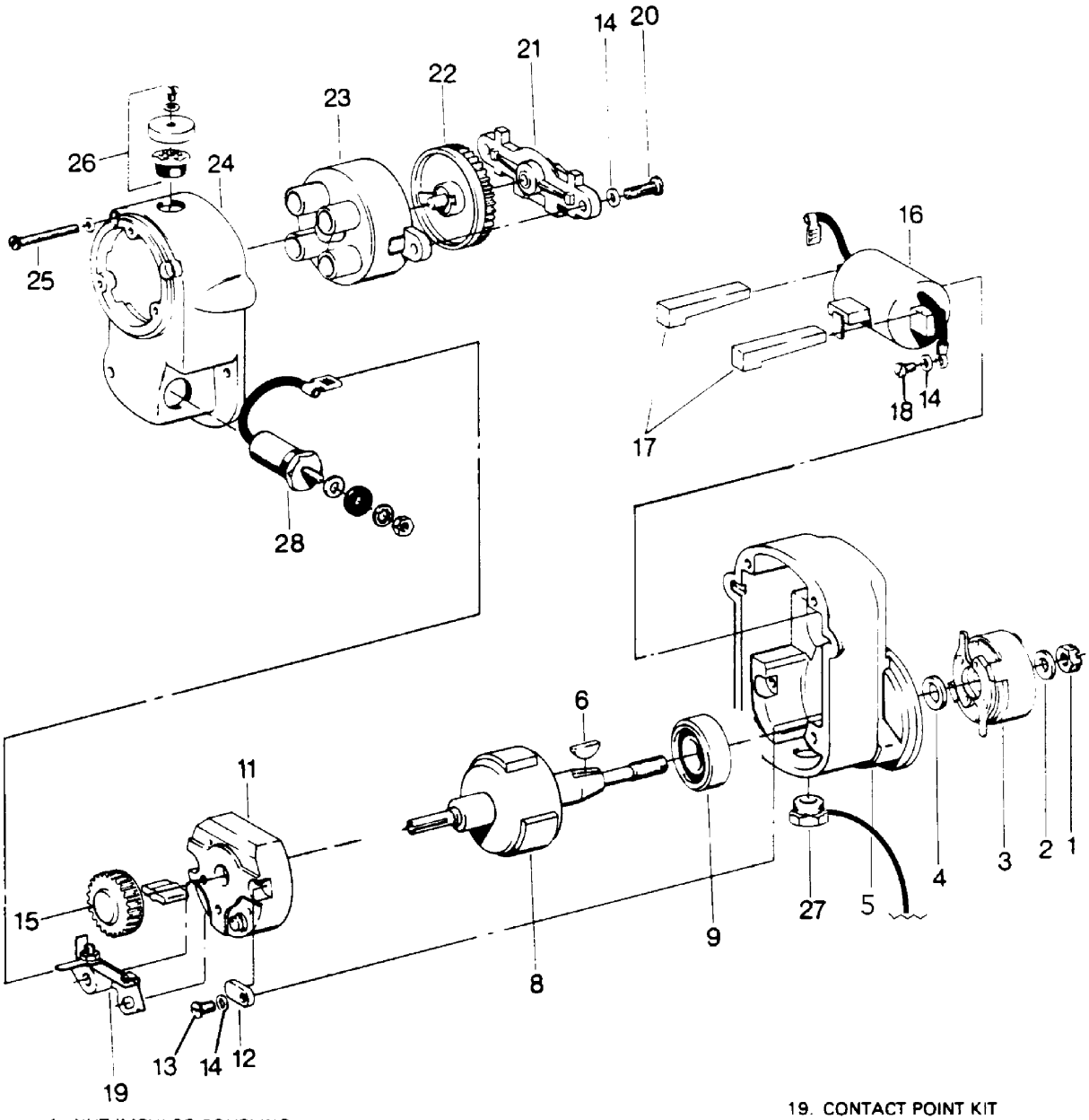
(b) Remove screws and washers from breaker assembly.

(c) Remove contact breaker assembly from bearing cap.

(d) Remove cam by prying straight up with a screwdriver blade.



.Slick T-100 Assembly and Timing Tool Kit
Figure 8



1. NUT IMPULSE COUPLING
2. WASHER, IMPULSE COUPLING
3. IMPULSE COUPLING ASSY.
4. OIL SEAL
5. FRAME
6. WOODRUFF KEY
7. NOT USED
8. ROTOR
9. BALL BEARING
10. NOT USED
11. BEARING CAP ASSEMBLY
12. BEARING CLAMP
13. SCREW
14. THICK LOCK WASHER
15. ROTOR GEAR
16. COIL
17. COIL WEDGE
18. SCREW
19. CONTACT POINT KIT
20. SCREW
21. BEARING BAR
22. GEAR, DISTRIBUTOR
23. BLOCK, DISTRIBUTOR
24. HOUSING, DISTRIBUTOR
25. SCREW
26. AIR VENT WITH HOOD
27. TACH MAGNETIC SENSOR
28. CONDENSER

Exploded View of 4300 Series Magneto
Figure 9

(8) Remove rotor assembly

CAUTION: DO NOT ALLOW ROTOR TO COME INTO CONTACT WITH METAL CHIPS OR FILINGS. ROTOR IS MAGNETIZED.

(a) Remove two screws and two bearing plate clamps.

(b) Press against the drive end of the rotor shaft and withdraw the rotor and bearing cap assembly from the drive frame.

(9) Remove bearings from shaft and discard

CAUTION: DO NOT DISASSEMBLE BEARING CAP ASSEMBLY SLICK PART NUMBER M-3485. THIS ASSEMBLY HOLDS A DOUBLE-SHIELDED BEARING CAPTIVE IN THE BEARING CAP AND IS PRE-LUBRICATED AT THE FACTORY WITH SPECIAL GREASE THAT TOLERATES THE OZONE RICH ENVIRONMENT WITHIN THE MAGNETO.

CAUTION: DO NOT ALLOW ROTOR TO COME INTO CONTACT WITH METAL CHIPS OR FILINGS. ROTOR IS MAGNETIZED.

(a) Place rotor on T-152 spacer with drive end down. Using T-125 assembly fixture, press rotor shaft, removing bearing cap assembly.

(b) Reverse rotor shaft and insert T-121 bearing puller (both halves) between the drive end bearing and the rotor magnet head.

(c) Place rotor and T-121 on T-152 spacer.

(d) Press rotor shaft and remove drive end bearing.

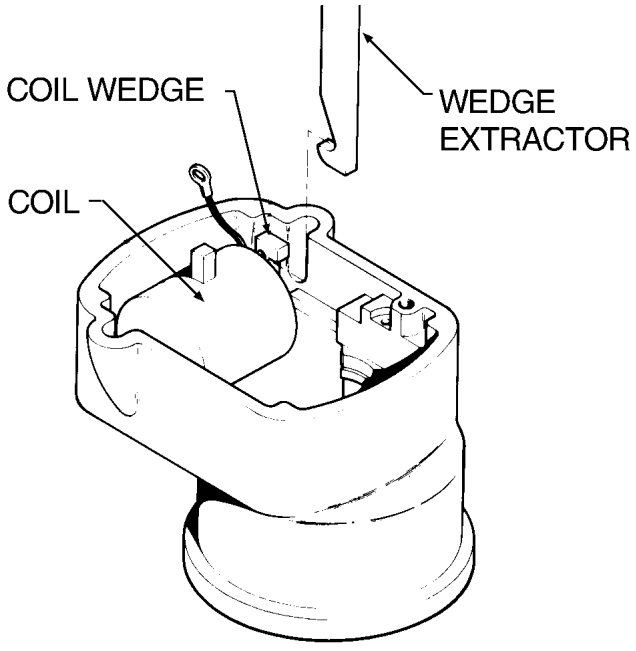
(10) Remove coil (See Figure 9.)

(a) Remove coil primary ground screw.

(b) Using coil wedge extractor T-122, remove coil wedges and lift out coil.

(11) Remove air vent/pressure vent plug from magneto.

(12) Remove oil seal from magneto.



Coil Wedge Removal
Figure 10

E. Assembly

NOTE: The following parts MUST BE REPLACED at engine overhaul (refer to Slick Service Bulletin No. SB-2-80C). Condenser, drive end bearing, bearing cap assembly, impulse coupling, coil, rotor gear, oil seal, contact point kit and distributor block and gear assembly. Refer to Slick Part List for part numbers. At each 500 hour inspection replace parts that are worn or damaged.

(1) Assemble new bearings onto shaft (see Figure 11.)

CAUTION: DO NOT ALLOW ROTOR TO COME INTO CONTACT WITH METAL CHIPS OR FILINGS. ROTOR IS MAGNETIZED.

(a) Insert the base plate (T-117) and adapter plate bushing (T-119) into T-125 assembly fixture.

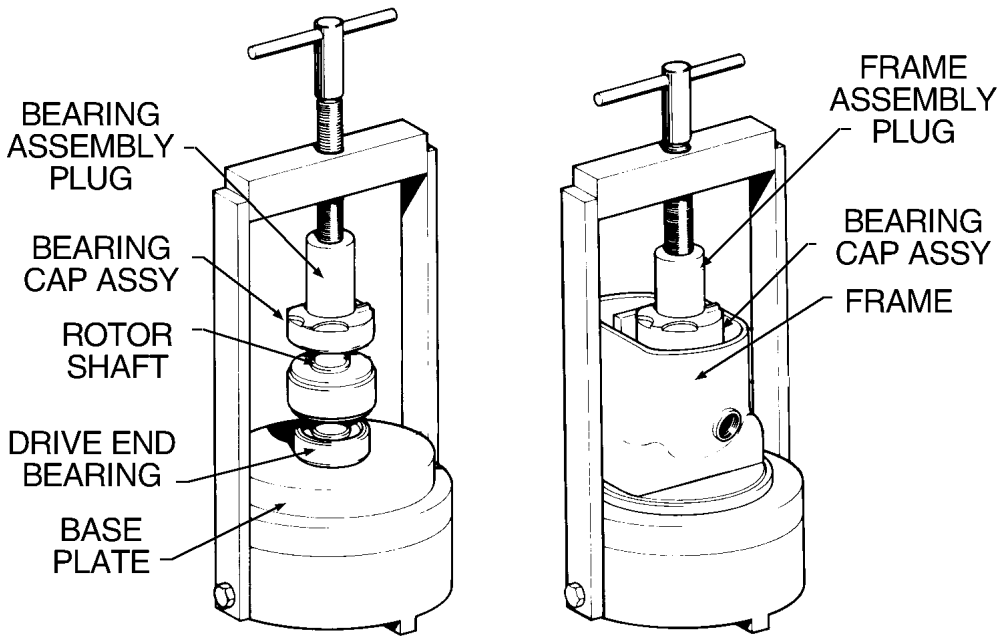
(b) Place one drive-end bearing and one bearing cap assembly onto the rotor shaft.

(c) Insert the rotor shaft into the adapter plate bushing (threaded end down).

(d) Place the bearing assembly plug (T-101) onto the exposed end of the rotor shaft.

(e) Turn T-handle screw to seat the bearings against the bearing shoulders on the rotor shaft.

(f) Remove the rotor shaft, adapter bushing, adapter plate and bearing assembly plug from T-125 assembly fixture.



Installing Bearings
Figure 11

(2) Install rotor shaft assembly (See Figure 11).

(a) Place magneto frame in T-125 assembly fixture (flange down).

(b) Position rotor shaft assembly in the magneto frame.

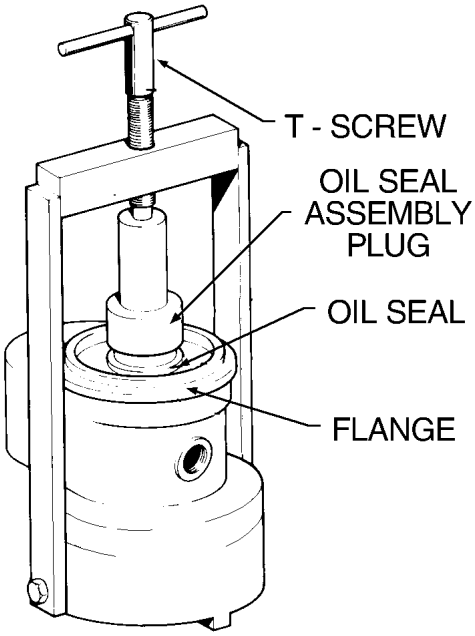
(c) Insert rotor and frame assembly plug (T-102) into the T-handle.

(d) Tum T-handle until the bearing cap bottoms in the frame. Place cap over end of rotorshaft first.

(e) Place T-151 cam and rotor set onto the end of the rotor shaft and turn T-handle until the shaft bottoms in magneto frame.

(f) Install bearing clamps and the hold-down screws.

(g) Torque screws to 20-24 in-lbs.



Oil Seal Installation
Figure 12

(3) Install oil seal (See Figure 12).

(a) Lubricate oil seal with engine oil.

(b) Reverse the magneto on the T-125 assembly fixture so the flange is facing up.

(c) Insert the oil seal over the rotor shaft.

(d) Press the oil seal flush into the frame using the oil seal assembly plug (T-103) and the T-handle screw.

(4) Install Woodruff Key by pressing Woodruff Key into the key slot of the rotor shaft.

(5) In the left magnetos only (i.e. - impulse coupled), assemble impulse coupling:

(a) Assemble inner eye of the impulse spring into the grooves in the impulse hub.

(b) Set the impulse shell and untensioned impulse spring on the hub.

(c) Holding the shell in one hand and the pawls with the thumb and forefinger of the other hand, pull the hub slowly, straight back, until its far enough to clear the projections on the shell.

CAUTION: DO NOT WIND THE IMPULSE SPRING MORE THAN 1/4 TURN.

(d) Hold the shell stationary and rotate the hub to wind the impulse spring until the projections on the other section of the pawl plate pass the projections on the shell. (Approximately 1/4 revolution or 90 degrees.)

(e) Ensure the shell is seated squarely on the hub and turns freely.

(6) In the left magnetos only (i.e. - impulse coupled), install impulse coupling:

(a) Install impulse coupling assembly onto the rotor shaft and install impulse washer.

(b) Install coupling nut and torque to 120 to 180 in. lbs. to seat the coupling on the rotor shaft. If cotter pin will not align with pin hole within the specified torque range, remove the nut and lightly lap its bottom surface with emory cloth.

(c) Verify that the coupling is free by snapping it through 3 or 4 times.

(7) Install coil

(a) Place the frame on the T-125 assembly fixture. Insert the coil into the frame, being sure that it is back against the stops. Insert coil wedges between the bridge and the frame.

(b) Drive the two wedges tight, using a hammer and flat punch. Attach the ground wire coil (either black or white - depending on coil type) to the frame with a screw. Torque to 20 in-lbs.

CAUTION: IF THE HIGH TENSION LEAD PROTRUDES ABOVE THE MAGNETO FRAME, IT CAN MAKE DIRECT CONTACT WITH THE DISTRIBUTOR GEAR AND CAUSE THE MAGNETO TO MALFUNCTION.

(c) Position the coil high tension lead flush to 1/32 (.031) inch below the parting surface of the magneto frame.

(8) Install contact points - All magnetos

Attach contact point assembly on the bearing cap using appropriate screw.

(9) Install rotor cam

(a) Install cam using a light hammer and T-151 cam and rotor set.

(b) Drive the cam until it bottoms in the rotor cam slot.

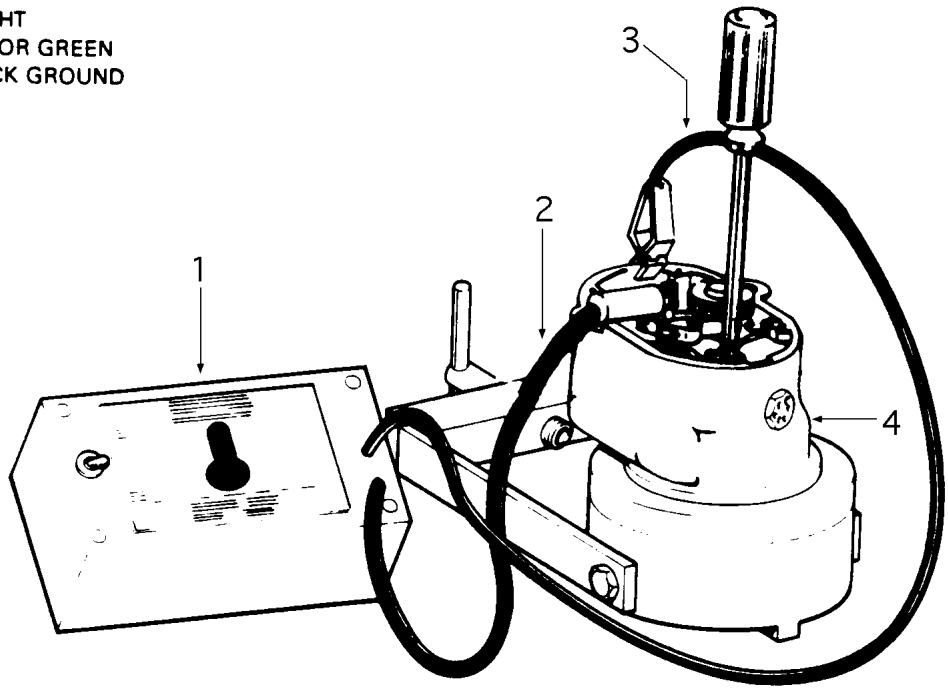
(10) Time the magneto internally - Set primary points - All magnetos

(a) Place the magneto on the T-125 assembly fixture, flange down, with the T-509 timing base adapter removed.

(b) In the right magnetos only (i.e. - non-impulse coupled), install the T-123 timing plug on the rotor shaft before placing the magneto on the T-125 assembly fixture.

(c) Looking directly down on the magneto, align the magneto so that the coil is oriented in the 12 o'clock position.

1. TIMING LIGHT
2. WIRE, RED OR GREEN
3. WIRE, BLACK GROUND
4. VENT



Magneto Internal Timing
Figure 13

(d) Insert T-150 "E" Gap Gauge between the pole laminations in the rotor shaft and the pole laminations in the frame. Read the magneto data plate for magneto rotation.

1 For old style rotor (i.e. - no slots on the magnet head), insert flat end of T-150 "E" Gap Gauge. Insert the "E" Gap Gauge against the right lamination for right-hand rotation magnetos and against the left laminations for left-hand rotation magneto.

2 For new style rotors (with slots on magnet head), insert notched end of T-150 "E" Gap Gauge. Locate the appropriate "L" or "R" timing slot on the rotor magnet head and insert the notched end of the "E" gap gauge. Use the "L" slot for left-hand rotation magnetos and the "R" slot for right-hand rotation magnetos.

(e) Rotate the magneto frame on the T-125 assembly fixture until the T-150 "E" Gap Gauge rests against the pole lamination in the magneto frame. Rotate the magneto frame clockwise for left-hand rotation magnetos and counterclockwise for right-hand rotation magnetos. The magneto rotor shaft is now in "E" Gap position.

(f) Using a timing light (see Figure 12), adjust the contact points to be just opening when the frame is against the T-150 gauge. This will provide a point gap opening of .008-.012 inches.

(g) Secure the points in this position by tightening the screws. Torque adjusting screw to 18-20 in-lbs. Torque the pivot screw to 15-18 in-lbs.

(h) Apply cam grease sparingly to each lobe of the cam.

(i) Attach coil lead wire to the vertical bronze male terminal of the primary point assembly.

(11) Assemble the condenser into the distributor housing, being sure to rotate the condenser wire the same rotation as the condenser is tightened in the housing..

(12) Distributor gear assembly

(a) Install carbon brush into spring.

1 Insert small end of carbon brus tapered end of spring.

2 Turn carbon brush clockwise until shoulder of carbon brush seats spring.

(b) Install carbon brush assembly into distributor gear.

1 Insert the open end of the spring into open end of the distributor gear shaft.

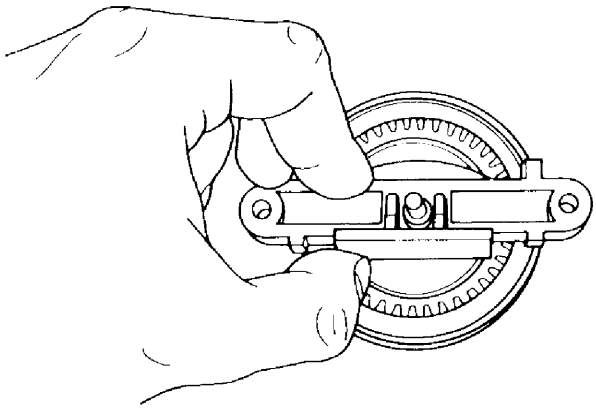
2 Gently press the carbon brush and spring assembly into the shaft until the spring seats on the bottom of the shaft. The top of the carbon brush should protrude from the top of the shaft approximately 1/4 inch.

(13) Install distributor block

(a) Assemble the distributor gear in the distributor block with the L&R facing you.

(b) Assemble the bearing bar to the distributor block as shown in Figure 14.

(14) Install rotor gear onto end of rotor shaft.



Bearing Bar Assembly
Figure 14

(15) Align the "L" or "R" (depending on the rotation of the magneto—look at data plate) on the rotor gear so that it points up, toward the high tension lead of the coil. Secure rotor shaft to prevent rotation during assembly. Alignment of rotor gear is critical. (See Figure 14.)

(16) Align the "L" or "R" hole in the distributor gear with the "L" or "R" in the distributor block. Use "L" for left-hand rotation and "R" for right-hand rotation magnetos.

CAUTION: DO NOT ROTATE MAGNETO ROTOR SHAFT WITH THE T-118 TIMING PIN INSERTED IN THE DISTRIBUTOR BLOCK. IF ROTOR SHAFT IS ROTATED WITH TIMING PIN INSERTED, THE MAGNETO MUST BE DISASSEMBLED AND INSPECTED FOR DISTRIBUTOR BLOCK AND GEAR DAMAGE.

(17) Lock the distributor gear in place with the T-118 timing pin through the appropriate hole in the block and gear. Then:

(a) Place distributor block spacers on magneto frame.

(b) Place distributor block on magneto frame. The distributor gear and rotor gear are properly meshed when the index mark on the rotor gear aligns with the index mark on the distributor block.

(c) Secure distributor block to frame with screws provided.

(18) Connect condenser wire

(a) Connect condenser wire to the remaining terminal of the contact assembly.

(b) Attach the terminal with the lead pointing left.

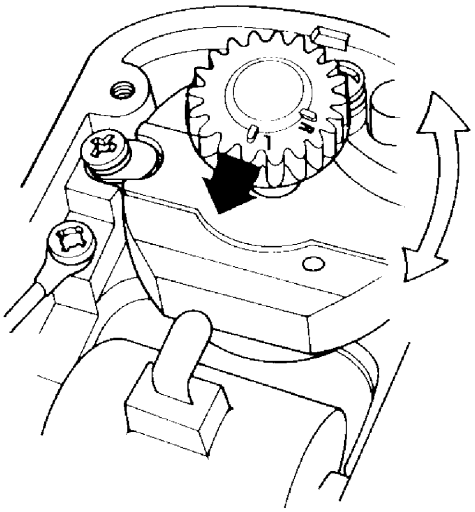
(20) Insert the top boss of the distributor housing into its mating pilot on the magneto frame.

CAUTION: MAKE SURE THE CARBON BRUSH IS CONTAINED WITHIN THE DISTRIBUTOR SHAFT DURING ASSEMBLY. IF THE CARBON BRUSH CATCHES ON THE SIDE OF THE DISTRIBUTOR SHAFT, THE COIL STRAP WILL BE BENT INTO THE WRONG POSITION DURING ASSEMBLY.

(21) Gently rotate the distributor housing onto the magneto frame.

(22) Secure the housing with three long screws and one short screw. Torque all four to 24 in-lbs.

(23) Remove T-118 timing pin.



Rotor Gear Alignment
Figure 15

F. Testing

Complete Magneto Reassembly, above. Verify that the T-118 Timing Pin has been removed.

(1) Mount the magneto on a suitable test stand in the same relative position as installed on the engine.

(2) Install a Slick High-Temperature Ignition Harness on the magneto and connect each output lead to a 5mm spark gap.

CAUTION: DO NOT OPERATE THE MAGNETO UNLESS THE IGNITION HARNESS IS INSTALLED AND THE OUTPUT LEADS ARE CONNECTED TO THE 5MM GAP.

(3) Impulse Coupling

(a) Rotate the test stand drive pulley in the same direction of rotation stated on the magneto data plate.

(b) The impulse coupling should engage the stop pin in the magneto frame below approximately 200 RPM. If the impulse coupling pawls slip past the stop pin or engage intermittently, the impulse coupling is not operating properly.

(4) Coming-in Speed

(a) Determine the lowest speed at which the magneto can be turned and still spark all 5mm gaps without missing.

(b) The test gap must fire consistently at 200 RPM on non-impulse coupled magnetos and 350 RPM on impulse coupled magnetos.

G. Installation

WARNING: BE SURE SWITCH IS IN OFF POSITION AND THE P LEAD IS GROUNDED.

When installing new or adjusting breaker points and before timing the magneto to the engine, it is important that the internal timing of the magneto is correct. To find number one tower, the following instructions should be performed:

NOTE: No need to spark out these magnetos.

(1) Insert the T - 118 timing pin in the L or R hole in the distributor block (depending on rotation of the magneto).

(2) Turn rotor opposite the rotation of the magneto until the pin engages the gear.

(3) If the pin is binding and will not go in the hole in the gear, you have hit the pointer on the gear. Pull the pin out enough to continue opposite rotation until the pointer has passed, then re-insert the pin.

(4) When the pin sticks through the hole in the gear about 1/4 (0.25) inch, you are now ready to fire number one cylinder.

(5) Turn the engine crankshaft in the normal direction of rotation until the No. 1 cylinder is in the full-advance firing position.

(a) Remove top spark plug from number one cylinder. (Refer to 74-20, “Spark Plugs” section, for detailed removal steps.) Place a thumb over spark plug hole and turn engine crankshaft in normal direction of rotation until compression stroke is reached. (Indicated by positive pressure on thumb.) In this position both valves of number one cylinder are closed. Turn crankshaft opposite to its normal direction of rotation until it is approximately 35 degrees BTC on compression stroke of number one cylinder. Rotate crankshaft in its normal direction of rotation until 25 degrees mark on starter ring gear and hole in starter housing align. (Figure 1)

NOTE: Always verify correct BTC on the engine data plate.

(6) Place a new gasket on magneto flange. Install magneto carefully so drive coupling lugs mate with slots of drive bushings. Install holding washers, lockwashers, and nuts.

NOTE: Do not tighten completely. Allow for turning magneto for final timing.

(7) After the magneto is installed on engine, remove the timing pin. The magneto is now ready to be timed to the engine.

(8) Complete magneto to engine timing procedure listed under 100 Hour Inspection, above.

WARNING: THE MAGNETO IS NOT INTERNALLY GROUNDED, WHEN THE GROUND LEAD IS DISCONNECTED THE MAGNETO IS HOT. REMOVING THE HARNESS ASSEMBLY FIRST AND INSTALLING IT LAST MINIMIZES THE DANGER OF STARTING THE ENGINE ACCIDENTALLY WHEN THE GROUND LEAD IS REMOVED FROM THE MAGNETO.

(9) Replace the harness cap onto the magneto. Align the index marks made on the harness cap and distributor housing when removed.

(10) Connect the P-lead and pressurization tube to magneto. Connect the retard breaker lead to the starting circuit to the left magneto.

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DISTRIBUTION

1. Ignition Harness

A. Inspection

(1) Check lead assemblies for nicks, cuts, mutilated braiding, badly worn section or any other evidence of physical damage. Inspect spark plug sleeves for chafing or tears, and damage or stripped threads on coupling nuts. Check compression spring is not broken or distorted. Inspect grommet for tears. Check all mounting brackets and clamps to see that they are secure and not cracked.

(2) Use an ohmmeter, buzzer, or other suitable low voltage device, and check each lead for continuity. If continuity does not exist, wire is broken and must be replaced.

(3) For electrical test of harness assembly, use high voltage, direct current tester such as TAKK model 86 or 86A or equivalent direct current high voltage tester capable of delivering test potential of 10,000 volts. Connect ground lead to high voltage tester to outer shielding braid of a single lead. Connect plug terminal. Turn tester ON and apply 10,000 volts. Insulation resistance should be 100 megohms minimum. Check all other harness leads in same manner.

(4) Minor repair to harness assembly, such as replacement of contact springs, spring retainer assemblies, insulating sleeves, or of one lead assembly, is done with harness assembly mounted on engine. To replace more than one lead assembly or cable outlet plate, harness should be removed from engine and sent to an overhaul shop.

B. Removal

(1) Disconnect clamps holding wires to engine and accessories.

(2) Loosen coupling nuts at spark plugs and remove insulators from spark plug barrel well. Do not damage insulator spring when withdrawing insulator.

(3) Place a guard over harness insulators.

(4) Remove harness assembly terminal plate from magneto.

(5) Remove harness from airplane.

C. Disassembly

(1) To remove spring, Slick M-2929, from damaged lead, turn spring counterclockwise while pulling gently. This will remove spring and M-1498 electrode screw from end of coiled conductor.

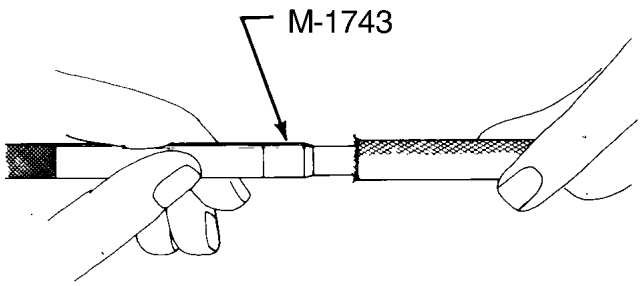
(2) To separate spring and screw, hold electrode screw with pliers and turn spring clockwise until it is through the threaded portion.

(3) Remove insulator sleeve from end of wire.

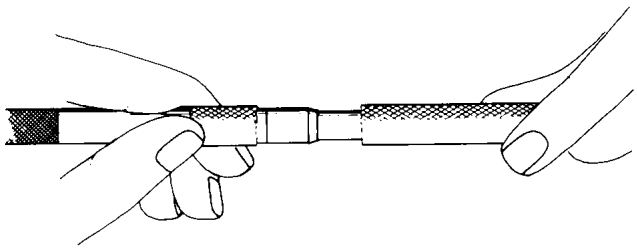
(4) To remove lead from M-1569 harness cap, use diagonals or cutting pliers and cut lead off close to cap. Use drift or punch to tap ferrule loose from harness cap.

NOTE: Further service on Slick harnesses will require the use of Slick T-200 or M-1495 Service Tool Kit, obtained from:

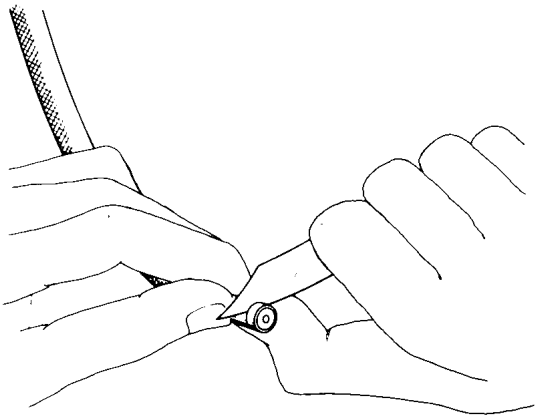
Unison Industries.
530 Blackhawk Park Avenue
Rockford, IL 61161



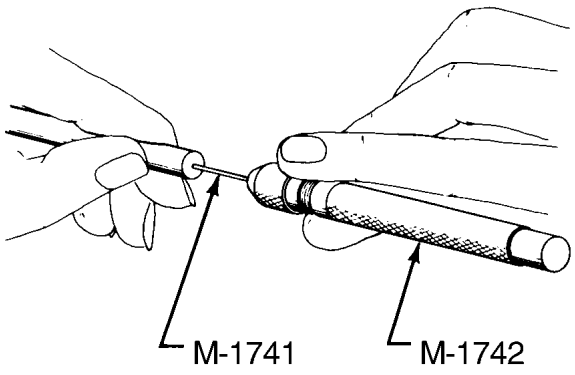
Stipping Tool
Figure 1



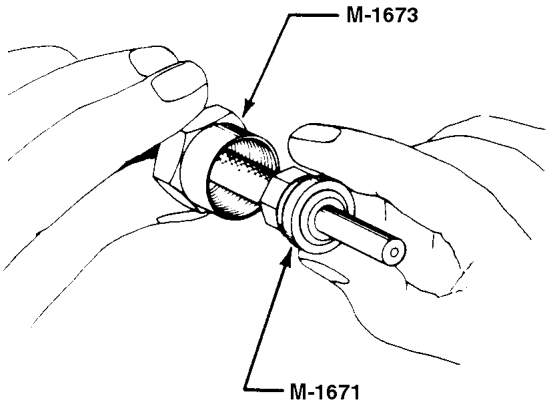
Inserting Stipping Tool
Figure 2



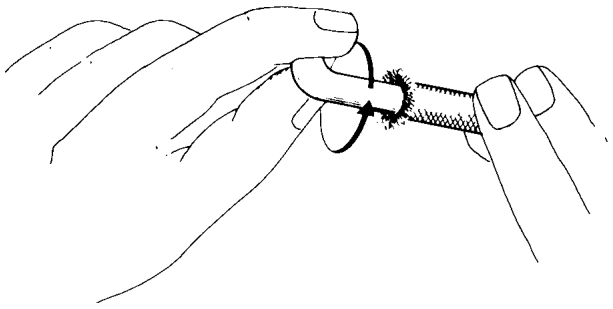
Cutting Insulation
Figure 3



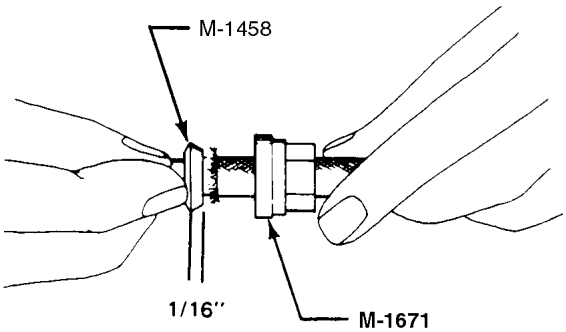
Removing Silicone Rubber from Wire
Figure 4



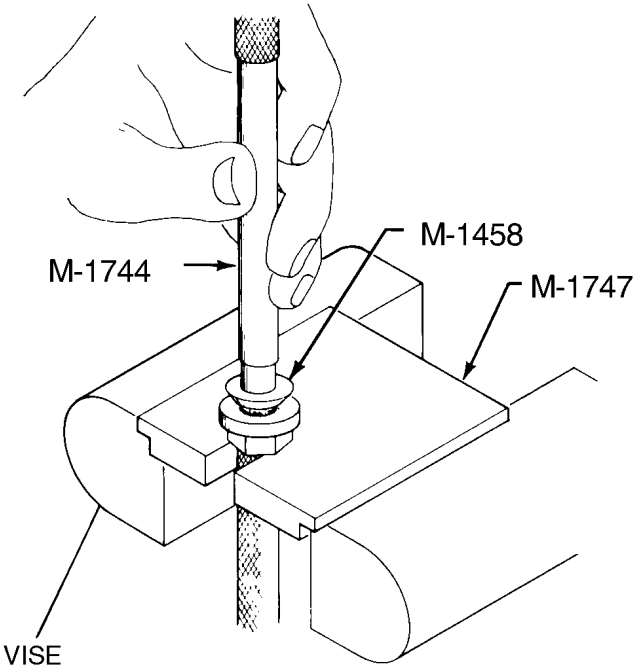
Installation of Plug Endnut
Figure 5



Flaring out the Shielding
Figure 6



Installation of Ferrule
Figure 7



Driving Tool
Figure 8

D. Assembly

(1) Cut a piece of harness wire to length required. Do not stretch wire when measuring it.

(2) On magneto end, make a final mark one inch from wire end. Another mark must be made 0.9375 inch from spark plug end of wire.

(3) Flare out shielding, then without allowing any shielding to fold under, insert Slick T-112 or M-1743 stripping tool under braided shielding. (See Figure 1.)

(4) Make sure stripping tool is inserted past cutting mark, and cut shielding with a sharp knife using a rolling motion. Remove shielding and stripping tool. Do not cut silicone insulation. (See Figure 2.)

(5) Cut exposed insulation 0.125 inch back from end and roll insulation clockwise to remove. Do not use a pulling motion when removing insulation. Trim end of coiled conductor to make a clear hole for inserting stud. (See Figure 3.)

(6) Using T-111 or M-1742 pin vise, insert T-110 or M-1741 drill (#72 drill), drill out silicone rubber from inside coiled conductor approximately 0.5 inch deep. (See Figure 4.)

(7) On spark plug end of wire install M-1673 nut followed by M-1671 female taper hex ferrule. (See Figure 5.)

(8) After installation of nut and ferrule, bend and rotate silicone insulation as per Figure 6 to flare out shielding so drive ferrule can be inserted. Do not cut silicone insulation with sharp braiding while wire is being rotated.

CAUTION: DO NOT REUSE THE M-1458 DRIVE FERRULE.

(9) On spark plug end of wire install M-1458 male tapered drive ferrule over silicone insulation and under shielding to within 0.0625 inch from flange of ferrule. Make sure that shielding is away from ferrule flange then slide ferrule M-1671 over the M-1458 drive ferrule until tight. (See Figure 7.)

(10) For spark plug end, mount M-1747 drive plate in a bench vise. Set hex ferrule in drive plate slot. Drive M-1458 drive ferrule flush against the hex ferrule using the M-1744 drive tool. (See Figure 8.) Or, press into place using T-109 pressing tool.

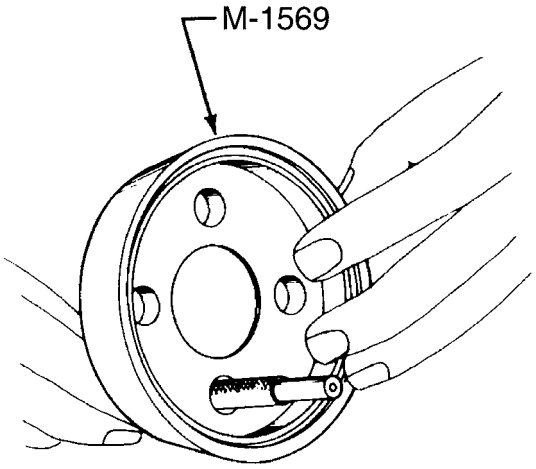
(11) For magneto end of wire, insert wire through hole in M-1569 harness cap so shielding is through hole as shown in Figure 9.

(12) Install an M-1458 male tapered drive ferrule over insulation and under shielding as in step 9, then drive ferrule into M-1569 harness cap using M-1744 drive tool, similar to step 10. (See Figure 10.) Or, press into place using T-109 pressing tool.

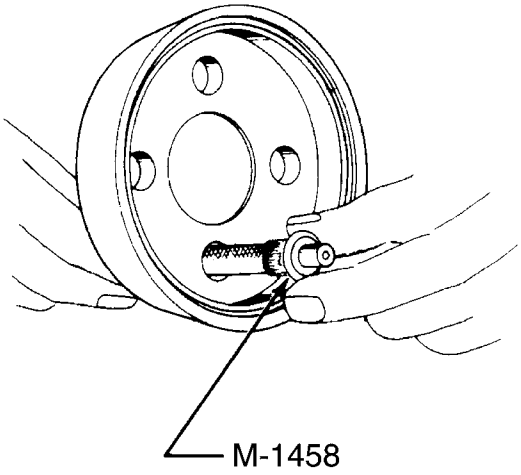
(13) Clamp threaded end of M-1498 electrode screw in T-111 or M-1742 pin vise. Insert tapered pin of electrode screw into center of coiled conductor by turning pin vise counterclockwise and pushing at same time until screw is flush with insulation. This is done at both ends of the wire assembly. (See Figure 11.)

(14) On magneto end of wire, place M-1738 insulator sleeve (brown, 0.75 inch long) over silicone insulation. On spark plug end of wire, use M-1677 insulator sleeve. (See Figure 12.)

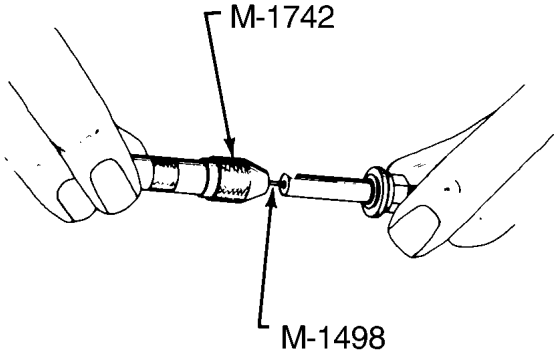
(15) Turn M-2929 spring clockwise on electrode screw three full turns until end is flush with first large coil of spring. This applies to both ends of wire. (See Figure 13.)



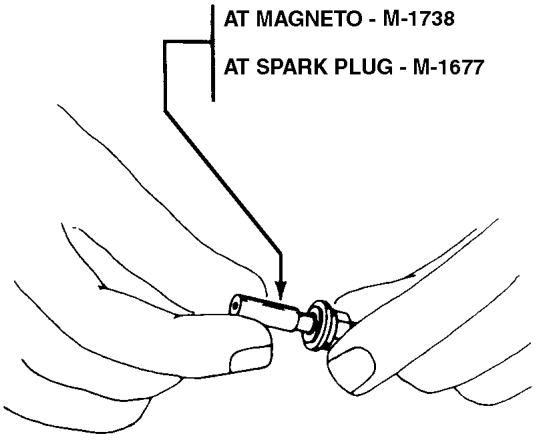
Installation of Harness Cap
Figure 9



Securing Wire in Harness Cap
Figure 10



Installation of Electrode Screw
Figure 11



Installation of Insulator Screw
Figure 12

E. Installation

(1) Before installing harness on magneto, check mating surfaces for cleanliness.

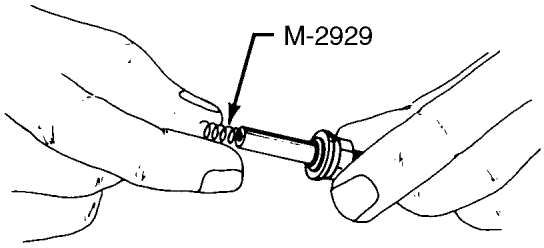
(2) Place harness terminal plate on magneto and tighten nuts around plate alternately to seat cover squarely on magneto.

NOTE: The left magneto is wired to fire all top spark plugs in this engine. The right magneto fires all bottom plugs.

(3) Route ignition wires to their respective cylinders.

(4) Clamp harness assembly in position and replace engine baffle plate.

(5) Connect leads to spark plugs.



Installation of Spring
Figure 13

2. Spark Plugs (See Figure 14.)

A. Removal

CAUTION: WHEN WITHDRAWING IGNITION CABLES LEAD CONNECTION FROM PLUG, CAREFULLY PULL LEAD STRAIGHT OUT AND IN LINE WITH CENTER LINE OF PLUG BARREL; OTHERWISE, A SIDE LOAD WILL BE APPLIED WHICH FREQUENTLY RESULTS IN DAMAGE TO BARREL INSULATOR AND CONNECTOR. A LEAD CANNOT BE REMOVED EASILY IN THIS MANNER, RESISTING CONTACT BETWEEN NEOPRENE COLLAR AND BARREL INSULATOR WILL BE BROKEN BY A ROTARY TWISTING OF COLLAR. AVOID UNDUE DISTORTION OF COLLAR AND POSSIBLE SIDE LOADING OF BARREL INSULATOR.

(1) Loosen coupling nut on harness lead and remove terminal insulator from spark plug barrel well.

CAUTION: DUE TO GREATER TORQUE VALUE REQUIREMENTS, TORQUE WRENCHES SHOULD NOT BE USED TO REMOVE SPARK PLUG.

CAUTION: DO NOT ALLOW FOREIGN OBJECTS TO ENTER SPARK PLUG HOLE.

(2) Remove spark plug from engine.

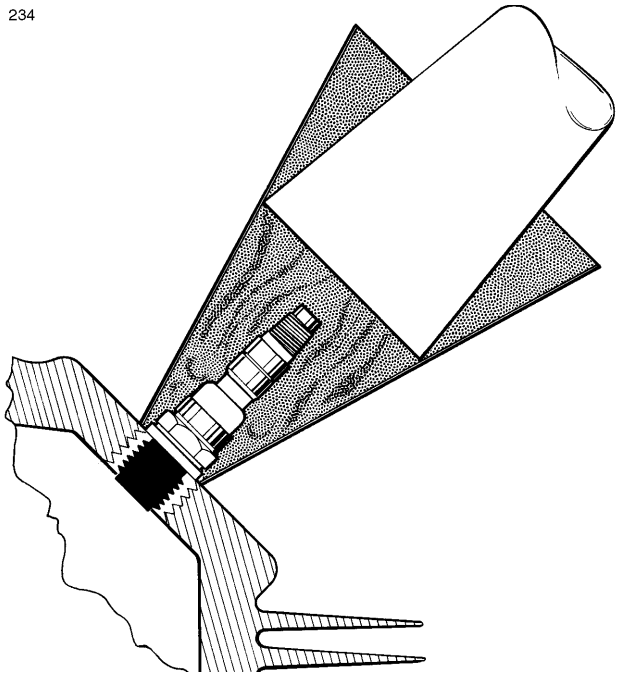
(a) In the course of engine operation, carbon and other combustion products are deposited on the end of spark plugs and will penetrate lower threads to some degree. As a result, a greater torque is required for removing a plug than for installation. Torque limitations given do not apply to plug removal, as sufficient torque must be used to unscrew plug.

(b) The higher torque required to remove plugs 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.

(3) Immediately upon removal, place spark plugs in a tray in a manner that will identify their position in the engine.

