AIRPLANE MAINTENANCE MANUAL

CARD 1 OF 5

PA-32R-301

Saratoga II HP

(S/N's 3246001 AND UP)

PA-32R-301T

Saratoga II TC

(S/N's 3257001 AND UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-879 **February 16, 2004**

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AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-879) published June 24, 1996 and reissued July 1, 1997 are as follows:

Revision	Publication Date	Aerofiche Card Effectivity
ORG950712	June 24, 1996	1, 2, 3, and 4
CR970701	July 1, 1997	1, 2, 3, 4, and 5
PR990715	July 15, 1999	1, 2, 3, 4, and 5
PR011215	December 15, 2001	1
PR020331	March 31, 2002	1
PR040216*	February 16, 2004	1, 3, and 5

*** PARTIAL REVISION OF MAINTENANCE MANUAL 761-879**

Revisions appear in Aerofiche Cards 1, 3, and 5. Accordingly, discard your existing Cards 1, 3, and 5 and replace them with these three cards dated 02/16/04.

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

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INTRODUCTION

TABLE OF CONTENTS / EFFECTIVITY

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INTRODUCTION

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-32R-301/301T Saratoga II HP and TC 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).

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-32R Parts Catalog P/N 761-880, 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.

Be sure to supply the correct serial number information in any correspondence or communication concerning your airplane.

EFFECTIVITY

This maintenance manual is effective for PA-32R-301 Saratoga II HP airplanes serial numbers 3246001 and up and PA-32R-301T Saratoga II TC airplanes serial numbers 3257001 and up.

This encompasses the following model years:

— Note —

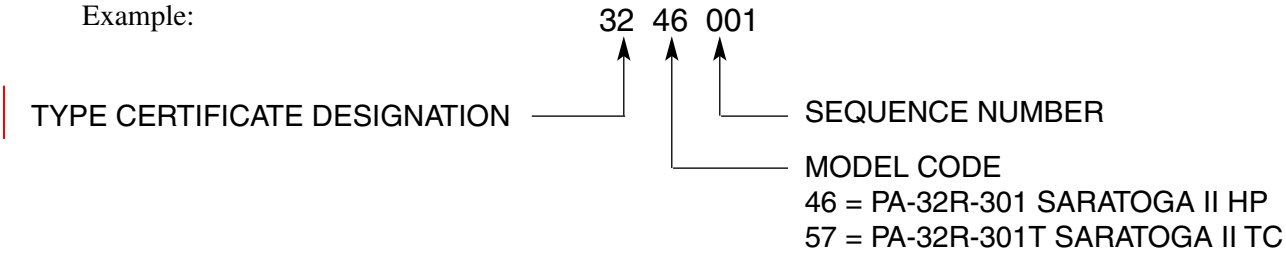
The following is provided as a general reference only.

PA-32R-301 Saratoga II HP:	Model Year	Serial Numbers
	1995	3246001 thru 3246017
	1996	3246018 thru 3246059
	1997	3246060 thru 3246087
	1998	3246088 thru 3246125
	1999	3246126 thru 3246153
	2000	3246154 thru 3246165
	2000.5	3246166 thru 3246181
	2001	3246182 thru 3246203
	2002	3246204 thru 3246209
	2003	3246210 thru 3246217
	2004	3246218 and up

PA-32R-301T Saratoga II TC:	Model Year	Serial Numbers
	Prototype	3257001
	1998	3257002 thru 3257075
	1999	3257076 thru 3257123
	2000	3257124 thru 3257155; less 3257144
	2000.5	3257156 thru 3257198; and 3257144
	2001	3257199 thru 3257266
	2002	3257267 thru 3257296
	2003	3257297 thru 3257338
	2004	3257339 and up

SERIAL NUMBER EXPLANATION

Example:



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

PAGINATION

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

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 List of Illustrations for all fiche in this set.
(3) A complete List of Charts for all fiche in this set.

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 illustrations, or list of charts.

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

Original and Reissue:	None	
Revisions:	First:	Revision Indication (1R Month-Year)
	Second:	Revision Indication (2R Month-Year)
	Subsequent revisions follow with consecutive numbers such as 3R, 4R, etc.	
Added Subject:		Revision Identification, (A Month-Year)
Deleted Subject:		Revision Identification, (D Month-Year)

INDEXING

Each System/Chapter begins with an individual Table of Contents.

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.

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.

SUPPLEMENTARY PUBLICATIONS

The following is a list of publications providing servicing, overhaul and parts information on various components on the PA-32R-301/301T airplanes, which you should use to supplement this manual.

A. Piper Publications:

(1) Parts Catalog - P/N 761-880

(2) Progressive Inspection Manuals (50 hour):
P/N 761-881 (pending) for the SARATOGA II HP (S/N's 3246001 & up), and
P/N 761-896 (pending) for the SARATOGA II TC (S/N's 3257001 & up).

(3) Periodic Inspection Report Forms:
P/N 230-1047 for the SARATOGA II HP (S/N's 3246001 & up), and
P/N 230-2047 for the SARATOGA II TC (S/N's 3257001 & up).

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.

AIR CONDITIONING COMPRESSOR:

Vendor:
York Industries
1750 Toronita Street
York, Pennsylvania 17402
(717) 846-1988

(or)

Sanden International (USA), Inc.
601 South Sanden Blvd.
Wylie, TX 75098-4999
(972) 442-8400
http://www.sanden.com

ALTERNATOR

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

AUTOFLIGHT:

Vendor(s):
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 76067-9236
PH - (940) 325-9406
www.s-tec.com

BRAKES:

Vendor:
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

ELECTRONIC FLIGHT DISPLAY SYSTEM (EFDS)

Vendor:	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

EMERGENCY LOCATOR TRANSMITTER:

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

ENGINE:

Vendor:	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:	IO-540- ..... - K1G5, ... ENGINES - P/N PC-615 TIO-540-AH1A ENGINES - P/N PC-615-12	
Operators Handbook:	O-540, IO-540 SERIES - P/N 60297-10 TIO-540 Series - P/N 60297-23	

— 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.

ELECTRIC FUEL PUMP:

Vendor(s):	Parker Hannifin Corp. Airborne Division 711 Taylor Street Elyria, Ohio 44035 PH - (800) 382-8422	(or)	Weldon Pump 640 Golden Oak Parkway Oakwood Village, OH 44146 PH - (216) 232-2282

http://www.parker.com/cleveland/Universe/book.pdf

FUEL CELLS:

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

GEAR LOCKING ACTUATORS, NOSE GEAR DOOR ACTUATOR, HYDRAULIC PUMP, AND ALL HYDRAULIC COMPONENTS:

Vendor:	Parker Hannifin Corp. (See Brakes, above)

HI-LOK FASTENERS AND TOOLS:

Vendor:	Hi-Shear Corporation 2600 Skypark Drive Torrance, California 90509 (213) 326-8110	PH - (213) 326-8110

LIGHTS - NAVIGATION/STROBE LIGHTS STANDBY/MAP:

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

MAGNETOS:

Vendor:	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	

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

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

OXYGEN SYSTEM: (TC only)

Vendor:	Scott Aviation 2225 Erie Street Lancaster, New York 14086 http://www.scottaviation.com/	PH - (716) 683-5100

PROPELLER:

Vendor:	Hartzell Propellor Inc. One Propellor Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH - (937) 778-4379 FAX - (937) 778-4321
Standard Practices:	Manual No. 202A	
Overhaul and Maintenance:	Manual No. 113B	
Aluminum Blade Overhaul:	Manual No. 133C	
Propeller Owner's Manual and Logbook:	Manual No. 115N	

PROPELLER GOVERNOR:

Vendor:	Hartzell Propeller Inc. One Propellor Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH - (937) 778-4379 FAX - (937) 778-4321
Governor Maintenance:	Manual No. 130B	

STANDBY ATTITUDE INDICATOR:

Vendor:	Mid-Continent Instruments Co., Inc. 9400 E. 34 TH Street N. Wichita, KS 67226 http://www.mcico.com/index.html	PH - (316) 630-0101 FAX - (316) 630-0723
Installation Manual and Operating Instructions:	Manual No. 9015762	

STARTER:

Vendor:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252

VACUUM PUMPS:

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

VACUUM REGULATORS:

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

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SYSTEM / CHAPTER INDEX GUIDE

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— Note —

For Vendor Publications, see Introduction - Supplementary Publications.

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LIST OF ILLUSTRATIONS

BY SUBJECT

LIST OF ILLUSTRATIONS (cont)

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CHAPTER

4

AIRWORTHINESS LIMITATIONS

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CHAPTER 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. No limitations, related to fatigue life of the airplane and its components, have been established for the PA-32R-301 nor the PA-32R-301T:

2. 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 dispositioned of in accordance with the applicable FARs. Piper recommends life limited parts with no time and/or cycles remaining be completely destroyed.

— Note —

Refer to the LIMITATIONS in the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual for a detailed delineation of the flight limitations of the airplane.

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CHAPTER

5

TIME LIMITS / MAINTENANCE CHECKS

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CHAPTER 5 - TIME LIMITS / MAINTENANCE CHECKS

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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 schedules for the PA-32R-301/301T Saratoga II HP and TC are 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 within a time limit set by the FAA. When an AD is issued, it is sent to the latest registered owner of the affected aircraft and also to subscribers of the service. The owner 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 "www1.faa.gov". Additionally, Avantext offers a free email notification service for new AD's as well as the last six weeks worth of AD's 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 Distributors world wide.

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 Program. It includes the frequency and extent of the inspections required for the continued airworthiness of the airplane.
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

This section provides instructions for conducting inspections. For repair or replacement instructions of those components found to be unserviceable during inspections, refer to the chapter(s) covering the applicable airplane system.

— WARNING —

GROUND THE MAGNETO PRIMARY CIRCUIT (P LEAD), BEFORE PERFORMING ANY MAINTENANCE OPERATION ON 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 schedules for the PA-32R-301 Saratoga II HP and PA-32R-301T Saratoga II TC are provided herein as Annual / 100 Hour Inspections. Progressive Inspection Programs will be available from Piper Distributors 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 this aircraft, utilizing 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 component and systems at scheduled interval 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 was 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 Distributors:

P/N 761-881 (pending) for the SARATOGA II HP (S/N's 3246001 & up), and

P/N 761-896 (pending) for the SARATOGA II TC (S/N's 3257001 & up).

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 Manuals (P/N's 761-881 and 761-896) referenced above will not be stand-alone documents. They will consitute snapshots 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 them 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.

4. ANNUAL / 100 HOUR INSPECTION PROCEDURE.

A. Scheduled Maintenance (i.e. - paragraphs 5 and 6)

(1) The required periodic inspection procedures are listed in paragraphs 5 (PA-32R-301) and 6 (PA-32R-301T). These inspection procedures are broken down into major groups which include Propeller, Engine, Cabin and Cockpit, Fuselage and Empennage,Wing, Landing Gear, 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 intervals 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 outside the 100 hour cycle, it will be indicated as:

As req'd by "applicable vendor publication."

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 230-1047 for the SARATOGA II HP (S/N's 3246001 & up), and

P/N 230-2047 for the SARATOGA II TC (S/N's 3257001 & up).

— Note —

Service centers conducting Part 91 Annual / 100 Hour Inspections can use the Inspection Report Forms (P/N's 230-1047 and 230-2047), as working check-off lists, provided they verify their 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. - paragraphs 5 and 6), 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 - SARATOGA II HP (S/N's 3246001 & up)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
A. PROPELLER GROUP		
—WARNING —		
USE EXTREME CAUTION WHEN ROTATING PROPELLER BY HAND; PROPELLER MAY KICK BACK. PRIOR TO ROTATING PROPELLER ENSURE BOTH MAGNETO SWITCH(S) ARE OFF (GROUNDED). IF MAGNETO(S) ARE NOT GROUNDED, TURNING PROPELLER MAY START ENGINE.		
1. Inspect spinner and back plate for cracks, dents, missing screws, and security	O	O
2. Inspect blades for nicks and cracks	O	O
3. Check for grease and oil leaks	O	O
4. Lubricate propeller per Lubrication Chart in maintenance manual	O	O
5. Inspect spinner mounting brackets for cracks and security		O
6. Inspect propeller mounting bolts for security and safety. Recheck torque values if safety is broken.		O
7. Inspect hub parts for cracks and corrosion		O
8. Rotate blades and check for tightness in hub pilot tube		O
9. Inspect complete propeller and spinner assembly for security, chafing, cracks, deterioration, wear, and correct installation		O
10. Overhaul or replace propeller governor. (See Note 36.)	As req'd by Hartzell Svc. Ltr. No. 61	
11. Overhaul propeller. (See Note 37.)		
B. ENGINE GROUP		
—WARNING —		
IF MAGNETO(S) ARE NOT GROUNDED, TURNING PROPELLER MAY START ENGINE. USE EXTREME CAUTION WHEN ROTATING PROPELLER BY HAND; PROPELLER MAY KICK BACK. PRIOR TO ROTATING PROPELLER ENSURE BOTH MAGNETO SWITCH(S) ARE OFF (GROUNDED).		
— Note —		
Read Note 5 prior to completing the following items.		
1. Remove engine cowl and inspect for internal and external damage. (See Note 26.)	O	O
2. Clean and inspect cowling for cracks, distortion, and loose or missing fasteners		O
3. Drain oil sump	O	O
4. Clean suction oil strainer at oil change; inspect strainer for foreign particles	O	O

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
B. ENGINE GROUP (cont.)		
5. Change full flow, cartridge type, oil filter element; inspect element for foreign particles. (See Note 7.)	O	O
6. Inspect oil temperature sender unit for leaks and security		O
7. Inspect oil lines and fitting for leaks, security, chafing, dents, and cracks	O	O
8. Clean and inspect oil radiator cooling fins		O
9. Fill engine with oil per information on cowl or lubrication chart, 12-20-00	O	O
10. Clean engine with approved solvents		O
—CAUTION —		
USE CAUTION NOT TO CONTAMINATE VACUUM PUMP WITH CLEANING FLUID. (REFER TO LATEST REVISION TEXTRON LYCOMING SERVICE INSTRUCTION NO. 1221.)		
11. Inspect condition of spark plugs. Clean and adjust gap as required; adjust per latest revision Textron Lycoming Service Instruction No. 1042		O
— NOTE —		
IF FOULING OF SPARK PLUGS IS APPARENT, ROTATE BOTTOM PLUGS TO UPPER PLUGS.		
12. Inspect spark plug cable leads	O	O
13. Check cylinder compression. (Refer to AC 43.13-1, latest revision.)		O
14. Inspect cylinders for cracked or broken fins. (See Note 9.)		O
— Note —		
Textron Lycoming requires a Valve Inspection be made after every 400 hours of operation. (See 5-30-00.)		
15. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds	O	O
16. Inspect ignition harness and insulators for high tension leakage and continuity		O
17. Check magneto points for proper clearance..		O
18. Inspect magneto for oil seal leakage		O
19. Inspect magnetos to engine timing		O
20. Remove air filter and clean per Chapter 12. Replace as required. (See Note 30.)	O	O
21. Clean fuel injector inlet line screen	O	O
22. Inspect condition of alternate air valve and housing	O	O
23. Inspect intake seals for leaks and clamps for tightness. (Torque clamps 40-50 in.-lbs.)	O	O

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
B. ENGINE GROUP (cont.)		
24. Inspect all air inlet duct hoses. Replace as required.	O	O
25. Inspect condition of flexible fuel lines		O
26. Inspect fuel system for leaks		O
27. Inspect engine-driven and electric fuel pumps for operation		O
28. Overhaul or replace engine-driven and electric fuel pumps. (See Note 11.)	Engine Overhaul or 5 yrs.	
29. Inspect and operationally test engine driven and auxiliary vacuum pumps and lines. (See Notes 12 and 33; and 500 Hour special inspection, 5-30-00.)		O
30. Inspect throttle, alternate air, mixture, and propeller governor controls for security, travel, and operation condition		O
31. Inspect exhaust stacks, connections and gaskets. Replace gaskets as required. (Refer to Chapter 78)	O	O
32. Inspect muffler, heat exchange, and baffles. (Refer to Chapter 78.)	O	O
33. Inspect breather tube for obstructions and security		O
34. Inspect crankcase for cracks, leaks, and security of seam bolts		O
35. Inspect engine mounts for cracks and loose mounting		O
36. Inspect all engine baffles		O
37. Inspect rubber engine mount bushings for deterioration. (Replace as required.)		O
38. Inspect firewall seals		O
39. Inspect condition and tension of alternator drive belt. (Refer to Chapters 21 and 24 if air conditioning is installed)	O	O
40. Lubricate alternator idler pulley (if installed); remove front grease seal and add grease. (Refer to lubrication chart, 12-20-00.) (Disregard if sealed bearing is installed)		O
41. Inspect condition of alternator and starter		O
42. Inspect security of alternator or mounting		O
43. Check air conditioning compressor oil level. (See Note 14.)		O
44. Inspect condition of compressor belt and tension. (Refer to Chapter 21.)	O	O
45. Inspect compressor clutch security and wiring. (See Note 15.)		O
46. Inspect compressor mounting for cracks, corrosion, and security		O
47. Check fluid in brake reservoir. Fill as required	O	O
48. Inspect and lubricate all controls. (Refer to 12-20-00.)		O
49. Complete overhaul of engine or replace with factory rebuilt. (See Lycoming Service Bulletin No. 240.)	As req'd by Lycoming Svc. Instr. No. 1009	
50. Install engine cowl	O	O

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
C. CABIN AND COCKPIT GROUP		
1. Inspect cabin entrance, doors, and windows for damage, operation, and security		O
2. Inspect windows for scratches, crazing, and condition		O
3. Check window and door seals for deterioration, cracks, and voids. (Refer to Chapter 56.)		O
4. Inspect upholstery for tears		O
5. Inspect seats, seat belts, shoulder harnesses, security brackets, and bolts. (See Seat Belt and Shoulder Harness Inspection, 25-10-00.)		O
6. Inspect trim operation		O
7. Inspect rudder pedals		O
8. Inspect parking brake valve and brake handle for operation and cylinder leaks		O
9. Inspect control wheels, column, pulleys, and cables. (See Notes 16 and 32.)		O
10. Inspect electric flap screw jack and attachments for condition and lubrication		O
11. Check landing, navigation, strobe, cabin, and instrument lights	O	O
12. Inspect instruments, lines, and attachments. (See Note 28.)		O
13. Inspect gyro operated instruments and electric turn and bank. (Overhaul or replace as required.)		O
14. Replace central air filter		O
15. Clean or replace vacuum regulator filter		O
16. Inspect altimeter and transponder for installation/certification per latest revision of AC43.13-1 and tested/inspected per FAR's 91.411 and 91.413, respectively. (See Two (2) Year special inspection, 5-30-00.)		O
17. Inspect and test ELT per FAR 91.207. (See Testing ELT, 23-20-00.)		O
18. Inspect operation of fuel selector valve.		O
19. Inspect fuel valve drain lever cover for security. Check that door opens and closes freely and prevents operation of lever when closed	O	O
20. Inspect condition of heater controls and ducts		O
21. Inspect condition and operation of air vents		O
22. Inspect condition of air conditioning ducts		O
23. Remove and clean air conditioning evaporator filter		O
D. FUSELAGE AND EMPENNAGE GROUP		
1. Remove inspection plates and panels		O
2. Check forward and rear wing attach bolts and fittings for corrosion. (Refer to Chapter 57.)		O
3. Inspect baggage doors, latches, and hinges for operation and security	O	O
4. Inspect battery, box or shelf, and cables. Flush box as required and fill battery per instructions on box or in Chapter 24		O
5. Inspect electronic installations		O

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (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.)		
6. Inspect skins, bulkheads and stringers for damage		O
7. Inspect antenna mounts and electric wiring		O
8. Check hydraulic pump fluid level. Fill as required	O	O
9. Inspect hydraulic pump lines for damage and leaks		O
10. Inspect air conditioning system for refrigerant leaks. (See Note 14.)		O
11. Inspect refrigerant level in sight gauge of receiver-dehydrator. (Refer to Chapter 21.)	O	O
12. Inspect air conditioner condenser air scoop for condition and rigging. (See Note 38.)	O	O
13. Inspect fuel lines, valves, and gauges for damage and operation		O
14. Remove, drain, and clean fuel strainer bowl and screen located in bottom of selector valve		O
15. Inspect security of all lines		O
16. Inspect vertical fin and rudder surfaces for damage		O
17. Inspect rudder hinges, sector and attachments for damage, security, & operation		O
18. Inspect vertical fin attachments for security		O
19. Inspect rudder control stops to ensure stops have not loosened and locknuts are tight		O
20. Inspect rudder hinge bolts for excess wear. Replace as required.		O
21. Inspect stabilator surfaces for damage		O
22. Inspect stabilator tab hinges, horn, and attachments for damage, security, and operation		O
23. Inspect stabilator attachments and attach brackets for corrosion, rust, and security. Repair as required. (Refer to Stabilator Attach Brackets Corrosion Inspection, 55-10-00)		O
24. Inspect stabilator and tab hinge bolts and bearings for excess wear. Replace as required		O
25. Inspect stabilator control stops to ensure stops are not loose. Ensure bolts and locknuts are tight		O
26. Inspect rudder and stabilator cables and check all cable tensions using a tensiometer. (See Notes 16 & 18.)		O
27. Inspect stabilator trim mechanism, stabilator trim cables, turnbuckles, guides, and pulleys for safety, damage, and operation. (See Note 16.)		O
28. Lubricate per lubrication chart, 12-20-00	O	O
29. Inspect anti-collision light for security and operation	O	O
30. Inspect security of Autopilot bridle cable clamps. (See Note 16.)		O
31. Inspect all control cables, air ducts, electrical leads, lines, radio antenna leads, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation. (See Note 16.)		O
32. Inspect ELT battery for condition/date per FAR 91.207		O
33. Inspect ELT installation and antenna for condition and security. Replace antenna if bent or damaged		O
34. Install inspection plates and panels		O

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
E. WING GROUP		
1. Remove inspection plates and fairings		O
2. Inspect surfaces and tips for damage, loose rivets, and conditions of walkway		O
3. Inspect aileron hinges and attachments. (See Note 34.)		O
4. Inspect aileron control stops to ensure stops have not loosened and locknuts are tight		O
5. Inspect aileron cables, pulleys, and bellcranks for damage and operation, and cable tensions. (See Note 16.)		O
6. Inspect pitot tube for damage and condition		O
— CAUTION — **SEVERE BURNS CAN RESULT FROM COMING IN CONTACT WITH A HEATED PITOT TUBE.**		
7. Check pitot heat		O
8. Inspect flaps and attachments for damage and operation		O
9. Inspect condition of bolts used with hinges. Replace as required		O
10. Lubricate per lubrication chart, 12-20-00	O	O
11. Inspect wing attachment bolts and brackets. (See Note 19.)		O
12. Inspect fuel tanks and lines for leaks and water. (See Note 20.)		O
13. Inspect fuel tanks for minimum octane markings		O
14. Inspect fuel cell vents		O
15. Inspect all control cables, air ducts, electrical leads, lines, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation. (See Note 16.)		O
16. Install inspection plates and fairings		O
F. LANDING GEAR GROUP		
1. Check oleo struts for proper extension and evidence of fluid 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. (Refer to Chapter 7.)		O
5. Inspect tires for cuts, uneven or excessive wear, and slippage		O
6. Remove wheels, clean, inspect, and repack bearings		O
7. Inspect wheels for cracks, corrosion, and broken bolts		O
8. Check tire pressure	O	O
9. Inspect brake lining and disc for wear		O
10. Inspect brake backing plates for cracks		O
11. Inspect condition of brake and hydraulic lines		O
12. Inspect shimmy dampener operation		O

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
F. LANDING GEAR GROUP (cont.)		
13. Inspect gear forks for damage		O
14. Inspect oleo struts for fluid leaks and scoring		O
15. Inspect gear struts, attachments, torque links, retraction links, and bolts for condition and security		O
16. Inspect down lock for operation and adjustment		O
17. Inspect torque link bolts and bushings. Rebush as required.		O
18. Inspect drag and side brace link bolts. Replace as required.		O
19. Inspect gear doors and attachments		O
20. Inspect warning horn and light for operation		O
21. Check normal-emergency gear retraction operation		O
22. Retract gear-inspect doors for clearance and operation		O
23. Inspect anti-retraction system		O
24. Inspect actuating cylinders for leaks and security. (See Note 31.)		O
25. Inspect all hydraulic lines, electrical leads, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation		O
26. Inspect position indicator switch and electrical leads for security		O
27. Lubricate per lubrication chart, 12-20-00	O	O
28. Ensure that landing gear is down and locked; remove airplane from jacks		O
G. SPECIAL INSPECTIONS		
See 5-30-00	O	O

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
H. OPERATIONAL INSPECTION		
— Note —		
Refer to Note 22 prior to starting engine or taxiing airplane.		
1. Check fuel pump and fuel tank selector	O	O
2. Check fuel quantity, pressure, and flow readings	O	O
3. Check oil pressure and temperature	O	O
4. Check alternator output	O	O
5. Check manifold pressure	O	O
6. Check alternate air	O	O
7. Check parking brake	O	O
8. Check vacuum gauge	O	O
9. Check gyros for noise and roughness	O	O
10. Check cabin heater operation	O	O
11. Check magneto switch operation	O	O
12. Check magneto rpm variation	O	O
13. Check throttle and mixture operation	O	O
14. Check propeller smoothness	O	O
15. Check propeller governor action	O	O
16. Check engine idle	O	O
17. Check annunciator light panel	O	O
18. Check electronic equipment operation	O	O
19. If installed, check operation of autopilot, including automatic pitch trim, and manual electric trim. (See Note 23.)	O	O
20. Check air conditioner compressor clutch operation	O	O
21. Check air conditioner condenser scoop operation	O	O
22. Fly airplane, check Landing Gear System. (See Note 24.)	O	O
I. GENERAL		
1. Aircraft conforms to FAA Specification	O	O
2. All latest revisions of Airworthiness Directives complied with	O	O
3. All latest revisions of Manufacturers' Service Bulletins and Letters complied with	O	O
4. Check for proper Pilot's Operating Handbook	O	O
5. Aircraft papers in proper order	O	O

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (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 Chapter/Section are to the appropriate Chapter or 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 (Textron Lycoming Part No. 60297-10) 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. Overhaul as required and at engine overhaul. In no case may Slick 6300 series magneto's time-in-service exceed engine TBO.
7. Refer to latest revision of Textron Lycoming Service Bulletin No. 480.

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (CONTINUED)

J. NOTES (cont.)

8. Not used.
9. Check cylinders for evidence of excessive heat 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 airplane 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 a while. This condition is neither harmful nor detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder must be replaced.
10. Not used.
11. Replace at engine overhaul or 5 years, whichever comes first. For engine overhaul, refer to latest revision of Textron Lycoming Service Bulletin No. 240 and Textron Lycoming Service Instruction 1009.
12. Complete vacuum system inspection of airplanes equipped with the Auxiliary Vacuum Pump/ Motor Assembly (4A3-1), requires gaining access under the floorboard on the right side of the forward baggage compartment, where this assembly is located.
13. Not used.

— CAUTION —

ENVIRONMENTAL REGULATIONS MAY REQUIRE SPECIAL EQUIPMENT AND PROCEDURES BE USED WHEN CHARGING AIR CONDITIONING SYSTEMS.

14. The compressor oil level should not be checked unless a refrigerant leak has occurred or system pressure has been released, requiring an addition of refrigerant to the system.
15. Clean any traces of oil from the clutch surface.
16. Examine cables for broken strands by wiping them 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. See Control Cable Inspection, 27-00-00, or the latest edition of FAA AC 43.13-1.
17. Not used.
18. Maintain cable tensions specified in Chapter 27.
19. Check torque at forward and aft spar attach per Chapter 57, Figure 57-1.
20. Sloshing of fuel tanks not approved.
21. Not used.
22. Refer to Section 4 of the Pilot's Operating Handbook for preflight and flight check list.
23. Refer to Pilot's Operating Handbook Supplement for preflight and flight check and for intended function in all modes.

5. SCHEDULED MAINTENANCE - SARATOGA II HP (S/N's 3246001 & up) (CONTINUED)

J. NOTES (cont.)

24. Fly airplane to check landing gear system in accordance with instructions given in Chapter 32, Operational Check of Retractable Landing Gear System.
25. Not used.
26. In S/N's 3246001 thru 3246070 only, ensure the requirements of Piper Service Bulletin No. 1005 (latest revision) have been complied with and an appropriate maintenance log entry was made.
27. Not used.
28. In S/N's 3246001 thru 3246087 only, ensure the requirements of Piper Service Bulletin No. 1015 (latest revision) have been complied with and an appropriate maintenance log entry was made.
29. In S/N's 3246001 thru 3246144 only, ensure the requirements of Piper Service Bulletin No. 1020 (latest revision) have been complied with and an appropriate maintenance log entry was made.
30. In S/N's 3246001 thru 3246117 only, ensure the requirements of Airworthiness Directive No. 99-05-09 (see also Piper Service Bulletin No. 1022 (latest revision)) have been complied with and an appropriate maintenance log entry was made.
31. In S/N's 3246001 thru 3246115 only, ensure the requirements of Piper Service Bulletin No. 1023 (latest revision) have been complied with and an appropriate maintenance log entry was made.
32. In S/N's 3246001 thru 3246112 only, ensure the requirements of Piper Service Bulletin No. 1024 (latest revision) have been complied with and an appropriate maintenance log entry was made.
33. In S/N's 3246001 thru 3246120 only, ensure the requirements of Piper Service Bulletin No. 1026 (latest revision) have been complied with and an appropriate maintenance log entry was made.
34. In S/N's 3246102 thru 3246121 only, ensure the requirements of Piper Service Bulletin No. 1028 (latest revision) have been complied with and an appropriate maintenance log entry was made.
35. Not used.
36. Overhaul or replace Hartzell propeller governors each 2000 hours or at engine overhaul. (Verify TBO in latest revision of Hartzell Service Letter No. 61.)
37. Overhaul or replace Hartzell propellers each five or six years or each 2000 or 2400 hours. (Refer to latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)
38. Refer to 21-50-00, Condenser Assembly Rigging, and verify/check microswitch adjustment.

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6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
A. PROPELLER GROUP		
—WARNING —		
USE EXTREME CAUTION WHEN ROTATING PROPELLER BY HAND; PROPELLER MAY KICK BACK. PRIOR TO ROTATING PROPELLER ENSURE BOTH MAGNETO SWITCH(S) ARE OFF (GROUNDED). IF MAGNETO(S) ARE NOT GROUNDED, TURNING PROPELLER MAY START ENGINE.		
1. Inspect spinner and back plate for cracks, dents, missing screws, and security	O	O
2. Inspect blades for nicks and cracks	O	O
3. Check for grease and oil leaks	O	O
4. Lubricate propeller per Lubrication Chart, 12-20-00	O	O
5. Inspect spinner mounting brackets for cracks and security		O
6. Inspect propeller mounting bolts for security and safety. Recheck torque values if safety is broken.		O
7. Inspect hub parts for cracks and corrosion		O
8. Rotate blades and check for tightness in hub pilot tube		O
9. Inspect complete propeller and spinner assembly for security, chafing, cracks, deterioration, wear, and correct installation		O
10. Overhaul or replace propeller governor. (See Note 33.)	As req'd by Hartzell Svc. Ltr. No. 61	
11. Overhaul propeller. (See Note 34.)		
B. ENGINE GROUP		
—WARNING —		
IF MAGNETO(S) ARE NOT GROUNDED, TURNING PROPELLER MAY START ENGINE. USE EXTREME CAUTION WHEN ROTATING PROPELLER BY HAND; PROPELLER MAY KICK BACK. PRIOR TO ROTATING PROPELLER ENSURE BOTH MAGNETO SWITCH(S) ARE OFF (GROUNDED).		
— Note —		
Read Note 5 prior to completing the following items.		
1. Remove engine cowl and inspect for internal and external damage	O	O
2. Clean and inspect cowling for cracks, distortion, and loose or missing fasteners		O
3. Drain oil sump	O	O
4. Clean suction oil strainer at oil change; inspect strainer for foreign particles	O	O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
B. ENGINE GROUP (cont.)		
5. Change full flow, cartridge type, oil filter element; inspect element for foreign particles. (See Note 7.)	O	O
6. Inspect oil temperature sender unit for leaks and security		O
7. Inspect oil lines and fitting for leaks, security, chafing, dents, and cracks	O	O
8. Clean and inspect oil radiator cooling fins		O
9. Fill engine with oil per information on cowl or Lubrication Chart, 12-20-00	O	O
10. Clean engine with approved solvents		O

— CAUTION —

USE CAUTION NOT TO CONTAMINATE VACUUM PUMP WITH CLEANING FLUID. (REFER TO LATEST REVISION TEXTRON LYCOMING SERVICE INSTRUCTION NO. 1221.)

11. Inspect condition of spark plugs. Clean and adjust gap as required; adjust per latest revision Textron Lycoming Service Instruction No. 1042		O

— Note —

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

12. Inspect spark plug cable leads	O	O
13. Check cylinder compression. (Refer to: AC 43.13-1A)		O
14. Inspect cylinders for cracked or broken fins. (See Note 9)		O

— Note —

Textron Lycoming requires a Valve Inspection be made after every 400 hours of operation. (See 5-30-00.)

15. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds	O	O
16. Inspect ignition harness and insulators for high tension leakage and continuity		O
17. Check magneto points for proper clearance..		O
18. Inspect magneto for oil seal leakage		O
19. Inspect magnetos to engine timing		O
20. Remove air filter and clean per Chapter 12. Replace as required	O	O
21. Clean fuel injector inlet line screen	O	O
22. Inspect condition of alternate air valve and housing	O	O
23. Inspect intake seals for leaks and clamps for tightness. (Torque clamps 40-50 in.-lbs.)	O	O
24. Inspect all air inlet duct hoses. Replace as required.	O	O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
B. ENGINE GROUP (cont.)		
25. Inspect condition of flexible fuel lines		O
26. Inspect fuel system for leaks		O
27. Inspect engine-driven and electric fuel pumps for operation		O
28. Overhaul or replace engine-driven and electric fuel pumps. (See Note 11.)	Engine Overhaul or 5 yrs.	
29. Inspect and operationally test engine driven and auxiliary vacuum pumps and lines. (See Notes 12 and 30; and 500 special inspection, 5-30-00.)		O
30. Inspect throttle, alternate air, mixture, and propeller governor controls for security, travel, and operation condition		O
31. Inspect exhaust stacks, connections and gaskets. Replace gaskets as required. (Refer to Chapter 78.)	O	O
32. Inspect muffler, heat exchange, and baffles. (Refer to Chapter 78.)	O	O
33. Inspect breather tube for obstructions and security		O
34. Inspect crankcase for cracks, leaks, and security of seam bolts		O
35. Inspect engine mounts for cracks and loose mounting		O
36. Inspect all engine baffles		O
37. Inspect rubber engine mount bushings for deterioration. (Replace as required.)		O
38. Inspect firewall seals		O
39. Inspect condition and tension of alternator drive belt. (Refer to Chapters 21 and 24 if air conditioning is installed.)	O	O
40. Lubricate alternator idler pulley (if installed); remove front grease seal and add grease. (Refer to Lubrication Chart, 12-20-00.) (Disregard if sealed bearing is installed.)		O
41. Inspect condition of alternator and starter		O
42. Inspect security of alternator or mounting		O
43. Check air conditioning compressor oil level. (See Note 14.)		O
44. Inspect condition of compressor belt and tension. (Refer to Chapter 21.)	O	O
45. Inspect compressor clutch security and wiring.(See Note 15.)		O
46. Inspect compressor mounting for cracks, corrosion, and security		O
47. Check fluid in brake reservoir. Fill as required.	O	O
48. Inspect and lubricate all controls. (Refer to 12-20-00.)		O
49. Complete overhaul of engine or replace with factory rebuilt. (See Lycoming Service Bulletin No. 240.)	As req'd by Lycoming Svc. Instr. No. 1009	
50. Install engine cowl	O	O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
C. TURBOCHARGER GROUP		
— 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 —		
Read Note 5 prior to completing the following items.		
1. Inspect all oil inlet ducting and compressor discharge ducting for worn spots, loose clamps, or leaks.	O	O
2. Inspect engine air inlet assembly for cracks, loose clamps, and screws. (See Note 32.)	O	O
3. Inspect exhaust ducting and exhaust stacks for tightness	O	O
4. Inspect exhaust heat exchanger		O
5. Carefully inspect all turbo support brackets, struts, etc., for damage, sagging, and wear.	O	O
6. Inspect all oil hoses, lines, and fittings for wear, leakage, heat damage, and fatigue	O	O
7. Inspect bypass valve for security and safety	O	O
8. Run up engine, and check all instruments for smooth, steady response	O	O
D. CABIN AND COCKPIT GROUP		
1. Inspect cabin entrance, doors, and windows for damage, operation, and security		O
2. Inspect windows for scratches, crazing, and condition		O
3. Check window and door seals for deterioration, cracks, and voids. (Refer to Chapter 56.)		O
4. Inspect upholstery for tears		O
5. Inspect seats, seat belts, shoulder harnesses, security brackets, and bolts. (See Seat Belt and Shoulder Harness Inspection, 25-10-00.)		O
6. Inspect trim operation		O
7. Inspect rudder pedals		O
8. Inspect parking brake valve and brake handle for operation and cylinder leaks		O
9. Inspect control wheels, column, pulleys, and cables. (See Note 16 and 29.)		O
10. Inspect the electric flap screw jack and attachments for condition and lubrication		O
11. Check landing, navigation, strobe, cabin, and instrument lights	O	O
12. Inspect instruments, lines, and attachments		O
13. Inspect gyro operated instruments and electric turn and bank. (Overhaul or replace as required.)		O
14. Replace central air filter		O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
D. CABIN AND COCKPIT GROUP (cont.)		
15. Clean or replace vacuum regulator filter		O
16. Inspect altimeter and transponder for installation/certification per latest revision of AC43.13-1 and tested/inspected per FAR's 91.411 and 91.413, respectively. (See Two (2) Year special inspection, 5-30-00.)		O
17. Inspect and test ELT per FAR 91.207. (See Testing ELT, 23-20-00.)		O
18. Inspect operation of fuel selector valve.		O
19. Inspect fuel valve drain lever cover for security. Check that door opens and closes freely and prevents operation of lever when closed	O	O
20. Inspect condition of heater controls and ducts		O
21. Inspect condition and operation of air vents		O
22. Inspect condition of air conditioning ducts		O
23. Remove and clean air conditioning evaporator filter		O
E. FUSELAGE AND EMPENNAGE GROUP		
1. Remove inspection plates and panels		O
2. Check forward and rear wing attach bolts and fittings for corrosion. (Refer to Chapter 57.)		O
3. Inspect baggage doors, latches, and hinges for operation and security	O	O
4. Inspect battery, shelf, and cables. Flush area as required and fill battery per instructions in Chapter 24.		O
5. Inspect electronic installations		O
6. Inspect skins, bulkheads and stringers for damage		O
7. Inspect antenna mounts and electric wiring		O
8. Check hydraulic pump fluid level. Fill as required.	O	O
9. Inspect hydraulic pump lines for damage and leaks		O
10. Inspect air conditioning system for refrigerant leaks. (See Note 14.)		O
11. Inspect refrigerant level in sight gauge of receiver-dehydrator. (Refer to Chapter 21.)	O	O
12. Inspect air conditioner condenser air scoop for condition and rigging. (See Note 36.)	O	O
13. Inspect fuel lines, valves, and gauges for damage and operation		O
14. Remove, drain, and clean fuel strainer bowl and screen located in bottom of selector valve		O
15. Inspect security of all lines		O
16. Inspect vertical fin and rudder surfaces for damage		O
17. Inspect rudder hinges, sector and attachments for damage, security, & operation		O
18. Inspect vertical fin attachments for security		O
19. Inspect rudder control stops to ensure stops have not loosened and locknuts are tight		O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
E. FUSELAGE AND EMPENNAGE GROUP (cont.)		
20. Inspect rudder hinge bolts for excess wear. Replace as required		O
21. Inspect stabilator surfaces for damage		O
22. Inspect stabilator tab hinges, horn, and attachments for damage, security, and operation		O
23. Inspect stabilator attachments and attach brackets for corrosion, rust, and security. Repair as required. (Refer to Stabilator Attach Brackets Corrosion Inspection, 55-10-00.)		O
24. Inspect stabilator and tab hinge bolts and bearings for excess wear. Replace as required		O
25. Inspect stabilator control stops to ensure stops are not loose. Ensure bolts and locknuts are tight		O
26. Inspect rudder and stabilator cables and check all cable tensions using a tensiometer. (See Notes 16 & 18.)		O
27. Inspect stabilator trim mechanism, stabilator trim cables, turnbuckles, guides, and pulleys for safety, damage, and operation. (See Note 16.)		O
28. Lubricate per Lubrication Chart, 12-20-00	O	O
29. Inspect anti-collision light for security and operation	O	O
30. Inspect security of Autopilot bridle cable clamps. (See Note 16.)		O
31. Inspect all control cables, air ducts, electrical leads, lines, radio antenna leads, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation. (See Note 16.)		O
32. Inspect ELT battery for condition/date per FAR 91.207. (See Note 27.)		O
33. Inspect ELT installation and antenna for condition and security. Replace antenna if bent or damaged		O
34. Install inspection plates and panels		O
F. WING GROUP		
1. Remove inspection plates and fairings		O
2. Inspect surfaces and tips for damage, loose rivets, and conditions of walkway		O
3. Inspect aileron hinges and attachments. (See Note 31.)		O
4. Inspect aileron control stops to ensure stops have not loosened and locknuts are tight		O
5. Inspect aileron cables, pulleys, and bellcranks for damage and operation, and cable tensions. (See Note 16.)		O
6. Inspect pitot tube for damage and condition.		O

— CAUTION —

SEVERE BURNS CAN RESULT FROM COMING IN CONTACT WITH A HEATED PITOT TUBE.

7. Check pitot heat		O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
F. WING GROUP (cont.)		
8. Inspect flaps and attachments for damage and operation		O
9. Inspect condition of bolts used with hinges. Replace as required.		O
10. Lubricate per Lubrication Chart, 12-20-00	O	O
11. Inspect wing attachment bolts and brackets. (See Note 19.)		O
12. Inspect fuel tanks and lines for leaks and water. (See Note 20.)		O
13. Inspect fuel tanks for minimum octane markings		O
14. Inspect fuel cell vents		O
15. Inspect all control cables, air ducts, electrical leads, lines, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation. (See Note 16.)		O
16. Install inspection plates and fairings		O
G. LANDING GEAR GROUP		
1. Check oleo struts for proper extension and evidence of fluid 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. (Refer to Chapter 7.)		O
5. Inspect tires for cuts, uneven or excessive wear, and slippage		O
6. Remove wheels, clean, inspect, and repack bearings		O
7. Inspect wheels for cracks, corrosion, and broken bolts		O
8. Check tire pressure	O	O
9. Inspect brake lining and disc for wear		O
10. Inspect brake backing plates for cracks		O
11. Inspect condition of brake and hydraulic lines		O
12. Inspect shimmy dampener operation		O
13. Inspect gear forks for damage		O
14. Inspect oleo struts for fluid leaks and scoring		O
15. Inspect gear struts, attachments, torque links, retraction links, and bolts for condition and security		O
16. Inspect down lock for operation and adjustment		O
17. Inspect torque link bolts and bushings. Rebush as required		O
18. Inspect drag and side brace link bolts. Replace as required		O
19. Inspect gear doors and attachments		O
20. Inspect warning horn and light for operation		O
21. Check normal-emergency gear retraction operation		O
22. Retract gear-inspect doors for clearance and operation		O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
G. LANDING GEAR GROUP (cont.)		
23. Inspect anti-retraction system		O
24. Inspect actuating cylinders for leaks and security. (See Note 28.)		O
25. Inspect all hydraulic lines, electrical leads, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation		O
26. Inspect position indicator switch and electrical leads for security		O
27. Lubricate per Lubrication Chart, 12-20-00	O	O
28. Ensure that landing gear is down and locked; remove airplane from jacks		O
H. SPECIAL INSPECTIONS		
See 5-30-00	O	O
I. OPERATIONAL INSPECTION		
— Note —		
Refer to Note 22 prior to starting engine or taxiing airplane.		
1. Check fuel pump and fuel tank selector	O	O
2. Check fuel quantity, pressure, and flow readings	O	O
3. Check oil pressure and temperature	O	O
4. Check alternator output	O	O
5. Check manifold pressure	O	O
6. Check alternate air	O	O
7. Check parking brake	O	O
8. Check vacuum gauge	O	O
9. Check gyros for noise and roughness	O	O
10. Check cabin heater operation	O	O
11. Check magneto switch operation	O	O
12. Check magneto rpm variation	O	O
13. Check throttle and mixture operation	O	O
14. Check propeller smoothness	O	O
15. Check propeller governor action	O	O
16. Check engine idle	O	O
17. Check annunciator light panel	O	O
18. Check electronic equipment operation	O	O
19. If installed, check operation of autopilot, including automatic pitch trim, and manual electric trim. (See Note 23.)	O	O
20. Check air conditioner compressor clutch operation	O	O
21. Check air conditioner condenser scoop operation	O	O
22. Fly airplane, check Landing Gear System. (See Note 24.)	O	O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

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

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
J. GENERAL		
1. Aircraft conforms to FAA Specification	O	O
2. All latest revisions of Airworthiness Directives complied with	O	O
3. All latest revisions of Manufacturers' Service Bulletins and Letters complied with	O	O
4. Check for proper Pilot's Operating Handbook	O	O
5. Aircraft papers in proper order	O	O

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

K. 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 Chapter/Section are to the appropriate Chapter or 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 (Textron Lycoming Part No. 60297-23) 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. Overhaul as required and at engine overhaul. In no case may Slick 6300 series magneto's time-in-service exceed engine TBO.
7. Refer to latest revision of Textron Lycoming Service Bulletin No. 480.

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

K. NOTES (cont.)

8. Not used.
9. Check cylinders for evidence of excessive heat 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 airplane 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 a while. This condition is neither harmful nor detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder must be replaced.
10. Not used.
11. Replace at engine overhaul or 5 years, whichever comes first. For engine overhaul, refer to latest revision of Textron Lycoming Service Bulletin No. 240 and Textron Lycoming Service Instruction 1009.
12. Complete vacuum system inspection of airplanes equipped with the Auxiliary Vacuum Pump/ Motor Assembly (4A3-1), requires gaining access under the floorboard on the right side of the forward baggage compartment, where this assembly is located.
13. Not used.

— CAUTION —

ENVIRONMENTAL REGULATIONS MAY REQUIRE SPECIAL EQUIPMENT AND PROCEDURES BE USED WHEN CHARGING AIR CONDITIONING SYSTEMS.

14. The compressor oil level should not be checked unless a refrigerant leak has occurred or system pressure has been released, requiring an addition of refrigerant to the system.
15. Clean any traces of oil from the clutch surface.
16. Examine cables for broken strands by wiping them 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. See Control Cable Inspection, 27-00-00, or the latest edition of FAA AC 43.13-1.
17. Not used.
18. Maintain cable tensions specified in Chapter 27.
19. Check torque at forward and aft spar attach per Chapter 57, Figure 57-1.
20. Sloshing of fuel tanks not approved.
21. Not used.
22. Refer to Section 4 of the Pilot's Operating Handbook for preflight and flight check list.
23. Refer to Pilot's Operating Handbook Supplement for preflight and flight check and for intended function in all modes.

6. SCHEDULED MAINTENANCE - SARATOGA II TC (S/N's 3257001 & up) (CONTINUED)

K. NOTES (cont.)

24. Fly airplane to check landing gear system in accordance with instructions given in Chapter 32, Operational Check of Retractable Landing Gear System.
25. Not used.
26. Not used.
27. In S/N's 3257001 thru 3257039 only, ensure the requirements of Piper Service Bulletin No. 1020 (latest revision) have been complied with and an appropriate maintenance log entry was made.
28. In S/N's 3257001 thru 3257046 only, ensure the requirements of Piper Service Bulletin No. 1023 (latest revision) have been complied with and an appropriate maintenance log entry was made.
29. In S/N's 3257001 thru 3257036 only, ensure the requirements of Piper Service Bulletin No. 1024 (latest revision) have been complied with and an appropriate maintenance log entry was made.
30. In S/N's 3257001 thru 3257063 only, ensure the requirements of Piper Service Bulletin No. 1026 (latest revision) have been complied with and an appropriate maintenance log entry was made.
31. In S/N's 3257029 thru 3257064 only, ensure the requirements of Piper Service Bulletin No. 1028 (latest revision) have been complied with and an appropriate maintenance log entry was made.
32. In S/N's 3257076 thru 3257087 only, ensure the requirements of Piper Service Bulletin No. 1030 (latest revision) have been complied with and an appropriate maintenance log entry was made.
33. Overhaul or replace Hartzell propeller governors each 2000 hours or at engine overhaul. (Verify TBO in latest revision of Hartzell Service Letter No. 61.)
34. Overhaul or replace Hartzell propellers each five or six years or each 2000 or 2400 hours. (Refer to latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)
35. Not used.
36. Refer to 21-50-00, Condenser Assembly Rigging, and verify/check microswitch adjustment.

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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

Each 400 Hours

☐ Each 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 SSP1776.

Each 500 Hours

☐ Remove propeller; clean sludge from propeller and crankshaft.

☐ Remove and flush oil radiator.

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

☐ The Airborne Auxiliary Vacuum Pump/Motor Assembly (4A3-1) must be removed from service and replaced at 500 hours of operating time as indicated on the elapsed time indicator, or 10 years of installed time in aircraft, whichever comes first.

☐ For airplanes equipped with Aero Accessories Inc., Tempest Dry Air Pumps only: 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.

Each 500 Hours (cont.)

- ☐ Inspect flap selector lever cable attachment for any signs of cable fraying. (See Note 16)
- ☐ Clean and lubricate stabilator trim drum screw.

Each 1000 Hours

- ☐ Overhaul or replace magnetos. See Note 6, 5-20-00.
- ☐ 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.
- ☐ Remove all turbocharger components from the engine. Inspect and repair or replace as necessary. Inspect turbocharger rotor for excessive play, carbon and dirt deposits. (Refer to Chapter 81.) Remove and inspect turbine and compressor housings. Inspect turbine wheel and impeller for physical damage and excessive build up of deposits. If excessive, replace turbocharger assembly.
- ☐ Clean and lubricate all exterior needle bearings.

Each 2000 Hours

- ☐ Each 7 years; or, each 2000 hours time-in-service, whichever comes 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.

2. PER CALENDAR YEAR

Each Thirty (30) Days

- ☐ Inspect battery, box or shelf, and cables. Flush box as required and fill battery per instructions on box or in Chapter 24.

Each Ninety (90) Days

- ☐ For airplanes equipped with the Avidyne Entegra Electronic Flight Display 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.
- ☐ Remove, drain, and clean fuel strainer bowl and screen located in bottom of fuel selector valve.

Each Twelve (12) Months

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

Each Seven (7) Years

- ☐ Each seven (7) years time-in-service, drain and remove the inboard metal fuel tank from each wing and inspect for corrosion as specified in Fuel Tank/Wing Spar Corrosion Inspection (28-10-00).
- ☐ 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 time-in-service, seven (7) years, or fuel tank removal, whichever comes first.
- ☐ Each 7 years; or, each 2000 hours time-in-service, whichever comes 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

- ☐ The Airborne Auxiliary Vacuum Pump/Motor Assembly (4A3-1) must be removed from service and replaced at 500 hours of operating time as indicated on the elapsed time indicator, or 10 years of installed time in aircraft, whichever comes first.
- ☐ For airplanes equipped with the Avidyne Entegra Electronic Flight Display 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 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.

Each Twenty (20) Years

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

3. PER SPECIFIC OPERATION / OPERATING ENVIRONMENT

A. High Dust or Industrial Pollution Environment

— CAUTION —

DISCONNECT LINES FROM PITOT/STATIC SYTEM 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 Up and Down Lock Assemblies.	Clean, inspect and lubricate. (Refer to Lubrication Chart, 12-20-00.)	100 Hours.
☐	Landing Gear Actuators and 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. High Salt or High Humidity Environment

	Item	Inspection	Inspection Interval
☐	Fuselage, Empennage and Wings.	Remove floor panels and exterior access plates; inspect for corrosion.	200 Hours.
☐	Landing Gear.	Inspect for corrosion and lubrication; switches and wiring for condition.	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.
☐	Oil cooler winterization plates. (Saratoga II TC only, see Note, below.)	If ground or inflight outside air temps are expected to be below 15 °F, installation of oil cooler winterization plates is recommended.	Each occurrence, before further flight.

— Note —

Not applicable in TC S/N's 3257273 and up.

Not applicable in TC S/N's 3257001 thru 3257272 when Piper Kit P/N 767-332 installed.

In TC S/N's 3257001 thru 3257102 only, ensure Piper Kit P/N 766-653 (Revision C or later) has been installed per Piper Service Bulletin No. 1018A. See Sections 2 and 8 in the Pilot's Operating Handbook, VB-1647 (Revision 7 or later).

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.

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 check 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, hydraulic, vacuum, pitot/static, and fuel systems, for damage and correct operation.	Each occurrence, before further flight.

1. LIGHTNING STRIKE (continued)

	Item	Inspection	Inspection Interval
☐	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 Distributor'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 trunnion mounts. 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, actuator and side brace damage and condition.Inspect landing gear attachment and drag link bolts (magnetic particle method).	Each occurrence, before further flight.
☐	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.

3. SEVERE TURBULENCE, HARD OR OVERWEIGHT LANDING (continued)

	Item	Inspection	Inspection Interval
☐	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.

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CHAPTER

6

DIMENSIONS AND AREAS

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CHAPTER 6 - DIMENSIONS AND AREAS

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DIMENSIONS AND AREAS.

A. General.

The principal airplane dimensions are shown in Figure 6-1, and the leading particulars/principal dimensions are listed in Chart 601. The airplane serial number is located on the Manufacturers Aircraft Association (MAA) plate located on the left side of the fuselage at approximately F.S. 278.6. The engine serial number plate is located on the left side of the engine oil sump just below cylinder number 5.

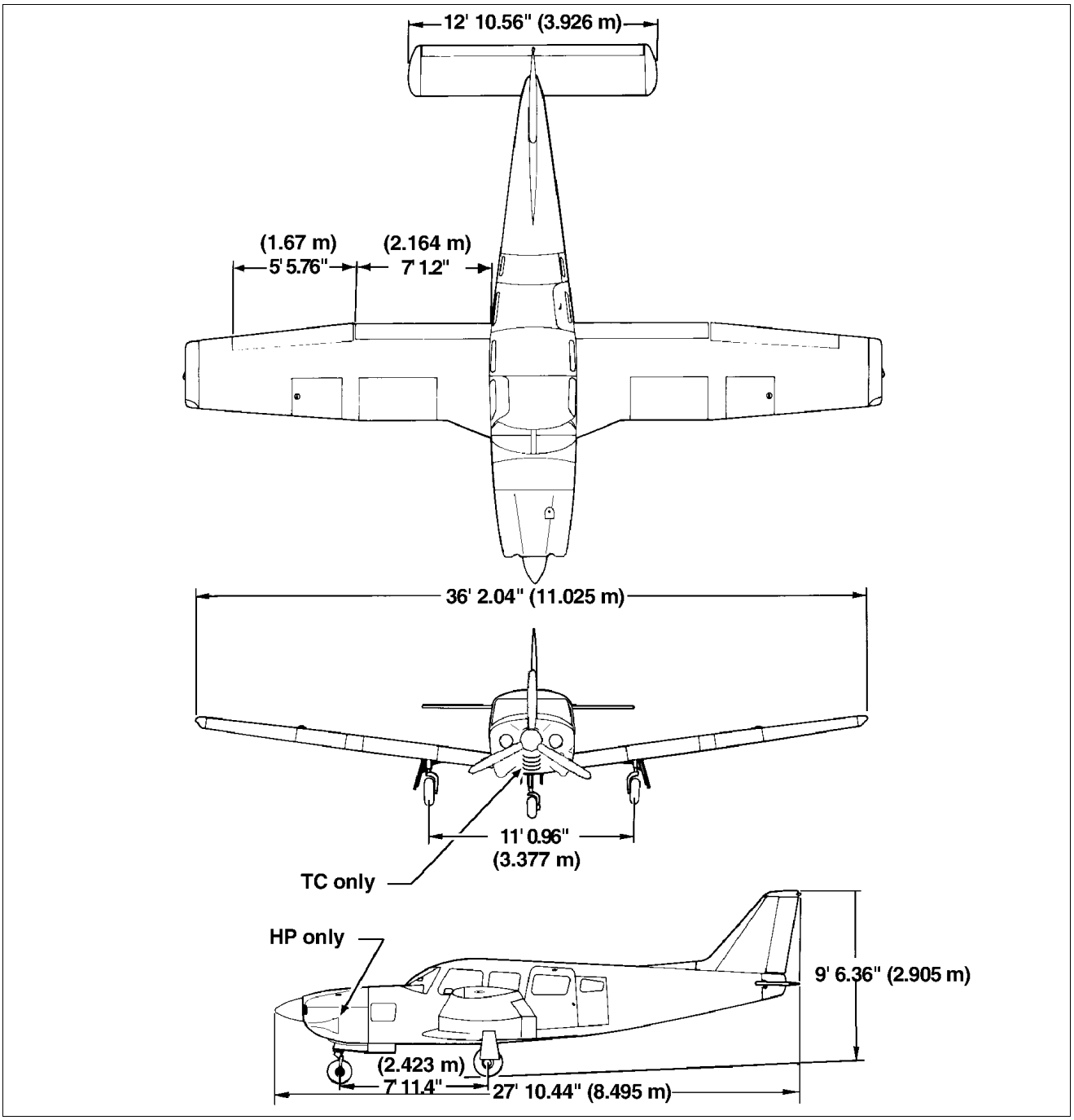


Figure 6-1. Three View

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL (SARATOGA II)	PA-32R-301 (HP)	PA-32R-301T (TC)
ENGINE		
Manufacturer	Textron Lycoming	
Model	IO-540-K1G5	TIO-540-AH1A
FAA Type Certificate	1E4	
Rated Horsepower	300 HP at Sea Level	300 HP to 12,000 ft.
Rated Speed	2700 RPM	2500 RPM
Oil Pressure (PSI):		
Minimum Idling	25	
Normal	55	
Starting and Warmup	115	
Maximum	95	
Oil Type and Grade	See Lubrication Chart	
Oil Sump Capacity	12 U.S quarts (9.25 quarts usable)	
Fuel, Aviation Grade (Minimum and Specified Octane)	100/100LL	
Magnetos:		
(L/H)	Slick 6351	Slick 6361
(R/H)	6350	6360
Magneto Timing	20 degrees BTC	
Magneto Point Clearance	.010 ± .002	
Spark Plugs / Spark Plug Gap Setting	Refer to latest revision of Textron Lycoming Service Instruction No. 1042.	
Firing Order	1-4-5-2-3-6	
Starter:		
Prestolite (12 volt)	MZ4206[1]	
Electrosystems (24 volt)	MHB4016[2]	
Skytech (28 volt)	149-24PM[3]	149-24PM
Alternator (90 amp):		
Electrosystems (14 volt)	P/N 690 019[1]	
Electrosystems (28 volt)	P/N 680 501	P/N 680 501
Voltage Regulator:		
Lamar (14 volt)	P/N 557 337[1]	
Lamar (28 volt)	P/N 584 290	P/N 584 290

Notes: (1) SNs 3246001 thru 3246017 only.
(2) SNs 3246017 thru 3246087 only.
(3) SNs 3246088 and up.

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS (cont)

MODEL (SARATOGA II)	PA-32R-301 (HP)	PA-32R-301T (TC)
PROPELLER	**THREE BLADE**	
Manufacturer	Hartzell	
Hub and Blade Model	HC-I3YR-1RF / F7663DR	
Diameter	78 in.	
Diameter, Minimum	77 in.	
Blade Angle:		
Low Pitch (High RPM)[1]	12.4° ± 0.2°	15.2° ± 0.2°
High Pitch (Low RPM)[1]	32°± 1°	34.0° ± 0.5°
Governor Control	Hartzell	
Governor Model	V-5-4	V-5-6
Note: (1) Measurement taken at 30 inch station.		
FUEL SYSTEM		
Fuel Tanks: (2 interconnected each wing / 4 total)		
Capacity:	53.5 U.S. Gallons / Wing	
Total Fuel Onboard	107 U.S. Gallons	
Total Usable Fuel	102 U.S. Gallons	
Electric Fuel Pump (14 volt)	Airborne 1B5-6[1]	
(28 volt)	Airborne 1B5-14	Weldon 461750
Note: (1) SNs 3246001 thru 3246017 only.		
LANDING GEAR		
Type	Hydraulically Retractable	
Shock Strut Type	Combination Air and Oil Oleo	
Fluid Required (Struts, Brakes & Hydraulics)	MIL-H-5606	
Wheel Tread	11.08 ft.	
Wheelbase	7.95 ft.	

(continued on next page)

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS (cont)

MODEL (SARATOGA II)	PA-32R-301 (HP)	PA-32R-301T (TC)
LANDING GEAR (cont.)		
Nose Wheel Travel	22.5° ± 2° Left and Right	
Turning Distance (Min.)	75 ft., 6 in.	
Turning Radius (Minimum): Nose Wheel Wing Tip	22 ft., 11 in.	
Wheel, Nose	5.00 x 5 Cleveland 40-77B or McCauley D-30500	
Wheel, Main	6.00 x 6 Cleveland 40-120C	
Brake Type	Cleveland 30-83	
Tire, Nose	Type III, 5:00 x 5, 6 ply (Michelin Air, B.F. Goodrich, or McCreary)	
Tire, Main,	Type III, 6:00 x 6, 8 ply (Michelin Air, B.F. Goodrich, or McCreary)	
Tire Pressure, Nose	35 psi	
Tire Pressure, Main	38 psi	
Nose Gear Strut Pressure	225 ± 22.5 psi	
Nose Gear Visible Piston Extension (Under Static Load)[1]	2.75 in. ± .25 in.	
Main Gear Strut Pressure	250 ± 25 psi	
Main Gear Visible Piston Extension (Under Static Load)[1]	4.00 in. ± 25 in.	
Note: (1) Static Load is the empty weight of the airplane plus full fuel and oil.		

B. 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 station, (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 which indicates station locations of structural members of the airplane. F.S. 0 is 78.4 inches ahead of the wing leading edge; B.L. 0 is the centerline of the airplane; and W.L. 0 is 20.5 inches below the cabin floor as measured at the rear wing spar with the airplane level. The reference datum line is located 78.4 inches ahead of the wing leading edge at the intersection of the straight and tapered section.

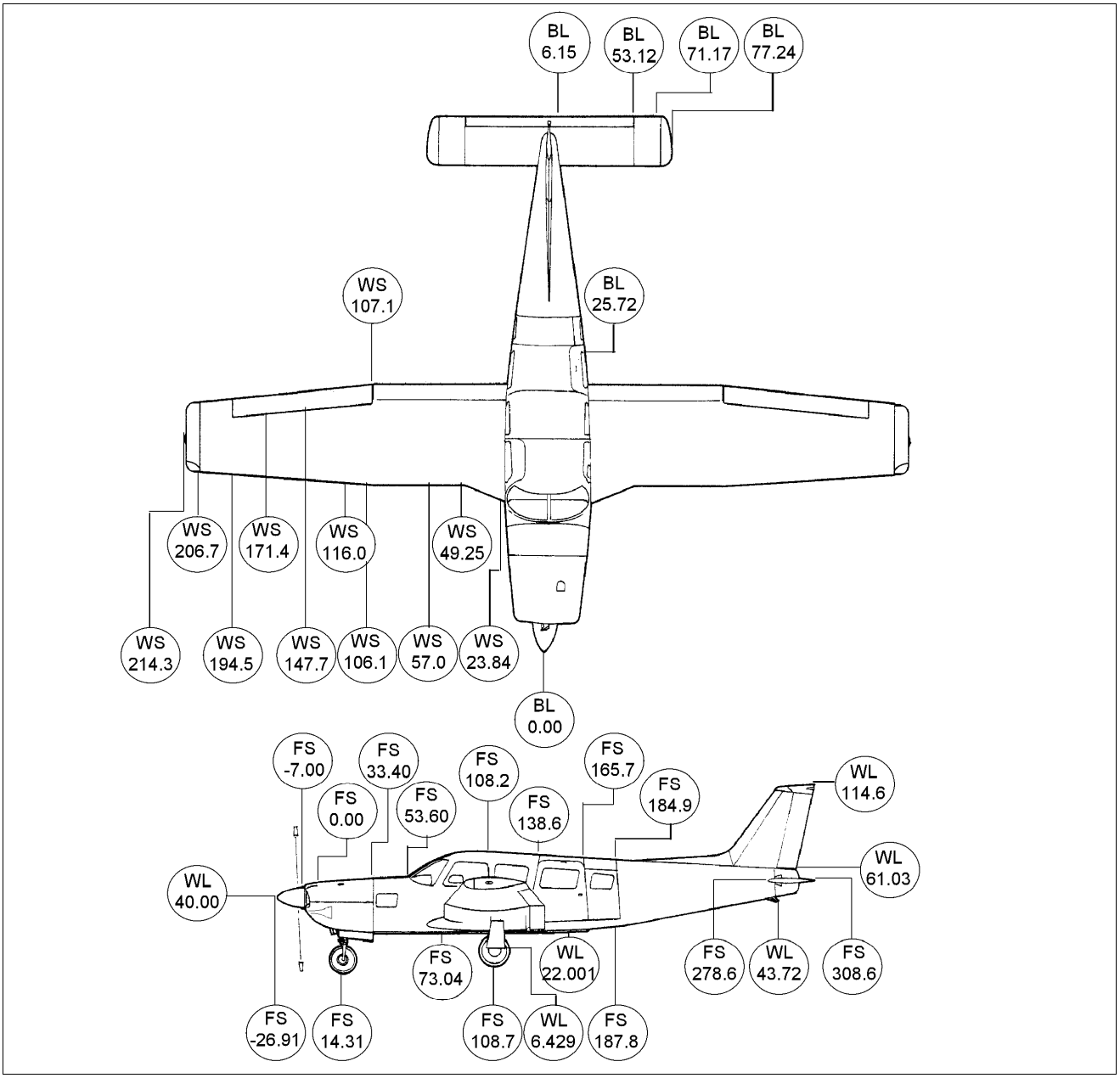


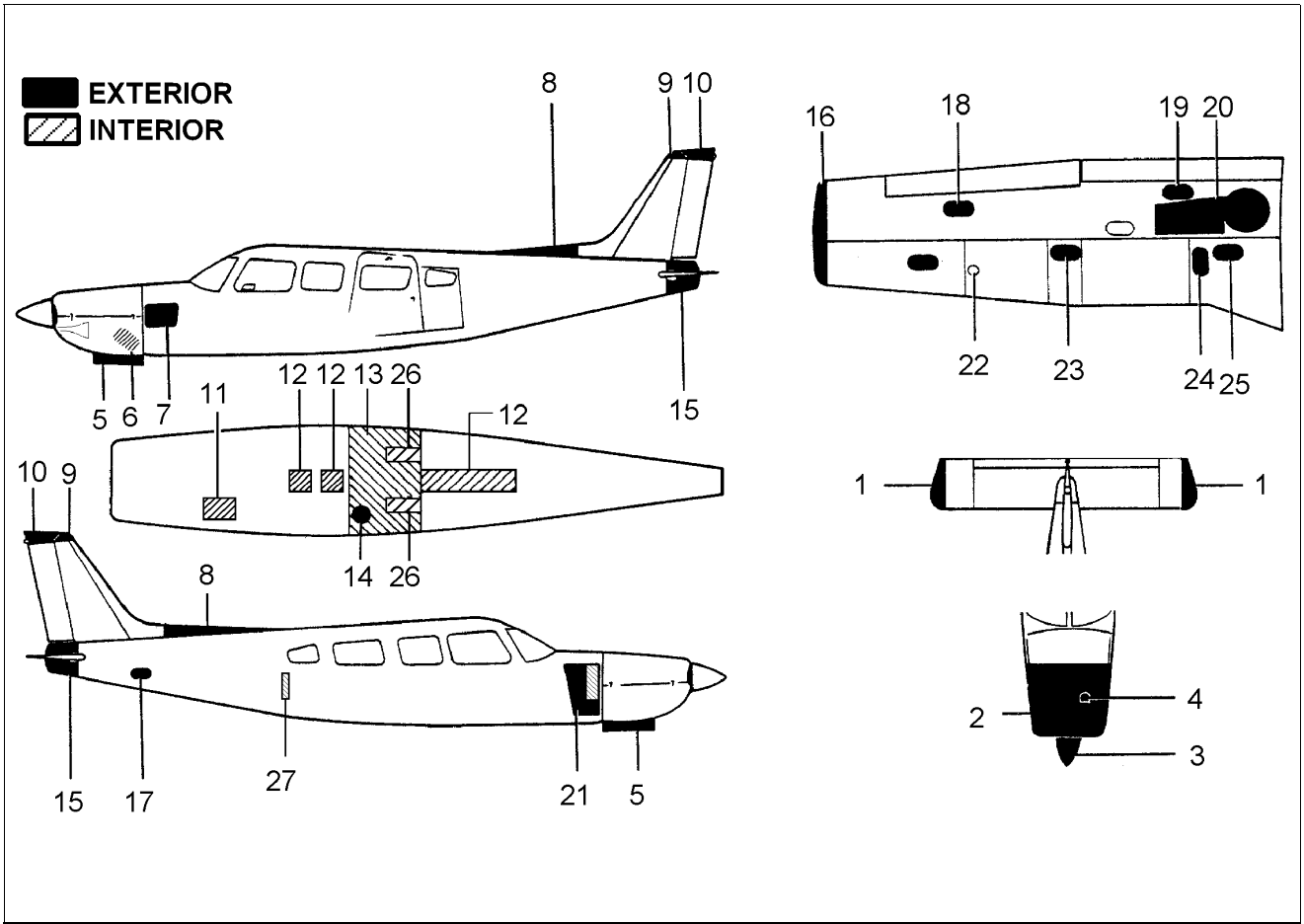
Figure 6-2. Station Reference Lines

C. Access And Inspection Provisions.

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

— CAUTION —

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



1. TIP, STABILATOR
2. COWL, ENGINE ACCESS
3. SPINNER, PROPELLER
4. DOOR, OIL FILLER
5. DOOR,NOSE GEAR
6. AIR FILTER (HP ONLY)
7. COVER, HYDRAULIC RESERVOIR & BATTERY[1] SERVICE
8. FAIRING, ACCESS
9. TIP, VERTICAL STABILIZER
10. TIP, RUDDER
11. PANEL, BATTERY[1] & HYDRAULIC
12. PLATES, TUNNEL ACCESS
13. PANEL, FLOOR
14. COVER, FUEL SELECTOR FILTER
15. TAIL CONE, CONTROL CABLES & TRIM SCREW
16. WING TIP & LANDING LIGHT COVER
17. COVER, E.L.T. ACCESS
18. COVER, AILERON BELLCRANK ACCESS
19. COVER, GEAR ATTACHMENT FITTING
20. DOOR, MAIN GEAR
21. DOOR, BAGGAGE
    (& COVER, MAGNETO ACCESS (TC ONLY))
22. CAP FUEL FITTING
23. COVER, FUEL FITTING
24. COVER, FUEL AND BRAKE FITTINGS
25. COVER, FUEL FITTINGS
26. REAR WING ATTACH. & CONTROL CABLE INSPECT. PNL
27. COVER, AFT FUSELAGE, OXYGEN[2] & BATTERY SERVICE

NOTE: (1) SN'S 3246001 THRU 3246087 ONLY
(2) IF INSTALLED

Figure 6-3. Access Plates and Panels

CHAPTER

7

LIFTING AND SHORING

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CHAPTER 7 - LIFTING AND SHORING

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JACKING.

A. General

Jacking the airplane is necessary to service the landing gear and other operations. The jacking operation can be performed by using tripod jacks; in other situations (i.e. - emergency, post-accident lifting, etc.), slings or air bags should be used.

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

B. Jacking

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

— CAUTION —

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

2. Attach a tail stand with approximately 300 pounds ballast to tail skid.

— CAUTION —

IF THE PURPOSE FOR PLACING THE AIRPLANE ON JACKS IS TO SERVICE THE HYDRAULIC SYSTEM, THE FREE-FALL VALVE KNOB SHOULD BE PULLED FULL OUT FROM THE INSTRUMENT PANEL.

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

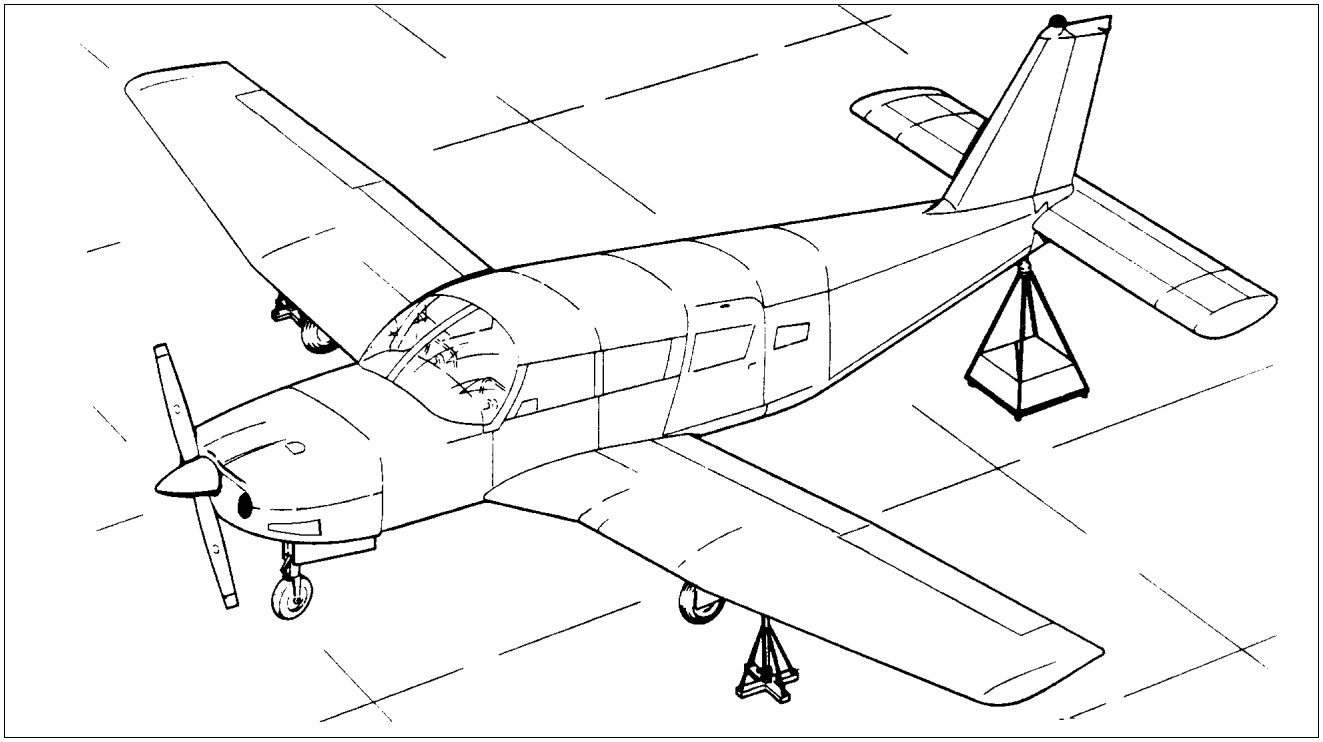

Figure 7-1. Jacking

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CHAPTER

8

LEVELING AND WEIGHING

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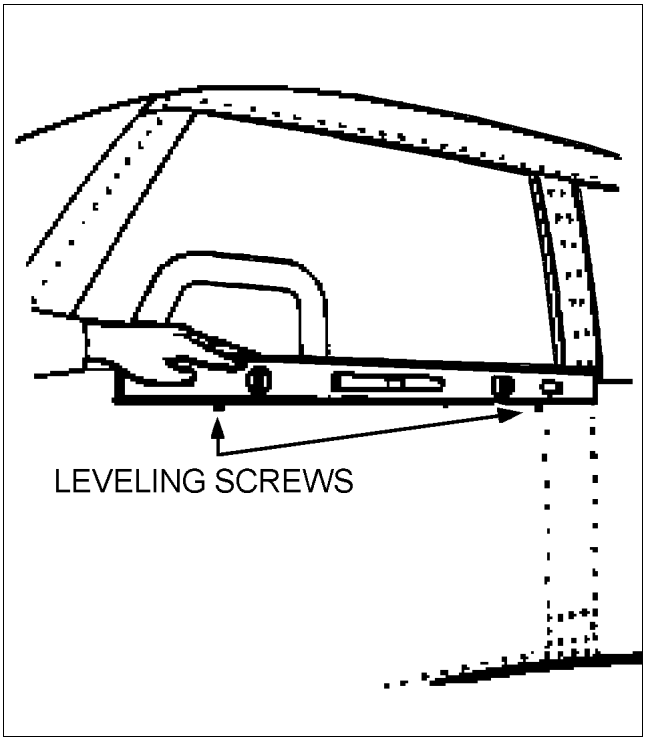
LEVELING.

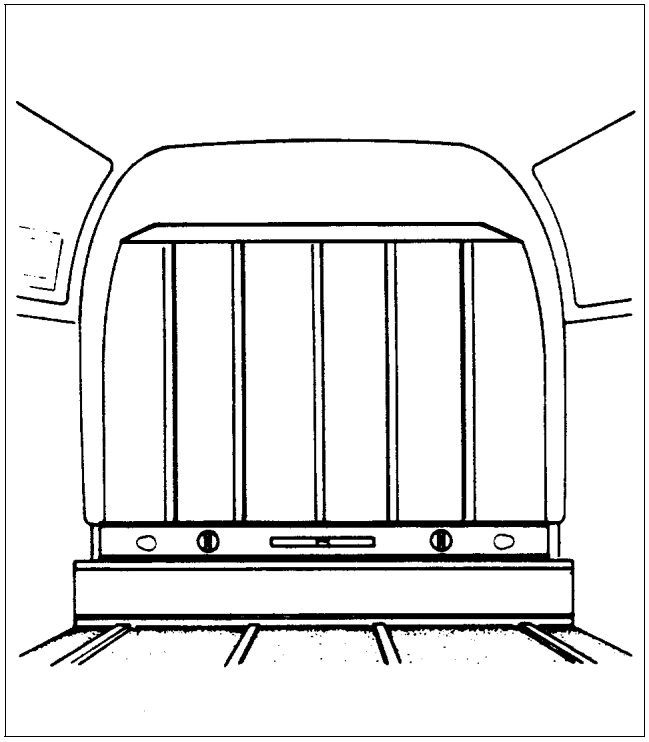
All configurations of the airplane are provided with a means for longitudinal and lateral leveling. The airplane may be leveled while on jacks, during the weighing procedure while the wheels are on scales, or while the wheels are on the ground. To level the airplane for purposes of weighing or rigging, the following procedures may be used:

(1) To longitudinally level the airplane, partially withdraw the two leveling screws located immediately below the left front side window. (Refer to Figure 8-1.) Place a spirit level on these screw heads and deflate the nose wheel tire or adjust the jacks until the bubble of the level is centered.

(2) To laterally level the airplane, place a spirit level across the baggage compartment floor along the rear bulkhead (refer to Figure 8-1) and deflate the tire on the high side of the airplane or adjust either jack until the bubble of the level is centered.



Longitudinally



Laterally

Figure 8-1. Leveling Airplane

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WEIGHING. (REFER TO FIGURE 8-2.)

The airplane may be weighed by the following procedure:

(1) Position a scale and ramp in front of each of the three wheels.

(2) Secure the scales from rolling forward and tow the airplane up onto the scales. (Refer to Towing, Chapter 9.)

(3) Remove the ramp so as not to interfere with the scales.

(4) If the airplane is to be weighed for weight and balance computations, level the airplane.

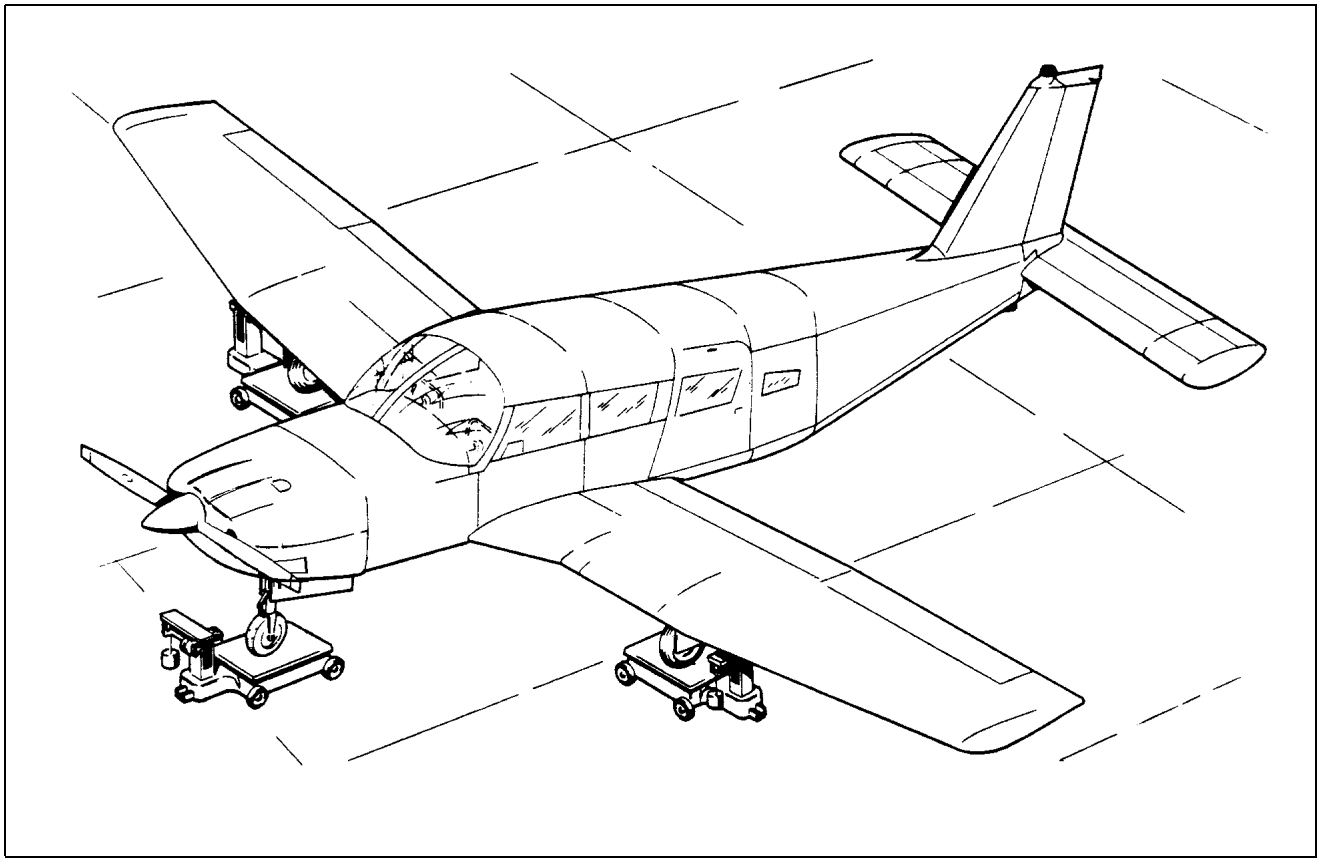

Figure 8-2. Weighing

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CHAPTER

9

TOWING AND TAXIING

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TOWING.

— CAUTION —

WHEN TOWING WITH POWER EQUIPMENT, TURNING THE NOSE GEAR IN EITHER DIRECTION BEYOND ITS STEERING RADIUS LIMITS WILL RESULT IN DAMAGE TO THE NOSE GEAR AND STEERING MECHANISM. PUSHING ON THE TRAILING EDGE OF THE AILERONS, WHEN MOVING THE AIRCRAFT FORWARD BY HAND, WILL CAUSE THE AILERON CONTOUR TO CHANGE RESULTING IN AN OUT-OF-TRIM CONDITION.

The airplane may be moved by using the nose wheel steering bar that is stowed below the forward ledge of the rear baggage compartment or 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:

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

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CHAPTER

10

PARKING AND MOORING

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PARKING.

A. 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.

1. To park the airplane, head it into the wind, if possible.
2. Set the parking brake by pulling back the brake lever and depressing the knob attached to the left side of the handle.
3. 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.

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

B. Locking Airplane.

The right front cabin door, left aft cabin door and the nose baggage compartment door are provided with a key lock on the outside. All doors and the locking gas cap (optional) 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.

(1) Head the airplane into the wind, if possible.

(2) Block the wheels.

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

— CAUTION —

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

(4) 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

REQUIRED PLACARDS

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CHAPTER 11 - REQUIRED PLACARDS

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EXTERIOR PLACARDS AND MARKINGS.

The airplane nameplate placard (See Figure 11-1, No. 16) is located on the left side of the fuselage near the stabilator leading edge at approximately F.S. 278.60. The placard 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 Piper Distributor Service Administrators (DSA's).

— 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.

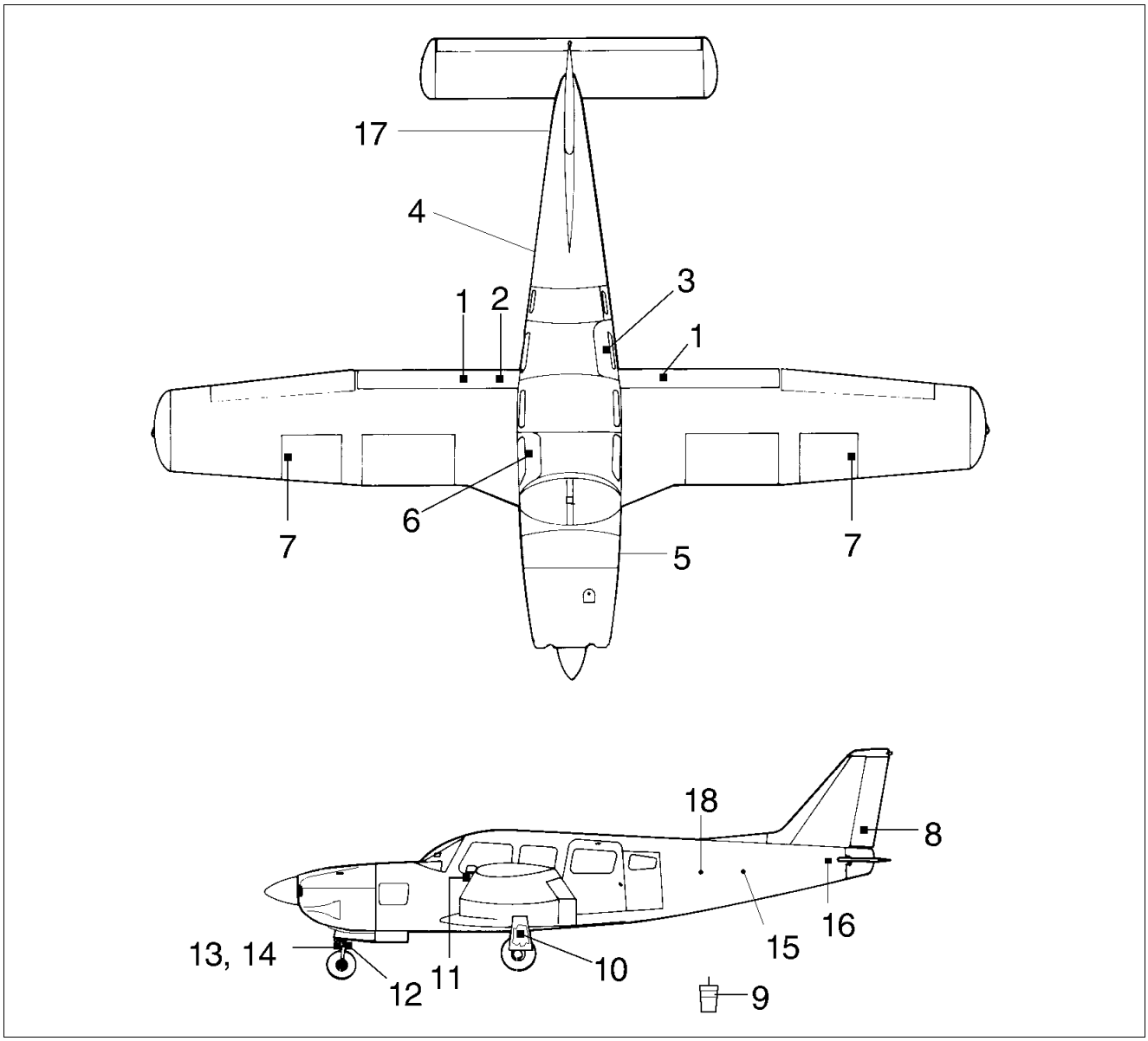

Figure 11-1. Exterior Placards and Markings

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1. PLACARD - NO STEP
2. PLACARD - WARNING - FLAP STEP UNSAFE
3. PLACARD - DOOR RELEASE
4. PLACARD - EXTERNAL POWER
   (HP S/N'S 3246088 & UP AND TC S/N'S 3257001 & UP)
5. PLACARD - EXTERNAL POWER (HP S/N'S 3246018 THRU 3246087 ONLY)
6. PLACARD - DOOR RELEASE (HP S/N'S 3246001 THRU 3246017 ONLY)
7. PLACARD - AVGAS ONLY
8. PLACARD - DO NOT PUSH
9. PLACARD - FUEL CHECK BOTTLE
10. PLACARD - OLEO SERVICE INSTRUCTIONS
11. PLACARD - LEVEL POINT
12. PLACARD - OLEO SERVICE INSTRUCTIONS
13. PLACARD - TURN LIMIT
14. PLACARD - TURN LIMIT CENTER MARK
15. PLACARD - STATIC VENT - KEEP CLEAN (EACH SIDE)
    (HP S/N'S 3246018 & UP AND TC S/N'S 3257001 & UP)
16. PLACARD - AIRPLANE NAMEPLATE
17. PLACARD - ELT BEHIND PANEL
    (MAY NOT BE INSTALLED ON EXPORT AIRPLANES)
18. PLACARD - OXY H.P. RELIEF (OPTIONAL IN TC)

Figure 11-1. Exterior Placards and Markings (cont)

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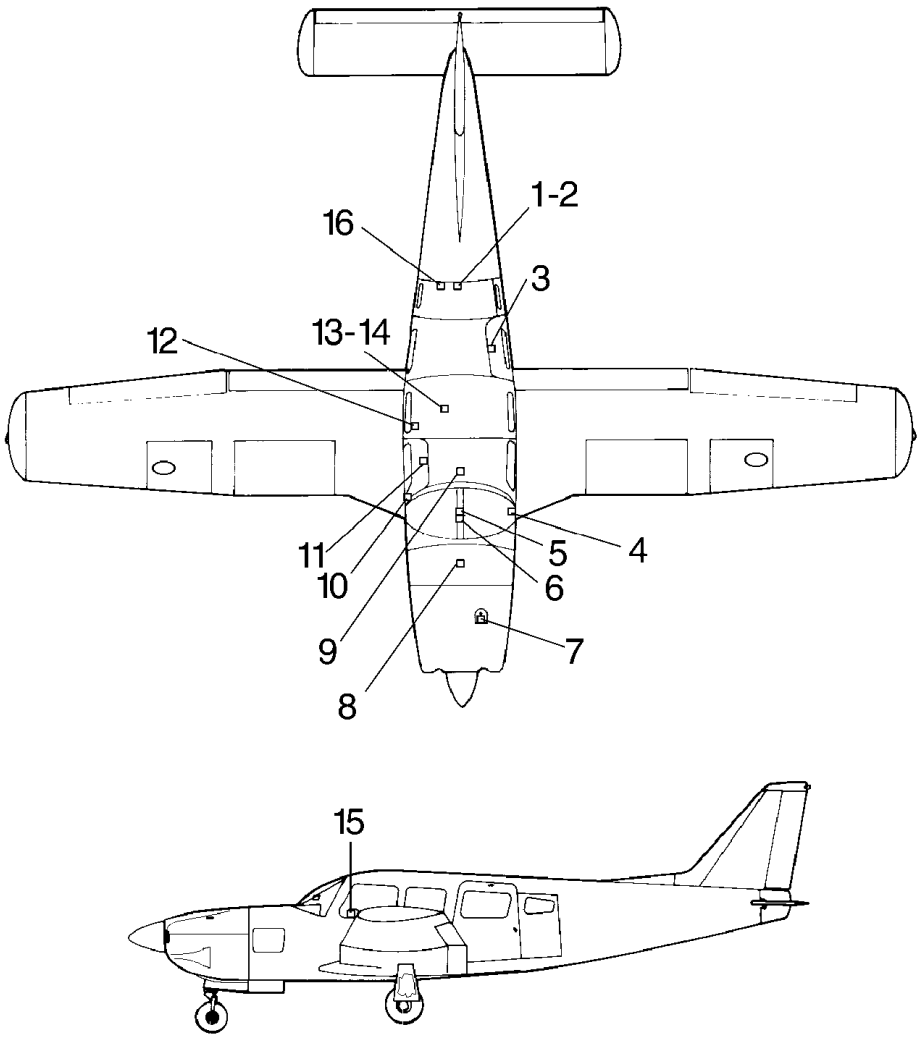
INTERIOR PLACARDS AND MARKINGS.



1. PLACARD - MAXIMUM BAGGAGE
2. PLACARD - SOFT WEAR ONLY
3. PLACARD - ENGAGE LATCH
4. PLACARD - AIRPLANE OPERATING CATEGORY
5. PLACARD - FUEL SELECTOR
6. PLACARD - NOSE L - R
7. PLACARD - OIL GRADE
8. PLACARD - MAXIMUM BAGGAGE
9. PLACARD - STABILATOR TRIM
10. PLACARD - OPEN
11. PLACARD - ENGAGE LATCH
12. PLACARD - FUEL SUMP DRAIN
13. PLACARD - STOW TABLE [1]
    PLACARD - CONSOLE STOWAGE [2]
14. PLACARD - TABLE - MAX. WGT. [1]
    PLACARDS - CONSOLE MAX. WGTS. AND AUX. POWER [2]
15. PLACARD - STORM WINDOW
16. PLACARD - MAX. REAR SEAT LOAD [2]

Notes: (1) HP S/N's 3246001 thru 3246087 and Optional on HP S/N's 3246088 & up.
(2) TC S/N's 3257001 & up and Standard on HP S/N's 3246088 & up.

Figure 11-2. Interior Placards and Markings

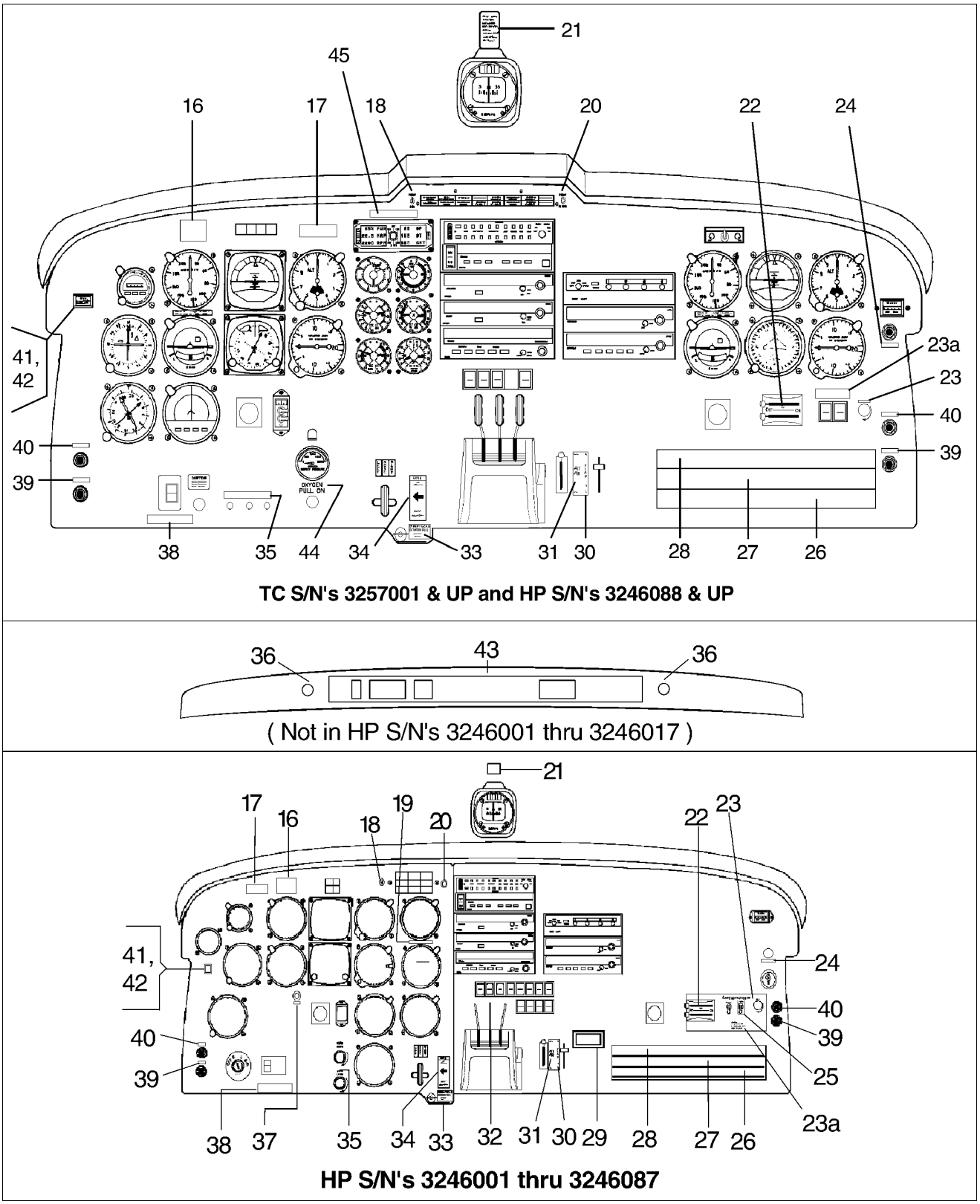


Figure 11-2. Interior Placards and Markings (cont)

16. PLACARD - DEMONSTRATED X-WIND
17 PLATE - (N .....)
18. PLACARD - DAY-NIGHT
19. PLACARD - DO NOT EXCEED - MANIFOLD PRESSURE [1]
20. PLACARD - PRESS TO TEST
21. PLACARD - COMPASS DEVIATION
22. PLACARD - HEAT-DEF - ON OFF
23. PLACARD - CLIMATE CONTROL CENTER (OPTIONAL) [3]
    COOLER (OPTIONAL) [4]
23a. PLACARD - AIR CONDITIONER TAKEOFF WARNING (OPTIONAL) [4 & 5]
24. PLACARD - KLN 90 DATA LOADER [1]
    GPS DATA LOADER [2]
25. PLACARD - FAN - HI LOW OFF [3]
26. PLACARD - CIRCUIT BREAKER PANEL
27. PLACARD - CIRCUIT BREAKER PANEL
28. PLACARD - CIRCUIT BREAKER PANEL
29. PLACARD - ALTERNATOR AMPS [1]
30. PLACARD - FLAPS
31. PLACARD - ALT AIR - OPEN CLOSE
32. PLACARD - CONTROL QUADRANT [3]
33. PLACARD - EMERGENCY GEAR EXTENSION
34. PLACARD - GEAR UP - DOWN SPEEDS
35. PLACARD - SWITCH LIGHTS - PANEL LIGHTS [3]
    DIMMING (SWITCH, PANEL, AVIONICS) [4]
36. PLACARD - DOME LIGHT [4]
37. PLACARD - GPS [3]
38. PLACARD - ALTERNATE STATIC SOURCE
39. PLACARD - MIKE
40. PLACARD - PHONE
41. PLACARD - CAUTION - BEFORE USING AUX PUMP
42. PLACARD - AUX VAC
43. PLACARD - NO SMOKING [2]
44. PLACARD - OXYGEN - PULL ON (OPTIONAL)
45. PLACARD - PROPELLER LIMITATION (MANIFOLD PRESSURE)
    (TC S/N'S 3257001 & UP ONLY)

Notes: (1) HP S/N's 3246001 thru 3246087 only.
(2) TC S/N's 3257001 & up and HP S/N's 3246088 & up.
(3) HP S/N's 3246001 thru 3246017 only.
(4) HP S/N's 3246018 & up and TC S/N's 3257001 & up.
(5) Included in "Climate Control Center" on HP S/N's 3246001 thru 3246017 only.

Figure 11-2. Interior Placards and Markings (cont)

MEYERCORD DECALS

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 of 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) Brush or wipe a fluid coat of Mark-It C-175 solution (P/N 179-496) on surface to receive decal.
(2) Mix a solution consisting of 2 parts water and 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 rubber squeegee, squeegee out from center to edges to remove excess solution.
(6) Wait approximately 1 to 1 1/2 minutes, then remove backing paper.
(7) Using a damp sponge, remove excess solution from face of decal and surrounding area.

CHAPTER

12

SERVICING

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CHAPTER 12 - SERVICING

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CHAPTER 12 - SERVICING

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GENERAL

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

1. Aircraft Finish Care

A. Polyurethane Enamel - HP S/N's 3246001 thru 3246125 and TC S/N's 3257001 thru 3257075

— 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.

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.

B. Dupont Imron 6000 Paint System - HP S/N's 3246126 & up and TC S/N's 3257076 & up

— 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 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.)

GENERAL (cont)

(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.

2. Cleaning

A. Engine Compartment

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

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

— CAUTION —

DO NOT SPRAY SOLVENT INTO THE ALTERNATOR, STARTER, VACUUM PUMP, AIR INTAKE AND ALTERNATE AIR INLETS.

(2) With the engine 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 (see section 12-20-00).

GENERAL (cont)

B. Landing Gear

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

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

(2) Spray or brush the bear area with solvent or a mixture of solvent and degreaser.

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

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

(5) Lubricate gear per Lubrication Chart (see section 12-20-00).

C. Windshield and Windows.

— WARNING—

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

— CAUTION —

USE ONLY MILD SOAP AND WATER WHEN CLEANING THE HEATED WINDSHIELD PANEL. USE OF ANY OTHER CLEANING AGENT OR MATERIAL MAY CAUSE DISTORTION OR DAMAGE TO HEATED PANEL COATINGS

(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. (Refer to Chapter 91, Chart 9105, List of Consumable Materials for Specifications and Manufacturer's address.)

GENERAL (cont)

D. Headliner, Side Panels and Seats.

(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.

E. 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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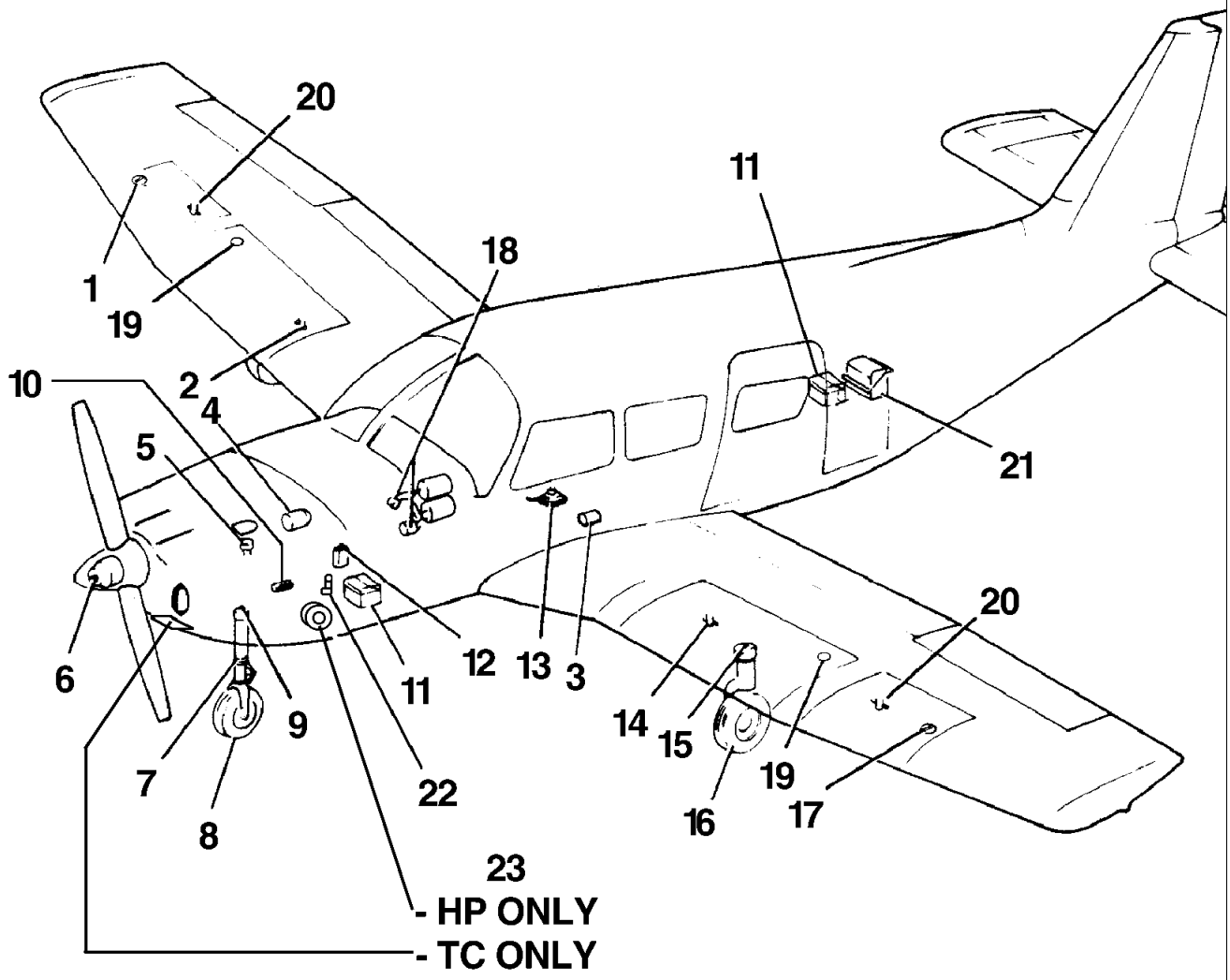
REPLENISHING



1. RIGHT MAIN FUEL TANK FILLER
2. RIGHT MAIN FUEL TANK DRAIN
3. ELECTRIC FUEL PUMP FILTER
4. ENGINE OIL FILTER CARTRIDGE
5. ENGINE OIL FILLER / INDICATOR
6. PROPELLER
7. NOSE GEAR LINK ASSEMBLY
8. NOSE GEAR TIRE
9. NOSE STRUT OLEO SHOCK FILLER
10. ENGINE OIL SUCTION SCREEN
11. BATTERY:
    HP (S/N's 3246001 - 3246087) IN NOSE
    HP (S/N's 3246088 & UP) IN TAIL
    TC (S/N's 3257001 & UP) IN TAIL
12. BRAKE SYSTEM RESERVOIR
13. FUEL SELECTOR VALVE FILTER AND DRAIN
14. LEFT MAIN FUEL TANK DRAIN
15. MAIN GEAR OLEO SHOCK STRUT FILLER
16. MAIN TIRE
17. LEFT MAIN FUEL TANK FILLER
18. VACUUM REGULATOR AND CENTRAL AIR FILTER
19. SIGHT GAUGE
20. OUTBOARD FUEL TANK DRAIN
21. CENTRAL AIR FILTER (AIR CONDITIONER)
22. HYDRAULIC PUMP / RESERVOIR
23. INDUCTION AIR FILTER

Figure 12-1. Service Points

REPLENISHING (cont)

A. FUEL SYSTEM

At intervals of 50 hours or 90 days, whichever comes first, clean the fuel screens or filters. The filters in the bowl of the fuel selector valve (refer to Figure 12-2) and the screen of the electric fuel pump are located under the floorboard aft of the main spar. Also clean the screen located in the inlet side of the injector.

(1) To flush the fuel tanks and selector valve, 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.

B. FILLING FUEL SYSTEM

The fuel tanks of each wing are filled through filler necks located on the forward slope of the wings. Each wing tank holds a capacity of 55.5 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.

C. DRAINING MOISTURE FROM FUEL SYSTEM

The fuel system should be drained daily prior to first flight and after refueling to avoid the accumulation of water sediment. Each fuel tank is equipped with an individual quick drain located at the lower inboard rear corner of the tank. The fuel selector valve is provided with a quick drain valve located on the forward face of the spar box. Drain fuel tanks and selector valve per the following:

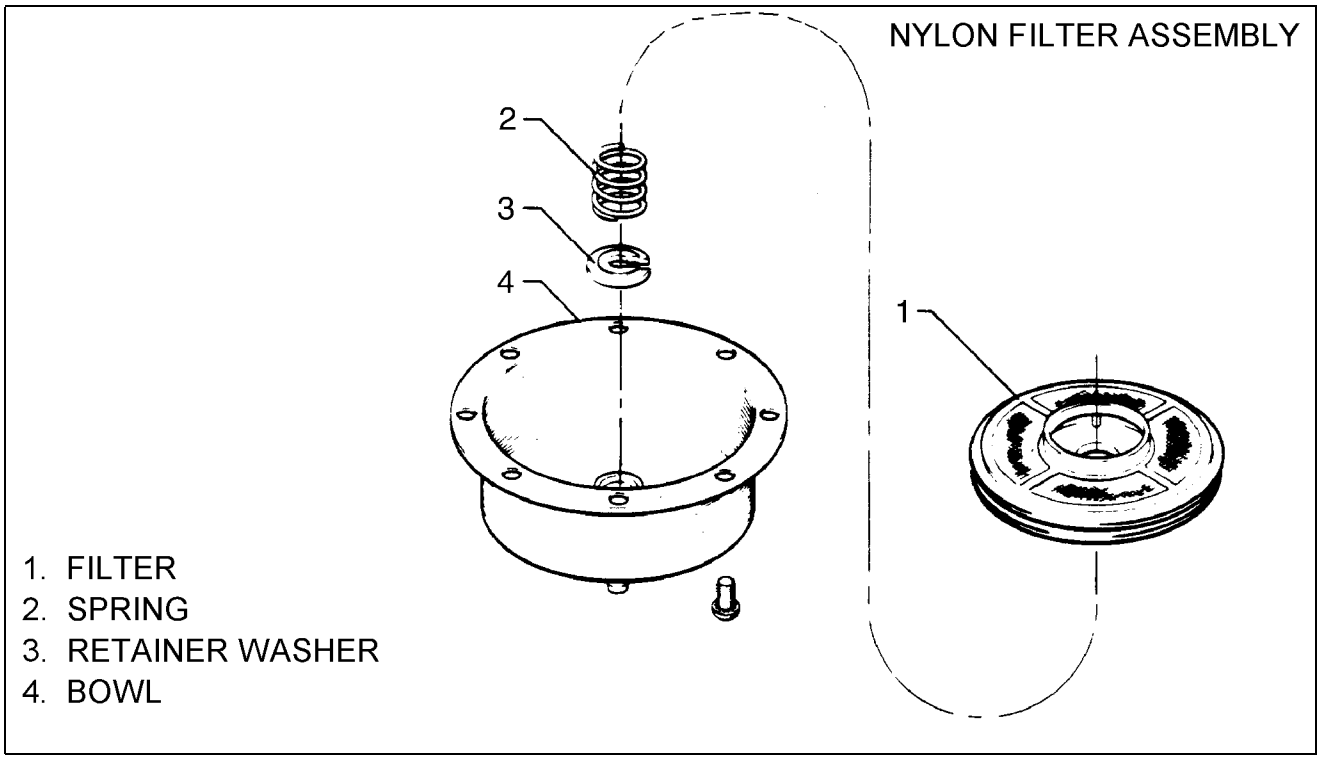


Figure 12-2. Fuel Filter Bowl and Screen

REPLENISHING (cont)

C. DRAINING MOISTURE FROM FUEL SYSTEM (cont)

(1) Drain each tank through its individual quick drain located at the lower inboard rear corner of the tank, making sure that enough fuel has been drained to insure that all water and sediment is removed.

— CAUTION —

AFTER EACH USE OF THE QUICK DRAIN VALVE, CHECK THE FUEL SELECTOR VALVE DRAIN TO ENSURE THAT THE QUICK DRAIN VALVE HAS PROPERLY SEATED AND THAT THERE IS NO LOSS OF FUEL FROM THE DRAIN.

(2) Place a container under the fuel selector valve drain. Depress the quick drain handle and allow a sufficient amount of fuel to drain from the selector valve.

(3) Examine the contents of the container placed under the fuel selector valve drain for water and sediment and dispose of the contents.

— CAUTION —

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

D. DRAINING FUEL SYSTEM

Fuel may be drained from the system by opening the valve at the inboard end of each fuel tank. The flush type drain valve requires the drain cup pin to hold the valve open. The remaining fuel in the system may be drained through the filter bowl. Any individual tank may be drained by closing the selector valve and then draining as desired.

E. OIL SYSTEM

— CAUTION —

DO NOT INTRODUCE ANY TRADE ADDITIVE TO THE BASIC LUBRICANT UNLESS RECOMMENDED BY THE ENGINE MANUFACTURER.

Engine oil level should be checked before each flight. The engine oil and full flow cartridge filter should be changed every 50 hours or four months, whichever occurs first. If a screen type filter is used, the screen filter and oil should be changed every 25 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.

F. DRAINING OIL SUMP

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

REPLENISHING (cont)

G. FILLING OIL SUMP

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 Chapter 6, Chart 601 - Leading Particulars and Principal Dimensions. The specified grade of oil may be found in Figure 12-9 - Lubrication Chart - Power Plant and Propeller; on the inside surface of the engine oil filler access door; 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 with dipstick.

H. 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.

I. 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.

(1) 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.
(2) When changing from straight mineral oil to compounded oil, the following precautionary steps should be taken:
    (a) Do not add additive oil to straight mineral oil. Drain the straight mineral oil from the engine and fill with additive oil.
    (b) Do not operate the engine longer than five hours before the first oil change.
    (c) Check all oil screens for evidence of sludge or plugging and change oil every ten hours if sludge conditions are evident. Resume normal oil drain periods after sludge conditions improve.

REPLENISHING (cont)

J. 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 18 to 20 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.

K. LANDING GEAR

The landing gear consists of tires, brakes and oleo strut assemblies. These should be inspected for proper gear extension, 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.

L. SERVICING OLEO STRUTS.

— 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 3.25 ± .25 inches of piston tube exposed, while the main gear struts require approximately 4.00 ± .25 inches of tube exposure.

— 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.

REPLENISHING (cont)

L. SERVICING OLEO STRUTS. (cont.)

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. 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 for the nose gear or Filling Main Gear Oleo Strut for the main gear. For repair procedures of the landing gear and/or oleo struts, refer to Chapter 32.

M. 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 required 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 Chapter 7.)
(2) Place a pan under the gear to catch spillage.
(3) If not previously accomplished, remove the engine cowl and 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 1:
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.
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.
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 45 foot-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.

REPLENISHING (cont)

M. FILLING NOSE GEAR OLEO STRUT. (cont.)

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.
6 Apply an appropriate thread lubricant threads of filler plug and install filler plug in the top of strut housing. Torque plug to 45 foot-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.
(7) Check that fluid is not leaking from around strut piston at bottom of housing.

N. 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, remove a cap on top wing to gain access to top of strut housing. 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.
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 45 foot-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 45 foot-pounds.

REPLENISHING (cont)

N. FILLING MAIN GEAR OLEO STRUT (cont.).

(5) With airplane raised, retract and extend gear strut several times to ascertain that the strut actuates 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.

O. INFLATING OLEO STRUTS.

Make certain that oleo strut has sufficient fluid and that torque link is properly connected. Attach a strut pump to air valve and inflate oleo strut to proper visible piston extension, or a pressure of 250 ± 25 psi (for the main gear struts) and 225 ± 22.5 psi for the nose gear strut.

When using pressure method pistons must be fully extended by raising aircraft off ground. (Refer to Chapter 7, Lifting and Shoring.)

When using the extension method, 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.

P. 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 Chapter 32.

Q. FILLING BRAKE CYLINDER RESERVOIR.

The brake cylinder reservoir is located on the left side of the firewall in the engine 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 Chapter 32.

R. 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.

REPLENISHING (cont)

S. 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.

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.

Maintain tires at pressure specified in Chart 601, Chapter 6. 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.

T. HYDRAULIC SYSTEM.

— CAUTION —

IF THE AIRPLANE MUST BE PLACED ON JACKS TO SERVICE THE HYDRAULIC SYSTEM, THE EMERGENCY GEAR EXTENSION KNOB SHOULD BE PULLED FULL OUT FROM THE INSTRUMENT PANEL.

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 be checked for leaks, kinks, corrosion and attachment fittings for tightness and security. Repair and check procedures for the hydraulic pump, cylinders, and various components may be found in Chapter 29.

REPLENISHING (cont)

U. SERVICING HYDRAULIC PUMP / RESERVOIR.

The fluid level of the reservoir of the combination pump and reservoir should be checked every 50 hours. Access to the pump is through the panel at the left side of the forward baggage compartment. To check fluid level, remove the dipstick and ascertain the fluid level. Should fluid be low, add fluid, MIL-H-5606, through the dipstick hole until full. Reinstall the dipstick.

— Note —

After tightening the dipstick, back it off $1\ 1/2$ turns to ensure proper venting of the reservoir.

V. BATTERY

The battery is located in the aft fuselage, aft of the rear baggage compartment, except in HP S/N's 3246001 thru 3246087. In those airplanes, the battery is under the left floor of the forward baggage 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 be found on or around the battery, remove the battery and clean it and the surrounding area in accordance with the instructions in Chapter 24.

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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.

A. ENGINE AIR FILTER.

Check induction air filter each 50 hour maintenance inspection. Clean or replace if found to be dirty. Replace the filter after one year, ten cleanings or 500 flight hours, whichever comes first.

(1) Removing Engine Air Filter

(a) Remove lower engine cowling.
(b) HP only: Remove wing nuts securing air filter cover plate located on lower left aft engine section.
TC only: Remove screws securing air filter retainer located between the propeller and nose wheel.
(c) Remove air filter

(2) Cleaning Engine Air Filter

(a) HP only:
1) Tap gently to remove dirt particles. Do not blow out with compressed air
2) Flush excessively dirty filter with running water (***less*** than 40 psi) and soak it in a solution of Donaldson D-1400 compound and water. Do not use solvents or gasoline. Rinse until clear water comes through the filter.
3) Dry filter thoroughly before inspection. Mechanical dryers may be used provided the heated air is circulated and maintained ***below*** 180°F. Do not use a light bulb.
4) Inspect filter medium for holes or tears and insure frame provides a good air seal. Replace defective filters.

(b) TC only:
1) To clean filter, blow out with compressed air from gasket side; or,
2) Wash in warm water and mild detergent and dry.
3) Do not use oil.

(3) Installation of Engine Air Filter

After cleaning or replacing the filter, install the filter in the reverse order of removal.
(a) Position air filter on engine.
(b) Secure air filter using cover plate with wingnuts (HP) or retainer and screws (TC).
(c) Install lower engine cowling.

B. ALTERNATE AIR DOOR

The alternate door is located in the air induction box to provide a source of air to the engine should there be an air stoppage through the filter system. The following should be checked during inspection:

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

SCHEDULED SERVICING (cont)

C. SERVICING PROPELLER.

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 at 100 hour intervals in accordance with the Lubrication Chart.

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

D. SERVICING 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.

E. 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 Figure 12-3 for balancer details. Balance the tire as follows:

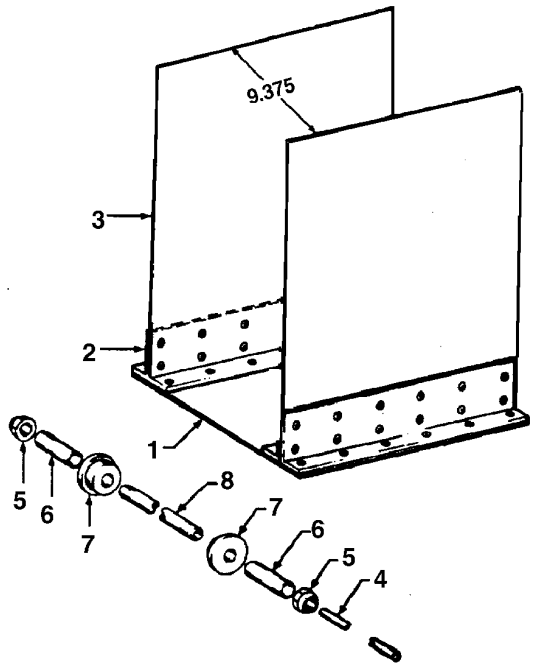
(1) Mount tire and tube (if one is used) on wheel, but do not install the securing bolts. Install wheel bearings in wheel; then, using the -7 bushings, -6 spacers, and -5 nuts, (refer to Figure 12-3) install the wheel-tire assembly on the pipe. Secure the nuts finger-tight so that the wheel halves touch 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 90Þ to the sides of the balancer.

(2) Release the tire. If it is out of balance it will rotate, coming to rest with the heaviest point on the bottom. Tape a 1/2 ounce patch across top center of the tire. Rotate the tire 45Þ and release it again. If the tire returns to the same position, add a 1 ounce patch and again rotate the tire and release it. Continue this procedure until the tire is balanced.

(3) When balance is attained, put a chalk mark on the sidewall directly below the patch. Use one mark for each half ounce of weight needed. Mark the valve stem location on the tire and the opposite wheel half to assure reassembly in the same position. Remove the wheel from the balance stand, break it down and clean the inside of the tire with toluol. Apply a coat of patch cement to both the patch and the inside center of the tire in line with the chalk marks. When the cement has dried, install the patches making certain they are on the center line of the tire and aligned with the chalk marks on the sidewall. Burnish the patches to remove trapped air, etc.

(4) When reassembling the wheel, powder the inside of the tire. Mount the tire on the valve side of the wheel in the same position it was in when it was balanced. Install the other wheel half, aligning the chalk marks. Install the bolts and tighten to required torque, then air the tire and recheck the balance. The wheel should not be more than 1/2 ounce out of balance.

SCHEDULED SERVICING (cont)



The following list of material were used in making the balancer:

-1	1 ea. Base	12 x 11	0.190 2024 T3 clad aluminum alloy
-2	2 ea. Tee	2.5 x 2 x 11	0.190 2024 T4 extruded aluminum alloy
-3	2 ea. Sides	14 x 11	0.125 2024 T3 clad aluminum alloy
-4	1 ea Axle	0.125 x 10.25	4130 steel, normalized
-5	2 ea. Nuts	AN 365-624	
-6	2 ea. Spacer	0.50 X 2.25	5052-0 aluminum tubing
	2 ea. Spacer	0.50 X 1.25	5052-0 aluminum tubing
-7	2 ea. Bushing	1.480 X 1.625 X 1.00	Richlight, phenolic or aluminum
	2 ea. Bushing	2.240 X 1.37 X 1.00	Richlight, phenolic or aluminum
-8	1 ea. Pipe	1/8 X 9.3	Black steel pipe
*	2 ea. Bearings	Save two of each sice worn wheel bearings from previous inspections	

Figure 12-3. Wheel Balancer

SCHEDULED SERVICING (cont)

F. Airframe 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. 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.

G. 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 effects propeller balance.

H. 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 SURFACE WINGS, FLAP TRACKS, ELEVATOR TRIM SCREW, AND ENGINE COMPARTMENT ARE STILL PROPERLY LUBRICATED

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

SCHEDULED SERVICING (cont)

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CHART 1201. THREAD LUBRICANTS

TYPE OF LINE	TYPE OF LUBRICANT
Brakes	MIL-H-5606
Air conditioning refrigerant	MIL -T-5544, Anti-Seize Compound
Fuel	MIL -T-5544, Anti-Seize, Graphite Patrolatum
Landing Gear Air Valve	6PB Parker
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)

— WARNING —

DO NOT PERMIT MIL-T-5544 ANTI-SIEZE COMPOUND TO ENTER SYSTEM. APPLY TO FITTING THREADS ONLY.

— CAUTION —

LUBRICATE ENGINE FITTINGS ONLY WITH THE FLUID CONTAINED IN THE PARTICULAR LINE.

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SCHEDULED SERVICING (cont.)

H. Lubrication Charts

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, Cautions, and Notes are listed at the beginning of the lubrication charts, with each applicable component illustration, and are consistent throughout.

SPECIAL INSTRUCTIONS
1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.
3. AIR FILTER (HP ONLY) - TO CLEAN FILTER, TAP GENTLY TO REMOVE DIRT PARTICLES OR WASH IN WARM WATER AND MILD DETERGENT AND DRY. DO NOT BLOW OUT WITH COMPRESSED AIR. DO NOT USE OIL. REPLACE FILTER IF DAMAGED.
3A. AIR FILTER (TC ONLY) - TO CLEAN FILTER, BLOW OUT WITH COMPRESSED AIR FROM GASKET SIDE OR WASH IN WARM WATER AND MILD DETERGENT AND DRY. DO NOT USE OIL.
4. WHEEL BEARINGS - DISASSEMBLE AND CLEAN WITH A DRY TYPE SOLVENT. ASCERTAIN THAT GREASE IS PACKED BETWEEN THE ROLLER AND CONE. DO NOT PACK GREASE IN WHEEL HOUSING. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
5. OLEO STRUTS, HYDRAULIC PUMP RESERVOIR, AND BRAKE RESERVOIR - FILL PER INSTRUCTIONS ON UNIT OR CONTAINER, OR REFER TO APPLICABLE CHAPTER IN THIS MANUAL.
6. DOOR SEALS - APPLY FLUOROCARBON RELEASE AGENT / DRY LUBRICANT TO DOOR SEALS AT LEAST ONCE A MONTH TO IMPROVE SEALING CHARACTERISTICS AND TO PREVENT THE SEAL FROM STICKING.
7. OIL AND FILTER - LYCOMING RECOMMENDS CHANGING THE OIL AND FILTER EVERY 50 HOURS OR FOUR MONTHS, WHICHEVER COMES FIRST.
8. PROPELLER - REMOVE ONE OF THE TWO GREASE FITTINGS FOR EACH BLADE. APPLY GREASE THROUGH FITTING UNTIL FRESH GREASE APPEARS AT HOLE OF REMOVED FITTING.
9. NOT USED.
10. FUEL SELECTOR VALVE - LUBRICATE AREA WHERE DETENT BALL MOVES ACROSS COVER PLATE (ON EXTERNAL VALVE ONLY).
— CAUTIONS —
1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVER LUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICATE TO RUBBER PARTS.
4. DO NOT LUBRICATE CABLES. LUBRICATING CABLES WILL CAUSE CABLE SLIPPAGE.
— Notes —
1. SEE THE LATEST REVISION OF LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF DETERGENT OIL.
2. REMOVE ALL EXCESS GREASE FROM GREASE FITTINGS.
3. BATTERY - FLUID LEVEL AND CONDITION CHECK EVERY 25 HOURS.

SCHEDULED SERVICING (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. MAIN GEAR PIVOT POINTS (See Spec. Instr. 1 and Note 2)	MIL-G-23827	100 HRS
2. MAIN GEAR DOOR HINGE (See Spec. Instr. 2)	MIL-L-7870	100 HRS
3. MAIN GEAR TORQUE LINKS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
4 EXPOSED MAIN OLEO STRUT (See Spec. Instr. 2)	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MIL-L-60326	100 HRS
5. MAIN GEAR WHEEL BEARINGS (See Spec. Instr. 4)	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE) MIL-G-3545C	100 HRS
6. MAIN GEAR DOOR CONTROL ROD ENDS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
7. MAIN GEAR SIDE BRACE LINK ASSEMBLY (See Spec. Instr. 1 and Note 2)	MIL-G-23827	100 HRS
8. UPPER SIDE BRACE SWIVEL FITTING (See Spec. Instr. 1 and Note 2)	MIL-G-23827	100 HRS
9. MAIN GEAR DOWNLOCK ASSEMBLY RETRACTION FITTING AND CYLINDER ATTACHMENT POINTS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
10. MAIN GEAR OLEO STRUT FILLER POINT (See Spec. Instr. 5 and Caution 1)	MIL-L-5606	AS REQUIRED
11. HYDRAULIC PUMP RESERVOIR (See Spec. Instr. 5 and Caution 1)	MIL-H-5606	AS REQUIRED
12. BRAKE RESERVOIR (See Spec. Instr. 5 and Caution 1)	MIL-H-5606	AS REQUIRED

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.
4. WHEEL BEARINGS - DISASSEMBLE AND CLEAN WITH A DRY TYPE SOLVENT. ASCERTAIN THAT GREASE IS PACKED BETWEEN THE ROLLER AND CONE. DO NOT PACK GREASE IN WHEEL HOUSING. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
5. OLEO STRUTS, HYDRAULIC PUMP RESERVOIR, AND BRAKE RESERVOIR - FILL PER INSTRUCTIONS ON UNIT OR CONTAINER, OR REFER TO APPLICABLE CHAPTER IN THIS MANUAL.

— CAUTIONS —

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.

— Notes —

2. REMOVE ALL EXCESS GREASE FROM GREASE FITTINGS.

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

SCHEDULED SERVICING (cont.)

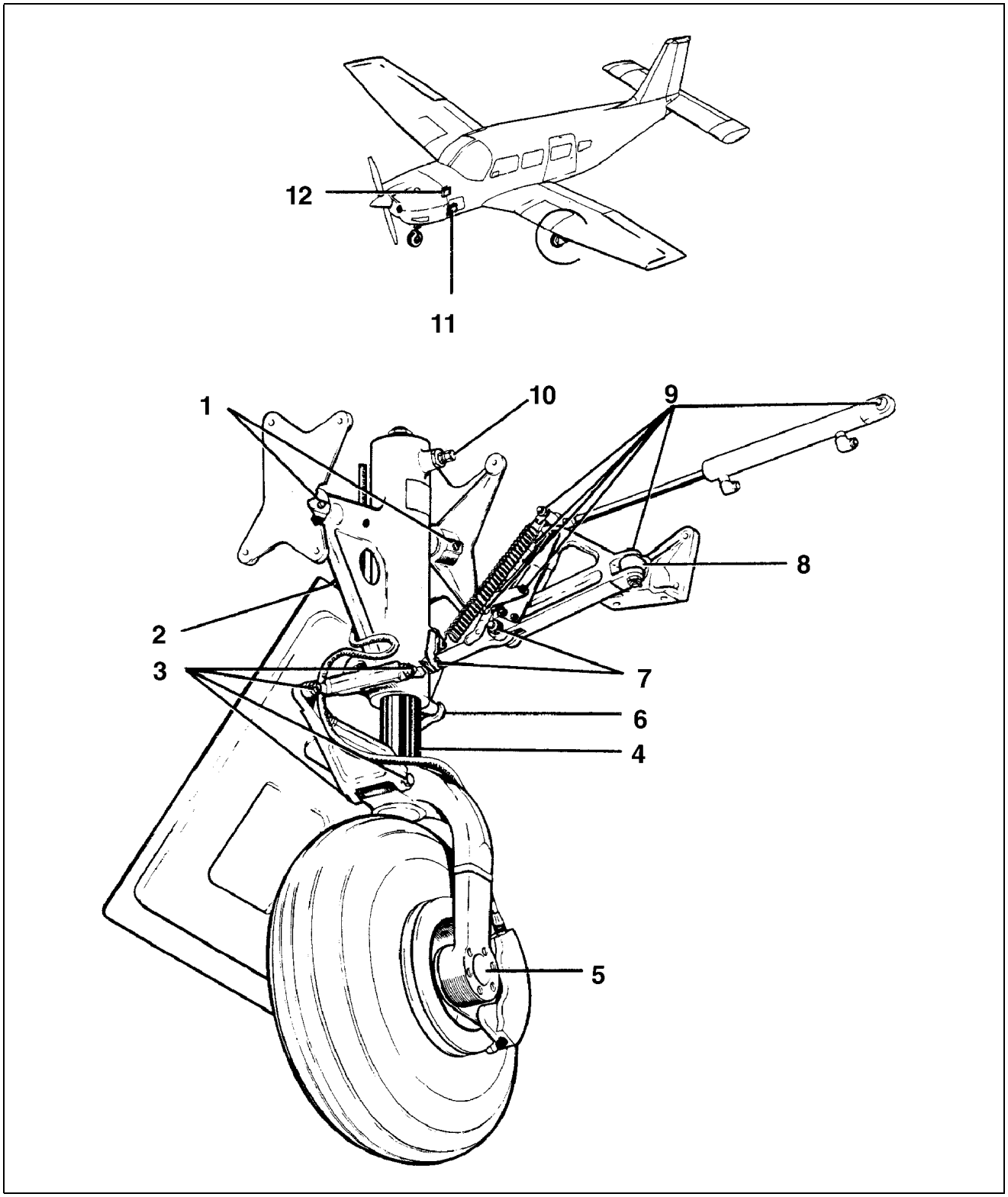

Figure 12-4. Lubricaiton Chart (Landing Gear, Main) (cont.)

SCHEDULED SERVICING (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. NOSE GEAR STRUT HOUSING GREASE FITTING (See Spec. Instr. 2 and Note 2)	MIL-G-23827	100 HRS
2. NOSE GEAR PIVOT POINT AND HYDRAULIC CYLINDER ROD END (See Spec. Instr. 2)	MIL-L-7870	100 HRS
3. NOSE GEAR DOOR RETRACTION MECHANISM (See Spec. Instr. 2)	MIL-L-7870	100 HRS
4 NOSE GEAR DOOR HINGES (See Spec. Instr. 2)	MIL-L-7870	100 HRS
5 EXPOSED OLEO STRUT (See Spec. Instr. 2)	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MIL-L-60326	100 HRS
6. NOSE WHEEL BEARINGS (See Spec. Instr. 4)	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE) MIL-G-3545C	100 HRS
7. NOSE GEAR DRAG LINK ASSEMBLIES (See Spec. Instr. 1)	MIL-L-7870	100 HRS
8. NOSE GEAR TORQUE LINK ASSEMBLY AND STRUT HOUSING (See Spec. Instr. 2 and Note 2)	MIL-G-23827	100 HRS
9. DOWNLOCK HOOK. TENSION SPRING ARMS. SHIMMY DAMPENER AND ALIGNING ROLLER PIVOT POINTS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
10. STEERING BELLCRANK PIVOT POINTS AND ROD ENDS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
11. NOSE GEAR OLEO STRUT FILLER POINT (See Spec. Instr. 5 and Caution 1)	MIL-H-5606	AS REQUIRED

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.
4. WHEEL BEARINGS - DISASSEMBLE AND CLEAN WITH A DRY TYPE SOLVENT. ASCERTAIN THAT GREASE IS PACKED BETWEEN THE ROLLER AND CONE. DO NOT PACK GREASE IN WHEEL HOUSING. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
5. OLEO STRUTS, HYDRAULIC PUMP RESERVOIR, AND BRAKE RESERVOIR - FILL PER INSTRUCTIONS ON UNIT OR CONTAINER, OR REFER TO APPLICABLE CHAPTER IN THIS MANUAL.

— CAUTIONS —

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.

— Notes —

2. REMOVE ALL EXCESS GREASE FROM GREASE FITTINGS.

Figure 12-5. Lubrication Chart (Landing Gear, Nose)

SCHEDULED SERVICING (cont.)

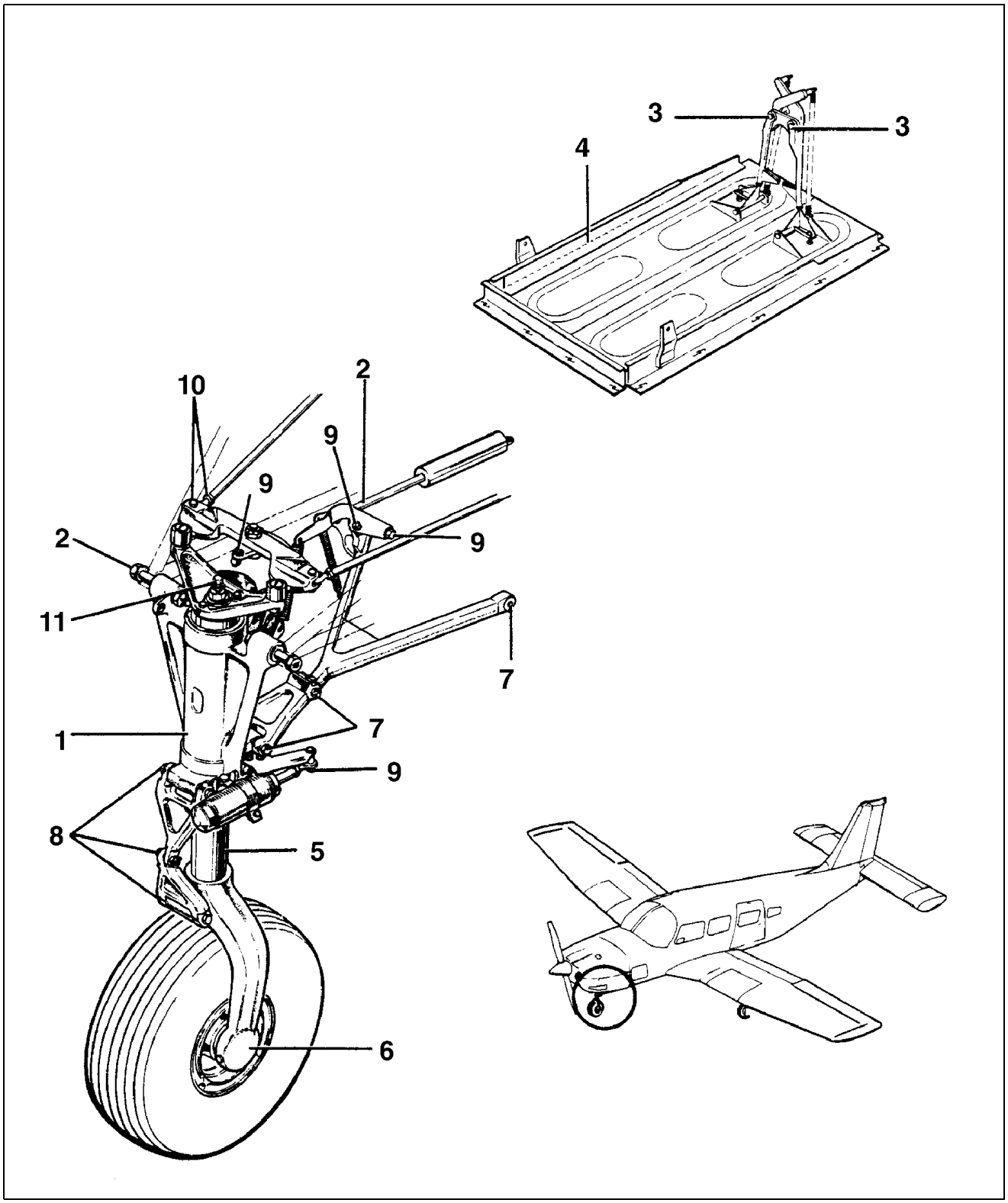

Figure 12-5. Lubrication Chart (Landing Gear, Nose) (cont.)

SCHEDULED SERVICING (cont.)

— CAUTION —

DO NOT LUBRICATE CONTROL WHEEL SHAFT OR BUSHING. CLEAN ONLY USING ALCOHOL OR OTHER SUITABLE SOLVENT.

COMPONENT	LUBRICANT	FREQUENCY
1. AILERON HINGE BEARINGS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
2. FLAP HINGE BEARINGS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
3. STABILATOR HINGE PINS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
4. RUDDER HINGE BEARINGS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
5. CONTROL CABLE PULLEYS (See Spec. Instr. 1 and Cautions 2 and 4)	MIL-L-787 0	100 HRS
6. STABILATOR TRIM CONTROL WHEEL (See Spec. Instr. 1 and Caution 2)	MIL-L-7870	100 HRS
7. O-RING, CONTROL SHAFT BUSHING (See Spec. Instr. 2 and Caution 2)	PARKER O-RING LUBRICANT (HP ONLY)	AS REQUIRED
7. O-RING, CONTROL SHAFT BUSHING (See Spec. Instr. 2 and Caution 2)	MIL-L-7870 (TC ONLY)	100 HRS
8. TEE BAR PIVOT POINT (See Spec. Instr. 1 and Caution 2)	MIL-L-7870	100 HRS
9. CONTROL COLUMN CHAIN (See Spec. Instr. 2 and Caution 2)	MIL-L-7870	500 HRS
10. CONTROL COLUMN FLEX JOINTS AND SPROCKET (See Spec. Instr. 2 and Caution 2)	MIL-L-7870	100 HRS
11. STABILATOR CONTROL (See Spec. Instr. 1 and Caution 2)	MIL-L-7870	100 HRS

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.

— CAUTIONS —

2. DO NOT OVER LUBRICATE COCKPIT CONTROLS.
4. DO NOT LUBRICATE CABLES. LUBRICATING CABLES WILL CAUSE CABLE SLIPPAGE.

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Figure 12-6. Lubrication Chart (Control System - Part 1)

SCHEDULED SERVICING (cont.)

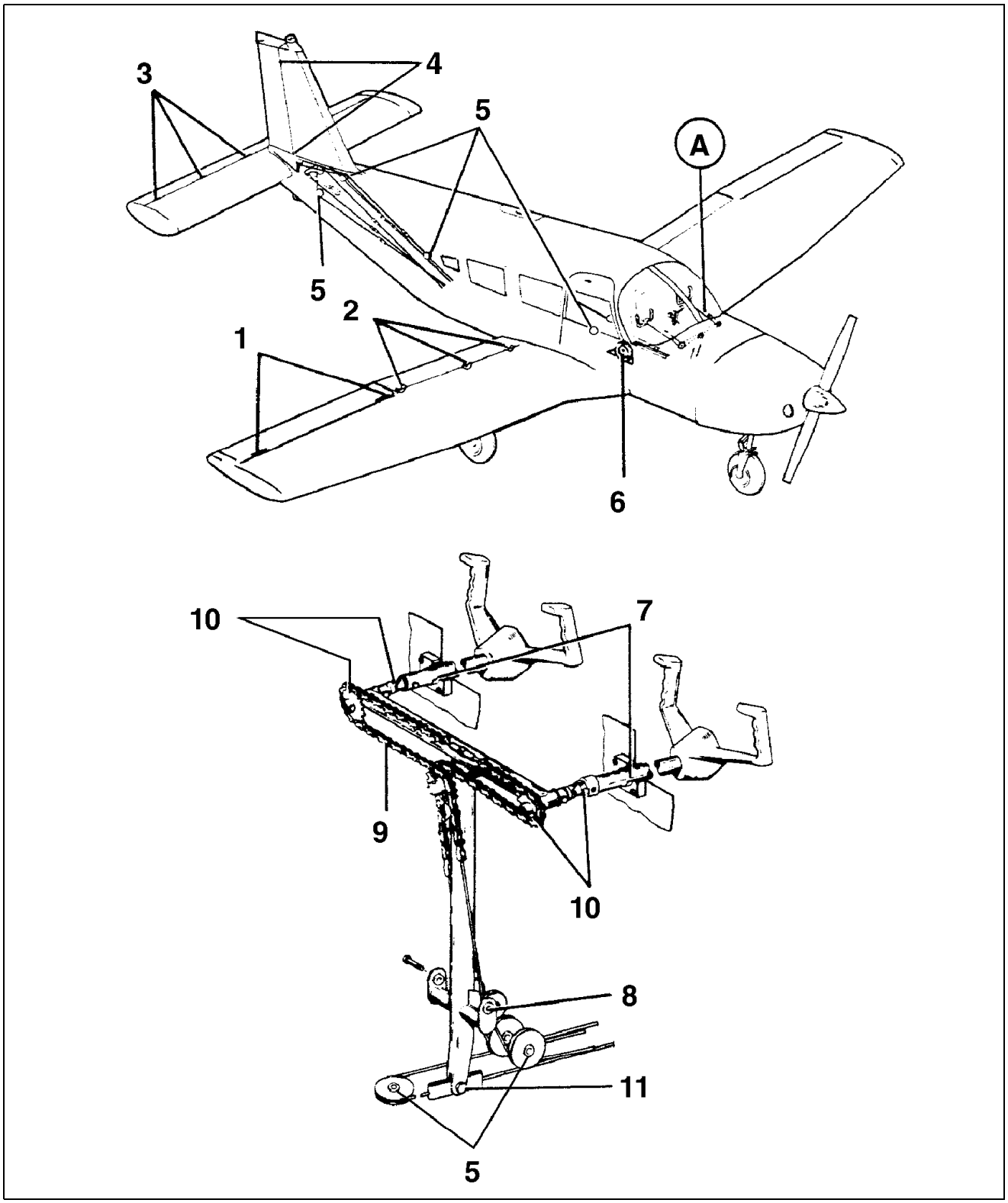


Figure 12-6. Lubrication Chart (Control System - Part 1) (cont.)

SCHEDULED SERVICING (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. FLAP TORQUE TUBE BEARING BLOCKS (See Spec. Instr. 2)	MIL-L-7870	100 HRS
2. FLAP CONTROL ROD END BEARINGS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
3. FLAP ACTUATOR SCREW JACK (See Spec. Instr. 2)	LUBRIPLATE #907, FISKE BROS. REFINING CO., OR, MIL-G-7711	100 HRS
4. FLAP ACTUATOR BELLCRANK (See Spec. Instr. 1)	MIL-L-7870	100 HRS
5. FLAP TORQUE TUBE PULLEY (See Spec. Instr. 2)	MIL-L-7870	100 HRS
6. AILERON BELLCRANK PIVOT POINTS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
7. AILERON CONTROL ROD END BEARINGS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
8. AILERON BELLCRANK CABLE ENDS (See Spec. Instr. 1)	MIL-L-7870	100 HRS

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.

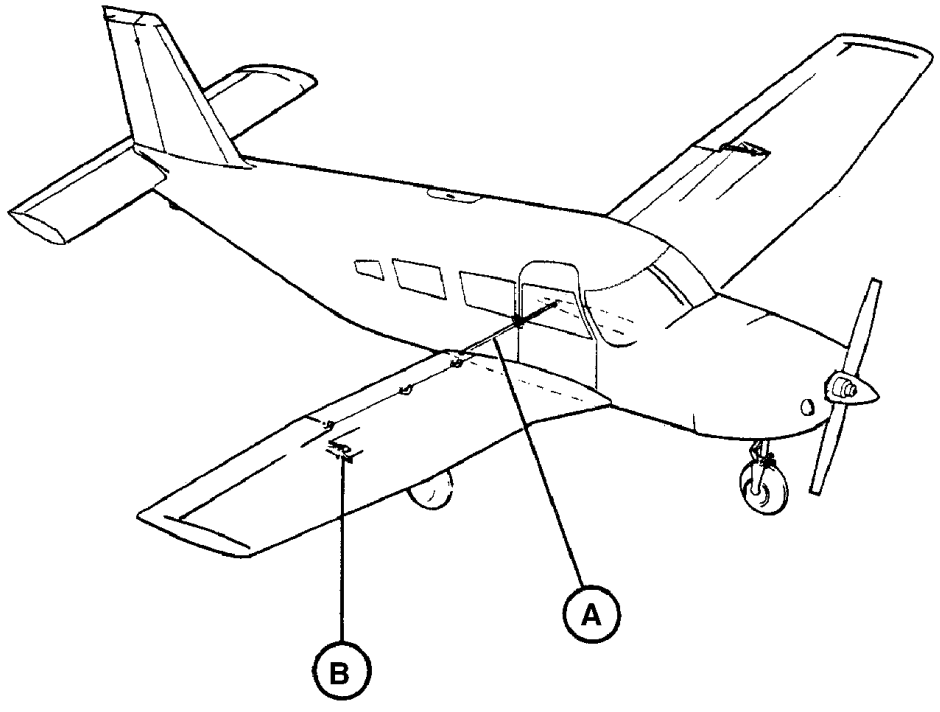
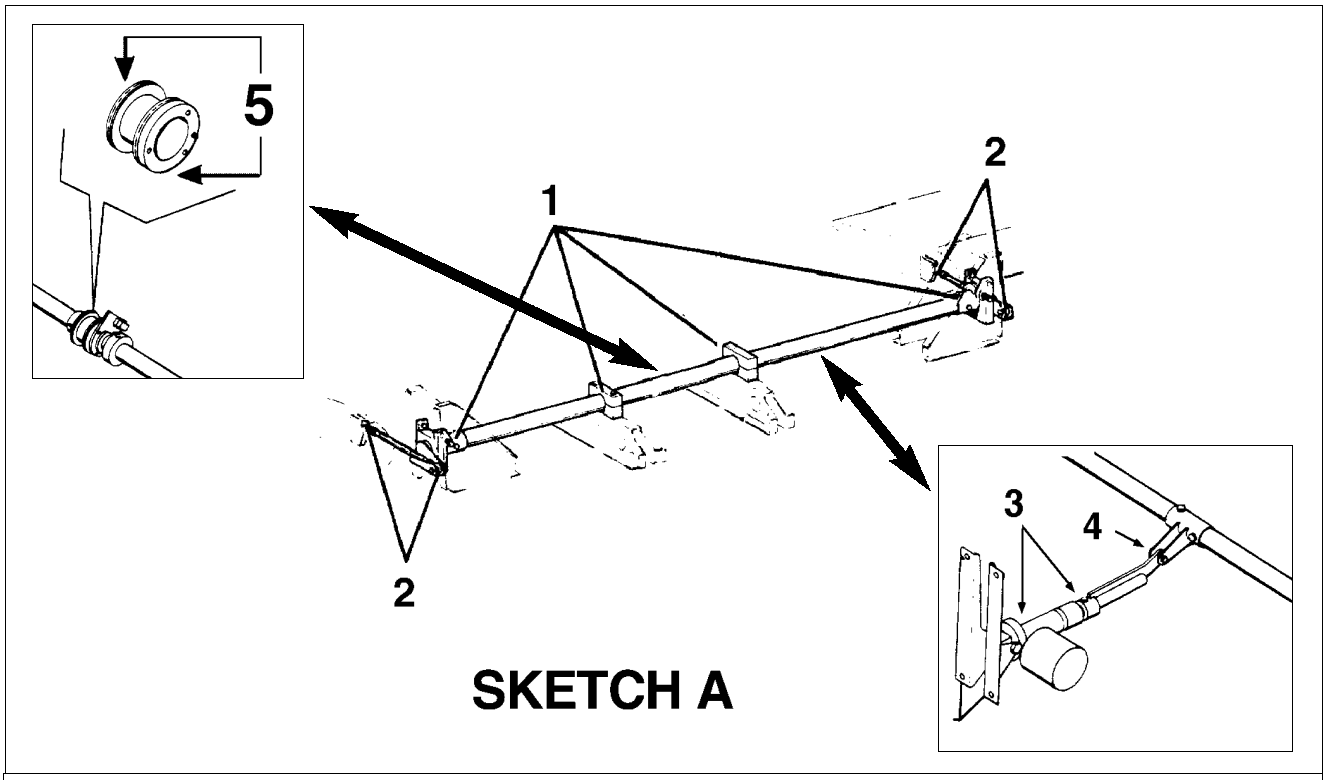


Figure 12-7. Lubrication Chart (Control System - Part 2)

SCHEDULED SERVICING (cont.)



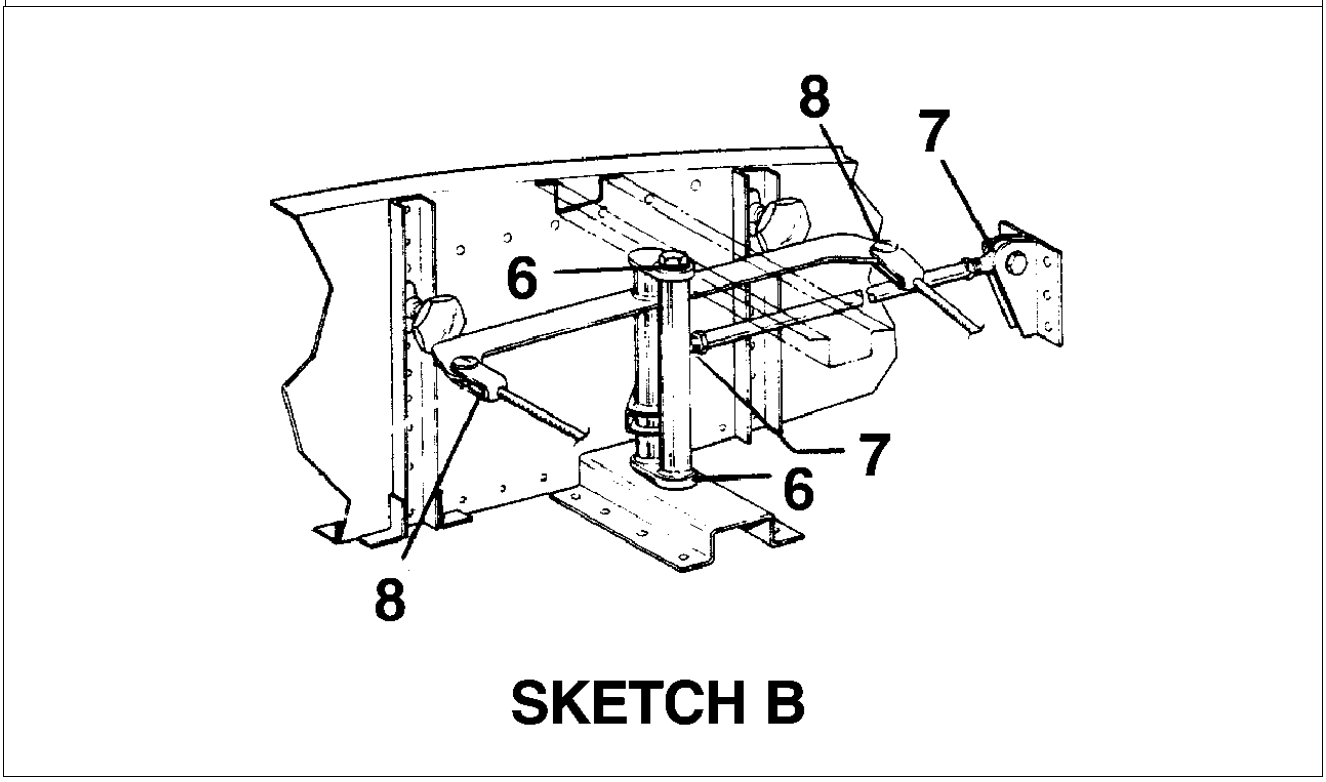


Figure 12-7. Lubrication Chart (Control System - Part 2) (cont.)

SCHEDULED SERVICING (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER TUBE BEARING BLOCKS (See Spec. Instr. 2 and Caution 2)	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MIL-L-60326	100 HRS
2. TOE BRAKE CYLINDER ATTACHMENTS (See Spec. Instr. 1 and Caution 2)	MIL-L-7870	100 HRS
3. RUDDER TUBE CONNECTIONS (See Spec. Instr. 1 and Caution 2)	MIL-L-7870	100 HRS
4. BRAKE ROD ENDS (See Spec. Instr. 1 and Caution 2)	MIL-L-7870	100 HRS
5. RUDDER TUBE CABLE ENDS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
6. NOSE GEAR STEARING ROD ENDS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
7. RUDDER ARM CABLE ENDS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
8. STABILATOR TRIM SCREW (See Spec. Instr. 2)	LUBRIPLATE #907, FISKE BROS. REFINING CO., OR, MIL-G-7711	100 HRS
9. STABILATOR SCREW/TAB LINKS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
10. STABILATOR HINGE POINTS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
11. RUDDER TRIM ASSEMBLY (See Spec. Instr. 1 and Caution 2)	MIL-L-7870	100 HRS

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.

— CAUTIONS —

2. DO NOT OVER LUBRICATE COCKPIT CONTROLS.

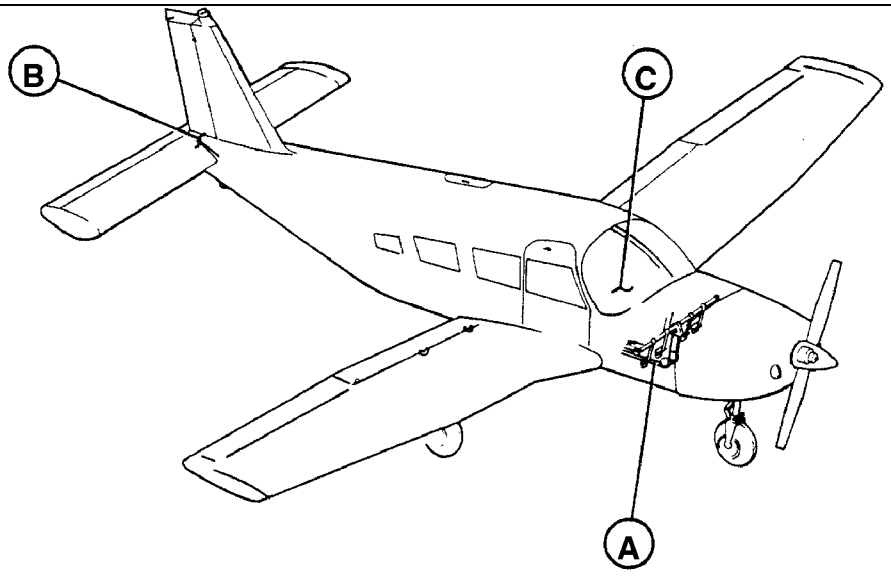


Figure 12-8. Lubrication Chart (Control System - Part 3)

SCHEDULED SERVICING (cont.)

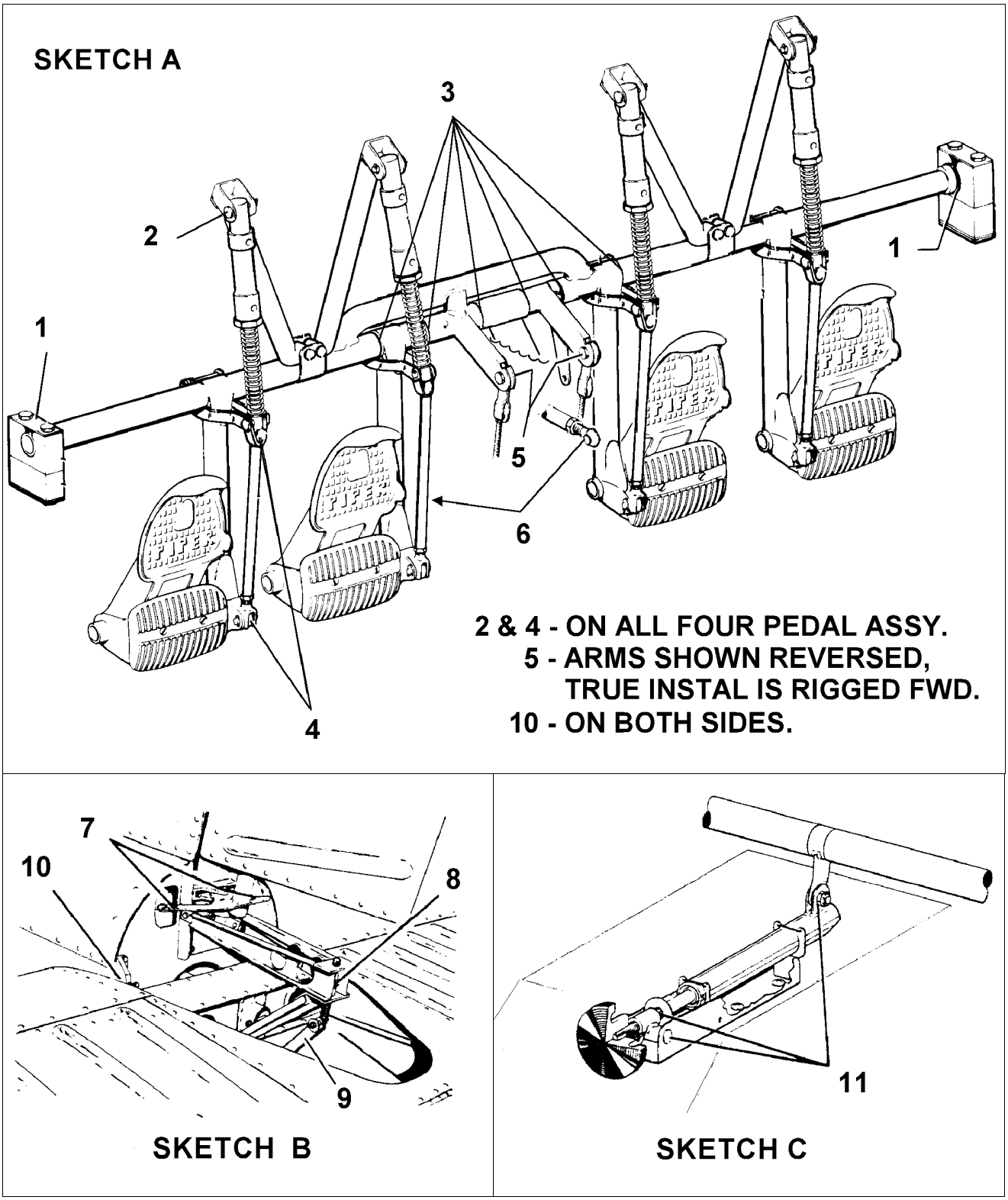


Figure 12-8. Lubrication Chart (Control System - Part 3)

SCHEDULED SERVICING (cont.)

COMPONENT	LUBRICANT			FREQUENCY
1. ENGINE SUMP LUBRICATING OIL, AIRCRAFT RECIPROCATING ENGINE (PISTON) (See Spec. Instr. 7 and Note 1)	AIR TEMPERATURE	MIL-L-6082	MIL-L-22851 (ASHLESS DISPERSANT)	50 HRS
	ALL		SAE 15W50 OR 20W50	
	ABOVE 80°F (26.67°C)	SAE 60	SAE 60	
	ABOVE 60°F (15.55°C)	SAE 50	SAE 40 OR 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 40,30,20W40	
	BELOW 10°F (-12.22°C)	SAE 20	SAE 30,20W30	
2. CARTRIDGE TYPE OIL FILTERS (See Spec. Instr. 7 and Note 1)				50 HRS
3. AIR FILTER (HP ONLY) (See Spec. Instr. 3)				50 HRS
3A. AIR FILTER (TC ONLY) (See Spec. Instr. 3A)				50 HRS
4. PROPELLER ASSEMBLY (See Spec. Instr. 8 and Note 2)		MIL-G-23827		100 HRS
5. ENGINE CONTROL AND ENVIRONMENTAL CONTROL PIVOT POINTS (See Spec. Instr. 1 and Caution 2)		MIL-L-7870		100 HRS
6. FRESH AIR VENT SHAFTS (See Spec. Instr. 2)		MIL-G-7711		500 HRS
7. ALTERNATOR IDLER PULLEY BEARING (See Spec. Instr. 2 and Note 2)		MIL-G-81322		100 HRS

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.
3. AIR FILTER (HP ONLY) - TO CLEAN FILTER, TAP GENTLY TO REMOVE DIRT PARTICLES OR WASH IN WARM WATER AND MILD DETERGENT AND DRY. DO NOT BLOW OUT WITH COMPRESSED AIR. DO NOT USE OIL. REPLACE FILTER IF DAMAGED.

3A. AIR FILTER (TC ONLY) - TO CLEAN FILTER, BLOW OUT WITH COMPRESSED AIR FROM GASKET SIDE OR WASH IN WARM WATER AND MILD DETERGENT AND DRY. DO NOT USE OIL.

7. OIL AND FILTER - LYCOMING RECOMMENDS CHANGING THE OIL AND FILTER EVERY 50 HOURS OR FOUR MONTHS, WHICHEVER COMES FIRST.
8. PROPELLER - REMOVE ONE OF THE TWO GREASE FITTINGS FOR EACH BLADE. APPLY GREASE THROUGH FITTING UNTIL FRESH GREASE APPEARS AT HOLE OF REMOVED FITTING.

— CAUTIONS —

2. DO NOT OVER LUBRICATE COCKPIT CONTROLS.

— Notes —

1. SEE THE LATEST REVISION OF LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF DETERGENT OIL.
2. REMOVE ALL EXCESS GREASE FROM GREASE FITTINGS.

Figure 12-9. Lubrication Chart (Power Plant and Propeller)

SCHEDULED SERVICING (cont.)

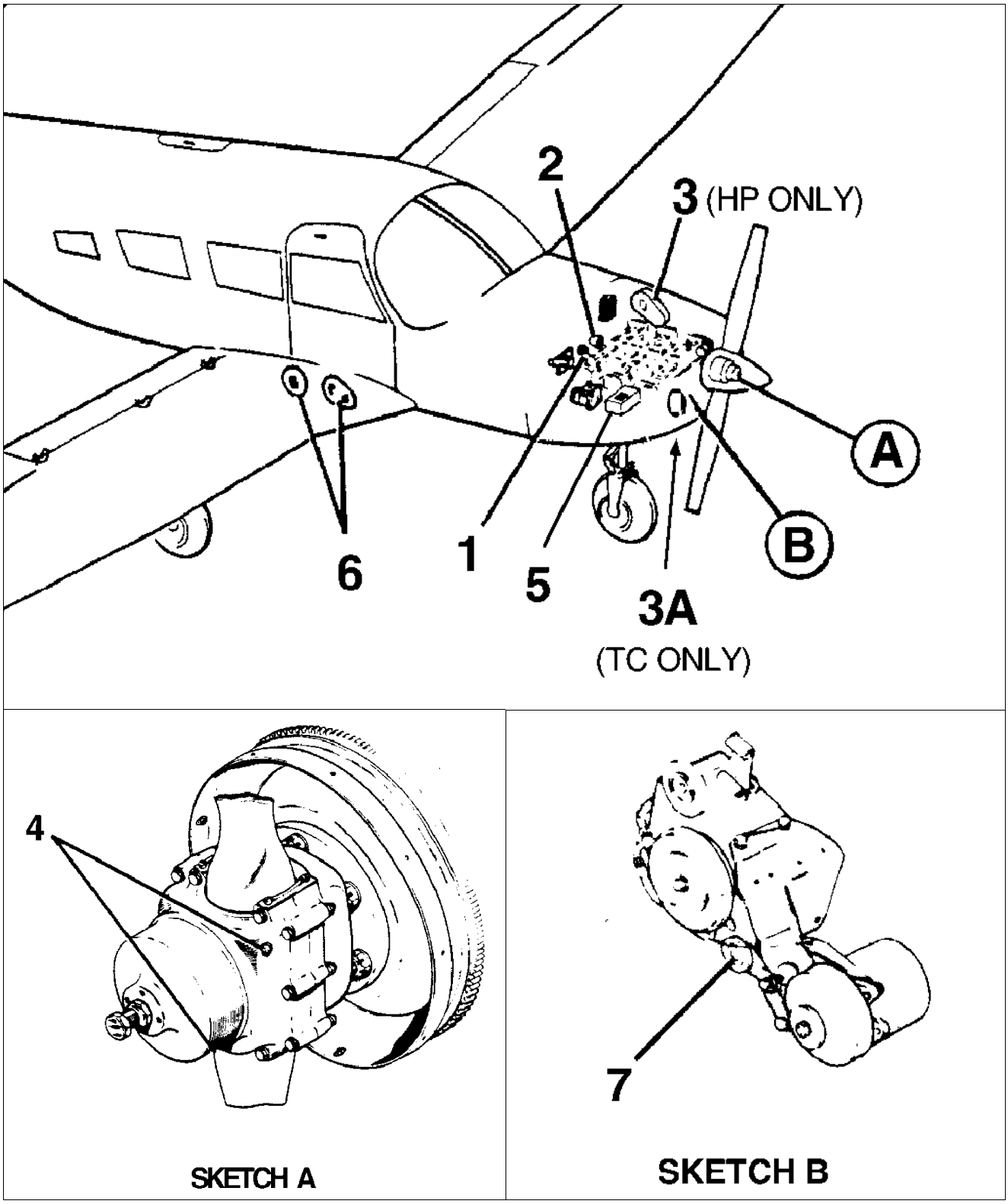


Figure 12-9. Lubrication Chart (Power Plant and Propeller) (cont.)

SCHEDULED SERVICING (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. FUEL SELECTOR LINKAGE (See Spec. Instr. 1 and Caution 2)	MIL-L-7870	100 HRS
2. FUEL SELECTOR VALVE COVER PLATE (See Spec. Instr. 10)	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MIL-L-60326	100 HRS

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.

10. FUEL SELECTOR VALVE - LUBRICATE AREA WHERE DETENT BALL MOVES ACROSS COVER PLATE (ON EXTERNAL VALVE ONLY).

— CAUTIONS —

2. DO NOT OVER LUBRICATE COCKPIT CONTROLS.

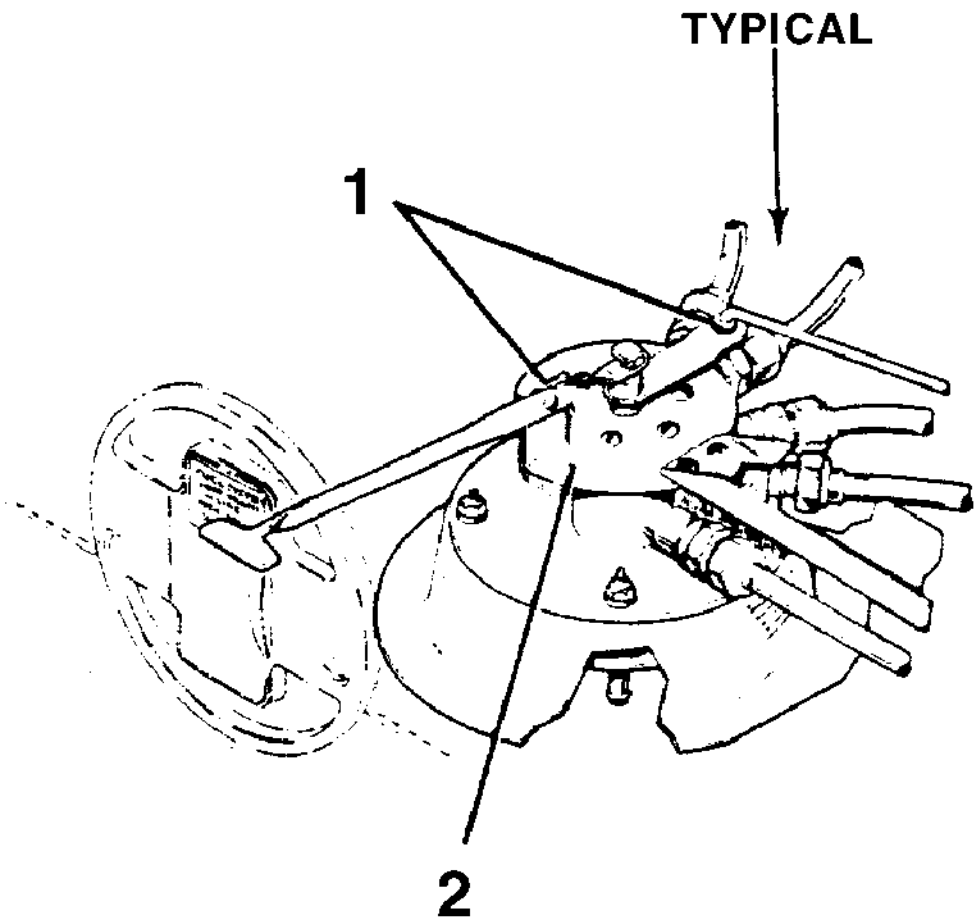


Figure 12-10. Lubrication Chart (Fuel Selector)

SCHEDULED SERVICING (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. DOOR HINGES (See Spec. Instr. 2)	MIL-L-7870	100 HRS
2 DOOR SEALS (See Spec. Instr. 6)	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MIL-L-60326	50 HRS
3 DOOR LATCH MECHANISMS (See Spec. Instr. 2)	MIL L-7870	500 HRS
4 SEAT TRACK ROLLERS, STOP PINS AN0 REAR SEAT LEG RETAINER (CLIP AND CAM) (See Spec. Instr. 2)	LUBRIPLATE #907 FISKE BROS. REFINING CO., OR, MIL-G-7711	100 HRS
5 SEAT LATCH STOP PIVOT POINT (COPILOT) (See Spec. Instr. 1)	MIL-L-7870	100 HRS

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.
6. DOOR SEALS - APPLY FLUOROCARBON RELEASE AGENT / DRY LUBRICANT TO DOOR SEALS AT LEAST ONCE A MONTH TO IMPROVE SEALING CHARACTERISTICS AND TO PREVENT THE SEAL FROM STICKING.

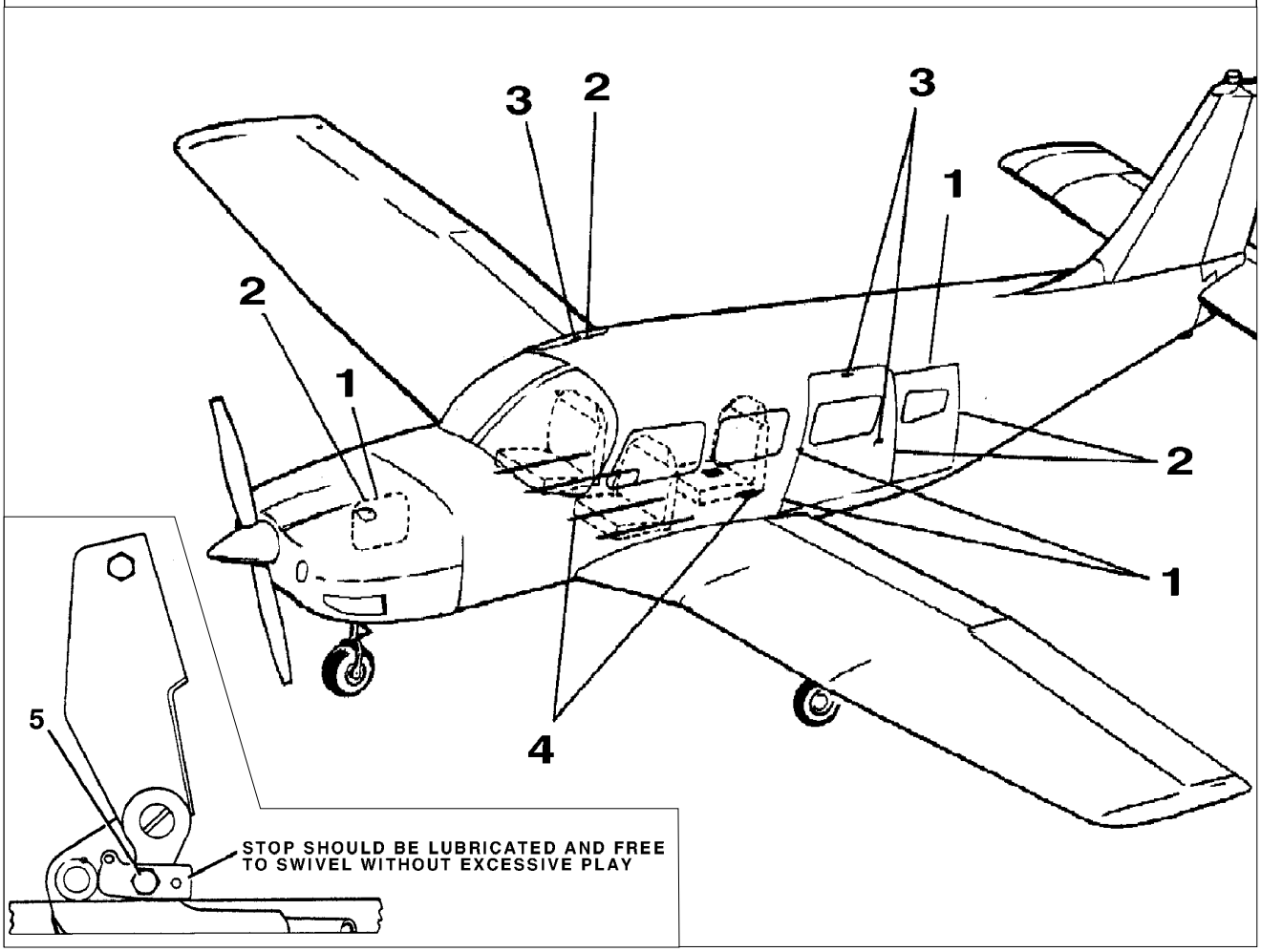


Figure 12-11. Lubrication Chart (Cabin Doors, Baggage Doors and Seats)

SCHEDULED SERVICING (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. CONDENSER HINGE AND ACTUATORS (See Spec. Instr. 1)	MIL-L-7870	100 HRS
2. CONDENSER DOOR ACTUATING TRANSMISSION (See Spec. Instr. 2	MIL-G-23827	500 HRS

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATING POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.

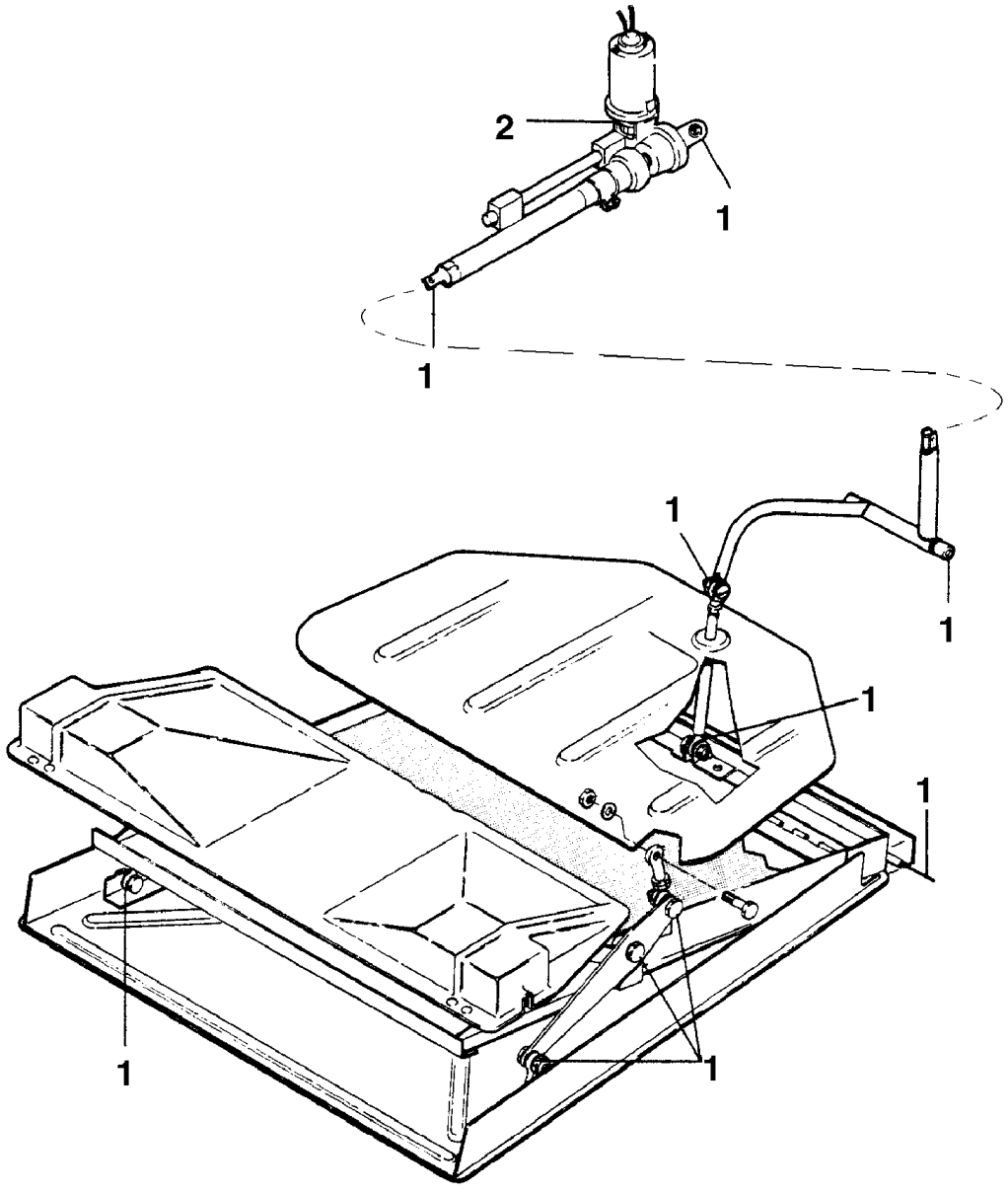


Figure 12-12. Lubrication Chart (Air Conditioning Condenser)

CHAPTER

20

STANDARD PRACTICES - AIRFRAME

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CHAPTER 20 - STANDARD PRACTICES - AIRFRAME

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL

A. Description

This chapter contains general information pertaining to standard aircraft hardware installation and removal practices.

The information included will be very helpful if it is referred to on a regular basis.

If non-destructive testing is needed after repair of 4130 steel, use the magnaflux method.

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.

B. Torque Wrenches

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

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

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

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

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.

$$C = \frac{1 \times 30}{1 + 0.25} \quad \text{or} \quad C = \frac{30}{1.25}$$

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.

GENERAL (cont.)

B. Torque Wrenches (cont.)

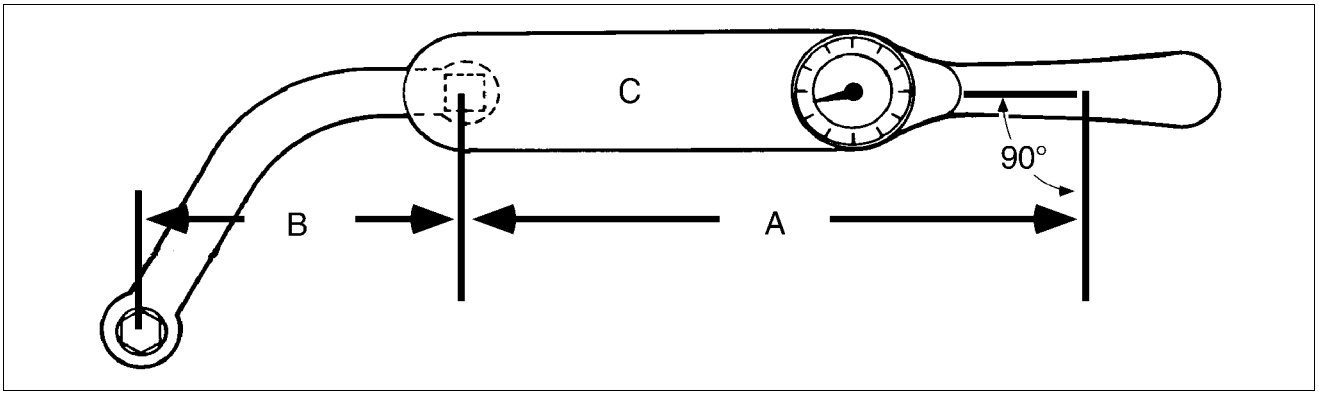

Figure 20-1. Torque Wrench Formula

C. Method For Installing Rod End Bearings

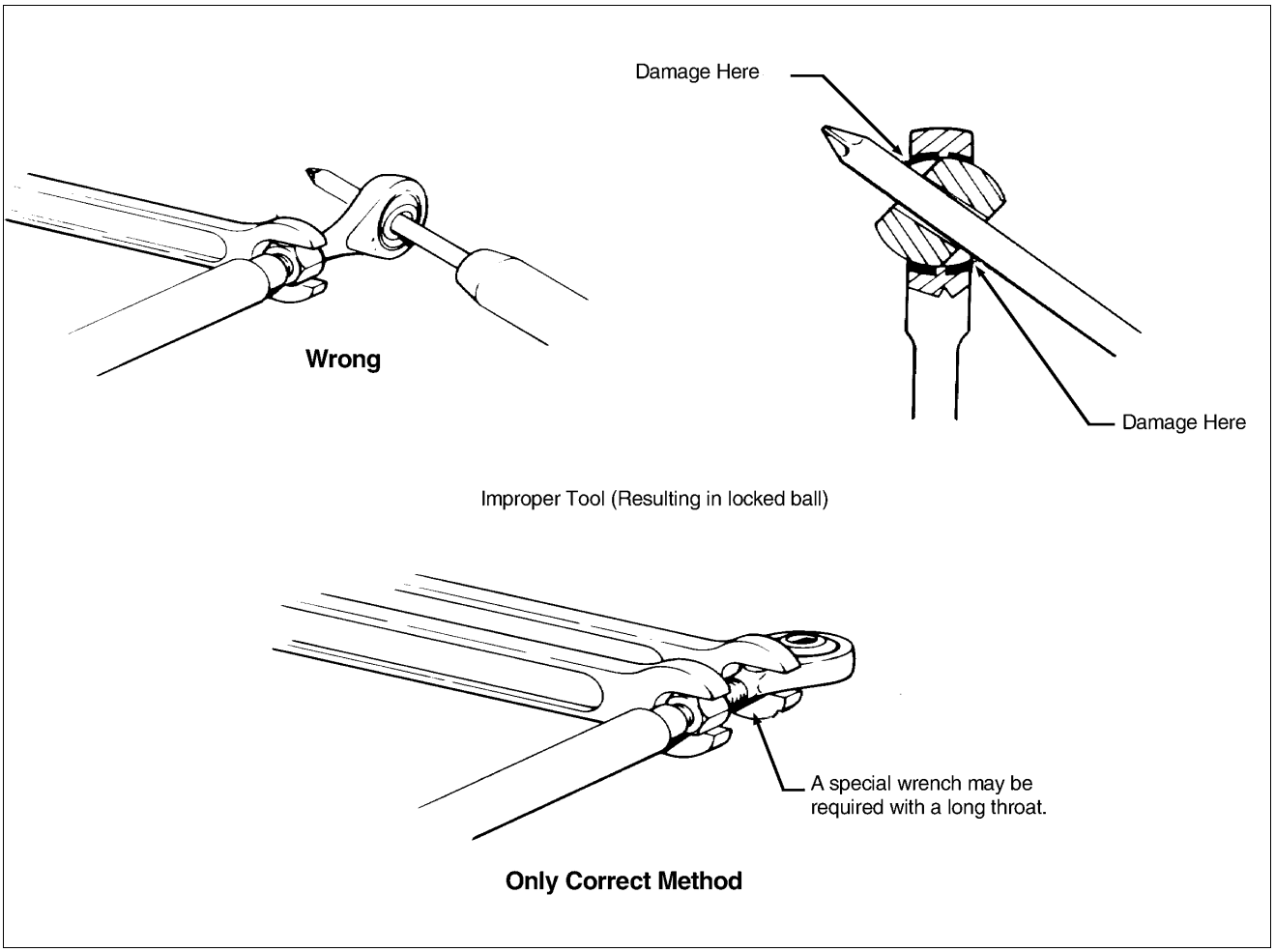

Figure 20-2. Installing Rod End Bearings

GENERAL (cont.)

D. Removing Cherrylock Rivets.

Use following procedure to remove cherrylock rivets

(1) To remove the lock in thick material, use a tapered steel drift pin to drive out rivet stem. (See Figure 20-3, 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.

(2) To remove rivet lock in 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 20-3, Views 2 and 3.)
(3) Pry remainder of locking collar out of rivet head with a drift pin. (See Figure 20-3 View 3.)
(4) Drill almost, but not completely, through head of rivet. Use a drill bit the same size as the rivet shank. (See Figure 20-3, View 4.)
(5) Use a drift pin as a lever to break off rivet head. (See Figure 20-3, View 5.)
(6) Drive out remaining rivet shank with a pin having same diameter as rivet shank. (See Figure 20-3, View 6.)

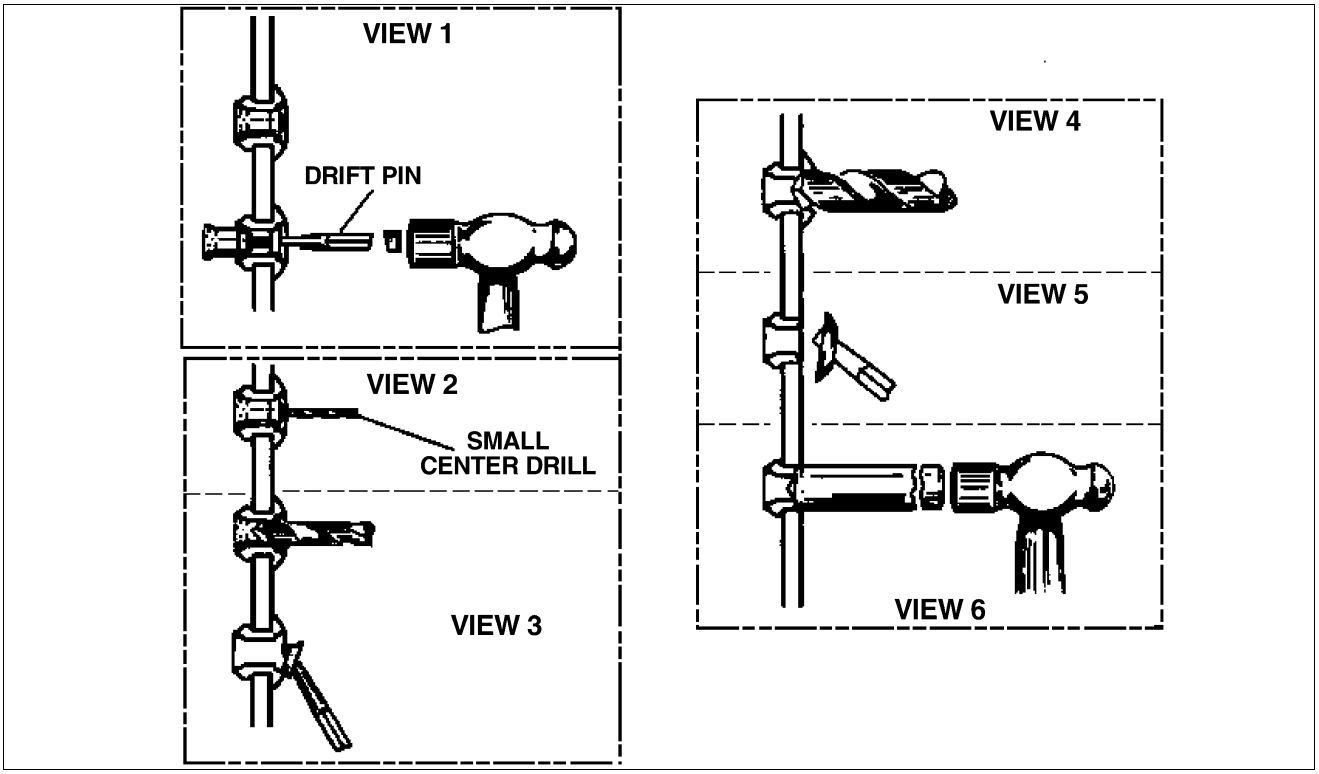

Figure 20-3. Removing Cherrylock Rivets

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GENERAL (cont.)

E. Identification of Fluid Lines (Refer to Figure 20-4)

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.

F. Flareless Tube Assemblies.

The use of flareless tube fittings eliminates all tube flaring. An operation, referred to as presetting, is necessary prior to installing a new flareless tube assembly. Presetting is performed as follows:

(1) Cut tube to correct length. Ensure ends are perfectly square. Deburr inside and outside of tube. Slip nut, then sleeve, over the tube. (refer to Figure 20-5, step 1)
(2) Lubricate fitting and nut threads as specified in table contained in Figure 20-5.
(3) Place fitting in a vise (refer to Figure 20-5, step 2). Hold tubing firmly and squarely on seat in fitting. (Tube must bottom firmly in the 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.
(4) Final tightening depends upon type and size of tubing. On aluminum alloy tubing up to and including half inch outside diameter, tighten nut from 1 to 1-1/6 turns. On aluminum alloy tubing over half inch outside diameter, or steel tubing, tighten nut from 1-1/6 to 1-1/2 turns.
(5) After presetting the sleeve, disconnect tubing from fitting and check the following points (refer to Figure 20-5, step 3):
    (a) Tube extends 3/32 to 1/8 inch beyond sleeve pilot to prevent blow off.
    (b) Sleeve pilot contacts tube. A maximum clearance of 0.005 inch for aluminum alloy tubing, or 0.015 inch for steel tubing, is acceptable.
    (c) A slight collapse of tube at sleeve cut is permissible. No movement of sleeve pilot, except rotation, is permissible.

GENERAL (cont.)

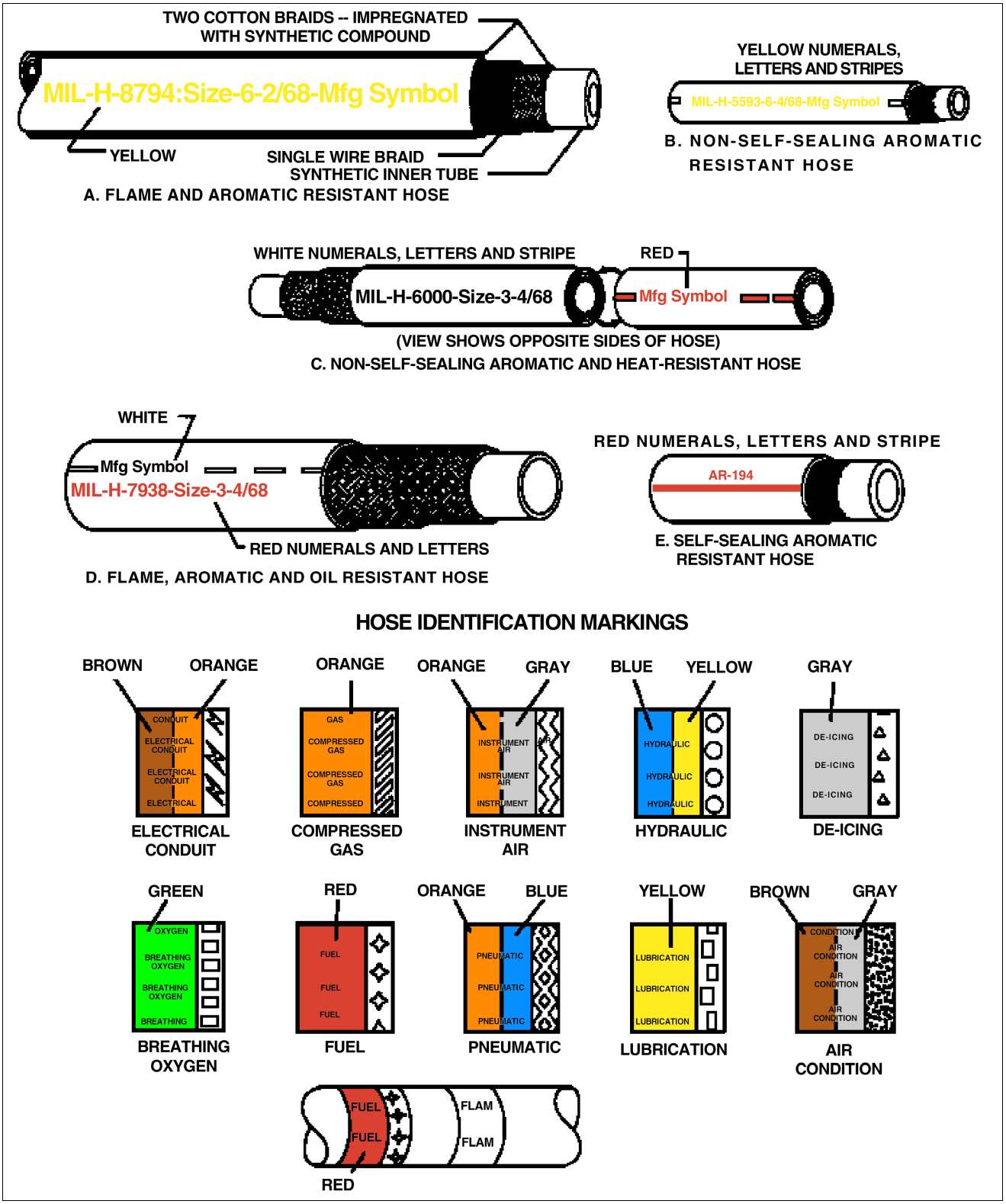

Figure 20-4. Hose, Tube and Line Markings

GENERAL (cont.)

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

(1) CAUTION - DO NOT USE OIL OR GREASE

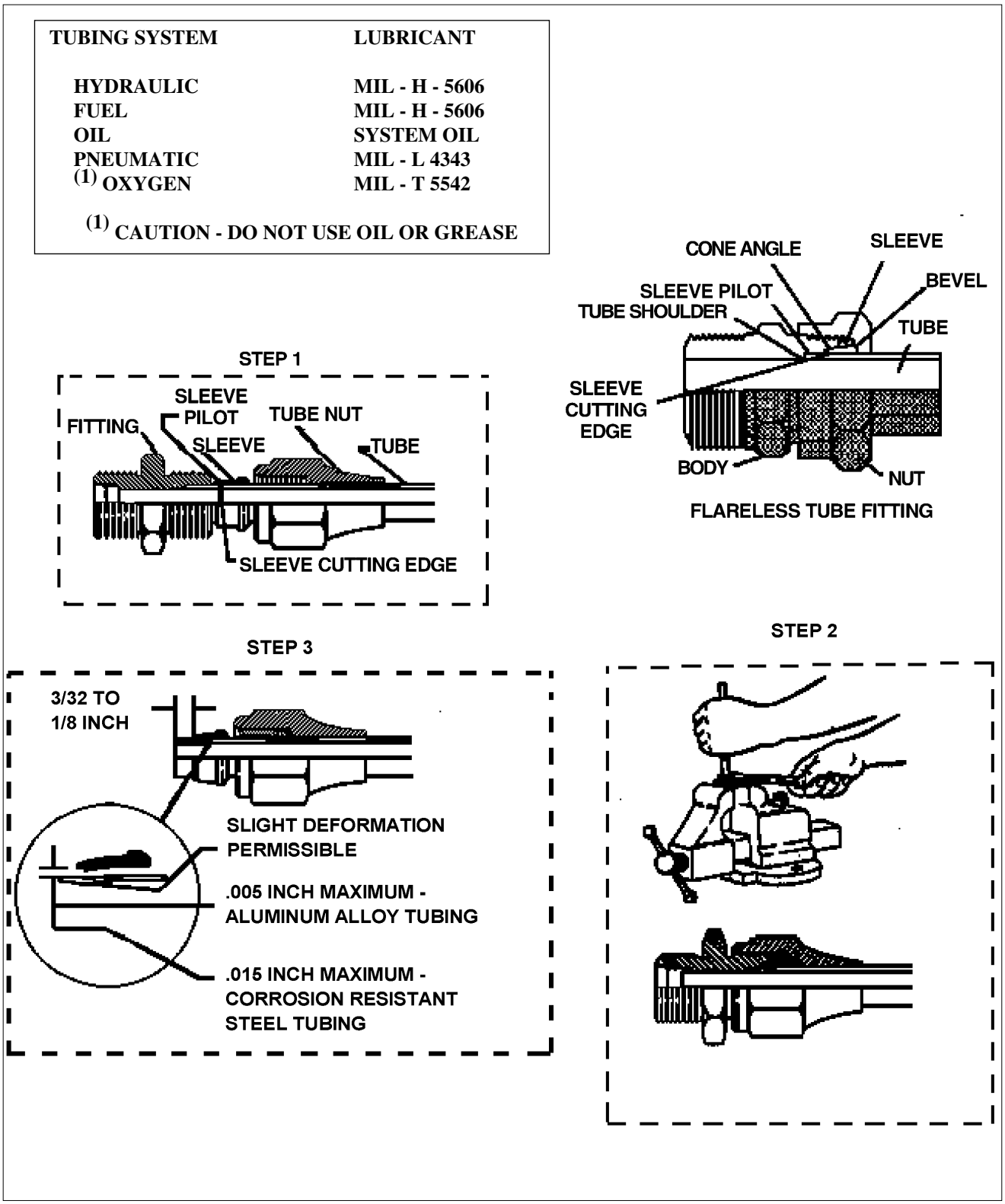

Figure 20-5. Flareless Tube Fittings

GENERAL (cont.)

G. Electrical Bonding

Aircraft electrical bonding should be accomplished or verified to establish a maximum allowable resistance value. See Chart 2001 for values.

All electrical, electronic equipment and components shall be installed in such a manner as to provide a continuous low resistance path from the equipment enclosure to the airplane structure.

Parts shall be bonded directly to the primary structure rather than to other bonded parts.

All parts shall be bonded with as short a lead as possible.

All bonding surfaces shall be cleaned prior to the installation of the bonded joint.

All nuts used in bonding shall be of the self-locking type. (Do Not use fiber-locking type).

All electrical bonding shall be accomplished without affecting the structural integrity of the airframe.

Bond connections shall be secure and free from corrosion.

Self Tapping Screws will not be used for bonding purposes.

CHART 2001. MAXIMUM ALLOWABLE RESISTANCE VALUES

ITEM TO BE ELECTRICALLY BONDED	MAXIMUM ALLOWABLE RESISTANCE VALUE IN OHMS
Static Wicks	0.0005
Starter/Alternator to Engine	0.0025
All Electrical/Electronic Equipment Ground Return to Primary Structure	0.0025
Instruments	0.0100
Battery to Primary Structure	0.0025
Radio Racks to Primary Structure	0.0025
R.F.I. Noise Filters	0.0025

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GENERAL (cont.)

H. Support Clamps.

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. 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.

All plumbing lines must be secured at specified intervals. The maximum distance between supports for rigid fluid tubing is shown in Chart 2002.

CHART 2002. MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

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

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CHAPTER

21

ENVIRONMENTAL SYSTEMS

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CHAPTER 21 - ENVIRONMENTAL SYSTEMS

TABLE OF CONTENTS / EFFECTIVITY

CHAPTER 21 - ENVIRONMENTAL SYSTEM

TABLE OF CONTENTS / EFFECTIVITY (cont.)

GENERAL.

This chapter contains instructions for operating, servicing, inspection and repair of the Environmental Systems components installed in this airplane.

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HEATING

A. Description and Operation

— 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.

Fresh air is ducted from the heating intake vent located on the left front of the lower cowling to the heater shroud which is attached to the muffler. The heated air is then ducted to the valve box mounted on the firewall. When the valve is open, heated air enters the heat ducts located along each side of the center console. Outlets in the heat ducts are located at each seat location. Airflow to the rear seats can be regulated by controls in the heat ducts located between the front seats. The temperature of the cabin is regulated by the heater control located on the right side of the instrument panel.

Defrosting is accomplished by heat outlets located on the right and left side of the cowl cover. Heated air is ducted directly from the heater valve box to the defroster shut-off valves at the firewall and then to the defroster outlets. The airflow is regulated by a defroster control located below the heat control.

To aid air distribution, the cabin air is exhausted overboard by an outlet located on the bottom of the fuselage. Cabin exhaust outlets are located below and aft of the rear seats.

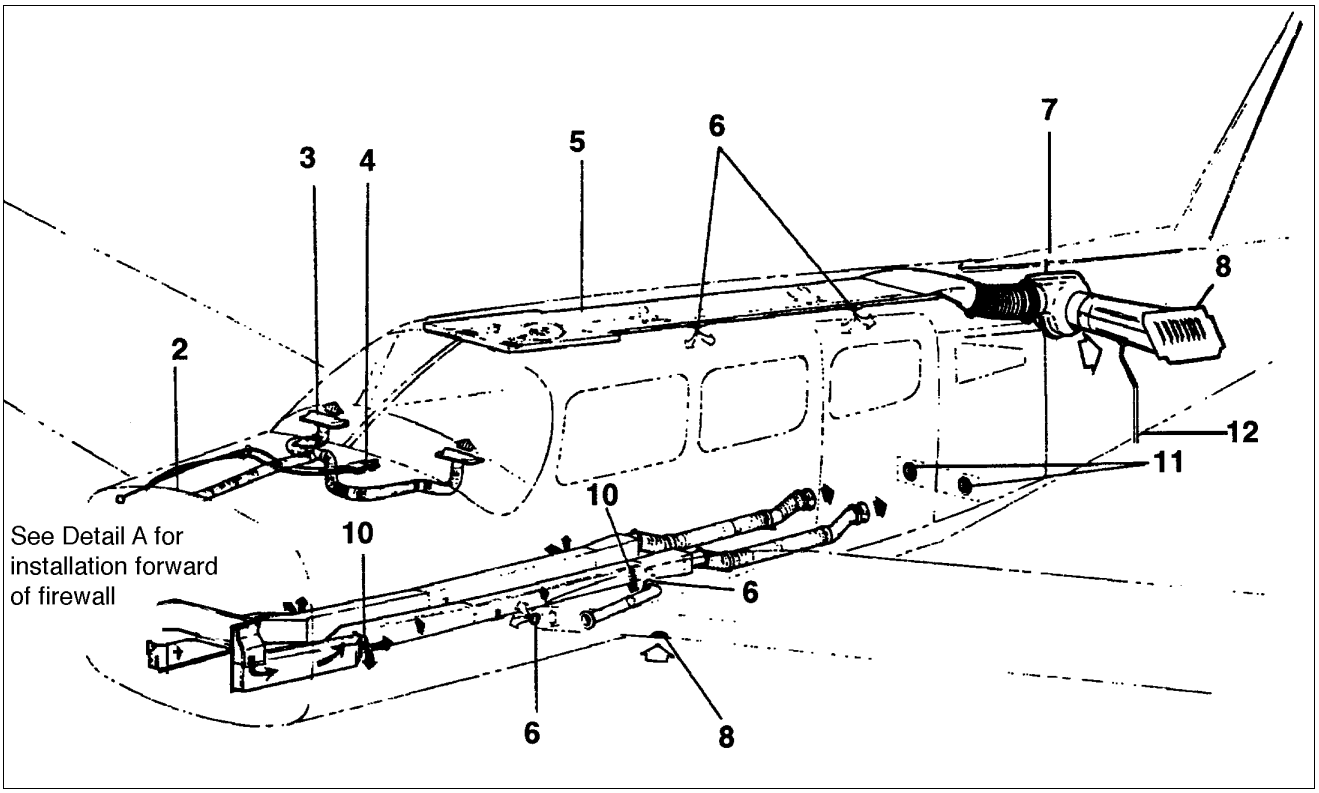
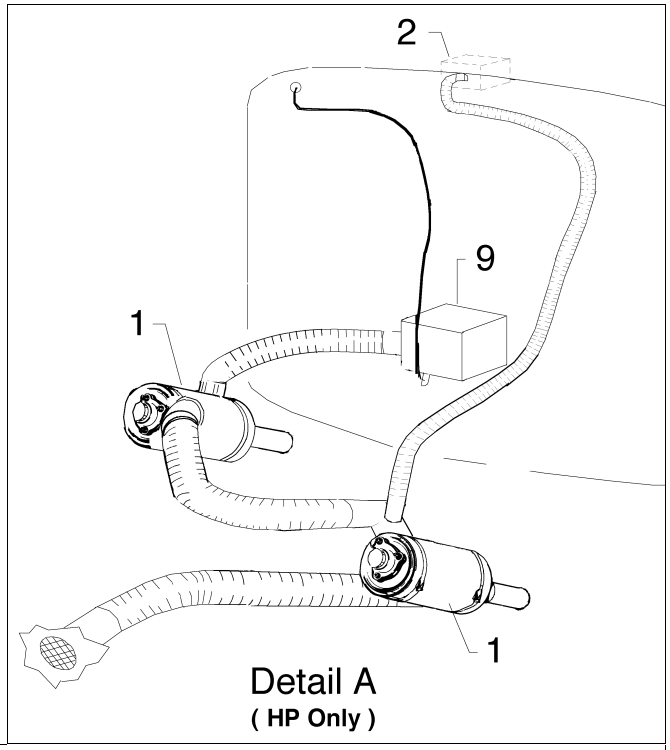


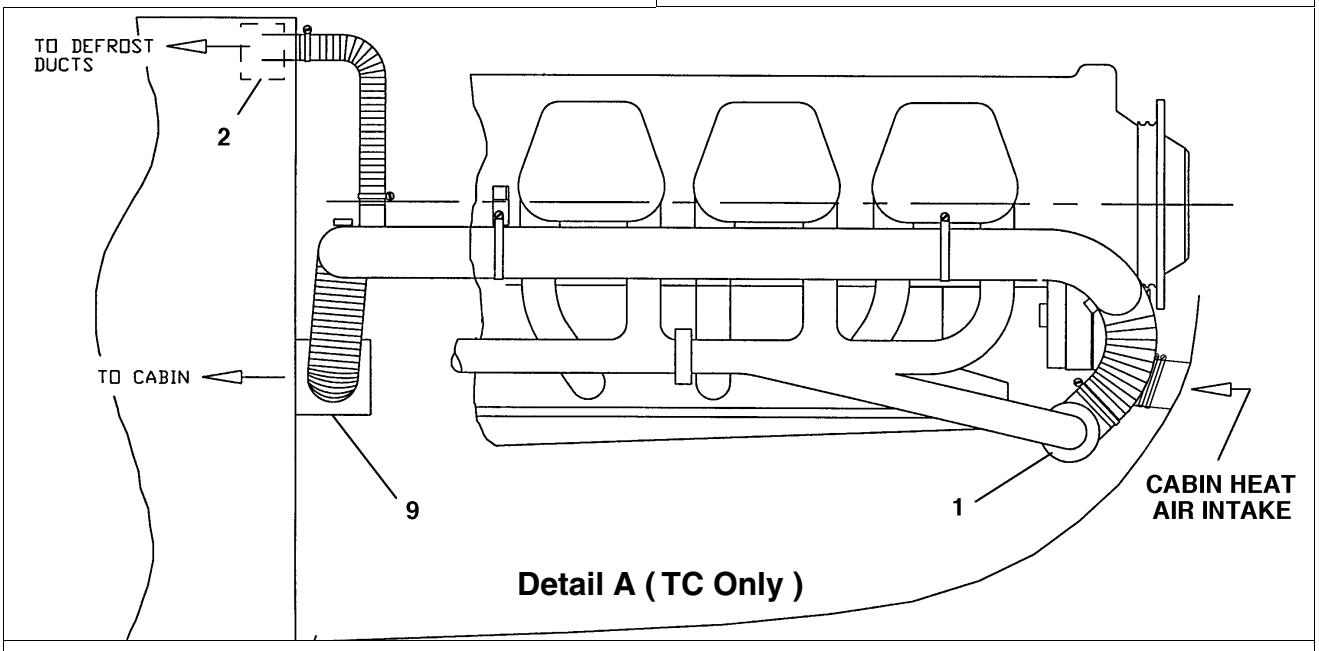
Figure 21-1. Cabin Heater, Defrosters and Overhead Vent System

HEATING (cont.)

B. Heater Maintenance

If the exhaust manifold should become defective, carbon monoxide fumes may be discharged into the cabin area. Therefore it is imperative that the exhaust manifold be inspected regularly. Refer to Chapter 78 for inspection of exhaust systems. The heater shroud must be removed in order to inspect the manifold assembly. Check the operation of the push-pull controls to insure the valve doors function properly. When the controls are pulled out, the door should be completely open to permit full airflow. When the controls are pushed in, the valves should close off all air passage and vent the air into the engine compartment. Refer to Figure 21-1 for an illustration of the heater system.





1. HEATER SHROUD
2. DEFROSTER VALVE
3. DEFROSTER OUTLET
4. HEAT AND DEFROSTER AIR CONTROLS
5. OVERHEAD FRESH AIR CONTROLS
6. FRESH AIR OUTLET
7. OVERHEAD VENT BLOWER
8. FRESH AIR INLET
9. AIR BOX
10. CABIN HEAT OUTLET
11. CABIN AIR EXHAUST
12. DRAIN TUBE

Figure 21-1. Cabin Heater, Defrosters and Overhead Vent System (cont.)

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COOLING

A. Overhead Vent System.

When the optional air conditioning system is not installed cabin ventilation and cooling is provided by an overhead vent system (ref. Figure 21-1). Air enters an inlet located on the rear left side of the fuselage and is ducted through overhead ducting to the cabin. Fresh air flow is controlled by a flapper valve positioned in the duct just forward of F.S. 220. A CABIN AIR knob, located in the cockpit overhead, controls the flapper valve.

1. Optional Overhead Vent Blower
   An optional blower will force air through the overhead vent system whenever desired. It is mounted aft of the close-out panel underneath the top of the fuselage and is connected to the overhead vent system. The vent blower draws air in from 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.
2. Removal of Vent Blower Assembly
   a. Remove the access door from the aft wall of the baggage area.
   b. With the master switch off, disconnect the plug assemblies at the blower assembly.
   c. Remove the inlet and outlet hoses from the blower assembly by removing the clamps.
   d. Remove the screws, washers and nuts that secure the blower assembly to the hanger braces.
   e. Remove the screws and washers which secure the blower assembly to the retainer and hangers.
   f. Remove the blower assembly from the aircraft.
3. Disassembly of Vent Blower
   a. Remove the hose duct from the forward edge of the blower assembly by removing the nuts, washers and screws.
   b. Remove the cover from the blower assembly by removing the nuts, washers and screws.
   c. Remove the blower fan from the motor shaft by removing the set screw.
   d. For removal of the motor, proceed 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. Assembling Vent Blower
   a. Mount motor on plate and secure with bolts, washers, and nuts. Check that motor nuts are snug and shaft spins freely.
   b. Position cover over motor plate with motor wires protruding through cover grommet.
   c. With holes in cover matching holes in motor plate, secure the two parts together with rivets.
   d. Fill any opening left where wires are pass through cover grommet with Sealant, Airframe and Window (see Chart 9105).
   e. Install wires in plug and receptacle.
   f. Position blower fan on motor shaft and secure with set screw.
   g. Position hose duct on blower assembly and secure with screws, washers, and nuts. Install screws with heads inside duct.
   h. Clean old sealant from all surfaces where duct attaches to blower assembly.
   i. Seal all surfaces where duct attaches to blower assembly with Sealant, Airframe and Window (see Chart 9105).

COOLING (cont.)

A. Overhead Vent System (cont.).

5. Installing Blower Assembly
   a. Position blower assembly in hangers and retainer. Install washers and screws.
   b. Secure blower assembly to hanger braces nuts, washers, and screws.
   c. Seal all hose joints with Arno No. C-520 wrap tape.
   d. Install inlet and outlet hoses. Secure with clamps.
   e. Ensure master switch is OFF. Connect plug and receptacles to blower.
   f. Check blower for proper operation.
   g. 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.

CHART 2101. BLOWER SYSTEM WIRE COLOR CODES

12 VOLT	UNE-YY1S062 Magnetek MOTOR WIRES		AIRCRAFT WIRES	
	Pin Nos.		Aircraft Harness	Pin Nos.
Ground	2	Black	AC26A	2
Low Speed	1	Yellow	Black	1
Medium Speed	2	Red	White	2
High Speed	1	Orange	Red	1
24 VOLT	1482-22-1 Dukes MOTOR WIRES		AIRCRAFT WIRES	
	Pin Nos.		Aircraft Harness	Pin Nos.
Ground	1	Green	AC26A	1
Low Speed	2	Red	AC8A	2
High Speed	2	Orange	AC10A	2

COOLING (cont.)

AIR CONDITIONING

A. Description and Operation (Refer to Figure 21-2)

— WARNING —

WHEN SERVICING THE AIR CONDITIONING SYSTEM, BE SURE TO IDENTIFY THE SPECIFIC REFRIGERANT, LUBRICANT, AND COMPONENTS USED IN THE PARTICULAR INSTALLATION. THE AIR CONDITIONING SYSTEM INSTALLED IN THESE AIRPLANES USES HFC-134A REFRIGERANT, EXCEPT FOR HP S/N'S 3246001 THRU 3246017 WHICH USE R12.

— CAUTION —

OPERATE AIR CONDITIONING SYSTEM AT LEAST ONCE A MONTH TO KEEP SYSTEM LUBRICATED AND PREVENT STICKING VALVES.

This installation consists of a compressor with special mounting brackets, and an evaporator, condenser, receiver-dehydrator, circulating fan, high pressure switch, and related plumbing.

The compressor is a York two cylinder (HP S/N's 3246001 thru 3246087) or Sanden five cylinder (HP S/N's 3246088 & up and TC S/N's 3257001 & up) piston type mounted opposite the alternator at engine front. A V-belt connected to engine ring gear drives the compressor through a magnetic clutch. The evaporator filters, dehumidifies, and cools air. The evaporator is mounted in a fabricated housing with the receiver/dehydrator, circulating fan, high pressure switch, and related plumbing which is in the rear fuselage, aft of baggage area closeout panel. The condenser is mounted on a door in the bottom of the fuselage section which is designed to allow extension into airstream during system operation. Electrically activated, the door extends when the system is ON and retracts when the system is OFF.

The system is designed not to increase aerodynamic drag during take-off and other maximum power operations. A micro-switch connected to the throttle de-clutches the compressor and retracts the condenser door automatically when full power is applied. To ensure maximum performance, however; the air conditioner is placarded to be switched off for takeoff.

The air conditioning system is a recirculating, independent unit. It filters, dehumidifies, and cools air as air cycles through evaporator. The unit operates from controls mounted on right side instrument panel. The air conditioning master switch has two positions, ON-OFF. If AIR COND position is selected, the compressor clutch engages, the condenser scoop opens, and the circulating fan is turned on. Temperature is controlled by temperature control selector thermostat. A two position fan switch (LOW-HIGH) operates the blower. The fan may be operated to circulate air without using air conditioning unit.

A pressure switch protects the system and automatically controls condenser maximum head pressure by temporarily declutching the compressor if pressure becomes excessively high. The air conditioning control switch, a fan control switch to govern cold air velocity, and a temperature control are on aircraft instrument panel adjacent to heater and defroster levers.

COOLING (cont.)

The air conditioning system in these airplanes uses HFC-134a (the new environmentally friendly refrigerant), except for HP S/N's 3246001 thru 3246017 only, which use refrigerant R12. Refrigerant enters the compressor as a vapor. The compressor pressurizes the heat laden vapor until the vapor temperature becomes warmer than the outside air temperature. The compressor then pumps the vapor to the condenser where the refrigerant is cooled and changes to liquid. The liquid now passes to the receiver/dehydrator. The receiver/dehydrator filter removes moisture and ensures a steady flow of liquid refrigerant (which is visible in the receiver/dehydrator's sight glass) into the evaporator through the expansion valve. The expansion valve is a temperature controlled metering valve which regulates the flow of liquid refrigerant to evaporator. The evaporator enables the liquid refrigerant to absorbs heat from the outside air passing over coils, converting it back to a vapor. From the evaporator, heat laden refrigerant in a vapor state returns to compressor, and the cycle repeats.

B. Troubleshooting

Troubles peculiar to air conditioner system components are listed in Chart 2102, with probable causes, and suggested remedies. Correct trouble and check entire system for security and components operation. The following definitions apply:

1. High Side: Consists of all lines and components between the compressor outlet and the expansion valve. It includes the condenser and receiver sight gauge.

2. Low Side: Consists of all lines and components between the expansion valve and the compressor inlet. It includes the evaporator.

3. Service Ports: Located on evaporator unit, and are used for evacuating and charging the system. The port in the short line between the receiver and the expansion valve is the high side service port. The other port, located nearby, is the low side service port. The Schrader valves used in these ports are of the quick-disconnect type (except as described below). The service hose couplers used in conjunction with this type of valve have a manually operated valve built in. After attachment, this coupler valve must be manually turned clockwise (in), to depress the Schrader valve spring and open it.

   As noted above, the Schrader valves used in HP S/N's 3246001 thru 3246017 only are threaded so that the service hose couplers must be screwed on. When attached, a device inset into the screw-on type service hose coupler will depress and open the Schrader valve core automatically.

COOLING (cont.)

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS REQUIRE USE OF A COLLECTION SYSTEM WHEN EVACUATING REFRIGERANT FROM AIR CONDITIONER.

CHART 2102. Troubleshooting Air Conditioning System (1 of 5)

GAUGE INDICATION	PROBABLE CAUSES	REMEDY
High discharge pressure.	Refrigerant overcharge.	Purge excess refrigerant.
	Air in system.	Check for leaks. Bleed charge from system. Evacuate and recharge system.
	Overheated condenser due to blocked air passage.	Clean bugs and dirt from condenser fins. Straighten bent fins.
	Flooded evaporator indicated by heavy frosting on suction line and compressor suction service valve.	Check capillary bulb is securely clamped to suction line. If capillary bulb ok replace expansion valve.
	Restriction in liquid line from condenser.	Check for kinked hoses and clogged filter.
Low discharge pressure.	Refrigerant undercharge. Sight glass shows bubbles or foam.	Add refrigerant until bubbles disappear. Check system for leaks.
	Damaged compressor valves or dirt under valves.	Replace compressor.
	Damaged compressor. Worn or broken piston or piston rings.	Replace compressor.
Low suction pressure accompanied by icing of evaporator.	Low air supply through evaporator.	Repair blower or blower motor Clean stoppage in air ducts.
	Very dirty evaporator fins and coils.	Clean and flush with water.
Low suction pressure. (Evaporator not cold enough.) Suction gauge reads vacuum indicating evaporator lacks refrigerant.	Refrigerant undercharge. Moisture freezing in expansion valve. Valve shows frost.	Add refrigerant. Install new dryer. Evacuate and recharge.
	Expansion valve inlet screen clogged. Inoperative expansion valve. Valve stuck closed or capillary bulb has lost charge.	Remove screen. Clean with solvent and replace. Warm capillary by holding in hand. If suction pressure does not change replace exp valve.
	Restriction in liquid line. Restriction will show frost.	Locate restriction and repair.

COOLING (cont.)

— Note —

Check all environmental regulations for your local area before servicing air conditioning system.

CHART 2102. TROUBLESHOOTING AIR CONDITIONER (2 of 5)

GAUGE INDICATION	PROBABLE CAUSES	REMEDY
High suction pressure.	Capillary bulb clamp loose on suction line. Suction line shows frost.	Clean contact surfaces of suction line and cap bulb. Tighten clamp.
	Expansion valve not closing. Evaporator flooded. Suction line frosted to compressor.	Replace expansion valve.
	Compressor drive belt slipping.	Adjust belt tension.
	Magnetic clutch slipping.	Check electrical circuit for proper voltage to clutch coil. Clean oily clutch surfaces.
	Leaking or broken compressor	Replace compressor valves.
TROUBLE	CAUSE	REMEDY
Condenser door will not close when air conditioner switch is in OFF position.	Faulty K-2 relay.	Replace relay.
System does not cool.	**If electrical:**	
	Blown fuse in control head.	Replace fuse.
	Open circuit breaker.	Set circuit breaker.
	Broken or disconnected electrical wire.	Check all terminals for loose connections. Check wiring for hidden breaks.
	Broken or disconnected ground wire.	Check ground wire is not loose, broken, or disconnected.
	Clutch coil burned out or disconnected.	Verify voltage to clutch. Replace if inoperative.
	Thermostat sensing element defective.	Check thermostat and cabin comfort control panel.
	Blower motor disconnected or burned out motor.	Verify voltage to blower. Repair or replace if inoperative.

COOLING (cont.)

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS REQUIRE USE OF A COLLECTION SYSTEM WHEN EVACUATING REFRIGERANT FROM AIR CONDITIONER.

CHART 2102. TROUBLESHOOTING AIR CONDITIONING SYSTEM (3 of 5)

TROUBLE	CAUSE	REMEDY
System does not cool (cont.)	**If mechanical:**	
	Loose or broken drive belt.	Replace drive belts and tighten to specifications.
	Compressor partially or completely frozen.	Remove compressor. Service or replace.
	Expansion valve stuck in open position.	Replace expansion valve.
	If refrigeration:	
	Broken refrigerant line.	Examine all lines for evidence of breakage by external stress or rubbing wear.
	Leak in system.	Evacuate system, apply static charge, leak test system, and repair leak as necessary.
	Compressor shaft seal leaking.	Replace compressor.
	Clogged screen or screens in receiver dehydrator or expansion valve; plugged hose or coil.	Repair as necessary.
System cooling inadequate	**If electrical:**	
	Blower motor operation sluggish	Remove blower motor for service or replacement.
	If mechanical:	
	Compressor clutch slipping.	Remove clutch assembly for service or replacement. On Sanden - check clutch airgap and coil.
	Obstructed blower passage.	Examine passage for obstruction. Correct as necessary.
	Insufficient air circulation over condenser coils; fins clogged with dirt or bugs.	Clean condenser coils.
	Clogged evaporator filter.	Clean with solvent.

COOLING (cont.)

— Note —

Check all environmental regulations for your local area before servicing air conditioning system.

CHART 2102. TROUBLESHOOTING AIR CONDITIONING SYSTEM (4 of 5)

TROUBLE	CAUSE	REMEDY
System cooling inadequate (cont.)	**If refrigeration:**	
	System refrigerant low.	Recharge system until bubbles disappear in receiver dehydrator and gauge readings stabilize to specifications.
	Clogged screen in expansion valve.	Purge system, replace expansion valve.
	Expansion valve thermal bulb has no charge.	Purge system, replace expansion valve.
	Clogged receiver dehydrator screen.	Purge system, replace receiver dehydrator.
	Excessive moisture in system.	Purge system, replace receiver dehydrator.
	Air in system.	Purge, evacuate, and charge system. (Replace receiver dehydrator.)
Excessively noisy system.	**If electrical:**	
	Defective winding or connection in compressor clutch coil.	Replace or repair as necessary.
	If mechanical:	
	Loose or worn drive belts, crankshaft pulley, or idler pulley or bearing.	Tighten or replace as required.
	Engine components such as: alternator, water pump, valves, timing or mounts.	Check.
	Compressor mounting bolts or brackets - broken or loose.	Check, repair, replace.
	Compressor oil level low.	Fill with proper amount of specified oil.
	Compressor failure.	Check shaft turning smoothness. Remove compressor for service or replacement.

COOLING (cont.)

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS REQUIRE USE OF A COLLECTION SYSTEM WHEN EVACUATING REFRIGERANT FROM AIR CONDITIONER.

CHART 2102. TROUBLESHOOTING AIR CONDITIONING SYSTEM (5 of 5)

TROUBLE	CAUSE	REMEDY
Excessively noisy system (cont.)	**If mechanical (cont):**	
	Magnetic clutch failure.	Check airgap (on Sanden), clutch pulley, front plate, coil, and bearing. Adjust, repair, or replace, as required.
	If refrigeration:	
	Excessive system charge.	Remove excess refrigerant until high pressure gauge drops within specifications.
	Low system charge.	Check system for leaks. Recharge system.
	Excessive moisture in system.	Replace dehydrator, purge, evacuate, and recharge system.

COOLING (cont.)

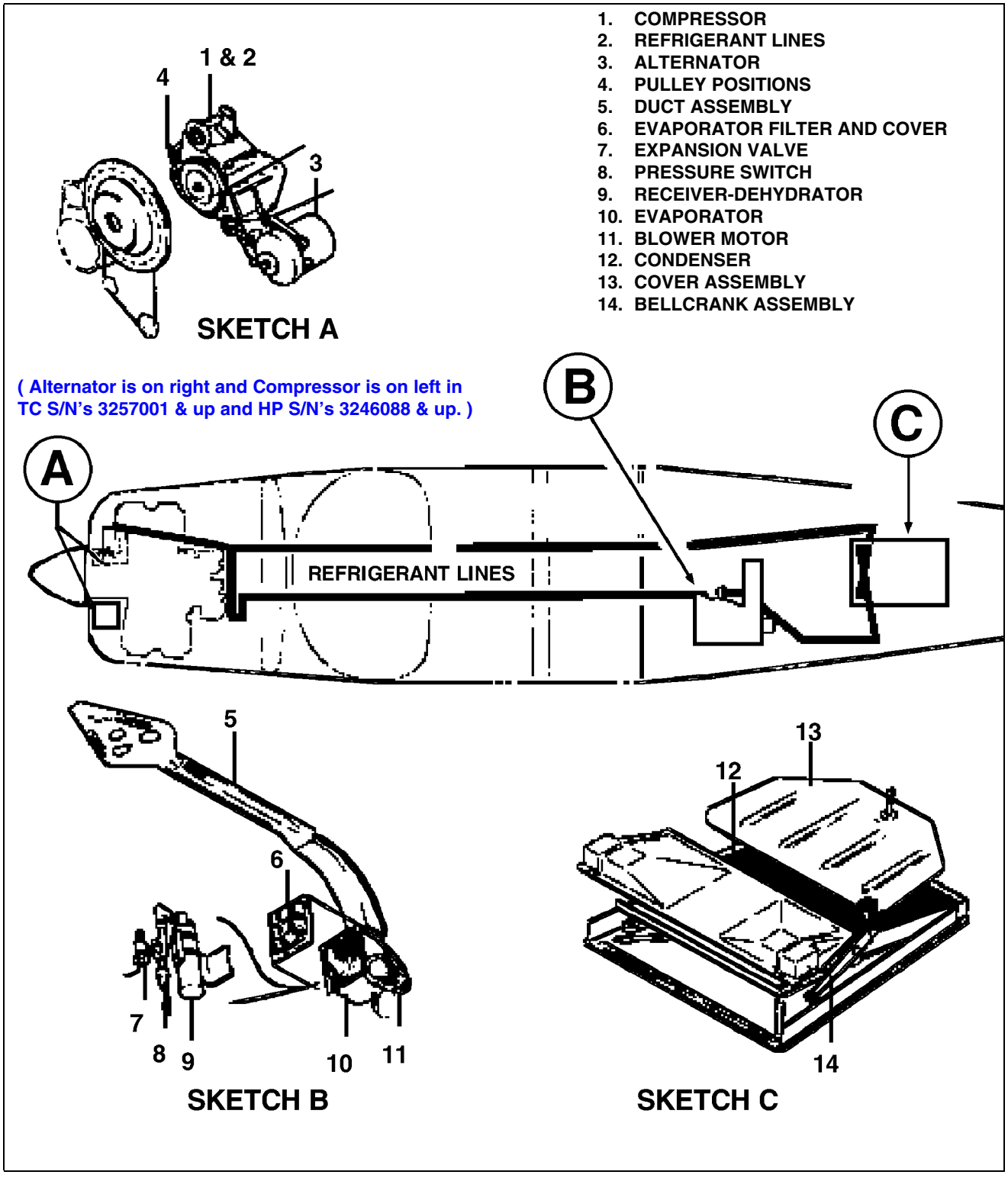

Figure 21-2. Air Conditioning System Installation (Typical)

COOLING (cont.)

C. Malfunction Detection

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

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

Early detection and repair saves time and prevents additional complications.

System performance tests verify efficient systems operation. Whenever possible, the air conditioning system should be given this test before work is begun on it. However, if system is completely inoperative, repairs must be performed before system can be properly tested. Performance tests should always be performed after repair work has been done and before the aircraft is returned to service. Careful testing ensures proper repairs have been accomplished and that the system is operating satisfactorily.

Performance tests include thorough outside and inside examination. Perform a thorough visual inspection of the complete system, followed by an operating inspection of the system.

1. Refrigerant R12 (HP S/N's 3246001 thru 3246017 only).
   Detection of system malfunction is made easier with the knowledge that temperature and pressure of refrigerant R12 is in close proximity between the pressures of 20 and 60 psi. A glance at the pressure-temperature chart will show that there is only a slight variation between the temperature and pressure of the refrigerant in the lower range. Refer to Chart 2103 for exact values.
   Assume that for every pound of pressure added to the low side, a temperature increase of about one degree Fahrenheit takes place. For instance, a pressure of 23.8 on the chart indicates a temperature of 24°F. A change of pressure of almost one pound to 24.6 psi gives a temperature increase to 25°F.

   — Note —

   Gauge readings are about one inch mercury or 1/2 psi higher than chart reads for each 1000 feet elevation above sea level.

   Actual air temperature of air passing over the evaporator coils will be several degrees warmer allowing for a temperature rise caused by the loss in the fins and tubing of the evaporator.

2. Refrigerant HFC134a (HP S/N's 3246088 & up and TC S/N's 3257001 & up).
   Detection of system malfunction is made easier with knowledge of the relationship between temperature and pressure of refrigerant HFC134a. Refer to Chart 2103 for specific values.

   — Note —

   Gauge readings are about one inch mercury or 1/2 psi higher than chart reads for each 1000 feet elevation above sea level.

   Actual air temperature of air passing over the evaporator coils will be several degrees warmer allowing for a temperature rise caused by the loss in the fins and tubing of the evaporator.

CHART 2103. REFRIGERANT TEMPERATURE VS. PRESSURE

Refrigerant R12 Evaporator Pressure Gauge Reading psi	Refrigerant R12 Evaporator Temperature °F	Refrigerant HFC134a Evaporator Pressure Gauge Reading psi	Refrigerant HFC134a Evaporator Temperature °F
0	-21	5	-27
2.4	-15	0	-15
4.5	-10	2	-9
10.1	2	4	-4
11.2	4	6	0
12.3	6	8	4
13.4	8	10	7
14.6	10	12	11
15.8	12	14	14
17.1	14	16	17
18.3	16	18	20
19.7	18	20	22
21	20	22	25
22.4	22	24	28
23.1	23	26	30
23.8	24	28	33
24.6	25	30	35
25.3	26	32	37
26.1	27	34	39
26.8	28	36	41
27.6	29	38	43
28.4	30	40	45
29.2	31	42	47
30	32	44	49
30.9	33	46	51
31.7	34	48	53
32.5	35	50	54
33.4	36	55	58
34.3	37	60	62
35.1	38	65	66
36	39	70	69
36.9	40		
37.9	41		
38.8	42		
39.7	43		
41.7	45		
43.6	47		
45.6	49		
48.7	52		
49.8	53		
55.4	57		
60	62		
64.9	66		

COOLING (cont.)

D. Special Servicing Procedures

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE RELEASE OF REFRIGERANT INTO THE ATMOSPHERE. SPECIAL EQUIPMENT IS REQUIRED WHEN TESTING, DISCHARGING, OR CHARGING THE SYSTEM.

United States federal environmental regulations require that air conditioning system repairs be accomplished by a qualified shop with appropriately trained personnel.

System efficiency depends upon the pressure-temperature relationship of pure refrigerant. The system is considered chemically stable when it contains only the appropriate pure refrigerant (R12 or HFC134a) plus a specified amount of the appropriate compressor oil (mixed with refrigerant). Foreign material within the system affects chemical stability, contaminates the system, and decreases efficiency.

— WARNING —

THE AIR CONDITIONING SYSTEM IN THESE AIRPLANES USES REFRIGERANT HFC-134A, EXCEPT FOR HP S/N'S 3246001 THRU 3246017 ONLY, WHICH USE R12. ANYONE SERVICING THE AIR CONDITIONING SYSTEM MUST BE FAMILIAR WITH THE REFRIGERANT, LUBRICANT, AND COMPONENTS USED IN THAT PARTICULAR INSTALLATION.

— WARNING —

RELEASE AND EVAPORATION OF PRESSURIZED LIQUID REFRIGERANT IS DANGEROUS DUE TO BOTH ITS HIGH PRESSURE AND EXTREME COOLING PROPERTIES. AIR CONDITIONING REFRIGERANT (BOTH R12 OR R134A) IS ODORLESS AND COLORLESS IN EITHER ITS LIQUID OR GASEOUS STATE. BOTH R12 AND HFC134A, USED FOR CHARGING REFRIGERATION SYSTEMS, ARE IN A PRESSURIZED CONTAINER IN LIQUID FORM. BOTH REFRIGERANTS ARE INERT AT ROOM TEMPERATURE.

—WARNING —

WEAR SUITABLE EYE PROTECTION WHEN HANDLING REFRIGERANTS. THE EYE WILL FREEZE IF CONTACTED BY ESCAPING LIQUID REFRIGERANT.

IF LIQUID REFRIGERANT CONTACTS EYE:

1. ***DO NOT RUB THE EYE.***
2. ***SPLASH LARGE QUANTITIES OF COOL WATER INTO EYE TO RAISE TEMPERATURE.***
3. ***APPLY EYE PATCH TO AVOID POSSIBILITY OF DIRT ENTERING EYE.***
4. ***RUSH TO PHYSICIAN OR HOSPITAL FOR IMMEDIATE MEDICAL CARE.***
5. ***DO NOT ATTEMPT TO TREAT YOURSELF.***

COOLING (cont.)

— WARNING —

LIQUID REFRIGERANT ON THE SKIN WILL CAUSE FROSTBITE. TREAT WITH COOL WATER AND PROTECT WITH PETROLEUM JELLY. SEEK MEDICAL ATTENTION.

— WARNING —

USE CARE NOT TO DISCHARGE REFRIGERANT INTO A CLOSED ROOM. REFRIGERANT DISPLACES AIR IN THE ROOM AND CAUSES OXYGEN STARVATION. GASEOUS REFRIGERANT IS HEAVIER THAN AIR AND FLOWS TO CONTAINER BOTTOM.

— WARNING —

USE CARE NOT TO DISCHARGE REFRIGERANT INTO AN OPEN FLAME OR ONTO A VERY HOT SURFACE (500°F).

— WARNING —

DO NOT APPLY DIRECT FLAME OR OTHER HIGH HEAT SOURCE TO A REFRIGERANT CONTAINER, BECAUSE HIGH PRESSURES RESULT. IF HEATING REFRIGERANT CONTAINERS, CONTAINER PRESSURE MUST BE MONITORED AND KEPT BELOW 150 PSI.

— WARNING —

DISCHARGE SYSTEMS SLOWLY TO PREVENT ESCAPE OF LIQUID REFRIGERANT AND LOSS OF LUBRICATING OIL. READ AND FOLLOW ALL INSTRUCTIONS PROVIDED BY MANUFACTURER OF EQUIPMENT USED FOR DISCHARGING SYSTEM.

— WARNING —

USE ONLY APPROVED REFRIGERATION OIL IN COMPRESSOR: MINERAL OIL FOR HP S/N'S 3246001 THRU 3246017 ONLY; POLYALKYLENE-GLYCOL (PAG) FOR ALL OTHERS. REPLACE WITH NEW OIL IF IN DOUBT ABOUT COMPRESSOR OIL CONTAMINATION.

— WARNING —

NEVER ADD ANYTHING BUT PURE REFRIGERANT (R12 FOR HP S/N'S 3246001 THRU 3246017 ONLY AND HFC134A FOR ALL OTHERS) INTO THE SYSTEM.

— WARNING —

KEEP REFRIGERANT OIL CONTAINERS TIGHTLY SEALED AND CLEAN TO PREVENT ABSORPTION OF MOISTURE OR OTHER CONTAMINATION.

— WARNING —

DO NOT REUSE OIL REMOVED FROM THE SYSTEM. DISPOSE OF IT PROPERLY.

COOLING (cont.)

— WARNING —

DO NOT LET AIR CONDITIONING SYSTEMS OPEN TO THE ATMOSPHERE WHEN DISCHARGED. MOISTURE AND OTHER CONTAMINATES WILL ENTER AND DAMAGE OPEN SYSTEMS.

— WARNING —

KEEP REFRIGERANT FREE FROM MOISTURE. WHEN R-12 COMES IN CONTACT WITH MOISTURE IT FORMS A VERY STRONG ACID (HCL). WHEN HFC134A COMES IN CONTACT WITH MOISTURE, IT ABSORBS IT INTO THE SYSTEM, WHICH WILL LEAD TO A SYSTEM FAILURE.

— CAUTION —

NEW RECEIVER DEHYDRATOR MUST BE OPENED AND CONNECTED TO SYSTEM ONLY WHEN READY TO CHARGE SYSTEM WITH REFRIGERANT.

— CAUTION —

USE RECOMMENDED TORQUE VALUES ON ALL FLARE FITTING AND O-RING JOINTS. (SEE CHART 2104.)

CHART 2104. RECOMMENDED TORQUE SPECIFICATIONS

ALUMINUM TUBING		
Metal Tube O. D.	Thread and Fitting Size	Torque
1/4	7/16	5-7 ft. lbs.
3/8	5//8	11-13 ft. lbs.
1/2	3/4	15- 20 ft. lbs.
5/8	7/8	21-17 ft. lbs.
3/4	1-1/16	28-33 ft. lbs.

FLARE CONNECTION			O-RING CONNECTIONS		
Tube O. D.	Thread Size	Ft./Lbs.	Tube O. D.	Thread Size	Ft./Lbs.
3/8	5/8	18-20	3/8	5/8	11-13
1/2	3/4	36-39	1/2	3/4	15-20
5/8	7/8	52-57	5/8	7/8	21-27

— CAUTION —

REPLACE RECEIVER DEHYDRATOR ASSEMBLY ON ANY SYSTEM OPERATING WITH A LEAK ALLOWING AIR TO ENTER SYSTEM. RECEIVER DEHYDRATOR LEFT OPEN TO THE ATMOSPHERE MUST BE REPLACED DUE TO LOSS OF EFFECTIVENESS OF THE DRYING COMPOUND IT CONTAINS.

COOLING (cont.)

1. Service Valves:

— CAUTION —

IF AIR CONDITIONING REFRIGERANT LINES OR SYSTEM IS OPENED, LINES AND FITTINGS MUST BE CAPPED AND SEALED IMMEDIATELY TO PREVENT DIRT AND OTHER CONTAMINANTS FROM ENTERING THE SYSTEM. (DO NOT PUT A PLUG INTO THE HOSES OR FITTINGS.)

Use inline service valves for all normal air conditioning service (i.e. - testing, bleeding, evacuating, and charging). The aircraft is equipped with inline service valves mounted in the suction and discharge lines of the evaporator assembly located behind the rear close-out panel. These inline service valves are quick disconnect type Schrader valves, except in HP S/N's 3246001 thru 3246017 only. Those seventeen airplanes are equipped with screw-on type Schrader valves.

— Note —

HP S/N's 3246001 thru 3246017 only, also have service valves on the compressor itself. Due the proximity of the propeller, use of these valves is not recommended for normal servicing. Should these valves be adjusted or removed, be sure to lubricate the O-ring gasket with oil of the same type used in the compressor before securing them to the valve port boss with 0.312-inch bolts. Torque to 15 - 23 inch pounds.

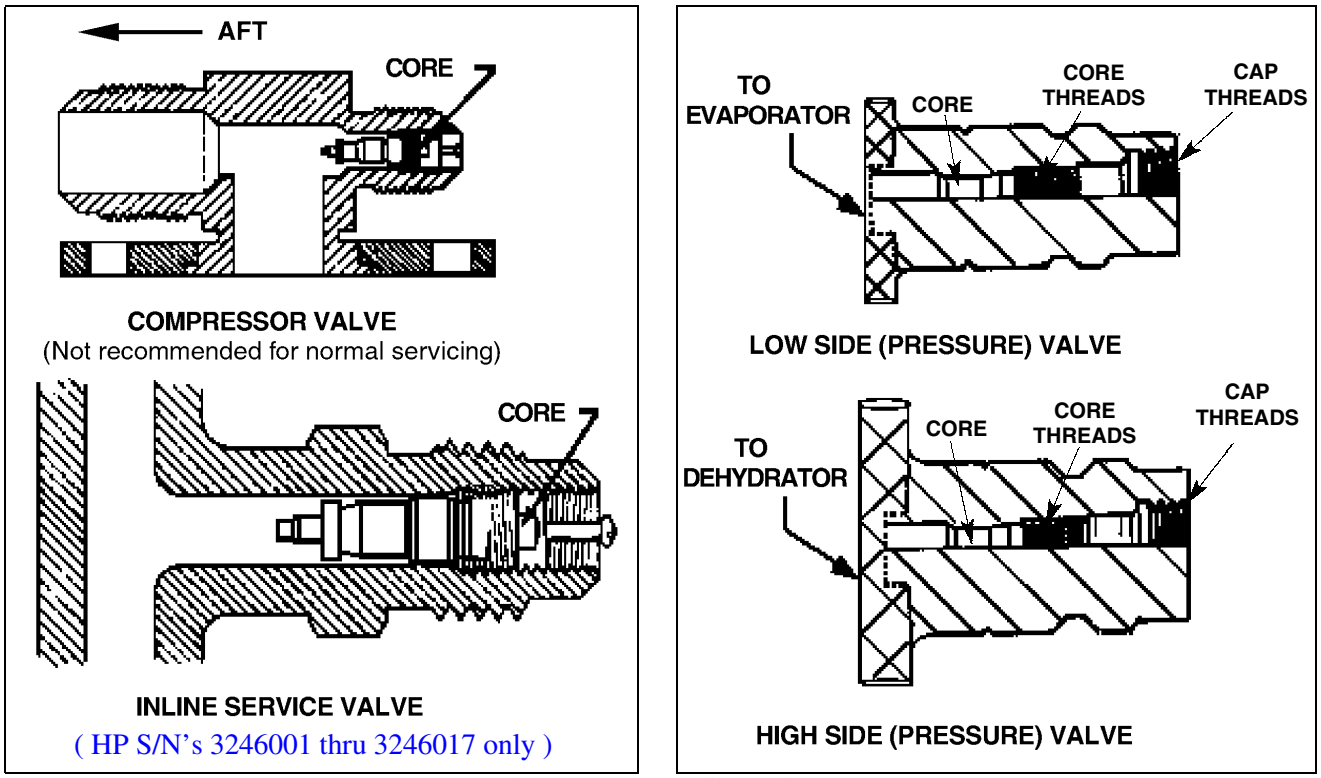

Figure 21-3. Service Valves

COOLING (cont.)

2. Charging Station And Hand Manifold Set

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE INTENTIONAL RELEASE OF REFRIGERANT INTO THE ATMOSPHERE.

United States environmental regulations require that an approved charging station be used when servicing any air conditioning system. The following text, describing the use of a charging station, is in reference to the Robinair 34700, which is for R-134a systems only, and should be augmented by reference to the instructions supplied by Robinair. This does not imply that Piper specifically recommends the use of the Robinair 34700. Refer to the instructions supplied by the manufacturer if another brand of station is employed.

— CAUTION —

BECAUSE MINERAL OIL AND P.A.G. ARE NOT COMPATIBLE, A SEPARATE MANIFOLD TEST SET AND / OR TEST STAND AND RECOVERY SYSTEM MUST BE USED FOR EACH REFRIGERANT TYPE.

— CAUTION —

USE RECOVERY UNIT SPECIFICALLY DESIGNED FOR THE TYPE OF REFRIGERANT USED IN THE AIRCRAFT SYSTEM. UNINTENDED AFFECTS MAY OCCUR IF REFRIGERANTS ARE COMBINED.

HP serial numbers 3246001 thru 3246017 only use R12 refrigerant, which uses mineral oil as a lubricant. The service valves are threaded screw-on type. All others use HFC134a refrigerant, which uses polyalkylene-glycol (P.A.G.) as a lubricant. These service valves are quick disconnect type.

Proper testing and diagnosis of air conditioning system requires a manifold gauge set and/or an appropriate test stand be attached to system. The manifold gauge set comprises a high pressure gauge in the discharge side of the the system and a low pressure gauge in the suction side of the system. The manifold has fittings for both gauges and hose connections for controlling refrigerant flow through manifold (ref. Figures 21-4 and 21-5). The center port of the manifold set is connected to the charging station for evacuating, charging, and servicing the system.

When a manifold set is used in conjunction with a test stand, the test stand low and high pressure valves must be in the OPEN position. Both the high and low side of the manifold set have hand shutoff valves, which are used to control flow with in the system. When a given hand valve is turned clockwise all the way in it closes that particular manifold section. Pressures on that side of system will, however, be recorded on the gauge above the hose, (ref. to Figure 21-6) for connecting manifold to the charging/test stand

Turning either hand valve counterclockwise opens the system to the middle service port of the manifold set. This is desirable only when necessary to let refrigerant out of or into system (ref Figures 21-4 and 21-5). When using only the charging cart/test stand all flow is controlled by the valves on the stand.

COOLING (cont.)

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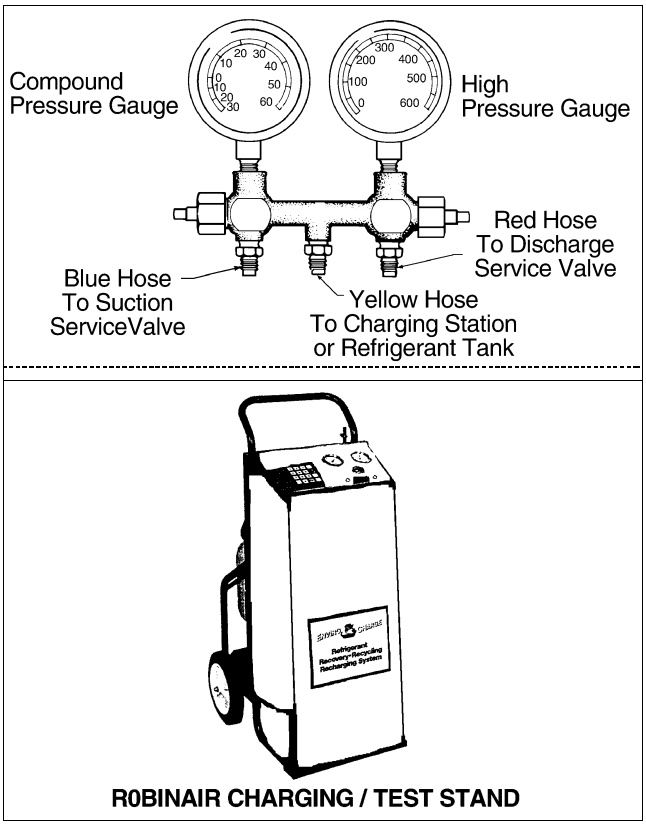

Figure 21-4. Test Manifold and Charging Cart

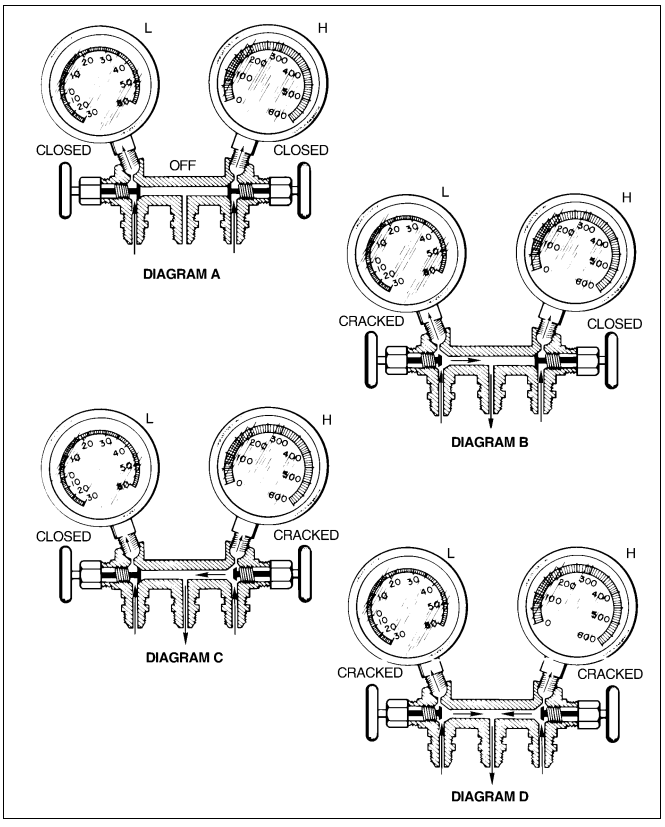

Figure 21-5. Manifold Set Operation

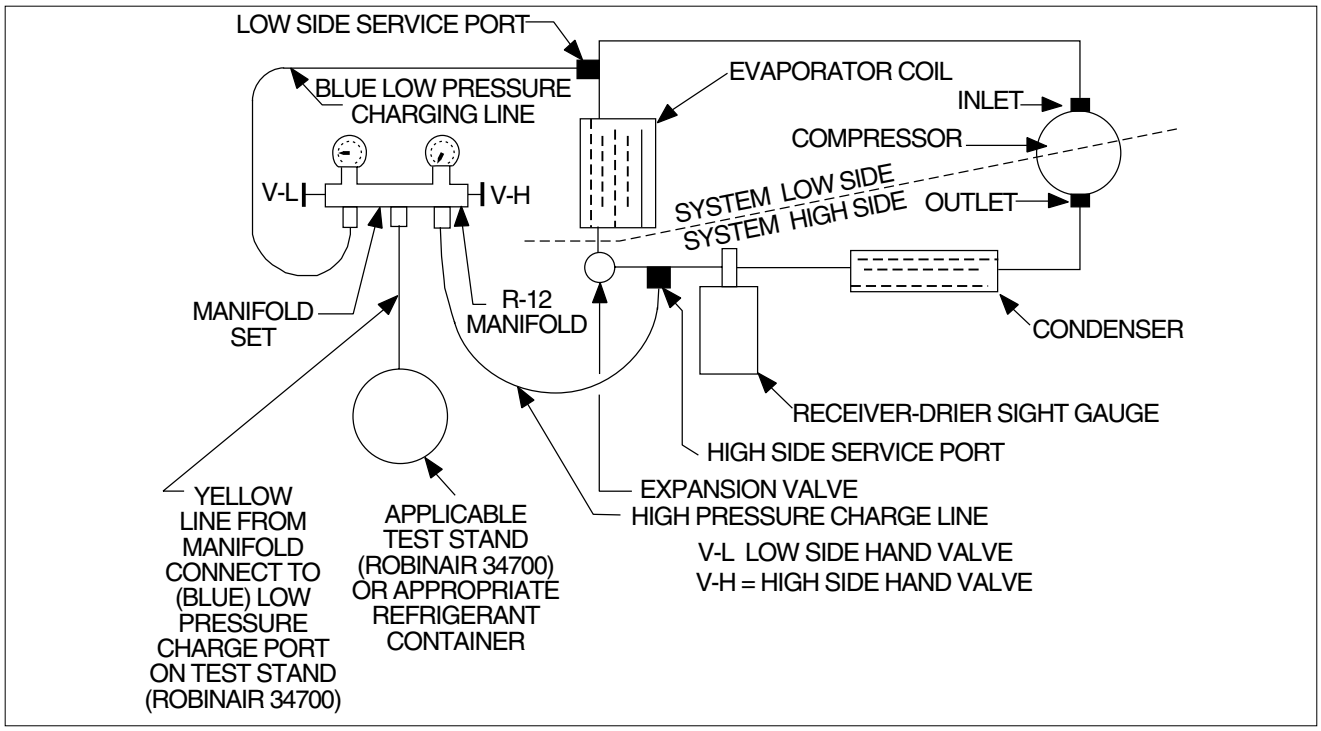

Figure 21-6. Manifold to Recharging/Test Stand Hookup

3. Evacuating The System

— CAUTION —

EVACUATE SYSTEM BEFORE LEAK CHECK.

If system is operated in a discharged condition, or has been open to atmospheric pressure, the receiver / dehydrator must be replaced, and the system evacuated to remove non-condensible gases and any trapped moisture from within the system. Use the Robinair or comparable charging / test stand to evacuate system. Water in vapor form will be pulled from system as lower pressure and lower water boiling temperatures occur. Chart 2105 shows the temperature at which water will vaporize at various vacuum (negative) pressures.

CHART 2105. SYSTEM VACUUM

	System Vacuum	Temperature °F
COMPOUND GAUGE READING IN INCHES OF MERCURY VACUUM	27.95	101
	28.74	84
	29.53	52
	29.76	29
	29.84	15
	29.88	1

— Note —

Compound gauge reading will be approximately one inch lower, numerically, for each 1000 feet elevation above sea level.

COOLING (cont.)

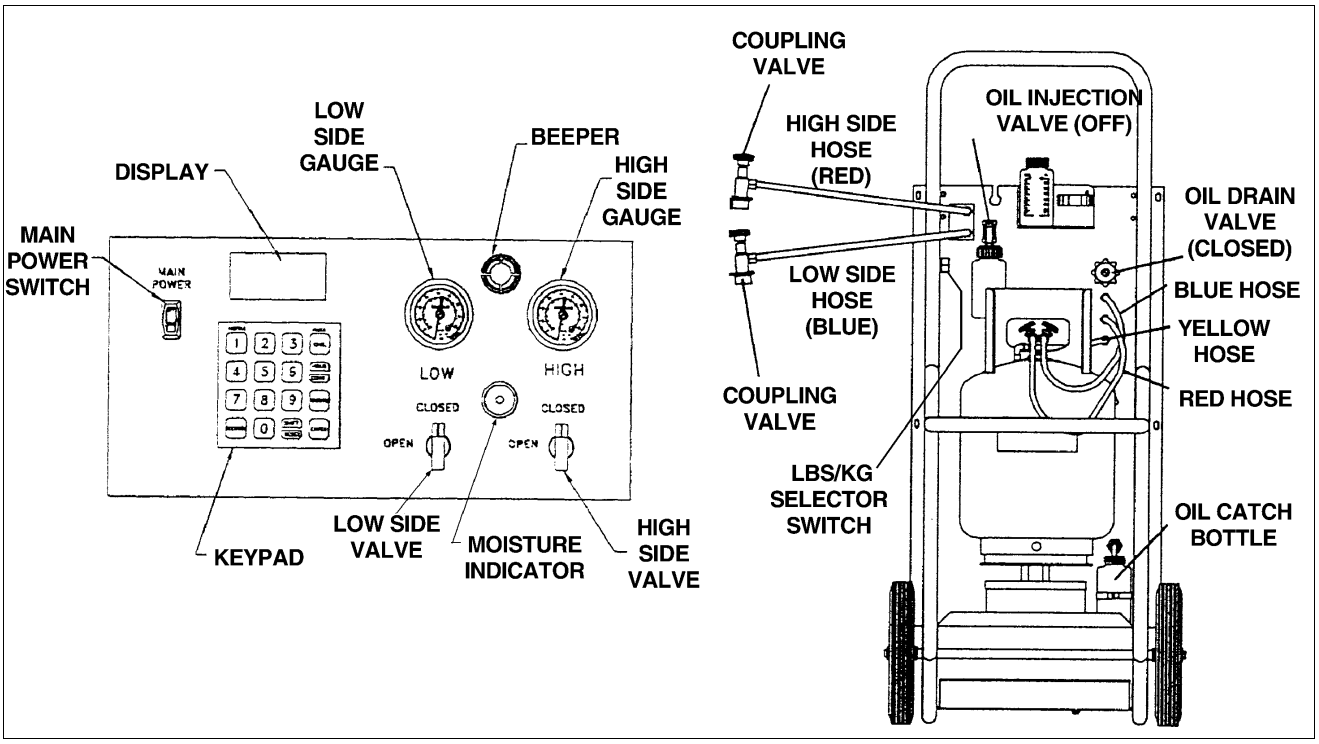

Figure 21-7. Robinair 34700 Control Panel and Hose Connections

a. Using the Robinair 34700 (R-134a systems only) (ref. Figures 21-7 and 21-8)

(1) Remove access panel at rear of cabin to gain access to service valves.
(2) Remove protective caps from the high and low side service ports on the evaporator unit.
(3) Close both the low side and high side valves on charging unit (ref.Figure 21-7).
(4) Connect the blue and red hoses to the service ports (ref Figure 21-8), on systems equipped with quick disconnect connections, open coupler valves
(5) Open blue (low side) valve (1) on unit's control panel
(6) Open both the red GAS (vapor) valve and the blue LIQUID valve on the tank (ref. Figure 21-8).
(7) Program the length of evacuation time.

(a) Press the VACUUM key on control panel key pad.
(b) Display will show unit is in VACUUM mode.
(c) Refer to operator's manual for further detail.

(8) Enter the required time in minutes and seconds (30:00 minutes minimum) by pressing appropriate keys and then ENTER on keypad. The display will show selected time in minutes and seconds. Example: one hour and fifteen minutes (1:15) would be entered as 7500. The display will show 75:00. Thirty minutes is entered as 3000. the display will show 30:00.
(9) To start the vacuum pump press the VACUUM key on keypad again.
(10) Vacuum sequence will continue for the programmed time. Digital display will then show CPL, indicating that the evacuation is completed.

COOLING (cont.)

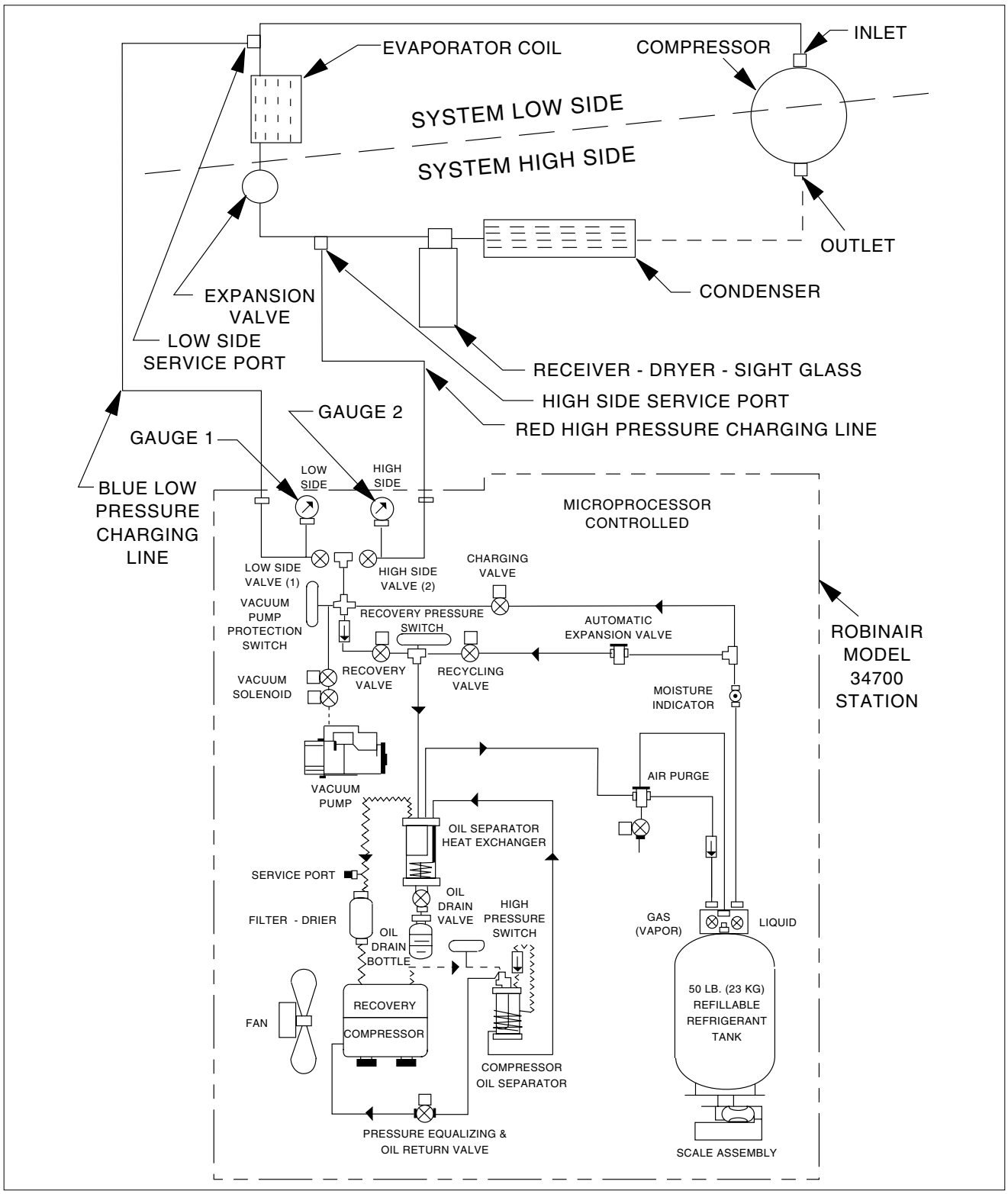

Figure 21-8. Robinair 34700 Hose Hookup

COOLING (cont.)

D. Special Servicing Procedures (cont.)

3. Evacuating The System (cont.)

a. Using the Robinair 34700 (cont.)

(11) If, after 5 minutes of pump operation, the RED gauge does not indicate a little below zero:

(a) Stop the pump by pressing the 1 key or the SHFT/RESET key.
(b) Eliminate blockage in the system by replacing faulty parts.
(c) Repeat steps (1) through (8) above.(12)When RED gauge indicates a little below zero, open red (high side) valve (2), and continue evacuation.

(13) Operate vacuum pump for 0:15 minutes, or until low side gauge (GAUGE 1) indicates 24 to 26 inches of mercury (in. Hg.), whichever occurs first.
(14) Close low side (1) and high side (2) valves.
(15) Stop vacuum pump and observe low side gauge (GAUGE 1). If gauge rises at a rate greater than 1 in. Hg. in 0:05 minutes. there is a leak in the system. Locate leak as described in paragraph 4, Leak Detection.
(16) Repair leak. Repeat steps (1) through (15), as necessary.
(17) With the low side (1) and high side (2) valves OPEN, continue pumping, holding system below 26 in. Hg. for a minimum of 30 minutes.

— Note —

All specified pumping times may be included in the 0:30 minutes, provided no blockage or leaks are noted, and provided the system is not opened by disconnecting or removing components.

(18) When panel display reads CPL (complete), close both the low side valve (1) and the high side (2) valves. Perform charging procedure immediately (see paragraph D.6).

b. Using A Hand Manifold Set

(1) Remove access panel at rear of cabin to gain access to service valves.
(2) Remove protective caps from the high and low side service ports on the evaporator unit.
(3) Disconnect small end of blue hose from low side port of Robinair charging/test stand. Connect yellow manifold hose to units low side port. See manufacturer's instructions for other model charging/test stands (ref. Figure 21-7).
(4) Check that all valves on manifold and test stand are closed. Connect manifold hoses to service valves. On systems equipped with quick disconnect connections, open coupler valves (ref Figure 21-7).
(5) OPEN Low side valve on recharging/test stand.
(6) Open both the red GAS (vapor) valve and the blue LIQUID valve on the tank.
(7) Program the length of evacuation time.

(a) Press the VACUUM key on control panel key pad.
(b) Display will show unit is in VACUUM mode.
(c) Refer to operator's manual for further detail.

COOLING (cont.)

D. Special Servicing Procedures (cont.)

3. Evacuating The System (cont.)

b. Using A Hand Manifold Set (cont.)

(8) Enter the required time in minutes and seconds (30:00 minutes minimum) by pressing appropriate keys and then ENTER on keypad. The display will show selected time in minutes and seconds. Example: one hour and fifteen minutes (1:15) would be entered as 7500. The display will show 75:00. Thirty minutes is entered as 3000. the display will show 30:00.

(9) OPEN the low side manifold hand set valve.

(10) To start the vacuum pump press the VACUUM key on keypad again.

(11) Vacuum sequence will continue for the programmed time. Digital display will then show CPL, indicating that the evacuation is completed.

(12) If, after 5 minutes of pump operation, the high side manifold hand set gauge does not indicate a little below zero:

(a) Stop the pump by pressing the 1 key or the SHFT/RESET key.
(b) Eliminate blockage in the system by replacing faulty parts.
(c) Repeat steps (7) through (10) above.

(13) When High side manifold hand set gauge indicates a little below zero, open High side manifold hand set valve and continue evacuation.

(14) Operate vacuum pump for 15 minutes, or until manifold hand set low side gauge indicates 24 to 26 inches of mercury (in. Hg.), whichever occurs first.

(15) Close manifold hand set low side and high side valves.

(16) Stop vacuum pump and observe manifold hand set low side gauge. If gauge rises at a rate greater than 1 in. Hg. in 5 minutes, there is a leak in the system. Locate leak as described in paragraph 4, Leak Detection.

(17) Repair leak. Repeat steps (7) through (15), as necessary.

(18) With the manifold hand set low side and high side valves OPEN, continue pumping, holding system below 26 in. Hg. for a minimum of 30 minutes.

— Note —

All specified pumping times may be included in the 30 minutes, provided no blockage or leaks are noted, and provided the system is not opened by disconnecting or removing components.

(19) When panel display reads CPL (complete), close the manifold hand set low side and high side valves. Perform charging procedure immediately. (see paragraph D.6)

COOLING (cont.)

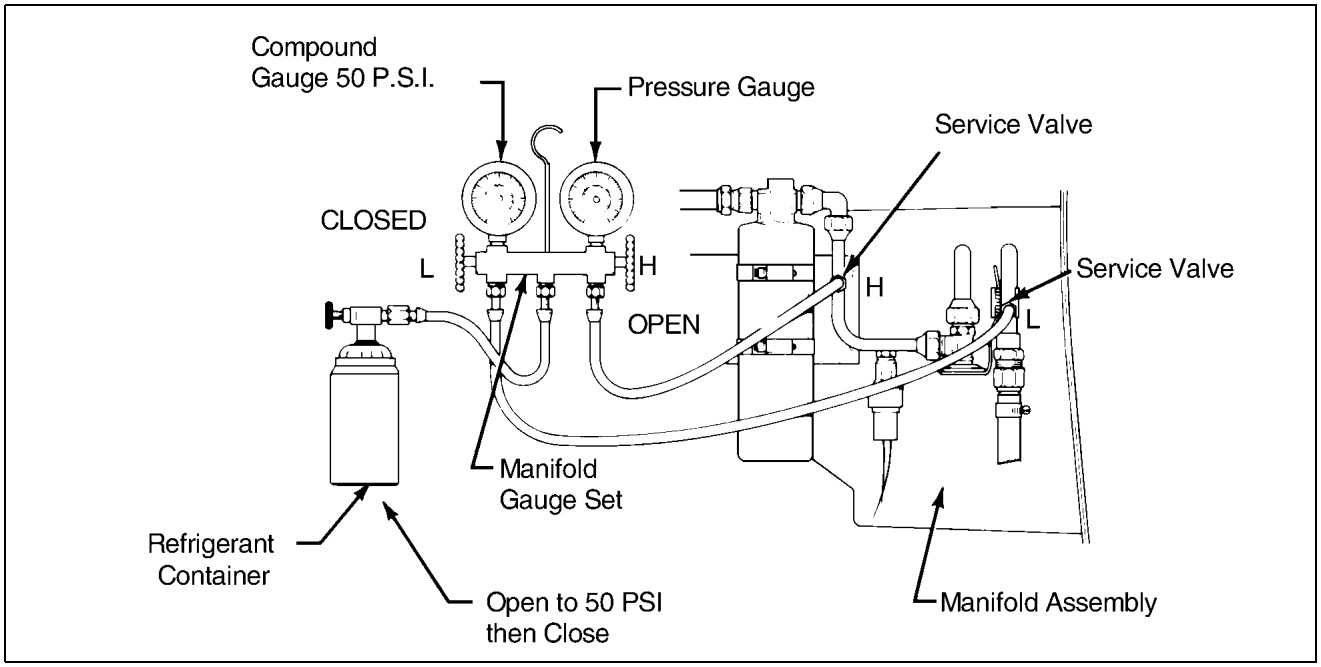

Figure 21-9. Leak Test

D. Special Servicing Procedures (cont.)

4. Leak Detection (reference Figure 21-9)

— WARNING —

DO NOT USE AN OPEN FLAME LEAK DETECTOR.

a. Using the Robinair 34700 (R-134a systems only) charging/test station

If step (15) in paragraph D, 3, a, above, indicates a leak, and location of the leak is not obvious, use the following procedure to locate leak.

(1) If recharge/test stand is not already connected to system, follow steps (1) through (4) in paragraph D, 3, a, above.
(2) Open the high side (2) valve and allow 1/2 pound of refrigerant to enter the system. Close high (2) side valve. (refer to Figure 21-7 and 21-8.)
(3) Locate leak(s) using an electronic leak detector designed to detect R134a refrigerant. Or, use soap and water in a thick solution.
(4) Repair leak(s).
(5) Discharge system per paragraph D, 5.
(6) Perform evacuation procedure per paragraph D, 3, a.
(7) Immediately perform charging procedure per paragraph D, 6.

COOLING (cont.)

b. Using A Manifold Hand Set.

If step (16) in paragraph D, 3, b, above, indicates a leak, and location of the leak is not obvious, use the following procedure to locate leak.

(1) Close both the low side and high side valves on manifold hand set.
(2) Disconnect manifold hand set middle port (yellow) hose from low side port on charging stand and connect it to a container of R12 or HFC134a refrigerant, as appropriate.
(3) Open refrigerant container service valve.
(4) Open the manifold hand set high side valve until a pressure of 50 psig is reached on low side gauge. Close high side valve.
(5) Locate leak(s) using an electronic leak detector designed to detect R12 and/or R134a refrigerant, as appropriate. Or, use soap and water in a thick solution.
(6) Repair leak(s)
(7) Check that the both high side and low side valves on the manifold hand set are closed.
(8) Close service valve on refrigerant container. Disconnect yellow manifold hand set center hose from refrigerant container.
(9) On systems equipped with quick disconnect connections, close coupler valves. Disconnect manifold hand set red and blue hoses from airplane service ports. Remove manifold hand set.
(10) Recover remaining refrigerant from system using the Robinair 34700 (or other approved) charging station (ref. paragraph D, 5). Any quantity of oil recovered from aircraft must be measured and an equal amount of new oil (mineral oil or P. A. G., as appropriate) must be added to system before recharging.
(11) On systems equipped with quick disconnect connections, close coupler valves. Disconnect charging/test station from service ports.
(12) Perform evacuation procedure per paragraph D, 3, b.
(13) Immediately charge system per paragraph D, 6.

5. Discharging (Bleeding or Purging) System (ref. Figure 21-7).

This procedure is required when it is necessary to remove all refrigerant from air conditioning system. The following instructions pertain to the Robinair 34700 charging/recovery station. Refer to manufacturers instructions when using a different make station.

— CAUTION —

BECAUSE UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE RELEASE OF REFRIGERANT INTO THE ATMOSPHERE, AN APPROPRIATELY CERTIFIED CHARGING / RECOVERY STATION MUST BE USED TO DISCHARGE ANY AIR CONDITIONING SYSTEM.

— Note —

See Operator's Manual for detailed instructions for discharging system.

a. Gain access to service valves by removing rear access panel.
b. Remove protective caps from access valves.

COOLING (cont.)

c. Connect high side (red) hose to air conditioner high side service valve. On systems equipped with quick disconnect connections, open coupler valve.
d. Connect low side (blue) hose to air conditioner low side service valve. On systems equipped with quick disconnect connections, open coupler valve.
e. Check the low side gauge (GAUGE 1) and high side gauge (GAUGE 2) to determine that there is pressure in the system. If there is no pressure, there is no refrigerant in the system to recover.
f. Check that the oil drain valve is closed.
g. Open both the low side and high side valves on control panel.
h. Open the red GAS (vapor) and the blue LIQUID valves on the charging station's refrigerant tank.
i. Slowly open the oil drain valve to see if system oil separator contains oil. If it does, let oil drain into the oil drain bottle (located at the bottom of the rear side of the charging station) until separator is empty.
j. Close the oil drain valve. Dispose of collected oil in an environmentally accepted manner. Return collection bottle to its place on the charging stand.
k. Plug unit into a proper voltage outlet. Turn MAIN POWER switch ON.
l. Press the RECOVER key on charging station keypad.
m. To assure complete recovery of refrigerant:

(1) Wait 5 minutes. Observe pressure gauges for a rise above zero (0),
(2) If a rise occurs, press the HOLD/CONT keys.
(3) Repeat as necessary until system maintains pressure for two minutes.

— Note —

Drain oil separator after each job. Display will indicate OIL (OUNCES) or (GRAMS) as a reminder

n. Slowly open oil drain valve. Drain oil into the oil catch bottle. When all recovered oil has been completely drained, close oil drain valve.
o. Measure the amount of oil in the catch bottle. The same amount of new oil must be added to the system before charging the system.
p. To enter diagnostic mode simultaneously press the SHIFT/RESET and ENTER keys To display the amount of refrigerant recovered by the unit, press the 3 key. The panel display will read the amount of recovered refrigerant in pounds or kilograms.
q. Simultaneously press the SHIFT/RESET and ENTER keys to clear internal counter. Press SHIFT/RESET to return to the main menu.

COOLING (cont.)

6. Charging The System

— CAUTION —

SERVICE VALVES ON R12 SYSTEMS ARE THE THREADED SCREW-ON TYPE. SERVICE VALVES ON R134A SYSTEMS ARE THE QUICK DISCONNECT TYPE.

— CAUTION —

USE ONLY SERVICING UNIT SPECIFICALLY DESIGNED FOR TYPE OF REFRIGERANT. THE SAME SERVICING UNIT CANNOT BE USED FOR BOTH TYPES OF REFRIGERANT.

— CAUTION —

ADD REFRIGERANT THROUGH THE LOW PRESSURE SIDE ONLY.

— CAUTION —

BECAUSE UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE RELEASE OF REFRIGERANT INTO THE ATMOSPHERE, AN APPROPRIATELY CERTIFIED CHARGING STATION MUST BE USED TO CHARGE ANY AIR CONDITIONING SYSTEM.

a. Using Robinair 34700 (R-134a systems only) charging stand (ref. Figure 21-7).

When system is able to maintain 24 to 26 in Hg. pressure on the low side gauge (GAUGE 1) per paragraph D, 3, a, (13) through (15), or D, 3.b.(14) through (16), above, charge system as follows:

(1) Check that main power switch is OFF.

— CAUTION —

DO NOT PLACE ANY WEIGHT, INCLUDING HANDS AND/OR FEET, ON REFRIGERANT TANK OR SCALE DURING CHARGING PROCESS. ANY WEIGHT DISTURBANCE WILL CAUSE AN INCORRECT TRANSFER OF REFRIGERANT.

(2) Check that the LBS/KG. selector switch on back of unit is in desired measurement mode.

— Note —

You may enter the amount of refrigerant to be charged when the unit is turned ON. The unit will store the amount in memory until it is turned off.

COOLING (cont.)

(3) Open the low side (blue) valve on units control panel.
(4) If message PROGRAM and CHANGE do not display, press the CHG key to enter the PROGRAM mode.

— Note —

The amount of refrigerant required must be determined for each airplane. It is the amount that will result in bubble-free operation at the system sight gauge specified in paragraph D, 7, Post Charging Operational Check.

(5) Enter amount of refrigerant required to charge the system by pressing the appropriate number keys and ENTER on keypad.
(6) To begin charging process, press CHG key on keypad.

(a) The digital display will read AUTOMATIC and show the amount of refrigerant programmed for the charge.
(b) As the solenoid opens, it will make and audible sound.
(c) The display will countdown to zero, and display message CPL, when charging is complete.

(7) Close low side (blue) valve. Check that the high (red) valve is also closed. Also close coupler valves.
(8) Perform post charging operational check per paragraph D, 7.

b. Using Airplane Compressor to Charge System

This method is the least desirable due to the requirement of operating the airplane's engine to run the compressor.

— WARNING —

IF THE AIR CONDITIONER IS TO BE OPERATED DURING GROUND SERVICING, THE TEST AREA SHOULD BE CLEAN AND FREE OF ANY LOOSE OBJECTS LYING ON THE RAMP. ONLY THE SERVICE VALVE LOCATED ON THE EVAPORATOR ASSEMBLY SHOULD BE USED FOR TESTING.

(1) With the system evacuated as outlined in the paragraph "Evacuating the System," connect the refrigerant charging hose to the manifold (refer to Figure 21-9a) and purge the charging hose of air.
(2) Place the refrigerant container on a scale to observe the amount of refrigerant entering the system. Open the high pressure valve and add as much refrigerant as possible.
(3) Close the high pressure valve, start the engine and operate it at 900 to 1000 rpm.
(4) Operate the air conditioner and set controls to maximum cooling.
(5) Open the low pressure valve and complete charging the system.
(6) Close the low pressure valve after two pounds of refrigerant have been added to the system.
(7) With the system still operating, observe the sight glass in the top of the receiver / dehydrator by removing the plastic plug.

COOLING (cont.)

(8) The sight glass should be clear of any bubbles or foam. If bubbles or foam are seen passing through the sight glass, it is an indication of a low refrigerant charge in the system and more refrigerant is required. This check should be made with OAT of 70°F or higher and with the air conditioner operating.

(9) If more refrigerant must be added to the system, open the low pressure valve and increase engine speed to 2000 rpm and observe the sight glass. After the sight glass has cleared, close the low pressure valve and observe the pressure gauges. At 1000 rpm, the gauge pressure should be 15 to 20 psi on the low side and 150 to 200 on the high side.

— Note —

Suspect leaks or an inaccurate scale if 2.25 pounds of refrigerant does not fill the system.

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

— Note —

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

(11) Install caps on service ports.

(12) Replace access panel.

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COOLING (cont.)

c. Partial Charge to System

The system can be topped off with refrigerant by the following method.

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

— Note —

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

(11) Shut off the air conditioner and engine. Remove the charging hose from the Schrader valve with care due to refrigerant remaining in the line.
(12) Install caps on service ports.
(13) Replace the access panels.

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COOLING (cont.)

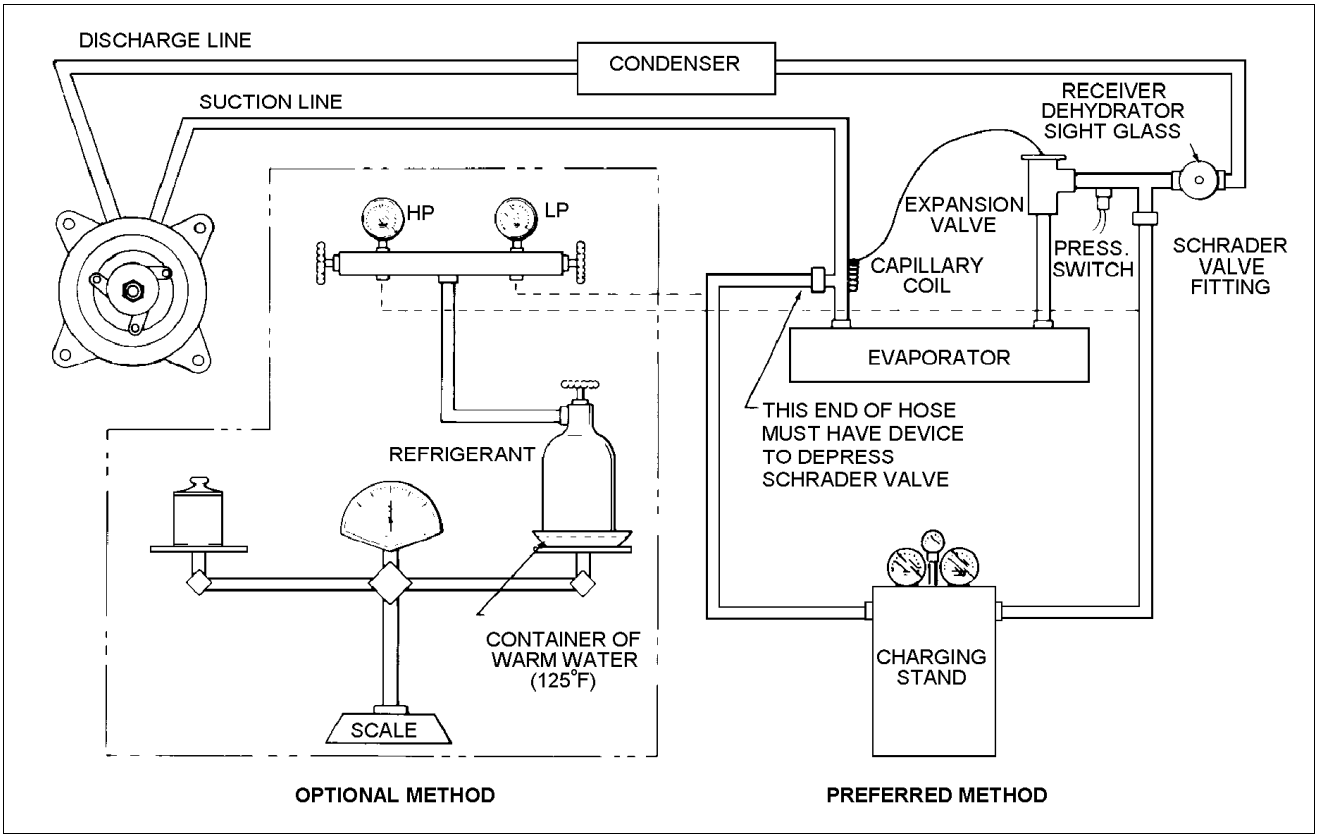

Figure 21-9a. Optional Charging Hookups (Typical)

7. Post Charging Operational Check

— WARNING —

VERIFY AREA AROUND THE AIRPLANE IS CLEAR AND THAT A QUALIFIED PERSON IS AT THE AIRPLANE CONTROLS.

— Note —

Airplane must be headed into the wind during the following check.

a. Using Robinair 34700 (R-134a systems only) charging stand.

(1) Check that the charging stand's blue hose is connected to the airplane's low side service port.
(2) Check that the charging stand's red hose is connected to the airplane's high side service port.
(3) Ensure that the charging stand's low and high side valves are both closed.
(4) If system uses HFC134a refrigerant, check that the coupler valves on both hoses are open.
(5) Start engine.
  (a) Operate at 1000 rpm for two minutes. Check sight gauge for bubbles.
  (b) Operate at 2000 rpm for two minutes. Check sight gauge for bubbles.
(6) Any bubbles passing through sight gauge indicates that additional refrigerant is required.

COOLING (cont.)

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT ADDING REFRIGERANT TO ANY AIR CONDITIONING SYSTEM WITH LEAKS.

(7) Add refrigerant slowly through the low side valve until sight gauge remains bubble free.
(8) Operate engine at 1000 rpm to 1500 rpm. The low and high side gauges on the control panel should indicate as follows:

GAUGE	AMBIENT TEMPERATURE	GAUGE INDICATION
Low Side (Pressure)	All	10 to 35 psig
High Side (Pressure)	Up thru 75° F	125 psig minimum to 175 maximum psig
High Side (Pressure)	Over 75° F	150 psig minimum to 300 maximum psig

(9) When charge is properly established:
  (a) Stop engine.
  (b) If system uses HFC134a refrigerant, close coupler valves
  (c) Close low side valve on control panel.
(10) Disconnect charging stand hoses from service valves.
(11) Install protective caps on service valve.
(12) Install rear close out panel.

b. Using A Hand Manifold Set.

— CAUTION —

ADD REFRIGERANT THROUGH THE LOW PRESSURE SIDE ONLY.

(1) Check the the blue hose on manifold set is connected to the airplane's low side service port.
(2) Check that the red hose on manifold set is connected the airplane's high side service port.
(3) Check that the yellow hose on manifold set is connected to a tank of appropriate refrigerant (R12 for HP S/N's 3246001 thru 3246017 only; HFC134a for all others).
(4) Ensure that both the low and high side (pressure) valves are closed.
(5) If system uses HFC134a refrigerant, check that the coupler valves on both hoses are open.
(6) Start engine.
  (a) Operate at 1000 rpm for two minutes. Check sight gauge for bubbles.
  (b) Operate at 2000 rpm for two minutes. Check sight gauge for bubbles.
(7) Any bubbles passing through sight gauge indicates that additional refrigerant is required.

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT ADDING REFRIGERANT TO ANY AIR CONDITIONING SYSTEM WITH LEAKS.

(8) Open refrigerant tank valve.
(9) Add refrigerant slowly through the low side valve until sight gauge remains bubble free.

COOLING (cont.)

(10) Operate engine at 1000 rpm to 1500 rpm. The low and high side gauges on the manifold set shall indicate as follows:

GAUGE	AMBIENT TEMPERATURE	GAUGE INDICATION
Low Side (Pressure)	All	10 to 35 psig
High Side (Pressure)	Up thru 75° F	125 psig minimum to 175 maximum psig
High Side (Pressure)	Over 75° F	150 psig minimum to 300 maximum psig

(11) When charge is properly established:
- (a) Stop engine.
- (b) Close valve on refrigerant tank.
- (c) If system uses HFC134a refrigerant, close coupler valves
- (d) Close low side valve on manifold set.

(12) Disconnect manifold set hoses from service valves.
(13) Install protective caps on service valve.
(14) Install rear close out panel.

E. Component Service

1. Compressor Service.

— CAUTION —

PREVENT DIRT OR FOREIGN MATERIAL FROM ENTERING SYSTEM. CAP ALL HOSE AND TUBING ENDS IMMEDIATELY. USE SAME TYPE REFRIGERANT OIL AS IN COMPRESSOR (MINERAL OIL FOR HP S/N'S 3246001 THRU 3246017 ONLY; PAG FOR ALL OTHERS) TO LUBRICATE COMPONENTS FOR ASSEMBLY.

Do not service compressor in the field. Service must be done by a qualified shop having special equipment and trained personnel to properly service unit.
Maintenance to unit and related components is limited to worn drive belt and magnetic clutch replacement. Other service requires compressor removal from system.

a. Compressor Removal.

— CAUTION —

CAP ALL OPEN LINES IMMEDIATELY TO PREVENT DIRT AND MOISTURE FROM ENTERING SYSTEM.

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE RELEASE OF REFRIGERANT INTO THE ATMOSPHERE. SPECIAL EQUIPMENT IS REQUIRED WHEN DISCHARGING OR CHARGING SYSTEM.

COOLING (cont.)

(1) Circuit protector for air conditioning system must be off.
(2) Remove engine cowl and right front baffles.
(3) Disconnect electrical leads to magnetic clutch on compressor.
(4) Using an approved refrigerant recovery system, completely discharge and depressurize air conditioning system. Refer to paragraph D, 5.
(5) Remove suction and discharge lines from compressor.
(6) Loosen bolt securing compressor idler pulley to release belt tension and remove belt from compressor pulley. (Do not force belt over pulleys.)
(7) Support compressor and remove bolts securing compressor to engine mounting brackets and remove compressor from engine compartment.

b. Compressor Installation.

— WARNING —

IF AIR CONDITIONER IS OPERATED ON GROUND FOR SERVICING, CLEAR TEST AREA OF LOOSE OBJECTS. ENSURE THAT A QUALIFIED PERSON IS AT THE AIRPLANE CONTROLS. USE SERVICE VALVES ON EVAPORATOR ASSEMBLY FOR TESTING.

(1) Place compressor to mounting bracket(s).

(a) In HP S/N's 3246001 thru 3246087 only: Install bolts and progressively tighten to a torque of 14 - 17 foot pounds. (Safety all bolts with 0.032 safety wire.).
(b) In TC S/N's 3257001 & up and HP S/N's 3246088 & up: Install bolts and progressively tighten to a torque of 30 foot pounds. (Safety with cotter pins). If required, adjust compressor drive sheave forward and aft alignment by adding shims (LYC. P/N 76534 - 1.130 IN. OD x .410 IN. ID x .005 IN. THK) between the compressor mounting bracket and compressor mounting ears. See paragraphs E.2.b and c for additional alignment details.

(2) Check oil level in compressor as described in paragraph E, 1, c, Checking Compressor Oil.

— CAUTION —

DO NOT FORCE BELT INTO PULLEY SHEAVE. IF NECESSARY, REMOVE IDLER ASSEMBLY.

(3) Place drive belt over clutch pulley and adjust alignment of pulleys and belt as described in paragraphs E.1.d and e.
(4) Connect discharge and suction lines to service valves on evaporator unit.
(5) Evacuate system per paragraph D, 3.
(6) Charge system per paragraph D, 6.
(7) Install right front baffle.
(8) Install engine cowl.

c. Checking Compressor Oil

Check oil level each time system is discharged, an oil leak is suspected, or it is specified as a diagnostic procedure. Check compressor oil as follows:

COOLING (cont.)

(1) York Compressor (HP's 3246001 thru 3246087 only):

— WARNING —

DO NOT REMOVE OIL PLUG WITH PRESSURE IN SYSTEM.

— CAUTION —

THE 10 OUNCE OIL LEVEL IS REQUIRED IN COMPRESSORS INSTALLED ON NEW SYSTEMS. SOME OIL IS DISTRIBUTED IN THE SYSTEM DURING OPERATION. CHARGE REPLACEMENT COMPRESSORS WITH 10 OUNCES OF OIL.

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE RELEASE OF REFRIGERANT INTO THE ATMOSPHERE. SPECIAL EQUIPMENT IS REQUIRED WHEN EVACUATING, DISCHARGING OR CHARGING SYSTEM.

(a) Discharge system. (ref. discharging.)
(b) Make an oil dipstick. (ref. Figure 21-10)
(c) Remove 0.375 inch oil fill plug in top side of compressor crankcase.
(d) Before inserting dipstick, crankshaft Woodruff key must be in up position. (Front face of compressor clutch is marked with a stamped K indicating key position.) Measure oil level from lowest point in crankcase. Use long end of dipstick (ref. Figure 21-10).
(e) When compressor is installed, use Chart 2106 for proper amount of oil in crankcase.

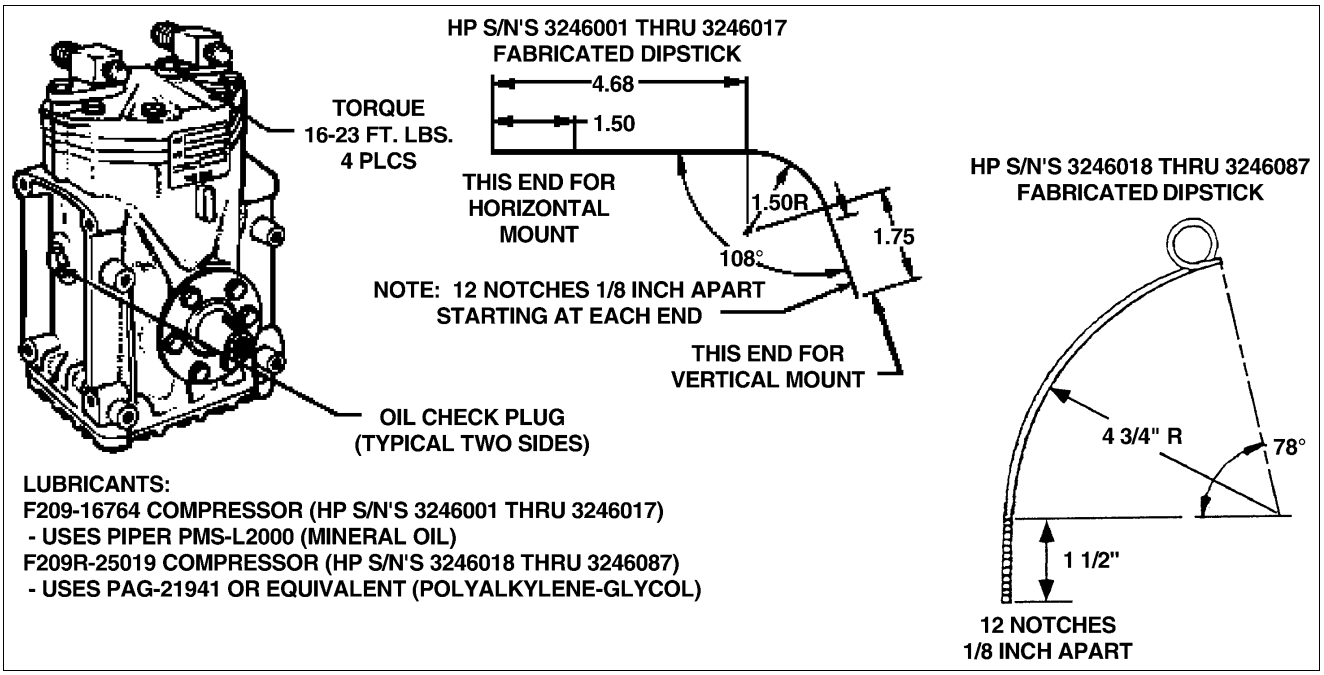

Figure 21-10. York Compressor and Fabricated Oil Dipstick (HP S/N's 3246001 thru 3246087 only)

COOLING (cont.)

CHART 2106. YORK COMPRESSOR OIL CHARGE

Oil (Oz.)	6	8	10	16
Dipstick Reading (In.)	$^{13}/_{16}$	1	$1\ ^{3}/_{16}$	$1\ ^{15}/_{16}$

(f) Do not operate compressor with less than 6 ounces oil. Do not add more than 10 ounces oil. On systems using R-12 refrigerant (HP S/N's 3246001 thru 3246017 only), use Piper refrigerant oil PMS-L2000 or equivalent 500 viscosity refrigerant oil. On systems utilizing HFC-134a (HP S/N's 3246018 thru 3246087) use PAG-21941 or equivalent.

(g) Evacuate and charge system. (Per evacuating the system and charging the system.)

(2) Sanden Compressor (HP's 3246088 & up and TC S/N's 3257001 & up):

(a) Run the compressor for ten minutes at engine idle RPM.

(b) Discharge system, recovering all refrigerant (refer to paragraph D,5). Be careful not to lose oil.

(c) Determine the mounting angle (or cant) by positioning an angle gauge across the flat surfaces of the two front mounting ears. Center the bubble and read the mounting angle to the nearest degree (needed for step h).

— Note —

From the factory, the mounting angle is essentially zero, but this procedure may be of use if the airplane is being serviced on a slope or uneven surface.

(d) Fabricate a dipstick as shown in Figure 21-11.

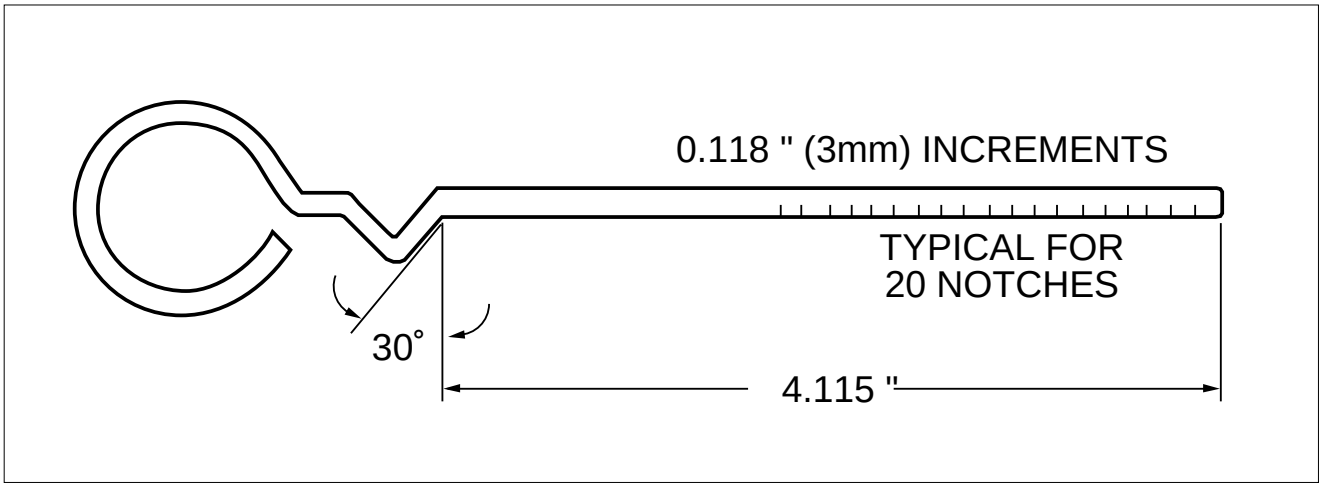

Figure 21-11. Fabricated Oil Dipstick for Sanden Compressor

(e) Remove oil filler plug. Referring to Figure 21-12, determine if the compressor is mounted with a right or left cant and rotate the counterweight located on the front of the clutch until it is at the angle shown relative to the oil filler hole.

COOLING (cont.)

(f) Insert the dipstick to its "Stop" (the bend near the top of the dipstick) as shown in Figure 21-12. Ensure the point of the bend is oriented appropriately for the cant of the compressor mount.
(g) Remove dipstick, count notches of oil.
(h) Using Chart 2107, determine correct oil level.

CHART 2107. SANDEN COMPRESSOR OIL LEVEL VS. MOUNTING ANGLE

Mounting Angle	0°	10°	20°	30°	40°	50°	60°	90°
Oil Level (in notches)	3-5	5-7	6-8	7-9	8-10	8-10	9-11	9-11

(i) If the dipstick measured oil level is not within acceptable limits; add or subtract oil in one ounce increments until the correct level is achieved. Care should be taken to achIeve the precise mid-range value. I.E. - if the angle is 20°, the desired oil level is 7.

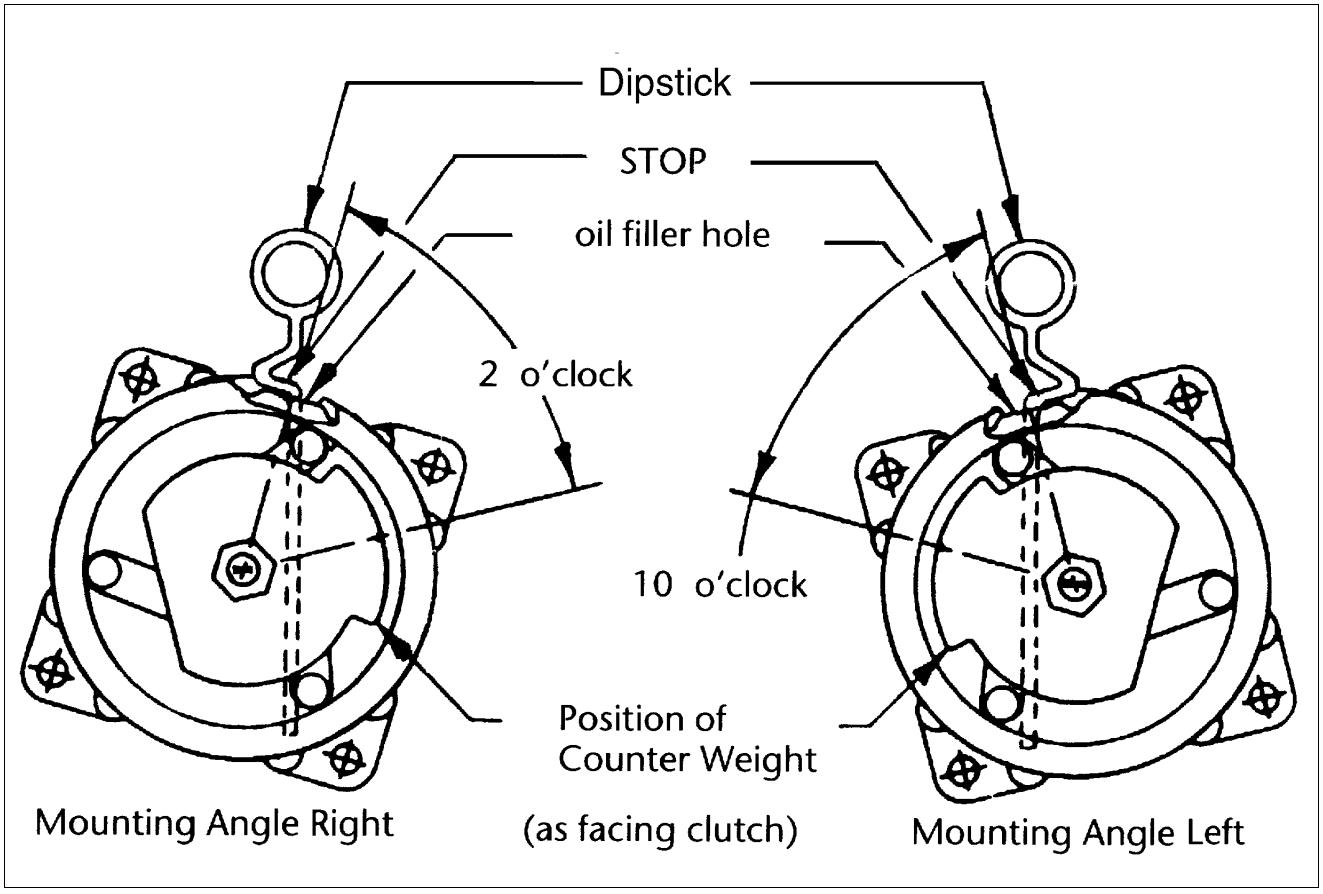

Figure 21-12. Sanden Compressor Oil Measurement

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COOLING (cont.)

2. Drive Belt Service.

   a. Replacement of Compressor Drive Belt (ref. Figure 21-13).

      (1) Remove old belt by removing spinner, propeller, nose cowl, engine baffles as required, starter ring gear assembly, and drive belt.

— CAUTION —

DO NOT FORCE BELT INTO PULLEY SHEAVE. REMOVE IDLER ASSEMBLIES, IF NECESSARY, AND ALTERNATOR LOWER MOUNTING BOLTS TO INSTALL BELT.

      (2) Position new belt on starter ring gear sheave.
      (3) Install starter ring gear assembly, propeller, and spinner.
      (4) Route belt to proper pulley sheaves.

   b. Alignment of Compressor Drive Belt (ref. Figure 21-13).

      Check and adjust compressor belt and pulley alignment as follows:

      (1) Establish a datum line for checking belt and pulley alignment by clamping a straightedge to the forward machined edge of the ring gear.

— CAUTION —

VERIFY THE STRAIGHTEDGE HAS SOLID CONTACT WITH THE SURFACE OF THE RING GEAR TO ENSURE TRUE READINGS.

      (2) Obtain the nominal compressor belt offset at the ring gear. Measure the dimension from the forward edge of the compressor belt (in its ring gear sheave) to the forward machined surface of the ring gear.
      (3) Measure actual compressor belt offset at the compressor sheave (Point-B). Measure the dimension from the forward edge of the compressor belt (in its compressor sheave) to the aft surface of the straightedge.

         (a) In HP S/N's 3246001 thru 3246087 only, note the measurement.
         (b) In TC S/N's 3257001 & up and HP S/N's 3246088 & up, if the compressor sheave offset is extreme, it may be adjusted by adding (or removing) shims between the compressor mounting ears and the compressor mounting bracket as described in paragraph E.1.b, Compressor Installation. If zero offset is not obtainable, note the measured offset.

      (4) Measure actual compressor belt offset at the compressor idler pulley (Point-A). Measure the dimension from the forward edge of the compressor belt (in its idler sheave) to the aft surface of the straightedge. Belt offset at Point-A should be approximately half the offset (if any) measured at Point-B.

COOLING (cont.)

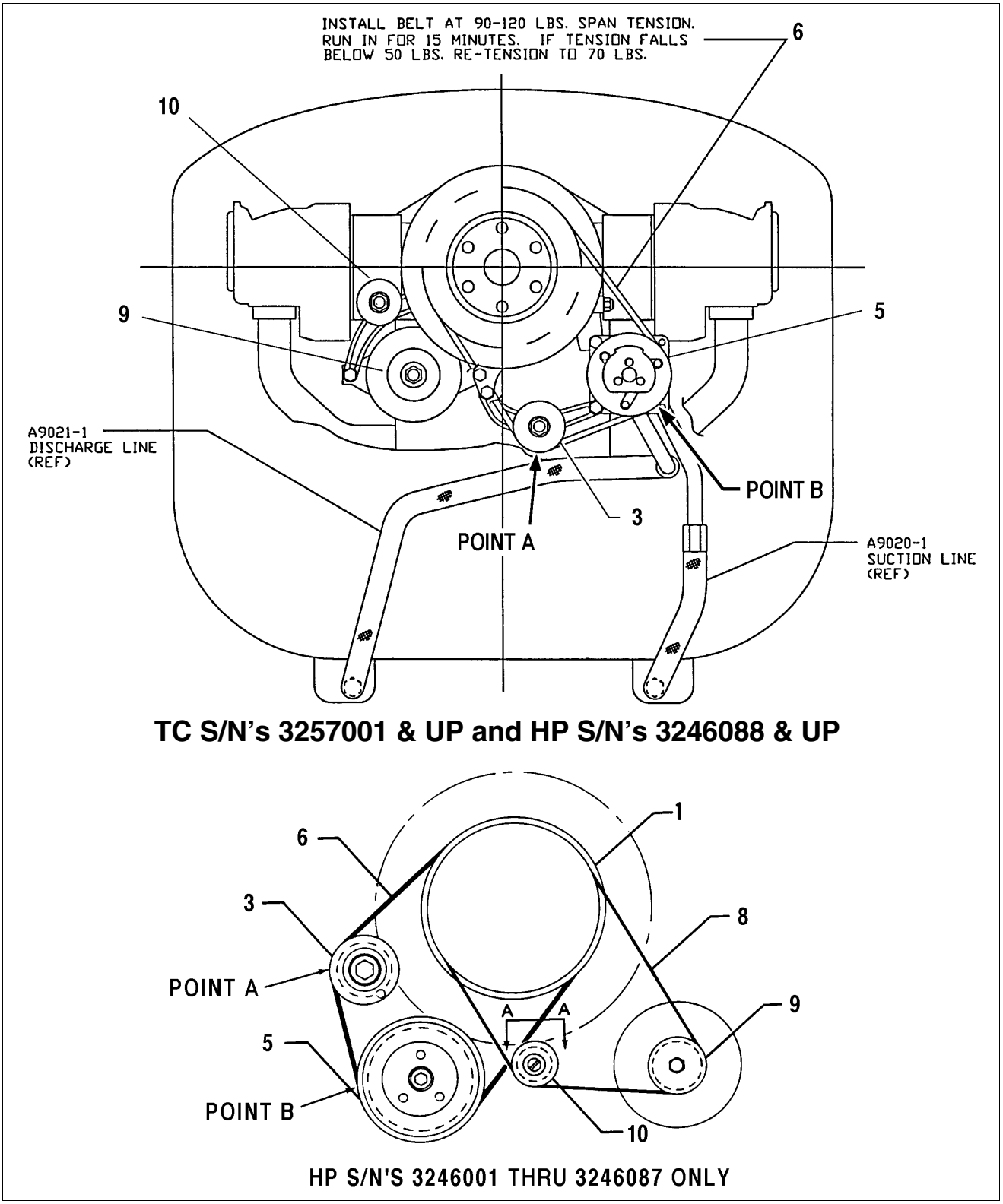
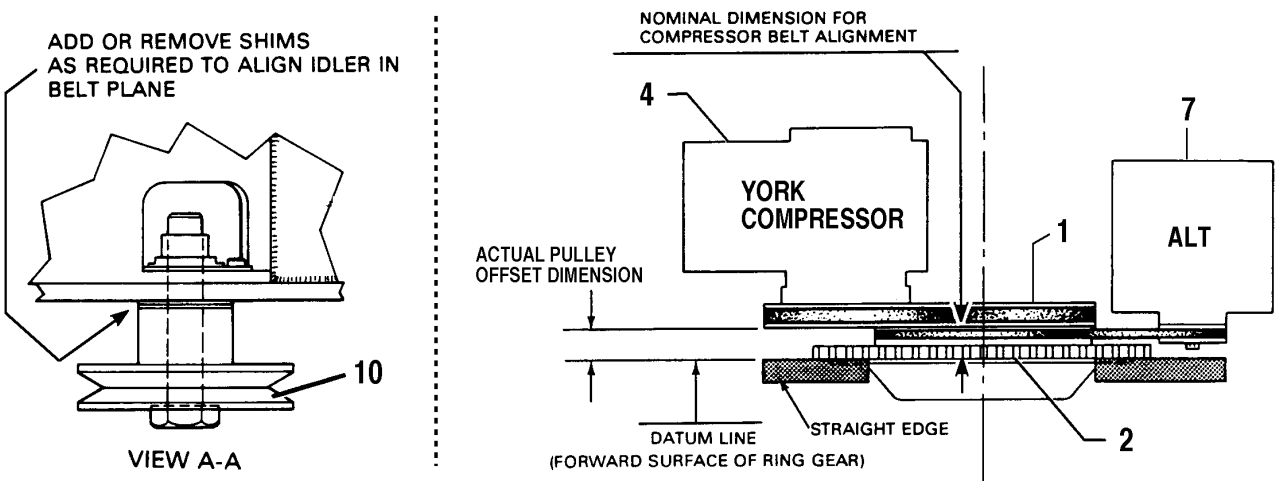
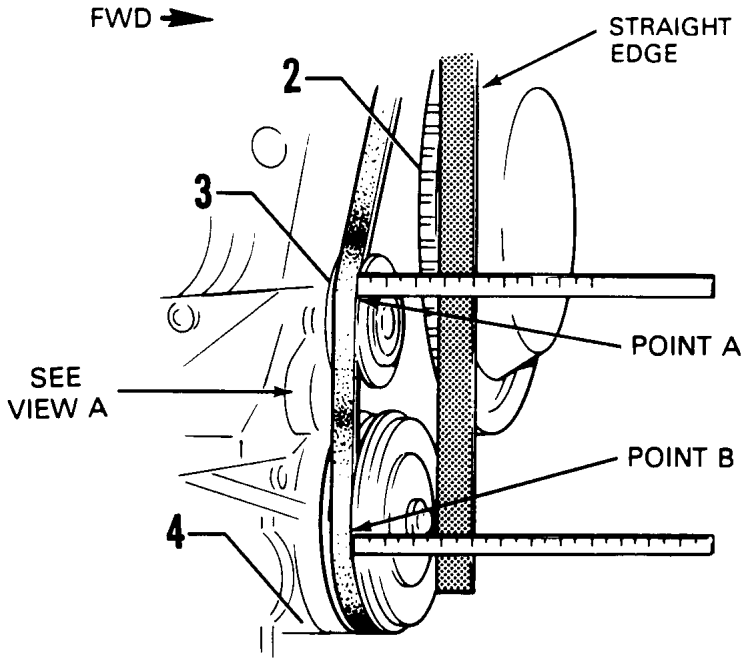
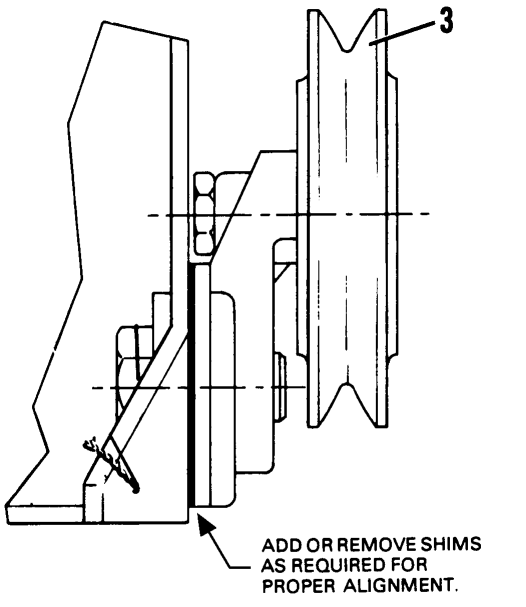


Figure 21-13. Compressor and Alternator Belt Installation







1. RING GEAR SHEAVE	6. COMPRESSOR DRIVE BELT
2. RING GEAR	7. ALTERNATOR
3. COMPRESSOR IDLER PULLEY	8. ALTERNATOR DRIVE BELT
4. COMPRESSOR	9. ALTERNATOR SHEAVE
5. COMPRESSOR SHEAVE	10. ALTERNATOR IDLER PULLEY

Figure 21-13. Compressor and Alternator Belt Installation (cont.)

COOLING (cont.)

(a) In HP S/N's 3246001 thru 3246087 only: Point-A nominal offset is indicated in Chart 2108, based on Point B measured offset. Add or remove shims (P/N 62833-33) as required (see View A, Figure 21-13) to align Compressor Idler Pulley. Belt alignment must be made as close to nominal as shims will allow, and in all cases to within 0.030 inch.

CHART 2108. YORK COMPRESSOR IDLER PULLEY NOMINAL OFFSET

Compressor Sheave (Point B) Actual Offset From Ring Gear	0.010	0.020	0.030	0.040	0.050	0.060
Idler Pulley (Point A) Nominal Offset	0.006	0.011	0.017	0.022	0.028	0.033

(b) In TC S/N's 3257001 & up and HP S/N's 3246088 & up: Compressor Idler Pulley (Point A) offset is adjusted by adding (or removing) shims (LYC. P/N 76534 - 1.130 IN. OD x .410 IN. ID x .005 IN. THK) between the compressor mounting ears and the compressor belt adjusting bracket until the idler pulley is in (or as close as shims will allow to) the belt plane. The nominal idler pulley offset at Point A will be approximately one-half the measured compressor sheave offset at Point B.

c. Alignment of Alternator Drive Belt (ref. Figure 21-13). Align alternator idler pulley in the belt plane by adding or removing shims, with alternator belt installed.

— CAUTION —

IN HP S/N'S 3246001 THRU 3246087 ONLY, ENSURE ALTERNATOR DRIVE BELT IS CORRECT PART NUMBER FOR SERIAL NUMBER RANGE, AND THAT THE ALTERNATOR IDLER PULLEY IS POSITIONED AWAY FROM THE COWLING WHEN ADJUSTING DRIVE BELT TENSION. IF IDLER PULLEY IS POSITIONED INCORRECTLY (I.E. - 180º OUT), CONTACT WITH THE COWLING IS LIKELY, RESULTING IN DAMAGE TO THE COWLING AND PULLEY, AND FAILURE OF THE DRIVE BELT.

COOLING (cont.)

d. Adjustment Of Drive Belt Tension (Compressor and/or Alternator)

— CAUTION —

THE HIGHER TENSION SPECIFIED FOR A NEW BELT IS TO COMPENSATE FOR INITIAL STRETCH AT FIRST OPERATION. DO NOT APPLY HIGHER TENSION VALUES TO USED BELTS.

(1) In HP S/N's 3246001 thru 3246087 only:

(a) Compressor Belt: - use a calibrated belt tension gauge to adjust a new belt to 73 - 87 pounds of static tension.

(b) Alternator Belt:

1) HP S/N's 3246001 thru 3246017 - use a calibrated belt tension gauge to adjust a new belt to 65 - 70 pounds static tension. Adjust a used belt 35 - 40 pounds static tension.

2) HP S/N's 3246018 thru 3246087 - use a calibrated belt tension gauge to adjust a new belt to 90-120 pounds of static tension. Run in for 15 minutes. If tension falls below 50 lbs., re-tension to 70 lbs.

(2) In TC S/N's 3257001 & up and HP S/N's 3246088 & up - Compressor or Alternator Belts - use a calibrated belt tension gauge to adjust a new belt to 90-120 pounds of static tension. Run in for 15 minutes. If tension falls below 50 lbs., re-tension to 70 lbs.

(3) Install engine baffles if removed. Install engine cowl.

— CAUTION —

IF AIR CONDITIONER IS OPERATED ON THE GROUND FOR SERVICING, CLEAR TEST AREA OF ANY LOOSE OBJECTS LYING ON RAMP. ENSURE THAT A QUALIFIED PERSON IS AT THE AIRPLANE CONTROLS.

(4) Run engine 15 minutes at 1200 rpm.

(5) Shut down engine, remove engine cowl, and check both belt tensions.

(6) Check tension every 100 hours or annual inspection, whichever comes first.

(7) Check all idler and bracket bolts for safety. Install engine cowl.

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COOLING (cont.)

3. Magnetic Clutch

a. Sanden Compressor (TC S/N's 3257001 & up and HP S/N's 3246088 & up)

(1) Sanden Magnetic Clutch Removal (ref. Figure 21-14)

(a) All clutch service operations should be performed on the bench and require special tools available from Sanden.

— WARNING —

THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT. (SEE INTRODUCTION, PAGE 4.)

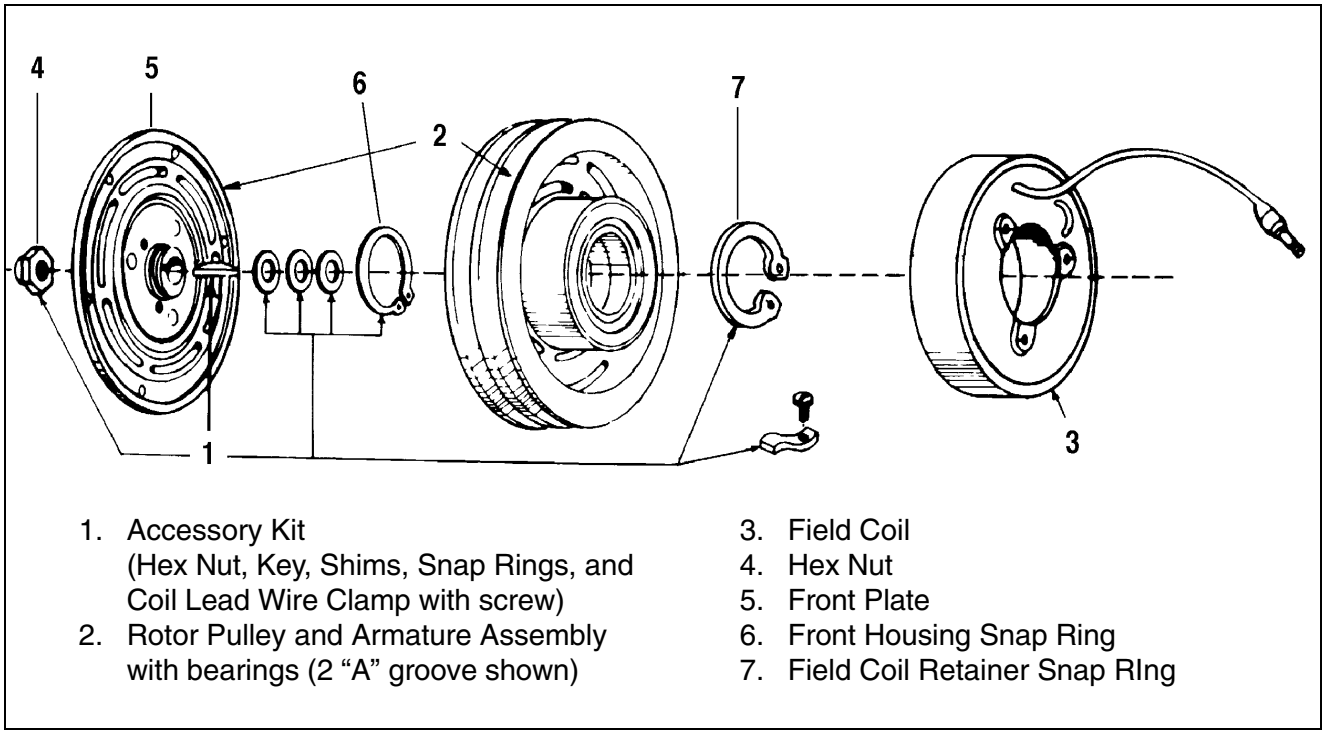
(b) Insert the two pins of the front plate spanner into any two threaded holes of the clutch front plate. Hold clutch plate stationary. Remove hex nut with 3/4 in. (19mm) socket.

(c) Remove clutch front plate using puller as follows: align puller center bolt to compressor shaft; thumb tighten the three puller bolts into the threaded holes; turn center bolt clockwise with 3/4 in. (19mm) socket until front plate is loosened.

(d) Remove shaft key by lightly tapping it loose with a slotted screw driver and hammer.

(e) Remove the internal bearing snap ring with snap ring pliers. Note - on some later model clutches this step is not necessary as the snap ring is below the bearing.

(f) Remove the external front housing snap with snap ring pliers.



1. Accessory Kit (Hex Nut, Key, Shims, Snap Rings, and Coil Lead Wire Clamp with screw)
2. Rotor Pulley and Armature Assembly with bearings (2 "A" groove shown)
3. Field Coil
4. Hex Nut
5. Front Plate
6. Front Housing Snap Ring
7. Field Coil Retainer Snap RIng

Figure 21-14. Sanden Magnetic Clutch

COOLING (cont.)

— CAUTION —

DO NOT USE A WHEEL PULLER ON OUTER FLANGE OF PULLEY. THIS WILL DAMAGE PULLEY GROOVES OR CLUTCH BEARINGS.

(g) Remove rotor pulley assembly with the Sanden rotor pulley set as follows: insert the lip of the jaws into the snap ring groove; place rotor puller shaft protector over the exposed shaft; align thumb head bolts to puller jaws and finger tighten; turn center puller bolt clockwise with a 3/4 in. (19mm) socket until rotor pulley is free.

(h) Remove field coil as follows: loosen coil lead wire from clip at top of compressor front housing; remove external snap ring field coil retainer with snap ring pliers and remove field coil.

(2) Sanden Magnetic Clutch Installation (ref. Figure 21-14)

(a) Install field coil as follows: match coil flange protrusion with hole in front housing to prevent coil movement and correctly locate lead wire; install field coil retainer snap ring; place lead wire under clip at top of compressor front housing and tighten retaining screw.

(b) Replace rotor pulley as follows: support the compressor on the four mounting ears at the compressor rear; if using a vice, clamp the mounting ears only, never the compressor body; align rotor assembly squarely on the front housing hub; using the Sanden rotor installer set, place the ring part of the set into the bearing cavity; ensure that the outer edge rests firmly on the rotor bearing inner race; place the tool set driver into the ring so that the collared end engages the ring; tap the end of the driver with a hammer while guiding the rotor to prevent binding; continue until the rotor bottoms against the compressor front housing hub (denoted by a distinct change in sound while tapping).

(c) Reinstall the internal bearing snap ring, as required.

(d) Reinstall the external front housing snap ring.

(e) Replace front plate assembly as follows: check that original clutch shims are in place on compressor shaft; replace compressor shaft key; align front plate keyway with compressor shaft key; using Sanden shaft protector, tap front plate to shaft until it bottoms to the clutch shims (again, denoted by a distinct change in sound while tapping).

(f) Replace shaft hex nut. Torque to 25-30 ft. lbs.

(g) Check air gap with feeler gauge. Standard gap is 0.016 in. to 0.031 in. If air gap is not consistent around the circumference, lightly pry up on the counter-weighted front plate at the low spots and lightly tap down at the high spots.

— Note —

The air gap is determined by the shims. When reinstalling (or installing a new) clutch assembly, try the original shims first. If the air gap cannot be adjusted to standard as described above, then add or subtract shims by repeating paragraphs (e) and (f).

b. York Compressor (HP S/N's 3246001 thru 3246087 only).

(1) York Magnetic Clutch Removal (ref. Figure 21-15).

COOLING (cont.)

— CAUTION —

DO NOT USE A WHEEL PULLER ON OUTER FLANGE OF PULLEY. THIS WILL DAMAGE PULLEY GROOVES OR CLUTCH BEARINGS.

(a) Remove self-locking capscrew and washer from compressor shaft.
(b) Insert 5/8 - 11 UNC-2B bolt in threaded part of hub and tighten. Pressure exerted by the bolt on compressor crankshaft end will force off rotor pulley assembly without clutch or compressor damage.
(c) Remove four bolts securing field assembly against compressor bosses and remove bolts, washers, and field assembly.

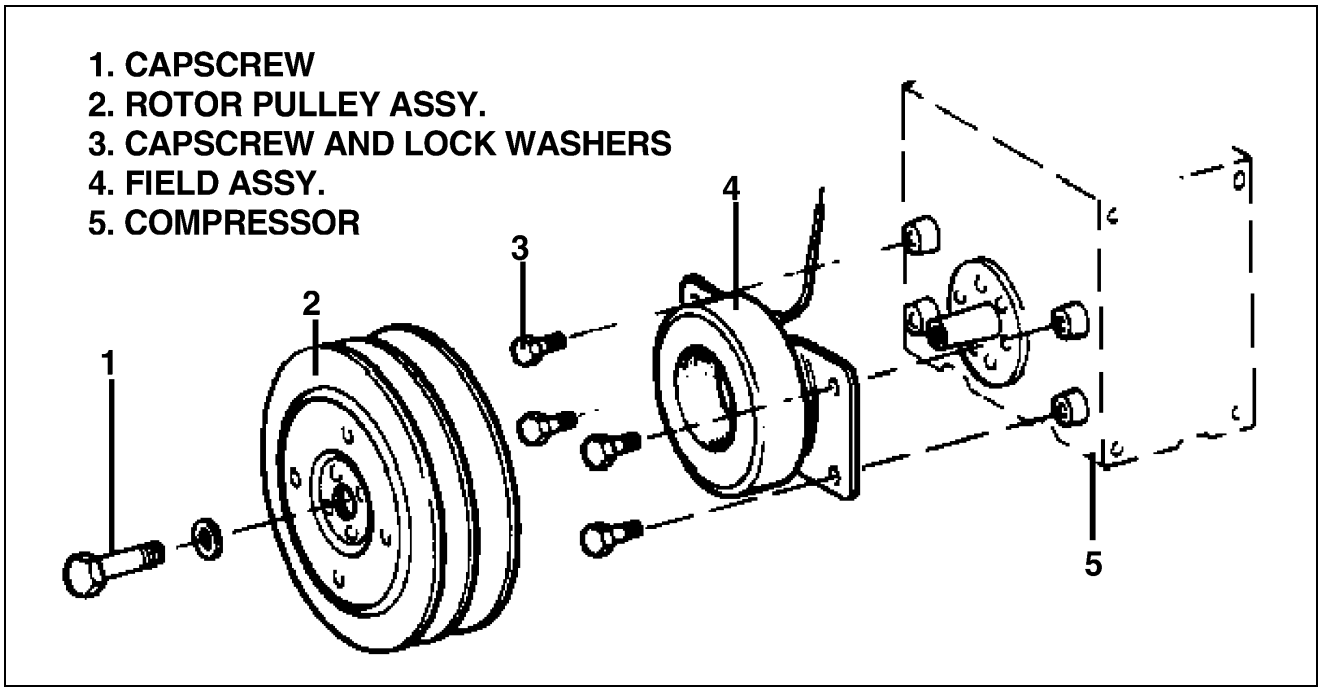


Figure 21-15. York Magnetic Clutch (HP S/N's 3246001 thru 3246087 only)

(2) York Magnetic Clutch Installation (ref. Figure 21-15)

— CAUTION —

COMPRESSOR SHAFT MUST BE CLEAN AND FREE FROM BURRS.

(a) Position field assembly against the compressor bosses, with electrical leads to cylinder side of compressor.
(b) Secure field assembly with four cap screws and lockwashers, (do not torque at this time).
(c) Connect electrical lead from the field assembly. On HP S/N's 3246018 thru 3246087, the ground wire must also be connected.
(d) Slide pulley assembly over field assembly and onto crankshaft, now torque field assembly to 85 - 120 inch-pounds. Secure pulley assembly with washer and new self-locking capscrew. Torque capscrew to 180 - 240 inch-pounds.

COOLING (cont.)

— Note —

If clutch is not engaged while tightening capscrew, insert a spanner into holes in armature face.

(e) Spin pulley by hand to check interference between the field and rotor pulley assemblies. If there is interference, a rubbing noise can be heard as pulley rotates . Remove rotor pulley assembly and adjust field assembly mounting until the interference is eliminated.

4. Refrigerant Lines And Routing

— CAUTION —

DISCHARGE SYSTEM COMPLETELY BEFORE HOSE COUPLINGS ARE UNCOUPLED. (SEE DISCHARGING SYSTEM.)

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE RELEASE OF REFRIGERANT INTO THE ATMOSPHERE. SPECIAL EQUIPMENT IS REQUIRED WHEN DISCHARGING OR RECHARGING SYSTEM.

Handle refrigerant lines carefully. Refrigerant lines are flexible high pressure hoses. Hoses in power plant area are routed for maximum protection from heat and abrasion. They couple at firewall to hoses routed through the two inboard, external hat sections on bottom of fuselage, up through floor to condenser and evaporator in tail cone. Discharge is in the right hand hat section. The suction is in the left hand hat section.

5. Receiver-Dehydrator

a. Removal of Receiver-Dehydrator

— CAUTION —

IF RECEIVER-DEHYDRATOR IS NOT SERVICEABLE, IT MUST BE REPLACED. RECEIVER-DEHYDRATOR MUST BE REPLACED WHEN SYSTEM HAS OPERATED WITHOUT A CHARGE OR HAS BEEN LEFT OPEN.

The unit is mounted on inboard side of evaporator assembly housing.

(1) Discharge system of all refrigerant. (See discharging.)
(2) Uncouple refrigerant lines at receiver-dehydrator. (See D. Special Servicing Procedures).
(3) Remove clamp attaching unit to evaporator housing.

b. Installation of Receiver-Dehydrator. On systems utilizing HFC 134a refrigerant, use only receiver-dehydrators marked with a GREEN arrow.

(1) Slip mounting bracket around receiver and put it in place on evaporator housing with tube fitting on top. Align fittings to proper line before securing mounting bracket.
(2) Replace O-rings on HFC-134a systems.
(3) Tighten fittings to torque listed in Chart 2104.
(4) Evacuate and charge system per evacuating the system and charging the system.

COOLING (cont.)

6. Condenser

a. Removing Condenser. Condenser is mounted in a frame assembly in fuselage bottom between stations 156.00 and 191.00.

(1) Discharge system. (See special servicing procedures and discharging.)
(2) Remove access panel from aft bulkhead of cabin.
(3) Remove forward cover panel.
(4) Uncouple suction and discharge hoses at condenser fitting. (See special servicing procedures.) Remove hose clamps holding hoses to condenser frame.
(5) Remove AN-3 bolts from upper ends of side hinges and rod ends.
(6) Support condenser assembly and remove bolt attaching actuating rod to condenser assembly.
(7) Lower aft end of assembly on the piano hinge at assembly forward end.
(8) Remove eight screws attaching piano hinge to condenser frame assembly and remove.
(9) To remove condenser core from assembly, remove screws in the side mounting frame.

b. Installing Condenser.

(1) Install condenser core to frame assembly with hose fittings forward and RT fitting pointed inboard.
(2) Place condenser and frame assembly to fuselage frame mounting bracket and insert the eight screws into piano hinge.
(3) Attach side hinges, actuating rod, and rig per condenser assembly rigging instructions.
(4) Seal and couple hose fittings (seal with Loctite refrigerant sealant applied to flares only).
(5) Adjust condenser per condenser assembly rigging instructions.

— WARNING —

CABIN REAR PANEL MUST BE REPLACED AND SEALED IN THE ORIGINAL MANNER. IF NOT SEALED PROPERLY, EXHAUST GASES CAN SEEP INTO CABIN DUE TO LOW PRESSURE AREA IN CABIN.

— WARNING —

TEST FOR CARBON MONOXIDE (CO) ON GROUND AND IN FLIGHT WITH AND WITHOUT AIR CONDITIONER OPERATING. PRESENCE OF CO MUST NOT EXCEED 1 PART IN 20,000.

(6) Seal around forward cover panel (and aft cover panel if removed) with Permagum Bead No. 576 purchased from Prestolite Engineering Company (ref. Figure 21-16).

c. Condenser Door Actuator

The actuator is on a bracket mounted between two bulkheads in tail cone. It is coupled to the condenser assembly through a bellcrank mounted to a bracket on bulkhead aft of condenser. Actuator travel is controlled by two limit switches. Both up and down switches are on the actuator,(ref. Figure 21-16) for switch locations.

d. Condenser Assembly Rigging Instructions (ref. Figure 21-16)

Condenser assembly is actuated by an electric motor through bellcranks, push rods, and limit switches. Condenser door must fit flush with fuselage skin, and with increased force along forward edge. Use the following steps:

COOLING (cont.)

(1) Adjust open limit switch to open condenser door 5.00 ± 0.50 inches measured from leading edge of door to fuselage skin.
(2) Adjust side push rods so a vertically measured gap of 0.16 inch exists along trailing edge of door the instant forward edge of door is flush with fuselage skin.
(3) Fully close door and adjust CLOSED limit switch so actuator travels an additional 0.12 inch with door fully closed, (this is necessary to preload mechanism, ref. Figure 21-16).
(4) Cycle assembly several times. Verify proper operation without binding.

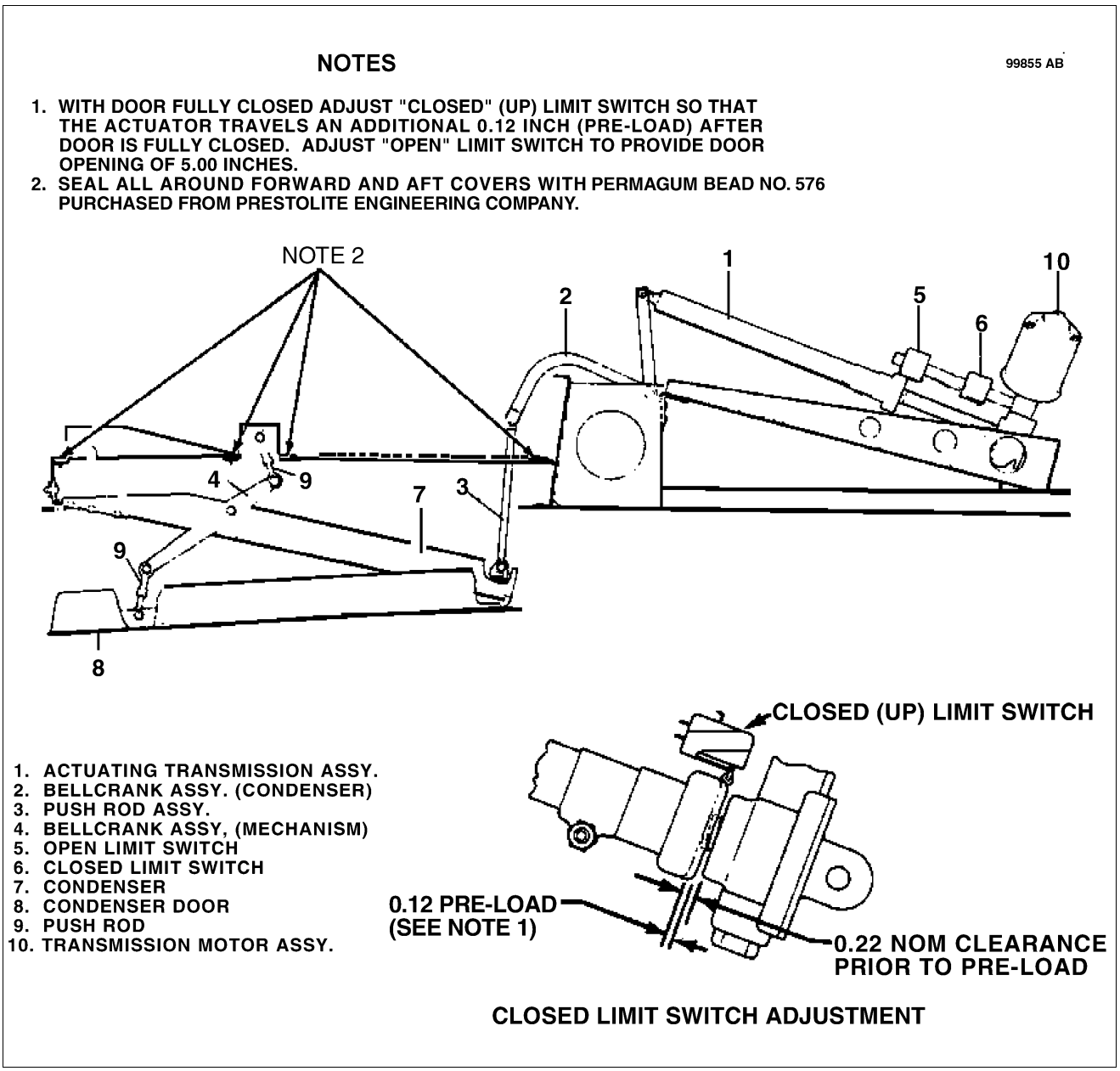


Figure 21-16. Condenser Air Scoop Installation

COOLING (cont.)