(4) Removal of seized spark plugs in cylinder is done by application of liquid carbon dioxide (CO_2) by a conical metal funnel adapter with a hole at the apex just large enough to accommodate the funnel of a 20-lb bottle. (Refer to Figure 14.) When a seized spark plug cannot be removed by normal means, funnel adapter is placed over and around spark plug. Place funnel of CO_2 bottle inside funnel adapter and release carbon dioxide to chill and contract spark plug. Break spark plug loose with a wrench. A warm cylinder head at the time carbon dioxide is applied will aid in removal of excessively seized plug.

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Removing Frozen Spark Plug
Figure 14

B. Inspection And Cleaning

(1) Visually inspect each spark plug for the following non-repairable defects.

(a) Severely damaged shell or shield; threads nicked up, stripped, or crossthreaded.

(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 percent of original size.

(2) Clean spark plug as required; remove carbon and foreign deposits.

(3) Test spark plug both electrically and for resistance.

(4) Set electrode gap at 0.017 to 0.021 inch.

C. Installation

CAUTION: DO NOT INSTALL ANY SPARK PLUG THAT HAS BEEN DROPPED.

(1) Before installing spark plugs, make sure that threads within cylinder are clean and not damaged.

CAUTION: MAKE CERTAIN DEEP SOCKET IS PROPERLY SEATED ON SPARK PLUG HEXAGON AS DAMAGE TO PLUG WILL RESULT IF WRENCH IS COCKED TO ONE SIDE WHEN PRESSURE IS APPLIED.

(2) Apply anti-seize compound sparingly on threads; install gasket and spark plugs. Tighten to a torque of 360 to 420 inch-pounds.

(3) Carefully insert terminal insulator in spark plug and tighten coupling nut per Chart 1.

CHART 1
SPARK PLUG COUPLING TORQUE

Application	Spark Plug Coupling Threads	Torque (In. - lb.)
All spark plugs	5/8-24	90 - 95

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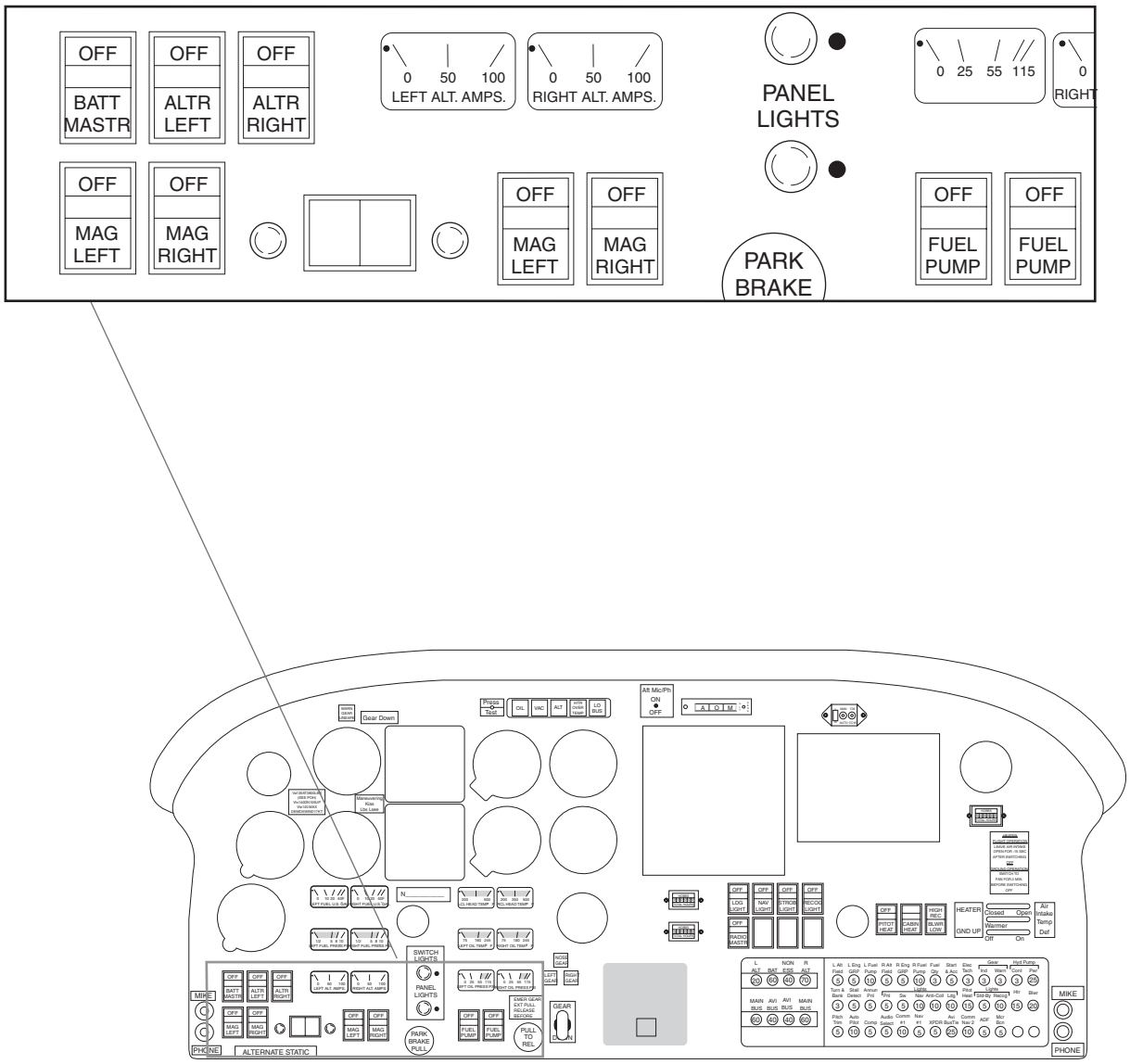
SWITCHING

Magneto and Starter Switches

The magneto switches and the starter switch are located in the instrument panel.

Removal and Installation

See Switches, 39-10-00.



Magneto and Starter Switches
Figure 1

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CHAPTER

76

ENGINE CONTROLS

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CHAPTER 76

LIST OF EFFECTIVE PAGES

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	2	Mar 15/06			
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CHAPTER 76 - ENGINE CONTROLS

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Throttle Adjustment		1	6E15
Mixture Adjustment		1	6E15

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POWER CONTROL

Throttle and Mixture Controls

A. Throttle Adjustment (See Figure 1.)

With the engine throttle control at full throttle position, rig quadrant throttle lever to provide a 0.030 to 0.060 inch cushion from forward stop. Adjust the throttle as follows:

(1) Disconnect the clevis end of the throttle control cable from the control arm at the carburetor. Loosen the jam nut that secures the clevis end.

(2) Adjust the linkage by rotating the clevis end of the cable to obtain 0.030 to 0.060 inch cushion on instrument panel stop when in full throttle position.

(3) Reconnect the clevis end to the control arm and safety.

B. Mixture Adjustment (See Figure 1.)

With the engine mixture control at full rich position, rig quadrant mixture lever to provide a 0.030 to 0.060 inch cushion from forward stop. Adjust the mixture as follows:

NOTE: Check the routing and security of the mixture cable to prevent interference between the cable and the nose gear linkage.

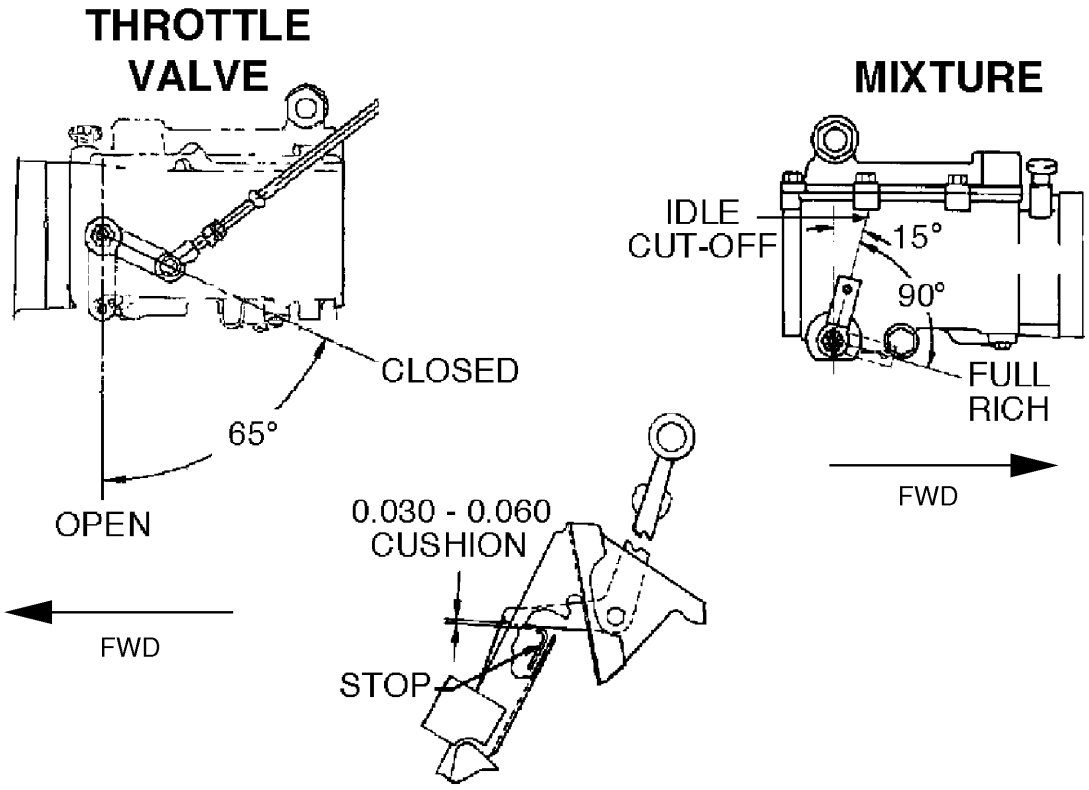
(1) At the carburetor, disconnect the clevis end of the mixture control cable from the control arm. Loosen the jam nut that secures the clevis end.

(2) Adjust the linkage by rotating the clevis end on the cable to obtain a 0.030 to 0.060 inch cushion from the instrument panel stop when in full rich position.

(3) Reconnect the clevis end to the control arm and safety.

NOTE: Check security of cable casing attachments.

C. Pull the throttle and mixture cockpit levers full aft to ensure that the carburetor idle screw contacts its stop and the carburetor mixture control arm contacts its lean position.



Engine Controls Adjustment
Figure 1

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CHAPTER

77

ENGINE INDICATING

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CHAPTER 77

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CHAPTER 77 - ENGINE INDICATING

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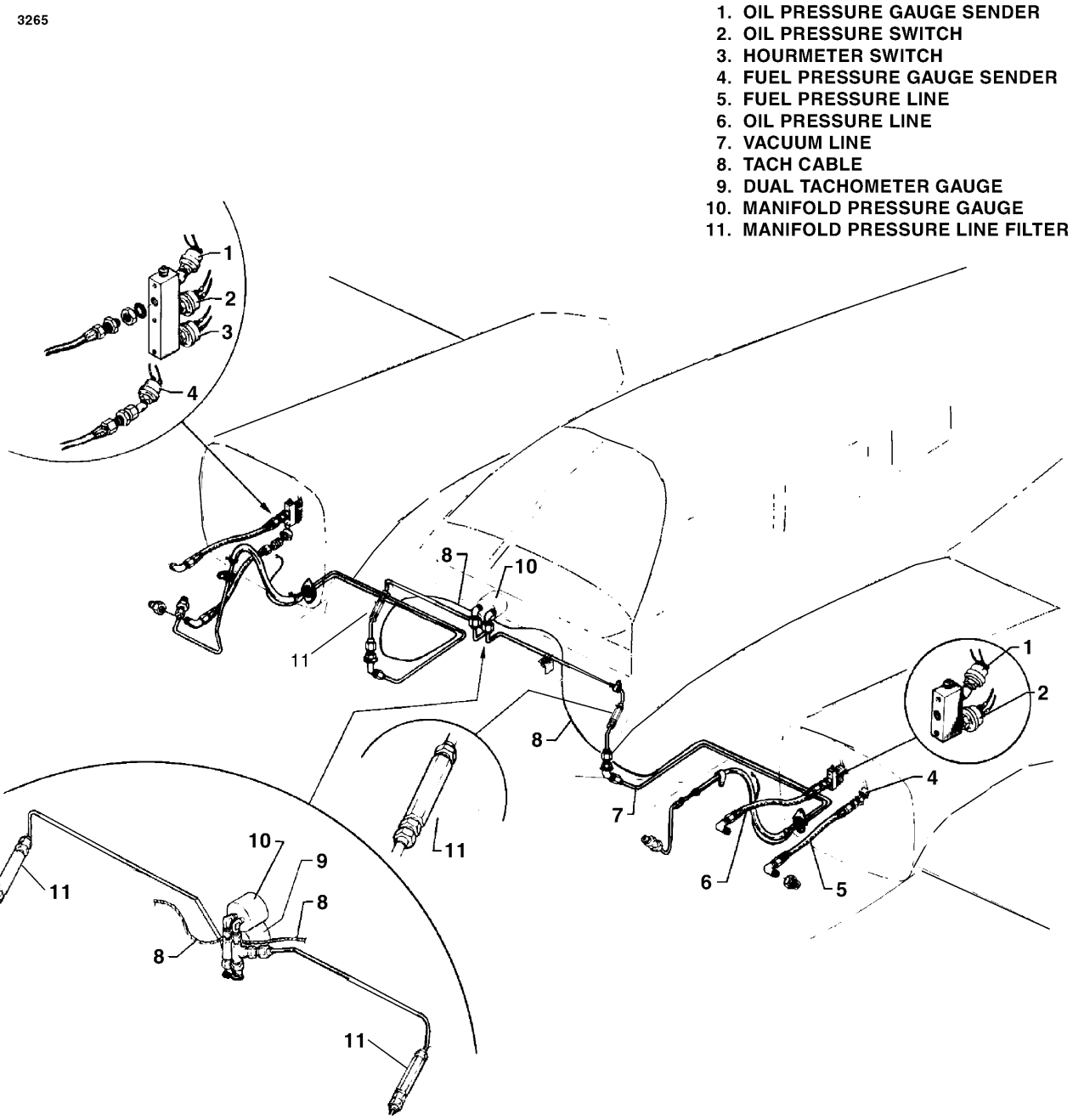
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GENERAL

NOTE: In S/N's 4496174; and, 4496224 and up, for airplanes equipped with the optional Avidyne Entegra system; engine data is collected by the Data Aquisition Unit (DAU) and is displayed on the Multi-Function Display (MFD) and Primary Flight Display (PFD). See Electronic Flight Instrument System, 34-20-00, and 91-77-40.

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 instrumentation may be seen in Figure 1.



Engine Instrumentation Lines Installation
Figure 1

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POWER

NOTE: In S/N's 4496174; and, 4496224 and up, for airplanes equipped with the optional Avidyne Entegra system; engine data is collected by the Data Aquisition Unit (DAU) and is displayed on the Multi-Function Display (MFD) and Primary Flight Display (PFD). See Electronic Flight Information System, 34-20-00, and 91-77-40.

1. Manifold Pressure Gauge (See 77-00, Figure 1.)

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.

A. Troubleshooting

See Chart 1.

B. Removal and Replacement

See 39-10-00.

CHART 1
TROUBLESHOOTING MANIFOLD PRESSURE GAUGE

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.

C. Manifold Pressure Line Filters

Contaminents such as moisture and fuel may enter the manifold pressure gauge through the line connecting the gauge to the port on the engine. In S/N's 4496027 and up, this condition has been remedied by factory installation of in-line filters. These filters should be replaced on condition/as required.

These filters may be installed in S/N's 4496001 thru 4496026 as follows:

(1) Materials Required

(a) P/N 84015-105 (1 each line).

(b) P/N 84015-106 (1 each line).

(c) P/N/ 84015-107 (1 each line)

(d) P/N 84015-108 (1 each line).

(e) P/N 78651-000 (2 each filter housings).

(f) P/N 476-608 (2 each union)

(g) P/N 560-686 (2 each filter)

(2) Procedure

(a) Remove the cockpit seats and interior side panels as required to gain access to the aft side of the instrument panel. Locate the position of the manifold pressure gauge. (See Figure 1.)

(b) The existing configuration of the manifold pressure system is shown in Figure 1, top. The new configuration containing the new filter assemblies and instrument lines is shown in Figure 1, bottom. Refer to each as required.

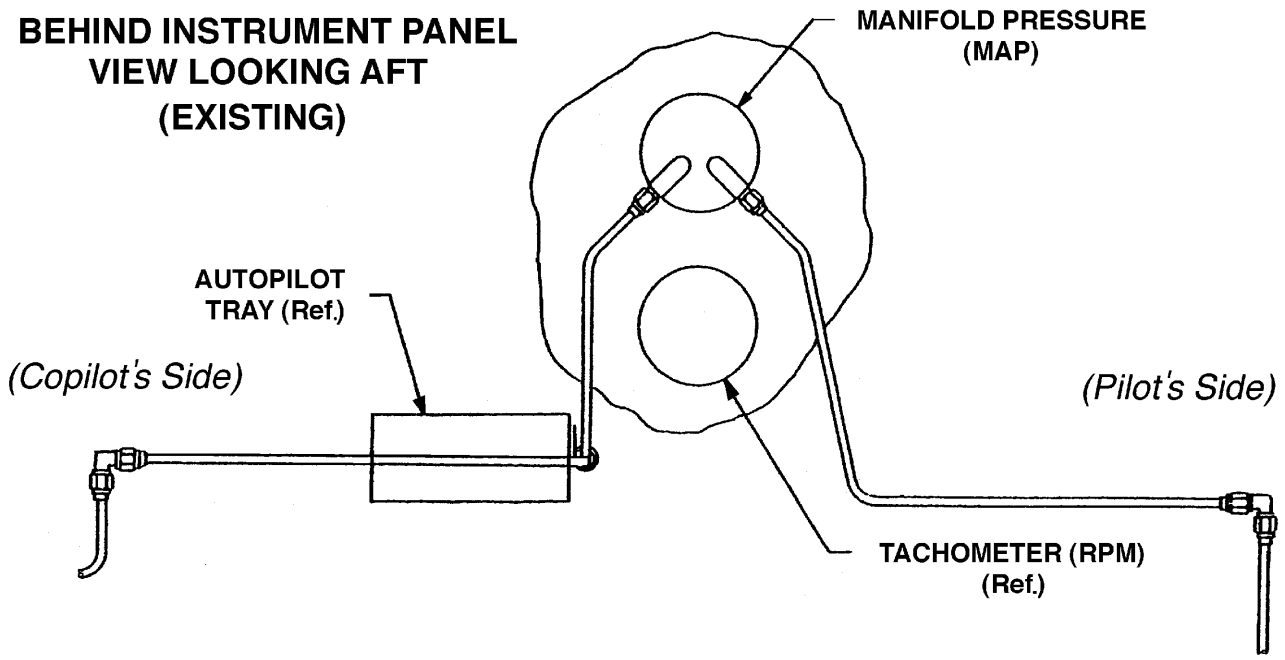
(c) Remove and discard the mainfold pressure instrument lines extending from the existing elbows to the next in-line connection leading to the left and right engine (See Figure 1.)

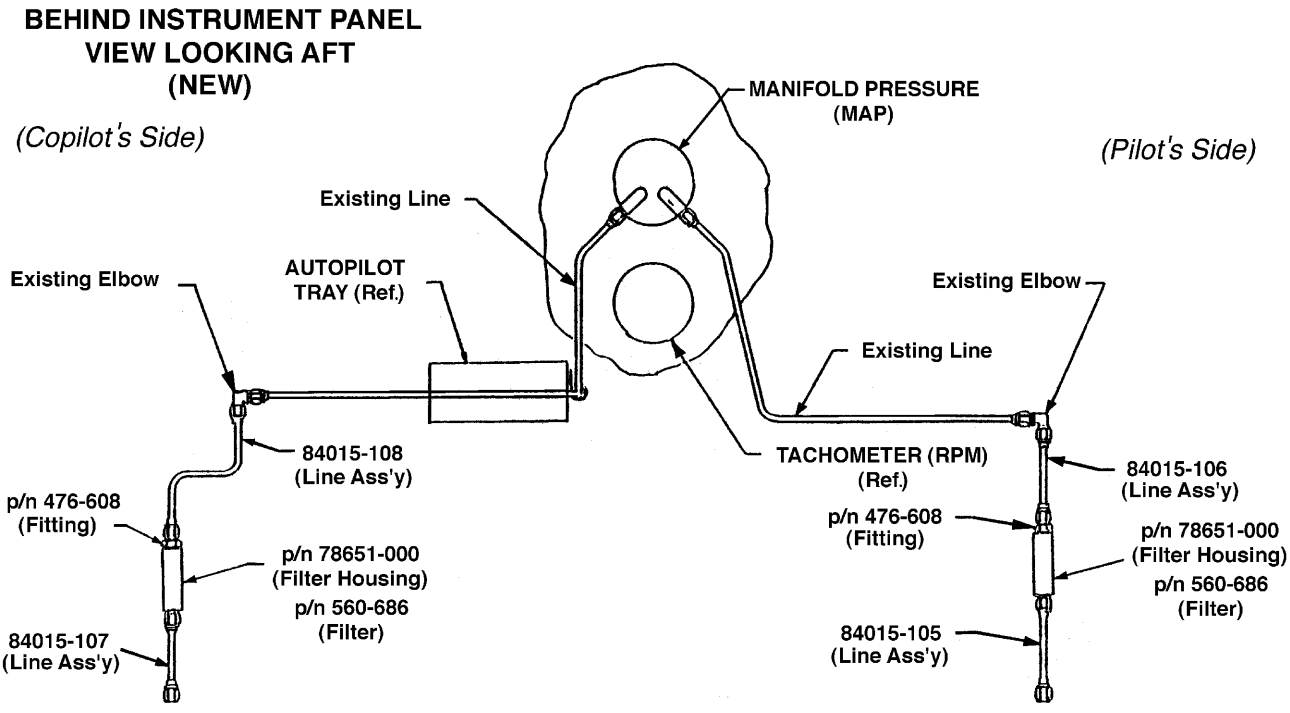
(d) Install the instrument lines as shown in Figure 2. Insert P/N 560-686, Filter, into the two Filter Housings, P/N 78651-000. Install Fittings, P/N 476-608, into each housing. Connect the existing instrument lines to the filter housing as shown in Figure 1.

(e) Check for security of the instrument lines and filter assembly installation and reinstall the cockpit seats and side panels. Check the seat stop and seat belt installation. Assure proper movement of the seats.

(f) Perform and engine ground run to ensure proper operation of the manifold pressure gauge.

(g) Make an appropriate logbook entry.





Manifold Pressure Line Filter Installation
Figure 1

2. Tachometer (See Figure 2.)

The tachometer is electric and provides an indication of crankshaft speed in revolutions per minute. It receives its information from a magnetic sensor mounted on the left magneto. It is located on the pilot's side of the instrument panel below the dual manifold pressure gauge. (Refer to Chapter 91 for electrical schematic.)

A. Removal and Replacement

Refer to Chapter 39 and Removal of Face Mounted Instruments.

3. Magnetic Sensor

A. Removal

(1) Access the left rear area of the engine.

(2) Locate the magnetic sensor on the right side of the left magneto. Trace the sensor wiring harness to the quick connector and disconnect.

(3) Unscrew the magnetic sensor from the magneto housing.

B. Installation

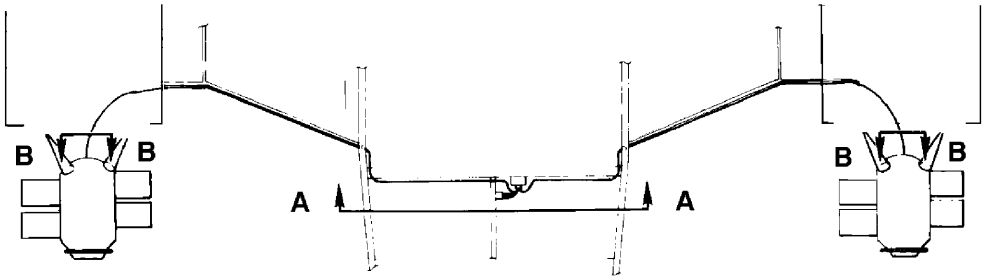
(1) Connect the sensor wiring harness to the quick connect.

(2) Install the magnetic sensor to the magneto housing using attachment screws.

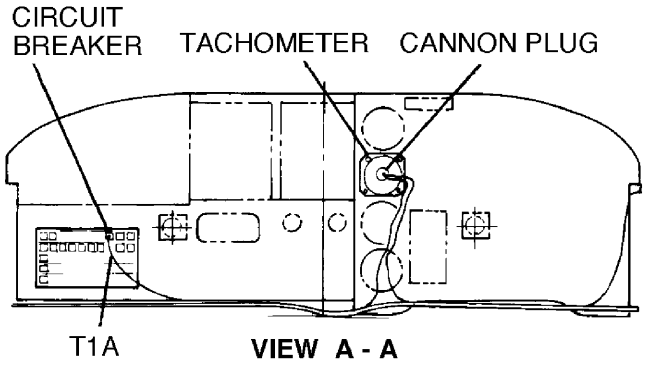
CHART 2
TROUBLESHOOTING TACHOMETER

Trouble	Cause	Remedy
Both pointers inoperative.	Circuit breaker tripped.	Reset circuit breaker.
One pointer inoperative.	Defective magnetic sensor.	Replace magnetic sensor.
One pointer inaccurate.	Defective instrument.	Replace tachometer.

CAUTION: ADJUSTMENT AND REPAIR OF THE TACHOMETER IS ONLY AUTHORIZED BY QUALIFIED INSTRUMENT REPAIR FACILITES.

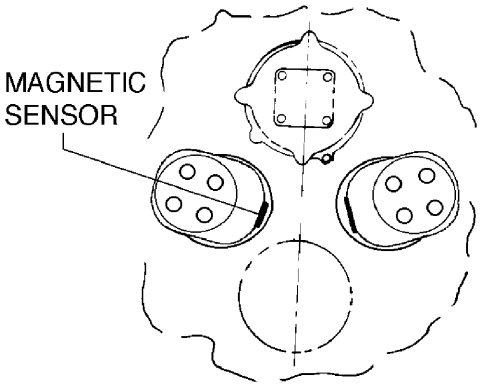


PLAN VIEW



VIEW A - A

— NOTE —
See Chapter 91 for
Electrical Schematic



VIEW B - B

Electric Tachometer Installation
Figure 2

CHART 3
TACHOMETER CALIBRATION DATA

RPM	PULSES / SECOND	TOLERANCE (RPM)
500	8.33	±25.0
1000	16.67	±25.0
1500	25	±25.0
2000	33.33	±25.0
2500	41.67	±25.0
2600	43	±25.0
3000	50	±40.0

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TEMPERATURE

NOTE: In S/N's 4496174; and, 4496224 and up, for airplanes equipped with the optional Avidyne Entegra system; engine data is collected by the Data Aquisition Unit (DAU) and is displayed on the Multi-Function Display (MFD) and Primary Flight Display (PFD). See Electronic Flight Information System, 34-20-00, and 91-77-40.

1. Exhaust Gas Temperature (EGT) Gauge

A. Description

This instrument aids the pilot in selecting the most economical fuel-air mixture for cruising flight at a power setting of 75% or less. It is a sensing device to monitor the fuel-air mixture leaving the engine cylinders. This gauge is adjustable. If it is found defective after checking with troubleshooting chart, it should be replaced. If the leads to the gauge are defective in any way, they should be replaced. When replacing leads, it is very important to use the same type and length of wire, as the resistance of the leads is critical for the proper operation of this gauge. The EGT probe is the clamp mounted type which is adjusted for proper depth into the exhaust stream.

B. Troubleshooting

See Chart 1.

C. Removal

(1) Gauge

Refer to Chapter 39 and Removal of Face Mounted Instruments.

(2) Probe

(a) Remove wires from the wire harness going to the engine.

(b) Loosen the nut or clamp which secures the EGT probe to the exhaust system and remove the probe.

CHART 1
TROUBLESHOOTING EGT GAUGE

Trouble	Cause	Remedy
Gauge inoperative.	Master Switch OFF.	Turn switch ON.
	Circuit Breaker OUT.	Push breaker IN.
	Defective gauge, probe or wiring.	Check probe and lead wires for chafing, breaks or shorting between wires and/or metal structure.
	Adjusting potentiometer turned off scale.	Reset potentiometer.
Fluctuating reading.	Loose, frayed or broken electrical leads or faulty connections.	Clean and tighten connections. Repair or replace defective leads.

D. Cleaning and Inspection

Unless mechanical damage is evident, broken glass, bent or broken pointer, or broken case, the following checks should be performed before removing the instrument.

(1) Remove probe and check for broken weld (at the 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. Resistance with lead wires connected to probe should be 3.3 ohms. Clean connections with steel wool before reassembly.

CAUTION: DO NOT CONNECT OHMMETER. IT WILL BURN OUT THE MOVEMENT OF THE METER.

(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 instrument off and no indication will be shown on the pointer. If meter still does not read. replace it.

E. Installation

(1) Probe

(a) Install the probe and secure with locknut or clamp.

(b) Route the thermocouple wires along with the existing wire harness to the instrument panel.

(2) Gauge

Refer to Chapter 39 and Installation of Face Mounted Instruments.

F. EGT Peak Adjustment Procedure

While the aircraft is in operation at 7,000' pressure altitude, complete the procedure as follows:

(1) Set engine to 2500 RPM, and maximum manifold air pressure.

(2) Lean each engine to peak EGT or maximum lean for smooth operation.

(3) Adjust each EGT needle to align with the " * " on the gauge.

2. Cylinder Head Temperature (CHT) 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.

A. Troubleshooting

See Chart 2.

B. Removal and Replacement

Refer to Chapter 39 and Removal of Face Mounted Instruments.

CHART 2
TROUBLESHOOTING CHT GAUGE

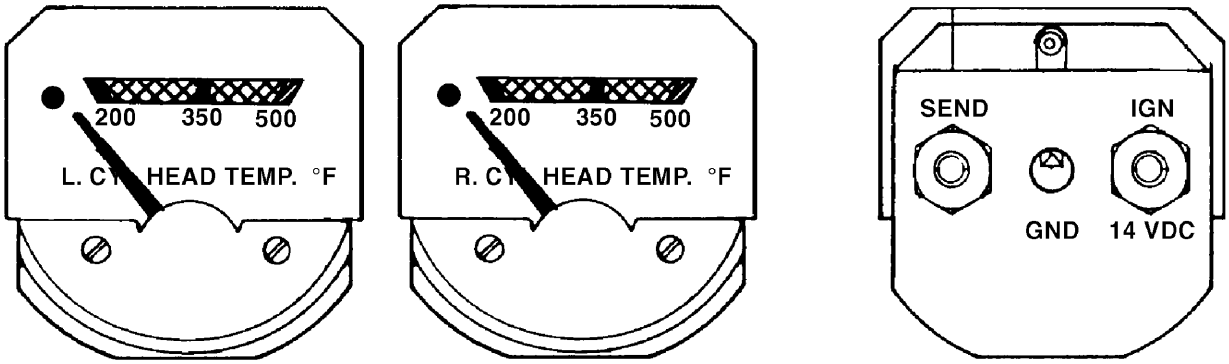
Trouble	Cause	Remedy
Instrument shows no indication.	Engine is cold.	Warm up engine.
	Power supply wire open.	Repair wire.
	Defective sender.	Replace sender.
	Defective instrument.	Replace instrument.
	Open circuit breaker.	Troubleshoot for fault.
Instrument goes all the way to upper stop.	Wire grounded between sender and gauge.	Repair wire.
	Defective sender.	Replace sender.

C. Calibration (See Figure 1)

See Chart 3 for use in verifing 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).
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.



Cylinder Head Temperature Calibration
Figure 1

CHART 3
CYLINDER HEAD TEMPERATURE CALIBRATION CHART

GRADUATION	OHMS	DEGREES	TOLERANCE*
DOT	MECH ZERO	-40°	± 1/2
200° F	745	-30°	± 1
350° F	110	+5°	± 1
500° F	34	+28°	+ 1, - 0

*Note: Tolerance is in pointer widths.

Use 14 VDC.

Use with SW338 or Rochester Gauge 3080 14 Sender (“Q” Curve)

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CHAPTER

78

EXHAUST

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CHAPTER 78

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CHAPTER 78 - EXHAUST

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GENERAL

Exhaust System

A. 100 Hour Inspection (See Figure 1.)

WARNING: A VERY THOROUGH INSPECTION OF THE ENTIRE EXHAUST SYSTEM, INCLUDING EXHAUST HEATER MUFF ASSEMBLY, CROSSOVER TUBES, MUFFLER AND MUFFLER BAFFLES, STACKS AND ALL EXHAUST CONNECTIONS AND WELDS MUST BE ACCOMPLISHED AT EACH 100 HOUR INSPECTION.

The possibility of exhaust system failure increases with use. Check the system even more carefully as the number of hours increase; for example an inspection at the 700 hour period would be more critical than one in the 100 hour period. The system should also be checked carefully before winter operation when cabin heat will be used.

NOTE: When installing an exhaust clamp having an alignment pin be certain that the pin engages the mating holes in exhaust pipe and muffler to prevent separation of components.

(1) Removal of the tail pipe and stacks are required for inspection of the muffler baffles.

(2) Remove or loosen all exhaust shields, cabin heat shroud, heat blankets, etc., as required to permit inspection of the complete system.

(3) Perform the necessary cleaning operations and inspect all external surfaces for dents, cracks and missing parts.

(3) Pay particular attention to welds, clamps, supports and support attachment lugs, slip joints, stack flanges and gaskets.

(4) Inspect internal baffles or diffusers. Any cracks, warpage or severe oxidation are cause for replacement of muffler or tail pipe assembly.

(5) If any component is inaccessible for a thorough visual inspection, accomplish one of the following:

(a) Perform a submerged pressure check of the muffler and exhaust stack at 2 psi air pressure.

(b) Conduct a ground test using a carbon monoxide indicator by heading the airplane into the wind, warming the engine on the ground, advancing the throttle to full static RPM with cabin heat valves open, and taking readings of the heated airstream inside the cabin at each outlet. Appropriate sampling procedures applicable to the particular indicator must be followed. If carbon monoxide concentration exceeds .005 percent or if a dangerous reading is obtained on an indicator not calibrated in percentages, the muffler must be replaced.

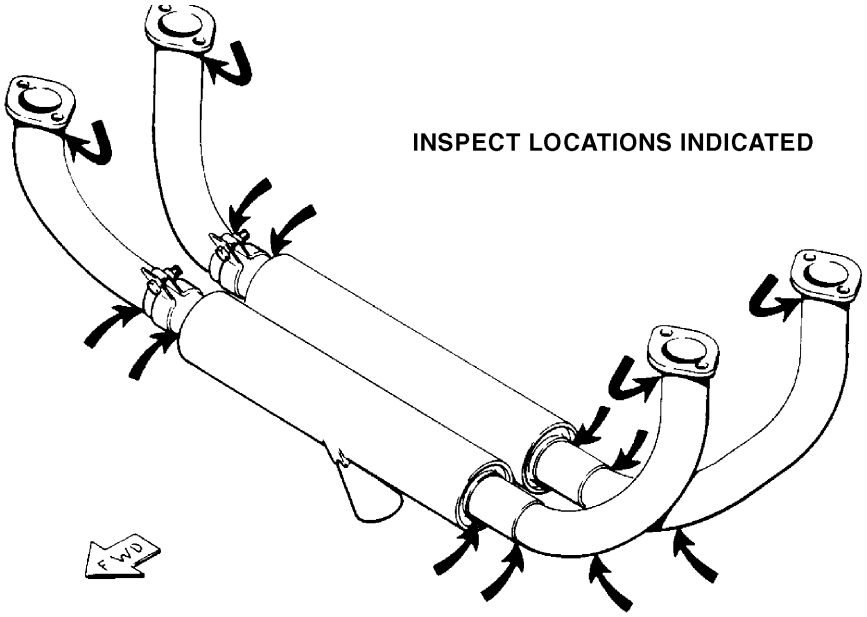
B. Removal

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.



Muffler Inspection
Figure 1

C. Installation

(1) Position exhaust system on engine and attach hardware.
(2) Connect alternate air tube to shroud and attach hardware.
(3) Install lower cowl. (See 71-10-00.)

D. Muffler Leak Test

NOTE: Inspect each muffler slip joint for excessive exhaust leakage (See Figure 1). Minor discoloration and leakage is normal. If excessive leakage is evident, repair (in accordance with latest revision of AC 43.13-1) or replace as required.

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.

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CHAPTER

79

OIL

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CHAPTER 79

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CHAPTER 79 - OIL

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GENERAL

Installation of Oil Cooler

A. When installing fittings in the oil cooler, care should be used to prevent excessive torque being applied to the cooler. When a rectangular fitting boss is provided, backup wrench should be used, employing a scissor motion, so that no load is transmitted to the cooler. When the oil cooler has a round fitting boss. care should be taken not to permit excessive torque on the fittings.

B. If a pipe thread fitting is used, it should be installed only far enough to seal with sealing compound.

C. Apply Lubon No. 404 to all male pipe thread fittings; do not allow sealant to enter the system.

D. Oil line routing should provide .50 in, minimum clearance between oil line and engine, engine mount or cowling, except for oil outlet line where it crosses over the engine mount. This area should have a clearance of .75 in. minimum.

E. If fitting cannot be positioned correctly using a torque of 9 to 15 foot-pounds, another fitting should be used.

F. When attaching lines to the cooler, a backup wrench should be used.

G. After installation, inspect the cooler for distorted end cups.

H. 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.

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INDICATING

NOTE: In S/N's 4496224 and up, for airplanes equipped with the optional Avidyne Entegra system, oil temperature and pressure data is collected by the Data Aquaisition Unit (DAU) and is displayed on the Multi-Function Display (MFD and Primary Flight Display (PFD). See Electronic Flight Information System, 34-20-00, and 91-77-40, Figure 1.

1. Oil Pressure Indicator

The oil pressure gauges are mounted in adjacent configuration on the instrument panel. 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 iondicate 0 psi +1 needle width.

A. Troubleshooting

See Chart 1.

B 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.

(1) Removal

Removal is accomplished by the following:

(a) Disconnect the electrical leads from the particular unit. It is suggested that the leads be marked for easy connection upon reinstallation of the sensor.

(b) Unscrew the unit from the manifold.

(c) Catch spillage and cover the fitting on the manifold to prevent foreign matter from entering the system.

(2) Installation

(a) 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.

(b) Remove the protective cover from the fitting and screw the unit into the manifold.

(c) Reconnect the electrical leads to the unit.

(d) Perform an operational check of the system.

NOTE: Refer to Chapter 91 for Electrical Schematics.

(3) Test (See Chart 2.)

The oil pressure sender works on the relationship of pressure to resistance. As the pressure increases so does the resistance and inturn alters the position of the needle of the instrument. To test the sender the following procedure should be followed:

(a) Connect a calibrated pressure source to the pressure port.

(b) Attach ohmmeter leads to the one pole extending from the sender and one to the sender itself.

(c) Raise and lower the pressure to the sender and crosscheck with the required tolerances in Chart 1.

CHART 1
TROUBLESHOOTING - OIL PRESSURE INDICATOR

Trouble	Cause	Remedy
Excessive error at zero.	Pointer loose on shaft. Overpressure or seasoning of burdon tube.	Replace instrument.
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation. leaks.	Air in line or rough engine relief.	Disconnect line and fill with light oil. Check for 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.

CHART 2
OIL PRESSURE SENDER TEST SPECIFICATIONS

Pressure (Psig)	Resistance (Ohms)	Tolerance(Ohms)
0	10	_
25	46	-5, +0
60	90	—
90	126	-0, +15

C. Calibration (See Chart 3 and Figure 1.)

A calibration chart has been included for use in verifing 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).

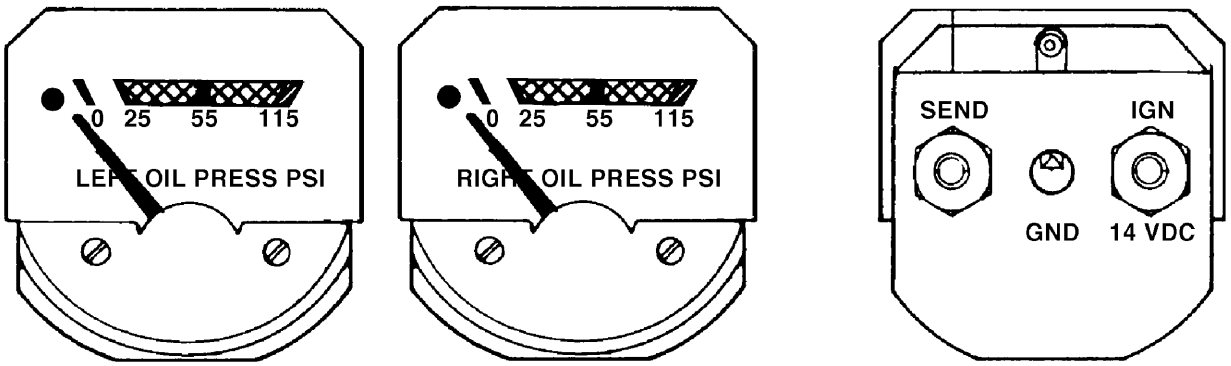
CHART 3
OIL PRESSURE CALIBRATION CHART

GRADUATION	OHMS	DEGREES	TOLERANCE*
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: Tolerance is in pointer widths.

Use 14 VDC.

Use with SW362 or Rochester Gauge 3060 18 Sender (“K” Curve)



Oil Temperature Gauge Calibration
Figure 1

2. Oil Temperature Indicator

A. Troubleshooting

See Chart 4.

B. Indicator

(1) Description

The oil temperature indicator is part of the combination engine gauge which also includes the oil pressure gauge and the cylinder head temperature gauge. This instrument will display a temperature indication of the engine oil in degrees Fahrenheit.

(2) Removal and Installation

See Face-mounted Instruments, 39-10-00.

C. Bulb

A standard temperature bulb, located in the oil filter housing on the engine accessory section, provides a signal to the indicator.

(1) Removal

(a) Remove safety wire from electrical connector and temperature bulb.

(b) Remove electrical connector.

(c) Unscrew and remove temperature bulb.

(2) Installation

(a) Screw in and tighten temperature bulb, then safety.

(b) Connect electrical connector and safety.

CHART 4
TROUBLESHOOTING - OIL TEMPERATURE INDICATOR

Trouble	Cause	Remedy
Instrument fails to show any reading.	Broken or damaged bulb. Wiring open.	Check engine unit and wiring to instrument.
Excessive scale error.	Improper calibration adjustment.	Repair or replace.
Pointer fails to move as engine is warmed up.	Broken or damaged bulb or open wiring.	Check engine unit and wiring.
Dull or discolored marking.	Age.	Replace instrument.

D. Calibration (See Chart 5 and Figure 2.)

A calibration chart has been included for use in verifying that the suspect 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).

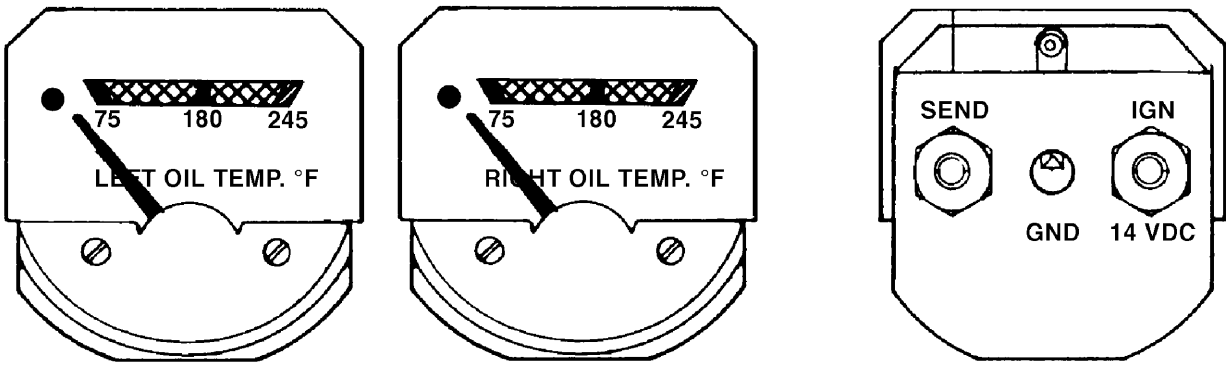
CHART 5
OIL TEMPERATURE CALIBRATION CHART

GRADUATION	OHMS	DEGREES	TOLERANCE*
DOT	MECH ZERO	-40°	± 1/2
75° F	903.5	-33.5°	± 1
180° F	100	+12.5°	± 1
245° F	36	+35°	+ 1, - 0

*Note: Tolerance is in pointer widths.

Use 14 VDC.

Use with SW362 or Rochester Gauge 3080 13 Sender (“E” Curve)



Oil Temperature Gauge Calibration
Figure 2

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CHAPTER

80

STARTING

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CHAPTER 80 - STARTING

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CRANKING

1. Description (See Figure 1.)

   When the starting circuit is energized, battery current is applied to the starting motor terminal. Current flows through the field coils creating a strong magnetic field. At the same time, current also flows through the brushes and commutator, and finally through the armature to ground. The result is a high cranking torque, for a limited period of time, with a high current flow at a minimum loss of voltage.

   The drive end gear of the armature mates with the reduction gear which drives the Bendix shaft. The Bendix drive is held in position on the shaft by a spirol pin. As the armature turns the reduction gear, the Bendix drive pinon meshes with the starter drive gear by inertia and action of the spirol grooves within the Bendix unit. A detent pin engages in a notch in the screw threads which prevents demeshing if the engine fails to start. When the engine does start and reaches a predetermined speed, centrifugal action forces the detent pin to release and allows the pinion to demesh from the starter drive gear.

2. Troubleshooting

   See Chart 1.

   NOTE: In Chart 1, for any remedy which requires disassembly` and cleaning or repair of the starter; replacement with a new, or known good, unit is always an alternative solution.

   NOTE: NEVER USE JUMPER CABLES to test voltage to the starter. The "toothed" jaws of jumper cables are meant to "bite" into soft, leaded terminals on car batteries, and simply WILL NOT provide enough contact with the starter terminal to supply the needed amperage to engage the starter properly.

   NOTE: Use an analog voltage meter if you can. Digital meters take intermittent 'snap shots' of voltage. In situations where voltage is being supplied intermittently (even in rapid cycles), the digital meter will simply not provide the correct 'picture' of the aircraft's voltage situation.

3. Starter

   WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

   A. Removal

      CAUTION: TO PREVENT SHORT CIRCUITING, DISCONNECT THE GROUND CABLE FROM THE BATTERY BEFORE REMOVING THE STARTER FROM THE ENGINE.

      (1) Disconnect starter cable from starter terminal post.
      (2) Remove mounting bolts.
      (3) Lift off starter motor.

   B. Installation

      (1) Clean all traces of rust, corrosion, or dirt from all mounting surfaces and mounting hardware. All ground points or straps must be clean and tight.
      (2) Place starting motor in position with no stresses or binding forces being present and install mounting bolts. Torque bolts to 204 in.-lbs. or as specified in Lycoming SSP-1776.
      (3) Reinstall starter cable to starter terminal post. Torque to 24 in.-lbs. or as specified in Lycoming SSP-1776.
      (4) Reconnect ground cable to negative post of battery.
      (5) Perform cranking tests, below.

CHART 1 (Sheet 1 of 2)
TROUBLESHOOTING - STARTER

Trouble	Cause	Remedy
Starter fails to operate.	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to wiring diagram and check all wiring.
	Defective starter solenoid or control switch.	Replace faulty unit.
	Binding, worn, or improperly seated brush, or brushes with excessive side play.	Brushes should be a free fit in the brush boxes without excessive side play. Binding brushes and brush boxes should be wiped clean with a gasoline (undoped) moistened cloth. A new brush should be run in until at least 50% seated; however, if facilities are not available for running in brushes, then the brush should be properly seated by inserting a strip of No. 0000 sandpaper between the brush and commutator with the sanded side next to the brush.
	CAUTION: DO NOT USE COARSE SANDPAPER OR EMERY CLOTH.	
		Pull sandpaper in the direction of rotation, being careful to keep it in the same contour as the commutator.
		After seating, clean thoroughly to remove all sand and metal particles to prevent excessive wear. Keep motor bearing free from sand or metal particles.
	Dirty commutator.	If commutator is rough or dirty, smooth and polish with No. 000 sandpaper. If too rough and pitted, remove and turn down. Blow out all particles.

CHART 1 (Sheet 2 of 2)
TROUBLESHOOTING - STARTER

Trouble	Cause	Remedy
Motor fails to operate. (continued)	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good condition.
	Grounded or open field circuit.	Test and then replace with new part.
Motor operates at proper speed but fails to crank.	Faulty Bendix drive.	Remove Bendix drive assembly. Clean and check engine. Reinstall.
Low motor and cranking speed.	Worn, rough, or improperly lubricated motor or starter.	Disassemble, clean, inspect and relubricate, replacing ball bearings, if worn.
	See electrical causes listed under “Stater fails to operate,” above.	See remedies listed for “Stater fails to operate,” above.
Excessive arcing of motor brushes.	Binding, worn, or improperly seated brush or brushes, with excessive side play.	See information above dealing with this trouble.
	Dirty, rough, pitted or scored commutator.	Clean as outlined above.
	Grounded or open field circuit.	Test and replace defective parts.
Excessive wear and arcing of motor brushes.	Rough or scored commutator.	Remove and turn commutator down on a lathe.
	Armature assembly not concentric.	Reface commutator.

4. Cranking Tests

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

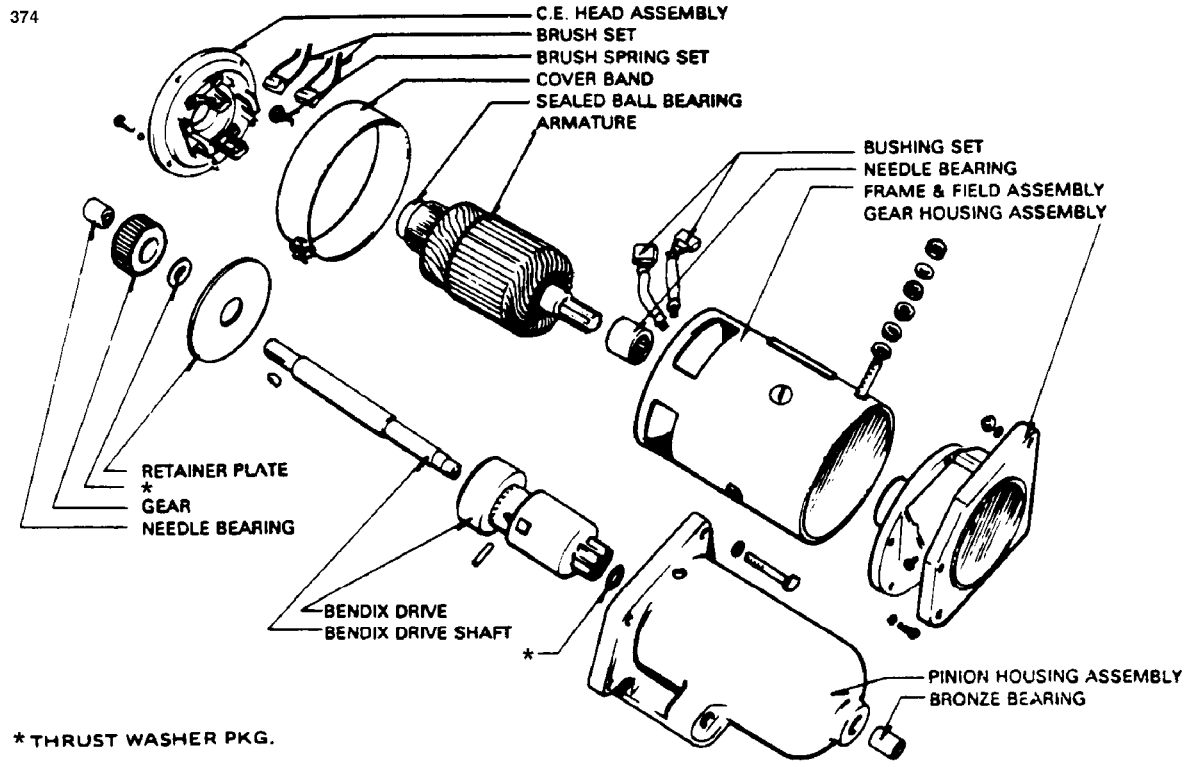
NOTE: NEVER USE JUMPER CABLES to test voltage to the starter. The "toothed" jaws of jumper cables are meant to "bite" into soft, leaded terminals on car batteries, and simply WILL NOT provide enough contact with the starter terminal to supply the needed amperage to engage the starter properly.

NOTE: Use an analog voltage meter if you can. Digital meters take intermittent 'snap shots' of voltage. In situations where voltage is being supplied intermittently (even in rapid cycles), the digital meter will simply not provide the correct 'picture' of the aircraft's voltage situation.

The starting circuit should be inspected at regular intervals. The frequency should be determined by the type of starting conditions and the amount of starter usage. In any case, it is recommended that the following tests be conducted each six months or every 100 hours time-in-service.

A. Check the battery with a hydrometer to make sure it is fully charged and filled to the proper level. A load test should be made on the battery to verify proper condition before proceeding.

B. Check all starter circuit wiring, making sure all connections, including battery terminals, are clean and tight and that all insulation is sound and complete.



Exploded View of Gear Reduction Starter Motor
Figure 1

C. A voltage loss test should be made to locate any high-resistance connections that would impair starting motor electrical efficiency. Using a low-reading voltmeter scale while cranking engine (or at approximately 100 amperes current flow) measure for the following limits:

(1) Voltage loss from the insulated (positive) battery post to the starter motor terminal = 0.3 volt maximum.

(2) Voltage loss from the battery negative (ground) terminal to the starter motor frame = 0.1 volt maximum.

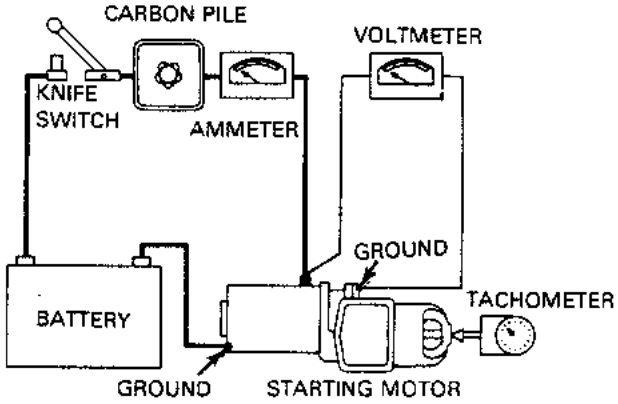
NOTE: If voltage loss exceeds the above limits, measure the voltage drops across all connections to discover the faulty connection. When within the maximum limits proceed to next step.

D. The starter motor should be operated for several seconds with the ignition OFF. The starter motor engagement should be prompt and the motor should turn freely at a uniform speed without binding or producing unusual sounds.

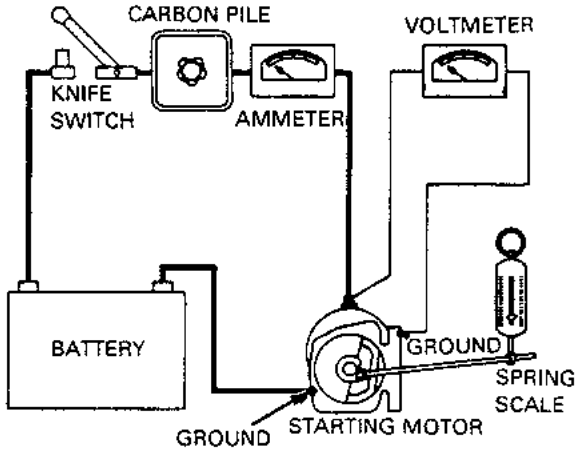
E. Re-engage the starter two or three times, listening for prompt engagement, without the clashing of gears, and to determine that the pinion disengages properly when the starter switch is released.

CHART 2
STARTER SERVICE TEST SPECIFICATIONS

Model	MHB-4016
Brush Tension	
Min.	32 oz.
Max.	40 oz.
No-Load Test (75°F)	
Volt	20
Max. Amps	35
Min. RPM	1300
Stall Torque Test	
Amps	260
Min. Torque, Ft.-Lbs.	27
Approx. Volts	14



No Load Current Test
Figure 2



Stall Torque Test
Figure 3

5. Bench Tests (See Figures 1 and 2.)

   A. No-Load Test

      (1) Connect as shown in Figure 1.

      (2) Current measured on voltmeter should be within specifications shown in Chart 2. If current is too high, the bearings may be mis-aligned or end play may be unacceptable. Two or three sharp raps on the frame with a rawhide hammer will often help to align the bearings and free the armature.

      (3) If the starter passes the No-Load Test, proceed to the Stall-Torque Test, below.

   B. Stall-Torque Test

      To see if the starter is producing its rated cranking power:

      (1) Make test connections and set-up as shown in Figure 2.

      (2) See specifications in Chart 2.

   C. If torque and current are not within specifications, overhaul or replace the starter.

6. Starter Control Circuit

   A. Inspect the control circuit wiring between the battery, solenoid and manual starting switches for breaks, poor connections and faulty insulation. Tighten all connections and make sure solenoid is firmly mounted and makes a good ground connection.

   B. Check the voltage loss across the switch contacts during normal starting. If loss is in excess of 0.2 volts per 100 amperes, the solenoid should be replaced.

   C. If solenoid fails to operate when the manual starting switch is turned on or if it fails to release when the manual starting switch is released, it should be removed and tested to specifications, if available. If either opening or closing voltages are not to specifications, or tests cannot be performed, replace the solenoid.

7. Starting with External Power

   See 24-40-00.

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GRIDS 6H8 THRU 6L24
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AIRPLANE MAINTENANCE MANUAL

CARD 7 OF 7

PA-44-180



(S/N's 4496001 & UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-892

March 15, 2006

Published by
Technical Publications

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2926 Piper Drive
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U.S.A.



Member
General Aviation
Manufacturers Association

THE NEW PIPER AIRCRAFT, INC.
PA-44-180, SEMINOLE
MAINTENANCE MANUAL

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-882) originally published March 1, 1998 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG970401	April 1, 1997	1, 2, 3, and 4
PR020228	February 28, 2002	1, 3, and 4
PR021206	December 6, 2002	2
CR060315 *	March 15, 2006	1, 2, 3, 4, 5, 6 and 7

*** COMPLETE REVISION OF MAINTENANCE MANUAL 761-892**

Revisions appear in all seven Aerofiche Cards. Accordingly, discard your entire existing Aerofiche Card set and replace it with this one dated 03/15/06.

Consult the Piper Customer Service Information Aerofiche (P/N 1753-755) for current revision dates for this manual.

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INTRODUCTION

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	2	Mar 15/06			
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INTRODUCTION

1. Instructions for Continued Airworthiness

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

The PIPER PA-44-180 Seminole Maintenance Manual constitutes the Instructions for Continued Airworthiness in accordance with Federal Aviation Regulations (FAR) Part 23, Appendix G. Chapter 4 contains the Airworthiness Limitations section (4-00-00) and the Inspection Program is in Chapter 5 (5-20-00).

2. General

This publication is prepared in accordance with the General Aviation Manufacturers Association (GAMA) Specification No. 2, with respect to the arrangement and content of the System/Chapters within the designated Chapter/Section-numbering system.

WARNING: USE ONLY GENUINE PIPER AIRCRAFT PARTS OR PIPER AIRCRAFT APPROVED PARTS OBTAINED FROM PIPER APPROVED SOURCES, IN CONNECTION WITH THE MAINTENANCE AND REPAIR OF PIPER AIRPLANES.

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-44-180 Parts Catalog P/N 761-891, and FAR 43 for proper utilization.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

THE NEW PIPER AIRCRAFT, INC. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: THE NEW PIPER AIRCRAFT, INC. expressly reserves the right to supersede, cancel and/or declare obsolete any part, part numbers, kits or publication that may be referenced in this manual without prior notice.

In any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence.

3. Effectivity

This maintenance manual is effective for PA-44-180 Seminole airplanes serial numbers 4496001 and up.

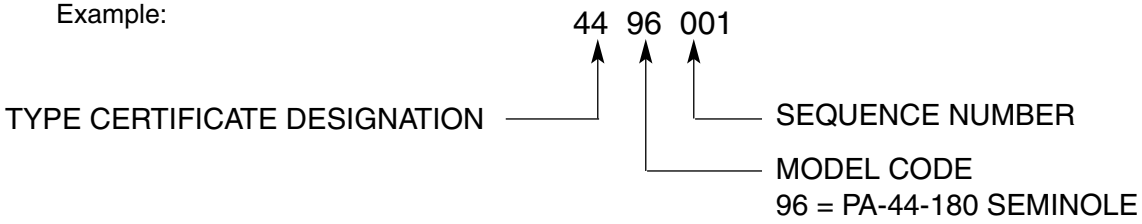
This encompasses the following model years:

NOTE: The following is provided as a general reference only.

Model Year	Serial Numbers
1995	4496001 thru 4496005
1996	4496006 thru 4496013
1997	4496014 thru 4496023; less 4496020
1999	4496024 thru 4496030; and 4496020
2000	4496031 thru 4496042
2001	4496043 thru 4496108
2002	4496109 thru 4496168
2003	4496169 thru 4496179
2004	4496180 thru 4496190
2005	4496191 thru 4496219
2006	4494220 and up

4. Serial Number Explanation

Example:



5. Assignment of Subject Material

This publication is divided into industry standard, three element, numeric subject groupings as follows:

A. System/Chapter - The various groups are broken down into major systems such as Environmental Systems, Electrical Power, Landing Gear, etc. They are assigned a number, which becomes the first element of the standardized numbering system. Thus, the element “28” of the number 28-40-01 refers to the chapter “Fuel”. Everything concerning the fuel system will be covered in this chapter.

B. Sub-System/Section - The major systems/chapters of an airplane are broken down into subsystems. These sub-systems are identified by the second element of the standard numbering system. The element “40” of the number 28-40-01 concerns itself with the indicating section of the fuel system.

C. Unit/Subject - The individual units within a sub-system/section may be identified by the third element of the standard numbering system. The element “01” of the number 28-40-01 is a subject designator. This element is assigned at the option of the manufacturer and is normally zeroed out by PIPER.

Refer to paragraph 14, Chapter/Section Index Guide, for a complete breakdown and list. The material is arranged in ascending numerical sequence.

6. Pagination

The Chapter - Section (i.e. - 28-40-00) numbering system (explained above) forms the primary page numbering system for this manual. Within each Section, pages are numbered consecutively beginning with Page 1 (i.e. - 28-40-00, Page 1). Additionally, the aerofiche grid numbering system (explained below) is also used to indicate location within the manual.

7. Aerofiche Effectivity

A. The General Aviation Manufacturers Association (GAMA) have developed specifications for microfiche reproduction of aircraft publications. 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. The “Aerofiche Effectivity” page at the front of this manual lists the current revision for each card in this set.

B. Conversion of Aerofiche alpha/numeric grid code numbers:

First number is the Aerofiche card number.
Letter is the horizontal row reference per card
Second number is the vertical column reference per card.

Example: 2J16 = Aerofiche card number two, row J, column 16.

C. To aid in locating information, the following is provided at the beginning of each aerofiche card:

(1) A complete Introduction containing the Chapter/Section Index Guide for all fiche in this set.

(2) A complete subject Index for all fiche in this set.

8. Identifying Revised Material

A revision to a page is defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a vertical line (i. e. - change bar) along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A change bar in the left-hand margin opposite the footer (i.e. - chapter/section/subject, page number and date), indicates that the text was unchanged but the material was relocated to a different page.



Example.

NOTE: Change bars are not used in the title pages, list of effective pages, or index. Likewise, all change bars are removed when a publication is completely revised (i.e. - reissued).

9. Indexing

An alphabetically arranged subject Index follows this introduction to assist the user in locating desired information. In addition, each System/Chapter begins with an individual Table of Contents.

10. List of Effective Pages

Each System/Chapter has a List of Effective Pages preceding the Table of Contents to identify the effective revision date for each page in that chapter.

11. Warnings, Cautions and Notes

These adjuncts to the text are used to highlight or emphasize important points when necessary. Warnings call attention to use of materials, processes, methods, procedures or limits which must be followed precisely to avoid injury or death to persons. Cautions call attention to methods and procedures which must be followed to avoid damage to equipment. Notes call attention to methods which make the job easier. Warnings and Cautions shall be located directly above and Notes directly beneath the text and be in line with the paragraphs to which they apply.

12. Accident/Incident Reporting

To improve our Service and Reliability system and aid in Piper's compliance with FAR 21.3, knowledge of all incidents and/or accidents must be reported to Piper immediately. To expedite and assist in reporting all incidents and accidents, Piper Form 420-01 has been created. See Service Letter 1041 for latest revision. This procedure is to be used by all Dealers, Service Centers and Repair Facilities.

13. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-44-180 airplane and its various components. Use them to supplement this manual.

A. Piper Publications:

	Piper P/N
(1) Parts Catalog:	761-892
(2) Periodic Inspection Report:	230-1963
(3) Progressive Inspection Manual (pending):	767-014

B. Vendor Publications:

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY.

(1) ALTERNATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

(2) AUTOFLIGHT:

Vendor Address: Honeywell (or) S-TEC Corporation
One Technology Center One S-TEC Way
23500 W. 105th St., M/D #45 Mineral Wells, Texas 76067
Olathe, Kansas 66061-1950 PH - (940) 325-9406
http://www.bendixking.com/ www.s-tec.com

(3) BATTERY:

Vendor Address: GILL Batteries PH: - (800) 456-0070
A Division of Teledyne Continental Motors
http://www.gillbatteries.com

(4) BRAKES AND WHEELS:

Vendor Address: Parker Hannifin Corp PH: - (800) 272-5464
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
http://www.parker.com/cleveland/Universe/book.pdf

(5) ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS):

Vendor Address: Avidyne Corporation PH - (800) 284-3963
55 Old Bedford Road
Lincoln, MA 01773
http://www.avidyne.com/index.htm

Instructions for Continued Airworthiness

Primary Flight Display and Magnetometer/OAT:	Document No. AVPFD-174
Multifuntion Display:	Document No. AVMFD-167
Data Acquisition Unit:	Document No. AVSIU-011

(6) EMERGENCY LOCATOR TRANSMITTER:

Vendor Address: Artex Airccraft Supplies PH: - (800) 547-8901
14405 Keil Road NE
Aurora, Oregon 97002
http://www.artex.net/

(7) ENGINE:

Vendor Address: Textron Lycoming PH - (717) 323-6181
652 Oliver Street FAX - (717) 327-7101
Williamsport, PA 17701
http://www.lycoming.textron.com/main.html

Overhaul Manual:	DIRECT DRIVE MODELS	- P/N 60294-7
Parts Catalog:	O, LO-360 A1H6 ENGINES	- P/N PC306-5
Operators Handbook:	O, HO, IO, AIO, HIO, TIO-360 SERIES	- P/N 60297-12

NOTE: The above Lycoming publications can be ordered as a set on CD-ROM from Avantext. See www.avantext.com or PH - (800) 998-8857.

(8) FIRE EXTINGUISHER (PORTABLE):

Vendor Address: H3R Inc. PH: - (800) 249-4289
43 Magnolia Ave # 4
San Francisco, California 94123-2911
http://www.h3r.com/index.htm

(9) FUEL CELLS:

Vendor Address: Engineered Fabrics Corporation PH - 770-684-7855
669 Goodyear Street FAX - 770-684-7438
Rockmart, Georgia 30153-0548
http://www.kfefc.com/index.htm

(10) HEATER

Vendor Address:	Kelly Aerospace Power Systems Airport Complex, PO Box 273 Fort Deposit, AL 36032 http://www.kellyaerospace.com/ts_heaters.html	PH: - (888) 461-6077 FAX - (334) 227-8596
Maintenance and Overhaul Manual:	Janitrol Maintenance and Overhaul Manual - 24E25-1	

(11) LIGHTS - NAVIGATION, STROBE, AND MAP LIGHTS:

Vendor Address:	Whelen Engineering Co. Inc. Route 145, Winthrop Rd. Chester, Conneticut 06412 http://www.whelen.com/	PH: - (860) 526-9504 FAX - (860) 526-2009

(12) MAGNETOS:

Vendor Address:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104 http://www.unisonindustries.com/index4.html	PH - (815) 965-4700 FAX - (815) 965-2457
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363	

(13) NAVIGATION, COMMUNICATIONS, AND GPS (NAV/COM/GPS):

Vendor Address:	Garmin International 1200 East 151ST Street Olathe, KS 66062 http://www.garmin.com	PH: (913) 397-8200

(14) PROPELLER:

Vendor Address:	Sensenich Corporation 14 Citation Lane Lititz, PA 17543 http://www.sensenich.com/	PH - (717) 569-0435 FAX - (717) 560-3725
Repair Manual:	METAL PROPELLER REPAIR MANUAL - SPRM 590	

(15) STARTER:

Vendor Address:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252
or	Electro Systems, Inc. (see “Voltage Regulator,” below)	

(16) VACUUM PUMP:

Vendor Address: Aero Accessories, Inc. PH - (800) 822-3200
1240 Springwood Avenue
Gibsonville, NC 27249
http://www.aeroaccessories.com/index.html

(17) VACUUM REGULATOR:

Vendor Address: Parker Hannifin Corp. PH: - (800) 382-8422
Airborne Division
711 Taylor Street
Elyria, Ohio 44035
http://www.parker.com/cleveland/Universe/book.pdf

(18) VOLTAGE REGULATOR:

Vendor Address: Electro Systems, Inc. PH: - (888) 461-6077
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 36032
http://www.kellyaerospace.com/index.htm/

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14. Chapter/Section Index Guide

NOTE: The following GAMA Specification No. 2 standard chapters are not included in this Maintenance Manual: 23, 35, 36, 38, 49, 54, 60, 72, 75, 81, and 83. These chapters are omitted because the subject system is either: not installed in these airplanes; adequately covered in vendor or other manuals; or, for ease of use, has been combined with another chapter.

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91

CHARTS & WIRING DIAGRAMS

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CHAPTER 91

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CHARTS

1. Torque Requirements

CAUTION: DO NOT OVERTORQUE FITTINGS.

NOTE: When installing flared fittings, verify that male threads are properly lubricated. Use torque fittings values in Chart 1.

Chart 1 lists the torque values for flared fittings of various sizes and material. The torque values given in Chart 2 are derived from oil-free cadmium-plated threads and are recommended for all airframe installation procedures where torquing is required, unless otherwise specified in the subject chapter or section. Engine torque values are found in the latest revision of Lycoming SSP-1776 and propeller torque values are found in 61-10-00.

A. Calibrate the torque wrench periodically to assure accuracy, and recheck frequently.

B. Unless otherwise specified, torque all nuts to the applicable torque in Chart 2. If the bolt, screw, or nut is listed but the mating fastener is not, torque to the lower end of the range given in Chart 2 for the listed fastener.

NOTE: If normal operation requires movement between any of the components being clamped together, tighten the nut (or bolt) enough to insure intended operation of the assembly.

C. Bolt and nut threads should be clean and dry unless otherwise specified. If the threads are to be lubricated, reduce the recommended nut torque given in Chart 2 (plus the friction drag torque) by 50%.

D. For thread sizes 8 through 7/16, add the friction drag torque (in Chart 2) for all self-locking fasteners. For non-self locking fasteners, assume the friction drag torque to be zero.

CHART 1
FLARE FITTING TORQUE VALUES

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	500	1150
1-1/4	600	900	———	———	———	———
1-1/2	600	900	———	———	———	———
1-3/4	———	———	———	———	———	———
2	———	———	———	———	———	———

E. For other bolt sizes, determine the friction drag torque by attaching a scale type torque wrench to the nut and determining the torque required to turn the nut on the bolt. (Before the nut makes contact with the bearing surface.) Add the friction drag torque to the specified torque to get the final torque.

NOTE: If the bolt is stationary and the nut is torqued, use the lower side of the torque range. If the nut is stationary and the bolt is torqued use the higher side of the torque range.

F. When torquing castellated nuts, begin with minimum torque plus friction drag torque, but do not exceed maximum torque plus friction drag torque when aligning cotter key hole with the castellations in the nut. If they do not align change washers and retorque.

NOTE: When using castellated nuts on movable joints, do not torque as described above. Tighten nuts only enough to remove looseness in the joint and install the cotter pin.

G. Unless otherwise specified, when parts are used on Lycoming engines, using Piper furnished or existing Lycoming threaded fasteners, use the torque specified in Lycoming Service Table of Limits SSP-1776 latest revision.

H. After the final torque, apply slippage mark to the nut or bolt or screw head as applicable.

NOTE: For more details on torquing, refer to FAA AC 43.13-1, latest revision.

2. Conversion Tables

The following charts contain various conversion data that may be useful when figuring capacities, lengths, temperatures, and various weights and measures from the English system to the metric system or back again:

Chart 3, Torque Conversion

Chart 4, Decimal Conversions

Chart 5, Temperature Conversion

Chart 6, Weights and Measures Conversion

Chart 7, Metric Conversion

Chart 8, Drill Sizes

3. Hose Specifications

See Chart 9.

4. Consumable Materials

See Chart 10.

5. Vendor Contact Information

See Chart 11.

6. Electrical Wire Coding

See Chart 12.

7. Electrical Symbols

See Chart 13.

CHART 2 (Sheet 1 of 2)
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 NAS1149 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 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 A

BOLT SIZE	FRICTION DRAG TORQUE (IN. -LB.) Coarse	Fine
8	15	--
10	18	18
1/4	30	15
5/16	60	60
3/8	80	80
7/16	100	100

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 21042 MS 21045 MS 20365 MS 20500 NAS 679	AN 320 AN 364 NAS 1022 MS 17826 MS 20364

Nut-bolt size	Torque Limits in-lbs.		Torque Limits in-lbs.	
	Min.	Max.	Min.	Max.
8-32	12	15	7	9
10-24	20	25	12	15
1/4-20	40	50	25	30
5/16-18	80	90	48	55
3/8-16	160	185	95	110
7/16-14	235	255	140	155
1/2-13	400	480	240	290
9/16-12	500	700	300	420
5/8-11	700	900	420	540
3/4-10	1,150	1,600	700	950
7/8-9	2,200	3,000	1,300	1,800
1-8	3,700	5,000	2,200	3,000
1-1/8-8	5,500	6,500	3,300	4,000
1-1/4-8	6,500	8,000	4,000	5,000

CHART 2 (Sheet 2 of 2)
RECOMMENDED NUT TORQUES

FINE THREAD SERIES

	BOLTS Steel		BOLTS Steel		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 NAS 464		AN 3DD THRU AN 20DD AN 173DD THRU AN 186DD AN 509DD AN 525D MS 27039D MS 24694DD	
	NUTS Steel Tension	NUTS Steel Shear	NUTS Steel Tension	NUTS Steel Shear	NUTS Alum. Tension	NUTS 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 20365 MS 21042 MS 21045 NAS 1021 NAS 679 NAS 1291	AN 320 AN 364 NAS 1022 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

CHART 3
TORQUE CONVERSION

INCH POUNDS (IN.-LBS.) TO CENTIMETER KILOGRAMS (CMKG.)
CENTIMETER KILOGRAMS (CMKG.) TO INCH POUNDS (IN.-LBS.)
FOOT POUNDS (FT.-LBS.) TO METER KILOGRAMS (MKG.)
METER KILOGRAMS (MKG.) TO FOOT-POUNDS (FT.-LBS.)

IN.-LBS.	CMKG.
5	5.76
10	11.52
15	17.28
20	23.04
25	28.80
30	34.56
35	40.32
40	46.08
45	51.84
50	57.60
55	63.36
60	69.12
65	74.88
70	80.64
75	86.40
80	92.16
85	97.92
90	103.68
95	109.44
100	115.20
105	120.96
110	126.72
115	132.48
120	138.24

CMKG.	IN.-LBS.
50	43.4
100	86.8
150	130.2
200	173.6
250	217.0
300	260.4
350	303.8
400	347.2
450	390.6
500	434.0
550	477.4
600	520.8
650	564.2
700	607.6

FT.-LBS.	MKG.
2.5	.346
5	.691
7.5	1.037
10	1.383
12.5	1.728
15	2.074
17.5	2.419
20	2.765
22.5	3.111
25	3.456
27.5	3.802
30	4.148
32.5	4.493
35	4.839
37.5	5.185
40	5.530
42.5	5.876
45	6.222
47.5	6.567
50	6.913
52.5	7.258
55	7.604
57.5	7.950
60	8.295
62.5	8.641
65	8.987
67.5	9.332
70	9.678
72.5	10.024
75	10.369
77.5	10.715
80	11.060
82.5	11.406
85	11.752
87.5	12.097
90	12.443
92.5	12.789
95	13.134
97.5	13.480
100	13.826
105	14.517
110	15.208

FT.-LBS.	MKG.
115	15.900
120	16.591
125	17.282
130	17.974
135	18.665
140	19.356
145	10.047
150	20.739
155	21.430
160	22.121
165	22.813
170	23.504
175	24.195
180	24.887
185	25.578
190	26.269
195	26.960
200	27.652
105	28.343
210	29.034
215	29.726
220	30.417
225	31.108
230	31.800
235	32.491
240	33.182
245	33.873
250	34.565
255	35.256
260	35.947
265	36.639
270	37.330
275	38.021
280	38.713
285	39.404
290	40.095
295	40.786
300	41.478

MKG.	FT.-LBS.
1	7.23
2	14.46
3	21.69
4	28.98
5	36.16
6	43.39
7	50.63
8	57.86
9	65.09
10	72.32
11	79.56
12	86.79
13	94.02
14	101.26
15	108.49
16	115.72
17	122.95
18	130.19
19	137.42
20	144.65
21	151.89
22	159.12

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CHART 4
DECIMAL CONVERSIONS

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	M.M. EQUIV.
				1/64	.016	.02	.397
			1/32		.031	.03	.794
				3/64	.047	.05	1.191
		1/16			.062	.06	1.587
				5/64	.078	.08	1.984
			3/32		.094	.09	2.381
				7/64	.109	.11	2.778
	1/8				.125	.12	3.175
				9/64	.141	.14	3.572
			5/32		.156	.16	3.969
				11/64	.172	.17	4.366
		3/16			.188	.19	4.762
				13/64	.203	.20	5.159
			7/32		.219	.22	5.556
				15/64	.234	.23	5.593
1/4					.250	.25	6.350
				17/64	.266	.27	6.747
			9/32		.281	.28	7.144
				19/64	.297	.30	7.540
		5/16			.312	.31	7.937
				21/64	.328	.33	8.334
			11/32		.344	.34	8.731
				23/64	.359	.36	9.128
	3/8				.375	.38	9.525
				25/64	.391	.39	9.922
			13/32		.406	.41	10.319
				27/64	.422	.42	10.716
		7/16			.438	.44	11.112
				29/64	.453	.45	11.509
			15/32		.469	.47	11.906
				31/64	.484	.48	12.303
					.500	.50	12.700

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	M.M EQUIV.
				33/64	.516	.52	13.097
			17/32		.531	.53	13.494
				35/64	.547	.55	13.891
		9/16			.562	.56	14.288
				37/64	.578	.58	14.684
			19/32		.594	.59	15.081
				39/64	.609	.61	15.478
	5/8				.625	.62	15.875
				41/64	.641	.64	16.272
			21/32		.656	.66	16.669
				43/64	.672	.67	17.065
		11/16			.688	.69	17.462
				45/64	.703	.70	17.859
			23/32		.719	.72	18.256
				47/64	.734	.73	18.653
3/4					.750	.75	19.050
				49/64	.766	.77	19.447
			25/32		.781	.78	19.844
				51/64	.797	.80	20.241
		13/16			.812	.81	20.637
				53/64	.828	.83	21.034
			27/32		.844	.84	21.431
				55/64	.859	.86	21.828
	7/8				.875	.88	22.225
				57/64	.891	.89	22.622
			29/32		.906	.91	23.019
				59/64	.922	.92	23.416
		15/16			.938	.94	23.812
				61/64	.953	.95	24.209
			31/32		.969	.97	24.606
				63/64	.984	.98	25.003
					1.000	1.00	25.400

CHART 5
TEMPERATURE CONVERSION

CENTIGRADE - FAHRENHEIT

Example: To convert 20°C, to Fahrenheit, find 20 in the center column headed (°F - °C); then read 68.0°F, in the column (°F) to the right. To convert 20°F, to Centigrade; find 20 in the center column and read -6.67°C, in the (°C) column to the left.

°C	°F - °C	°F	°C	°F - °C	°F
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
- 45.6	-50	-58.0	115.56	240	464.0
- 40.0	-40	-40.0	121.11	250	482.0
- 34.0	-30	-22.0	126.67	260	500.0
- 38.9	-20	-4.0	132.22	270	518.0
- 23.3	-10	14.0	137.78	280	536.0
- 17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
27.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
38.89	120	248.0	210.00	410	770.0
54.44	130	266.0	215.56	420	788.0
60.00	140	284.0	221.11	430	806.0
65.56	150	302.0	226.67	440	824.0
71.00	160	320.0	232.22	450	842.0
76.67	170	338.0	257.78	460	860.0
82.22	180	356.0	243.33	470	878.0
87.78	190	374.0	248.89	480	896.0
93.33	200	392.0	254.44	490	914.0
98.89	210	410.0	260.00	500	932.0

CHART 6
WEIGHTS AND MEASURES CONVERSION

MULTIPLY	BY	TO OBTAIN
CENTIMETERS	0.3937	IN.
	0.03281	FT.
CU. CENTIMETERS	0.001	LITERS
	0.06102	CU. IN.
	0.0002642	U.S. GAL.
CU. FT.	28.320	CU. CM.
	1.728	CU. IN.
	7.481	U.S. GAL.
	28.32	LITERS
CU. IN.	16.39	CU. CM.
	0.01639	LITERS
	0.004329	U.S. GAL.
	0.01732	QUARTS
CU. METERS	1000000	CU. CM.
	35.314	CU. FT.
	61.023	CU. IN.
	264.17	GAL.
	999.97	LITERS
FEET	0.3048	METERS
	12.000	MILS
	304.8	MM.
	0.3333	YARDS
FT.-LB.	0.1383	M-KG
	0.001285	BTU
	0.000000376	KW-HR
FLUID OZ.	8	DRAM
	29.6	CU. CM.
GAL., IMPERIAL	277.4	CU. IN.
	1.201	U.S. GAL.
	4.546	LITERS
GAL., U.S. DRY	268.8	CU. IN.
	0.1556	CU. FT.
	1.164	U.S. GAL., LIQ.
	4.405	LITERS
GAL., U.S. LIQ.	231.0	CU. IN.
	0.1337	CU. FT.
	3.785	LITERS
	0.8327	IMPERIAL GAL.
	128	FLUID OZ.
IN.	2.540	CM.
	.08333	FT.
JOULES	0.000948	BTU
	0.7376	FT.-LB.

MULTIPLY	BY	TO OBTAIN
KILOGRAMS	2.205	LB.
	35.27	OZ.
	1000	GRAMS
LITERS	1000	CU. CM.
	61.03	CU. IN.
	0.03532	CU. FT.
	0.2642	U.S. GAL.
	0.22	IMPERIAL GAL.
	1.057	QUARTS
METERS	39.37	IN.
	3.281	FT.
	1000	MM.
METER-KILOGRAM	7.233	FT.-LB.
	9.807	JOULES
OUNCES, AVDP	0.0625	LB., AVDP
	28.35	GRAMS
	437.5	GRAINS
OUNCES, FLUID	29.57	CU. CM.
	1.805	CU. IN.
LB., AVDP	453.6	GRAMS
	7000	GRAINS
	16.0	OUNCES
SQUARE INCH	6.4516	SQ. CM.
POUND PER SQUARE INCH (PSI)	0.0703	KG.-CM SQUARED
STATUTE MILE	1.609	KILOMETER
	0.8684	NAUTICAL MILE
NAUTICAL MILE	1.151	STATUTE MILE
QUART	.9463	LITER
MILLIMETER	1000	MICRON
MICRON	0.001	MILLIMETER
	0.000039	INCH
INCH POUNDS	11.521	METER GRAMS
INCH OUNCES	0.72	METER GRAMS
POUNDS	0.453	KILOGRAMS

CHART 7
METRIC CONVERSION

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).

INCHES TO MILLIMETER

INCHES	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
	MILLIMETER									
0.000		0.0025	0.0050	0.0076	0.0101	0.0127	0.0152	0.0177	0.0203	0.0228
0.001	0.0254	0.0279	0.0304	0.0330	0.0355	0.0381	0.0406	0.0431	0.0457	0.0482
0.002	0.0508	0.0533	0.0558	0.0584	0.0609	0.0635	0.0660	0.0685	0.0711	0.0736
0.003	0.0762	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	0.0965	0.0990
0.004	0.1016	0.1041	0.1066	0.1092	0.1117	0.1143	0.1168	0.1193	0.1219	0.1244
0.005	0.1270	0.1295	0.1320	0.1346	0.1371	0.1397	0.1422	0.1447	0.1447	0.1498
0.006	0.1524	0.1549	0.1574	0.1600	0.1625	0.1651	0.1676	0.1701	0.1727	0.1752
0.007	0.1778	0.1803	0.1828	0.1854	0.1879	0.1905	0.1930	0.1955	0.1981	0.2006
0.008	0.2032	0.2057	0.2082	0.2108	0.2133	0.2159	0.2184	0.2209	0.2235	0.2260
0.009	0.2286	0.2311	0.2336	0.2362	0.2387	0.2413	0.2438	0.2463	0.2489	0.2514

INCHES	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
	MILLIMETER									
0.00		0.025	0.050	0.076	0.101	0.127	0.152	0.177	0.203	0.228
0.01	0.254	0.279	0.304	0.330	0.355	0.381	0.406	0.431	0.457	0.482
0.02	0.508	0.533	0.558	0.584	0.609	0.635	0.660	0.685	0.711	0.736
0.03	0.762	0.787	0.812	0.838	0.863	0.889	0.914	0.939	0.965	0.990
0.04	1.016	1.041	1.066	1.092	1.117	1.143	1.168	1.193	1.219	1.244
0.05	1.270	1.295	1.320	1.346	1.371	1.397	1.422	1.447	1.473	1.498
0.06	1.524	1.549	1.574	1.600	1.625	1.651	1.676	1.701	1.727	1.752
0.07	1.778	1.803	1.828	1.854	1.879	1.905	1.930	1.955	1.981	2.006
0.08	2.032	2.057	2.082	2.108	2.133	2.159	2.184	2.209	2.235	2.260
0.09	2.286	2.311	2.336	2.362	2.387	2.413	2.438	2.463	2.489	2.514

INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	MILLIMETER									
0.0		0.254	0.508	0.762	0.016	1.270	1.524	1.778	2.032	2.286
0.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
0.2	5.080	5.334	5.558	5.842	6.096	6.350	6.604	6.858	7.112	7.366
0.3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
0.4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
0.5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
0.6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
0.7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
0.8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
0.9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

INCHES	0.00	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	MILLIMETER									
0.0		2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86
1.0	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26
2.0	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66
3.0	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06
4.0	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46
5.0	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86
6.0	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.26
7.0	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66
8.0	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06
9.0	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46

CHART 8
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	0.0696
19/64	0.2968	7.5387	16	0.177	4.4958	44	0.086	2.1844	74	0.0229	0.58166
M	0.295	7.4930	17	0.173	4.3942	45	0.082	2.0828	75	0.021	0.5334
L	0.290	7.3660	11/64	0.1718	4.3656	46	0.081	2.0574	76	0.020	0.508
9/32	0.2812	7.1425	18	0.1695	4.3053	47	0.0785	1.9939	77	0.018	0.4572
K	0.281	7.1374	19	0.166	4.2164	5/64	0.0781	1.9844	1/64	0.0156	0.3969
J	0.277	7.0358	20	0.161	4.0894	48	0.076	1.9304	78	0.016	0.4064
I	0.272	6.9088	21	0.159	4.0386	49	0.073	1.8542	79	0.0145	0.3683
H	0.266	6.7564	22	0.157	3.9878	50	0.070	1.778	80	0.0135	0.3429
17/64	0.2656	6.7462									

DRILL SIZES AVAILABLE

Drill may be obtained in regular sizes to a 4 inch diameter, and increase in 64ths of an inch. The regular metric drills vary from 2 to 76mm and increase in 0.5mm variations.

CHART 9
HOSE SPECIFICATIONS

SINGLE WIRE BRAID FABRIC COVERED

MIL PART NO.	TUBE SIZE O.D.	HOSE SIZE I.D.	HOSE SIZE O.D.	RECOMMENDED OPER. PRESS	MIN BURST PRESS	MAX PROOF PRESS	MIN BEND RADIUS
MIL-H-8794- 3-L	3/16	1/8	.45	3,000	12,000	6,000	3.00
MIL-H-8794- 4-L	1/16	3/16	.52	3,000	12,000	6,000	3.00
MIL-H-8794- 5-L	5/16	1/4	.58	3,000	10,000	5,000	3.38
MIL-H-8794- 6-L	3/8	5/16	.67	2,000	9,000	4,500	4.00
MIL-H-8794- 8-L	1/2	13/32	.77	2,000	8,000	4,000	4.63
MIL-H-8794-10-L	5/8	1/2	.92	1,750	7,000	3,500	5.50
MIL-H-8794-12-L	3/4	5/8	1.08	1,500	6,000	3,000	6.50
MIL-H-8794-16-L	1	7/8	1.23	800	3,200	1,600	7.38
MIL-H-8794-20-L	1 1/4	1 1/8	1.50	600	2,500	1,250	9.00
MIL-H-8794-24-L	1 1/2	1 3/8	1.75	500	2,000	1,000	11.00
MIL-H-8794-32-L	2	1 13/16	2.22	300	1,400	700	13.25
MIL-H-8794-40-L	2 1/2	2 3/8	2.88	200	1,000	300	24.00
MIL-H-8794-48-L	3	3	3.56	200	800	300	33.00

Construction: Seamless synthetic rubber inner tube reinforced with one fiber braid, one braid of high tensile steel wire and covered with an oil resistant rubber impregnated fiber braid.

Identification: Hose is identified by specification number, size number, quarter year and year, hose manufacturer's identification.

Uses: Hose is approved for use in aircraft hydraulic, pneumatic, coolant, fuel and oil systems.

Operating Temperatures:

Sizes -3 thru -12: Minus 65°F. to plus 250°F.

Sizes -16 thru -48: Minus 40°F to plus 275°F.

NOTE: Maximum temperatures and pressures should not be used simultaneously.

MULTIPLE WIRE BRAID RUBBER COVERED

MIL PART NO.	TUBE SIZE O.D.	HOSE SIZE I.D.	HOSE SIZE O.D.	RECOMMENDED OPER. PRESS	MIN BURST PRESS	MAX PROOF PRESS	MIN BEND RADIUS
MIL-H-8788- 4-L	1/4	7/32	.63	3,000	16,000	8,000	3.00
MIL-H-8788- 5-L	5/16	9/32	.70	3,000	14,000	7,000	3.38
MIL-H-8788- 6-L	3/8	11/32	.77	3,000	14,000	7,000	5.00
MIL-H-8788- 8-L	1/2	7/16	.86	3,000	14,000	7,000	5.75
MIL-H-8788-10-L	5/8	9/16	1.03	3,000	12,000	6,000	6.50
MIL-H-8788-12-L	3/4	11/16	1.22	3,000	12,000	6,000	7.75
MIL-H-8788-16-L	1.00	7/8	1.50	3,000	10,000	5,000	9.63

Hose Construction: Seamless synthetic rubber inner tube reinforced with one fabric braid, two or more steel wire braids, and covered with a synthetic rubber cover (for gas applications, request perforated cover).