7. Expansion Valve

a. Expansion Valve Removal (ref. Figure 21-17)

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

— Note —

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

(1) Remove access panels, and discharge system. Refer to paragraph D, 5.
(2) Remove capillary coil from outlet line. (Do not kink capillary tube.)
(3) Uncouple all related tube fittings. (See special servicing procedures.)

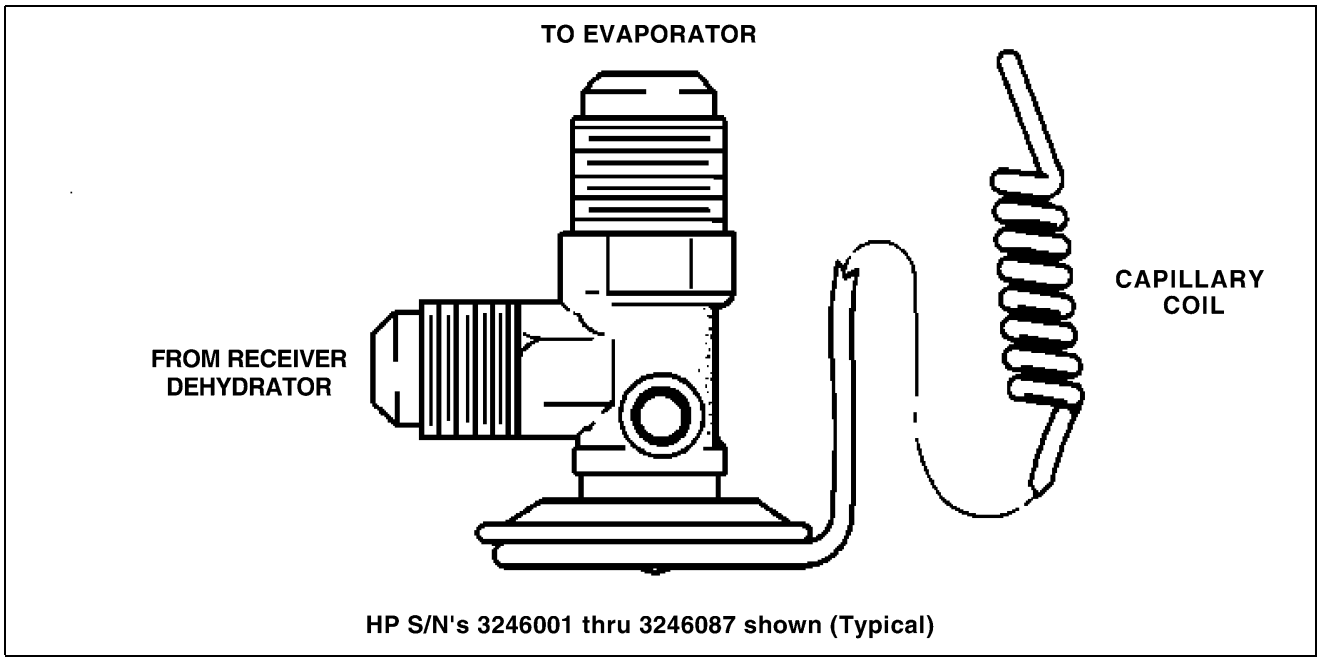


Figure 21-17. Expansion Valve

b. Expansion Valve Installation

(1) On systems using R-12 refrigerant (HP S/N's 3246001 thru 3246017 only), install expansion valve in inlet line of evaporator core. Seal all couplings with sealant applied to tube flanges only. Systems using HFC-134a refrigerant, apply P.A.G. lubricant on O-rings and replace O-rings on fittings, torque fittings to per Chart 2104.
(2) Secure capillary coil to evaporator outlet line.
(3) Evacuate and charge system. (See evacuating the system and charging the system. Refer to paragraphs D, 3 and D, 6.)
(4) Check for leaks. (See checking the system for leaks. Refer to paragraph D, 4.)
(5) Replace access panels.

COOLING (cont.)

8. Evaporator

a. Evaporator Removal

— CAUTION —

DISCHARGE THE SYSTEM BEFORE DISASSEMBLING ANY COMPONENTS FOR SERVICE.

— CAUTION —

UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE RELEASE OF REFRIGERANT INTO THE ATMOSPHERE. SPECIAL EQUIPMENT IS REQUIRED WHEN DISCHARGING OR RECHARGING SYSTEM.

Evaporator assembly consists of evaporator core, receiver-dehydrator, expansion valve, circulating fan, pressure switch, necessary housing, and plumbing. The housing is made of thermoplastic material and the condensed moisture is dumped overboard through a hose clamped to fitting on bottom of evaporator housing.
Evaporator assembly is behind cabin rear panel, attached to mounting panel with 12 screws, washers, and a bracket securing the back to mounting panel.

(1) Remove air conditioning filter cover, filter, and rear access panels.
(2) Uncouple the liquid line from inlet side of receiver-dehydrator and suction line from evaporator core outlet (See special servicing procedures).
(3) Disconnect related electrical wires.
(4) Remove flexible air duct from housing outlet and remove drain hose from housing.
(5) Remove temperature probe from evaporator housing.
(6) Remove screws attaching support bracket and evaporator housing to mounting panel.
(7) Remove assembly through access hole in bulkhead.

b. Evaporator Installation

(1) Cement gasket in place on flanges of evaporator housing and attach large end of mounting gasket to back of housing.
(2) Install housing through access hole with air duct outlet on top and mate mounting flanges to surface of mounting panel and insert screws (Do not tighten at this time).
(3) Line mounting bracket with mating holes in mounting panel, insert screws and tighten. Tighten screws in flange and check that the gasket is in place, flange seal must be air tight.
(4) Couple suction and discharge lines to their proper fittings (apply Loctite refrigerant sealant to tube flares only).

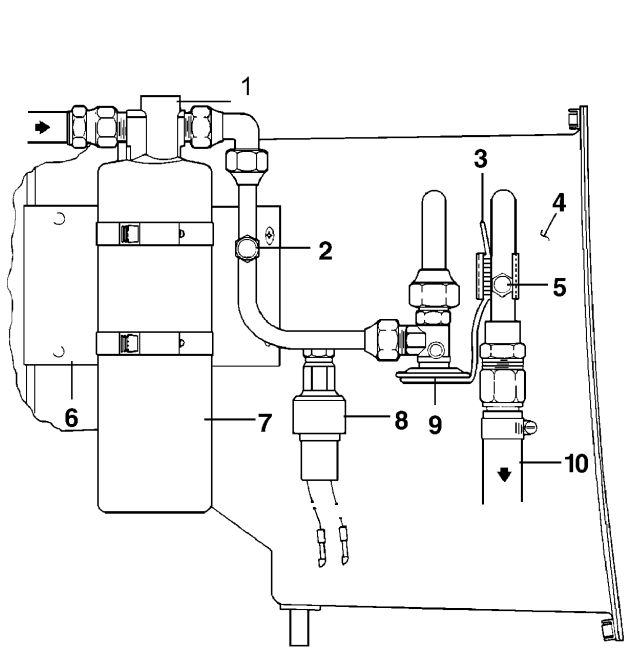
COOLING (cont.)

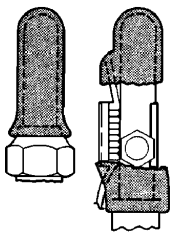
(5) Evacuate and charge system (See evacuating the system and charging the system).
(6) Check for leaks (see checking the system for leaks), if no leaks are detected, seal, and install access panel on evaporator housing.
(7) Couple flexible air duct and drain tube.
(8) Make and check electrical connections (ref. Figure 21-19)
(9) Check blower operation and refrigerant systems.

— WARNING —

REAR CABIN PANEL MUST BE REPLACED AND SEALED IN ORIGINAL MANNER TO PREVENT EXHAUST FROM ENTERING CABIN. AFTER REMOVING AND REPLACING REAR PANEL, CONDUCT A CARBON MONOXIDE (CO) TEST ON THE GROUND AND IN FLIGHT WITH AND WITHOUT AIR CONDITIONER OPERATING. PRESENCE OF CO MUST NOT EXCEED ONE PART IN 20,000.

(10) Install and seal rear bulkhead panels.





WRAP TAPE AROUND THERMOSTAT CAPILLARY LEAVING SERVICE PORT ACCESSIBLE.

1. SIGHT GLASS
2. SERVICE VALVE (SCHRADER) (HI)
3. CAPILLARY COIL
4. HOUSING ASSY
5. SERVICE VALVE (SCHRADER) (LOW)
6. RECEIVER DEHYDRATOR CLAMP
7. RECEIVER DEHYDRATOR
8. PRESSURE RELIEF SWITCH (RANCO)
9. EXPANSION VALVE
10. OUTLET HOSE

NOTES

1. TORQUE FITTINGS PER CHART 2104 EXCEPT TORQUE FITTINGS TO 270 -300 IN. LB. ON SYSTEMS USING R12.

2. QUICK DISCONNECT FITTINGS EXCEPT HP S/N'S 3246001 THRU 3246017 = THREADED FITTINGS

Figure 21-18. Components Installation

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COOLING (cont.)

9. Pressure Relief Switch

   Texas Instruments (except Ranco used in R-12 systems in HP S/N's 3246001 thru 3246017 only).

   — CAUTION —

   BEFORE RELIEF SWITCH REMOVAL, AIR CONDITIONING SYSTEM MUST BE DISCHARGED. (REFER TO DISCHARGING.)

   —CAUTION —

   UNITED STATES ENVIRONMENTAL REGULATIONS PROHIBIT THE RELEASE OF REFRIGERANT INTO THE ATMOSPHERE. SPECIAL EQUIPMENT IS REQUIRED WHEN DISCHARGING OR RECHARGING SYSTEM.

   (1) Remove electrical connections from switch.
   (2) Remove switch assembly from service port on steel line.
   (3) Apply sealant sparingly to flare. When O-ring is present in HFC-134a systems, lube O-ring with PAG oil.
   (4) Install new switch.
   (5) Charge system.

10. Electrical Installation

    The wiring harness is connected to switches in the climate control center on the right side of the instrument panel. The harnesses cross the instrument panel to the left side where two wires are taken off for the compressor clutch. The harness then passes aft along the left side of fuselage connecting to the blower motor, the pressure relief switch, and the condenser actuating motor. Two fuses behind the air conditioning system control panel and a 10 amp circuit breaker mounted in circuit breaker panel protect the complete air conditioning electrical system, except in HP S/N's 3246001 thru 3246017 only. Those airplanes use a 20 amp circuit breaker.

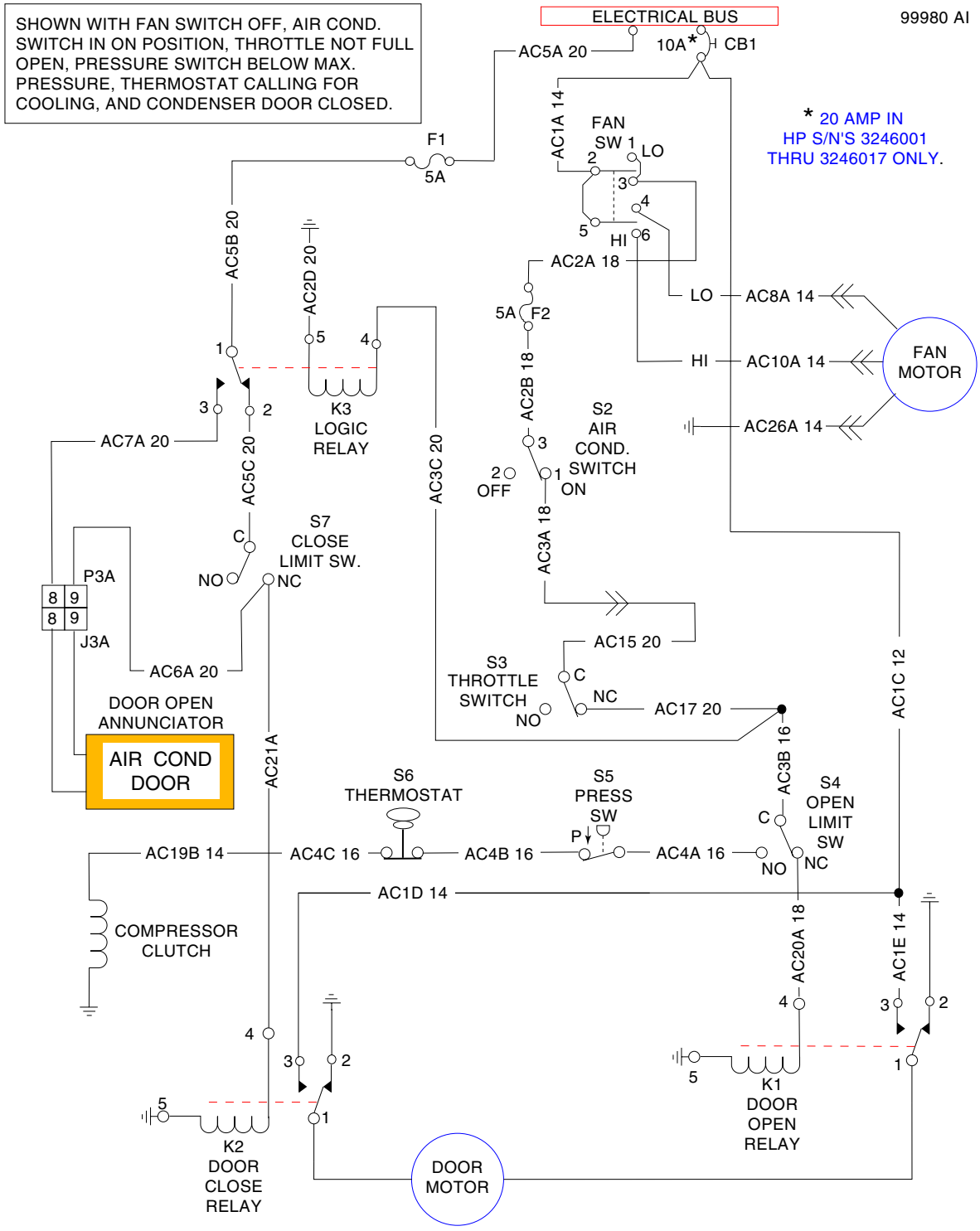
    a. Adjustment of Throttle Switch

       The throttle switch is mounted forward and below the throttle arm. The switch must be adjusted to actuate at the last quarter inch of full open throttle travel. Position the switch so that the throttle arm contacts the center of the switch actuator button.

    b. Fuse Replacement

       Locate the fuse to be replaced behind the air conditioning system control panel.

       (1) Open the fuse holder by applying a slight pushing,, counterclockwise twisting, pressure.
       (2) Remove blown fuse and insert a new 5 amp fuse
       (3) Close the fuse holder by applying a slight pushing and clockwise twisting pressure.



Air Conditioning Wiring Schematic
(1995 thru 1998 Models shown; see Figure 91-9, Sheet 2 for 1999 & up)
Figure 21-19

CHAPTER

22

AUTOFLIGHT

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CHAPTER 22 - AUTO FLIGHT

TABLE OF CONTENTS / EFFECTIVITY

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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.)

DESCRIPTION.

A. HP S/N's 3246001 thru 3246125 (1995 - 1998) and TC S/N's 3257001 thru 3257075 (1998):

A King Autopilot/Flight Director (A.P.F.D.), 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 A.P.F.D. equipment 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. HP S/N's 3246126 and up and TC S/N's 3257076 and up (1999 and up):

The S-TEC System 55/55X is installed in these airplanes. Maintenance information for these systems only is provided in Appendix I (see 5J1).

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CHAPTER

23

COMMUNICATIONS

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CHAPTER 23 - COMMUNICATIONS

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL.

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

The ELT is located in the aft fuselage/tail cone, just forward of the stabilator leading edge.

The transmitter operates on the emergency frequencies of 121.5 and 243 MHz. Both frequencies are monitored by various FAA installations.

Electrical power for the ELT is totally supplied by its own self-contained battery. The battery must be replaced on or before the replacement date marked on battery pack label. Also, the battery must also be replaced any time it has been used in an emergency situation ***or*** after more than one hour of accumulated test time.

RADIO MASTER SWITCH.

A separate master switch for the radios is located in the switch panel in the center of the instrument panel.

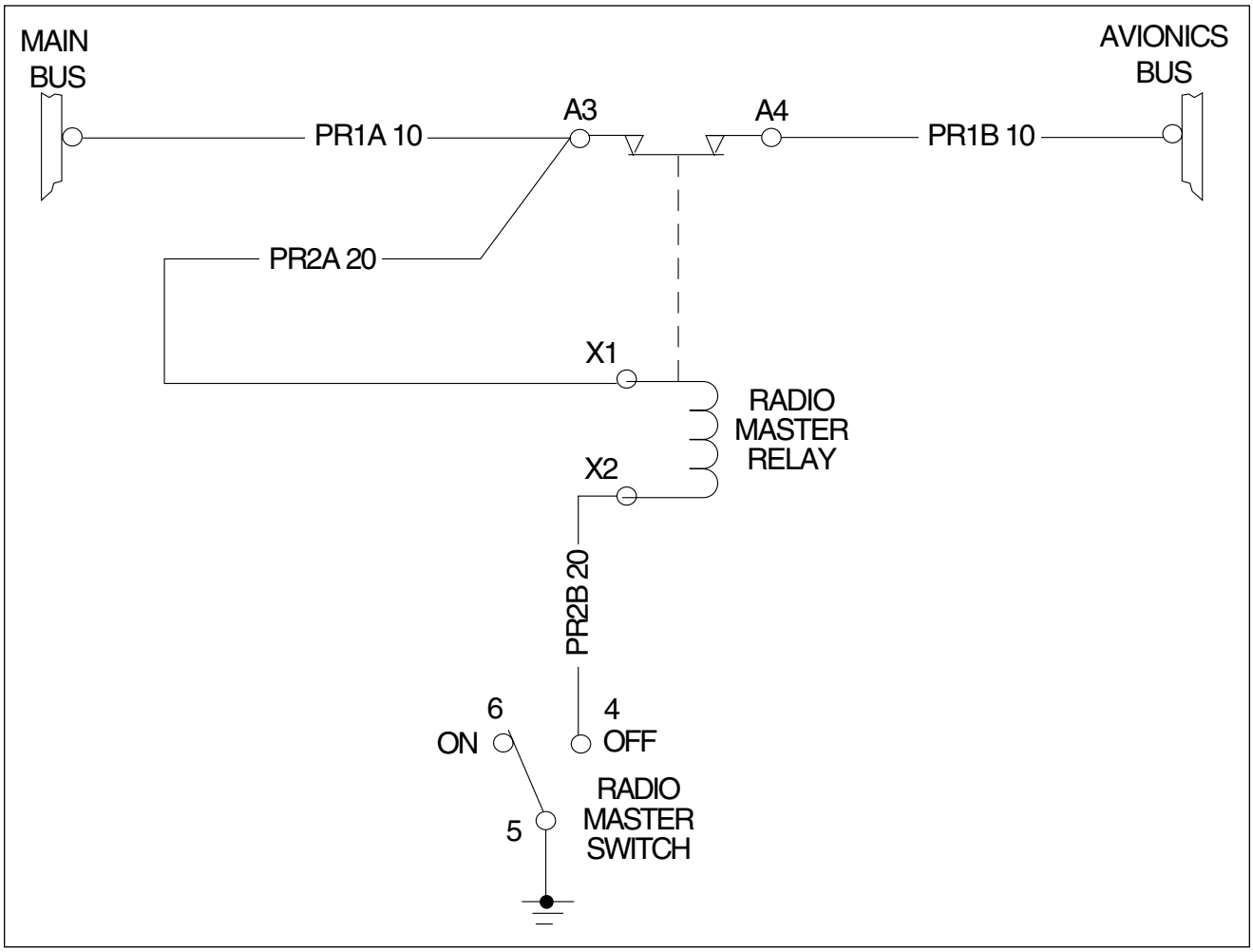

Figure 23-1. Radio Master Switch Schematic

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EMERGENCY LOCATOR TRANSMITTER (ARTEX ELT-110)

A. General

The Artex ELT-110 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.

The Artex 110 cannot be accidently 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 accidently, it must be reset. To reset:

1. Position the remote cockpit switch to ON, then immediately repositioning it to ARM, or;
2. Position the switch on the ELT to ON, then immediately repositioning it to OFF.

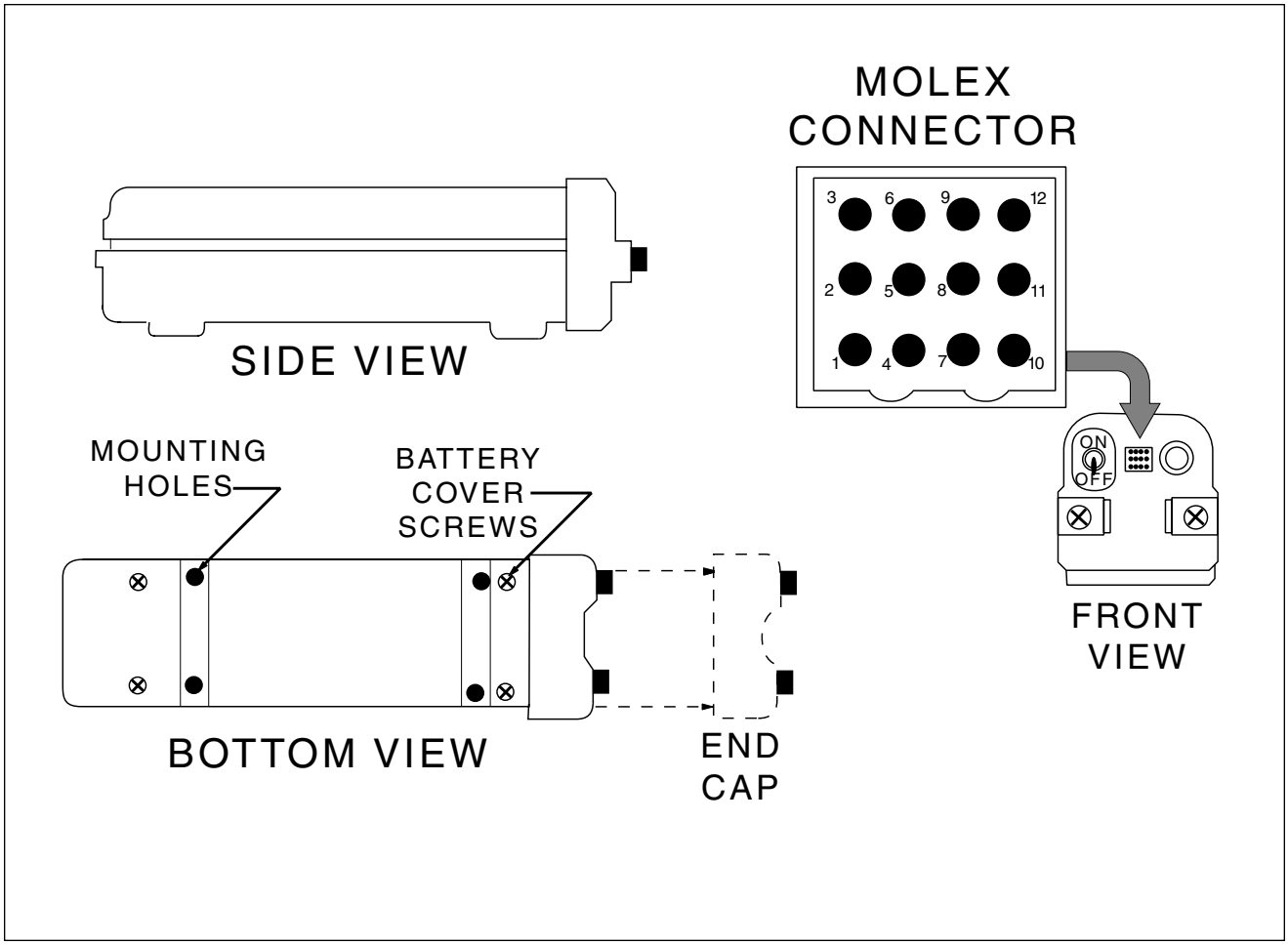

Figure 23-2. Artex 110 ELT

EMERGENCY LOCATOR TRANSMITTER (ARTEX ELT-110) (cont.)

B. Artex ELT-110 Battery Removal And Installation (Refer to Figures 23-2 and 23-3.)

— Note —

Although the ELT is independent of the airplane's electrical system, remove positive cable from airplane's battery anytime work is to be done on any electrical or electronic equipment.

1. Disconnect and remove positive cable from airplane's battery.
2. Remove E. L. T. from the airplane by:
   a. Loosening the two screws on the front of the mounting tray and pull mounting tray cap off.
   b. Disconnecting coax (antenna) cable.
   c. Disconnecting the Molex cable from the E. L. T. unit.
   d. Remove unit from airplane.
3. Remove the four screws on the bottom of the E.L.T. securing the battery pack.
4. Disconnect battery pack connector from main unit.
5. Remove battery pack from unit.
6. Securely plug in new battery pack connector to main unit.
7. ***Immediately*** reset unit by positioning unit switch to ON, then to OFF.

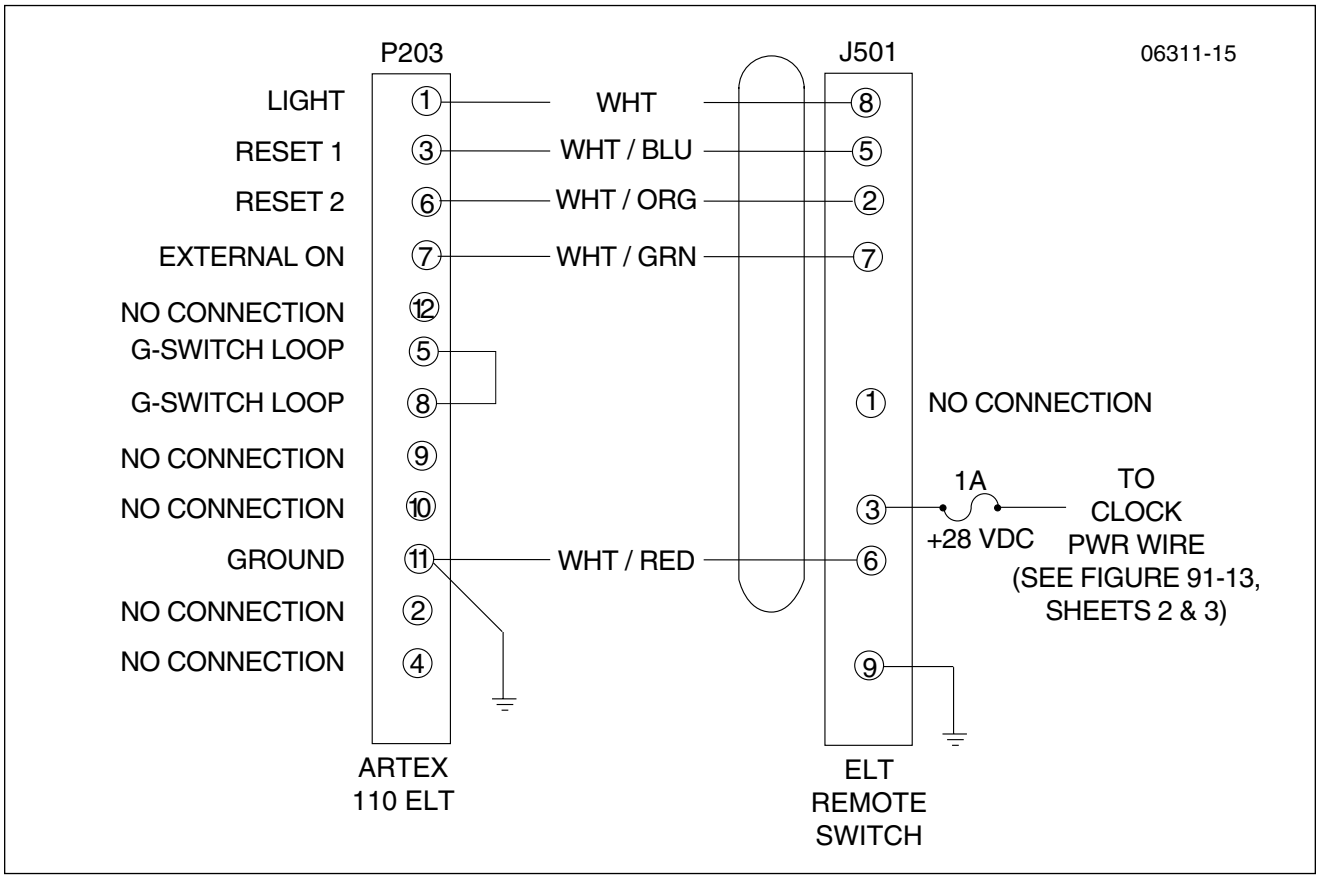

Figure 23-3. Artex ELT-110 Wiring Schematic

EMERGENCY LOCATOR TRANSMITTER (ARTEX ELT-110) (cont.)

8. Fit new battery pack into place. Ensure all gaskets are properly aligned.
9. Replace the four screws. Dress wires away from standoffs to avoid pinching wires between standoffs and the battery pack.
10. Install unit into mounting tray:
    a. Connect molex and coax cables to ELT unit.
    b. Install mounting tray cap and secure to front of mounting tray with the two screws.
11. Install positive cable to airplane's battery.
12. Test transmitter.

C. Testing the Artex ELT-110 Emergency Locator Transmitter

— Note —

Consult FAA Advisory Circular AC 20-81 for detailed testing information and precautions

1. Conduct test only during the first five minutes after any hour.
2. If operational test must be made at any time other than the first five minutes after the hour, notify the nearest FAA traffic Control Tower or Flight Service Station prior to the test.
3. Test should be no longer than three audio sweeps.
4. Tune airplane communications receiver to 121.5 mHz. Check that aircraft battery and radio master switches are ON.
5. 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.

PAGES 1L18 THRU 1L24 INTENTIONALLY BLANK

AIRPLANE MAINTENANCE MANUAL

CARD 2 OF 5

PA-32R-301

Saratoga II HP

(S/N's 3246001 AND UP)

PA-32R-301T

Saratoga II TC

(S/N's 3257001 AND UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-879 **REVISED: JULY 15, 1999**

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Manufacturers Association

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-879) published June 24, 1996 and reissued July 1, 1997 are as follows:

Revision	Publication Date	Aerofiche Card Effectivity
ORG950712	June 24, 1996	1, 2, 3, and 4
CR970701	July 1, 1997	1, 2, 3, 4, and 5
PR990715*	July 15, 1999	1, 2, 3, 4, and 5

*** PARTIAL REVISION OF MAINTENANCE MANUAL 761-879**

Revisions appear in all five cards of this set. Remove the previous Aerofiche card set and replace it with the five card set dated July 15, 1999.

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

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INTRODUCTION

TABLE OF CONTENTS / EFFECTIVITY

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INTRODUCTION

The PIPER PA-32R-301/301T Saratoga II HP and TC Maintenance Manual 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-32R Parts Catalog P/N 761-880, 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.

Be sure to supply the correct serial number information in any correspondence or communication concerning your airplane.

EFFECTIVITY

This maintenance manual is effective for PA-32R-301 Saratoga II HP airplanes as follows:

Model Year	Serial Numbers
1995	3246001 thru 3246017
1996	3246018 thru 3246059
1997	3246060 thru 3246087
1998	3246088 thru 3246125
1999	3246126 and up

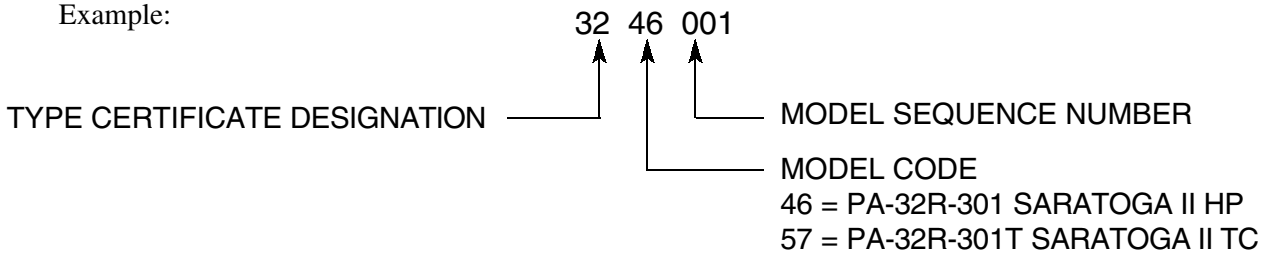
EFFECTIVITY (cont.)

This maintenance manual is effective for PA-32R-301T Saratoga II TC airplanes as follows:

Model Year	Serial Numbers
1997	3257001 thru 3257027
1998	3257028 thru 3257075
1999	3257076 and up

SERIAL NUMBER EXPLANATION

Example:



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

PAGINATION

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

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 List of Illustrations for all fiche in this set.
(3) A complete List of Charts for all fiche in this set.

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 along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A vertical line 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.

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

Original and Reissue:	None	
Revisions:	First:	Revision Indication (1R Month-Year)
	Second:	Revision Indication (2R Month-Year)
	Subsequent revisions follow with consecutive numbers such as 3R, 4R, etc.	
Added Subject:		Revision Identification, (A Month-Year)
Deleted Subject:		Revision Identification, (D Month-Year)

INDEXING

Each System/Chapter begins with an individual Table of Contents.

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.

SUPPLEMENTARY PUBLICATIONS

The following is a list of publications providing servicing, overhaul and parts information on various components on the PA-32R-301/301T airplanes, which you should use to supplement this manual.

A. Piper Publications:

(1) Parts Catalog - P/N 761-880

(2) Progressive Inspection Manuals (50 hour):

P/N 761-881 (pending) for the SARATOGA II HP (S/N's 3246001 & up), and

P/N 761-896 (pending) for the SARATOGA II TC (S/N's 3257001 & up).

(3) Periodic Inspection Report Forms:

P/N 230-1047 for the SARATOGA II HP (S/N's 3246001 & up), and

P/N 230-2047 for the SARATOGA II TC (S/N's 3257001 & up).

B. Vendor Publications

— WARNING —

THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT.

The following is a list of the vendor publications, used in conjunction with the servicing, overhaul and parts information on various components.

AIR CONDITIONING COMPRESSOR:

Vendor:

York Industries
1750 Toronita Street
York, Pennsylvania 17402
(717) 846-1988

(or)

Sanden International (USA), Inc.
601 South Sanden Blvd.
Wylie, TX 75098-4999
(214) 442-8400

ALTERNATOR

Vendor:

Electro Systems
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 06032
(205) 227-8306

AUTOFLIGHT:

Vendor:

AlliedSignal
General Aviation Avionics
Product Support Departmemt
400 North Rogers Road M/D #18
Olathe, Kansas 66062-1212

BRAKES:

Vendor:
Parker Hannifin Corp.
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
(216) 871-6424

EMERGENCY LOCATOR TRANSMITTER:

Vendor:
Artex Aircraft Supplies
P. O. Box 1270
10714 S. Township Rd.
Canby, Oregon 97013
(503) 266-3959

ENGINE:

Vendor:
Textron Lycoming
652 Oliver Street
Williamsport, PA 17701
PH - (717) 323-6181
FAX - (717) 327-7101

Overhaul Manual: DIRECT DRIVE MODELS - P/N 60294-7
Parts Catalog: IO-540- ..... - K1G5, ... ENGINES - P/N PC-615
TIO-540-AH1A ENGINES - P/N PC-615-12
Operators Handbook: O-540, IO-540 SERIES - P/N 60297-10
TIO-540 Series - P/N 60297-23

ELECTRIC FUEL PUMP:

Vendor:
Parker Hannifin Corp.
Airborne Division
P.O. Box 4032, 711 Taylor Street
Elyria, Ohio 44036
(216) 323-4676

(or)

Weldon Pump
640 Golden Oak Parkway
Oakwood Village, OH 44146
(216) 232-2282

FUEL CELLS:

Maintenance:
LORAL, Engineered Fabrics
669 Goodyear Street
Rockmart, Georgia 30153-0548

(or)

Goodyear Aerospace Corp.
Engineered Fabrics Division
Rockmart, Georgia 30153

GEAR LOCKING ACTUATORS, NOSE GEAR DOOR ACTUATOR, HYDRAULIC PUMP, AND ALL HYDRAULIC COMPONENTS:

Vendor:
Parker Hannifin Corp.
1160 Center Road
Avon, Ohio 44011
(216) 871-6424

HI-LOK FASTENERS AND TOOLS:

Vendor:
Hi-Shear Corporation
2600 Skypark Drive
Torrance, California 90509
(213) 326-8110

MAGNETOS:

Vendor:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104	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	

NAVIGATION/STROBE LIGHTS STANDBY/MAP LIGHTS:

Vendor:	Whelen Engineering Co. Inc. Deep River, Conneticut (203) 526-5308

OXYGEN SYSTEM:

Vendor:	Scott Aviation 2225 Erie Street Lancaster, New York 14086 (716) 683-5100

PROPELLER:

Vendor:	Hartzell Propellor Inc. One Propellor Place Piqua, OH 45356-2634	PH - (513) 778-4200 FAX - (513) 778-4321
Overhaul Instructions:	HARTZELL COMPACT CONSTANT SPEED and FEATHERING PROPELLER - P/N 117-D	

VACUUM PUMP, VACUUM REGULATORS, DEICER PUMP:

Vendor:	Parker Hannifin Corp. 1160 Center Road Avon, Ohio 44011 (216) 871-6424

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GENERAL

This chapter contains instructions for correcting difficulties which may occur in the electrical system. It includes a general description and function of each part of the system along with test and adjustments of the various components.

Description and Operation

The electrical system is a 28-volt (HP S/N's 3246018 & up and TC S/N's 3257001 & up), or 14-volt (HP S/N's 3246001 thru 3246017 only), direct current, single wire, negative ground system. All electrical equipment is grounded to the metal structure of the airplane; therefore, the structure takes the place of the second wire. A 24-Volt, or 12-volt, as appropriate, battery is incorporated in the system to furnish power for starting and as a reserve power source in case of alternator failure. With the exception of the starter, which receives its power direct from the load side of the battery, the battery and alternator (90 Amp Electrosystem, Inc.) are both connected to the bus bar, from which all electrical equipment is powered. The battery master switch controls the battery relay. A ground clearance switch is installed as standard equipment (except in HP S/N's 3246001 thru 3246017) and provides a direct circuit to COMM1, speakers, and radio accessories when switched ON. Otherwise, the battery master switch must be on before any electrical equipment will operate. The airplane is equipped with standard navigation lights, anti collision lights, and a landing light mounted on the nose landing gear.

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D.C. GENERATION

A. Troubleshooting

— WARNING—

ALL CHECKS AND ADJUSTMENTS OF THE ALTERNATOR AND/OR ITS COMPONENTS SHOULD BE MADE WITH THE ENGINE STOPPED. TO COMPLETE SOME CHECKS OR ADJUSTMENTS, IT WILL BE NECESSARY TO REMOVE THESE UNITS FROM THE AIRPLANE AND PLACE ON A TEST STAND.

Typical electrical system problems are listed in Chart 2401 along with their probable causes and suggested remedies. The wiring diagrams included in Chapter 91 will give a physical breakdown of the different electrical circuits used in the airplane.

After the trouble has been corrected, check the entire electrical system for security and operation of its components.

CHART 2401. TROUBLESHOOTING ELECTRICAL SYSTEM

Trouble	Cause	Remedy
Zero output indicated on ammeter regardless of rpm (refer to alternator system test procedure)	Open field circuit	With the battery switch turned on, check for battery voltage from the airplane's main bus through the entire field circuit to the alternator field terminal. Measure the voltage from the ground (-) to the following points (+) in sequence: bus bar, field circuit breaker (5A), field terminals of master switch voltage regulator and alternator field terminal. Interruption of voltage through any of these points isolates the faulty component or wire which must be replaced. (See wiring schematic, Chapter 91.)
	Open output circuit.	With the battery switch turned on, check for battery voltage from the airplane's main bus through the entire output circuit to the alternator battery (continued on next page)

D.C. GENERATION (cont.)

CHART 2401. TROUBLESHOOTING ELECTRICAL SYSTEM (cont.)

Trouble	Cause	Remedy
Zero output indicated on ammeter regardless of rpm (refer to alternator system test procedure). (continued)	Open output circuit. (continued)	post. Measure voltage from ground (-) to the following points (+) in sequence: bus bar, output current limiter, 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, Chapter 91.) Open circuit in alternator output will usually burn out ALT annunciator and the 50 ohm resistor. Check 5.0 amp in line fuse
	Open field winding in alternator.	Disconnect field terminal of alternator from field wiring and check for continuity from field terminal to ground with ohmmeter (20-100 ohms) depending on brush contact resistance. **— CAUTION —** **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 are okay and field reads open, replace alternator.

D.C. GENERATION (cont.)

CHART 2401. TROUBLESHOOTING ELECTRICAL SYSTEM (cont.)

Trouble	Cause	Remedy
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 buss bar (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, Chapter 91.) 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.
	Open rectifier.	If any of the six rectifiers pressed pressed into the rear bell housing of the alternator open up internally, it will result in a definite limitation on the current that can be drawn from the alternator. After having checked the previous causes of low output it can be assumed that a faulty rectifier exists. See paragraph titled Inspection and Testing of Components

D.C. GENERATION (cont.)

CHART 2401. TROUBLESHOOTING ELECTRICAL SYSTEM (cont.)

Trouble	Cause	Remedy
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, disconnect each leg of field circuit, working from 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, Chapter 91.)
	Short circuit in field winding of alternator	Disconnect field wiring at terminal of alternator. Turn on master switch. Set breaker, and if breaker fails to trip, this isolates short circuit to field of alternator itself. Check brush holders for shorting against frame. If there are no obvious signs of a physical short circuit at field terminal or brush holder, replace alternator — Note — Intermittent short circuit. Internal short circuit of the field can occur at various positions of the rotor, therefore, reconnect field, reset breaker. **— CAUTION —** **TURN MAGNETO SWITCH TO OFF BEFORE TURNING PROP.** Pull propeller slowly by hand turning alternator rotor through 360 of travel. Observe circuit breaker for signs of tripping.

D.C. GENERATION (cont.)

CHART 2401. TROUBLESHOOTING ELECTRICAL SYSTEM (cont.)

Trouble	Cause	Remedy
Ammeter indicates 60 amps at 1400 rpm and above, ALT annunciator light on.	Short to ground in alternator output wiring	Check condition of teflon insulators on feet of diode heat sink. When the mounting screws are over torqued they can cut through insulators causing a short-to-ground. Check other wiring for chafing, etc.
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 the terminals of the following components one at a time until the faulty unit is isolated. a. Field 5-amp (alternator circuit protector). b. Alternator switch. c. Overvoltage relay.
	Defective voltage regulator.	Replace voltage regulator.
	Faulty grounds. from grounding points.	Completely clean all corrosion

D.C. GENERATION (cont.)

B. 90 Amp Electrosystems. Inc. (ESI), Alternator System (Refer to Figure 24-1)

1. Description

The principal components of the alternator are the front housing, fan and pulley, rear housing and terminal identification, stator core and coil assembly, rotor core and coil, brushes and holder assembly and rectifier assembly.

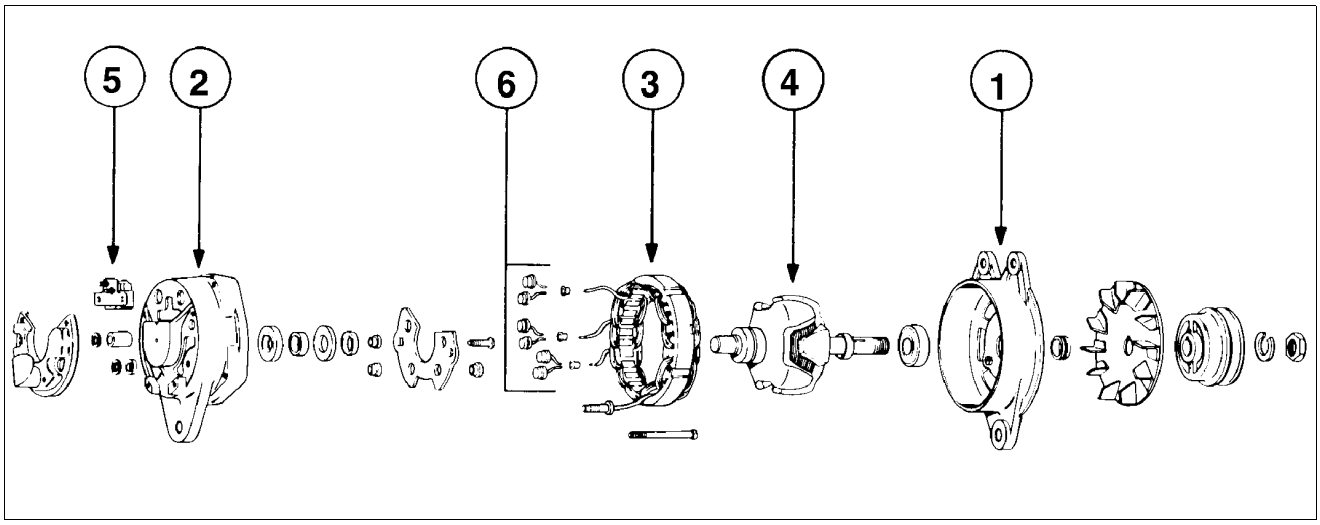

Figure 24-1. Exploded View of Electrosystems Alternator

a. The front housing (1) is a die-cast aluminum part which meets design requirements for a lightweight, non-magnetic material. This casting incorporates the bosses used to attach the assembly to its mounting bracket. It also provides the supporting surface for the rotor shaft front bearing and vendor identification data stamped into the front housing.
The fan and pulley are attached to the rotor shaft with a nut and lock-washer. The forward end of the shaft is threaded to accept the nut.

b. The rear housing (2) is also a die-cast aluminum part which supports the rotor shaft rear bearing and provides mounting bosses for the rectifier assembly. The housing contains the various electrical connections and openings for cooling airflow. (Refer to Figure 24-2 for Terminal identification.)

c. The stator core and coil assembly (3) consists of a number of steel stampings riveted together to form the stator core which contains 36 equally spaced vertical slots to accommodate the stator coil windings. (Refer to Figure 24-3.)

d. The rotor core and coil assembly (4) consists of the rotor shaft, two slip rings, two rotor halves and the coil assembly. The shaft is supported at each end by bearings. The front bearing (ball-type) is a slip fit on the shaft and is retained in the front housing with a retainer. The rear bearing (needle-type) is pressed into the rear housing. The slip rings, core and coil assembly are press-fitted to the shaft with a rotor half enveloping each end of the coil.
The rotor core and coil assembly turns inside the stator core and coil assembly with a very narrow air gap between the two assemblies, thus developing maximum magneto induction.

D.C. GENERATION (cont.)

e. The brush and holder assembly (5) is installed in a cavity inside the rear housing. The brushes ride the surfaces of the slip rings on the rotor shaft under spring pressure and transmit field current through their circuit to ground. One brush or field terminal is, therefore, insulated from the housing.

f. The rectifier assembly is located between the stator and the inside surface of the rear housing. Attachment to the housing is made by means of mounting studs that protrude from the positive and negative diode plates (heat sinks). The positive plate is insulated from the housing, and the negative plate is grounded to the housing through the studs. The rectifier assembly has a printed circuit board spaced away from the heat sinks. (Refer to Figure 24-4.)

The stator winding leads (6) are soldered to integral terminals on the back of the circuit board. The stator phase top is attached to the insulated stator terminal. The heat sinks are attached to the circuit board with insulated spacers and roll pins maintaining the necessary separation between the two assemblies. The diodes themselves are exposed. The rectifier assembly has three diode plates connected to an AC potential. Each of the three plates is connected to one of the three stator leads. Two steel conductor plates or “bus bars”, one positive and the other negative, circle the diodes beginning at the BAT and GND terminal studs. The bus bars act as termination points for collecting the DC current from the terminal wire of each diode. One positive and one negative diode is soldered to each of three stamped aluminum plates to form the plate and diode assemblies. The aluminum plates serve as heat sinks to cool the diodes by providing increased surface area to the air flow through vent slots in the rear housing to the fan at the front of the alternator.

One plate and diode assembly is connected to each of the three leads to form the full wave bridge rectifier. Diode terminal wires are connected to the bus bars by means of a flexible connector wire. One diode is connected to the positive bus bar, and the other diode, on each plate, is connected to the grounded or negative bus bar. (Refer to Figure 24-5.)

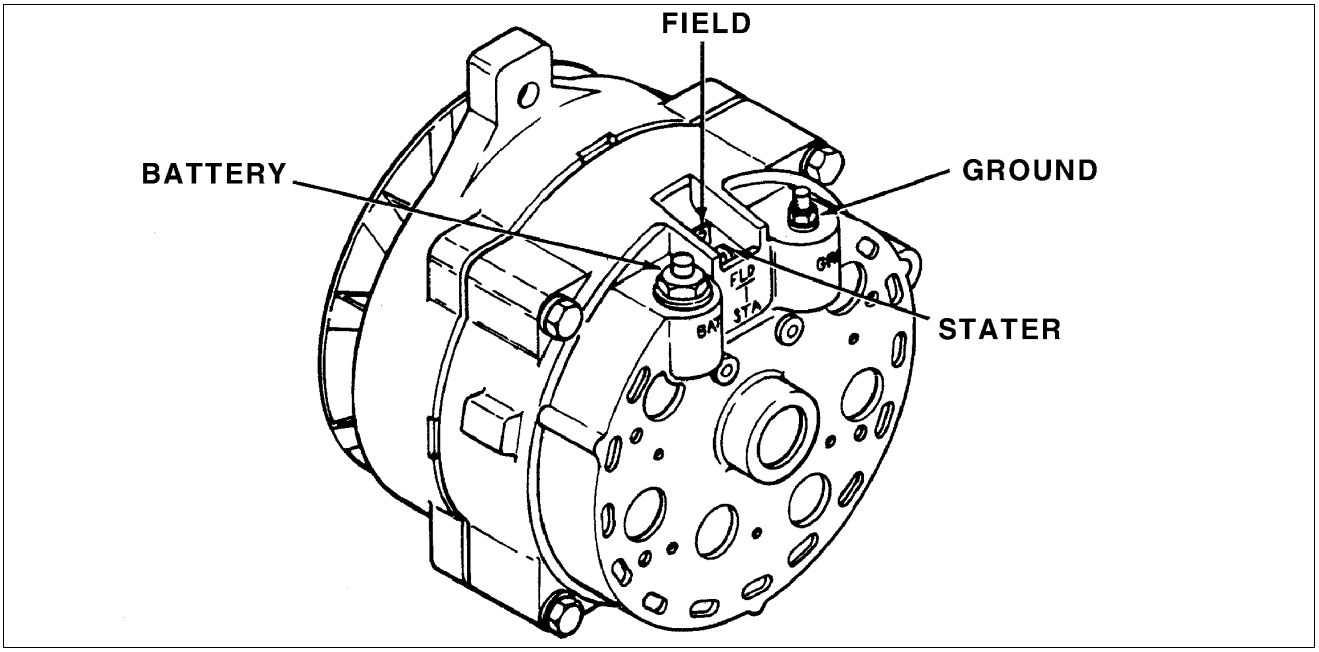

Figure 24-2. Rear View and Terminal Identification

D.C. GENERATION (cont.)

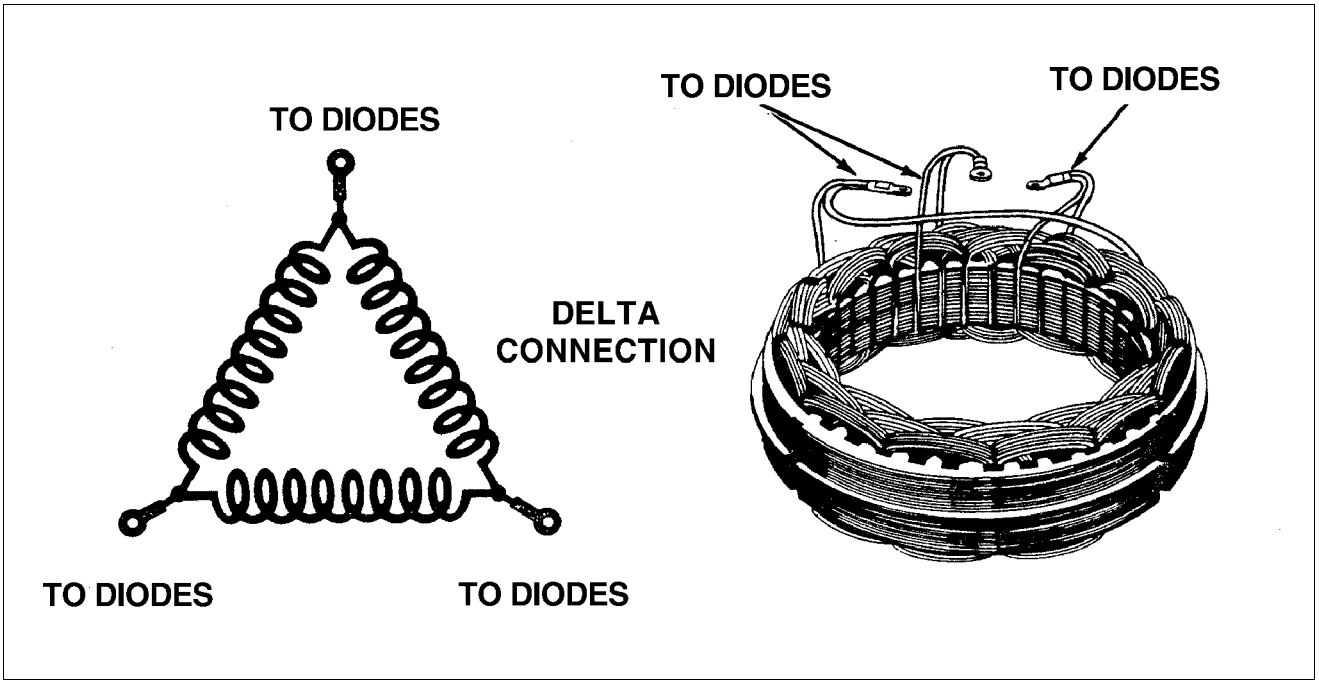

Figure 24-3. Stator Core and Windings

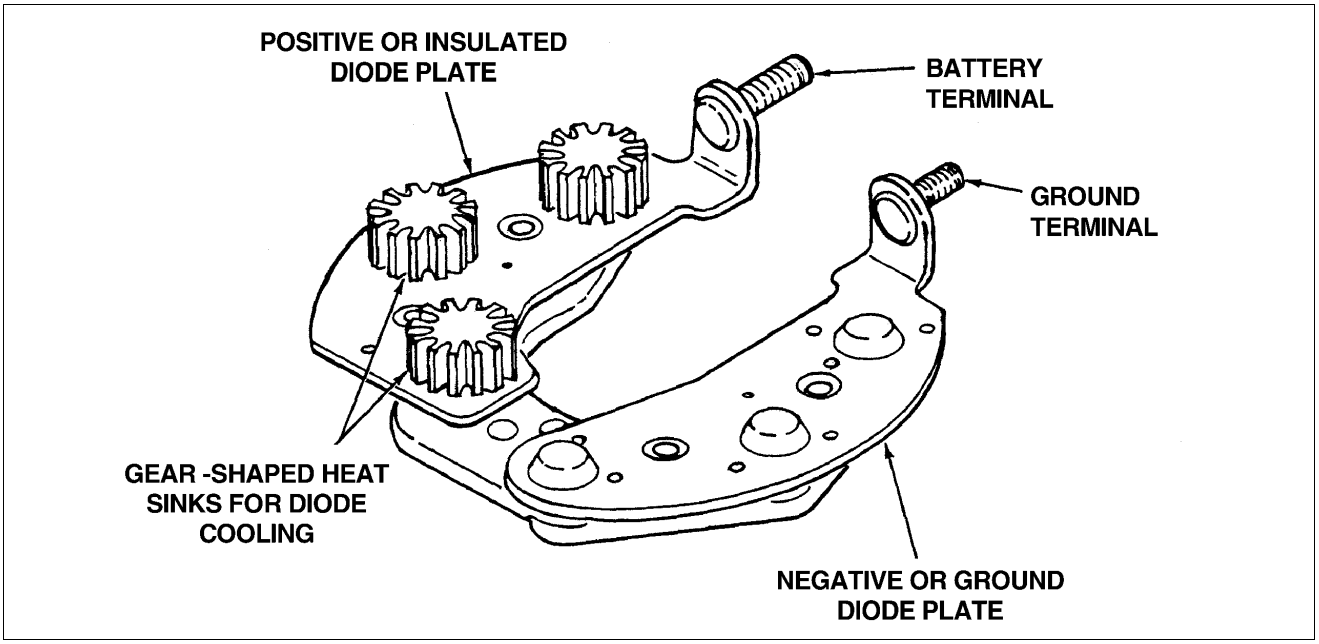

Figure 24-4. Rectifier Assembly

D.C. GENERATION (cont.)

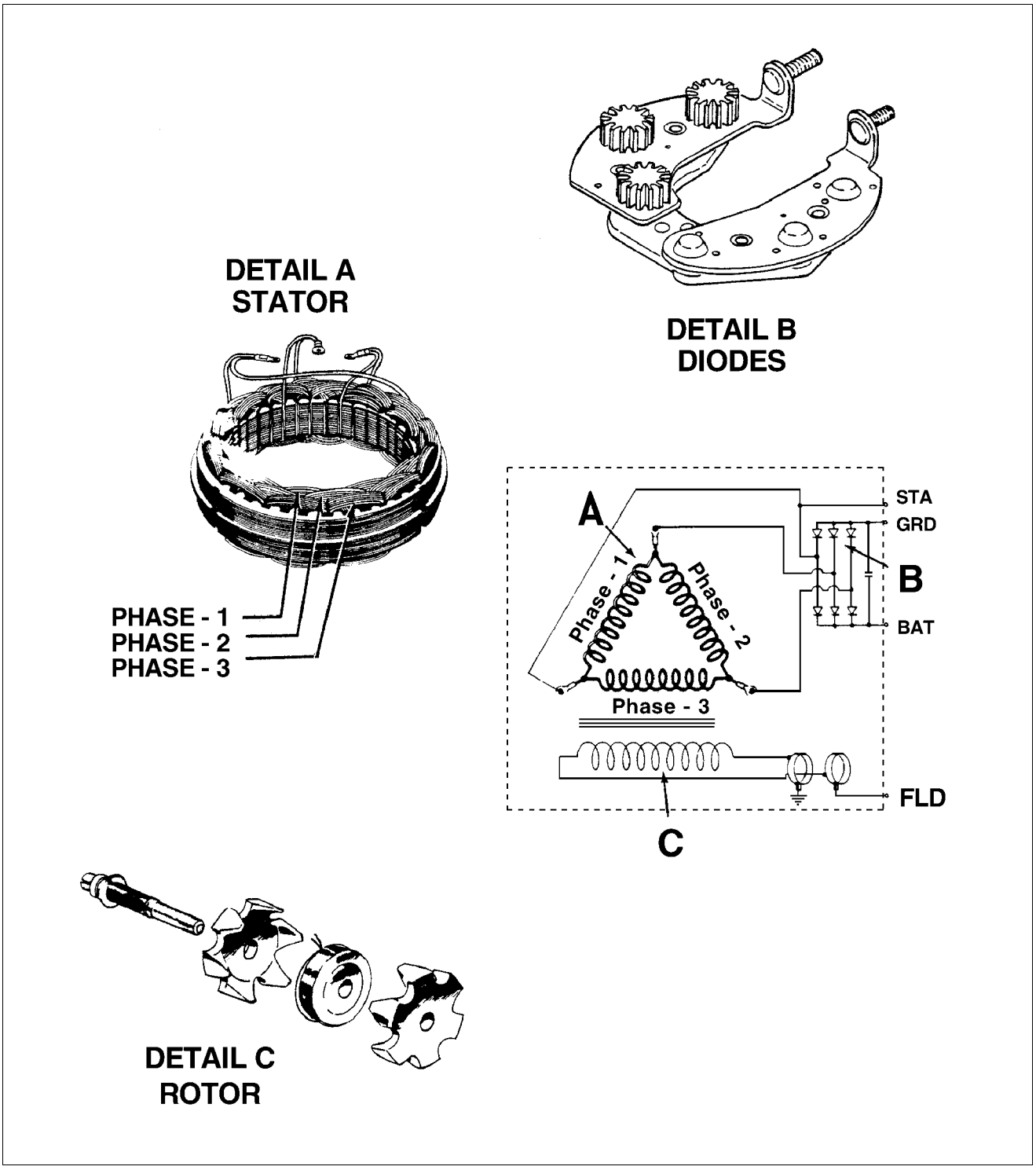

Figure 24-5. Internal Relationships of Alternator Components

D.C. GENERATION (cont.)

2. Precautions

Considerable time and expense can be saved observing the following precautions prior to testing the charging system.

a. Always ***disconnect*** the ***battery ground*** cable ***before*** disconnecting wiring or components of system.
b. Whenever the battery cables ***are connected*** and the ***BATT MASTR switch*** is ***ON***, ***avoid*** contacting ***alternator output*** terminal (BAT), because it is directly connected to the battery bus voltage
c. ***Never connect*** the ***battery ground*** cable until all system wiring connections and components are complete.
d. When adjusting belt tension, always ***apply force near pulley*** of the alternator to avoid damage to stator and rectifier, or use a 1 1/8" open end wrench on the adjustment lug of the alternator case casting.
e. ***Never*** attempt to ***polarize*** the ***alternator.*** Polarizing is not applicable to alternator and could damage the regulator.
f. ***Observe polarity*** when installing a battery in aircraft. Reverse polarity will destroy the diodes in alternator.
g. Always connect a booster battery in parallel, negative to negative, positive to positive.
h. ***Before*** disconnecting a ***booster*** battery, reduce ***engine*** speed to ***idle.*** Turn taxi light ON to prevent a voltage surge that could destroy small light bulbs. Disconnect booster battery; turn landing light OFF.
i. ***Disconnect*** the battery ***ground*** cable ***before*** connecting a charger to the battery.

3. On Aircraft Check of Alternator System

a. Visual Inspection.

Prior to testing, perform a visual inspection of charging system components. What appears to be a charging system problem can, in some instances, be traced to some of the relatively simple discrepancies outlined here that are easily corrected.

(1) Proper belt tension. If alternator pulley wheel can be slipped on belt by hand the belt is too loose or glazed. Replace or tighten belt per specification.
(2) Specific gravity of battery reading. A fully charged battery should read 1.275.
(3) Clean and tighten battery posts and cable clamps.
(4) Clean and tighten wiring connection at alternator.
(5) Clean and tighten wiring connections at regulator.

b. Ammeter Validity Test.

With engine off, place BATT MASTR switch in the ON position. Switch landing light switch ON. Ammeter should show discharge. If ammeter needle does not move:

(1) Check wiring connections at ammeter are tight and clean, or;
(2) Ammeter is defective. Replace ammeter.

D.C. GENERATION (cont.)

c. Battery Supply Voltage Test.

If airplane ammeter shows discharge with engine running, perform the following test before checking alternator voltage output. The test will verify that battery voltage is being supplied to regulator. Alternator cannot provide output unless field voltage is supplied.

(1) Disconnect connector at voltage regulator.
(2) Connect voltmeter positive lead to pin 1 of disconnected plug (B lead of regulator) and negative lead to aircraft structure.
(3) Turn BATT MASTR and ALTR switches ON. Voltmeter should read battery voltage. If voltage is not present:

(a) Check continuity of wiring harness from regulator plug to alternator circuit breaker.
(b) Ensure that alternator regulator circuit breaker is closed and not defective.

d. Voltage Output No-Load Test.

Perform this test, as well as the following voltage output load test, whenever an **over-charging** or **undercharging** condition is suspected. Make a visual check as previously outlined. Engine should be at normal operating temperature .

(1) Connect voltmeter positive lead to positive battery terminal and negative lead to negative battery terminal. Record Reading.
(2) Assure that all switches and lights are off, i. e., no load condition.
(3) Start engine and slowly increase speed to approximately 1500 rpm.
(4) Voltmeter reading should increase, but not more than 4 volts above voltage recorded in step 1.
(5) If the voltage does not increase, or if the increase is within the 4 volt limit, proceed to Voltage Output Load Test.
(6) If voltage increase exceeds 4 volts, stop engine, and isolate overvoltage problem as follows:

(a) Disconnect regulator plug from regulator and repeat the test with plug disconnected.
(b) Voltmeter should show no increase in voltage because excitation voltage to alternator is cut-off. Replace regulator.
(c) If voltage increases, with the regulator plug disconnected, excitation voltage is being supplied to alternator field by a short circuit. Isolate and check continuity of wiring harness. Repair or replace.

D.C. GENERATION (cont.)

e. Voltage Output Load Test

This test will determine if there is an ***undercharge*** condition.

(1) Connect regulator plug.
(2) Connect voltmeter to negative and positive post of battery. Record voltage reading.
(3) Turn off all accessory switches. Open circuit breakers where switches do not control circuits.
(4) Start the engine. Apply a load by turning on the landing light.
(5) Slowly increase engine speed to 1500 rpm.
(6) Voltage reading should increase a minimum of 0.5 volt above previous reading.
(7) Turn off landing light and shut down engine.
(8) If voltage fails to increase a minimum of 0.5 volt, position alternator switch to OFF. An under voltage condition exists. Proceed as follows to isolate problem.

(a) Disconnect regulator plug and install a jumper from positive terminal of battery to pin 2 (F pin of regulator plug).

— CAUTION —

DO NOT OPERATE ENGINE MORE THAN 2 MINUTES WITH JUMPER INSTALLED. DAMAGE TO COMPONENTS OF ELECTRICAL SYSTEM COULD OCCUR.

(b) Start engine. Turn ALTR switch ON. Apply electrical load by turning landing light ON. Slowly increase engine speed to determine that voltage obtained in step (b) increases. Stop rpm increase when voltage measures 0 volts.
(c) Voltage reading at battery should increase above previous reading a minimum of 0.5.
(d) Turn landing light OFF Turn ALTR switch OFF. Shut down engine. If the increase in voltage reading is still less than 0.5 volt, the problem is in the wiring harness ***or*** alternator.
(e) To isolate the wiring harness, remove jumper end from the voltage regulator plug and connect it to the FLD pin of the alternator (plug removed).
(f) Leave alternator regulator plug disconnected.
(g) Start engine. Turn ALTR switch ON. Apply electrical load by turning taxi and landing lights ON. Slowly increase engine speed to determine that voltage of step (b) increases. Stop rpm increase when voltage measures 0.0 volts. Observe 2 minute operation caution.

1) If the voltage increase is now a minimum 0.5 volt, fault is wiring harness. Repair or replace harness.
2) If the voltage increase is still below 0.5 volt, fault is in alternator. Remove alternator from aircraft for bench test.

D.C. GENERATION (cont.)

4. Alternator Bench Test Procedures

The only equipment required to bench check the alternator is an ohmmeter. Zero ohmmeter when ***each*** resistance setting is selected. Zeroing is accomplished by touching ohmmeter probes together and adjusting zero knob to align meter on full scale reading.

a. Rectifier Ground and ***Positive*** Diode Test (Refer to Figure 24-6)

— CAUTION —

DO NOT USE DIGITAL OHMMETER FOR THIS TEST; IT WILL GIVE FALSE INDICATIONS.

(1) Set the ohmmeter selector switch to resistance scale 10 and zero the meter.
(2) Attach one ohmmeter lead to BAT terminal and the other to the STA (Stator) terminal. A reading of 60 ohms should be obtained. Reverse leads. An infinite (no needle movement) should be obtained.
(3) A reading of 60 ohms or less in ***both*** directions indicates:
  (a) A defective positive diode.
  (b) A grounded positive diode plate.
  (c) A grounded alternator BAT terminal.
(4) Infinite reading (no needle movement) in ***both*** directions indicates an open STA terminal connection.

b. Stator Ground and ***Negative*** Diode Test (Refer to Figure 24-7)

— CAUTION —

DO NOT USE DIGITAL OHMMETER FOR THIS TEST; IT WILL GIVE FALSE INDICATIONS.

(1) Set the ohmmeter selector switch on resistance scale 10 and zero meter.
(2) Connect one lead to the “STA” terminal and the other lead to the GRD terminal. A reading of approximately 60 ohms should be obtained. Reverse leads and check in opposite direction. An infinite reading (no needle movement) should be obtained.
(3) A reading of 60 ohms or less in ***both*** directions indicates:
  (a) A defective negative diode.
  (b) A grounded positive diode plate.
  (c) A grounded alternator BAT terminal.
  (d) A grounded STA terminal.
  (e) A grounded stator winding (laminations grounded or windings grounded to front or rear housing).
(4) Infinite readings (no needle movement) in ***both*** directions indicates an open STA terminal connection.

D.C. GENERATION (cont.)

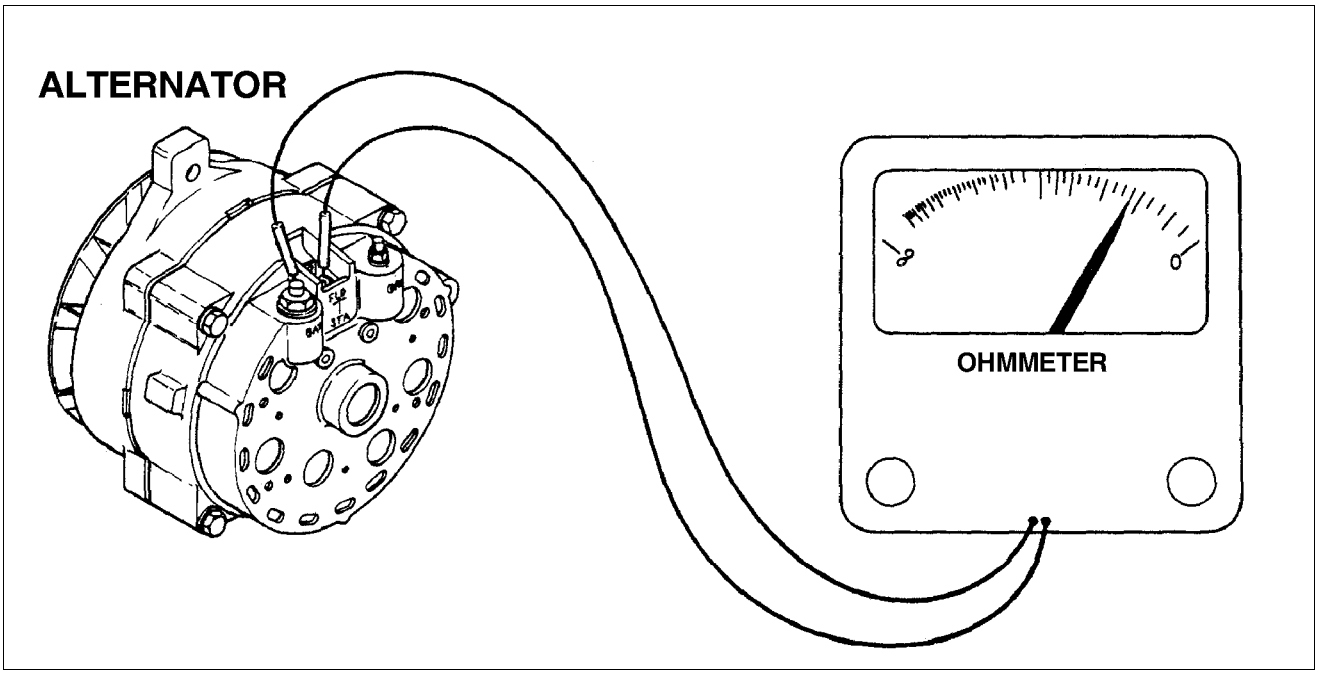

Figure 24-6. Rectifier Ground and Positive Diode Test

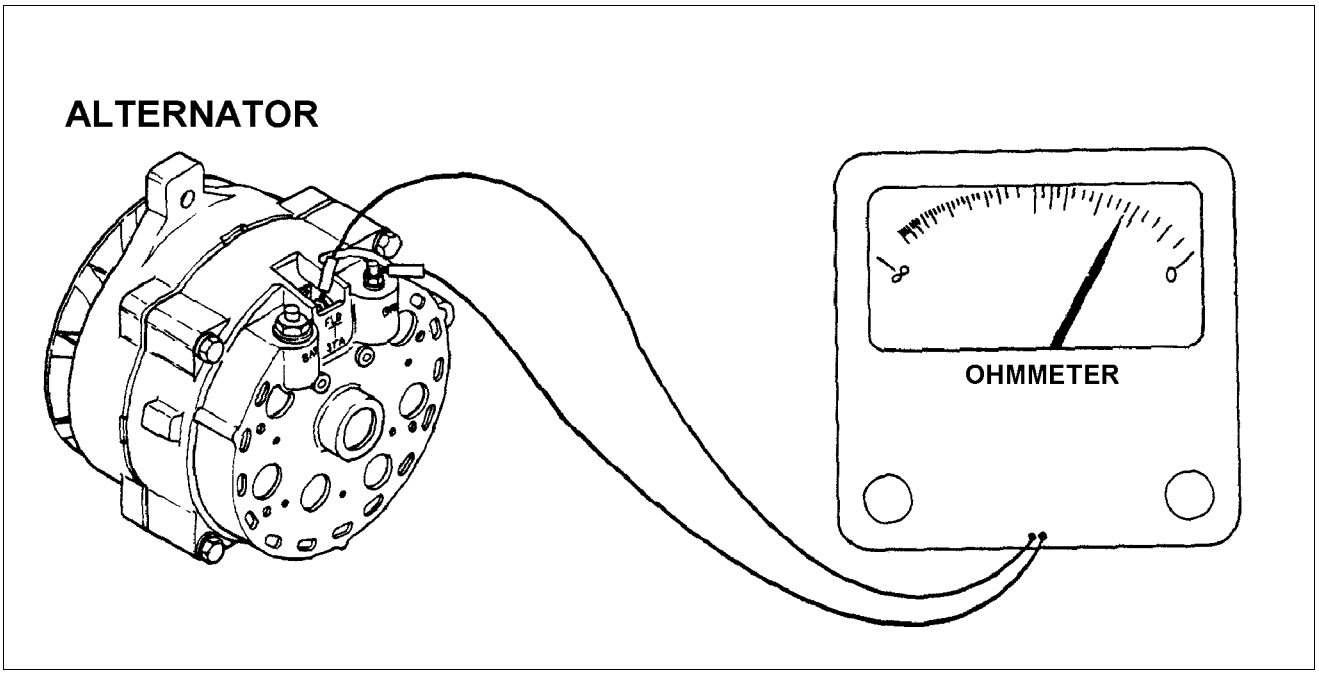

Figure 24-7. Stator Ground and Negative Diode Test

D.C. GENERATION (cont.)

c. Field Circuit Open or Ground Test (Refer to Figure 24-8)

(1) Set ohmmeter selector switch to resistance scale one and zero meter.
(2) Connect one lead to the FLD terminal and the other lead to the GRD terminal.
(3) Spin alternator pulley and note ohmmeter reading. Meter should read between 4 and 200 ohms and fluctuate while rotor is turning.
(4) A reading lower than four ohms indicates:
  (a) A grounded positive brush.
  (b) A grounded field terminal.
  (c) A defective rotor.
(5) A reading higher than 200 ohms indicates:
  (a) Worn out or hung brushes.
  (b) An open brush lead.
  (c) A defective rotor.

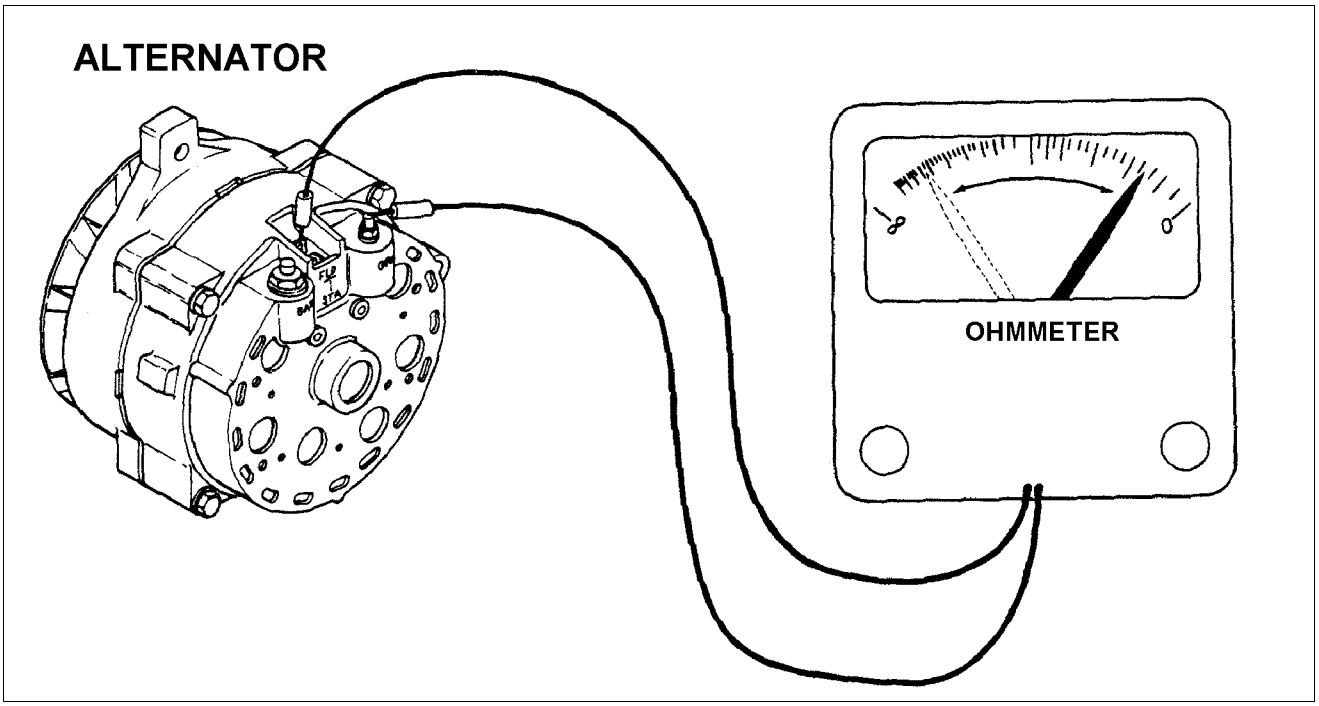

Figure 24-8. Field Circuit Open or Ground Test

5. Overhaul of Alternator

a. Disassembly

(1) Scribe a mark across stator and front and rear housings to facilitate alignment during assembly. (Refer to Figure 24-9.)
(2) Separate front housing and rotor from rear housing by removing four thru bolts between housings. Remove rear housing.
(3) Remove retainer nuts and insulators from the BAT and GRD terminals.

D.C. GENERATION (cont.)

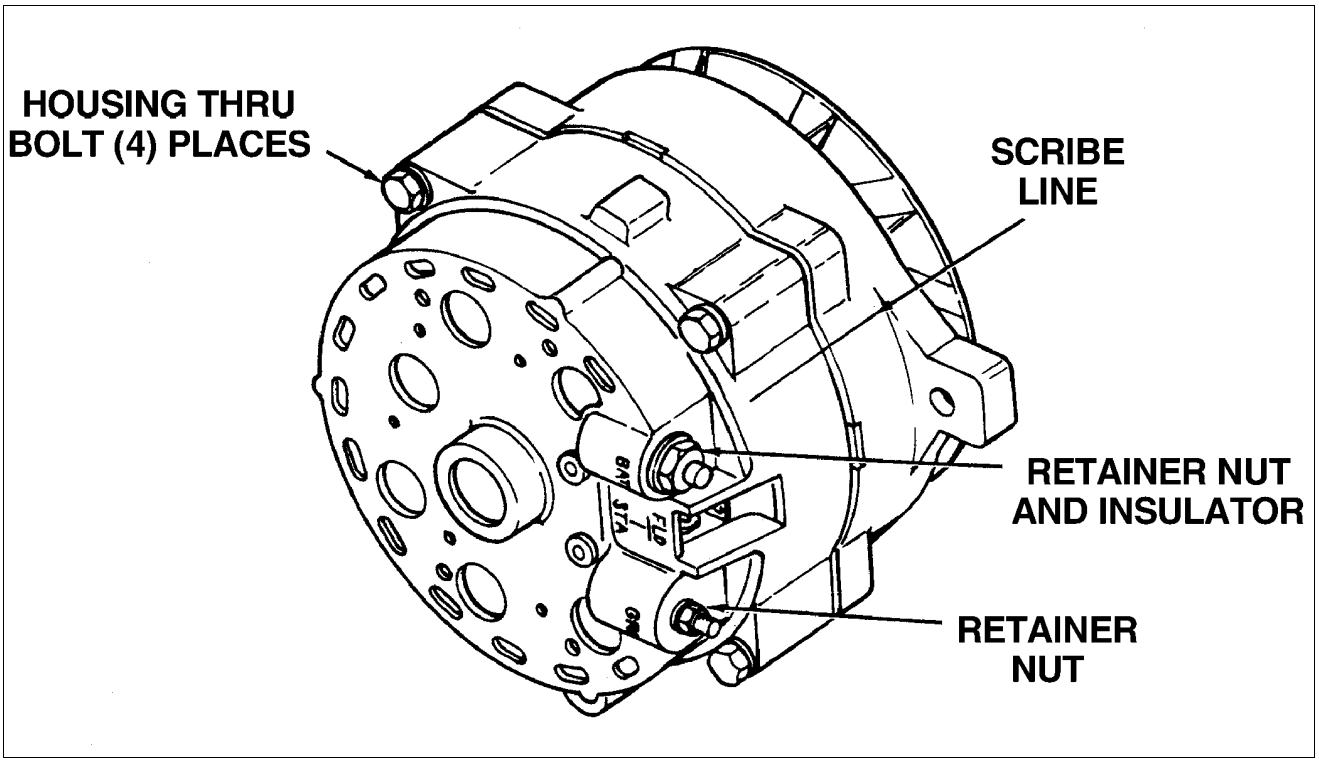

Figure 24-9. Alternator Housing Disassembly

(4) It is not necessary to disassemble the complete rear housing to replace the brush assembly only. Unsolder the stator lead, remove two screws securing the brush holder assembly. (Refer to Figure 24-10.) (Refer to the Assembly Section for installation procedure.)

(5) Remove four retainer bolts from rectifier assembly, two retainer bolts from brush assembly,and one screw from radio suppression capacitor lead. Remove stator, rectifier assembly and brush assembly from rear housing.

(6) If replacing the rear shaft bearing, support housing on the inner bearing boss and press bearing from housing.

(7) If the rectifier is to be replaced, or, if the stator and diodes are to be bench checked, separate rectifier from stator by unsoldering terminal connections of stator windings and rectifier assembly. (Use 100 Watt soldering iron to prevent excessive heat buildup.)

(8) Unsolder stator terminal from rectifier.

D.C. GENERATION (cont.)

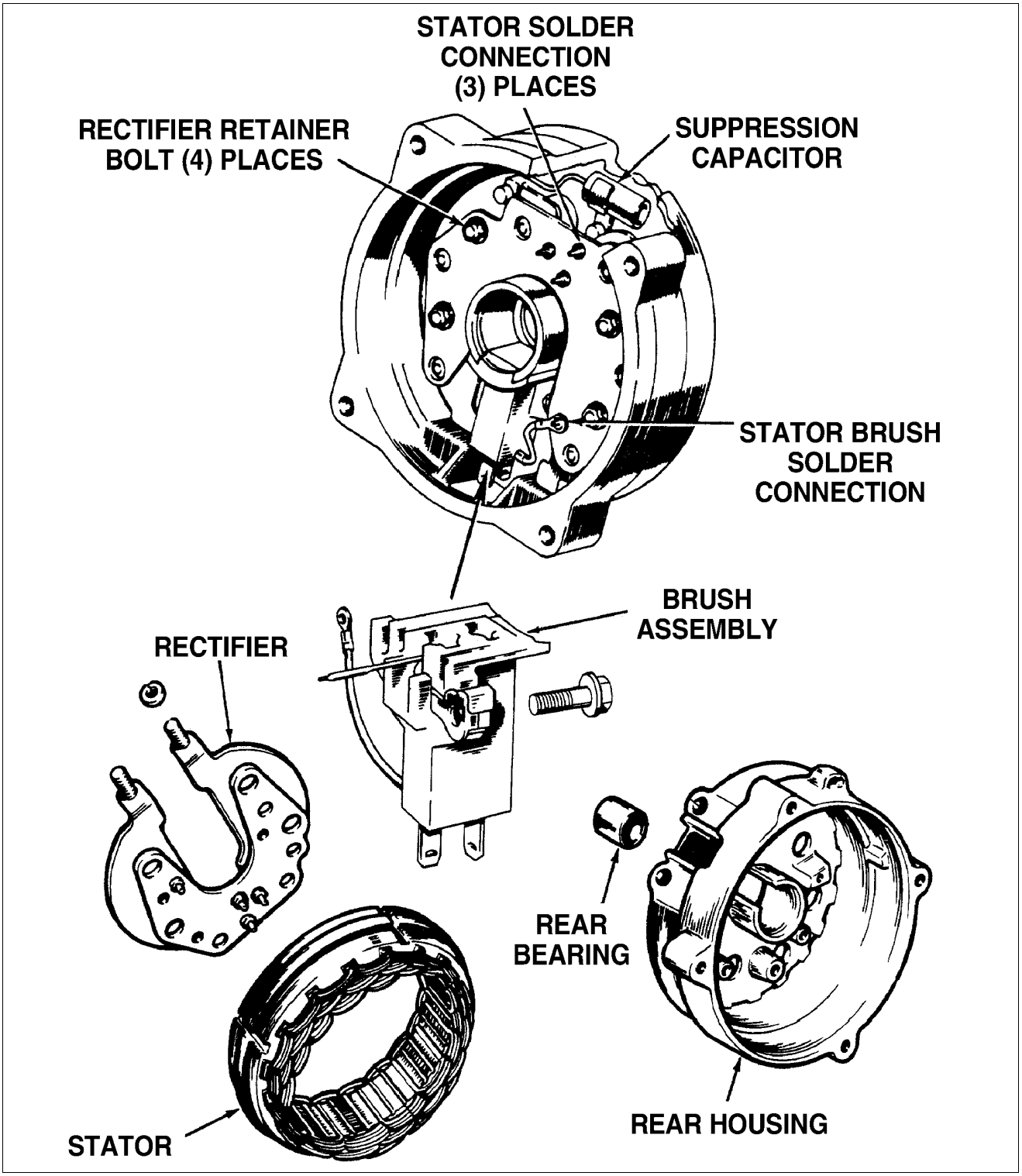

Figure 24-10. Rear Housing Components

D.C. GENERATION (cont.)

(9) Separate rotor, fan and pulley from the front housing by removing hex nut. A special tool, similar to that depicted in Figure 24-11, is required to remove nut. Remove pulley, fan and rotor.

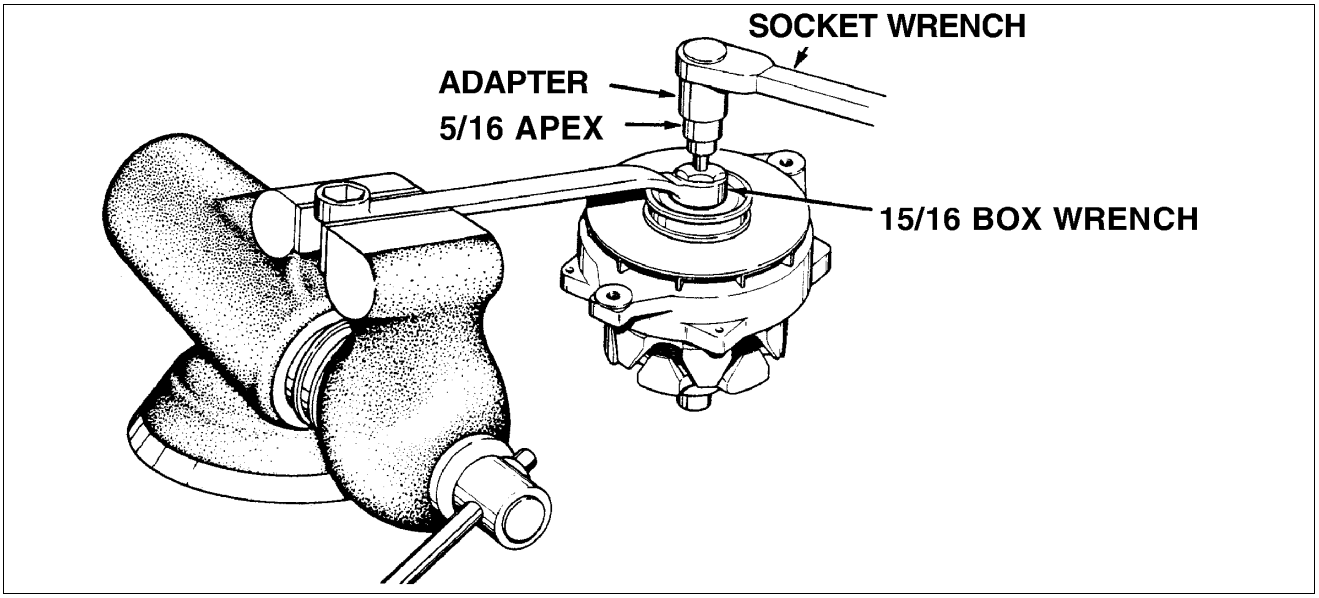

Figure 24-11. Front Housing Disassembly

(10) Remove front bearing from housing by removing bearing retainer screws. The bearing is normally a slip-fit. If stuck, support housing and press bearing from the housing. (Refer to Figure 24-12)

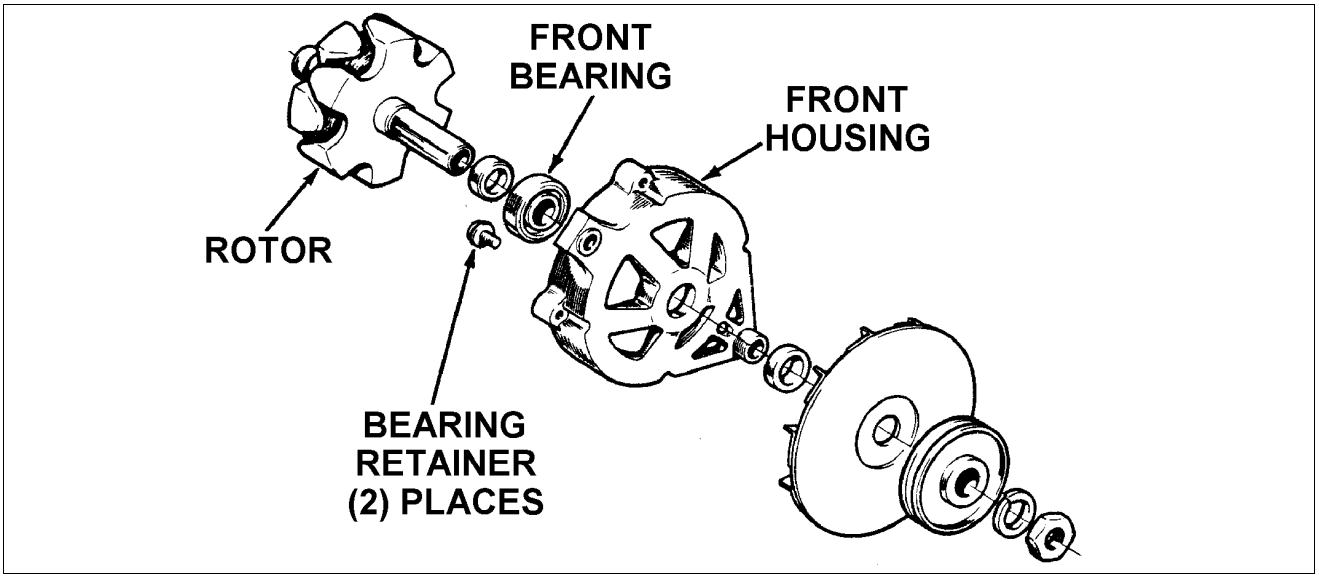

Figure 24-12. Front Housing Components

D.C. GENERATION (cont.)

5. Overhaul of Alternator (cont.)

b. Cleaning and Inspection

(1) Clean the rotor, stator and bearings with a clean cloth. Do not clean these parts with solvent.
(2) Rotate the front bearing on the drive end of the rotor shaft. Check for any scraping noise, looseness, or roughness. Look for excessive lubricant leakage. If any of these conditions exist, replace bearing.
(3) Inspect the rotor shaft rear bearing surface for roughness or severe chatter marks. Replace the rotor assembly if the shaft is not smooth.
(4) Place the rear bearing on the slip-ring end of the rotor shaft and rotate the bearing. Make the same check for noise, looseness, or roughness as was made for the front bearing. Inspect the rollers and cage for damage. Replace the bearing if these conditions exist, or if the lubricant is lost or contaminated.
(5) Check the pulley and fan for excessive looseness on the rotor shaft. Replace any pulley or fan that is loose or bent out of shape.
(6) Check both the front and rear housings for cracks, particularly in the webbed areas, and at the mounting ear. Replace damaged or cracked housings.
(7) Check all wire loads on both the stator and rotor assemblies for loose or broken soldered connections and for burned insulation. Resolder poor connections. Replace parts that show signs of burned insulation.

— CAUTION —

DO NOT TURN DOWN SLIP-RINGS BEYOND A MINIMUM DIAMETER OF 1.22 INCHES. IF THE RINGS ARE BADLY DAMAGED, REPLACE THE ROTOR ASSEMBLY.

(8) Check the slip-rings (brush contacts) for nicks and surface roughness. Nicks and scratches may be removed by turning down the slip rings.
(9) Replace brush assembly if brushes are worn beyond 5/16 inch minimum length.

c. Rotor Continuity Test (Refer to Figure 24-13.)

(1) Separate front housing and rotor assembly from rear housing by removing four housing-thru bolts and separating rear and front housings. Springs and brushes are not retained by brush holder when housings are separated.
(2) Set the ohmmeter selector switch on resistance scale 1 and zero meter.
(3) Touch one lead of ohmmeter to each segment of the slip ring. The meter should read 3 to 5 ohms.
(4) Readings higher than 5 ohms indicate a damaged solder connection at the slip rings or a broken wire.
(5) Readings lower than 3 ohms indicate a shorted wire or slip ring.
(6) Replace the rotor if repairs cannot be made.

D.C. GENERATION (cont.)

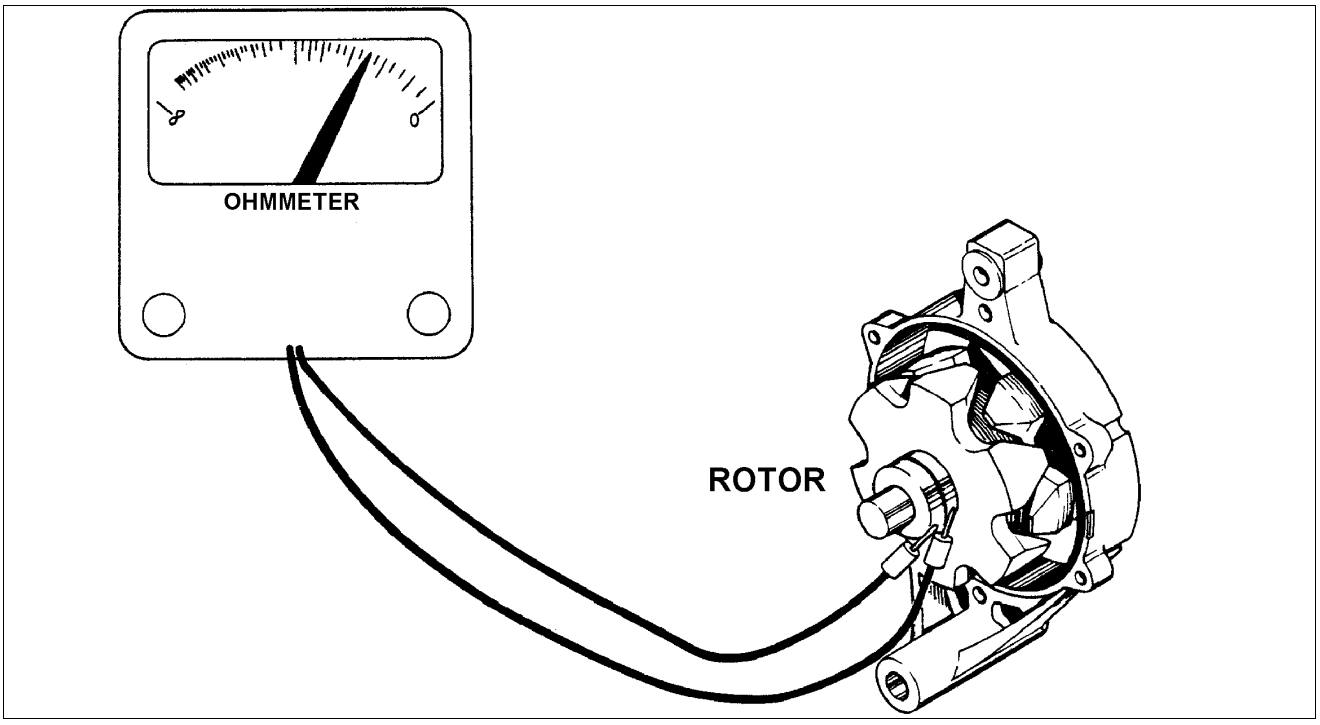

Figure 24-13. Rotor Continuity Test

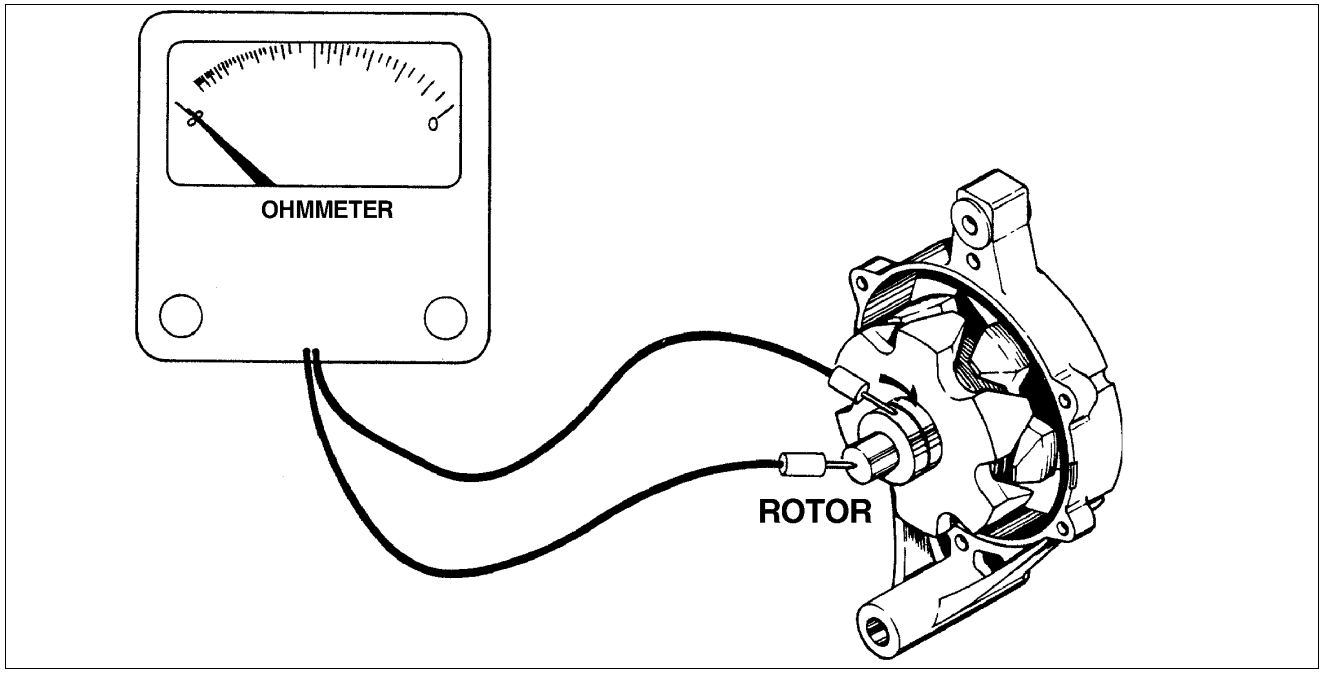

Figure 24-14. Rotor Ground Test

D.C. GENERATION (cont.)

d. Rotor Ground Test (Refer to Figure 24-14.)

(1) Set the ohmmeter selector switch on 1000 scale and zero the meter.
(2) Touch one lead to the rotor shaft and the other lead to first slip ring then to the other. The ohmmeter should read infinity (no needle movement) in both checks.
(3) If the meter shows a reading (needle moves) a short to ground exists. Check the soldered connections at the slip rings to make sure they are secure and grounding against the rotor shaft, or that excess solder is not grounding the rotor coil.
(4) Replace the rotor if repairs cannot be made.

e. Stator Continuity Test (Refer to Figure 24-15)

(1) Using a 100 watt soldering iron, disconnect the three stator wires from diode assembly, and remove stator from rear housing.
(2) Set the ohmmeter selector switch on resistance scale 1 and zero the meter.
(3) Connect ohmmeter leads alternately between all three sets of leads. Meter readings should be equal between any pair of stator leads.
(4) If unequal readings are obtained, the stator winding is open. Check wiring junction. If breaks are found repair and recheck. If unequal readings still exist, replace the stator.

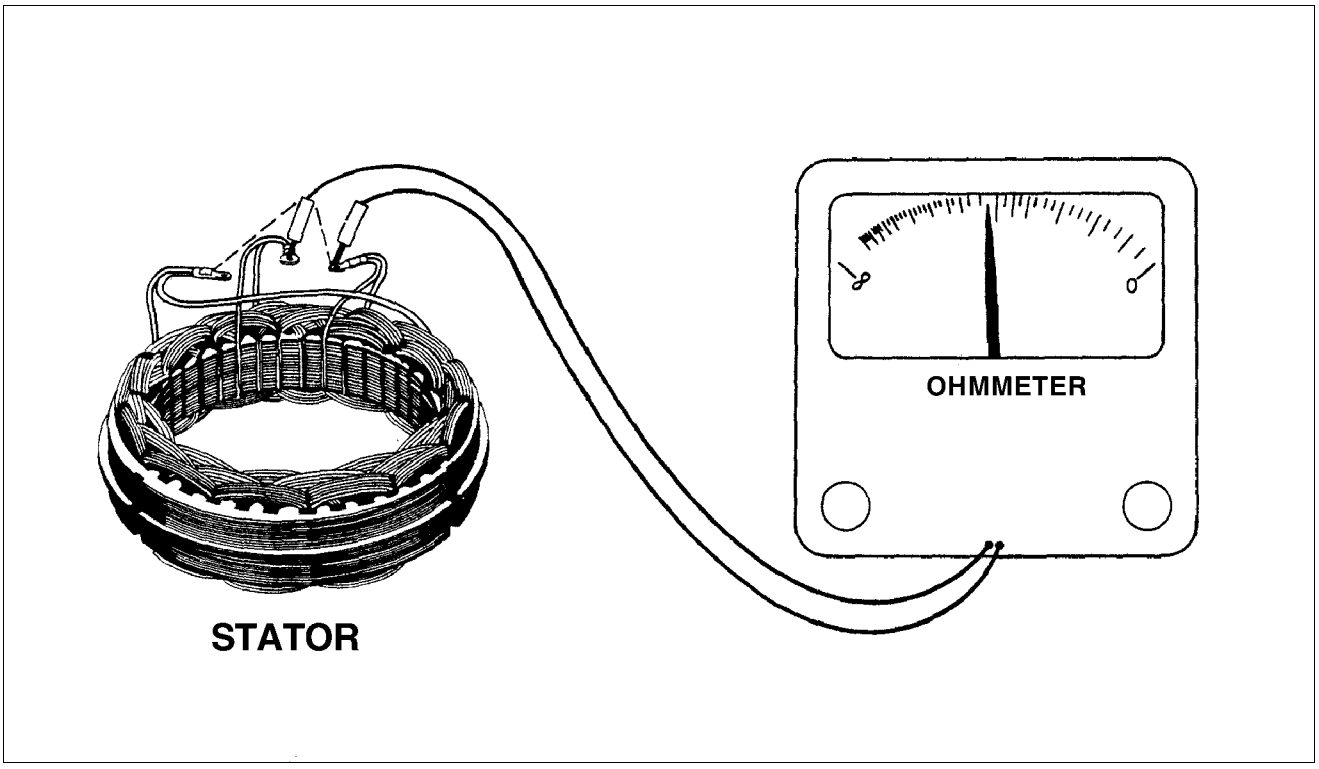

Figure 24-15. Stator Continuity Test

D.C. GENERATION (cont.)

f. Stator Ground Test (Refer to Figure 24-16)

(1) Set ohmmeter selector switch on resistance scale 1000 and zero the meter.
(2) Connect one meter lead to bare metal portion of stator core and other lead alternately to each of the stator leads. The ohmmeter should read infinity (no needle movement). Be sure lead is making good contact with stator core surface.
(3) If meter shows any reading (needle moves) the stator is grounded and must be replaced.

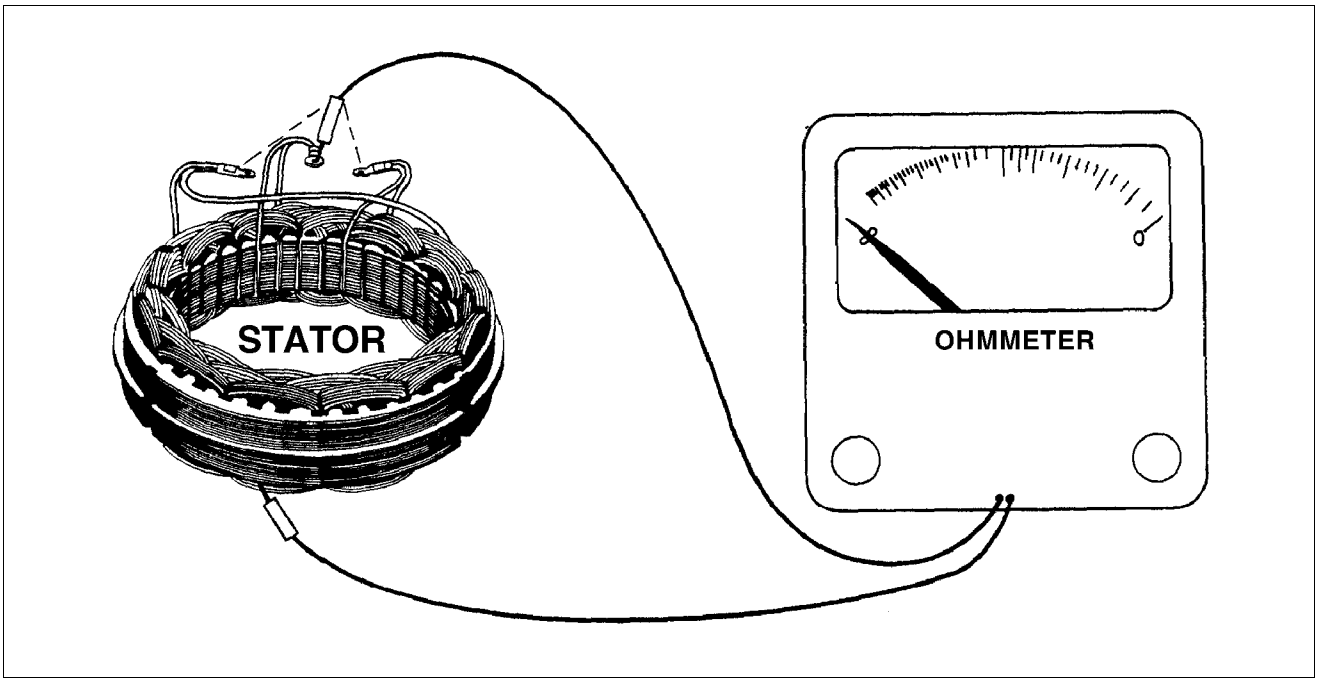

Figure 24-16. Stator Ground Test

g. Diode Testing (Refer to Figure 24-17)

Stator must be disconnected from rectifier assembly to perform this test. Rectifier shown removed for clarity.

(1) Set the ohmmeter selector on resistance scale 10 and zero the meter.
(2) Test the negative diodes by connecting one ohmmeter lead to GRD post terminal on rectifier and connect other lead to each stator lead connection of rectifier momentarily. Reverse ohmmeter leads and check in opposite direction. Meter must shown continuity in one direction and infinity (no needle movement) in other direction.
(3) Test the positive diodes by connecting one ohmmeter lead to the BAT terminal on rectifier and other lead to each stator lead connection of rectifier momentarily. Reverse ohmmeter leads and check in the opposite direction. Meter must show continuity in one direction and infinity (no needle movement) in other direction.
(4) If continuity is observed in both directions, the diode(s) is shorted.
(5) If no continuity is observed in both directions, the diode(s) is open.
(6) Replace the rectifier assembly if open or shorted diodes are found.

D.C. GENERATION (cont.)

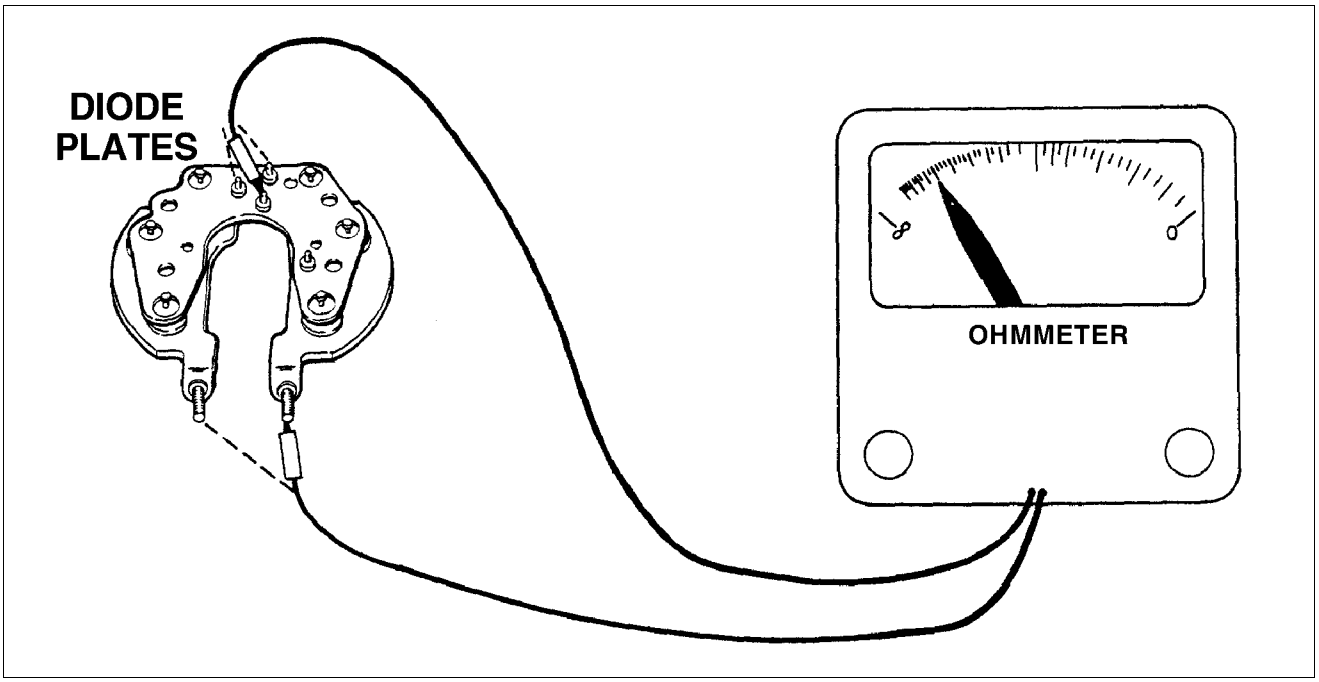

Figure 24-17. Diode Testing

h. Assembly Procedure (Refer to Figures 24-18, 24-19, 24- 20, and 24-21)

(1) Clean all parts with a lint free cloth.
(2) Position the front bearing in the front housing and install the bearing retainer screws.
(3) Install spacer on rotor shaft and slide rotor shaft through housing and bearing.
(4) Install spacer, fan, pulley, flat washer, lock washer and nut. Tighten the nut to 60-100 ft.-lbs. A special tool similar to Figure 24-18 is required to torque nut.
(5) If the rear bearing was removed, press a new bearing into place from inside the housing. Apply pressure to the outer race only. Install dust cover over bearing end of housing.
(6) Install radio suppressor capacitor in rear of housing and install retainer screw.
(7) Install springs and brushes into brush holder. Install short length of 0.040 wire through brush holder to retain brushes in place. Wire should be long enough to extend through hole in housing for removal after housings are assembled.
(8) Install two retainer screws in brush assembly and housing. Hold down on brush assembly while tightening screws, to prevent breaking brush assembly attachment brackets.
(9) Install insulator on BAT post of rectifier assembly and install insulators (2) in place in the rear housing for mounting bolts in positive BAT side of rectifier.
(10) Carefully install rectifier and stator into rear housing. Ensure insulators are in place. Install BAT post insulator and nut and GRD post retainer and nut, finger tight.

D.C. GENERATION (cont.)

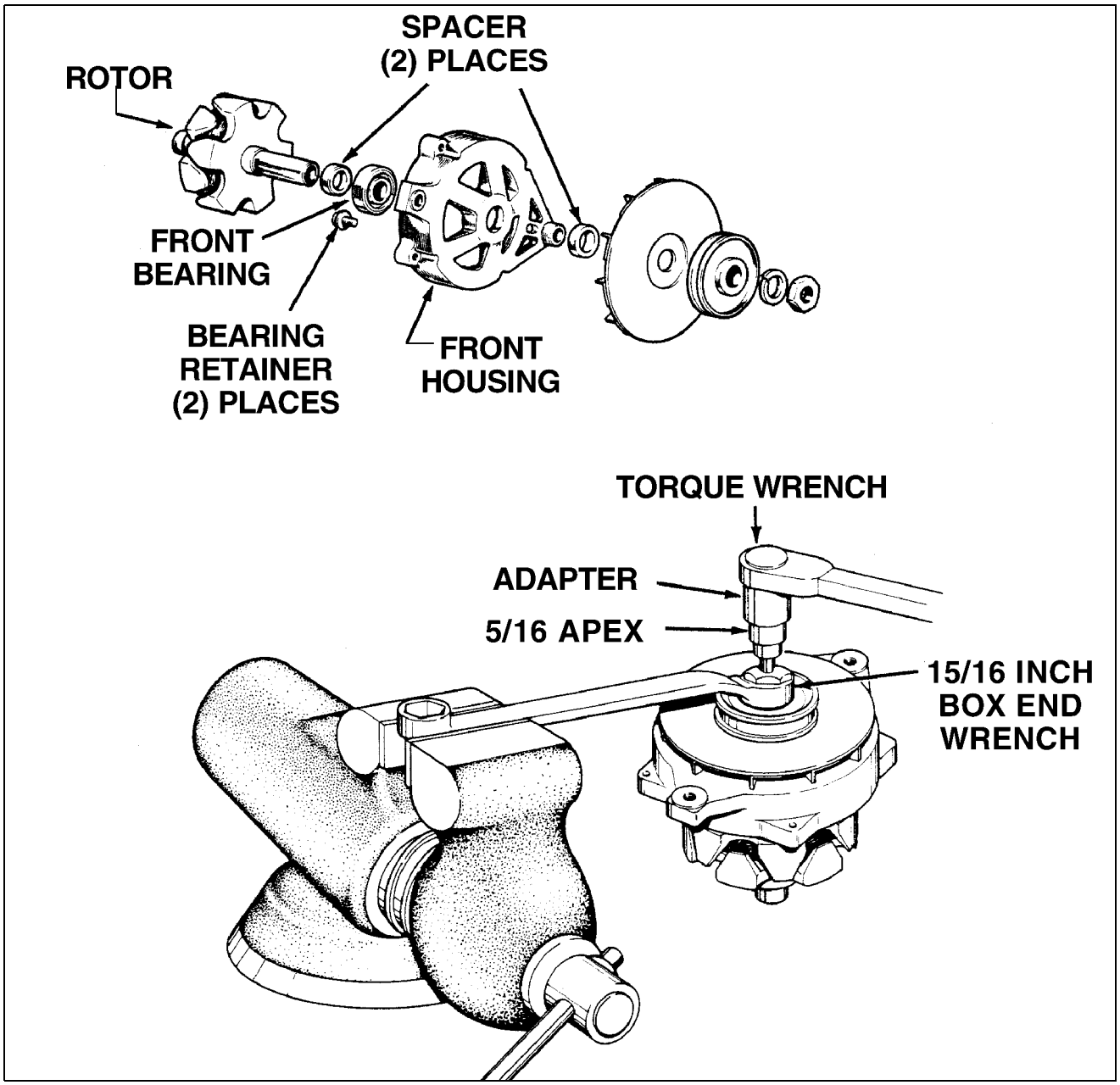

Figure 24-18. Front Housing Assembly

(11) Install the 4 rectifier retainer bolts (check insulators on positive side) finger tight. Install suppression capacitor lead to rectifier and tighten screw.
(12) Tighten BAT and GRD retainer nuts then 4 rectifier retainer bolts.
(13) Install the 3 stator winding leads to rectifier posts and solder with 100 watt iron (to prevent overheating of connection) and resin core solder. Solder stator terminal lead to diode assembly.

D.C. GENERATION (cont.)

(14) Position the front and rear housings together, align scribe marks on housings and stator, and install four thru-bolts in housings. Alternately tighten each thru-bolt around alternator until a preliminary torque of 15 to 25 inch-pounds is reached for each bolt. Final torque each thru-bolt alternately around the alternator until each bolt is torqued 45 to 60 inch-pounds.

(15) Spin pulley to ensure that alternator is free of binding or noise.

(16) Pull retainer wire from brush assembly and seal hole in housing with EP-711 sealant or equivalent. (Available from Coast Pro-Seal Compton, California or equivalent.)

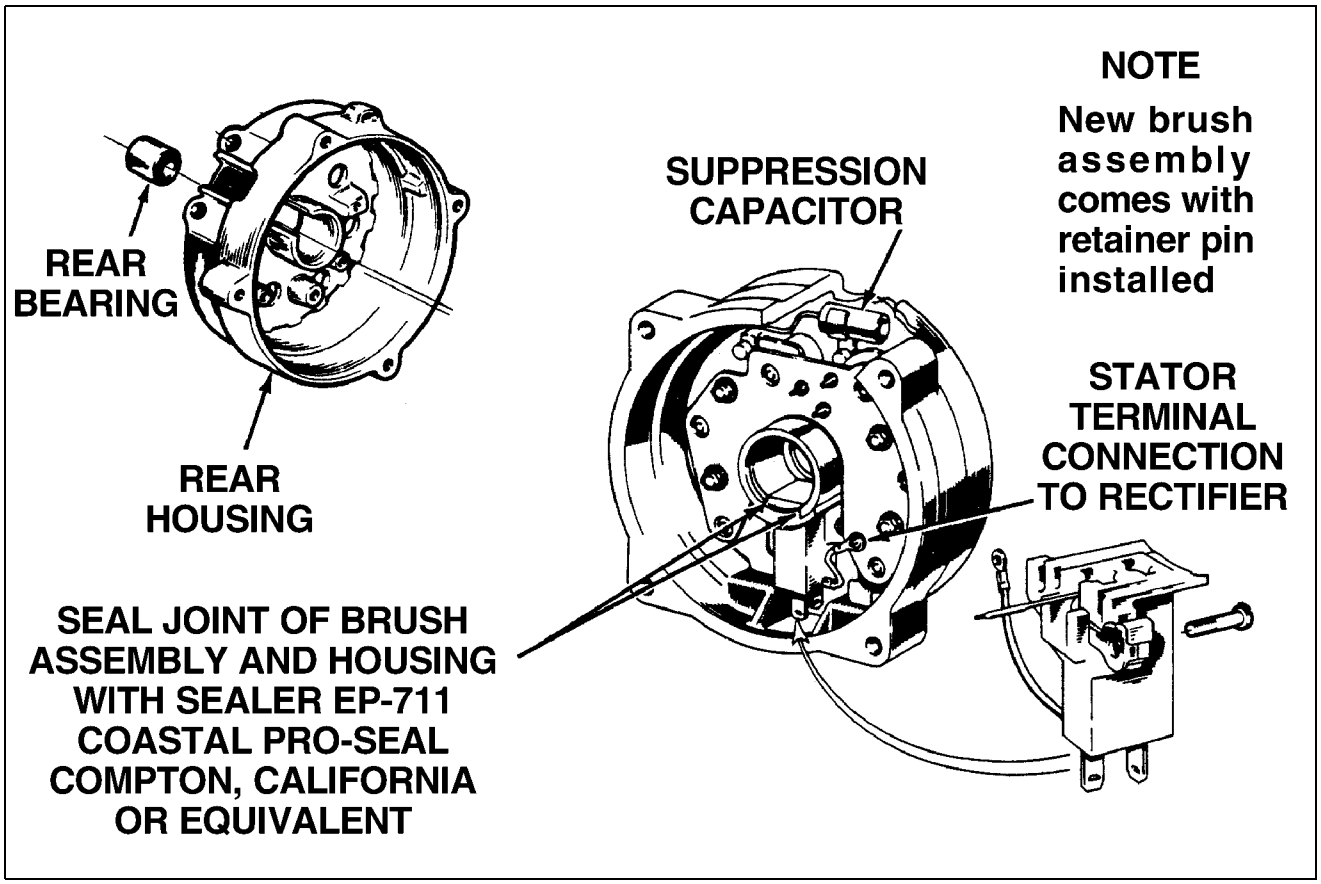

Figure 24-19. Rear Housing Bearing and Brush Assembly Installation

D.C. GENERATION (cont.)

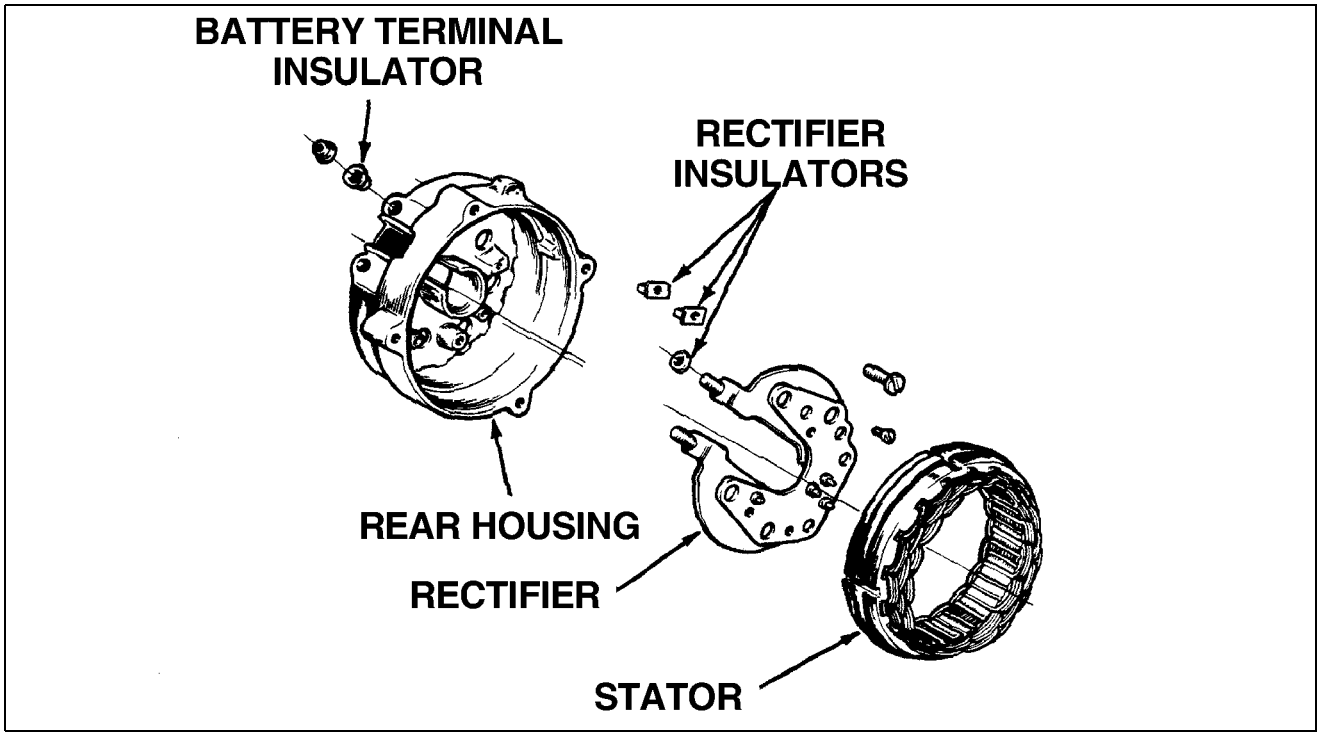

Figure 24-20. Rear Housing Components

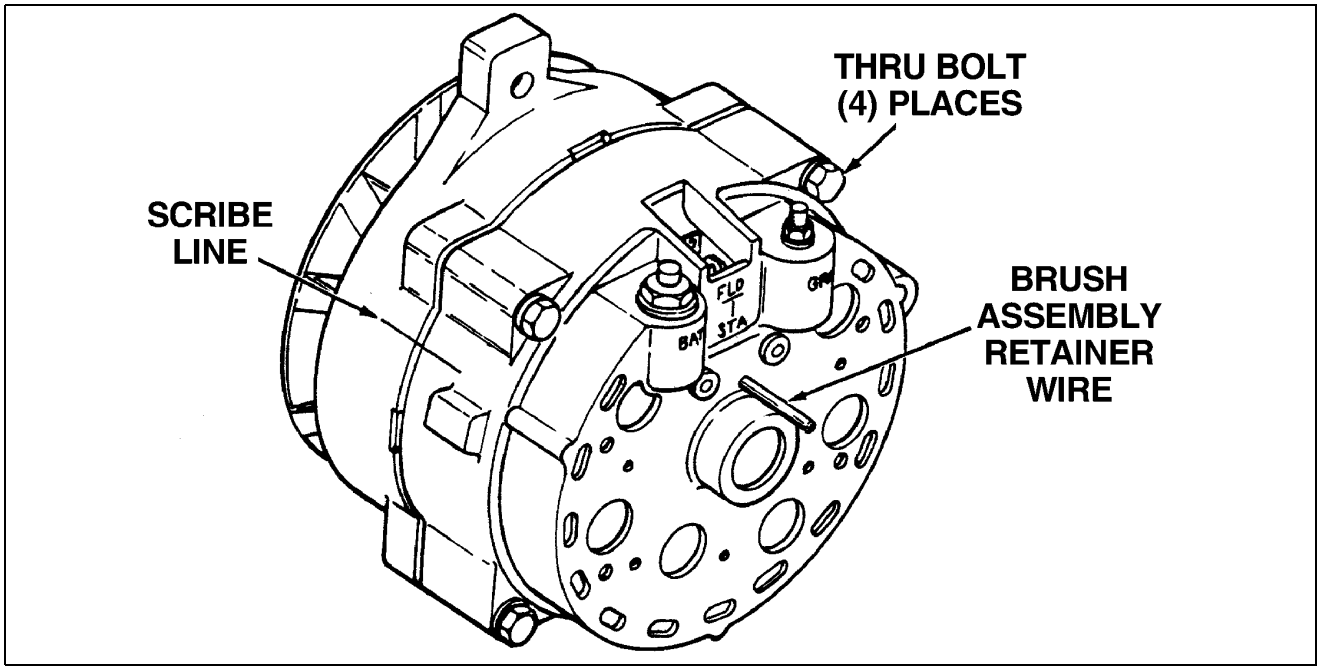

Figure 24-21. Housings Assembly

D.C. GENERATION (cont.)

6. Alternator Removal and Installation.

   The alternator is factory-installed by the engine manufacturer (Lycoming) using Lycoming mounting brackets. Removal and installation instructions may be found in the appropriate vendor service publication or in the instructions / drawings for Lycoming Kit No. 05J22487.

   See Chapter 21 for additional information on drive belt alignment.

   — WARNING —

   THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT. (SEE INTRODUCTION, PAGE 4.)

7. Adjusting Alternator Belt Tension.

   — CAUTION —

   IN HP S/N'S 3246001 THRU 3246087 ONLY, ENSURE ALTERNATOR DRIVE BELT IS CORRECT PART NUMBER FOR SERIAL NUMBER RANGE, AND THAT THE ALTERNATOR IDLER PULLEY IS POSITIONED AWAY FROM THE COWLING WHEN ADJUSTING DRIVE BELT TENSION. IF IDLER PULLEY IS POSITIONED INCORRECTLY (I.E. - 180º OUT), CONTACT WITH THE COWLING IS LIKELY, RESULTING IN DAMAGE TO THE COWLING AND PULLEY, AND FAILURE OF THE DRIVE BELT.

   (a) Loosen bottom mounting bolt and belt adjusting bolt. Adjust alternator belt tension by applying pressure to the adjusting lug of alternator with a one-inch open end wrench.

      (1) In HP S/N's 3246001 thru 3246017 - use a calibrated belt tension gauge to adjust a new belt to 65 - 70 pounds static tension. Adjust a used belt to 35 - 40 pounds static tension.
      (2) In the TC S/N's 3257001 & up and HP S/N's 3246018 & up - use a calibrated belt tension gauge to adjust a new belt to 90 - 120 pounds of static tension. Run in for 15 minutes. If tension falls below 50 lbs., re-tension to 70 lbs.

   — CAUTION —

   IF AIR CONDITIONER IS OPERATED ON THE GROUND FOR SERVICING, CLEAR TEST AREA OF ANY LOOSE OBJECTS LYING ON RAMP. ENSURE THAT A QUALIFIED PERSON IS AT THE AIRPLANE CONTROLS.

   (b) Run engine 15 minutes at 1200 rpm.
   (c) Shut down engine, remove engine cowl, and check both belt tensions.
   (d) Check all idler and bracket bolts for safety. After tension is set and upper bolt safetied, tighten lower mounting bolt 450 to 500 lb.-in. There should be no end play in alternator mount. Add thin washers between alternator and mount to remove end play.
   (e) Install engine cowl.
   (f) Re-check tension every 100 hours or annual inspection, whichever comes first.

D.C. GENERATION (cont.)

C. Battery Service (See also Chapter 12)

The battery is located in the aft fuselage, aft of the rear baggage compartment, or under the left floor of the forward baggage compartment (HP S/N's 3246001 thru 3246087 only). Access to the battery is through the aft fuselage access panel in the rear baggage compartment, below the hat shelf; or, in HP S/N's 3246001 thru 3246087 only, via the external access panel on the left side of the forward baggage compartment fuselage section.

The manifold-type battery and its associated acid recovery sump jar are shelf mounted. Fumes accumulated from the natural charging process are vented to the outside of the aircraft, through the recovery jar. These vents must be checked for corrosion. Positive and negative drains extend from the battery manifold and acid recovery jar and exit through vent tubes located on the bottom of the fuselage.

In HP S/N's 3246001 thru 3246017 only, the battery is enclosed in a box with a vent system and a drain. The vents allow 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 off from the bottom of the fuselage and should be opened occasionally to drain any accumulation of liquid or during cleaning of the box.

The battery should be checked for fluid level, but must not be filled above the baffle plates. A hydrometer check should be performed to determine the percent of charge in the battery. All connections must be clean and tight. If the battery is not up to normal charge, remove it from the airplane and recharge.

1. Battery Removal

   (a) Open the appropriate access panel(s).
   (b) In HP S/N's 3246001 thru 3246017 only, cut the safety wire and remove wing nuts securing battery box cover.

— CAUTION —

REMOVE GROUND CABLE FIRST AND INSTALL IT LAST TO PREVENT AN ACCIDENTAL SHORT CIRCUIT OR ARCING.

   (c) Disconnect battery cables.
   (d) In HP S/N's 3246018 & up and TC S/N's 3257001 & up:

      (1) Disconnect manifold overflow tube and positive vent line, in that order.
      (2) Remove battery hold down bolts

   (e) Remove battery.

2. Battery Installation

— CAUTION —

DO NOT INSTALL BATTERY WITH REVERSE POLARITY. CONNECT GROUND TO NEGATIVE TERMINAL OF BATTERY.

   (a) In HP S/N's 3246018 & up and TC S/N's 3257001 & up, ensure that all vent lines are free of kinks, cracks, and loose connections. Replace only with special hoses specified in Parts Catalog. (DO NOT USE ORDINARY RUBBER HOSE.)
   (b) Properly position battery on shelf or in box, as appropriate.

D.C. GENERATION (cont.)

(c) In HP S/N's 3246018 & up and TC S/N's 3257001 & up:

(1) Connect positive vent line.
(2) Connect manifold overflow tube

(d) Connect battery cables. First, connect and secure the positive cable; then, connect and secure the ground (negative) cable.

(e) In HP S/N's 3246018 & up and TC S/N's 3257001 & up, install and secure battery hold down bolts

(f) In HP S/N's 3246001 thru 3246017 only, install and safety wire wing nuts securing battery box cover.

(g) Reinstall aft fuselage access panel or floor panel and external access panel, as appropriate.

3. Testing Battery

Specific gravity values for checking battery charge using a hydrometer are listed in Chart 2402. If the alternator output is known to be correct, battery capability can be more accurately determined with a load type tester.

CHART 2402. 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

4. Battery Charging

— CAUTION —

NEVER ALLOW LEAD ACID BATTERIES OR TOOLS USED ON THEM TO BE NEAR NI-CAD BATTERIES AND NI-CAD BATTERY TOOLS.

The National Electric Code forbids charging batteries installed in aircraft ***or*** within 10 feet of fuel tank areas. Remove battery from the airplane for charging. Further, an aircraft battery should not be allowed to deteriorate to the point where safety of flight is jeopardized. The batteries emergency capacity should be sufficient to power the essential bus for a minimum of thirty minutes.

(a) Remove battery from airplane.
(b) Remove cell plugs and ensure that vents in plugs are open and that vent valves operate freely.
(c) Check that the electrolyte level in each cell is at the bottom of the split ring.
(d) A hydrometer check of each cell should be accomplished. (Refer to Chart 2102)
(e) Place a wet cloth be over the vent caps within the manifold to prevent splashing of electrolyte.
(f) The battery may be charged at any rate (in amperes), but in no case to the point which would produce bubbling and gassing of the electrolyte or a cell temperature of 115°F.

D.C. GENERATION (cont.)

— CAUTION —

WEAR EYE PROTECTION WHEN CHARGING BATTERY. ENSURE THE CHARGING AREA IS WELL VENTILATED. IF CENTRAL AIR CONDITIONING IS USED, VENT BATTERY CHARGING AREA TO OUTSIDE AIR TO PREVENT HYDROGEN GASSES FROM BEING CIRCULATED THROUGHOUT THE BUILDING.

— Note —

Refer to latest version of applicable battery manufacturer's service manual for any limitations or special charging procedures.

(g) A constant current charge is recommended. Start charging at 3 amperes; finishing with 1.5 amps. A fast charge is not recommended.

(h) As charging occurs, if any cells sputter or flood, the electrolyte level is too high and the excess must be removed. Adjust electrolyte level at the end of the charge. The level will rise due to acid returning to the electrolyte mix, normal gassing, and expansion due to temperature rise.

(i) Thoroughly clean battery after charging to remove acid bridges which can form during charging.

5. Battery Corrosion Prevention.

Check battery for spilled electrolyte or corrosion each 50 hour inspection or every 30 days, whichever comes first. Should spilled electrolyte or corrosion be found in, on, or near the battery, clean the battery, its mounting, and the general area as follows:

(a) Remove battery from airplane.

— CAUTION —

DO NOT ALLOW BAKING SODA SOLUTION TO ENTER BATTERY.

(b) In HP S/N's 3246001 thru 3246017 only,

(1) Remove the box drain cap from the under side of the fuselage. Drain off any electrolyte that may have overflowed into the box.

(2) Clean the battery and the box. Corrosion effects may he neutralized by applying a solution of baking soda and water mixed to a consistency of thin cream. The application of this mixture should be applied until all bubbling action has ceased.

(3) Rinse the battery and box with clean water and dry.

(4) Place cap over the battery box drain.

(c) In HP S/N's 3246018 & up and TC S/N's 3257001 & up:

(1) Remove all accumulated contamination from the battery exterior with a stiff bristle brush. (Do not use a metal brush or abrasive materials.) Wipe exterior of battery and interior of manifold, including manifold top cover, with a cloth saturated with a solution of bicarbonate of soda mixed - one part soda to twenty parts of water. (Check that cell plugs are tight - do not allow soda solution to enter any cells.)

D.C. GENERATION (cont.)

(2) Wash entire battery with clear water and dry thoroughly.
(3) Wash down the battery support and floor area, hold down supports, connectors and cable ends with a soda solution followed by clear water. Dry entire area and component parts thoroughly. Apply fresh acid resistant paint if required.
(4) Removal of Battery Acid Recovery Jar

a) Remove battery.
b) Keeping the jar upright in a vertical position, remove the acid recovery jar by removing the two bracket screws that secure jar to bracket.

(5) Cleaning Acid Recovery Jar and Vent Lines

a) Visually inspect all vent lines for kinks, cracks, flexibility, and loose connections. Replace only with special hoses from parts catalog. (DO NOT REPLACE WITH ORDINARY RUBBER HOSE.)
b) Slowly pour the soda solution into the vent hoses, still attached to the bottom of the aft fuselage surface, using a small funnel. The solution will flow out the bottom vents.
c) Follow with a final purge of clear water to flush the vent lines and then blow dry with low pressure air. This ensures that the vent line is not kinked or restricted and that it is neutralized.
d) Wipe down the bottom aft fuselage area surrounding the vents with soda solution and clear water. Apply a fresh coat of high quality wax to entire area.
e) Unscrew the bottom of the recovery jar and separate from the top. Remove jar pad. Observing environmental regulations, empty jar contents into a suitable container for safe disposal.
f) Thoroughly wash and neutralize the jar, pad, top (including bracket), and the short length of vent hose still attached to the jar top with soda solution and clear water rinse.
g) Thoroughly dry all components and recharge the jar with 0.75 bicarbonate of soda. Place dry jar pad in the jar on top of the soda charge.
h) Screw jar back together and keep it in a vertical position.
i) Install jar in aircraft.
j) Install battery.

(d) Reinstall battery.

D. Checking Voltage Regulator, 14V (HP S/N's 3246001 thru 3246017 only)

The regulator is a fully transistorized unit in which all the components are encapsulated in epoxy, which makes field repair of the unit impractical. If it does not meet specifications, it must be replaced. Test the regulator by the following procedure:

1. Check that battery is fully charged and in good condition.
2. Disconnect ***regulator*** from circuit. Check ***alternator*** per manufactures instructions to determine it is functioning properly. After completing check, connect ***regulator*** into circuit.

D.C. GENERATION (cont.)

3. Use a good quality voltmeter with at least a 15 volt scale.
4. Connect the positive voltmeter lead to the red wire at the ***regulator*** harness connector or terminal or terminal block.
5. Connect the negative voltmeter lead to the ***regulator*** housing. ***DO NOT*** connect the voltmeter across the battery. The regulator is designed to compensate for resistance contained within the wiring harness.
6. If bench testing regulator, connect a number 14 wire between to ***regulator*** case and the ***alternator.***
7. With the ambient temperature surrounding the ***regulator*** of 50°F to 100F, and the ***alternator*** turning to produce approximately 25 amperes output, the voltmeter should read between 13.6 to 14.3 volts.
8. If regulator does not regulate between 13.6 to 14.3 volts, check the following:

   (a) Regulates, but out of specifications: Regulator is out of calibration and must be replaced.
   (b) The voltmeter continues to read battery voltage.

      (1) Poor or open connections within the wiring harness.
      (2) The regulator is "open."

   (c) Voltage continues to rise.

      (1) Regulator housing not grounded.
      (2) Regulator shorted, must be replaced.

9. Major causes of regulator failure are:

   (a) Poor or loose connections.
   (b) Poor ground on the regulator housing.
   (c) Shorted alternator windings.
   (d) A grounded yellow wire. (Will cause instantaneous failure.)
   (e) Disconnecting the regulator while circuit is energized.
   (f) Open circuit operation of the alternator. (Battery disconnected.)

E. Checking Voltage Regulator, 28V (HP S/N's 3246018 & up and TC S/N's 3257001 & up)

1. Use only a good quality, adjustable DC power source.

— CAUTION —

ALL TESTS MUST BE ACCOMPLISHED WITH THE REGULATOR OUT OF THE CIRCUIT.

2. Use a quality, accurate voltmeter with at least a 35-volt scale.

— CAUTION —

AMBIENT TEMPERATURES SURROUNDING VOLTAGE REGULATOR MUST BE BETWEEN 50°F AND 100°F.

3. Voltmeter connections (refer to Figure 24-22)

   (a) Connect positive voltmeter lead to red wire (supply) at regulator harness connector or wire.
   (b) Connect negative voltmeter lead to regulator ground wire (black).

D.C. GENERATION (cont.)

4. Light Bulb Connections (refer to Figure 24-23)

   (a) Connect one bulb lead to blue wire (field) at regulator harness connector or wire.
   (b) Connect other bulb lead to regulator ground wire (black).

5. In the regulation check procedure, increase voltage to regulator and monitor both the voltmeter and bulb.
6. As the regulation point of a properly functioning control unit is approached, the bulb will blink OFF and ON. At regulation, the bulb will be ON continuously.
7. If regulator does not regulate to 28 Volts, it is out of calibration, and must be replaced.
8. If regulator checks good, check airplane for:

   (a) Poor or loose connections.
   (b) Poor ground on regulator housing.
   (c) Shorted alternator windings.
   (d) A grounded wire.

9. After completing test, connect regulator into circuit

F. Checking Overvoltage Relay, 14 volt (HP S/N's 3246001 thru 3246017 only)

1. Equipment required to test overvoltage relay.

   (a) A good quality, accurate voltmeter, with a scale of at least 20-volts.
   (b) A suitable power supply, with an output of at least 20-volts, or sufficient batteries with a voltage divider to regulate voltage.

2. Connect test equipment as follows:

   (a) Connect B+ to BAT of the overvoltage control. Be sure connection is secure and made to a clean, bright surface.
   (b) Connect B- to frame of the overvoltage control. Be sure connection is secure and made to a clean, bright surface.
   (c) Connect positive lead of voltmeter to the BAT terminal of overvoltage control.
   (d) Connect negative lead of voltmeter to frame of the overvoltage control.

3. Set overvoltage control to operate between 16.2-volts to 17.3-volts. When adjusting the voltage, an audible “click” may be heard when relay operates.
4. Replace overvoltage control if it does not operate between 16.2 and 17.3-volts.

G. Checking Overvoltage Relay, 28V (HP S/N's 3246018 & up and TC S/N’s 3257001 & up)

The Lamar regulator has an incorporated overvoltage relay. To check relay operation use the same test connections as testing the regulator, except connect the bulb across the RED and BLUE wires. Test as follows:

1. While monitoring both the voltmeter and the light bulb, increase voltage to circuit slowly to 32 volts.
2. After a slight delay, the bulb will light.
3. If overvoltage control fails to operate at 32 Vdc, it must be replaced.

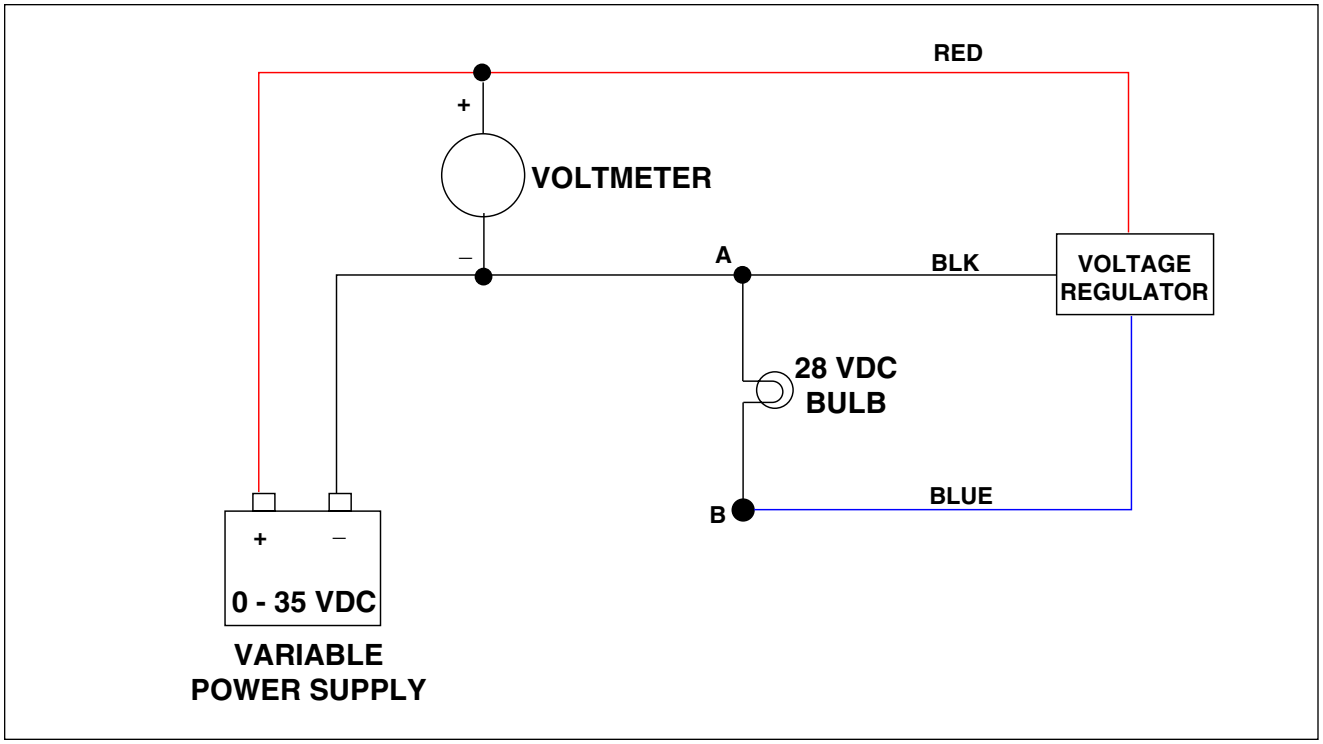

Figure 24-22. Lamar 28Vdc Regulator Check

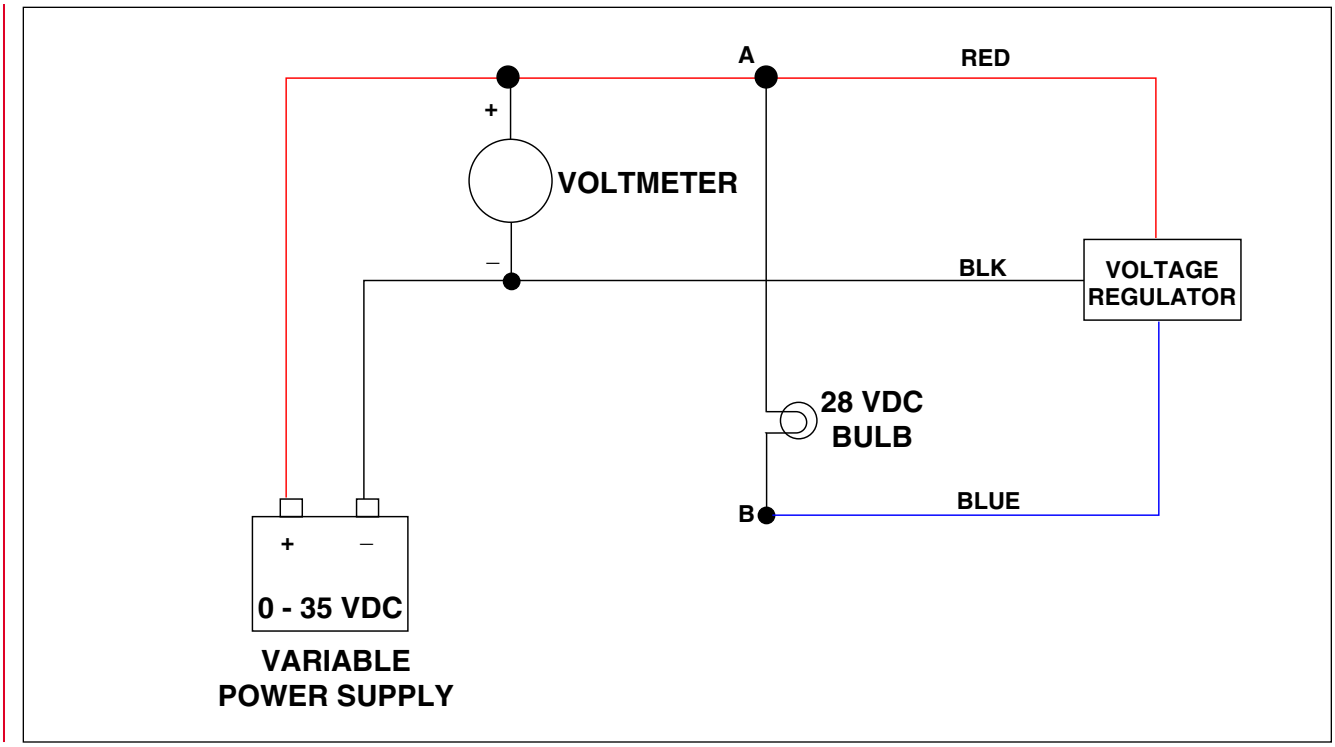

Figure 24-23. Lamar 28Vdc Overvoltage Check

EXTERNAL POWER.

A. Location.

The external power receptacle is located near the battery on the right side aft fuselage, aft of the rear baggage compartment door, except in HP S/N's 3246001 thru 3246087. In those airplanes the battery is under the forward baggage compartment and the external power receptacle is accordingly located on the lower left side of that fuselage section, if installed (external power was optional in those aircraft and requires the use of a special jumper cable supplied in a Piper External Power (PEP) kit).

B. Operation.

Proceed as follows when using external power for engine start or operation of any of the airplane's equipment:

1. Turn the master switch OFF.
2. Turn all electrical equipment OFF.
3. With TC S/N's 3257001 & up and HP S/N's 3246018 & up: Insert plug of a standard 28Vdc power source into the external power socket in the fuselage. Note that, after inserting plug, the electrical system is ON.
4. With HP S/N's 3246001 thru 3246087 only: Connect RED lead of the PEP jumper cable to the POSITIVE (+) terminal and BLACK lead to the NEGATIVE (-) terminal of an external 12-volt battery and then plug jumper cable into external power socket located on fuselage. Note that, after inserting plug, the electrical system is ON.
5. Proceed with the normal engine starting technique.

— Note —

Starter manufacturers recommend limiting cranking to thirty second periods with a two minute rest between periods. Lengthy cranking will shorten the starter's life.

6. After engine start:
   a. Reduce power to the lowest possible rpm to reduce sparking when disconnecting jumper cable.
   b. Disconnect the jumper cable from the aircraft.
   c. Turn the master switch ON and check the alternator ammeter. DO NOT ATTEMPT FLIGHT IF THERE IS NO INDICATION OF ALTERNATOR OUTPUT. If aircraft battery is weak, charging current will be high. DO NOT TAKE OFF until charging current falls below 20 amps.

— Note —

For all normal operations using jumper cables, the master switch should be OFF. The aircraft battery can be used in parallel with the external battery by turning the master switch ON. This will give longer cranking capabilities, but will not increase the amperage. Exercise care, because if the aircraft battery has been depleted, the external power supply can be drawn down to the level of the aircraft battery. This can be tested by turning the master switch ON momentarily while the starter is engaged. If cranking speed increases, the aircraft battery is at a higher level than the external power supply.

   d. When the engine is firing evenly, advance throttle to 800 RPM. If oil pressure is not indicated within thirty seconds, stop engine and determine trouble. It will take a few seconds longer in cold weather to get an oil pressure indication. If the engine fails to start, refer to the Lycoming Operating Handbook: Engine Troubles and Their Remedies.

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ELECTRICAL SYSTEM LOAD DISTRIBUTION

CHART 2403. ELECTRICAL SYSTEM COMPONENT LOADS

14 Volt System					
Duty Cycle		Circuit	Circuit		
Cont.	Inter.	Equipment	Breaker	(Amps)	Optional
X	X	Alternator Field	5		
X		Nav Lights	10		
X		Anti-Collision Light			
		Whelen WRML-12	10	3.5	
X		Whelen White Strobe	10	3.8	
	X	Landing Lights	10	8.0	
X		Panel Lights	5	2.4	
		Flood Lights	3	1.0	
	X	Reading Light	5	0.6	
	X	Fuel Pump	10		
X		Engine Gauges	5	Approx. 1.0	
X		Elec. Turn Cordinator	5	0.5	
X		Pitot Heat	15	13.2	
	X	Starter Relay /	15	10.0	
	X	Cigar Lighter		8.0	
X		Master Solenoid	—	0.8	

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ELECTRICAL SYSTEM LOAD DISTRIBUTION (cont.)

CHART 2403. ELECTRICAL SYSTEM COMPONENT LOADS (cont.)

28 Volt System					
Duty Cycle		Circuit	Circuit		
Cont.	Inter.	Equipment	Breaker	(Amps)	Optional
X	X	Alternator Field	5		
X		Nav Lights	10	3.6	
X		Anti-Collision Lights	10	3.0	
	X	Taxi Light /	15	3.6	
	X	Landing Lights		7.2	
X		Panel Lights /	7.5	.88	
X		Switch Lights		.96	
	X	Courtesy/Reading Lights	5	1.5	
	X	Cockpit Flood Lights	3	.6	
	X	Fuel Pump	10	3.0	
X		Engine Gauges [1]	5	.2	
X		Engine Monitor (DDMP) [2]	3	.25	
X		MAP [2]	1	.06	
X		RPM [2]	1	.06	
X		TIT / FF [2]	1	.12	
X		CHT / VAC [2]	1	.12	
X		Oil Temp. / Press. [2]	1	.12	
X		Elec. Turn & Bank	5	.28	
X		Copilot Elec. Turn & Bank	5	.28	X
X		Pitot Heat	10	8.0	
	X	Starter Contactor /	15	1.47	
	X	Cigar Lighter		8.0	
X		Master Contactor	—	.5	

Notes:

(1) HP S/N's 3246018 thru 3246087 only.
(2) TC S/N's 3257001 & up and HP S/N's 3246088 & up.

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CHAPTER

25

EQUIPMENT / FURNISHINGS

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CHAPTER 25 - EQUIPMENT / FURNISHINGS

TABLE OF CONTENTS / EFFECTIVITY

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FLIGHT COMPARTMENT

A. Pilots Seat Lock and Release Rigging (Refer to Figure 25-1)

1. Loosen screws and loosen clamps to allow push-pull cable to move within the clamps.
2. Place a straightedge along lower surface of seat back release bushing.
3. Adjust push-pull cable by raising or lowering until lower surface of the stop assembly is parallel to straightedge.
4. Secure push-pull cable in position by tightening screws on clamps. The stop must be lubricated and free to swivel without excessive play.
5. Push on seat back to check stop assembly engagement. Rotate seat back release handle and check for seat back disengagement.

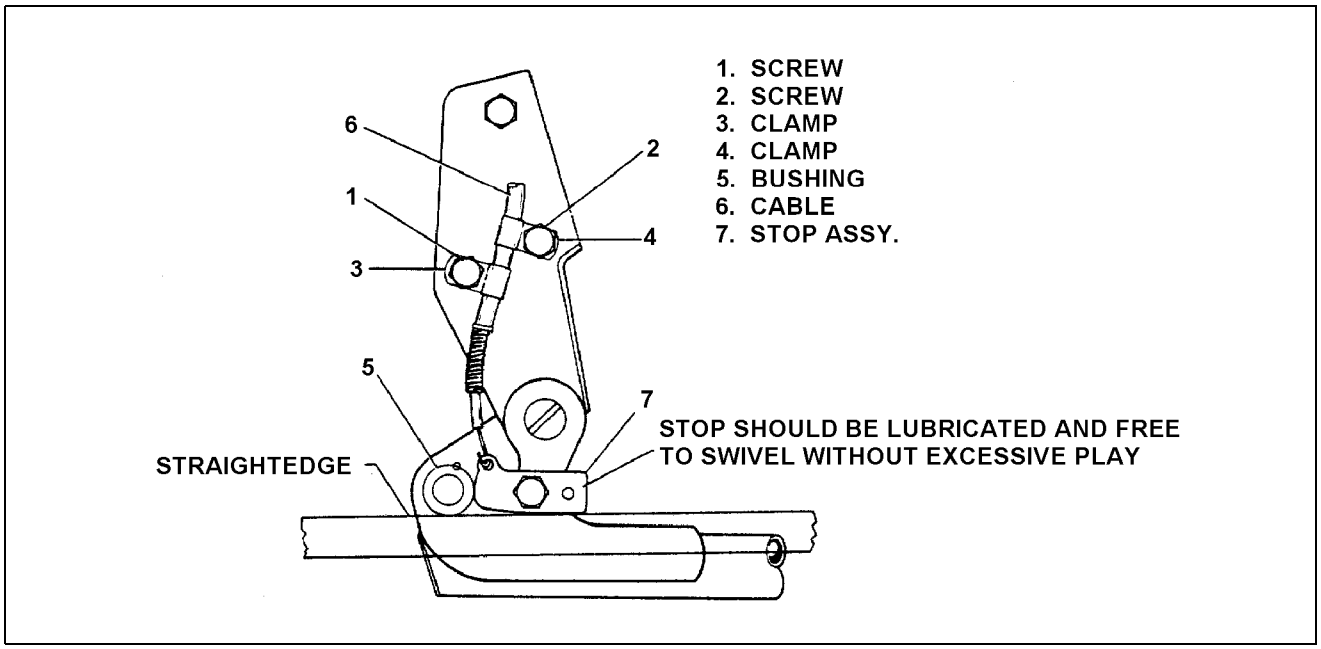

Figure 25-1. Seat Back Lock

B. Lumbar Seats (Refer to Figure 25-2)

Lumbar pilot and co-pilot seats are installed on the Saratoga II HP and TC as standard equipment. 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.

1. Removal Of Lumbar Bladder. To remove the lumbar bladder for repair or replacement:

   a. Remove seat from airplane.
   b. Loosen velcro securing seat back filler cover.
   c. Remove only enough of seat back filer cover to expose lumbar bladder.

FLIGHT COMPARTMENT (cont.)

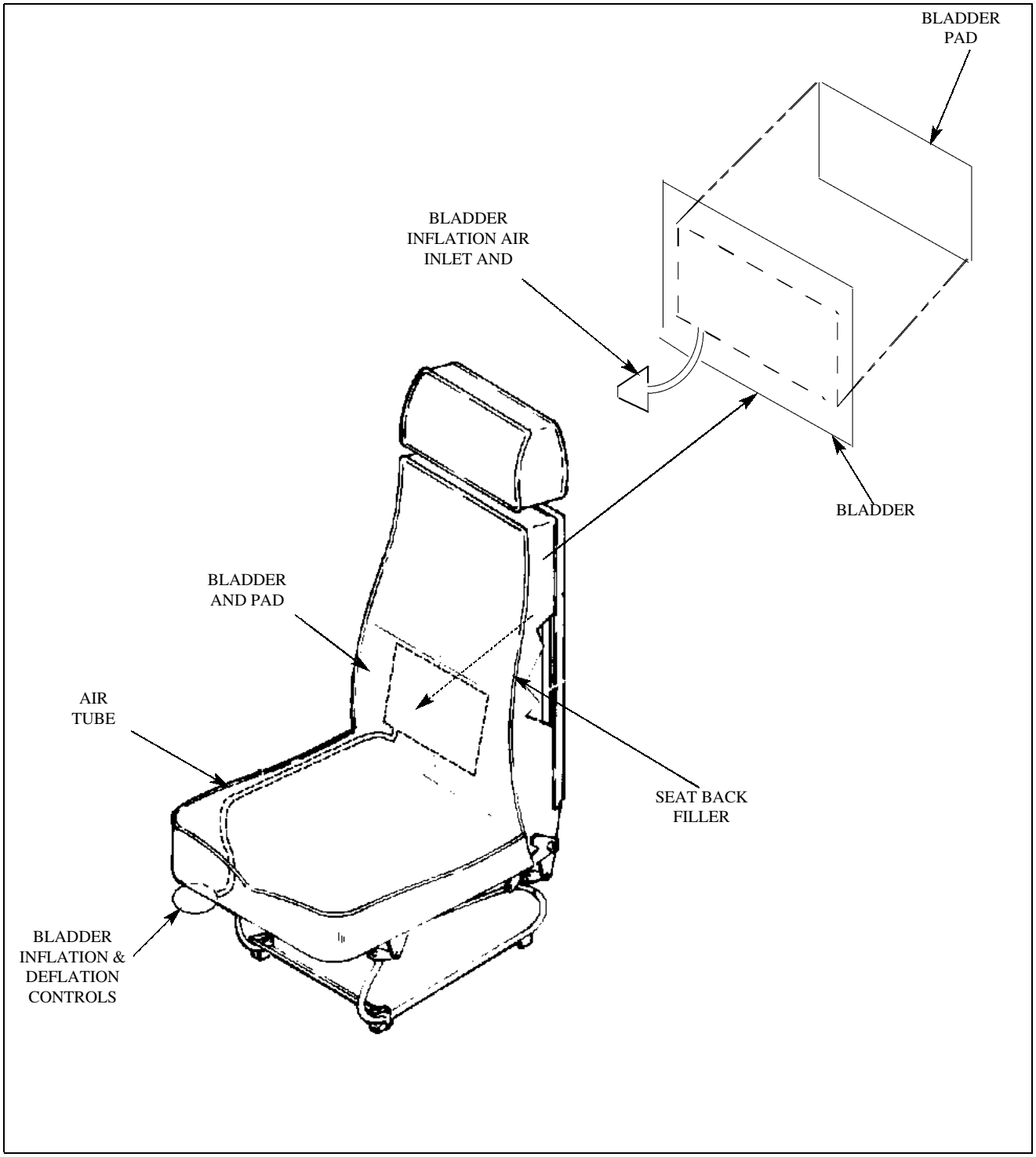

Figure 25-2. Lumbar Seat Bladder Installation

FLIGHT COMPARTMENT (cont.)

— 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.

d. 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.

e. Starting at either right or left edge of bladder, carefully and slowly pull bladder and pad assembly from seat back filler.

2. Installation Of Lumbar Bladder

— Note —

An installation kit is required for airplanes not previously equipped with a lumbar support. Refer to Piper's Illustrated Parts Catalog for kit part number.

a. If necessary to assemble pad and bladder:

(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.

b. Apply a layer of 3M 847 cement to rough side of bladder pad.
c. Apply a layer of 3M 847 cement to seat back filler where bladder is to be located.
d. Attach bladder and pad assembly to seat back filler. Depending on temperature and humidity, allow 0:30 minutes to 1:00 hour for cement to set.
e. Install seat back filler cover and secure velcro fastenings.
f. Install seat in airplane.

FLIGHT COMPARTMENT (cont.)

C. Shoulder Harness Inertia Reel Adjustment

Shoulder harnesses with inertia reels are on each front seat and forward facing rear seats. Check inertia reel mechanism by pulling sharply on strap. Check reel will lock in place under sudden stress. The locking feature prevents strap from extending, and holds occupant in place. For normal movement strap will extend and retract as required. On aircraft with a single strap adjustable shoulder harness (above the side window for each front and forward facing seat) shoulder strap is routed over the shoulder by the window and attached to the lap belt at the occupant's hip. Adjust strap so all controls are accessible while maintaining adequate restraint. Optional shoulder straps are available for rear occupants. Shoulder harnesses must be worn during takeoff, landing, and for an in flight emergency situation. Adjust inertia reel as follows:

1. Allow harness to wind up on the reel as much as possible.
2. Pry off the plastic cap over the spring, on the end of the reel. Check spring does not come out of the plastic cap. Set cap aside.
3. Unwind harness completely, measure and mark harness 24 inches from reel center.
4. Wind harness onto reel until 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 turns ±1/2 turn and snap plastic cover into holes in reel end shaft.
6. Release harness, allowing it to wind up, and extend harness a few times to check reel for smooth operation.
7. With reel fully wound, hold inertia mechanism end up and pry off plastic cap over mechanism and set reel aside.
8. Install nut in plastic cap so stud in cap is flush with nut surface, position cap over reel end and snap in place. Extend harness a few times to verify proper action.

D. Seat Belt and Shoulder Harness Inspection

1. Shoulder Harness

   a. Inspection.

      (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.

2. Lap Belt Inspection

   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 adjustable buckle end. If excessively worn, replace.
   c. Inspect shoulder harness keeper nylon bushing. If excessively worn or missing, replacement of that half of the lap belt is required.
   d. For HP S/N's 3246001 thru 3246009 only, verify compliance with Piper Service Bulletin No. 990 (latest revision).

PASSENGER COMPARTMENT

Entertainment/Executive Console
(HP S/N's 32460088 & up and TC S/N's 3257001 & up only) (Refer to Figure 25-3)

The Entertainment/Executive Console is standard equipment in the Saratoga II TC (S/N's 3257001 & up) and Saratoga II HP (S/N's 3246088 & up) in place of the right side aft facing seat.

The console features: a horizontally sliding, pull out table, which when in the extended position, reveals a storage compartment; a cabinet designed to house a multimedia entertainment system, which is hidden away by a vertically sliding tambour door (controls for the entertainment system are located in this compartment); a fore and aft sliding beverage cooler drawer with a removable stainless steel container; a pilot's reference material compartment; and a three-cup cup holder that folds into the side of the console when not in use.

1. Entertainment/Executive Console Removal. (Refer to Figure 25-4)

— ***WARNING*** —

REMOVE ALL ELECTRICAL POWER FROM THE AIRPLANE BEFORE REMOVING CONSOLE.

a. Remove fire extinguisher from forward side of console (behind copilot seat).
b. Disconnect electrical connections from console. (Electrical connections are standard connections, no special tools are necessary.)
c. Remove four mounting bolts from aft side, bottom of console (the side facing the forward facing passenger seats). (Bolts may be hidden behind carpet.)

— **CAUTION** —

DO NOT LIFT CONSOLE BY PULLING UP ON TABLE. DAMAGE TO CONSOLE COULD RESULT.

— **CAUTION** —

WHEN MOVING CONSOLE, BE SURE TO SECURE ALL DOORS AND DRAWERS TO PREVENT THEM FROM SLAMMING OPEN AND CLOSED. DAMAGE TO CONSOLE COULD RESULT.

d. Slide console aft until back legs are clear of retainers.

— **CAUTION** —

SET CONSOLE DOWN ON TO SURFACE GENTLY TO PREVENT BENDING ANGLE BRACKET.

e. Carefully remove console from airplane.

— Note —

If the console is not going to be immediately reinstalled, tape over and/or cover the retaining and stud plates to prevent dirt from fouling the assemblies. Also cover the electrical connectors and secure the harnesses.

No option exists for field installation of a sixth seat in place of the console.

Figure 25-3. Entertainment / Executive Console

Figure 25-4. Console Mounting Bolts

PASSENGER COMPARTMENT (cont.)

2. Entertainment/Executive Console Installation. (Refer to Figure 25-4)

— CAUTION —

DO NOT LIFT CONSOLE BY PULLING UP ON TABLE. DAMAGE TO CONSOLE COULD RESULT.