Identification: Hose is identified by specification number, size number, quarter year and year, hose manufacturer's identification.

Uses: High pressure hydraulic, pneumatic, coolant, fuel and oil.

Operating Temperature:

Minus 65°F to plus 200°F.

CHART 10 (Sheet 1 of 7)
CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
ABS-Solvent/ Cements		Solarite, #11 Series	Solar Compounds Corp.
Adhesive		EC 801 EC 807 EC 1357 Scotch Grip 210 (Rubber Adhesive)	Minnesota Mining and Manufacturing Adhesive Coating and Sealers Division
Adhesive, Neoprene Rubber		EC 1300L	Minnesota Mining and Manufacturing Adhesive Coating and Sealers Division
Anti-Galling Solution	MIL-A-907	Ease-Off	Taxacone Company
Anti-Seize Compound (Graphite Petrolatum)	MIL-T-5544	Armite Product Anti-Seize Compound Royco 44	Armite Laboratories Exxon Oil Company Royal Lubricants Co.
Anti-Seize Compound (White Lead Base)	TT-A-580 (JAN-A-669)	Armite Product	Armite Laboratories
Anti-Seize Thread Compound “HIGH TEMPERATURE”		Fel-Pro C5-A	Fel-Pro Incorporated
Buffing and Rubbing Compounds		Automotive Type DuPont #7 Ram Chemical #69	DuPont Company Ram Chemicals
Compound for Polishing		Mirror Glaze	Mirror Bright Polish Co., Incorporated
Plexiglas Polish and Cleaner	P-P-560	Part Number 403D	Permatex Co., Inc. Kansas City, Kansas 66115
Cleaners		Fantastic Spray Perchlorethylene VM&P Naphtha (Lighter Fluid)	Local Supplier
Deicer Boot Surface Coatings		Agemaster	B.F. Goodrich
Dry Lubricant	MIL-L-60326	MS-122-6075	Local Supplier
Epoxy Patching Compound		Solarite #400	Solar Compounds Corp.
Gasket Cement		Permatex No. 2	Permatex Company, Inc.

CHART 10 (Sheet 2 of 7)
CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, Actuator		2196-74-1	Dukes Astronautics Co.
Grease, Aircraft Instrumentation, Gear and Actuator Screw (Temp. Range - (100°F to +250°F)	MIL-G-23827A (See Note at end.)	Supermil Grease No. A72832	Amoco
		Royco 27A	Royal Lubricants Co.
		Shell 6249 Grease	Shell Oil Company
		RR-28	Socony Mobil Oil Co.
		Castrolease A1	Burmah-Castrol LTD.
		Low-Temp. Grease E.P.	Texaco Incorp.
		5114 E.P. Grease AV55	Standard Oil of Calif.
		Aeroshell Grease 7 Braycote 627S	Shell Oil Company
		Mobil Grease 27	Mobil Oil Corporation
		B.P. Aero Grease 31B	B.P. Trading Limited
Grease, Aircraft Instrumentation, Gear and Actuator Screw (Temp. Range - 65°F to +250°F)	MIL-G-3278	Unitemp E.P.	Texaco Incorporated
		RPM Aviation Grease 5, Supermil Grease No. 8723	Standard Oil of Calif.
		Aeroshell Grease 7A Royco 78	Shell Oil Corporation Royal Lubricants Company
		L-1212	Sinclair Refining Co.
		1916 Uni-Temp Grease	California Texas Oil Corporation
Grease Ball and Roller Bearing	MIL-G-18709	Regal ASB-2 Formula TG-10293	Texaco Incorporated
		Andok B Code 1-20481, Darina Grease 1 XSG-6213 Code 71-501, Darina Grease 2 XSG-6152 Code 71-502, Alvania Grease 2 XSG-6151 Code 71-012, Cyprina Grease 3 XSG-6280 Code 71-003	Exxon Company, U.S.A. Shell Oil Company

CHART 10 (Sheet 3 of 7)
CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, General Purpose Wide Temperature	MIL-G-81322	Marfax All Purpose	Texaco Incorporated
		Aeroshell No. 6	Shell Oil Company
		Mobil Grease 77 or Mobilux EP2	Mobil Oil Corporation
		Shell Alvania EP2	Shell Oil Company
		Royco 22	Royal Lubricants Company
		Mobil Grease 28	Mobil Oil Corporation
		Aeroshell No. 22	Shell Oil Company
Grease, High Temperature	MIL-G-3545	High Temp. Grease, Marfak All Purpose	Texaco Incorporated
		Shellaire Grease HT Alvania E.P. Grease 2 Aeroshell Grease 5	Shell Oil Company
		Grease 77, Mobilux E.P. 2	Mobil Oil Corporation
		Royco 45A	Royal Lubricants Co.
		L-1231	Sinclair Refining Company
Grease, Aircraft General Purpose	MIL-G-7711	Regal AFB2 Regal Starfak Premium	Texaco Incorporated
		PED 3040	Standard Oil of Calif.
		Aeroshell Grease 6	Shell Oil Company
		Royco II	Royal Lubricants Co.
Grease, Lubricating, Molybdenum Disulfide, Low and High Temperature	MIL-G-21164	Aeroshell Grease No. 17	Shell Oil Company
		Royco 64C	Royal Lubricants Co.
		Castrolease MSA (c)	Burmah Castrol LTD.
Grease, Lubricating, Plug Valve, Gasoline and Oil Resistant	MIL-G-6032	Royco 32	Royal Lubricant Co.
		Castrolease PV	Burmah Castrol LTD.
		Parker Fuel Lube 44	Parker Seal Company
		B.P. Aero Grease 32	B.P. Trading Limited
		L-237	Lehigh Tenneco Chemicals Co., Inc.
		Rockwell 950	Rockwell International

CHART 10 (Sheet 4 of 7)
CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, Waterproof, High and Low Temperature		Aero Lubriplate	Fiske Brothers Refining Company
"Hot Melt" Adhesive Polyamids and "Hot Melt" Gun.	Stick Form 1/2 in. diameter, 3 in. long		Sears, Roebuck and Company or most hardware stores.
Hydraulic Fluid	MIL-H-5606	Brayco 756D	Bray Oil Company
		TL-5874	Texaco Incorporated
		PED 3565	Standard Oil Company of California
		Aircraft Hydraulic Oil AA	Texaco Incorporated
		RPM Aviation Oil No. 2 Code PED 2585 PED 3337	Standard Oil Company of California
		3126 Hydraulic Oil (Univis 40)	Exxon Company U.S.A.
		Aeroshell Fluid 4, SL-7694	Shell Oil Company
		Aero HF	Mobil Oil Corporation
		Royco 756, 756A and 756B	Royal Lubricants Co.
Isopropyl Alcohol	Fed. Spec. TT-I-735		Local Supplier
Isocryl Tape	(PMS-C1012-2)		Schnee Moorehead Chemicals, Incorporated
Kevlar		Kevlar	Kevlar Special Products
Leak Detector Solution for Oxygen Systems	MIL-L-25567	ALPHA 73 Oxygen Leak Detector Type 1	U.S. Gulf Corporation
		Leak Tec #16-OX	American Gas and Chemical Co. LTD.
Loctite	MIL-S-22473 Grade AA	Loctite 290	Loctite Corporation
	MIL-S-22473 Grade H and HV	Loctite 222	
Methylethylketone	Fed. Spec. TT-M-261		Local Supplier

CHART 10 (Sheet 5 of 7)
CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Molybdenum Disulfide	MIL-M-7866	Molykote-Type G (Paste)	Dow Corning Corp.
		Molykote - Type 2 (Powder)	
Oil, Air Conditioner, R12		Frigidaire #525	Virginia Chemical
		Suniso #5	Sun Oil Company of Pennsylvania
		Texaco Capilla "E"	Texaco Incorporated
Oil, Air Conditioner, HFC-134a	Piper P/N 923-384	PAG-21941	
Oil Lubricating, General Purpose, Low Temperature	MIL-L-7870	Caltex Low Temp. Oil	Caltex Oil Products Company
		Sinclair Aircraft Orbit Lube	Sinclair Refining Company
		1692 Low Temp Oil	Texaco Incorporated
		Aviation Instrument Oil	Standard Oil Company of California
		Royco 363	Royal Lubricants Co.
Rain Repellent	FSCM 50150	Repcon	Unelco Corporation
Safety Walk Pressure Sensitive		Flextred 300	Wooster Products, Incorporated
Sealant	MIL-S-11031B	PRC 5000 PRC 383	Products Research Company
Sealant, Fuel Tank Sealing		*RS-36b, Stripper (thin)	CEE BEE Chemical Co.
		*RS-24b, Stripper (thick)	
		*PR 1422 A-2 Sealant (Brushing Consistency)	Products Research Company
		*PR 1422 B-2 Sealant (Trowling Consistency)	
		*PR 1431G, Faying Surface Seal, Type 1	
		* PR 1321-B 1/2, Access Panel Sealant	
		* PR 1560 MK, Primer (Anti-Bacteriological Coating)	Products Research Company

CHART 10 (Sheet 6 of 7)
CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Sealant, Fuel Tank Sealing(continued)		* BJO-0930, Phenolic Balloons	Union Carbide Plastics Division
		* ERL-2795, Epoxy Resin	
		* 22LA-0340 Polyamid Hardener	
	Class A-2	* Thiokol MC-236	
	* NOTE: Use of Equivalent Sealant Approved.		
Sealant, Fuselage Structure	Class A-1/2, A-2, B-2 B-4, B-6, B-8		H.S. Bancroft Corp.
		EC 1239	Minnesota Mining and Manufacturing Industrial Specialties Division
		EC 612 (Leak Marker or Weather Stripping, etc)	
		G.E.-SS-4004 (Primer) RTV-88 with RTV-9811	General Electric Silicone Products Department
Sealant, Windshield & Windows	MIL-S-7502B B-1/4, B-1/2, B-2, B-4, B-8, B-12	PR 1221	Products Research Company
		PR 1425	
	Piper P/N 279-066	* Thiokol MC-236-B4	
Sealing Compound, Gasket and Joint		Tite-Seal	Radiator Specialty Co.
Sealer		PR 1321 B-1/2	Products Research Company
Silicone Compound	MIL-S-8660 (MIL-C-21567) Piper P/N 279-149	DC-4, DC-6 Compound	Dow Corning
		G-624	General Electric Co. Silicone Products Department

CHART 10 (Sheet 7 of 7)
CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Solvents		Methylethyl Ketone Methylene Chloride Acetone	Local Suppliers
		Y2900	Union Carbide; Plastic Division
	Fed. Spec. PD 680 Type I - Stoddard Solvent		Local Supplier
	Type II - High Temperature		Local Supplier
Propeller Slip Ring Cleaning Solvent		CRC-2-26	Corrosion Reaction Consultants, Inc.
Toluol	TT-M-261		Local Supplier
Trichlorethylene	MIL-T-7003	Perm-A-Clor	Dextrex Chemical Industries, Inc.
		Turco 4217	Turco Products, Inc.
Teflon Tape	.003" x .5" wide/-1		Minnesota Mining and Manufacturing Company
			Shamban W.S. and Co.
	.003" x .25" wide/-2		Johnson & Johnson, Inc. Permacel Division
Thread Sealant for High Pressure Oxygen System	MIL-T-27730	Permacel 412	Johnson & Johnson, Inc. Permacel Division
Vinyl Foam	1 in. x 1/8 in.	530 Series, Type I	Norton Tape Division
Vinyl, Foam Tape	1/8 in. x 1 in.	501 Series, Type II	Norton Tape Division
Vinyl, Black Plastic	2 in. x 9 mil. and/or 1 1/2 in. x 9 mil.		
Corrosion Retardant Compounds	MIL-C-16173 D (Piper P/N 197-508)	LPS-3 Heavy Duty Rust Inhibitor	Holt Lloyd Corp.
	(Piper P/N 197-509)	Metal Parts Protector Protector Flex	Chemi-Cap. Chemical Packaging Corp.

NOTE: Take precautions when using MIL-G-23827 and engine oil. These lubricants contain chemicals harmful to painted surfaces.

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CHART 11 (Sheet 1 of 2)
VENDOR CONTACT INFORMATION

A

American Gas and
Chemical Co. LTD
220 Pegasus Avenue
Northvale, NJ 07647
201-767-7300

Amoco Oil Co.
200 E. Randolph Drive
Chicago, IL 60601
312-856-5111

Armite Laboratories
1845-49 Randolph Street
Los Angeles, CA 90001
213-587-7744

B

BP Trading Limited
Moore Lane
Brittanic House
London E.C. 2
England

Bray Oil Company
1925 N. Marianna Avenue
Los Angeles, CA 98103
213-268-6171

Burmah - Castrol Inc.
30 Executive Avenue
Edison, NJ 08817
201-287-3140

C

California Texas Oil Corp.,
380 Madison Avenue
New York, NY 10017

Caltex Oil Products Co.
New York, NY 10020

CEE BEE Chemical Co.
9520 E. CEE BEE Drive
Box 400
Downey, CA 92041

Chemi-cap
Chemical Packaging Corp.
1100 N.W. 70th Street
Ft. Lauderdale, FL 33309
305-665-9059

Corrosion Reaction
Consultants, Inc.
Limekin Pike
Dresher, PA 19025

D

Dextrex Chemical
P. O. Box 501
Detroit, MI 48232

Dow Corning Corporation
Alpha Molykote Plant
64 Harvard Avenue
Stanford, CT 06902

Dukes Astronautics Co.
7866 Deering Avenue
Canoga Park, CA 91304

DuPont Company
Finishes Div.
DuPont Building
Wilmington, DE 19898
302-774-1000

E

Exxon Oil Company
1251 Avenue of the Americas
New York, NY 10020
212-398-3093

F

Fel-Pro Incorporated
7450 N. McCormick Blvd.
Box C1103
Skokie, IL 60076
312-761-4500

Fiske Brothers
Refining Company
120 Lockwood Street
Newark, NJ 07105
201-589-9510

G

General Electric Co.
Silicone Products Dept.
Waterford, NY 12188
518-237-3330

H

H. S. Bancroft Corp.
One Rockhill
Industrial Park
Cherry Hill, NJ 08003
609-854-8000

Holt Lloyd Corp.
4647 Hugh Howell Rd.
Tucker, GA 30084
404-934-7800

J

Johnson & Johnson, Inc.
Permacel Division
501 George Street
New Brunswick, NJ 08901
201-524-0400

K

Kevlar Special Products
E.I. DuPont de Nemours & Co.,
(Inc.)
Textile Fibers Department
Centre Road Building
Wilmington, DE 19898
302-999-3156

L

Lehigh - Tenneco Chemicals Co.,
Inc.
Chestertown, MD 21620
301-778-1991

Loctite Corporation
777 N. Mountain Road
Newington, CT 06111
800-243-8160
In CT 800-842-0225

CHART 11 (Sheet 1 of 2)
VENDOR CONTACT INFORMATION

M

Minnesota Mining and MFG
3M Center
St. Paul, MN 55144
612-733-1110

Mirror Bright Polish Co., Inc.
Irvine Industrial Complex
P.O. Box 17177
Irvin, CA 92713
714-557-9200

Mobil Oil Corporation
150 E. 42nd Street
New York, NY 10017
212-883-4242

Morton Inc.
7341 Anacona Ave
Garden Grove, CA 92641
724-373-2837
Fax 724-373-1913

N

Norton Tape Division
Department 6610
Troy, NY 12181
518-273-0100

P

Parker Seal Company
17325 Euclid Avenue
Cleveland, OH 44112
216-531-3000

Permatex Co., Inc.
P.O. Box 11915
Newington, CT 06111
203-527-5211

Products Research Co.
2919 Empire Avenue
Burbank, CA 91504
213-849-3992

R

Radiator Specialty Co.
P.O. Box 34689
Charlotte, NC 28234
704-377-6555

Ram Chemicals
201 E. Alondra Blvd.
Gardena, CA 90248
213-321-0710

Rockwell International
600 Grant Street
Pittsburgh, PA 15219
412-565-2000

Royal Lubricants Company
River Road
E. Hanover, NJ 07936
201-887-3100

S

Schnee Moorhead Chemicals, Inc.

Shamban W.S. and Co.
1857 Centinela Avenue
Santa Monica, CA 90404
213-397-2195

Shall Oil Company
One Shell Plaza
Houston, TX 77003
713-220-6697

Sinclair Refining Co.
600 Fifth Avenue
New York, NY 10020

Socony Mobil Oil Co.
Washington 5, DC 20005

Solar Compounds Corp.
1201 W. Blancke Street
Linden, NJ 07036
201-862-2813

Standard Oil of California
225 Bush Street
San Francisco, CA 94104
415-894-7700

Sun Oil Company of Penna
5 Penn Center Plaza
Philadelphia, PA 19103
215-972-2000

T

Taxacone Company
P.O. Box 10823 TR
Dallas, TX 75208

Texaco, Inc.
2000 Westchester Avenue
White Plains, NY 10650
914-253-4000

Turco Products Inc.
24600 S. Main Street
Box 6200
Carson, CA 90749
213-835-8211

U

U.S. Gulf Corp.
P.O. Box 233
Stoney Brook, NY 11790
212-683-9221

Unelko Corporation
727 E. 110th Street
Chicago, IL 60628

Union Carbide; Plastic Div.
270 Park Avenue
New York, NY 10017
212-551-3763

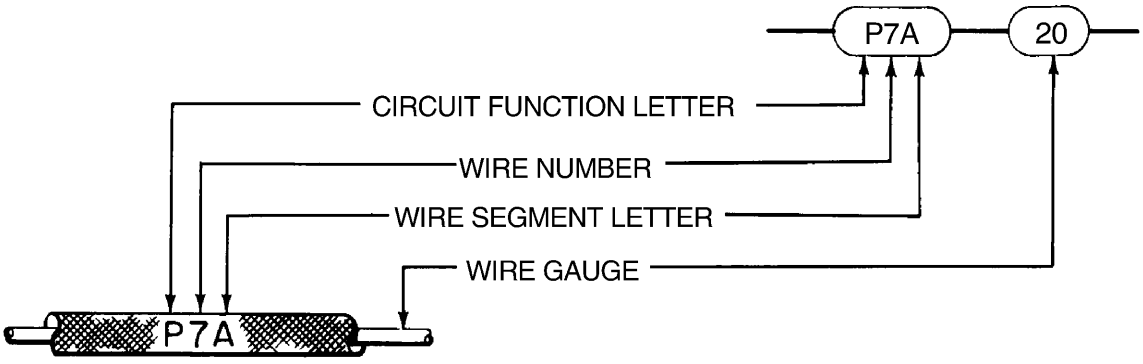
V

Virginia Chemical
3340 W. Norfolk Rd.
Portsmouth, VA 23703
703-484-5000

W

Wooster Products, Inc.
1000 Spruce Street
Wooster, OH 44691
800-321-4936
In OH 216-264-2844

CHART 12
ELECTRICAL WIRE CODING



CIRCUIT FUNCTION LETTER	CIRCUITS
A	AUTOPILOT
C	CONTROL SURFACE
E	ENGINE INSTRUMENT
F	FLIGHT INSTRUMENT
G	LANDING GEAR
H	HEATER - VENTILATING & DEICING
L	LIGHTING
P	POWER
Q	FUEL & OIL
RP	RADIO POWER
RZ	RADIO AUDIO
J	IGNITION
W	WARNING
K	STARTER

CHART 13 (Sheet 1 of 3)
ELECTRICAL SYMBOLS

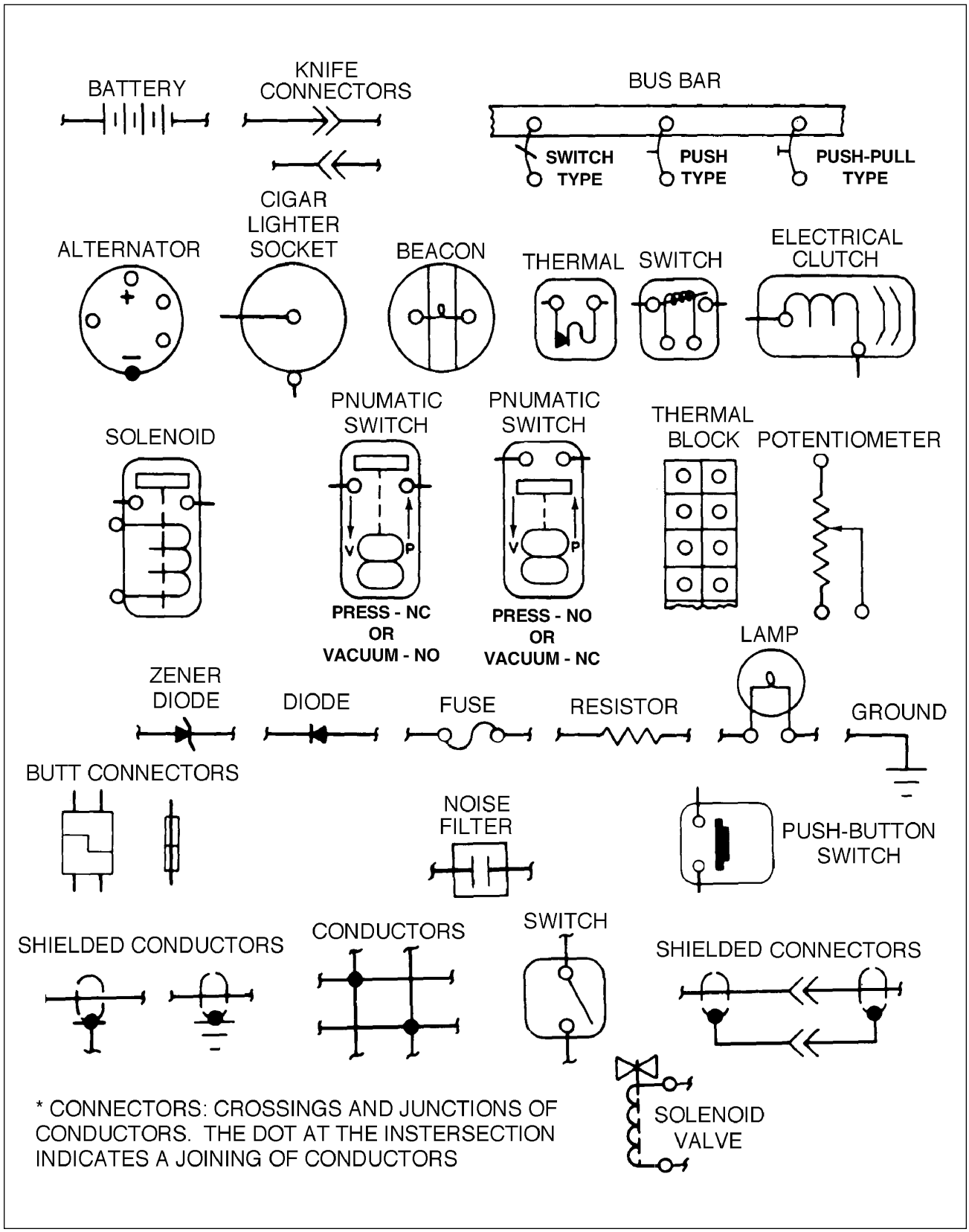


CHART 13 (Sheet 2 of 3)
ELECTRICAL SYMBOLS

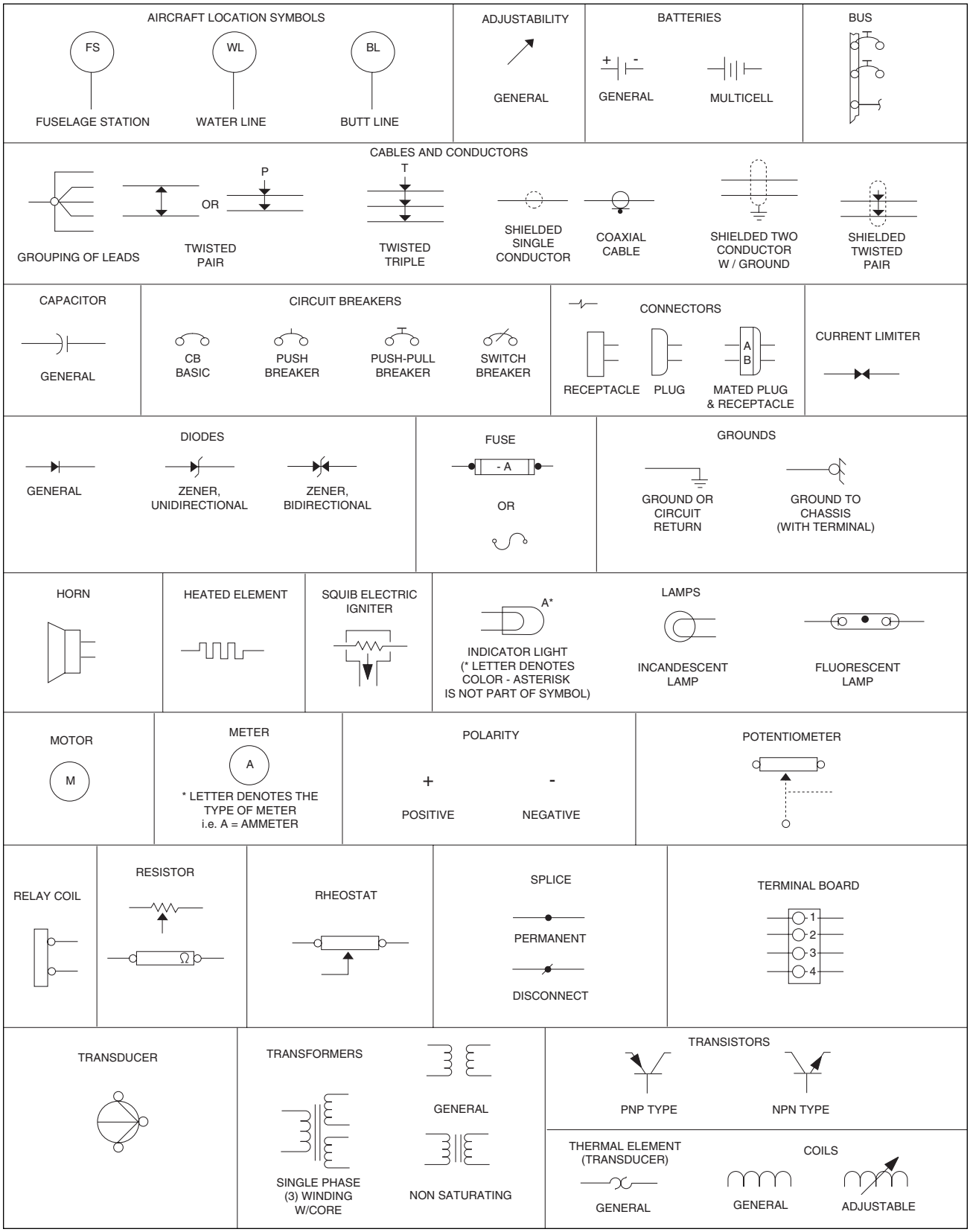
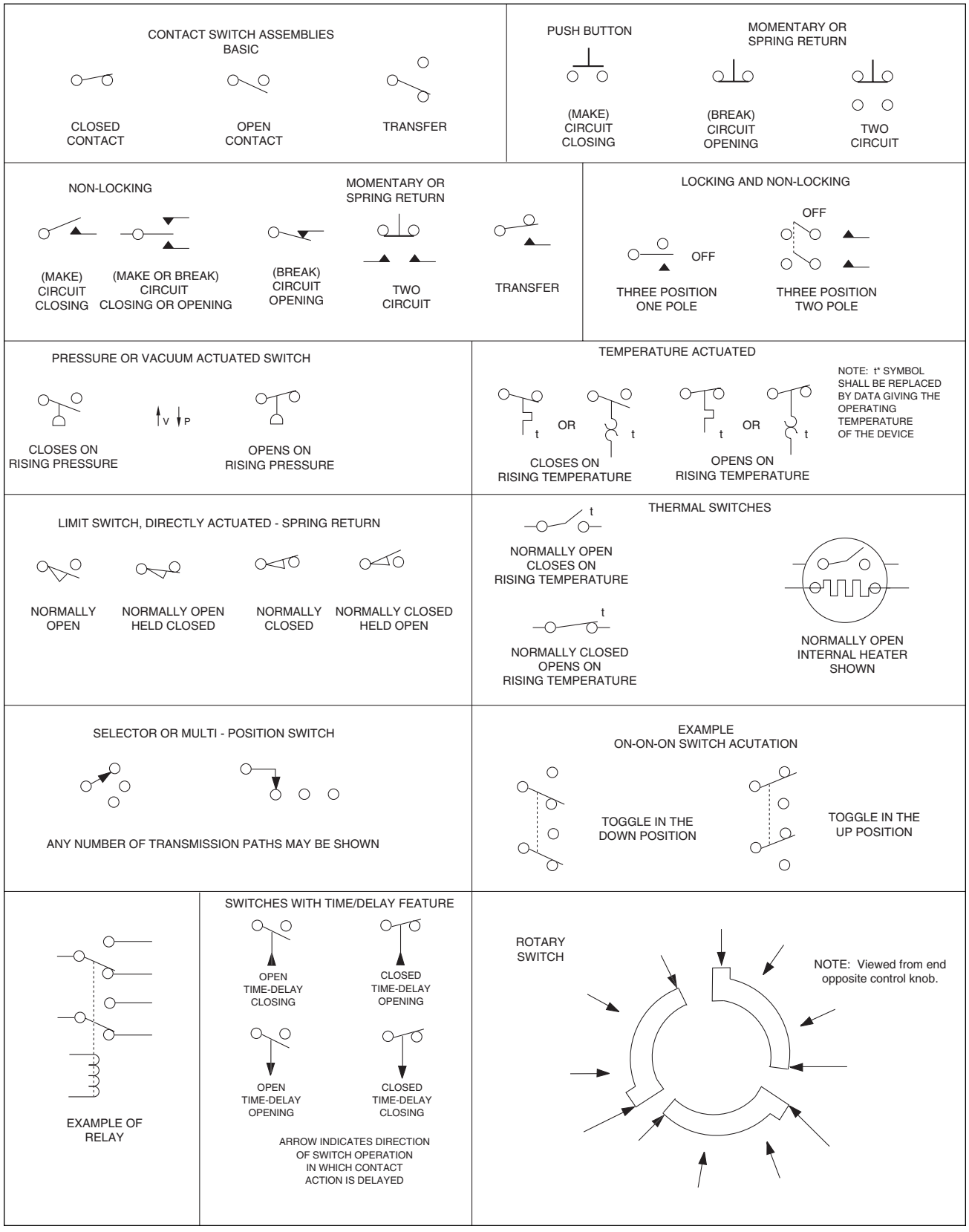
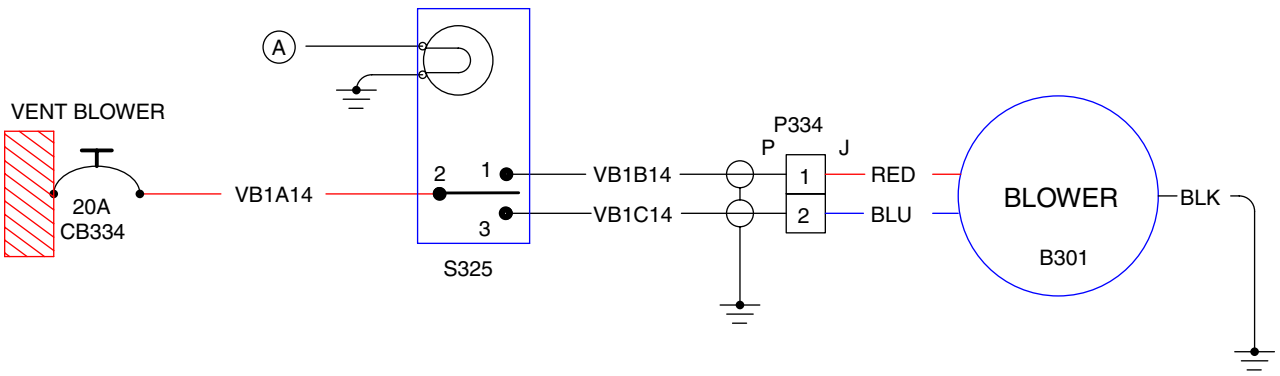


CHART 13 (Sheet 3 of 3)
ELECTRICAL SYMBOLS



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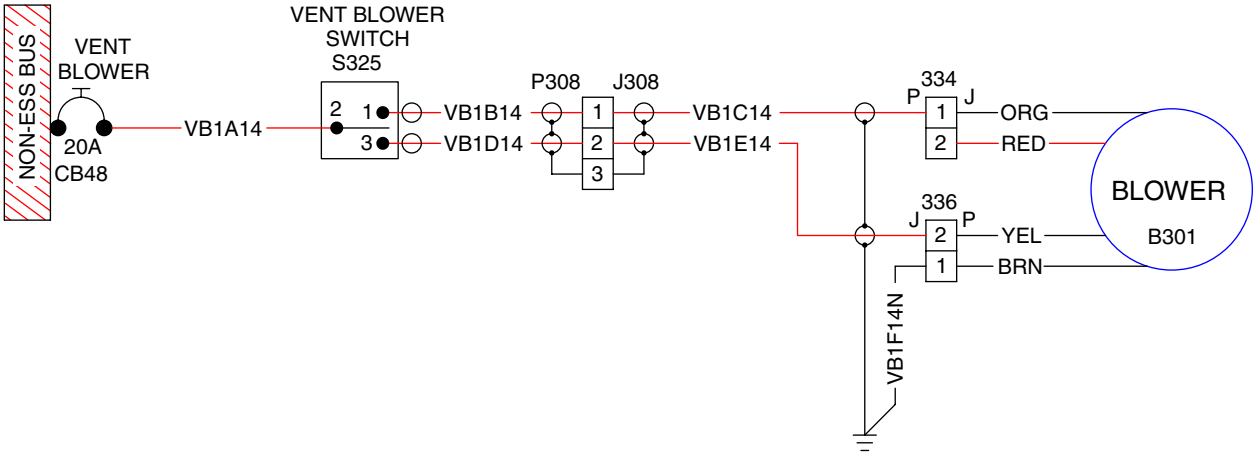
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NOTE: (A) CONNECTS TO SWITCH LIGHTS DIMMER.

89295 A/Y 2.22

Fresh Air Blower (Optional)
Figure 1 (Sheet 1 of 2)

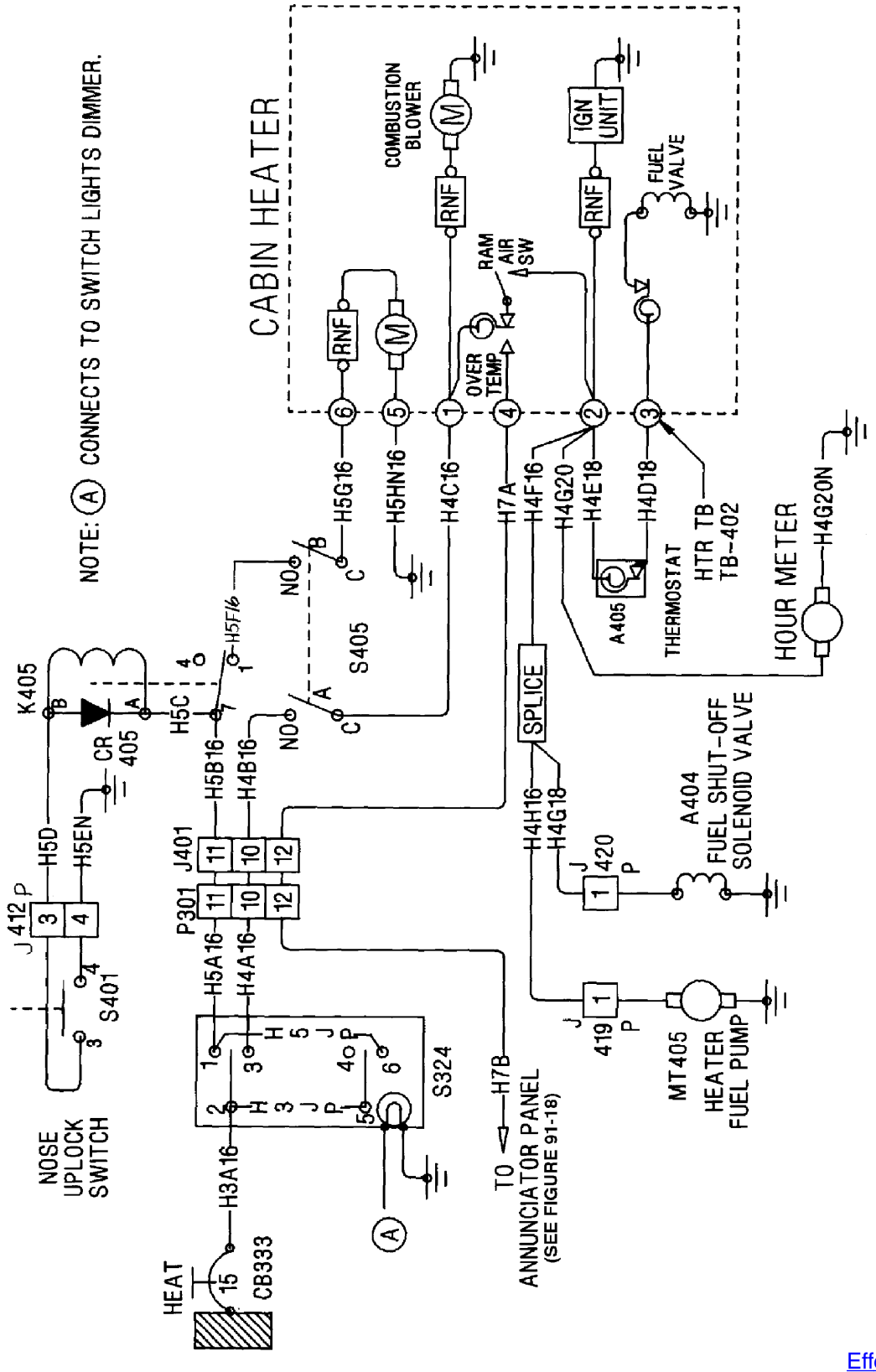


101837 NEW 14.0

Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

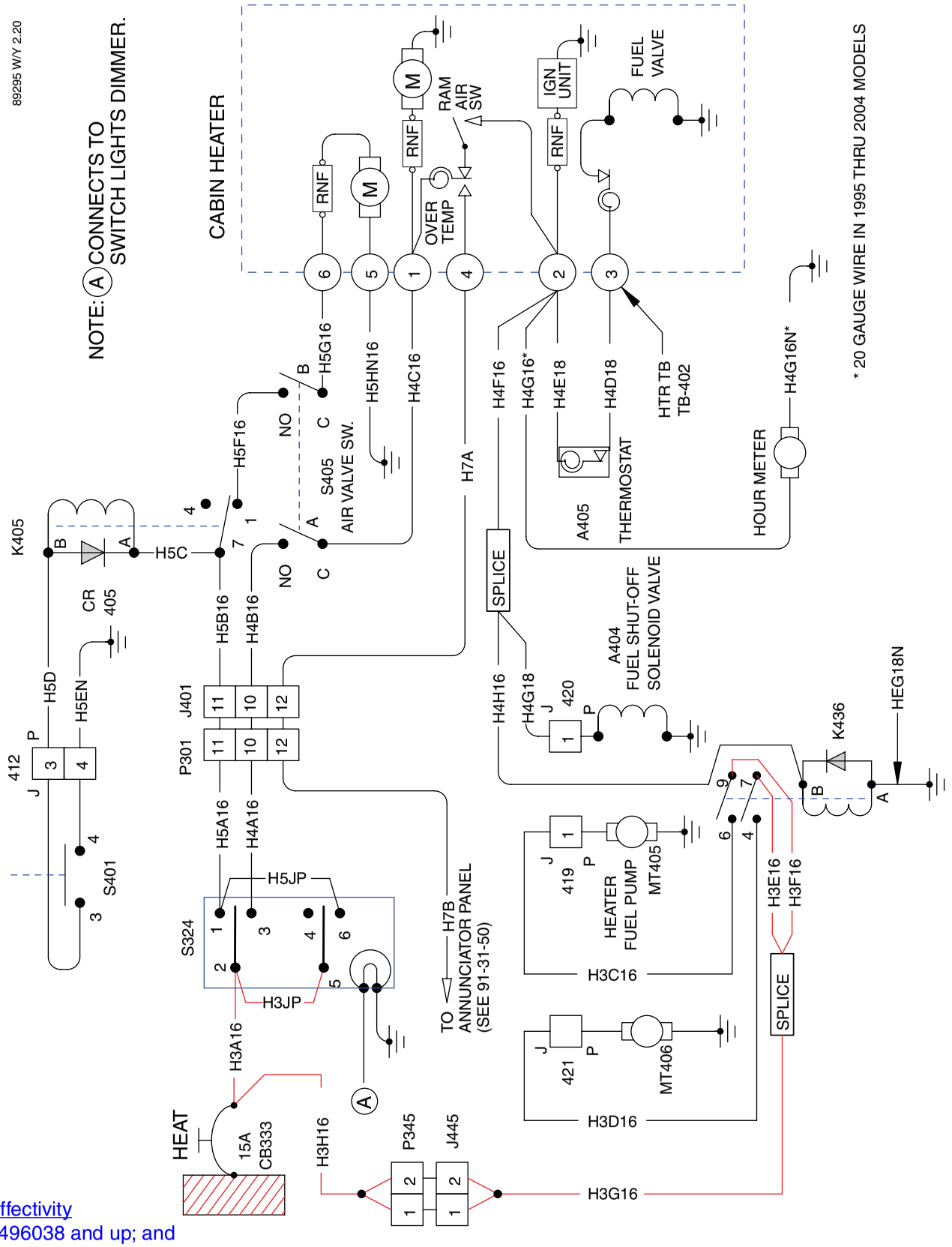
Fresh Air Blower (Optional)
Figure 1 (Sheet 2 of 2)

89295 D/N 2.20



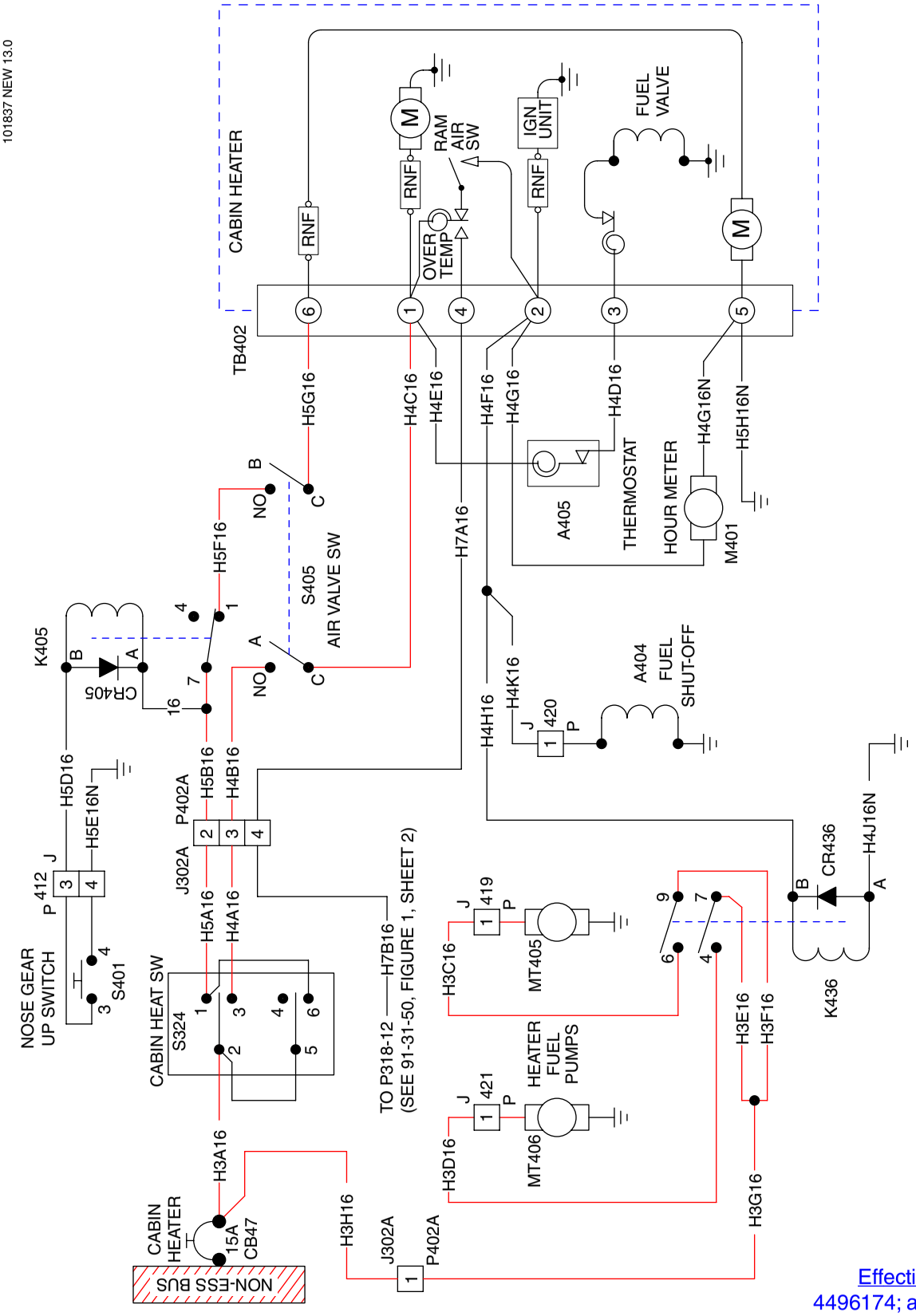
Cabin Heat
Figure 1 (Sheet 1 of 3)

Effectivity
4496001 thru 4496037
before Kit No. 766-686



Effectivity
4496038 and up; and
4496001 thru 4496037
after Kit No. 766-686

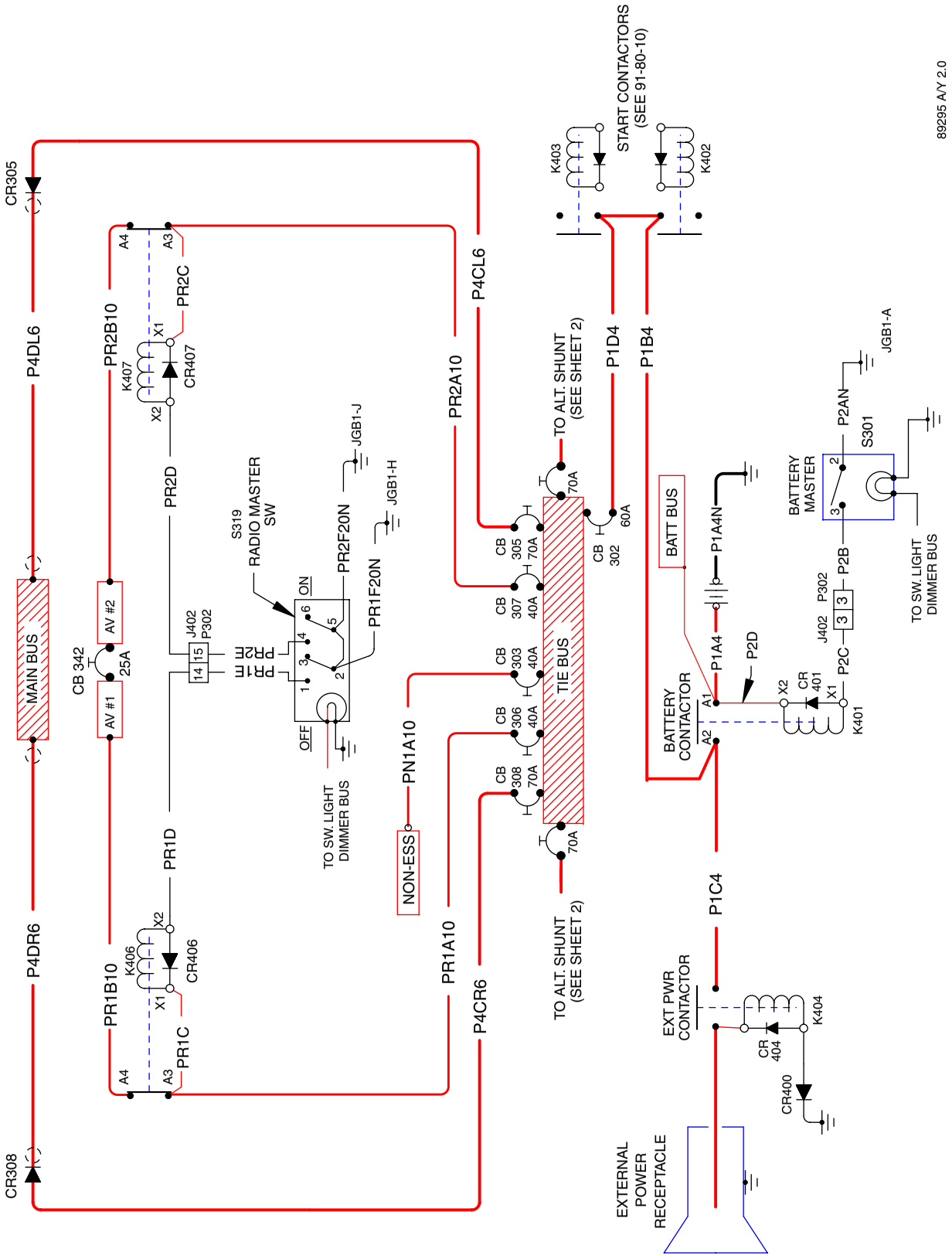
Cabin Heat
Figure 1 (Sheet 2 of 3)



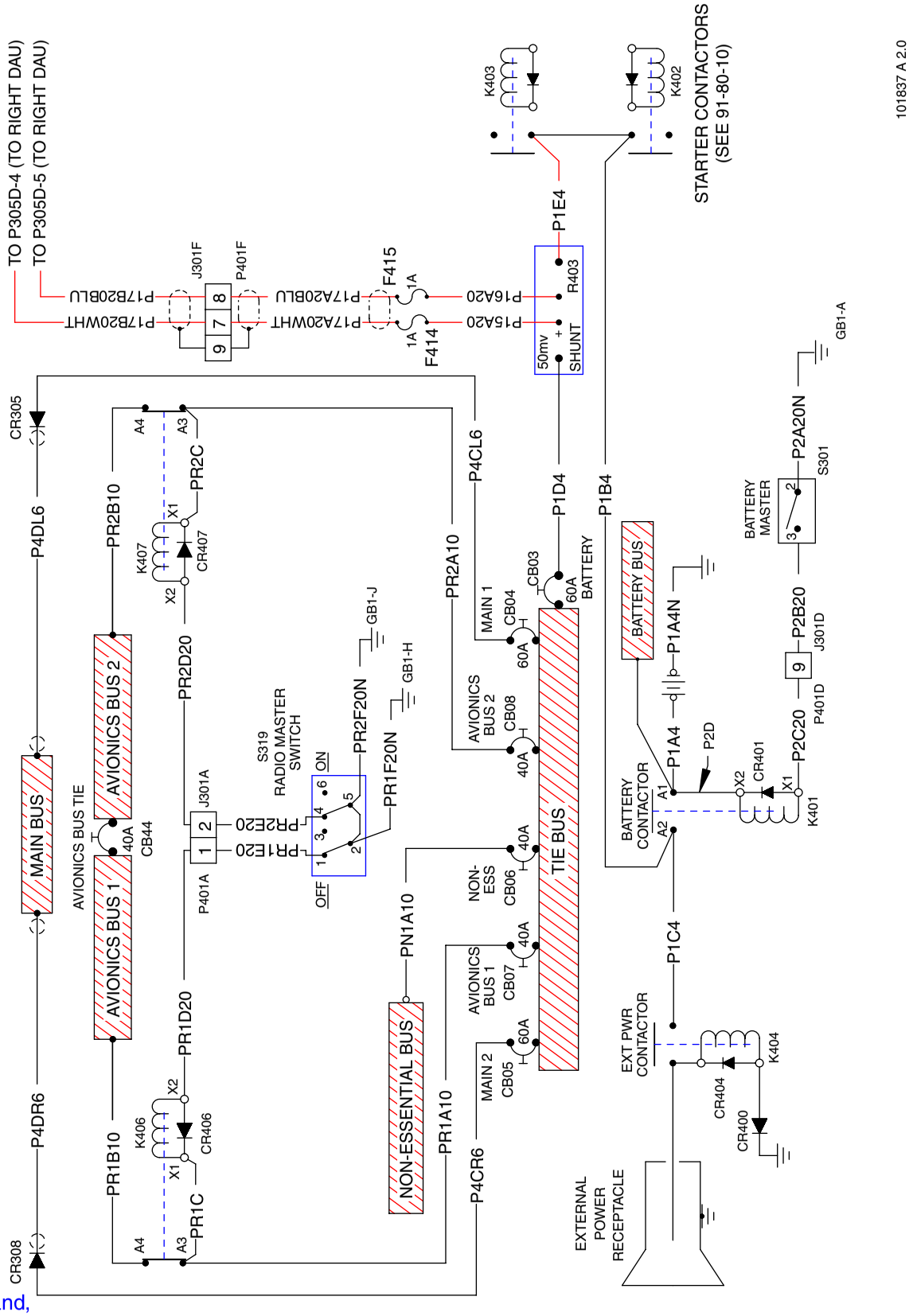
Cabin Heat
Figure 1 (Sheet 3 of 3)

Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

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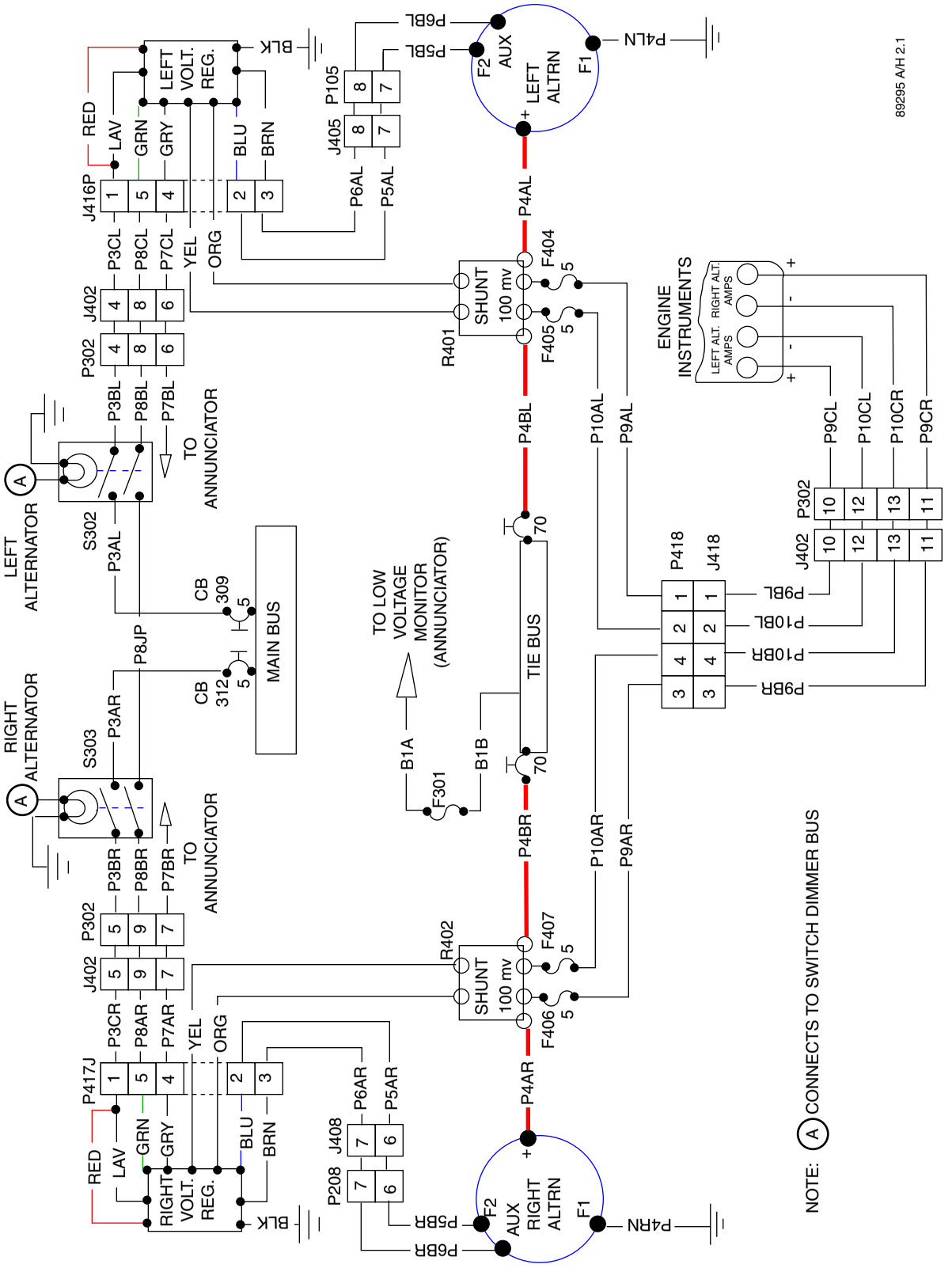


Power Distributor and Control
Figure 1 (Sheet 1 of 2)



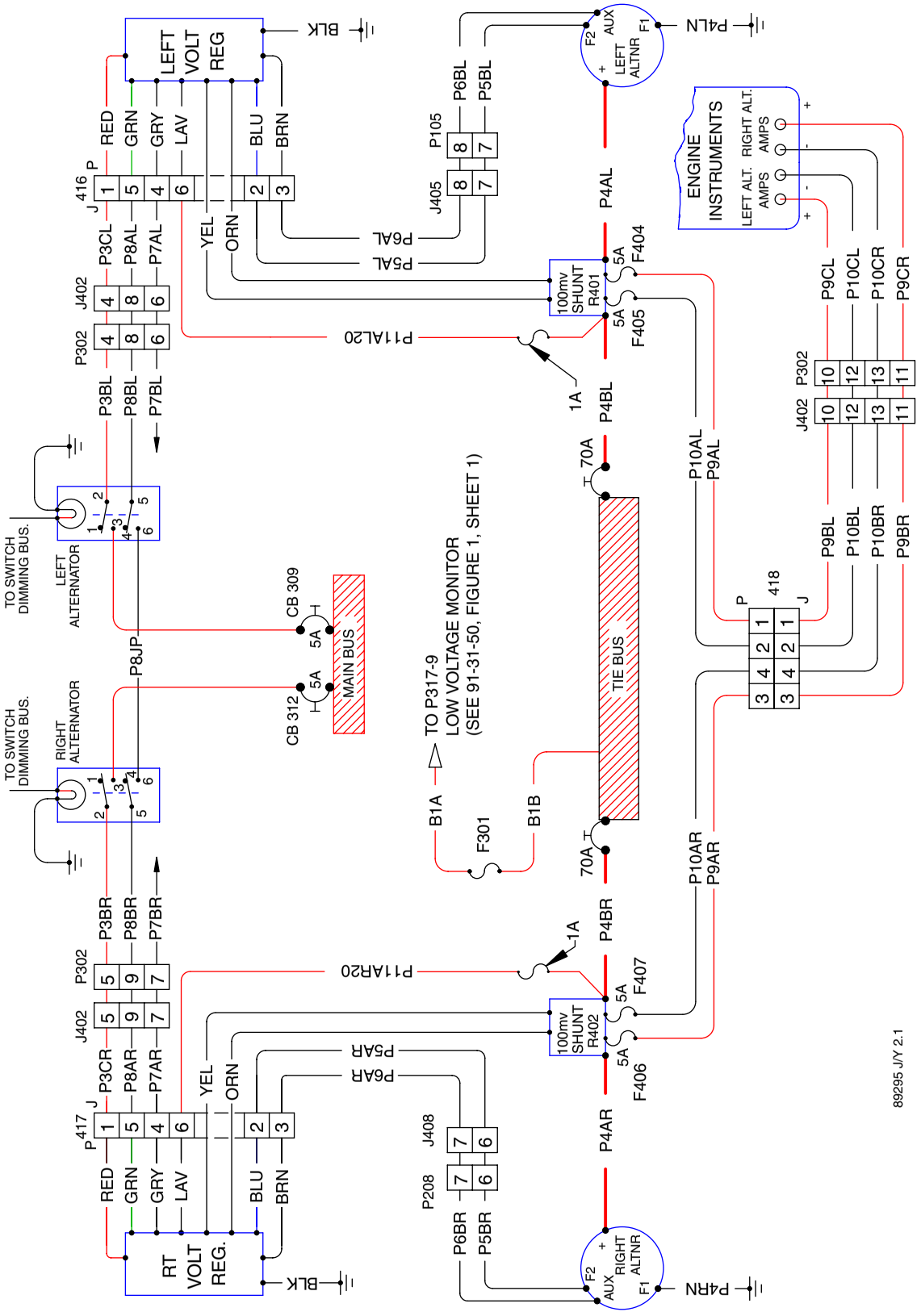
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Power Distributor and Control
Figure 1 (Sheet 2 of 2)



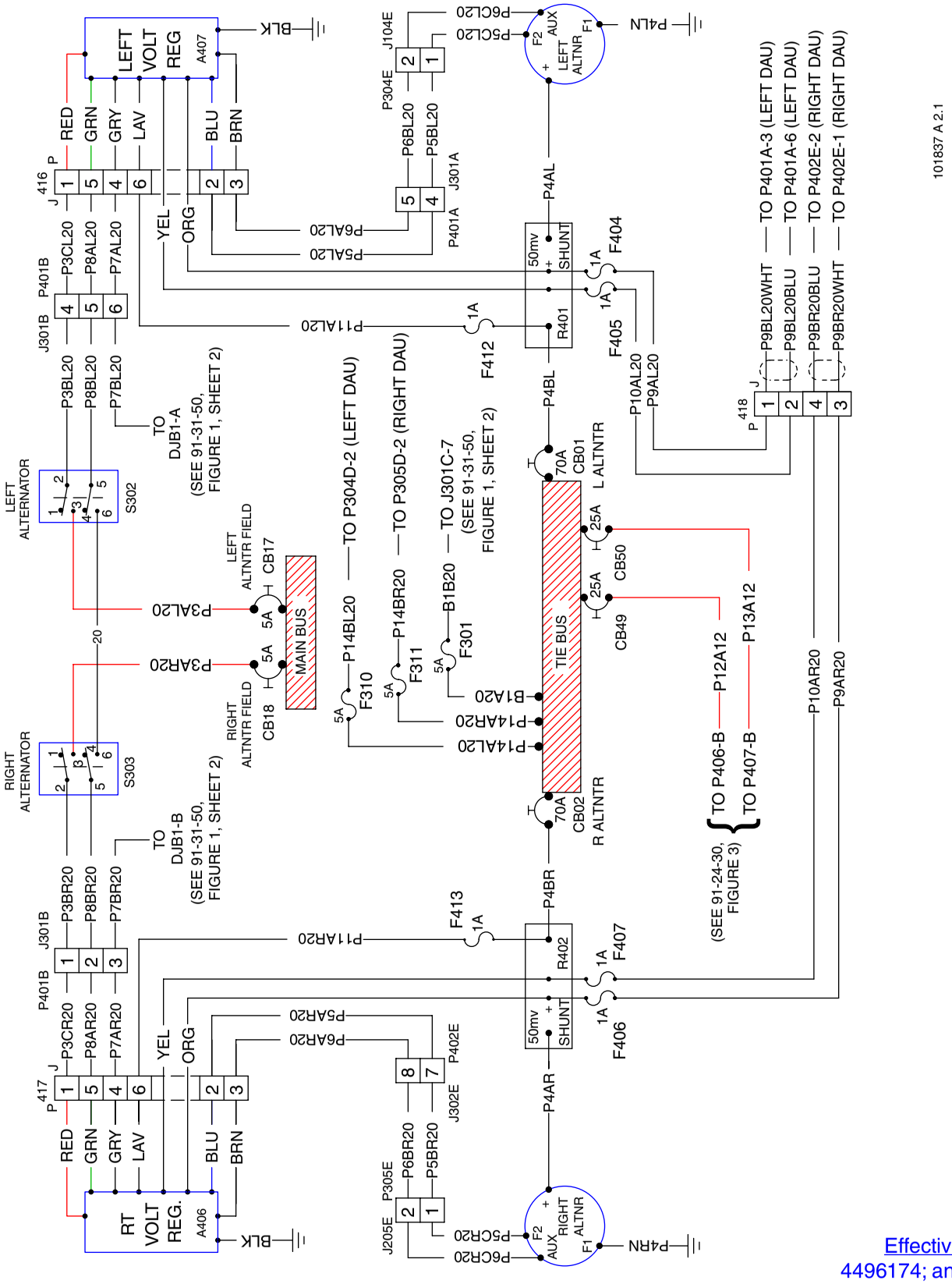
Power Monitor and Control
Figure 2 (Sheet 1 of 3)

Effectivity
4496001 thru 4496019



Effectivity
4496020 and up

Power Monitor and Control
Figure 2 (Sheet 2 of 3)

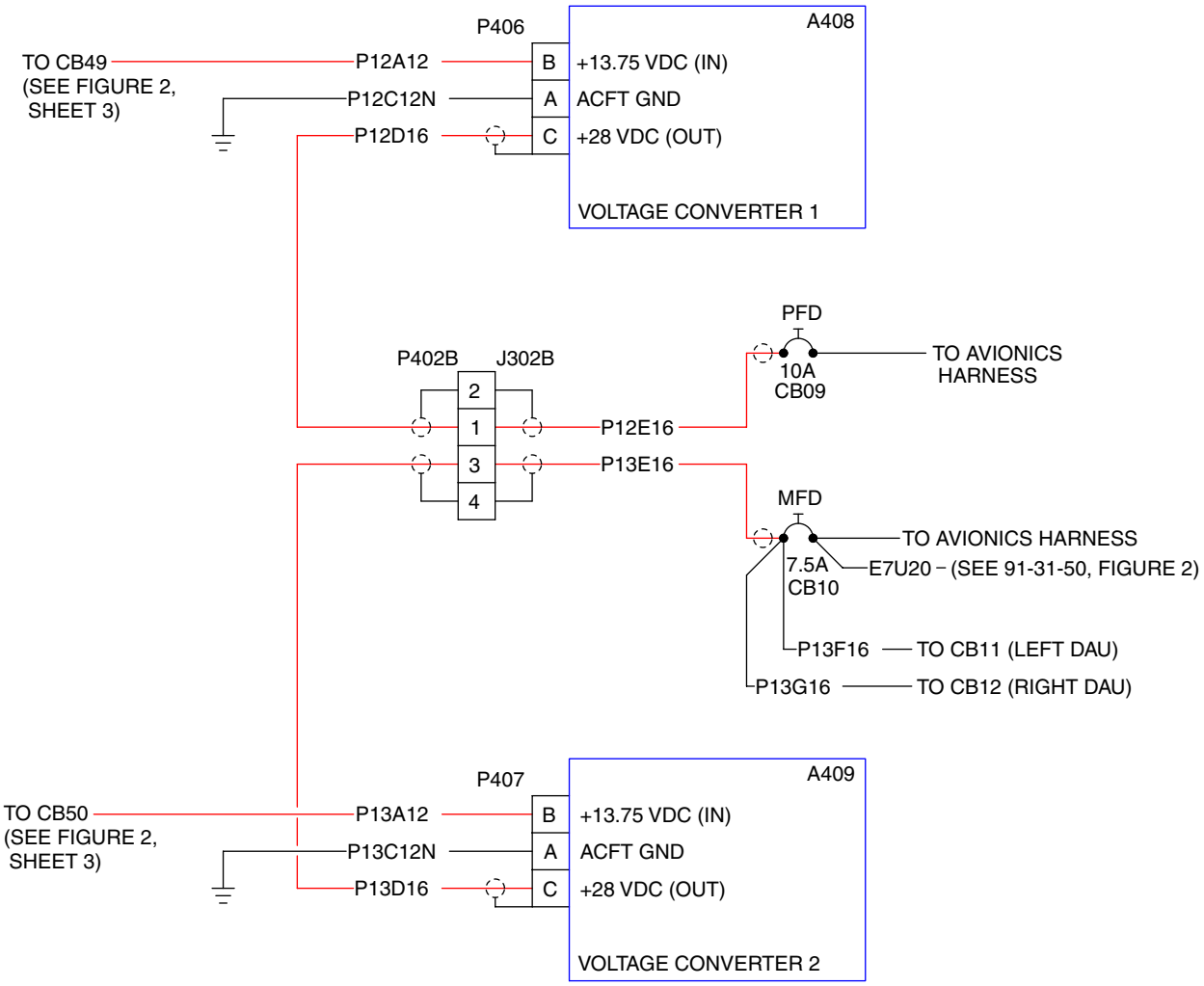


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Power Monitor and Control
Figure 2 (Sheet 3 of 3)

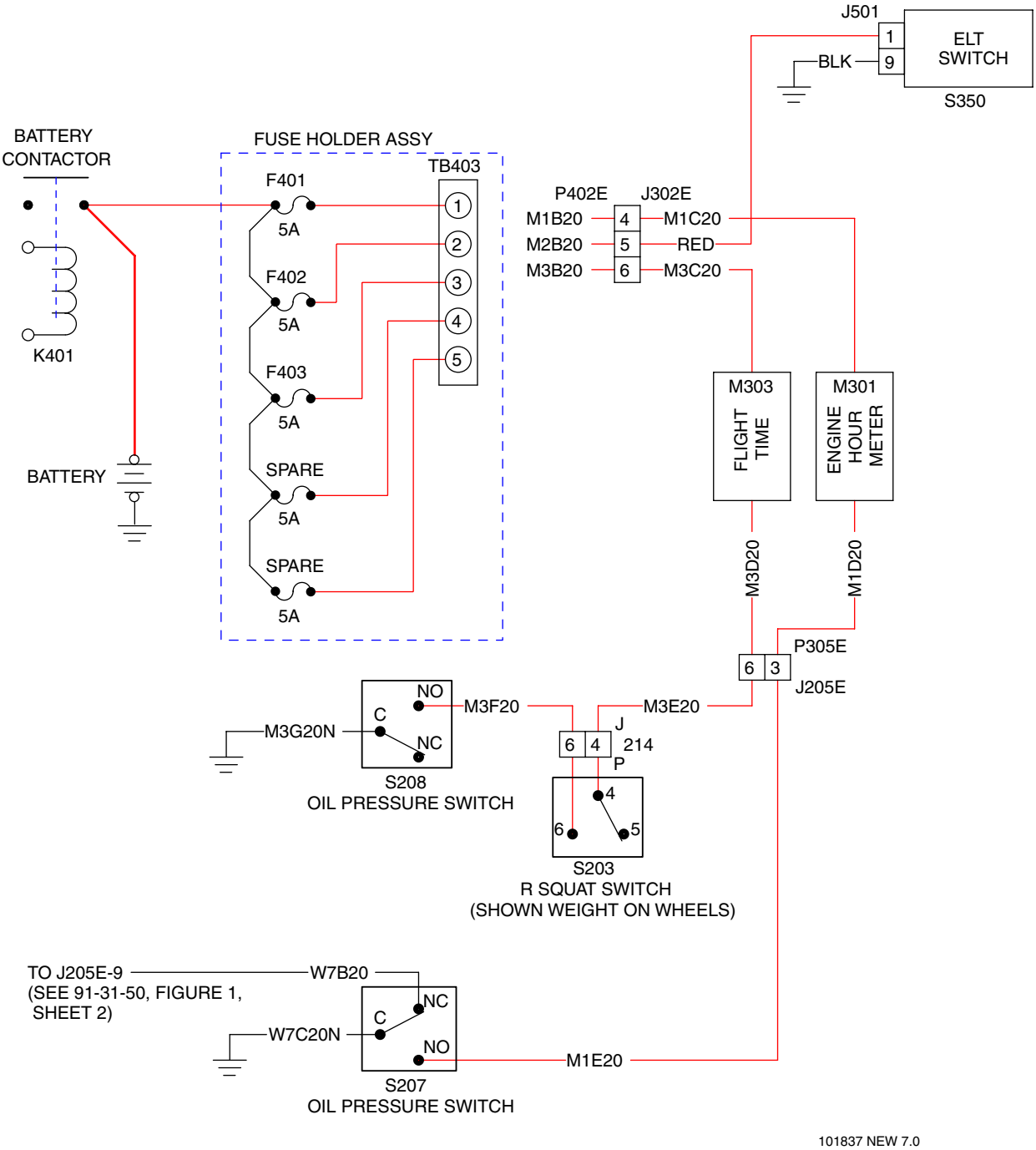
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

101837 A 2.2



Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

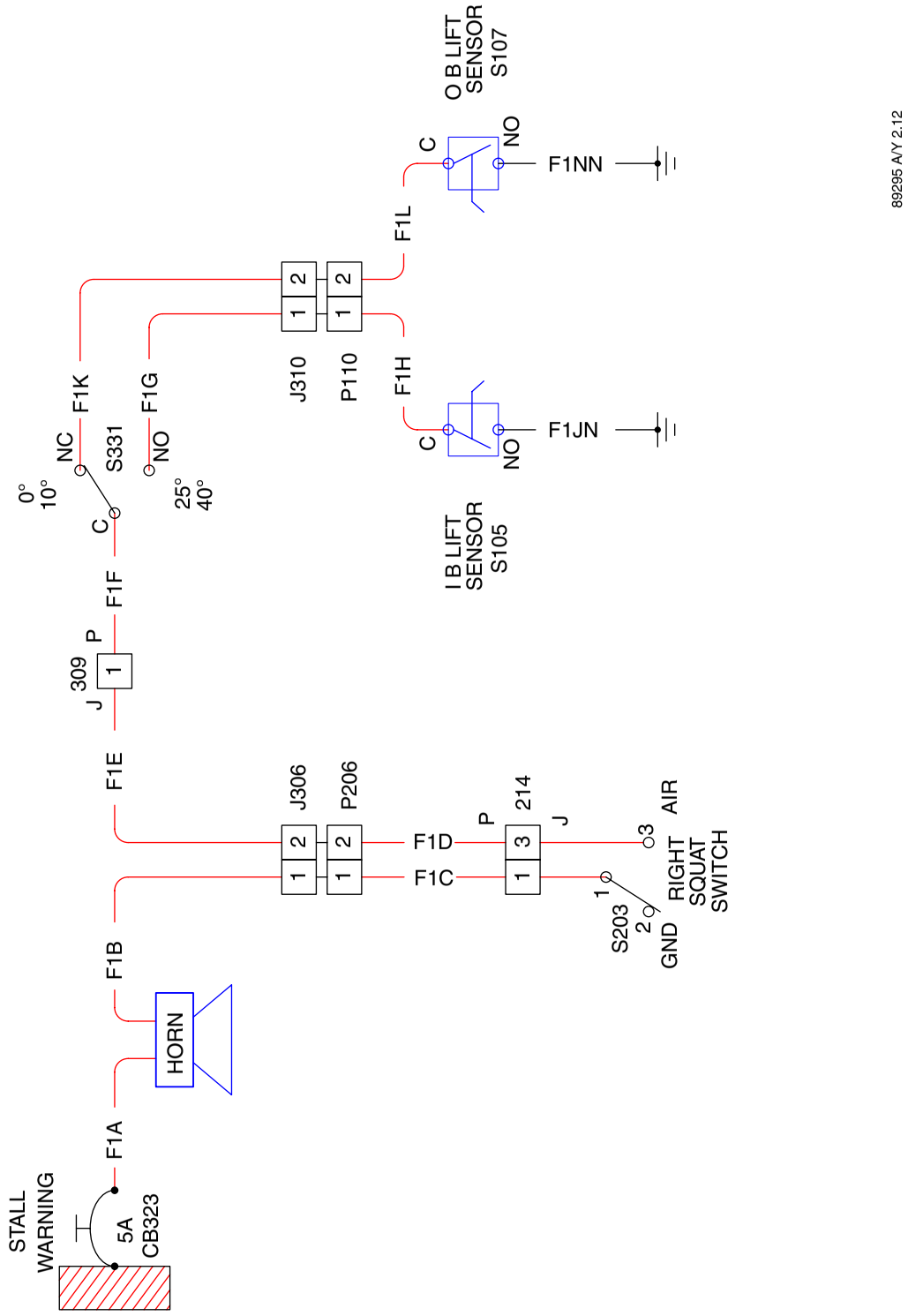
Voltage Converters
Figure 3



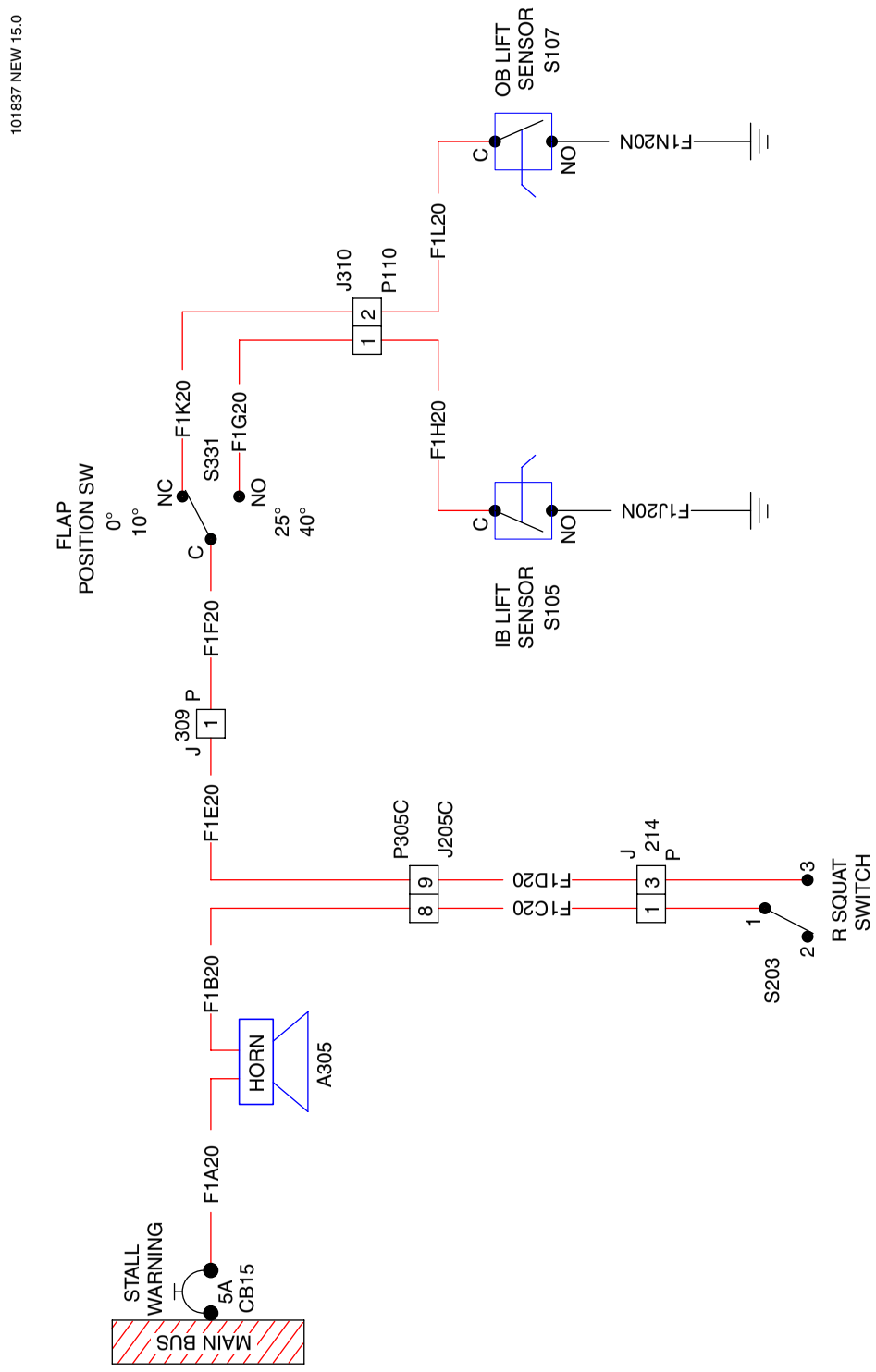
Battery Bus
Figure 4

Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

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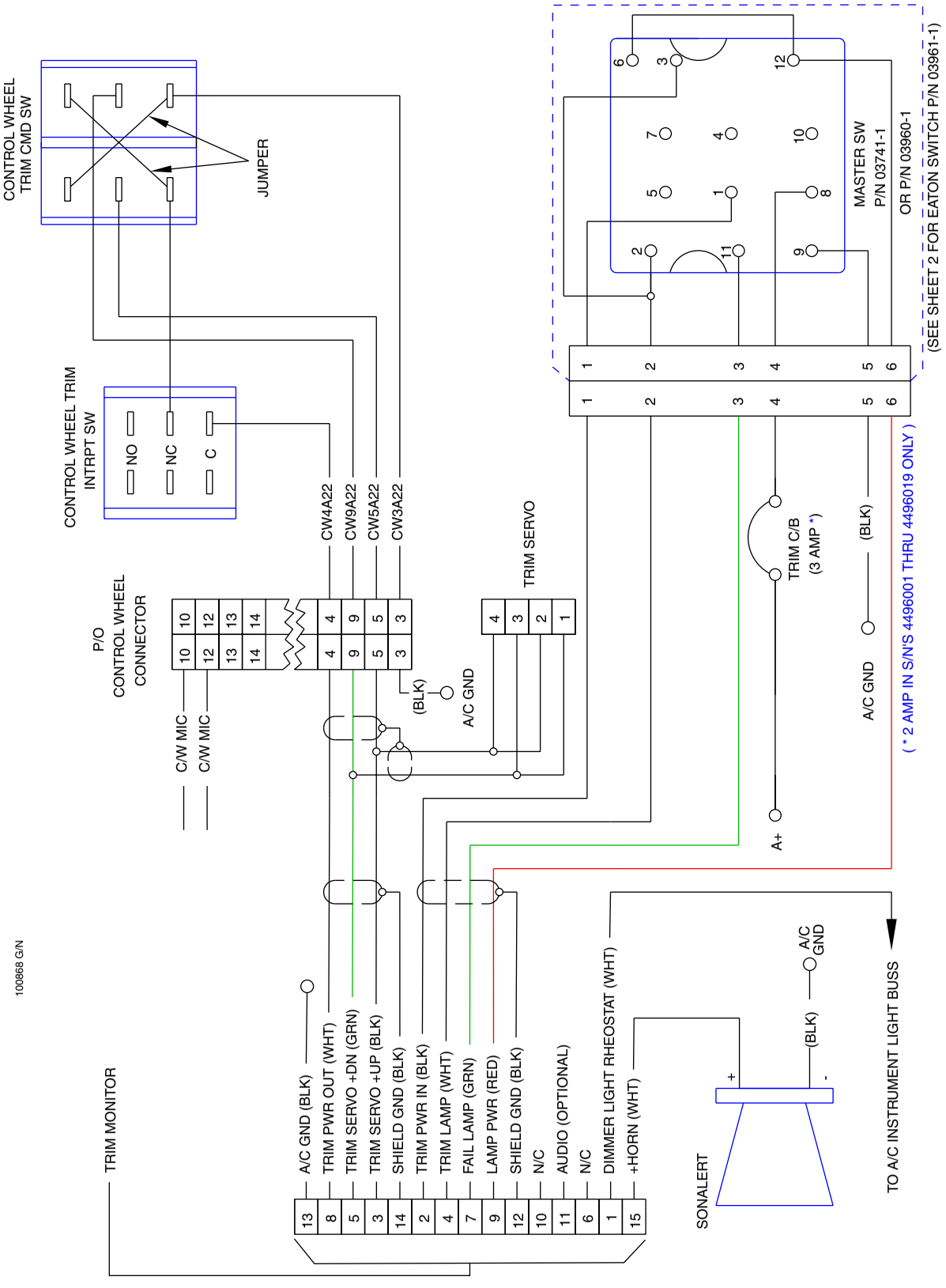


Stall Detection and Warning
Figure 1 (Sheet 1 of 2)

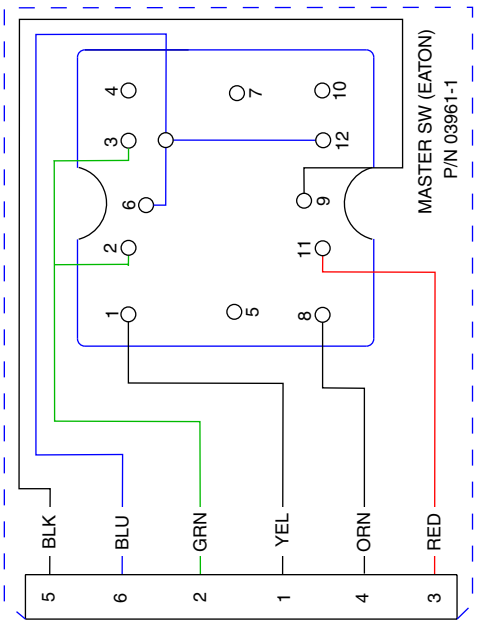


Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

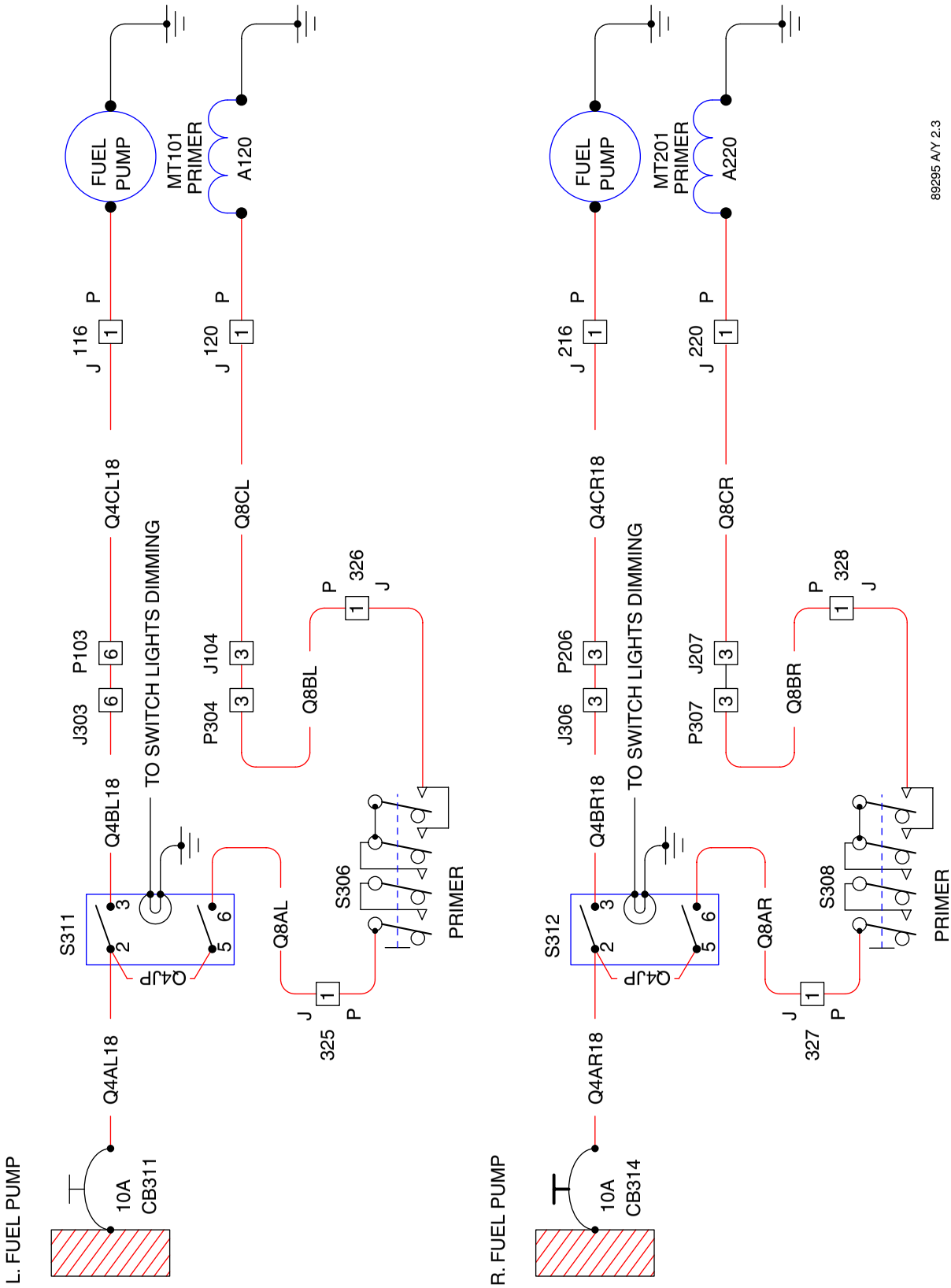
Stall Detection and Warning
Figure 1 (Sheet 2 of 2)



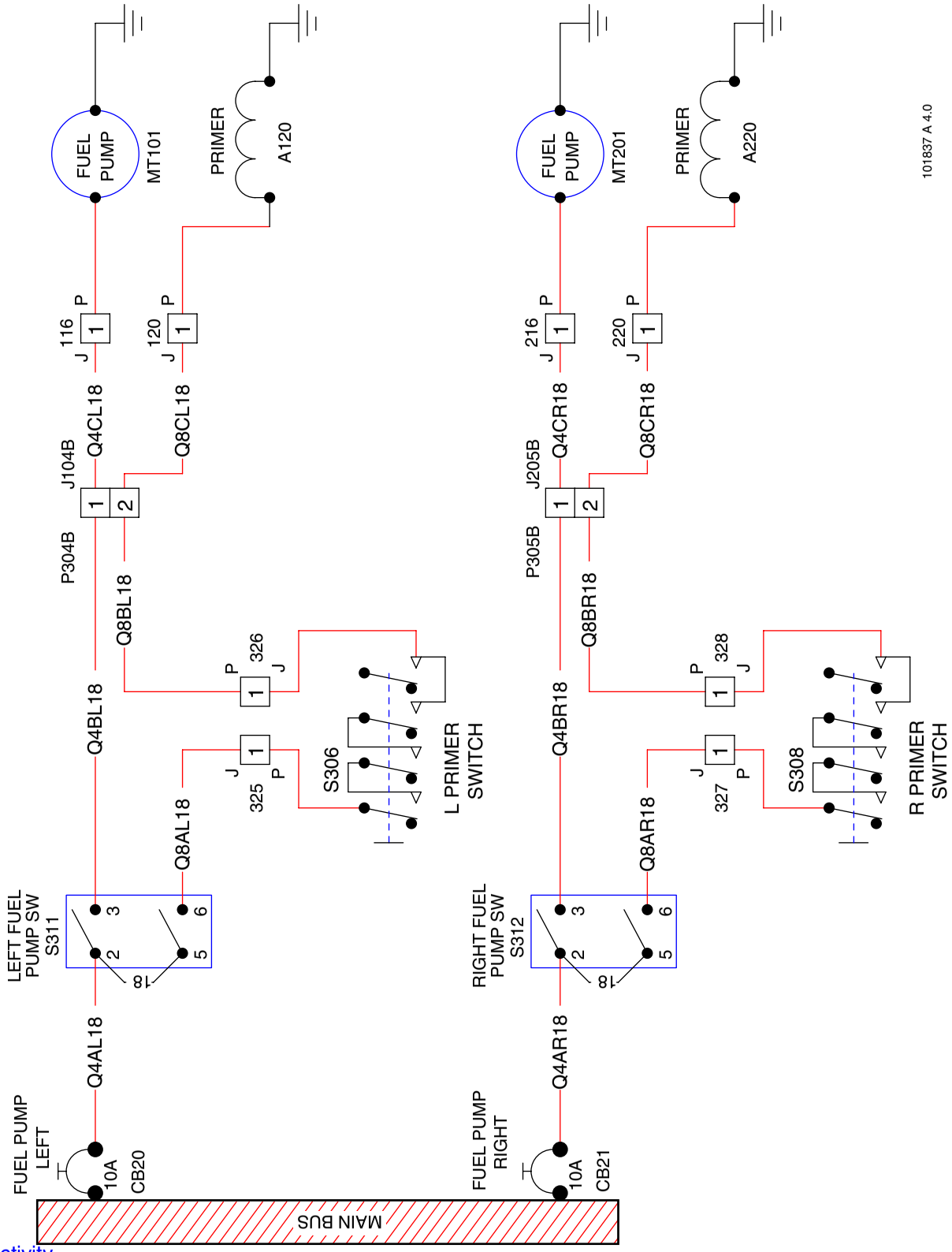
S-TEC Manual Electric Trim
Figure 2 (Sheet 1 of 2)