— CAUTION —

WHEN MOVING CONSOLE, BE SURE TO SECURE ALL DOORS AND DRAWERS TO PREVENT THEM FROM SLAMMING OPEN AND CLOSED. DAMAGE TO CONSOLE COULD RESULT.

a. Align console into position, engaging back legs into retainers.
b. Install four mounting bolts to aft side, bottom of console (the side facing the forward facing passenger seats).

— WARNING —

REMOVE ALL ELECTRICAL POWER FROM THE AIRPLANE BEFORE CONNECTING ELECTRICAL CONNECTIONS TO CONSOLE.

c. Connect electrical connections to console. (Electrical connections are standard connections, no special tools are necessary.)
d. Install fire extinguisher to front of console (behind copilot seat).

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CHAPTER

27

FLIGHT CONTROLS

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CHAPTER 27 - FLIGHT CONTROLS

TABLE OF CONTENTS / EFFECTIVITY

CHAPTER 27- FLIGHT CONTROLS

TABLE OF CONTENTS / EFFECTIVITY (cont.)

GENERAL.

A. Description and Operation.

The airplane is controlled in flight by standard three-axis control surfaces, consisting of: ailerons (roll); stabilator (pitch); and rudder (yaw). These controls are operated by movement of the 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 push rod 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. Cables are routed aft from the drum to a screw assembly mounted above the stabilator attachment point. This screw assembly in turn moves the push rod which controls the stabilator trim tab. Rudder trim is controlled by a knob and screw assembly attached to the rudder pedal assembly.

The flaps are electrically operated.

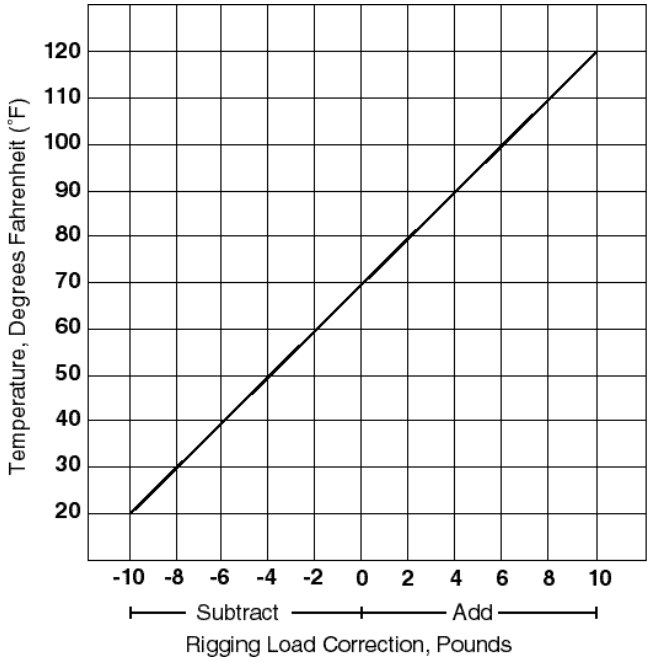
1. Standard Practices and Procedures

The following tips may be helpful in the removal, installation, and rigging of individual control system assemblies.

a. Turnbuckles must be assembled and adjusted in a manner that each terminal end is screwed into the barrel an approximately equal distance. During adjustment, the terminals must not be turned in a manner which would put a permanent twist in the cable.
b. After adjustment is completed, each turnbuckle must be checked. Not more than three terminal threads shall be visible outside the barrel. Locking clips must be installed and checked for proper installation by trying to remove the clips using fingers only. Locking clips which have been installed and removed must be scrapped and new clips used.
c. Torque all nuts in the flight control surface rigging system in accordance with AC 43.13-1A or to torques specified within this manual.
d. After completion of adjustment, each jam nut must be tightened securely and inspected.
e. On push rods or rod ends provided with an inspection hole, screws must be screwed in sufficiently far to pass the hole. This can be determined visually or, by feel, by inserting a piece of wire into the inspection hole. If no inspection hole is provided, a minimum of 0.375 of an inch thread engagement must be maintained.
f. All cable rigging tensions given must be corrected to ambient temperature in the area where the tension is being checked. Refer to Chart 2701.
g. See Figure 27-1 for proper method of adjusting rod ends to prevent possible damage and binding of bearing surface in rod end.
h. All pulley guard pins should be properly installed.

GENERAL. (cont.)

CHART 2701. CABLE TENSION VS AMBIENT TEMPERATURE



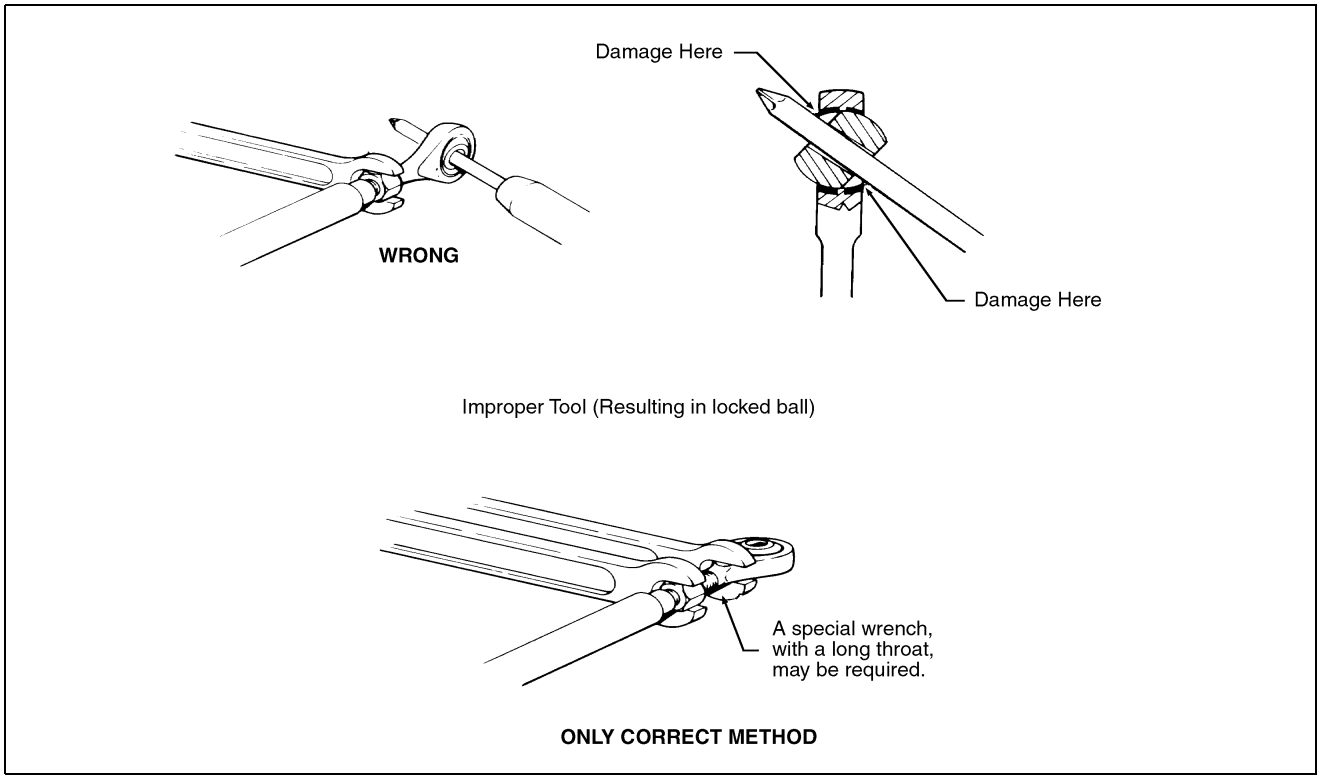


Figure 27-1. Rod End Installation Method

GENERAL. (cont.)

2. 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 27-2, 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.

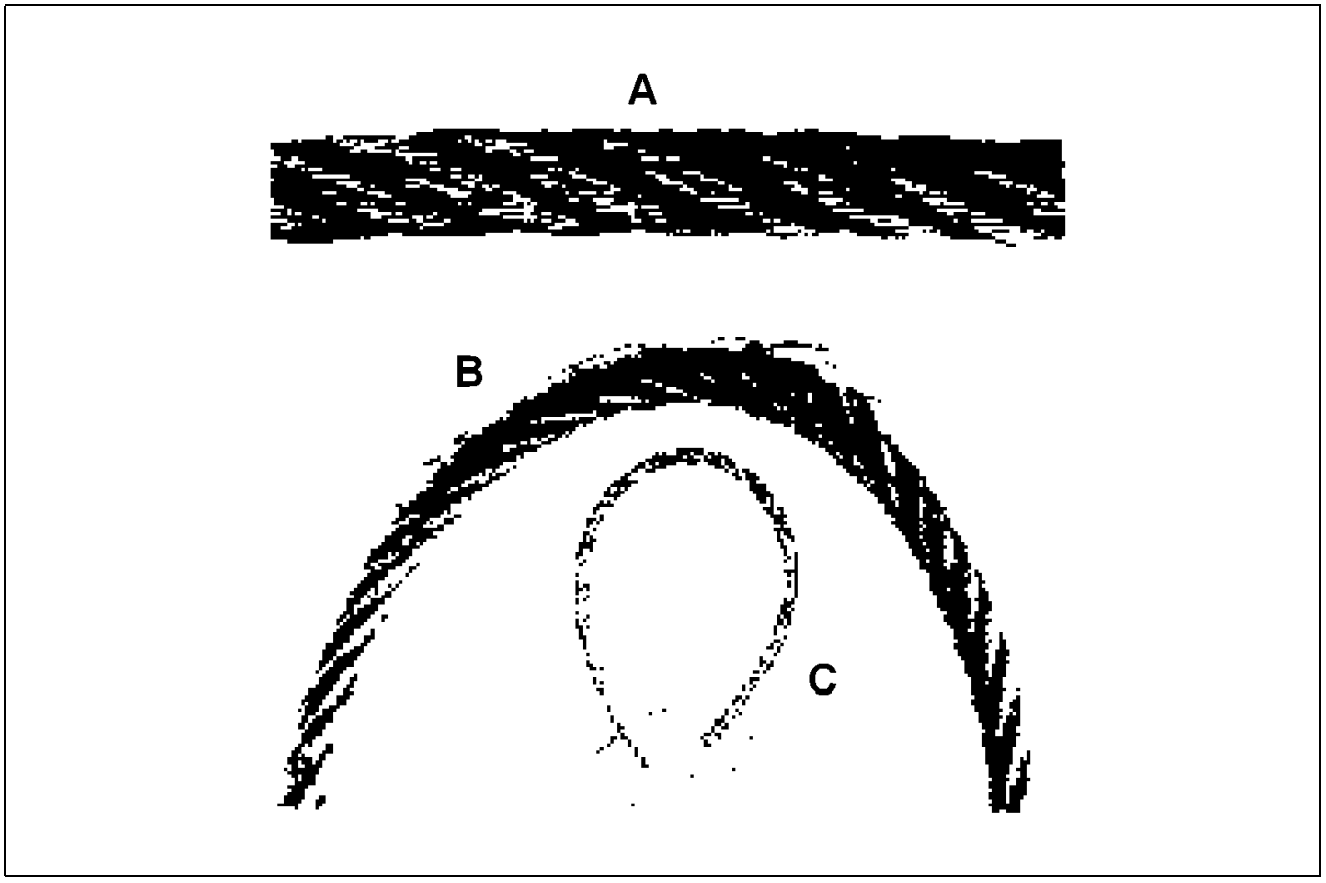


Figure 27-2. Control Cable Inspection Technique

GENERAL. (cont.)

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 27-3.

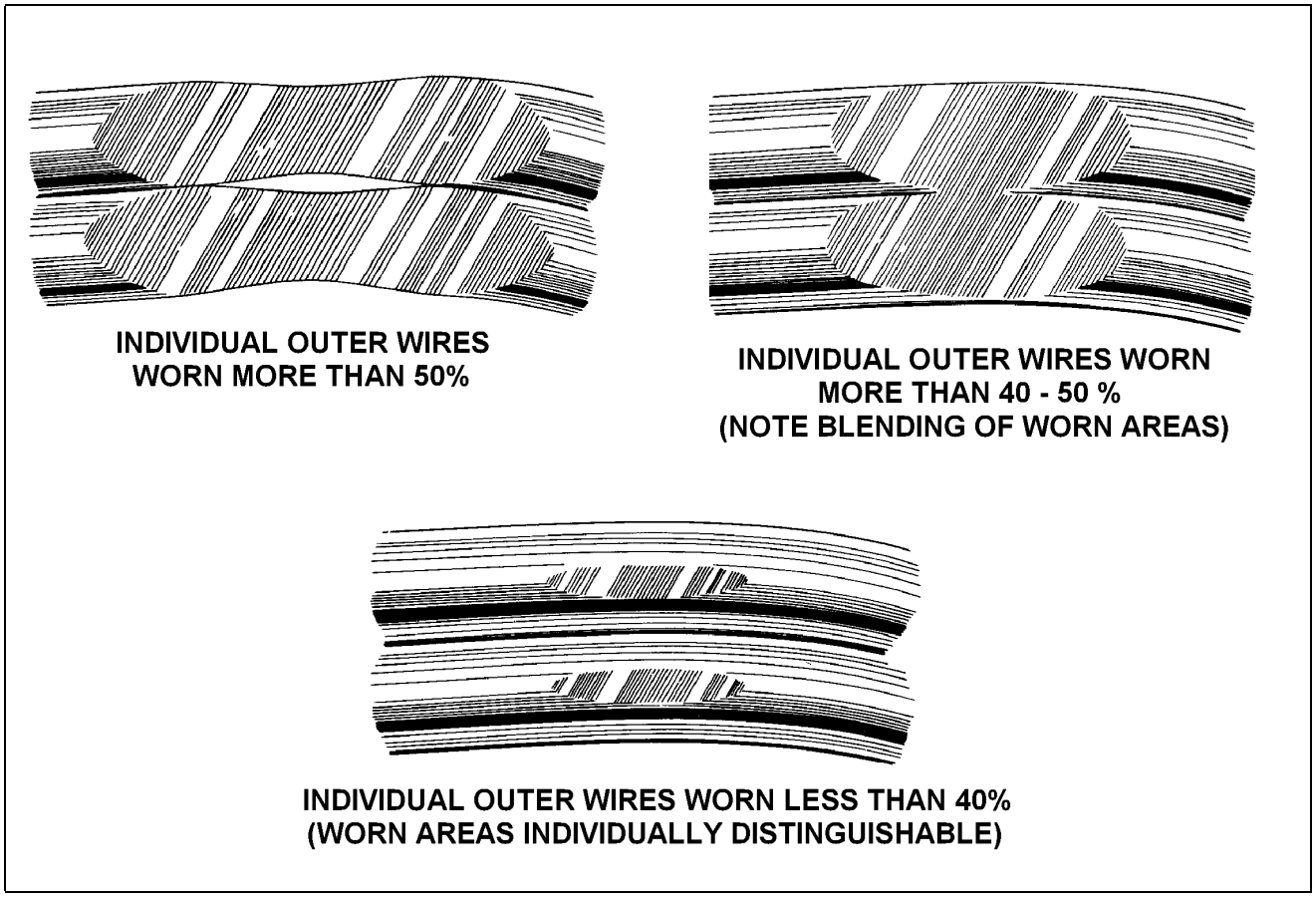


Figure 27-3. Cable Wear Patterns

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.

GENERAL. (cont.)

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.

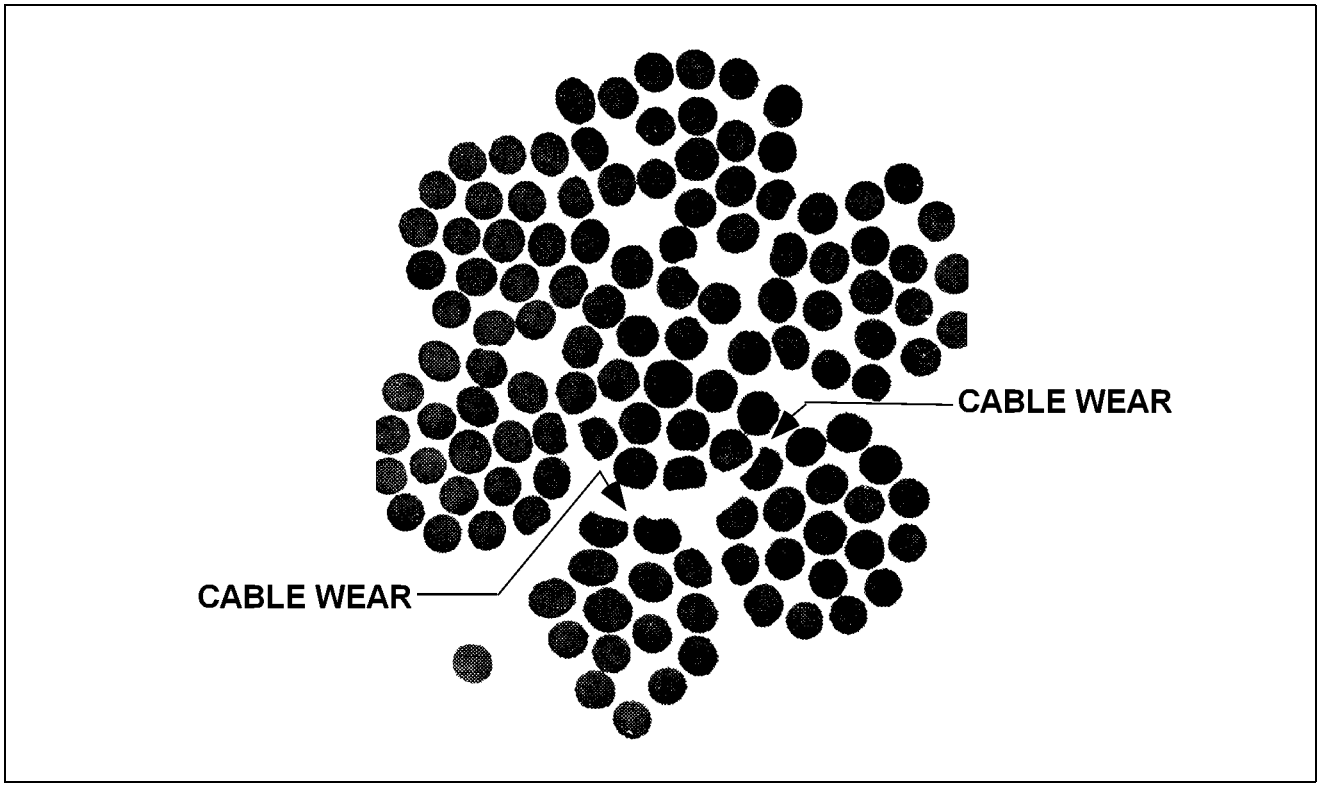


Figure 27-4. Internal Cable Wear

— Note —

Check all exposed sections of cable for corrosion after a cleaning and/or metal-brightening operation has been accomplished in that area.

GENERAL. (cont.)

3. Cable Maintenance

   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 with a light coat of graphite grease or general purpose, low-temperature oil.

   – CAUTION –

   TO AVOID REMOVAL OF CORROSION-PREVENTATIVE COMPOUNDS AND CABLE INTERNAL LUBRICANT, DO NOT USE VAPOR DEGREASING, STEAM CLEANING, METHYLETHYLKETONE (MEK) OR OTHER SOLVENTS..

4. Cable Fittings

   Check swaged terminal reference marks for an indication of cable slippage within fitting. Inspect fitting assembly for distortion and/or broken strands at the terminal. Assure 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.

5. Pulleys

   a. 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.

   b. 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 27-5.

GENERAL. (cont.)

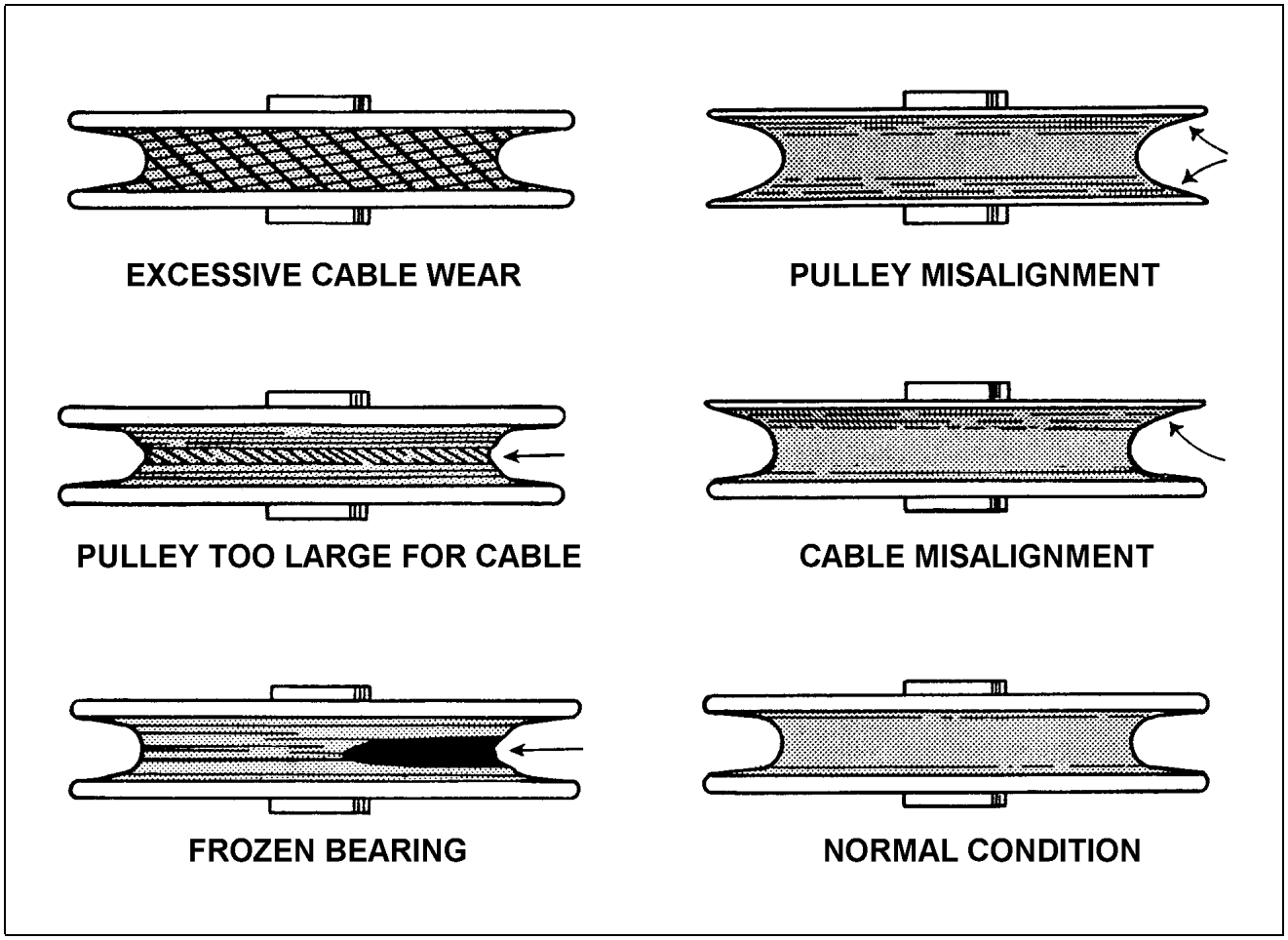


Figure 27-5. Pulley Wear Patterns

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AILERON AND TAB

A. Troubleshooting Aileron Control System

CHART 2702. 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.	Check control column rigging.
Control wheels not horizontal when ailerons are neutral.	Incorrect rigging of aileron system.	Check aileron system.
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.	Check controls for proper rigging
Control wheel stops before control surfaces reach full travel.	Incorrect rigging between control wheel and control cables.	Check controls.

AILERON AND TAB (cont.)

B. Control Column Removal (Refer to Figure 27-6.)

1. To remove either control wheel and tube:

   a. Separate the control wheel tube from the flexible joint that is located on either side of the tee bar assembly by removing the nut, washer and bolt. Pull the tube from the flexible joint.
   b. If removing the left control tube, slide the stop from the tube.
   c. Should wires for the various Autopilot systems be installed in the control tube, disconnect them at the quick disconnect terminals behind the instrument panel. Draw the wires back into the tube and back out through the forward end of the tube.
   d. Remove the control wheel assembly from the instrument panel.

2. To remove tee bar with assembled parts:

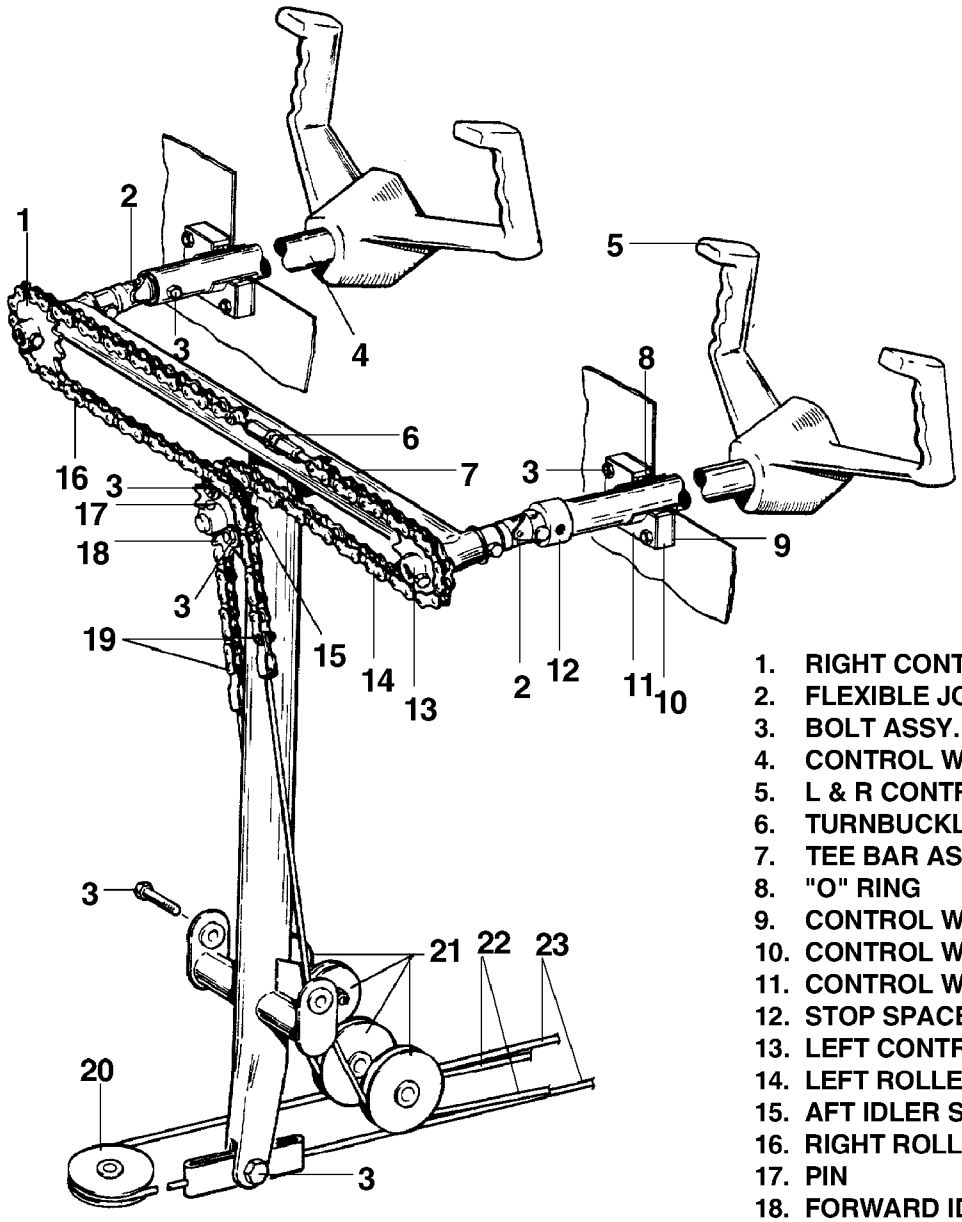
   a. Remove access panel to aft section of the fuselage.
   b. Relieve cable tension from stabilator control cables at one of the stabilator cable turnbuckles in the aft section of fuselage.
   c. Relieve tension from aileron control cables and chains at turnbuckle that connects the chains at the top of the tee bar.
   d. Disconnect control chains from control cables where chains and cables join by removing cotter pins, nuts, bolts and bushings.
   e. If control wheel assemblies have not been previously disconnected from tee bar assembly, separate control wheel tubes at the flexible joints by removing nuts, washers and bolts.
   f. Remove tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove plate attachment screws.
   g. Remove the two aileron control cable pulleys attached to lower section of tee bar by removing pulley attachment bolt.
   h. Disconnect stabilator control cables from lower end of tee bar assembly.
   i. Disconnect necessary engine control cables, such as the propeller pitch control, mixture control, etc., to allow tee bar assembly to be removed.
   j. Remove tee bar assembly by removing attachment bolts with washers and nuts that are through each side of the floor tunnel, and lifting it up and out through the right side of the cabin.

C. Control Column Installation

1. To install of tee bar assembly (Refer to Figure 27-6.)

   a. Swing the tee bar assembly into place from the right side of the cabin and secure with attachment bolts, washers and nuts inserted through each side of the floor tunnel.
   b. Connect the stabilator control cables to the lower end of the tee bar with bolt, washer, nut and cotter pin. Allow the cable ends free to rotate.
   c. Place the aileron control cables around the pulleys that attach to the lower section of the tee bar; position pulleys and secure with bolt, washers and nut.
   d. Install the control wheel per Step 2, 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.

AILERON AND TAB (cont.)



1. RIGHT CONTROL WHEEL SPROCKET
2. FLEXIBLE JOINT
3. BOLT ASSY.
4. CONTROL WHEEL TUBE
5. L & R CONTROL WHEELS
6. TURNBUCKLE
7. TEE BAR ASSY
8. "O" RING
9. CONTROL WHEEL WASHER
10. CONTROL WHEEL PLATE
11. CONTROL WHEEL WASHER
12. STOP SPACER
13. LEFT CONTROL WHEEL SPROCKET
14. LEFT ROLLER CHAIN
15. AFT IDLER SPROCKET
16. RIGHT ROLLER CHAIN
17. PIN
18. FORWARD IDLER SPROCKET
19. BOLT, BUSHING, NUT & COTTER PIN
20. STABILATOR PULLEY
21. AILERON PULLEYS
22. AILERON CONTROL CABLES
23. STABILATOR CONTROL CABLES

Figure 27-6. Control Column Assembly

AILERON AND TAB (cont)

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 27-7. 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 safety wiring 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 0.030 to 0.040 inch clearance between sprocket pin and adjustable stop bolts on models having adjustable tee bar stops.
i. Set stabilator cable tension with the turnbuckle in the aft section of the fuselage. Check safety of all turnbuckles upon completion of adjustments.
j. Tighten the connecting bolts of the idler sprockets.
k. Install the floor tunnel plate and secure with screws. Fasten the tunnel carpet in place.

2. To install either control wheel assembly (Refer to Figure 27-6.)

a. Insert the control wheel tube through the instrument panel.
b. Should wires for the various Autopilot systems need to be installed in the control tube, route them through the hole in the forward side of the tube and out of the small hole in the side. Position the rubber grommet in the hole in the side of the tube.
c. On the left control tube, install the stop.
d. Connect the control wheel tube 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. To install flex joint replacement (Refer to Figures 27-6 and 27-7)

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 in paragraph (a).
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 tube surface, install a AN960-10 washer.
(2) If pin shoulder ***does*** protruded past tube surface, install a MS20364-1032C washer.

AILERON AND TAB (cont)

e. Install nut. Torque 35 - 40 inch-pounds.

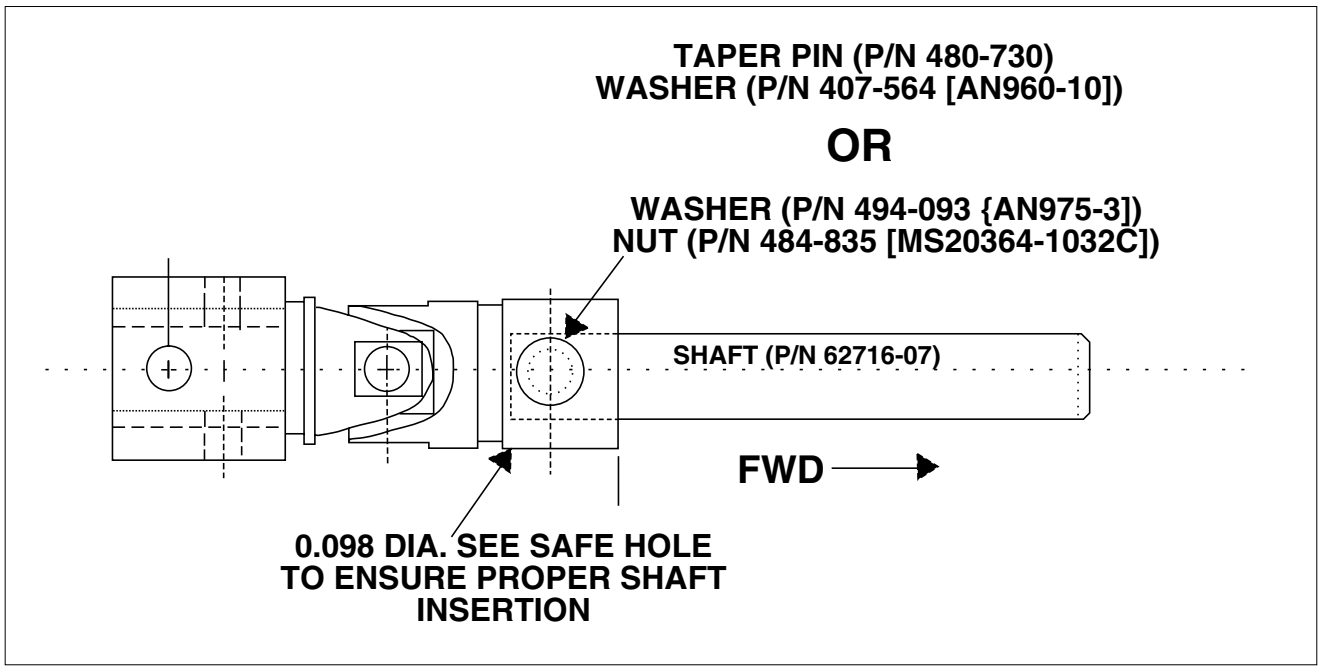


Figure 27-7. Flex (Universal) Joint Assembly

D. Aileron Control Cables Removal (Refer to Figure 27-8)

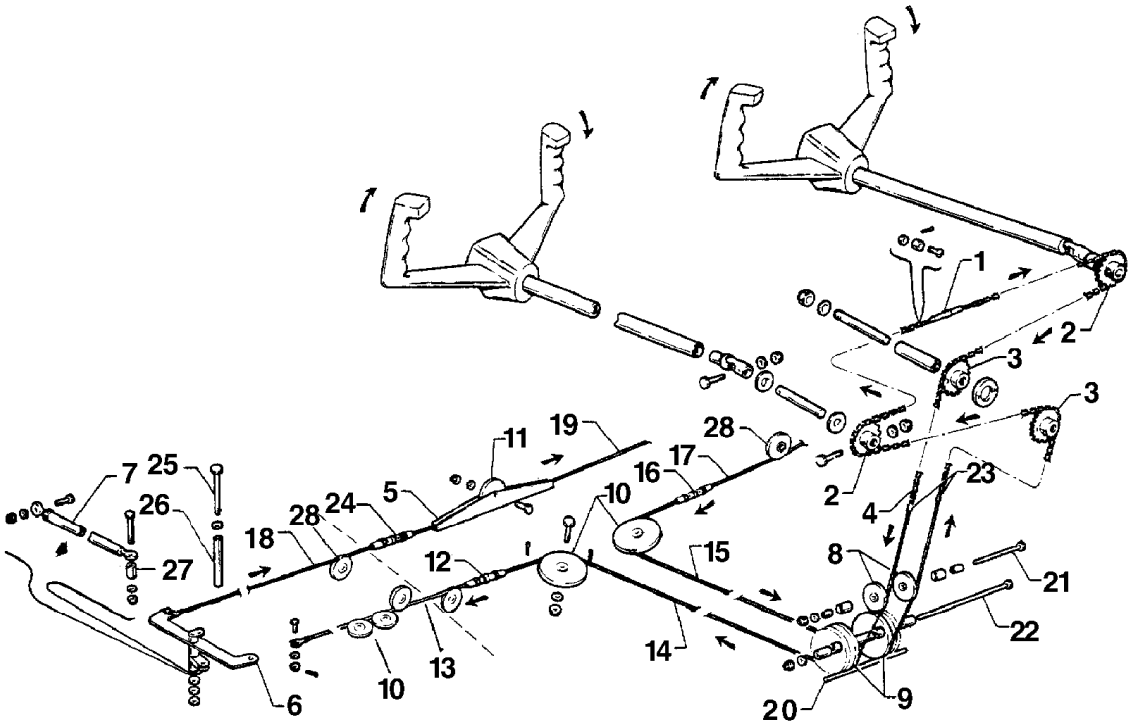
1. To remove any of the aileron control cables in the fuselage or either wing:

   a. Remove center seats and seat belt attachments
   b. Remove screws securing floor panel located directly aft of the main spar. Lift panel and remove from airplane.
   c. Remove tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove plate attachment screws.
   d. Remove forward heat duct from side of floor tunnel from which the cable is to be removed by removing trim control wheel cover, heater baffles from side of duct, floor carpet and the duct attachment screws.
   e. Separate primary control cable at turnbuckle located in floor opening aft of main spar.
   f. Remove cable pulleys attached to lower section of control column tee bar assembly by removing pulley attachment bolt.
   g. Move cable guard located under pulley cluster below the fuel selector by removing cotter pin from exposed end of 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.
   j. Draw the cable back through the floor tunnel.

AILERON AND TAB (cont)

2. To remove 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.



1. CONTROL CHAIN TURNBUCKLE
2. CONTROL WHEEL SPROCKET
3. IDLER SPROCKET
4. AILERON CONTROL CHAIN
5. PULLEY BRACKET
6. AILERON BELLCRANK
7. AILERON CONTROL ROD
8. TEE BAR PULLEY
9. FORWARD CLUSTER PULLEY
10. PRIMARY CONTROL CABLE PULLEY
11. BALANCE CABLE PULLEY
12. RIGHT PRIMARY TURNBUCKLE
13. RIGHT WING PRIMARY CABLE
14. RIGHT FUSELAGE PRIMARY CABLE
15. LEFT FUSELAGE PRIMARY CABLE
16. LEFT PRIMARY TURNBUCKLE
17. LEFT WING PRIMARY CABLE
18. RIGHT BALANCE CABLE
19. LEFT BALANCE CABLE
20. CABLE GUARD ROD
21. BOLT, WASHER & NUT
22. BOLT, WASHER & NUT
23. BOLT, NUT, BUSHING & COTTER PIN
24. BALANCE CABLE TURNBUCKLE
25. BELLCRANK PIVOT BOLT
26. BELLCRANK BUSHING
27. TEFLON TUBE
28. PRIMARY CONTROL CABLE PULLEY

Figure 27-8. Aileron Controls

AILERON AND TAB (cont)

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.

3. 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.

E. Aileron Control Cables Installation (Refer to Figure 27-8)

1. To install left or right primary control cable in fuselage:

a. Draw cable through fuselage floor tunnel.
b. Connect cable to the end of control chain and secure using bushing, bolt, nut and cotter pin.
c. Place cable around pulley located in the tunnel below the fuel selector.
d. Position cables and install cable pulleys that attach to lower section of tee bar assembly. Secure with bolt, washer and nut.
e. Place the cable around pulley located in floor opening just aft of main spar.
f. If primary control cable in the wing is already installed, connect control cable ends at turnbuckle located in floor opening aft of main spar.
g. Check rigging and adjustment per Rigging and Adjustment of Aileron Controls.
h. Position heat duct and secure with screws.
i. Install tunnel plate aft of tee bar assembly and secure with screws.
j. Put floor carpet in place and secure.
k. Install lower and upper selector covers and secure with screws.
l. Place fuel selector knobs in place and secure with set screws.

2. To install primary control cable in left or right wing:

a. Draw control cable into wing.
b. Connect cable to the forward end of aileron bellcrank using a bolt, washer, nut and cotter pin. Allow cable end to rotate freely on bellcrank.
c. If primary control cable is already installed in fuselage, connect ends at turnbuckle located under rear seat aft of main spar.
d. Check rigging and adjustment per Rigging and Adjustment of Aileron Controls.
e. Install access plate on underside of wing.

AILERON AND TAB (cont)

3. To install left or right balance cable:
   a. Draw the cable into wing.
   b. Connect cable to the aft end of aileron bellcrank using a bolt, washer, nut and cotter pin. Allow the cable end to rotate freely on bellcrank.
   c. Connect balance cable ends at turnbuckle located under rear seat aft of main spar.
   d. If left cable was removed, install cotter pin cable guard at pulley located within fuselage aft of main spar.
   e. Check rigging and adjustment per Rigging and Adjustment of Aileron Controls.
   f. Install access plate on the underside of wing.
4. Install floor panel, seat belt attachments, rear seat and two front seats.

F. Aileron Bellcrank Assembly Removal (Refer to Figure 27-8.)

1. Remove rear seat and floor panel.
2. Remove access plate to aileron bellcrank located on underside of wing, forward of inboard end of aileron.
3. Relieve aileron control cables tension by loosening balance cable turnbuckle located in opening aft of main spar.
4. Disconnect primary and balance control cables from bellcrank assembly by removing cotter pins, nuts, washers and bolts.
5. Disconnect aileron control rod at aft or forward end, as desired, by removing the cotter pin, nut, washer and bolt.
6. Remove nut, pivot bolt and washers that secure bellcrank. The nut is visible from underside of wing.
7. Remove bellcrank from within wing.

G. Aileron Bellcrank Assembly Installation (Refer to Figure 27-8.)

1. Ensure that bellcrank pivot bushing is lubricated. Install pivot bushing in torque tube portion of bellcrank.
2. Place bellcrank in position in wing with a washer located between each end of torque tube and mounting brackets.
3. Install bellcrank pivot bolt with head up. Install a washer and nut on bolt. Torque nut 20 to 25 inch-pounds. Check that bellcrank rotates freely with little up-down play.
4. Install and adjust control rod. Check aileron travel per Rigging and Adjustment of Aileron Controls.
5. Connect ends of primary and balance control cables to bellcrank using bolts, washers, nuts and cotter pins. Allow cable ends to rotate freely on the bellcrank.
6. Tighten control cables at balance cable turnbuckle in floor opening aft of main spar. Check cable tension per Rigging and Adjustment of Aileron Controls.
7. Install access plate on underside of wing.
8. Install floor panel, seat belt attachments and seats.

H. Aileron Controls Rigging and Adjustment. (Refer to Figures 27-9 and 27-10)

— 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.

AILERON AND TAB (cont)

— Note —

Flap adjustment must be completed before starting aileron adjustment.

1. To check and adjust rigging of aileron controls:

   a. Determine that control chains have been rigged per Control Column Assembly Installation.
   b. Set the right and left aileron bellcranks at neutral position by:

      (1) Removing access plate to each aileron bellcrank located on underside of wing, forward of inboard end of aileron, by removing plate attaching screws.
      (2) Affix a bellcrank rigging tool between the forward arm of each bellcrank and the adjacent rib as shown in Figure 27-9. (Tool may be fabricated from dimensions given in Chapter 95.)

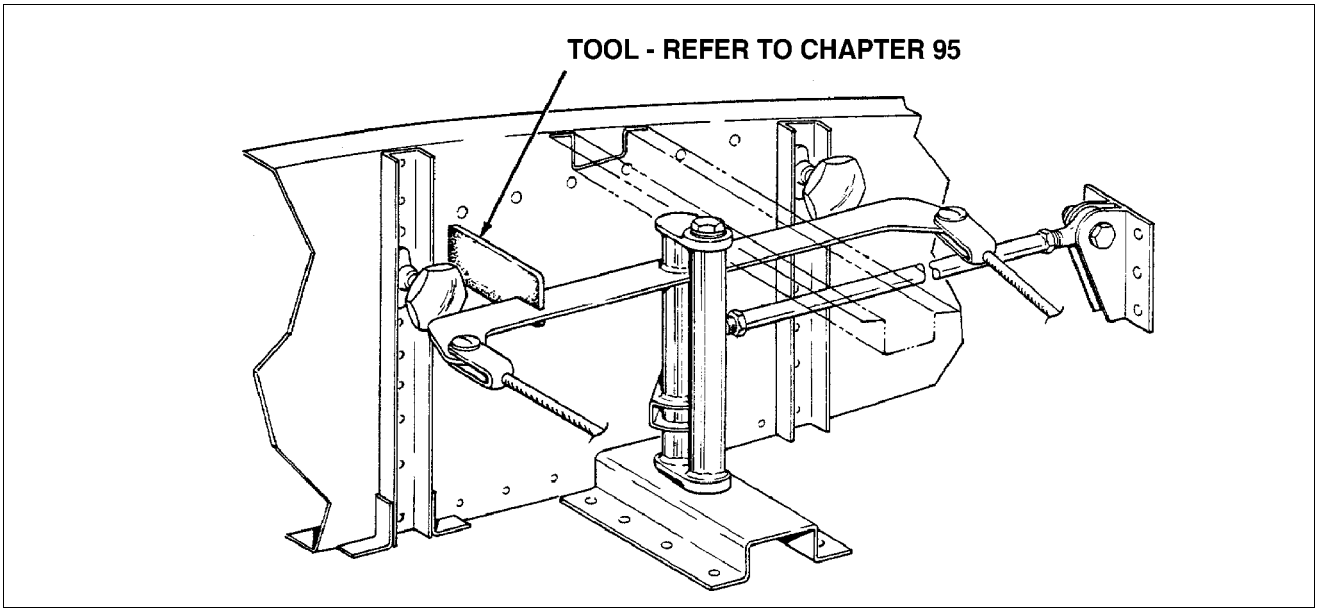


Figure 27-9. Bellcrank Rigging

      (a) Slotted end of the tool fits on bellcrank arm forward of and adjacent to the primary control cable end.
      (b) Position other end of the tool so that side of tool contacts aft side of bellcrank stop. Bellcrank must be moved to allow a snug fit of tool between bellcrank arm and rib. It may be necessary to loosen a primary control cable or balance cable.
      (c) Neutral position of bellcrank is position at which forward and aft cable connection holes are an equal distance from adjacent outboard wing rib.

   c. With each bellcrank set at neutral, the ailerons may be checked and adjusted for neutral as follows:

      (1) Ensure that bellcrank rigging tool fits snug between bellcrank and rib.
      (2) Place an aileron rigging tool, as shown in Figure 27-11, against underside of the wing and aileron as close as possible to inboard end of aileron without contacting any rivets. Tool must be positioned parallel with wing ribs, with aft end of the tool even with trailing edge of the aileron. (Tool may be fabricated from dimensions given in Chapter 95.)

AILERON AND TAB (cont)

(3) With aileron control rod connected between bellcrank and aileron:

(a) Check that surface of the wing contacts tool at its forward surface and at spacer.

(b) Check that trailing edge of flap contacts aft end of the tool. The aileron is neutral at this position.

(4) Should the three points not contact, loosen jam nut at the aft end of control rod and rotate rod until the three points contact. While making this adjustment, apply a slight up pressure against trailing edge of aileron. After adjustment, tighten jam nut.

2. To adjust primary and balance cable tension, as given in Figure 27-10:

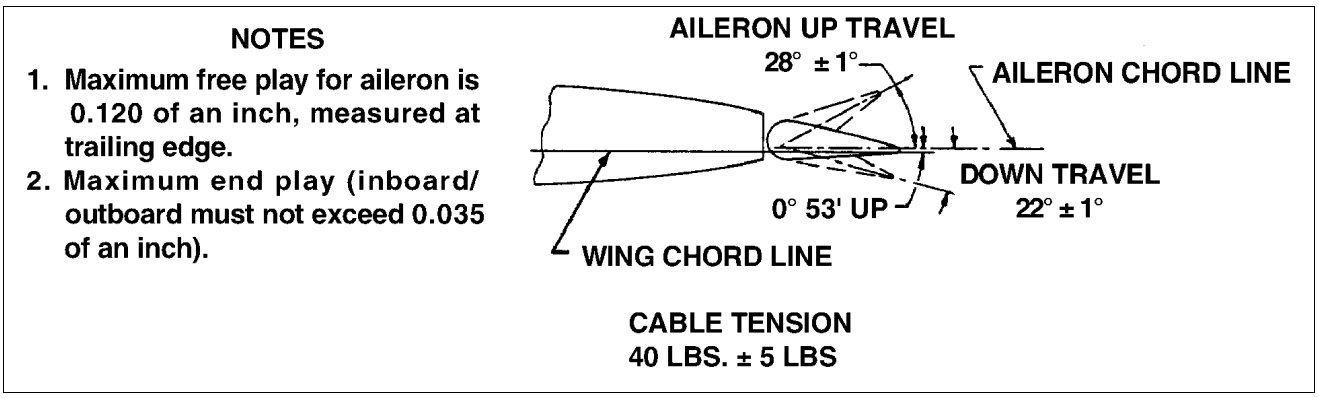


Figure 27-10. Aileron Rigging Limits

a. Remove the two front seats if desired, the rear seat and floor panel to facilitate in the necessary operation.

b. Loosen connecting bolts of idler cross-over sprockets at control tee bar to allow chain to fit snug around control wheel sprockets and over idler sprockets.

c. Ensure both bellcranks are at neutral position.

d. Adjust turnbuckles of primary and balance cables, located in access opening just aft of main spar, to proper tension. Maintain neutral-center position of control wheels. To obtain neutral position of both control wheels, it may be necessary to adjust roller chain turnbuckle located between the control wheel sprockets. During adjustment, apply a little more tension on primary control cables to hold bellcranks in neutral position against rigging tools.

e. When adjustment is complete there should be even tension on all cables.

f. Tighten the bolts to secure the idler cross-over sprockets.

g. Remove the aileron bellcrank rigging tool from each wing.

3. Aileron Tab.

A fixed trim tab is located on the trailing edge of the left aileron. The tab is ground adjustable only.

AILERON AND TAB (cont)

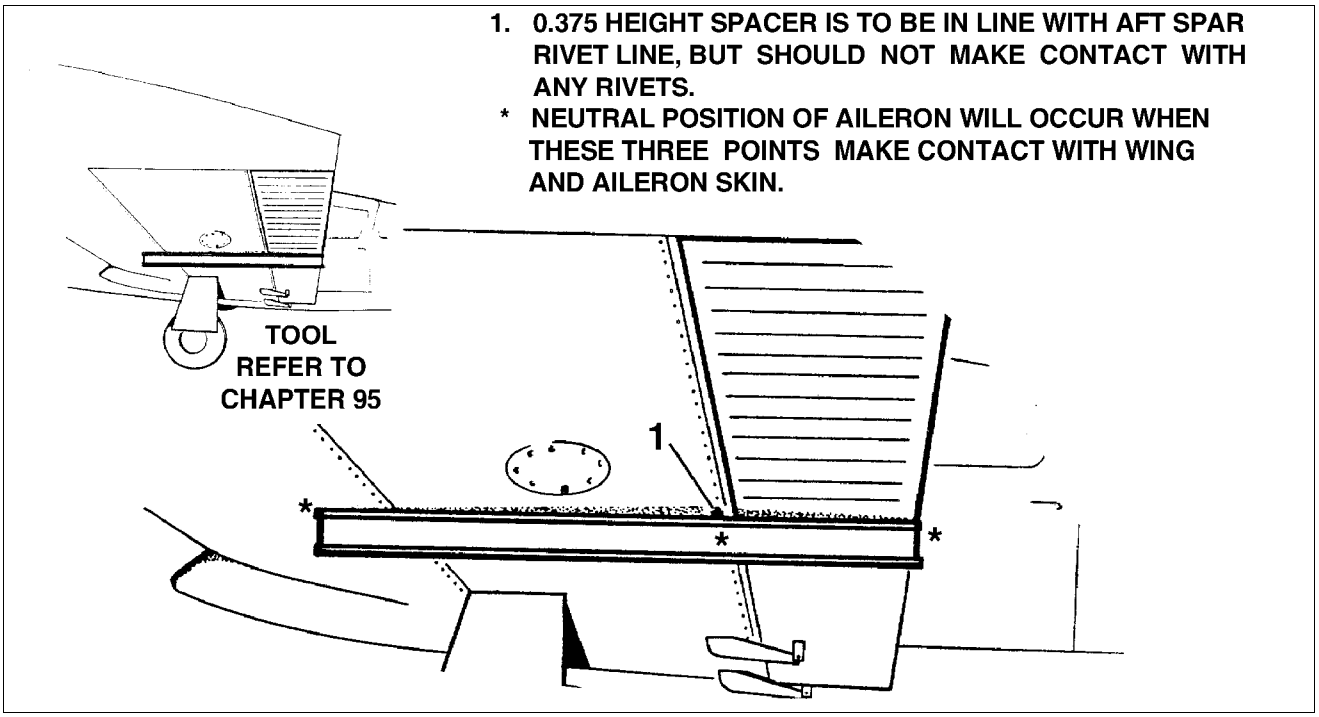


Figure 27-11. Aileron Rigging

4. Check ailerons for correct travel from neutral per limits given in Figure 27-10 by the following procedure:

   a. Center bubble of a protractor over surface of either 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.
   c. If travel is not correct, set by rotating bellcrank stops in or out. Stops are attached to wing rib adjacent to aileron bellcrank.
   d. Repeat procedure for other aileron.
   e. Check the bellcrank stops to assure that the bellcrank contact is made simultaneously, but still have cushion before contacting the control wheel stops. Maintain 0.030 to 0.040 clearance between sprocket pin and adjustable stop bolts on models having adjustable tee bar stops.
   f. Check complete system for operation and safety for turnbuckles, bolts, etc., install all pulley guard pins.
   g. Install access plates and panels.

— Note —

When an out of trim condition exists after all rigging corrections have been made, the possibility exists that the trailing edge of the aileron has been used to move the aircraft forward. This will result in an out of rig condition, caused by a slight bulging of aileron contour at the trailing edge, which could require replacement of the aileron to correct.

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RUDDER AND TAB.

A. Troubleshooting Rudder Control System

CHART 2703. 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.
	Broken pulley.	Replace pulley.
	Bolts attaching rudder to bellcrank are loose.	Tighten bellcrank bolts.
Excessive resistance to rudder pedal movement.	System not lubricated properly.	Lubricate system.
	Rudder pedal torque tube bearing in need of lubrication.	Lubricate torque tube bearings.
	Cable tension too high.	Adjust cable tension.
	Pulleys binding or rubbing.	Replace binding pulleys and or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Rudder pedals not neutral when rudder is streamlined.	Rudder cables incorrectly rigged.	Check rigging of rudder cables.
Incorrect rudder travel.	Rudder bellcrank stop incorrectly adjusted.	Check rigging of bellcrank stops.
	Nose wheel contacts stops	Check rigging of nose wheel stops. before rigging rudder.
Trim control knob moves with excessive resistance.	System not lubricated properly.	Lubricated system.

RUDDER AND TAB. (cont)

B. Rudder Cables Removal (Refer to Figure 27-12.)

1. To remove either forward rudder cable:

   a. Remove access panel to aft section of fuselage.
   b. Disconnect desired cable at turnbuckle in aft section of fuselage.
   c. Remove tunnel cover in the aft area of cabin by removing carpet over the tunnel and cover attachment screws.
   d. Remove cable guard plate from underside of pulley cluster located in aft area of floor tunnel, by removing guard attachment screws.
   e. Remove floor panel located directly aft of main spar by removing center seats, seat belt attachments and screws securing floor panel. Lift panel and remove from airplane.
   f. From within area of floor opening, remove cable rub blocks attached to spar housing by removing block attachment screws.
   g. Remove cable guard pin at pulley cluster in aft area of opening by removing cotter pin from one end of the guard.
   h. Remove fuel selector panel cover by removing rudder trim knob and cover attachment screws.
   i. Remove lower fuel selector cover and fuel selector control lever by removing attachment pin at bottom of lever that holds lever on selector torque tube.
   j. Remove tunnel plate just aft of tee bar by removing enough carpet from tunnel to allow plate attachment screws and plate to be removed.
   k. Remove forward head duct from one side of the floor tunnel from which control cable is to be removed.
   l. Move cable guard pin located under pulley cluster and below fuel selector by removing cotter pin from exposed end and sliding it to the left or right as required.
   m. Disconnect the end of cable from arm on rudder pedal torque tube by removing cotter pin, nut, washer and bolt.
   n. Draw the cable from floor tunnel.

2. To remove either aft rudder control cable:

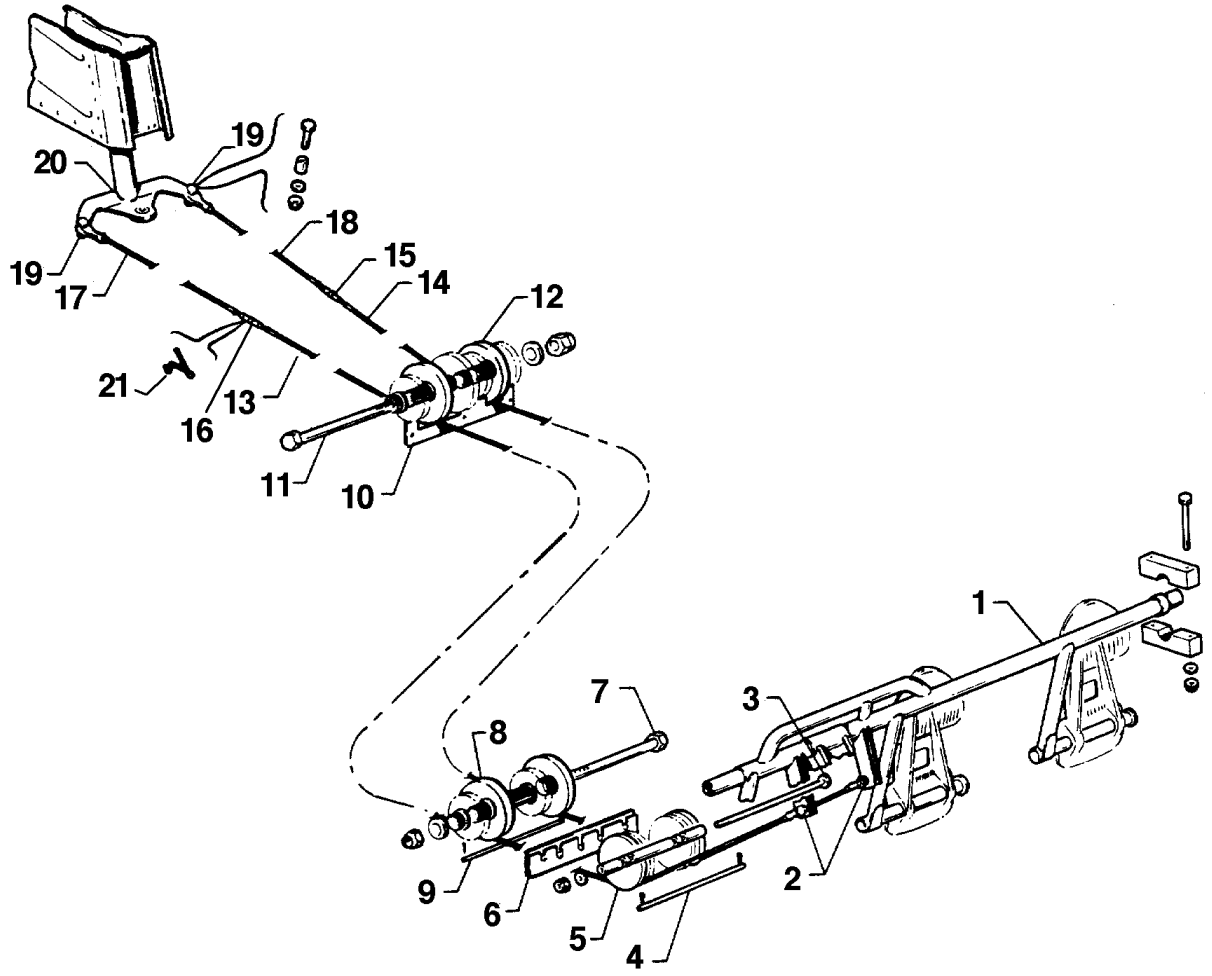
   a. Remove access panel to aft section of fuselage.
   b. Remove tail cone by removing its attachment screws.
   c. Disconnect desired cable at turnbuckle in aft section of fuselage.
   d. Disconnect cable from rudder horn by removing cable clevis bolt, bushing, washer and nut.
   e. Draw the cable through the fuselage.

C. Rudder Cables Installation (Refer to Figure 27-12)

1. To install aft rudder control cable:

   a. Position control cable(s).(Refer to Figure 27-12)
   b. Connect cable(s) at turnbuckle(s) in aft section of fuselage.
   c. Connect cable to rudder horn with clevis bolt, bushing, washer and nut.
   d. Set cable tension and check rigging adjustment per Rigging and Adjustment of Rudder Controls.
   e. Install tail cone and secure with screws.
   f. Install the access panel to the aft section of the fuselage.

RUDDER AND TAB. (cont)



1. RUDDER & STEERING PEDAL ASSY.
2. BOLT, WASHER, NUT, & COTTER PIN
3. BOLT, BUSHING, WASHER, & NUT
4. CABLE GUARD PIN
5. PULLEY CLUSTER
6. RUB BLOCKS
7. BOLT, BUSHING, WASHER, & NUT
8. PULLEY CLUSTER
9. CABLE GUARD PIN
10. CABLE GUARD PLATE
11. BOLT, BUSHING, WASHER, & NUT
12. PULLEY CLUSTER
13. RIGHT FORWARD CABLE
14. LEFT FORWARD CABLE
15. LEFT TURNBUCKLE
16. RIGHT TURNBUCKLE
17. RIGHT AFT CABLE
18. LEFT AFT CABLE
19. BOLT, BUSHING, WASHER, & NUT
20. RUDDER HORN
21. TURNBUCKLE CLIP (2 PER TURNBUCKLE)

Figure 27-12. Rudder Controls

RUDDER AND TAB. (cont)

2. To install forward rudder control cables**:**

— Note —

Aft control cable(s) must be installed before installing forward cable(s). (Refer to paragraph C, 1)

a. Draw control cable through floor tunnel.
b. Connect end of cable to arm on rudder pedal torque tube by installing bolt, washer, nut and cotter pin. Ensure cable end is free to rotate.
c. Connect forward cable to aft control cable at turnbuckles in aft section of fuselage. Ensure each cable is in the groove of its pulley.
d. Move cable guard, located in forward tunnel under pulley cluster and below the fuel selector, into position, and secure with cotter pin.
e. Install cable guard blocks, located within floor opening aft of main spar, onto spar housing. Secure with screws.
f. Install cable guard pin at pulley cluster in aft area of floor opening by sliding it into position and fastening with a cotter pin.
g. Install cable guard plate under pulley cluster located in aft area of aft floor tunnel. Secure with screws.
h. Set cable tension and check rigging adjustment per Rigging and Adjustment of Rudder Controls.
i. Install heat duct. Secure with screws.
j. Install forward tunnel plate aft of tee bar. Secure with screws.
k. Put floor carpet in place and secure.
l. Place fuel selector lever on selector torque tube. Secure with pin and cotter pin.
m. Install lower and upper selector covers. Secure with screws.
n. Install floor panel and seat belt attachment aft of main spar. Secure panel with screws.
o. Install seats.
p. Install cover and carpet of aft floor tunnel.

D. Rigging and Adjustment of Rudder Controls

— 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. To check and set correct degree of rudder travel:

a. Check rudder travel by swinging rudder until it contacts its stop. If control cables are connected, rudder pedals must be used to swing rudder .
b. With rudder against either left or right stop, place a rigging tool against side of the rudder and vertical stabilizer as shown in Figure 27-13. ***Be sure tool is not contacting any rivets***. If no gap exists between rigging tool and surfaces of the rudder and vertical stabilizer, rudder stop for that direction of travel is correct. (Refer to Figure 27-15.) (Tool may be fabricated from dimensions given in Chapter 95.)
c. Swing the rudder in the other direction and check travel as directed in Step (b).
d. Should rudder travel be incorrect, indicated by showing a gap between tool and any part of control surface, remove tail cone fairing and the reset stops to obtain correct rudder travel . (Refer to Figures 27-14 and 27-15.)

RUDDER AND TAB. (cont)

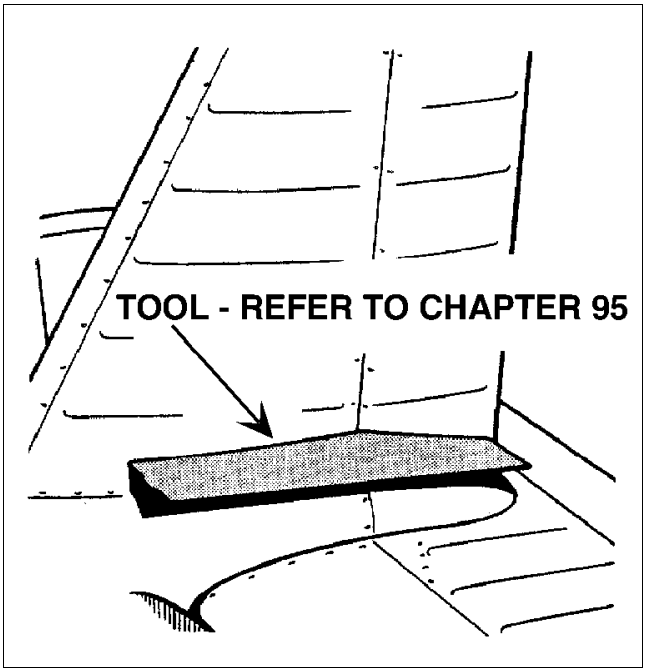


Figure 27-13. Rudder Rigging

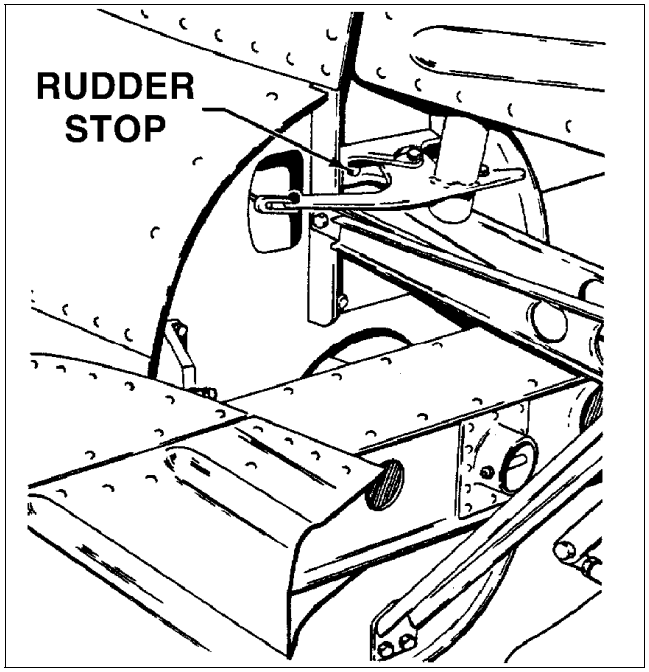


Figure 27-14. Rudder Travel Adjustments

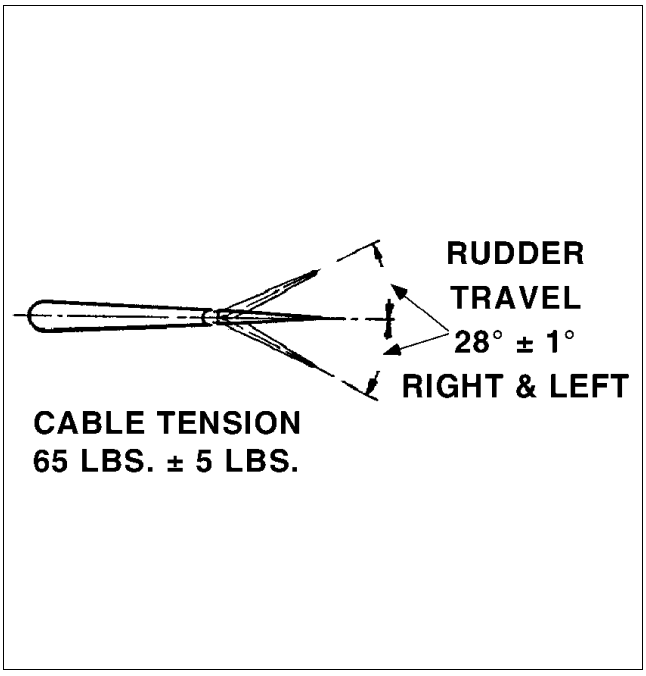


Figure 27-15. Rudder Rigging Limits

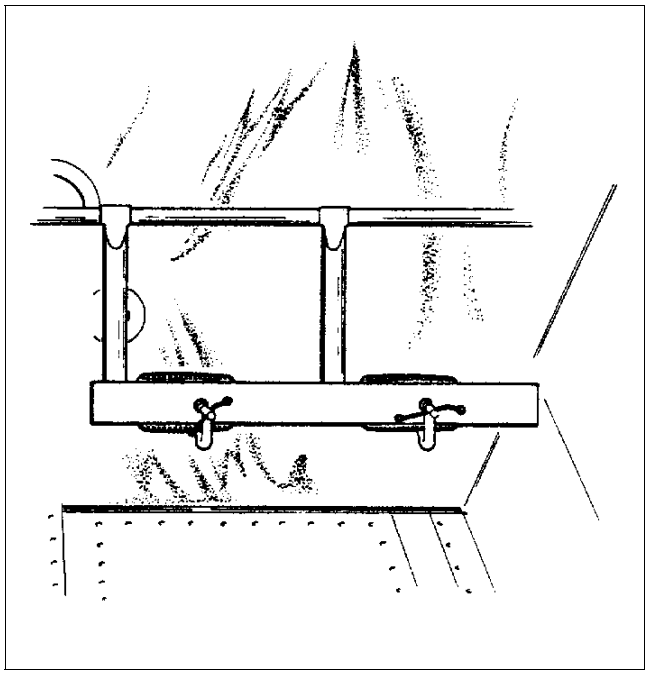


Figure 27-16. Clamping Rudder Pedals

RUDDER AND TAB. (cont)

2. To set cable tension and align rudder:

   a. Remove tail cone and fuselage aft access panel.
   b. Check that nose gear steering has been aligned.
   c. Clamp rudder pedals together in neutral position. (Refer to Figure 27-16 and Alignment of Nose Landing Gear, Chapter 32.)
   d. Adjust turnbuckles in aft section of fuselage to obtain proper cable tension and to allow rudder to align at neutral position.
   e. Check safety of turnbuckles.

— CAUTION —

TO AVOID CABLE STRETCH, DO NOT PUSH RUDDER HARDER THAN NECESSARY.

   f. Adjust rudder pedal stops by pushing on pilot's left rudder pedal until rudder stop is contacted.

      (1) Adjust pedal stop (on fire wall) to provide 0.06 to 0.120 of an inch clearance.
      (2) Repeat procedure with the copilot's right rudder pedal.

   g. Install tail cone and fuselage aft access panel.

E. Rudder Trim Control.

1. To remove Rudder Trim Control (Refer to Figure 27-17.)

   a. Remove fuel selector panel cover by removing rudder trim knob and cover attachment screws.
   b. Place trim knob on assembly and rotate to extreme left (counterclockwise) trim position.
   c. Disconnect housing lug from arm on rudder pedal torque tube by removing cotter pin, nut, washer and bolt.
   d. Remove threaded bushing from aft end of mounting channel by removing cotter pin and clevis pin.
   e. Remove mounting channel may by removing channel attachment screws inside of channel.

      (1) Middle and aft screws need only be turned out.
      (2) Forward screw is secured by a nut on underside of tunnel. To remove forward screw

         (a) Lift floor carpet on right side of tunnel adjacent to channel and remove access plate on side of tunnel.
         (b) Secure nut and turn out screw.

2. To Install Rudder Trim Control. (Refer to Figure 27-17.)

   a. Install trim control mounting channel on upper side of floor tunnel. Install a spacer plate between the channel and tunnel.

      (1) Install the middle and aft attachment screws. Secure screws and with anchor nuts.
      (2) Install forward screw. Forward screw is secured with a nut that must be held from within the tunnel.

   b. Install the access plate on the side of the tunnel and secure carpet in place.
   c. Before attaching assembly to mounting channel, check that:

      (1) Clips are installed so safety wire will be on top.
      (2) Threaded bushing is installed on assembly shaft with welded attachment bushing forward or toward housing.

   d. Attach housing lug to arm provided on rudder pedal torque tube. Secure with bolt, washer and nut. Tighten nut only finger tight and safety with cotter pin.

RUDDER AND TAB. (cont)

e. Clamp rudder pedals in neutral. Position threaded bushing and shaft extension in mounting channel.

(1) Install the clevis pin and cotter pin.
(2) Check that dimensions noted in Figure 27-17 are maintained.

f. Install fuel selector panel cover and cover attachment screws.
g. Install rudder trim knob
h. Ensure that neutral indicator aligns with neutral position on cover placard.

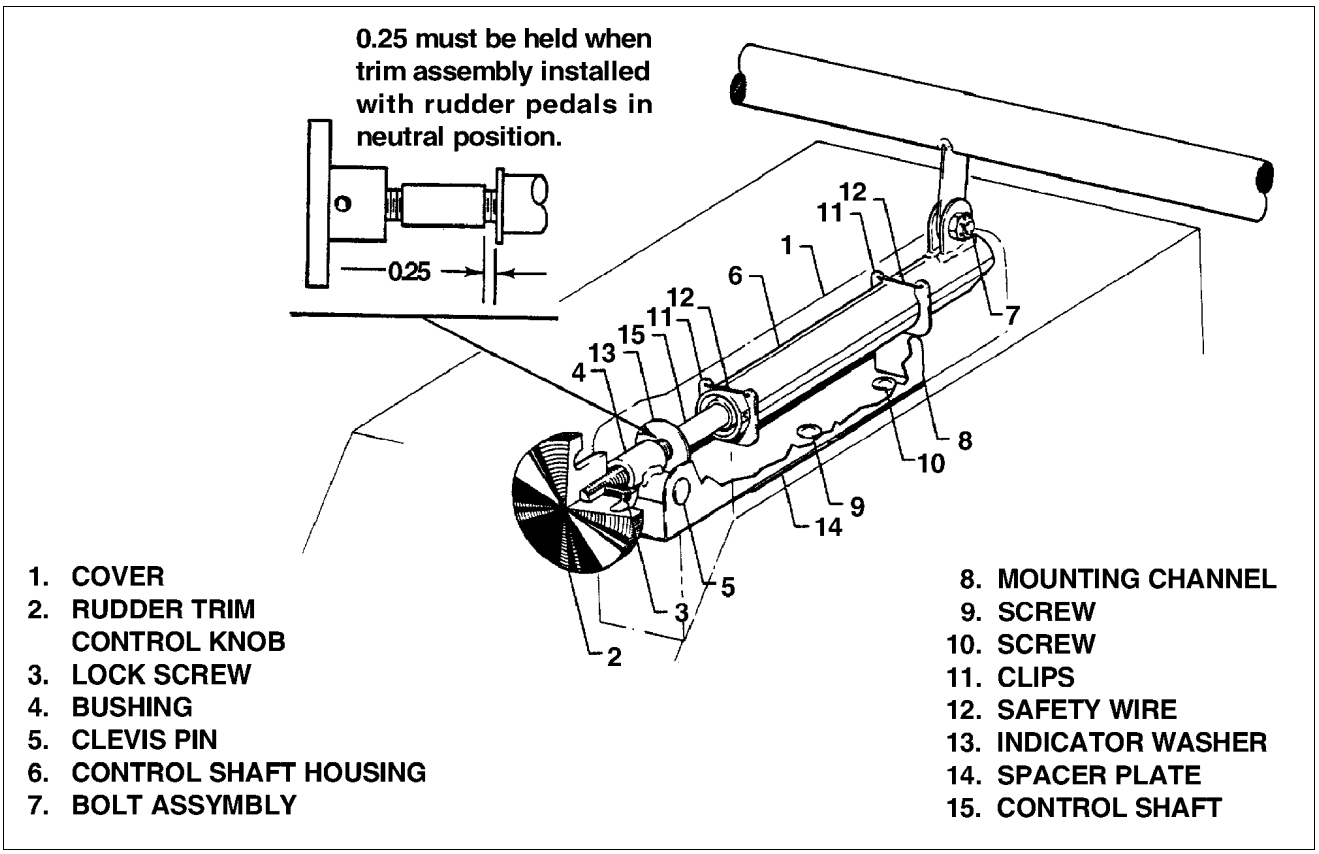


Figure 27-17. Rudder Trim Control

3. Rigging and Adjustment of Rudder Trim Controls

— 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 TRIM RIGGING AND ADJUSTMENT, VERIFY THAT THE RUDDER MOVES LEFT WHEN THE RUDDER TRIM WHEEL IS TRIMMED LEFT; AND, THAT THE RUDDER MOVES RIGHT WHEN THE RUDDER TRIM WHEEL IS TRIMMED RIGHT.

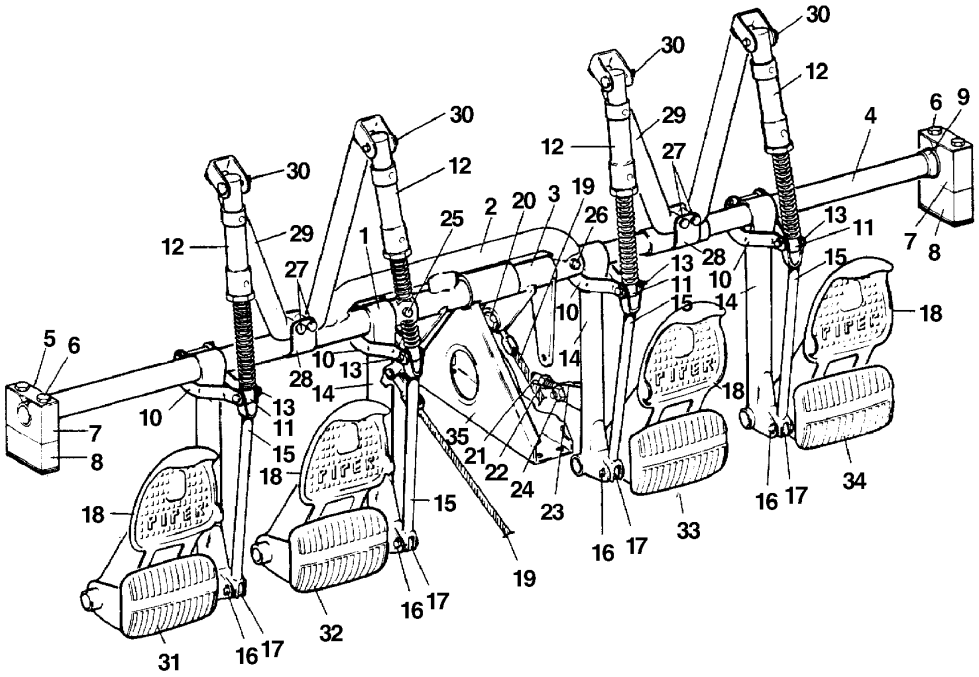
No adjustments are necessary, other than those required during installation of assembly in the airplane. Refer to Installation of Rudder Trim Controls, paragraph E, (2).

RUDDER AND TAB. (cont)

F. Rudder and Steering Pedal Assembly

1. To Remove Rudder and Steering Pedal Assembly (Refer to Figure 27-18.)

   a. Remove access panel to aft section of fuselage.
   b. Relieve rudder and stabilator cable tension by loosening one rudder and one stabilator cable turnbuckle in aft section of fuselage.
   c. Remove fuel selector panel cover by removing rudder trim knob and cover attachment screws.
   d. Remove lower selector cover. Disconnect fuel selector control lever from selector torque tube by removing attachment pin located at bottom of the lever.
   e. Remove tunnel plate just aft of tee bar by laying back enough tunnel carpet to remove plate attachment screws.
   f. Disconnect stabilator control cable from lower end of tee bar assembly.
   g. Remove 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.



1. L. OUTER TUBE
2. L. CENTER TUBE
3. R. CENTER TUBE
4. R. OUTER TUBE
5. PLATE
6. BOLT & NUT
7. UPPER SUPPORT BLOCK
8. LOWER SUPPORT BLOCK
9. SPACER WASHER
10. IDLER ARM
11. BRAKE 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. L. OUTER RUDDER PEDAL
32. L. INNER RUDDER PEDAL
33. R. INNER RUDDER PEDAL
34. R. OUTER RUDDER PEDAL
35. TUBE SUPPORT BRACKET

Figure 27-18. Rudder and Steering Pedal Assembly

RUDDER AND TAB. (cont)

h. Disconnect control cable ends from arms of torque tube by removing cotter pins, washers, nuts and bolts.
i. Disconnect rudder trim from torque tube assembly by removing cotter pin, washers and bolt.
j. Disconnect steering rods at the rudder pedals by removing nuts and bolts.
k. Disconnect brake cylinders at lower end of each cylinder rod by removing cotter pins, washers, nuts and bolts.
l. Disconnect vee braces from torque tube by removing nuts, washers and bolts that secure strap bracket to vee brace.
m. If an AutoPilot amplifier is installed over the torque tube at the right side of the fuselage, disconnect electrical plug and release the two fasteners that secure it to its mounting bracket.
n. Disconnect torque tube support bracket where it attaches to floor tunnel by removing its attachment bolts.
o. Remove two bolts located at the center of the torque tube assembly over the floor tunnel that extend through torque tube. Compress the tubes.
p. Disconnect torque tube support blocks from their support brackets on each side of fuselage by removing attachment nuts, washers and bolts.
q. Remove trim side panels, if desired.
r. Remove assembly from airplane. Note the spacer washer on each end between support blocks.

2. To Install Rudder and Steering Pedal Assembly (Refer to Figure 27-18.)

a. Assemble torque tube assembly as shown in Figure 27-18. Do not install the two bolts through the center of the tube assembly at this time.
b. Place upper support blocks on the ends of the torque tube assembly. Note that a washer is required on each end of tube.
c. Position support blocks on their mounting brackets at each side of fuselage and secure with bolts, washers and nuts.

(1) A bushing is required in bolt holes of upper support block.
(2) A plate is required on top of upper block, between upper and lower blocks and under block mounting bracket.

d. Align bolt holes in center area of torque tube assembly. Install bolts, washers and nuts and tighten.
e. Position torque tube support bracket on floor tunnel and secure with bolts.
f. Position vee braces on torque tube. Install strap bracket around torque tube and brace. Secure with bolts, washers and nuts.
g. Connect ends of brake cylinder rods and clevis rods to idler arms. Secure with clevis and cotter pins.
h. Connect steering rods to rudder pedals and secure with bolts and nuts. Check steering rod adjustment per Alignment of Nose Gear, Chapter 32.
i. Connect rudder trim to arm of torque tube and secure with bolt, washer, nut and cotter pin. Installed a thin washer under nut. Tighten nut only finger tight.
j. Connect ends of rudder control cables to arms provided on torque tube. Secure with bolts, washers, nuts and cotter pins. Ends must be free to rotate.

RUDDER AND TAB. (cont)

k. Swing tee bar into place. Insert attachment bolts through each side of the floor tunnel. Secure with washers and nuts.
l. Connect stabilator control cables to lower end of tee bar with bolt, washer and nut. Secure with cotter pin. Cable ends must be free to rotate.
m. Set rudder cable tension and check rigging and adjustment per Rigging and Adjustment of Rudder Controls.
n. Set stabilator cable tension. Check rigging and adjustment per Rigging and Adjustment of Stabilator Controls, Section 27-30-00.
o. Check aileron cable tension.
p. Check safety of bolt and turnbuckles.
q. Install floor tunnel plate and secure with screws. Fasten tunnel carpet in place.
r. Install fuel selector lever on selector torque tube. Secure with clevis pin and safety with cotter pin.
s. Install fuel selector covers and rudder trim control knob.
t. Install access panel to aft section of the fuselage.

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STABILATOR AND TAB.

A. Troubleshooting Stabilator Control System

CHART 2704. 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 pulleys.	Install cables correctly.
Resistance to stabilator control movement.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension.
	Binding control column.	Adjust and lubricate.
Resistance to stabilator control movement. (cont)	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
Incorrect stabilator travel.	Stabilator stops incorrectly adjusted.	Adjust stop screws.
Correct stabilator travel cannot be obtained by adjusting stops.	Stabilator cables incorrectly rigged.	Check rigging of stabilator cables.
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.

STABILATOR AND TAB. (cont.)

CHART 2704. TROUBLESHOOTING STABILATOR CONTROL SYSTEM. (CONT.)

Trouble	Cause	Remedy
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.
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.	Adjust trim indicator.

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STABILATOR AND TAB. (cont.)

B. Stabilator Cables Removal. (Refer to Figure 27-19.)

1. To Remove Forward Stabilator Control Cables:

   a. Remove access panel to aft section of the fuselage.
   b. Disconnect desired control cable at turnbuckle in aft section of fuselage.
   c. Remove floor tunnel cover in aft area of cabin by:

      (1) Removing trim plate.
      (2) Removing carpet over tunnel.
      (3) Removing cover attachment screws.

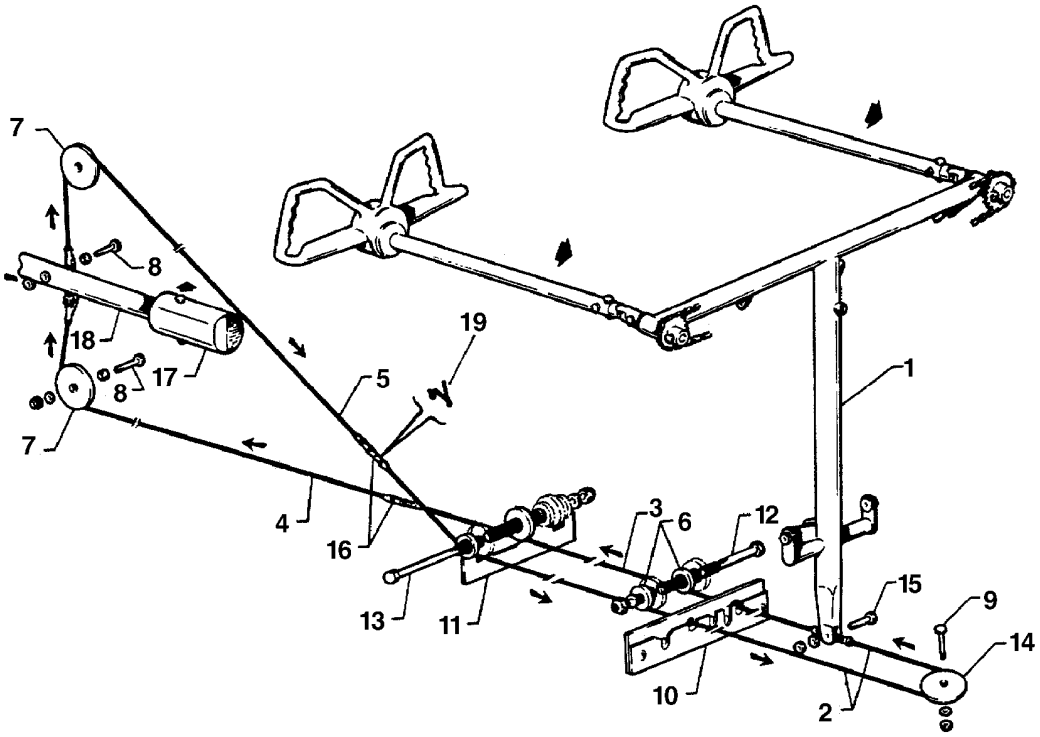
   d. Remove cable guard plate from underside of pulley cluster in aft area of tunnel opening by removing guard attachment screws.
   e. Remove floor panel located directly aft of main spar by removing center seats, seat belt attachments and screws securing the panel. Lift panel and remove from airplane.
   f. Remove cable rub blocks attached to the spar housing, located in floor opening, by removing block attachment screws.
   g. Remove cotter pin cable guard at pulley cluster in aft area of floor opening.
   h. Remove fuel selector panel cover by removing rudder trim knob and cover attachment screws.
   i. Remove lower fuel selector cover. Disconnect fuel selector control lever from selector torque tube by removing attachment pin located at bottom of lever.
   j. Remove tunnel plate just aft of tee bar by removing enough carpet from tunnel to allow plate attachment screws and plate to be removed.
   k. To remove right (upper) stabilator control cable:

      (1) Remove cotter pin cable guards at pulley located in forward area of the tunnel.
      (2) Disconnect cables from lower end of tee bar by removing cotter pin, nut, washer and bolt.
      (3) Draw cable aft through the floor tunnel.

2. To remove either aft stabilator control cable:

   a. Remove access panel to aft section of the fuselage.
   b. Disconnect desired control cable at turnbuckle in aft section of fuselage.
   c. Disconnect cable end at stabilator balance arm by removing the cotter pin, nut, washer and bolt.
   d. Remove cable guard pin at the pulley.
   e. Remove cable from airplane.

STABILATOR AND TAB. (cont.)



1. CONTROL COLUMN TEE BAR
2. RIGHT FORWARD CABLE
3. LEFT FORWARD CABLE
4. LEFT, LOWER AFT CABLE
5. RIGHT, UPPER AFT CABLE
6. FORWARD CLUSTER PULLEY
7. AFT PULLEY
8. BOLT, WASHER, NUT & COTTER PIN
9. BOLT, WASHER & NUT
10. CABLE RUB BLOCK
11. CABLE GUARD
12. BOLT, WASHER (7) & NUT
13. BOLT, WASHER (11) & NUT
14. FORWARD PULLEY
15. BOLT, WASHER, NUT & COTTER PIN
16. TURNBUCKLE
17. BALANCE ARM WEIGHT
18. STABILATOR BALANCE ARM
19. LOCKING CLIP

Figure 27-19. Stabilator Controls

C. Stabilator Cables Installation (Refer to Figure 27-19.)

1. To install either aft stabilator control cable:

   a. Route left (lower) cable under pulley located beneath balance arm. Route right (upper) cable over pulley located above balance arm.
   b. Connect cable to the stabilator balance arm. Insert bolt and washer. Install nut and finger tighten as much as possible. Install cotter pin.
   c. Connect cable to forward cable at turnbuckle in aft section of fuselage. Upper aft cable connects to right forward cable and lower cable to left forward cable.
   d. Install cable guard pin at pulley.
   e. Set cable tension. Check rigging and adjustment per Rigging and Adjustment of Stabilator Controls.
   f. Install access panels to aft section of the fuselage.

STABILATOR AND TAB. (cont.)

— Note —

Aft control cable(s) must be installed before installing forward cable(s). Refer to paragraph C, (2)

2. To install forward stabilator control cables:

   a. Draw control cable through floor tunnel. Be sure right (upper) cable is routed around the pulley that is in the forward area of the forward floor tunnel.
   b. Connect cables totower ind of control column tee bvar with bolt, washer, nut and cotter pin. Encure that cable is free to rotate.
   c. Connect contrtol cable to aft cable at turn buckle in aft section of fuselage.
   d. If installing right cable, install cotter pin cable gu atrd at pulley in forward area of tunnel
   e. Install the cable rub blocks to the spar housing located inforward area of floor opening aft of main spar. Secure with screws.
   f. Install cotter pin cable guard at pulley cluster located in aft area of floor opening.
   g. Install cable guard under pulley cluster located in aft area of aft floor tunnel. Secure with screws.
   h. Set cable tension. Check rigging and adjustment per paragraph D, Stabliator Controls Rigging and Adjustment.
   i. Install tunnel plate directly aft of tee bar assembly. Secure with screws.
   j. Put floor carpet in place and secure.
   k. Place fuel selector lever on selector torque tube. Secure with pin and safety with cotter pin.
   l. Install lower and upper selector covers. Secure with screws.
   m. Install floor panel aft of main spar. Secure with screws.
   n. Install the seat belt attachments and seats.
   o. Install cover and carpet of aft floor tunnel.
   p. Install access panels to aft section of the fuselage.

D. Stabilator Controls Rigging and Adjustment.

— 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. To check and set the correct degree of stabilator travel:

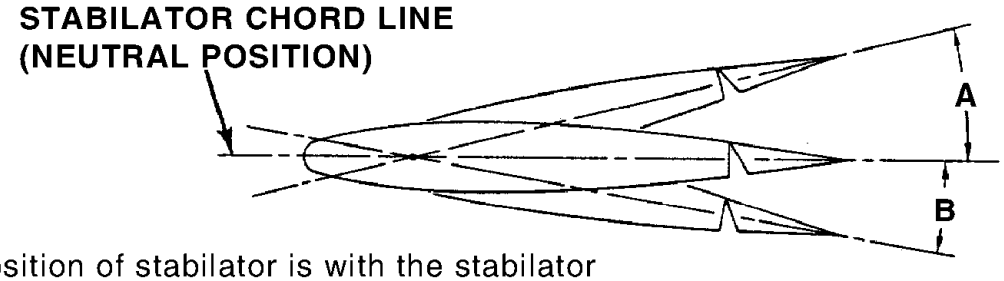
   a. Level airplane. (Refer to Leveling, Chapter 8.)
   b. Place stabilator in neutral position. Neutral position is obtained when a level, placed on stabilator rigging tool (Figure 27-20), indicates that stabilator is parallel (bubble centered) with leveling holes noted in Chapter 8, Figure 8-1. (Rigging tool may be fabricated from dimensions given in Chapter 95.)
   c. To check the stabilator travel:

— Note —

The stabilator should contact both of its stops before the control wheel contacts its stops.

   (1) Place rigging tool on the upper surface of stabilator.
   (2) Set number of degree up travel, specified in Figure 27-20, on a bubble protractor
   (3) Place protractor on rigging tool.

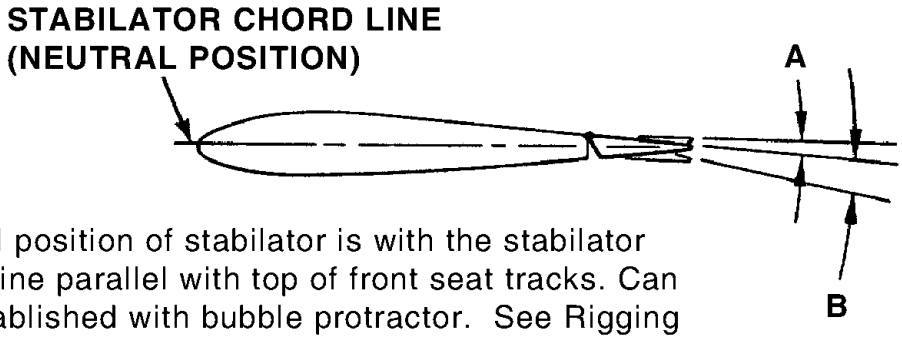
STABILATOR AND TAB. (cont.)



Neutral position of stabilator is with the stabilator chord line parallel with top of front seat tracks. Can be established with bubble protractor. See Rigging and Adjustment of Stabilator Controls in text.

Stabilator

A - STABILATOR TRAILING EDGE UP TRAVEL FROM NEUTRAL = 14.5° ± 0.5°
B - STABILATOR TRAILING EDGE DOWN TRAVEL FROM NEUTRAL = 5.5° ± 0.5°
C - CABLE TENSION = 40 LBS. ± 5 LBS



1. Neutral position of stabilator is with the stabilator chord line parallel with top of front seat tracks. Can be established with bubble protractor. See Rigging and Adjustment of Stabilator Controls in text.
2. Maximum free play for control surface tab is 0.06 of an inch measured at tab trailing edge.

Stabilator Trim Tab

A - STABILATOR TAB TRAILING EDGE UP TRAVEL FROM NEUTRAL = 5° ± 1°
B - STABILATOR TAB TRAILING EDGE DOWN TRAVEL FROM NEUTRAL = 8° ± 1°
C - CABLE TENSION 14 LBS. ± 1 LB.

Figure 27-20. Stabilator and Tab Rigging Limits

STABILATOR AND TAB. (cont.)

(4) Raise trailing edge of stabilator. Check that, when stabilator contacts its stops, protractor bubble is centered.
(5) Set the number of degrees down travel specified Figure 27-20 on a bubble protractor
(6) Place protractor on the rigging tool.
(7) Lower trailing edge of stabilator. Check that, when stabilator contacts its stops, protractor bubble is centered.

d. If stabilator travel is not correct in either the up or down position:

(1) Remove tail cone by removing the attachment screws.
(2) With use of rigging tool and bubble protractor, turn stops located at each stabilator hinge in or out to obtain correct degree of travel. (Refer to Figure 27-21.)
(3) Check that locknuts of stop screws are secure.
(4) Install the tail cone.

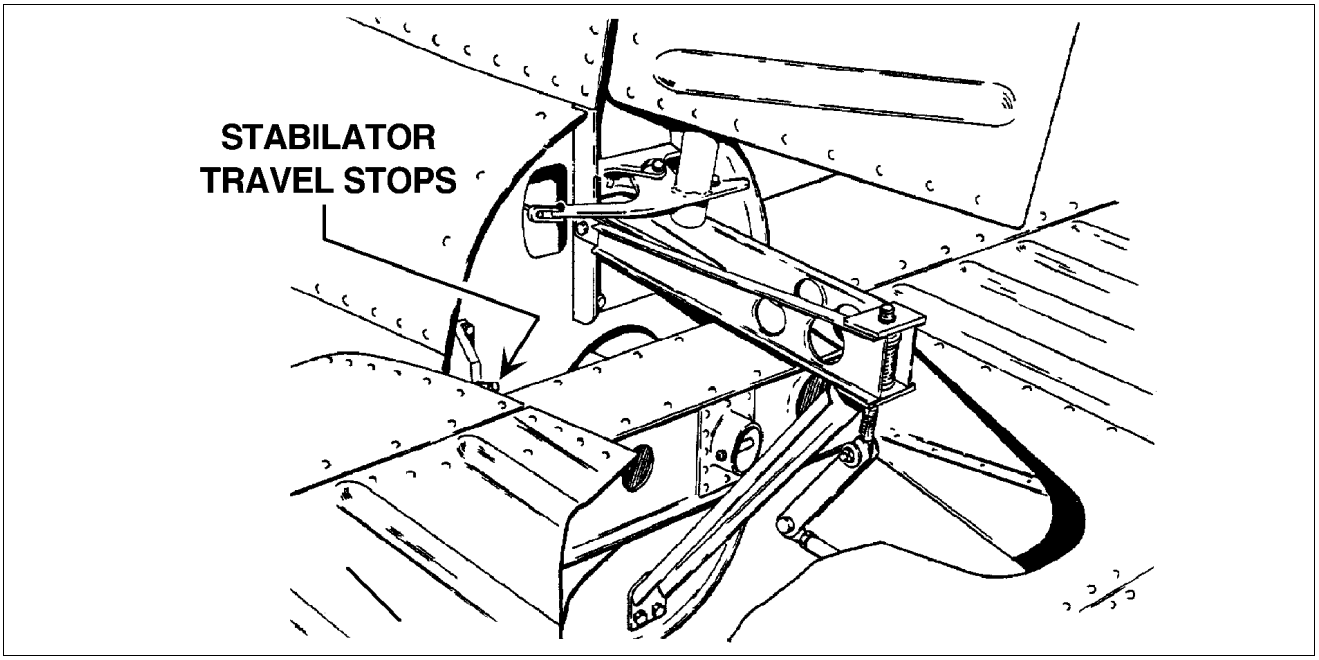


Figure 27-21. Stabilator Travel Adjustments

2. To check and set stabilator control cable tension:

a. Check that stabilator travel is correct.
b. Remove access panel to aft section of fuselage and tail cone.
c. Position and secure tee bar (control column) 1/2 inch ± 1/4 inch off forward tee bar stop .
d. Check each stabilator control cable for correct tension as given in Figure 27-20.
e. If tension is not correct, loosen turnbuckle of ***lower*** cable in aft section of fuselage and adjust turnbuckle of ***upper*** cable to obtain correct tension. Cable tension should be obtained with control wheel one-quarter inch dimension from stop and stabilator contacting its stop.

STABILATOR AND TAB. (cont.)

f. With the tension of upper cable correct and control wheel still forward, adjust the turnbuckle of ***lower*** cable to obtain correct tension.
g. Check safety of all turnbuckles and bolts.
h. Check the full travel of the control wheel with relation to the full travel of the stabilator. Determine that stabilator contacts its stop before control wheel contacts its stops. Move control wheel to full fore and aft positions. Travel distance from point where stabilator contacts its stops, and control wheel contacts its stops, should be approximately equal. Adjust turn buckles if incorrect.
i. Install access panels and tail cone.

E. Stabilator Trim Assembly

1. To Remove Forward Stabilator Trim Assembly (Refer to Figure 27-23.)

a. Remove panel to the aft section of airplane.
b. Remove trim control wheel assembly and/or trim control cables
c. If aft trim cable is not to be removed, block cables at pulleys in aft section of fuselage to prevent them from unwrapping from trim drum. (Refer to Figure 27-22.)
d. To remove trim control wheel, loosen cables at trim cables turnbuckles in aft section of fuselage.

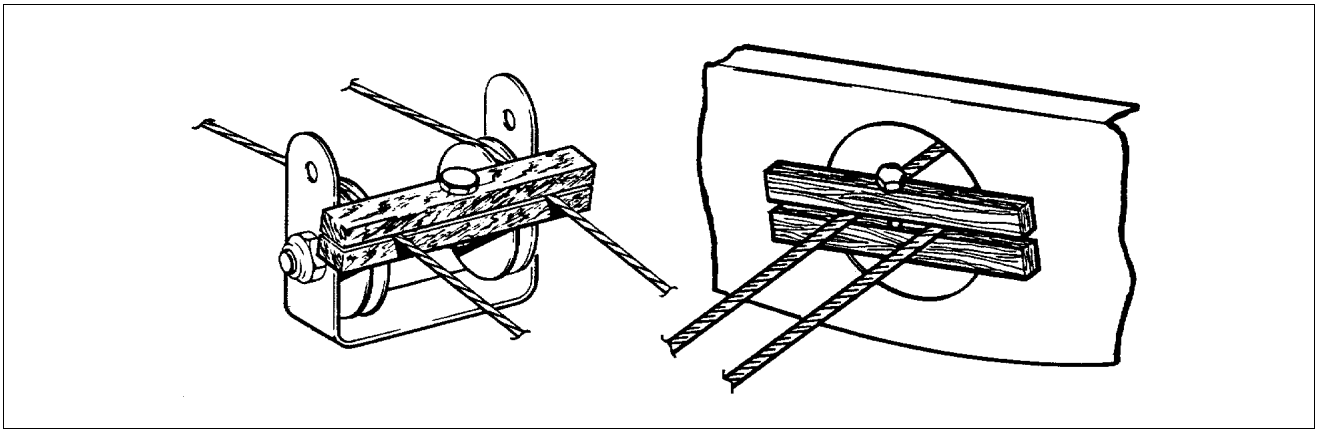


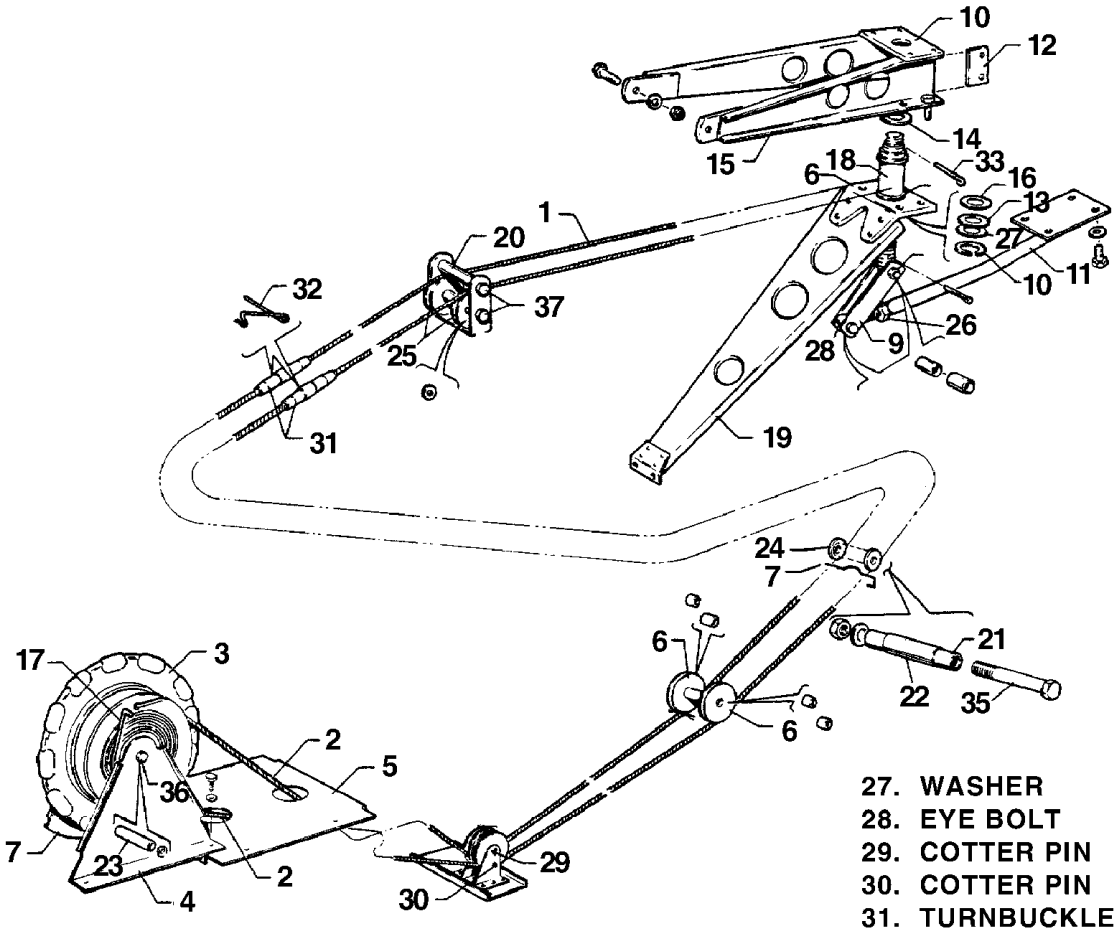
Figure 27-22. Methods of Securing Trim Cables

e. To remove trim cables, disconnect cables at trim cables turnbuckles in aft section of fuselage.
f. To remove control wheel with drum:

(1) Remove control wheel cover by removing cover attaching screws.
(2) Remove wheel assembly from its mounting brackets by removing nut, washer and bolt that secures wheel between the brackets. Draw wheel from brackets. ***Use caution not to damage trim indicator wire***.
(3) Unwrap ***left*** cable from drum.
(4) Wheel and drum are joined by a push fit. Separate these two items with their center bushing. Unwrap ***right*** cable.
(5) Tie cables forward to prevent them from slipping back into floor tunnel.

STABILATOR AND TAB. (cont.)

1. AFT CABLE
2. FWD CABLE
3. TRIM TAB WHEEL ASSEMBLY
4. BRACKET ASSEMBLY
5. TRIM WHEEL PLATE ASSEMBLY
6. TRIM TAB PULLEY
7. CABLE GUARD
8. STABILATOR TRIM PLATE
9. STABILATOR TRIM LINK
10. SNAP RING
11. STABILATOR TRIM ARM ASSEMBLY
12. CABLE GUARD
13. THRUST BEARING
14. BEARING
15. STABILATOR TRIM RIB
16. STABILATOR TRIM SHIM
17. STABILATOR TRIM INDICATOR
18. STABILATOR TRIM BARREL
19. STABILATOR TRIM RIB
20. PULLEY BUSHING



21. INNER BUSHING
22. OUTER BUSHING
23. BUSHING
24. PULLEY
25. PULLEY
26. NUT
27. WASHER
28. EYE BOLT
29. COTTER PIN
30. COTTER PIN
31. TURNBUCKLE BARREL
32. TURNBUCKLE CLIP
33. COTTER PIN
34. BOLT, WASHER, NUT
35. BOLT, WASHER, NUT
36. BOLT, WASHER, NUT
37. BOLT, WASHER, NUT

Figure 27-23. Stabilator Trim Controls

STABILATOR AND TAB. (cont.)

f. To remove trim control cables:

(1) Remove pilot and rear seats.
(2) Remove seat belts attached to forward floor tunnel by removing attachment nuts, washers and bolts.
(3) Remove heater deflectors from each side of aft end of forward floor tunnel by sliding deflector sideways and releasing retainer spring.
(4) Unfasten carpet from aft portion of forward floor tunnel and lay it forward.
(5) Remove tunnel cover located between trim control wheel and spar cover by removing selector knobs and cover attachment screws.
(6) Remove cable pulleys located in forward tunnel by removing cotter pin, washer and clevis pin.
(7) Remove floor panel aft of main spar by removing panel attachment screws and seat belt attachments. Lift panel and remove from airplane.
(8) Remove cable rub blocks located in floor opening on aft side of main spar by removing block attachment screws.
(9) Remove trim plate located on top of forward end of aft floor tunnel.
(10) Remove carpet from aft floor tunnel.
(11) Remove cover plate from top of aft floor tunnel by removing attachment screws.
(12) Remove cable guard from underside of trim cable pulleys located in forward area of aft floor tunnel by removing tinnerman nut and withdrawing the cable guard.
(13) Remove cable guard plate from underside of pulley cluster located in aft area of floor tunnel by removing plate attachment screws.
(14) Remove cable guard from cable pulleys in aft lower section of fuselage forward of cable turnbuckles.
(15) With cables disconnected from trim control wheel, draw cable(s) through floor tunnel.

2. To Install Forward Stabilator Trim Assembly (Refer to Figure 27-23.)

a. Install trim control wheel with drum:

(1) Wrap right trim cable on trim drum by inserting swaged ball of cable in slot provided in right side of drum that mates with the control wheel. Looking at this side, wrap drum with three wraps of cable in a clockwise direction.
(2) Attach trim control wheel to cable drum by aligning long lug of drum with long slot of wheel and pushing the two pieces together.
(3) Wrap left trim cable on drum by inserting swaged ball of cable in slot provided in the flanged left side of drum. Looking at this side, wrap drum with three wraps of cable in a clockwise direction.
(4) Lubricate and install bushing in control wheel and drum.
(5) Align control cables and position trim control wheel assembly between its mounting brackets. Check that end of trim indicator wire is positioned in spiraled slot of drum with no bind on end. Install retainer bolt from left side. Install washer and nut.
(6) Install cover over trim control wheel. Secure with screws, unless the control cables have to be installed.

STABILATOR AND TAB (cont.)

b. To install trim control cables:

(1) Draw cable(s) through floor tunnel.
(2) Wrap cable drum and install trim control wheel as given in step (2), (a).
(3) Position cable pulleys on their mounting bracket and install clevis pin, washer and cotter pin.
(4) Connect forward cable to aft cable at turnbuckle in aft section of fuselage. If aft cable has not been installed, refer to paragraph (4).
(5) Install cable guard at cable pulleys in aft lower section of fuselage forward of cable turnbuckles.
(6) Install cable guard plate at underside of pulley cluster located in aft area of aft floor tunnel. Secure with screws.
(7) Install pin type cable guard at underside of pulleys located in forward area of aft floor tunnel. Secure with a tinnerman nut.
(8) Install cable rub blocks located on aft side of main spar housing. Secure with screws.
(9) Remove blocks that secure aft trim cable. Check that cables are seated on their pulleys.
(10) Set cable tension. Check rigging and adjustment. Check safety of all turnbuckles.
(11) Install tunnel cover on]forward tunnel. Secure with screws.
(12) Install carpet over floor tunnel.
(13) Install heat deflectors on each side of floor tunnel.
(14) Install cover over trim control wheel and secure with screws and special washers.
(15) Install fuel selector knobs and secure with set screws.
(16) Install seat belts removed from top of floor tunnel. Secure with bolt, washer and nut.
(17) Install floor panel and seat belt attachments aft of main spar. Secure panel with screws.
(18) Install aft floor tunnel and secure with screws.
(19) Install carpet over aft floor tunnel.
(20) Install trim plate on top of forward end of aft floor tunnel.
(21) Install panel to aft section of airplane.
(22) Install seats.

3. To Remove Aft Stabilator Trim Controls (Refer to Figure 27-23.)

a. Remove access panel to aft section of the fuselage.
b. Block trim cables at the first set of pulleys forward of cable turnbuckles in the aft section of the fuselage by method shown in Figure 27-22.
c. Disconnect cable at the turnbuckles in aft section of fuselage.
d. Remove cable guard from pulley cluster.
e. Remove tail cone by removing attachment screws.
f. Disconnect link between trim screw and trim control arm by removing nut, washer and bolt connecting link to screw.
g. Remove cotter pin from top of trim screw. Turn screw down and out of barrel.
h. Remove snap ring, washer and thrust washer from the bottom of barrel.
i. Disconnect diagonal rib from the horizontal rib that supports trim assembly by removing four attachment nuts, washers and bolts.
j. Draw trim cable from fuselage.

STABILATOR AND TAB. (cont.)

4. To Install Aft Stabilator Trim Controls (Refer to Figure 27-23)

   a. Wrap the trim barrel by (refer to Figure 27-24):

      (1) Laying center (as measured equally from each end to center of the cable) of trim cable in slot of the barrel.
      (2) Bring half of cable to be used on right side through e diagonal slot in flange at forward end of barrel and wrap aft in a clockwise direction 11.5 wraps to the center of barrel.
      (3) Bring half of cable to be used on left side through diagonal slot in aft end of barrel and wrap forward in a counterclockwise direction 11.5 wraps to the center of barrel.
      (4) Count a total of 23 cable wraps on top side of the barrel. (Refer to Figure 27-24.)

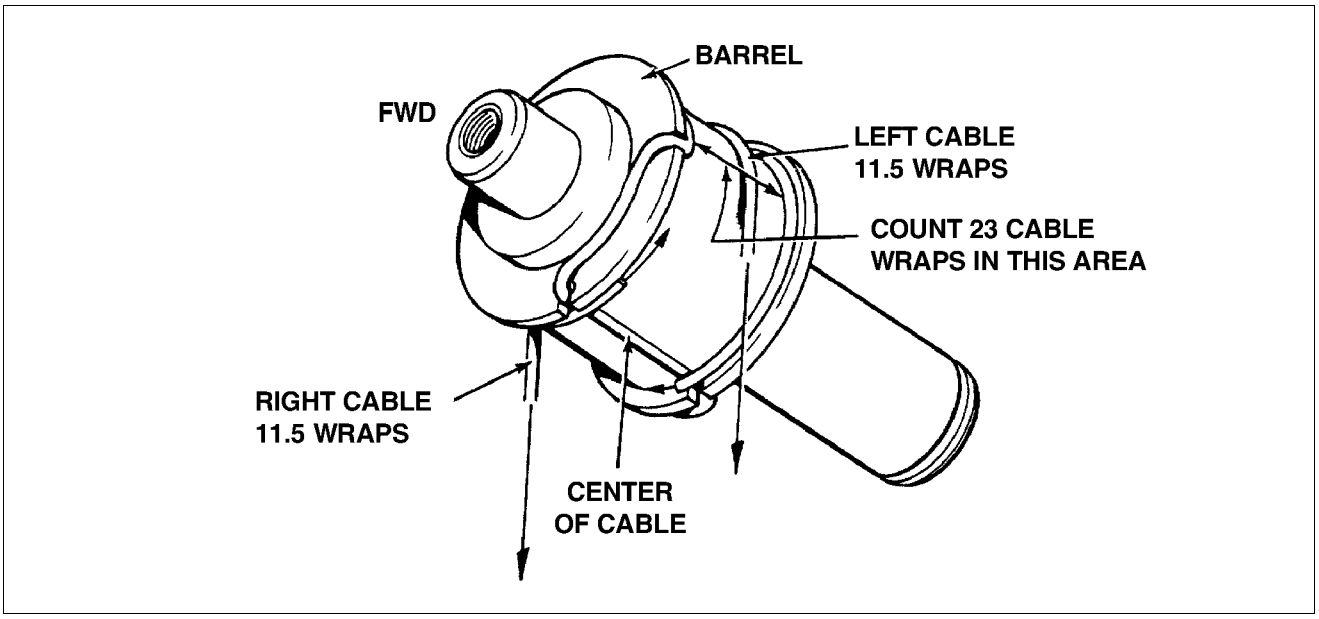


Figure 27-24. Wrapping Trim Barrels

   b. Block cable by clamping between two pieces of wood laid next to wraps to prevent unwrapping. Fabricate block with a notch so hardware can be installed After installation of hardware safety wire the bolts.
   c. Ensure barrel bushings are installed in rib plate and clip.
   d. Lubricate bushings and install trim barrel in bushings between the two support ribs.
   e. Attach bottom diagonal rib to horizontal rib. Secure with bolt, washer and nut.
   f. Install thrust washer, washer and snap ring on lower end of barrel.
   g. Install trim screw in barrel. Secure both ends with a cotter pin through trim screw.
   h. Route cables into fuselage. Attach ends to forward trim cables.
   i. Remove blocks holding forward cables tight.
   j. Set cable tension. Check rigging and adjustment per Rigging and Adjustment of Stabilator Trim. Check safety of all turnbuckles.
   k. Install tail cone and secure with screws.
   l. Install aft fuselage access panel.

STABILATOR AND TAB. (cont.)

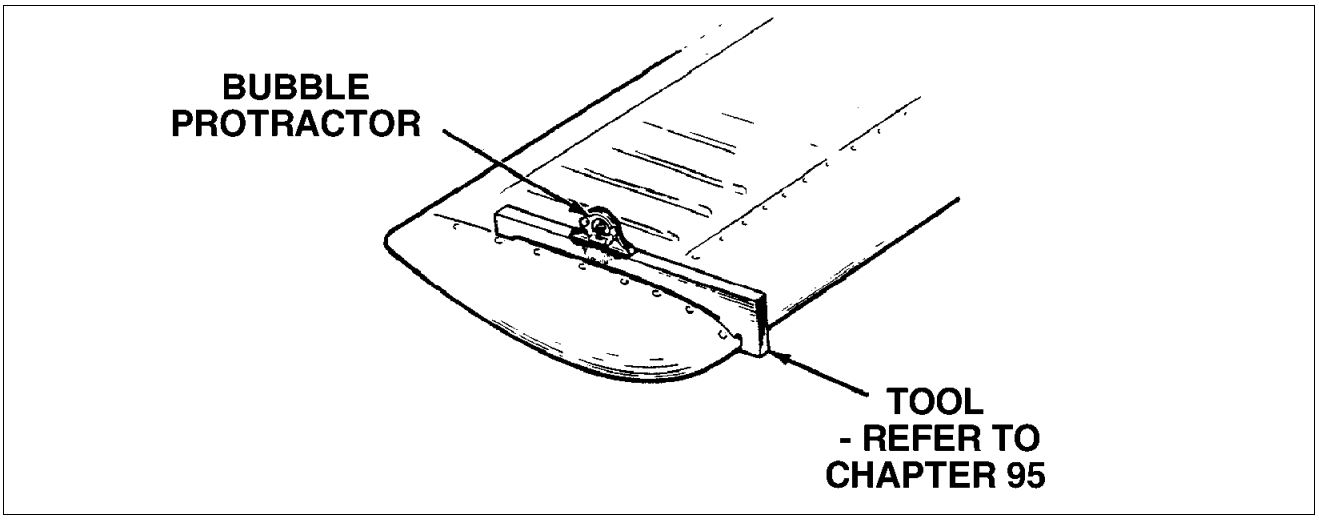


Figure 27-25. Stabilator Rigging

F. Stabilator Trim Rigging and Adjustment (Refer to Figure 27-25.)

— 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, Chapter 8.)
2. Check for proper stabilator trim cable tension as given in Figure 27-20. If cables were disconnected, rotate trim control wheel several times to allow cables to seat and recheck tension.
3. Secure stabilator in neutral position. Refer to 23-30-00.
4. Turn trim control wheel until aft end of turn buckle of ***right*** trim cable is approximately two inches forward of double pulleys at top of rear bulkhead.
5. Check that trim screw is turned down until cotter pin stop in top of screw is contacting plate on horizontal support rib of trim assembly.
   a. If stop is not contacting plate, and links between the screw and trim control arm are not disconnected, disconnect the two by removing nut, washers and bolt.
   b. With turnbuckle still two inches from pulley, turn screw down until pin contacts plate.
6. Check rod end on tab actuating arm for approximately six threads forward of jam nut.
7. Connect links to trim screw and secure with bolt, washers and nut.
8. Turn the trim wheel until trim tab streamlines with neutral stabilator.

STABILATOR AND TAB. (cont.)

9. Check bubble of protractor over neutral tab; then check tab travels specified in Figure 27-20. Degree of travel on protractor is determined by taking difference between protractor reading at neutral and up position, and neutral and down. With airplane level, bubble must be centered at each reading. To obtain correct travel:

    a. Disconnect links at actuating arm rod end.
    b. Turn rod end in or out, as required.
    c. Connect links to actuating arm rod end.
    d. Secure jam nut on actuating arm rod link

10. Turn trim wheel full travel. Check for turnbuckle clearance and location of tab indicator.

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STABILATOR AND TAB. (CONT.)

G. Stall Warning System

1. Description and Operation

This system consists of two lift detectors located on the leading edge of the left wing, at wing station 174.00, that are electrically connected to the flap position switch and stall warning horn. As a stalling condition is approached, the lift detector will activate the stall warning horn. Perform the following ground check to determine that the lift detectors are functioning properly.

a. Apply electrical power to the airplane.
b. Extend flaps to the 10° position. The 0° and 10° flap position activates the inboard lift sensor only. ***Gently*** lifting the ***inboard*** lift detector sensor should activate the stall warning horn. ***Gently*** lifting the ***outboard*** lift detector sensor should ***not*** activate the stall warning horn.
c. Position the flap to 25° or 40°. ***Gently*** lifting on the ***outboard*** lift detector sensor should activate the stall warning horn. Lifting on the ***inboard*** lift detector sensor should ***not*** activate the stall warning horn.
d. Remove electrical power from the airplane.

2. Removal of Lift Detectors.

— Note —

The master (battery) switch must be off prior to performing any work on the lift detector. Place reference marks on holding plate and wing skin for use when installing.

a. Remove screws holding plate around tab. The lift detector is attached to plate. Remove unit from wing.
b. Mark electrical wires and terminals to facilitate installation. Remove electrical wires from lift detector. Remove lift detector from airplane.

3. Installation of Lift Detector

a. Attach electrical leads to appropriate terminals of lift detector.
b. Using reference marks made during removal, position lift detector and holding plate assembly on wing. Determine that sensor blade of unit drops down freely.
c. Ensuring unit is aligned with reference marks, secure in position with screws previously removed.

STABILATOR AND TAB. (CONT.)

4. Adjustment of Lift Detector

The lift detector switch is adjusted at the factory, when the airplane is test flown, and should not require any further adjustment. If some type of service on the wing require moving the switch, use the following procedure to position the switch at the proper position.

— CAUTION —

NEVER ADJUST THE SWITCH BY BENDING THE VANE.

a. Loosen the two Philips head screws; one on either side of the vane.

(1) If the stall warning comes on too late, move switch up.
(2) If the stall warning comes on to early, move switch down.

b. Tighten the screws after making any adjustments.

5. Testing Stall Warning Accuracy

— WARNING —

ALL FLIGHT TESTS SHALL BE CONDUCTED BY A QUALIFIED PILOT EXPERIENCED IN THIS PARTICULAR MAKE AND MODEL OF AIRPLANE.

The only way to test the accuracy of the setting is in flight. It may be necessary to make several test flights and alternate adjustments before the desired setting is obtained

a. To test the ***inboard*** lift detector stall warning switch:

(1) Place the airplane in a flaps ***up*** and landing gear ***up,*** power off configuration.

— Note —

When 5 to 10 knots above the airspeed at which stall warning is anticipated, limit airspeed reduction rate to approximately 1 knot per second, to ensure unaccelerated stall conditions.

(2) ***Fly*** the airplane into a stall condition.
(3) ***Note*** the speed at which the stall warning comes on.
(4) The stall warning should come on not ***less*** than five knots, nor ***more*** than ten knots, before the actual stall occurs.

b. To test the ***outboard*** lift detector stall warning switch:

(1) Place the airplane in a configuration of flaps ***down 40°,*** landing gear ***down,*** power off.

STABILATOR AND TAB. (CONT.)

— Note —

When 5 to 10 knots above the airspeed at which stall warning is anticipated, limit airspeed reduction rate to approximately 1 knot per second, to ensure unaccelerated stall conditions.

(2) ***Fly*** the airplane into a stall condition.
(3) ***Note*** the speed at which the stall warning comes on.
(4) The stall warning should come on not ***less*** than five knots, nor ***more*** than ten knots, before the actual stall occurs.

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FLAPS

A. Flap Operating Systems

The SARATOGA II HP's and TC's are equipped with electrically operated flaps. A control lever and an in-transit indicator light are located on the lower right instrument panel. Selection of a new flap position will activate the flap motor and the light. When the flaps reach the desired position, the flap motor is switched off automatically and the indictor light goes out.

The flap control lever has four stops: 0°, 10°, 25°, and 40°.

B. Wing Flap Maintenance

1. Removal of Wing Flap Controls. (Refer to Figure 27-26.)

a. To remove flap torque tube assembly:

(1) Extend flaps to 40° position.
(2) Remove floor panel located aft of main spar by removing center seats, seat belt attachments and screws securing panel. Lift panel and remove from airplane.
(3) Remove access plate located between underside of aft section of each wing and fuselage by removing attaching screws.
(4) Disconnect left and right flap control tubes (rods) either:

(a) At the flaps by removing nuts, washers and bolts at the torque tube cranks (arms) or by;
(b) Removing bolts and washers from inner side of each crank. Remove bolt through a hole in the fuselage side skin located over torque tube .

(5) Disconnect electrical connections from limit switches mounted to torque tube switch plate.
(6) Disconnect cable ends from torque tube pulley assembly by removing the cotter pins.
(7) Disconnect jack screw actuator from torque tube bellcrank by removing nut, washers and bolt.
(8) Remove tube support bearing blocks by removing block attachment bolts.
(9) Remove nuts, washers and bolts securing right and left cranks, and stop fittings on torque tube.
(10) From between each wing and fuselage, remove cranks from torque tube.
(11) Disconnect one bearing block from its mounting brackets by removing nuts, washers and bolts.
(12) Slide tube from bearing block still attached to its brackets. Raise end and lift it from floor opening.

b. To remove flap control cable:

(1) Remove center seats. Remove center floor panel by removing screws securing panel.
(2) Remove aft heat deflectors on each forward floor tunnel by sliding them far enough to release spring fasteners.
(3) Lift aft section of tunnel carpet far enough to remove screws securing tunnel cover. Remove cover.
(4) Remove cotter pins securing cable ends to pulley assembly on torque tube.
(5) Remove clamps securing cable housings to support bracket.
(6) Disconnect flap selector lever and cable from flap selector lever support bracket mounted on aft side of instrument panel.
(7) Remove cable assembly from tunnel.

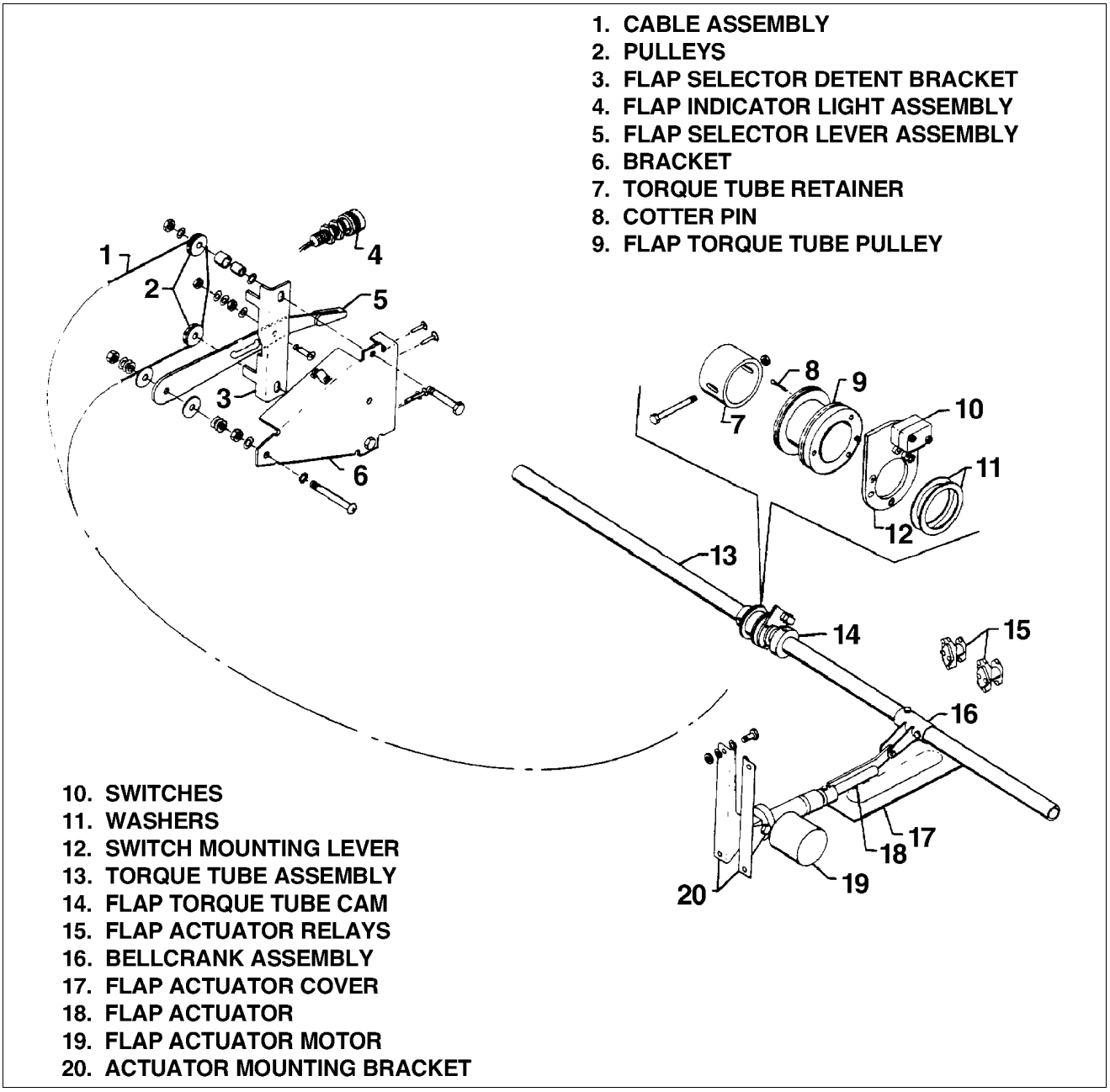

Figure 27-26. Electrically Operated Flap System

c. To remove flap actuator jack screw and motor assembly:

(1) Remove center seats. Remove center floor panel by removing screws securing panel.
(2) Disconnect electrical leads to flap actuator motor.
(3) Remove nut, washers and bolt securing flap actuator jack screw to torque tube bellcrank.
(4) Remove nut, washers and bolt securing flap actuator jack screw to its mounting bracket. Do not drop bushing in jack screw mounting end.

FLAPS (cont.)

(5) Remove flap actuator jack screw and motor assembly through center floor opening

2. Installation of Wing Flap Controls (Refer to Figure 27-26)

a. To install flap actuator jack screw and motor assembly:

(1) Position flap actuator jack screw and motor assembly through center floor opening. Do not drop bushing in jack screw mounting end.
(2) Install nut, washers and bolt securing flap actuator jack screw to its mounting bracket.
(3) Install nut, washers and bolt securing flap actuator jack screw to torque tube bellcrank.
(4) Connect electrical leads to flap actuator motor.

b. To install flap control cable:

(1) Position cable assembly in tunnel.
(2) Connect cable to flap selector lever and flap selector lever support bracket mounted on aft side of instrument panel.
(3) Attach cable ends to pulley assembly on torque tube by installing cotter pins.
(4) Install clamps securing cable housings to support bracket.
(5) Install aft section tunnel cover and secure with screws.
(6) Install tunnel carpet and heat deflectors.
(7) Install center seats.

c. To install flap torque tube assembly:

(1) Check that one end bearing block fitting is installed between its attachment brackets.
(2) Slide the other end bearing block over its respective end of torque tube.
(3) Position torque tube by placing end with bearing block attached between appropriate mounting bracket Slide other end into previously attached end bearing block. Secure with bolts, washers and nuts.
(4) Between each wing and fuselage, attach cranks to torque tube.
(5) Install nuts, washers and bolts securing right and left cranks, and stop fittings on torque tube.
(6) Install tube support bearing blocks. Secure by installing block attachment bolts.
(7) Connect jack screw actuator to torque tube bellcrank and secure with nut, washers and bolt.
(8) Connect cable ends to torque tube pulley assembly and secure with cotter pins.
(9) Connect electrical connections to limit switches mounted to torque tube switch plate.
(10) Connect left and right flap control tubes (rods) either:

(a) At flaps by installing nuts, washers and bolts at torque tube cranks (arms) or by;
(b) Installing bolts and washers to inner side of each crank. Install bolt through a hole in the fuselage side skin located over torque tube.

(11) Install access plate located between underside of aft section of each wing and fuselage by installing attaching screws.
(12) Install floor panel located aft of main spar and secure with screws
(13) Install center seats and seat belt attachments.
(14) Retract flaps.

FLAPS (cont.)

3. Rigging and Adjustment of Wing Flaps:

— 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 SELECTOR LEVER IS UP; AND, THAT THE FLAPS MOVE DOWN WHEN THE SELECTOR LEVER IS DOWN.

a. To Rig Control Cable:

(1) Loosen lever cable clamp nut so that cable can move freely through cable clamp. Secure lever in the full down position. (Refer to Figure 27-27).

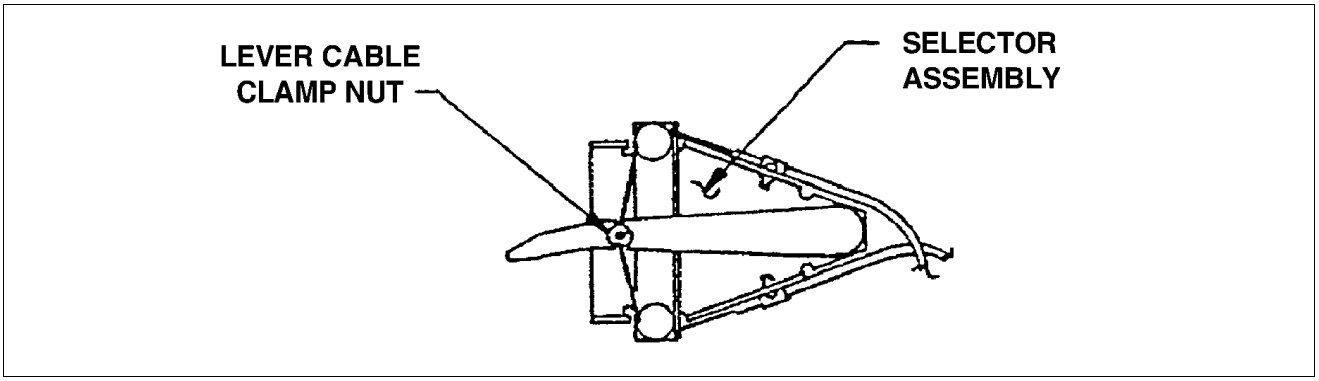

Figure 27-27. Flap Selector and Cable Assembly

(2) Position the swash plate assembly on torque tube and secure in place. (Refer to Figure 27-28.)
(3) Loosen cable housing clamps at pulley support channel. Adjust cable tension so that a 5 ± 0.5 pound pull midway between cable housing clamps and swash plate assembly will deflect the cable 0.38 inch from relaxed position. Tighten cable housing clamp. (Refer to Figure 27-28.)
(4) Tighten lever cable lamp nut so that cable is compressed to $^{1}/_{2}$ its full diameter. (Refer to Figure 27-27.)

b. To Adjust Cam:

(1) Pull the electric flap circuit breaker.
(2) Disconnect actuator motor power leads and connect a reversible 24 volt DC (except 12 volt in HP S/N's 3246001 thru 3246017 only) power source.
(3) Run actuator out so that there is 0.10 inch clearance between torque tube and the actuator push rod. (Refer to Figure 27-29)
(4) Connect aircraft wires to actuato motor and secure.
(5) Pull electric flap circuit breaker. Apply power to aircraft buss.

— Note —

Be sure that switch rollers are in cam "null point," as shown in Figure 27-28 inset, and not 180 degrees off.

FLAPS (cont.)

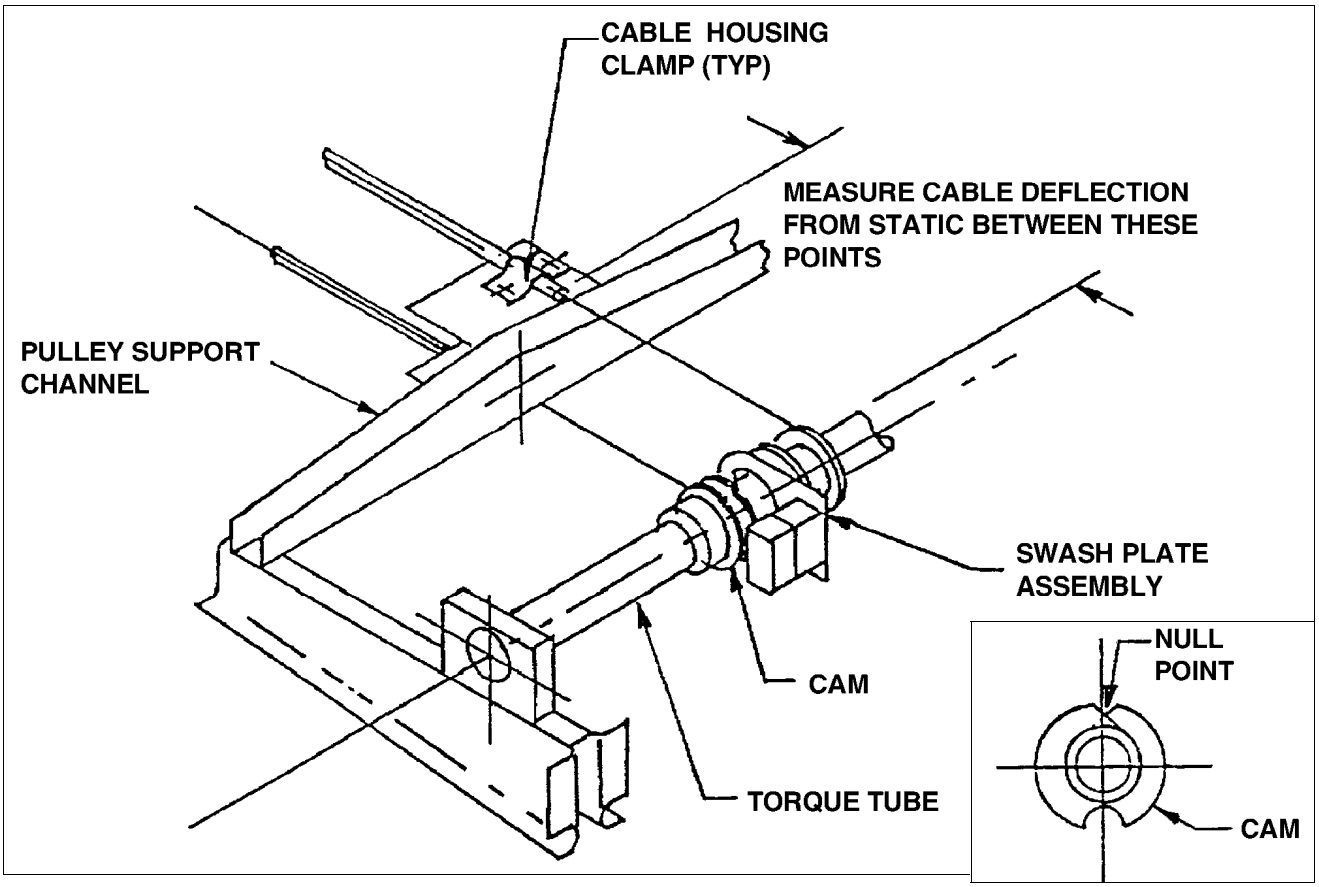

Figure 27-28. Electrically Operated Flap Torque Tube Assembly

(6) Loosen set screw in cam and rotate until flap in-transit light is out (Refer to Figure 27-28). Tighten the cam set screws.
(7) Push in electric flap circuit breaker and verify that flap motor does not run.
(8) Move selector lever to full DOWN position. Verify that actuator retracts and stops about 0.4 inch short of bottoming out.
(9) Move flap selector lever to the full UP position. Verify that clearance between actuator push rod and torque tube is .07 inch minimum and 0.19 inch maximum. (Refer to Figure 27-29).
(10) Adjust left and right stop screws so that contact is just made with stop. Tighten jam nuts. (Refer to Figure 27-30).

c. To Set Flap Angle

(1) Place flap selector in UP position.

— Note —

While making adjustment, maintain a slight up pressure on underside of flap sufficient to take slack out of linkage.

(2) Adjust each flap push rod so that chord line of flap forms a 0° ± 1° angle with wing chord at outboard end of flap.

FLAPS (cont.)

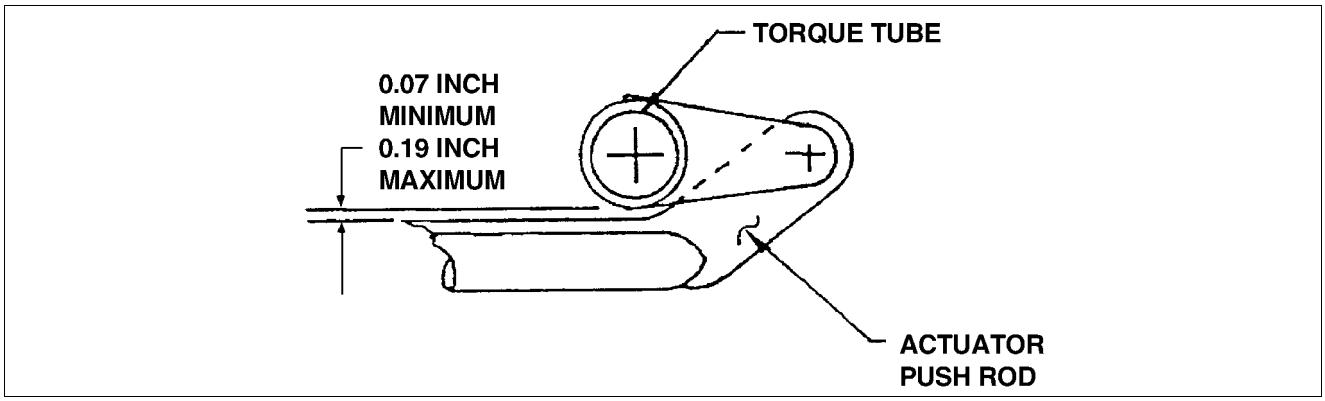

Figure 27-29. Electrically Operated Flap Cam Adjustment

d. Flap Travel Check.

While checking flap travel, maintaining a light up pressure on underside of flap. Travel shall be:

(a) In the full UP position: 0° ± 1°.
(b) At FIRST stop:10° ± 2°.
(c) At the SECOND stop: 25° ± 2°.
(d) At full DOWN position: 40° ± 2°.

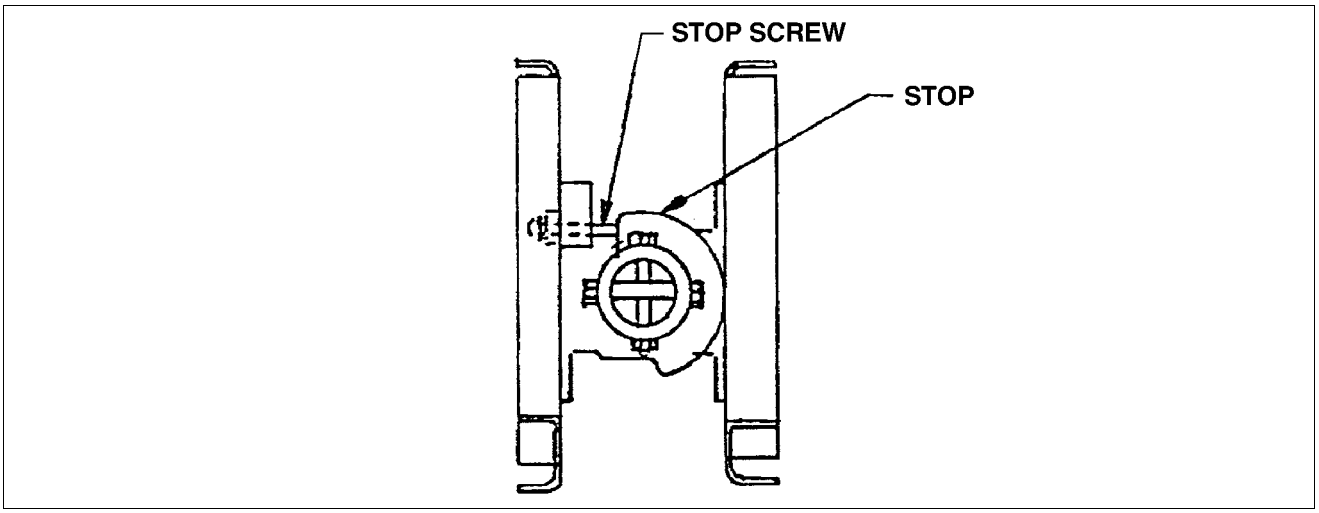

Figure 27-30. Stop Screws Adjustment

CHAPTER

28

FUEL

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CHAPTER 28 - FUEL

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CHAPTER 28 - FUEL

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GENERAL

A. Description.

The fuel system consists of two interconnected tanks in each wing, having a combined capacity of 53.5 U.S. gallons per wing, for a total capacity of 107.0 U.S. gallons. The inboard tank is an integral part of the wing surface. Fuel flow is indicated on the gauge located in the instrument panel. A fuel quantity dual gauge is also located in the instrument panel, and indicates the amount of fuel remaining in each wing system as transmitted by the electric fuel quantity sending units located in the wing tanks. An exterior sight gauge is installed in the inboard tank of each wing so fuel quantities can be checked on the ground during the preflight of the airplane.

Fuel is drawn through a finger screen located in the inboard fuel tank and routed to a three position fuel selector valve and filter unit which is located aft of the main spar. The valve has OFF, LEFT and RIGHT positions which are remotely selected by means of a torque tube operated by a handle located in the pedestal. The handle has a spring loaded detent to prevent accidental selection to the OFF position. From the selector valve the fuel goes to the electric fuel pump which is also mounted aft of the main spar and then goes forward to the engine driven fuel pump which forces the fuel through the injector unit into the engine.

Refer to Figure 28-1 for layout and relationship of the fuel system and components.

B. Troubleshooting

Electrical and mechanical troubles of the system are found in Chart 2801. When troubleshooting, check from the power supply to the items affected. If no problem is found by this method, the trouble probably exists inside individual pieces of equipment, which may then be removed from the airplane and replaced with an identical unit or units, tested and known to be good.

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GENERAL (cont.)

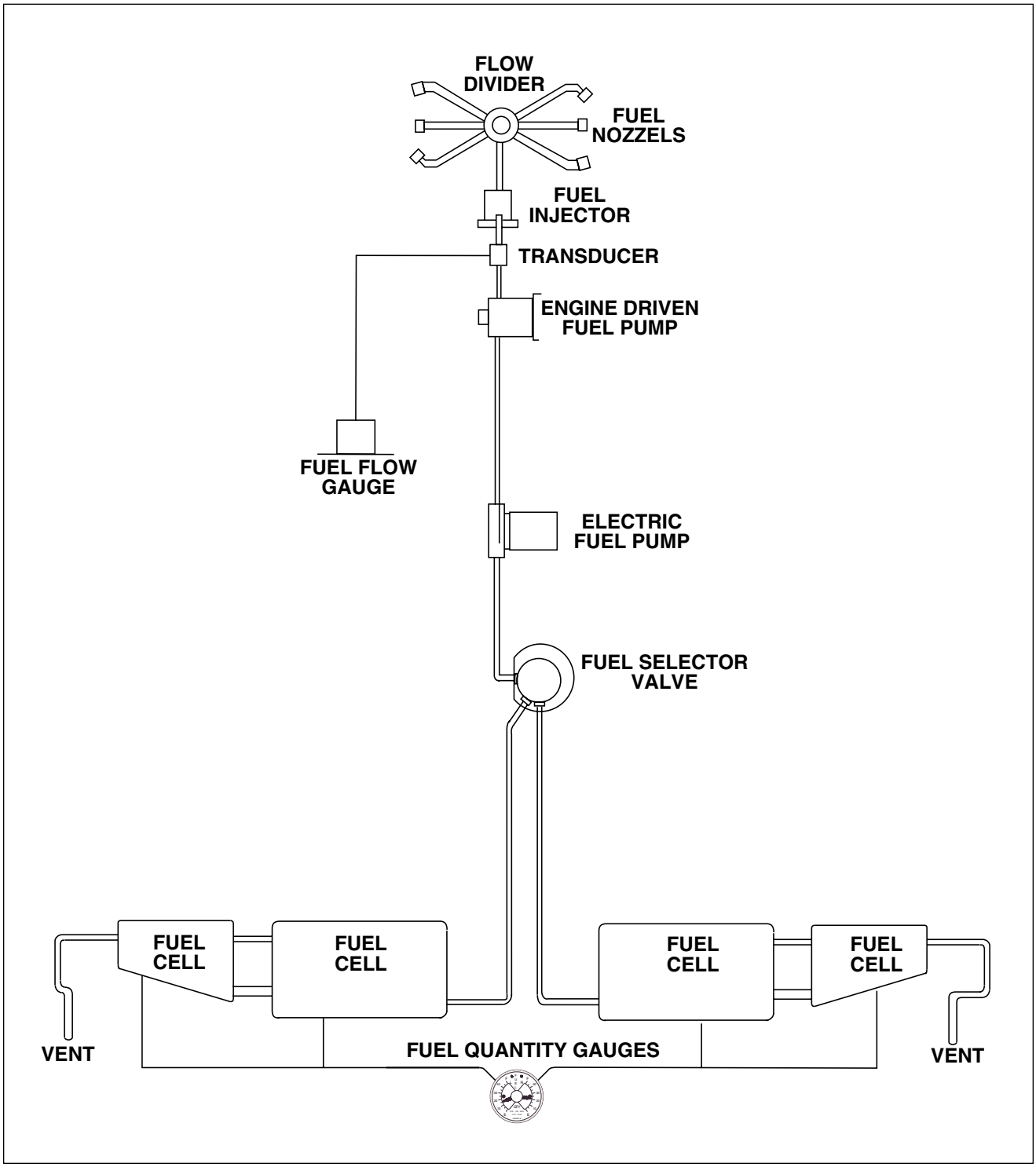

Figure 28-1. Fuel System (Sheet 1 of 2)
(HP S/N's 3246088 & up; TC S/N's 3257001 & up)

GENERAL (cont.)

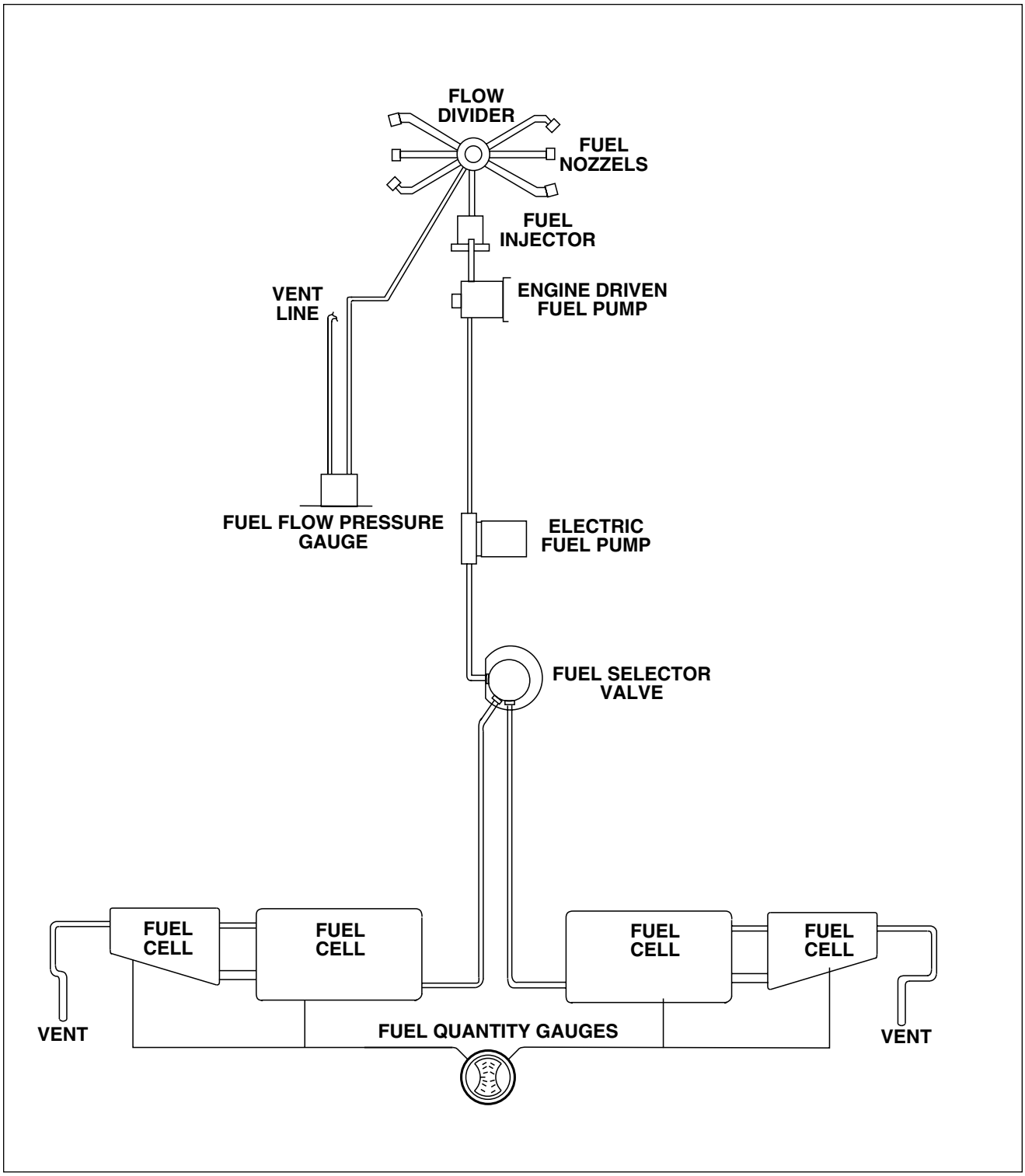

Figure 28-1. Fuel System (Sheet 2 of 2)
(HP S/N's 3246001 thru 3246087)

GENERAL (cont.)

CHART 2801. 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 mechaism.
	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.
Lower pressure or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Air in line to pressure gauge.	Bleed line.

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STORAGE

A. Aluminum (Inboard) Fuel Tanks Inspection and Repair

— WARNING —

IF DRAIN VALVES ARE REMOVED TO DRAIN TANKS, APPLY PARKER HANNIFIN THREAD LUBE, PIPER CODE NO. 913-224, TO MALE PIPE THREADS BEFORE INSTALLING. DO NOT ALLOW LUBRICANT TO ENTER FUEL SYSTEM.

— WARNING —

SLOSHING OF FUEL TANKS IS PROHIBITED.

Completely drain fuel tanks (Refer to Draining Fuel Systems, Chapter 12). Inspect each tank for signs of leaks as indicated by telltale stains. If a fuel leak is detected, remove fuel tank and repair as follows:

Seal leaks with Products Research Corporation PR 1422A series or PR1433G series sealant. For example: PR1422A1

1. Inboard Fuel Tank Removal
   a. Completely drain fuel from tank (Refer to Draining Fuel Systems, Chapter 12).
   b. Remove cover from access hole located on underside of wing between wing stations 88.75 and 115.95.
   c. Loosen clamps at hose connections on fuel line and fuel vent line. Slide hose connections away from fuel tank.
   d. Disconnect fuel line on inboard side of tank.
   e. Remove screws from around perimeter of the tank. Carefully pull tank away from wing far enough to gain access to/and remove sender wire.
   f. Remove tank.
2. Inboard Fuel Tank Installation
   a. Position fuel tank in wing recess. Connect fuel sender wires. Slide tank completely into position. Secure with screws around its perimeter.
   b. Through access hole located on underside of wing:
      (1) Slide hose on interconnecting fuel line.
      (2) Slide fuel vent line into position.
      (3) Tighten clamps on both lines.
   c. Connect fuel line on inboard side of tank.
   d. Fill fuel tanks and check for:
      (1) Leaks
      (2) Unrestricted fuel flow
      (3) Accurate sender indications on fuel quantity gauge.
      (4) Ground wire is securely attached to interconnecting fuel line, fuel vent line, and wing rib at wing station 88.75.

STORAGE (cont.)

3. Fuel Tank / Wing Spar Corrosion Inspection.
(Refer to Figure 28-2 - sub-paragraphs a and b keyed to figure)

   a. Each seven calendar years time-in-service, remove the fuel tanks and conduct inspections as specified below. Each inspection is for corrosion (intergranular, exfoliation, etc.), but while exposed all areas and parts should be checked for other anomalies such as damage, cracking, or wear. Any part or area determined to be defective must be repaired or replaced using standard FAA approved parts and methods.

      A1. Inspect the fuel tank attach hardware and gang channels (nut plate strips).

      A2. Inspect the exterior of the fuel tanks for leaks. Inspect the interior for corrosion or sloshing compound. If either condition exists, clean, repair, or replace the fuel tank as required.

      A3. Remove fuel quantity senders. Inspect fot condition, operation, and security and freedom of movement of the float arm. Inspect condition of wires and terminals. Replace components as required. Replace gaskets.

      A4. Inspect hard fuel vent lines for interior and exterior corrosion, wear, or deposits. Flush and clean with mineral spirits under pressure. If excessive debris, deposits, or corrosion observed, replace the line.

      A5. Inspect flexible fuel hoses and couplings. Replace as required. Replacement is recommended regardless of servicability.

      A6. Inspect the spar, spar angles (cap), and ribs behind and adjacent to the fuel tank. If corrosion is detected, conduct a thorough inspection of the entire wing.

      A7. Remove the lacing at the wing root and inspect the spar and forward wing attach fittings.

   b. Treat the following areas with Dinotrol AV 8 before reassembly.

      B1. Wing spar at root and forward wing attach fittings.

      B2. Entire wing spar, spar angles (cap), and ribs behind and adjacent to the fuel tank..

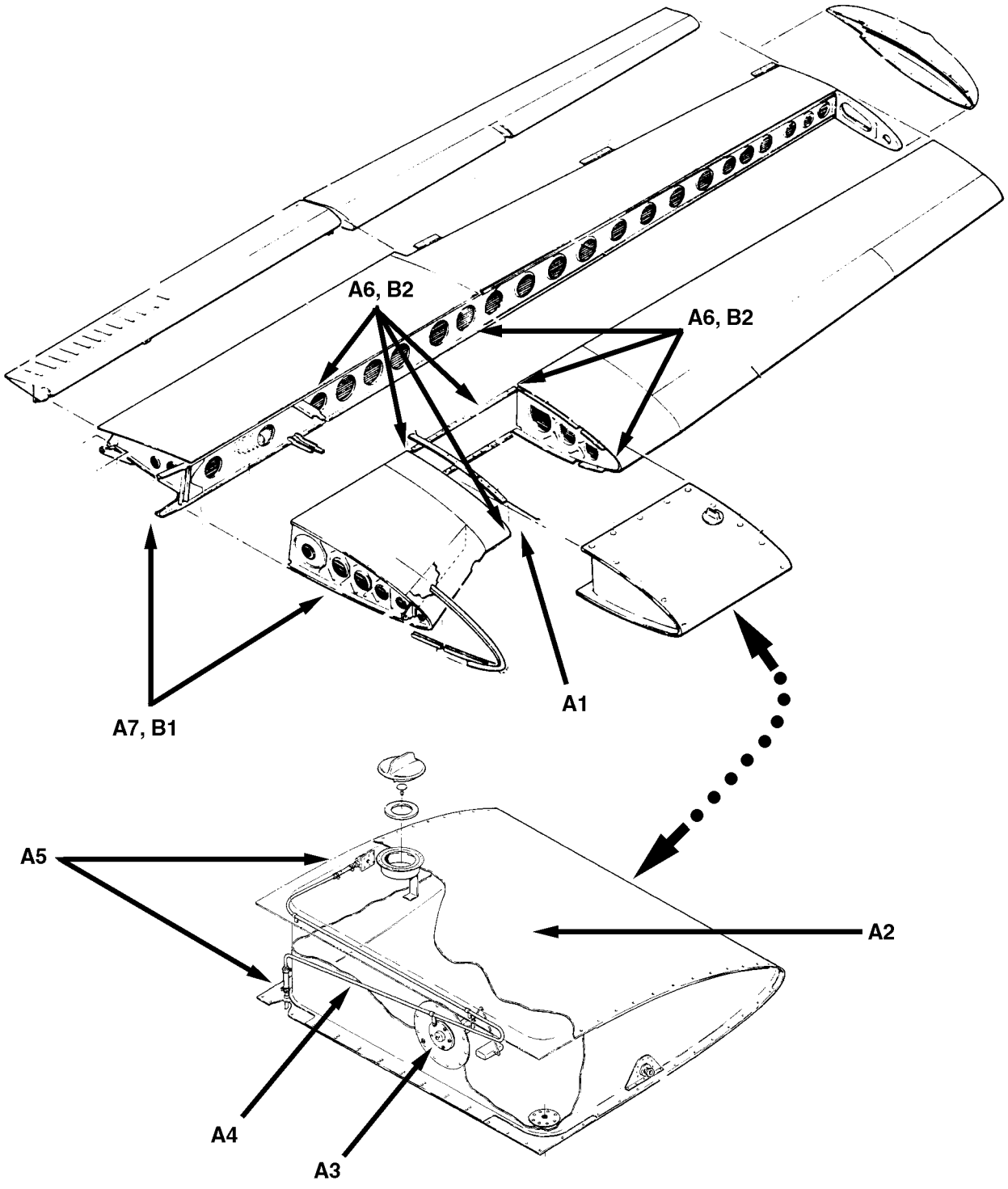


Figure 28-2. Fuel Tank / Wing Spar Corrosion Inspection (Typical)

STORAGE (cont.)

B. Bladder-type (Outboard) Fuel Cell Inspection and Repair

1. Removal (Refer to Figure 28-2)

   a. Drain fuel cell (Refer to Draining Fuel Systems, Chapter 12).
   b. Remove the access covers located on bottom of wing at wing stations 111.8, 165.5, and 129.3.
   c. Remove the twelve screws securing fuel cap adapter assembly to upper wing surface (wing station 140.09). Remove adapter assembly.
   d. Remove four screws securing fuel cell and nut ring and gasket to the top of wing. Remove nut ring and gasket.
   e. Utilizing access opening at wing station 165.5, loosen the two clamps which secure fuel vent line and fuel vent valve assembly in fuel cell nipple.
   f. Carefully separate \fuel vent line from fuel cell nipple.
   g. Reach in fuel cell and remove fuel vent valve assembly from fuel cell nipple.
   h. Utilizing access opening at wing station 111.8, loosen clamps securing fuel cell to upper and lower fuel interconnecting lines. Separate interconnecting lines from fuel cell.
   i. Working through access opening at wing station 129.3 (lower wing surface), disconnect electrical wire from fuel sender unit terminal. Remove the five bolts securing fuel sender unit and remove sender unit from fuel cell.
   j. Inserting arm between fuel cell and top of wing, separate velcro strips which hold fuel cell in place.
   k. Fold fuel cell into a manageable form and withdraw it through the access opening at top of wing.

2. Molded Nipple Fittings Installation

   The lightweight molded nipple fitting was developed for ease of installation. To receive the best service from this type fitting, it is necessary to exercise certain precautions during installation.

   a. Unless otherwise specified, insert tubing into fitting until end is flush with inside edge of nipple.
   b. Hose clamp must clear end of fitting by 1/4 inch where possible.
   c. Locate hose clamp on fabric reinforced area of nipple.
   d. Do not use sealing paste or gasket compound.
   e. Use lightweight motor oil to facilitate insertion of tubing into nipple.

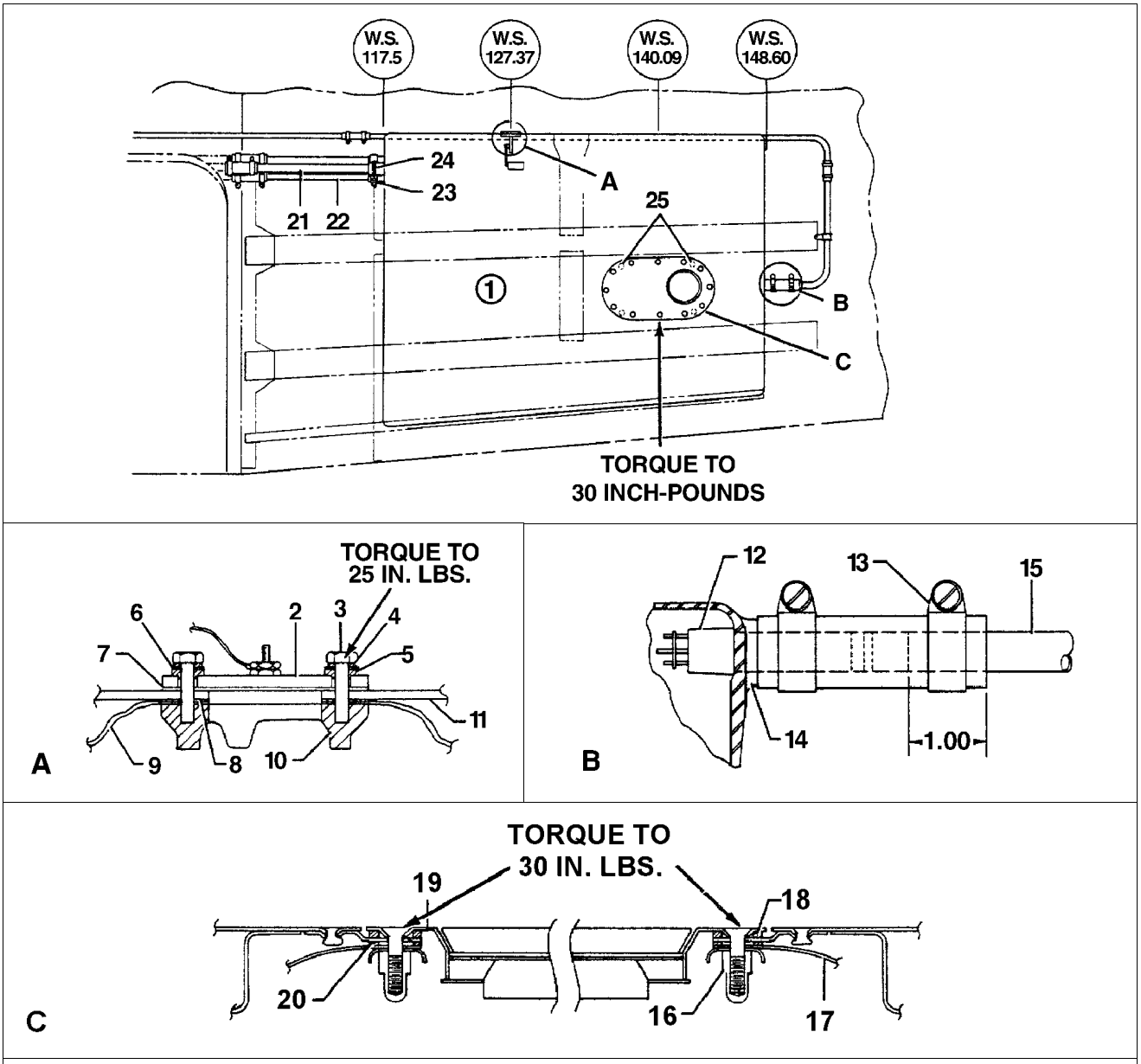
3. Fuel Cell Compartment

   a. Clean compartment thoroughly of all filings, trimmings, loose washers, nuts, bolts and etc.
   b. Round off all sharp edges. Where this is not possible tape over all sharp edges or rough rivets.
   c. Inspect compartment for cleanliness and condition prior to installation of fuel cell.