S-TEC Manual Electric Trim
Figure 2 (Sheet 2 of 2)

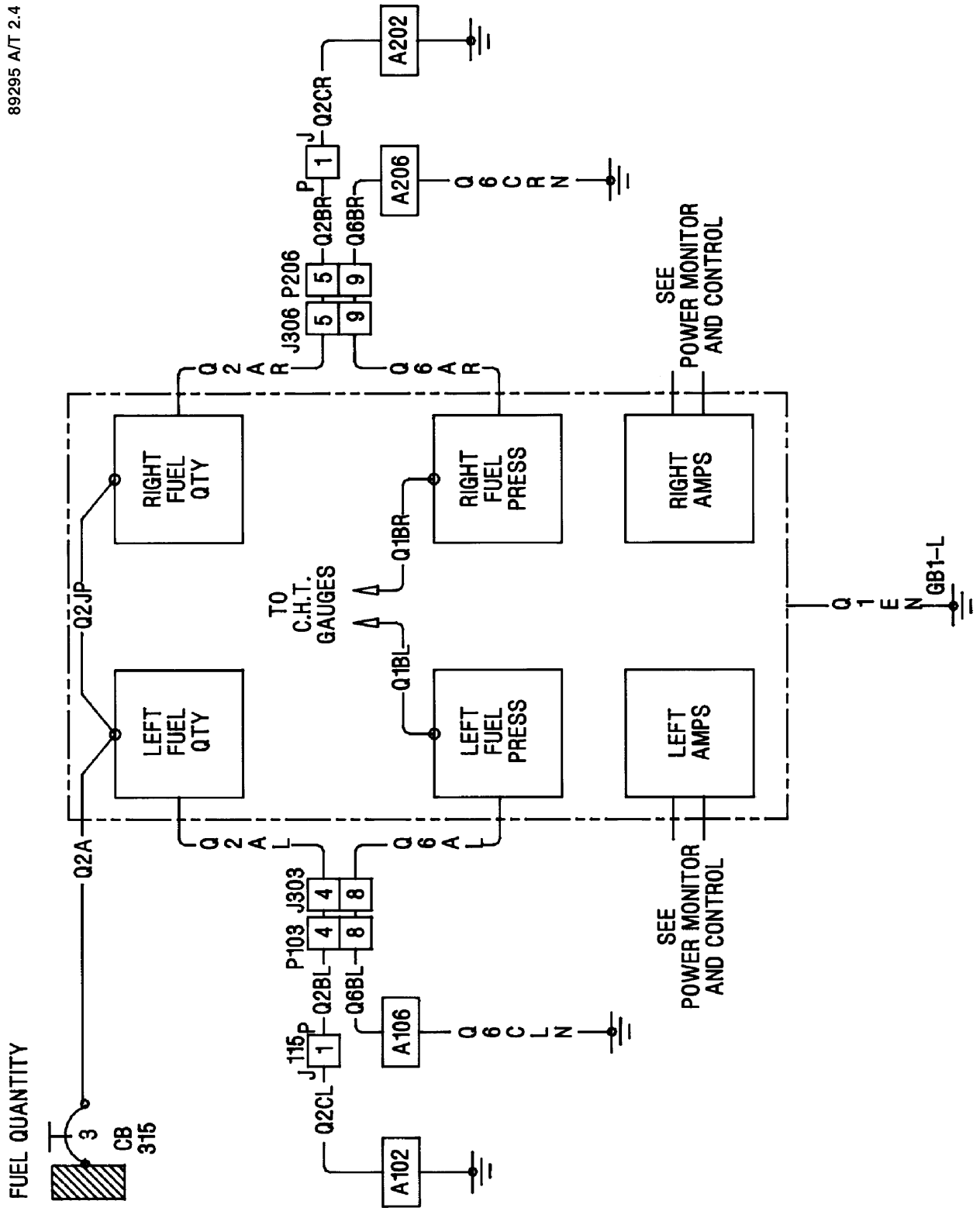


Fuel Pumps
Figure 1 (Sheet 1 of 2)



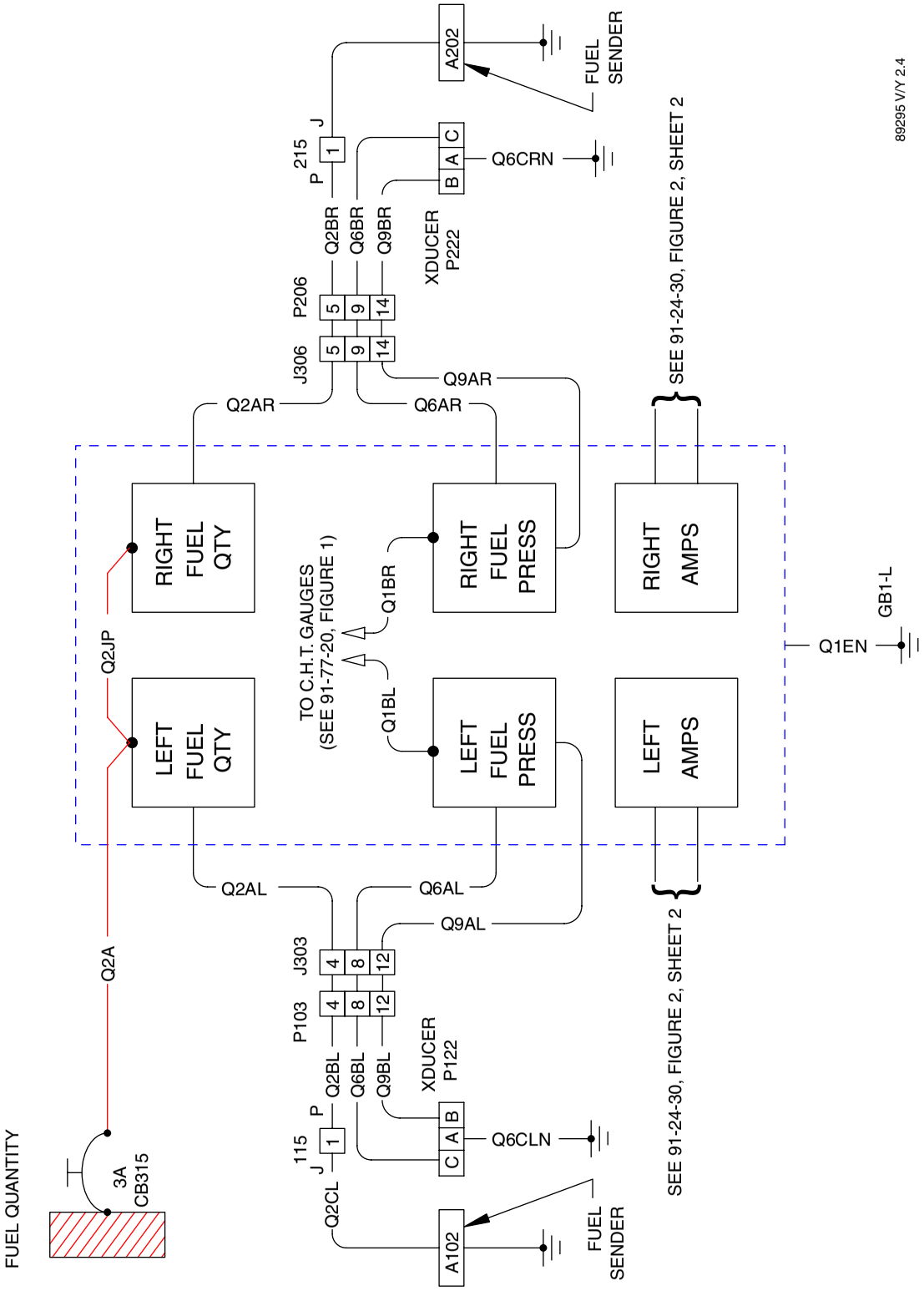
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Fuel Pumps
Figure 1 (Sheet 2 of 2)



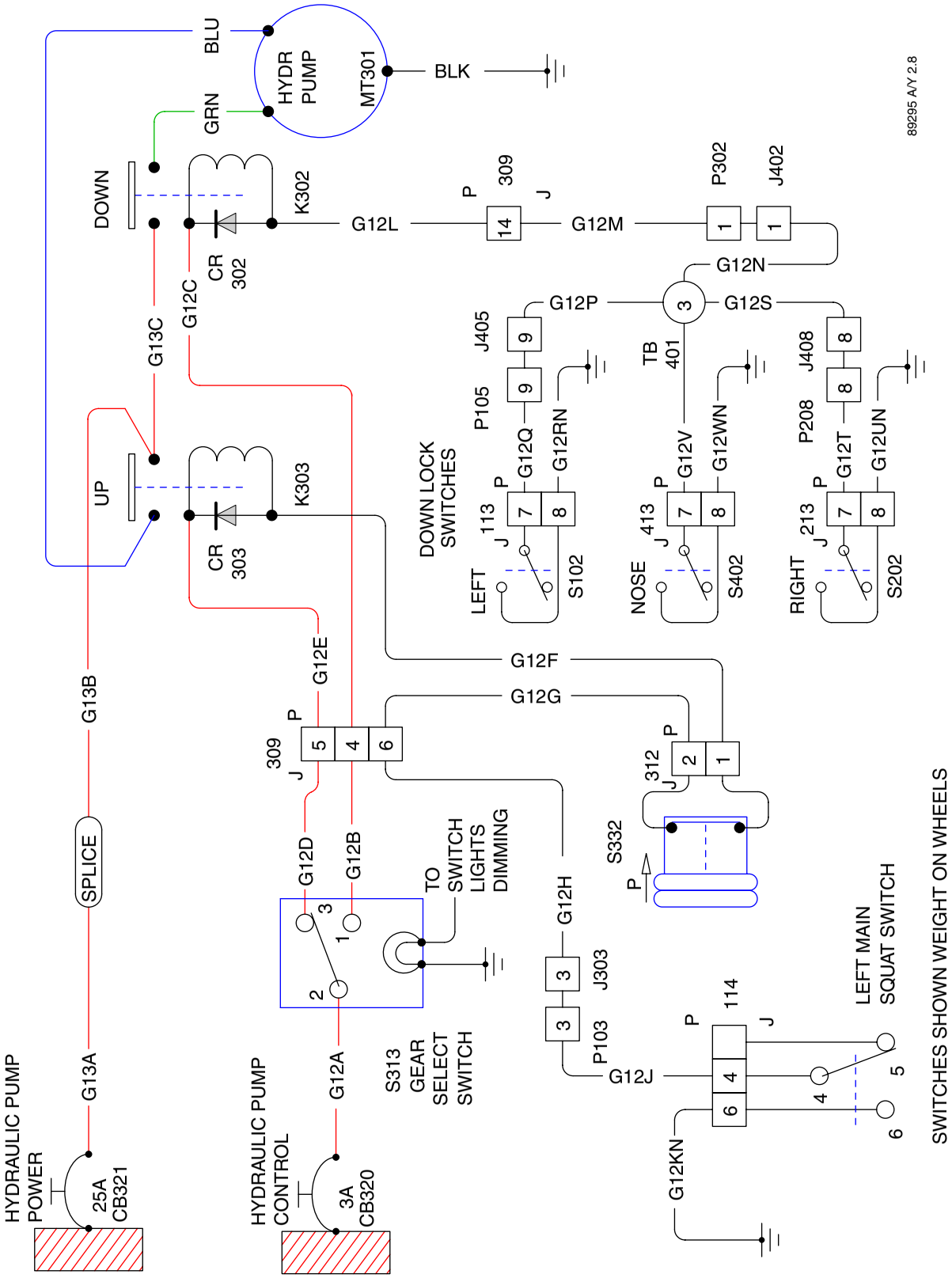
Fuel and Ampere Indicators
Figure 1 (Sheet 1 of 2)

Effectivity
4496001 thru 4496189

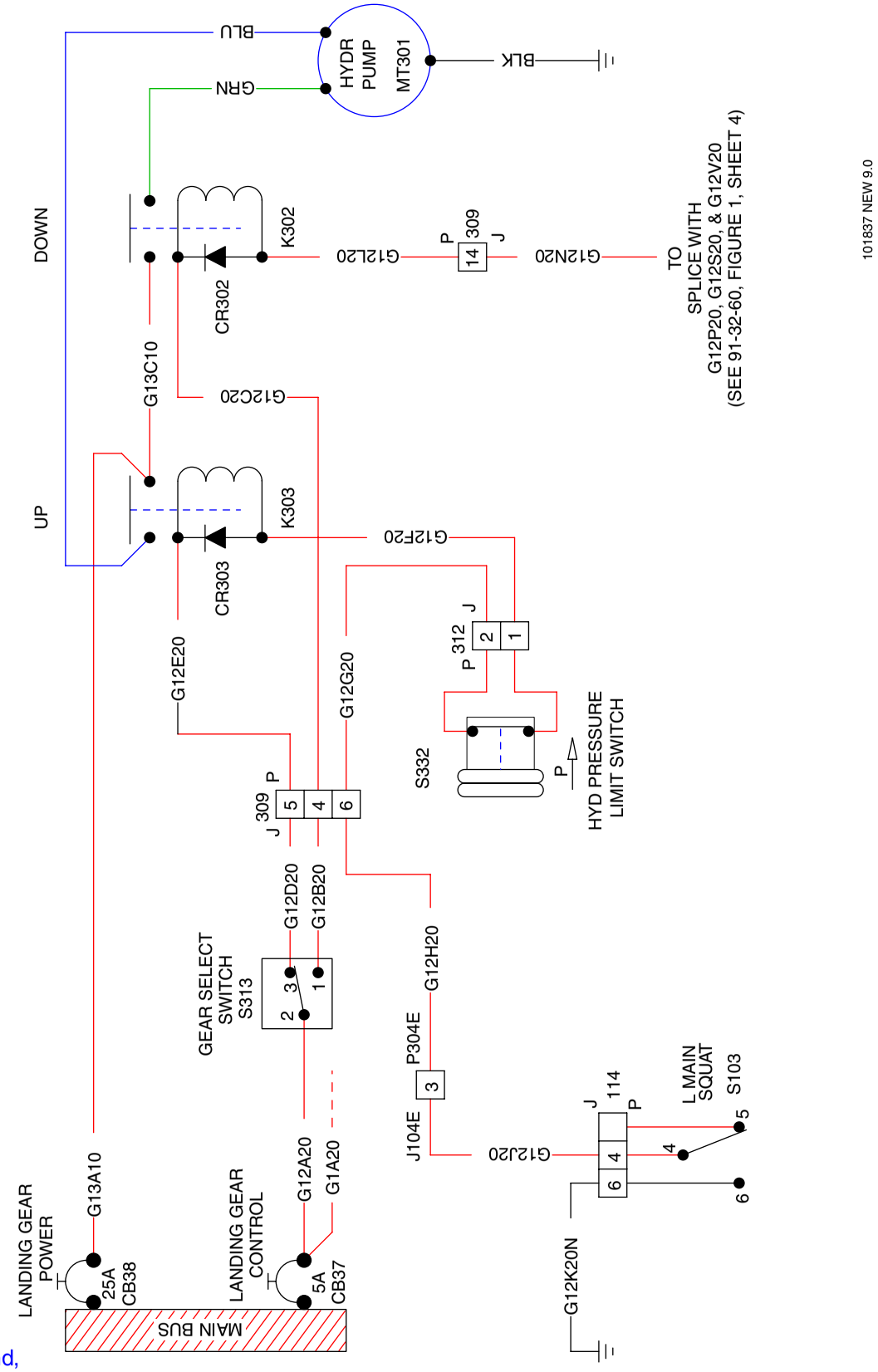


Effectivity
4496190 and up

Fuel and Ampere Indicators
Figure 1 (Sheet 2 of 2)

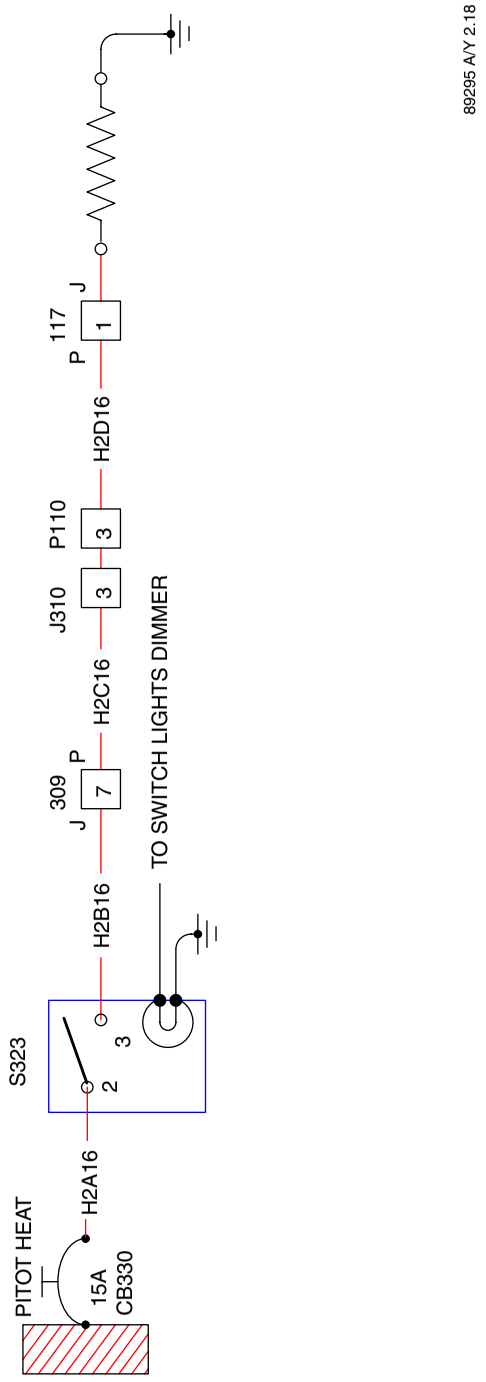


Hydraulic Pump
Figure 1 (Sheet 1 of 2)

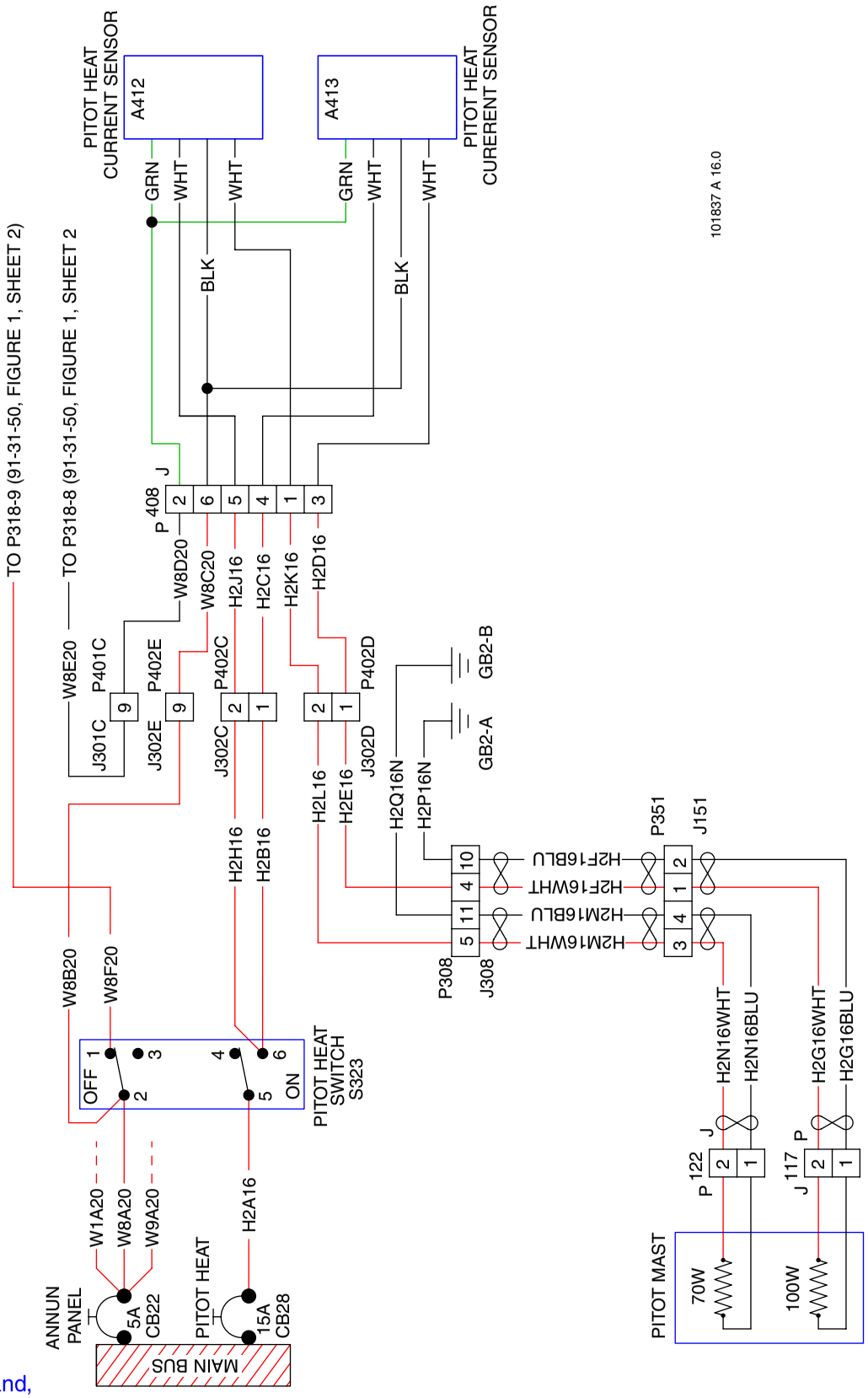


Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Hydraulic Pump
Figure 1 (Sheet 2 of 2)

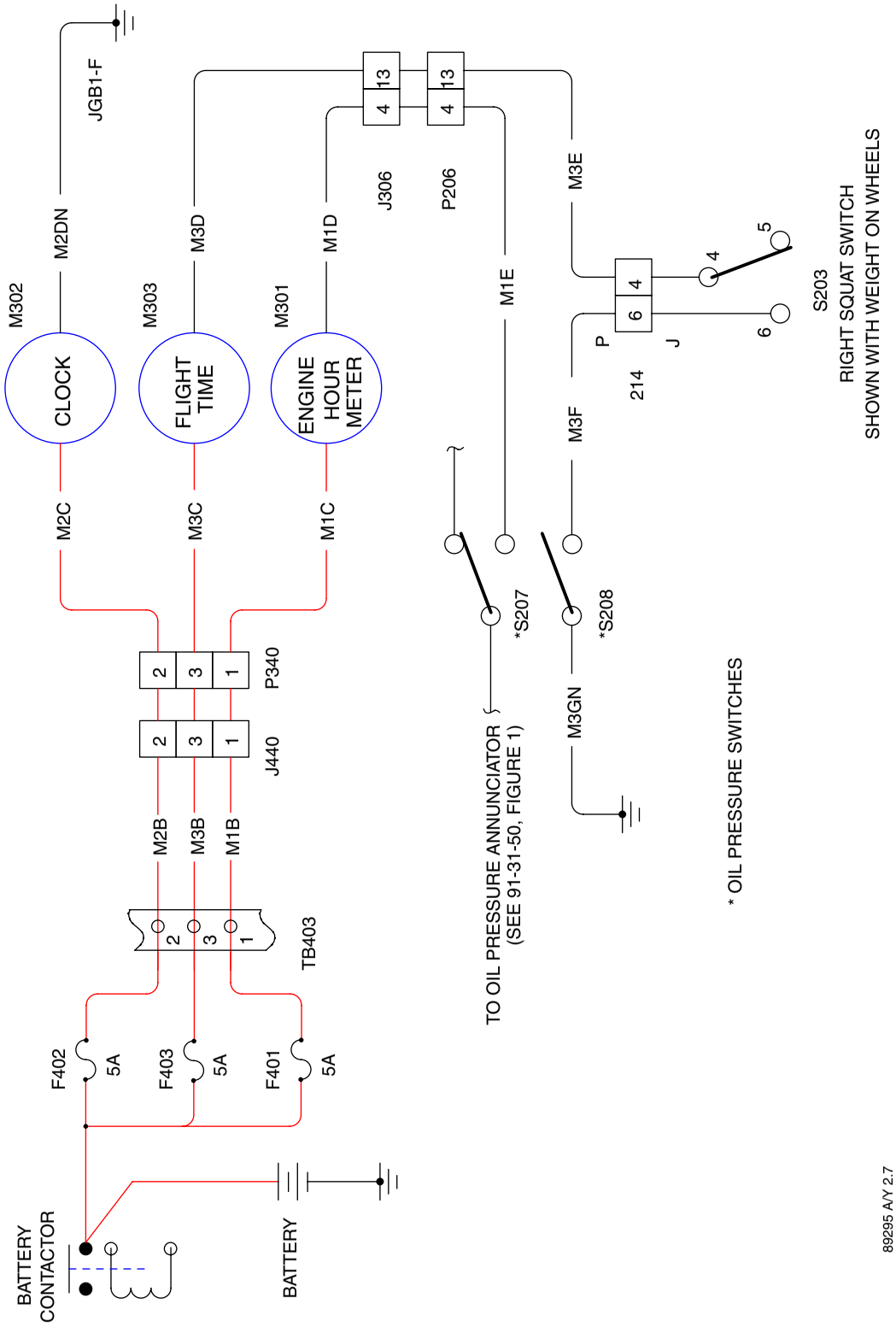


Pitot Heat
Figure 1 (Sheet 1 of 2)



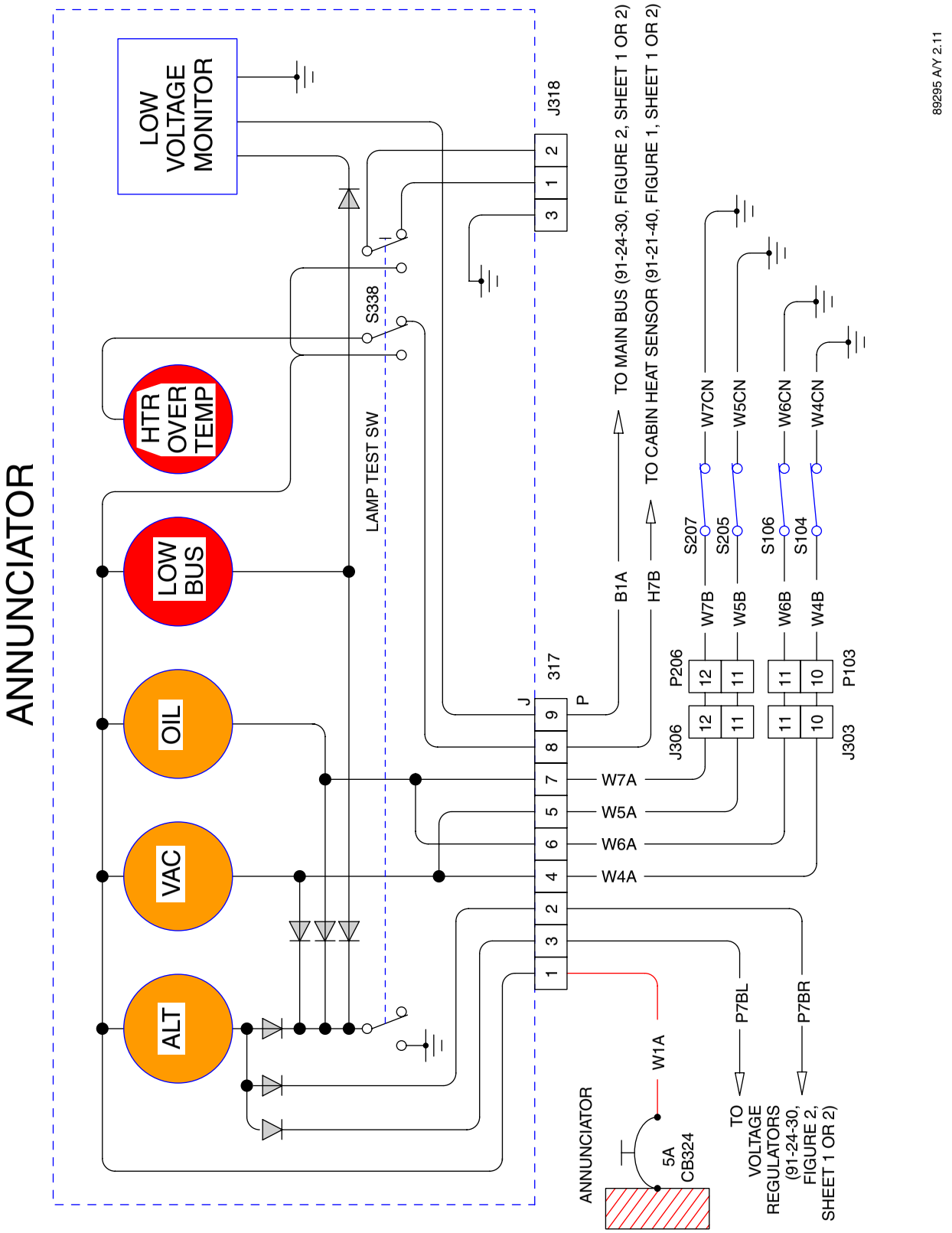
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Pitot Heat
Figure 1 (Sheet 2 of 2)

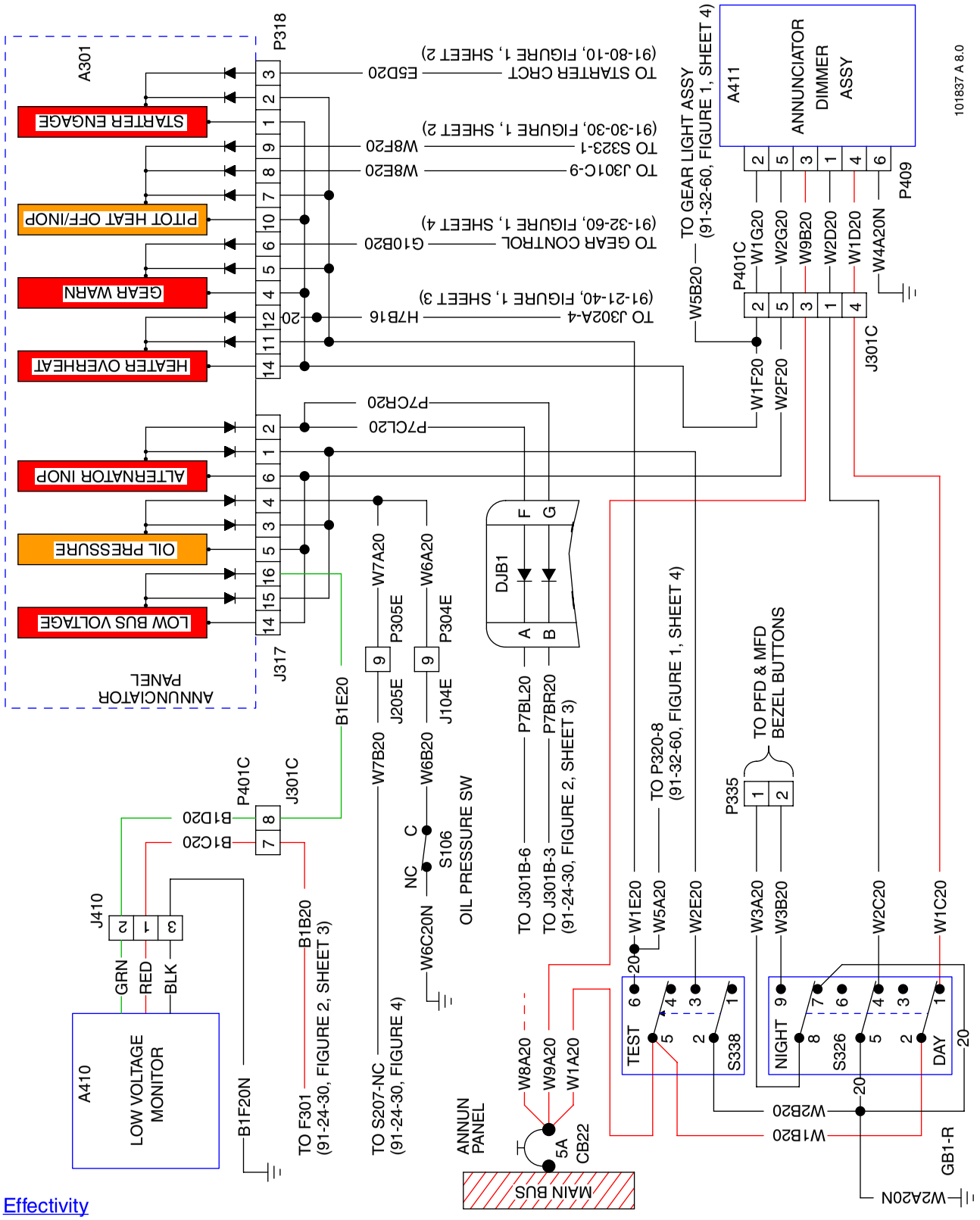


Engine Hour Meter
Figure 1

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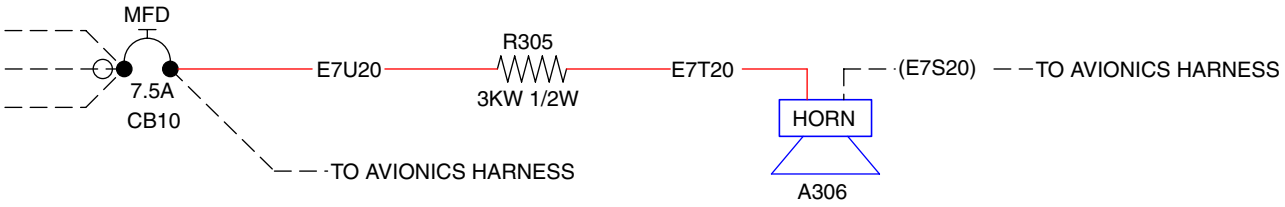


Annunciator
Figure 1 (Sheet 1 of 2)



Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Annunciator
Figure 1 (Sheet 2 of 2)

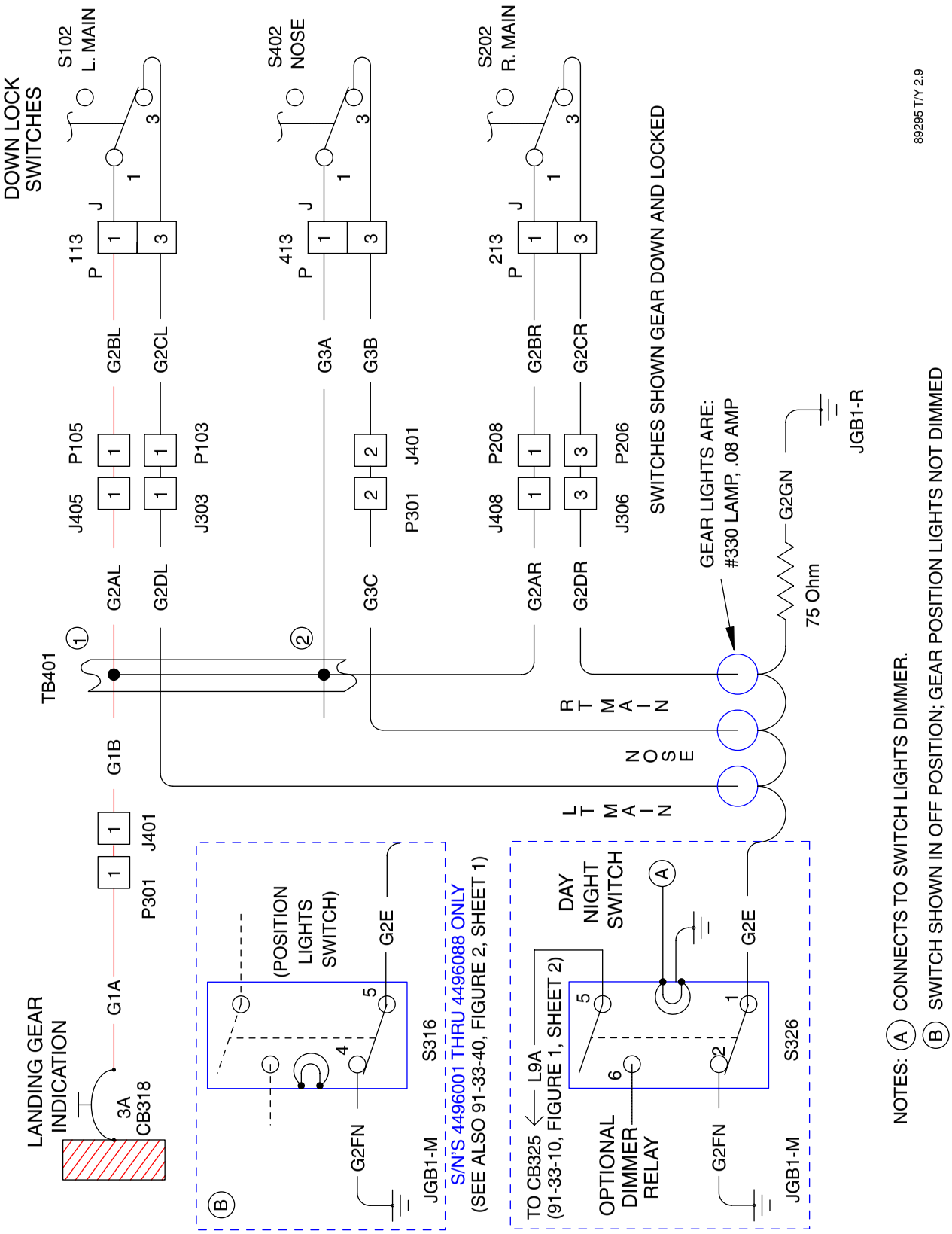


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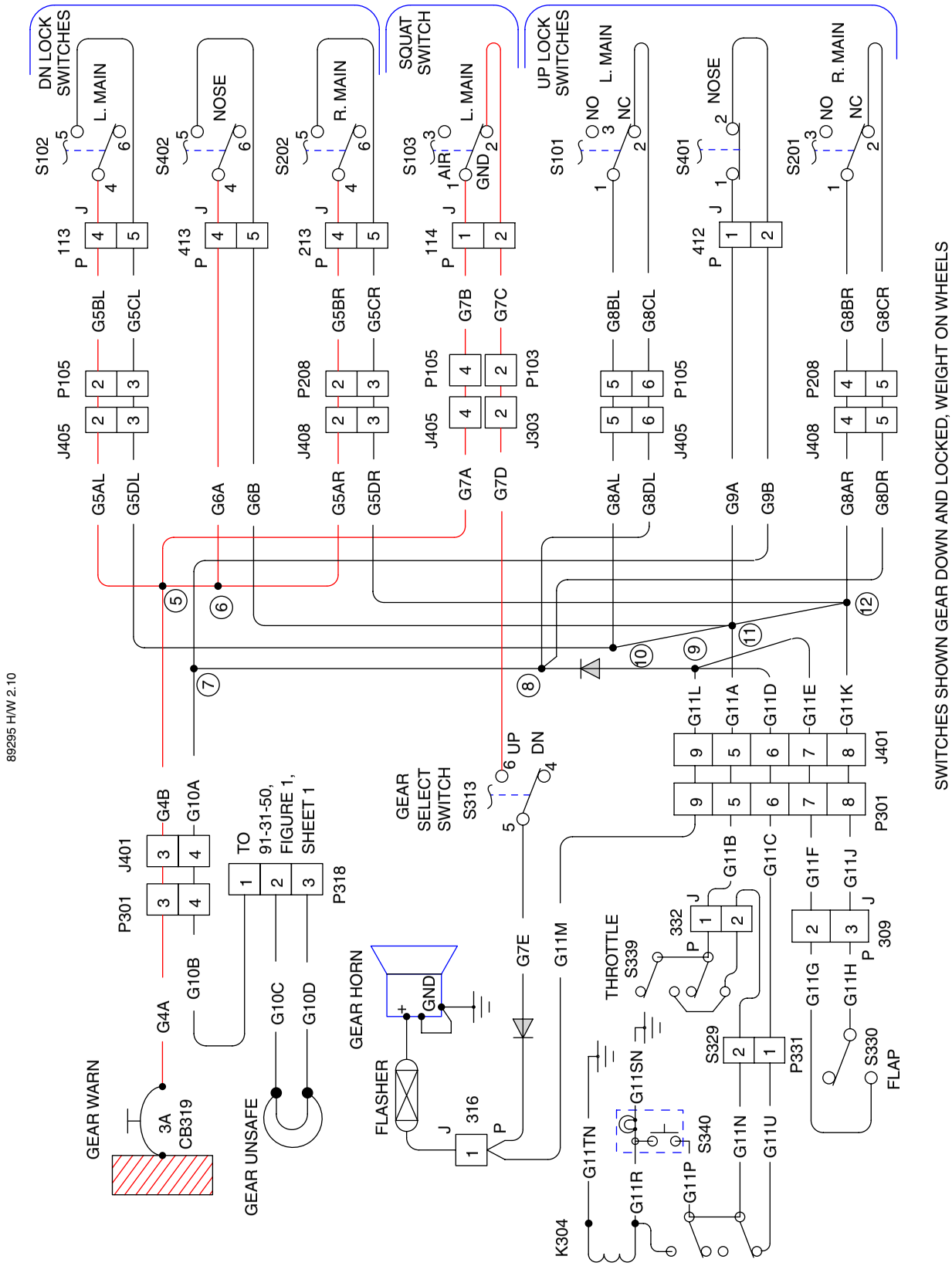
Exceedance Alert
Figure 2

Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

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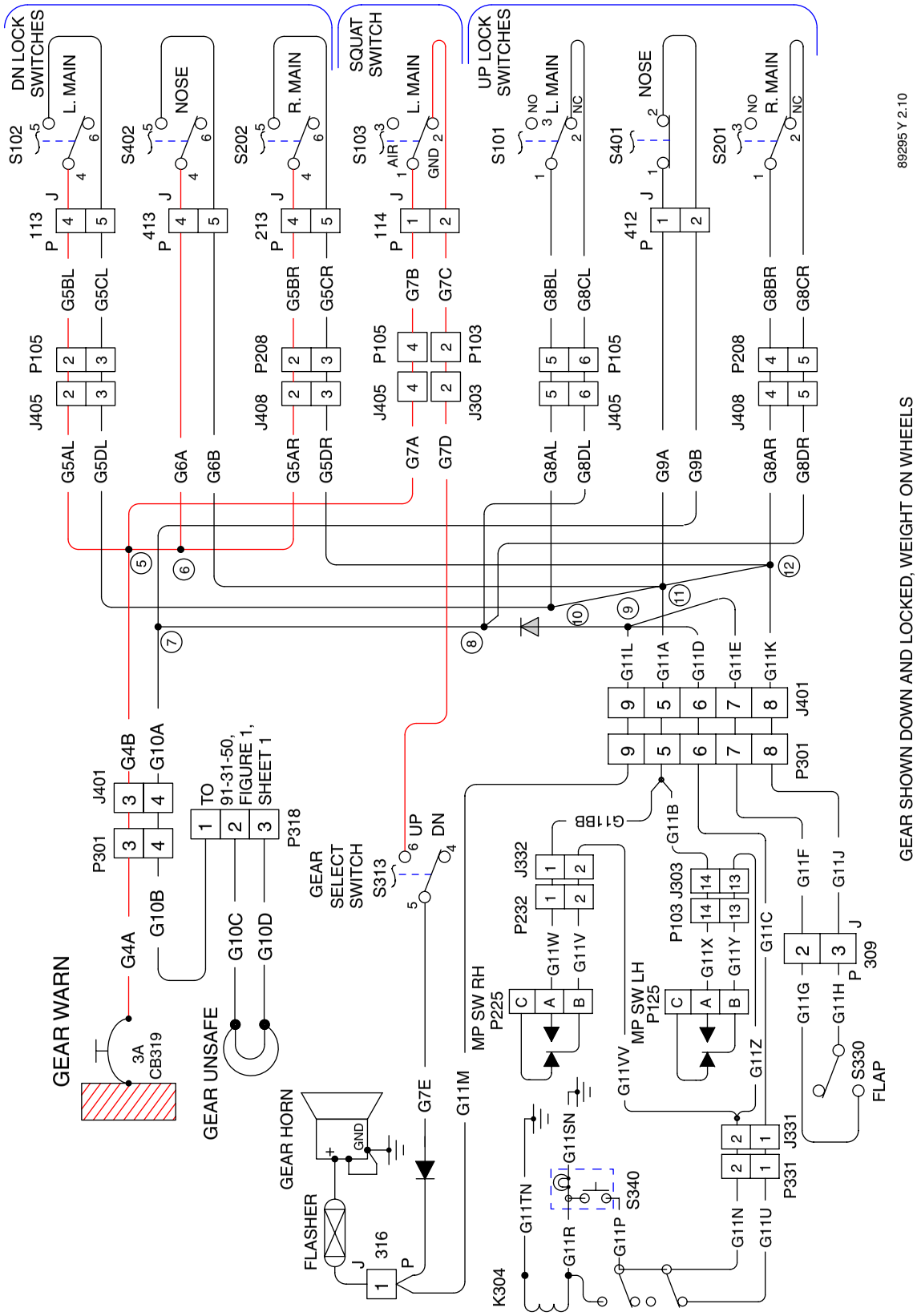