4. Cleaning of Fuel Cells

   a. New fuel cells kept in their shipping containers should not require cleaning prior to installation. If a cell should become dirty, clean with soap and warm water.
   b. Prior to removal, a used cell should be drained, purged with fresh air and swabbed out to remove all traces of fuel. Upon removal the cell should be cleaned thoroughly with soap and warm water.

STORAGE (cont.)



1. FUEL CELL
2. FUEL SENDER UNIT
3. AN3-6A BOLT. TORQUE TO 25 IN.-LBS.
4. AN935-10 LOCK WASHER
5. INSULATING WASHER
6. AN960-10 7.WASHER
7. NEOPRENE GASKET
8. CORK GASKET
9. FUEL CELL
10. NUT RING
11. SPAR
12. FUEL VENT VALVE ASSEMBLY
13. #10HL CLAMP. TORQUE 12 -16 IN.-LBS.
14. NIPPLE
15. FUEL VENT LINE
16 NUT RING
17. FUEL CELL
18. GASKET
19. FUEL CAP ADAPTER ASSEMBLY
20. GASKET
21. FUEL VENT INTERCONNECT LINE
22. FUEL TANK INTERCONNECT LINE
23. #32HL CLAMP. TORQUE 30 - 35 IN.- LBS.
24. #12HL CLAMP. TORQUE 15 - 20 IN.- LBS.
25. SCREWS (12)

Figure 28-2a. Fuel Cell Components

STORAGE (cont.)

5. Inspection of Fuel Cells.

   a. Inspect fuel cells during regularly scheduled airplane maintenance inspections.
   b. Inspect interior of each cell for cracking, porosity or other signs of deterioration.
   c. Inspect nipple as follows:

      (1) Attempt to scrape the rubber off the nipple fitting with a fingernail. If rubber has not degraded, the fingernail will glide across rubber without damage to the rubber. If an unsatisfactory condition exists, the fingernail will dig into the rubber.
      (2) Deteriorated rubber has consistency of either art gum or chewing gum. Usually it will have changed from a light tan color to a dark reddish-brown, bluish or greenish color, depending upon the color of fuel used.

   d. Replace any cell found seeping or with soft nipples.

6. Handling and Storage of Fuel Cells

   a. Do not remove fuel cells from shipping container until time of installation.
   b. After removing fuel cell from its shipping container, inspect cell for damage due to crating or removal from crate.
   c. Do not use fuel cell nipple fittings as handholds. Do not drag fuel cells.
   d. Stack fuel cells only in original shipping containers.
   e. Prior to storing used fuel cells, clean with soap and warm water.
   f. Fold fuel cells smoothly and loosely with a minimum number of folds. Protective wadding should be placed between folds.

— CAUTION —

SHOULD THE TEMPERATURE BE BELOW 70° F MOVE THE CELLS TO A WARMER STORAGE LOCATION.

   g. Store fuel cells in a dry area protected from sunlight. Recommended storage temperature is 70° F.

7. Repair of Fuel Cells (Refer to Chart 2802.)

   The following procedure is recommended for field repair of fuel cells constructed of Goodyear Vithane material. These repairs may be accomplished by two methods. One method is by heat cure; the other is air cure. The end result of either method is a neat, permanent repair. The heat repair allows the cell to be cured and ready for reinstallation in two hours; while the air cure method requires that the cell not be moved for 72 hours during the air cure period.

— Note —

Air cure repairs are to be made at a room temperature of approximately 75°F. For each 10°F drop in temperature, add 20 hours cure time. For instance, if the room temperature reads 65°F, air cure for 92 hours instead of 72 hours.

STORAGE (cont.)

CHART 2802. FUEL CELL REPAIR EQUIPMENT LISTS

Repair Kit, Goodyear Part No. 2F1-3-37813		
GROUP I MATERIALS		
80C27 Repair Cement	8	Pint cans (320 grams in each)
80C28 Cross-Linker	8	1 four oz bottle (81 cc in each)
Methylethylketone (MEK)	2	1 pint can
FT-192 Repair Fabric	2	Sheet 12 x 12
AP368 Manual	1	
GROUP II MATERIALS		
The following equipment is necessary to perform the repair.		
Group II equipment will be furnished at additional cost, if ordered by customer.		
Foam Rubber Cloth Sheet, 1/4 x 12 x 12	2	
Paint Brush, 1 inch wide	2	
Aluminum Plates, 1/4 x 6 x 6	4	
Measuring Cup (250 ml)	1	
Cellophane (Sheet 12 x 24)	2	
— NOTES —		
Accessories - order per individual cell requirements.		
Phenol plates, phenol plate assemblies and phenol test equipment can be ordered as required from cell manufacturer.		
Alodine 1200 to be ordered as required from cell manufacturer.		
Cure Iron (Set 240°F) Optional.		

a. Handling of Repair Materials

(1) Protect all materials from dirt contamination, sunlight, and excessive heat or cold while in storage. Keep containers tightly capped and stored at a temperature of 70°F.

— Note —

80C27 repair cement requires thorough mixing to obtain full adhesive values.

(2) The 80C27 cement referred to in this text is prepared immediately prior to use by mixing repair cement 80C27 (pint can with 320 gms) with cross-linker 80C28 (4 oz. bottle with 81cc).

STORAGE (cont.)

— CAUTION —

ALL CONTAINERS FOR CEMENTS AND SOLVENTS SHOULD BE PROPERLY IDENTIFIED.

(3) Repair cement has a pot life of 20 minutes after mixing. The unmixed 80C27 and 80C28 have a shelf life of six months from the date of packaging.

b. Repair Procedures of Goodyear Vithane Fuel Cells

— Note —

The repair of Goodyear Vithane fuel cells is restricted to authorized personnel. Authorized personnel are those who have been certified and trained by Goodyear representatives, or those who have received their training from persons who have been certified and trained by Goodyear representatives.

c. Fuel Cell Repair Limitations

(1) FT-192 repair fabric is for repair of simple contours only. Patches referred to in this text are of this material.
(2) Inside patches are to lap defect edges a minimum of 1.0 inches in each direction.
(3) Outside patches are to lap defect edges 0.25 to 0.50 inches inside patches.
(4) Outside patches are to be applied and cured prior to applying an inside patch.
(5) Blisters between inner liner and fabric larger than 0.25 of an inch in diameter require an outside and an inside patch.
(6) Separations between layers or plies larger than 0.50 inch in diameter require an outside and inside patch. Holes and punctures require an outside and inside patch.
(7) Slits or tears up to 6.0 inches maximum length require an outside and inside patch.
(8) External abraded or scuffed areas without fabric damage require an outside patch only.
(9) A loose edge may be trimmed provided a 0.50 inch minimum lap or seam is maintained.

— CAUTION —

FOR EACH 10°F DROP IN TEMPERATURE FROM 75°F, ADD 20 HOURS CURE TIME. FOR EXAMPLE: AT 65°F, CURE FOR 92 HOURS.

(10) Air cure repair patches are to remain clamped and undisturbed for 72 hours at a room temperature of approximately 75°F.
(11) All heat cured patches are ready for use when cool.
(12) Fitting repairs are confined to loose flange edges, seal surface rework and coat stock.
(13) The maximum number of heat cure repairs in the same area is four.

— Note —

Damaged fuel cells, not covered by the above procedures, should be returned for repair to: Engineered Fabrics Corporation, 669 Goodyear Street, Rockmart, Georgia 30153.

STORAGE (cont.)

d. Heat Cure Repair Patch Method

(1) Prepare the exterior cell wall and exterior patch.

(a) Cut a repair patch from FT-192 material to size required to insure a proper lap over injury in all directions. (See Limitations, above.)

1) Hold shears at an angle to produce a beveled edge (feather) on patch. (Dull side or gum contact face of repair patch should be largest surface after beveling.)
2) Round corners of patch.

(b) Wash one square foot of cell wall surrounding injury with a clean cloth soaked with Methylethylketone solvent.
(c) Wash repair patch contact side with a clean cloth soaked with Methylethylketone solvent.
(d) Abrade cell wall surface about the injury and on the contact side of patch with fine emery cloth to remove the shine.
(e) Repeat Methylethylketone washings two more times, for a total of three washings for each surface.
(f) Tape a 8'' x 8'' piece of cellophane inside the cell over the injury.

(2) Position cell for patch application on repair table.
(3) Mix the 80C27 cement (320 gms) with the cross-linker 80C28 (81cc), and stir mixture thoroughly, for five minutes.

— Note —

Cement must be at a minimum of 70°F before mixing. Keep away from water and excessive heat.

(4) Brush one even coat of mixed repair cement on the cell wall around the injury and on the contact side of the repair patch. Allow to dry for fifteen minutes.

— CAUTION —

DO NOT USE THE FIRST CAN OF MIXED CEMENT FOR SECOND COAT.

(5) Repeat a second mixing of repair cement and brush a second coat.

— CAUTION —

MAKE SURE CELLOPHANE INSIDE CELL OVER INJURY REMAINS IN PLACE BECAUSE CEMENT WILL STICK CELL WALLS TOGETHER WITHOUT IT AS A SEPARATOR.

(6) After cement has dried approximately five minutes, center patch over injury.

(a) Lay patch by rolling it down on surface from ***center*** to ***edge*** without trapping air.
(b) Hold unrolled portion of repair patch off cemented surface until roller contact insures an air-free union.
(c) The patch may now be moved by hand on the wet surface to improve lap. ***Do not lift repair patch, slide it***.

STORAGE (cont.)

7. Repair of Fuel Cells (Refer to Chart 2802) (cont.)

d. Heat Cure Repair Patch Method (cont.)

(7) Using two aluminum plates larger than patch:

(a) Cover one smooth surface of each plate with fabric-backed air foam, fabric side out. Foam must cover edges of plate for protection.
(b) Tape air foam in place.

(8) Using a cellophane separator to prevent cement from sticking in the wrong place:

(a) Fold cell adjacent to patch and place one prepared plate over repair patch.
(b) Place second prepared plate outside of bladder opposite patch.

— CAUTION —

MAKE SURE THAT CELL FOLD IS NOT CLAMPED BETWEEN PLATES. THIS WOULD CAUSE A HARD PERMANENT CREASE. ALSO MAKE SURE THAT THE PATCH DOES NOT MOVE WHEN CLAMP IS TIGHTENED.

(9) Center repair iron 2F1-3-25721-1 on plate over repair patch. Secure assembly with a C-clamp. Tighten by hand. Check cement flow to determine pressure.
(10) Connect repair iron into 110-volt current and cure repair for two hours.
(11) After curing, unplug repair iron and allow it to cool to touch. Remove C-clamp. Wet cellophane to remove it from repair.

— CAUTION —

APPLYING BOTH AN OUTSIDE AND INSIDE REPAIR PATCH SIMULTANEOUSLY NOT RECOMMENDED.

(12) After outside patch has been cured, apply inside patch using same procedure as above, except for side of repair patch (see Limitations, paragraph 7.c.)

— CAUTION —

FOR EACH 10°F DROP IN TEMPERATURE FROM 75°F, ADD 20 HOURS CURE TIME. FOR EXAMPLE: AT 65°F, CURE FOR 92 HOURS.

e. Air Cure Repair Patch Method

Follow procedure for heat cure method, except omit repair iron. Cure each patch per air limitations (minimum 72 hours), undisturbed at 75°F.

f. Accessory Replacement

(1) Obtain a cured repair accessory from cell manufacturer.
(2) Mark location of old accessory. Preserve markings for guide lines to locate new part.
(3) Remove old accessory by gradually loosening an edge with a blunt probe-like instrument.
(4) When a loose edge is created, grasp the accessory by loose edge with pliers and gently peel it off cell wall. Be careful not to pull cell lap open while peeling accessory off. Pull from blind side of a cell lap toward the exposed edge.

STORAGE (cont.)

— Note —

Removal of the old accessory will probably leave an uneven cavity and surface.

(5) Buff cell surface under accessory with emery cloth to smooth roughness and prepare for cement.
(6) Prepare replacement accessory by buffing and washing contact surface. Also wash the cell surface (see paragraphs 7, d, (1), (b) and (c).)
(7) Apply mixed 80C27 repair cement to both surfaces being sure to level cavity left by removal of old accessory.
(8) Roll new accessory into place as with a repair patch. Place suitable padded plates in position to insure adequate pressure when clamped. Use a cellophane separator to prevent the cement from sticking in the wrong place [see paragraphs 7, d, (7) and (8)].
(9) Cure by either heat cure or air cure method.

g. Fuel Cell Defect Repairs

(1) Blisters:

(a) Remove loose material by trimming.
(b) Apply an outside and inside repair patch.

(2) Holes, Punctures, Cuts, Tears and Deep Abraded Areas:

(a) Trim away any ragged material
(b) Apply an outside and inside repair patch.

(3) Loose Seams:

(a) Buff loose edges and contact surfaces with emery cloth.
(b) Wash three times with Methylethylketone.
(c) Apply 80C27 mixed cement in two coats as with a repair patch.
(d) Clamp and cure. Cure by either heat cure or air cure method.
(e) Loose seams may be trimmed if a minimum lap remains.

(4) Loose Fitting Flange - Inside:

(a) Buff the edge of the flange and the contact surface under the flange.
(b) Apply 80C27 mixed repair cement, cellophane, padded plates and clamp.
(c) Follow procedure as outlined for repair patch.

(5) Looseness Against Metal:

(a) Prepare metal as per metal fitting - sealing surfaces.
(b) Apply 80C27 mixed cement and cure.

8. Testing Fuel Cells. Use either of the following procedures detect leaks in bladder cells:

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 suspected of leakage. Bubbles will appear at any point where leakage occurs.
(4) After testing, remove all plates and wipe soap residue from the exterior of the cell.

STORAGE (cont.)

b. Chemical Test:

— Note —

The chemical test is the more sensitive and preferred test.

(1) Attach a test plate to all fitting openings except one.
(2) Make up a Phenolphthalein solution as follows:

(a) Add 40 grams Phenolphthalein crystals in 1/2 gallon of Ethyl Alcohol and mix, then;
(b) Add 1/2 gallon of water.

(3) Pour ammonia on an absorbent cloth in the ratio of 3 ml per cubic foot of cell capacity. Place ammonia saturated cloth inside the cell.
(4) Install remaining test plate to opening used to insert ammonia saturated cloth.
(5) Inflate cell with air to a pressure of 1/4 psi ***maximum***. Cap and maintain pressure for fifteen minutes.
(6) Soak a large white cloth in phenolphthalein solution. Wring it out thoroughly. Spread cloth smoothly on outer surface of cell. Press cloth down to insure detection of minute leaks.
(7) Check cloth for red spots, which indicate a leak. Mark any leaks found and move cloth to a new location. Repeat procedure until entire exterior surface of cell has been covered. Red spots appearing on cloth may be removed by resoaking cloth in phenolphthalein solution.
(8) Phenolphthalein solution and test cloth are satisfactory only as long as they remain clean. Any phenolphthalein solution that is not in immediate use should be stored in a closed rust proof container to prevent evaporation and deterioration.
(9) After test, remove all plates and test equipment. Allow cell to air out.

c. 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.

9. Bladder-type (Outboard) Fuel Cell Installation (Refer to Figure 28-2.)

a. Inspect cell compartment as explained in the paragraph 3, “Fuel Cell Compartment”.
b. Do not use sharp tools such as screwdrivers, files, etc. for installation purposes.
c. Roll cell into a shape and size which can be inserted through access opening of the cell compartment.
d. Place cell within cell compartment. Unroll and establish correct relationship of cell to compartment.
e. Secure cell by pressing velcro strips of fuel cell against velcro strips of cell compartment.
f. Using appropriate access opening in bottom of wing, install fuel sender unit as shown in Figure 28-2, View “A”.
g. Reaching into fuel cell, place fuel vent valve assembly in place in fuel cell vent nipple. Secure with clamp installed through appropriate access opening in bottom of wing. Torque clamp 12-16 inch - pounds.
h. Insert fuel vent line one inch into fuel cell vent nipple and secure with clamp. Torque clamp 12-16 inch - pounds.

STORAGE (cont.)

i. Insert fuel interconnect lines into appropriate fuel cell openings and secure with clamps. Torque 3/4 inch fuel vent interconnect clamp (12HL) 15-20 inch - pounds. Torque 2 inch fuel tank interconnect clamp (32HL) 30-35 inch - pounds.
j. Align holes of cork gasket, fuel cell, and nut plate. Secure with four screws. Torque to 12-15 inch - pounds.
k. Using a clean soft lint-free cloth, wipe inside of cell clean of all dirt and foreign material. Inspect for cleanliness.
l. Install a new gasket and fuel cap adapter assembly. Coat each of the twelve screws' threads with PR 1422 CL2 sealant. Install screws and torque from 20 to 25 inch-pounds. After torquing, clean screws with MEK solvent.
m. Fill fuel tanks and check for leaks, unrestricted fuel flow, and proper fuel level indication.
n. Install access covers.

C. Fuel System Inspection

Fill tanks with fuel. Inspect tanks and fuel line connections for leaks.

1. If fuel tanks leak, follow instructions given in Aluminum Fuel Tanks Inspection and Repair.
2. If fuel line connections leak tighten clamps.
3. If fuel line connections continue to leak:

a. Drain tanks.
b. Replace hose connections.

D. Locking Fuel Cap (Refer to Figure 28-3)

One key operates the locking fuel cap, the ignition and door locks.

1. Disassembly of Locking Fuel Cap

a. Remove the two screws from top of fuel cap.
b. Remove screw and lock washer that secures pawl to bottom of key lock. Remove pawl.
c. Remove nut that secures key lock to cover.
d. Slide lock, gaskets, and spring over back of key lock.
e. Remove key lock by pushing key lock through cover. Ensure that the O–ring is not lost.

2. Assembly of Locking Fuel Cap

a. Insert key lock through cover. Make sure that O–ring gasket is installed under head of key lock.
b. Slide spring, gaskets, and lock over back of key lock.
c. Install nut that secures key lock to cover.
d. Apply loctite #211 or #680 to screw threads primed with locquic "N" or "T". Attach pawl to back of lock assembly with screw and lock washer.
e. Apply a thin coating of PR-1422 sealant to shank and thread of the screws removed from top of cap. Install screws and lock washers on top of fuel cap.

STORAGE (cont.)

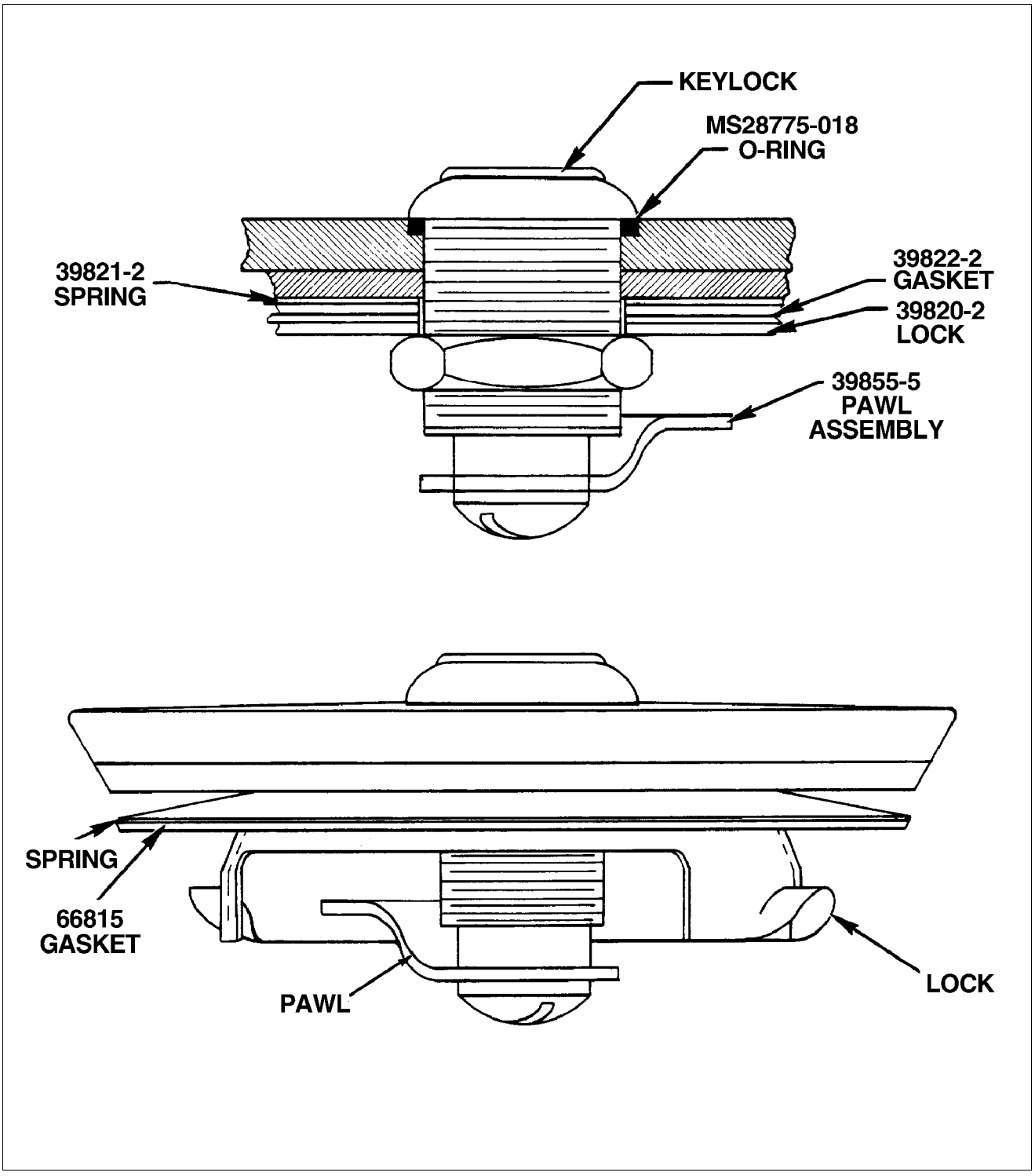


Figure 28-3. Locking Fuel Cap Assembly

DISTRIBUTION

A. Fuel Selector Valve and Filter Assembly

When the fuel selector handle is not in a positive selector detent position, more than one fuel port will be open at the same time. Ensure that the fuel selector is positioned in a detent, which can be easily felt when moving the handle through its various positions.

— CAUTION —

NO FIELD REPAIR OF FUEL SELECTOR VALVES IS AUTHORIZED.

1. Fuel Selector Valve and Filter Removal.

   a. Drain fuel from tanks. (Refer to Draining Fuel System, Chapter 12.)
   b. Remove center seats, seat belt attachments and floor panel just aft of main spar by removing floor attachment screws. Lift panel and remove.
   c. Remove plate from bottom of fuselage that covers fuel selector.
   d. Disconnect fuel lines and selector linkage from valve assembly.
   e. Remove the four mounting screws that holds fuel selector in place. Remove selector assembly.

2. Cleaning Filter Assembly (Refer to Figure 28-4)

   a. Remove access panel to filter bowl on bottom of fuselage.
   b. Remove fuel strainer bowl.
   c. Remove filter disc assembly from center stem by compressing filter retainer spring and removing filter retainer washer.
   d. Inspect bowl gasket. Replace if necessary.
   e. Filter discs may be cleaned as follows:

      (1) Plug open ends of filter disc center with stoppers to prevent dirt from entering.

— CAUTION —

DO NOT USE ACETONE, METHYLETHYLKETONE, ETC., TO CLEAN NYLON FILTER DISCS.

      (2) Wash metallic filter disc in acetone, gasoline, carbon tetrachloride, trichlorethylene (permachor) or Bendix cleaner. Wash nylon filter disc with soap and water.
      (3) Remove stubborn deposits from filter disc with a soft bristle brush.
      (4) Rinse all traces of soap solution. Drain or blow dry. Remove stoppers.

   f. Replace the filter disc if damage is evident.
   g. Reinstall filter disc assembly and strainer bowl.

3. Fuel Selector Valve and Filter Installation

— Note —

When installing fuel selector valve, drain and flush complete fuel system and tanks to ensure no contamination is present. (Refer to Cleaning Fuel System.)

   a. Position the valve inside the airplane just aft of the main spar.
   b. Secure the valve with machine screws, washers and self-locking nuts.
   c. Connect the fuel lines.

DISTRIBUTION (Cont.)

d. Connect fuel selector valve linkage to insure that selector handle engages the left indent position when it is against the safety stop on the console cover.
e. Fill the fuel tanks and check all connections for leaks.
f. Install the rear seat and fuel drain placard cover.
g. Install the access plate to the bottom of the fuselage with attaching screws.

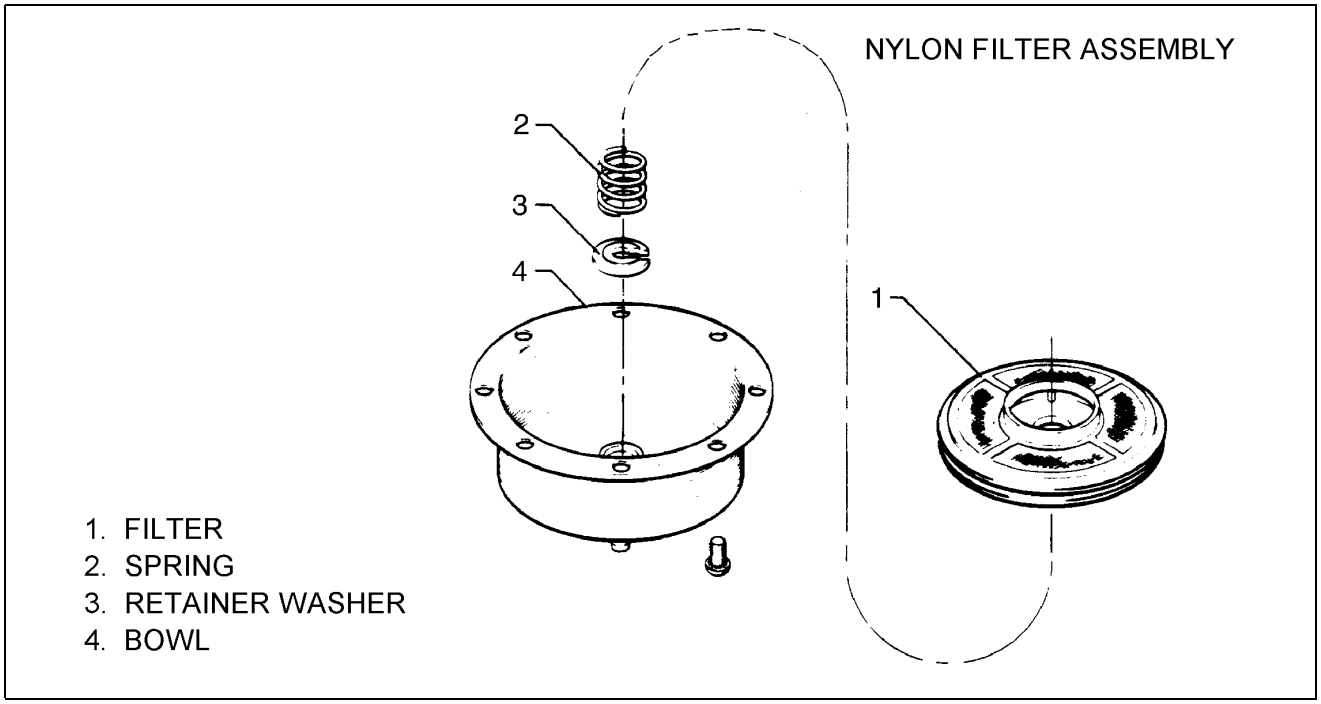


Figure 28-4. Fuel Filter Asssembly

B. Cleaning Fuel System

1. Remove all fuel from tanks. Drain fuel a chamois or other straining equipment to inspect for presence of foreign matter.
2. Flush each tank by opening tank drain and adding two or three gallons of clean fuel. While fuel is draining, raise and lower airplane wing to allow the fuel to rinse out any contamination remaining in tank through drain.
3. After fuel selector valve is installed and the aircraft refueled:

   a. Disconnect fuel inlet line to injector.
   b. Turn electric fuel pump ON to flush lines.
   c. While flushing, move fuel selector back and forth from one tank to another.

4. Make proper logbook entry.

DISTRIBUTION (Cont.)

C. Electric Fuel Pump

1. Removal

   a. Turn fuel selector to OFF position.
   b. Remove center seats, seat belt attachments. Remove floor panel located directly aft of main spar by removing screws that secure panel. Lift panel and remove it from the airplane.
   c. Disconnect electrical lead from pump.
   d. Disconnect pump inlet and outlet lines.
   e. Remove pump by removing pump attachment hardware.

2. Installation

   a. Position pump in airplane. Secure with attachment hardware.
   b. Connect pump inlet and outlet lines.
   c. Attach electrical leads to pump.
   d. Install floor panel in airplane and secure with screws. Install center seats and seat belt attachments.
   e. Set fuel selector to desired position.

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INDICATING

All airplanes addressed in this manual are equipped with traditional analog dual gauges to indicate fuel quantity, but HP S/N's 3246088 & up and TC S/N's 3257001 & up also have a sophisticated multi-function Digital Display Monitoring Panel (see Figure 28-8). The DDMP can display numerous fuel functions, such as: Flight Endurance, Fuel Remaining, Fuel Used, Nautical Miles Per Gallon, Estimated Fuel Required to Destination, and Estimated Fuel Remaining at Destination. Calibrating fuel quantity is the only function of the DDMP addressed in this chapter - the remaining functions are addressed in Section 77-40-00.

Inboard and outboard fuel tanks in each wing are interconnected and have a total capacity of 53.5 gallons per wing. The cumulative quantity of fuel in each set of tanks is read on a single fuel quantity gauge with dual (left and right) indications (Refer to Fgure 28-5). The gauge is mounted at the bottom right of the two-inch engine instrument twin stacks to the right of the pilot's flight instruments; or, in HP S/N's 3246001 thru 3246087 only, in the instrument panel to the left of the gear selector handle.

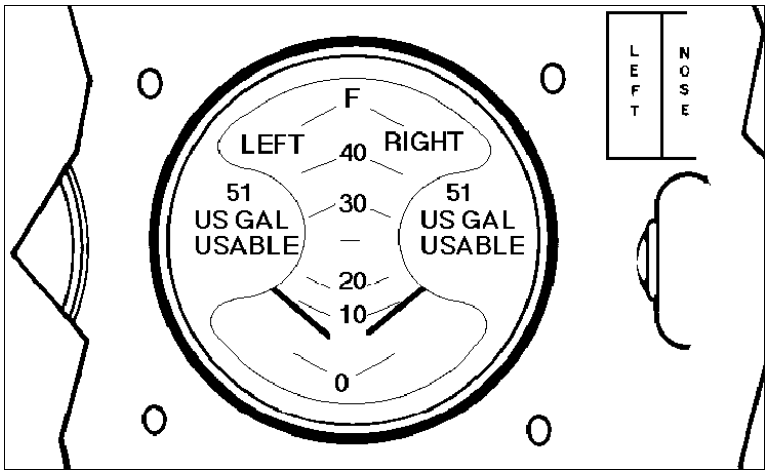

Figure 28-5. Fuel Dual Gauge
(HP S/N's 3246001 thru 3246087 shown)

1. FUEL QUANTITY SENDER AND GAUGE CHECK (HP S/N's 3246001 thru 3246087 only)

To check fuel quantity sender units and analog fuel quantity gauges while installed in airplane:

A. Level airplane laterally and longitudinally ± 1° (refer to Leveling, Chapter 8).

B. Place battery switch in OFF position.

C. Connect external power supply to airplane using APU connector. Adjust to provide 24 to 28 Vdc; or, for HP S/N's 3246001 thru 3246017 only, 12 to 14 Vdc.

D. Desired fuel quantity in side to be tested is obtained by either:

(1) Completely draining fuel tanks on the side to be checked. Then adding fuel in increments specified in Chart 2803; or,

(2) with tanks completely full, defueling each tank 10 gallons at a time.

(3) After measured amount has been added or drained, vibrate tank by bumping lower wing surface. Vibrate gauge by tapping gauge glass with fingers.

INDICATING (Cont.)

— WARNING —

WHEN TESTING FUEL SENDER ELECTRICAL RESISTANCE, WITH SENDER INSTALLED IN THE AIRPLANE, ENSURE ONLY A HIGH IMPEDANCE OHM-METER IS USED.

E. If gauge does not read within tolerances specified in Chart 2803, verify sender's resistance is as specified in Chart 2803.

F. If sender checks out OK, remove gauge and bench test/adjust as specified in paragraph 2, below.

G. If gauge or sender fails to meet accuracy requirements in Chart 2803, replace gauge or sender, as applicable.

CHART 2803. FUEL QUANTITY ANALOG GAUGE / SENDER TOLERANCES

(HP S/N's 3246001 thru 3246087 only)

Total Fuel in Tanks [Side Being Tested] Gallons	Required Gauge Reading	Tolerance (Plus or Minus) Needle Widths*	Resistance (Ohms) Both Senders
2 1/2	0	+0, -1	5
12 1/2	10	± 3/4	21
22 1/2	20	± 1	32
32 1/2	30	± 1 1/2	46
42 1/2	40	± 1 1/2	63
53 1/2	F	± 1 1/2	90

* See Figure 28-6

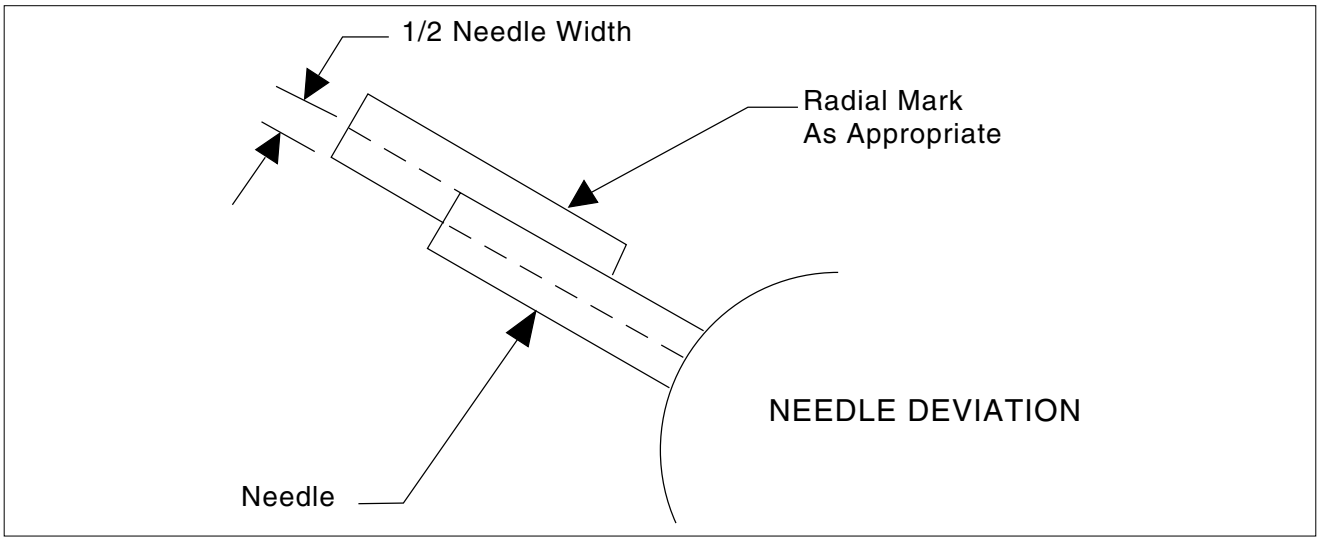

Figure 28-6. Needle Deviation

2. FUEL QUANTITY GAUGE BENCH TEST/ADJUSTMENT
(HP S/N's 3246001 thru 3246087 only) (Refer to Figure 28-7)

A. Install 5 ohm dummy resistor across sender terminal not to be tested as shown.

B. Connect resistance decade across sender terminal to be tested as shown.

C. Connect power supply as shown and adjust to provide 24 to 28 Vdc; or, for HP S/N's 3246001 thru 3246017 only, 12 to 14 Vdc.

D. Low End Adjustment

Select posistion "F" on resistance decade. Verify that instrument needle points to "0". If not, adjust respective "NULL" potentiometer to center needle on "0" radial.

E. High End Adjustment

Select posistion "A" on resistance decade. Verify that instrument needle points to "F". If not, adjust respective "GAIN" potentiometer to center needle on "F" radial.

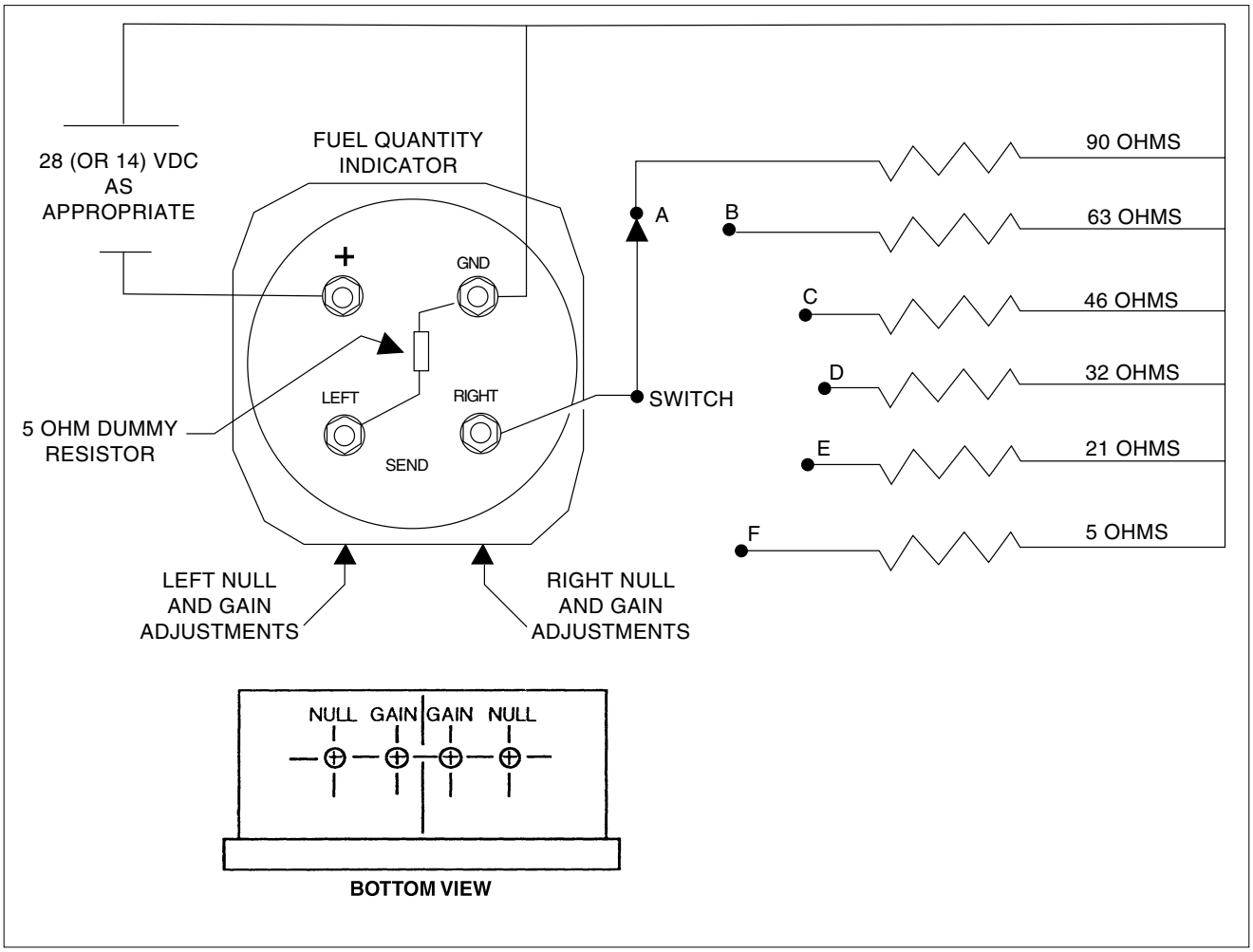

Figure 28-7. Fuel Quantity Gauge Bench Test/Adjust Set-Up
(HP S/N's 3246001 thru 3246087 only)

INDICATING (Cont.)

F. Full Range Check

After low and high end adjustments have been made, verify that for each resistance value, the gauge indication is as shown in Chart 2804.

CHART 2804. FUEL QUANTITY GAUGE BENCH TEST TOLERANCES
(HP S/N's 3246001 thru 3246087 only)

Switch Position**	Required Gauge Reading	Tolerance (Plus or Minus) Needle Widths*	Resistance (Ohms)
F	0	+0, -1/2	5
E	10	± 1/2	21
D	20	± 1/2	32
C	30	± 1/2	46
B	40	± 1/2	63
A	F	± 1/2	90

** See Figure 28-7 * See Figure 28-6

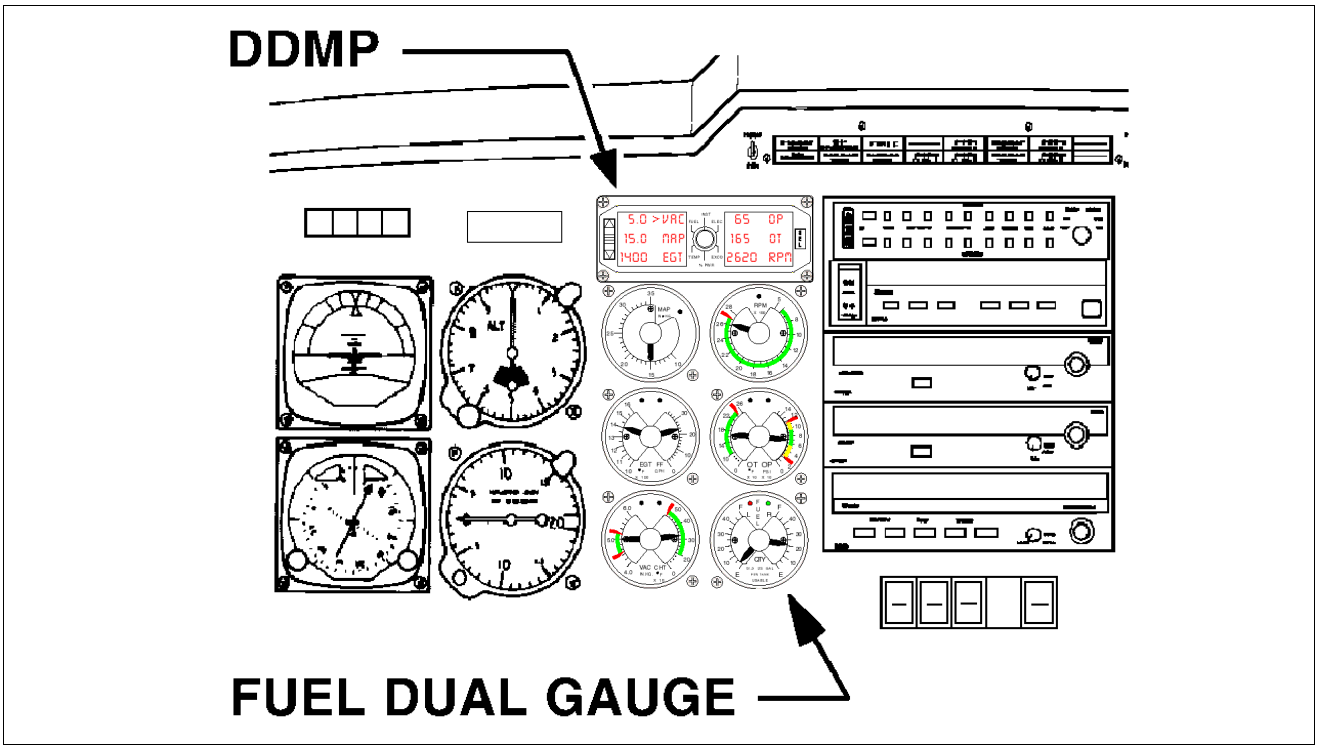

Figure 28-8. DDMP and Fuel Dual Gauge
(TC S/N's 3257001 & up and HP S/N's 32460088 & up)

3. FUEL QUANTITY GAUGE CALIBRATION PROCEDURE

(HP S/N's 3246088 & up and TC S/N's 3257001 & up)

— CAUTION —

REPLACEMENT OF THE FUEL QUANTITY INDICATOR REQUIRES THAT THE NEW INDICATOR BE CALIBRATED PER THE PROCEDURE BELOW.

— Note —

Additional information on the Digital Display Monitoring Panel (DDMP) is in Section 77-40-00.

A. Prepare the aircraft for testing as follows:

(1) Level the aircraft ± 1 degree laterally and longitudinally.

(2) Place the battery switch in the OFF position.

(3) Connect the external power supply unit to the aircraft electrical system using the APU connector.

(4) Adjust the power supply to provide 24.0 to 28.0 Vdc.

(5) Record test results in logbook.

B. Calibration Procedure

— Note —

If power failure occurs during calibration, the calibration must be started over.

(1) Enter the maintenance mode of the Digital Display Monitor Panel (DDMP) by turning the rotary switch to "ELEC" (HP S/N's 3246126 & up and TC S/N's 3257001 & up) or "MAINT" (HP S/N's 3246088 thru 3246125 only), and pressing the key sequence up, down, up, up, "SEL". If entered incorrectly, the DDMP will show an error message.

(2) The next screen allows you to select between maintenance mode, initiate self test, or set the clock. Press the "SEL" key to select maintenance mode.

(3) Press the "SEL" key to start the password sequence. Enter the password using the up/down arrow to change the character, and the "SEL" key to enter that character and move to the next. The password is currently "A130".

— Note —

Figure 28-9 is a Menu Flow Chart for the remaining DDMP procedure.

(4) Select "FUEL" using the up/down arrow to move the cursor, then press the "SEL" button to enter the selection.

(5) Select "LEFT" tank, then press the "SEL" key.

(6) One of two menus will appear, depending on whether or not the DDMP is currently calibrated or is set at the factory default settings.

(a) If "LEFT CAL COMPLETE RE-CAL" appears move cursor to "yes" and press "SEL" and continue with paragraphs (7), (8), and (9), below.

(b) If "FUEL LFT; CALIBRATE, CLR ALL, CANCEL" appears, jump to paragraph (10), below.

INDICATING (Cont.)

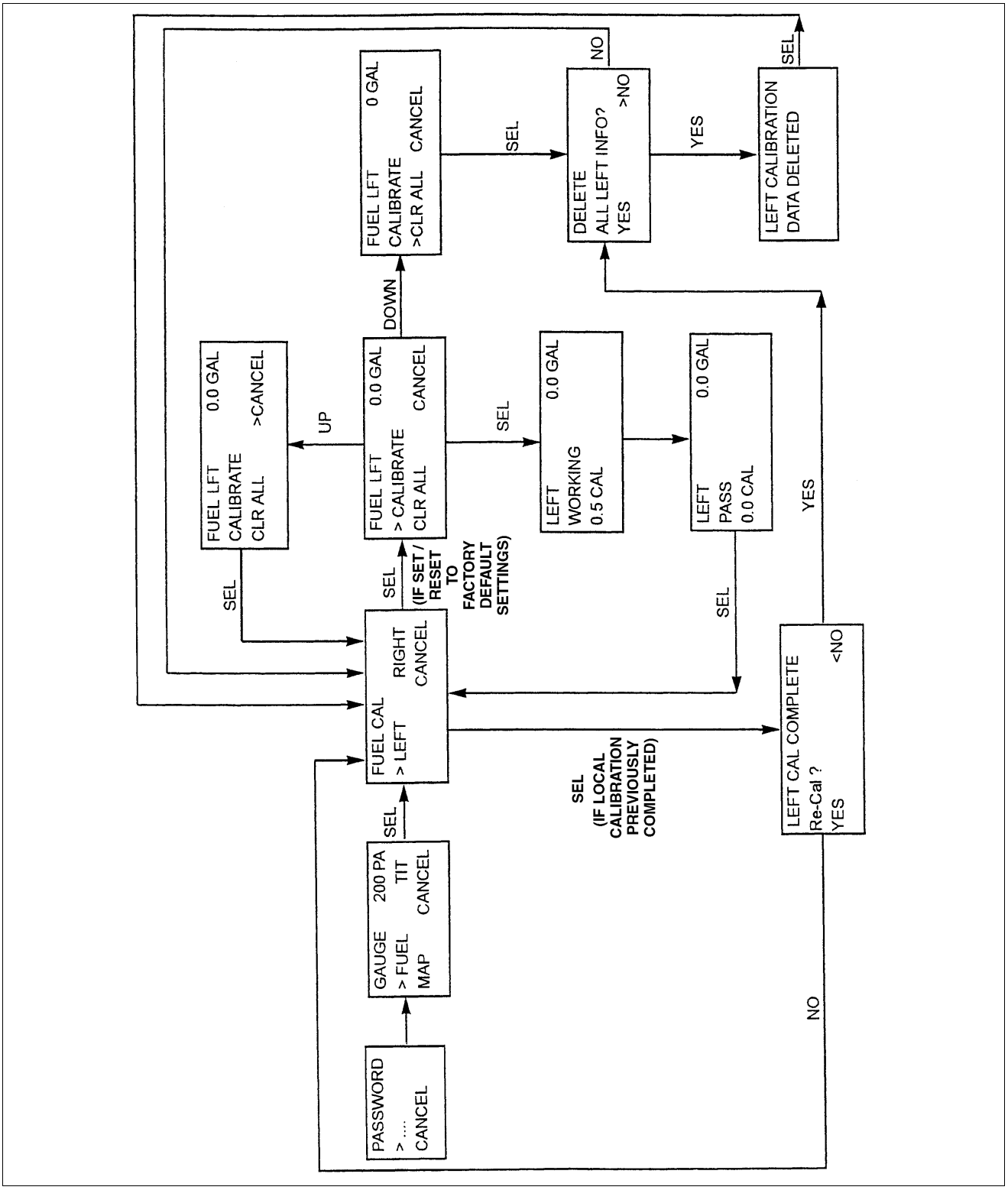

Figure 28-9. DDMP Fuel Calibration Menu Flow Chart

(7) Choose "yes" to delete all left info and press "SEL" key. (This will delete non-factory calibration program).

(8) When "LEFT CALIBRATION DATA DELETED" menu appears press "SEL" key.

(9) Deleting existing calibration data will take you back to the "FUEL CAL; LEFT, RIGHT, CANCEL" menu options. Move cursor to "LEFT" and press "SEL" key.

(10) The DDMP will now query the instrument to find out what calibration step it is at. The instrument knows which quantities have been calibrated, and automatically goes to the next quantity to be calibrated. This requirement forces the instrument to be calibrated sequentially at "E", “10”, “20”, “30”, “40”, and "F". Once the DDMP has queried the instrument, it displays the quantity to be calibrated, and gives the user three choices: "CALIBRATE", "CLEAR ALL", or "CANCEL". "Cancel" takes you out of the menu, with nothing being modified, "CALIBRATE" begins the sequence and "CLEAR ALL" uncalibrates the instrument. In other words, the clear command will delete all local calibration data, and revert to the factory default settings.

(11) Add 2.5 gallons of fuel (unusable) to left wing tank. Select "CALIBRATE" from menu in DDMP. Use up/down buttons to move cursor to selection noted above and enter by pressing the "SEL" key. After selection has been made "0.0" will appear in upper part of right window for the first quantity to be calibrated. Wait one minute for the fuel to stop sloshing. Press "SEL" key and in middle of right window a message "WORKING" will flash. In lower portion of left window, the digits will change until the number is within + or - (0.1) of the number in upper portion of right window. When this occurs, the message changes from "WORKING" to "PASS". If "ERROR" message appears, the resistance of the tank senders is out of range and one or both senders may have to be replaced. Additionally, during this step, the exceedence warning horn will sound indicating a low fuel exceedence condition (i.e. - less than 5 gal. usable fuel). Press “SEL” and the horn will be cancelled.

— Note —

The fuel quantity gauges in HP S/N’s 3246130 & up and TC S/N’s 3257082 & up incorporate updated software to add a low fuel exceedence latch that can only be reset by cycling the aircraft power.

(12) Once the "SEL" key is depressed after the message "PASS" has appeared, the menu will display allowing a choice between "RIGHT" or "LEFT" tanks. Select "left" tank and depress "SEL" key. (10) will appear in the upper portion of the right screen. Add 10 gallons to left tank - during this step, the warning horn will sound again indicating a low fuel (at 5 gallons, + or - 1 gallon) condition (except in HP S/N’s 3246130 & up and TC S/N’s 3257082 & up). Depress "SEL" key and the horn will be canceled. After the 10 gallons has been added, wait one minute for fuel to stop sloshing. Press "SEL" key and a "WORKING" message will appear. When the digits in the lower portion of the left window agree to within + or - (0.1) of the (10) indicated in upper portion of right window, the "WORKING" message will change to "PASS" and the "SEL" key can be depressed.

(13) Repeat step (12) for “20”, “30”, “40”, and “F” calibration points.

— Note —

The calibration must be done sequentially; otherwise, a possible error could be introduced into the program.

INDICATING (Cont.)

(14) When "COMPLETE" message is displayed, depress "SEL" key and use cursor to select right tank and hit "SEL" to accept.

(15) Repeat steps (10), (11), (12), (13), and (14), for right tank.

(16) When right tank calibration is complete, turn rotary switch to "Inst" mode. This will save the calibration.

C. Full Gauge Range Check

(1) Defuel both fuel tanks.

(2) Add 2.5 gallons of fuel to each tank (unusable).

(3) Verify that fuel gauges indicate "O" or "E". (See Figure 28-10)

(4) Add 10 gallons of fuel to each tank and again observe analog and digital gauge readings. When adding fuel, wait one (1) minute after each filling before recording digital and analog gauge readings.

(5) Repeat step (4) for 20, 30, and 40 gallon, and "F" increments for both left and right tanks. See Figure 28-11 for analog needle display limits at “F”.

(6) Gauge reading tolerances are given in Chart 2805, which can also be used to record the data.

CHART 2805. FUEL QUANTITY GAUGE TOLERANCES

(HP S/N’s 3246088 & up and TC S/N’s 3257001 & up)

FUEL CALIBRATION				
TANK CAPACITY (EITHER SIDE) (GALLONS)	CALIBRATION POINTS [1] (OHMS [2])	GAUGE READINGS [3]		TOLERANCE (GALS) (ON GAUGE READING)
		ANALOG	DIGITAL	
0.0 (E)	1.1 (+1, -1.1)			± 0
(2.5) Gal. Unusable	1.1 (+1, -1.1)			± 0
10	18.5			± 2
20	30.3			± 2
30	44.0			± 2
40	61.5			± 2
51 (F)	86.8			+ 0, - 1

Notes:

1. Sensor Full Scale Output is 5.0 to 87.8 OHMS (Empty to Full)
2. Allowed ± 1 OHM, unless otherwise noted.
3. One (1) gallon variance between digital and analog reading allowable.

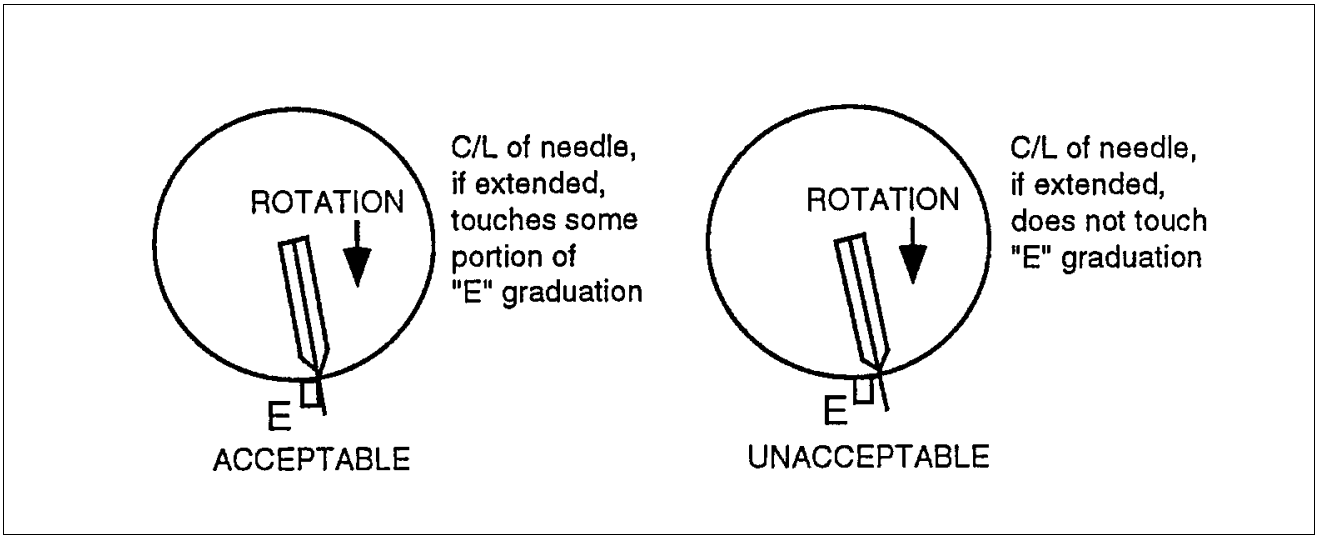

Figure 28-10. Analog Needle Display Limits at “E”

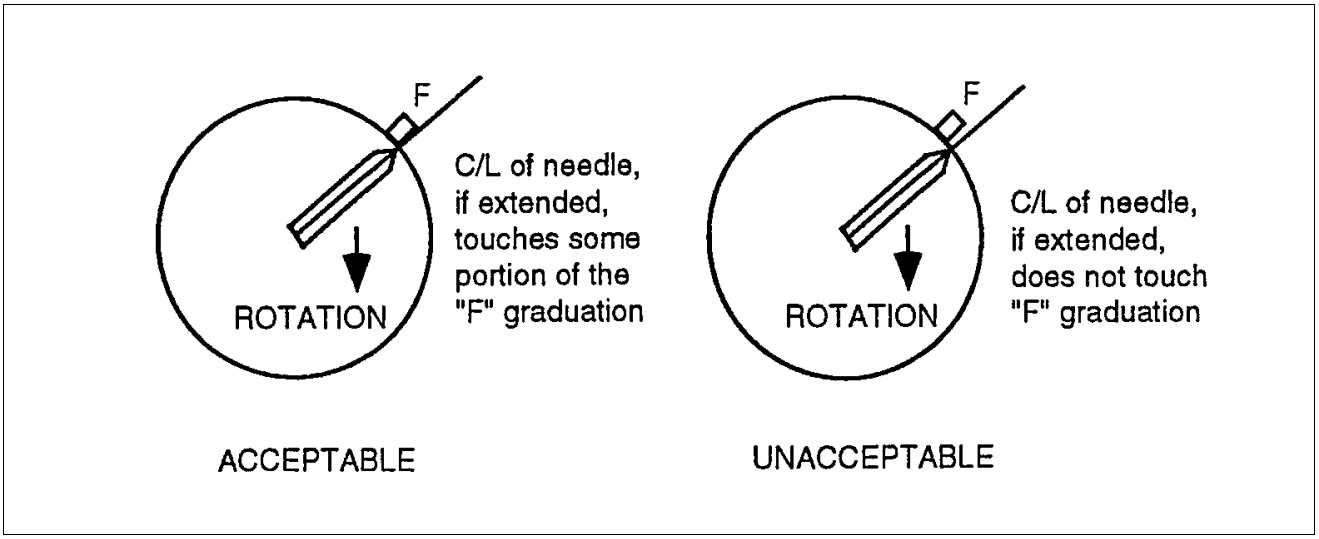

Figure 28-11. Analog Needle Display Limits at “F”

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CHAPTER

29

HYDRAULIC POWER

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CHAPTER 29 - HYDRAULIC POWER

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GENERAL

This chapter provides an overview of the main hydraulic system which is used for landing gear extension and retraction. Detailed information on the combination hydraulic pump and reservoir and the hydraulic lines are provided herein. See 32-30-00 for detailed information on landing gear extension and retraction components and operation.

The brake system, although hydraulically operated, is not included in Chapter 29 as it is entirely independent of the gear retraction system. The brake system and its components are covered in Chapter 32.

— WARNING —

PRIOR TO STARTING ANY INVESTIGATION OF THE HYDRAULIC SYSTEM, PLACE THE AIRPLANE ON JACKS. (REFER TO JACKING, CHAPTER 7.)

A. Description

Hydraulic fluid is supplied to the landing gear actuating cylinders by an electrically powered, reversible, pump located below the raised floor in the forward baggage compartment at F.S. 45. A reservoir is also an integral part of the pump. The pump is controlled by the landing gear selector switch located on the instrument panel to the left of the throttle 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. As fluid pressure increases at one side of a cylinder piston, fluid at the other side is directed back through the other line to the pump. 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 29-1.)

A pressure switch is installed on a cross fitting connected to the pump mount assembly. During landing gear 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. As long as the gear selector handle is in the up position the switch will continue to hold the circuit open until system pressure drops to 200 to 400 psi. At that time, the pump will again operate to build up pressure to prevent the gear from free falling. The pressure switch has no effect on the system when the gear selector is in the down position.

The hydraulic pump is a gear type unit, driven by a 28-volt reversible motor (except in HP S/N's 3246001 thru 3246017 only, which are 14-volt), designed to operate in a pressure range of 2000 - 2500 psi. To prevent excessive buildup of pressure in the hydraulic system due to expansion, a thermal relief valve is incorporated in the pump. The relief valve will open at 3000 ± 500 psi. Other valves in the pump channel fluid to the proper outlet during retraction or extension of landing 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. (Refer to Figure 29-1 and Chart 2901 for specific pressures.)

A by-pass or free-fall valve allows the gear to drop should a malfunction in the pump system occur. This valve is manually controlled by the Emergency Gear Extension Knob, located on the instrument panel, below the gear selection switch. A special restrictor nipple on the main gear retraction line prevents the gear from extending too fast.

Pulling the emergency gear extension knob out manually releases hydraulic pressure, permitting the gear to free-fall, with spring assistance on the nose gear.

GENERAL (Cont.)

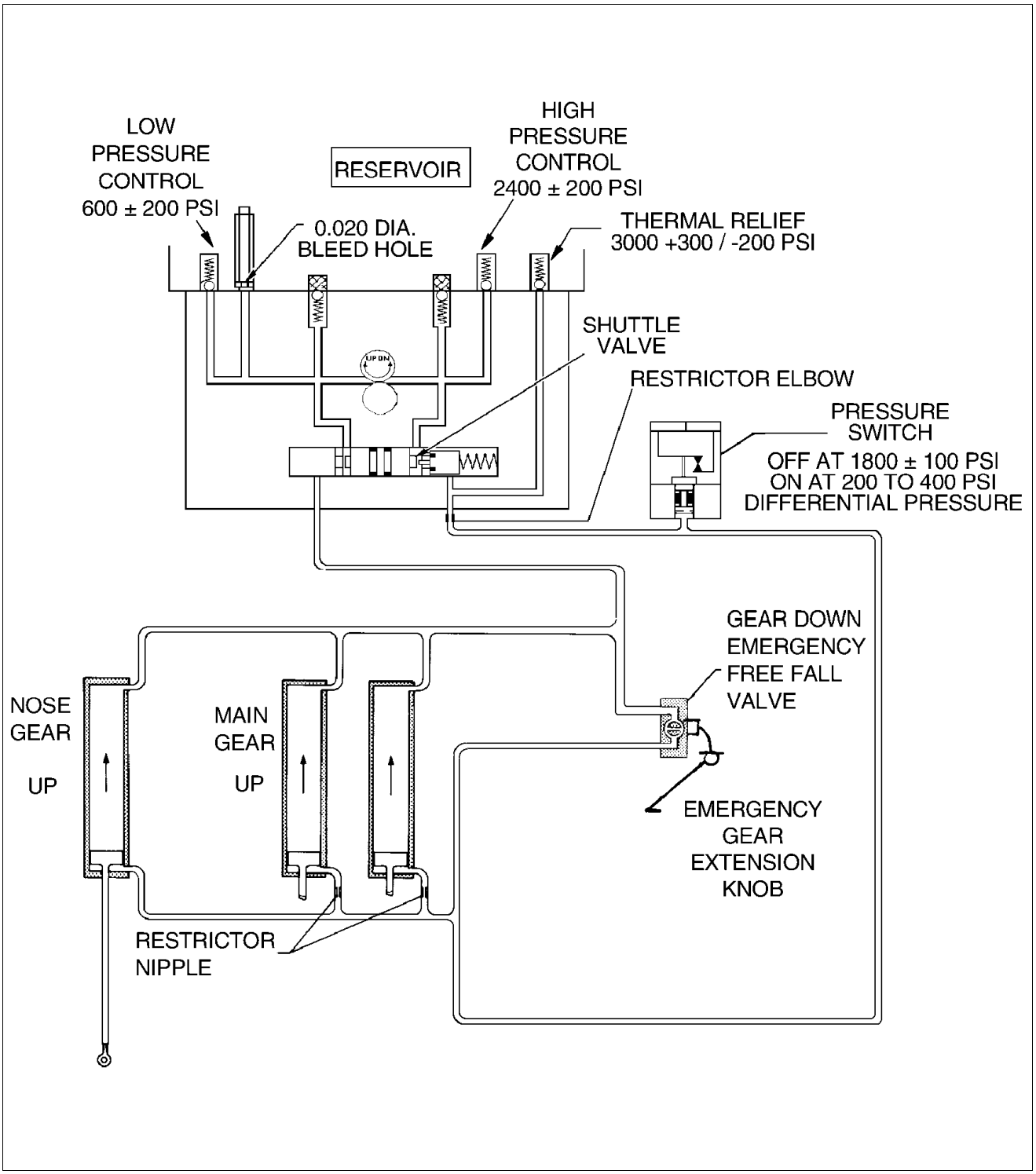


Figure 29-1. Hydraulic System Schematic

GENERAL (Cont.)

Refer to Chapter 32, Landing Gear, for a description of the landing gear and associated electrical switches.

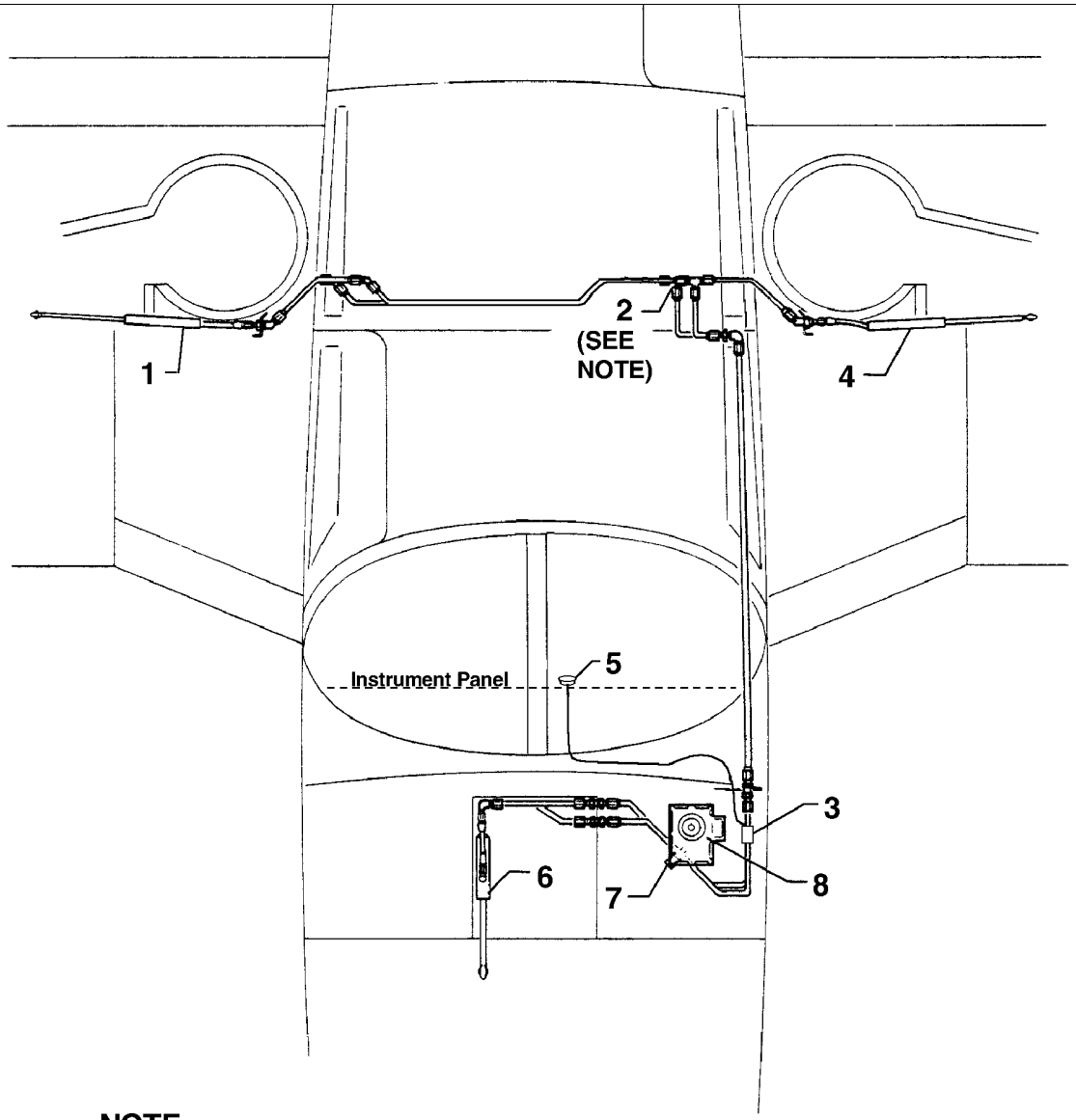
CHART 2901. HYDRAULIC SYSTEM LEADING PARTICULARS

HYDRAULIC PUMP	OILDYNE
TC S/N's 3257001 & Up and HP S/N's 3246018 & Up	P/N 38992-8 (28V)
HP S/N's 3246001 - 3246017	P/N 38992-5 (14V)
Hydraulic Pump	
High Pressure	2000 ± 200 psi
Low Pressure	600 ± 200 psi
Flow Rate @ 1000 psi	60 cu. in. per min.
Hydraulic Fluid	MIL-H-5606
Relief Valve (Thermal)	3000 +300 / -200 psi
Pressure Switch	
Open (OFF) Pressure	1800 + 100 psi
Close (ON) Pressure	200 to 400 psi
	Differential pressure

CHART 2902. HYDRAULIC PUMP MOTOR ELECTRICAL CHARACTERISTICS

Voltage	28 V.d.c. or 14 V.d.c.
Rotation	Reversible
Polarity	Negative ground
Operating Current	25 amps, max. at 28-volts (both rotations)
	18 amps, max. at 14-volts (both rotations)
Overload Protection	25 ampere Landing Gear Actuator circuit breaker

GENERAL (Cont.)



NOTE

SPECIAL RESTRICTOR NIPPLE (2) IS INSTALLED ON THE MAIN GEAR RETRACTION LINE. DO NOT MISTAKE THIS FOR A STANDARD NIPPLE.

1. RIGHT ACTUATING CYLINDER
2. RESTRICTOR NIPPLE (SEE NOTE)
3. LANDING GEAR FREE FALL VALVE
4. LEFT ACTUATING CYLINDER
5. EMERGENCY GEAR EXTENSION KNOB
6. NOSE ACTUATING CYLINDER
7. PRESSURE SWITCH
8. PUMP / RESERVOIR

Figure 29-2. Hydraulic System Installation

GENERAL (Cont.)

B. Troubleshooting

Malfunctions in the hydraulic system will result in failure of the landing gear to operate properly. When trouble develops, place the airplane on jacks (refer to Jacking, Chapter 7), in order to determine the extent of the problem. Chart 3203 lists troubles which may be encountered, along with their probable cause, and suggests a remedy for the trouble involved. A hydraulic system operational check may be conducted using Figures 29-1 or 29-2. Hydraulic system troubles are not always traceable to one cause. A malfunction may be the result of more than one problem within the system. Starting with the most obvious and most probable reasons for the trouble, check each possibility and, by process of elimination, isolate the troubles.

— 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.

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MAIN

A. Hydraulic Pump

1. Removal of Hydraulic Pump

The hydraulic pump, with reservoir incorporated, is located in the nose section of the fuselage. Access to the pump is through the access panel in the nose baggage compartment. To remove pump:

a. Disconnect the pump electrical leads from the pump solenoid relays and the ground wire from the battery shelf.
b. Disconnect the hydraulic lines from the pump. Cap the line ends to prevent contamination.
c. Remove pump by removing pump attaching bolts.
d. Cap or plug all ports.
e. Clean exterior of pump using a dry cleaning solvent to remove accumulated dirt and dust.

2. Field Servicing Hydraulic Pump (Refer to Figure 29-3)

Field service of the hydraulic pump is limited to removal, cleaning, and inspecting the hydraulic fluid reservoir. Should pump malfunction, either replace pump, or return pump to Piper, via the local Piper distributor, for servicing or repairs.

The Oildyne pump incorporates a dipstick to check the quantity of hydraulic fluid in the reservoir. Replenish only with MIL-H-5606 petroleum base hydraulic fluid.

3. Disassembly of Hydraulic Pump from Bracket (Refer to Figure 29-3)

a. Remove safety wire securing two bolts that attach bracket to pump.
b. Remove the two bolts and washers.
c. Separate pump assembly from bracket.

4. Disassembly of Motor Assembly from Pump-Adapter (Refer to Figure 29-3)

a. Remove two each mounting bolts on flange of motor assembly and separate the motor assembly from the pump.
b. Remove coupling and O-ring and discard.

— Note —

New O-ring and coupling are included in replacement motor assembly.

5. Disassembly of Reservoir Assembly from Pump-Adapter (Refer to Figure 29-3)

— CAUTION —

DO NOT DISASSEMBLE PUMP ASSEMBLY FROM ADAPTER ASSEMBLY. DAMAGE TO VALVES AND CHANGES TO PRESSURE SETTINGS, WHICH ARE NON-ADJUSTABLE, WILL OCCUR.

a. Remove screw and O-ring securing the reservoir to the adapter assembly.
b. Remove reservoir and reservoir seal.
c. 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.

MAIN (Cont.)

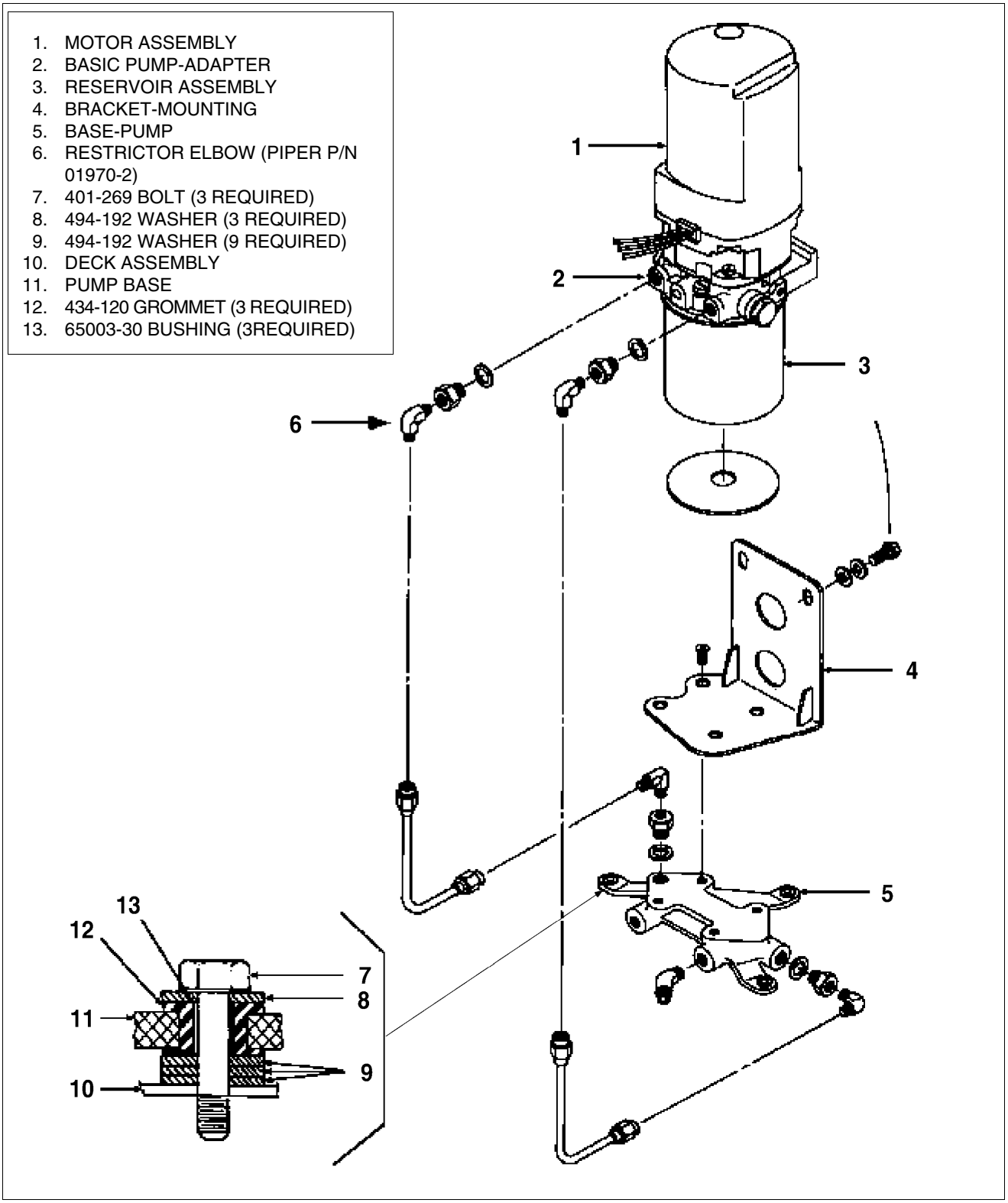

Figure 29-3. Hydraulic Pump

MAIN (Cont.)

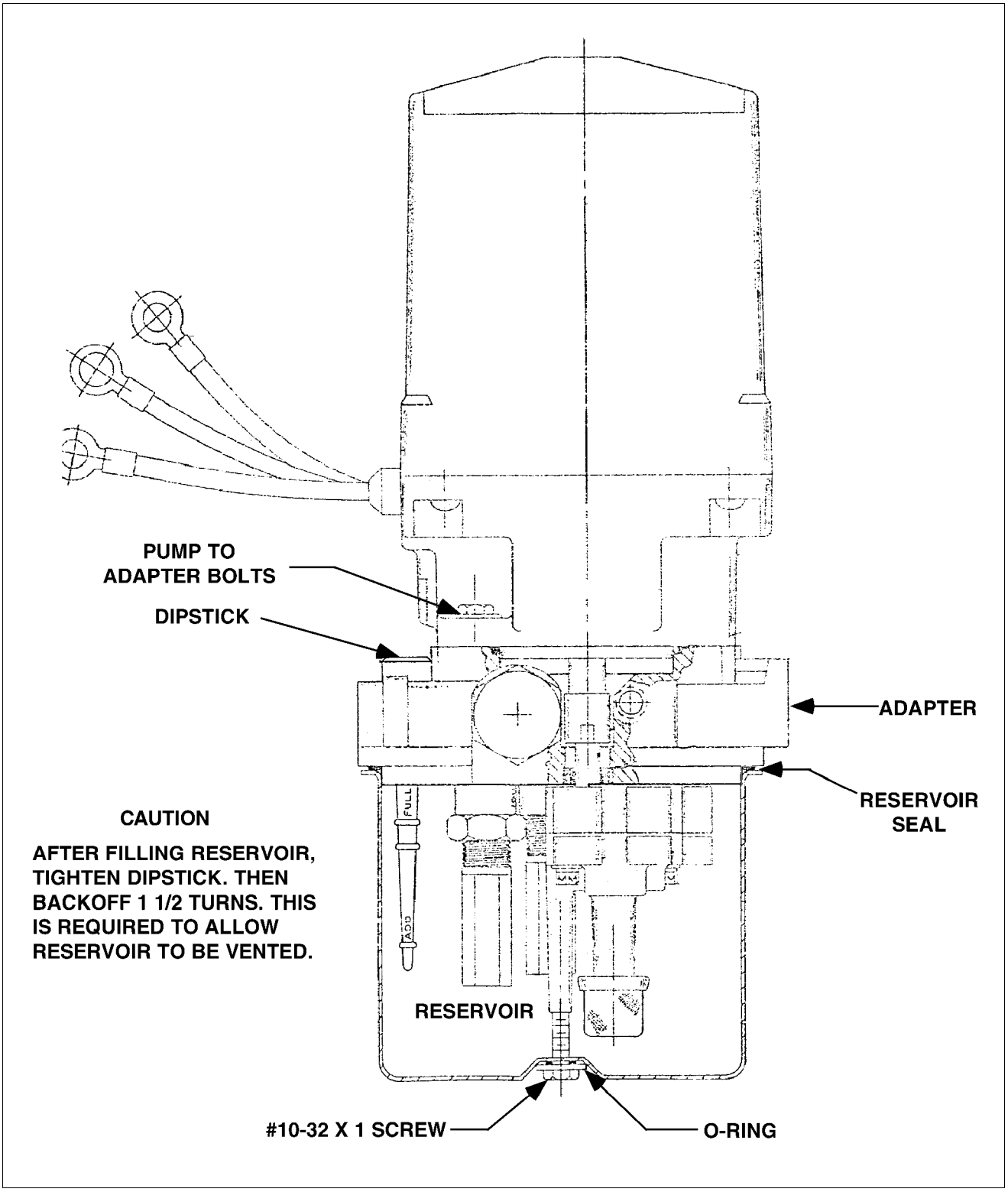

Figure 29-3. Hydraulic Pump (cont.)

MAIN (Cont.)

6. Assembly of Reservoir to Pump-Adapter Assembly. (Refer to Figure 29-3.)

   a. 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.
   b. Position the reservoir seal between the reservoir and the adapter assembly.
   c. 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.
   d. Position the O-ring on the bolt, and install it through the reservoir and into the pump-adapter securing the reservoir.
   e. Tighten this bolt to a torque value of 40 - 50 inch pounds.

7. Assembly of Motor Assembly to Pump-Adapter Assembly. (Refer to Figure 29-3.)

   a. Locate the replacement O-ring and coupling.
   b. Place the coupling and O-ring into position between the motor assembly and pump-adapter assembly.
   c. Apply light coating of Titeseal No. 3 in back of the first two threads of mounting bolts.
   d. Positioning the two units in place, install two each mounting bolts through the flange of the motor assembly and into the pump-assembly housing.
   e. Torque bolts to 15 -20 inch pounds.

8. Assembly of Piper Bracket to Hydraulic Pump Assembly. (Refer to Figure 29-3.)

   a. If bracket was removed from was removed from pump mount, install bracket to Piper pump mount with four MS24693-S298 screws.
   b. Position pump assembly on bracket so that tapped holes in oildyne adapter align with bolt holes on bracket.
   c. Install two AN960-616 washers and two MS20074-06-05 bolts to secure pump assembly to bracket.
   d. Safety bolts with MS20995-C41 wire.

9. Installation of Hydraulic Pump. (Refer to Figure 29-3.)

   a. Position assembled pump, bracket, and pump mount on pump deck in airplane.
   b. 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.

   c. Install the UP and DOWN pressure hydraulic lines to pump mount.
   d. Connect the three knife connectors that attach the black, blue, and green forward and reverse harness wires.
   e. Install nose baggage compartment access panel.

MAIN (Cont.)

B. Removal and Installation of Hydraulic Lines

Remove a damaged hydraulic line by disconnecting fitting at each end and by disconnecting where secured by brackets. Refer to Figure 29-2 as an aid in the location of attaching brackets and bends in lines. Provide a small container for draining line. Install a new or repaired line in reverse. Operate hydraulic pump to purge the system of air. Check fluid level in reservoir.

C. Servicing Hydraulic Pump/Reservoir

— Note —

Hydraulic pump/reservoir fluid level must be checked with landing gear down and locked.

1. Check fluid level in reservoir of combination pump and reservoir at least every 50 hours.
2. To check fluid level:

   a. Using a screwdriver, remove dipstick/filler plug located on right front of pump. (Refer to Figure 29-3.)
   b. If fluid level is between the ADD zone and FULL mark, fluid level is satisfactory.
   c. If fluid level is in the ADD zone, add MIL-H-5606A fluid through dip stick hole to bring level up to at least top of ADD zone.
   4. Install and, using a screwdriver, tighten dipstick. Then, back off 1 $^{1}/_{2}$ turns to allow reservoir to be vented.

D. Testing Hydraulic System

Test hydraulic system after performing any service or repairs to determine that it functions properly. See 32-30-00 for a more extensive functional test of the landing gear extension and retraction system.

1. Place airplane on jacks. (Refer to Jacking, Chapter 7.)

— CAUTION —

TURN MASTER SWITCH OFF BEFORE INSERTING OR REMOVING EXTERNAL POWER SUPPLY PLUG.

2. Connect airplane to an outside power source. (Refer to External Power Receptacle, Chapter 24.)
3. With gear down, master switch ON, and hydraulic pump circuit breaker closed, place landing gear selector switch in the UP position. Check that hydraulic pump ***starts*** operating immediately, and that gear retracts. Check that ***red*** gear unsafe light on instrument panel is ON until gear is fully retracted. Confirm hydraulic pump ***stops*** operating after full gear retraction.
4. Place gear selector switch in DOWN position. Gear should extend and lock in position. Gear down lights on instrument panel will be ON when all three gears are locked in position. Inspect hydraulic system for leakage of hydraulic fluid.
5. Recycle the landing gear to determine that it functions properly.

— CAUTION —

PRIOR TO REMOVING THE AIRPLANE FROM JACKS, TURN MASTER SWITCH ON AND DETERMINE THAT ALL THREE GEAR DOWN GREEN LIGHTS ARE ON.

MAIN (Cont.)

6. Confirm that the 3 green gear down lights are illuminated.
7. Turn master switch OFF.
8. Disconnect external power from airplane.
9 Remove airplane from jacks.

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CHAPTER

30

ICE AND RAIN PROTECTION

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CHAPTER 30 - ICE AND RAIN PROTECTION

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GENERAL

The SARATOGA II HP and TC are not approved for operation in icing conditions. Accordingly, the only ice and rain protection provided is a heated pitot-static mast. Material contained herein provides information for general maintenance of the pitot-static heat system. If further information is necessary contact your Piper Distributor Service Adminstrator (DSA).

The pitot-static heat system is activated by the PITOT HEAT switch located on the center instrument panel just above the engine power quadrant. In addition to the switch, the system incorporates a heated pitot-static head and the 10 amp (except 15 amp in HP S/N's 3246001 thru 3246017) PITOT HEAT circuit breaker.

— Note —

Refer to Figure 91-3 for pitot heat wiring schematic.

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PITOT AND STATIC

The heated pitot-static mast installed in these airplanes is controlled by a single switch in the center of the instrument panel.

The system is quite simple in that it comprises only a heated pitot-static head, an ON-OFF switch, and a circuit breaker to protect the circuit. The pitot-static head is installed on the left wing.

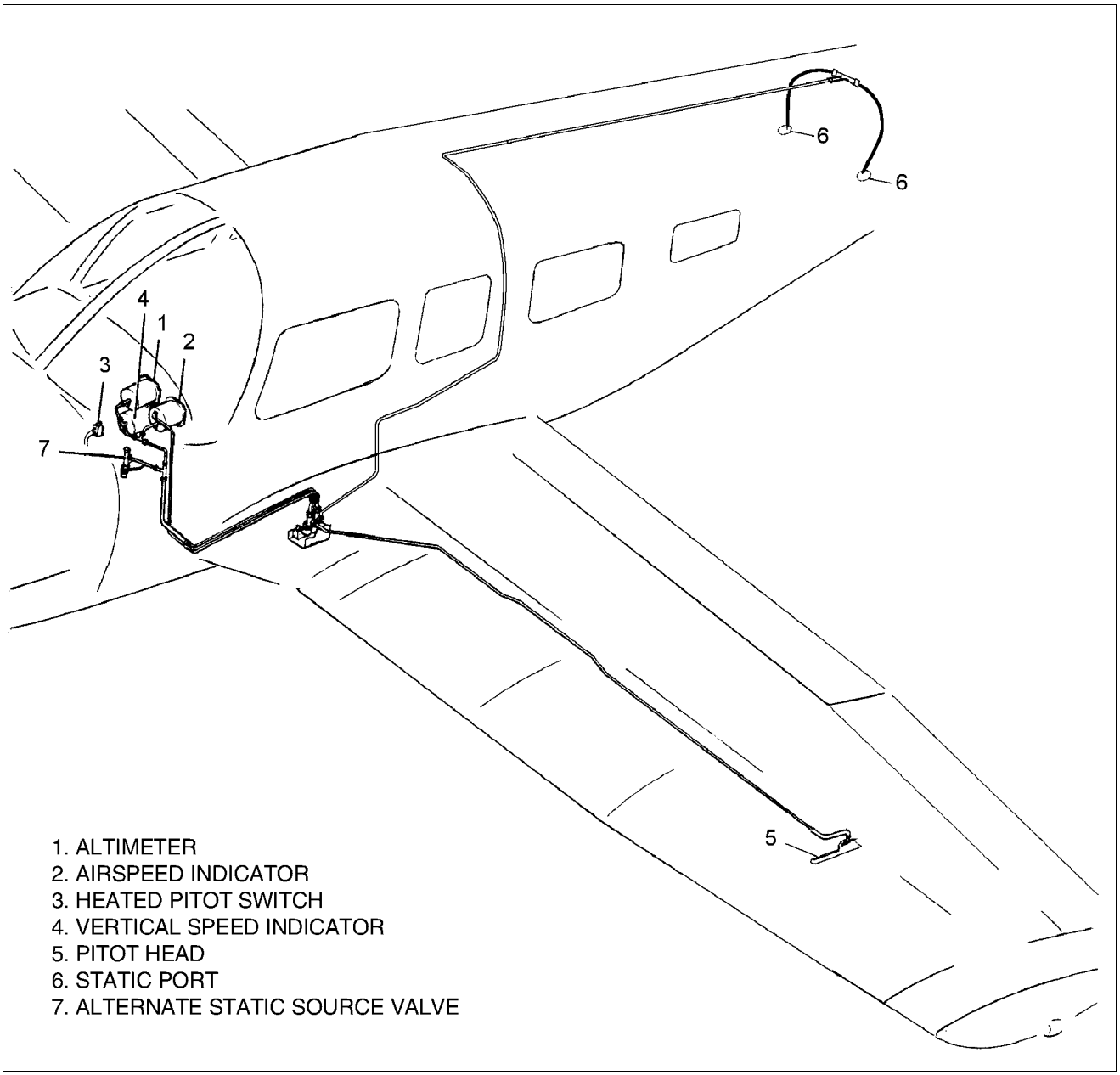

Figure 30-1. Pitot Static System Installation (Sheet 1 of 3)
(TC S/N's 3257001 & up and HP S/N's 3246018 & up)

PITOT AND STATIC (Cont.)

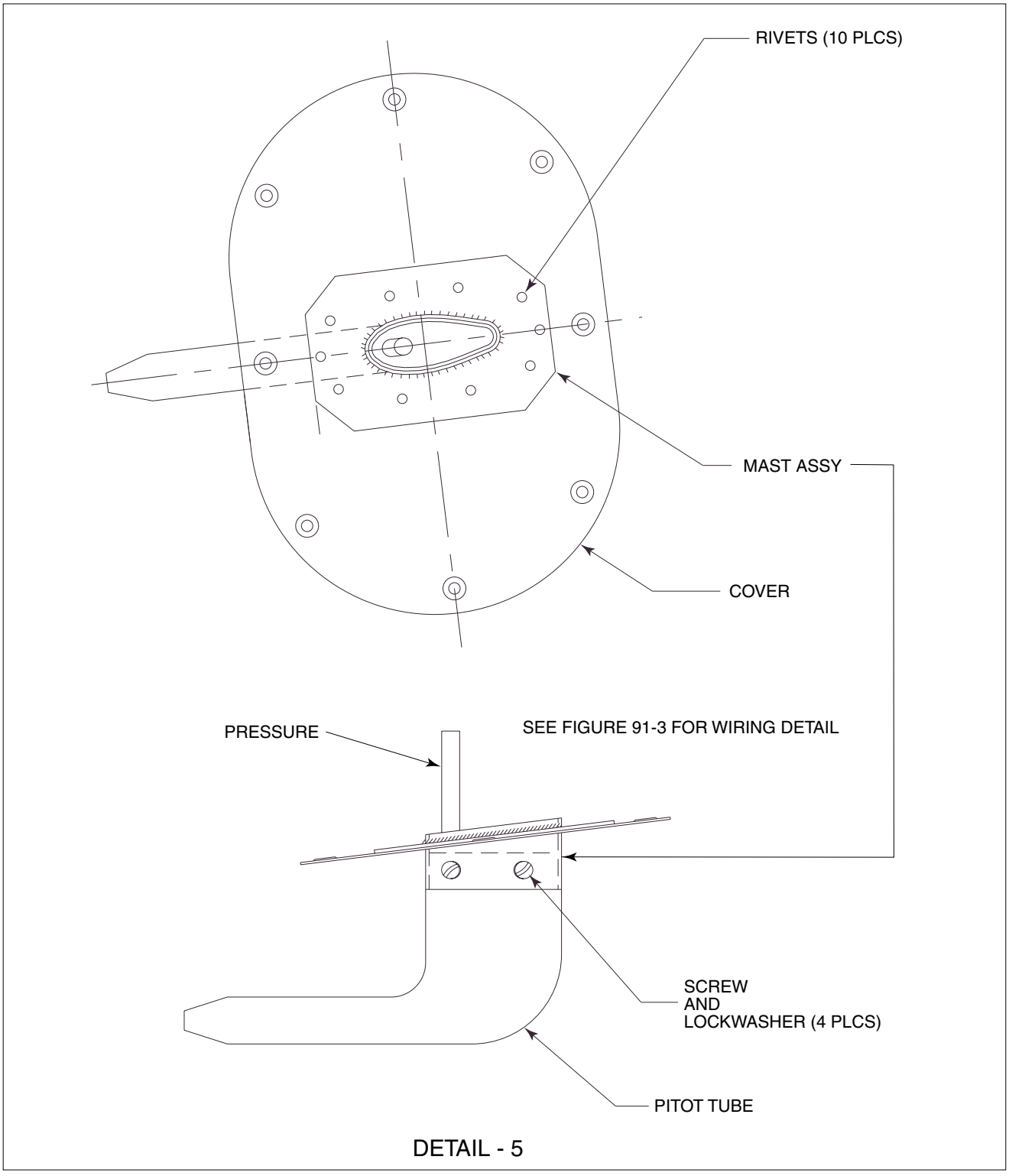

Figure 30-1. Pitot Static System Installation (Sheet 2 of 3)
(TC S/N's 3257001 & up and HP S/N's 3246018 & up)

PITOT AND STATIC (Cont.)

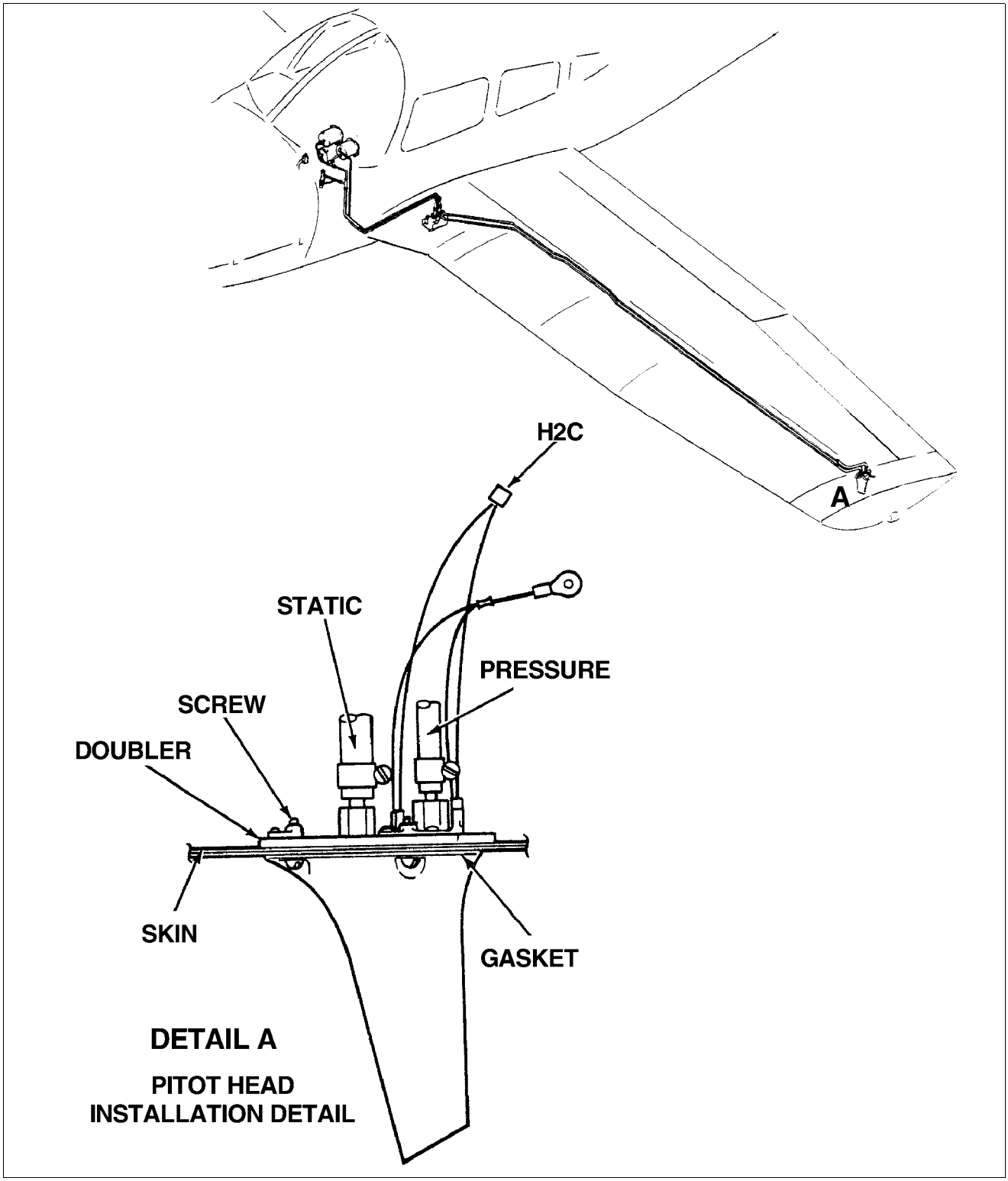

Figure 30-1. Pitot Static System Installation (Sheet 3 of 3)
(HP S/N's 3246001 thru 3246017 only)

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CHAPTER

31

INDICATING / RECORDING SYSTEMS

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CHAPTER 31 - INDICATING / RECORDING SYSTEMS

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CENTRAL WARNING SYSTEMS

A. Description and Operation

The annunciator panel includes OIL PRESSURE, ALTERNATOR INOP, LOW BUS VOLTAGE, VACUUM INOP, GEAR WARN (GEAR WARNING), FLAPS IN TRANSIT (FLAPS), STARTER ENGAGE, BAGGAGE DOOR (BAGG DOOR AJAR), PITOT HEAT OFF/INOP (except in HP S/N's 3246001 thru 3246017 only), and AIR/COND DOOR OPEN (AIR/COND DOOR) (if installed) indicator lights. Annunciator panel lights are provided only as a warning to the pilot that a system may not be operating properly. The applicable system gauge should be checked and monitored to determine when, or if, any action is required.

Circuit breakers are located on lower right instrument panel.

B. Troubleshooting

When checking the lighting system, the master switch must be on in order for lights to operate. Ensure that the appropriate circuit breaker is pushed ON.

— Note —

Press-to-Test switch tests only the operation of the annunciator light bulbs. It does not test functioning of the warning circuit.

CHART 3101. TROUBLESHOOTING ANNUNCIATOR (1 of 6)

Trouble	Cause	Remedy
All warning lights fail to operate	Defective/tripped circuit breaker.	Reset/replace 5 amp CB.
	No current from bus.	Check all wire segments, connections, and the receptacle at the left side of the annun ciator panel.
All the warning lights fail to extinguish after engine is running	Test switch grounded out.	Check terminals and replace switch if necessary.
OIL PRESSURE warning light fails to operate.	Bulb burned out.	Replace.
	No ground to sensor.	Check all wire segments and connections
	Sensor activates at too low a setting.	Replace.
	Defective sensor.	Replace.

CENTRAL WARNING SYSTEMS (Cont.)

CHART 3101. TROUBLESHOOTING ANNUNCIATOR (2 of 6)

Trouble	Cause	Remedy
OIL PRESSURE warning light fails to extinguish.	Sensor activates at too high a setting.	Replace sensor.
	Sensor terminals bridged.	Remove material between terminals.
	Defective sensor.	Replace sensor.
VACUUM INOP warning light fails to operate.	Bulb burned out.	Replace bulb.
	No ground to sensor.	Check all wire segments and connections.
	Sensor activates at too low a setting.	Replace sensor.
	Defective sensor.	Replace sensor.
VACUUM INOP warning light fails to extinguish.	Sensor activates at too high a setting.	Replace sensor.
	Sensor terminals bridged.	Remove material between terminals.
	Defective sensor.	Replace sensor.
ALTERNATOR INOP warning light fails to operate.	Bulb burned out.	Replace bulb.
	No current from bus to resistor.	Check all wire segments and connections.
	Defective Alt out switch.	Replace switch.
ALTERNATOR INOP warning light fails to extinguish.	Blown fuse.	Replace 1/4 amp fuse near the alternator.
	No current from the fuse to the Alternator out switch.	Check all wire segments and connections.
Test switch fails to activate warning lights	Bad switch or connections.	Check wires and replace switch if necessary
ALTERNATOR INOP warning light fails to extinguish, ammeter reads full output.	Diode heat sink shorted to airframe.	Replace teflon insulating washers. Do not tighten screws excessively.

CENTRAL WARNING SYSTEMS (Cont.)

CHART 3101. TROUBLESHOOTING ANNUNCIATOR (3 of 6)

Trouble	Cause	Remedy
GEAR WARN fails to light.	Nose gear down limit switch fails to open.	Replace nose gear down limit switch.
	One of the main gear down limit switches fails to open.	Replace appropriate main gear down limit switch.
	Wire broken between a gear down lock switch and GEAR WARN light annunciator.	Locate break. Fix or replace wire.
GEAR WARN fails to light when power is reduced to approx. 14 inches Hg.	Faulty landing gear warning (throttle) switch.	Replace switch.
GEAR WARN fails to go out.	Nose gear up limit switch fails to close.	Replace nose gear up limit switch.
	One of the main gear up limit switches fails to close.	Replace appropriate main gear down limit switch.
GEAR WARN fails to light when Press-To-Test button is pushed.	Faulty bulb	Replace bulb.
	Faulty squat switch	Replace squat switch.
BAGGAGE DOOR light fails to operate.	Bulb burned out.	Replace bulb.
	No ground to switch.	Check all wire segments and connections.
	Defective switch.	Replace switch.
BAGGAGE DOOR light fails to extinguish.	Switch terminals bridged.	Remove material between terminals.
	Defective switch.	Replace switch.

CENTRAL WARNING SYSTEMS (Cont.)

CHART 3101. TROUBLESHOOTING ANNUNCIATOR (4 of 6)

Trouble	Cause	Remedy
LOW BUS VOLTAGE light fails to operate.	Bulb burned out.	Replace bulb.
	No ground to monitor.	Check wiring to monitor.
	Sensor activates at too low a setting.	Replace sensor.
	Defective sensor.	Replace sensor.
LOW BUS VOLTAGE light fails to extinguish.	1A fuse open.	Replace fuse.
	Sensor activates at too high a setting.	Replace sensor.
	Defective sensor.	Replace sensor.
AIR/COND DOOR OPEN light fails to operate.	Bulb burned out.	Replace bulb.
	No current to sensor.	Check all wire segments and connections.
	Sensor activates at too low a setting.	Replace sensor.
	Defective sensor.	Replace sensor.
AIR/COND DOOR OPEN light fails to extinguish.	Sensor terminals bridged.	Remove material between terminals.
	Sensor activates at too high a setting.	Replace sensor.
	Defective sensor.	Replace sensor.

CENTRAL WARNING SYSTEMS (Cont.)

CHART 3101. TROUBLESHOOTING ANNUNCIATOR (5 of 6)

Trouble	Cause	Remedy
STARTER ENGAGE light fails to operate.	Bulb burned out.	Replace bulb.
	5A fuse open.	Replace fuse.
	Sensor activates at too low a setting.	Replace sensor.
	Defective sensor.	Replace sensor.
STARTER ENGAGE light fails to extinguish.	Starter contactor terminal shorted.	Replace contactor.
	Defective annunciator.	Replace annunciator.
FLAPS IN TRANSIT light fails to operate.	Bulb burned out.	Replace bulb.
	No current to sensor.	Check all wire segments and connections.
	Sensor activates at too low a setting.	Replace sensor.
	Defective sensor.	Replace sensor.
FLAPS IN TRANSIT light fails to extinguish.	Sensor terminals bridged.	Remove material between terminals.
	Sensor activates at too high a setting.	Replace sensor.
	Defective sensor.	Replace sensor.

CENTRAL WARNING SYSTEMS (Cont.)

CHART 3101. TROUBLESHOOTING ANNUNCIATOR (6 of 6)

Trouble	Cause	Remedy
PITOT HEAT OFF/INOP light fails to operate.	Bulb burned out.	Replace bulb.
	No current to sensor.	Check all wire segments and connections.
	Defective sensor.	Replace sensor.
PITOT HEAT OFF/INOP light fails to extinguish.	Heat switch fails to open.	Replace switch.
	Sensor activates at too high a setting.	Replace sensor.
	Defective sensor.	Replace sensor.

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CENTRAL WARNING SYSTEMS (Cont.)

C. Annunciator Panel

The annunciator panel is a small cluster of lights which warn of malfunctions in various circuits or systems. A malfunction is identified by illumination of an individual warning light. There are seven to ten warning lights (depending on installed options). Power is supplied from bus bar through a 5 amp ANNUN PANEL ciruit breaker.

VACUUM INOP warning light is controlled by a vacuum sensor switch located at bulkhead and is attached to vacuum regulator. Sensor switch will activate when differential pressure is below 3.5 in. hg.

OIL PRESSURE warning light is controlled by an oil pressure switch in oil line, located at bulkhead. Sensor switch will activate when oil pressure is below 35 psi.

On 14-volt systems (HP S/N's 3246001 thru 3246017 only) the ALTERNATOR INOP warning light is illuminated by current flowing from bus bar to alternator circuit. This condition exists when alternator is not operating properly and output is zero. During normal operation, alternator warning circuit is also supplied with power from top diode terminal. This current flows through a 5 amp fuse, located above diode heat sink, to resistor and diode creating a no-flow condition which does not allow warning light to light.

On 28-volt systems (HP S/N's 3246018 & up and TC S/N's 3257001 & up) the ALTERNATOR INOP warning light comes from the alternator winding through a fuse to an alternator out switch which controls the annunciator light.

FLAPS IN TRANSIT (FLAPS) annunciator lights whenever a new flap position is selected and remains on while the flaps are moving.

GEAR WARN (GEAR WARNING) annunciator will light whenever:

1. Power is reduced below approximately 14 inches of manifold pressure with the landing gear up.
2. Gear selector switch is in UP position while airplane is on ground with weight on wheels
3. Flaps are extended beyond approach position (10°) and landing gear is retracted.

BAGGAGE DOOR (BAGG DOOR AJAR) annunciator lights when baggage door is not properly closed

AIR/COND DOOR OPEN (AIR/COND DOOR) (optional) annunciator lights when air conditioner door is not properly closed.

PITOT HEAT OFF/INOP annunciator (not in HP S/N's 3246001 thru 3246017) lights when pitot heat fails or is selected off.

STARTER ENGAGE annunciator lights to indicate when the starter is engaged.

LOW BUS VOLTAGE annunciator lights to indicate low voltage supply to the bus.

The press-to-test button is used to check operation of lights when engine is running. Lights will work when engine is not running with master switch turned on.

GRIDS 2K12 THRU 2L24
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AIRPLANE MAINTENANCE MANUAL

CARD 3 OF 5

PA-32R-301

Saratoga II HP

(S/N's 3246001 AND UP)

PA-32R-301T

Saratoga II TC

(S/N's 3257001 AND UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-879 **February 16, 2004**

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Member
General Aviation
Manufacturers Association

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-879) published June 24, 1996 and reissued July 1, 1997 are as follows:

Revision	Publication Date	Aerofiche Card Effectivity
ORG950712	June 24, 1996	1, 2, 3, and 4
CR970701	July 1, 1997	1, 2, 3, 4, and 5
PR990715	July 15, 1999	1, 2, 3, 4, and 5
PR011215	December 15, 2001	1
PR020331	March 31, 2002	1
PR040216*	February 16, 2004	1, 3, and 5

*** PARTIAL REVISION OF MAINTENANCE MANUAL 761-879**

Revisions appear in Aerofiche Cards 1, 3, and 5. Accordingly, discard your existing Cards 1, 3, and 5 and replace them with these three cards dated 02/16/04.

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

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INTRODUCTION

TABLE OF CONTENTS / EFFECTIVITY

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INTRODUCTION

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-32R-301/301T Saratoga II HP and TC 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).

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-32R Parts Catalog P/N 761-880, 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.

Be sure to supply the correct serial number information in any correspondence or communication concerning your airplane.

EFFECTIVITY

This maintenance manual is effective for PA-32R-301 Saratoga II HP airplanes serial numbers 3246001 and up and PA-32R-301T Saratoga II TC airplanes serial numbers 3257001 and up.

This encompasses the following model years:

— Note —

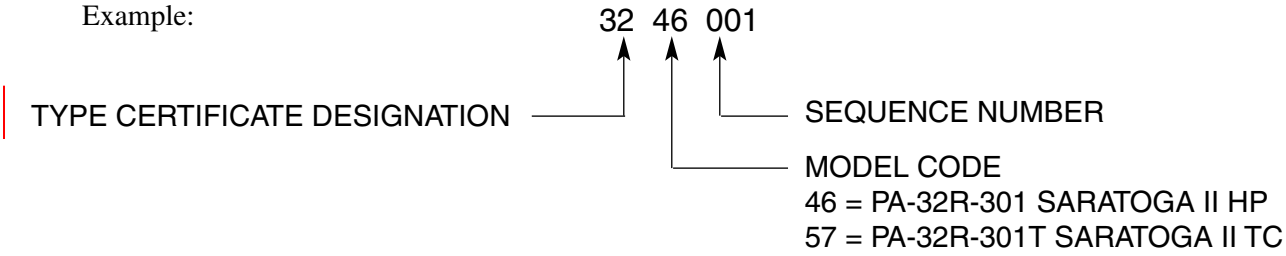
The following is provided as a general reference only.

PA-32R-301 Saratoga II HP:	Model Year	Serial Numbers
	1995	3246001 thru 3246017
	1996	3246018 thru 3246059
	1997	3246060 thru 3246087
	1998	3246088 thru 3246125
	1999	3246126 thru 3246153
	2000	3246154 thru 3246165
	2000.5	3246166 thru 3246181
	2001	3246182 thru 3246203
	2002	3246204 thru 3246209
	2003	3246210 thru 3246217
	2004	3246218 and up

PA-32R-301T Saratoga II TC:	Model Year	Serial Numbers
	Prototype	3257001
	1998	3257002 thru 3257075
	1999	3257076 thru 3257123
	2000	3257124 thru 3257155; less 3257144
	2000.5	3257156 thru 3257198; and 3257144
	2001	3257199 thru 3257266
	2002	3257267 thru 3257296
	2003	3257297 thru 3257338
	2004	3257339 and up

SERIAL NUMBER EXPLANATION

Example:



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

PAGINATION

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

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 List of Illustrations for all fiche in this set.
(3) A complete List of Charts for all fiche in this set.

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 illustrations, or list of charts.

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

Original and Reissue:	None	
Revisions:	First:	Revision Indication (1R Month-Year)
	Second:	Revision Indication (2R Month-Year)
	Subsequent revisions follow with consecutive numbers such as 3R, 4R, etc.	
Added Subject:		Revision Identification, (A Month-Year)
Deleted Subject:		Revision Identification, (D Month-Year)

INDEXING

Each System/Chapter begins with an individual Table of Contents.

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.

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.

SUPPLEMENTARY PUBLICATIONS

The following is a list of publications providing servicing, overhaul and parts information on various components on the PA-32R-301/301T airplanes, which you should use to supplement this manual.

A. Piper Publications:

(1) Parts Catalog - P/N 761-880

(2) Progressive Inspection Manuals (50 hour):
P/N 761-881 (pending) for the SARATOGA II HP (S/N's 3246001 & up), and
P/N 761-896 (pending) for the SARATOGA II TC (S/N's 3257001 & up).

(3) Periodic Inspection Report Forms:
P/N 230-1047 for the SARATOGA II HP (S/N's 3246001 & up), and
P/N 230-2047 for the SARATOGA II TC (S/N's 3257001 & up).

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.

AIR CONDITIONING COMPRESSOR:

Vendor:
York Industries
1750 Toronita Street
York, Pennsylvania 17402
(717) 846-1988

(or)

Sanden International (USA), Inc.
601 South Sanden Blvd.
Wylie, TX 75098-4999
(972) 442-8400
http://www.sanden.com

ALTERNATOR

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

AUTOFLIGHT:

Vendor(s):
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 76067-9236
PH - (940) 325-9406
www.s-tec.com

BRAKES:

Vendor:
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

ELECTRONIC FLIGHT DISPLAY SYSTEM (EFDS)

Vendor:	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

EMERGENCY LOCATOR TRANSMITTER:

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

ENGINE:

Vendor:	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:	IO-540- ..... - K1G5, ... ENGINES - P/N PC-615 TIO-540-AH1A ENGINES - P/N PC-615-12	
Operators Handbook:	O-540, IO-540 SERIES - P/N 60297-10 TIO-540 Series - P/N 60297-23	

— 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.

ELECTRIC FUEL PUMP:

Vendor(s):	Parker Hannifin Corp. Airborne Division 711 Taylor Street Elyria, Ohio 44035 PH - (800) 382-8422	(or)	Weldon Pump 640 Golden Oak Parkway Oakwood Village, OH 44146 PH - (216) 232-2282

http://www.parker.com/cleveland/Universe/book.pdf

FUEL CELLS:

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

GEAR LOCKING ACTUATORS, NOSE GEAR DOOR ACTUATOR, HYDRAULIC PUMP, AND ALL HYDRAULIC COMPONENTS:

Vendor:	Parker Hannifin Corp. (See Brakes, above)

HI-LOK FASTENERS AND TOOLS:

Vendor:	Hi-Shear Corporation 2600 Skypark Drive Torrance, California 90509 (213) 326-8110	PH - (213) 326-8110

LIGHTS - NAVIGATION/STROBE LIGHTS STANDBY/MAP:

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

MAGNETOS:

Vendor:	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	

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

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

OXYGEN SYSTEM: (TC only)

Vendor:	Scott Aviation 2225 Erie Street Lancaster, New York 14086 http://www.scottaviation.com/	PH - (716) 683-5100

PROPELLER:

Vendor:	Hartzell Propellor Inc. One Propellor Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH - (937) 778-4379 FAX - (937) 778-4321
Standard Practices:	Manual No. 202A	
Overhaul and Maintenance:	Manual No. 113B	
Aluminum Blade Overhaul:	Manual No. 133C	
Propeller Owner's Manual and Logbook:	Manual No. 115N	

PROPELLER GOVERNOR:

Vendor:	Hartzell Propeller Inc. One Propellor Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH - (937) 778-4379 FAX - (937) 778-4321
Governor Maintenance:	Manual No. 130B	

STANDBY ATTITUDE INDICATOR:

Vendor:	Mid-Continent Instruments Co., Inc. 9400 E. 34 TH Street N. Wichita, KS 67226 http://www.mcico.com/index.html	PH - (316) 630-0101 FAX - (316) 630-0723
Installation Manual and Operating Instructions:	Manual No. 9015762	

STARTER:

Vendor:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252

VACUUM PUMPS:

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

VACUUM REGULATORS:

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

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SYSTEM / CHAPTER INDEX GUIDE

SYSTEM / CHAPTER INDEX GUIDE (cont)

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SYSTEM / CHAPTER INDEX GUIDE (cont)

— Note —

For Vendor Publications, see Introduction - Supplementary Publications.

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32

LANDING GEAR

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CHAPTER 32 - LANDING GEAR

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GENERAL

This chapter contains instructions for the overhaul, inspection, and adjustment of the landing gear, extension and retraction, and brake systems; and, adjustments for the electrical limit, safety and warning systems. Information on the hydraulic pump and distribution system is found in Chapter 29, Hydraulics.

A. DESCRIPTION AND OPERATION

The SARATOGA II HP and SARATOGA II TC are equipped with a retractable tricycle air-oil strut type landing gear which is hydraulically operated by an electrically powered reversible pump. A selector handle on the instrument panel to the left of the control quadrant is used to select gear up or down positions.

Gear positions are indicated by three green lights located above the selector lever for gear down and locked position. A red gear warning light located on the annunciator panel indicates gear unsafe condition. There are no indications that the landing gear has fully retracted other than all lights are out. When the landing gear moves to the down position and each down lock hook moves into its locked position, a limit switch is actuated to its normally closed (NC) condition. This will illuminate a green light indicating that the individual gear is safely down and locked. The activation of all three down lock switches will also shut off the hydraulic pump. When the Day/Night switch is in the night position, the green lights will dim. When the gear begins to retract and the down lock hook disengages, the down limit switch actuates to the (NC) position and is in series with the (NC) circuit of the up limit switch allowing 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) position. When the gear begins to extend, the up limit switches will again move to their NC position. Since the down limit switches are already in their NC position, the unsafe light will illuminate, and the gear horn will sound, until the down lock hooks engage, moving the down limit switches to their NO position.

The red gear unsafe light also operates simultaneously with the warning horn. Both serve a dual purpose. Their primary purpose is to give warning when power is reduced below approximately 14 inches of manifold pressure and the landing gear has not reached the down and locked position. This circuit is controlled by the three paralleling down limit switches connected in series with the throttle switch. The secondary function of the warning light and horn is to give warning when the gear selector handle is up while the airplane is on the ground. The warning light will also illuminate, and the warning horn will sound, when the flaps are extended more than 10° and the landing gear is ***not*** down and locked. A micro switch installed on a cam located on the flap torque tube will, when closed, give an indication that the gear is not down and locked regardless of the gear lever up or down position. When the airplane is setting on the ground, the warning circuit is controlled through the (NO) side of the safety switch (squat switch) located on the left gear and on the up position of the gear selector lever. When the airplane is raised from the ground, such as in flight, far enough to move the safety switch to its (NC) position, current is directed in series through the hydraulic pressure switch, the pump switch, and the up positioned selector lever. The up limit, safety, pressure and selector switch, and pump solenoids are all protected by the landing gear control and warning circuit protector. (Refer to Chapter 91 for electrical schematic.)

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 assemblies of each main gear. As the gear retracts, doors partially enclose each gear through mechanical linkage. Each main gear is held in its up position by hydraulic pressure on each cylinder. There are no up locks, and loss of hydraulic pressure will allow the gears to drop. The landing gears are normally extended and retracted by the operation of the gear selector switch.

GENERAL (cont.)

There is an emergency system for extending the gear in the event the gear fails to extend after placing the gear selector switch in the down position. A gear down emergency free fall valve, located under the floorboard on the left side of the forward baggage compartment, allows the landing gear to extend when opened by the operation of a push pull cable knob, located on the instrument panel just below the primary gear selector switch.

To help the nose gear to extend, there are two springs, one inside the other, mounted on arms above the gear links. The main gear requires no assist springs. Once the gear is down and the down lock hooks engage, a spring maintains each hook in a locked position until hydraulic pressure releases it. A further description of the hydraulic system will be found in Chapter 29, Hydraulic System.

The nose gear is steerable through a 45 degree arc by use of the rudder pedals. As the gear retracts, however, the steering linkage becomes disengaged 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.

The two main wheels are equipped with self-adjusting heavy duty double piston, single-disc hydraulic brake assemblies. Toe brakes are standard on both pilot and copilot's rudder pedals.

A parking brake is incorporated with a handle and is applied by pulling back on the handle and, while holding the handle back, pushing forward on the button located left of the handle. To release the hand brake, pull aft on the handle and allow it to swing forward. Hydraulic fluid for the cylinder is supplied by a reservoir installed on the left forward side of the fire wall.

B. TROUBLESHOOTING.

Mechanical and electrical switch troubles peculiar to the landing gear system are listed in Chart 3201. When troubleshooting, first eliminate hydraulic malfunctions as listed in Chapter 29 and Chart 3203. Then proceed to switch malfunctions and last to the mechanical operation of the gear itself, both of which are listed in this section. Always place the airplane on jacks before attempting any troubleshooting of the gear.

CHART 3201. TROUBLESHOOTING LANDING GEAR (1 of 6)

Trouble	Cause	Remedy
Red GEAR WARN annunciator out light 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.

GENERAL (cont.)

CHART 3201. TROUBLESHOOTING LANDING GEAR (2 of 6)

Trouble	Cause	Remedy
— Note — The out of adjustment or failed switch may be determined by noting which down light is not lit.		
Red GEAR WARN annunciator light on though gear has retracted.	One or more up limit switches failed. Nose gear up limit switch out of adjustment. Main gear not retracting enough to actuate switch.	Isolate and replace switch(es). Check gear up adjustment and readjust up limit switch. Check gear up adjustment.
Red GEAR WARN annunciator on though gear is down and locked.	One or more down limit switches failed. Nose gear down limit switch out of adjustment. Main gear down limit switch out of adjustment.	Isolate and replace switch(es). Readjust down limit switch. Readjust down limit switch.
Red GEAR WARN annunciator light operates on and off after gear has retracted.	Light circuit wire loose. Hydraulic system losing pressure. Gear up switch out of adjustment	Check wiring. Refer to Hydraulic System, Chapter 29. Check gear up adjustment and then switch adjustment.
Red GEAR WARN annunciator and one green gear down light out though gear is down and locked.	Lamp burned out. Gear down limit switch failed. Light circuit wire broken.	Replace lamp. Replace switch. Check wiring.

GENERAL (cont.)

CHART 3201. TROUBLESHOOTING LANDING GEAR (3 of 6)

Trouble	Cause	Remedy
Red GEAR WARN annunciator and all green lights out.	Indicator lights circuit breaker open	Reset circuit breaker and determine cause for open circuit breaker.
	Light circuit wire broken.	Check wiring.
Red GEAR WARN annunciator 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. — Note — When replacing diode, connect banded end (cathode) to terminal ends of wires G2K and G2L on mounting block.
	Diode in circuit between throttle switch "A" and light/horn open.	Replace diode.
After gear has been extended through use of the free fall knob, Red GEAR WARN annunciator and horn fail to stop when throttle is closed.	Gear selector handle in up position.	Place handle in down position.
Red GEAR WARN annunciator and horn fail to operate when selector switch is moved to up position with gear extended and throttle ***not*** full forward: 1. In flight	Annunciator light and horn circuit wire broken.	Check wiring.
2. On ground	Defective safety (squat) switch.	Replace switch.

GENERAL (cont.)

CHART 3201. TROUBLESHOOTING LANDING GEAR (4 of 6)

Trouble	Cause	Remedy
Hydraulic pump shuts off after gear retraction, but Red GEAR WARN annunciator remains on.	Gear not fully retracted. Gear not contacting up micro switches.	Check gear retraction adjustments. Check gear up switches.
Green gear down lights dim though position light switch is off,and gear is down and locked.	Lights grounding through dimming resistor instead of instrument panel control switch. (Failed instrument panel light control switch.)	Replace switch.
Green gear down light fails to go out with gear in transit or retracted.	Gear down limit switch failed.	Replace switch.
Greengear down lights blink momentarily before the down lock is engaged on roller.	Micro switch out of adjustment.	Adjust microswitch.
Nose landing gear shimmies during fast taxi, take-off or landing.	Internal wear in shimmy dampener. Shimmy dampener or bracket loose at mounting. Tire out of balance Worn or loose wheel bearings. Worn torque link bolts and/or bushings.	Replace shimmy dampener. Replace necessary parts and bolts. Check balance and replace tire if necessary. Replace and/or adjust wheel bearings. Replace bolts and/or bushings.
Excessive or uneven wear on nose tire.	Incorrect operating pressure. Wear resulting from shimmy.	Inflate tire to correct pressure. Refer to preceding for correction; then replace tire.

GENERAL (cont.)

CHART 3201. TROUBLESHOOTING LANDING GEAR (5 of 6)

Trouble	Cause	Remedy
Nose gear fails to steer properly.	Oleo cylinder bindings in strut housing.	Lubricate strut housing (refer to Lubrication Chart, Chapter 12).
		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, take-off, 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.

GENERAL (cont.)

CHART 3201. TROUBLESHOOTING LANDING GEAR (6 of 6)

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 alignment
	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

A. Main Gear Oleo

1. Disassembly of main gear oleo (Refer to figure 32-1)

The main gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed in the airplane.

a. Place airplane on jacks.
b. Place a drip pan under main gear to catch spillage.
c. Remove air and fluid from oleo. Depress air valve core pin until strut pressure has diminished; remove filler plug and with a thin hose siphon as much hydraulic fluid from strut as possible.
d. Disconnect brake line at joint located in wheel well.
e. Remove piston tube assembly from oleo housing:

(1) Remove upper and lower torque link connecting bolt assembly and separate links.
(2) Note number and thickness of spacer washer(s) between two links.

f. Compress piston tube; reach up into tube and release snap ring from annular slot at bottom of oleo housing.
g. Pull piston tube with component parts from cylinder housing.
h. Remove piston tube components by reaching in tube and pushing out upper bearing retainer pins. Slide off upper bearing with O-rings, wiper and washer.
i. Remove orifice tube from oleo housing by removing locknut and washer from top of housing. Draw tube with O-ring and retainer from housing.
j. Removed orifice plate from bottom of orifice tube by releasing snap ring holding plate in position.
k. To remove piston tube plug and O-ring located in bottom end of tube, remove bolt assembly and insert a rod up through hole in body of fork and push plug with O-ring from top of tube.

2. Cleaning, Inspection and Repair of Main Gear Oleo

a. Clean all parts with a suitable dry type cleaning solvent.
b. Inspect landing gear oleo assembly components for following:

(1) Bearings and bushings for excess wear, corrosion, scratches and overall damage.
(2) Retaining pins for wear and damage.
(3) Lock rings for cracks, burrs, etc.
(4) Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.
(5) Orifice plate for hole restriction.
(6) Fork tube for corrosion, scratches, nicks, dents and misalignment.
(7) Air valve general condition.

c. Repair of oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.

MAIN GEAR AND DOORS (Cont.)

1. SWITCH ACTUATOR BRACKET
2. BOLT, WASHER, NUT AND COTTER PIN
3. BOLT, WASHER, NUT AND COTTER PIN
4. BOLT, WASHER, NUT AND COTTER PIN
5. AXLE NUT
6. NUT
7. WASHER
8. RETAINER
9. O-RING
10. VALVE ASSEMBLY
11. OLEO STRUT HOUSING
12. ORIFICE TUBE
13. ORIFICE PLATE
14. SNAP RING
15. UPPER LINK ASSEMBLY
16. LOWER LINK ASSEMBLY
17. BEARING RETAINER PIN
18. UPPER BEARING
19. OUTER O-RING
20. LOWER BEARING
21. INNER O-RING
22. WIPER STRIP
23. WASHER
24. SNAP RING
25. PISTON TUBE
26. PLUG
27. O-RING
28. FORK ASSEMBLY
29. BOLT ASSEMBLY
30. SQUAT SWITCH BRACKET
31. SPRING ATTACHMENT PLATE
32. PISTON RING

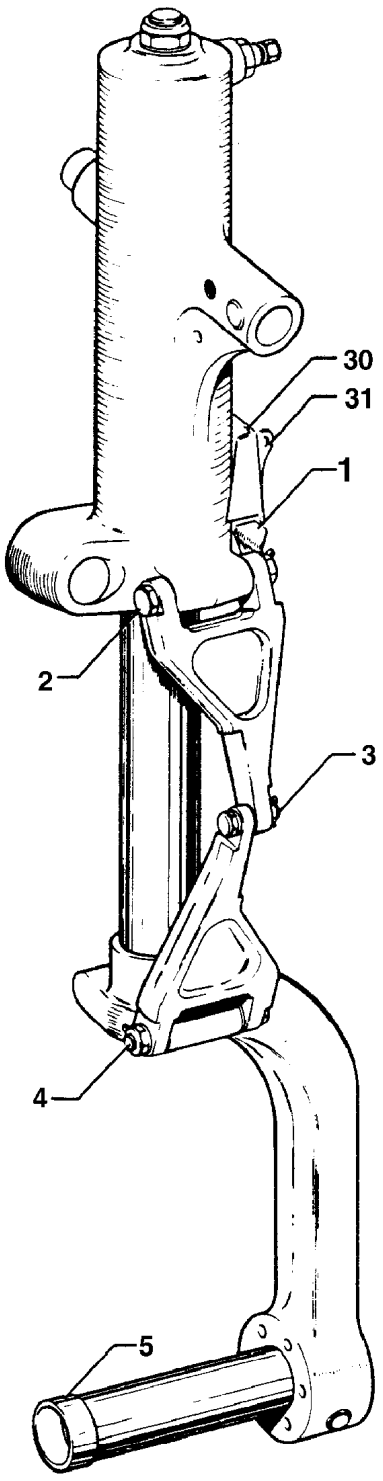


Figure 32-1. Main Gear Oleo Strut Assembly (1 of 2)

MAIN GEAR AND DOORS (Cont.)

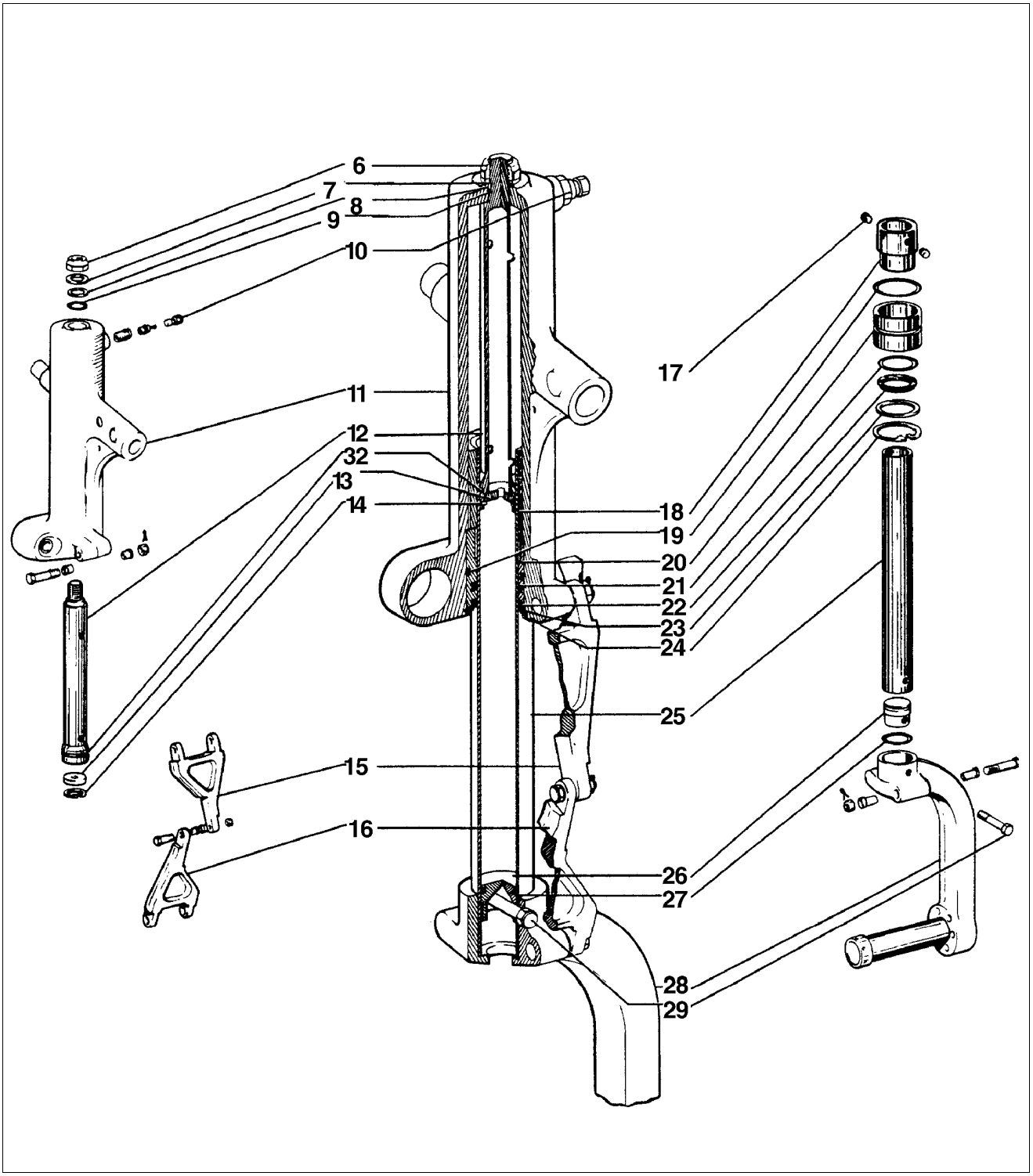


Figure 32-1. Main Gear Oleo Strut Assembly (2 of 2)

MAIN GEAR AND DOORS (Cont.)

3. Assembly of Main Gear Oleo (Refer to Figure 32-1)

   a. Determine that all parts are cleaned and inspected.
   b. To install piston tube plug, first lubricate plug o-ring with hydraulic fluid (MIL-H-5606A) and install it on plug. Lubricate inside wall of tube. Insert plug into top of tube and push it to fork end. Align the bolt holes of fork, tube and plug, and install bolt assembly.
   c. If desired, cement a cork in hole in bottom of fork body to prevent dirt from entering between fork and tube.
   d. To assemble components of orifice tube, insert orifice plate into bottom of tube and secure with snap ring.
   e. To install tube in oleo housing, insert tube up through housing. With end of tube exposed through top of housing, install o-ring, retainer, washer, and locknut. Tighten locknut only finger tight at this time.
   f. Assemble components of piston tube on tube by placing, in order, snap ring, washer, lower bearing with outer and inner o-ring and upper bearing. Align two .125 diameter holes and lock pin holes with corresponding holes in piston tube and install pins.
   g. Lubricate wall of cylinder oleo housing and tube, and carefully insert tube assembly into housing, guiding orifice tube into piston tube. Install wiper strip, slide washer into position and secure assembly with snap ring.
   h. Tighten locknut at top of housing.
   i. Ascertain that bushings are installed in upper and lower torque links and then install links. Torque link bolt assemblies should be lubricated and installed with flat of bolt head hex adjacent to milled stop of wide end of link. (Use same thickness of spacer washers between two links as those removed to maintain correct wheel alignment.) Tighten bolts only tight enough to allow no side play in links, yet be free enough to rotate.

— Note —

Instructions contained in paragraph 3j, below, pertain to left oleo strut assemblies only.

   j. Assemble squat switch actuator bracket on bolt assembly. Insert a rivet through hole provided in bracket into upper link and install nut. Install squat switch bracket immediately above actuator bracket.
   k. Attach spring attachment plate to mounting lug on base of housing immediately above upper link.
   l. Connect brake line and bleed brakes.
   m. Lubricate gear assembly. (Refer to Lubrication Chart, Chapter 12.)
   n. Compress and extend strut several times to ascertain strut will operate freely. Weight of gear wheel and fork should allow strut to extend.
   o. Service oleo strut with fluid and air. (Refer to Oleo Struts, Chapter 12.)
   p. Check main gear alignment (refer to Alignment of Main Landing Gear) and gear operation. Ascertain that gear is down and locked.
   q. Remove airplane from jacks.

MAIN GEAR AND DOORS (Cont.)

B. Main Landing Gear.

1. Removal of Main Landing Gear (Refer to Figure 32-2)

a. Place airplane on jacks.
b. Side brace link assembly may be removed by following procedure:

(1) With gear in extended position, disconnect gear down lock spring.
(2) Disconnect rod end of actuating cylinder from retraction fitting on upper side brace removing nut, washer and bolt, and bushing and spring swivel.
(3) Disconnect lower side brace link from gear housing by removing attachment nut, washer and bolt. Note bushings on each side of end bearing.
(4) Disconnect upper side brace link from side brace support fitting stud by removing cotter pin, nut, washer and attachment bolt.
(5) Remove side brace support fitting by removing cap bolts securing fitting to web of spar.
(6) Remove assembly and further disassemble and inspect as needed.

c. Strut housing with components may be removed by following procedure:

(1) Disconnect brake line at its upper end in wheel well.
(2) Disconnect gear door actuating rod at gear housing.
(3) Remove access plate located on underside of wing, aft of landing gear.
(4) If not previously disconnected, disconnect lower side brace link from gear housing.
(5) Disconnect forward support fitting of housing from web of main spar by removing fitting attachment bolts.
(6) Remove retainer tube in aft support fitting that supports aft arm of housing by reaching through access opening on underside of wing, through hole in web and removing bolt that secures tube in housing. Insert a hook through bolt hole in tube, and slide it aft from support fitting. Remove tube from wing.
(7) Allow gear to drop free from wing.
(8) Aft support fitting may be removed by holding nuts in position, reaching through access opening, and removing fitting attachment bolts.
(9) Forward support fitting may be removed from arm of housing by removing bolt and washer from base side of fitting. Slide fitting from arm. Remove washer from arm.

d. Either bearing installed in support fittings may be removed by removing snap rings that hold bearing in housing. Push bearing from housing.

2. Cleaning, Inspection and Repair of Main Landing Gear.

a. Clean all parts with suitable dry type cleaning solvent.
b. Inspect gear components for the following unfavorable conditions:

(1) Bolts, bearing and brushing for excess wear, corrosion and damage.
(2) Gear housing, side brace links, torque links and attachment plates for cracks, bends or misalignment.
(3) Down lock hook for excessive wear of bearing surfaces.

MAIN GEAR AND DOORS (Cont.)

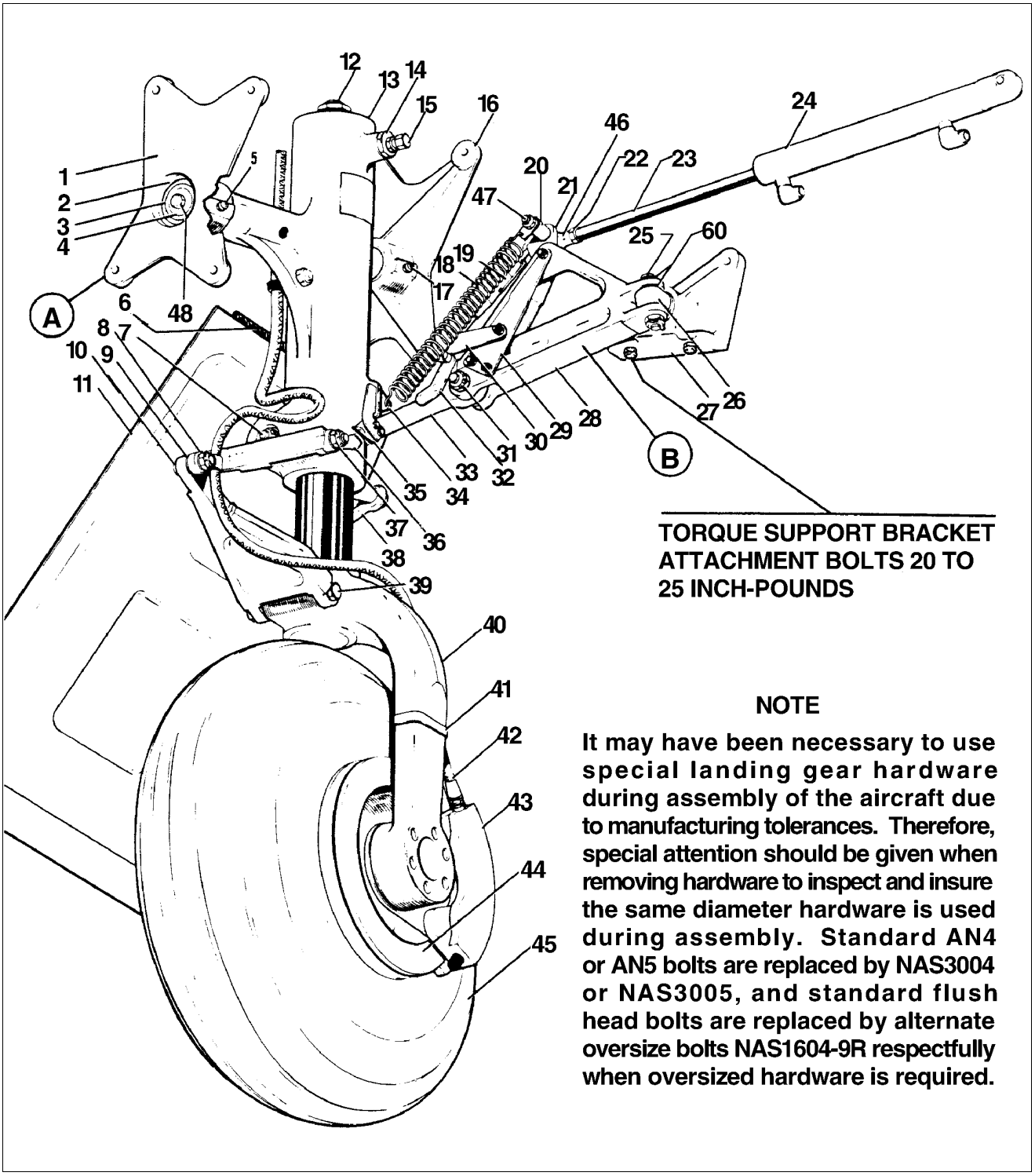
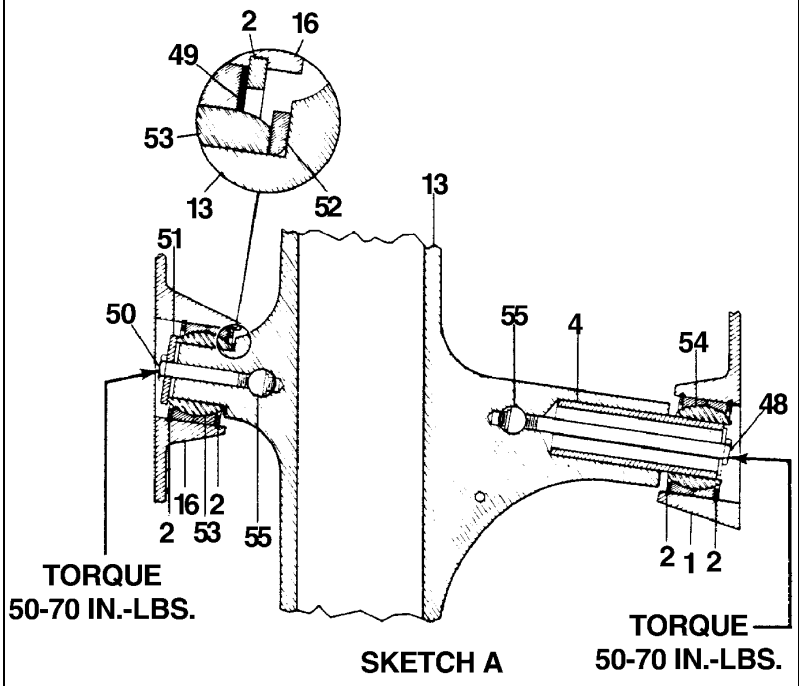


Figure 32-2. Main Gear Removal and Installation (1 of 2)

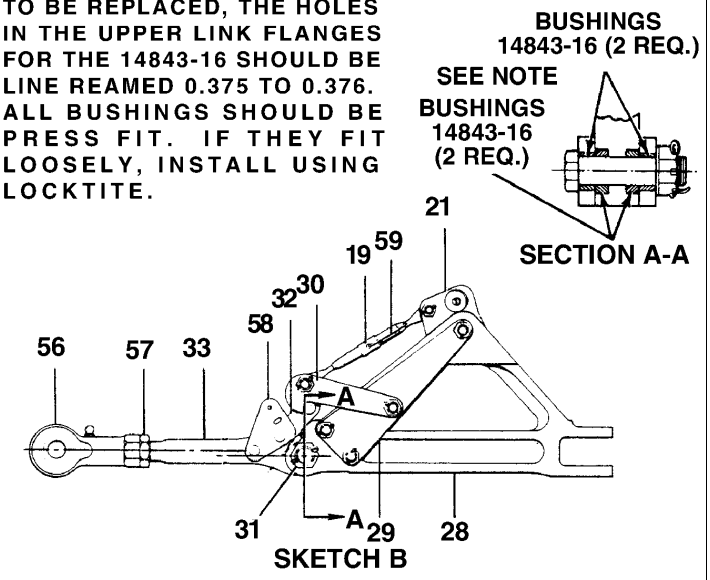
MAIN GEAR AND DOORS (Cont.)

1. SUPPORT FITTING, AFT
2. SNAP RING
3. BEARING
4. RETAINER, TUBE ASSEM8LY
5. FITTING, GREASE
6. HINGE, GEAR DOOR
7. BOLT, WASHERS AND NUT
8. LINK, UPPER
9. WASHER, SPACER
10. 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



SKETCH A

NOTE: WHEN THE TRUSS ASSEMBLY IS DISMANTLED, IF IT IS FOUND THAT THE BUSHINGS NEED TO BE REPLACED, THE HOLES IN THE UPPER LINK FLANGES FOR THE 14843-16 SHOULD BE LINE REAMED 0.375 TO 0.376. ALL BUSHINGS SHOULD BE PRESS FIT. IF THEY FIT LOOSELY, INSTALL USING LOCKTITE.



SKETCH B

Figure 32-2. Main Gear Removal and Installation (2 of 2)

MAIN GEAR AND DOORS (Cont.)

c. Inspect gear down lock spring for the following:

(1) Excessive wear or corrosion, especially around hook portion of spring. A spring should be rejected if wear or corrosion exceeds one-quarter diameter of spring. Clean away all corrosion and repaint.

(2) Check spring for load tensions below minimum allowable tolerance. Minimum tension of spring is 48 pounds pull at 7.9 inches. Measurement is taken from inner side of each hook.

d. Check general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

e. Check side brace link through center travel by attaching upper and lower links, setting them on a surface table, and ascertaining that when stop surfaces of the two links touch, linkage is not less than .062 nor more than .125 of an inch through center. Should distance exceed required through center travel and bolt and bushings are tight, replace one or both links.

f. With side brace links assembled and checked, ensure that when stop surfaces of the two links contact, clearance between each down lock hook and flat of down lock pin is not less than 0.010 of an inch. Should clearance be less than that required, hook only may be filed not to exceed a gap of more than 0.025 of an inch. Maximum allowable clearance between each hook and down lock pin that are service worn is 0.055 of an inch. Should clearance be more than 0.055 of an inch, replace pin, check clearance and then if still beyond tolerance, replace hooks. Gap between each hook should be equal.

g. Repair of 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.

3. Installation of Main Landing Gear (Refer to Figure 32-2)

— Note —

When assembling components of landing gear, lubricate bearings, bushings and friction surfaces with proper lubricant as described in Chapter 12.

a. Insert a gear support bearing in each support fitting and secure with snap rings. Check bearing for excess end play, shim as necessary with shim washers (P/N 62833-44).

b. Gear housing may be installed in wheel well of wing by the following procedure:

(1) Place spacer washer and then forward support fitting on forward arm of housing. Determine that barrel nut is properly positioned in arm and insert attachment bolt through washer and fitting into arm. Tighten bolt and ascertain that bearing is free to rotate.

(2) Position aft support fitting at its attachment point in wheel well and secure with bolts, washers and nuts. Install nuts and washers by reaching through access hole on underside of wing.

(3) With retainer tube for aft arm of housing in hand, reach up through access opening and insert tube into support fitting through hole in web.

(4) Position gear housing in wheel well and install forward support fitting with bolts and washers (One each AN960-416 and AN960-416L washer per bolt.)

MAIN GEAR AND DOORS (Cont.)

(5) Push retainer tube into arm of housing and secure with bolt.
(6) Check that gear rotates freely in its support fittings and recheck thrust.
(7) Connect brake line to its mating line in wheel well and bleed brakes.

c. Gear side brace link assembly may be installed by the following procedure:

(1) Position link support bracket with swivel stud installed at its attachment point on web of spar and secure with bolts and washers.

— Note —

When installing new wing, it will be necessary to back drill two (2) holes 0.250 inch and countersink 100 x .499 through spar cap. (Screw head should be flush with spar.) Use hole in support bracket as guide in drilling.

(2) Check that upper and lower links are assembled with down lock hook retraction fitting, etc, attached, and through travel of links and down lock hook clearance checked according to cleaning inspection and repair of main landing gear.
(3) Attach upper link to swivel stud of support fitting and secure with bolt, bushing, washer, nut and copper pin.
(4) Actuating cylinder rod end bearing and lower side brace link may be attached respectively to retraction fitting and strut housing during adjustment of landing gear.

d. Ensure that the landing gear is lubricated per Lubrication Chart, Chapter 12.
e. Check adjustment of landing gear per adjustment of main landing gear.
f. Check alignment of wheel per alignment of main landing gear.
g. Install access plate on underside of wing and remove airplane from jacks.

4. Adjustment of Main Landing Gear

a. Place airplane on jacks.
b. Level airplane laterally and longitudinally. (Refer to Leveling, Chapter 8.)
c. Disconnect gear door actuating rods at either door or housing, as desired, by removing rod attachment bolt. Secure door out of way.
d. 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.
e Check that rod end has sufficient thread engagement in end bearing, align flat sides of bearing casting with flat side of bearing and tighten jam nut.
f. Adjust turnbuckle of down lock mechanism by first determining that gear is down and locked, and then move retraction fitting outboard until it contracts stop slot of side brace link. Hold fitting in this position and turn turnbuckle barrel until down lock hooks make contact with lock pin. Safety the turnbuckle.
g. For easier adjustment of down lock limit switch, set it at this time as explained in Adjustment of Main Gear Down Limit Switch.
h. Retract and extend gear manually several times to ensure that side brace link falls through center; down lock hook falls into position and there is no binding of gear assembly.

MAIN GEAR AND DOORS (Cont.)

B. Main Landing Gear (cont.)

4. Adjustment of Main Landing Gear (cont.)

i. Adjust gear in up position to allow gear fork to press lightly into rubber bumper pad on wing. Adjust as follows:

— Note —

If it requires less than .025 of an inch to move gear into correct adjustment, paragraphs B, 4, i, 3, 4, and 5, below, may be skipped.

(1) Check that rod end bearing of actuating cylinder is disconnected from retraction fitting.
(2) Actuate hydraulic system to bring hydraulic cylinder to up position by turning master switch on and moving gear selector handle to up position. Piston of cylinder should be bottomed.
(3) Raise gear by pushing up on retracting fitting, thus disengaging hooks, and pushing up on pivot point at bottom of side brace links to bring links out of locked position. Raise gear until fork presses lightly into rubber pad. Retain gear in this position.
(4) Loosen jam nut on piston rod of actuating cylinder and turn rod end gearing in or out to allow a slip fit of attachment bolt.
(5) Install with attachment bolt, bushing, spring swivel, and secure with washer and nut. Install gear down lock spring.
(7) When gear is to within 0.125 of an inch of correct adjustment, rod end need not be disconnected Just loosen jam nut, place a wrench on the flat at end of piston rod and turn to obtain correct adjustment.
(8) Check rod end bearing for adequate thread engagement and tighten jam nut.
(9) If down lock limit switch is properly adjusted, retract and extend gear to ensure that the gear operates properly.

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MAIN GEAR AND DOORS (Cont.)

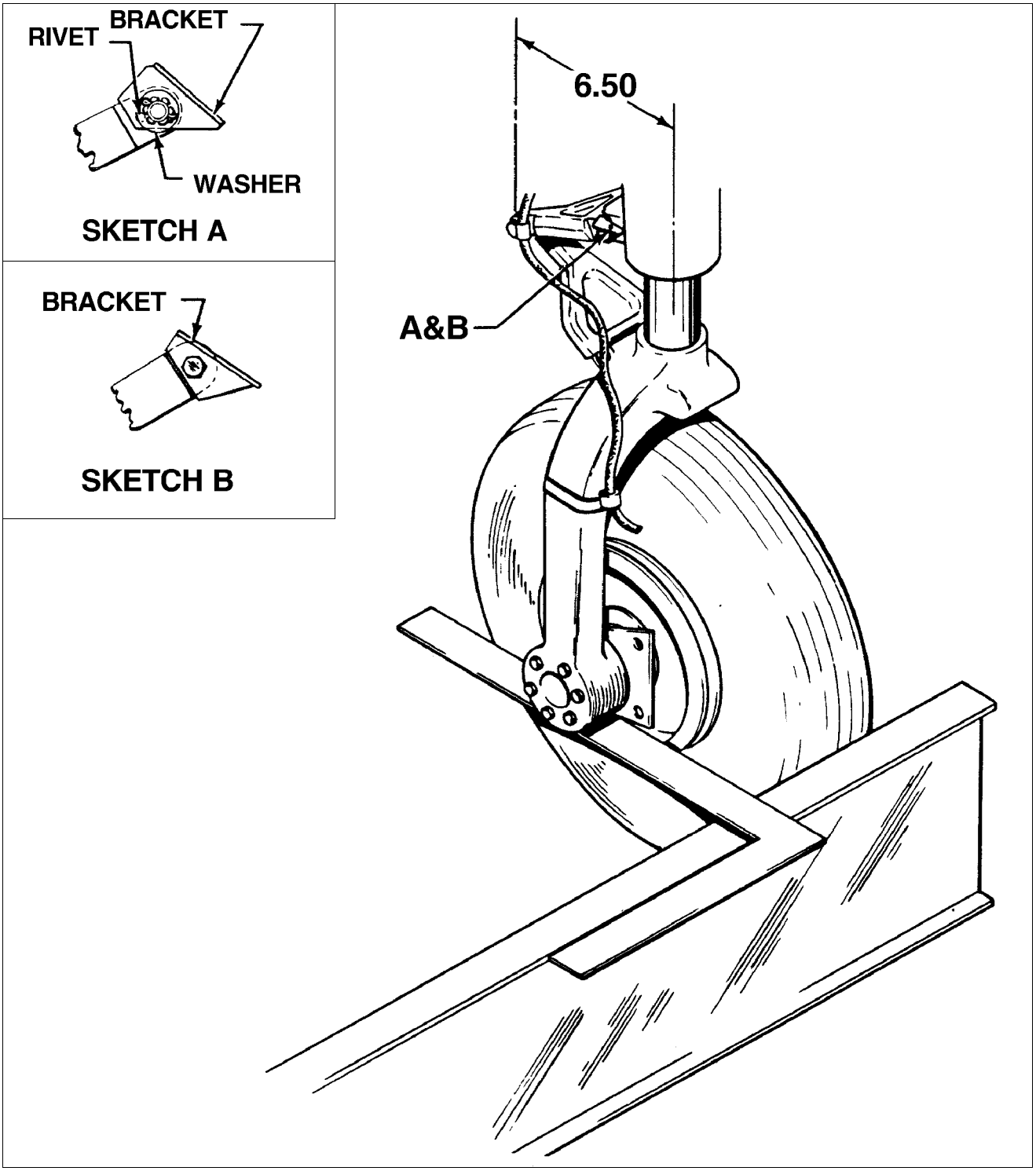

Figure 32-3. Aligning Main Gear

MAIN GEAR AND DOORS (Cont.)

5. Alignment of Main Landing Gear (Refer to Figure 32-3)

   a. Place a straightedge no less than 12 feet long across front of both main landing gear wheels. Butt straightedge against tire at hub level of landing gear wheels. Jack airplane up just high enough to obtain a six and one-half inch dimension between centerline of strut piston and centerline of center pivot bolt of gear torque links. Devise a support to hold straightedge in this position.

   b. Set a square against straightedge and check to see if its outstanding leg bears on front and rear side of brake disc. (It may be necessary to remove brake assembly to have clear access to disc.) If it touches both forward and rear flange, landing gear is correctly aligned. Toe-in for main landing gear wheels is $0 \pm {}^{1}/_{2}$ degree.

CHART 3202. TOE-IN / TOE-OUT CORRECTION

TOE-IN TOE-OUT ANGLE	SHIM WASHERS	WASHERS UNDER HEAD	WASHERS UNDER NUT	AN 174 BOLT
0°		AN960-416	AN960-416 (3)	-14
0° 33’	AN960-416	AN960-416	AN960-416 (2)	-14
0° 48’	AN960-416L AN960-416	AN960-416	AN960-416	-14
1° 04’	AN960-416 (2)	AN960-416	AN960-416	-14
1° 19’	AN960-416L AN960-416 (2)	AN960-416L	AN960-416	-14
1° 35’	AN960-416 (3)	AN960-416	AN960-416 (2)	-15
2° 05’ Max. Allow.	AN960-416 (4)	AN960-416	AN960-416	-15

AN960-416L Washers 0.031 Thick

AN960-416 Washers 0.062 Thick

— Note —

A carpenter’s square, because of its especially long legs, is recommended for checking main landing gear wheel alignment.

   c. If square contacts rear side of disc, leaving a gap between it and front flange, wheel is toed-out. If a gap appears at rear flange, wheel is toed-in.

   d. To rectify toe-in and toe-out condition, remove bolt connecting upper and lower torque links and remove or add spacer washers to move wheel in desired direction. Refer to the Tow-in, Toe-out Correction Chart (Chart 3202).

MAIN GEAR AND DOORS (Cont.)

e. Should a condition exist that all spacer washers have been removed and it is still necessary to move wheel further in or out, then it will be necessary to turn torque link assembly over. This will put link connecting point on opposite side allowing use of spacers to go in same direction.
f. Recheck wheel alignment. If alignment is correct, safety castellated nut with cotter pin.
g. If a new link on top left main gear had to be installed or it had to be reversed during alignment check, it will be necessary to check gear safety switch (squat switch) bracket for engagement and locking in place. If large machine surface of link is inboard, bracket is mounted with small rivet hole next to link. (Refer to Sketch A, Figure 32-3.) This hole should be aligned with centerline of link and a .096 inch hold drilled .150 inch deep. Insert an MS20426AD3-3 rivet in hole. This locking rivet is held in place by the flat washer, castellated nut and cotter pin. If link has to be reversed, then bracket and bolt are also reversed. (Refer to Sketch B, Figure 32-3.)
h. Check adjustment of landing gear safety switch (squat switch).

C. Main Gear Door Assembly

1. Removal of main gear door assembly.

a. With landing gear extended, disconnect door retraction rod from door by removing nut, washers, and bolt.
b. Remove door from wing panel by bending door hinge pin straight and from other end pulling out pin.
c. Door retraction rod may be removed from gear housing by cutting safety wire and removing attachment bolt and washer. Note number of washers between rod end bearing and housing.

2. Cleaning, inspection and repair of main gear door assembly.

a. Clean door and retraction rod with a suitable cleaning solvent.
b. Inspect door for cracks or damage, loose or damaged hinges and brackets.
c. Inspect door retraction rod and end bearing for damage and corrosion.
d. Repairs to a door may be replacement of hinge, repair of fiberglass and painting.

3. Installation of main gear door assembly.

a. Install door by positioning hinge halves of door and wing, and inserting hinge pin. It is recommended a new pin be used. Bend end of pin to secure in place.
b. Install door retraction rod by positioning rod at its attachment points at door and strut housing. At door attachment, thin washers are inserted at each side of rod end bearing and it is secured with bolt, washer and nut. At strut housing, place washers between rod end bearing and housing not to exceed .12 of an inch to obtain proper clearance and secure with bolt. Safety bolt with MS20995C41 wire.
c. Check that all around clearance between door and wing skin is not less than .032 of an inch.

MAIN GEAR AND DOORS (Cont.)

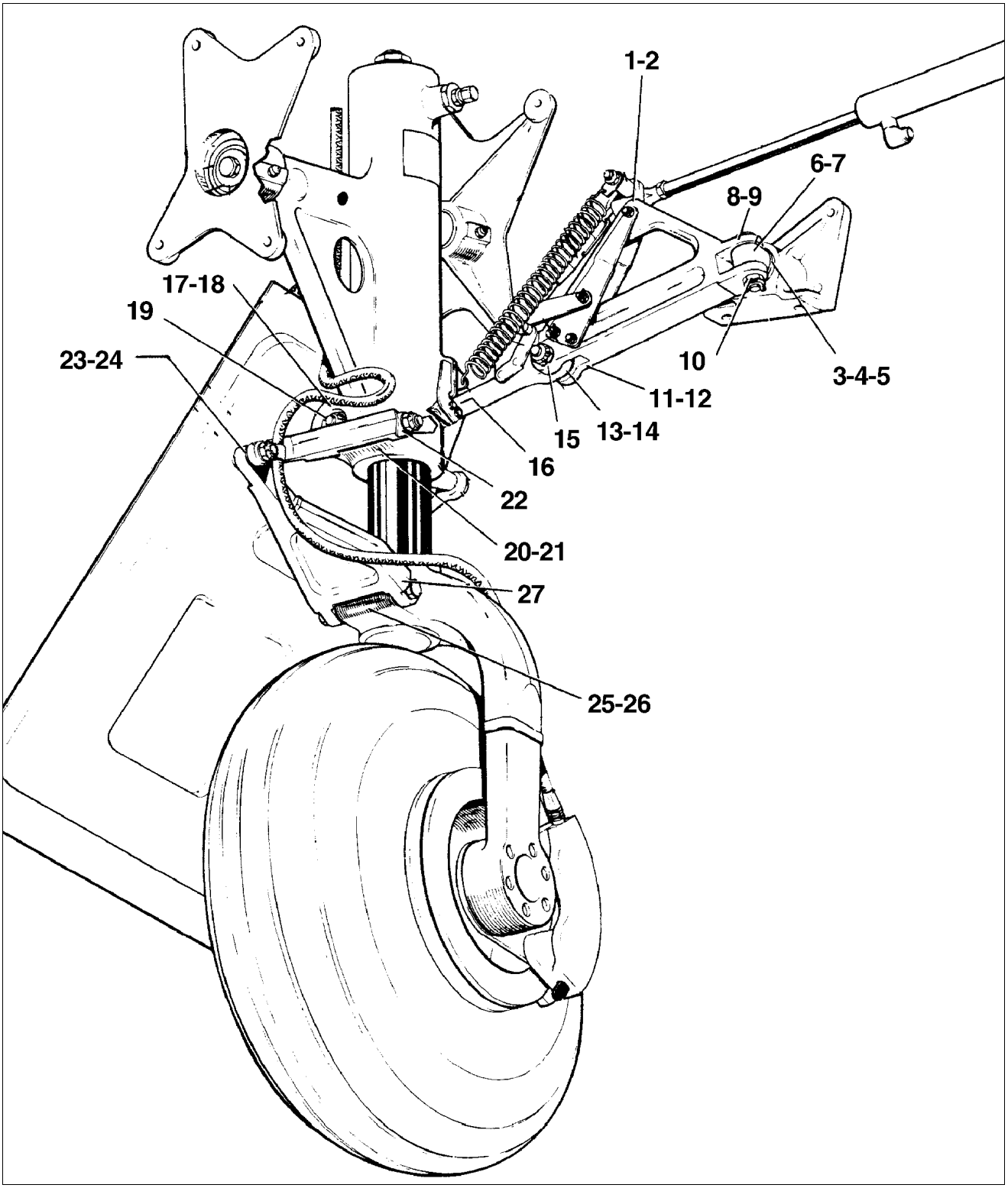

Figure 32-4. Main Gear Tolerances (1 of 3)

MAIN GEAR AND DOORS (Cont.)

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension [1]	Service Dimension [1]	Service Tolerance	Remarks
1.	67514-02	Link, Upper Side Brace	0.3645 0.3625			No Rotation
2.	63900-89	Bushing, Upper Side Brace Link	0.249 0.251	0.248 0.252	0.004	SEE NOTES 2 AND 5
3.	95643-6 95643-7	Support Bracket, Side Brace	0.7465 0.7470			
4.	67026-12	Bushing, Support Bracket	0.624 0.625	0.624 0.626	0.002	SEE NOTE 4
5.	78717-2	Stud, Side Brace Support	OD 0.6235 0.6225	OD 0.6220		
6.	78717-2	Stud, Side Brace Support	0.4365 0.4385	0.4355 0.4395	0.004	
7.	67514-02	Link, Upper Side Brace	0.4945 0.4935	0.4925		
8.	14843-16 (2)	Bushings, Side Brace Link	0.376 0.375	0.374		SEE NOTES 2 AND 5
9.	67514-02	Link, Upper Side Brace	0.4945 0.4935	0.4925		
10.	402 921 (NAS 464 P6-20)	Bolt, Link/Stud	OD 0.373+0 -0.002	OD.373+0 -0.004	0.004	
11.	67514-02	Link, Upper . Side Brace	0.4945 0.4935	0.4925		
12.	14843-16 (2)	Bushings, Side Brace Link	0.3745 0.3755	0.374		SEE NOTE 2
13.	67797-03	Link, Lower Side Brace	0.4925 0.4905	0.500		
14.	65003-44 (2)	Bushings, Lower Side Brace Link	0.373	0.372	0.004	SEE NOTES 2 AND 5
15.	402 927 (NAS-464-6-16)	Bolt, Side Brace Link	OD 0.3742+.00 -0.0005	0.3740		
16.	452 368	Bearing Assembly, Rod End	50 +0.0015 -0.0005	.50 +0.0030 -0.0005	.0035	
17.	67926-10 67926-11	Trunnion Housing, Side Brace Attachment	0.7530 0.7550	0.7530 0.7550		
18.	67026-05	Trunnion Bushing	0.499 0.500	0.498	0.004 0.502	SEE NOTE 3
19.	402 960 (NAS-464-P8A-44)	Bolt, Trunnion Side Brace Attachment	OD 0.04991+.00 -0.0009	0.4972		
20.	67926-10 67926-11	Trunnion Housing, Torque Link Attachment	0.4410 0.4430	0.4410 0.4440		
21.	67026-07 (2)	Trunnion Bearing	0.313 0.314	0.315		SEE NOTES 2, 3 AND 5

Figure 32-4. Main Gear Tolerances (2 of 3)

MAIN GEAR AND DOORS (Cont.)

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension [1]	Service Dimension [1]	Service Tolerance	Remarks
22.	67012-00	Torque Link	0.312 +0.001 -0.0	0.312 +0.002 -0.0		
23.	67012-00	Torque Link	0.3760 0.3745	0.3770 0.3745	0.0025	
24.	31796-00	Bushing, Torque Link	0.252 0.251	0.253 0.251	0.002	SEE NOTES 2 AND 5
25.	67037-04	Strut Assembly	0.4385	0.4395 0.4370	0.0025 0.4370	
26.	67026-07	Strut Bearing	0.313 0.314	0.313 0.315	0.002	SEE NOTES 2 AND 5
27.	67012-00	Torque Link	0.312 +0.001 -0.0	0.312 +0.002 -0.0		

— Notes —

1. ALL DIMENSIONS ARE INSIDE DIMENSIONS (ID), UNLESS SPECIFIED OTHERWISE.
2. LINE REAM TO THIS DIMENSION AFTER INSTALLATION OF NEW PART.
3. INSTALL BEARING WITH WET ZINC CHROMATE ON ADJACENT SURFACES OF BEARING AND CASTING.
4. INSTALL USING LOCTITE 601. ROTATE PART WHILE INSERTING, IF POSSIBLE, TO INSURE COMPLETE COVERAGE.
5. PRESS FIT.

Figure 32-4. Main Gear Tolerances (3 of 3)

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NOSE GEAR AND DOORS

A. Nose Gear Oleo

1. Disassembly of nose gear oleo (Refer to Figure 32-5)

   Nose gear oleo assembly may be removed and disassembled from gear oleo housing with gear either removed from or installed on the airplane.

   a. Place airplane on jacks. (Refer to Jacking, Chapter 7.)
   b. Place a drip pan under nose gear to catch spillage.
   c. Remove air and fluid from oleo strut. Depress air valve core pin until strut chamber pressure has diminished; remove filler plug and with a small hose siphon as much hydraulic fluid from strut as possible.
   d. Remove complete cylinder and fork assembly from oleo housing:

      (1) Cut safety wire at top of unit.
      (2) Remove cap bolts that attach steering arm and aligner guide bracket to top of oleo cylinder.

   e. Disconnect shimmy dampener by removing each cotter pin, nut, washer and bolt that connects dampener to oleo cylinder and housing.
   f. Release and remove snap ring and washer(s), if installed, at top of housing, and pull complete cylinder and fork assembly from bottom of housing.
   g. To remove piston tube and fork from cylinder:

      (1) Separate upper and lower torque links by removing link connecting bolt assembly.
      (2) Separate the two links. ***Note spacer washer between the two links***.

   h. Compress piston tube; reach up along tube and release snap ring from annular slot at bottom of oleo housing.
   i. Pull piston tube with component parts from cylinder.
   j. Piston tube components may be removed by reaching in tube and pushing out upper bearing retainer pins. Slide from tube, upper bearing, lower bearing with outer and inner O-rings, wiper strip, washer and snap ring.
   k. To remove orifice tube

      (1) Remove large locknut and lock washer from top of cylinder.
      (2) Pull tube from cylinder.

   l. Remove orifice plate from bottom of orifice tube by releasing snap ring that holds plate in position.
   m. To remove piston tube plug with o-ring located in lower end of tube:

      (1) Remove bolt assembly.
      (2) Insert a rod up through hole in body of fork and push plug out through top of tube.

2. Cleaning, inspection and repair of nose gear oleo.

   a. Clean all parts with a suitable dry type cleaning solvent.

NOSE GEAR AND DOORS (Cont.)

1. CAP BOLTS AND WASHERS
2. SAFETY WIRE
3. SUPPORT FITTING
4. SUPPORT FITTING BUSHING
5. BUSHING
6. BOLT, WASHER, NUT AND COTTER PIN
7. BOLT, WASHER, NUT AND COTTER PIN
8. AXLE
9. CAP BOLT
10. ROLLER BUSHING
11. STEERING ARM
12. BRACKET ALIGNER
13. AIR VALVE CAP
14. AIR VALVE CORE
15. AIR VALVE BODY
16. ORIFICE TUBE NUT
17. SNAP RING
18. ROLL PIN
19. STOP WASHER
20. STRUT HOUSING
21. OLEO CYLINDER
22. UPPER TORQUE LINK
23. BOLT, WASHER, BUSHINGS, NUT AND COTTER PIN
24. LOWER TORQUE LINK
25. BEARING RETAINING PIN
26. O-RING
27. UPPER TUBE BEARING
28. ORIFICE TUBE
29. ORIFICE PLATE
30. SNAP RING
31. O-RING
32. LOWER TUBE BEARING
33. O-RING
34. WIPER STRIP
35. WASHER
36. SNAP RING
37. PISTON TUBE
38. PISTON TUBE PLUG
39. O-RING
40. FORK
41. WASHER

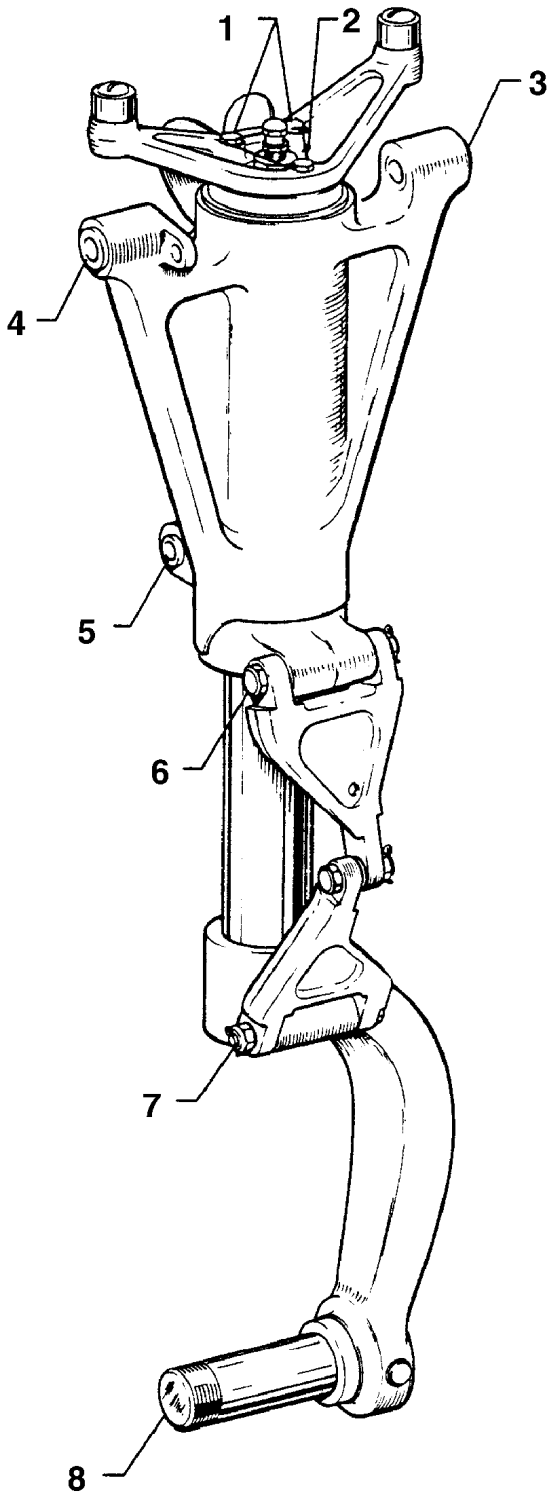


Figure 32-5. Nose Gear Oleo Strut Assembly (1 of 2)

NOSE GEAR AND DOORS (Cont.)

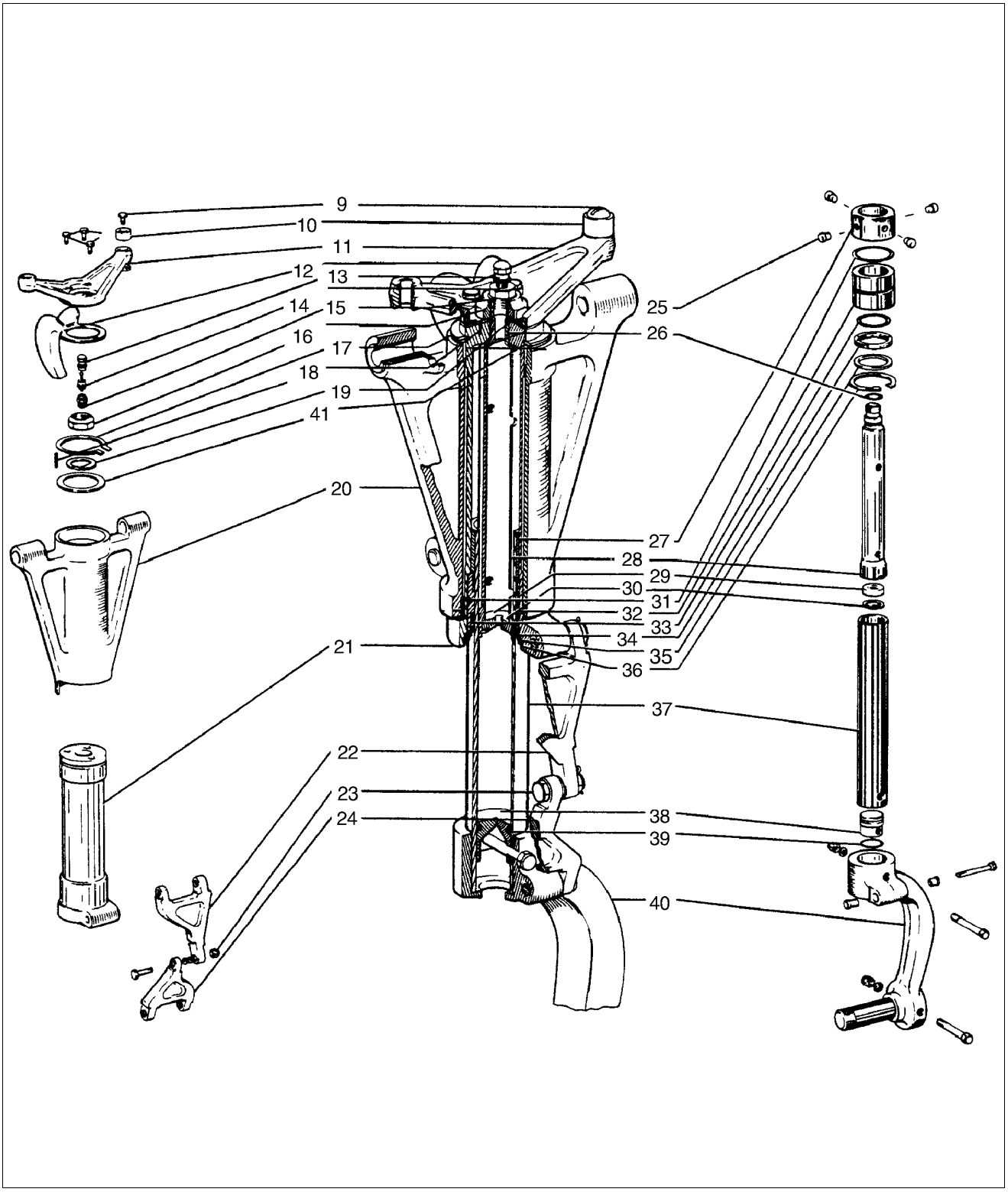


Figure 32-5. Nose Gear Oleo Strut Assembly (2 of 2)

NOSE GEAR AND DOORS (Cont.)

b. Inspect landing gear oleo assembly component for the following:

(1) Bearings and bushings for excess wear, corrosion, scratches and overall damage.
(2) Retaining pins for wear and damage.
(3) Lock rings for cracks, burrs, etc.
(4) Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.
(5) Upper and lower cylinder bushings loose or turning in cylinder.
(6) Orifice plate for hole restriction.
(7) Fork tube for corrosion, scratches, nicks, dents and misalignment.
(8) Air valve general condition.

c. Repair of oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.

3. Assembly of Nose Gear Oleo. (Refer to Figure 32-5)

a. Check that parts are cleaned and inspected.
b. To install piston tube plug:

(1) Lubricate tube plug and O-ring with hydraulic fluid (MIL-H5606A).
(2) Install o-ring on plug.
(3) Lubricate inside wall of tube.
(4) Insert plug into top of tube and push it to fork end.
(5) Align bolt holes of fork, tube and plug.
(6) Install bolt assembly.

c. Cement a cork in hole in bottom of fork body to prevent dirt from entering between fork and tube.
d. To assemble components of orifice tube:

(1) with countersunk side of orifice hole exposed, insert orifice plate into bottom of tube.
(2) Secure plate with snap ring.
(3) Lubricate and install o-ring on upper end of tube.

e. Insert orifice tube up through bottom of cylinder. With tube exposed through top of cylinder, install lock washer and insert roll pins through lock washer into piston. Install tube locknut finger tight at this time.
f. Assemble fork and tube assembly by:

— Note —

Install tube components on tube in the order shown.

(1) Slide snap ring, washer, lower bearing with outer and inner o-rings and upper bearing.onto tube.
(2) Align lock pin holes in upper bearing with pin holes in piston tube
(3) Install pins.

NOSE GEAR AND DOORS (Cont.)

g. Lubricate inner wall of cylinder with hydraulic fluid. Carefully insert piston tube assembly into bottom of cylinder, allowing orifice tube to guide itself into fork tube, until snap ring can be in- stalled in annular slot at bottom of cylinder. Install wiper strip, slide washer into piston and secure assembly with snap ring.
h. Tighten (torque) orifice tube locknut at top of cylinder.
i. Check that bushings are installed in upper and lower torque links and then install both links. Torque link bolt assemblies should be lubricated and installed with flat of bolt head hex adjacent to milled stop on wide end of link. Tighten bolts only tight enough to allow no side play in link, yet be free enough to rotate.
j. Install cylinder into oleo housing., Position spacer washer(s) over top of cylinder and secure with snap ring. Install spacer washers as required to obtain .0 to .015 of an inch thrust of cylinder within housing.
k. At top of oleo housing, install on cylinder aligner guide bracket and steering arm. Install cap bolts, tighten 20 to 25 inch-pounds torque and safety with MS20995C40 wire.
l. Install shimmy dampener and safety.
m. Lubricate gear assembly. (Refer to Lubrication Chart, Chapter 12.)
n. Compress and extend strut several times to ascertain that strut will operate freely. Weight of gear wheel and fork should allow strut to extend.
o. Service oleo strut with fluid and air. (Refer to Oleo Struts, Chapter 12.)
p. Check nose gear for alignment (refer to Alignment of Nose Landing Gear) and gear operation.

B. Nose Landing Gear Assembly

1. Removal of nose landing gear (Refer to Figure 32-6)

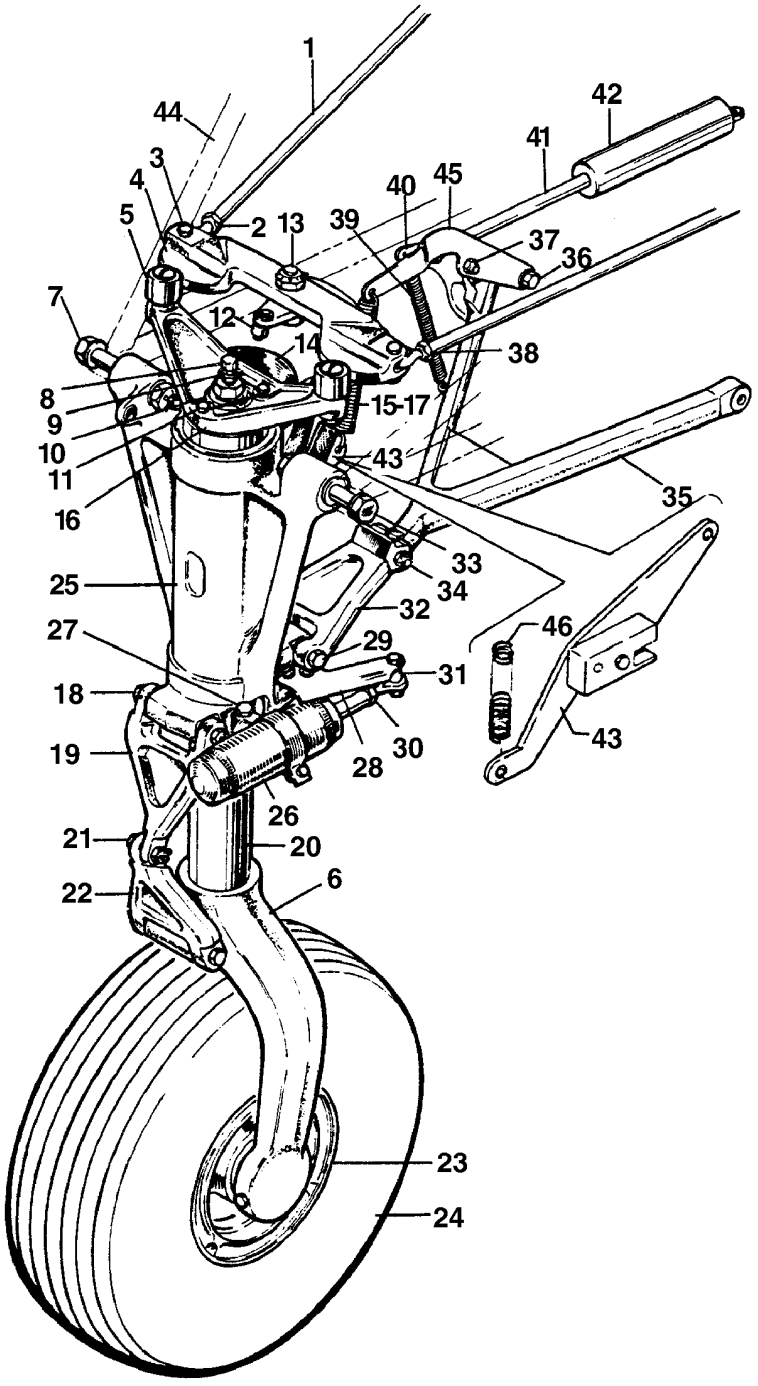
a. Remove engine cowiling by:

(1) Release quarter-turn fasteners (5 on each side, 2 on top aft).
(2) Remove machine screws from around intake (2 each side).
(3) Pull slightly aft and then up, and remove upper cowling.
(4) Remove the screws securing the bottom cowling at its aft end and fuselage firewall flange.
(5) Remove screws which support bottom cowling to the nose gear doors support brackets and fuselage firewall flange.
(6) Remove screws securing induction filter housing to lower cowling (8 places) and disengage housing from NACA duct.
(7) Remove clamps securing fresh air inlet.
(8) Remove clamps securing alternator cooling air.
(9) Push nose gear doors inward against spring pressure and remove bottom cowling.

b. Place airplane on jacks. (Refer to Jacking, Chapter 7.)
c. Disconnect gear tension springs from forward spring arm that is attached to right side of strut housing.
d. Retract nose gear slightly to remove gear from its downlocked position.
e. To remove upper and lower drag links, the following procedure may be used:

(1) Disconnect rod end of hydraulic cylinder from downlock hook by removing nut and bolt that connect these two units. This will require manually unlocking nose gear to allow clearance from engine mount.

NOSE GEAR AND DOORS (Cont.)



1. STEERING ROD
2. JAM NUT
3. BOLT AND NUT ASSEMBLY
4. STEERING
5. STEERING ARM BUSHING
6. FORK
7. BOLT, WASHER, NUT AND COTTER PIN
8. AIR VALVE CAP
9. AIR VALVE BODY
10. SAFETY WIRE
11. CAP BOLT AND WASHER
12. ALIGNER GUIDE ROLLER
13. BOLT, WASHER, NUT AND COTTER PIN
14. ALIGNER BRACKET
15. INNER SPRING
16. STEERING ARM
17. OUTER SPRING
18. BOLT, WASHER, NUT AND COTTER PIN
19. UPPER LINK
20. PISTON ROD
21. BOLT, WASHER, NUT AND COTTER PIN
22. LOWER LINK
23. WHEEL
24. TIRE
25. TRUNION HOUSING
26. SHIMMY DAMPENER
27. BOLT, WASHER, NUT AND COTTER PIN
28. SHIMMY DAMPENER BRACKET
29. BOLT, WASHER, NUT AND COTTER PIN
30. JAM NUT
31. ROD END BEARING
32. LOWER DRAG LINK
33. BOLT, WASHER, NUT AND COTTER PIN
34. BOLT, WASHER, NUT AND COTTER PIN
35. UPPER DRAG LINK
36. BOLT AND NU T ASSEMBLY
37. BOLT, WASHER AND NUT
38. JAM NUT
39. DOWN LOCK SPRING
40. DOWN LOCK HOOK
41. ACTUATOR ROD
42. HYDRAULIC CYLINDER
43. SPRING ARM
44. ENGINE MOUNT
45. SPRING ARM
46. SPRING

Figure 32-6. Nose Gear Removal and Installation

NOSE GEAR AND DOORS (Cont.)

— CAUTION —

BEFORE MANUALLY RETRACTING NOSE GEAR ASSEMBLY, WITH AIRPLANE ON JACKS , INSURE NOSE GEAR DOWNLOCK IS FULLY DISENGAGED BEFORE RELEASING NOSE GEAR DRAG LINKS. DAMAGE COULD OCCUR TO DOWN LOCK IF NOT DISENGAGED FULLY.

(2) Retract gear and disconnect gear downlock spring from upper drag link.
(3) Remove cotter pins, washers and nuts from bolts that secure upper drag link and lower drag link.
(4) Remove lower and upper gear tension spring arms.
(5) Slide attachment bolts from upper and lower drag links and remove links.

f. With lower drag link disconnected from gear oleo housing, housing may be removed by removing cotter pins, nuts, washers, and bolts at attachment points on each side of housing at engine mount.
g. Steering bellcrank may be removed by removing nut and bolt at steering rod, and nut and bolt with bushing at bellcrank pivot point.

2. Cleaning, inspection and repair of nose landing gear

a. Clean all parts with a suitable dry type cleaning solvent.
b. Inspect gear components for 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 pin to insure no looseness is present.

c. Inspect gear tension and downlock hook springs for the following:

(1) Excess wear or corrosion, especially around hook portion of springs. A spring should be rejected if wear or corrosion exceeds one-quarter diameter of spring. Clean away all corrosion and repaint.
(2) Check gear tension springs for load tensions below minimum allowable tolerances. Minimum allowable tension of inner spring is 37 pounds pull at 13.75 inches and outer is 60 pounds pull at 13.75 inches. Measurement is taken from inner side of each hook. If it is found that ***either*** spring should be rejected, replace ***both*** springs.
(3) Check gear downlock hook spring for load tension below minimum allowable tolerance. Minimum tension of spring is 10.5 pounds pull at 4.5 inches. Measurement is also taken from inner side of each hook.

d. Check 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 upper and lower drag links, and checking that when stop surfaces of two links touch, linkage is not less than .062 nor more than .250 of an inch through center. Should distance exceed required through center travel and bolt and bushing are tight, replace one or both drag links.

NOSE GEAR AND DOORS (Cont.)

f. Shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, dampener should be replaced rather than repaired.

g . Repair to 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. Installation of nose landing gear (Refer to Figure 32-6)

— Note —

When assembling any units of landing gear, lubricate bearings, bushings, and friction surfaces with proper lubricant as described in Chapter 12.

a. Attach steering bellcrank with bushing to its mounting plate on engine mount and connect steering rods. Secure each with bolt and nut. Adjustment, fore and aft, of bellcrank may be made after gear has been installed and rigged and adjusted.

b. To install gear housing assembly, position the gear so that bolt attachment points on housing align with attachment points on engine mount. Install pivot bolts, washers and nuts. Tighten nuts to a snug fit, yet allowing gear to swing free, and safety.

c. Drag links and gear tension spring arms may be installed by following procedure:

(1) Determine that the upper and lower links are assembled with downlock hook attached, and through center travel of links checked according to Cleaning, Inspection and Repair of Nose Landing Gear.

(2) Position link assembly to allow bolt holes in links to align with holes in gear housing and engine mount.

(3) Add upper gear tension spring arm, bushings and washers on upper link attachment bolt.

(4) Install bolt and tighten nut to allow link to rotate freely and safety.

(5) Install lower gear tension spring arm on drag link bolt on right side of gear oleo housing, secure and safety. A washer is installed on bolt between lower drag link and arm.

d. Connect gear downlock spring between downlock and upper drag link.

e. Connect two gear tension springs.

f. Adjust eccentric bushing (used for downlock pin) with gear extended and downlock engaged to obtain .001 to .010 clearance between bottom of downlock pin (bearing) and downlock hook (Refer to Figure 32-7).

g. Retract gear and tighten with eccentric bushing in its adjusted position. Cycle gear a minimum of three times to ensure proper operation and engagement.

h. Ensure that landing gear is lubricated per Lubrication Chart, Chapter 12.

i. Check adjustment of gear per Adjustment of Nose Landing Gear.

j. Install engine cowling.

k. Retract landing gear and check door operation as per Adjustment of Nose Gear Doors.

l. Check alignment of nose gear per Alignment of Nose Landing Gear.

m. Remove airplane from jacks.

NOSE GEAR AND DOORS (Cont.)

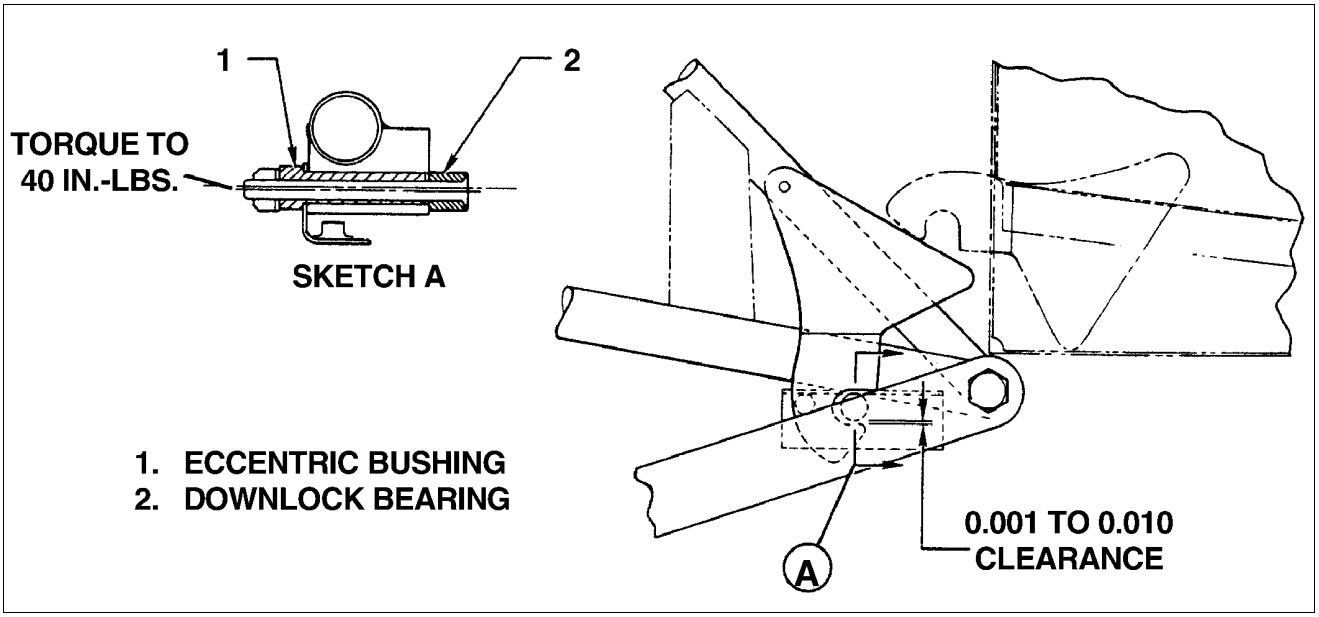


Figure 32-7. Adjustment of Eccentric Bushing

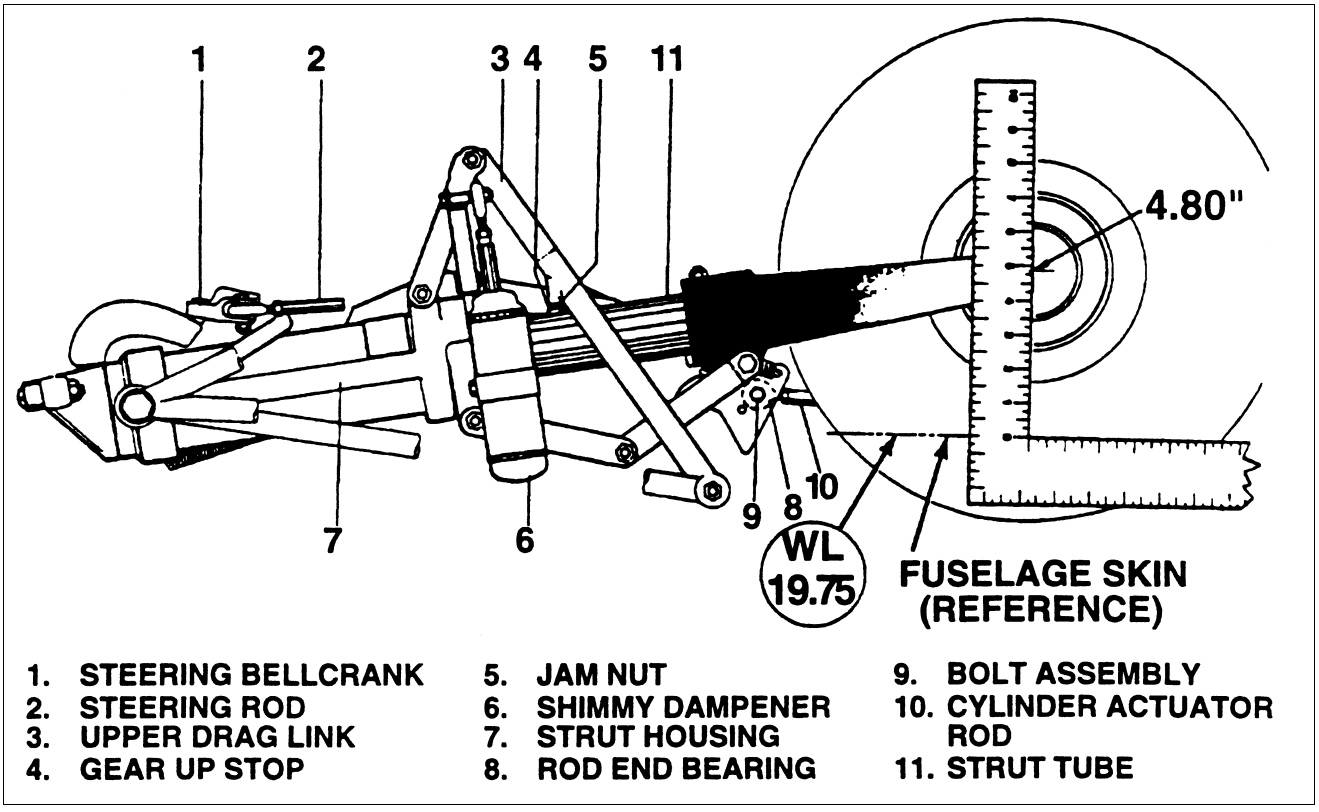


Figure 32-8. Nose Gear Adjustment

NOSE GEAR AND DOORS (Cont.)

4. Adjustment of Nose Landing Gear (Refer to Figure 32-8)

   The gear up stop is located on under side of upper drag link.

   a. Remove engine cowl.
   b. Place airplane on jacks. (Refer to Jacking, Chapter 7.)
   c. Retract landing gear hydraulically by turning master switch on and moving gear selector switch to up position.
   d. Check adjustment of gear up stop by placing a carpenters square with longest end along bottom of fuselage, and shortest end running up through centerline of wheel axle. Measure up along square from bottom of fuselage 4.80 inches, to determine if center of wheel axle meets this measure- ment. If this measurement is incorrect, extend gear, loosen jam nut on gear up stop, and make required adjustment by turning stop.
   e. Adjust rod end of nose gear retracting cylinder so that at least 0.07 to 0.10 rod travel remains to full extension when downlock is fully engaged. Check rod end safety hole and tighten safety nut.
   f. Recheck all adjustments and retighten jam nut on gear up stop. When gear is fully retracted, strut tube should be firmly against gear up stop. Extend gear.
   g. Adjust shimmy dampener by turning nose wheel against stops and adjusting rod end of dampener for adequate travel to both extremes.
   h. Install engine cowling.
   i. Confirm that down locks are engaged and that the three green gear down lights are on.
   j. Remove airplane from jacks.

5. Alignment of Nose Landing Gear

   a. Place airplane on a smooth level floor that will accommodate striking of a chalk line.
   b. Check that nose gear is properly adjusted as given in Adjustment of Nose Landing Gear.
   c. With landing gear in down-locked position, weight proportionally on nose gear and nose wheel facing forward, adjust steering bellcrank. Bellcrank is attached to lower front of engine mount directly aft of gear housing and may be adjusted by loosening its attachment bolt and sliding bell- crank fore and aft until it clears each steering arm rollers by 0.03 of an inch. Retighten attachment bolt.
   d. Place airplane on jacks. (Refer to Jacking, Chapter 7.)
   e. Level airplane laterally and longitudinally. (Refer to Leveling, Chapter 8.)
   f. From center point of tail skid, extend a plumb bob and mark contact point on floor.
   g. Extend a chalk line from mark on floor below tail skid to a point approximately three feet forward of nose wheel. Allow line to pass under wheel at centerline of tire. Snap chalk line.
   h. Clamp rudder pedals to align them in a lateral position. Ensure that rudder pedals are in their neutral position. (Refer to Figure 32-9 and Figure 32-10)

NOSE GEAR AND DOORS (Cont.)

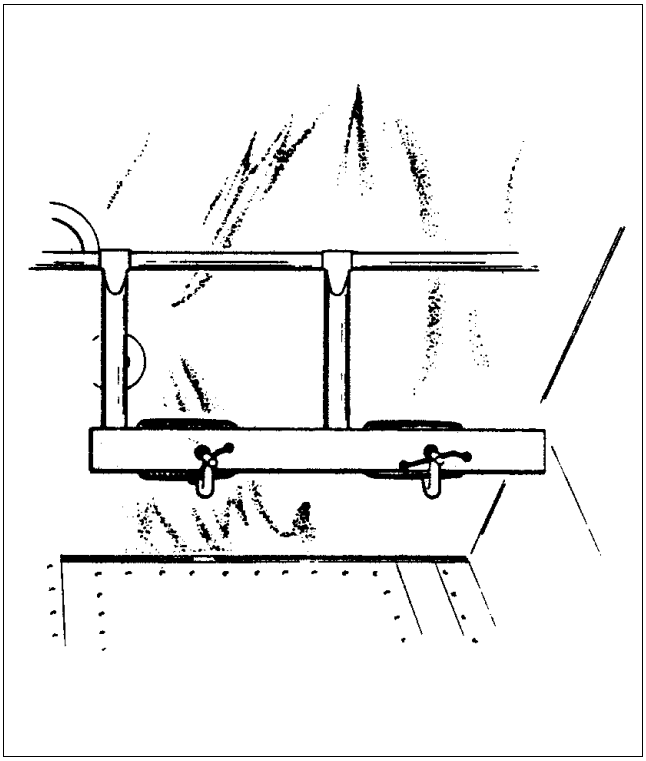


Figure 32-9. Clamping RudderPedals in Neutral

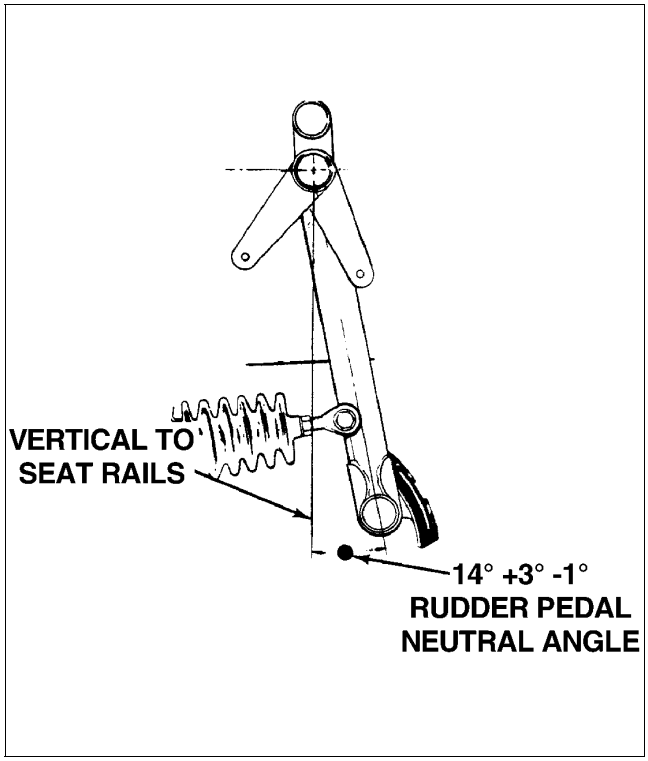


Figure 32-10. Rudder Pedals at Neutral Angle

i. Adjust rod end bearings of each steering control rod to align nose wheel with chalk line and to bring rudder pedals into neutral angle fore and aft.

j. Install steering push rods on rudder pedals. Adjust rods so lengths are both same and rudder pedals are at their neutral position.

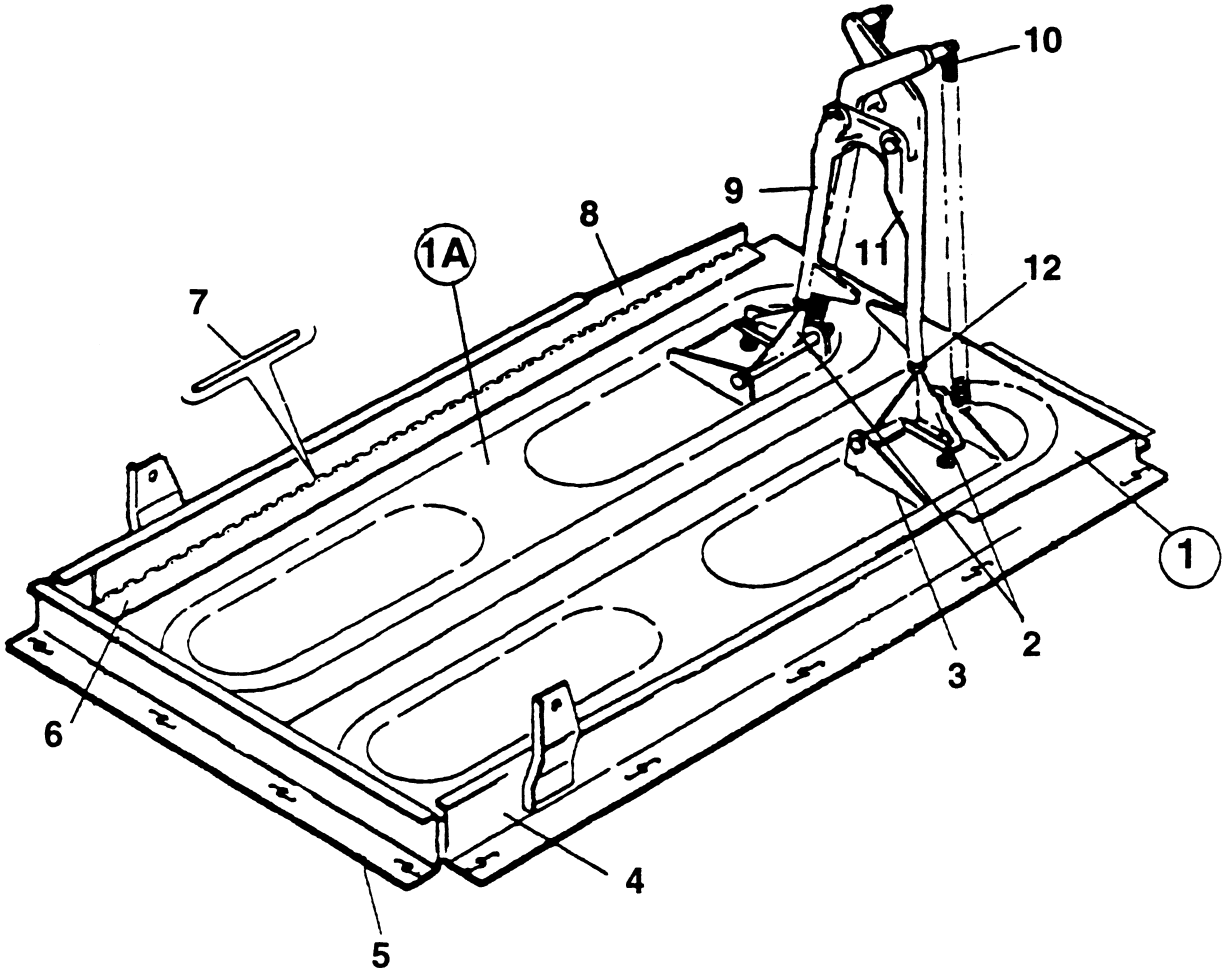
k. To align nose wheel straight forward, stand in front of nose gear and align center rib of tire with chalk line, or lay a straightedge along side of tire and parallel straightedge with chalk line.

l. Place a bubble protractor against a rudder pedal steering tube to check the neutral angle. (Refer to Figure 32-10.)

m. One end of each rod must be disconnected and jam nuts loosened to make any adjustment. Do not attempt to make adjustment by means of one rod end bearing, but divide adjustment between bearings at each end of each rod. Check that rod ends have sufficient thread engagement by ascertaining that a wire will not go through check hole in rod. Where no check holes are provided, ascertain a minimum of 3/8 inch thread engagement. Reinstall rods and tighten jam nuts.

n. To check nose gear steering for its 22.5° ± 2° maximum right and left travel, mark on each side of nose wheel an angle line from centerline and wheel pivot point. Turn wheel to its maximum travel in both directions to check for allowable travel. Should travel be exceeded in one direction and not enough in other direction, check for possible damage to gear fork or torque links.

NOSE GEAR AND DOORS (Cont.)



1. LEFT NOSE GEAR DOOR ASSY.
1A. RIGHT NOSE GEAR DOOR ASSY.
2. LINK ASSEMBLY
3. CHANNEL
4. SUPPORT ASSEMBLY
5. LOWER COWL SUPPORT
6. HINGE HALF
7. HINGE PIN
8. HINGE HALF
9. RIGHT ARM
10. SPRING
11. LEFT ARM
12. JAM NUT

Figure 32-11. Nose Gear Doors

NOSE GEAR AND DOORS (Cont.)

C. Nose Gear Door Assembly

1. Removal of Nose Gear Door Assembly (Refer to Figure 32-11)

   a. With nose gear extended, disconnect spring from door arms by removing upper attachment hardware.
   b. Disconnect link assemblies from doors and remove mechanism.
   c. To remove doors from cowl, bend end of hinge pin straight and pull out pin.

2. Cleaning, Inspection and Repair of Nose Gear Door Assembly

   a. Clean all parts with a suitable cleaning solventb
   b. Inspect doors for damage, loose or damaged hinges and brackets.
   c. Inspect door retraction link assemblies and arms for damage and wear.
   d. Check door tension springs for wear and tension. Reject springs if tension does not maintain doors in full open position.
   e. Repairs to doors may be replacement of hinges and painting.
   f. Repairs to retraction mechanism is limited to replacement of parts, and sanding and painting.

3. Installation of Nose Gear Door Assembly (Refer to Figure 32-11)

   a. Install gear doors by positioning hinge valves of door and door support assembly, and inserting hinge pins. New pins are recommended. Bend ends of pins to secure in place.
   b. Assemble door mechanism to doors and attach springs.

4. Adjustment of Nose Gear Door Assembly

   a. Place airplane on jacks. (Refer to Jacking, Chapter 7.)
   b. Adjust door retraction links to align doors with lower cowl in closed position.
   c. Door down adjustment bolts should be positioned to limit doors travel to 90 degrees from closed position.
   e. Check attaching hardware and jam nuts for safety and tightness.
   f. Remove airplane from jacks.

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NOSE GEAR AND DOORS (Cont.)

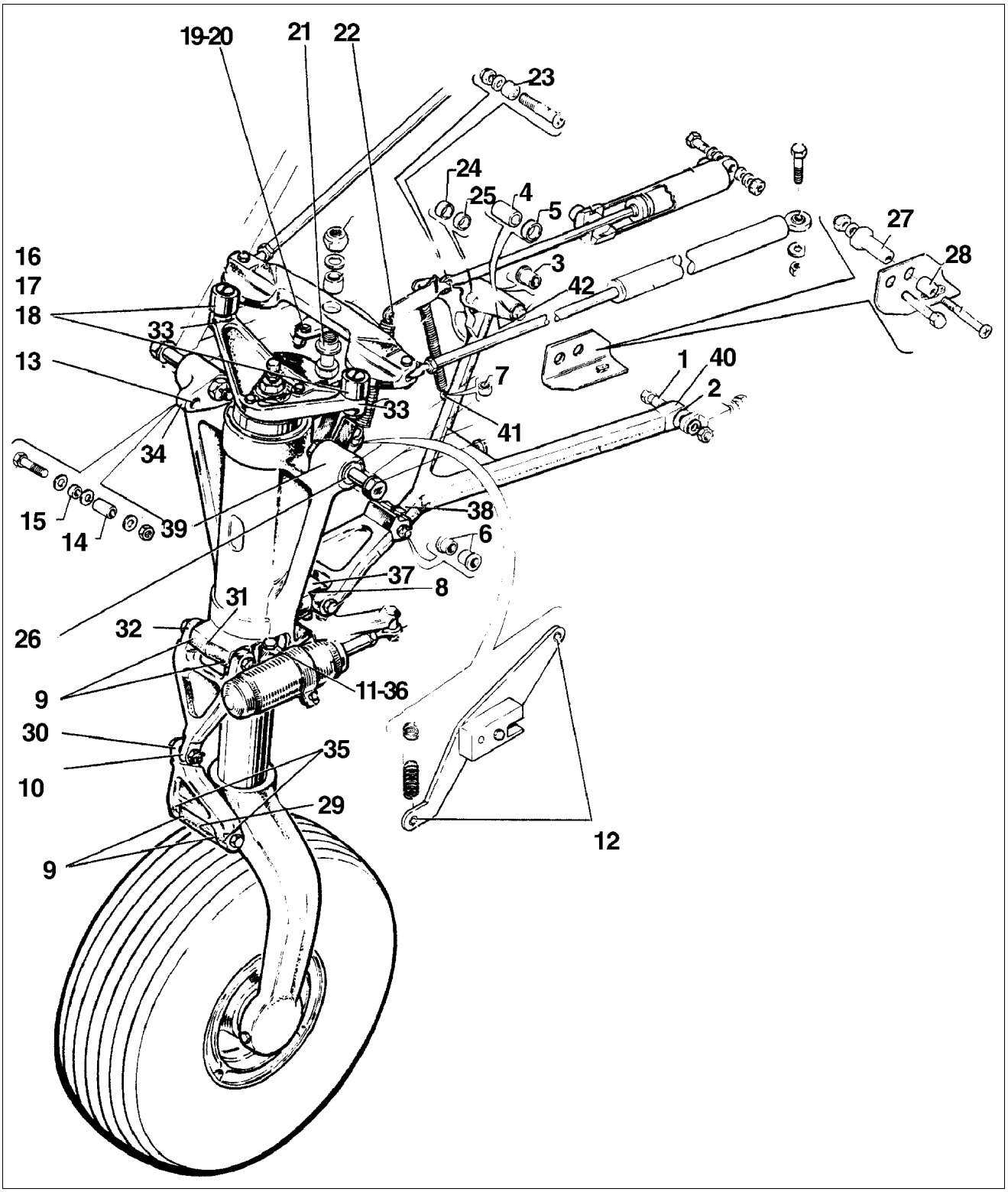

Figure 32-12. Nose Gear Tolerances (1 of 3)

NOSE GEAR AND DOORS (Cont.)

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension [1]	Service Dimension [1]	Service Tolerance	Remarks
1.	65003-45	Upper Draglink Bushing	.4385 .4375	.4395 .4375	002	
2.	452 474	Upper Drag Brace Bearing L.H.	.4385 .4375	.4395 .4375	.002	
3.	452 623	Uppet Drag Brace Bearing R.H.	.502 .501	.503 .501	.002	
4.	95061-133	Bushing	.376 .375	.376 .377	.002	
5.	95061-134	Bushing	.645 .640	.640 .647	.002	
6.	452 450	Upper Drag Brace Bearing	.2505 .2495	.2515 .2495	.002	
7.	61402-93	Upper Drag Brace Bushing	.189 .191	.193 .189	.004	
8.	67026-07	Drag link Trunnion Bearing	.313 .314	.3130 .3165	.0025	SEE NOTE 4
9.	67026-07	Bearing	.313 .314	.313 .315	.002	SEE NOTES 2, 3 AND 5
10.	452 366	Link Assembly Bearing	.2495 .2505	.2495 .2515	.002	SEE NOTES 3 AND 5
11.	21831-04	Nose Gear Strut Tube Bearing	.247 .248	.247 .250	.003	SEE NOTE 3
12.	82732-99	Nose Gear Arm Bushing	.241 .246	.241 .251	.010	
13.	95061-144	Trunnion Assembly Bushing	.248 .250	.249 .259	.010	SEE NOTE 4
14.	95061-168	Bushing	.250			
15.	82732-95	Bushing	.249 .251	.253 .245	.008	
16.	63900-122	Nose Gear Outer Bushing	.443 .441	.443 .4445	.0015	
17	452 477	Sleeve Bearing .375		.395 .375	.020	
18	63900-109	Nose Gear Inner Bushing	.3125 .3180	.3235 .3125	.011	
19.	14976-15	Bushing	.385 .390	.385 .395	.010	
20.	14976-16	Bushing	.260 .265	.270 .260	.010	

Figure 32-12. Nose Gear Tolerances (2 of 4)

NOSE GEAR AND DOORS (Cont.)

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension [1]	Service Dimension [1]	Service Tolerance	Remarks
21.	452 445	Steering Cam Bearing	.502	.512 .502	.020	
22	82732-99	Nose Gear Arm Bushing	.241 .246	.241 .251	.010	SEE NOTE 5
23.	65003-30	Downlock Bushing	.193 .195	.196 .193	.003	
24.	96061-1 35	Bushing	.2495 .2505	.2515 .2495	.002	
25.	95061-136		.2495 .2505	.2515 .2495	.002	
26.	67026-11	Bearing				SEE NOTE 4
27.	35662-2	Eccentric Bushing	.189 .191			
28.	38068-2	Downlock Bearing	.191 .189			
29.	67050-2	Lower Strut Assy. Torque Link Fitting				
30.	20735-5	Torque Link	.377 .3785	.377 .3790	.002	SEE NOTE 5
31.	67148-00	Trunnion Torque Link Fitting	.4385 .4370	.4385 .4370	.0015	
32.	20735-5	Torque Link	.312 .313	.312 .314	.002	
33.	44386-03	Steering Arm	.4370 .4385	.0015	.0015	
34.	67054-03	Trunnion Assy. Assist Spring Fitting	.302 .303	.302 .3035	.0015	
35.	20735-05	Torque Link	.312 .313	.312 .314	.002	SEE NOTE 2
36.	67148-00	Shimmy Dampener Fitting	.3745 .3760	.3745 .3760	.001	
37.	67054-03	Trunnion Housing Drag Link Attachment	.4415 .4425	.4415 .4424	.0010	
38.	38043-0	Upper Drag Link	.378 .379	.3775 .3795	.002	
39.	67054-03	Trunnion Assy. Main Attachment Fitting	.6285 .6295	.6285 .6295	.001	
40.	38043-0	Upper Drag Link	.4385 .4375	.4385 .4405	.002	

Figure 32-12. Nose Gear Tolerances (3 of 4)

NOSE GEAR AND DOORS (Cont.)

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension [1]	Service Dimension [1]	Service Tolerance	Remarks
41.	38043-0	Downlock Spring Attachment Fitting	.247 .248			
42.	38043-0	Upper Drag Link	.6235 .6245	.6230 .6250	.002	

– NOTES –

1. ALL DIMENSIONS ARE INSIDE DIMENSIONS (ID), UNLESS OTHERWISE NOTED.
2. LINE REAM TO THIS DIMENSION AFTER INSTALLATION OF PART.
3. INSTALL BUSHING WITH WET ZINC CHROMATE.
4. INSTALL NEW BUSHING BY COATING O.D. OF BUSHING WITH LOCTITE 601, ROTATING BUSHING WHILE INSERTING IT TO INSURE COVERAG E.
5. PRESS FIT.

Figure 32-12. Nose Gear Tolerances (4 of 4)

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EXTENSION AND RETRACTION.

The landing gear extension and retraction system is hydraulically operated. This section provides detailed information on troubleshooting and testing the system, and on maintaining the free-fall (emergency release) valve assembly and the gear actuating cylinders. Detailed information on other components (i. e. - the hydraulic pump and lines) is in Chapter 29.

1. Troubleshooting

   When trouble develops, place the airplane on jacks (refer to Jacking, 7-10-00), in order to determine the extent of the problem. Chart 3203 lists troubles which may be encountered, along with their probable cause, and suggests a remedy for the trouble involved. Hydraulic system troubles are not always traceable to one cause. A malfunction may be the result of more than one problem within the system. Starting with the most obvious and most probable reasons for the trouble, check each possibility and, by process of elimination, isolate the troubles.

CHART 3203. TROUBLESHOOTING EXTENSION AND 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. (Refer to 32-60-00)
	Squat switch inoperative.	Replace switch.
	Pressure switch inoperative.	Replace switch.
	Pump retraction solenoid inoperative (inboard solenoid).	Replace solenoid.
	Gear selector switch ground incomplete.	Check ground.
	Gear selector switch inoperative.	Replace switch.
	Hydraulic pump ground incomplete.	Check ground.

EXTENSION AND RETRACTION (Cont.)

CHART 3203. TROUBLESHOOTING EXTENSION AND RETRACTION (cont.)

— Note —

If you hear the retracting solenoid on the pump actuate when the gear selector switch is operated, assume the gear control circuit is operating properly and check the actuator circuit further.

Trouble	Cause	Remedy
Landing gear retraction system fails to operate. (cont.)	Hydraulic pump inoperative.	Replace or overhaul pump. Return to Piper, via local Piper distributor, for overhaul.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Battery low or dead.	Check condition of battery.
Landing gear extension system fails to operate.	Landing gear actuator circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Check wiring. wires broken.	
	Landing gear selector circuit wires broken.	Check wiring.
	Pump extension solenoid inoperative (outboard solenoid).	Replace solenoid.
	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. Return to Piper, via local Piper distributor, for overhaul.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Low or dead battery.	Check condition of battery.

EXTENSION AND RETRACTION (Cont.)

CHART 3203. TROUBLESHOOTING EXTENSION AND RETRACTION (cont.)

Trouble	Cause	Remedy
Landing gear retraction extremely slow.	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Restriction in hydraulic lines.	Isolate and check hydraulic lines.
	Shuttle valve sticking in pump base.	Check cause.
Pump stops during gear retraction.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Pressure switch out of adjustment.	Remove and readjust or replace switch.
	Hydraulic pump may require overhaul.	Replace and/or return pump to Piper, via local Distributor, for overhaul.
	Mechanical restriction or obstruction in hydraulic system allows pressure to build up and shut off pump before gear has retracted.	Place airplane on jacks and run retraction check. Isolate and determine cause.
	Shuttle valve sticking in pump base.	Check cause.
Pump stops during gear extension.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine cause for overload.

EXTENSION AND RETRACTION (Cont.)

CHART 3203. TROUBLESHOOTING EXTENSION AND RETRACTION (cont.)

Trouble	Cause	Remedy
Pump fails to shut off though gear has fully retracted.	Pressure switch inoperative.	Replace switch.
	Pressure switch out of adjustment.	Replace switch.
	Pump retraction solenoid sticking (inboard solenoid).	Replace solenoid.
	Internal leakage of system.	Check gear actuating cylinders for ***internal*** leakage.
		Internal damage to hydraulic pump. Return to Piper Aircraft via local Piper distributor for overhaul.
	External leakage of system.	Check gear actuating cylinders for ***external*** leakage.
		Check free-fall valve for external leakage.
		External damage to hydraulic pump. Return to Piper Aircraft via local Piper distributor for overhaul.
	Pump relief valve out of adjustment.	Replace pump.
— Note — The out of adjustment or failed switch may be determined by noting which down light is not ON.		
Pump fails to shut off though the gear has fully extended.	Pump extension solenoid sticking (out-board solenoid).	Replace solenoid.
	Nose gear down limit switch actuator out of adjustment.	Adjust switch actuator. (Refer to Adjustment of Nose Gear Down Limit Switch, 32-60-00)

EXTENSION AND RETRACTION (Cont.)

CHART 3203. TROUBLESHOOTING EXTENSION AND RETRACTION (cont.)

Trouble	Cause	Remedy
Pump fails to shut off though the gear has fully extended. (cont.)	Nose gear down limit switch failed.	Replace switch.
	Main gear down limit switch out of adjustment.	Adjust switch. (Refer to Adjustment of Main Gear Down Limit Switch, 32-60-00)
	Main gear down limit switch failed.	Replace switch.
Pump running intermittently after gear has retracted.	Leakage of high pressure check valve.	Remove pump. Return to Piper Aircraft, via local Piper distributor, for overhaul.
	Internal leakage of system.	Check auxiliary retraction unit valve for internal leakage.
		Check gear actuating cylinders for internal leakage.
	External leakage of system.	Check gear actuating cylinders for external leakage.
		Check for broken or damaged hydraulic lines.
Gear stops part way up, but pump continues to run.	Pump high pressure relief valve out of adjustment.	Replace pump.
	Internal leakage of system.	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.

EXTENSION AND RETRACTION (Cont.)

CHART 3203. TROUBLESHOOTING EXTENSION AND RETRACTION (cont.)

Trouble	Cause	Remedy
All gears fail to free fall.	Free-fall valve fails to open.	Replace valve.
With gear selector down and three green lights on, gear unsafe light comes ON or intermittently ON.	Shorted gear up solenoid.	Replace solenoid.
With gear selector down and three green lights ON, pump motor circuit breaker opens.	Shorted gear up solenoid.	Replace solenoid.
With gear unsafe light on, pump operates on and off.	Shorted gear down solenoid.	Replace solenoid.
With gear unsafe light on, pump motor circuit breaker opens.	Shorted gear down solenoid.	Replace solenoid.

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2. Functional Test

— CAUTION —

VERIFY THAT HYDRAULIC PUMP RESERVOIR IS FILLED. AFTER FILLING RESERVOIR, TIGHTEN DIPSTICK, THEN BACK OFF 1 1/2 TURNS. THIS IS ESSENTIAL TO ALLOW THE RESERVOIR TO BE VENTED.

The following tests and checks shall be performed in the sequence shown. Any failure of the system to respond as specified indicates a malfunction which shall be corrected before proceeding.

A. Verify that nose and main gears are properly adjusted. (See 32-10-00 and 32-20-00)

B. Place the airplane on jacks. (See 7-10-00)

C. Connect a 28 volt (dc) (or 14 vdc in HP S/N's 3246001 thru 3246017 only) ground power unit capable of supplying a minimum of 50 amperes to the aircraft electrical system.

D. Gear Lights.

(1) All switches off and gear selector in the down position.

(2) Throttle in mid position.

(3) Master switch on. (Remains on-through all tests.)

Check: Three green safe lights on.
Red warning light off.
Gear warning horn does not sound.

E. Gear Down Microswitches.

(1) Throttle in mid position.

(2) Gear selector switch up.

(3) When nose gear is approximately half retracted, pull the landing gear pump circuit breaker. Operate the gear free fall control. Manually restrain nose gear from failing. Main gear shall fall to the extended position. Return free fall control to the "NORMAL" position.

(4) Push in 25 amp landing gear pump circuit breaker and with gear selector switch down;

Check: Pump operates.
Main gear green safe lights on.
Nose gear green safe lights off.
Red warning light on.
Gear warning horn does not sound.

(continued on next page)

EXTENSION AND RETRACTION (Cont.)

(5) Allow nose gear to extend slowly.

Check: Pump continues to operate and nose gear green safe light remains off until nose gear is fully extended and nose gear downlock is engaged on roller.

— Note —

Momentary "blinking" of the nose gear green light before the downlock is engaged on the roller indicates an improperly adjusted microswitch.

Red warning light off when all green safe lights are on.

Gear warning horn does not sound.

(6) "Unlock" left gear down lock manually.

Check: Pump operates.

Correct green safe light off.

Red warning light on.

Gear warning horn does not sound.

(7) Repeat step (6) for the right main gear.

F. Squat Switch.

(1) Deactivate squat switch on left main gear by one of the following methods:

(a) Loosen the squat switch adjustment screws and rotate the switch until the tang is free.

(b) Partially compress the left main gear shock absorber so that the squat switch operating tang is free.

(2) Gear selector switch up.

Check: Pump does not operate.

Three green gear safe lights remain on.

Red warning light on.

(3) Open throttle fully.

Check: Pump does not operate.

Red warning light remains on.

Three green lights remain on.

(4) Close throttle.

Check: Pump does not operate.

Red warning light remains on.

Three green lights remain on.

Horn sounds (intermittently).

(5) Gear selector switch down.

(6) Re-activate squat switch.

G. Retraction and Extension.

— Note —

The gear free-fall control must be in the normal position throughout G, H, I and J until instructed otherwise.

(1) Throttle in mid position.

(2) Move landing light switch from off to on position and verify landing light is illuminated.

(3) Gear selector switch up. Hold for 5 minutes.

Check: Three green safe lights off.
Red warning light on.
Gear retracts in less than ten seconds.
Pump stops operating when gear is fully retracted.
Red warning light out.
Gear warning horn does not sound.
Landing light is extinguished.

(4) Gear selector switch down.

Check: Pump operates.
Red warning light on.
Pump stops operating when gear is fully extended.
Red warning light out.
Three green gear safe lights on in less than 15 seconds.
Nose gear downlock fully engaged.
Landing light is illuminated.

(5) Wait eight seconds, then move gear selector switch up.

Check: Gear retracts in less than ten seconds.
Red warning light off.

H. Second Retraction Test.

The second retraction check (see G (4) and (5), above) after an eight second wait, tests the functioning of the pump base shuttle valve. Retraction time will be prolonged beyond the time specified (i.e. - 10 seconds) if the shuttle valve is sticking.

I. Throttle Closed Microswitch.

(1) With gear still up, close throttle.

Check: Red warning light on.
Gear warning horn sounds.

(2) Open throttle to mid position.

Check: Red warning light off.
Gear warning horn stops sounding.

EXTENSION AND RETRACTION (Cont.)

J. Free-fall.

(1) Pull out 25 amp landing gear pump circuit breaker.

(2) Operate gear free fall control to the extend position.

Check: All gear return to the "down and locked" position, with down latches engaged.
Three green gear safe lights on. (Within 10 seconds max)

(3) Return gear free fall control to the normal position.

(4) Gear selector switch down.

(5) Push in 25 amp landing gear pump circuit breaker.

Check: Pump does not operate.
Red warning light remains off.
Three green gear safe lights remain on.

K. Flap Position Warning Check (Throttle to be in Middle Position)

(1) Flap rigging complete.

(2) Gear selector switch up.

Check: Gear retracts.
Pump stops.
Red warning light out.

(3) Flap selector in first down (10°) position.

Check: Flaps operate to first position.
Warning horn does not sound.

(4) Flap selector in second down (25°) position.

Check: Flaps operate to second position.
Warning horn sounds.

(5) Flap selector in full down position.

Check: Flaps operate to full down position.
Warning horn continues to sound.

(6) Flap selector back to first down (10°) position.

Check: Flaps operate to first position.
Warning horn stops sounding.

(7) Flap selector to full up (0°) position.

Check: Flaps retract.
Warning horn does not sound.

(8) Gear selector switch down.

Check: Gear extends.
Three green safe lights on.
Pump stops.

(9) Flap selector to full down position.

Check: Flaps operate to full down position.

Warning horn does not sound.

(10) Flap selector to full up position.

Check: Flaps operate to full up position.

Warning horn does not sound.

(11) Master switch off.

L. Disconnect the ground power unit.

M. Verify gear remains full down and locked. Remove airplane from jacks. (See 7-10-00)

3. Landing Gear Actuating Cylinders

A. Nose Gear Actuating Cylinder

(1) Removal of Nose Gear Actuating Cylinder.

(a) Place airplane on jacks. (Refer to Jacking, 7-10-00)

(b) Disconnect hydraulic lines from actuating cylinder. Cover open line ends to prevent contamination.

(c) Disconnect cylinder operating rod end. Manually unlock nose gear to allow clearance from engine mount for removal of attachment bolt.

– CAUTION –

WHENEVER AIRCRAFT IS PLACED ON JACKS FOR PURPOSE OF MANUALLY RETRACTING NOSE GEAR ASSEMBLY, ENSURE NOSE GEAR DOWN LOCK IS FULLY DISENGAGED BEFORE RELEASING NOSE GEAR DRAG LINKS. DAMAGE COULD OCCUR TO DOWN LOCK IF NOT FULLY DISENGAGED.

(d) Disconnect aft end of cylinder from its attachment fitting. Remove cylinder from the wheel well.

(2) Disassembly of Nose Gear Actuating Cylinder (Refer to Figure 32-13.)

(a) With cylinder removed from airplane, mark position of end gland to facilitate reinstallation.

(b) Remove safety wire and unscrew end gland.

(c) Remove piston and O-rings .

(3) Cleaning, Inspection, and Repair of Nose Gear Actuating Cylinder

(a) Clean cylinder parts with a suitable dry type solvent. Dry thoroughly.

(b) Inspect cylinder assembly for the following:

1 Interior walls of cylinder and exterior surfaces of piston for scratches, burrs, corrosion, etc.

2 Threaded areas for damage.

3 Rod end fitting and swivel fitting of cylinder for wear and corrosion.

(c) Repairs to cylinder are limited to polishing out small scratches, burrs, etc., and replacing O-rings.

EXTENSION AND RETRACTION (Cont.)

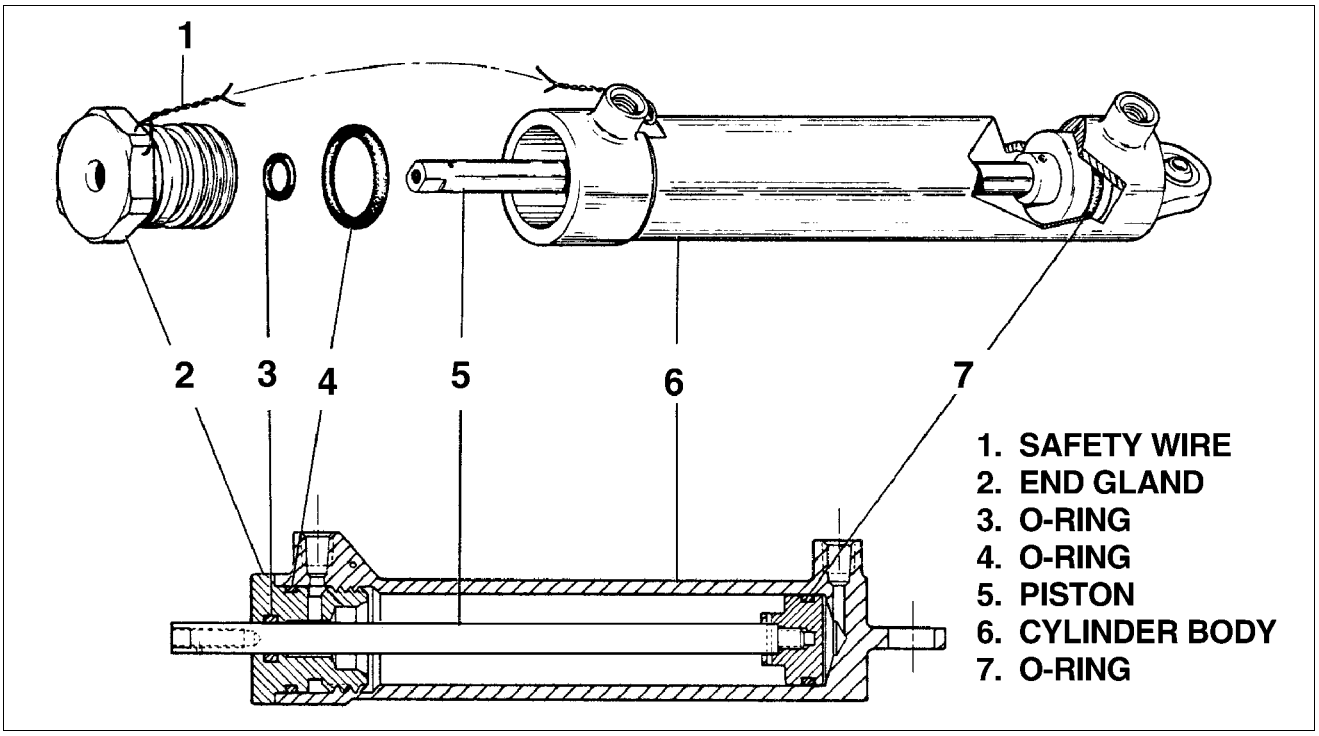


Figure 32-13. Nose Gear Actuating Cylinder

(4) Assembly of Nose Gear Actuating Cylinder (Refer to Figure 32-13)

(a) Install O-ring on the exterior of end gland.

(b) Install O-ring in the interior of end gland.

(c) Install O-ring on the body of piston assembly.

(d) Lubricate areas around O-rings with hydraulic fluid. Slide end gland on piston rod. Screw end gland in cylinder body.

(e) Align reference marks and secure end gland with safety wire.

(f) Check smoothness of piston operation.

(5) Installation of Nose Gear Actuating Cylinder

(a) Attach cylinder to its attachment fitting using bolt and nut.

(b) Attach operating rod end to down lock. Manually unlock nose gear to provide necessary clearance from engine mount for installing attaching bolt.

(c) Connect hydraulic lines to cylinder fittings.

(d) Check adjustment of cylinder rod end. (Refer to Adjustment of Nose Landing Gear.)

(e) Operate pump to purge system of air. Check fluid level in reservoir.

(f) Remove the airplane from jacks.

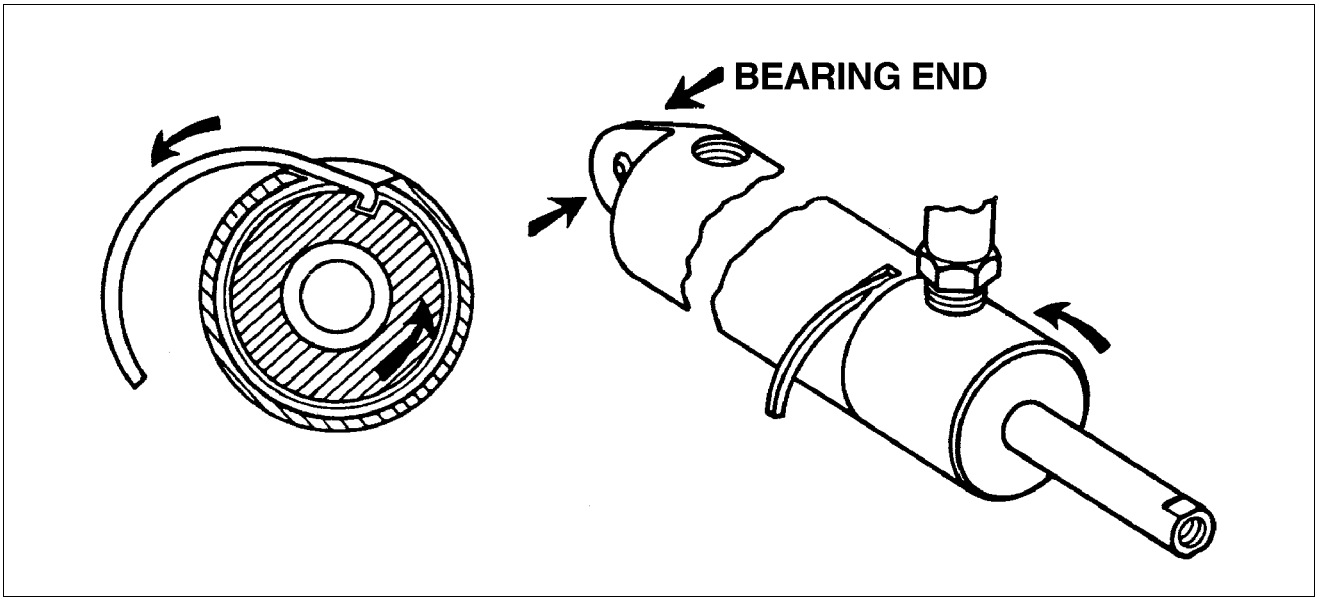


Figure 32-14. Main Gear End Gland Locking Device

B. Main Gear Actuating Cylinder

(1) Removal of Main Gear Actuating Cylinder

(a) Place airplane on jacks. (Refer to Jacking, 7-10-00)

(b) Disconnect hydraulic lines from actuating cylinder. Cover open line ends to prevent contamination.

(c) Disconnect gear down lock spring from swivel fitting at upper end of spring.

(d) Remove down lock spring swivel fitting. Disconnect cylinder operating rod end from upper side brace retraction fitting by removing attaching nut, washer and bolt.

(e) Disconnect cylinder from its attachment by removing nut and bolt.

(f) Remove cylinder from wheel well.

(2) Disassembly of Main Gear Actuating Cylinder (Refer to Figures 32-14 and 32-15)

(a) With cylinder removed from airplane, push piston rod (by hand) toward clevis to remove oil from unit.

(b) Put clevis only in a soft jaw vise and clamp against clevis bearing.

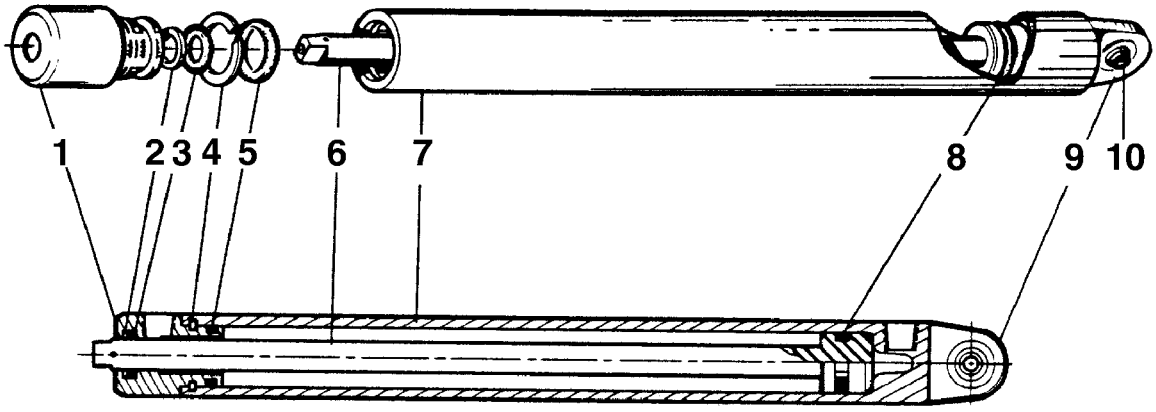
(c) If no pipe fitting is installed in port of end gland, install a fitting (1/8-27) into port. This fitting will be used for leverage only and need not be tight.

(d) Rotate gland counterclockwise (with use of fitting) until end of gland lock ring shows in slot in cylinder body. Reverse rotation of gland (clockwise direction) to allow lock ring to move out of the slot. (Refer to Figure 32-14) It may be necessary to give ring an assist to start out of slot. If so, insert a strong wire pick or other available tool in slot to lift up end of ring and then rotate gland.

(e) Pull piston and end gland from cylinder.

(f) Remove O-rings as desired.

EXTENSION AND RETRACTION (Cont.)



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

Figure 32-15. Main Gear Actuating Cylinder

(3) Cleaning, Inspection and Repair of Main Gear Actuating Cylinder

(a) Clean cylinder parts with a suitable dry type solvent and dry thoroughly.

(b) Inspect cylinder assembly for following:

1 Interior walls of cylinder and exterior surfaces of piston for scratches, burrs, corrosion, etc.

2 Threaded areas for damage.

3 End fitting retainer slot for excess wear.

4 Rod end fitting and swivel fitting of cylinder for wear and corrosion.

(c) Repairs to cylinder are limited to polishing out small scratches, burrs, etc., and replacing O-rings. (Refer to Parts Catalog for replacement part numbers.)

(4) Assembly of Main Gear Actuating Cylinder (Refer to Figure 32-15).

(a) Install O-ring on exterior of end gland.

(b) Install O-ring and back-up ring in the interior of end gland.

(c) Install O-ring on the body of piston assembly.

(d) Lubricate areas around O-rings with hydraulic fluid, park-o-lube or vaseline. Slide end gland on piston rod. Slide piston into the cylinder housing.

(e) Insert hook end of a new lock ring (P/ N 755-997) in slot in cylinder body and slot in end gland. Rotate gland counterclockwise to completely wrap lock ring into assembly.

(f) Align port in end gland and cylinder body.

(g) Check smoothness of piston operation. Static pressure test unit to check for possible cut O-rings.

(5) Installation of Main Gear Actuating Cylinder

(a) Attach the cylinder to its attachment fitting in the wheel well using bolt and nut.

(b) 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.

(c) Connect the downlock spring to the swivel fitting.

(d) Check the adjustment of the cylinder rod end. (Refer to Adjustment of Main Landing Gear, 32-10-00)

(e) Operate pump to purge system of air and check fluid level in reservoir.

(f) Remove the airplane from jacks.

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EXTENSION AND RETRACTION (Cont.)

4. Landing Gear Free-Fall (Emergency Release) Valve Assembly.

The valve is located is located in the nose section of the fuselage. Access to the valve is through the access panel in the nose baggage compartment.

A. Removal of Free-Fall Valve Assembly. (Refer to Figure 32-16.)

(1) Loosen screw securing cable to valve arm.

(1) Loosen clamp securing cable in position. Withdraw cable.

(1) Loosen (do not disconnect) hydraulic lines connected to the valve. Place a rag in position to absorb any hydraulic fluid spillage that may result.

(1) Remove clamps nuts and bolts securing the valve to bracket.

(1) Disconnect and remove hydraulic lines connected to valve. Cap the lines to avoid contamination.

(1) Remove the assembly from the airplane.

(1) Note direction of tees and elbows connected to valve. Remove tees and elbows.

B. Installation of Free-Fall Valve Assembly. (Refer to Figure 32-16.)

(1) Apply Titeseal No. 3 in back of first two male threads of elbows and tees. Titeseal should be applied sparingly to prevent it entering the hydraulic system.

(1) Insert tees and elbows. Tighten to same direction noted during removal.

(1) Connect hydraulic lines to tee and elbow fittings in valve; finger tighten only

(1) Install valve on bracket and secure in position with clamp bolts and nuts..

(1) Push arm assembly fully forward.

(1) Pull cable full forward. Insert loose end of cable through the hole in the bushing of the arm assembly

(1) Place clamp over reinforced portion of cable and tighten screws.

(1) Tighten arm lock screw on cable

(1) Tighten all hydraulic lines.

(1) Check for leaks. (Refer to Testing Hydraulic System, 29-10-00).

(1) Install nose compartment access panel.

C. Inspection and Repair.

(1) 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.

(2) Repair is impractical. If leaks appear, the valve assembly should be replaced.

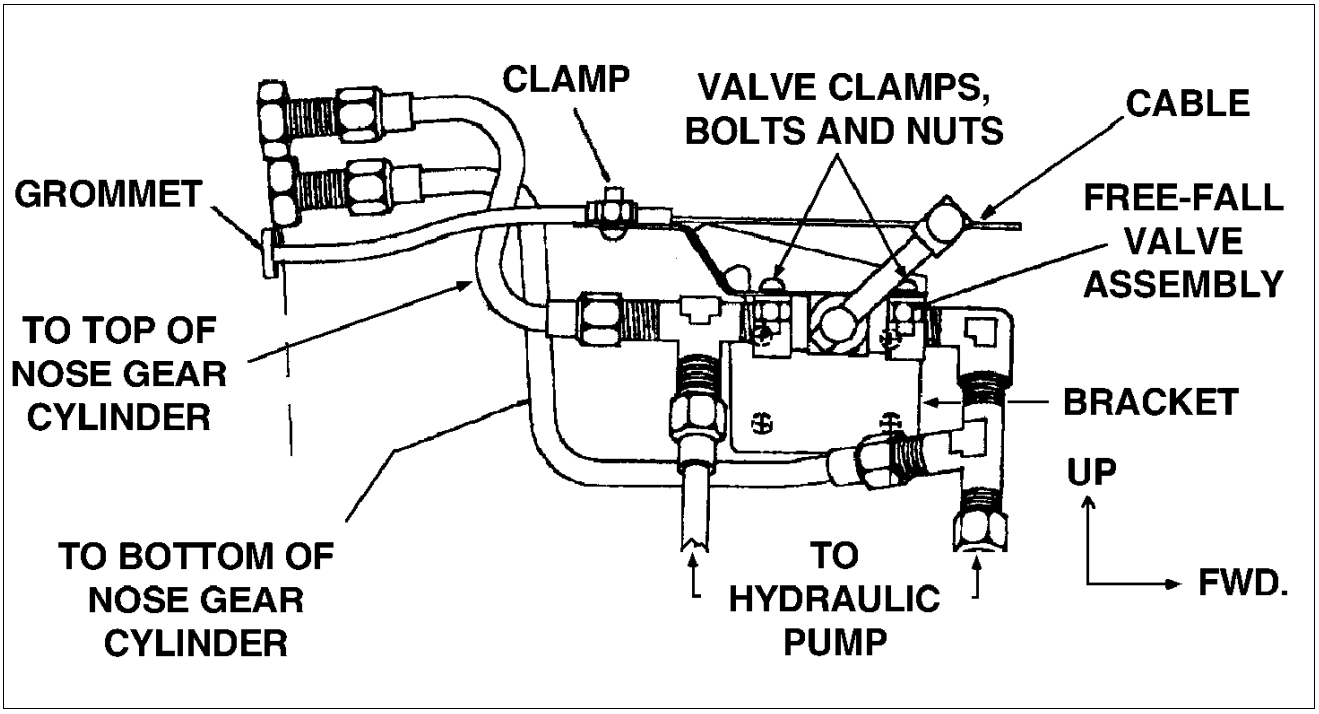

Figure 32-16. Free-Fall Valve Assembly

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WHEELS AND BRAKES

A. Nose Wheel Assembly

1. Removal and Disassembly of Nose Wheel (Refer to Figure 32-17)

a. Jack airplane enough to raise nose wheel clear of ground. (Refer to Jacking, Chapter 7.)
b. To remove nose wheel, first remove cotter pin and washer that secures safety clevis pin of wheel nut. Next remove clevis pin, wheel nut and then slide wheel from axle.
c. Wheel halves may be separated by first deflating tire. With tire sufficiently deflated, remove wheel through bolts. Pull wheel halves from tire by removing wheel half opposite valve stem first and then other half.
d. Wheel bearing assemblies may be removed from each wheel half by first removing snap rings that secure grease seal retainers, and then retainers, grease seals and bearing cones. Bearing cups should be removed by tapping out evenly from inside.

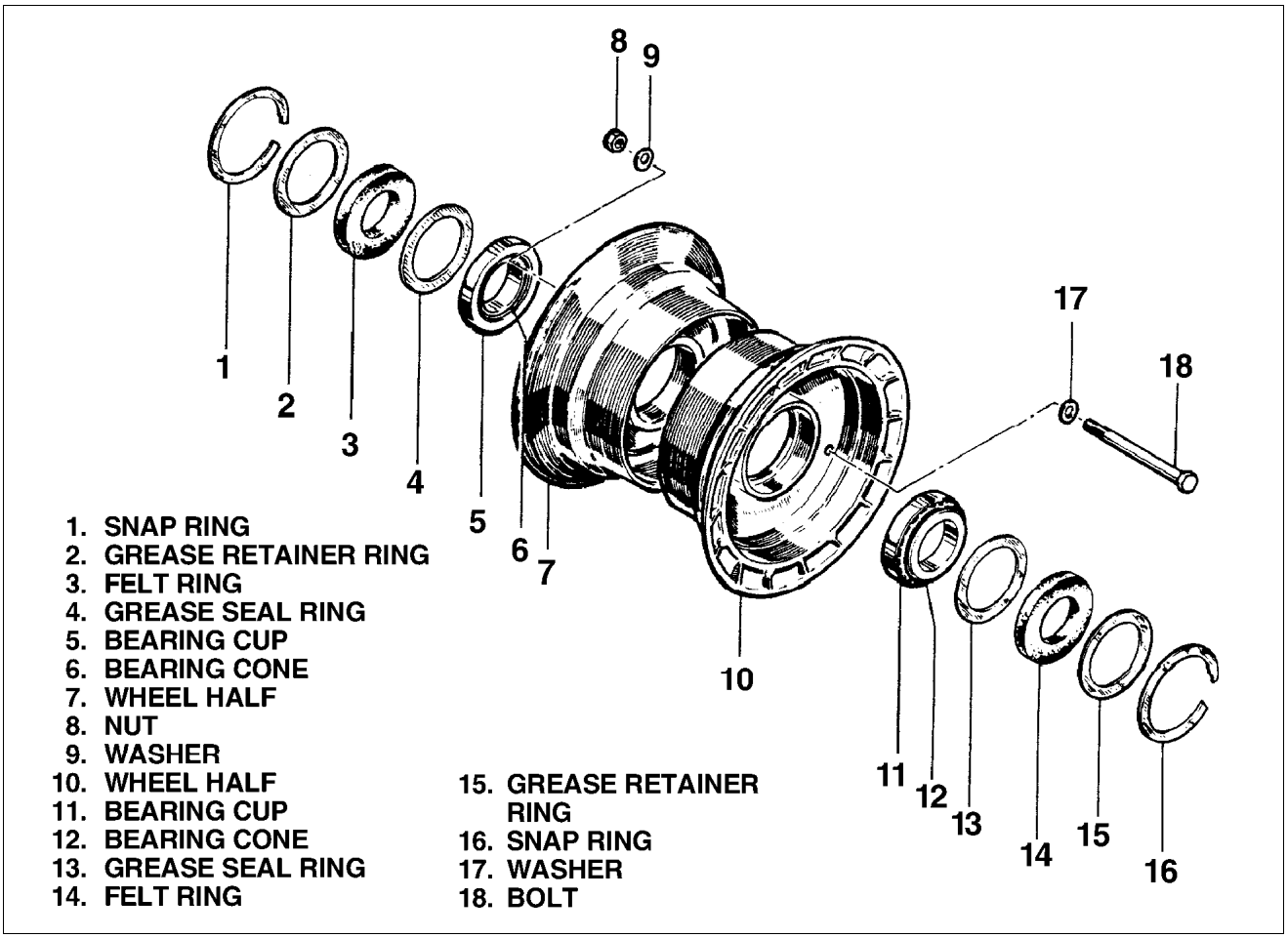


Figure 32-17. Nose Wheel Assembly

WHEELS AND BRAKES (Cont.)

2. Inspection of Nose Wheel Assembly.

   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. Replace felt grease seal if surface is hard or gritty.
   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.

3. Assembly and Installation Nose Wheel. (Refer to Figure 32-17.)

   a. Check that bearing cup for each wheel is properly installed. Install tire with tube on wheel half with valve stem hole and then join two wheel halves. Install through bolts with washers and nuts to valve stem side. Torque nuts to 90 inch-pounds.
   b. Lubricate bearing cones and install cones, grease seals, felt rings and seal retainer rings. Secure with snap rings.
   c. Slide wheel on axle and secure with retainer nut. Tighten nut to allow no side play, yet allow wheel to rotate freely. Safety nut with clevis pin and secure pin with washer and cotter pin.
   d. Insure nose gear is down and locked. Remove jack.

B. Main Wheel Assembly

1. Removal and Disassembly of Main Wheel. (Refer to Figure 32-18.)

   a. Place airplane on jacks. (Refer to Jacking, 7-10-00.)
   b. To remove main wheel, remove cap bolts that join brake cylinder housing and lining back plate assemblies. Remove back plate from between brake disk and wheel.
   c. Remove dust cover, cotter pin and flat head pin that safeties wheel nut, and slide wheel from axle.
   d. Wheel halves may be separated by first deflating tire. With tire sufficiently deflated, remove wheel through bolts. Pull wheel halves from tire by removing inner half from tire first, and then outer half.
   e. Wheel bearing assemblies may be removed from each wheel half by first removing retainer snap rings that secure grease seal retainers, and then retainers, grease seals and bearing cone. Bearing cups should not be removed only for replacement. See Repair of Nose and Main Wheel Assemblies for bearing cup replacement instructions.

2. Inspection of Main Wheel Assembly

   Inspect brake disk for cracks, excessive wear or scoring, rust, corrosion and warpage. Remove rust and blend out nicks, using fine 400 grit sandpaper. Replace disk if cracked or when disk is worn below minimum thickness. (Refer to Cleaning, Inspection and Repair of Wheel Brake Assembly.) In addition also perform same inspection for nose wheel in Inspection of Nose Wheel Assembly.

WHEELS AND BRAKES (Cont.)

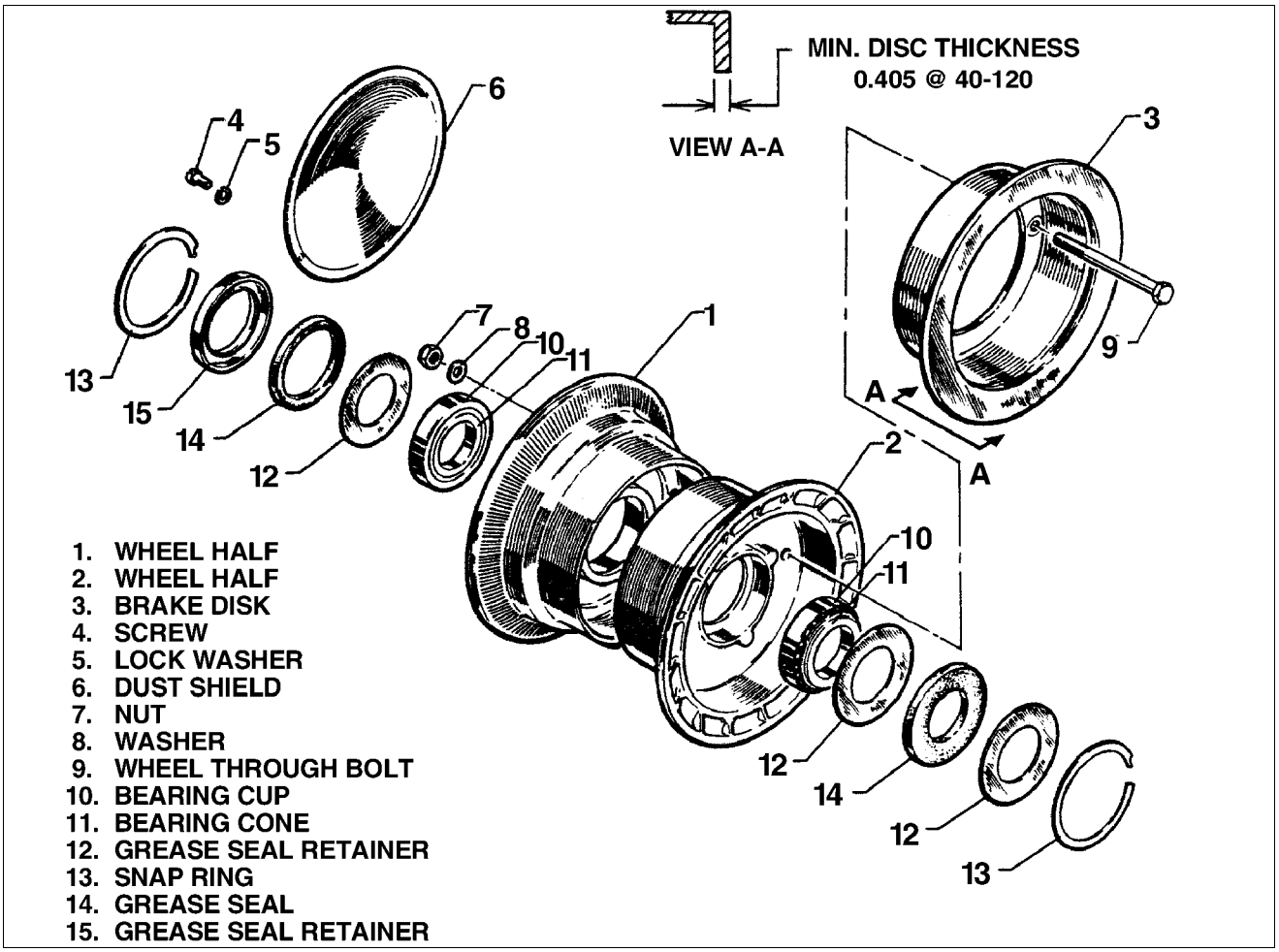


Figure 32-18. Main Wheel Assembly

3. Assembly and Installation of Main Wheel. (Refer to Figure 32-18)

   a. Check that bearing cup for each wheel is properly installed. Install tire with tube and wheel half with valve stem hole. Ascertain that index mark is aligned with index mark on tire to insure proper tire, tube and wheel balance. Join two wheel halves and position brake disk in inner wheel half. Install through bolts with nuts on valve stem side. Torque wheel nuts to 150 inch-pounds and inflate tire.

   b. Lubricate bearing cones and install cones, grease seals and seal retainer rings. Secure retainer with snap ring.

   c. Slide wheel on axle and secure with retainer nut. Tighten nut to allow no side play, yet allow wheel to rotate freely. Safety nut with a flat head pin, washer and cotter pin. Install dust cover.

   d. Position brake lining back plates between wheel and brake disk and brake cylinder on torque plate. Insert spacer blocks between back plates and cylinder, and install four bolts to secure assembly. If brake was disconnected, connect line and bleed brakes.

WHEELS AND BRAKES (Cont.)

C. Repair of Nose and Main Wheel Assemblies

— Note —

Remove rust and blend out small nicks, using fine 400 grit sandpaper.

Repairs are limited to blending out small nicks, scratches, gouges and areas of slight corrosion, plus replacement of parts which are cracked or badly corroded.

— Note —

Never paint working surfaces of bearing cups.

Wheels may also be repainted if parts have been repaired and thoroughly cleaned. Paint exposed areas with one coat zinc chromate primer and one coat of aluminum lacquer.

D. Bearing Cup Replacement:

1. Removal:

   a. Insert wheel half into boiling water for 15 minutes or place in an oven not exceeding 250°F (121°C) for 15 minutes.
   b. Remove from source of heat and invert wheel half. If cup does not drop out, tap cup evenly from axle bore with a fiber drift pin or suitable arbor press.

2. Installation:

   a. To replace a new cup, apply one coat of zinc chromate primer to wheel half bearing bore.
   b. 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.
   c. Remove wheel half from source of heat and bearing cup from dry ice. Install chilled bearing cup into bearing bore of heated wheel half. Tap gently to seat evenly in place,using a fiber drift pin or suitable arbor press.

E. Brake Adjustment and Lining Tolerance

Because they are self-adjusting, no adjustment of brake lining clearance is necessary. Inspection of lining is necessary, and may be inspected visually while installed on airplane.

F. Wheel Brake Assembly

1. Removal and Disassembly of Wheel Brake Assembly. (Refer to Figure 32-19.)

   a. Disconnect brake line from brake cylinder at tube fitting.
   b. Remove cap bolts that join brake cylinder housing and lining back plate assembly. Remove back plate from between brake disk and wheel.
   c. Slide brake cylinder housing from torque plate.
   d. Remove pressure plate by sliding off anchor bolts of housing.
   e. Piston(s) may be removed by injecting low air pressure in cylinder fluid inlet and forcing piston from housing.
   f. Check anchor bolt for wear.

WHEELS AND BRAKES (Cont.)

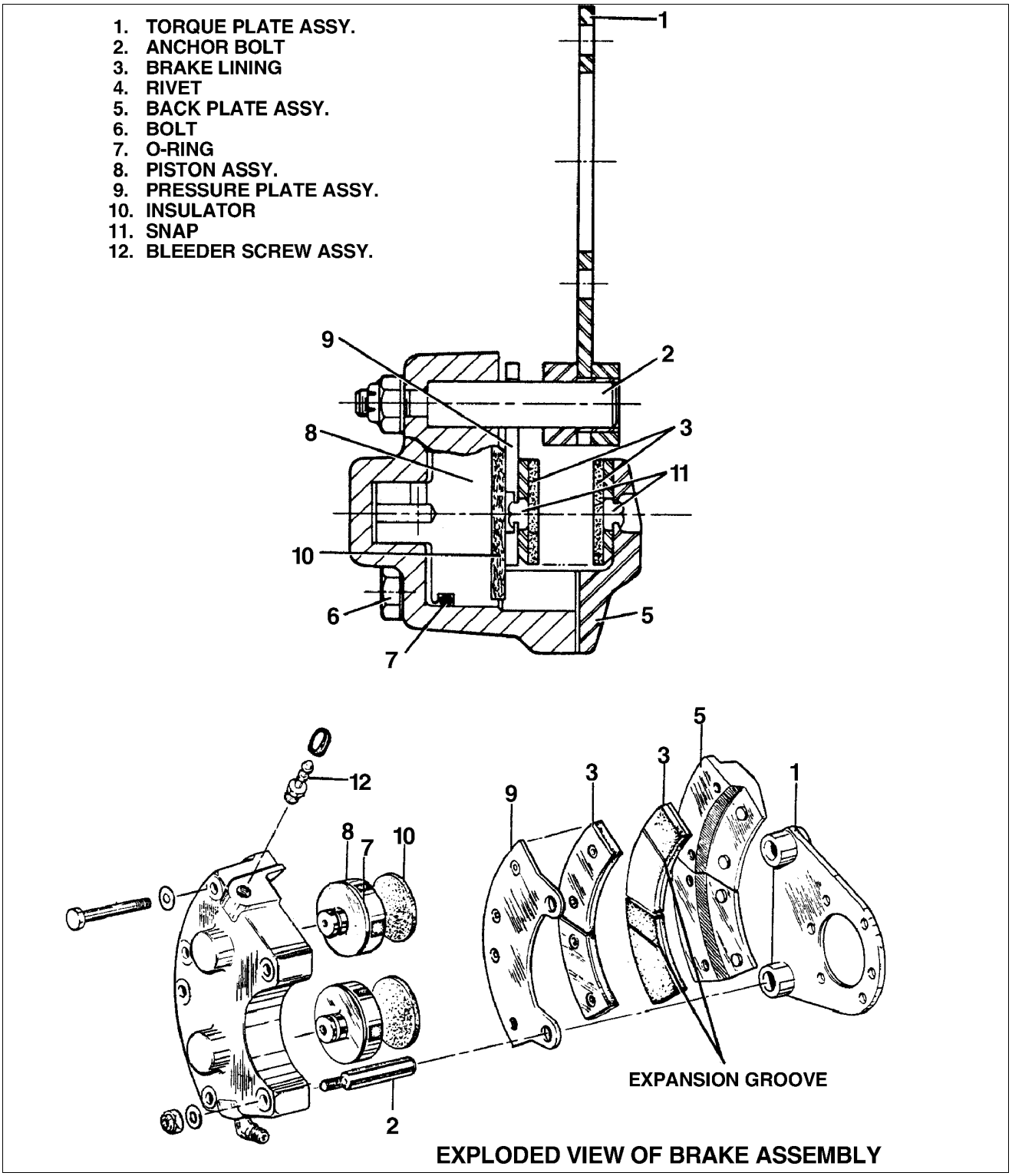


Figure 32-19. 30-83 Wheel Brake Assembly

WHEELS AND BRAKES (Cont.)

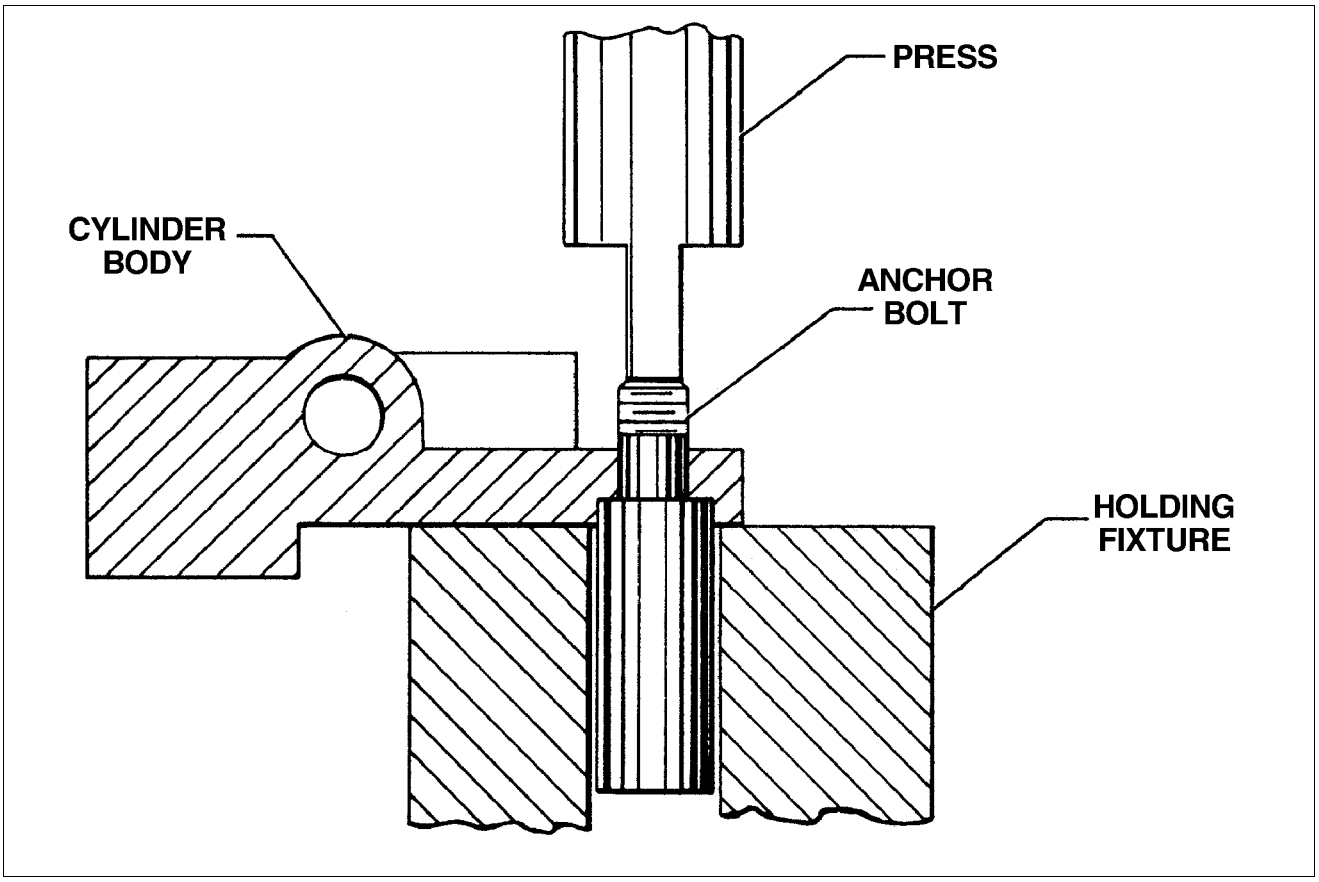


Figure 32-20. Removal of Anchor Bolt

g. Remove anchor bolt by the following procedure:

(1) Position cylinder assembly on a holding fixture. (Refer to Figure 32-20.)
(2) Use a suitable arbor press to remove anchor bolt from cylinder body.

h. Install anchor bolt by the following procedure:

(1) Support anchor bolt in a holding fixture. (Refer to Figure 32-21, step A.)
(2) Align cylinder body over anchor bolt. (Refer to Figure 32-21, step B.)
(3) Use a suitable arbor press and apply pressure on spot face directly over anchor bolt hole. (Refer to Figure 32-21, step C.)

2. Cleaning, Inspection and Repair of Wheel Brake Assembly

a. Clean assembly with a suitable solvent and dry thoroughly.
b. Check wall of cylinder housing and piston for scratches, burrs, corrosion, etc., that may damage O-rings.
c. Check general condition of brake bleeder screw and lines.

WHEELS AND BRAKES (Cont.)

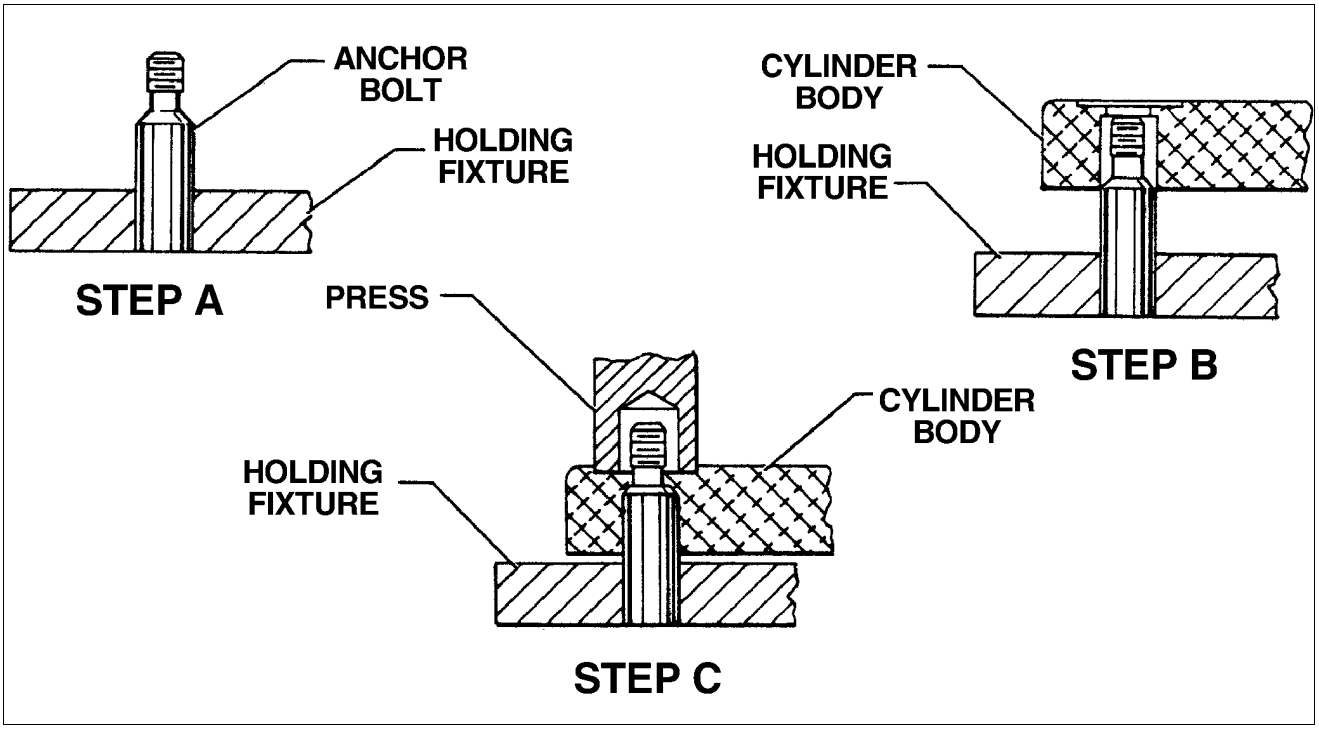


Figure 32-21. Installation of Anchor Bolt

d. Check brake disk for wear, grooves, scratches, or pits. Minimum ***disk*** thickness of Disk 164-46 used on Wheel Assembly 40-120 is 0.405. A single groove or isolated grooves up to .030 of an inch deep would not necessitate ***disk*** replacement. A grooving of entire ***disk*** surface would reduce lining life and should be replaced. If necessary to remove wheel ***disk,*** refer to Removal and Disassembly of Main Wheel.

e. Check ***lining*** expansion groove. If groove is not showing replace ***linings.*** Remove linings by prying loose with a screwdriver or a thin flat wedge. To install linings:

(1) Position linings onto pins
(2) Apply pressure to snap into position.

— Note —

After installation, condition new linings by performing two (2) consecutive full stop braking applications from 30 to 35 kts. Do not allow brake discs to cool substantially between stops.

WHEELS AND BRAKES (Cont.)

3. Assembly and Installation of Wheel Brake Assembly. (Refer to Figure 32-19.)

   a. Lubricate piston O-ring(s) with fluid MIL-H-5606A and install on piston(s). Slide piston(s) in cylinder housing until flush with surface of housing.
   b. Slide lining pressure plate onto anchor bolts of housing.
   c. Slide cylinder housing assembly on torque plate of gear.
   d. Position lining back plate between wheel and brake disc. Install bolts and torque to 40 inch - pounds to secure assembly.
   e. Connect brake line to brake cylinder housing.
   f. Bleed brake system as described in Bleeding Brakes.

G. Hand/Parking Brake Master Cylinder

1. Removal of Hand brake Master Cylinder (Refer to Figure 32-22.)

   a. To remove brake master cylinder, first disconnect inlet supply line from fitting at top of cylinder and allow fluid to drain from reservoir and line into a suitable container.
   b. Disconnect pressure line from fitting on cylinder and allow fluid to drain from cylinder line.
   c. Disconnect end of cylinder rod from brake handle by removing cotter pin that safeties connecting clevis pin. Remove clevis pin and spacer washers.
   d. Disconnect base of cylinder from its mounting bracket by removing attaching bolt assembly.
   e. Handle assembly may be removed by removing attaching bolt assembly that secures handle to its mounting bracket.

2. Disassembly of Hand Brake Master Cylinder. (Refer to Figure 32-23.)

   a. Remove cylinder from its mounting bracket as per Removal of Brake Master Cylinder.
   b. To disassemble cylinder, first remove piston rod assembly by removing snap ring from annular slot at rod end of cylinder. Draw piston rod assembly from cylinder.
   c. Piston rod assembly may be disassembled by first removing small snap ring securing retainer bushing, spring, piston, seal, gland, and, if desired, large return spring.
   d. Remove o-rings from piston and gland.

3. Cleaning, Inspection and Repair of Hand Brake Master Cylinder

   a. Clean cylinder parts with a suitable solvent and dry thoroughly.
   b. Inspect interior walls of cylinder for scratches, burrs, corrosion, etc.
   c. Inspect general condition of fitting threads of cylinder.
   d. Check piston for scratches, burrs, corrosion, etc.
   e. Repairs to cylinder are limited to polishing out small scratches, burrs, etc., and replace O-rings.

4. Assembly of Hand Brake Master Cylinder. (Refer to Figure 32-23)

— Note —

Use a small amount of hydraulic fluid (MIL-H-5606A) on O-ring and component parts to prevent damage and ease of handling during assembly.

WHEELS AND BRAKES (Cont.)

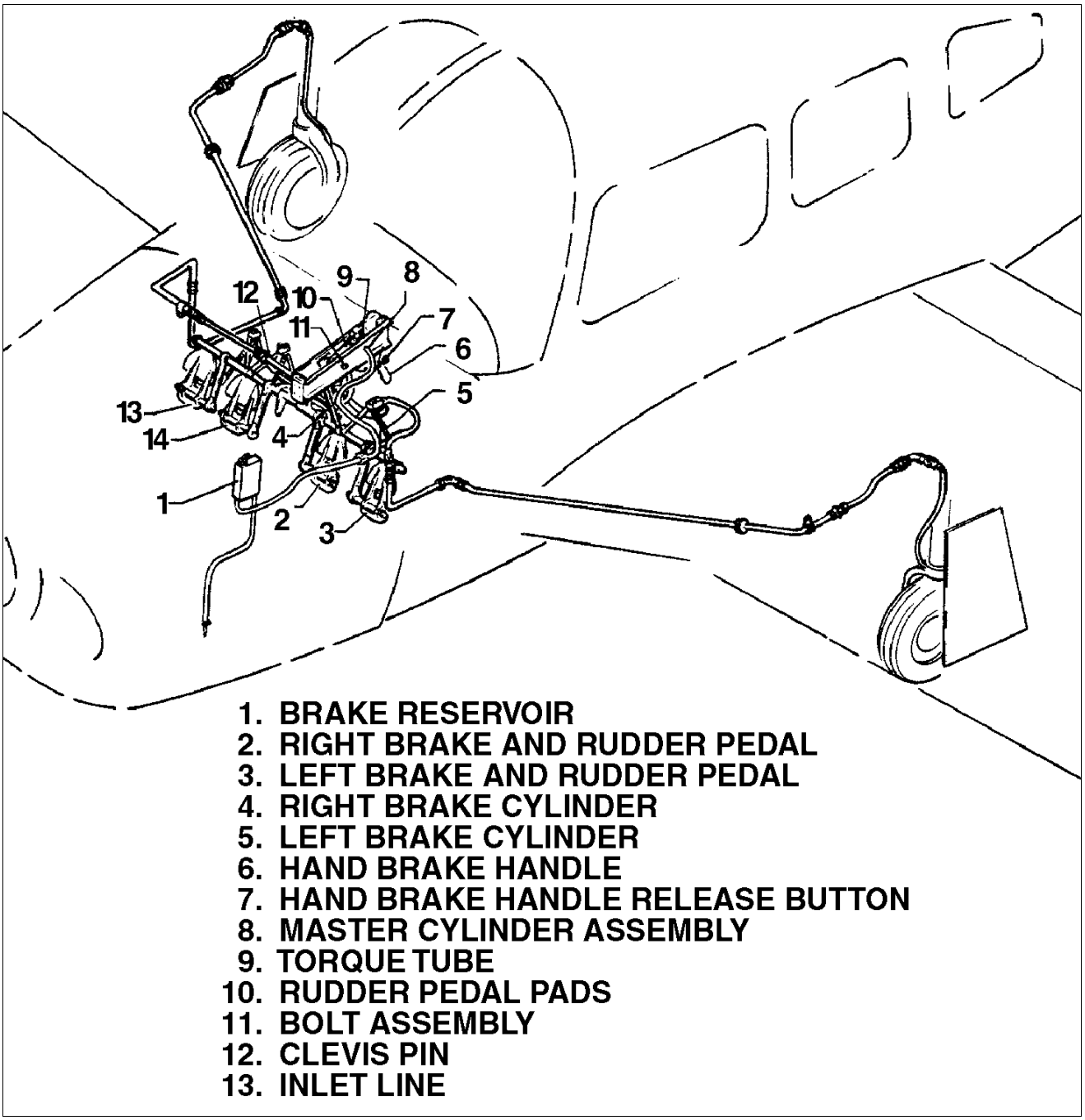


Figure 32-22. Brake System Installation

a. Install new O-rings on outside of packing gland and on outside of piston. (Install ***teflon*** O-ring on piston, with use of a cone placed against piston. Cone may be constructed of plastic or metal with dimensions shown in Figure 32-23.)

WHEELS AND BRAKES (Cont.)

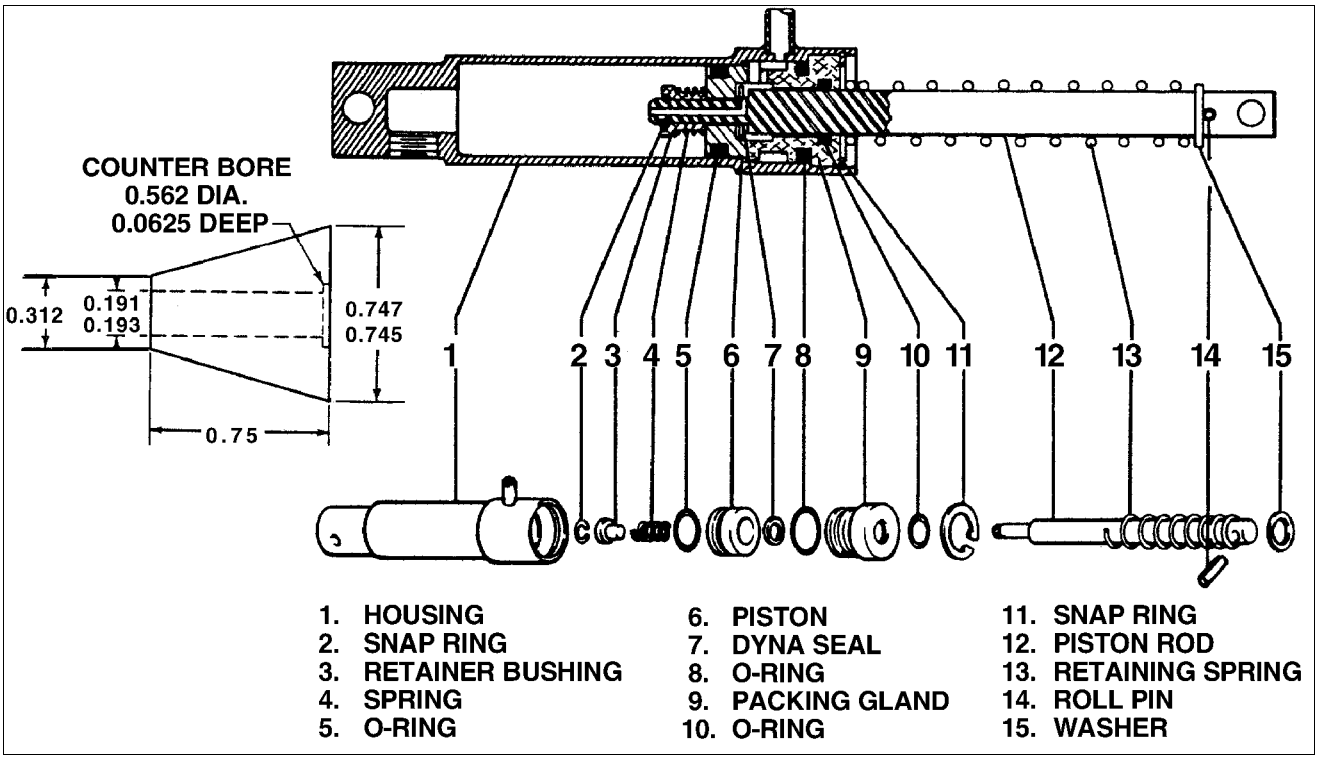


Figure 32-23. Hand/Parking Brake Master Cylinder

b. To assemble piston rod assembly, install on rod, in order:

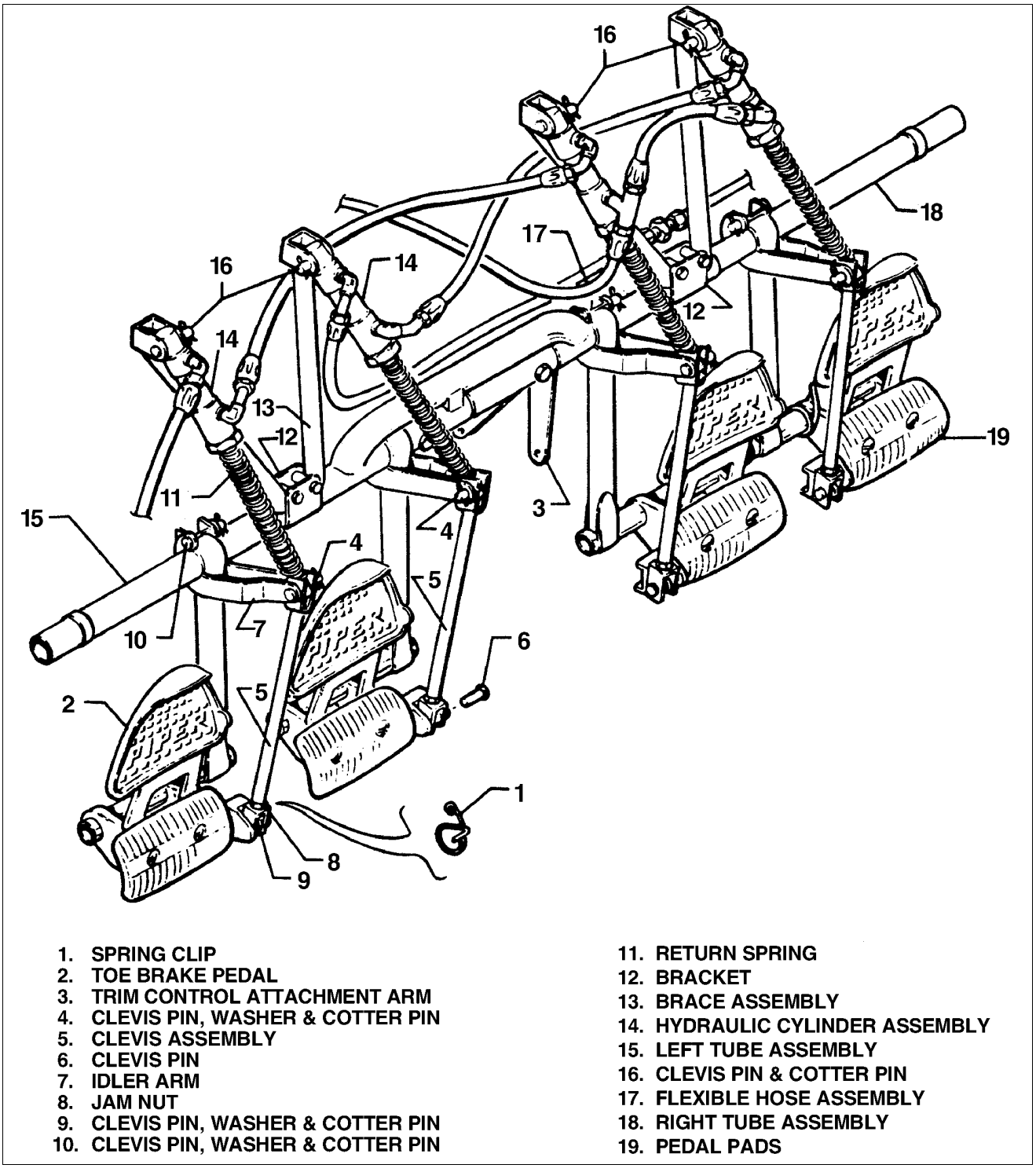
(1) Roll pins.
(2) Return spring retainer washer.
(3) Return spring, packing gland with O-rings.
(4) Seal.
(5) Piston with O-ring.
(6) Spring and retainer bushing.
(7) Secure with small snap ring on end of rod.

c. Insert piston rod assembly in cylinder and secure packing gland with snap ring.
d. Install cylinder per Installation of Brake Master Cylinder.

5. Installation of Hand Brake Master Cylinder. (Refer to Figure 32-22)

a. Install brake handle assembly between its mounting bracket and secure with bolt, washers, nut and cotter pin. Place washers on each side of handle, between bracket and under nut.
b. Place the cylinder between the mounting bracket and secure the base end with bolt, washers,nut and cotter pin. Place washers on each side of the cylinder and under the nut.
c. Connect rod end of cylinder to brake handle with a clevis pin and thin washers Safety clevis with a cotter pin.

WHEELS AND BRAKES (Cont.)



1. SPRING CLIP
2. TOE BRAKE PEDAL
3. TRIM CONTROL ATTACHMENT ARM
4. CLEVIS PIN, WASHER & COTTER PIN
5. CLEVIS ASSEMBLY
6. CLEVIS PIN
7. IDLER ARM
8. JAM NUT
9. CLEVIS PIN, WASHER & COTTER PIN
10. CLEVIS PIN, WASHER & COTTER PIN
11. RETURN SPRING
12. BRACKET
13. BRACE ASSEMBLY
14. HYDRAULIC CYLINDER ASSEMBLY
15. LEFT TUBE ASSEMBLY
16. CLEVIS PIN & COTTER PIN
17. FLEXIBLE HOSE ASSEMBLY
18. RIGHT TUBE ASSEMBLY
19. PEDAL PADS

Figure 32-24. Toe Brake Installation

d. Connect pressure line to fitting at bottom of cylinder.
e. Connect inlet supply line to fitting at top of cylinder and secure with spring clamp.
f. Bleed brake system per Bleeding Brakes.

H. Toe Brake Cylinder(s) (10-30)

1. Removal of Toe Brake Cylinder(s) (Refer to Figure 32-24)

a. Disconnect upper and lower lines from cylinder to be removed and cap lines to prevent fluid leakage or drain fluid from brake reservoir and master cylinder.
b. Remove cylinder from its attachment fittings by first removing cotter pins that safety cylinder attaching pins and then removing pins.

2. Disassembly of Toe Brake Cylinder(s) (Refer to Figure 32-25)

a. Remove cylinder from its mounting bracket per Removal of Brake Cylinder.
b. To disassemble cylinder, first remove piston rod assembly by removing retaining ring from annular slot in cylinder housing. Draw piston rod assembly from cylinder.
c. Piston rod assembly may be disassembled by first removing retaining ring, sleeve, spring, and then piston assembly, O-ring, and gland, washer wiper, and if desired, return spring.
d. Remove O-ring from piston and packing gland.

3. Cleaning, Inspection and Repair of Toe Brake Cylinder(s)

a. Clean cylinder components with a suitable solvent and dry thoroughly.
b. Inspect interior walls of cylinder for scratches, burrs, corrosion, etc.
c. Inspect general condition of fitting threads.
d. Inspect piston for scratches, burrs, corrosion, etc.
e. Repairs to cylinder are limited to polishing out small scratches and burrs, and replacing seal and O-rings.

4. Assembly of Toe Brake Cylinder(s). (Refer to Figures 32-25)

— Note —

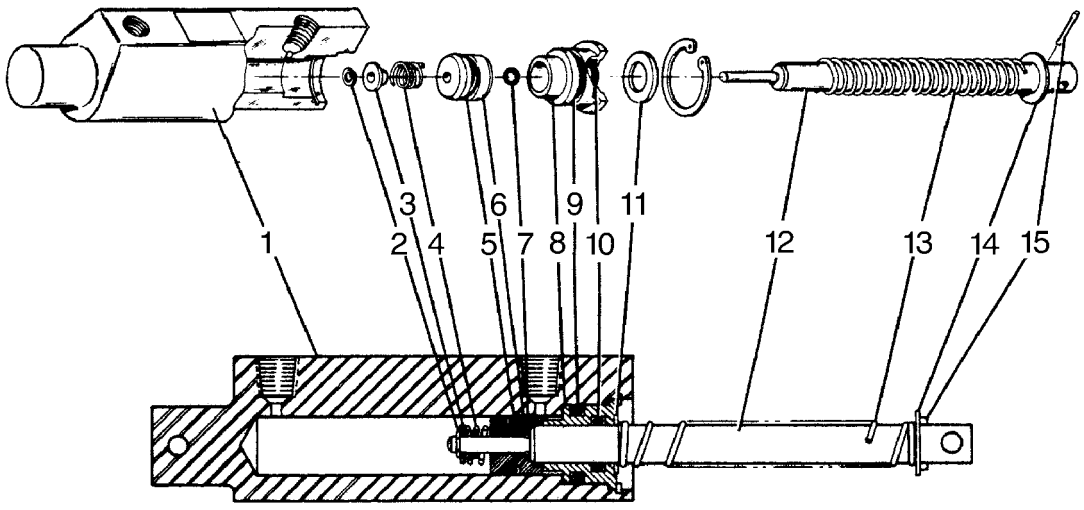
Rub a small amount of hydraulic fluid (MIL-H-5606A) on all O-rings and component parts for ease of handling during reassembly and to prevent damage.

a Install new O-rings on inside and outside of packing gland and on outside of piston.
b. To assemble piston rod assembly, install on rod, in order, roll pin, washer, spring, washer, packing gland with O-rings, seal, piston assembly with O-ring, sleeve and retaining ring.
c. Insert piston rod assembly in cylinder and secure with retaining ring.
d. Install cylinder per Installation of Brake Cylinder.

5. Installation of Toe Brake Cylinder(s). (Refer to Figure 21-24)

1. Position cylinder at its mounting points and attach with clevis pins. Safety pins with cotter pins.
2. Connect brake lines to cylinder fittings.
3. Bleed brakes per Bleeding Brakes.

WHEELS AND BRAKES (Cont.)



1. HOUSING	5. O-RING	9. O-RING	13. SPRING
2. RETAINING RING	6. PISTON	10. O-RING	14. WASHER
3. SLEEVE	7. O-RING	11. WASHER WIPER	15. ROLL PIN
4. SPRING	8. GLAND	12. ROD	

Figure 32-25. Toe Brake Cylinder (10-30)

I. Bleeding Brakes

1. Gravity Brake Bleeding Procedure

a. On both main landing gear wheel brake assemblies, attach a clear plastic hose to brake bleeders and extend into container partially filled with hydraulic fluid, MIL-H-5606A. Ends of this hose should be submerged in the fluid. Open both bleeders approximately one and one-half to two turns.
b. Fill brake reservoir on firewall with hydraulic fluid, MIL-H-5606A.
c. Disconnect toe brake cylinders from pedal connection by removing clevis pin, washer and cotter pin.
d. Invert toe brake cylinder to aid in releasing trapped air in top of cylinder.
e. Check toe brake pedals in cockpit to insure pedals are pulled full aft.
f. Pull hand brake handle, pumping master cylinder very slowly approximately 25 times until fluid is observed passing through clear plastic hoses at wheel cylinder.

— Note —

Maintained fluid level in reservoir to prevent air from entering line.

g. Tighten both wheel bleeders.
h. Pull hand brake until a firm handle is maintained.

WHEELS AND BRAKES (Cont.)

2. Pressure Brake Bleeding Procedure

   a. Place a small clear plastic hose on vent tube of brake reservoir and place a second small clear plastic hose on bleeder fitting on one main landing gear. Place open ends of these tubes in a suitable container to collect fluid overflow. Open bleeder fitting one or two turns.
   b. On other main gear, slide hose of pressure unit over bleeder fitting then open fitting one or two turns and pressure fill brake system with MIL-H-5606A fluid.
   c. With fluid continually flowing through brake system, SLOWLY and together actuate hand brake and toe brake pedal of side being bled, several times, to purge cylinders of air. On dual brake installations, both right and left pedals must be actuated.

— Note —

To determine if any air is left in system, watch fluid passing through the plastic hose at fluid reservoir and bleeder fitting on gear being bled . If air bubbles are evident, continue filling system until all air is out of system and a steady flow of fluid is observed. If brake handle remains spongy, disconnect bottom of toe brake cylinders (next to pedal) and rotate cylinder horizontally, or above horizontal, and, by use of hand brake alone, purge air from system.

   d. Close open bleeder fitting on gear being bled. Close open bleeder fitting to which pressure hose is attached; then close pressure unit and remove hoses from bleeder fittings. Check brakes for proper pedal pressure. Replace caps over bleeder fittings.

— Note —

It may be necessary to remove any trapped air in top of wheel brake unit by applying pressure to system with hand brake lever, slowly opening bleeder, and releasing hand lever.

   e. Repeat this procedure, if necessary, on other gear.
   f. Drain excess fluid from reservoir to fluid level line with a syringe.

3. Brake System Leak Check.

   Pull for a good firm hand brake and lock parking brake mechanism. Allow system to stand for approximately 10 minutes; then by gripping parking brake handle, it should not be able to be pulled aft further than original set. Should handle be able to be pulled towards panel and feel spongy, a leak is present at some point in system. This leak may appear at any one of the connections throughout system or internally in master brake cylinder or wheel brake assemblies.

WHEELS AND BRAKES (Cont.)

4. Bleeding of Brakes After a Unit Has Been Changed.

— CAUTION —

TO PREVENT AIR FROM ENTERING SYSTEM, DO NOT ALLOW PRESSURE TO BLEED OFF BEFORE CLOSING BLEEDERS. REPEAT PUMPING AND BLEEDING APPROXIMATELY 10 OR MORE TIMES OR UNTIL ALL AIR IS RELEASED FROM SYSTEM. MAINTAINED RESERVOIR FLUID LEVEL DURING ALL BLEEDING.

a. Actuate hand brake handle until some pressure builds up in system. At this time, crack attaching B nuts at any of hose connections of replaced unit. Most of handle sponge feeling should be displaced by this action. Retighten B nuts.
b. Actuate master cylinder and toe brake cylinder of side on which unit was changed. Bleed fluid through brake assembly on wheel by pumping pressure and cracking bleeder until pressure drops.

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POSITION AND WARNING

A. Landing Gear Limit Switches

— Note —

Make all adjustments of limit switches with airplane on jacks. Do not bend actuator springs mounted on limit switches.

1. Adjustment of Nose Gear ***UP*** Limit Switch.

The gear ***up*** limit switch is mounted on a bracket above the point where right side of upper drag link attaches to engine mount. (Refer to Figure 32-26.)

a. Raise airplane on jacks. (Refer to Jacking, 7-10-00.)
b. Disconnect gear doors or remove bottom cowl, as desired.
c. Retract landing gear hydraulically by turning master switch on and moving gear selector switch to UP position.
d. Block nose gear in up position. Turn master switch off.
e. Push gear up tight and block.
f. Loosen lower attachment screw of switch bracket and rotate switch toward actuator tang until 0.06 to 0.08 inch measurement (noted in Figure 32-26) is obtained. Switch tang should be actuated a minimum of 0.12 inches in from lower end of tang.
g. Manually move gear up and down only as far as necessary to check that switch actuates within 0.12 of full up position. Remove block from under gear.
h. Select master switch ON. Cycle gear hydraulically several times. Check that red gear unsafe light will go out when gear has retracted and pump has shut off. Select master switch OFF.
i. Confirm gear is down and locked. Remove airplane from jacks.

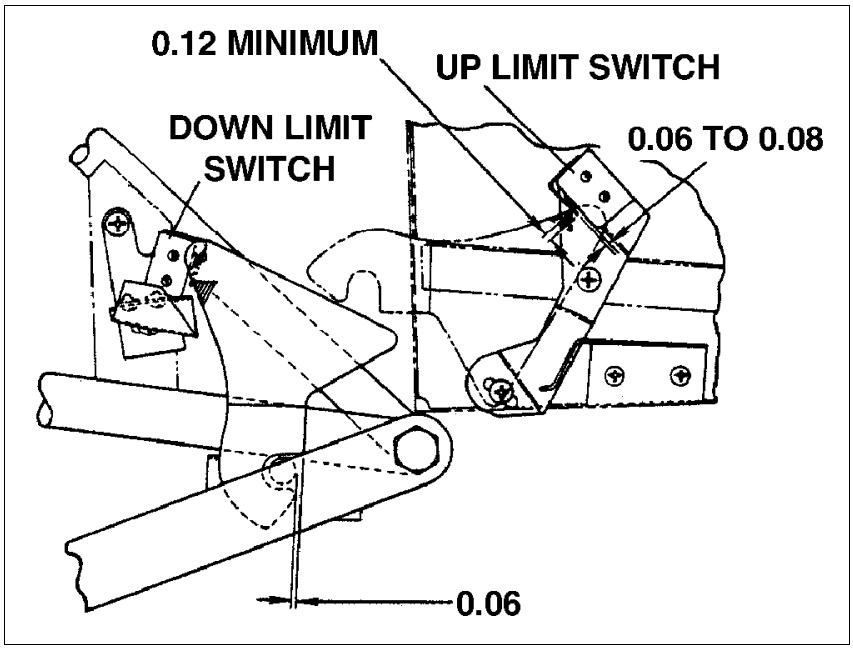

Figure 32-26. Adjustment of Nose Gear Limit Switches

POSITION AND WARNING (Cont.)

2. Adjustment of ***Nose*** Gear ***DOWN*** Limit Switch.

   Gear down limit switch is mounted on horizontal support tube of engine mount that runs between right attachment points of gear housing and upper drag link.

   a. Check that gear is down and locked. Check the master switch is OFF.
   b. Raise airplane on jacks. (Refer to Jacking, 7-10-00)
   c. Down limit switch should actuate only after leading edge of down lock hook, when moving to locked position, has passed down lock roller by 0.06 of an inch. (Refer to Figure 32-26.) Position hook at this location in relation to roller by moving actuator piston manually toward up position. If necessary, disconnect down lock spring
   d. Loosen lower attachment screw of switch mounting bracket. Move bracket toward down lock hook until it is heard to actuate (click). Retighten bracket attachment screw.
   e. Manually move hook from locked to unlocked position and determine that switch actuates(clicks) at correct location of hook.
   f. Turn master switch ON. Using gear selector switch, cycle gear hydraulically several times. As gear begins to retract, the appropriate green light above selector switch should go out and red GEAR WARN annunciator light come on.
   i. Select master switch OFF
   j. Confirm gear is down and locked. Remove airplane from jacks.

3. Adjustment of ***Main*** Gear ***UP*** Limit Switch

   A gear up limit switch is located in each wheel well above gear door hinge. There is no adjustment of these switches other than to check that gear, when retracting, will actuate switch within 0.88 of an inch of full up. Switch operation will extinguish red GEAR WARN annunciator light.

4. Adjustment of ***Main*** Gear ***DOWN*** Limit Switch.

   A gear down limit switch is mounted on a bracket attached to the lower drag link of each main gear. The switch should be adjusted so that, when the down lock hook has entered locked position, and is within 0.025 and 0.035 of an inch of contacting down lock pinto, it actuates and illuminates the appropriate green indicator light in cockpit . (Refer Figure 32-27.) Adjust switch as follows:

   a. Check that main gear ***down lock*** is properly adjusted as described in Adjustment of Main Landing Gear.
   b. Raise airplane on jacks. (Refer to Jacking, 7-10-00)
   c. Check that master switch is OFF.
   d. Confirm that landing gear is down and pressure is relieved from hydraulic system. To relieve pressure, pull ***OUT*** the emergency extender knob
   e. Raise down lock hook assembly and place a 0.030 of an inch feeler gauge between horizontal surface of hook that is next to switch (surface that contacts down lock pin) and rounded surface of pin. Lower hook and allow it to rest on feeler gauge.
   f. Loosen attaching screws of switch and, while pushing up on center of link assembly, rotate switch toward hook until it is heard to actuate (clicks). Retighten attaching screws of switch.

POSITION AND WARNING (Cont.)

g. Manually move hook assembly up from pin until hook nearly disengages from pin. Then, with pressure against bottom of link assembly, move back to check that switch actuates within 0.025 to 0.035 of an inch of full lock.
h. Push emergency extender knob ***IN***.
i. Turn master switch ON. Using gear selector switch, cycle gear hydraulically several times. As gear begins to retract, appropriate green light above selector should go ***OUT*** and red gear unsafe light at top of instrument panel should come ***ON.***
i. Select master switch OFF.
j. Confirm gear is down and locked. Remove airplane from jacks.

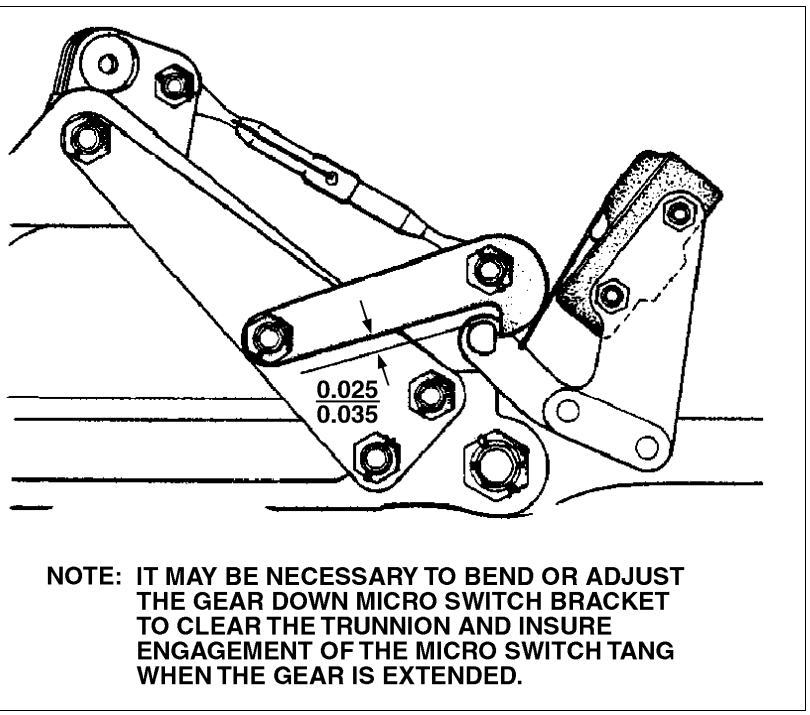

Figure 32-27. Adjustment of Main Gear Down Limit Switch

5. Adjustment of Landing Gear Safety Switch (Squat Switch)

— CAUTION —

BEFORE BEGINNING THE FOLLOWING PROCEDURES, CHECK THAT THE LEFT GEAR OLEO HAS BEEN SERVICED PER SECTION 32-10-00, PARAGRAPH A, 3.

The landing gear safety switch, located on left main gear housing, is adjusted so that switch is actuated within last quarter of an inch of gear extension.

a. Compress strut until 7.875 inches is obtained between top of gear fork and bottom of gear housing. Maintain gear at this measurement.

POSITION AND WARNING (Cont.)

b. Adjust switch down until it actuates at this point. Secure switch.
c. Extend and then compress strut to ascertain that switch will actuate within last quarter of an inch of oleo extension.

B. Landing Gear Up/Power Reduced Warning Switch

The gear up/power reduced warning switch (refer to Figure 32-28, switch A) is within control quadrant below throttle control lever. This switch will actuate the warning horn and the red GEAR WARN annunciator light simultaneously, when the landing gear is not down and locked, and the throttle is reduced below 14 inches of manifold pressure.

1. Removal of Landing Gear Up/Power Reduced Warning Switch

a. Loosen quadrant cover by removing cover attaching screws from each side and at bottom of cover.
b. Pull cover aft enough to remove screws that secure reinforcing clip to top underside of cover. Remove cover.
c. Remove switch from its mounting bracket by removing switch attaching screws.
d. Disconnect electrical leads from switch.

2. Installation of Landing Gear Up/Power Reduced Warning Switch

a. Connect electrical leads to switch.
b. Position switch with actuator follower against its mounting bracket and secure with screws.
c. Switch may be adjusted at this time per instructions in Adjustment of Landing Gear Up/Power Reduced Warning Switch.
d. With control levers aft, slide quadrant cover into position around controls far enough to allow cover reinforcement clip to be installed at top underside of cover and secure with screws.
e. Install cover and secure with screws.

3. Adjustment of Landing Gear Up/Power Reduced Warning Switch

a. Remove control quadrant cover as given in Removal of Landing Gear Up/Power Reduced Warning Switch.
b. Flight test airplane and at a safe altitude, establish a normal descent with gear up and propeller control at a desired low pitch setting.
c. Retard throttle to a manifold pressure of approximately 14 inches.
d. In some manner, mark throttle lever in relation to its position next to mounting bracket.
e. With airplane on ground and throttle positioned to mark, loosen screws that secure switch and rotate it toward throttle until it is heard to actuate. Retighten switch attachment screws.
f. Advance and retard throttle to check that switch actuates at desired throttle lever setting.
g. Flight test airplane to determine that horn and light will actuate when throttle is reduced below approximately 14 inches of manifold pressure with gear up.
h. Install quadrant cover as given in Installation of Landing Gear Up/Power Reduced Warning Switch.

POSITION AND WARNING (Cont.)

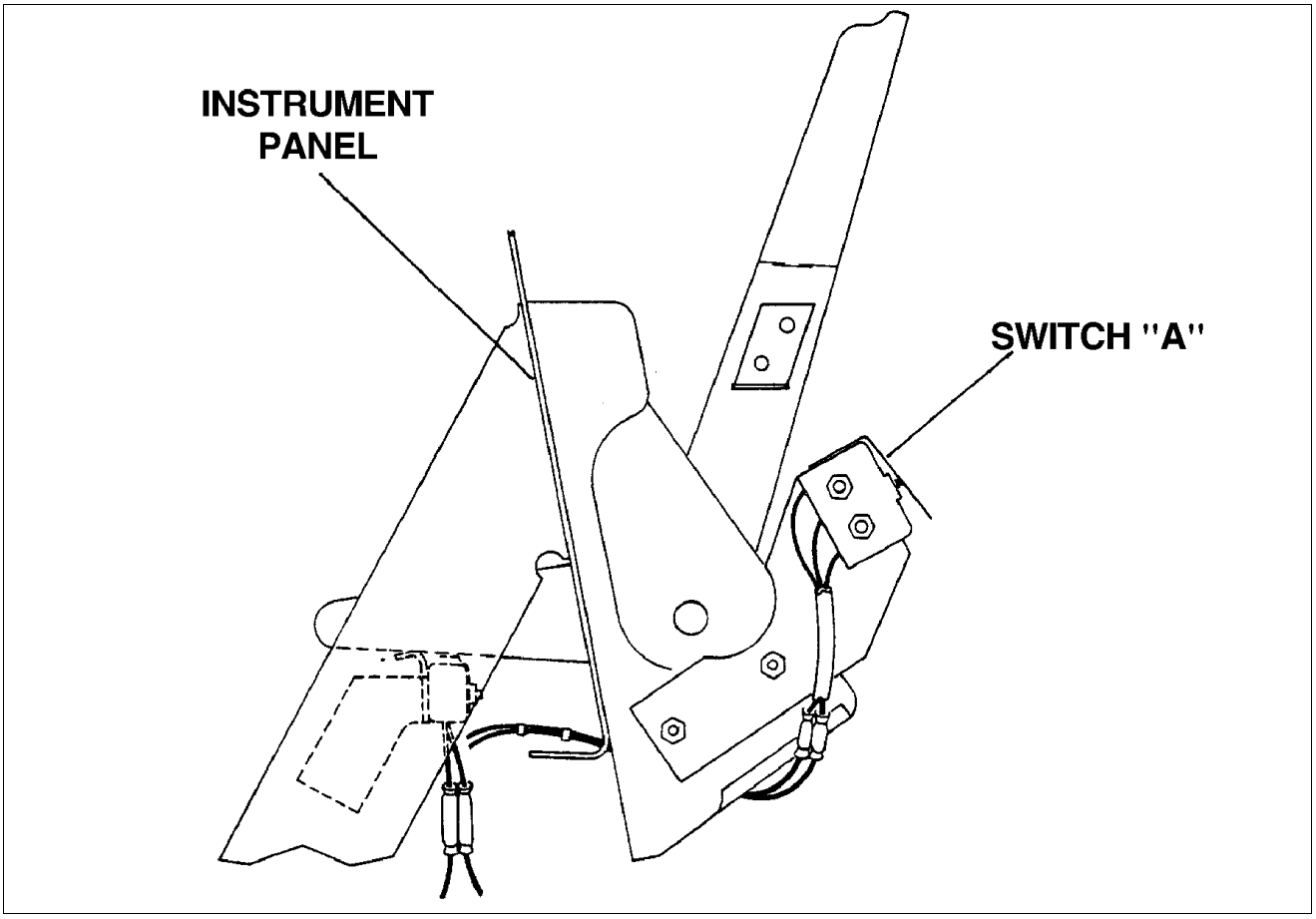

Figure 32-28. Throttle Warning Switch

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POSITION AND WARNING (Cont.)

C. Operational Check of Retractable Landing Gear and Flap Warning Systems

— WARNING —

ALL FLIGHT TESTS SHALL BE CONDUCTED BY A QUALIFIED PILOT EXPERIENCED IN THIS PARTICULAR MAKE AND MODEL AIRPLANE.

The following checks must be in done in flight

1. Normal landing gear extension and retraction

   a. Maximum Gear Extend.

      Place the gear selector in the down position at ***130 KIAS***. In approximately 5 to 10 seconds the three green gear lights should be on indicating that the gear is down and locked.

   b. Maximum Gear Retract:

      Allow approximately 8 seconds for the pressure in the hydraulic system to normalize between gear extension and retraction. Place the selector switch in the UP position at ***108 KIAS***. In approximately 5 to 10 seconds all the gear indicating lights should be out, indicating that the gear is fully retracted.

2. Emergency Gear Extension:

   a. Establish level flight cruise condition at ***90 KIAS***.
   b. Pull 25 amp hydraulic pump circuit breaker.
   c. Place landing gear selector handle in down position and note hydraulic pump does ***not*** operate.

      (1) While fishtailing airplane, pull emergency landing gear extension control.
      (2) Landing gear should extend, and three green locked down position lights should come ON, within 10 seconds.
      (3) After green position lights are ON, release emergency gear extension control. Reset 25 amp hydraulic pump circuit breaker. Pump should ***not*** operate. If pump does run, it could indicate gear not fully down and locked.
      (4) Retract gear, system should operate normally.

3. Gear Warning Horn:

   The horn will sound, in conjunction, whenever red gear unsafe light is on and throttle is closed. Reduce throttle at a normal rate. The gear warning horn and red light should come on at 14 + 2 inches of manifold pressure.

4. Flap / Landing Gear Position Warning Horn:

   Reduce to appropriate flap extended airspeed. With landing gear retracted:

   a. Extend flaps to 10°. Check that horn does ***not*** sound.
   b. Extend flaps to 25° position. Check that horn sounds ***before*** flaps reach 25° position.

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CHAPTER

33

LIGHTS

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CHAPTER 33 - LIGHTS

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GENERAL

A. DESCRIPTION AND OPERATION

Exterior lighting switches are located in the overhead switch panel, except for HP S/N's 3246001 thru 3246017 only. (In those airplanes the exterior lighting switches are located in the center of the instrument panel.) Interior flood/map lights are located in the overhead switch panel and controlled by adjacent reostats. Instrument panel and avionics lighting are controlled by separate dimmer switches located below the pilot's control wheel.

Circuit breakers are located on lower right instrument panel.

B. TROUBLESHOOTING

When checking the lighting system, the master switch must be on in order for lights to operate. Ensure that the appropriate circuit breaker is pushed ON.

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FLIGHT COMPARTMENT

A. Instrument Post and Overhead Map / Flood Lights

Instruments are illuminated by use of instrument post lights. They are powered through the PANEL/SWITCH LIGHTS 7.5 amp circuit breaker (or PANEL LIGHTS 5 amp circuit breaker in HP S/N's 3246001 thru 3246017 only) and lights dimmer assembly. The dimmer controls are located below the pilot's control wheel. An additional dimmer controls light intensity for all avionic equipment.

Two lights, located in the overhead panel, provide instrument and cockpit lighting for night flying. They are controlled by rheostats located adjacent to overhead switches. A map light window in each lens is actuated by the slide switch.

1. Removal of Dimmer Control Assembly

   a. Access to Dimmer Control Assembly is from beneath instrument panel.
   b. Disconnect electrical connection from assembly.
   c. Remove two screws securing assembly to instrument panel.
   d. Remove assembly from airplane.

2. Installation of Dimmer Control Assembly

   a. Position assembly in instrument panel with control knobs inserted into appropriate slots.
   b. Secure assembly to instrument panel with two screws previously removed.
   c. Connect electrical connection to assembly.
   d. Check operation of Dimmer Control Assembly.

B. Annunciator Panel

The annunciator panel, located at the top center of the whole instrument panel (HP S/N's 3246088 & up; TC S/N's 3257001 & up) or at the top right of the pilot's side instrument panel (HP S/N's 3246001 thru 3246087 only), provides visual warning of critical aircraft systems status. A complete functional description is provided in 31-50-00.

C. Annunciator Panel Lamp Replacement

Push in the individual annunciator light until it "clicks", and release pressure. The cover assembly will be partially ejected from the annunciator base assembly. Pull the cover from the base and rotate to expose the lamp bulb. Replace defective bulb and reinstall by pushing the lamp cover assembly home.

Verify lamp function by pressing the "Press-to-Test" switch.

— Note —

Press-to-Test switch tests only the operation of the annunciator light bulbs. It does not test functioning of the warning circuit.

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EXTERIOR

A. Landing / Taxi Light(s)

The landing lights consist of two wing tip lights and one nose gear light, except in HP S/N's 3246001 thru 3246017 (see below).

HP S/N's 3246126 & up and TC S/N's 3257076 & up incorporate a pulse relay to allow flashing the wing tip landing lights for recognition purposes. Two rocker-type switches in the overhead switch panel (wired through the 15 amp LANDING / TAXI LIGHT circuit breaker) control these three lights. A two-position (on/off) Taxi lights switch allows the nose gear mounted light to be controlled independently for ground operation. A three-position Landing/Pulse lights switch controls all three lights in flight. When the switch is in the up (landing) position, all three lights (one on the nose gear and one on each wing tip) illuminate. When the switch is in the center (off) position, all three lights are off. When the switch is in the down (pulse) position, the nose gear mounted light is off and wing tip lights will illuminate alternately (i.e. - pulse) at 55 pulses-per-minute.

In HP S/N's 3246018 thru 3246125 and TC S/N's 3257001 thru 3257075, the lights are controlled by a single 3-position switch located in the overhead switch panel and wired through the 15 amp LANDING / TAXI LIGHT circuit breaker., when LAND LIGHT (down) is selected, all three lights illuminate. When TAXI LIGHT (up) is selected, only the nose gear light illuminates.

In HP S/N's 3246001 thru 3246017 only, the landing and taxi light is contained in one light bulb. This 100 watt unit is located on the nose gear. The light is controlled by a switch in the center of the instrument panel which is wired through the 10 amp LANDING LIGHT circuit breaker.

In all cases, the nose gear light is wired through a safety switch mounted on the nose gear which turns off the nose gear light when the landing gear is retracted.

Removal and Installation of Landing / Taxi Light(s)

1. For wing tip lights:
   a. Remove screws (9) securing clear light cover and remove cover.
   b. Remove screws (3) securing lamp retainer ring and remove ring.
   c. Pull lamp out and disconnect electrical leads. (Make note of wire placement on lamp to facilitate installation.)
   d. To install lamp, reconnect electrical leads and insert lamp into position, then position retainer ring and secure with screws (3).
   e. Replace clear light cover and secure with screws (9).

2. For nose gear light:
   a. Remove screws (4) securing retainer ring/bezel and remove retainer ring/bezel.
   b. Pull lamp out and remove electrical leads connected to it. (Make note of wire placement on lamp to facilitate installation.)
   c. To install lamp, reconnect electrical leads and insert lamp into position, then position retainer ring/bezel and secure with screws (4).

EXTERIOR (Cont.)

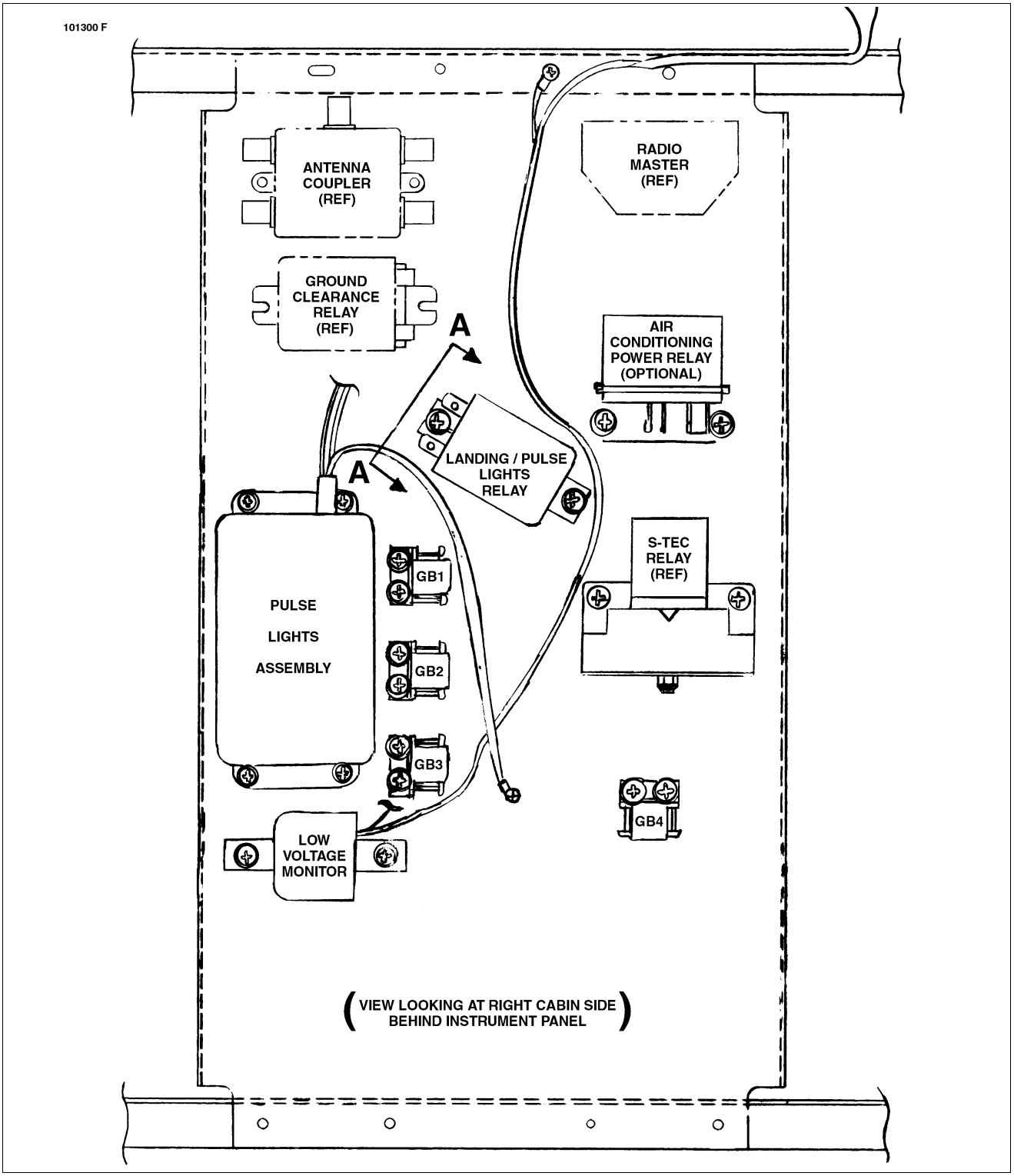

Figure 33-1. Landing / Pulse Lights Assembly and Relay (Sheet 1 of 2)
(HP S/N's 3246126 & up and TC S/N's 3257076 & up)

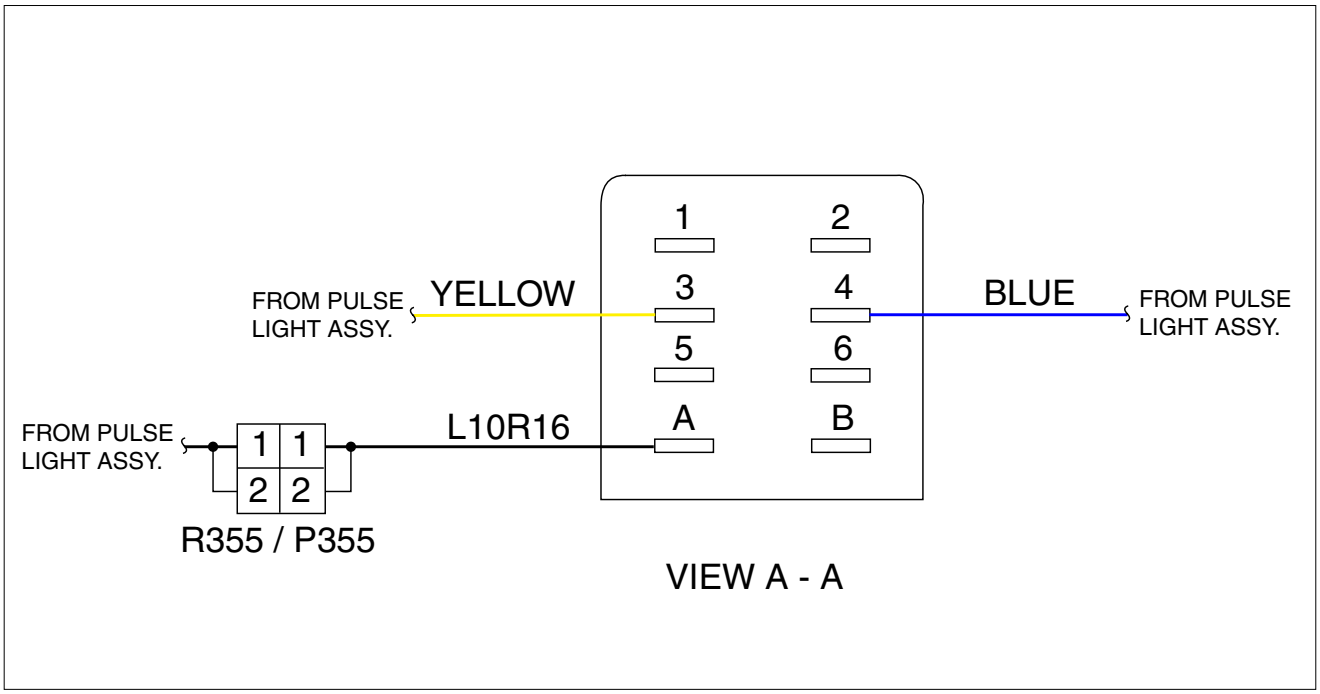

Figure 33-1. Landing / Pulse Lights Assembly and Relay (Sheet 2 of 2)
(HP S/N's 3246126 & up and TC S/N's 3257076 & up)

B. Recognition Lights

In HP S/N's 3246001 thru 3246017 only, a recognition light is located in the leading edge of each wing tip. Recognition lights are controlled by a single switch in the center of the instrument panel and a 10 amp circuit breaker. Removal and Installation is the same as "For wing tip lights", paragraph A.1 above.

C. Navigation (Position) Lights

Two navigation lights are located in each wing tip in the same assembly as the wing tip strobe light. The navigation lights are controlled by a single switch and a 10 amp circuit breaker.

EXTERIOR (Cont.)

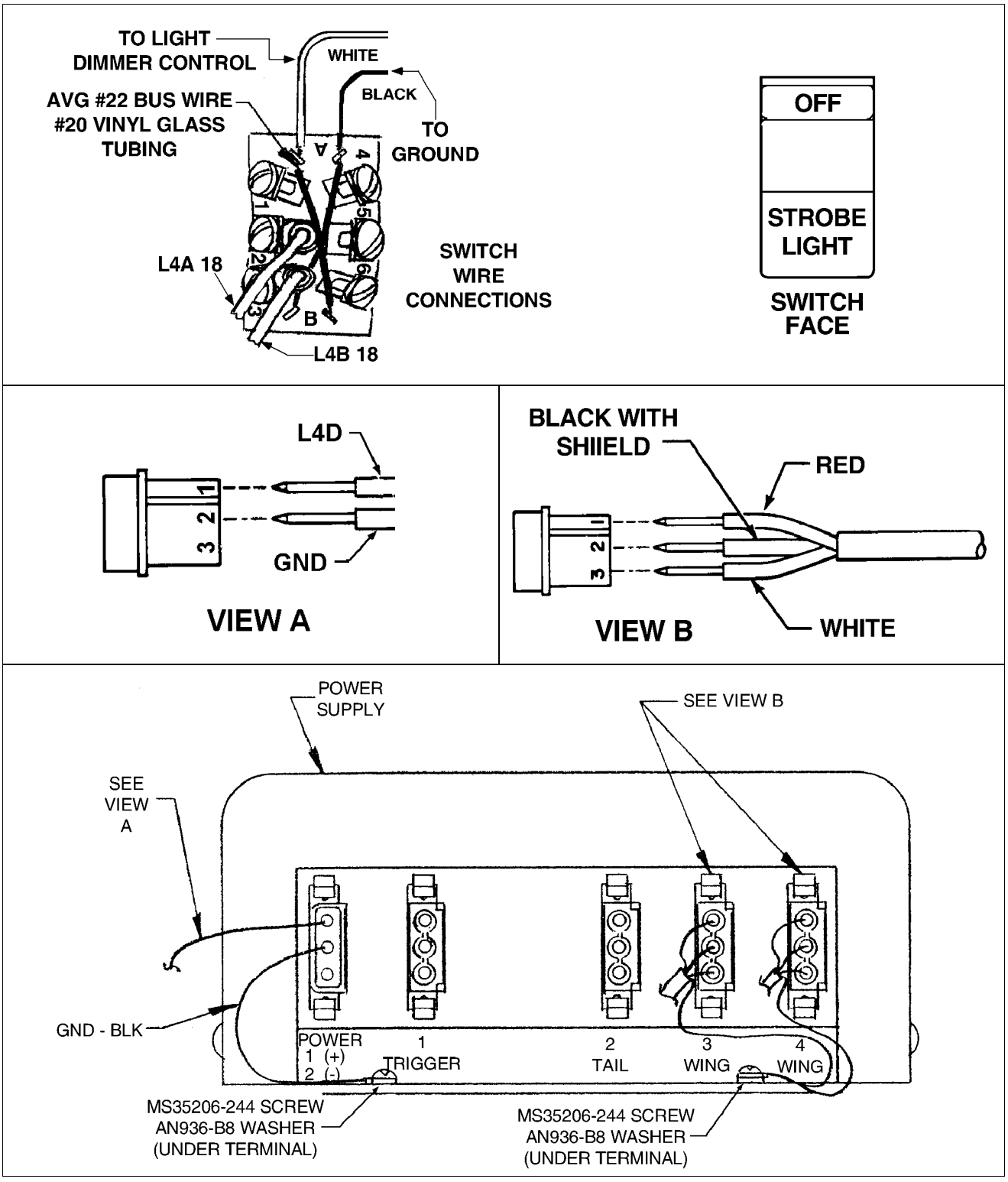

Figure 33-2. Strobe Light Connections

D. Anti-Collision Strobe Light

Anti-collision strobe lights are mounted on each wing tip in the same assembly as the navigation lights. These units are rated to flash at approximately 45 times per minute and are controlled by the STROBE LT switch through the 10 amp ANTI COLL circuit breaker.

1. Removal of Wing Tip Strobe Light

   a. Remove screw securing navigation light cover and remove cover.
   b. Remove the three screws securing navigation light bracket assembly and pull out.
   c. Remove strobe lamp by cutting wires on lamp beneath mounting bracket.
   d. Remove defective lamp.
   e. Remove and discard plug with cut wires from its electrical socket.

2. Installation of Wing Tip Strobe Light

   a. Route wires from new lamp down through hole in navigation light bracket.
   b. Insert wire terminals in plastic plug supplied with new lamp. Wire according to schematic diagram located in back of this section. Connect plug to receptacle.
   c. Position strobe lamp on navigation light bracket.
   d. Secure navigation light assembly and bracket with appropriate screw.

3. Removal of Strobe Power Supply

   Strobe power supply is in aft section of fuselage.

   a. Remove access panel to aft section of fuselage in rear baggage compartment to gain access to power supply.
   b. Remove power supply disconnect electrical plugs and leads. (Make note of placement of plugs to facilitate installation.)
   c. Remove screws securing power supply to fuselage. Power supply can now be removed.

4. Installation of Strobe Power Supply (Refer to Figure 33-1)

   a. Position power supply in place and secure with four screws previously removed.
   b. Connect electrical leads in their proper place.
   c. Connect electrical plugs in their proper place.
   d. Replace access panel in rear baggage compartment.

EXTERIOR (Cont.)

5. Troubleshooting Procedure

Strobe light functions as a condenser discharge system. A condenser in the power supply is charged to approximately 450 volts DC then discharged across Xenon flash tube at intervals of approximately 45 flashes per minute. Condenser is parallel across the Xenon flash tube which is designated to hold off the 450 volts DC applied until flash tube is triggered by an external pulse. This pulse is generated by a solid state timing circuit in power supply.

When troubleshooting strobe light system, it must first be determined if trouble is in flash tube or power supply. Replacement of flash tube will confirm if tube is defective. A nomally operating power supply will emit an audible tone of 1 to 1.5 KHZ. If there is no sound emitted, check system according to the following instructions. When troubleshooting system, utilize appropriate schematic at back of this section.

a. Verify input voltage at power supply is 28 volts (unless in HP S/N's 3246001 thru 3246017 only, then 14 volts).

— CAUTION —

WHEN DISCONNECTING AND CONNECTING POWER SUPPLY INPUT CONNECTIONS, DO NOT GET CONNECTIONS REVERSED. REVERSED POLARITY OF INPUT VOLTAGE FOR JUST AN INSTANT WILL PERMANENTLY DAMAGE POWER SUPPLY. REVERSED POLARITY DESTROYS A PROTECTIVE DIODE IN POWER SUPPLY, CAUSING SELF-DESTRUCTION FROM OVERHEATING OF POWER SUPPLY. THIS DAMAGE IS SOMETIMES NOT IMMEDIATELY APPARENT, BUT WILL CAUSE FAILURE OF SYSTEM IN TIME.

b. Check for malfunction in interconnecting cables.

— Note —

A short of type described in steps 1 and 2, below, will not cause permanent damage to power supply, but system will be inoperative if such a short exists. Avoid any connection between pins 1 and 3 of interconnecting cable as this will discharge condenser in power supply and destroy trigger circuits.

(1) Ascertain pins 1 and 3 of interconnecting cables are not reversed.
(2) Using an ohmmeter, check continuity between pin 1 and 3 of interconnecting cable. If a reading is obtained on meter, cable is shorted and should be replaced.

—CAUTION —

WHEN DISCONNECTING POWER SUPPLY, ALLOW FIVE MINUTES OF BLEED DOWN TIME PRIOR TO HANDLING UNIT.

c. Check interconnecting cables for shorts.

(1) Disconnect output cables from power supply outlets.
(2) The following continuity checks can be made with an ohmmeter.
(3) Check for continuity between connectors of each interconnecting cable by checking from pin 1 to pin 1, pin 2 to pin 2, and pin 3 to pin3. When making these checks if no continuity exists, cable is broken and should be replaced.
(4) Check continuity between pins 1 and 2, 1 and 3, 2 and 3 of interconnecting cable. If continuity exists between any of these connections, cable is shorted and should be replaced.

d. Check tube socket assembly for shorts.

(1) Disconnect tube socket assembly of anti-collision light from interconnecting cable.
(2) The following continuity checks can be made with an ohmmeter.
(3) 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, tube socket assembly is broken and should be replaced.

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CHAPTER

34

NAVIGATION AND PITOT / STATIC

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CHAPTER 34 - NAVIGATION AND PITOT / STATIC

TABLE OF CONTENTS / EFFECTIVITY

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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.)

These airplanes are equipped with conventional air, vacuum, and mechanically driven flight instruments as standard equipment. An Electronic Flight Display System (i.e. - Avidyne Entegra) is available as an option in HP S/N's 3246218 and up and TC S/N's 3257339 and up.