Landing Gear Position and Warning
Figure 1 (Sheet 1 of 4)



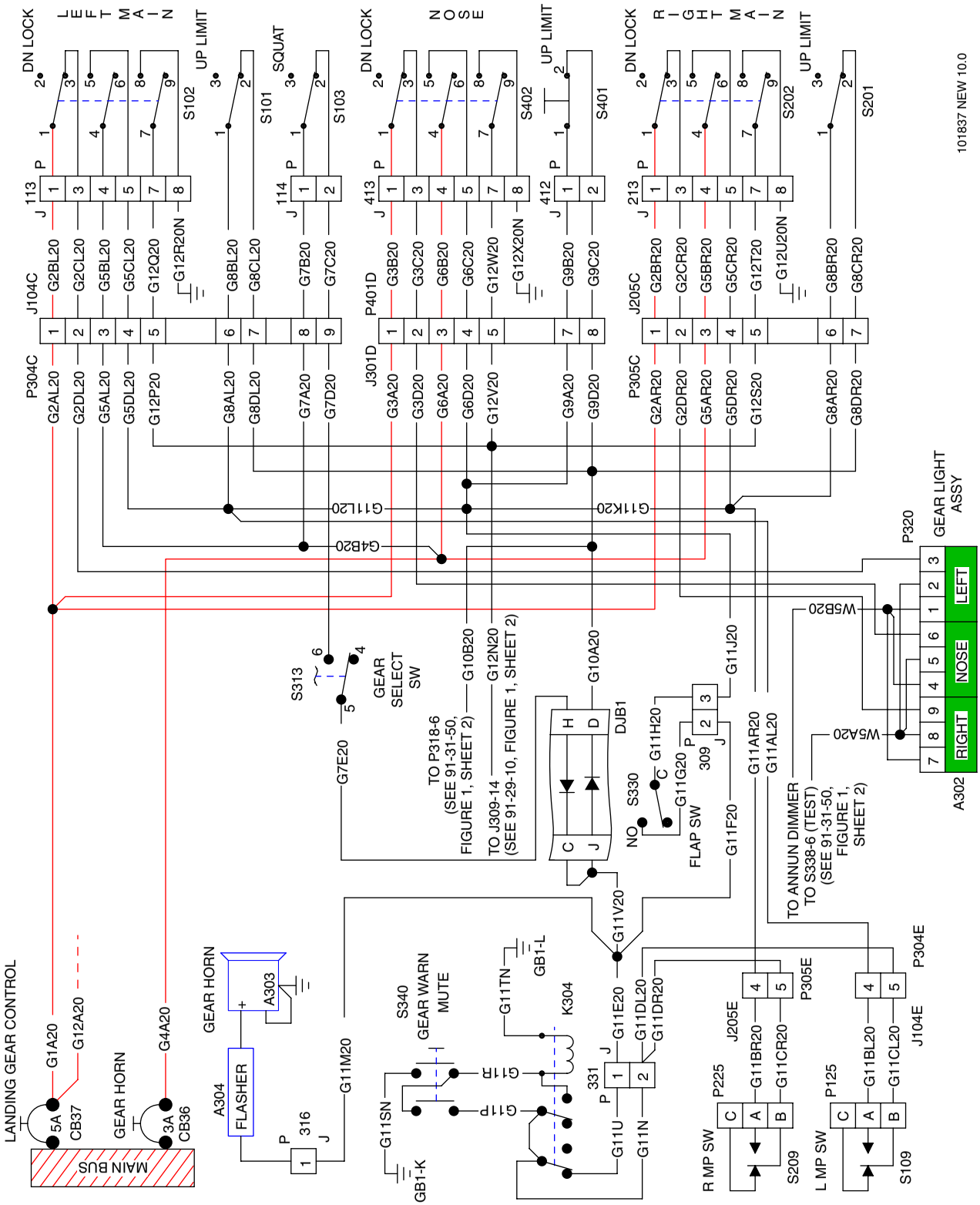
Landing Gear Position and Warning
Figure 1 (Sheet 2 of 4)

Effectivity
4496001 thru 4496216



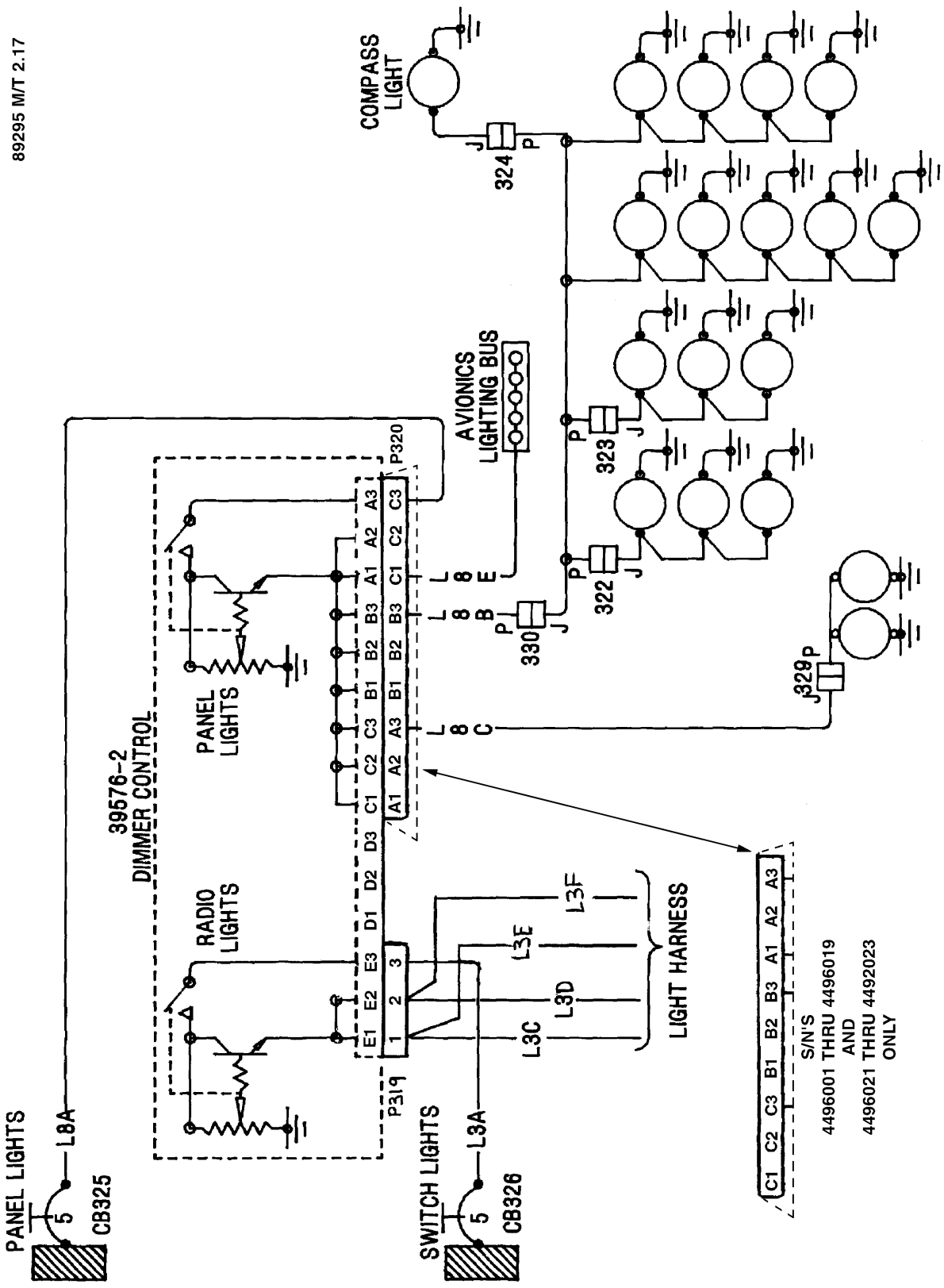
Landing Gear Position and Warning
Figure 1 (Sheet 3 of 4)

Effectivity
4496217 and up



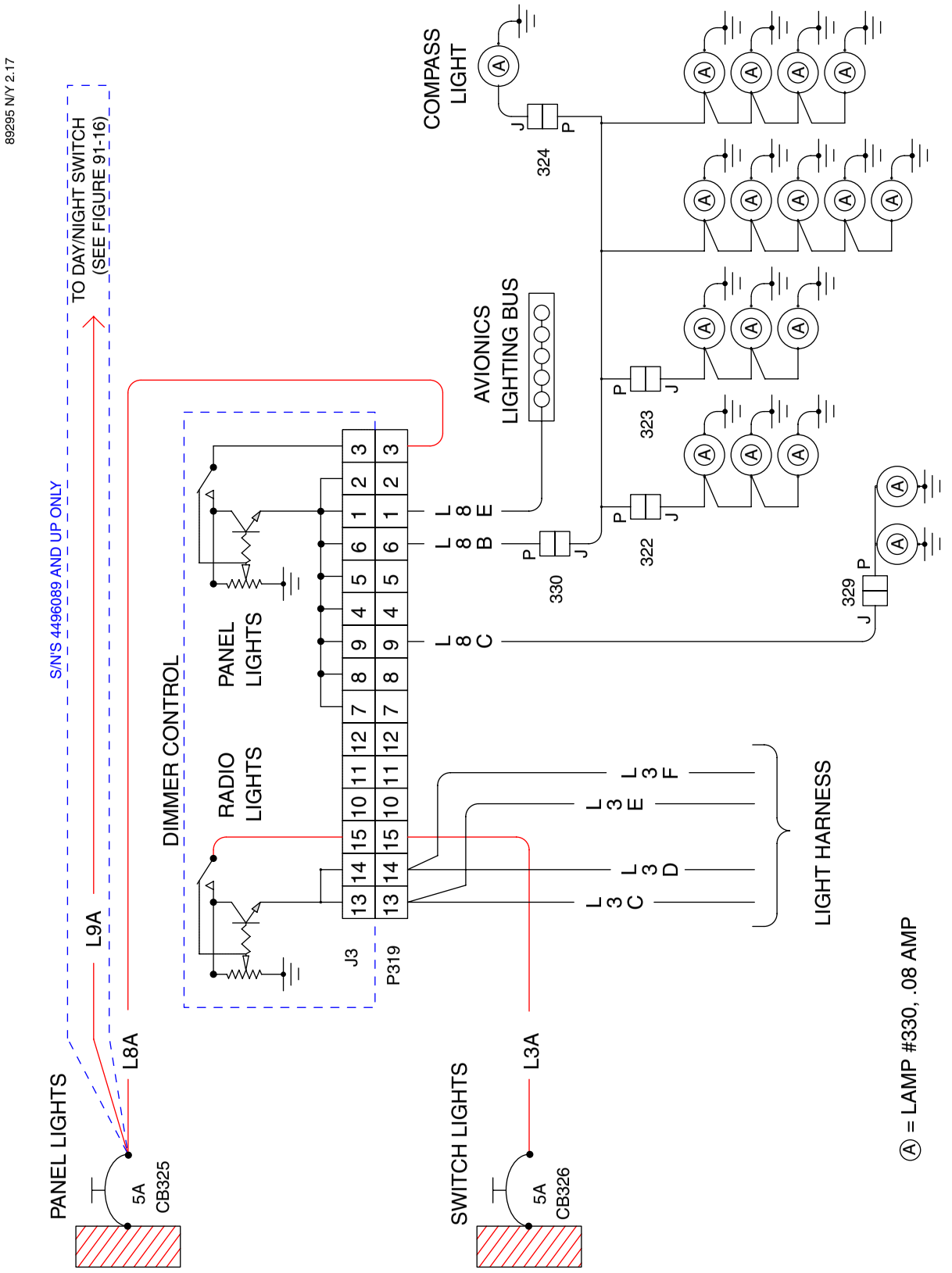
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Landing Gear Position and Warning
Figure 1 (Sheet 4 of 4)



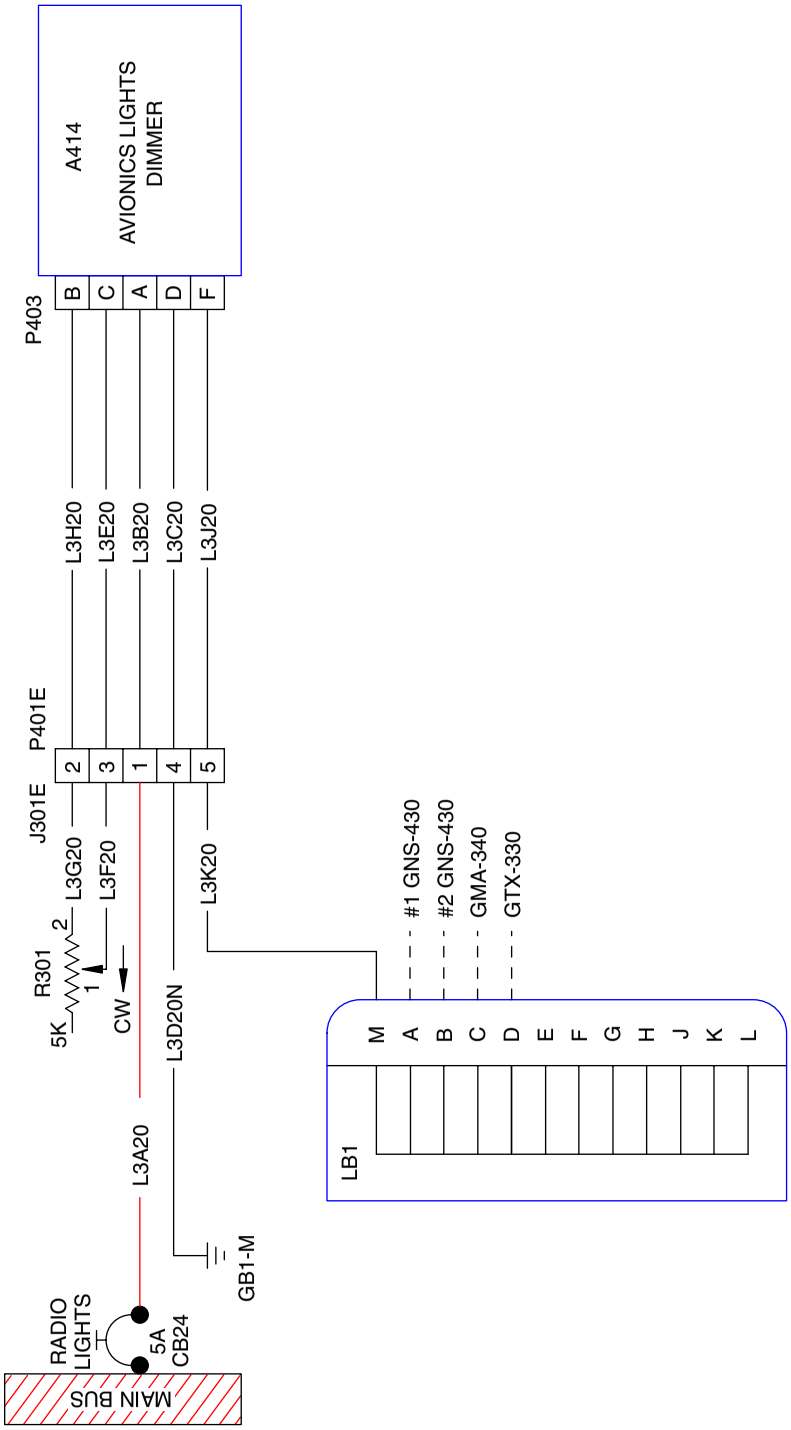
Panel and Switch Lighting
Figure 1 (Sheet 1 of 5)

Effectivity
4496001 thru 4496029



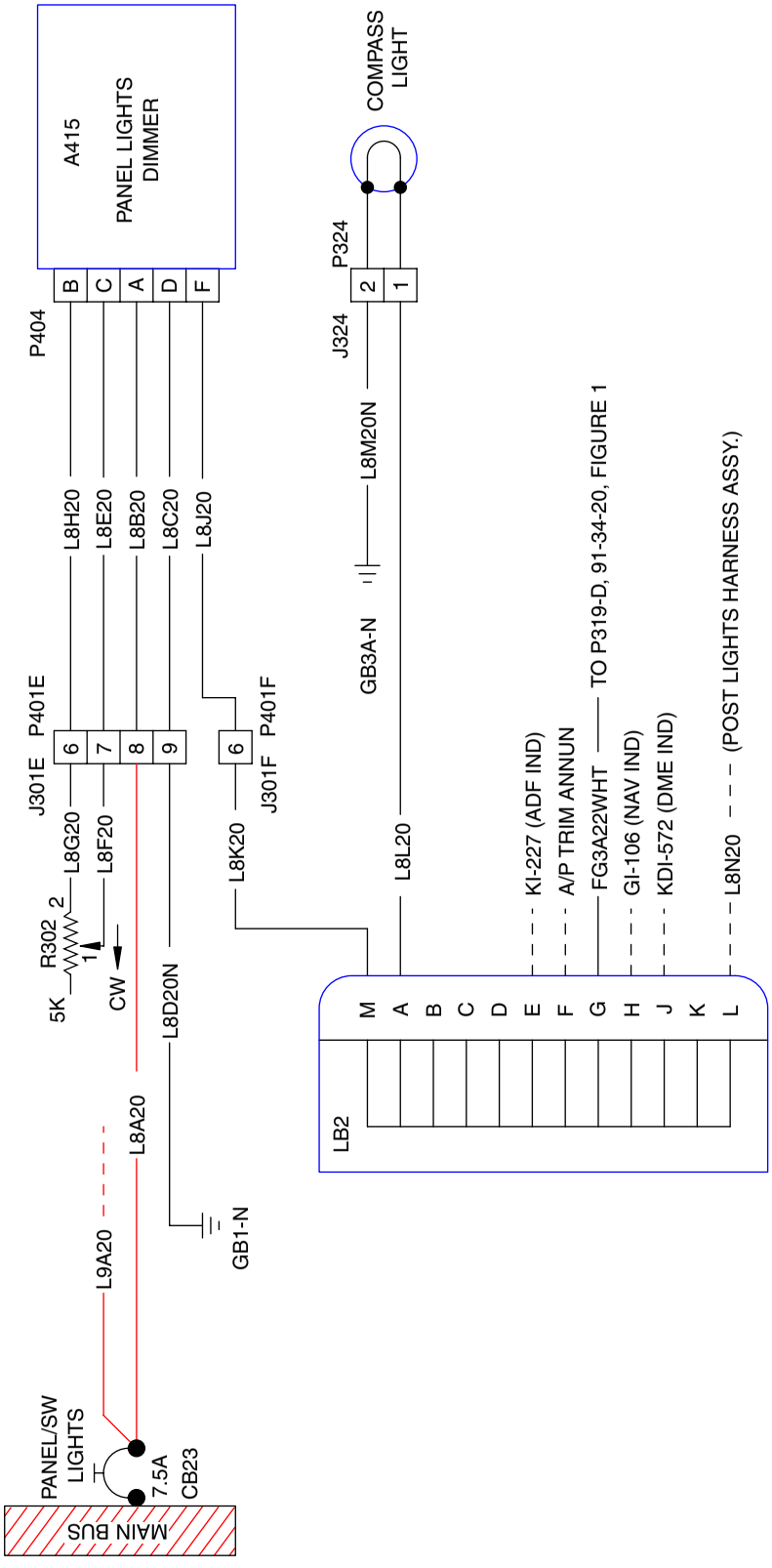
Effectivity
4496030 and up

Panel and Switch Lighting
Figure 1 (Sheet 2 of 5)



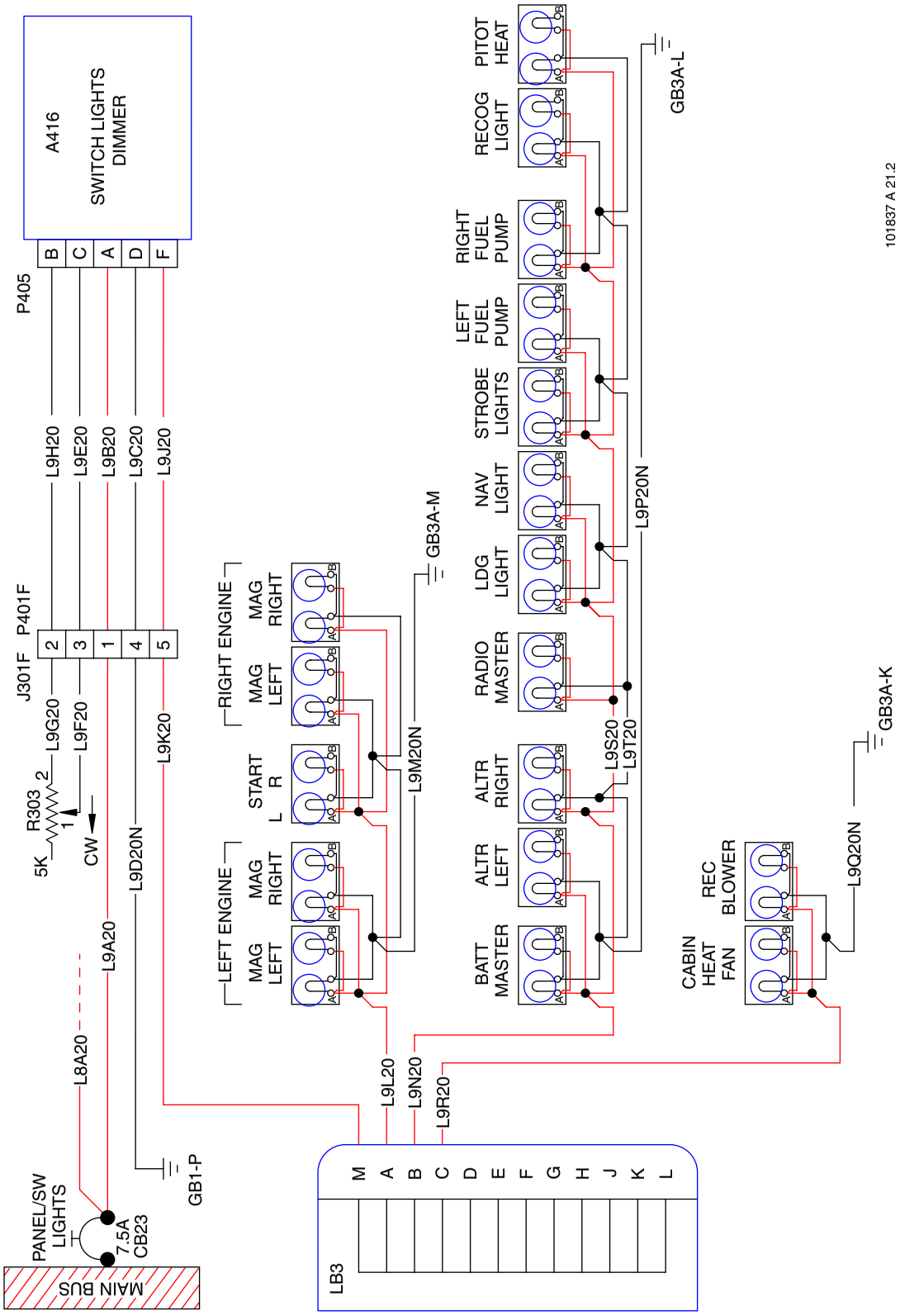
Panel and Switch Lighting
Figure 1 (Sheet 3 of 5)

Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option



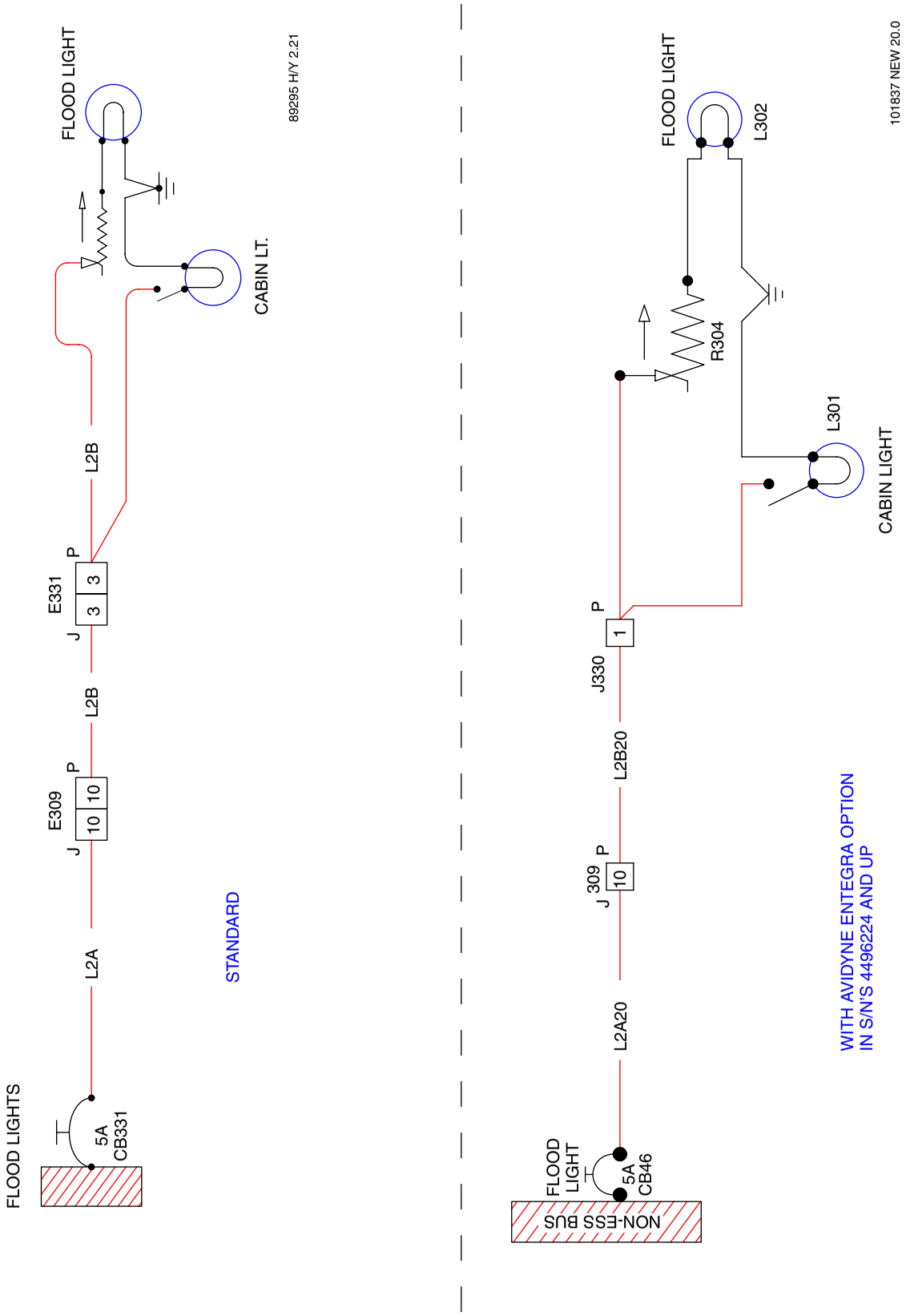
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Panel and Switch Lighting
Figure 1 (Sheet 4 of 5)

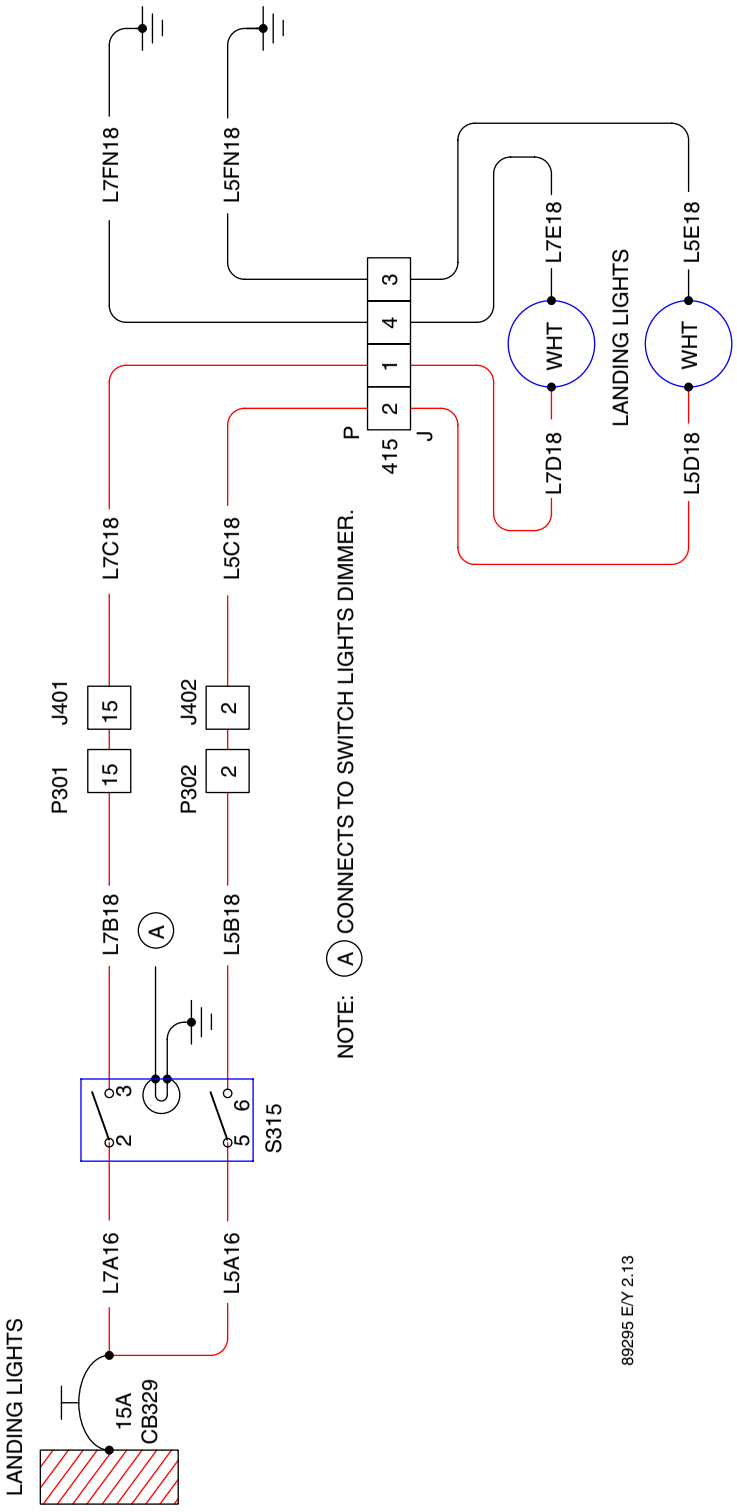


Panel and Switch Lighting
Figure 1 (Sheet 5 of 5)

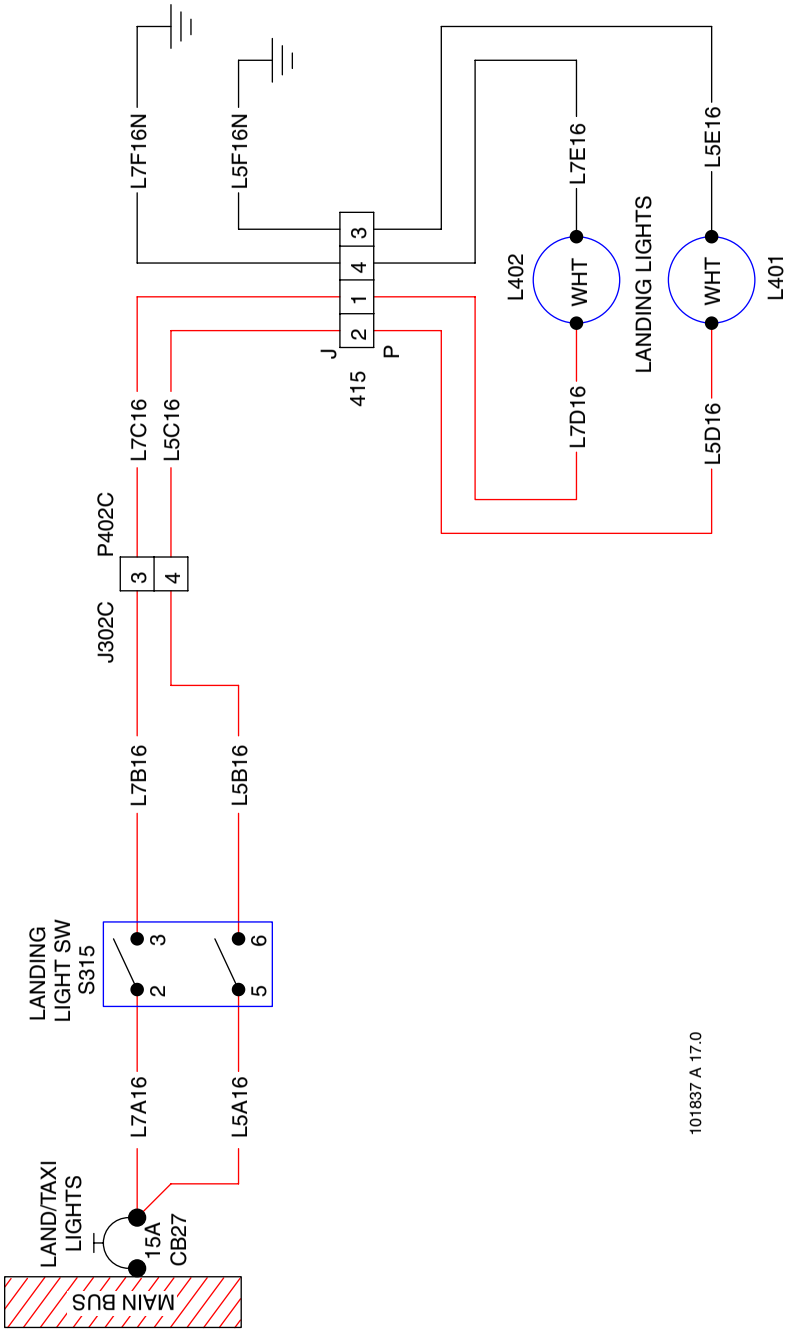
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option



Cockpit / Cabin Flood Lights
Figure 2

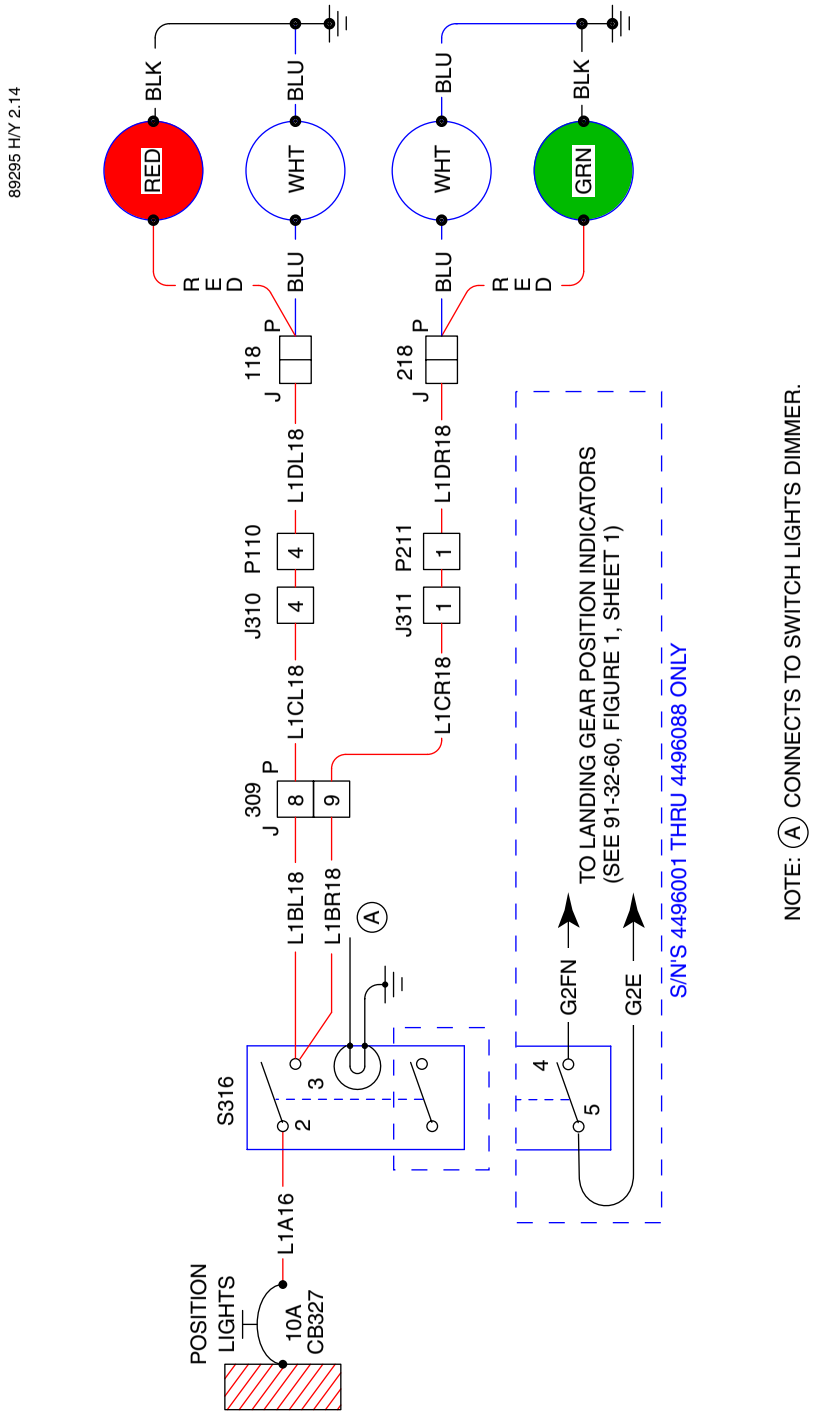


Landing Lights
Figure 1 (Sheet 1 of 2)

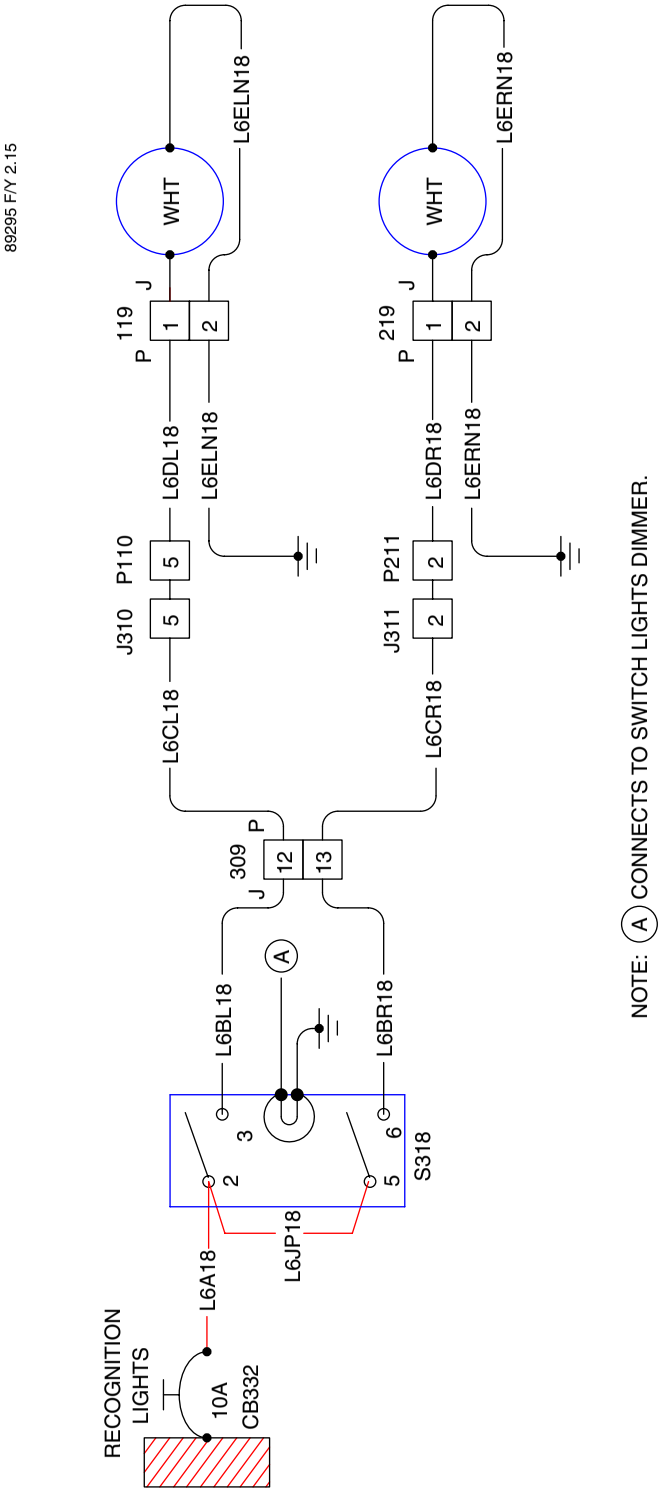


Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

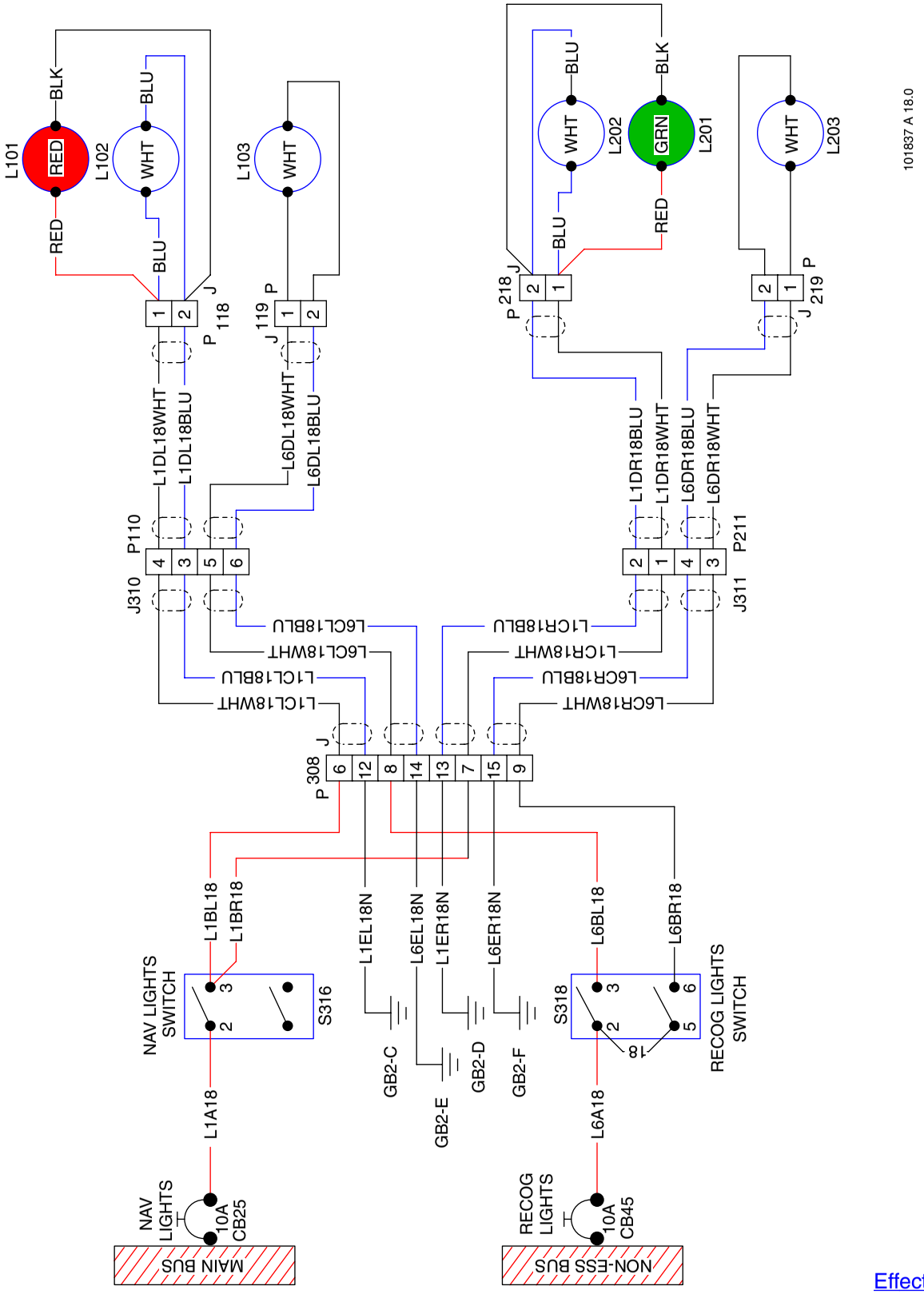
Landing Lights
Figure 1 (Sheet 2 of 2)



Navigation and Recognition Lights
Figure 2 (Sheet 1 of 3)