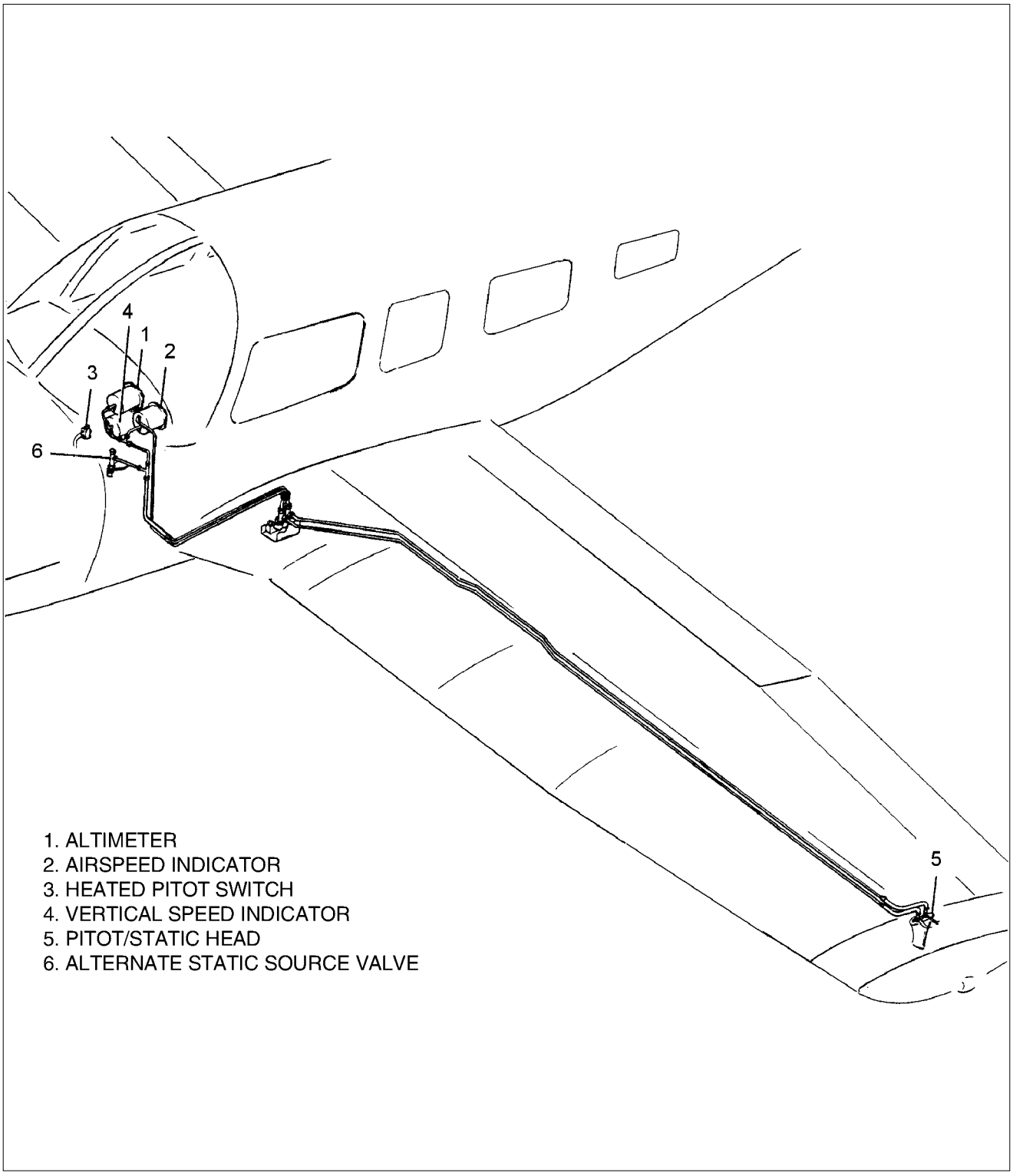
Removal and installation instructions are given in 39-10-00.

FLIGHT ENVIRONMENT DATA / PITOT STATIC

A. DESCRIPTION AND OPERATION (Refer to Figure 34-1 and See Also 30-30-00)

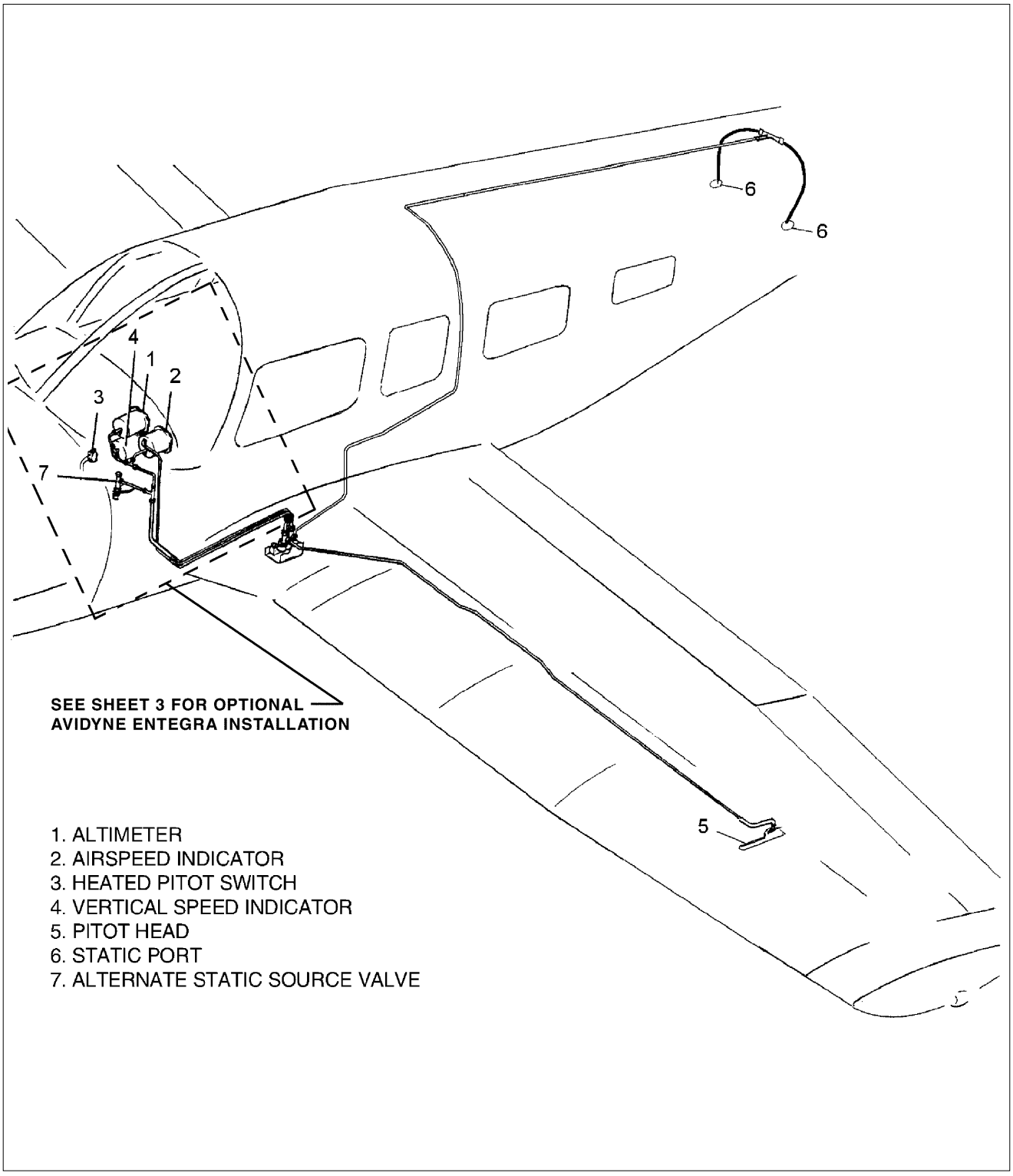
The pitot air system consists of a pitot mast located on underside of left wing, with its related plumbing. Ram air pressure entering the pitot is transmitted from the pitot inlet through hose and tubing (routed through the wing) to the airspeed indicator (and, if installed, to the Primary Flight Display (PFD) of the Avidyne Entegra system) on the instrument panel. A partially or completely blocked pitot head will give erratic or zero readings on the instruments.

The static air system consists of two static ports located on the left and right side of the aft fuselage, except in HP S/N's 3246001 thru 3246017. Those seventeen airplanes have a single static port located on the bottom of pitot mast. The static ports are directly connected to the airspeed, altimeter and rate of climb indicators in the instrument panel by means of hose and tubing. An alternate static air source is located below instrument panel in front of pilot. Alternate static source is part of standard system and has a shutoff valve which closes port when it is not needed. A placard giving instructions for use is located on instrument panel. Pitot and static lines can be drained through separate drain valves located on left lower side of fuselage interior.



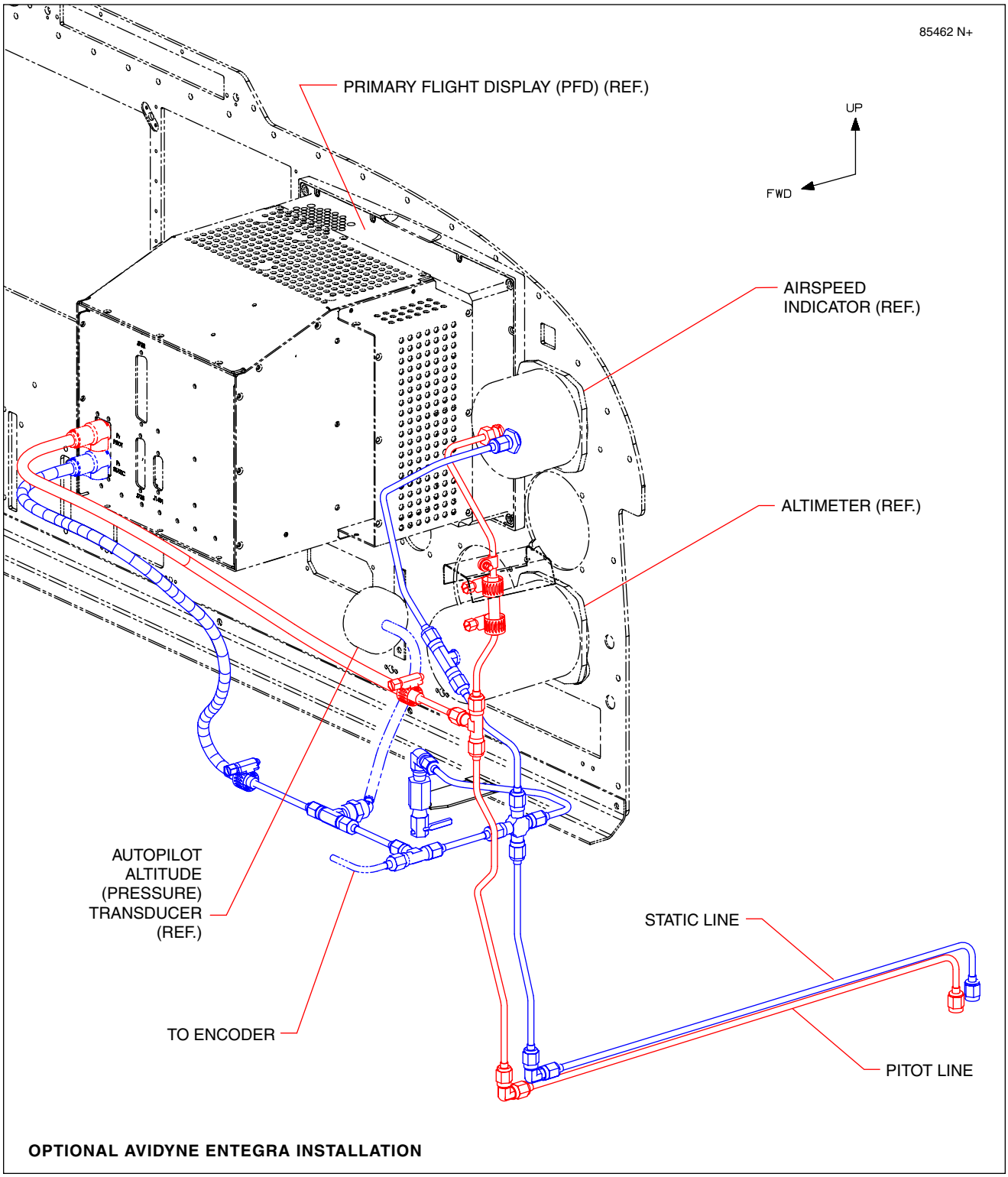
Effectivity
3246001 thru 3246017 only

Pitot-Static System Installation
Figure 34-1 (Sheet 1 of 3)



Pitot-Static System Installation
Figure 34-1 (Sheet 2 of 3)

Effectivity
3246018 and up
3257001 and up



Effectivity
3246218 and up
3257339 and up

Pitot-Static System Installation
Figure 34-1 (Sheet 3 of 3)

FLIGHT ENVIRONMENT DATA / PITOT STATIC (Cont.)

B. VERTICAL SPEED INDICATOR

Vertical speed indicator measures rate of change in static pressure when airplane is climbing or descending. By means of a pointer and dial this instrument will indicate a rate of ascent or descent of airplane in feet per minute. But due to lag of the instrument, aircraft will be climbing or descending before instrument starts to read and instrument will continue to read after aircraft has assumed level flight. In rough air this should not be considered a malfunction.

— Note —

When any connections in the static system are opened for checking, system must be rechecked per F.A.R. 23.1325.

CHART 3401. 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 instrments for obstruction in lines.
	Obstruction in pitot head.	Clean lines and head.
Pointer oscillates.	Leak 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.
Vertical speed indicates when aircraft is banked.	Water in static line.	Disconnect static lines and blow out lines from cockpit out to pitot head.
Pointer has to be set before every flight.	Temperature compensator inoperative.	Replace instrument.
Pointer cannot be reset to zero.	Diaphragm distorted.	Replace instrument.
Instrument reads very low during climb or descent.	Case of instrument broken or leaking.	Replace instrument.

FLIGHT ENVIRONMENT DATA / PITOT STATIC (Cont.)

C. ALTIMETER

The altimeter indicates pressure altitude in feet above mean sea level. The indicator has three pointers and a dial scale; long pointer is read in hundreds of feet, middle pointer in thousands of feet and short pointer in ten thousands of feet. A barometric pressure window is located on right side of indicator dial is set by knob located on lower left corner of instrument. Altimeter consists of a sealed diaphragm that is connected to pointers through a mechanical linkage. Instrument case is vented to static air system and as static air pressure decreases, diaphragm expands, causing pointers to move through mechanical linkage.

— Note —

When any connections in the static system are opened for checking, system must be rechecked per F.A.R. 23.1325.

CHART 3402. TROUBLESHOOTING ALTIMETER (1 of 2)

Trouble	Cause	Remedy
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism.	Replace instrument.
High or low reading.	Improper venting.	Eliminate leak in static pressure system and check alignment of 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 was reset.	Tighten instrument screw, if loose.Replace instrument, if screw is missing.
Cracked or loose cover glass.	Case gasket hardened.	Replace instrument.
Dull or discolored markings.	Age.	
Barometric scale and reference markers out of synchronism.	Slippage of mating parts.	Replace instrument.
Barometric scale and reference markers out of synchronism with pointers.	Drift in mechanism.	Refer to the latest revision of AC43.13-1.
Altimeter sticks at altitude or does not change with change of altitude.	Water or restriction in static line.	Remove static lines from all instruments, blow line clear from cockpit to pitot head.

CHART 3402. TROUBLESHOOTING ALTIMETER (2 of 2)

Trouble	Cause	Remedy
Altimeter charges reading as aircraft is banked	Water in static line.	Remove static lines from all instruments, and blow line clear from cockpit to pitot head.
Altimeter requires resetting frequently.	Temperature compensator inoperative.	Change instrument.

D. AIRSPEED INDICATOR

The airspeed indicator provides a means of indicating speed of airplane passing through air. Airspeed indication is differential pressure reading between ram air to pressure and static air pressure. This instrument has diaphragm vented to pitot air source and case is vented to static air system. As airplane increases speed, pitot air pressure increases, causing diaphragm to expand. A mechanical linkage picks up this motion and moves instrument pointer to indicated speed. Instrument dial is calibrated in knots, and also has necessary operating range markings for safe operation of airplane.

— Note —

When any connections in the static system are opened for checking, system must be rechecked per F.A.R. 23.1325.

CHART 3403. TROUBLESHOOTING AIRSPEED INDICATOR AND TUBES

Trouble	Cause	Remedy
Pointers of stick 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. Leaking static system.	Replace instrument. Find leak and correct.
Instrument reads low.	Pointer not on zero. Leaking static system. Pitot head not aligned correctly.	Replace instrument. Find leak and correct. Realign pitot head.
Airpeed changes as aircraft is banked.	Water in pitot line.	Remove lines from static - instruments and blow out lines from cockpit to pitot head.

FLIGHT ENVIRONMENT DATA / PITOT STATIC (Cont.)

E. OUTSIDE AIR TEMPERATURE (OAT)

(1) In HP S/N's 3246001 thru 3246087 only, OAT is provided by a direct reading thermometer mounted in the lower forward corner of the pilot's side window.

(2) In HP S/N's 3246088 & up and TC S/N's 3257001 & up, OAT is provided by a sensor probe, mounted in the underside of the outboard right wing, which feeds temperature data to the Digital Display Monitoring Panel (DDMP). See 77-40-00 and Figure 91-16, Sheet 1 for additional information.

— 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.)

(3) In HP S/N's 3246218 & up and TC S/N's 3257339 & up with the optional Avidyne Entegra Electronic Flight Display System 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 Display System and Magnetometer in 34-20-00 for additional information.

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ATTITUDE AND DIRECTION

A. ATTITUDE INDICATOR

Attitude Indicator is essentially an air driven gyroscope rotating in a horizontal plane and is operated by same principal as directional gyro (see below). Due to gyroscopic inertia, spin axis continues to point in vertical direction, providing a constant visual reference to attitude of airplane relative to pitch and roll axis. A bar across face of indicator represents horizon and aligning miniature airplane to horizon bar simulates alighnent of airplane to acutal horizon. Any deviation simulates deviation of airplane from true horizon. Attitude Indicator is marked for different degrees of bank.

CHART 3404. TROUBLESHOOTING ATTITUDE 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 does not indicate level flight.	Instrument not level in panel.instrument.	Loosen screws and level
	Aircraft out of trim.	Trim aircraft.
Bar high after 180° turn.	Normal, if it does not exceed 1/16 inch.	
Instrument tumbles in flight.	Low 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.

ATTITUDE AND DIRECTION (Cont.)

B. 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 HP S/N's 3246218 & up and TC S/N's 3257339 & up with the optional Avidyne Entegra Electronic Flight Display 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 under the instrument panel mounted to a bracket on the left side of the fuselage. See Appendix 2 (grid 5K3) for an illustration.

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. 90157262.

C. ELECTRONIC FLIGHT DISPLAY 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.)

HP S/N's 3246218 & up and TC S/N's 3257339 & up may be equipped with the Avidyne Entegra Electronic Flight Display System as an optional installation. If so, see Appendix 2 (grid 5K3).

ATTITUDE AND DIRECTION (Cont.)

D. DIRECTIONAL GYRO

Directional gyro is a flight instrument incorporating an air driven gyro stabilized in vertical plane. Gyro is rotated at high speed by lowering pressure in air tight case and simultaneously allowing atmospheric air pressure to enter instrument against gyro buckets. Due to gyroscopic inertia, spin axis continues to point in same direction even though aircraft yaws to right or left. This relative motion between gyro and instrument case is shown on instrument dial which is similar to a compass card. Dial, when set to agree with airplane magnetic compass, provides a positive indication free from swing and turning error. However, directional gyro has no sense of direction and must be set to magnetic compass. Since magnetic compass is subject to errors due to magnetic fields, electric instruments, etc, directional gyro is only accurate for heading it has been set for. If gyro is set on 270°, for instance, and aircraft is turned to some other heading, there can be a large error between gyro and magnetic compass due to error in compass compensation. This will appear as gyro precession. Gyro should only be checked to heading on which it was first set. Due to internal friction, spin axis error, air turbulence and airflow, gyro should be set at least every 15 minutes for accurate operation, whether it has drifted or not.

CHART 3405. TROUBLESHOOTING DIRECTIONAL GYRO

Trouble	Cause	Remedy
Excess drift in either direction.	Setting error.	Review paragraph titled "General" for gyro operation.
	Defective instrument.	Replace instrument.
	High or low vacuum. If vacuum is not correct, check for the following:	
	1. Relief valve improperly adjusted.	1. Adjust relief valve
	2. Incorrect gauge reading.	2. Replace gauge.
	3. Pump failure.	3. Repair or replace.
	4. Vacuum line kinked or leaking.	4. Check and repair. Check for collapsed inner wall of hose.
Dial spins during turn.	Limits (55° bank) of gimbal exceeded.	Recage gyro in level flight.
Dial spins continuously.	Defective mechanism	Replace.

ATTITUDE AND DIRECTION (Cont.)

E. MAGNETIC COMPASS

Magnetic compass is a self-contained instrument. This instrument has an individual light which is connected to instrument lighting circuit. Compass correction card is located in card holder mounted on instrument. Compass should be swung whenever instruments or radios are changed and at least once a year.

Adjustment of Compass

Before attempting to compensate compass, every effort should be made to place aircraft in simulated flight conditions; check to see that 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 ON position. All other cockpit controlled electrical switches should be in OFF position.

— Note —

Use a non-magnetic screwdriver to adjust magnetic compass

(1) Set adjustment screws of compensator on zero. Zero position of adjusting screws is when dot of screw is lined up with dot of 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. Adjust E-W adjustment screw until compass reads exactly East.

(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 a magnetic West heading and note resulting West error. Adjust E-W adjusting screw until one-half of this error has been removed.

(6) Head aircraft in successive magnetic 30° headings and record compass readings on appropriate deviation card. Deviations must not exceed ± 10° on any heading.

F. MAGNETOMETER

In HP S/N's 3246218 & up and TC S/N's 3257339 & up with the optional Avidyne Entegra Electronic Flight Display System installed, the Magnetometer / OAT Sensor Assembly (Mag/OAT) mounted in the underside of the outboard left wing, supplies magnetic heading information to the Primary Flight Display (PFD).

See Appendix 2 (grid 5K3) for additional information.

ATTITUDE AND DIRECTION (Cont.)

CHART 3406. TROUBLESHOOTING MAGNETIC COMPASS

Trouble	Cause	Remedy
Excessive card error.	Compass not properly compensated.	Compensate instrument.
	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Insufficient liquid.	Replace instrument.
Card sluggish.	Weak 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	Check lamp or continuity of circuit.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.	

ATTITUDE AND DIRECTION (Cont.)

G. TURN AND BANK INDICATOR

These airplanes are equipped with electric Turn Coordinators, which indicate both ***rate*** of turn and ***rate*** of roll. This instrument consists of two components:

1. An electrically driven, inclined, gyro rotor is slaved to the turn indicator (small airplane). The spinning gyro resists change in position as the airplane moves around it. This resistance is mechanically translated into indicator movement. If the aircraft is rolled right or left rapidly, the small airplane will move, indicating a turn. But, if aircraft is held in a bank and opposite rudder is applied, the small airplane will come back to zero (level) indicating no turn. When the aircraft is established in a coordinated turn, the small airplane will remain deflected, indicating the turn.
2. A metal ball sealed in a curved glass tube filled with dampening fluid provides a sensitive indication of yaw (slip/skid) and is used to maintain coordinated flight. The ball rolls freely within the curved glass tube display on the lower instrument face. Any deflection from center indicates the presense of side forces on the aircraft.

CHART 3407. TROUBLESHOOTING TURN AND BANK INDICATOR

Trouble	Cause	Remedy
Pointer fails to respond.	Foreign matter lodged in instrument.	Replace instrument.
Incorrect sensitivity.	Out of calibration.	Replace instrument.
Incorrect turn rate (electric).	Out of calibration. Aircraft not in coordinated turn.	Replace instrument. Center ball in turn.
Ball sticky.	Flat spot on ball.	Replace instrument.
Ball not in center when aircraft is correctly trimmed.	Instrument not level in panel.	Level instrument.
Instrument will not run (electric).	No power to instrument. Instrument malfunction.	Check circuit and repair. Replace instrument.

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CHAPTER

35

OXYGEN

(TC S/N'S 3257001 & UP ONLY)

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CHAPTER 35 - OXYGEN

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL

— WARNING —

THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT. (SEE INTRODUCTION, PAGE 4.)

The following provides supplemental information for the servicing of the oxygen systems. Major repairs to the oxygen systems should be accomplished by an approved shop.

When refilling any oxygen cylinder make sure to use only aviation breathing oxygen as specified in MIL-O-27210C. The moisture content of aviation oxygen cannot exceed 0.005 milligrams of water vapor per liter of gas at 70°F (21°C) and 29.92 inches of mercury (760 mm Hg.).

A. Description and Operation (See Figure 35-1)

— WARNING —

DO NOT USE GREASE OR ANY TYPE OF GREASE FITTING ON ANY OXYGEN SYSTEM. WHEN WORKING WITH AN OXYGEN SYSTEM MAKE SURE HANDS, CLOTHING, TOOLS, AND IMMEDIATE AREA ARE FREE OF GREASE.

A fixed oxygen system is available in TC S/N's 33257001 & up only, as an option. The major components for this system are manufactured by Scott Aviation. Accordingly, Scott Aviation, as well as Piper Distributor Service Administrators (DSA's), should be contacted for information / procedures not covered herein.

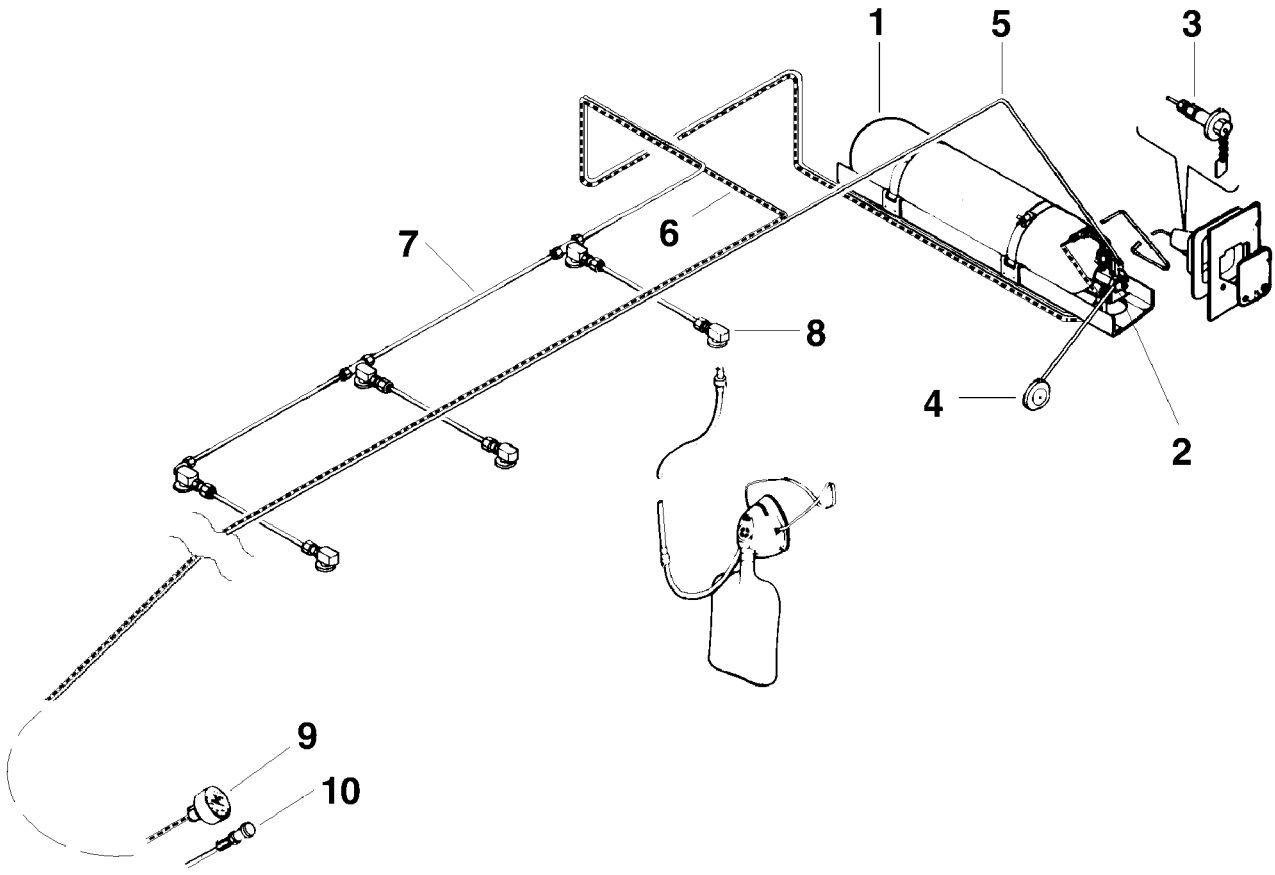
The oxygen system cylinder is installed in the tailcone, behind the baggage compartment, and is connected to an external recharge valve mounted to the left side of the fuselage, aft of FS 222.437. The low pressure (L.P.) feed line for the outlets is routed to the right side of the fuselage and then up into the cabin overhead. It joins the outlets' distribution manifold at a tee-fitting on the right rear passenger outlet.

The PULL-ON regulator valve control knob and pressure gauge are installed in the pilot's instrument panel below, and slightly to the right of, the control wheel. The control knob actuates a cable routed through the center cabin overhead and attached to the oxygen system cylinder regulator valve. The pressure gauge is fed by a high pressure line routed from the oxygen system cylinder along the right side of the fuselage and then up into the center cabin overhead where it joins the control cable and the two are then routed down the windshield centerpost and into the back of the instrument panel.

— Note —

Oxygen cylinders are identified by the ICC or DOT identification stamped on the cylinder. The lightweight cylinder of composite construction (DOT E8162) installed in these airplanes must be hydrostatically tested every 3 years, and the service life may not exceed 15 years. The month and year of the last test is stamped beneath the ICC/DOT identification.

GENERAL (continued)



1. OXYGEN CYLINDER
2. REGULATOR
3. H. P. RECHARGE VALVE
4. H. P. RELIEF VALVE EXHAUST PORT
5. REGULATOR CONTROL CABLE
6. H. P. LINE TO PRESSURE GAUGE
7. L. P. LINE TO OUTLETS
8. OUTLET
9. PRESSURE GAUGE
10. REGULATOR CONTROL KNOB (PULL ON)

Figure 35-1. Fixed Oxygen System Installation

GENERAL (continued)

CHART 3501. TROUBLESHOOTING OXYGEN SYSTEM

Trouble	Cause	Remedy
No indication of pressure on pressure gauge.	Cylinder empty or leak in system has exhausted pressure.	Purge, charge, and check system for leaks.
	Pressure gauge or regulator defective.	Replace gauge.
Pressure indication normal but no oxygen flowing.	Oxygen cylinder regulator assembly defective.	Remove tank and have regulator removed.
Offensive odors in oxygen.	Cylinder pressure below 50 psi. Foreign matter has entered the system during previous servicing.	Purge the oxygen system.

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CREW / PASSENGER

— WARNING —

WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRPLANES, IT IS THE USERS RESPONSIBILITY TO REFER TO THE APPLICABLE PUBLICATIONS. (SEE INTRODUCTION, PAGE 4.)

— CAUTION —

DO NOT ATTEMPT TO TIGHTEN ANY CONNECTIONS WHILE THE SYSTEM IS CHARGED.

— CAUTION —

BOTTLES WHICH HAVE BEEN EVACUATED TO 200 PSI FOR A SIGNIFICANT LENGTH OF TIME, OR THOSE THAT DO NOT PRODUCE AN AUDIBLE HISSING SOUND WHEN THE VALVE IS CRACKED, SHOULD BE REMOVED AND HYDROSTATICALLY TESTED. IF EITHER OF THESE CONDITIONS HAS EXISTED FOR A SIGNIFICANT LENGTH OF TIME, PURGE THE SYSTEM.

— CAUTION —

MAKE SURE THERE IS NO OIL, GREASE, HYDRAULIC FLUID, OR FUEL IN THE VICINITY OF ANY FITTINGS BEING SERVICED.

— CAUTION —

DO NOT USE THREAD LUBRICANTS OF ANY KIND. USE TEFLON TAPE (3M NO. 48) ON TAPERED PIPE THREADS, WITHOUT TAPE EXTENDING BEYOND THE FIRST THREAD. SEE PARA A, 4 - APPLICATION OF TEFLON TAPE THREAD SEALANT.

— CAUTION —

BEFORE WORKING WITH THE SYSTEM, MAKE SURE AIRCRAFT IS ELECTRICALLY GROUNDED AND YOUR HANDS TOOLS, AND CLOTHES ARE FREE OF OIL, GREASE AND DIRT.

CREW / PASSENGER (cont.)

A. Inspection and Maintenance

— WARNING —

WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRPLANES, IT IS THE USERS RESPONSIBILITY TO REFER TO THE APPLICABLE VENDOR PUBLICATIONS. (SEE INTRODUCTION, PAGE 4)

Due to the nature of the process used to test compressed gas tanks, servicing and hydrostatic tests must be conducted by a DOT or manufacturer (Scott Aviation) approved shop. The following material gives recommended inspection and maintenance information for the various parts of the oxygen systems.

— Note —

Oxygen cylinders are identified by the ICC or DOT identification stamped on the cylinder. On these airplanes, the lightweight cylinder of composite construction (DOT E8162), must be hydrostatically tested every 3 years, and the service life may not exceed 15 years. The month and year of the last test should be stamped on the cylinder beneath the ICC, DOT identification.

1. Inspections

   a. Check the outlets for leakage both in the use and non-use condition and for leakage around an inserted connector. For leak testing information, refer to the appropriate subject in this chapter.
   b. Check the high pressure gauge for accuracy by comparing its indicated pressure with that of a gauge of known accuracy connected to the fill port.
   c. Inspect tank for dents, bulges, corrosion, and major strap chaffing marks. Should any of these problems exist, the tank should be removed and hydrostatically tested.
   d. An operational check of the regulator can be accomplished as follows: (Refer to Figure 35-2.)

      (1) Using an 18 inch (45.72 cm) long hose having a 1/4 in. (0.635cm) I.D. x 1/2 in. (1.27cm) O.D., attach a Scott Aviation 8570-00 plug-in to a sensitive pressure gauge having a range of 0 to 100 psi. Connect the apparatus to the pilot's outlet in the overhead panel.
      (2) Using a second 18 inch long hose having a 1/4 in. (0.635cm) I.D. x 1/2 in. (1.27cm) O.D., attach a Scott Aviation 8570-00 plug-in to a pneumatic flow apparatus having a range of 0-5 liters per minute. Connect the flow apparatus to the copilot's outlet.
      (3) Insert a Scott plug-in in each of the other outlets and pull the oxygen control knob to the on position. The pressure and flow at sea level should be 55 to 80 psi and 3.3 to 5.3 liters per minute respectively.

   e. Check airframe logbook for last maintenance on oxygen system and perform as required per Chart 3502.
   f. Test the oxygen for odor. Pure oxygen is odorless and tasteless. Any system having a significant odor present in the gas should be purged and the bottle replaced or removed and purged.

CREW / PASSENGER (cont.)

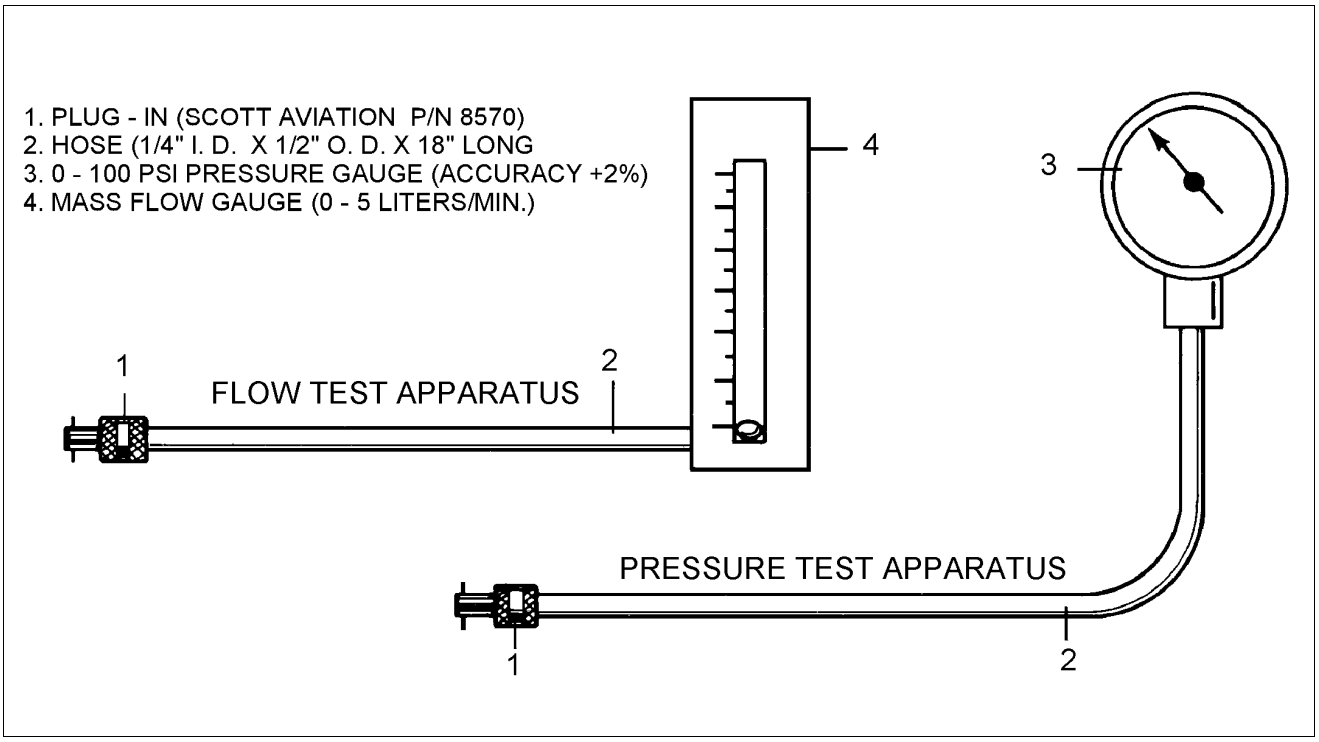

Figure 35-2. Test Apparatus For Testing Oxygen System

CHART 3502. FIXED OXYGEN SYSTEM COMPONENT LIMITS

Parts	Inspection	Overhaul
Regulator	300 Flight Hours	Every 6 Years
Pressure Gauge	300 Flight Hours	Replace on Condition
High Pressure Lines	300 Flight Hours	Replace on Condition
Low Pressure Lines	300 Flight Hours	Replace on Condition
Outlets	300 Flight Hours	Every 5 Years [1]
External Recharge Valve	Each Use	Every 5 Years [2]
Masks	At least once per year	Replace as Necessary

[1] On condition, replace the rubber components in the assembly or replace assembly.

[2] If the screen in front of valve is dirty, replace valve. Valve replacement is recommended every 5 years.

CREW / PASSENGER (cont.)

g. Any fittings, connectors, and tubes which have imperfect threads, pitted or disfigured cones, or other damage should be replaced.

— CAUTION —

OXYGEN TUBES MUST NOT BE CLAMPED TO, OR SUPPORTED BY ELECTRICAL WIRE BUNDLES, HYDRAULIC, PNEUMATIC OR OTHER LINES.

h. Check plumbing for kinking, cracks, gouges, dents, deep scratches, or other damage. Replace as necessary.

i. Make sure to check the oxygen lines for proper clearance as follows: (Refer to Figure 35-3.)

(1) Two inch minimum between oxygen tubes and all flexible moving parts of the aircraft (flexible control cables, etc.). If enough space cannot be attained, protection from abrasion must be provided.

(2) At least 1/2 inch minimum between oxygen tubes and all rigid moving parts of the aircraft such as levers and rigid control rods.

(3) Six inch minimum separation between oxygen tubes and hydraulic, fuel and electrical system lines and components.

— Note —

When the six inch requirement cannot be complied with, one inch is allowed as long as electrical cables and other lines are supported at least every two inches; and, the oxygen tube(s) is protected by rubber neoprene hose fastened in place with cable ties at the location the specific item crosses or is near the oxygen tube(s). If an item is near the oxygen tube for a certain distance the oxygen tube for that distance must be covered.

(4) A minimum of 1/8 inch between tubing and structure adjoining the supporting clamp as shown in Figure 35-3, Sketch A.

(5) Where a tube passes through a grommet, the tube must not bear on the grommet in any way that might cause cutting of the grommet in service as shown in Figure 35-3, Sketch D.

(6) While in service, items may receive vibrations causing them to come in contact with other parts of the aircraft. With this in mind, low pressure tubing that is supported well enough to prevent relative motion must have at least a minimum clearance of 1/8 inch from a projection (bolt, nut, etc). Low pressure tubing that cannot be supported well enough to prevent motion must have a minimum clearance of 1/8 inch allowed after the maximum travel of the tube. High pressure lines are affected similarly but require 1/2 inch minimum clearances. (Refer to Figure 35-3, Sketch B.)

j. Perform any other required maintenance as directed in AC43.13-1A, Chapter 8.

k. Clean components as necessary per the following subject-paragraph.

CREW / PASSENGER (cont.)

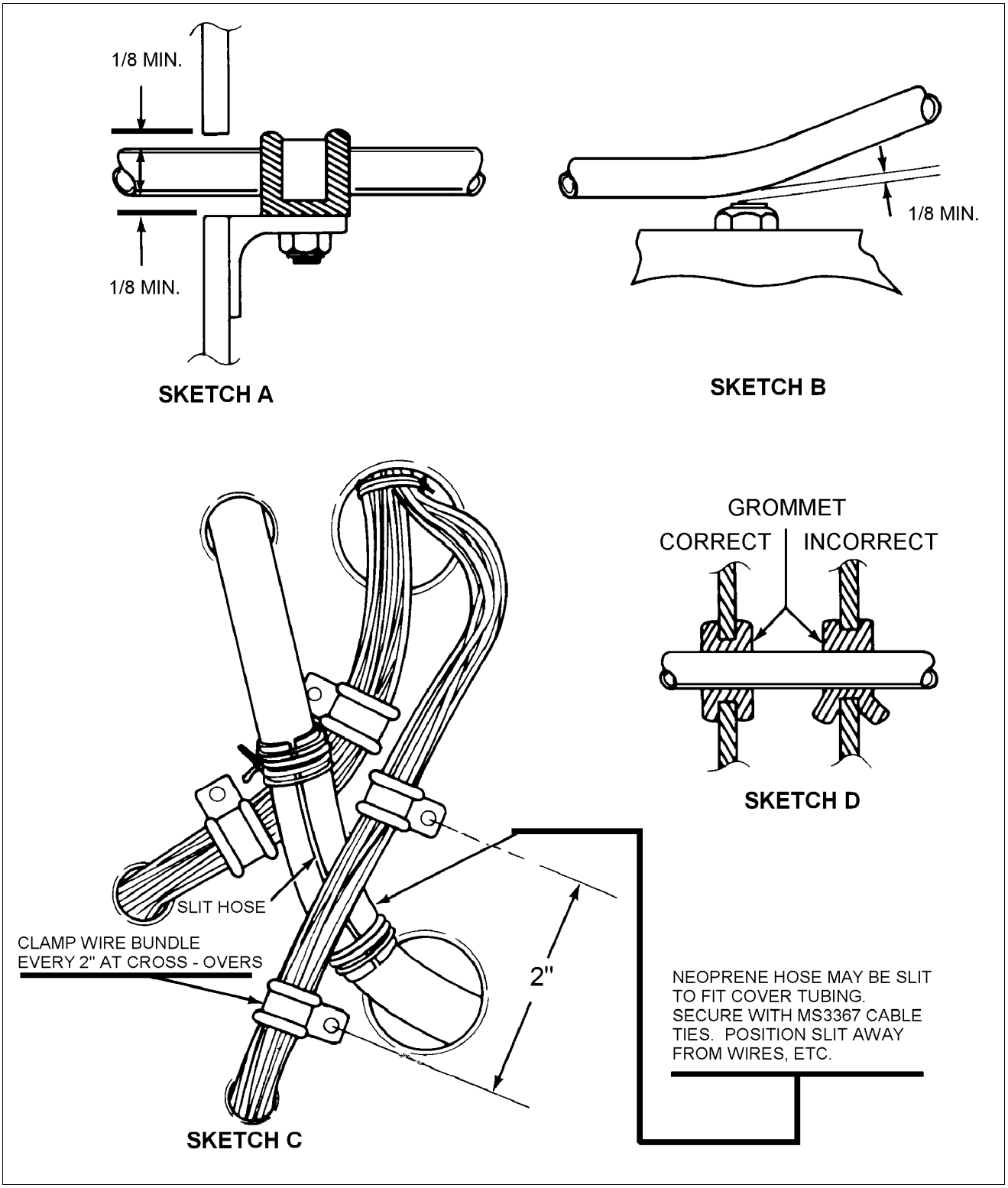

Figure 35-3. Oxygen Tubing Installation

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CREW / PASSENGER (cont.)

2. Cleaning and Purging of Oxygen System Components

— CAUTION —

CARE MUST BE EXERCISED TO PREVENT CONTAMINATION OF COMPONENTS BY OIL, GREASE, WATER, OR FOREIGN MATTER. COMPRESSED AIR USED IN CLEANING AND FLUSHING TUBES MUST BE CLEAN, DRY, FILTERED (OIL FREE) AIR ONLY.

Three methods are recommended for cleaning oxygen system components:

a. Method I.

(1) Vapor degrease part(s) with trichlorethylene.
(2) Blow part(s) dry with a stream of compressed air or dry nitrogen. Refer to previous caution.

b. Method II.

(1) For tubing, flush with naptha per specification TT-N-95.
(2) Blow clean and dry off all solvent with clean, dry, filtered air. Refer to previous caution.
(3) Flush with isopropyl alcohol.
(4) Rinse thoroughly with fresh water.
(5) Dry with air as described in previous caution or by heating at a temperature of 250° to 300°F for one-half hour.

— Note —

Solvents can be reused provided they do not become badly contaminated with oil. This condition can be determined by thoroughly evaporating 100 millimeters of the liquid in a glass dish of a determined weight. Evaporation may be accomplished by heating the dish at 200°F (93°C) for one-half hour. If after evaporation and cool down, the residue exceeds 100 milligrams in weight, the solvent cannot be used for this purpose.

c. Method III.

(1) Flush with hot inhibited alkaline cleaner until free from oil and grease.
(2) Rinse thoroughly with fresh water.
(3) Dry thoroughly with a stream of clean air as described in the previous caution or by heating 250°F to 300°F (121°C to 149°C) for one-half hour minimum.

— CAUTION —

DO NOT USE ADHESIVE TAPE FOR ATTACHING OR SECURING PROTECTIVE COVERINGS ON OXYGEN COMPONENTS. USE WAXED LACING TWINE OR TIE RAPS.

d. After cleaning, all tubing must be protected by caps, plugs and/or plastic bags.
e. Before installation, make sure fitting, tube, and fixture threads are in good condition and that the cones do not exhibit pitting or disfigurement.

CREW / PASSENGER (cont.)

3. Swageloc Fitting Installation (Refer to Figure 35-4)

— Note —

The high pressure line fitting at the regulator should be tightened until it bottoms. Make sure to use teflon tape on all male pipe threads.

a. For swageloc fittings not preswaged or for in-aircraft installation, proceed as follows:

(1) Turn the fitting nut onto the fitting finger tight and insert the tube until it bottoms firmly on the shoulder in the fitting.
(2) Tighten the nut with a wrench until the tube will not turn by hand.
(3) Mark the nut at the six o'clock position.
(4) Hold the fitting body steady with a backup wrench and tighten as follows:

(a) On tubing with a diameter bigger than 3/16 inch, tighten 1 1/4 turns (to the nine o'clock position).
(b) On tubing of 1/16, 1/8, and 3/16 inch diameter, tighten only 3/4 turn.

(5) If nut and tube must be disconnected from the fitting, reconnect by seating the tube on the shoulder of the fitting and tightening the nut finger tight. Follow up by tightening the nut with a wrench, one quarter turn (if absolutely necessary the original 1 1/4 or 3/4 tight position) and then snug with wrench.

b. Preswaged swageloc fittings are fabricated and installed as follows:

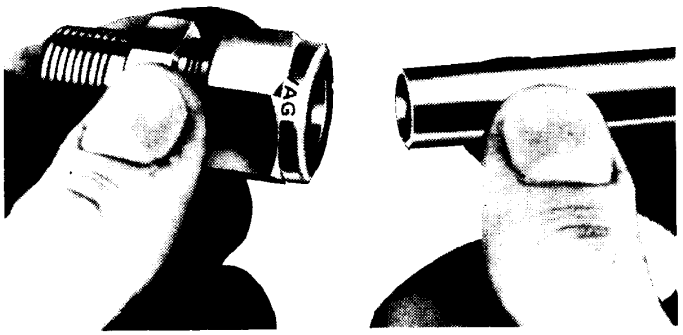
(1) Assembly the nut and ferrules finger tight on the preswaging tool and insert the tube until it firmly bottoms on the shoulder in the tool. The preswaging tool can be attained from Crawford Fitting Company, refer to List of Consumable Materials in Chapter 91.
(2) Tighten the nut on the fitting just enough that the tube within the fitting will not turn by hand.
(3) With a wrench, tighten the nut as follows:

(a) On tubing with diameters over 3/16 inch, tighten 1 1/4 turns.
(b) On tubing with 1/16, 1/8, or 3/16 inch diameter, tighten 3/4 of a turn.

(4) Unscrew the nut to release the ferrule-tube assembly from the tool.
(5) The assembly is installed on the fitting as follows:

(a) Slide tube in fitting until it bottoms, turn nut to finger tight position and tighten one quarter turn with wrench.
(b) Snug slightly with wrench.

CREW / PASSENGER (cont.)

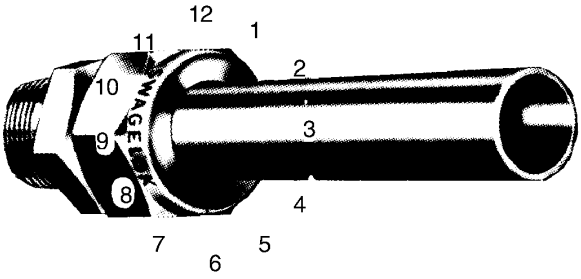


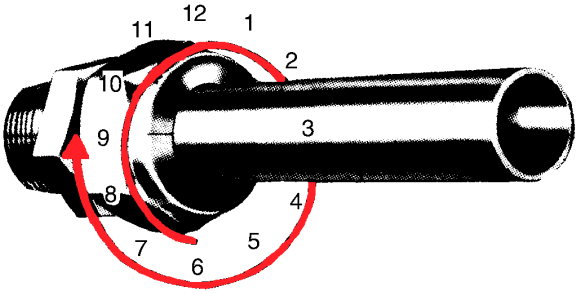
STEP 1

TURN THE FITTING NUT ONTO THE FITTING FINGER TIGHT AND INSERT THE TUBE UNTILL IT BOTTOMS FIRMLY ON THE SHOULDER IN THE FITTING

STEP 2

MARK THE NUT AT THE SIX O' CLOCK POSITION





STEP 3

HOLD THE FITTING WITH A WRENCH AND TIGHTEN THE FITTING NUT AS FOLLOWS:

A. TUBING WITH A DIAMETER GREATER THAN 3/16 INCH SHALL BE TIGHTENED 1 - 1/4 TURNS (THE NINE O' CLOCK POSITION)

B. TUBING WITH A DIAMETER OF 1/16, 1/8, OR 3/16 INCH SHALL BE TIGHTENED ONLY 3/4 TURN.

Figure 35-4. Installation of Swageloc Fittings

CREW / PASSENGER (cont.)

A. Inspection and Maintenance (cont.)

4. Application of Teflon Tape Thread Sealant

All male pipe (tapered) threads of the oxygen system should be sealed with 3M No. 48 teflon tape. Teflon tape should not be used on straight threads. Do not use any other lubricants in place of the teflon or on any other threads.

a. Wrap tape on the threads, starting with those farthest from the opening, in the direction of the thread spiral. Circle the threads, making sure that each side of the tape has a slight overlap.
b. Wrap the tape such that it does not extend beyond the last thread on the fitting at the opening. The tape should then be pulled till it separates. Do not cut tape, it will not stick properly.

5. Leak Tests

Solutions recommended for leak testing are Leak-Tec Formula #16-OX and is available from Scott Aviation. Refer to the List of Consumable Materials for consumer information.

a. Remove the royalite covers in the baggage compartment and, with oxygen system turned off, disconnect the low pressure supply line and connect it to a regulated cylinder charged with dry nitrogen.

— Note —

Whenever a leak check is performed, all fitting connections as well as other questionable areas, should be inspected.

b. Apply the leak detector solution to the test surface and watch for indication of leakage.
c. Large leaks will produce bubbles immediately, but small leaks will form a white foam in 5 to 60 seconds.
d. With outlets vacated of masks, connect a test pressure gauge to the copilot's outlet as described in paragraph A, 1, Inspections, see Figure 35-2.
e. Adjust the regulator on the dry nitrogen cylinder for 100 psi and check for leakage at the outlets.
f. Correct any leaks and wipe off excess leak detector solution.
g. Close the valve on the nitrogen gas tank and insert a Scott plug-in to relieve system pressure.
h. Disconnect test gauge, plug-in, and nitrogen tank.
i. If the oxygen cylinder is not to be hooked up or installed immediately, cap and cover the exposed fittings with new clean plastic bags. Temporarily support lines as needed to prevent damage. Make sure caps and coverings are as clean as possible.

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CREW / PASSENGER (cont.)

B. Oxygen System Component Handling

Keeping in mind the effect of compressed oxygen on materials, oxygen system components must be handled carefully. Ports on regulators, indicators, and other opened components must also be kept capped or plugged to prevent ingestion of foreign material. Adjustments or modifications should only be initiated under the auspices of the FAA, Piper, or Scott Aviation.

1. Removal of Oxygen Cylinder (Refer to Figures 35-5.)

— Note —

Replacement time for the recharge valve is every 5 years, and the regulator requires overhaul every 6 years. The lightweight composite cylinder must be removed every 3 years for hydrostatic test.

a. From inside the aft cabin:

(1) Remove screws attaching finished bulkhead to fuselage bulkhead.
(2) Remove finished bulkhead.
(3) With immediate area clear of flammables (grease, hydraulic fluid, fuel, etc.) and oxygen system off; connect a mask or tube to an outlet to exhaust any pressure in the system.

b. When working in the rear of the airplane, an appropriate tailstand should be used:

— Note —

Continuous pressure is applied to high pressure line until it is disconnected from cylinder. A check valve will close when high pressure line is disconnected from cylinder. The closing of this valve is frequently accompanied by a loud popping sound.

(1) Carefully unscrew high pressure feed/recharge line at regulator until pressure decreases and then remove line. Cap line immediately after removal.
(2) Disconnect high pressure relief line from regulator. Cap line immediately after removal.
(3) Disconnect low pressure line from regulator. Cap line immediately after removal.
(4) Loosen and open clamps securing oxygen cylinder to its shelf.
(5) If necessary, move cylinder slightly to gain access to regulator valve control arm. Disconnect regulator valve control cable from cylinder by removing the retaining screw and clamp from the cable support bracket and the cotter pin attaching the cable to the control arm. Take care not to kink cable.

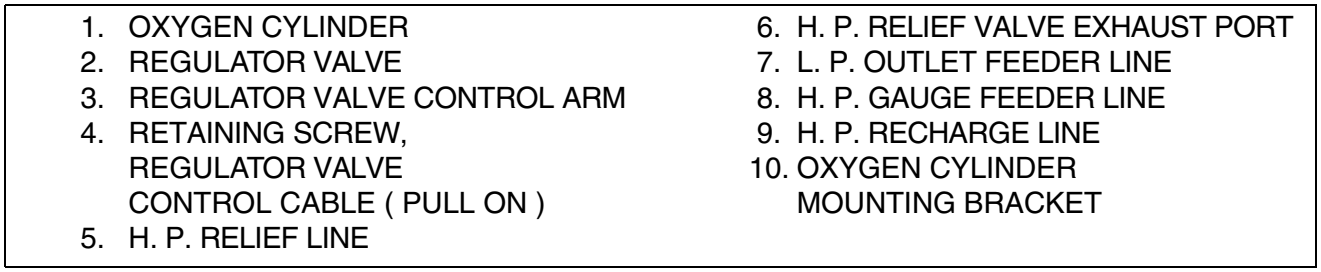

Figure 35-5. Oxygen Cylinder and Regulator Valve (Sheet 1 of 2)

CREW / PASSENGER (cont.)

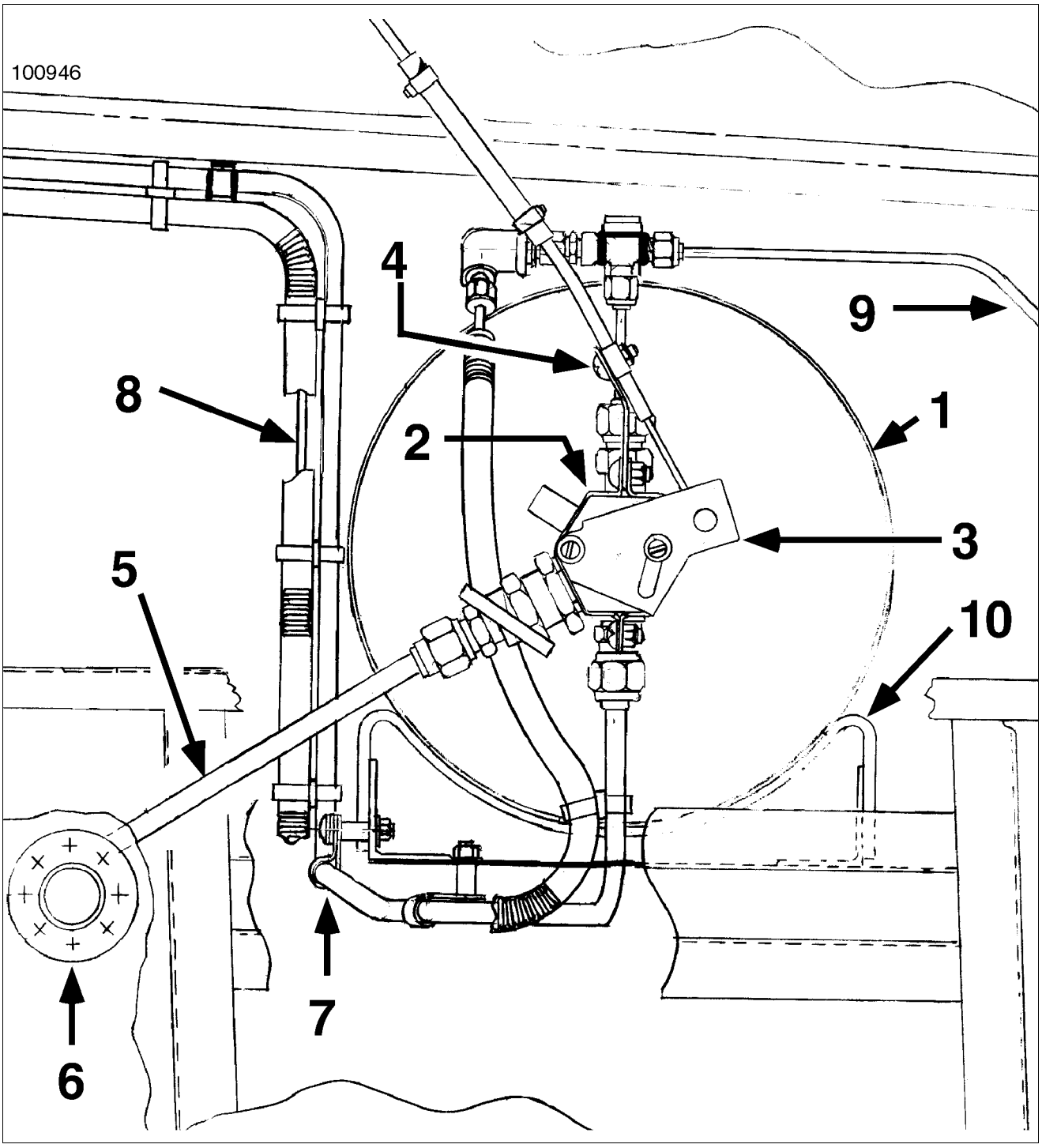

Figure 35-5. Oxygen Cylinder and Regulator Valve (Sheet 2 of 2)

CREW / PASSENGER (cont.)

1. Removal of Oxygen Cylinder (Refer to Figures 35-5.) (cont.)

   b. When working in the rear of the airplane, an appropriate tailstand should be used: (cont.)

— CAUTION —

OPENING CONTROL VALVE DURING REMOVAL OF OXYGEN LOW PRESSURE LINE FROM CYLINDER WILL RESULT IN AN UNCHECKED FLOW OF OXYGEN INTO BAGGAGE COMPARTMENT UNTIL VALVE CAN BE CLOSED.

   (6) Safety valve on cylinder in the OFF position.
   (7) Remove cylinder from airplane.

2. Removal of Recharge Valve (See Figure 35-6)

   The recharge valve is located on the left rear side of the aircraft and is covered by its own access door. This valve is connected to a T-fitting which interconnects the H. P. line from the regulator and the H. P. gauge feeder line. Accordingly, the recharge valve and its line are under constant cylinder pressure as long as the H. P. line is connected to the regulator.

   a. Remove oxygen cylinder (see para B, 1, above) before attempting work on the recharge valve assembly. Removal of the oxygen cylinder mounting shelf is also recommended to further improve access.

— Note —

Continuous pressure is applied to high pressure line until it is disconnected from cylinder. A check valve will close when high pressure line is disconnected from cylinder. The closing of this valve is frequently accompanied by a loud popping sound.

   b. Remove screws securing the recharge valve shroud to the valve mounting dish and slide the shroud back up the high pressure line.
   c. Disconnect the high pressure line from the recharge valve assembly. Cap line immediately after removal.
   d. Remove three screws from recharge valve mounting plate.
   e. Remove valve from airplane.

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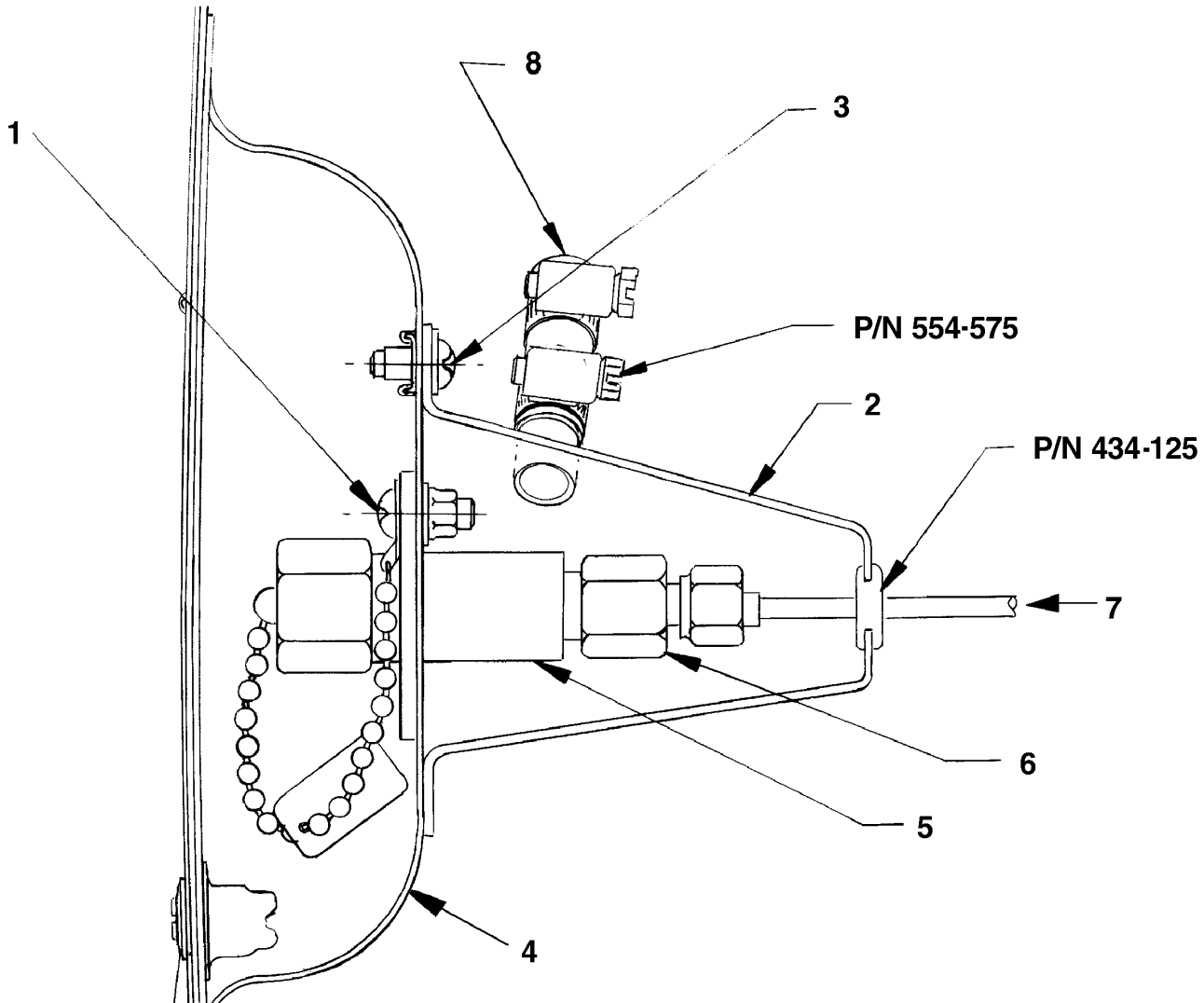
CREW / PASSENGER (cont.)



1. MOUNTING PLATE ATTACHMENT SCREWS (3)
   (SCREW - P/N 415 308, WASHER - P/N 407-563, NUT - 404-910)
2. SHROUD
3. SHROUD ATTACHMENT SCREWS (3)
   (SCREW - P/N 415-308, WASHER - P/N 407-563)
4. VALVE MOUNTING DISH
5. RECHARGING VALVE ASSEMBLY
6. FEMALE CONNECTOR (UNION) (TORQUE TO 30 - 150 IN. LBS.)
7. HIGH PRESSURE LINE TO REGULATOR
8. VENT TUBE PLUG ASSEMBLY

Figure 35-6. Oxygen System Recharge Valve Installation

CREW / PASSENGER (cont.)

3. Installation of Recharge Valve (Refer to Figure 35-6)

— Note —

Apply teflon tape to all tapered male threads as cautioned in paragraph A, 4.

a. Insert valve assembly into hole in mounting dish.
b. Align screw holes in valve mounting plate with those in mounting dish.
c. Install the three mounting screws. Attach cap chain, with information plate attached, with one of the screws.

— CAUTION —

CONNECT HIGH PRESSURE LINE TO VALVE BEFORE CONNECTING TO CYLINDER.

d. Connect H. P. line to valve. Torque to 30 - 150 in. lbs.
e. Slide shroud down H. P. line and secure with screws (3).
f. Reinstall oxygen cylinder (and mounting shelf, if previously removed), per para B, 4, below.

4. Installation of Oxygen Cylinder (Refer to Figures 35-5.)

a. If cylinder mounting shelf has been removed, reinstall it first.
b. Position cylinder in airplane as shown in Figure 35-5. Ensure that regulator valve control arm is free to move and does not contact surrounding area.
c. Attach and secure regulator valve control cable (use a new cotter pin), before securing cylinder to shelf.
d. Install and secure two cylinder hold down clamps.

— Note —

Apply teflon tape to all tapered male threads as cautioned in paragraph A, 4.

e. Connect L. P. line to regulator. Insert tubing into fitting until ferrule seats in fitting. Tighten the nut by hand and then one quarter turn with a wrench. If fitting is relatively new the nut might be turned 3/4 of a turn. Follow up by snugging the nut slightly with a wrench.
f. Connect H. P. feed/recharge and relief lines to regulator. Insert tubing into fitting until ferrule seats in fitting. Tighten the nut by hand and then one quarter turn with a wrench. If fitting is relatively new the nut might be turned 3/4 of a turn. Follow up by snugging the nut slightly with a wrench.
g. Unsafety valve on cylinder. Check that valve remains in OFF position.
h. Check pressure and refill bottle as necessary.
i. Inspect for leaks, especially at fittings that have been separated.
j. Reinstall finished bulkhead in aft cabin, secure with screws.
k. If used, remove tailstand from airplane.

CREW / PASSENGER (cont.)

5. Removal and Installation of Pressure Gauge

The oxygen system pressure gauge is installed in the bottom center of the pilot's instrument panel below, and slightly right of, the control wheel. Access is obtained from beneath the instrument panel.

The pressure gauge is tied into the same high pressure line as the recharge valve, through a T-fitting near the tank regulator-control valve.

a. To remove oxygen pressure gauge:

(1) Disconnect H. P. line at oxygen cylinder:

— Note —

When working in the rear of the airplane, an appropriate tailstand should be used.

(a) Remove screws attaching finished bulkhead to fuselage bulkhead.
(b) Remove finished bulkhead.
(c) With immediate area clear of flammables (grease, hydraulic fluid, fuel, etc.) and oxygen system off; connect a mask or tube to an outlet to exhaust any pressure in the system.

— Note —

Continuous pressure is applied to high pressure line until it is disconnected from cylinder. A check valve will close when high pressure line is disconnected from cylinder. The closing of this valve is frequently accompanied by a loud popping sound.

(d) Carefully unscrew high pressure line until pressure decreases and then remove line. Cap line immediately after removal.

(2) At the instrument panel:

(a) Disconnect high pressure line from gauge and cap immediately.
(b) Remove two nuts from brass studs securing gauge to panel.
(c) Remove gauge from pilot's side of instrument panel.

b. To install pressure gauge:

(1) Insert pressure gauge into instrument panel.
(2) Secure to panel by installing nuts on the two brass studs extending from gauge. Finger tighten, then snug with wrench. Be careful not to over torque; studs break off easily.
(3) Connect H. P. line to gauge.
(4) Connect H. P. line to cylinder.
(5) Inspect fittings that have been separated for leaks.
(6) Reinstall finished bulkhead in aft cabin, secure with screws.
(7) If used, remove tailstand from airplane.

CREW / PASSENGER (cont.)

6. Removal of Outlets

   a. Check that the oxygen system is completely turned off. Insert an oxygen mask to release pressure and ensure the system is off.
   b. With a suitable spanner wrench, unscrew and remove the outlet retainer ring(s) and information plate(s).
   c. Remove or drop overhead panel sufficiently to gain access to low pressure line connections.
   d. Disconnect outlet(s) from L. P. feed lines:

      (1) If removing right side outlet(s), for each outlet, as appropriate: disconnect the two T-unions or the one elbow-union connecting the outlet to main L. P. feed line and one union connecting outlet to left outlet branch L. P. feed line.
      (2) If removing left side outlet(s), disconnect one union connected to branch L. P. feed line(s).

   e. Remove outlet(s) from airplane.

7. Installation of Outlets

   a. Position outlet(s) in airplane.
   b. Connect outlet(s) to L. P. feed lines:

      (1) If installing left side outlet(s), connect union(s) to branch L. P. feed line(s) from right side outlet(s).
      (2) If installing right side outlet(s), for each outlet, as appropriate: connect the two T-unions or the one elbow-union connecting the outlet to main L. P. feed line and one union connecting outlet to left outlet branch L. P. feed line.

   c. Inspect fittings that have been separated for leaks.
   d. Replace overhead paneling and secure in place.
   e. For each outlet, position the information plate so that the word “OXYGEN” can be read when viewed from the seat that is supported by that outlet. With a suitable spanner wrench, screw on the outlet retainer ring.

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CREW / PASSENGER (cont.)

8. Removal and Installation of Oxygen On/Off Control

The oxygen system PULL ON (push off) control knob is installed in the bottom center of the pilot's instrument panel below, and slightly right of, the control wheel. Access is obtained from beneath the instrument panel.

a. Removal:

(1) Disconnect cable from regulator-control mechanism on cylinder:

(a) Remove screws attaching finished bulkhead to fuselage bulkhead.
(b) Remove finished bulkhead.

— Note —

When working in the rear of the airplane, an appropriate tailstand should be used.

(c) If necessary, move cylinder slightly to gain access to regulator valve control arm. Disconnect regulator valve control cable from cylinder / control arm by removing the retaining screw from the cable support bracket and the cotter pin attaching the cable to control arm. Cut loop off end of cable core.
(d) Release cable from all clamps and cut the tie wraps securing cable to H. P. Gauge feed line. Note position of tie wraps for reinstallation.

(2) Remove or drop overhead panel sufficiently to gain access to the control cable running the entire length of the cabin.
(3) Release cable from all clamps and cut the tie wraps securing cable to H. P. Gauge feed line, both in the cabin overhead and under the instrument panel. Note position of tie wraps for reinstallation.
(4) Remove retaining nut from rear of control knob.
(5) Pull cable from airplane through instrument panel. Retrieve retainer nut as cable bitter end pulls through the instrument panel.

b. Installation:

(1) Insert cable through instrument panel. Slide retainer nut onto cable and secure control knob to instrument panel.
(2) Feed cable up through windshield centerpost and along H. P. Gauge feed line to cylinder.
(3) Secure cable to H. P. Gauge feeder line and structure with same number of tie wraps, CR-2M ring connectors and clamps installed at same locations as those cut or loosened to remove cable.
(4) Trim cable shield and core to allow sufficient material to make a two turn loop, two inches (5.08 cm) from the end of the shield.
(5) Bend core wire end for 1 1/2 to 2 turns with 0.188 (0.478 cm) inside diameter.
(6) Place loop over pin on regulator control arm and secure with washer and cotter pin. Secure cable with retaining screw and clamp to cable support bracket
(7) Check operation, adjust as required.
(8) Replace and secure overhead panels in the cabin.
(9) Replace and secure finished bulkhead in aft cabin. If used, remove tailstand.

CREW / PASSENGER (cont.)

C. Refilling Oxygen System

— CAUTION —

BEFORE SERVICING THE OXYGEN SYSTEM, MAKE SURE THE AIRCRAFT IS SECURELY GROUNDED ELECTRICALLY.

— CAUTION —

DO NOT OPERATE ELECTRICAL EQUIPMENT WHILE SERVICING OXYGEN SYSTEM.

— CAUTION —

DO NOT ATTEMPT TO TIGHTEN ANY CONNECTIONS WHILE THE SYSTEM IS CHARGED.

Refilling of oxygen systems should be done by qualified personnel. For comparison of filling pressures to ambient temperatures refer to Chart 3503. The following are parameters to be followed for filling.

1. Only aviators breathing oxygen (MIL-0-27210) and appropriate filling equipment should be used to fill the system.
2. If a cylinder has less than 5 psi pressure or has insufficient pressure to produce an audible hissing sound when the valve is cracked, it should be removed and/or purged, and if the condition has existed for a significant length of time, hydrostatically test cylinder.
3. Make sure both the charge valve and recharge cart fittings are clean and free of contamination.

— WARNING —

BE CERTAIN THERE IS NO OIL OR OTHER PETROLEUM BASED MATERIAL ON THE FITTINGS OR IN THE IMMEDIATE VICINITY.

4. Attach service cart hose to recharge port. Fill the system at a rate not exceeding 200 psig per minute proceeding as follows:
   a. To obtain the correct filling pressure for the oxygen system at various ambient temperatures, a table is included for your convenience. The pressures given are not exact, but sufficiently accurate for practical purposes of working pressures between 1800 and 2400 psig cylinders. The cylinder should be allowed to cool to a stabilized temperature after filling before checking against the values in Chart 3503.
   b. When using a recharge unit consisting of one supply cylinder, slowly open the valve of the supply unit and allow the oxygen to transfer.
   c. When using a recharge unit consisting of two or more supply cylinders (cascade storage system), it is recommended that the following procedure be used:

CREW / PASSENGER (cont.)

(1) Before opening any valves, check the pressure remaining in the airplane's oxygen cylinder. If it is still partly charged, note the pressure indicated on the cylinder gauge. Then open and close each valve on the cascade storage system and determine which cylinder has the lowest pressure. When found, if this cylinder has a pressure lower than the oxygen cylinder in the aircraft, do not attempt using it for filling; use the storage cylinder that has a pressure higher than the aircraft's cylinder but lower than the others.

(2) Open the valve on only the one storage cylinder with the lowest pressure. When the pressure indicated on the aircraft's oxygen gauge and charging gauge has become equal, close the valve of the storage cylinder, then go to the storage cylinder with the next higher pressure and repeat the procedure.

(3) If after using the last storage cylinder the aircraft's oxygen system is still not fully charged, a full storage cylinder should be put in place of a cylinder with the lowest pressure and used in the same manner.

(4) A good amount of oxygen will remain in the large cylinders used in the cascade system after filling only one of the cylinders. This remaining oxygen will be at a pressure something less than the 1850 psi. This is not sufficient pressure to completely refill another aircraft cylinder, although it will refill several small cylinders.

(5) It is not economical, even on a three or four cylinder cascade system, to begin recharging with oxygen at less than 300 psi pressure in the 300 cubic foot bank of cylinders. So use 300 cubic foot cylinders down to approximately 300 psi; then return for refilling. In two cylinder systems use to approximately 100 psi; then return for filling.

(d) When the pressure gauge on the recharge unit or in the aircraft reaches 1800 to 1850 psi, close the pressure regulator valve on the recharge unit. Disconnect the filler hose from the filler valve; replace the protective cap on the filler valve and close the access cover. Check the cylinder pressure according to Chart 3503 after the cylinder temperature stabilizes.

5. After detaching the service cart, cap hose and fittings to prevent contamination.
6. Perform a leak check of the high pressure lines and clean off solution afterwards. If solution is not properly cleaned off, corrosion may result.

CHART 3503. FILLING PRESSURES* FOR CERTAIN AMBIENT TEMPERATURES

Ambient Temperature °F/°C	Filling Pressure	Ambient Temperature °F/°C	Filling Pressure
0 / -17.78	1650 (PSI)	70 / 21	1975 (PSI)
10 / -12.22	1700	80 / 27	2000
20 / - 6.67	1725	90 / 32	2050
30 / - 1.11	1775	100 / 38	2100
40 / 4.44	1825	110 / 43	2150
50 / 10	1875	120 / 49	2200
60 / 15.56	1925	130 / 54	2250

* Filling pressures are for 1850 PSI at 70°F (21.11°C). Table assumes 25°F (11.8°C) rise due to heat of compressor with max. fill rate.

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CHAPTER

37

VACUUM

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CHAPTER 37 - VACUUM

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL

— WARNING —

THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT. (SEE INTRODUCTION, PAGE 4.)

DESCRIPTION AND OPERATION

The vacuum system operates the gyro instruments which provide critical flight information (i.e. - attitude and direction). It consists of an engine driven dry vacuum pump, a vacuum regulator and filter, and necessary plumbing to connect the components. An auxiliary dry air pump system provides a backup source to operate gyro flight instruments, should the engine driven pump fail. A vacuum gauge is used to monitor the system constantly.

Maintenance, other than that described, must be performed by the instrument manufacturer or an authorized instrument repair station.

TROUBLESHOOTING

CHART 3701. TROUBLESHOOTING VACUUM SYSTEM (1 of 3)

Trouble	Cause	Remedy
No vacuum gauge indication.	Open vacuum line.	Locate and repair.
	Faulty instrument.	Replace.
	Faulty transducer. *	Replace transducer.
No vacuum gauge indication at instrument or source.	Faulty gauge and/or malfunctioning pump.	Replace gauge, and/or pump(s)
Low vacuum system indications.	Filter dirty.	Clean or replace filter.
	Vacuum regulator valve needs adjusting.	Adjust regulator valve as per adjustment instructions in this section.
	Restrictions in gyros to filter line.	Repair or replace line.
	Pump(s) to gyros line leaking.	Check all lines and fittings.
	Faulty transducer. *	Replace transducer.
Abnormal gyro precession - vacuum gauge reading correct or at maximum pressure.	Dirty filter.	Replace filter and adjust regulator.

* HP S/N's 3246088 & up, TC S/N's 3257001 & up.

GENERAL (Cont.)

CHART 3701. TROUBLESHOOTING VACUUM SYSTEM (2 of 3)

Trouble	Cause	Remedy
Normal vacuum indication but sluggish operation of instruments.	Faulty instrument.	Replace instrument.
	Dirty or clogged filter	Replace filter.
	Vacuum line kinked.	Repair lines.
	Faulty transducer. *	Replace transducer.
High System vacuum.	Vacuum regulator is improperly adjusted.	Adjust regulator properly.
	Dirty or clogged filter.	Replace filter.
	Vacuum lines bent, kinked, or restricted.lines.	Repair or replace
	Vacuum regulator sticking or dirty screen	Clean screen and check regulator operation.
Regulator cannot be adjusted to maintain correct pressure.	Lines leaking.	Check all lines and fittings.
	Vacuum pump malfunctioning.	Replace pump.
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.
	Faulty transducer. *	Replace transducer.
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.

* HP S/N's 3246088 & up, TC S/N's 3257001 & up.

GENERAL (Cont.)

CHART 3701. TROUBLESHOOTING VACUUM SYSTEM (3 of 3)

Trouble	Cause	Remedy
AUX ON selected on ground check and auxiliary vacuum pump will not run.	Circuit breaker open.	Reset circuit breaker(s).
	Faulty electrical motor.	Isolate and check operation. Replace pump or motor assembly if required.
	Faulty contactor.	Check operation. Replace if required.
	Loose or broken wire	Tighten all wire connections connections.and terminals. Check all wires for open breaks and repair as needed.
AUX ON selected on ground check and/or no vacuum is indicated.	Leak in vacuum system.	Tighten clamps and check hoses. Replace if necessary.
AUX ON annunciator will not light.	Restriction in hose lines.	Inspect, repair, or replace hose line if necessary.
	Dirty filter.	Replace filter.
	Regulator not adjusted properly.	Adjust properly.
VAC OFF AUX ON annunciator switching will not engage auxiliary vacuum pump system.	Circuit breaker open.	Reset circuit breaker(s).
	Faulty switch.	Test switch for operaiton. Replace if necessary.
Auxiliary vacuum pump maintains correct pressure on ground but not at altitude.	Auxiliary vacuum pump is worn.	Replace auxiliary vacuum pump assembly.
	Regulator is sticky.	Clean or replace regulator.

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DISTRIBUTION

A. Vacuum System Service Tips

The following information is intended to acquaint field service personnel with a means to diagnose vacuum system service symptoms on those components which are serviced by removal and replacement. These items include hoses, clamps, gyro filters, vacuum regulating valves and vacuum gauges.

1. Hoses and Clamps:

   a. These items should be examined periodically and inspected carefully whenever engine maintenance activities cause hose disconnections to be made at the pump, regulating valve, gyros and/or vacuum gauge.

   b. Ends of hoses should be examined for rubber separation and slivers of rubber on inside diameter of hoses. These slivers can and do become detached. If this happens, vacuum pump sucks these loose particles and eventually ingests them. This can cause premature pump failure.

   c. Hose clamps and fittings should be replaced when broken, damaged or corroded.

— CAUTION —

WHEN REPLACING ANY OF THE THREADED FITTINGS, DO NOT USE PIPE DOPE OR ANY OTHER ANTI-SEIZE TAPE OR COMPOUND. AIRBORNE FITTINGS ARE ALL CADMIUM PLATED TO AVOID THE NEED FOR ANY OTHER ANTI-SEIZE MATERIALS. THE REASON FOR THIS CAUTION IS TO PROTECT PUMP FROM INGESTING ANY FOREIGN MATERIALS THAT COULD CAUSE PREMATURE SERVICE.

2. Vacuum Gauges:

   a. Vacuum gauges seldom require service and usually are replaced when malfunctions occur.

— Note —

Vacuum gauge failure in a properly operating vacuum system does not impair safety of flight.

   b. If vacuum gauge malfunctions in a manner to cause an incorrect reading in normal cruise conditions, gauge must be checked by comparing reading with a gauge of known accuracy. If gauge is indicating correct values and system vacuum level is not in accordance with specified vacuum, then and only then should regulator be reset.

   c. Visual examination of gauge performance should cover the following steps:

      (1) With engine stopped and no vacuum supplied to gauge, its pointer should rest against the the internal stop in 7 o'clock position (or 9 o'clock in HP S/N's 3246001 thru 3246087 only). Any other displacement from this position suggests need for replacement.

      (2) A slight overshoot during engine startup, not to exceed half an inch of mercury, is normal and is not cause to replace gauge.

DISTRIBUTION (Cont.)

(3) With engine operating at normal cruise RPM, gauge should read within the normal operating range as marked on the gauge.

— Note —

In HP S/N's 3246001 thru 3246087 only, the normal operating range is 4.8 to 5.2 IN. HG.

In HP S/N's 3246088 & up and TC S/N's 3257001 & up, the normal operating range is either 4.8 to 5.2 or 4.5 to 5.2 IN. HG., depending on the gauge installed in the individual aircraft.

(4) At 1200 rpm, vacuum gauge reading should be more than four inches of mercury.

3. Gyro Filters:

a. Gyro filters must be serviced on a scheduled basis, not to exceed 100 hours, or sooner as condition indicates.

b. The system installation employs a large central filter and differential vacuum gauge that continuously monitors filter condition while indicating vacuum readings.

— Note —

The system employs a central filter in combination with a differential vacuum gauge and will indicate a decline in panel gauge reading when filter becomes clogged. Filters should be replaced when gauge reading declines; DO NOT adjust regulator.

4. Vacuum Regulator:

a. Vacuum regulating valve seldom needs replacement. Symptoms that suggest replacement are:

(1) Chatter as indicated by rapid fluctuation of vacuum gauge needle or an audible sound.

(2) Non-repeatability of vacuum gauge reading when panel gauge is not suspect or has been checked against a known test gauge (cruise RPM only).

b. All modes of regulator malfunction tend to increase vacuum power applied to gyros. Thus, although excess vacuum is applied, a loss of vacuum does not occur.

c. Gyros themselves act as a limiting device to keep vacuum power applied from exceeding safe levels.

— Note —

If panel gauge has been checked and found OK and vacuum gauge reading does not repeat within the normal operating range as marked on the gauge, then regulating valve should be changed. Observe usual precautions for maintaining system cleanliness to avoid premature pump service.

B. Vacuum Pump

Vacuum pump is a rotary vane, positive displacement type. This unit consists essentially of an aluminum housing, a carbon rotor and carbon vanes. This assembly is driven by means of a coupling mated to engine driven gear assembly. Pump is mounted on accessory section of engine.

DISTRIBUTION (Cont.)

1. Removal of Vacuum Pump
   a. Remove top portion of engine cowling. (Refer to Chapter 71.)
   b. Loosen hose clamp and remove hose from pump fitting.
   c. Remove four retaining nuts, lock washers and plain washers used to secure pump to engine; then remove pump.
2. Replacing Pump Fittings
   a. Before installing any fittings on pump, check for any external damage. A pump that has been damaged or dropped should not be installed.
   b. 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.

— CAUTION —

DO NOT APPLY VISE PRESSURE TO OUTSIDE DIAMETER OR OVERALL LENGTH OF PUMP.

   c. The ports of AIRBORNE pump 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 a powdered moly-sulfide or graphite in dry form or in an evaporating vehicle; or employ a silicone spray. Apply sparingly to external threads of fittings only.

— CAUTION —

DO NOT USE PIPE TAPE, THREAD DOPE, HYDROCARBON OIL OR GREASE, AS THESE CAN CONTAMINATE PUMP AND CAUSE MALFUNCTION.

3. Installation of Vacuum Pump
   a. Place pump gasket in its proper place and align spline on pump drive with spline on engine drive assembly.

— 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.

   c. Secure pump to engine with four plain washers, lock washers and retaining nuts. Torque nuts 50 to 70 inch-pounds.
   c. Connect hoses to pump and secure with hose clamps.
   d. Reinstall engine cowling.

DISTRIBUTION (Cont.)

C. Vacuum Regulator Valve

One vacuum regulator valve is incorporated in system to control vacuum pressure to gyro instruments. Regulator valve is located under instrument panel. Access to valve for maintenance and adjustment is gained from below instrument panel.

1. Adjustment of Vacuum Regulator Valve

   a. Loosen locking nut or remove protective cap from valve, depending on which type is installed.

   — Note —

   Do not attempt adjustment of this valve with engine in operation, without qualified pilot or other responsible person at controls.

   b. Start engine, after allowing time for warm-up, run engine at 2000 rpm

   c. With engine running at 2000 rpm suction gauge should indicate within the normal operating range as marked on the gauge. If vacuum reading fails to fall within this range, shut down engine and adjust regulator valve by moving valve adjustment screw clockwise to increase pressure, and counterclockwise to decrease pressure. Start engine and repeat check. With engine running at 2000 rpm suction gauge should indicate within the normal operating range as marked on the gauge.

   d. Restart engine and repeat check.

   e. After system pressure has been adjusted to these recommended settings, replace protective cap or retighten locknut, whichever applies to type of valve installed.

2. Removal and Replacement of Regulator Valve

   a. To remove regulator valve, disconnect the three lines and remove mounting nut. Remove valve from airplane.

   b. Replace regulator in reverse order given for removal. Check complete vacuum system for proper operation.

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INDICATING

A. HP S/N's 3246001 thru 3246087 only.

1. Vacuum Gauge

Suction gauge is mounted on left side of instrument panel. This gauge is calibrated in inches of mercury and indicates amount of vacuum created by engine driven vacuum pump. Suction gauge has a direct pressure line and vent line. Therefore, the gauge indicates differential pressure or actual pressure being applied to gyro instruments. As system filter becomes clogged or lines obstructed, gauge will show a decrease in pressure. Do not reset regulator until filter and lines have been checked.

2. VACUUM INOP Sensor/Switch

Access to VACUUM INOP sensor/switch unit is gained by reaching up under instrument panel to vacuum regulator.

a. Removal

(1) Disconnect the two electrical leads.

(2) Unscrew sensor/switch unit from vacuum regulator.

(3) Cover hole to prevent foreign matter from entering regulator.

b. Installation

(1) Screw sensor/switch unit into vacuum regulator.

(2) Reconnect the two electrical leads.

(3) Perform operational check.

B. HP S/N's 3246088 & up and TC S/N's 3257001 & up.

1. Vacuum Gauge

CHT/VAC gauge is mounted on left side of instrument panel in the twin stack under the Digital Display Monitoring Panel. The VAC side of this gauge is calibrated in inches of mercury and measures the differential pressure across the gyros by use of a transducer mounted between the system filter and the regulator. As system filters becomes clogged or lines obstructed, gauge will show a decrease in pressure. Do not reset regulator until filter and lines have been checked.

2. VACUUM INOP Sensor/Switch

Access to VACUUM INOP sensor/switch unit is gained by reaching up under instrument panel to vacuum regulator.

a. Removal

(1) Disconnect the two electrical leads.

(2) Unscrew sensor/switch unit from vacuum regulator.

(3) Cover hole to prevent foreign matter from entering regulator.

b. Installation

(1) Screw sensor/switch unit into vacuum regulator.

(2) Reconnect the two electrical leads.

(3) Perform operational check.

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CHAPTER

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ELECTRIC / ELECTRONIC PANELS & MULTIPURPOSE PARTS

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CHAPTER 39 - ELECTRICAL / ELECTRONIC PANELS AND MULTIPURPOSE PARTS

TABLE OF CONTENTS / EFFECTIVITY

— Note —

Refer to Chapter 91 for all wiring diagrams (schematics).

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INSTRUMENT AND CONTROL PANELS

GENERAL

A. Face-Mounted Instruments

Most instruments are face-mounted and secured to the instrument panel by screws from the front of the panel. 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.

(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.

CIRCUIT BREAKER PANEL

Circuit breakers are installed in a single panel in the lower right of the intrument panel. 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.

Circuit breakers are single hole mounting, pushbutton type with manual reset; they must be reset by the pilot whenever tripped.

SWITCHES

A. Overhead Switch Panel (Not installed in HP S/N's 3246001 thru 3246017.)

Most switches are located in the overhead switch panel. When working on the overhead switch panel, remove it from the aircraft first.

(1) Removal

(a) Remove panel retaining screws (8).

(b) Slide the switch panel down to gain access to the electrical connectors at the back of the panel.

(c) Disconnect the electrical connectors and remove panel from aircraft.

(2) Switch Replacement

Switches in the overhead switch panel are not replaceable. If one switch fails, the entire switch panel must be replaced.

(3) Installation

— Note —

The overhead switch panel is lighted with electroluminescent placards. The left and right placards bear part of the load exerted by the panel retaining screws. Take care not to overtighten the panel retaining screws when installing the switch panel or you may damage the placards.

(a) Holding the switch panel below the opening in the headliner, connect the electrical connectors to the rear of the panel.

(b) Slide the panel into position and secure with screws (8).

B. Rocker-type Switches

A few rocker-type switches are used in the instrument panel, except in HP S/N's 3246001 thru 3246017. Those seventeen airplanes have all their electrical switches in the middle of 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.

(1) Removal

(a) Gain access to the switch from behind the instrument panel.

(b) Squeeze retainer blades on top and bottom of the switch together and push switch from the panel.

(c) Make note of the placement of, and / or tag, wires on the switch to facilitate installation.

(d) Disconnect wires from the switch. Remove switch.

(2) Installation

(a) Connect wires to the switch.

(b) Squeeze retainer blades on top and bottom of the switch together and push switch into panel until retainer blades engage the panel.

C. Push ON - Push OFF Switches

A few Push ON - Push OFF switches may be used in the instrument panel, depending on installed options.

(1) Removal

(a) Gently pry off the switch cap.

(b) With a small screwdriver, rotate the two retaining tabs until they disengage.

(c) Slide the switch out.

(2) Installation

(a) Slide the switch into place.

(b) With a small screwdriver, rotate the two retaining tabs until they engage.

(c) Press on the switch cap.

CHAPTER

51

STRUCTURES

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CHAPTER 51 - STRUCTURES

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL

A. Description

This airplane has an all metal semi-monocoque structure. The fuselage is constructed of bulkheads, stringers and stiffeners, to which all of the outer skin is riveted. Crew entrance door is located on right side of fuselage above wing. Forward baggage door is forward of the wing on the right side of fuselage, just aft of firewall. Passenger entrance door is provided on left side of fuselage aft of wing and is adjacent to the aft baggage door. Wings and empennage are all metal, full cantilever semi-monocoque type construction with removable tips.

B. Structural Repairs

Structural repair methods used must be made in accordance with regulations set forth in FAA Advisory Circular 43-13-1A. To assist in making repairs and/or replacements, Figure 51-1 identifies type and thickness of various skin material used.

— WARNING —

NO ACCESS HOLES ARE PERMITTED IN ANY CONTROL SURFACES. 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

Repair procedures in this manual will describe methods for repair of Fiberglass Reinforced Structures; Fiberglass Touch-Up and Surface Repairs such as blisters, open seams, delamination, cavities, small holes and minor damages that have not harmed fiberglass cloth material; and, Fiberglass Fracture and Patch Repairs such as puncture, breaks and holes that have penetrated through structure and damaged fiberglass cloth. A repair kit, part number 766 222 will furnish necessary material for such repairs, and is available through Piper Aircraft Distributorrs.

— Note —

Very carefully follow resin and catalyst mixing instructions furnished with repair kit.

2. Fiberglass Touch-Up and Surface Repairs

a. Remove wax, oil and dirt from around damaged area with acetone, Methylethylketone or equivalent and remove paint to gel coat.
b. Damaged area may be scraped with a fine blade knife or a power drill with a burr attachment to roughen bottom and sides of damaged area. Feather edge surrounding scratch or cavity. Do not undercut edge. (If scratch or cavity is shallow and penetrates only surface coat, continue to para h, below.)

GENERAL (CONT.)

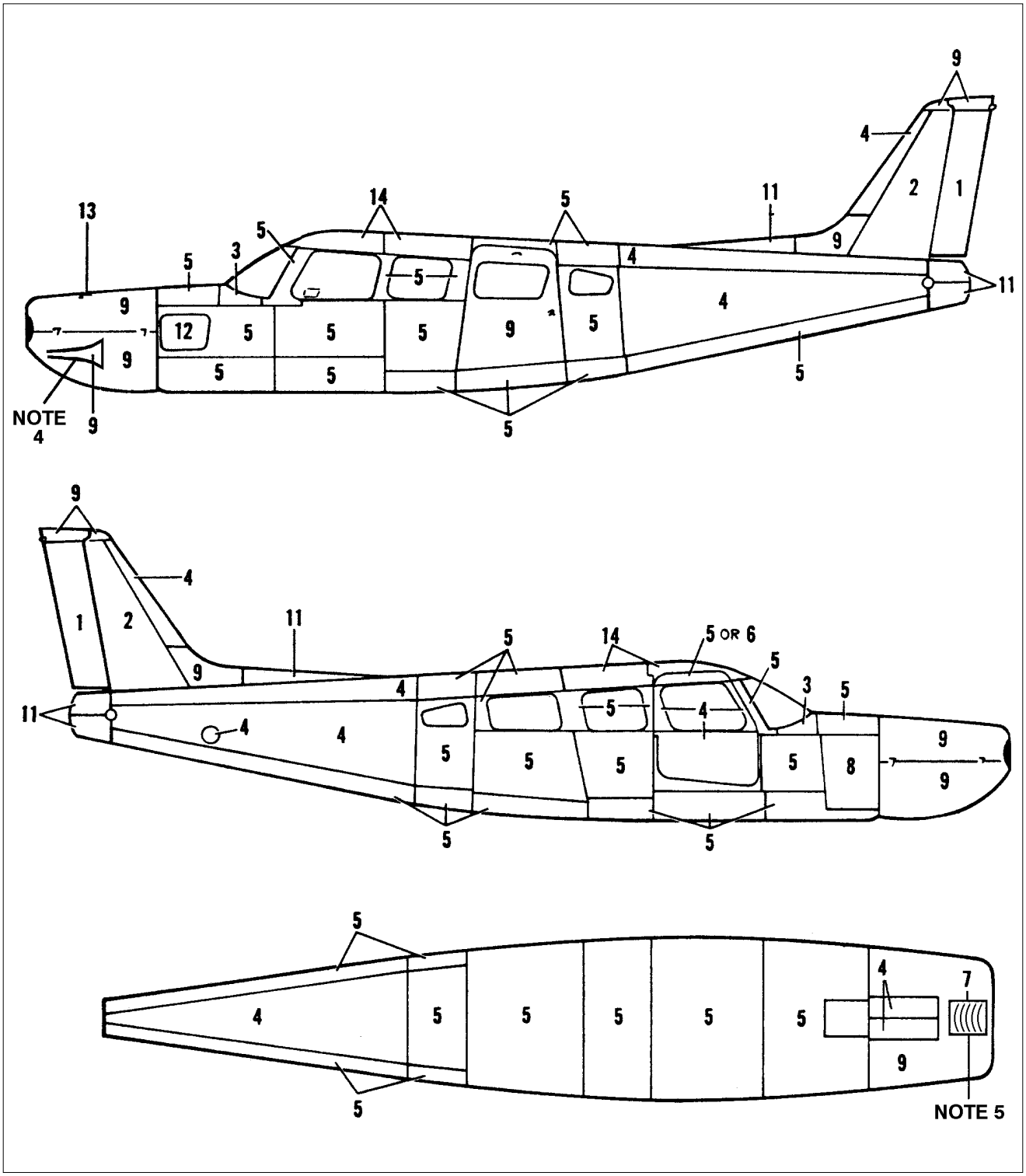
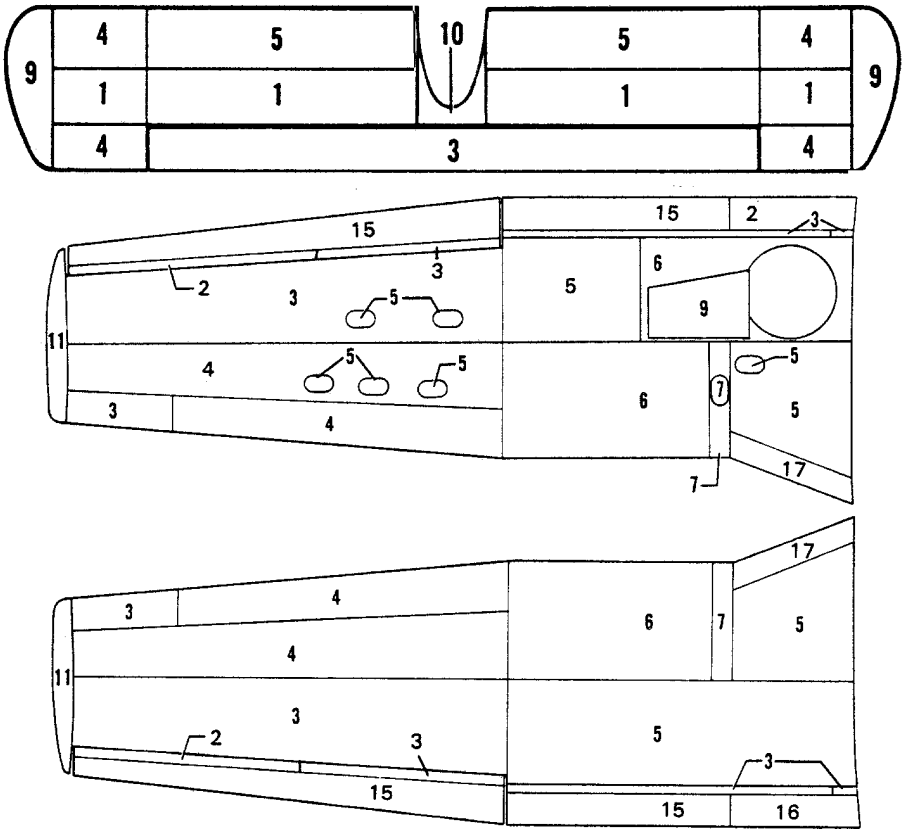


Figure 51-1. Skin Materials and Thickness (1 of 2)

GENERAL (CONT.)



NUMBER	MATERIAL	THICKNESS
1	2024-T3	.016
2	2024-0 (1)	.020
3	2024-T3	.020
4	2024-T3	.025
5	2024-T3	.032
6	2024-T3	.040
7	2024-0 (1)	.040
8	2024-0 (2)	.032
9	FIBERGLASS	
10	2024-T3 (2)	.020
11	THERMOPLASTIC OR FIBERGLASS	
12	2024-T3 (2)	.040
13	5052-H34	.040
14	2024-T3 (2)	.032
15	2024-T3 (1)	.016
16	2024-0 (3)	.020
17	2024-T3 (1)	.040

NOTES: LEFT WING SHOWN, RIGHT WING OPPOSITE.

1. HEAT TREAT TO 2024-T42 AFTER FORMING.
2. HEAT TREAT TO 2024-T3 AFTER FORMING.
3. HEAT TREAT TO 2024-T4 AFTER FORMING.
4. HP S/N'S 3246001 & UP ONLY.
5. TC S/N'S 3257001 & UP ONLY.

Figure 51-1. Skin Materials and Thickness (2 of 2)

GENERAL (CONT.)

c. Pour a small amount of resin into a jar lid or on a piece of cardboard, just enough to fill area being worked on. Mix an equal amount of milled fiberglas with resin, using a putty knife or stick. Add catalyst, according to kit instruction, to resin and mix thoroughly. A hypodermic needle may be used to inject gel into small cavities not requiring fiberglas millings mixed with gel.

d. Work mixture of resin, fibers and catalyst into damaged area, using sharp point of a putty knife or stick to press it into bottom of hold and to puncture any air bubbles which may be present. Fill scratch or hole above surrounding undamaged area about 1/16 inch.

e. Lay piece of cellophane or waxed paper over repair to cut off air and start cure of gel mixture.

f. Allow gel to cure 10 to 15 minutes until it feels rubbery to touch. Remove cellophane and trim flush with surface, using a sharp razor blade or knife. Replace cellophane and allow to cure completely for 30 minutes to an hour. Patch will shrink slightly below structure surface as it cures. (If wax paper is used, ascertain wax is removed from surface.)

g. Rough up bottom and edges of hole with electric burr attachment or rough sandpaper. Feather hole into surrounding gel coat, do not undercut.

h. Pour out a small amount of resin, add catalyst and mix thoroughly, using a cutting motion rather than stirring. Use no fibers.

i. Using tip of putty knife or fingertips, fill hole to about 1/16 inch above surrounding surface with gel coat mixture.

j. Lay piece of cellophane over patch to start curing process. Repeat para f, above, trimming patch when partially cured.

k. After trimming patch, immediately place another small amount of gel coat on cut edge of patch and cover with cellophane. Then, using a squeegee or back of a razor blade, squeegee level with area surrounding patch, leave cellophane on patch for one or two hours or overnight, for complete cure.

l. After repair has cured for 24 hours, sand patched area using sanding block with fine wet sand- paper. Finish by priming, again sanding and applying color coat.

3. Fiberglass Fracture and Patch Repairs

a. Remove wax, oil and dirt from around damaged area with acetone, methylethyketone or equivalent.

b. Using a key hole saw, electric saber saw, or sharp knife cut away ragged edges. Cut back to sound material.

c. Remove paint three inches back from around damaged area.

d. Working inside structure, bevel edges to approximately a 30 degree angle and rough-sand hole and area around it, using 80-grit dry paper. Feather back for about two inches all around hole. This roughens surface for strong bond with patch.

e. Cover a piece of cardboard or metal with cellophane. Tape it to outside of structure covering hole completely. Cellophane should face toward inside of structure. If repair is on a sharp contour or shaped area, a sheet of aluminum formed to a similar contour may be placed over area. Aluminum should also be covered with cellophane.

GENERAL (CONT.)

f. Prepare a patch of fiberglas mat and cloth to cover an area two inches larger than hole.
g. Mix small amount of resin and catalyst, enough to be used for one step at a time, according to kit instructions.
h. Thoroughly wet mat and cloth with catalyzed resin. Daub resin on mat first, and then on cloth. Mat should be applied against structure surface with cloth on top. Both pieces may be wet out on cellophane and applied as a sandwich. Enough fiberglas cloth and mat reinforcements should be used to at least replace amount of reinforcements removed in order to maintain original strength. If damage occurred as a stress crack, an extra layer or two of cloth may be used to strengthen area.
i. 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 patch and they should all be worked out to edge. Remove excess resin before it gels on part. Allow patch to cure completely.
j. Remove cardboard or aluminum sheet from outside of hole and rough-sand patch and edge of hole. Feather edge of hole about two inches into undamaged area.
k. Mask area around hole with tape and paper to protect surface. Cut a piece of fiberglas mat about one inch larger than hole and one or more pieces of fiberglas cloth two inches larger than hole. Brush catalyst 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 fiberglas cloth to build up patch to surface of structure. Wet out each layer thoroughly with resin.
l. With a squeegee or broad knife, work out all air bubbles in patch. Work from center to edge, pressing patch firmly against structure. Allow patch to cure for 15 to 20 minutes.
m. As soon as patch begins to set up, but while still rubbery, take a sharp knife and cut away extra cloth and mat. Cut an outside edge of feathering. Strip cut edges of structure. Do this before cure is complete, to save extra sanding. Allow patch to cure overnight.
n. 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.
o. Mix catalyzed resin and work into patch with fingers. Smooth carefully and work into any crevices.
p. Cover with cellophane and squeegee smooth. Allow to cure completely before removing cellophane. Let cure and resand.
q. 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.

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GENERAL (CONT.)

4. Thermoplastic Repairs

The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane. A list of material needed to perform these repairs is given along with suggested suppliers of the material. Common safety precautions should be observed when handling some of the materials and tools used while making these repairs.

CHART 5101. THERMOPLASTIC REPAIR LIST OF MATERIALS

ITEMS	DESCRIPTIONS	SUPPLIERS
Buffing and Rubbing Compounds	Automotive Type - DuPone #7	DuPont Company Wilmington, DE 1998
	Ram Chemical #69 x 1	Ram Chemicals Gardena, CA 90248
	Mirror Glaze #1	Mirror Bright Polish Co., Inc. Irvin, CA 92713
Cleaners	Fantastic Spray Perchlorethylene VM&P Naptha (Lighter Fluid)	Obtain From Local Suppliers
ABS-Solvent Cements	Solarite 11 Series	Solar Compounds Corp. Linden, NJ 07036
Solvents	Methylethyl Ketone Methylene Chloride Acetone	Obtain From Local Suppliers
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp. Linden, NJ 07
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick From 1/2 in. dia. 3 in. long	Sears Roebuck & Co., or most hardward stores
Hot Air Gun	Temp. Range 300° to 400°F	Local Suppliers

a. Surface Preparation:

(1) Surface dirt and paint if applied must be removed from item being repaired. Household cleaners have proven most effective in removing surface dirt.

(2) Preliminary cleaning of damaged area with perchlorethylene or VM&P Naptha will generally insure a good bond betweenn epoxy compounds and thermoplastic.

GENERAL (CONT.)

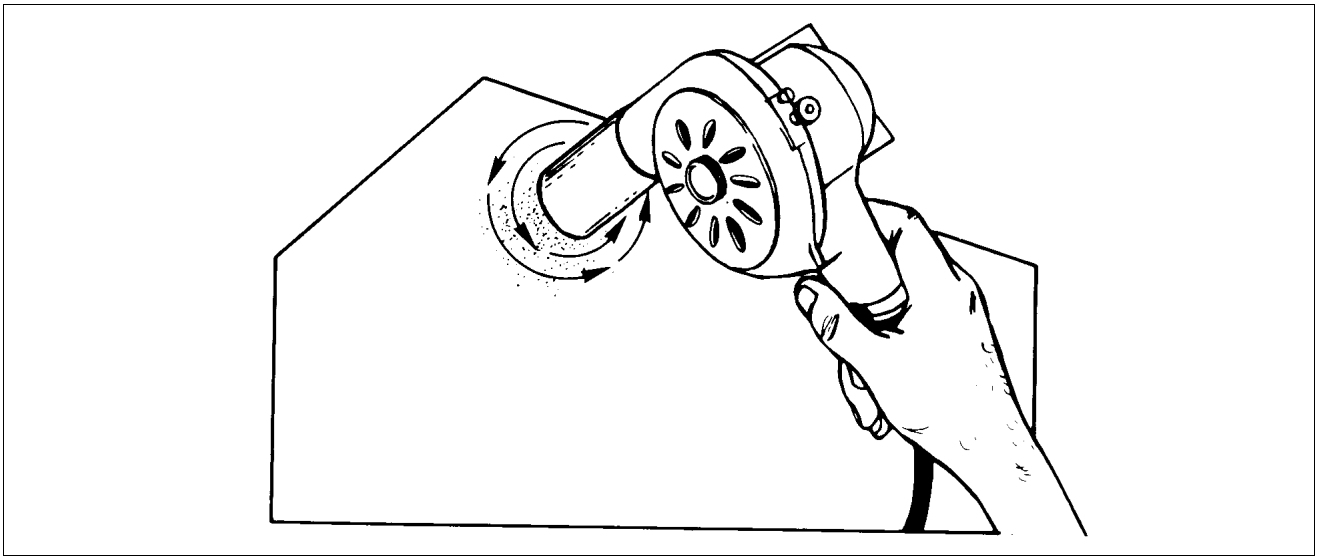

Figure 51-2. Surface Scratches, Abrasions or Ground-in-Dirt

b. Surface Scratches, Abrasion or Ground-in-Dirt: (Refer to Figure 51-2.)

(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 temperature range of 300 to 400F. Use care not to overheat material. Hold nozzle of gun about 1/4 of an inch away from surface and apply heat with a circular motion until area is sufficiently soft to remove dirt particles.
(3) Thermoplastic will return to its original shape upon cooling.

c. Deep scratches, Shallow Nicks and Small Holes: (Less than 1 inch diameter.) (See Figure 51-3.)

(1) Solvent cements will fit virtually any of these applications. If 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 desired paste-like consistency is achieved.
(2) This mixture is then applied to damaged area. Upon solvent evaporation, hard durable solids remaining can easily be shaped to desired contour by filing or sanding.
(3) Solvent adhesives are not recommended for highly stressed areas, on 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 bonding surface with sandpaper and by utilizing as much surface area for bond as possible.
(6) Patching compound is mixed in equal portions on a hard flat surface using a figure eight motion. Damaged area is cleaned with perchlorethylene or VM&P Naptha prior to applying compound. (Refer to figure 51-4.)
(7) A mechanical sander can be used after compound is cured, providing sander is kept in constant motion to prevent heat buildup.

GENERAL (CONT.)

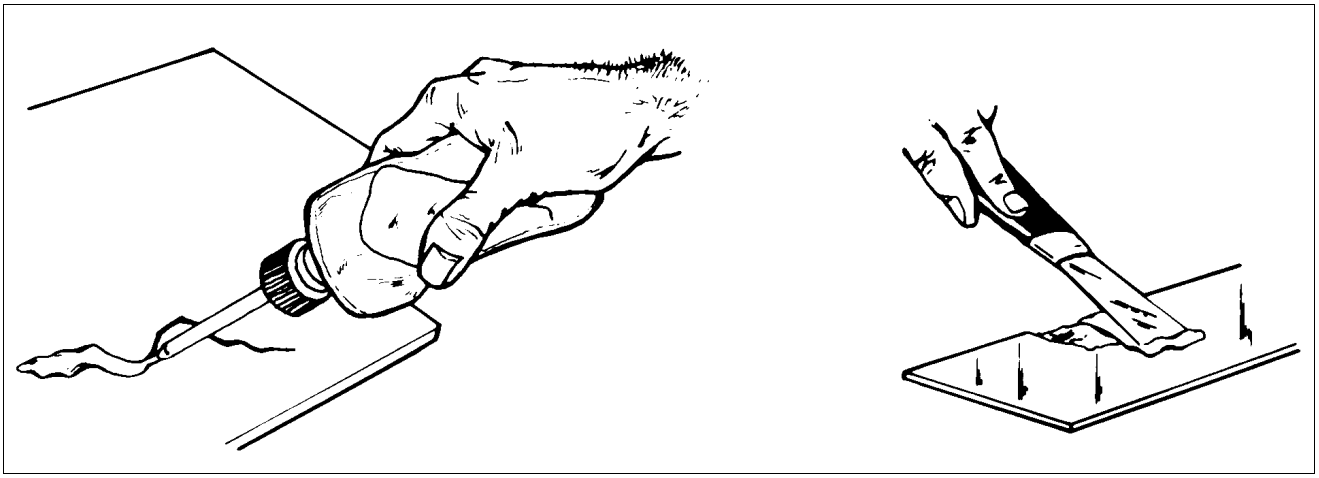

Figure 51-3. Deep Scratches, Shallow Nicks and Small Holes

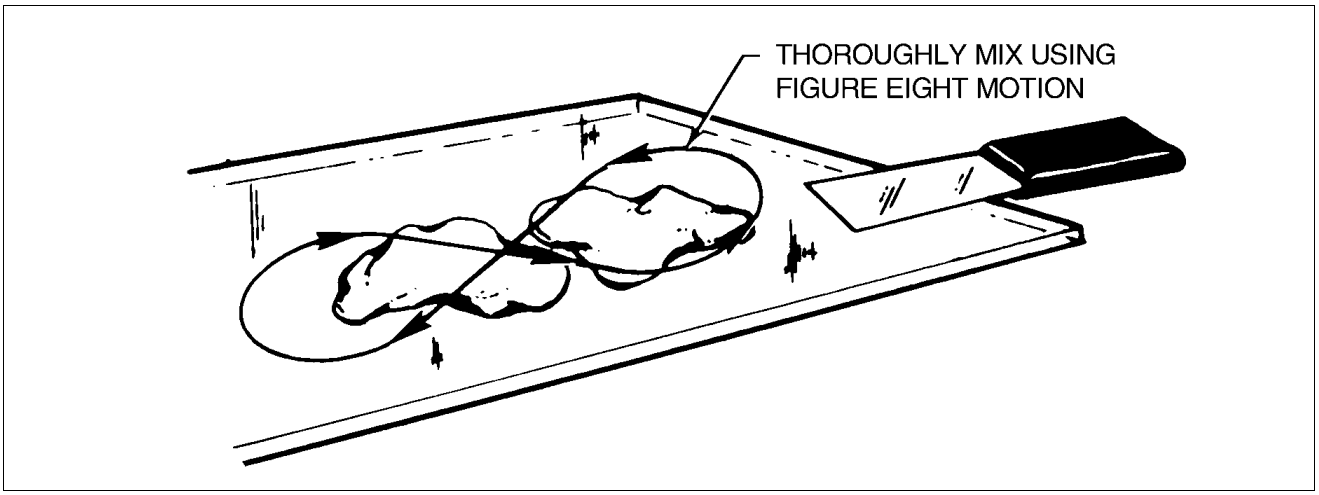

Figure 51-4. Mixing of Epoxy Patching Compound

(8) For repairs in areas involving little or no shear stress, 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 material where high stress is apparent or thin walled sections are used, welding method is suggested.

(10) Welding method requires a hot air gun and ABS rods. To weld, gun should be held to direct flow of hot air into fusion (repair) zone, heating damaged area and rod simultaneously. Gun should be moved continuously in a fanning motion to prevent discoloration of material. Pressure must be maintained on rod to insure good adhesion. (Refer to Figure 51-5.)

(11) After repair is completed, sanding is allowed to obtain surface finish of acceptable appearance.

GENERAL (CONT.)

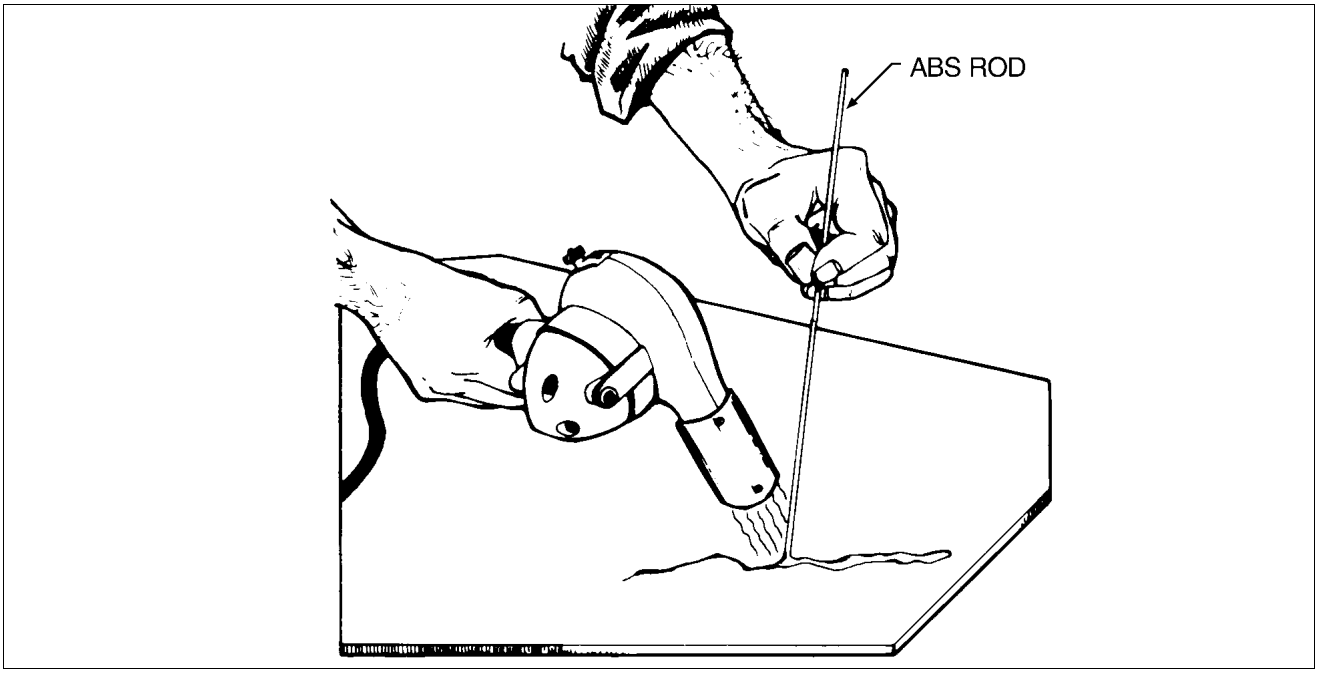

Figure 51-5. Welding Repair Method

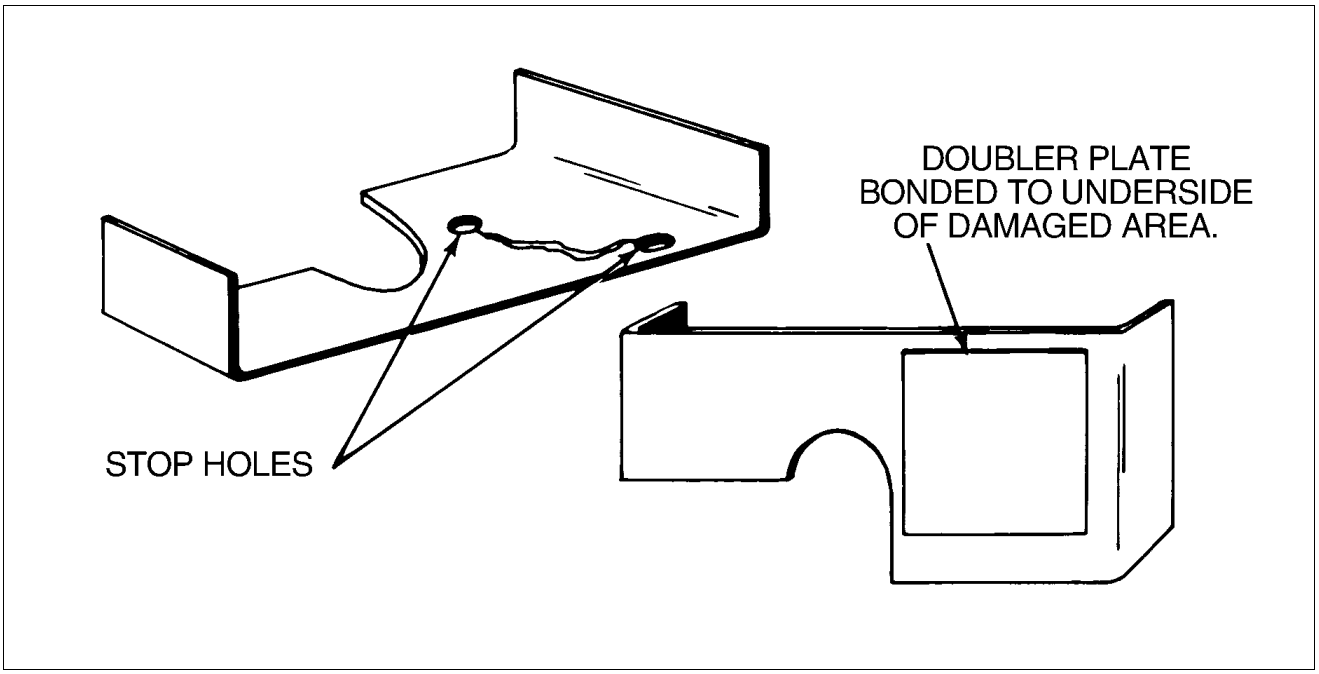

Figure 51-6. Repairing of Cracks

GENERAL (CONT.)

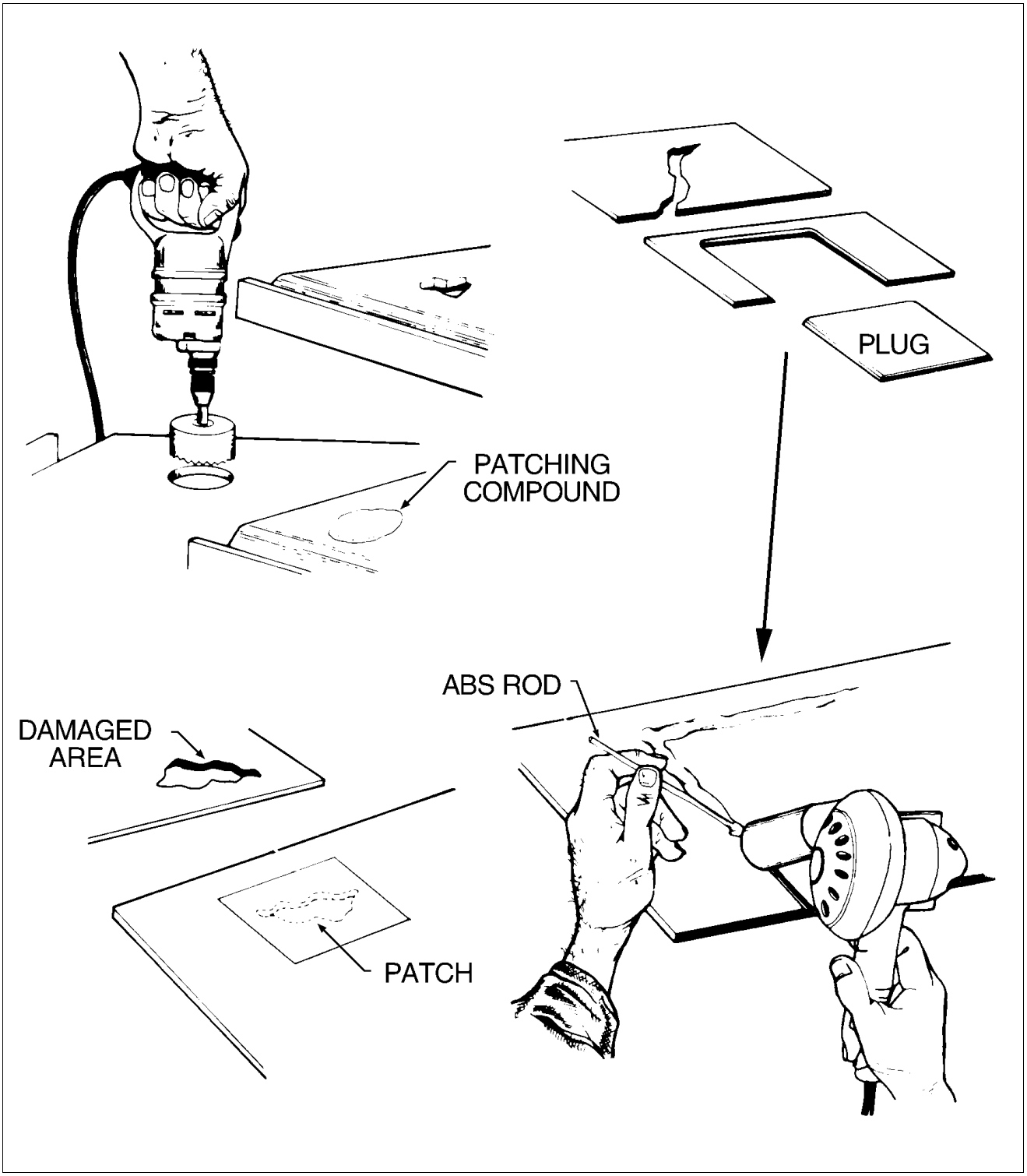

Figure 51-7. Various Repairs

GENERAL (CONT.)

d. Cracks: (Refer to Figure 51-6.)

(1) Before repairing a crack in thermoplastic part, first determine what caused crack and alleviate that condition to prevent it recurring after repair is made.
(2) Drill small stop holes at each end of crack.
(3) If possible, a double plate should be bonded to reverse side of crack to provide extra strength to part.
(4) Crack should be V-grooved and filled with repair material, such as solvent cement, hot melt adhesive, epoxy patching compound or hot air welded, whichever is preferred.
(5) Affter repair has cured, it may be sanded to match surrounding finish.

e. Repairing Major Damage: (Larger than 1 inch in diameter.) (Refer to Figure 51-7.)

(1) If possible a patch should be made of same material and cut slightly larger than section being repaired.
(2) When appearances are important, large holes, cracks, tears, etc, should be repaired by cutting out damaged area and replacing it with a piece of similar material.
(3) When cutting away damaged area, under cut perimeter and maintain a smooth edge. Patch and/or plug should also have a smooth edge to insure a good fit.
(4) Coat patch with solvent adhesive and firmly attach it over damaged area.
(5) Let patch dry for approximately one hour before any additional work is performed.
(6) Hole, etc, is then filled with repair material. A slight overfilling of repair material is suggested to allow for sanding and finishing after repair has cured. If patching compound is used, repair should be made in layers, not exceeding a 1/2 inch in thickness at a time, thus allowing compound to cure and insuring a good solid buildup of successive layers as required.

f. Stress Lines: (Refer to Figure 51-8.)

(1) Stress lines produce a whitened appearance in a localized area and generally emanate from severe bending or impacting of material. (Refer to Figure 51-9.)
(2) To restore material to its original condition and color, use a hot air gun or similar heating device and carefully apply heat to affected area. Do not overheat material.

g. Painting the Repair:

(1) An important factor in obtaining a quality paint finish is proper preparation of 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 waer.
(3) Paint used for coating thermoplastic can be either lacquers or enamels depending on which is preferred by repair facility or customer. (See Note.)

— Note —

It is extremely important that solvent formulations be considered when selecting a paint, because not all lacquers or enamels can be used satisfactorily on thermoplastics. Some solvents used in paints can significantly affect and degrade 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.

GENERAL (CONT.)

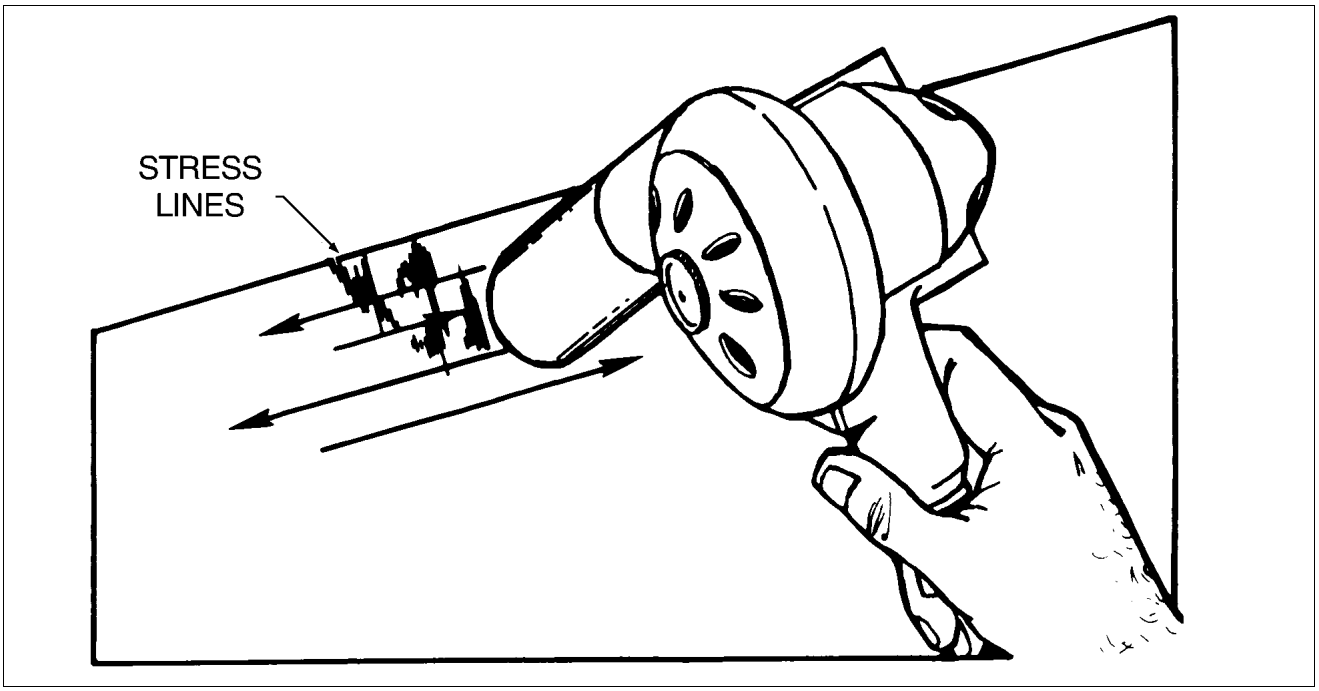

Figure 51-8. Repair of Stress Lines

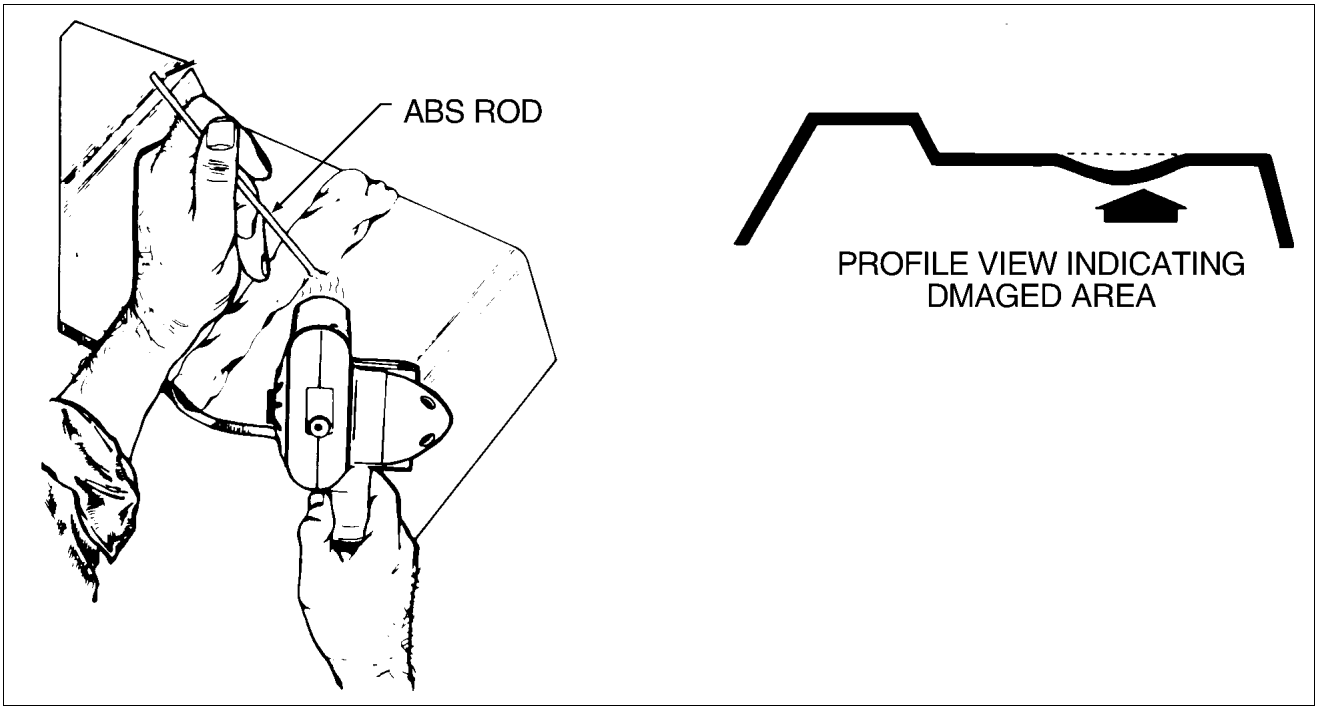

Figure 51-9. Repair of Impact Damage

GENERAL (cont.)

C. Safety Walk Repair

1. Pressure Sensitive Safety Walk

a. Surface Preparation For Pressure Sensitive Safety Walk

— Note —

Areas to which pressure sensitive safety walk is to be installed must be free from all contaminates and no moisture present.

If liquid safety walk is installed the area must be prepared as follows:

(1) Area must be masked off to protect painted surfaces.
(2) Apply suitable stripper MEK Federal Spec. TT-M-261, U.S. Rubber No. 3339 to windwalk compound. As compound softens remove by using putty knife or other suitable tool.
(3) Area must be clean and dry prior to painting.
(4) Prime and paint area.

b. Application of Pressure Sensitive Safety Walk

— Note —

Newly painted surfaces shall be allowed to dry for 2.5 hours minimum prior to application of safety walk.

— Note —

Wipe area with a clean dry cloth to insure that no moisture remains on surface. Do not apply when surface temperature is below 50F.

(1) Peel back full width of protective liner approximately 2 inches from leading edge of safety walk.
(2) Apply safety walk to wing area, begin at leading edge, insure proper alignment and position from wing lap.
(3) Remove remaining protective liner as safety walk is being applied from front to back of wing area.
(4) Roll firmly with a long handled cylindrical brush in both lengthwise directions. Make sure all edges adhere to wing skin.
(5) Install and rivet leading edge retainer.

GENERAL (cont.)

2. Liquid Safety Walk

These airplanes were delivered from the factory with Pressure Sensitive Safety Walk installed. Use of exisiting shelf stocks of Liquid Safety Walk Compound is an authorized replacement option.

a. Surface Preparation

(1) Clean all surfaces with a suitable cleaning solvent to remove dirt, grease and oils. Solvents may be applied by dipping, spraying or mopping.
(2) Insure that no moisture remains on surface by wiping with a clean, dry cloth.
(3) Outline area to which liquid safety walk compound is to be applied, and mask adjacent surfaces.

b. Product Listing For Liquid Safety Walk Compound

(1) Suggested Solvents:

Safety Solvent per MIL-S-18718
Sherwin Williams Lacquer Thinner R7KC120
Glidden Thinner No. 207

(2) Safety Walk Material:

Walkway Compound and Matting Nonslip (included in Piper Part No. 179872)

c. Application Of Liquid Safety Walk Compound

— Note —

Newly painted surfaces shall be allowed to dry for 2.5 hours minimum prior to application of safety walk.

— Note —

Liquid safety walk compound shall be applied in an area free of moisture for a period of 24 hours minimum after application. Do not apply when surface to be coated is below 50°F. Apply liquid safety walk compound as follows:

(1) Mix and thin liquid safety walk compound in accordance with manufacturer's instructions on container.
(2) Coat specified surfaces with a smooth, unbroken film of liquid safety walk compound. A nap type roller or a stiff bristle brush is recommended, using fore and aft strokes.
(3) Allow coating to dry for 15 minutes to one hour before recoating or touchup, if required after application of initial coating.
(4) After recoating or touchup, if one, allow coating to dry for 15 minutes to one hour before removing masking.

— Note —

Coated surface shall not be walked on for six hours minimum after application of final coating.

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CHAPTER

52

DOORS

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CHAPTER 52 - DOORS

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL

A. Description

These airplanes are equipped with a forward cabin (or crew) door located on the right side of fuselage over the wing and an aft cabin (or passenger door) on the left side of fuselage aft of the wing. A rear baggage compartment door adjoins the passenger door. The forward baggage compartment door is located on right side of fuselage at station 41.1.

B. Replacement of Door Snubber Seals

Door snubber seals are incorporated in the door jambs to improve door sealing. The latching mechanism used in the forward cabin door in HP S/N's 3246018 & up and TC S/N's3257001 & up, however, improved sealing sufficiently to allow the removal of snubber seals from those doors.

— 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

1. To replace door snubber seal, proceed with the following steps:
   a. Remove windlace retainers, "roll" back windlace (tape to secure) out of way, remove all scuff plates and disconnect door holder.
   b. Remove all striker plates except where shown in Figure 1, Section A-A.
   c. 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.
2. Install snubber as follows:
   a. 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.
   b. Mask jamb as shown in View E of Figure 52-1.
   c. Apply adhesive to door jamb as shown in View E of Figure 52-1.
   d. Apply adhesive to inside surface of snubber.
   e. 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.

   f. 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.
   g. 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 52-1.
   h. Check that doors close properly and readjust as necessary to achieve a flush fit. Latching effort must not have increased.
   i. With all hardware and plates installed, coat snubbers with silicone.

GENERAL (Cont.)

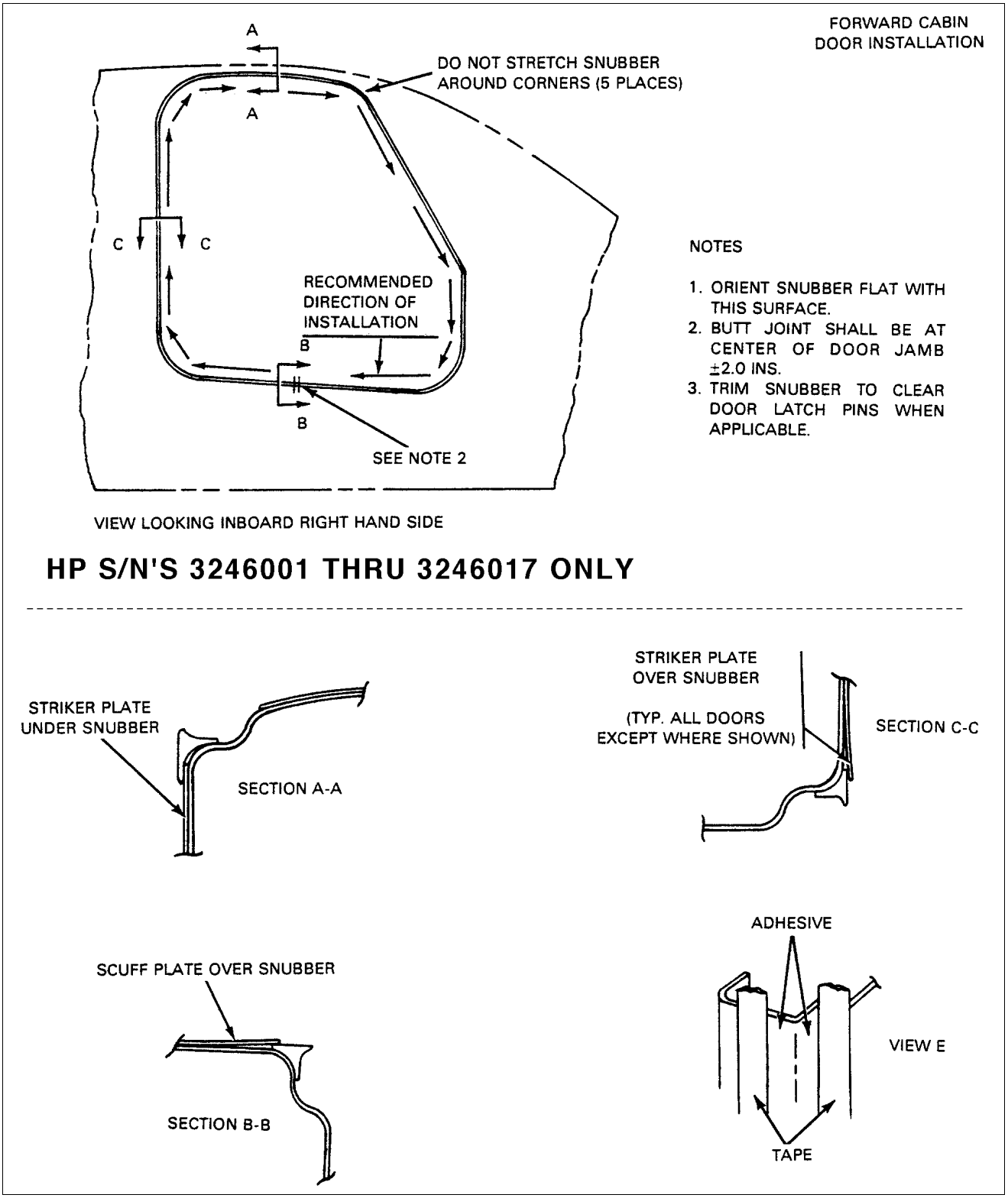

Figure 52-1. Snubber Installation (1 of 3)

GENERAL (Cont.)

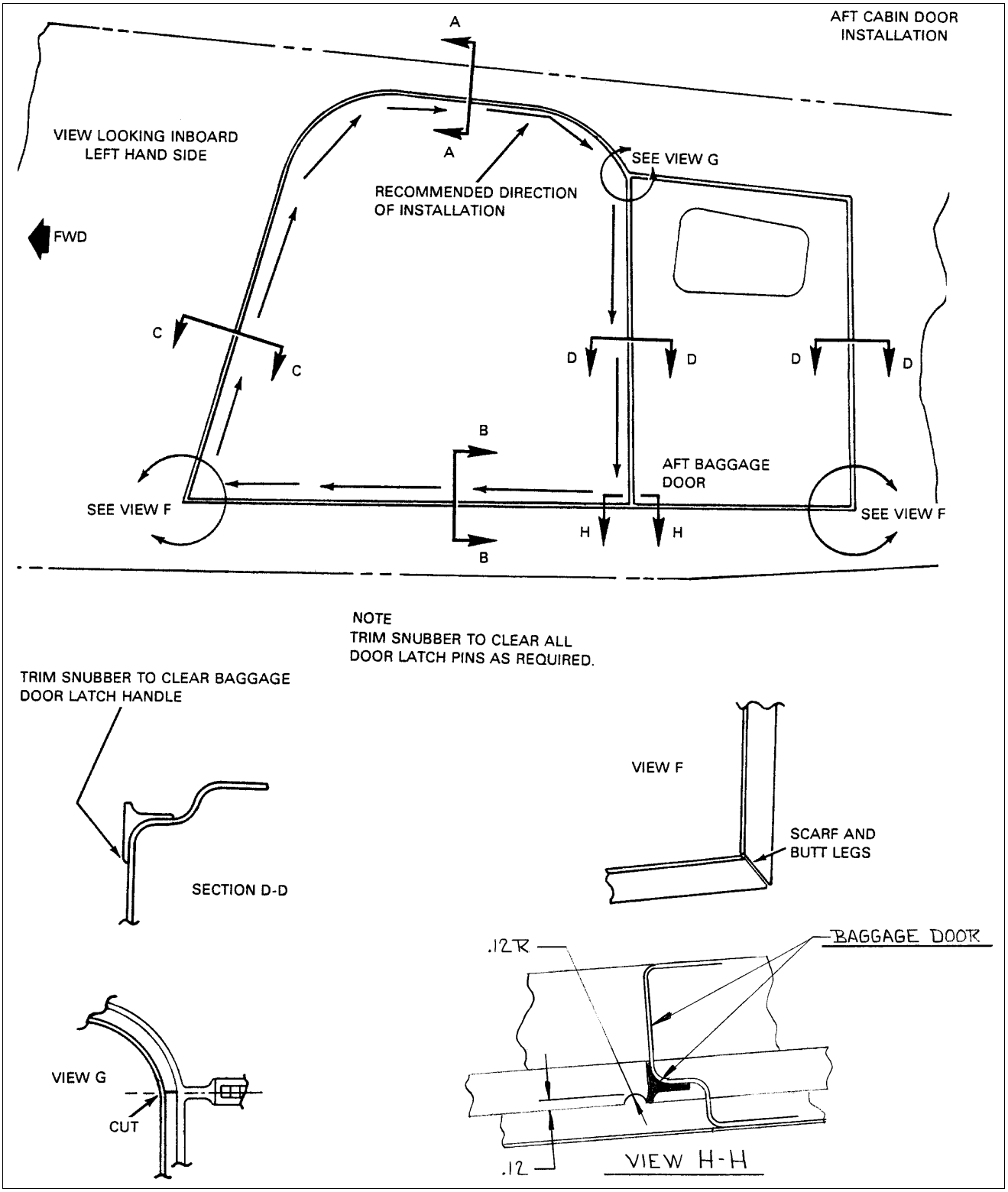

Figure 52-1. Snubber Installation (2 of 3)

GENERAL (Cont.)

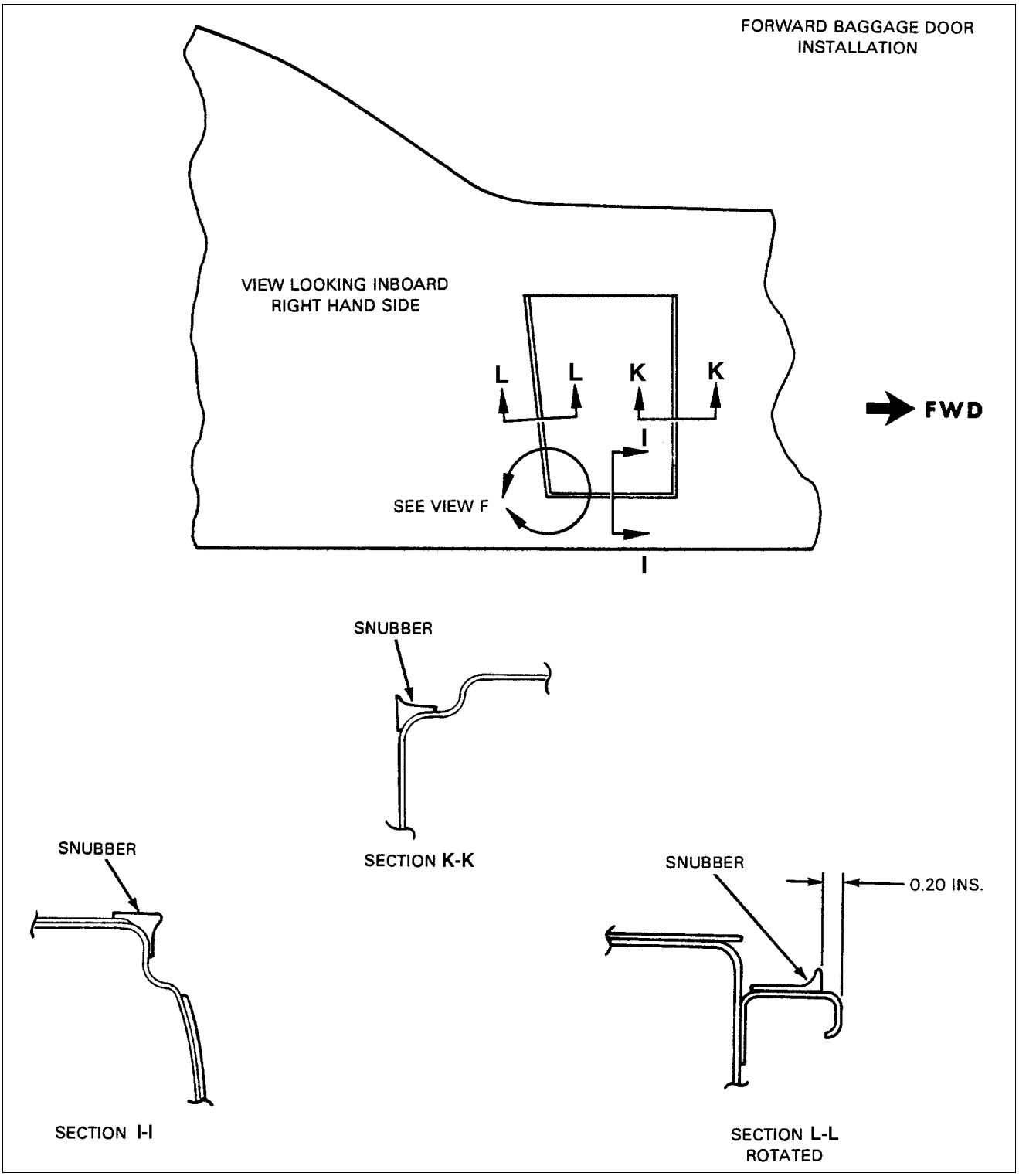

Figure 52-1. Snubber Installation (3 of 3)

PASSENGER / CREW

A. Cabin Doors

1. Removal of Door

   a. Remove the clevis bolt, washer and bushing from the door holder assembly.
   b. Remove cotter pins, clevis pins and washers from door hinges.
   c. Remove the door from the airplane.

2. Installation of Door

   a. Insert the door into position and install the washers, clevis bolts and cotter pins on the door hinges.
   b. For adjustment of door, refer to Adjustment of Door, below.
   c. Hook up and install the clevis bolt, bushing and washer into the door holder assembly.

3. Adjustment of Door

   a. To acquire the proper vertical adjustment of the door, insert the necessary washer combination between the cabin door hinge and fuselage bracket assembly.
   b. 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.
   c. To ensure long life of door seals and improve sealing characteristics, lubricate with a dry lubricant in a spray can.

B. Door Locks

1. Removal of Door Lock Assembly

   a. Remove the door trim upholstery by removing the attachment screws.
   b. Loosen the nut on the lock assembly and remove the lock by turning it sideways.

2. Installation of Door Lock Assembly

   a. Install the lock in the door by turning it sideways and placing it through the opening provided.
   b. Replace the nut on the back of the lock assembly and tighten.
   c. Replace the door trim upholstery and secure with the attachment screws.

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PASSENGER / CREW (cont.)

C. Upper Door Latch on Forward Cabin Door - Adjustment (Refer to Figure 52-2)
(TC S/N's 3257001 & up and HP S/N's 3246018 & up)

— CAUTION —

DO NOT LUBRICATE LOCK PIN / LOCK PIN TEFLON GUIDE BEARING.

1. Remove the door trim upholstery by removing the attachment screws.
2. Remove upper cabin door access cover on inside of door to gain access to the upper door latch assembly.
3. Remove lockwire from nut at aft end of pin assembly.
4. Back nut off from lock plate.
5. Move lock plate to disengage from aft pin.
6. Adjust pin so that, in extended position, rigging groove on pin aligns with forward face of pin receptacle on aft door frame.
7. Engage lock plate, making sure safety wire tab on lock plate is facing inboard.
8. Tighten nut.
9. Install safety wire.

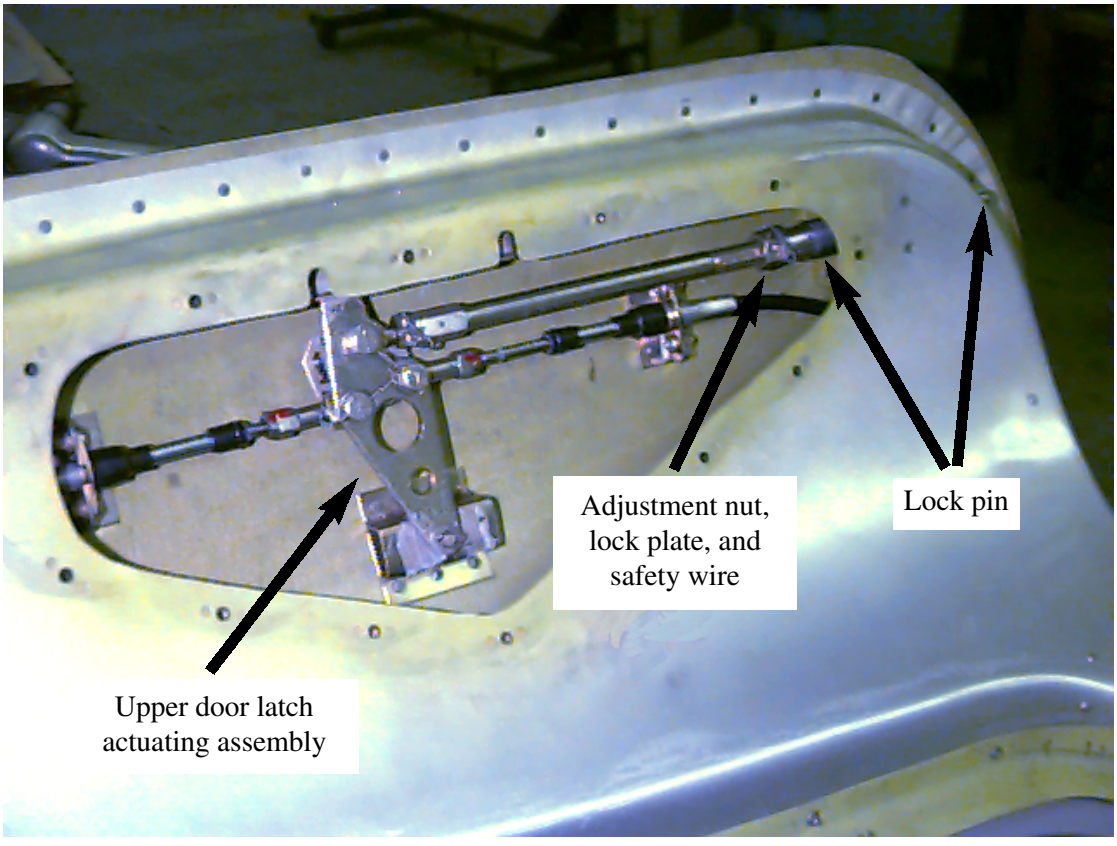

Figure 52-2. Adjustment of Upper Door Latch on Forward Cabin Door

PASSENGER / CREW (cont.)

D. Door Latch Mechanism on Lower Aft Door

1. Removal

a. 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.
b. Disconnect the latch pull rod from the inside door handle.
c. Remove the complete latch mechanism.

2. Installation

a. Place the latch assembly into position on the door.
b. Connect the latch pull rod to the inside door handle.
c. Replace the screws that attach the latch plate and mechanism to the door. Install the door trim upholstery and secure with screws.

3. Adjustment

To adjust the door latch, loosen the screws on the striker plate, make necessary adjustment, and retighten the screws.

E. Door Safety Latch (Upper Aft Door (and, in HP S/N's 3246001 thru 3246017 only, Upper Fwd Door))

1. Removal

a. Remove the inside and outside handles and the screws holding the pan on the inside of the door.
b. Remove the pan and pull the latch assembly through the opening on the door. With the aft door only, pull the pan and latch forward to ensure the locking pin assembly comes free from its receptacle and exits the opening without bending.

2. Installation

a. Place the latch assembly into position for installation. With the aft door only, insert the locking pin assembly first and guide it into its receptacle as the latch assembly reaches its final position.
b. Replace the pan and install the screws and handles.
c. Check the latch assembly for operation and be certain that it is free of rubbing on the trim panels.

3. Adjustment

a. To adjust the door safety latch, remove the two screws from latch plate found at the top of the door opening.
b. Remove the plate and turn the loop assembly in or out to make necessary adjustments.
c. Replace the latch plate and secure with the two attachment screws.
d. In the aft door only, the locking pin may be adjusted through the opening near the locking pin receptacle.

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CARGO

A. Baggage Doors

1. Removal

With door open remove hinge pin from hinge and remove the door.

2. Installation

Place door in position so that hinge halves are properly matched and install hinge pin. It will not be necessary to replace hinge pin with a new pin if it is free of bends and wear.

B. Baggage Door Locks

1. Removal

a. With door open remove nut from back of lock assembly by use of a special made wrench. (This tool may be fabricated from dimensions given in Figure 95-3.)
b. Remove lock assembly through front of door.

2. Installation

a. Place lock into position for installation.
b. Install nut on lock assembly and tighten with use of a special wrench.

C. Baggage Door Hinges

1. Removal

a. Remove door from airplane as described in Removal of Baggage Door.
b. Remove hinge half from airplane or door by drilling out rivets and removing hinge.

2. Installation

a. Place hinge halves together and install hinge pin.
b. Install door into closed position and drill two end rivet holes and install rivets.
c. Operate door and check for proper fit and installation. Drill remaining holes and install rivets.

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GRIDS 3K24 THRU 3L24
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AIRPLANE MAINTENANCE MANUAL

CARD 4 OF 5

PA-32R-301

Saratoga II HP

(S/N's 3246001 AND UP)

PA-32R-301T

Saratoga II TC

(S/N's 3257001 AND UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-879 **REVISED: JULY 15, 1999**

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AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-879) published June 24, 1996 and reissued July 1, 1997 are as follows:

Revision	Publication Date	Aerofiche Card Effectivity
ORG950712	June 24, 1996	1, 2, 3, and 4
CR970701	July 1, 1997	1, 2, 3, 4, and 5
PR990715*	July 15, 1999	1, 2, 3, 4, and 5

*** PARTIAL REVISION OF MAINTENANCE MANUAL 761-879**

Revisions appear in all five cards of this set. Remove the previous Aerofiche card set and replace it with the five card set dated July 15, 1999.

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

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INTRODUCTION

TABLE OF CONTENTS / EFFECTIVITY

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INTRODUCTION

The PIPER PA-32R-301/301T Saratoga II HP and TC Maintenance Manual 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-32R Parts Catalog P/N 761-880, 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.

Be sure to supply the correct serial number information in any correspondence or communication concerning your airplane.

EFFECTIVITY

This maintenance manual is effective for PA-32R-301 Saratoga II HP airplanes as follows:

Model Year	Serial Numbers
1995	3246001 thru 3246017
1996	3246018 thru 3246059
1997	3246060 thru 3246087
1998	3246088 thru 3246125
1999	3246126 and up

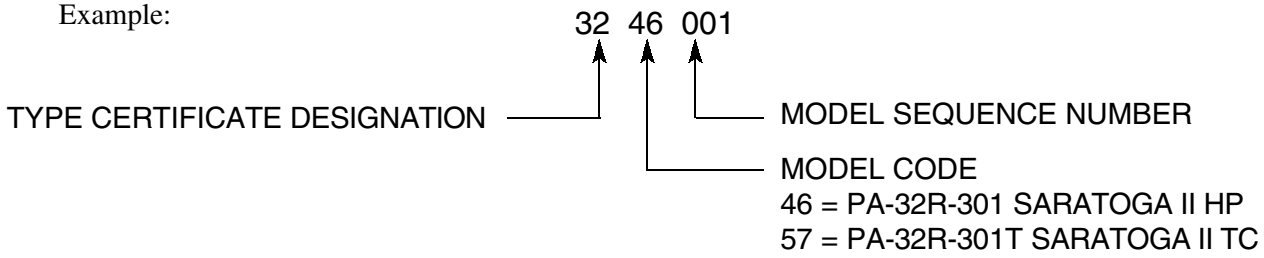
EFFECTIVITY (cont.)

This maintenance manual is effective for PA-32R-301T Saratoga II TC airplanes as follows:

Model Year	Serial Numbers
1997	3257001 thru 3257027
1998	3257028 thru 3257075
1999	3257076 and up

SERIAL NUMBER EXPLANATION

Example:



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

PAGINATION

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

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 List of Illustrations for all fiche in this set.
(3) A complete List of Charts for all fiche in this set.

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 along the left-hand margin of the page opposite only that portion of the printed matter that was changed.

A vertical line 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.

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

Original and Reissue:	None	
Revisions:	First:	Revision Indication (1R Month-Year)
	Second:	Revision Indication (2R Month-Year)
	Subsequent revisions follow with consecutive numbers such as 3R, 4R, etc.	
Added Subject:		Revision Identification, (A Month-Year)
Deleted Subject:		Revision Identification, (D Month-Year)

INDEXING

Each System/Chapter begins with an individual Table of Contents.

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.

SUPPLEMENTARY PUBLICATIONS

The following is a list of publications providing servicing, overhaul and parts information on various components on the PA-32R-301/301T airplanes, which you should use to supplement this manual.

A. Piper Publications:

(1) Parts Catalog - P/N 761-880

(2) Progressive Inspection Manuals (50 hour):

P/N 761-881 (pending) for the SARATOGA II HP (S/N's 3246001 & up), and

P/N 761-896 (pending) for the SARATOGA II TC (S/N's 3257001 & up).

(3) Periodic Inspection Report Forms:

P/N 230-1047 for the SARATOGA II HP (S/N's 3246001 & up), and

P/N 230-2047 for the SARATOGA II TC (S/N's 3257001 & up).

B. Vendor Publications

— WARNING —

THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT.

The following is a list of the vendor publications, used in conjunction with the servicing, overhaul and parts information on various components.

AIR CONDITIONING COMPRESSOR:

Vendor:

York Industries
1750 Toronita Street
York, Pennsylvania 17402
(717) 846-1988

(or)

Sanden International (USA), Inc.
601 South Sanden Blvd.
Wylie, TX 75098-4999
(214) 442-8400

ALTERNATOR

Vendor:

Electro Systems
Airport Complex
P. O. Box 273
Fort Deposit, Alabama 06032
(205) 227-8306

AUTOFLIGHT:

Vendor:

AlliedSignal
General Aviation Avionics
Product Support Departmemt
400 North Rogers Road M/D #18
Olathe, Kansas 66062-1212

BRAKES:

Vendor:
Parker Hannifin Corp.
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
(216) 871-6424

EMERGENCY LOCATOR TRANSMITTER:

Vendor:
Artex Aircraft Supplies
P. O. Box 1270
10714 S. Township Rd.
Canby, Oregon 97013
(503) 266-3959

ENGINE:

Vendor:
Textron Lycoming
652 Oliver Street
Williamsport, PA 17701
PH - (717) 323-6181
FAX - (717) 327-7101

Overhaul Manual: DIRECT DRIVE MODELS - P/N 60294-7
Parts Catalog: IO-540- ..... - K1G5, ... ENGINES - P/N PC-615
TIO-540-AH1A ENGINES - P/N PC-615-12
Operators Handbook: O-540, IO-540 SERIES - P/N 60297-10
TIO-540 Series - P/N 60297-23

ELECTRIC FUEL PUMP:

Vendor:
Parker Hannifin Corp.
Airborne Division
P.O. Box 4032, 711 Taylor Street
Elyria, Ohio 44036
(216) 323-4676

(or)

Weldon Pump
640 Golden Oak Parkway
Oakwood Village, OH 44146
(216) 232-2282

FUEL CELLS:

Maintenance:
LORAL, Engineered Fabrics
669 Goodyear Street
Rockmart, Georgia 30153-0548

(or)

Goodyear Aerospace Corp.
Engineered Fabrics Division
Rockmart, Georgia 30153

GEAR LOCKING ACTUATORS, NOSE GEAR DOOR ACTUATOR, HYDRAULIC PUMP, AND ALL HYDRAULIC COMPONENTS:

Vendor:
Parker Hannifin Corp.
1160 Center Road
Avon, Ohio 44011
(216) 871-6424

HI-LOK FASTENERS AND TOOLS:

Vendor:
Hi-Shear Corporation
2600 Skypark Drive
Torrance, California 90509
(213) 326-8110

MAGNETOS:

Vendor:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 530 Blackhawk Park Ave. Rockford, IL 61104	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	

NAVIGATION/STROBE LIGHTS STANDBY/MAP LIGHTS:

Vendor:	Whelen Engineering Co. Inc. Deep River, Conneticut (203) 526-5308

OXYGEN SYSTEM:

Vendor:	Scott Aviation 2225 Erie Street Lancaster, New York 14086 (716) 683-5100

PROPELLER:

Vendor:	Hartzell Propellor Inc. One Propellor Place Piqua, OH 45356-2634	PH - (513) 778-4200 FAX - (513) 778-4321
Overhaul Instructions:	HARTZELL COMPACT CONSTANT SPEED and FEATHERING PROPELLER - P/N 117-D	

VACUUM PUMP, VACUUM REGULATORS, DEICER PUMP:

Vendor:	Parker Hannifin Corp. 1160 Center Road Avon, Ohio 44011 (216) 871-6424

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STABILIZERS

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CHAPTER 55 - STABILIZERS

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STABILATOR

A. Removal and Installation of Stabilator (Refer to Figure 55-1)

— CAUTION —

AT EACH REMOVAL / INSTALLATION OF THE STABILATOR, CONDUCT ATTACH BRACKETS CORROSION CONTROL INSPECTION AS SPECIFIED IN PARAGRAPH D, BELOW.

1. Remove the tail cone assembly.
2. Relieve the tension on the trim cable and remove the trunnion assembly.
3. From inside the fuselage, disconnect the two stabilator control cables from the stabilator balance arm assembly.
4. Remove the two hinge bolts at the pivot points and remove the stabilator as a complete assembly.
5. Reinstall the stabilator in reverse of removal instructions. Tension trim cable and stabilator control cables to specifications given in Figure 27-20.

B. Checking Control Surfaces Free Play

The following checks are recommended before balancing to ascertain amount of free play in stabilator trim tab and aileron:

1. Stabilator: Check the stabilator for any free play at its attachment points by grasping each half near the tip and gently trying to move it up and down, fore and aft, and in and out. No play is allowed.
2. Stabilator Trim Tab: Set the stabilator trim tab in neutral position. This neutral position is determined with the airplane properly rigged per instructions given in Chapter 27 of this Service Manual and the trim indicator at its neutral position. Obtain a straightedge long enough to extend from the ground up to a few inches above the trim tab trailing edge. Place the straightedge next to the trim tab inboard (center) trailing edge, secure the stabilator in neutral and grasping the tab, gently move it up and down, mark the limit of tab free play on the straightedge. The overall travel (free play) must not exceed 0.15 of an inch. The use of a dial indicator and fixed stand is recommended.

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STABILATOR (Cont.)