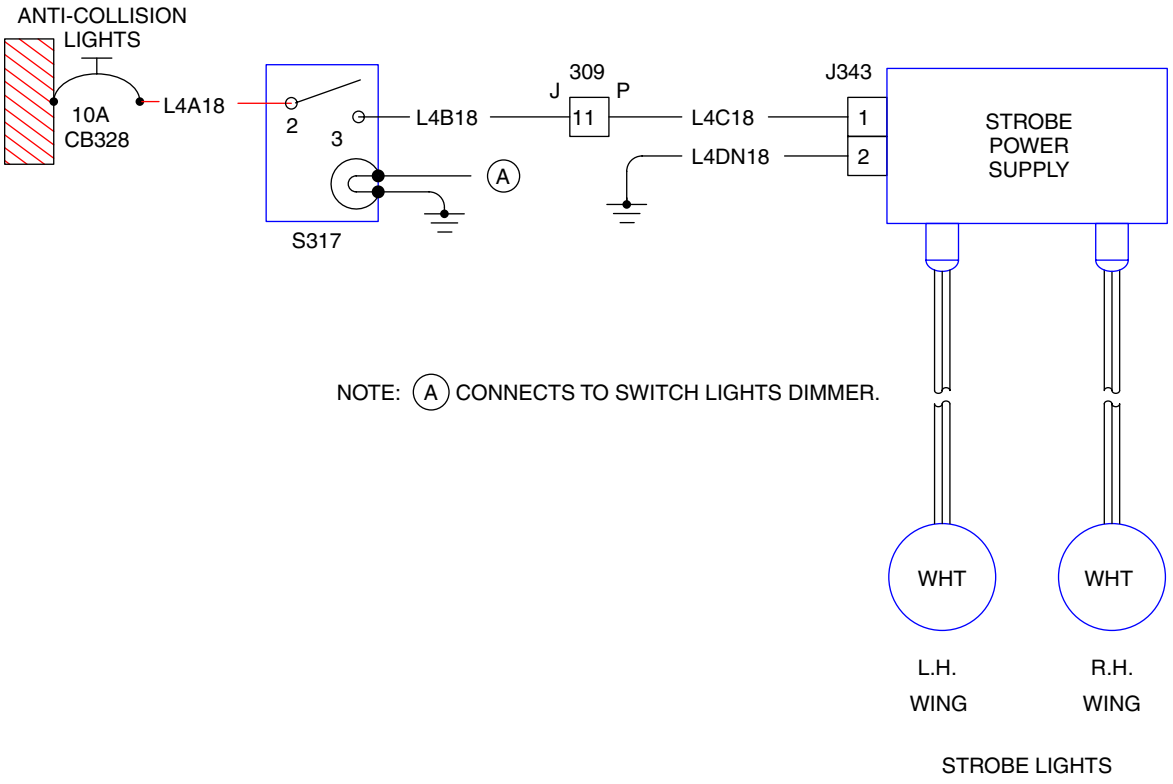
Navigation and Recognition Lights
Figure 2 (Sheet 2 of 3)



Navigation and Recognition Lights
Figure 2 (Sheet 3 of 3)

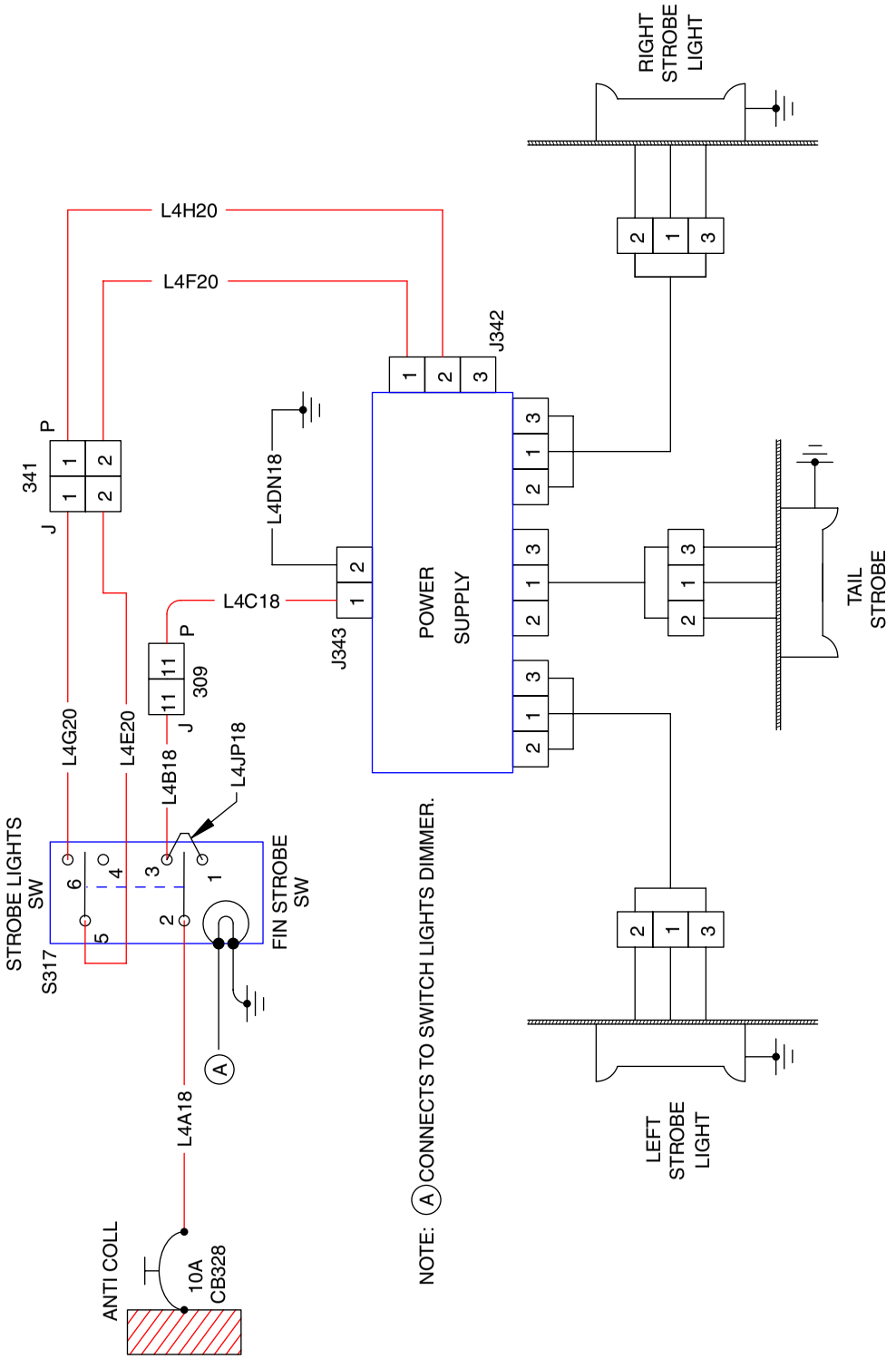
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

89295 L/Y 2.16



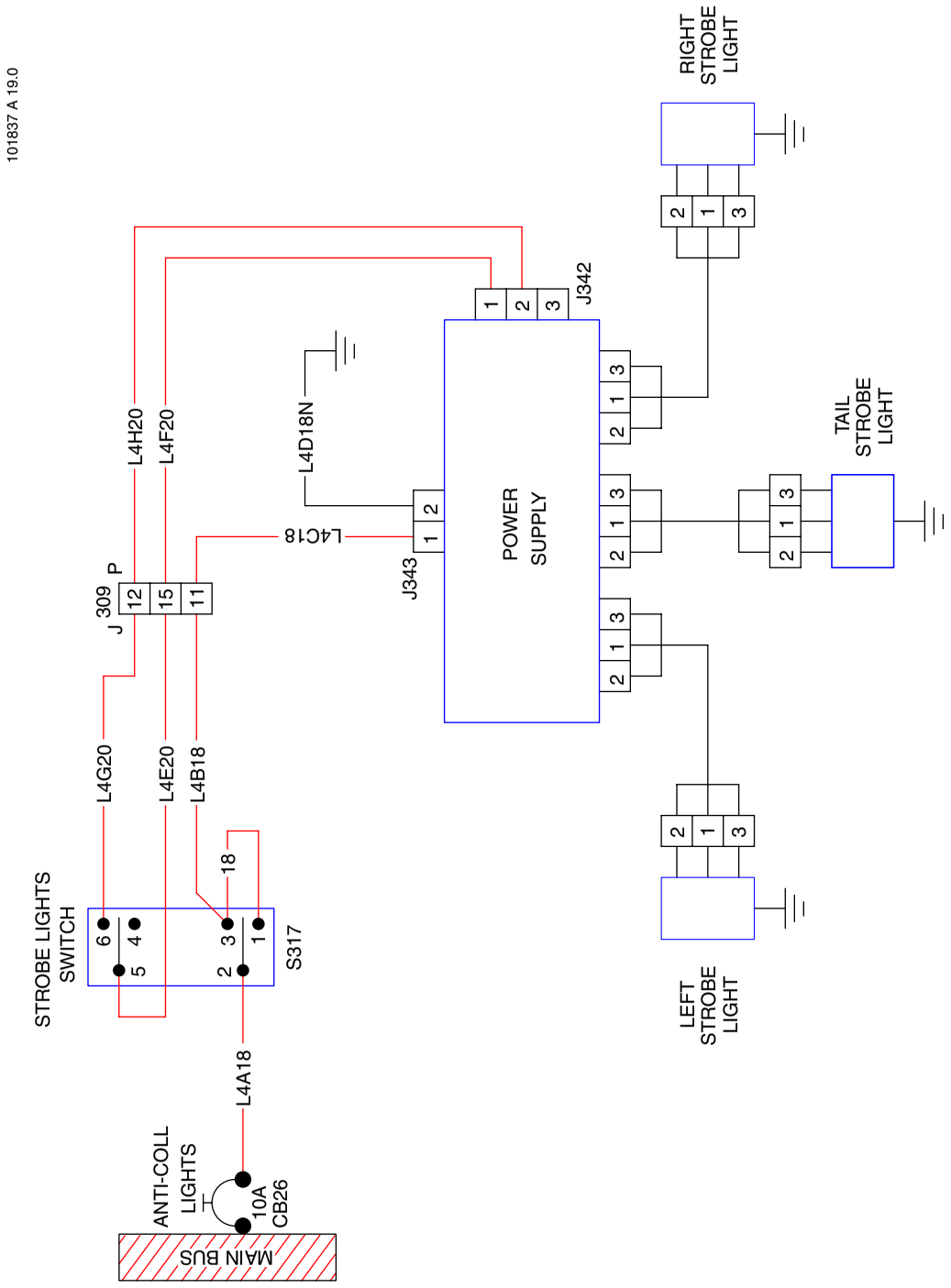
Effectivity
4496001 thru 4496023,
less 4496020

Anti-Collision (Strobe) Lights
Figure 3 (Sheet 1 of 3)



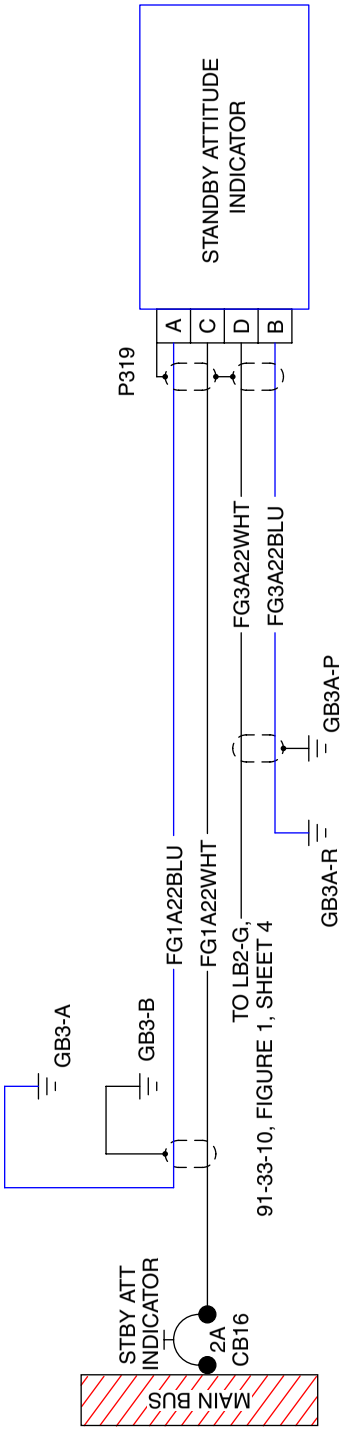
Anti-Collision (Strobe) Lights
Figure 3 (Sheet 2 of 3)

Effectivity
4496020, and
4496024 and up



Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

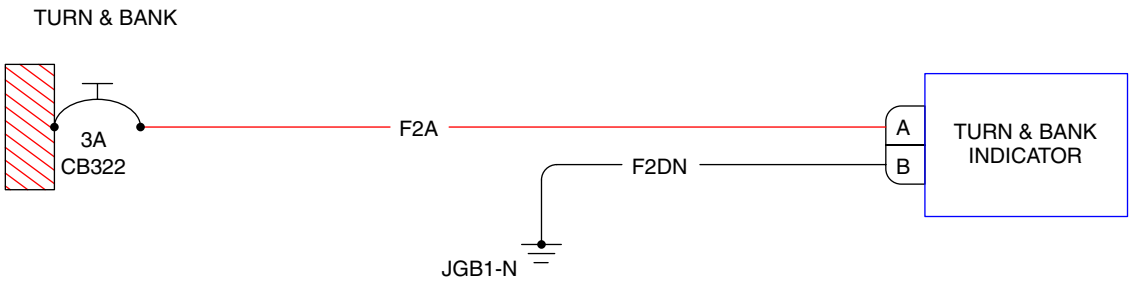
Anti-Collision (Strobe) Lights
Figure 3 (Sheet 3 of 3)



Standby Attitude Indicator
Figure 1

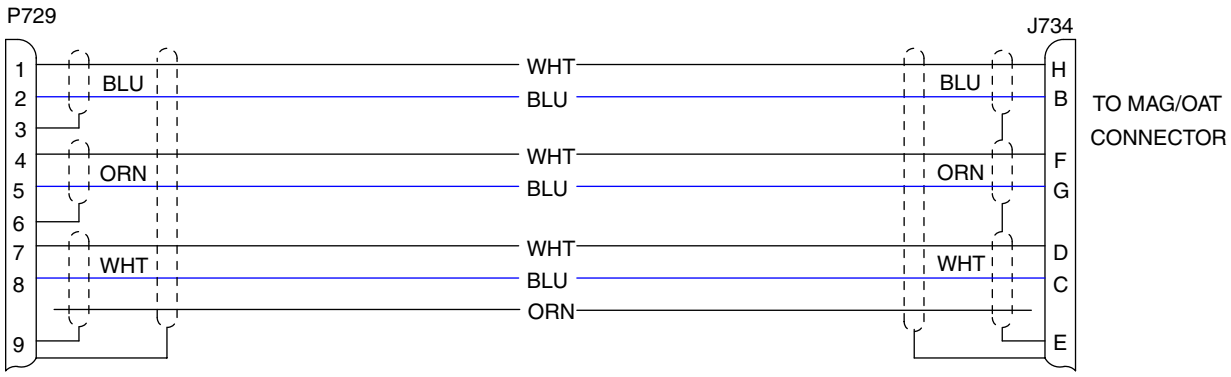
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

89295 G/Y 2.19



Turn and Bank Indicator
Figure 2

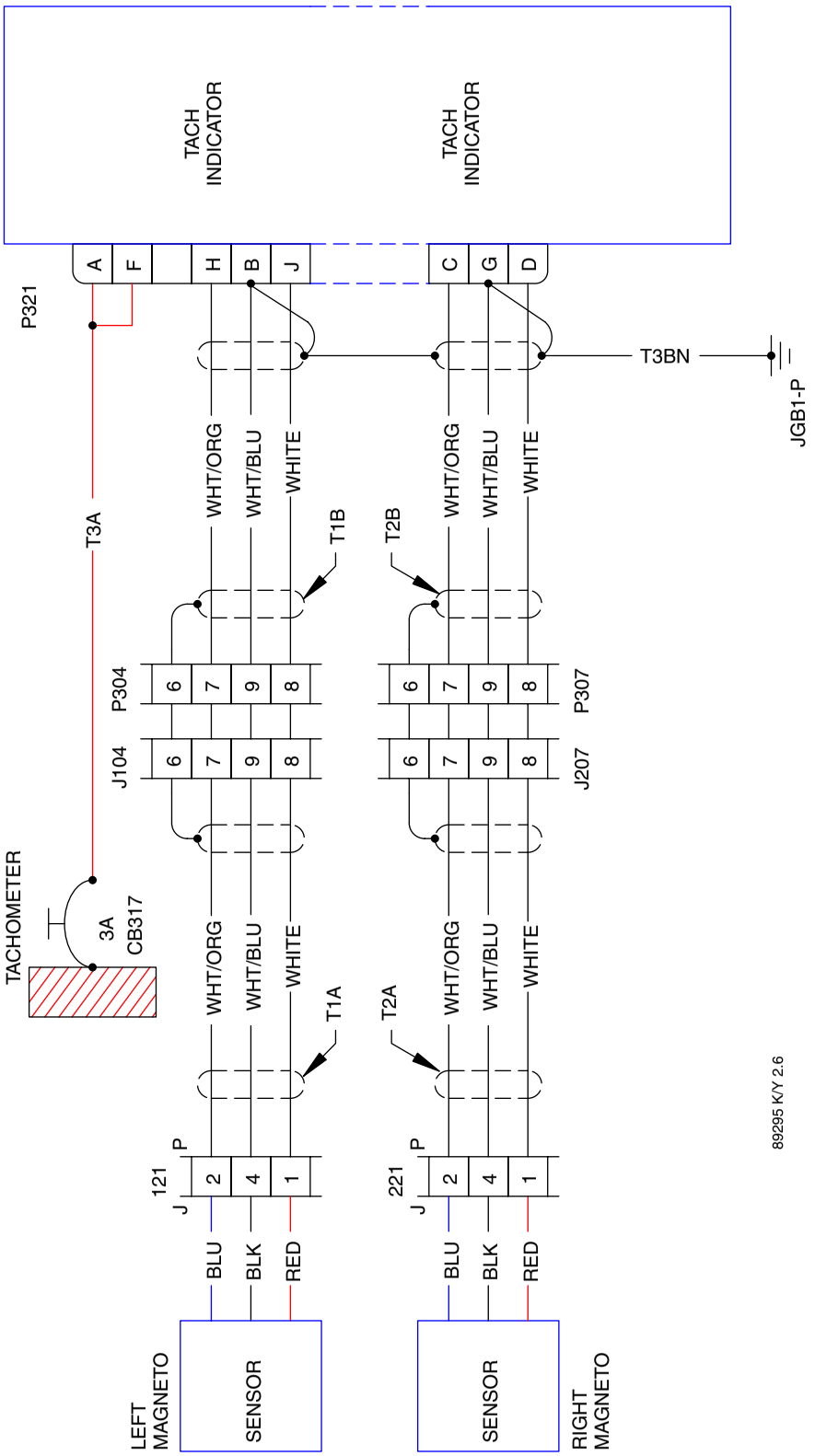
101753 C



Magnetometer / OAT Installation
Figure 3

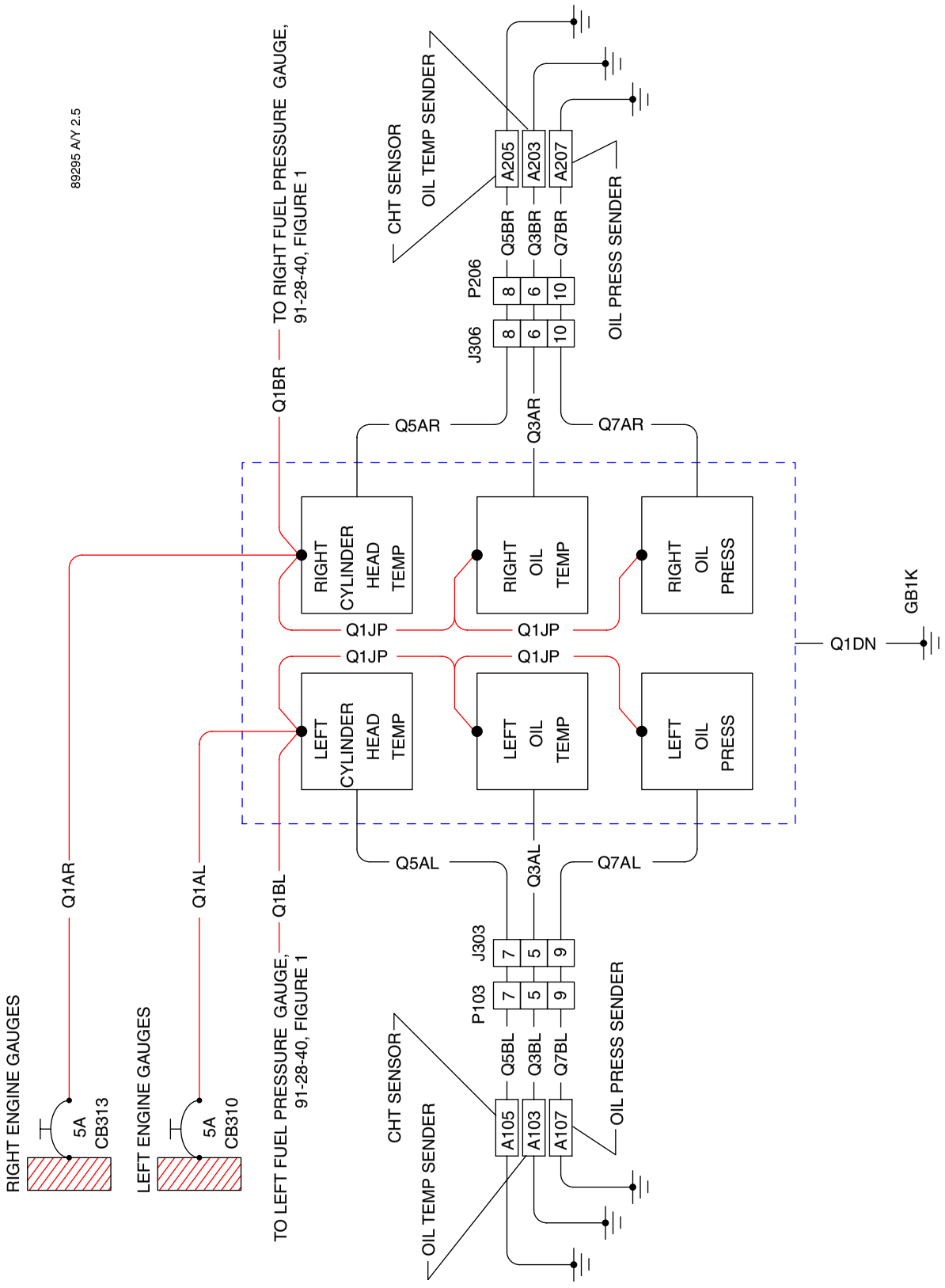
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

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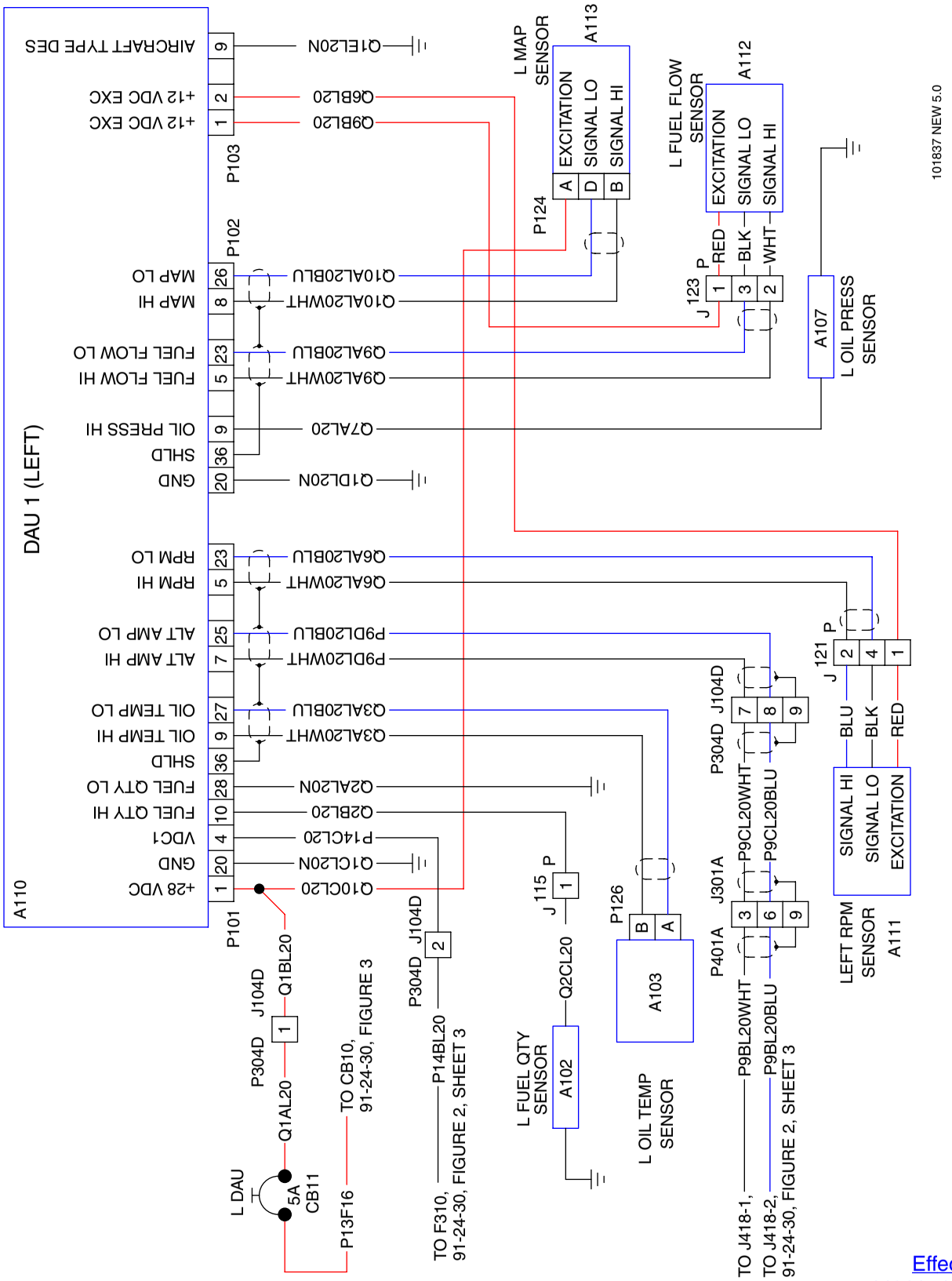
Electric Tachometer
Figure 1

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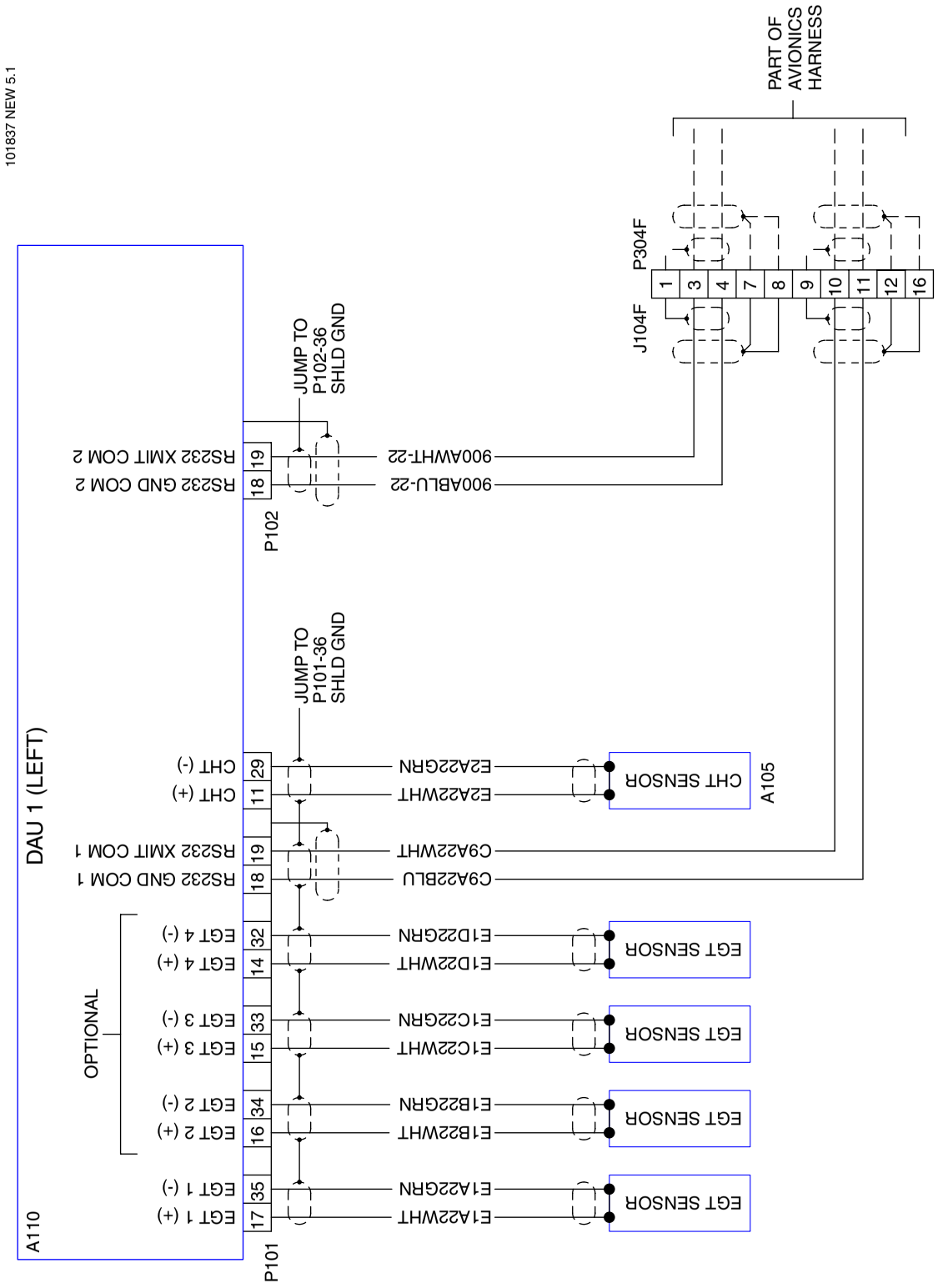
Cylinder Head Temperature (CHT) and Oil Indicators
Figure 1

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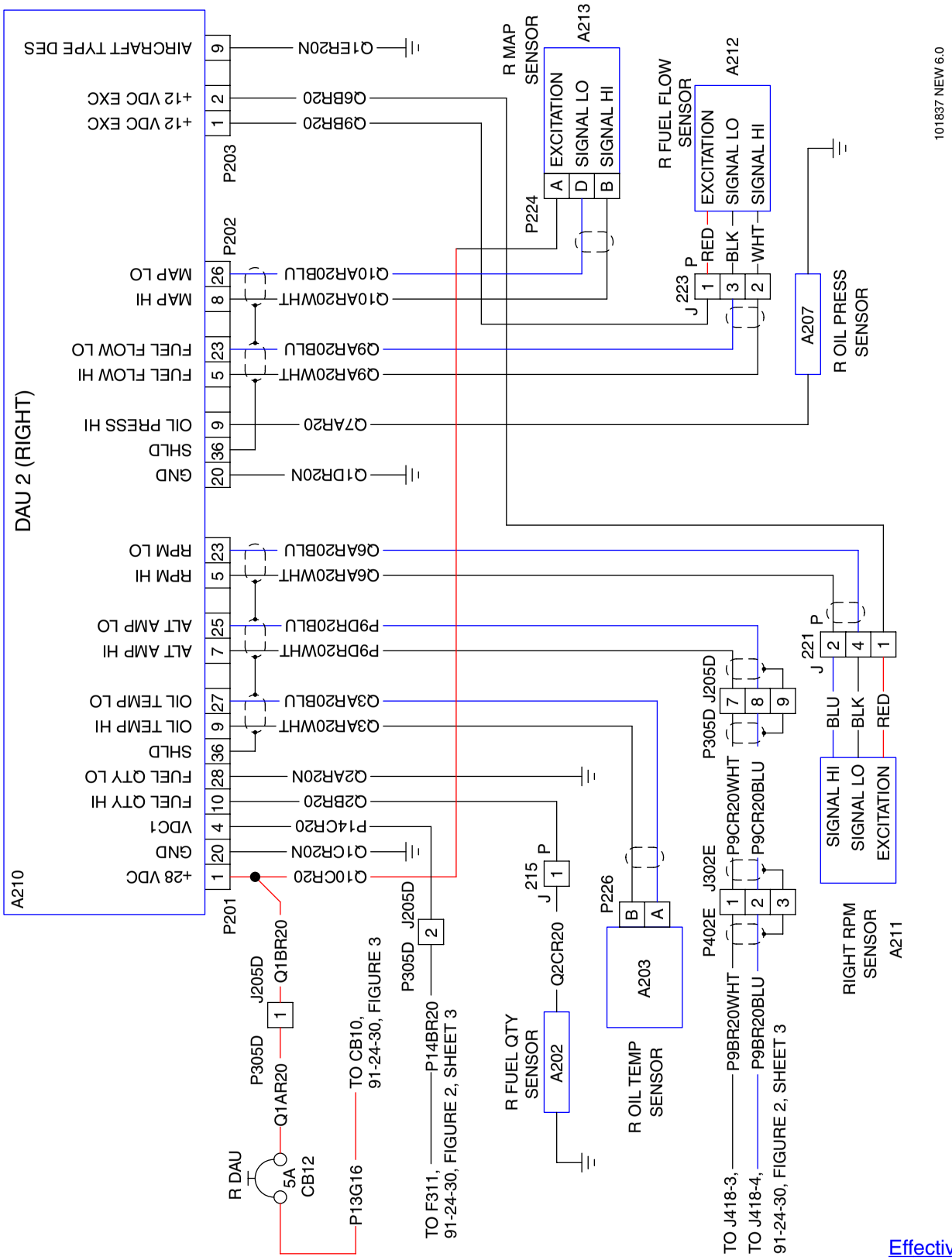
Data Acquisition Unit (DAU)
Figure 1 (Sheet 1 of 4)

Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option



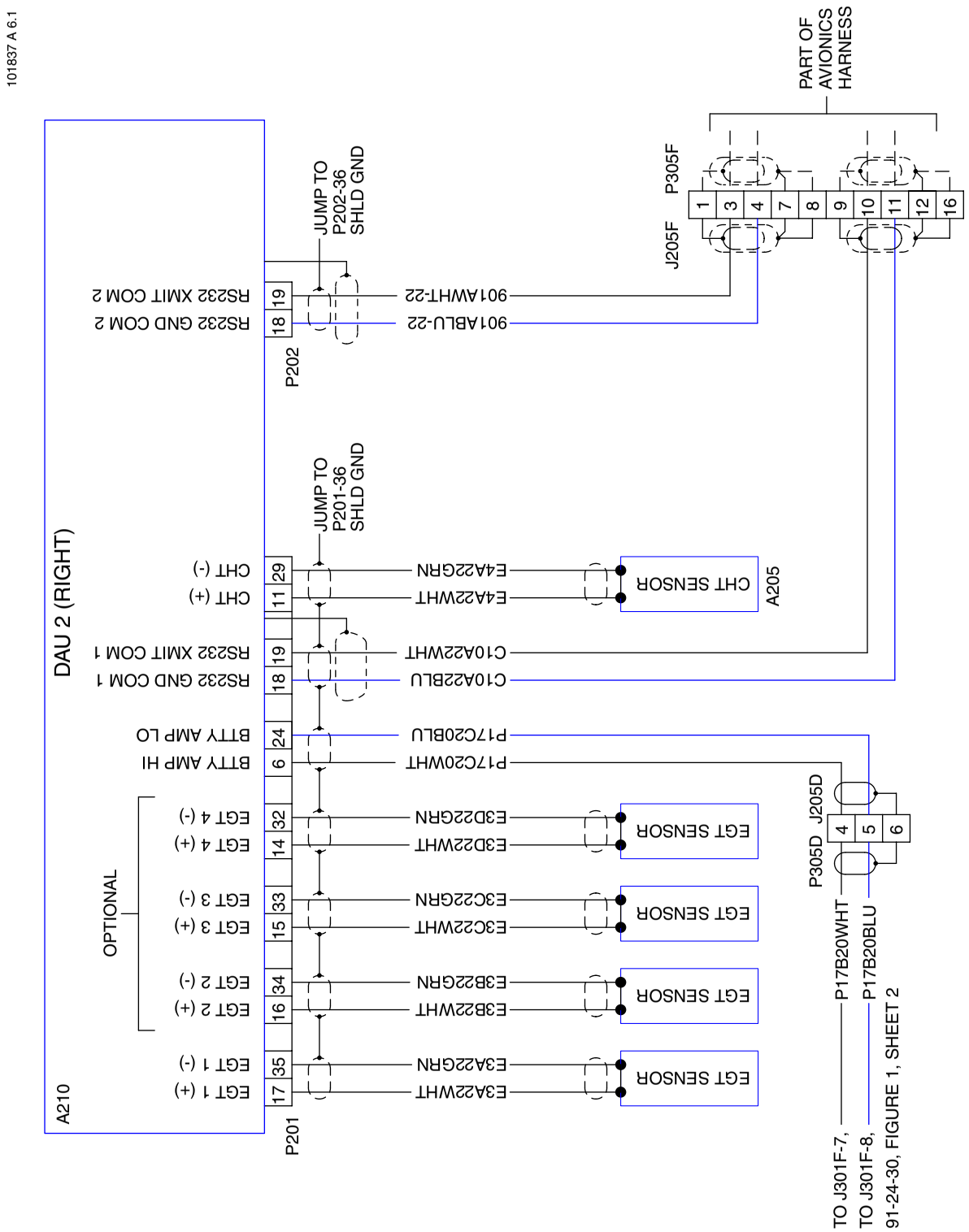
Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Data Acquisition Unit (DAU)
Figure 1 (Sheet 2 of 4)



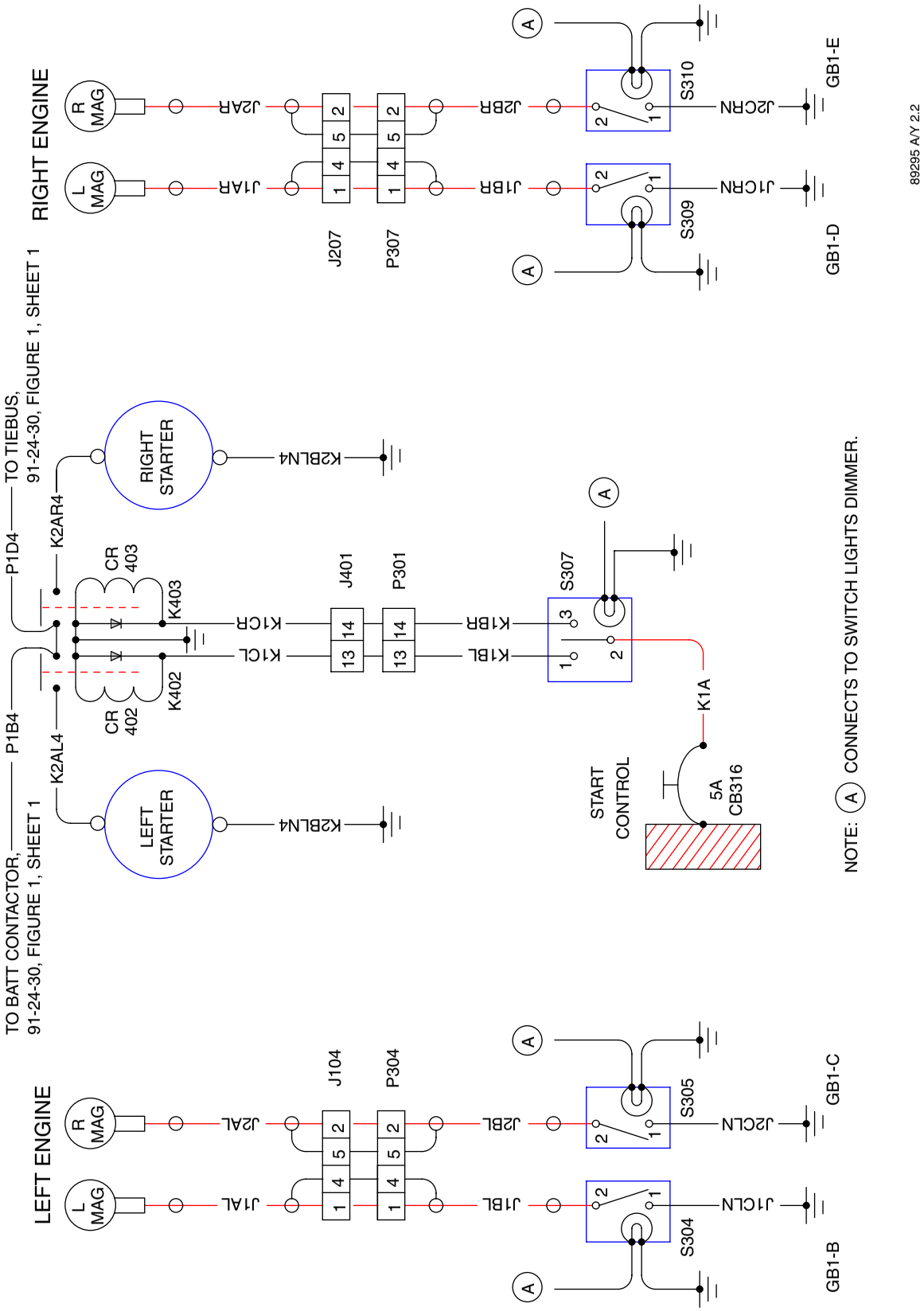
Data Acquisition Unit (DAU)
Figure 1 (Sheet 3 of 4)

Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

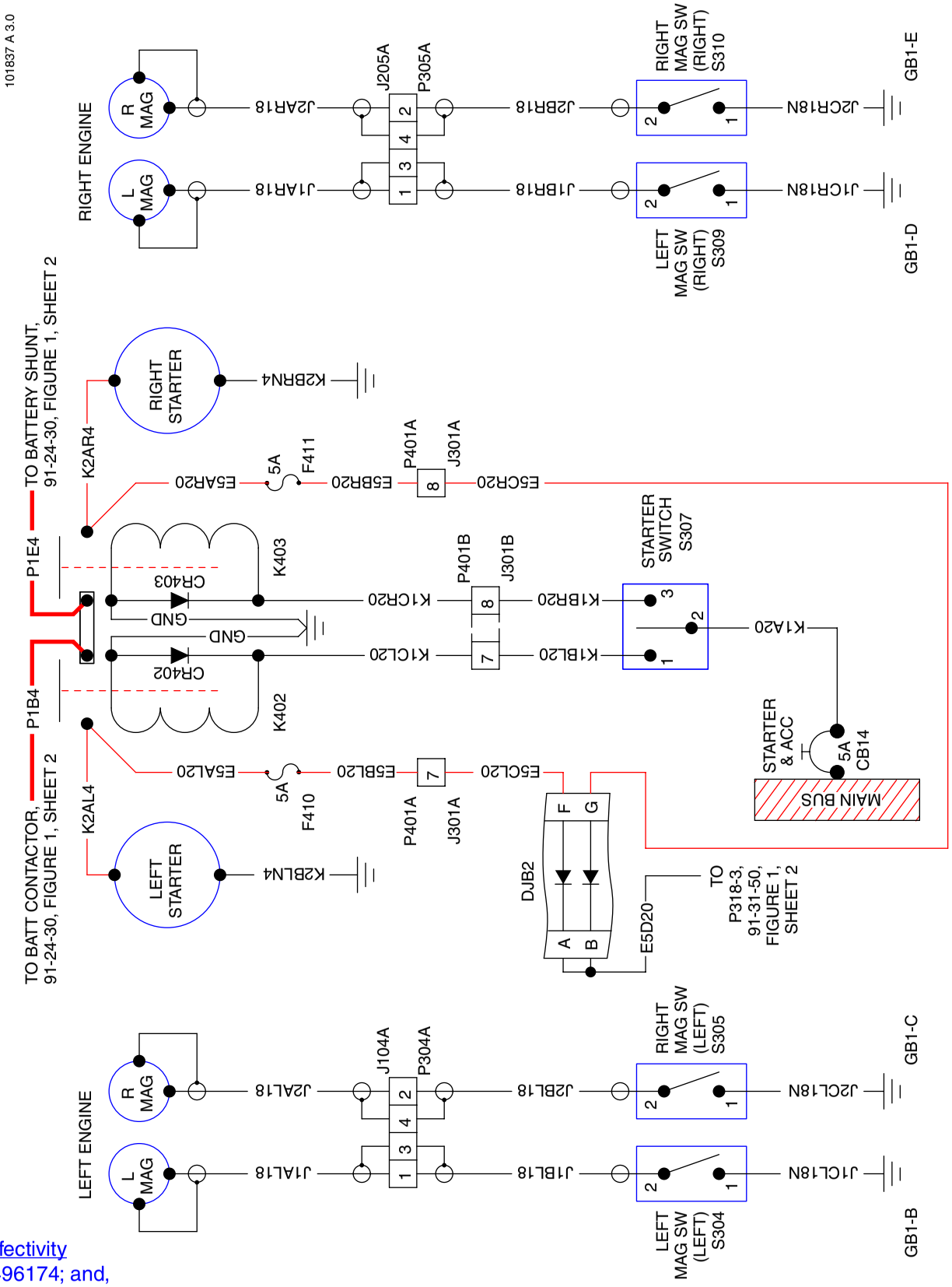


Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Data Acquisition Unit (DAU)
Figure 1 (Sheet 4 of 4)



Starter and Ignition Control
Figure 1 (Sheet 1 of 2)



Effectivity
4496174; and,
4496224 and up,
with Avidyne Entegra Option

Starter and Ignition Control
Figure 1 (Sheet 2 of 2)

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