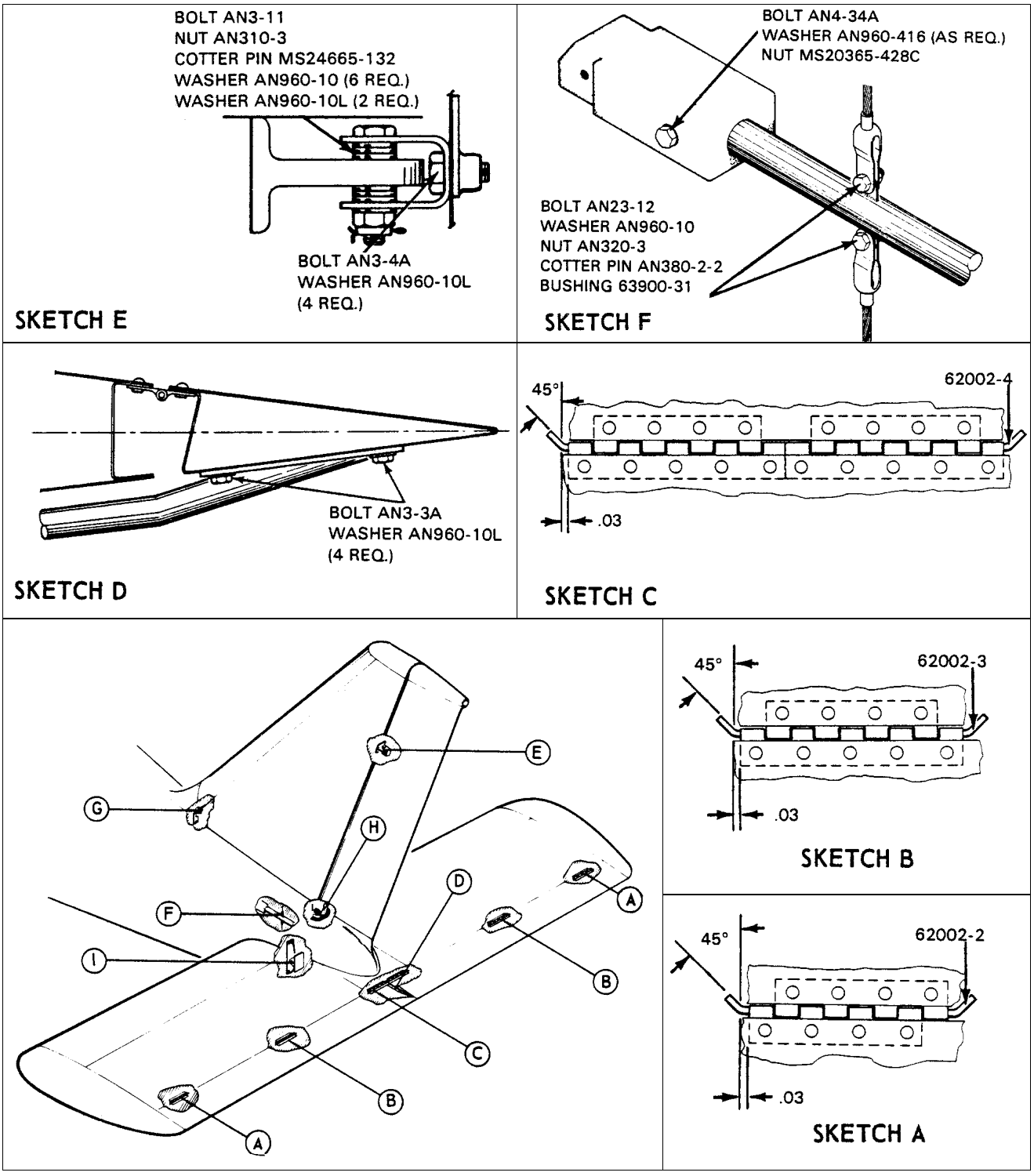

Figure 55-1. Empennage Group (1 of 2)

STABILATOR (Cont.)

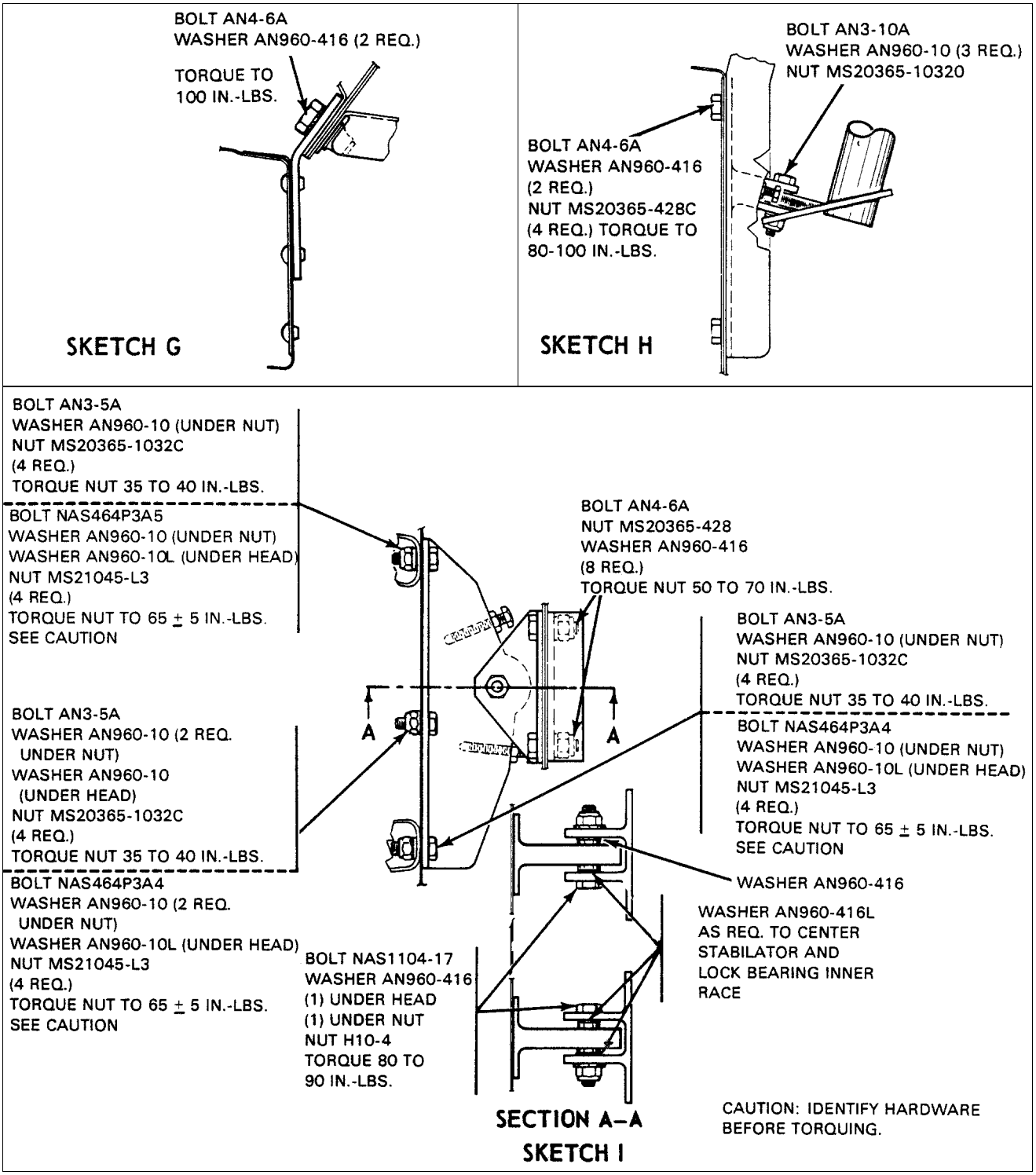

Figure 55-1. Empennage Group (2 of 2)

STABILATOR (Cont.)

C. Balancing

1. Balancing Equipment (Refer to Figure 95-2)

Balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from centerline of control surface hinge pin. A suggested tool configuration is shown in Figure 95-2. Other tool configurations may be used, provided accuracy is maintained and recalibration capability is provided. The tool shown in Chapter 95 may be calibrated by placing it on the control surface to be balanced with balance points over control surface hinge centerline and balance bar parallel to cord line. Position trailing edge support to align tool with control surface cord line and secure in this position. Remove tool without disturbing trailing edge support and balance tool by adding weight to light end as required. (Movable weight must be at centerline.) Place tool on control surface perpendicular to hinge centerline. Read scale when bubble level has been centered by adjustment of movable weight.

— WARNING —

ALL CONTROL SURFACES THAT HAVE BEEN REPLACED, REPAINTED, OR REPAIRED, MUST BE REBALANCED ACCORDING TO THE PROCEDURES IN THIS MANUAL.

2. Balancing Stabilator (Refer to Figure 55-2)

To balance stabilator, assembly must be complete including trim tab, tab pushrod and end bearing, stabilator tips and all attaching screws. Before balancing, tape trim tab in neutral position with a small piece of tape. Place complete assembly on knife edge supports in a draft-free beam perpendicular to hinge centerline. Do not place tool on trim tab. Calibrate tool as described in Balancing Equipment. Read scale when bubble level has been centered by adjustment of movable weight and determine static balance limit. If static balance is not within limits given, 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.

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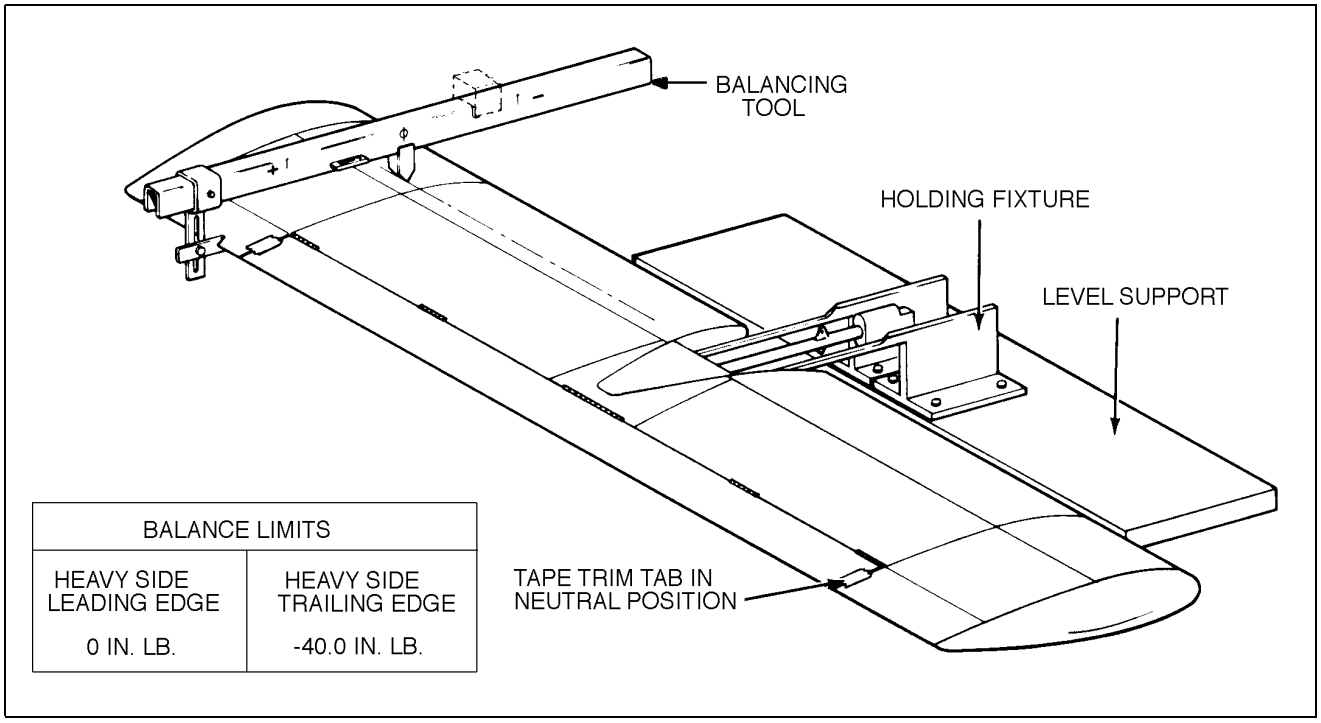
STABILATOR (Cont.)



BALANCE LIMITS	
HEAVY SIDE LEADING EDGE	HEAVY SIDE TRAILING EDGE
0 IN. LB.	-40.0 IN. LB.

Figure 55-2. Stabilator Balancing

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STABILATOR (Cont.)

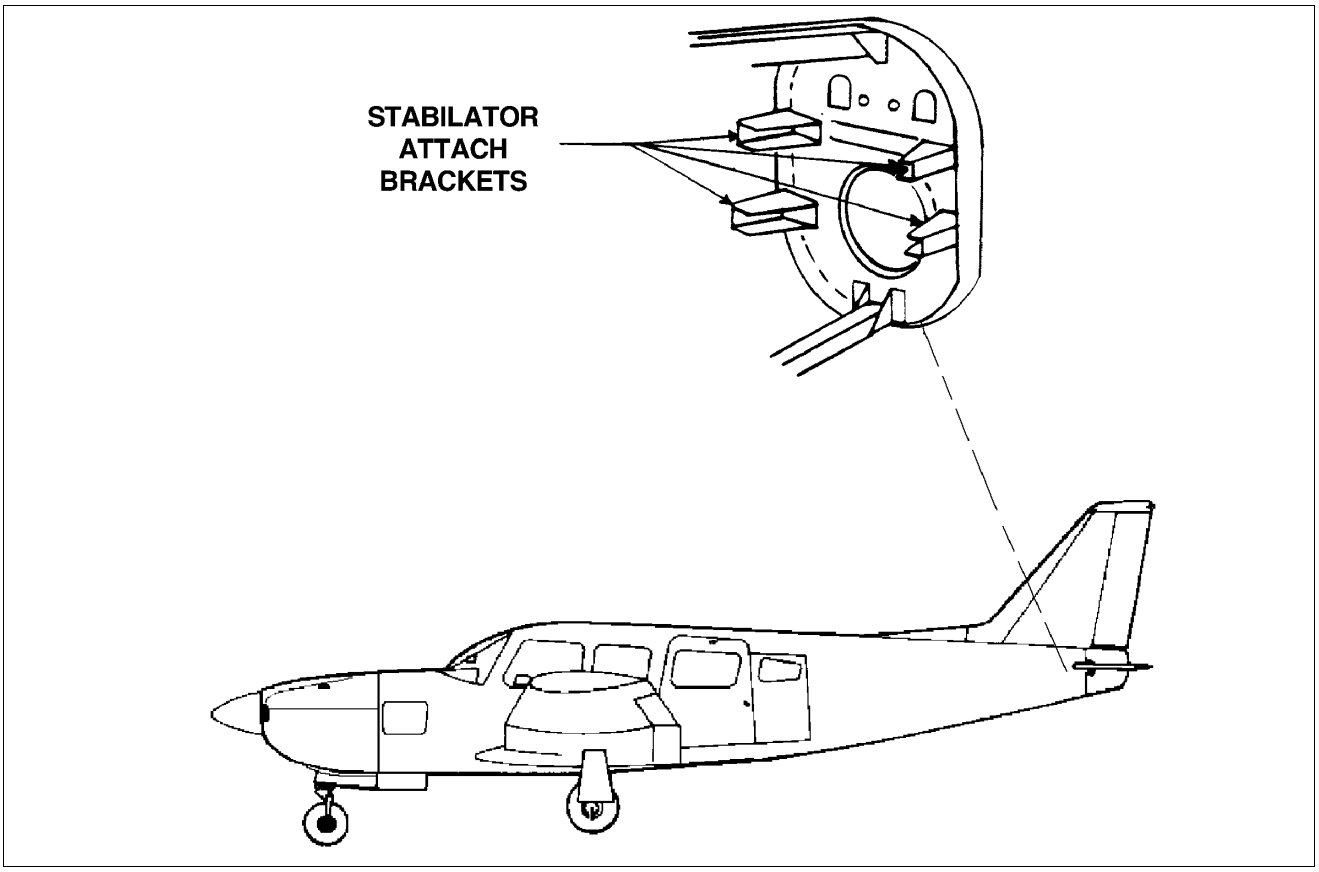

Figure 55-3. Stabilator Attach Brackets (Typical)

D. Stabilator Attach Brackets Corrosion Control Inspection (Refer to Figure 55-3)

During each annual inspection, use the following method to inspect stabilator attach brackets for rust and corrosion between the steel attach fittings and the adjacent fuselage structure. Take corrective action as required.

1. Remove upper and lower tail cone fairing assembly.
2. Remove the aft fuselage closeout plate assembly on the applicable models.
3. Inspect the steel stabilator attach fittings (4 places) and adjacent fuselage structure for the presence of rust and/or corrosion. (Refer to Figure 55-3)

— Note —

Refer to F.A.A. Advisory Circular AC43-4A, Corrosion. Control for Aircraft.

4. If rust and/or corrosion is present, repair or replace as required. Add corrosion protection per AC43-4A.
5. Install aft fuselage closeout plate assembly. Verify integrity of rubber seals; replace if required
6. Install upper and lower tail cone fairing assembly.

VERTICAL STABILIZER

Vertical Fin (Refer to Figure 55-1.)

1. Removal

   a. Remove tail cone fairing and fairing at forward edge of fin.
   2. Remove rudder.
   3. Disconnect antenna wire from antenna assembly, attach a fish line to antenna cable before removing it from fin.
   4. Separate stabilator trim cable at turnbuckle, and remove cable from trim mechanism.
   5. Remove one bolt at leading edge of fin.
   6. Remove the two bolts which secure trim mechanism to fin spar. Remove the four bolts which secure fin spar to aft bulkhead. Remove fin.

2. Installation

   Install fin in reverse of removal instructions using Figure 55-1 as reference for proper hardware and torques. Check all bolts for safety.

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RUDDER

A. Removal and Installation of Rudder (Refer to Figure 55-1.)

1. Remove tail cone fairing.
2. Disconnect the two control cables from rudder horn.
3. Disconnect rudder from lower rudder hinge bracket.
4. Remove the one remaining hinge bolt. Disconnect tail light electrical wire and remove rudder.
5. Install rudder in reverse of removal, check all bolts and pins for safety.

— WARNING —

ALL CONTROL SURFACES THAT HAVE BEEN REPLACED, REPAINTED, OR REPAIRED, MUST BE REBALANCED ACCORDING TO THE PROCEDURES IN THIS MANUAL (SEE NEXT PAGE).

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RUDDER (cont.)

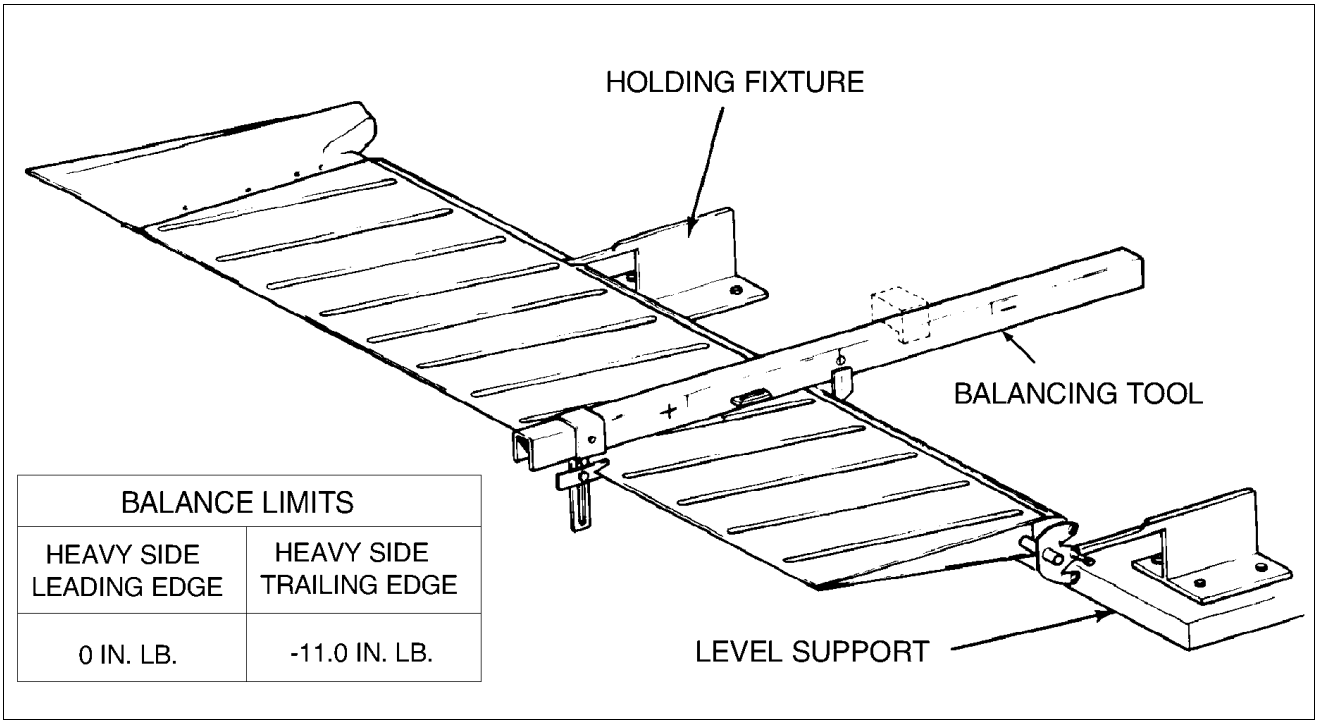

Figure 55-4. Rudder Balancing

B. Balancing of Rudder (Refer to Figure 55-4)

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 Balancing Equipment. 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.

CHAPTER

56

WINDOWS

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CHAPTER 56 - WINDOWS

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FLIGHT COMPARTMENT.

WINDSHIELD.

1. REMOVAL. (Refer to Figure 56-1.)

   a. Remove the collars from around the bottom of the windshield and the trim strip from between the windshield halves by removing the attaching screws.
   b. 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.

   c. Clean old tape and sealer off the affected mating surfaces.

2. INSTALLATION. (Refer to Figure 56-1.)

   a. Match new winshield to old. If necessary, cut or grind the new windshield to matching dimensions.
   b. Apply 1/8 in. by 1 in. vinyl foam tape, Norton V510 or equivilent (see Chart 9105, Tape - Vinyl Foam, Type 2), around entire edge of windshield.
   c. 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.
   d. 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 56-1.
   e. Apply polyurethane, urethane, acrylic, or polysulfide sealant (see Chart 9105, Sealant - Window and Airframe), to seal the forward edge of the vinyl tape at the bottom of the center post, as indicated in Figure 56-1, View E-E.
   f. Reinstall collars and trim strip. Apply sealant as indicated in Figure 56-1 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.
   g. 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.

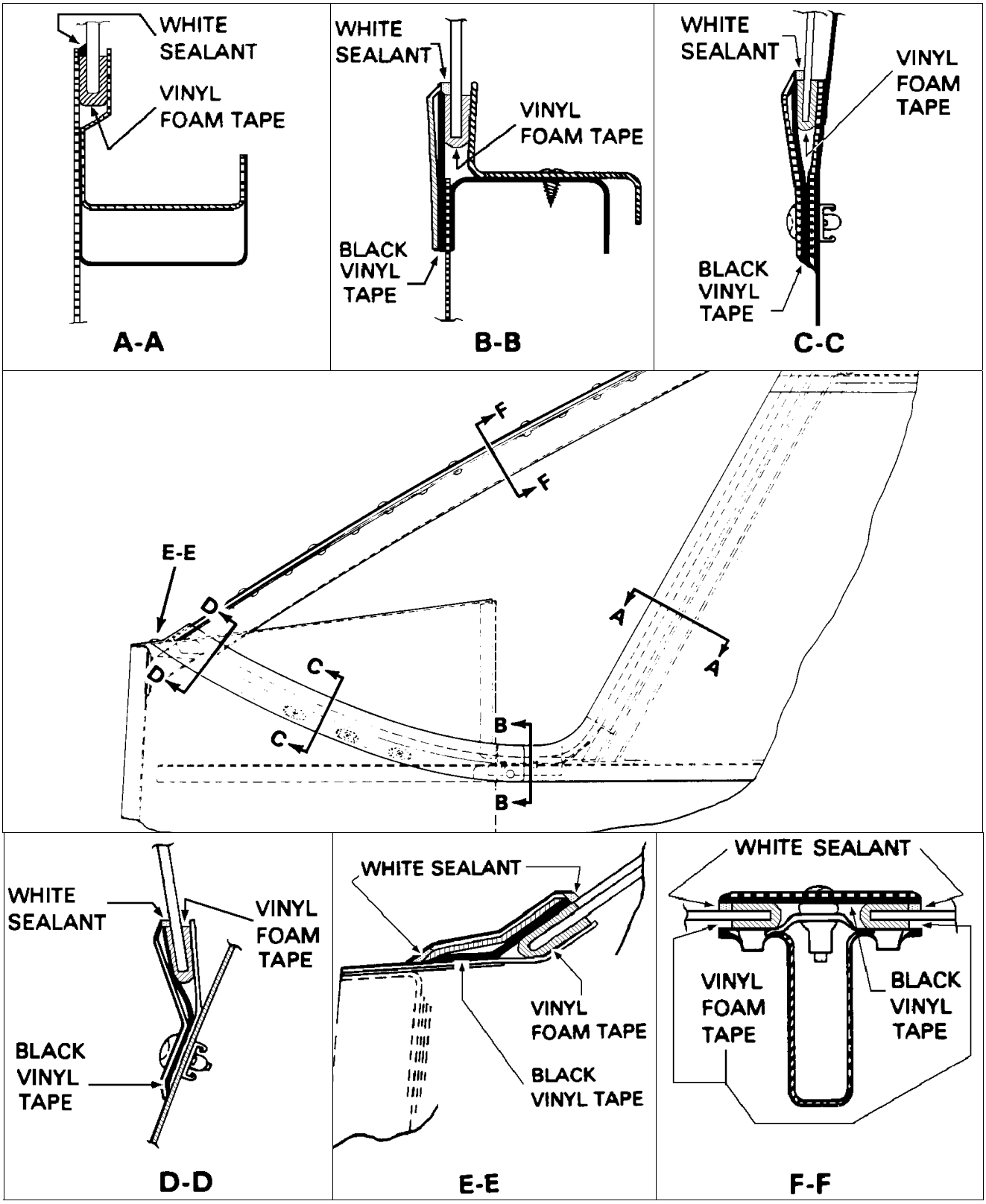

Figure 56-1. Windshield Installation (Typical)

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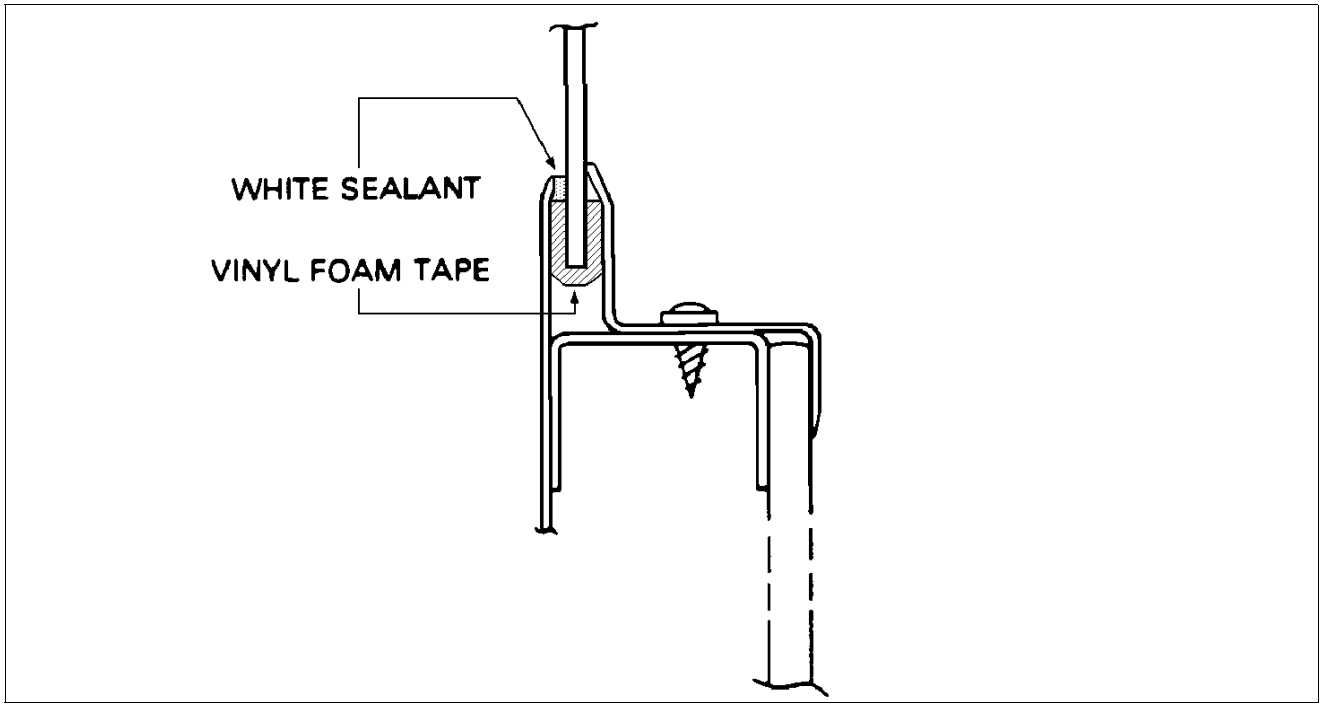

Figure 56-2. Side Window Installation

SIDE WINDOWS.

The airplane is equipped with single pane side windows. For removal and installation of the windows, the following instructions may be used.

1. REMOVAL. (Refer to Figure 56-2.)
   a. Remove the molding and retainer from around the window by removing attaching screws.
   b. Carefully remove the damaged window from the frame.
   c. 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.

2. INSTALLATION. (Refer to Figure 56-2.)
   a. Match new window to old. If necessary, cut or grind the new window to the same dimensions.
   b. Apply 1/8 in. by 1 in. vinyl foam tape, Norton V510 or equivilent (see Chart 9105, Tape - Vinyl Foam, Type 2), around entire edge of window.
   c. 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.

CABIN (cont.)

d. Apply polyurethane, urethane, acrylic, or polysulfide sealant (see Chart 9105, Sealant - Window and Airframe) completely around the outer surface of the window at all attachment flanges as indicated in Figure 56-2. 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.
e. Tighten attachment screws until vinyl foam tape is compressed approximately 25 percent.
f. 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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CHAPTER

57

WINGS

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CHAPTER 57 - WINGS

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GENERAL

This chapter explains the removal and installation procedures for the wings and related components installed on these aircraft.

DESCRIPTION

Each wing panel is an all metal, full cantilever, semi-monocoque type structure with removable tips and and access panels. Attached to each wing are the aileron, flap, main landing gear and fuel tank. 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.

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AXUILIARY STRUCTURE

Wing Tip

1. Removal of Wing Tip

   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 Chapter 51.

2. Installation of Wing Tip

   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.

3. Repair of Wing Tip

   Badly damaged thermoplastic tips should be replaced. (Refer to Chapter 51.)

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ATTACH FITTINGS

Wing to Fuselage Fittings.

1. Removal of Wing (Refer to Figure 57-1)

   a. Close the fuel valve and drain the fuel from the wing to be removed. (Refer to Draining Fuel System, Chapter 12.)
   b. Drain the brake line and reservoir. (Refer to Draining Brake System, Chapter 12.)
   c. Remove the access plate at the wing butt rib and wing inspection panels. (Refer to Access Plates and Panels, Figure 6-3.)
   d. Remove the front and back seats from the airplane.
   e. Expose the spar box and remove the cockpit side trim panel assembly that corresponds with the wing being removed.
   f. Place the airplane on jacks. (Refer to Jacking, 7-10-00.)

— Note —

To help facilitate reinstallation of control cables, 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.

   g. Disconnect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar.
   h. 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.
   i. 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.
   j. Disconnect the fuel line at the fitting located forward of the spar at the wing butt line.

— CAUTION —

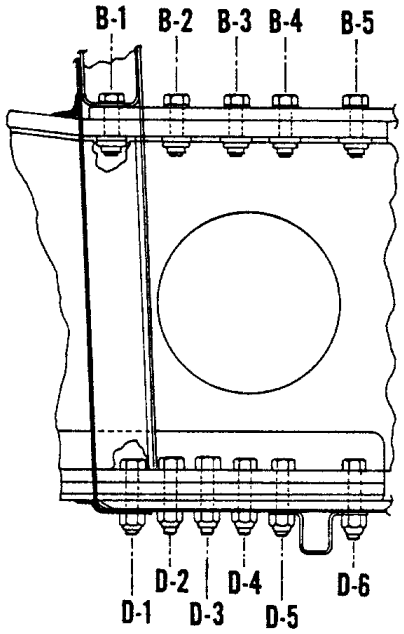
TO PREVENT DAMAGE OR CONTAMINATION OF FUEL, HYDRAULIC AND MISCELLANEOUS LINES, PLACE A PROTECTIVE COVER OVER THE LINE FITTINGS AND ENDS.

   k. Remove the clamps necessary to release the electrical harness assembly. Disconnect the leads from the terminal strip assembly by removing the cover, and appropriate nuts and washers.
   l. 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.
   m. If the left wing is being removed, it will be necessary to disconnect the pitot static tube at the elbows located within the cockpit at the wing butt line.
   n. Arrange a suitable fuselage cradle and supports for both wings.
   o. Remove the jacks.
   p. Remove the front and rear spar nuts, washers and bolts.
   q. Remove the eighteen main spar bolts. Do not drive out bolts. Take care not to damage bolt holes. Number bolts and bolt holes to ensure that, if reused, each bolt is reinstalled in the same hole it came out of. Replacement of all (18) nuts is recommeneded.
   r. Slowly remove the wing being certain that all electrical leads, cables and lines are disconnected.

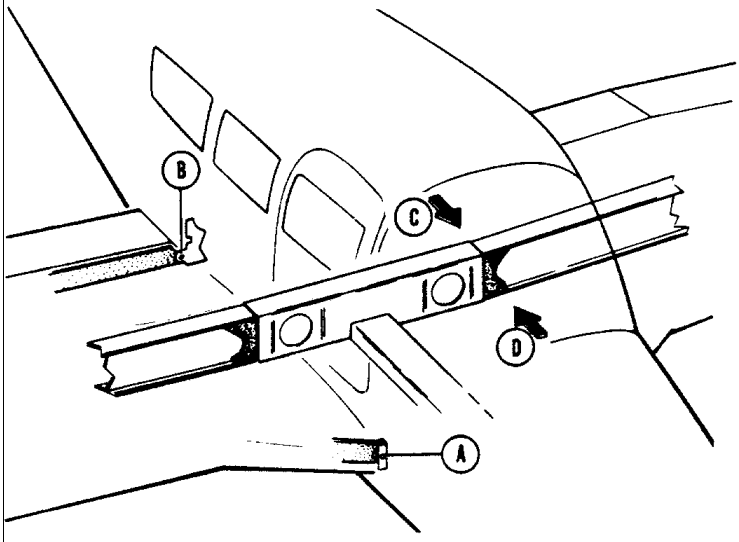
ATTACH FITTINGS (Cont.)

	BOLT LEGEND		WASHER	
POSITION	BOLT	NUT	UNDER HEAD	UNDER NUT
A1	NAS464P6LA17	MS21042-6	AN960-616	AN960-616 (2 Max)
A2	NAS464P6LA16	MS21042-6	AN960-616	AN960-616 (2 Max)
A3	NAS464P6LA16	MS21042-6	AN960-616	AN960-616 (2 Max)
A4	NAS464P6LA16	MS21042-6	AN960-616	AN960-616 (2 Max)
A5	NAS464P6LA16	MS21042-6	AN960-616	AN960-616 (2 Max)
B1	NAS464P6LA15	H19300-6	AN960-616L	K19301-6
B2	NAS464P6LA14	H19300-6	AN960-616	K19301-6
B3	NAS464P6LA14	H19300-6	AN960-616	K19301-6
B4	NAS464P6LA14	H19300-6	AN960-616	K19301-6
B5	NAS464P6LA14	H19300-6	AN960-616	K19301-6
C1	NAS464P5LA20	MS21042-5	AN960-516L	AN960-516 (2 Max)
C2	NAS464P6LA20	MS21042-6	AN960-616L	AN960-616 (2 Max)
C3	NAS464P6LA20	MS21042-6	AN960-616L	AN960-616 (2 Max)
C4	NAS464P6LA20	MS21042-6	AN960-616L	AN960-616 (2 Max)
C5	NAS464P6LA21	MS21042-6	AN960-616L	96352-3
C6	NAS464P5LA21	MS21042-5	AN960-516L	96352-2
D1	NAS464P5LA20	MS21042-5	AN960-516L	AN960-516 (2 Max)
D2	NAS464P6LA20	MS21042-6	AN960-616L	AN960-616 (2 Max)
D3	NAS464P6LA20	MS21042-6	AN960-616L	AN960-616 (2 Max)
D4	NAS464P6LA20	MS21042-6	AN960-616L	AN960-616 (2 Max)
D5	NAS464P6LA21	MS21042-6	AN960-616L	96352-3
D6	NAS464P5LA21	MS21042-5	AN960-516L	96352-2

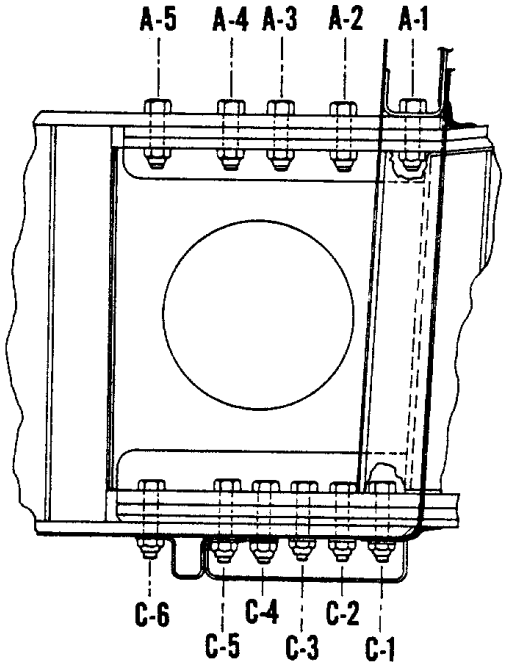
TORQUE BOLT HEADS ON UPPER SPAR CAP & NUT ON LOWER SPAR CAP AS FOLLOWS: 5/16 INCH BOLT = 205-225 IN-LBS
3/8 INCH BOLT = 360-390 IN-LBS.



SKETCH C



— WARNING —
DO NOT DRIVE BOLTS IN OR OUT OF THE MAIN SPAR ATTACHING BOLT HOLES (C AND D). TAKE EXTRA CARE IN REMOVING AND REPLACING THESE BOLTS TO PRECLUDE DAMAGING THE BOLT HOLES.



SKETCH D

Figure 57-1. Wing Installation (Sheet 1 of 2)

ATTACH FITTINGS (Cont.)

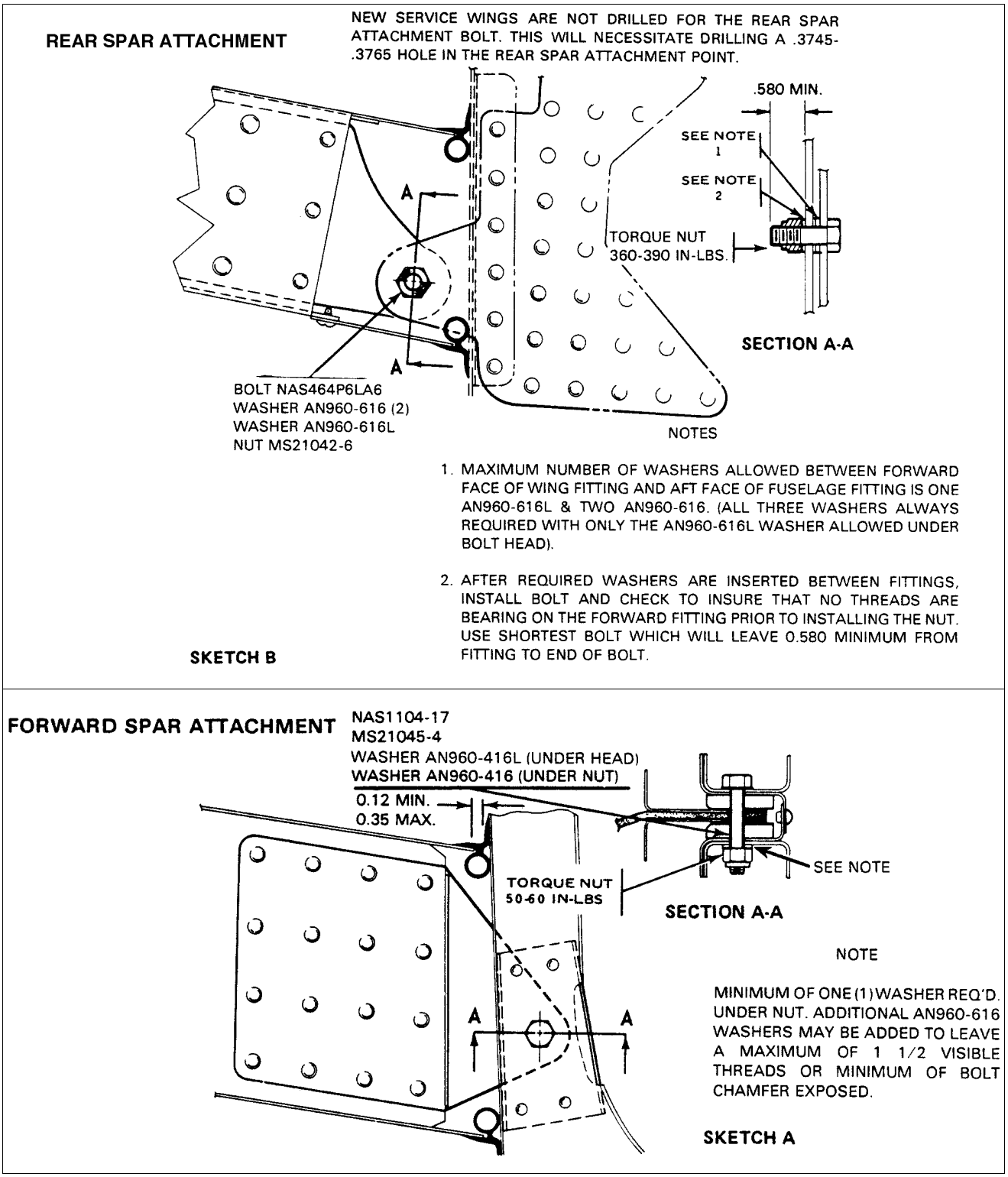


Figure 57-1. Wing Installation (Sheet 2 of 2)

ATTACH FITTINGS (Cont.)

2. Installation of Wing (Refer to Figure 57-1.)

   a. Ascertain that the fuselage is positioned solidly on a support cradle.
   b. Place the wing in position for installation, with the spar end a few inches from the side of the fuselage and set on trestles.
   c. Prepare the various lines, control cables, etc., for inserting into the wing or fuselage when the wing is slid into place.
   d. Slide the wing into position on the fuselage.
   e. Install the eighteen main spar bolts in accordance with the bolt legend. Do not drive bolts in. Take care not to damage bolt holes. If reusing bolts, ensure that each bolt goes back into the same hole that it came out of. Use of new nuts (18) is recommended.

— Note —

When replacing a wing assembly, ascertain the wing butt clearance is maintained (Refer to Sketch A, Figure 57-1.)

   f. Install the bolt, washers and nut that attaches the front spar with the fuselage fitting. A minimum of one washer under the nut and one washer under the head is required. Then add washers as needed to leave a maximum of one and one-half threads visible or a minimum of the bolt chamfer exposed.
   g. Insert the number of washers required between the forward face of the wing fitting and aft face of the fuselage fitting of the rear spar attachment. The maximum number of washers allowed is one AN960-616L and two AN960-616. It is also acceptable to have the faces of the fittings against each other. 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. Use the shortest bolt which will leave 0.580 of an inch minimum from the fitting to the end of the bolt.
   h. Torque the eighteen main spar bolt nuts or bolt heads to the required torque. Be certain that the bolts, nuts and washers are installed in accordance with the bolt legend. The forward spar attachment bolt should be torqued in accordance with the chart of recommended torque requirements given in Chapter 91. Torque the rear spar attachment bolt as specified in Figure 57-1.
   i. Install the wing jacks and the 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.
   j. If the left wing was removed, it is necessary that the pitot static tube to be connected at the elbows located within the cockpit at the wing butt line. Replace or install clamps where found necessary. In the event that a heated pitot is installed, the plus lead must be connected at the fuselage.
   k. Connect the hydraulic brake line onto the fitting located within the cockpit at the leading edge of the wing.
   l. Connect the leads to the appropriate posts on the terminal strip and install the washers and nuts. (For assistance in connecting the electrical lead, 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.
   m. Remove the cap from the fuel line and connect it at the fitting located forward of the spar at the wing butt line.

ATTACH FITTINGS (Cont.)

n. 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.
o. 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.
p. Check the rigging and control cable tension of the ailerons and flaps. (Refer to Rigging and Adjustment of Ailerons, and Rigging and Adjustment of Flaps, Chapter 27.)
q. Service and refill the brake system with hydraulic fluid in accordance with Servicing Brake System, Chapter 12. Bleed the system as given in Chapter 32 and check for fluid leaks.
r. Service and fill the fuel system in accordance with Servicing Fuel System, Chapter 12. Open the fuel valve and check for leaks and flow.
s. Check the operation of all electrical equipment, and pitot system.
t. Remove the airplane from the jacks.
u. Install the cockpit trim panel assembly, spar box carpet, the front and back seats, and wing butt rubber molding.
v. Replace all the access plates and panels on the wing involved.

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FLIGHT SURFACES

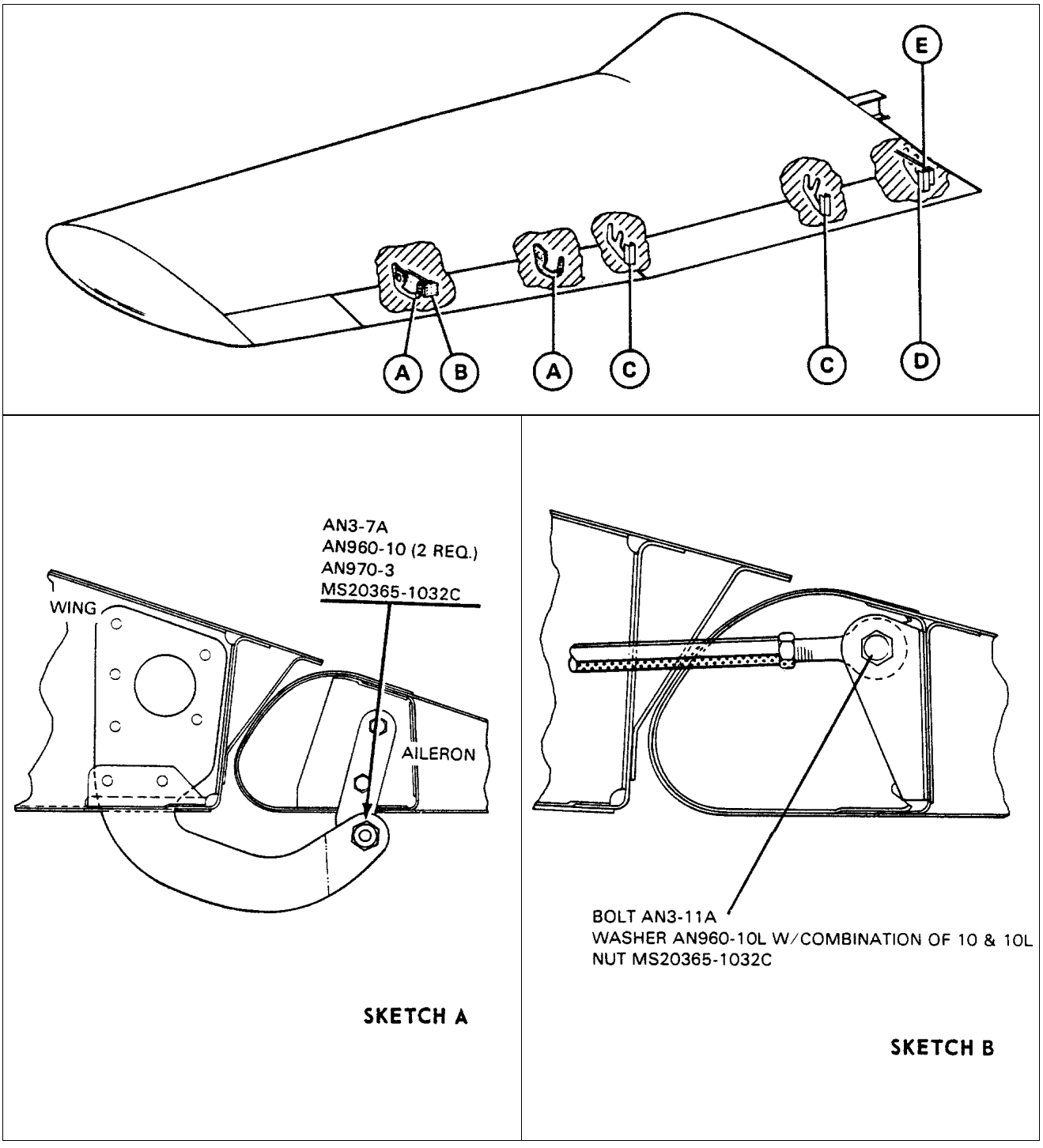

Figure 57-2. Aileron and Flap Installation (Sheet 1 of 2)

FLIGHT SURFACES (Cont.)

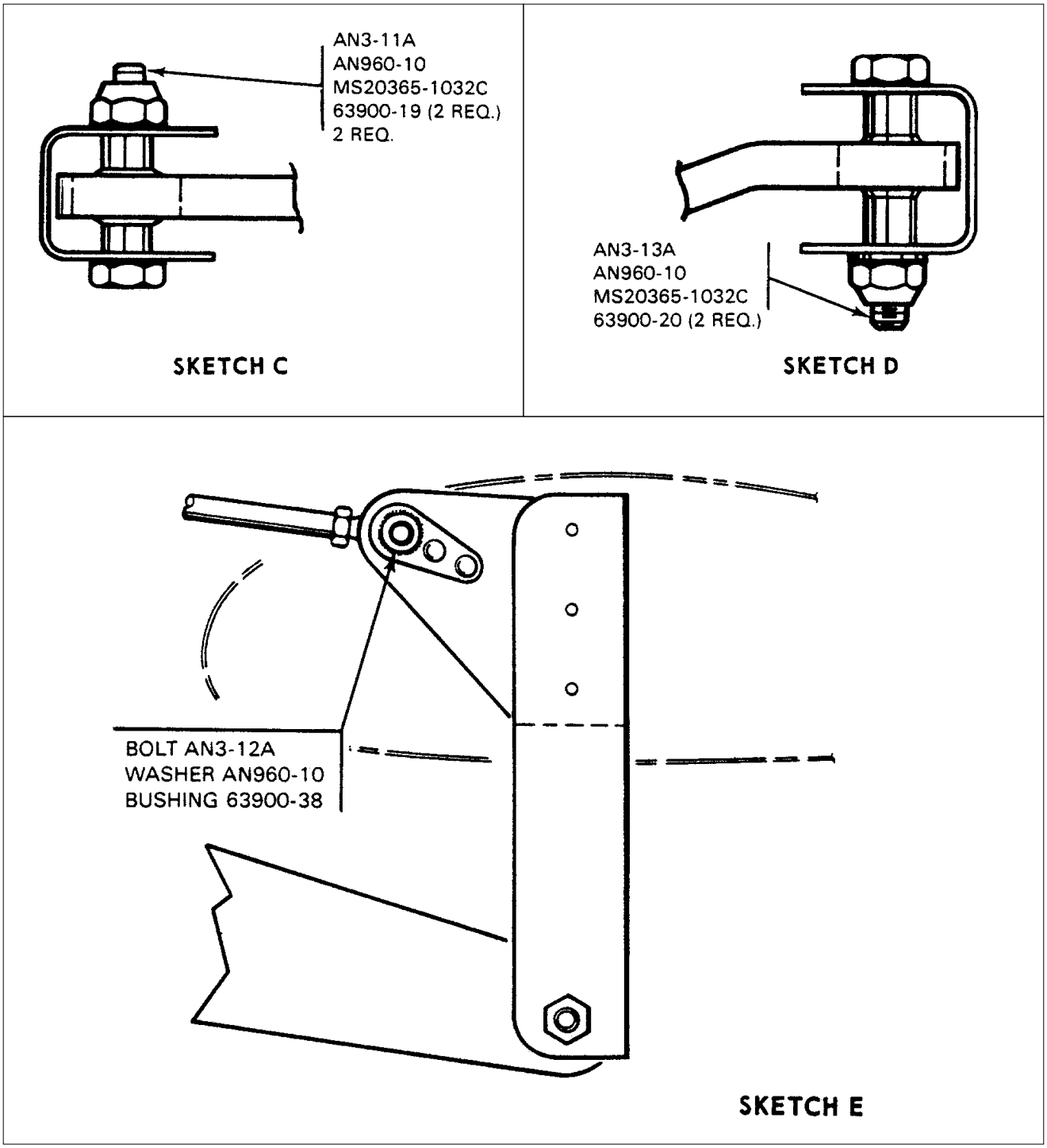

Figure 57-2. Aileron and Flap Installation (Sheet 2 of 2)

FLIGHT SURFACES (Cont.)

A. Aileron

1. Removal of Aileron. (Refer to Figure 57-2.)

   a. 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.
   b. Remove the attaching nuts, bolts and washers from the hinges at the leading edge of the aileron, and remove the aileron.

2. Installation of Aileron (Refer to Figure 57-2.)

   a. Move the aileron into place and install attaching bolts, washers and nuts. Ascertain that the aileron is free to move with no interference.
   b. 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.
   c. Actuate the aileron controls to insure freedom of movement.

3. Checking Aileron Free Play.

   The following checks are recommended before balancing to ascertain the amount of “free play” in the aileron:

   a. Set the aileron in its neutral position and secure.
   b. Obtain a straightedge long enough to extend from the ground up to a few inches above the aileron trailing edge. Place the straightedge next to the aileron trailing edge and gently move the aileron up and down, mark the limit of travel (free play) on the straightedge.
   c. The overall travel (free play) must not exceed 0.24 of an inch. Should free play exceed the limit stated make necessary repairs as required to eliminate free play.
   c. Grasp the aileron and move it spanwise (inboard/outboard) to insure maximum end play of 0.035 of an inch is not exceeded.

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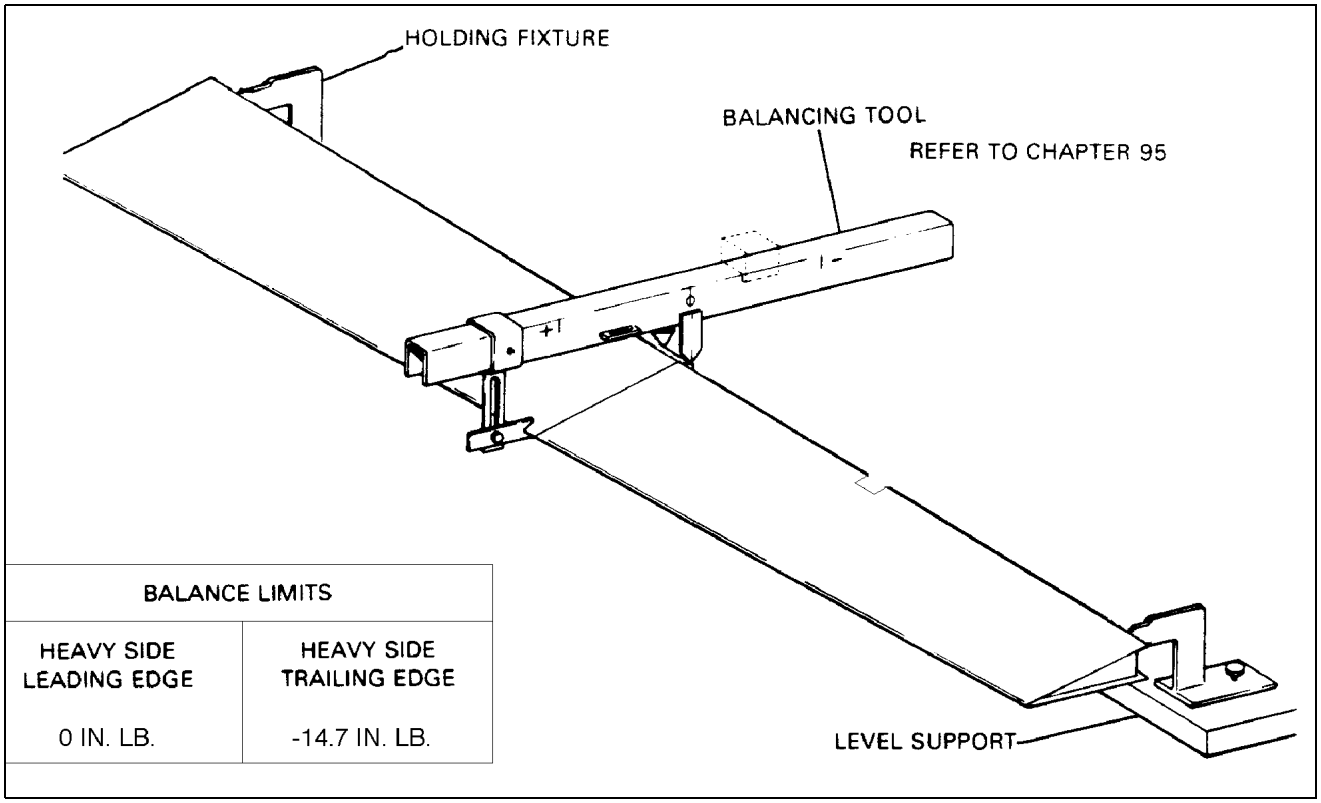
FLIGHT SURFACES (Cont.)



BALANCE LIMITS	
HEAVY SIDE LEADING EDGE	HEAVY SIDE TRAILING EDGE
0 IN. LB.	-14.7 IN. LB.

Figure 57-3. Aileron Balance Configuration

4. Balancing Aileron (Refer to Figure 57-3)

—WARNING —

ALL CONTROL SURFACES THAT HAVE BEEN REPLACED REPAINTED, OR REPAIRED, MUST BE REBALANCED ACCORDING TO THE PROCEDURES IN THIS MANUAL.

Position the aileron on the balancing fixture in a draft free area and in a manner which allows unrestricted movement of the aileron. Place the tool on the aileron, avoiding rivets, and keep the beam perpendicular to the hinge centerline. Read the scale when the bubble level has been centered by adjustment of the movable weight and determine the static balance. If the static balance is not within the limits specified in Figure 57-3, 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.

FLIGHT SURFACES (Cont.)

B. Wing Flap

1. Removal of Wing Flap (Refer to Figure 57-2)

   a. Extend the flaps to their fullest degree and remove the bolt and bushing from the rod end bearing.
   b. Remove the nuts, washers, bushing and hinge bolts that hold the flap to the wing assembly.
   c. Pull the flap straight back off the wing.

2. Installation of Wing Flap (Refer to Figure 57-2)

   a. Replace the wing flap by placing the flap onto its proper position and inserting the hinge bolts, bushings, washers and nuts.
   b. 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.
   c. Operate the flap several times to be certain it is operating freely. (Refer to Chapter 27 for Flap Rigging and Adjustment.)

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CHAPTER

61

PROPELLER

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CHAPTER 61 - PROPELLER

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PROPELLER ASSEMBLY.

This section lists procedures for the removal, cleaning, inspection, repair, and installation of the propeller assembly. Servicing information may be found in Chapter 12 of this manual.

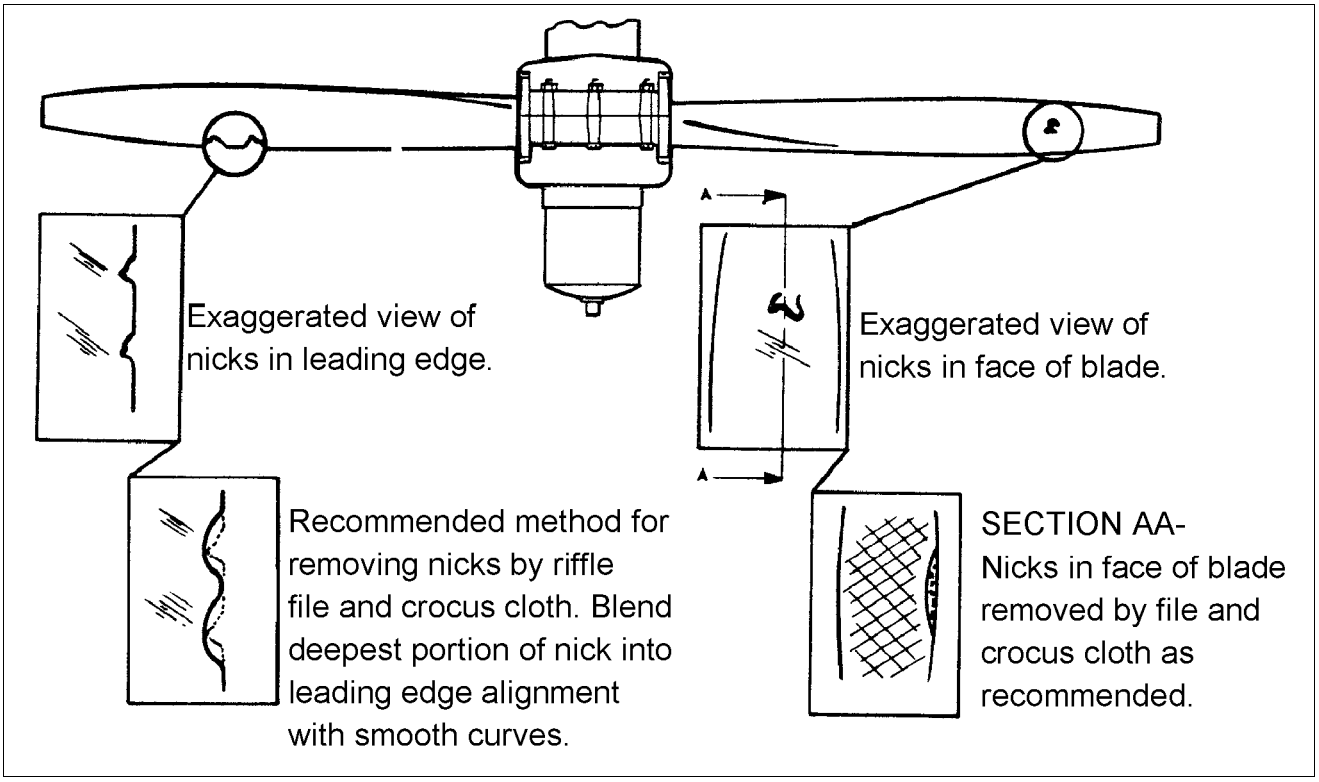

Figure 61-1. Typical Nicks and Removal Method

1. Removal of Propeller

   a. Insure that the master and magneto switches are off.
   b. Move fuel selector to off position.
   c. Place the mixture control in idle cut-off.
   d. Note position of each component to facilitate reinstallation.
   e. Remove the screws from around the spinner assembly and remove spinner.
   f. Remove the safety wire from the six propeller mounting nuts on studs and remove studs.
   g. Place a drip pan under the propeller to catch oil spillage, then remove the propeller.

PROPELLER ASSEMBLY (Cont.)

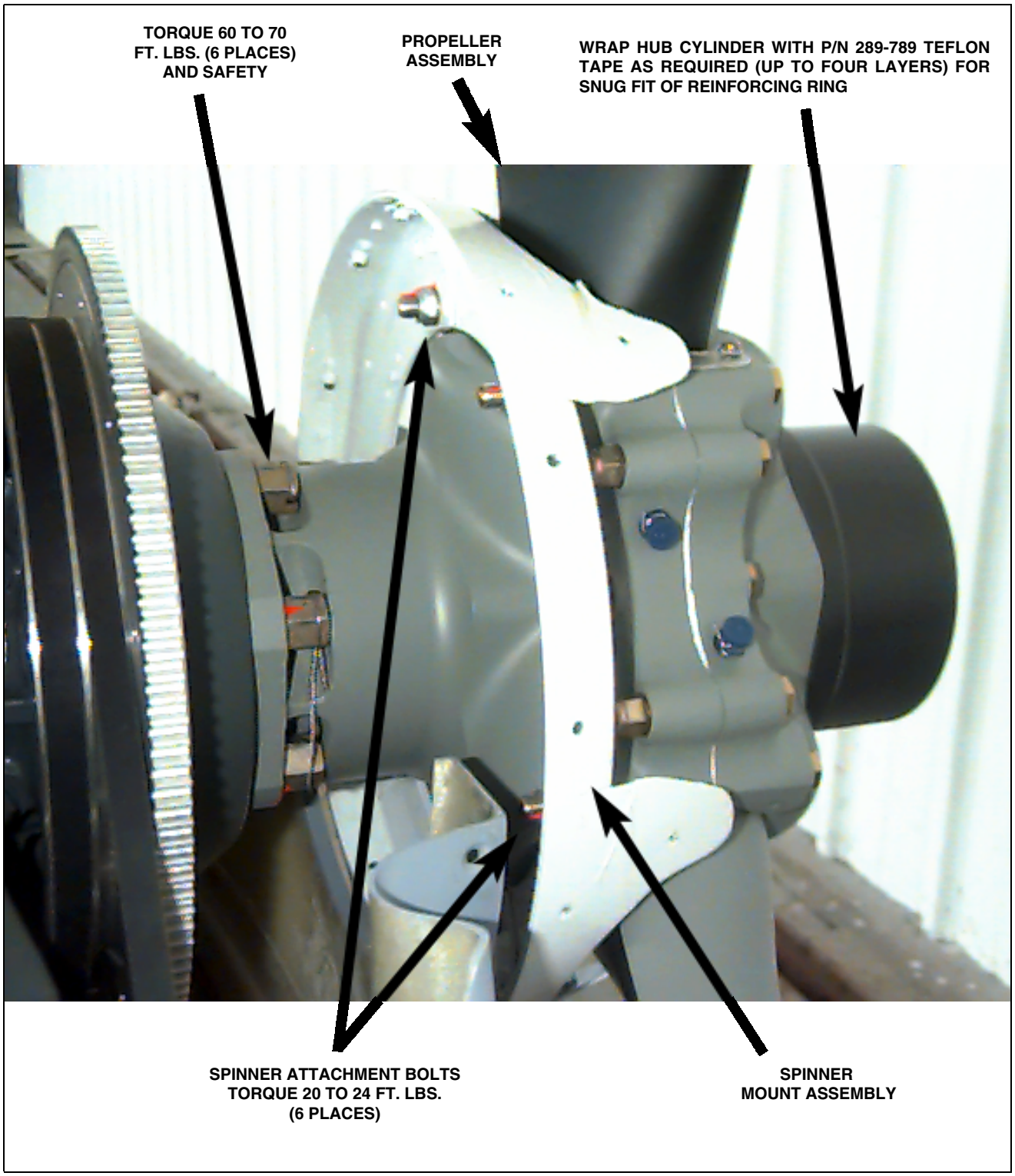

Figure 61-2. Propeller Installation (Sheet 1 of 2)

PROPELLER ASSEMBLY (Cont.)

CHART 6101. PROPELLER TORQUE LIMITS

Description	Required Torque (Dry)
Propeller Mounting Nuts	60-70 foot-pounds
Fwd. Bulkhead Attachment Bolts	20-24 inch-pounds
Spinner Attachment Screws	20-22 inch-pounds

NOTES

1. LOCATION OF BOLT HOLE MARKED "0" WHEN #1 PISTON IS ON TOP DEAD CENTER.
2. INSTALL PROPELLER WITH BLADES INDEXED TO "O" BOLT HOLES AS SHOWN.

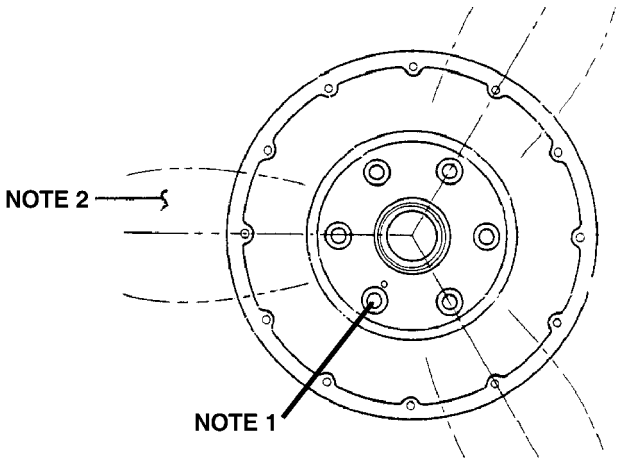

Figure 61-2. Propeller Installation (Sheet 2 of 2)

PROPELLER ASSEMBLY (Cont.)

2. Cleaning, Inspection, and Repair of Propeller.

   a. Check for oil and grease leaks.
   b. Clean the spinner, propeller hub interior and exterior, and blades with a non-corrosive solvent.
   c. Inspect the hub parts for cracks.
   d. Steel hub parts should not be permitted to rust. Use aluminum paint to touch up if necessary, or replate during overhaul.
   e. Check all visible parts for wear and safety.
   f. 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.
   g . Inspect blades for damage or cracks. Nicks in leading edges of blades should be filed out and all edges rounded, as cracks sometimes start from such places. Use fine emery cloth for finishing. Refer to Figure 61-1 for propeller blade care.

3. Installing Propeller (Refer to Figure 61-2)

   a. Insure master and magneto switches are off.
   b. Place fuel selector to off position.
   c. Place mixture control in idle cut-off.
   d. 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.
   e. Wipe crankshaft and propeller pilot to assure that no chips or foreign matter enter the propeller mechanism.
   f. 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.
   g. Install rear spinner bulkhead.
   h. Slide propeller carefully over pilot, taking care that “O” ring is not damaged.
   i. Install the six hexagon head propeller hub mounting bolts and torque per Chart 6101.
   j. Check propeller blade track as given in Blade Track.
   k. Safety the propeller mounting bolts with MS20995-C41 safety wire.
   l. 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.
   m. Install spinner. Torque all attachment screws per Chart 6101.

PROPELLER ASSEMBLY (Cont.)

4. 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:

   a. 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.
   b. Carefully rotate propeller by hand to bring the opposite (or next) blade down. Center the tip and scribe a pencil line as before and check that lines are not separated more than .0625 inchx
   c. Propellers having excess blade track should be removed and inspected for bent blades, or for parts of sheared “O” ring, or foreign particles, which have lodged between hub and crankshaft mounting faces. Bent blades will require repair and overhaul of assembly.

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CONTROLLING

Propeller Governor

1. Removal

   a. Remove the upper engine cowl.
   b. Disconnect the control cable end from the governor control arm.
   c. Remove the governor mounting stud nuts. It will be necessary to raise the governor as the nuts are being removed before they can be completely removed.
   d. Remove the mounting gasket. If the governor is to be removed for a considerable length of time and another unit not substituted, it is advisable to cover the mounting pad to prevent damage caused by foreign matter.

2. Installation

   a. Clean the mounting pad thoroughly, making very certain that there are no foreign particles in the recess around the drive shaft.
   b. Place the governor mounting gasket in position with the raised portion of the screen facing awav from the engine.
   c. Align the splines on the governor shaft with the engine drive and slide the governor into position.
   d. With the governor in position, raise the governor enough to install washers and start mounting nuts. Torque nuts even.
   e. Connect the control cable end to the governor control arm. The ball stud is installed in the inner hole of the control arm.
   f. Adjust governor control per Rigging and Adjustment of Propeller Governor.
   g. Install engine cowl.

3. Rigging and Adjustment (Refer to Figure 61-3.)

   a. Prior to adjusting the propeller governor high rpm setting, the control linkage should be thoroughly checked for correct function.

   — Note —

   A calibrated tachometer must be used to ascertain propeller high rpm setting. Final high rpm adjustment must be checked in flight or during high speed taxi.

   To check rigging, move propeller control full forward. The propeller governor high rpm stop must contact the adjusting screw when the cockpit control is 0.010 to 0.030 inch from the cockpit mechanical stop.

   b. If adjustment is required complete the following steps.

      (1) Insure that the governor control arm is located approximately as shown on Figure 61-3.
      (2) Adjust control cable end hardware to obtain cockpit control cushion. Insure there is adequate thread engagement of clevis end and rod end bearing (witness holes) after adjustment.
      (3) Insure that the control cable assembly is not bottoming internally.

   c. Start engine, park 90° to wind direction and warm in normal manner.

CONTROLLING (Cont.)

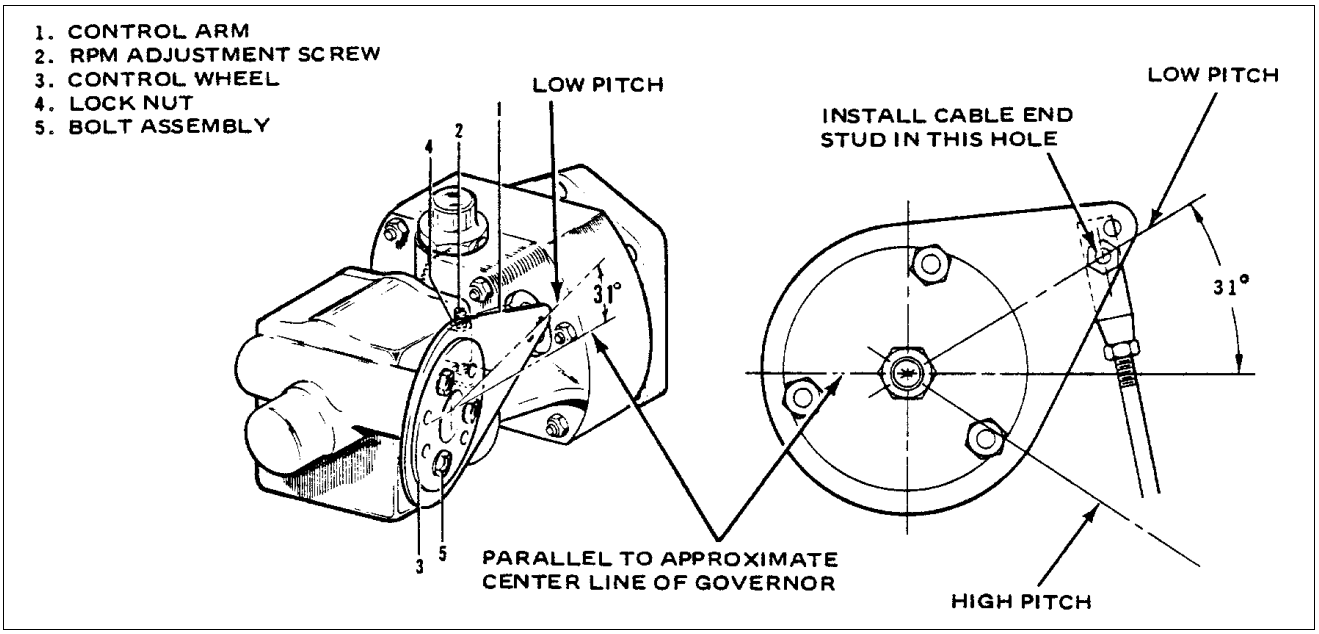

Figure 61-3. Propeller Governor

d. To check high rpm low pitch setting, move the propeller control all the way forward. At this position the governor speed control arm should be against the high rpm fine adjusting screw. With the throttle full forward, observe engine rpm which should be adjusted as follows:

(1) Shut down the engine and remove the upper engine cowl.
(2) Adjust the governor by means of the fine adjustment screw to: 2700 RPM for HP S/N's 3246001 & up; 2500 RPM for TC S/N's 3257001 & up. To do this, loosen the high RPM fine adjustment screw locknut and turn the screw in a clockwise direction to decrease engine speed or in a counterclockwise direction to increase engine speed.

— Note —

One revolution of the fine adjustment screw will increase or decrease the engine speed approximately 20 rpm.

(3) Reinstall upper engine cowl and repeat step b to ascertain proper rpm setting.
(4) After setting the proper high rpm adjustment, run the self-locking nut on the fine adjustment screw against the base projection to lock.
(5) Ascertain that the governor control arm is adjusted to the proper angle on the control wheel as shown in Figure 61-3.

e. With the high rpm adjustment complete, the control system should be adjusted so that the governor control arm will contact the high rpm stop when the propeller lever is 0.010 to 0.030 of an inch from forward stop on the power quadrant. To adjust the control travel, disconnect the control cable end from the control arm, loosen the cable end jam nut and rotate the rod end to obtain the desired lever clearance. Reconnect the cable end and tighten jam nut.

f. It is usually only necessary to adjust the high rpm setting of the governor control system, as the action automatically takes care of the positive high pitch setting.

CHAPTER

70

STANDARD PRACTICES - ENGINE

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CHAPTER 70 - STANDARD PRACTICES - ENGINE

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GENERAL

The following suggestions should be applied wherever they are needed when working on the power plant.

1. To insure proper reinstallation and/or assembly, tag and mark all parts, clips, and brackets as to their location prior to their removal and/or disassembly.
2. During removal of various tubes or engine parts, inspect them for indications of scoring, burning or other undesirable conditions. To facilitate reinstallation, observe the location of each part during removal. Tag any unserviceable part and/or units for investigation and possible repair.
3. Extreme care must be taken to prevent foreign matter from entering the engine, such as lockwire, washers, nuts, dirt, dust, etc. This precaution applies whenever work is done on the engine, either on or off the aircraft. Suitable protective caps, plugs, and covers must be used to protect all openings as they are exposed.

— Note —

Dust caps used to protect open lines must always be installed OVER the tube ends and NOT IN the tube ends. Flow through the lines may be blocked off if lines are inadvertently installed with dust caps in the tube ends.

4. Should any items be dropped into the engine, the assembly process must stop and the item removed, even though this may require considerable time and labor. Insure that all parts are thoroughly clean before assembling.
5. Never reuse any lockwire, lockwashers, tablocks, tabwashers or cotter pins. All lockwire and cotter pins must fit snugly in holes drilled in studs and bolts for locking purposes. Cotter pins should be installed so the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Use only corrosion resistant steel lockwire and/or cotter pins. Bushing plugs shall be lockwired to the assembly base or case. Do not lockwire the plug to the bushing.
6. All gaskets, packings and rubber parts must be replaced with new items of the same type at reassembly. Insure the new nonmetallic parts being installed show no sign of having deteriorated in storage.
7. When installing engine parts which require the use of a hammer to facilitate assembly or installation, use only a plastic or rawhide hammer.
8. Anti-seize lubrication should be applied to all loose-fit spline drives which are external to the engine and have no other means of lubrication. For certain assembly procedures, molybdenum disulfide in either paste or powdered form mixed with engine oil or grease may be used.

— CAUTION —

ENSURE THAT ANTI-SEIZE COMPOUNDS ARE APPLIED IN THIN EVEN COATS, AND THAT EXCESS COMPOUND IS COMPLETELY REMOVED TO AVOID CONTAMINATION OF ADJACENT PARTS.

9. Temporary marking methods are those markings which will ensure identification during ordinary handling, storage and final assembly of parts.

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CHAPTER

71

POWER PLANT

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CHAPTER 71 - POWER PLANT

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GENERAL

A. Description.

1. SARATOGA II HP (S/N's 3246001 & up).

This airplane is powered by a 300 horsepower Lycoming engine, Model IO-540-K1G5. The engine is furnished with a starter, a 90 ampere 28-volt alternator (except 14-volt in HP S/N's 3246001 thru 3246017 only), a voltage regulator, a shielded ignition system, a vacuum pump drive, both engine-driven and electric fuel pumps, a fuel injector and a dry paper element induction air filter. In the event of air stoppage through the filter, an alternate air source can be opened manually by the use of a lever in the cockpit.

The exhaust system consists of two individual mufflers, one on each side of the engine. The left side cylinders feed into a muffler on the left side of the engine and the right side cylinders feed into a muffler on the right side of the engine. A heat shroud encircles each muffler to provide heat for both the cabin and defrosting.

The engine is provided with a constant speed propeller controlled by a governor mounted on the engine supplying oil through the propeller shaft at various pressures.

2. SARATOGA II TC (S/N's 3257001 & up).

This airplane is powered by a 300 horsepower turbocharged Lycoming engine, Model TIO-540-AH1A. The engine is furnished with a starter, a 90 ampere 28-volt alternator, a voltage regulator, a shielded ignition system, a vacuum pump drive, both engine-driven and electric fuel pumps, a fuel injector and a dry paper element induction air filter. In the event of air stoppage through the filter, an alternate air source can be opened manually by the use of a lever in the cockpit.

Exhaust from the left cylinders is collected into a single pipe and routed through a heat shroud above the induction air filter to provide heat for both the cabin and defrosting. The left side exhaust joins the right side above the turbocharger installation. Exhaust is then alternately routed through the turbocharger or the wastegate and out a single tailpipe on the right side.

The engine is provided with a constant speed propeller controlled by a governor mounted on the engine supplying oil through the propeller shaft at various pressures.

— WARNING —

THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT. (SEE INTRODUCTION, PAGE 4.)

B. Troubleshooting.

Troubles peculiar to the power plant are listed in Chart 7101 along with their probable causes and suggested remedies.

— WARNING —

GROUND THE MAGNETO PRIMARY CIRCUIT BEFORE PERFORMING ANY CHECKS OF THE ENGINE.

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CHART 7101. TROUBLESHOOTING ENGINE (Sheet 1 of 4)

Trouble	Cause	Remedy
Failure of engine to start.	Lack of fuel.	Check fuel system for leaks.
		Fill Fuel tank.
		Clean dirty lines, strainers or fuel valves.
		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.
	Water in fuel injector.	Drain fuel injector and fuel lines.
	Internal failure.	Check oil screens for metal particles. If found, complete overhaul of engine may be indicated.

CHART 7101. TROUBLESHOOTING ENGINE (Sheet 2 of 4)

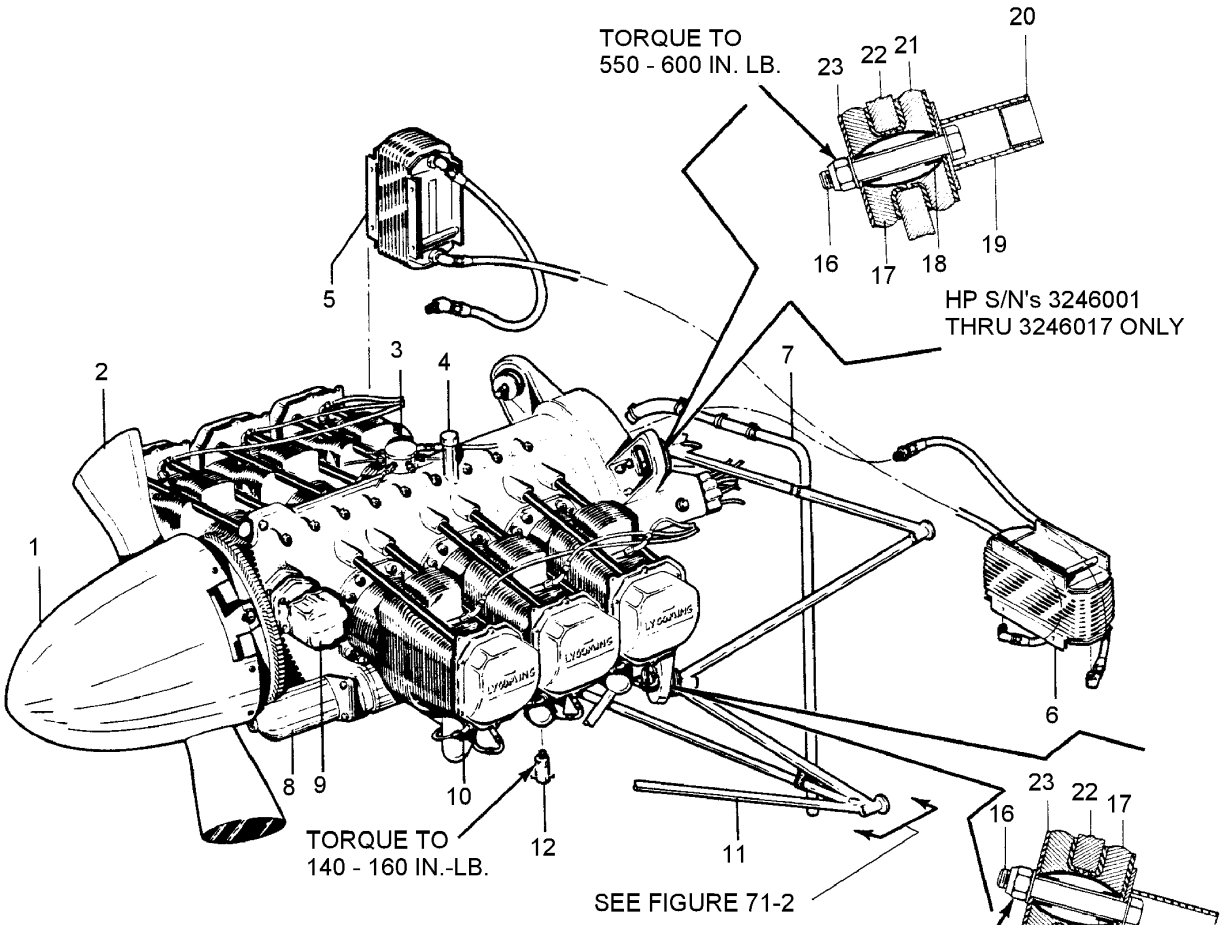
Trouble	Cause	Remedy
Failure of engine to idle properly.	Incorrect idle mixture.	Adjust mixture.
	Leak in the induction system.	Tighten all connections in the induction system. Replace any parts that are defective.
	Incorrect idle adjustment.	Adjust throttle stop to obtain correct idle.
	Uneven cylinder compression.	Check condition of piston rings and valve seats.
	Faulty ignition system.	Check entire ignition system.
	Insufficient fuel pressure.	Adjust fuel pressure.
Lower 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 fuel injector by authorized personnel is indicated.
	Mixture too lean; indicated by overheating or backfiring.	Check fuel lines for dirt or other restrictions. Check fuel injection nozzles.
	Leaks in induction system.	Tighten all connections in the induction system. Replace any parts that are defective.
	Defective spark plugs.	Clean and gap, or replace spark plugs.
	Improper fuel.	Drain and refill tank with recommended 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 connectors on spark plug wire.

CHART 7101. TROUBLESHOOTING ENGINE (Sheet 3 of 4)

Trouble	Cause	Remedy
Failure of engine to develop full power.	Leak in the induction system.	Tighten all connections in the induction system. Replace any parts that are defective.
	Throttle lever out of adjustment.	Adjust throttle lever.
	Improper fuel flow.	Check strainer, gauge, and flow at fuel injector inlet.
	Restriction in air scoop.	Examine air scoop and remove restrictions.
	Improper fuel.	Drain and refill tank with recommended fuel.
	Faulty ignition.	Tighten all connections.
		Check system with tester.
		Check ignition timing.
Rough engine.	Cracked engine mount.	Replace or repair mount.
	Defective mounting bushings.	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.

CHART 7101. TROUBLESHOOTING ENGINE (Sheet 4 of 4)

Trouble	Cause	Remedy
High Oil Temperature.	Insufficient air cooling.	Check air inlet and outlet for deformation or obstruction.
	Insufficient oil supply.	Fill oil sump to proper level with specified oil.
	Low grade of oil.	Replace with oil conforming to specifications.
	Clogged oil lines or strainers.	Remove and clean oil strainers.
	Excessive blow-by.	Usually caused by worn or stuck rings.
	Failing or failed bearing.	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gauge.	Replace gauge.
Excessive oil consumption.	Low grade of oil.	Fill tank 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.	Correctly 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.

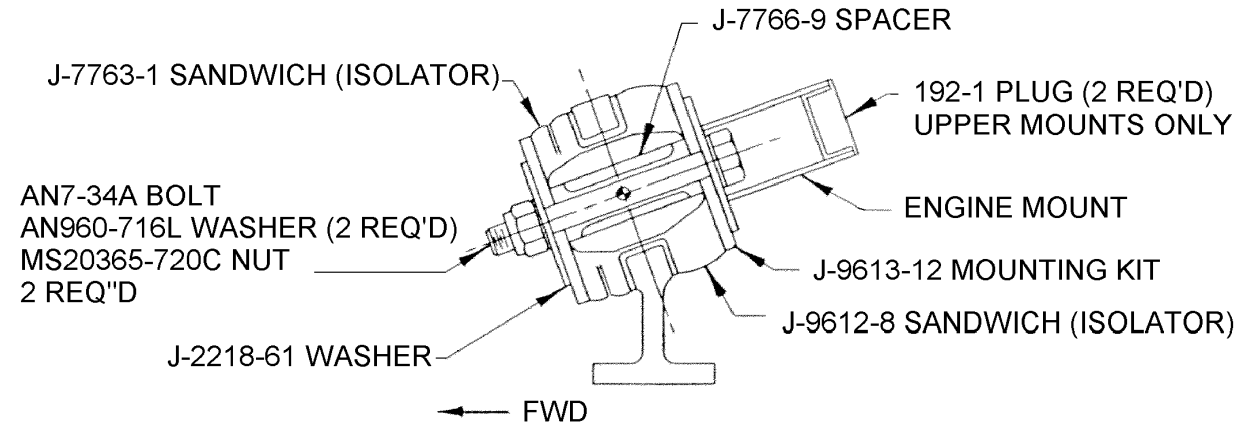


1. SPINNER
2. PROPELLER (3 RD BLADE NOT SHOWN)
3. FUEL FLOW DIVIDER
4. OIL FILLER
5. OIL COOLER, RIGHT
6. OIL COOLER, LEFT
   (VERTICAL ORIENTATION IN TC S/N's 3257001 & UP)
7. VENT TUBE
8. STARTER
9. GOVERNOR
10. FUEL NOZZLE
11. ENGINE MOUNT
12. VALVE, OIL DRAIN
13. - 15. NOT USED
16. BOLT, NUT, WASHER
17. SANDWICH (J-3049-38) OR (J-3049-66)
18. SPACER (J-12333-2) OR (Y-6769-1-S)
19. ENGINE MOUNT
20. PLUG
21. SANDWICH (J-3049-35) OR (J-3049-66)
22. ENGINE
23. MOUNTING KIT (J-3804-31)
    OR MOUNTING KIT (J-3804-40)

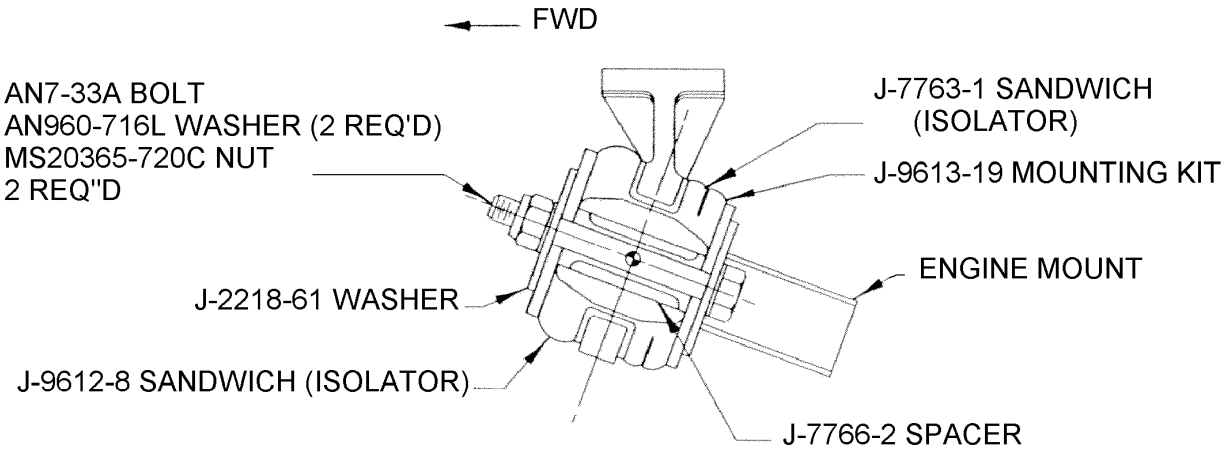
SARATOGA II HP SHOWN

SARATOGA II TC SIMILAR

Figure 71-1. Engine Installation (1 of 2)



UPPER MOUNTS



LOWER MOUNTS

ENGINE MOUNT INSTALLATION FOR:

- SARATOGA II HP S/N'S 3246018 & UP
- SARATOGA II TC S/N'S 3257001 & UP

Figure 71-1. Engine Installation (2 of 2)

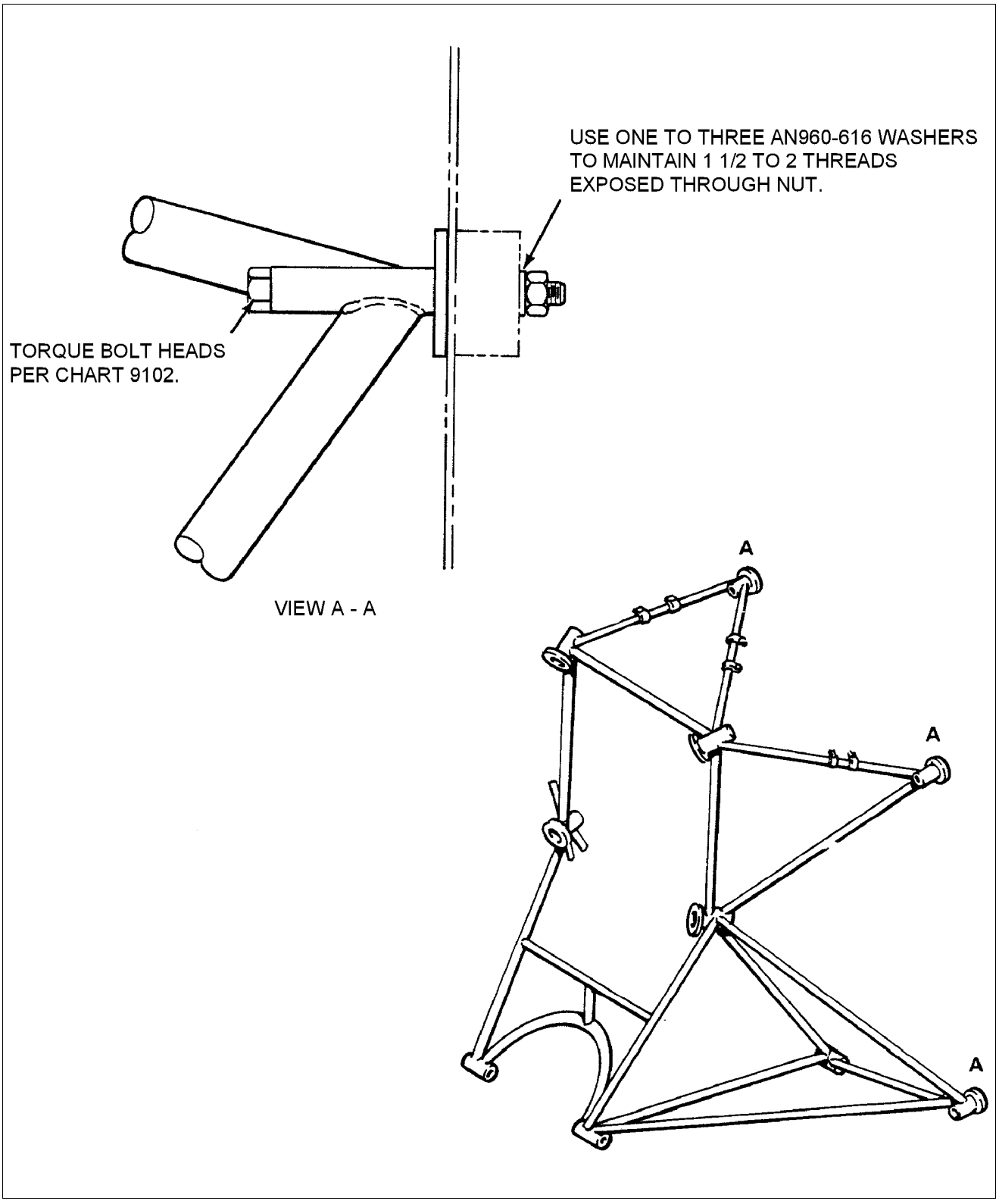


Figure 71-2. Engine Mount Installation (Dynafocal Mount)

GENERAL (cont)

C. Engine

1. Removal (Refer to Figure 71-1)

a. Turn off all electrical switches in the cockpit and then disconnect the battery ground wire at the battery.
b. Ascertain that the fuel selector lever is in the "OFF" position.
c. Remove the cowling and propeller. (Refer to Chapter 61.)

— Note —

Tag hoses, lines and wires at separation to facilitate reinstallation. Open fuel, oil, vacuum lines and fittings should be covered to prevent contamination.

d. Disconnect the following electrical systems/components:

(1) starter positive and ground leads at the injector. (The injector may be removed if desired.)
(2) alternator leads and the cable attachment clamps.
(3) magneto "P" leads at the magnetos.
(4) tachometer magnetic sensor lead at the left magneto. (HP S/N's 3246088 & up and TC S/N's 3257001 & up)
(5) oil temperature, cylinder head temperature (CHT), and exhaust gas temperature (EGT) (or turbine intlet temperature (TIT) in TC S/N's 3257001 & up) leads.

e. Disconnect the following mechanical systems/components:

(1) governor control cable at the governor and cable attachment clamps.
(2) throttle and mixture cables at the injector. (The injector may be removed if desired.)
(3) tachometer drive cable at the engine. (HP S/N's 3246001 thru 3246087 only)
(4) induction air intake duct hose.
(5) cooling ducts to vacuum pump and fuel pump shroud.
(6) in TC S/N's 3257001 & up only, the injector intake ducting and associated lines.

f. Disconnect the following environmental systems/components:

(1) heater and defroster hoses.
(2) air conditioning compressor lines (if installed).

g. The following engine lines should also be disconnected:

(1) fuel pump supply line at the left side of the pump. Disconnect pump vent line.
(2) both lines from each oil cooler at the coolers.
(3) engine vent tube at the engine.
(4) Untie the ignition harness hoses and lines at the aft of the engine.
(5) vacuum pump lines at pump and remove the fittings from pump.
(6) oil pressure line at the engine.
(7) deck pressure and fuel flow lines.
(8) manifold pressure line.
(9) injector line at the flow divider.

GENERAL (cont)

h. Attach a one-half ton (minimum) hoist to the hoisting straps and relieve the tension from the engine mounts .

— CAUTION —

PLACE A TAIL STAND UNDER THE TAIL OF THE AIRPLANE BEFORE REMOVING THE ENGINE.

i. Check the engine for any attachments remaining to obstruct its removal.
j. Drain the engine oil, if desired, and then close drain.
k. Remove the four engine mount assemblies and swing the engine free, being careful not to damage any attaching parts.

2. Installation of Engine (Refer to Figure 71-1.)

a. Attach a one-half ton (minimum) hoist to the engine hoisting straps and swing the engine into alignment with its attaching points.
b. Insert an engine mount bolt, with washer against head, in the engine mount and slide half of the mount assembly on the bolt. (Refer to Figure 71-1 for proper shock mount assembly.) Repeat this procedure for the other three attachment parts.

— Note —

Shock mount Part No. J-7763-1 sandwich must be positioned on the compression side of the engine lugs, with the upper mounts on the forward side, and the lower mounts on the aft side. The part number is stamped on the metalface of the mount.

c. Position the mounting lugs of the engine so that they align with the engine mount attaching points, then move the engine rearward onto the mounts.
d. Slide onto each mounting bolt a spacer and the forward half of the mount. Install washers and nut, and torque the nuts of the bolts to 550 to 600 inch-pounds.
e. Turn off all electrical switches in the cockpit and, if not already done, disconnect the battery ground wire at the battery.
f. Ascertain that the fuel selector lever is in the “OFF” position.
g. Connect the following engine lines:

(1) fuel pump supply line, at the left side of the pump, and pump vent line.
(2) both lines from each oil cooler at the coolers.
(3) engine vent tube at the engine.
(4) Resecure the ignition harness hoses and lines at the aft of the engine.
(5) vacuum pump lines at pump and remove the fittings from pump.
(6) oil pressure line at the engine.
(7) deck pressure and fuel flow lines.
(8) manifold pressure line.
(9) injector line at the flow divider.

h. Connect the following environmental systems/components:

(1) heater and defroster hoses.
(2) air conditioning compressor lines (if installed).

GENERAL (cont)

i. Connect the following mechanical systems/components:

(1) governor control cable at the governor and cable attachment clamps.
(2) throttle and mixture cables at the injector. (Reinstall the injector if previously removed.)
(3) tachometer drive cable at the engine. (HP S/N's 3246001 thru 3246087 only)
(4) induction air intake duct hose.
(5) cooling ducts to vacuum pump and fuel pump shroud.
(6) in TC S/N's 3257001 & up only, the injector intake ducting and associated lines.

j. Connect the following electrical systems/components:

(1) starter positive and ground leads at the injector.
(2) alternator leads and the cable attachment clamps.
(3) magneto "P" leads at the magnetos.
(4) tachometer magnetic sensor lead at the left magneto. (HP S/N's 3246088 & up and TC S/N's 3257001 & up)
(5) oil temperature, cylinder head temperature (CHT), and exhaust gas temperature (EGT) (or turbine intlet temperature (TIT) in TC S/N's 3257001 & up) leads.

k. Secure the ignition harness, lines,and any hoses, wires, etc. that may be loose.
l. Check the engine for any additional components/systems still disconnected.
m. Fill engine oil, if previously drained.
n. Install cowling and propeller. (Refer to Chapter 61.)

— Note —

To avoid possible high speed bearing failure resulting from lack of lubrication during initial starts after engine installation, refer to the latest revision of Lycoming Service Instruction No. 1241 for instructions on Pre-Oiling engines.

o. Reconnect the battery ground wire at the battery.
p. Perform an engine operation check.

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COWLING

A. Removal

1. Release quarter-turn fasteners (5 on each side, 2 on top aft).
2. Remove machine screws from around intake (2 each side).
3. Pull slightly aft and then up, and remove upper cowling.
4. Remove the screws securing the bottom cowling at its aft end and fuselage firewall flange.
5. In TC S/N's 3257001 & up only: remove screws (12) from around the induction air intake grill and remove grill.
6. Remove screws which support bottom cowling to the nose gear doors support brackets and fuselage firewall flange.
7. In HP S/N's 3246001 & up only: remove screws securing induction air filter housing to lower cowling (8 places) and disengage housing from NACA duct.
8. Remove clamps securing fresh air inlet.
9. Remove clamps securing alternator cooling air.
10. Push nose gear doors inward against spring pressure and remove bottom cowling.

B. Cleaning, Inspection and Repair.

1. Clean cowling with a suitable cleaning solvent and wipe dry with a clean cloth.
2. Inspect cowling for dents, cracks, loose rivets, elongated holes and damaged or missing fasteners.
3. Repair all defects to prevent further damage.

C. Installation.

1. Position the bottom cowling in place.
2. In HP S/N's 3246001 & up only: engage filter housing to NACA duct.
3. Secure bottom cowling with screws along the sides, nose gear doors support brackets, and firewall flange.
4. In TC S/N's 3257001 & up only: replace the induction air intake grill and reinstall and secure screws (12).
5. In HP S/N's 3246001 & up only: secure lower cowling assembly to induction air filter housing with screws (8).
6. Install hose and secure clamp for fresh air inlet.
7. Install hose and secure clamp for alternator cooling air.
8. Install the upper cowling.

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CHAPTER

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ENGINE FUEL SYSTEM

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DISTRIBUTION

A. Fuel Injector Maintenance (Refer to Figures 73-2 and 73-3)

1. In general, little attention is required between injector overhauls. However, it is recommended that the following items be checked during periodic inspection of the engine:

   a. Check tightness and lock of all nuts and screws which fasten the injector to the engine, torquing all nuts to 135-150 inch-pounds.
   b. Seat the pal type locknuts and finger tighten them against the plain nuts. After this has been done tighten the locknuts an additional 1/3 to 1/2 turn.
   c. Check all fuel lines for tightness and evidence of leakage. A slight fuel stain adjacent to the air bleed nozzles is not cause for concern.
   d. Check throttle and mixture control rod ends and levers for tightness and lock.
   e. Remove and clean the injector inlet strainer at the first 25 hours of operation and each 50 hour inspection thereafter. Check the screen for distortion or openings in the strainer. Replace for either of these conditions. Clean screen assembly in solvent and dry with compressed air. Damaged strainer O-rings should be replaced. To install the screen assembly, place the gasket on the screen assembly and install the assembly in the throttle body and tighten to 35-40 inch-pounds torque.

B. Fuel Nozzle (Air Bleed) (Refer to Figure 73-1)

1. Removal of Fuel Nozzle (Air Bleed)

— CAUTION —

THE FUEL NOZZLES MUST BE CAREFULLY REMOVED, OR THE CYLINDERS MAY BE DAMAGED.

   a. Remove the lower engine cowl.
   b. Disconnect the fuel line from the nozzle.
   c. Carefully remove the nozzle, using the correct size deep socket.
   d. Clean and inspect the nozzle as given in the next paragraph.

2. Cleaning and Inspection of Fuel Nozzle (Air Bleed)

   a. Clean the nozzle with acetone or equivalent and blow out all foreign particles with compressed air in the direction opposite that of fuel flow. Do not use wire or other hard objects to clean orifices. Refer to Lycoming Service Instruction No. 1275, rev. B or latest revision.
   b. Inspect the nozzle and cylinder threads for nicks, stripping or cross-threading.
   c. Inspect for battered or rounded hexagons.
   d. A test procedure for air bleed nozzles is described in Lycoming Service Instruction No. 1275, rev. B or latest revision.

DISTRIBUTION (cont)

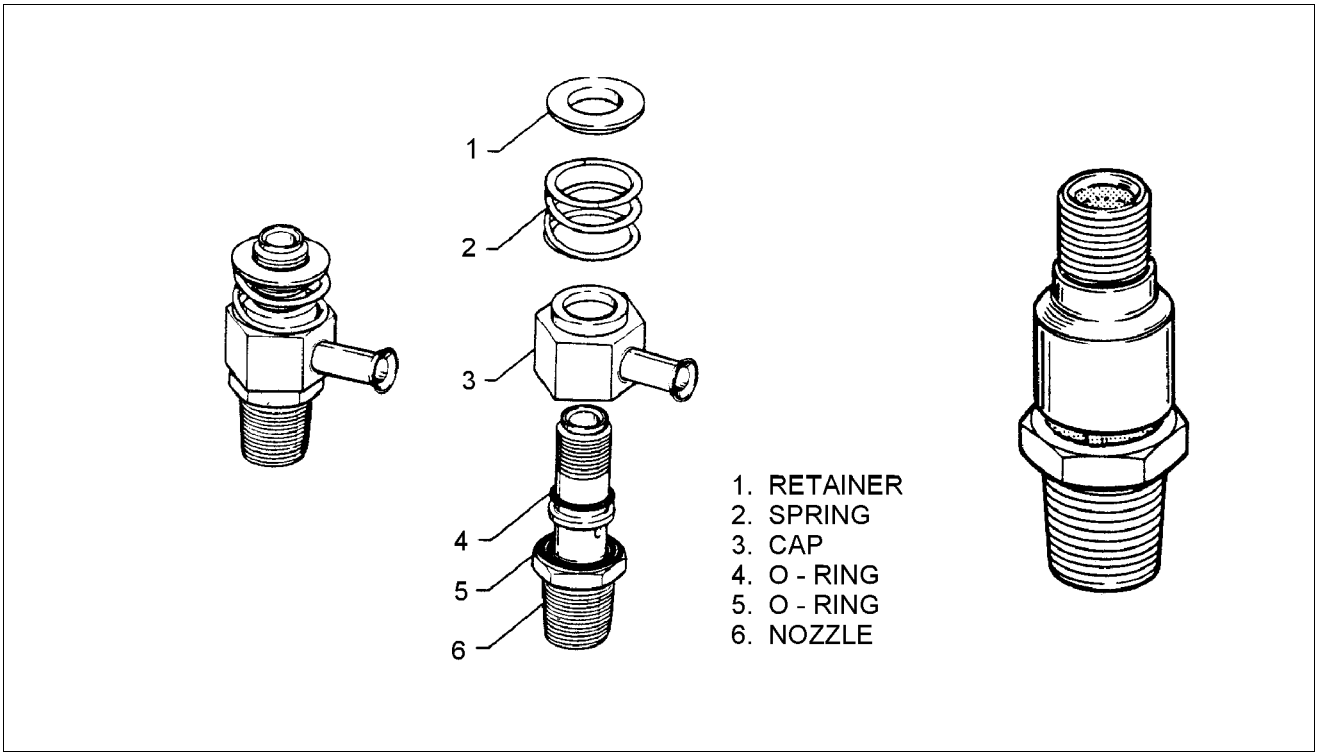


Figure 73-1. Fuel - Air Bleed Nozzle

3. Installation of Fuel Nozzle (Air Bleed)

— CAUTION —

WHEN INSTALLING THE FUEL NOZZLES, BE CAREFUL AS YOU APPROCH THE CYLINDERS TO AVOID DAMAGING THE CYLINDERS AND FUEL NOZZLES.

a. Installation and torque procedures for the fuel nozzles are per Lycoming Service Instruction No. 1275, rev. B or latest revision.
b. Carefully install the nozzle, using the correct size deep socket.
c. Connect the fuel line to the nozzle.
d. Install the lower engine cowl.

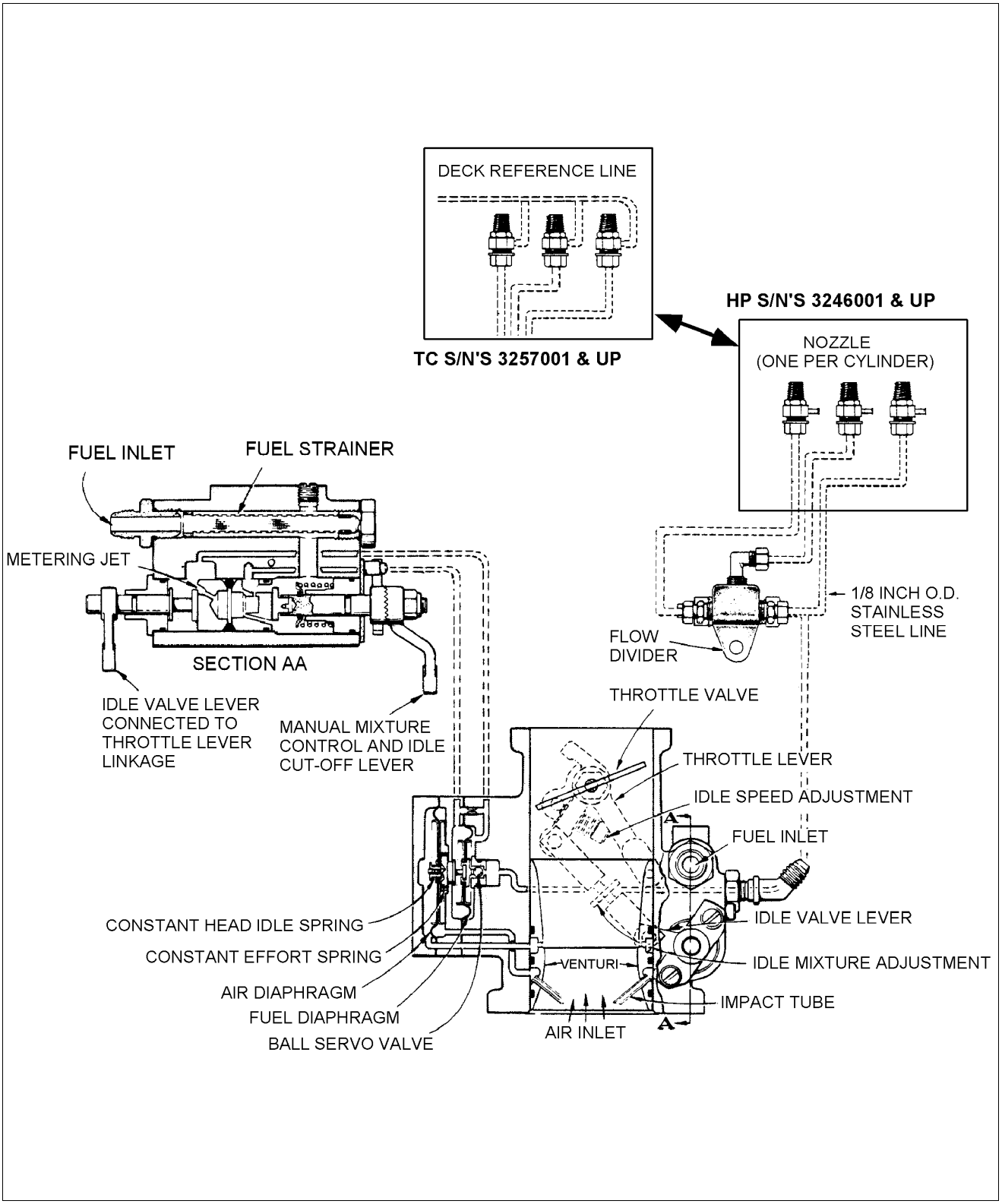
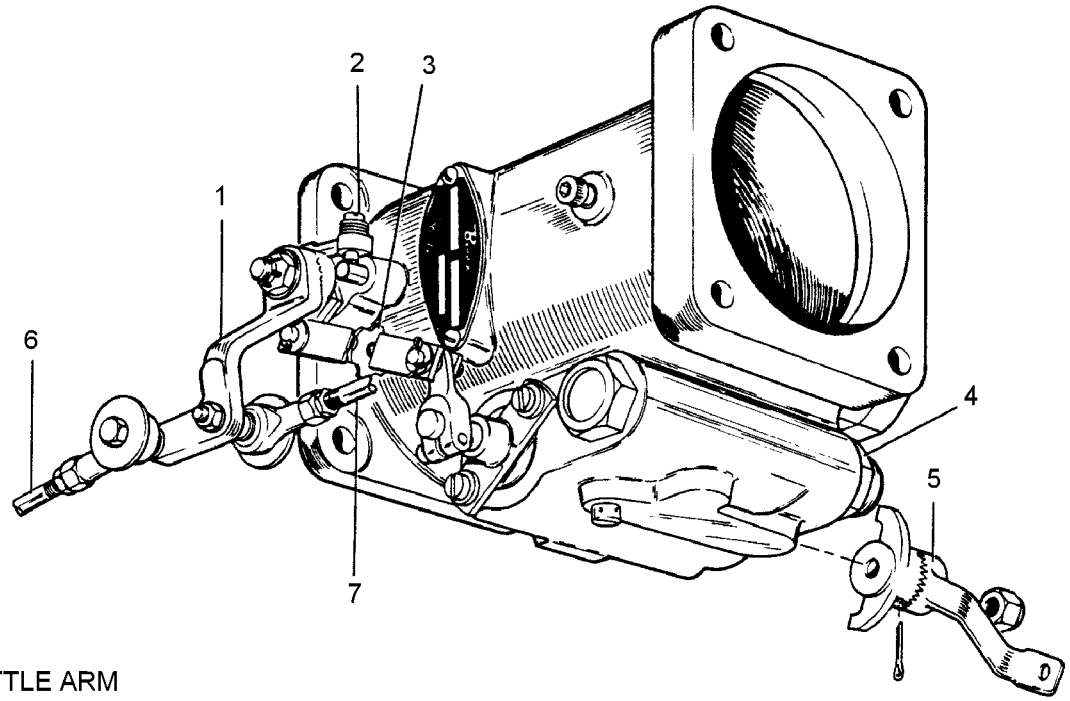


Figure 73-2. Schematic Diagram of RSA Fuel Injection System



1. THROTTLE ARM
2. IDLE SPEED ADJUSTMENT
3. IDLE MIXTURE ADJUSTMENT
4. FUEL SCREEN
5. MIXTURE ARM
6. THROTTLE CONTROL CABLE
7. WASTE GATE INTERCONNECT (TC S/N'S 3257001 & UP ONLY)

Figure 73-3. Fuel Injector

DISTRIBUTION (cont)

C. Adjustment of Idle Speed and Mixture

1. Start the engine and warm up in the usual manner until oil and cylinder head temperatures are normal.
2. Check magnetos. If the “mag-drop” is normal, proceed with idle adjustment.
3. Set throttle stop screw so that the engine idles at 700 RPM (± 50 RPM). If the RPM changes appreciably after making the mixture adjustment during the succeeding steps, readjust the idle speed to the desired RPM.
4. When the idling speed has been stabilized, move the cockpit mixture control lever with a smooth, steady pull toward the “Idle Cut-Off” position and observe the tachometer for any change during the leaning process. Caution must be exercised to return the mixture control to the “Full Rich” position before the RPM can drop to a point where the engine cuts out. An increase of more than 10 RPM while “leaning out” indicates an excessively rich idle mixture. An immediate decrease in RPM (if not preceded by a momentary increase) indicates the idle mixture is too lean.
5. If the above indicates that the idle adjustment is too rich or too lean, turn the idle mixture adjustment in the direction required for correction, and check this new position by repeating the above procedure. Make additional adjustments as necessary until a check results in a momentary pick-up of approximately 5 (never more than 10) RPM. Each time the adjustment is changed, the engine should be run up to 2000 RPM to clear the engine before proceeding with the RPM check. Make final adjustment of the idle speed adjustment to obtain the desired idling RPM with closed throttle. The above method aims at a setting that will obtain maximum RPM with minimum manifold pressure. In case the setting does not remain stable, check the idle linkage; any looseness in this linkage would cause erratic idling. In all cases, allowance should be made for the effect of weather conditions and field altitude upon idling adjustment.

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CONTROLLING

Adjustment of Throttle and Mixture Controls (Refer to Figure 73-4.)

Throttle and Mixture Controls are adjusted so that when the throttle arm on the fuel injector is rotated forward against its full throttle stop and the mixture control is rotated forward against its full rich stop, the cockpit control levers of the throttle and mixture should have 0.010 to 0.030 of an inch spring back on instrument panel stop when in full throttle or full rich position.

1. The throttle may be adjusted as follows:
   (a) At the fuel injector, disconnect the clevis end of the throttle control cable from the control arm. Loosen the jam nut that secures the clevis end.
   (b) Adjust the linkage by rotating the clevis end on the cable to obtain 0.010 to 0.030 of an inch spring back on instrument panel stop when in full throttle position.
   (c) On aircraft equipped with air conditioning systems, a micro switch is located below the throttle control which is set to actuate in the full open position. With the throttle adjusted to obtain a clearance of .010 to .030, adjust the micro switch to actuate at this point also.
   (d) Reconnect the clevis end to the control arm and safety.
2. The mixture may be adjusted as follows:
   (a) At the fuel injector, disconnect the clevis end of the mixture control cable from the control arm. Loosen the jam nut that secures the clevis end.
   (b) Adjust the linkage by rotating the clevis end on the cable to obtain 0.010 to 0.030 of an inch spring back on the instrument panel stop when in full rich position.
   (c) Reconnect the clevis end to the control arm and safety.

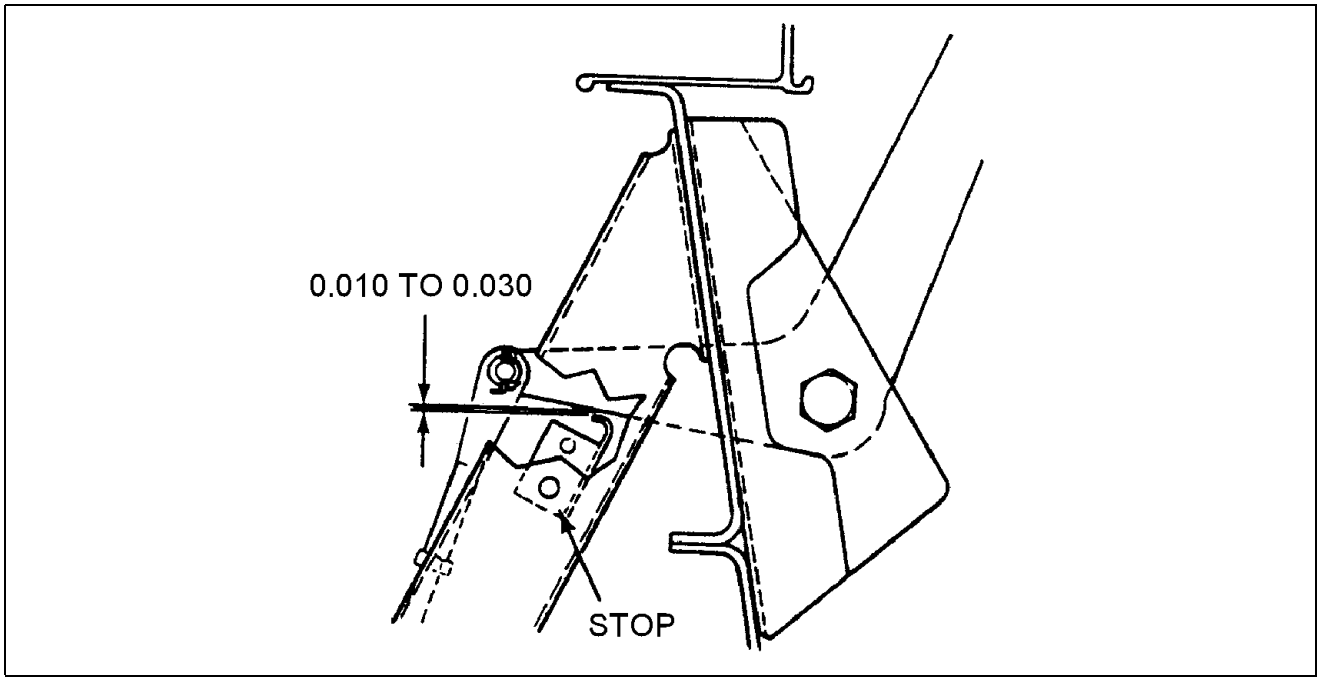

Figure 73-4. Adjustment of Engine Controls

CONTROLLING (cont)

3. Check security of cable casing attachments.
4. Pull the throttle and mixture levers in the cockpit full aft to ascertain that the idle screw contacts its stop and the mixture control arm contacts its lean position. A mixture control lock is incorporated in the quadrant cover which prevents the mixture control from being moved to the idle cutoff position inadvertently. The lock must be depressed before the control can be moved completely aft. Ascertain that the lock operates freely without any tendency to bind or hang up.

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CHAPTER

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IGNITION

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CHAPTER 74 - IGNITION

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ELECTRICAL POWER SUPPLY

1. IGNITION SYSTEM

— WARNING —

THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT. (SEE INTRODUCTION, PAGE 4.)

A. Description

Ignition of the fuel charge in each cylinder is accomplished by two spark plugs independently excited by one of two Slick 6300 series magnetos. Each magneto separately generates, times and distributes high tension (voltage) through leads to each cylinder. In TC S/N's 3257001 & up only, both magnetos are pressurized by turbo compressor bleed air to improve magneto efficiency at altitude.

The magnetos are controlled by two switches in the overhead switch panel (HP S/N's 3246018 & up; TC S/N's 3257001 & up) or by the combination magneto/ignition keylocked switch in the pilot's instrument panel (HP S/N's 3246001 thru 3246017 only). 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.

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 reachs 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.

B. Replacement Magnetos

— Note —

Check the magneto data plate to verify the specific model number and series of the magneto being worked on.

C. Overhaul

Overhaul is required as conditions indicate, but in no case may Slick 6300 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.

— Note —

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.

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
Unison Industries
Attn: Subscription Dept.
530 Blackhawk Park Avenue
Rockford, IL 61104

PH: 815-965-4700

D. Troubleshooting

CHART 7401. 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.

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.

(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 Remove plug in front of number six cylinder. Rotate crankshaft slowly to observe timing mark on alternator drive gear. When the mark on the gear is centered in the viewing hole, number one piston is at 20° BTC.

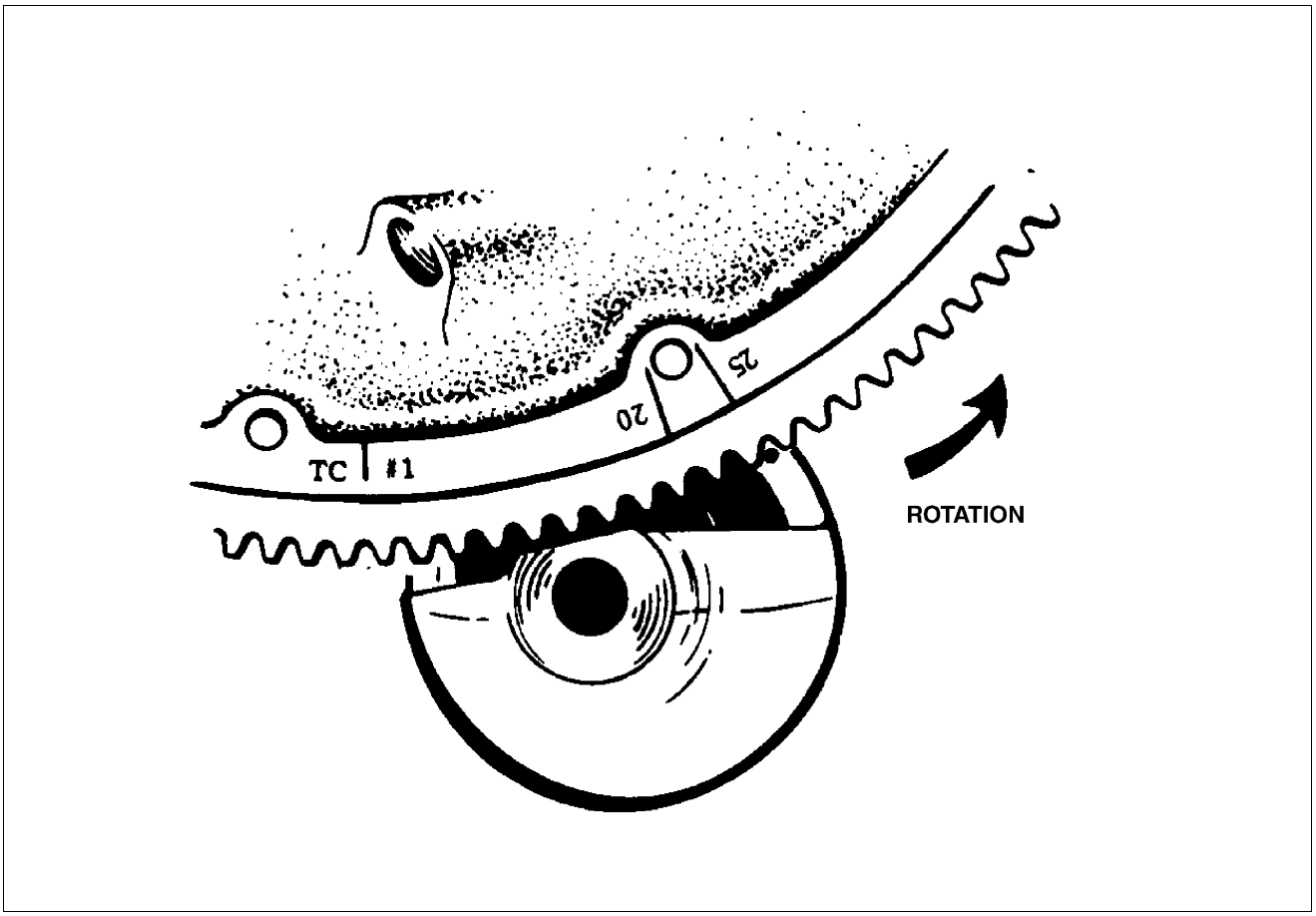


Figure 74-1. Engine Timing Marks

(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.

(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) In HP S/N's 3246001 & up only (i.e. - non-pressurized magnetos), 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.

(5) In TC S/N's 3257001 & up only (i.e. - pressurized magnetos):

(a) Inspect turbo filter. Look for yellow or red color, condensation, water, or foreign matter in the filter element. If the filter is contaminated: replace filter; inspect and repair pressurization system; and remove and inspect magnetos.

(b) Inspect and clean inlet nozzle. Yellow or white particles or any oily film indicates moisture contamination and possible lack of pressurization. Inspect and repair pressurization system.

(c) Inspect and clean ofifice vent. Maximum orifice diameter is .025 inch.

B. Removal

— CAUTION —

ASCERTAIN THAT THE PRIMARY CIRCUIT OF THE ENGINE IS GROUNDED BEFORE WORKING ON THE ENGINE.

Before removing the magnetos, make sure the magneto switches are OFF.

— 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 74-2). 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.

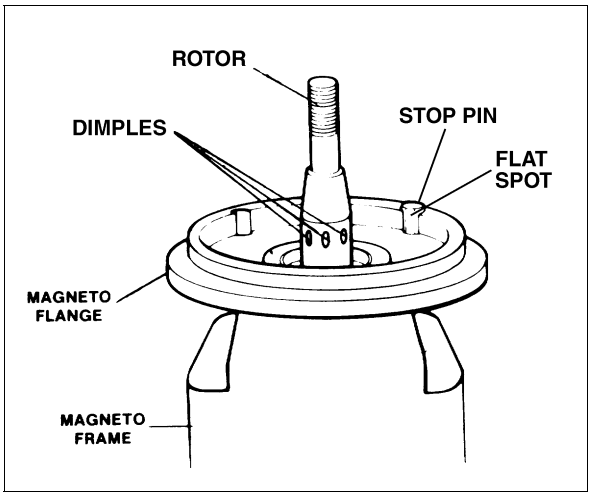


Figure 74-2. Rotor and Stop Pin

(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 74-4). 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 74-4.

(g) Maximum clearance for pawls with one boss is .150 inch (see Figure 74-5). 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 74-2). Replace magneto frame, if found.

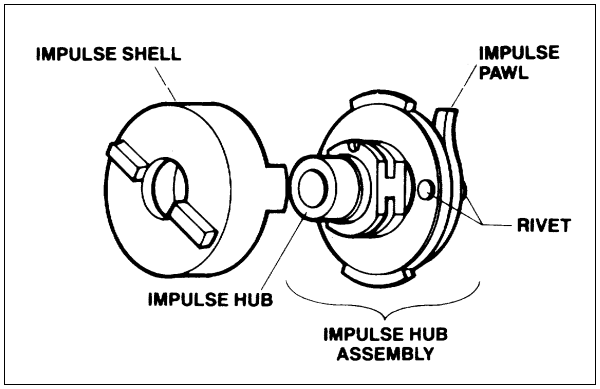


Figure 74-3. Impulse Coupling

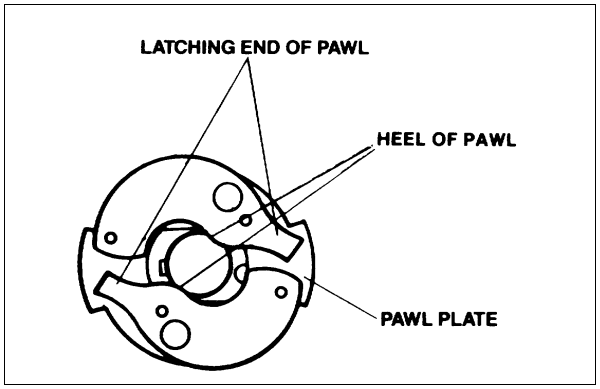


Figure 74-4. Impulse Coupling Pawls

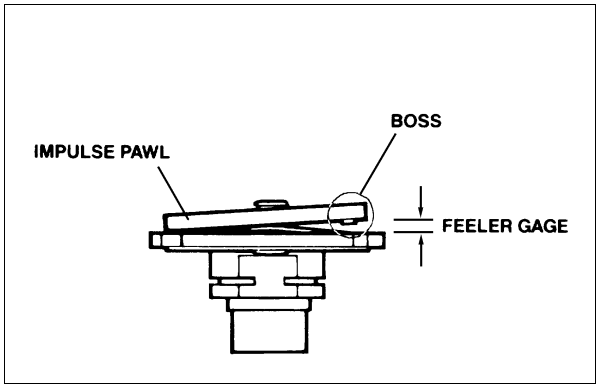


Figure 74-5. Measuring Pawl Clearance

(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.

(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.

(8) Clean and Inspect Distributor Block

(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.

— 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.

(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.

(9) Inspect the carbon brush. Overall length must be greater than 19/64 (.297) inch and the outside diameter must be uniform (see Figure 74-6). Replace as required.

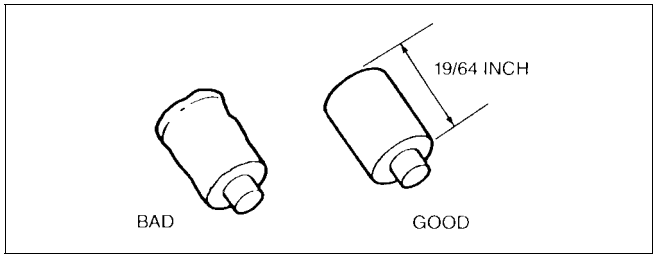


Figure 74-6. Carbon Brush Assembly

(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.

(11) In TC S/N's 3257001 & up only (i.e. - pressurized magnetos):

(a) Inspect turbo filter. Look for yellow or red color, condensation, water, or foreign matter in the filter element. If the filter is contaminated: replace filter; inspect and repair pressurization system; and remove and inspect magnetos.

(b) Inspect and clean inlet nozzle. Yellow or white particles or any oily film indicates moisture contamination and possible lack of pressurization. Inspect and repair pressurization system.

(c) Inspect and clean ofifice vent. Maximum orifice diameter is .025 inch.

(d) Inspect frame gasket for wear. Replace as required. Use only Slick replacement gaskets as gasket contains a metal mesh to insure proper ground between magneto frame and housing. Inspect screw gaskets for wear. Replace as required.

(e) Inspect harness cap O-ring for wear. Replace as required.

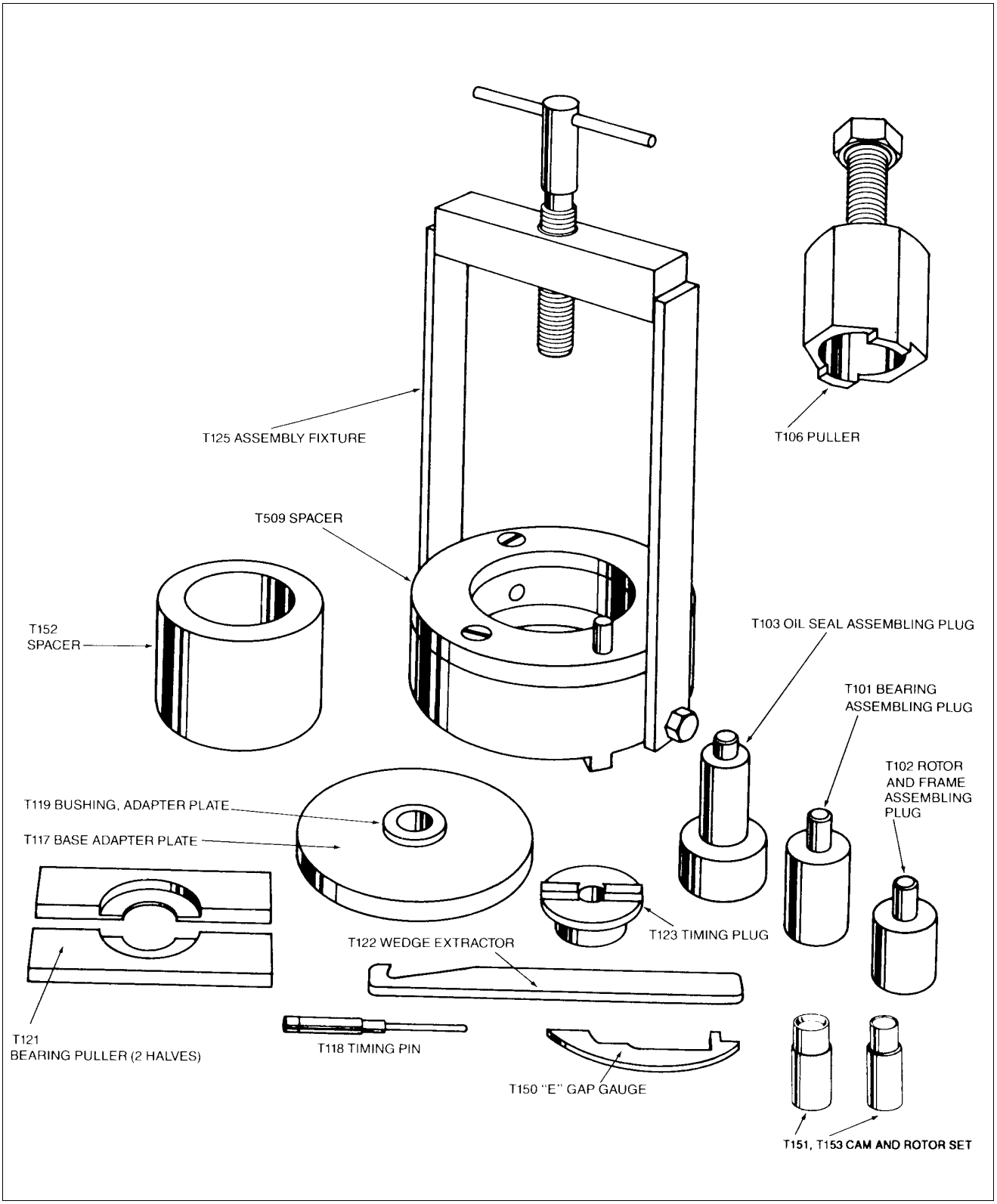


Figure 74-7. Slick T-100 Assembly and Timing Tool Kit

D. Disassembly (see Figures 74-7 and 74-8)

— Note —

Use of the Slick T - 100 Assembly and Timing Kit (Figure 74-7) 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:

(a) Remove cotter pin, nut, washer and bushing.

— CAUTION —

THE SHELL OF THE IMPULSE COUPLING ASSEMBLY IS UNDER CONSIDERABLE SPRING TENSION.

(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.

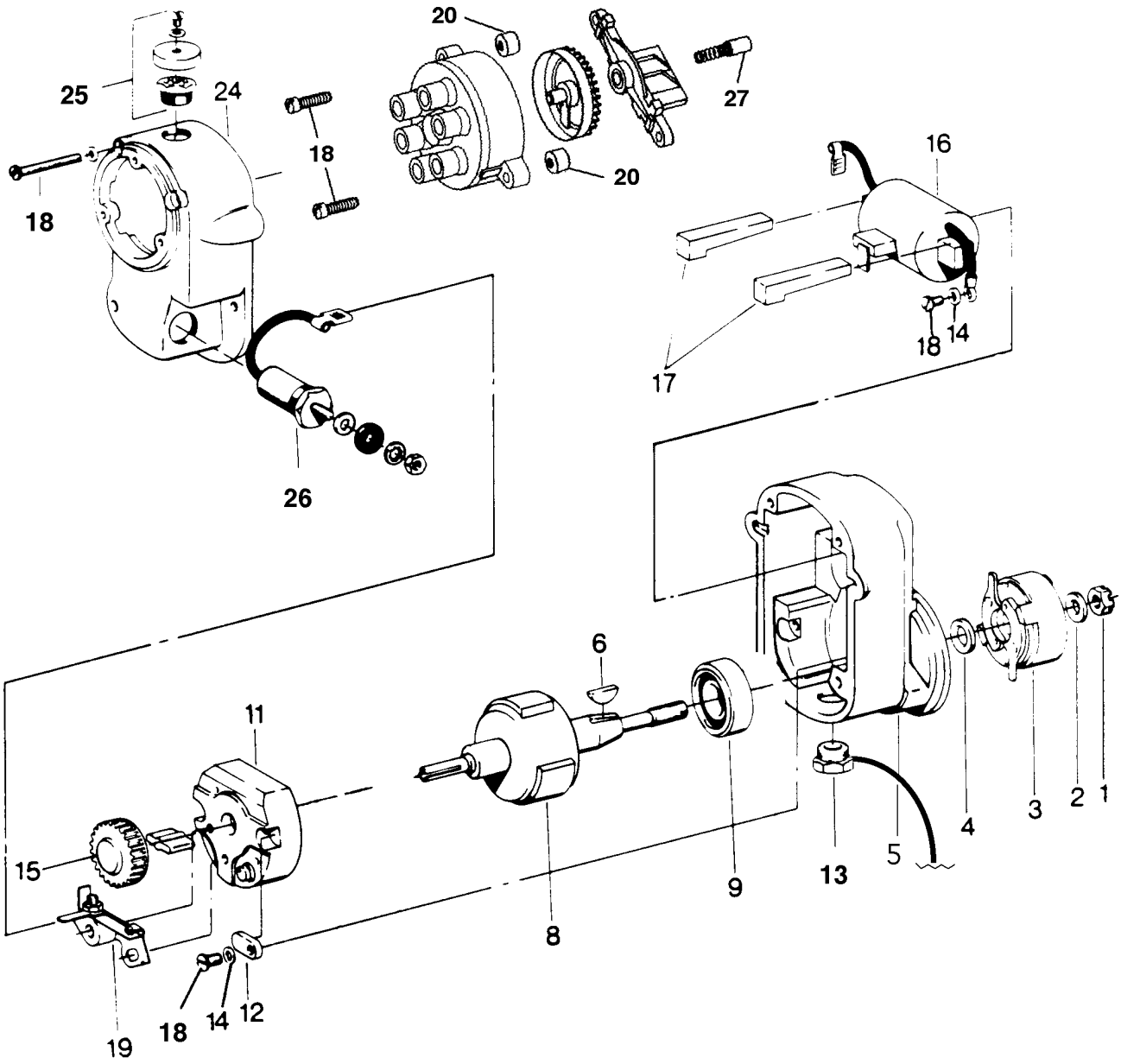
(c) Remove contact breaker assembly from bearing cap.

(d) Remove cam by prying straight up with a screwdriver blade.

(8) Remove rotor assembly

(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.



1. NUT IMPULSE COUPLING
2. WASHER IMPULSE COUPLING
3. IMPULSE COUPLING ASSY.
4. OIL SEAL
5. WOODRUFF KEY
7. NOT USED
8. ROTOR
9. BALL BEARING
10. NOT USED
11. BEARING CAP ASSEMBLY
12. BEARING CLAMP
13. HP S/N'S 3246088 & UP AND TC S/N'S 3257001 & UP:
    - TACH MAGNETIC SENSOR.
    HP S/N'S 3246001 THRU 3246087 ONLY:
    - AIR VENT (SEE #25)
14. THICK LOCK WASHER
15. ROTOR GEAR
16. COIL
17. COIL WEDGE
18. SCREW (VARIOUS)
19. CONTACT POINT KIT
20. SPACER
21. BEARING BAR
22. GEAR, DISTRIBUTOR
23. BLOCK, DISTRIBUTOR
24. HOUSING, DISTRIBUTOR
25. HP S/N'S 3246001 & UP:
    - AIR VENT WITH HOOD.
    TC S/N'S 3257001 & UP:
    - PRESSURE TUBE FITTING (NOT SHOWN)
26. CONDENSOR
27. CARBON BRUSH

Figure 74-8. Exploded View of 6300 Series Magneto

(9) Remove bearings from shaft and discard

(a) Place rotor on T-152 spacer with drive end down. Using T-125 assembly fixture, press rotor shaft, removing bearing cap assembly.

— 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.

(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.

— CAUTION —

DO NOT ALLOW ROTOR TO COME INTO CONTACT WITH METAL CHIPS OR FILINGS. ROTOR IS MAGNETIZED.

(10) Remove coil

(a) Remove coil primary ground screw.

(b) Using coil wedge extractor T-122, remove coil wedges and lift out coil (see Figure 74-9).

(11) Remove air vent/pressure vent plug from magneto.

(12) Remove oil seal from magneto.

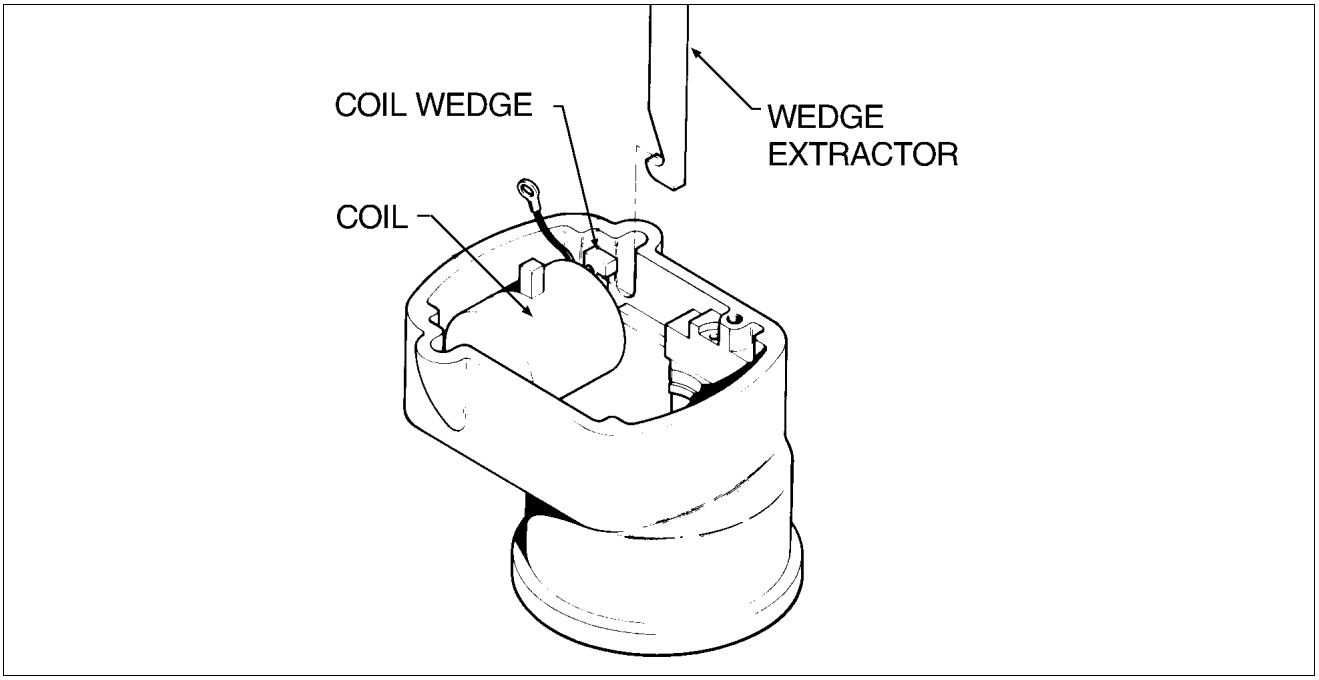


Figure 74-9. Removing Coil Wedges

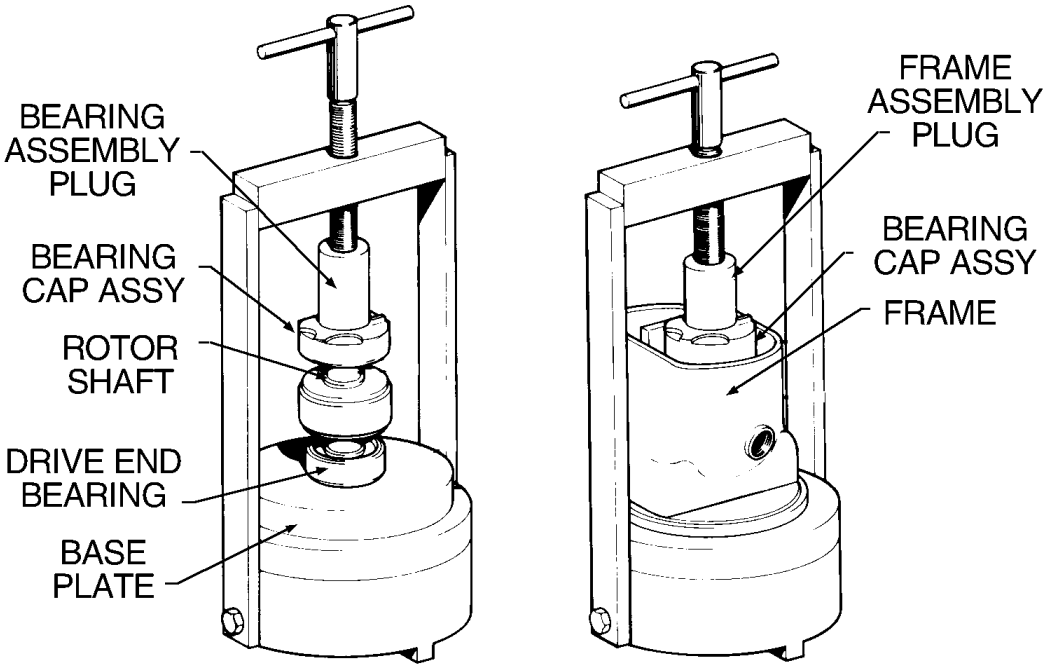


Figure 74-10. Installation of Bearings

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 74-10)

(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.

(2) Install rotor shaft assembly (see Figure 74-10)

(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.

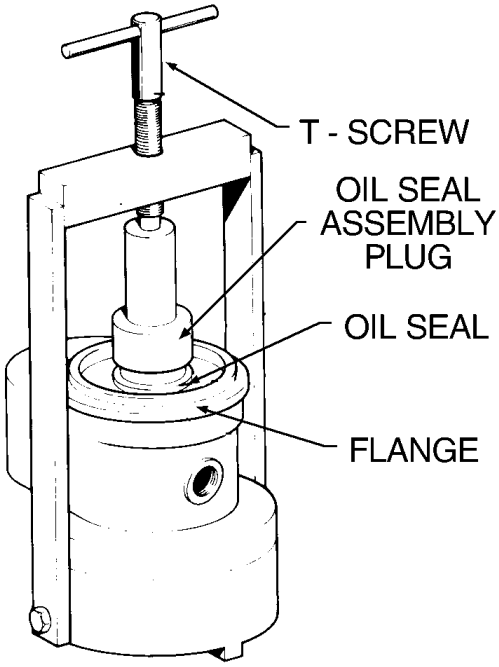


Figure 74-11. Magneto Oil Seal Installation on T-125 Assembly Fixture

(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.

(3) Install oil seal (see Figure 74-11)

(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 320 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.

(c) Position the coil high tension lead flush to 1/32 (.031) inch below the parting surface of the magneto frame.

— 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.

(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.

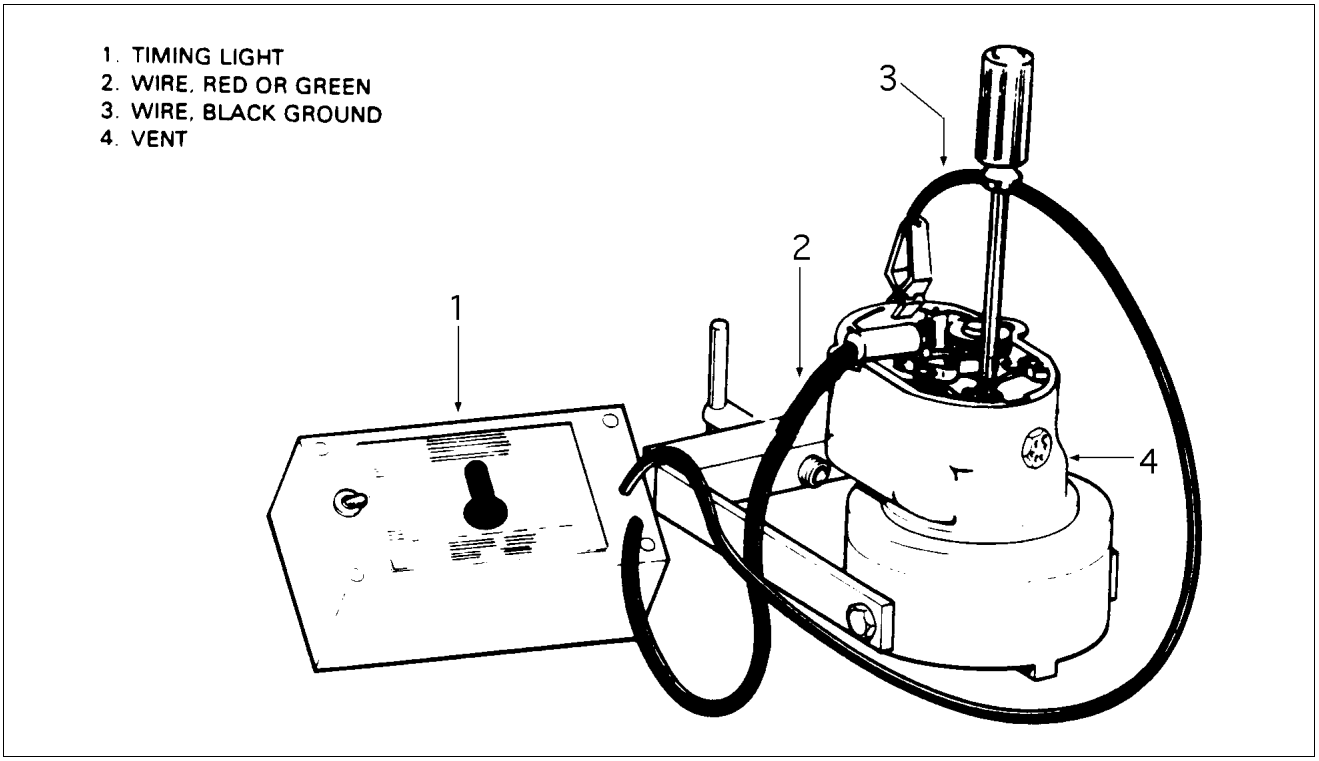


Figure 74-12. Magneto Internal Timing

(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, 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 74-13.

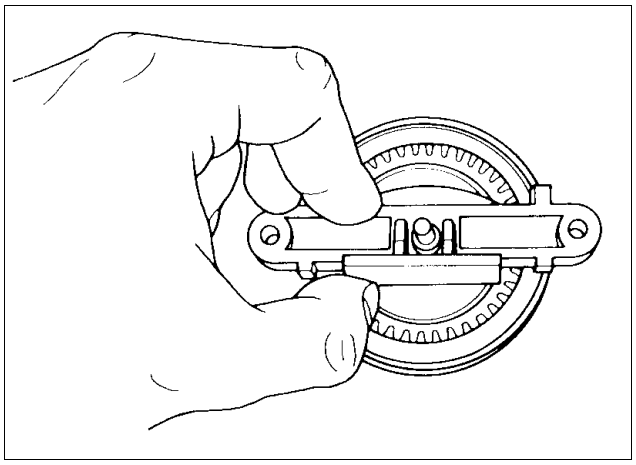


Figure 74-13. Bearing Bar Assembly

(14) Install rotor gear onto end of rotor shaft.

(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 74-14)

(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.

(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.

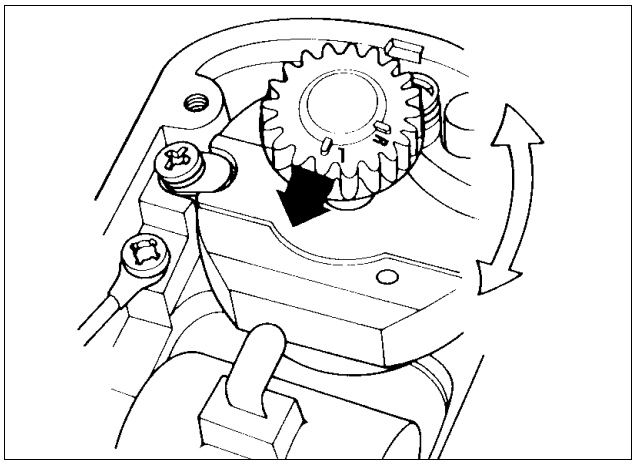


Figure 74-14. Rotor Gear Alignment

(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.

(19) In TC S/N's 3257001 & up only (i.e. - pressurized magnetos), install the distributor housing gasket.

(20) Insert the top boss of the distributor housing into its mating pilot on the magneto frame.

(21) Gently rotate the distributor housing onto 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.

(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.

— 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.

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.

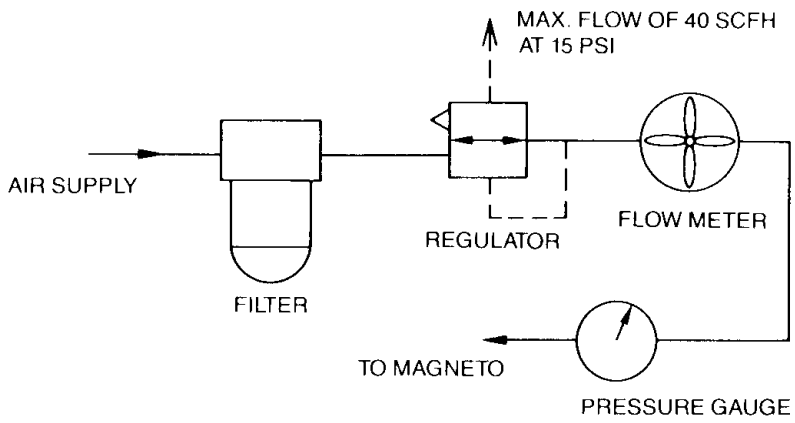


Figure 74-15. Pressurized Magneto Pressure Testing

(5) Pressure Testing - In TC S/N's 3257001 & up only (i.e. - pressurized magnetos)

After magneto reassembly, install a pressurized harness cap and apply 15 psi filtered air to the inlet nozzle of the magneto (See Figure 74-15). Air flow at 15 psi is not to exceed 40 standard cubic feet per hour (SCFH). If flow is excessive, reposition gaskets and retorque housing and harness cap screws. Screws should be torqued to 21-25 in-lbs. for 6300 series magnetos. Testing should be conducted with magneto at room temperature.

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 be 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, re-insert pin.

(4) When the pin sticks through the hole in the gear about 1/4 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) Cover spark plug hole of number one cylinder with thumb. Rotate crankshaft until pressure is felt on thumb.

(b) Remove plug in front of number six cylinder. Rotate crankshaft slowly to observe timing mark on alternator drive gear. When the mark on the gear (see Figure 74-1) is centered in the viewing hole, number one piston is at 20° BTC.

(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

IGNITION HARNESS

INSPECTION OF HARNESS

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.

REMOVAL OF HARNESS

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.

DISASSEMBLY OF HARNESS

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-1568 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

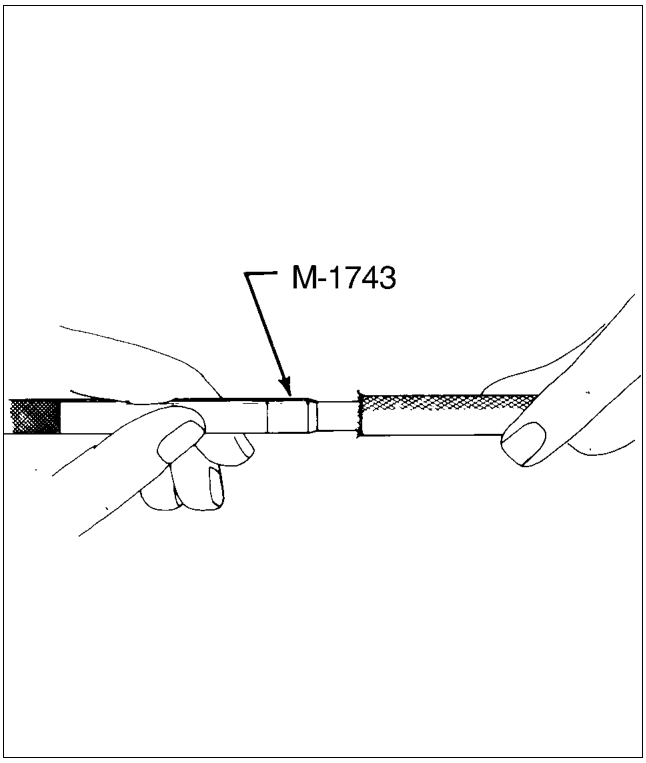

Figure 74-16. Stripping Tool

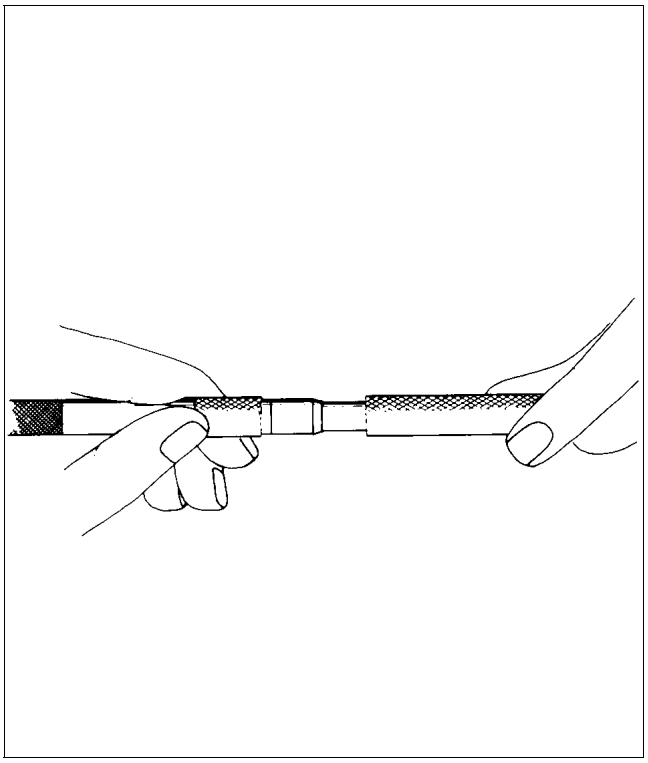

Figure 74-17. Inserting Stripping Tool

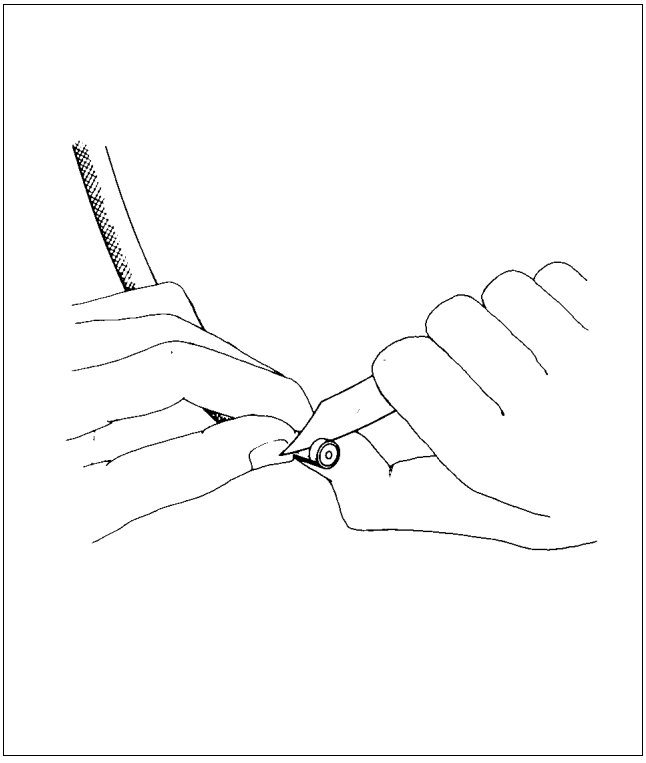

Figure 74-18. Cutting Insulation

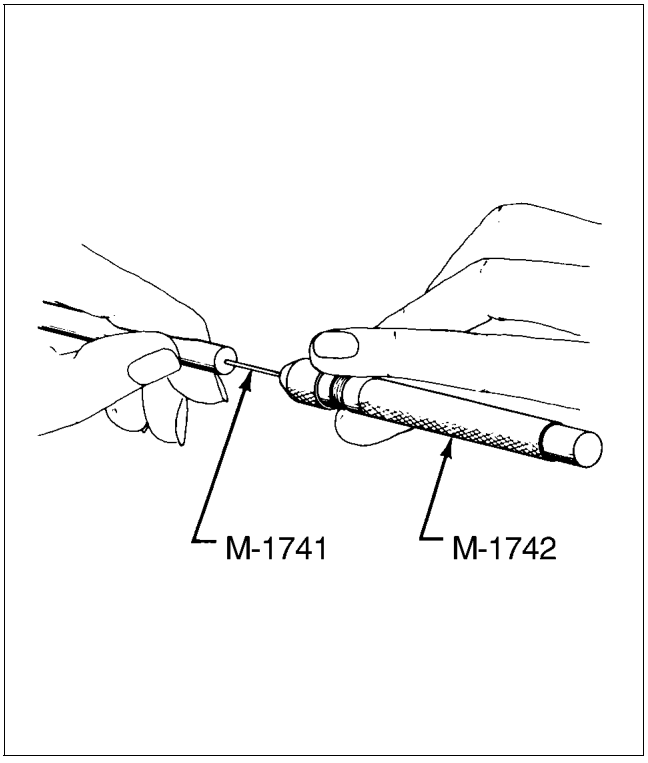

Figure 74-19. Removing Silicone Rubber from Wire

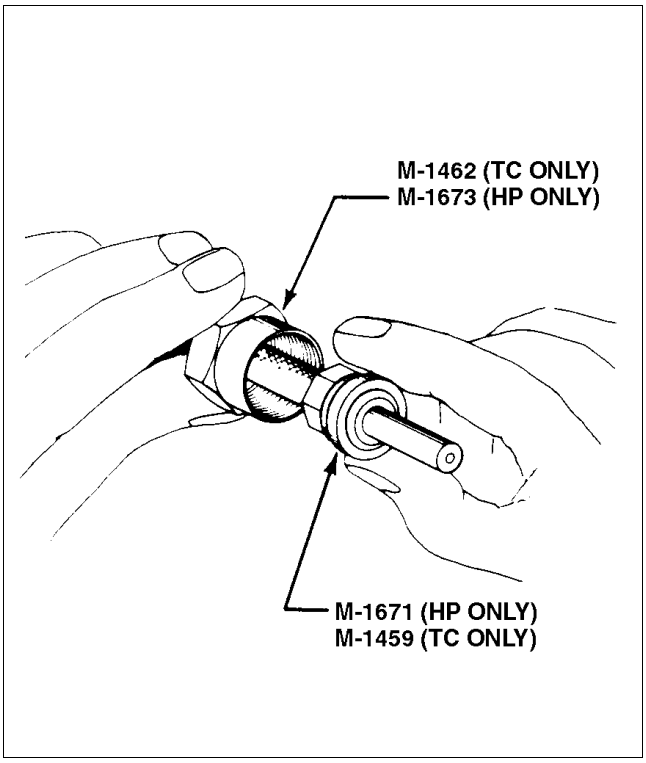

Figure 74-20. Installation of Plug Endnut

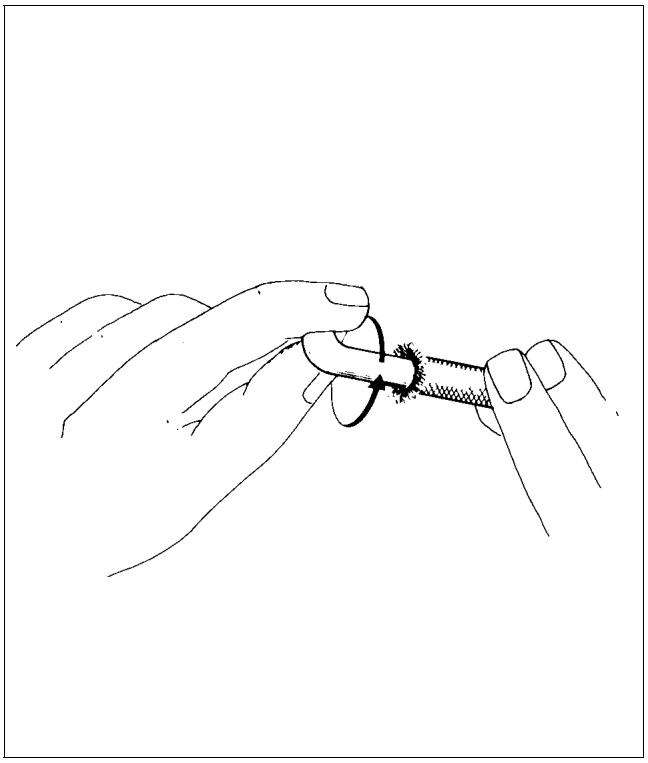

Figure 74-21. Flaring out the Shielding

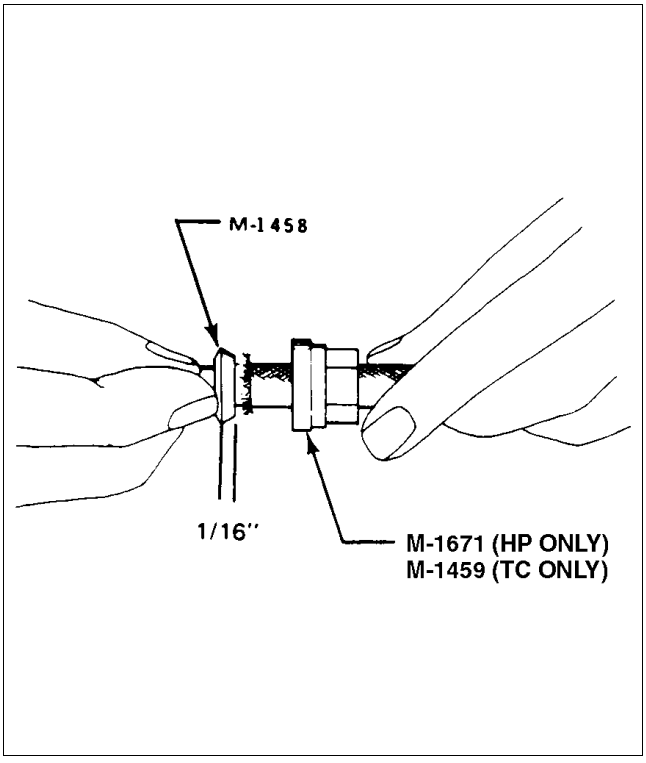

Figure 74-22. Installation of Ferrule

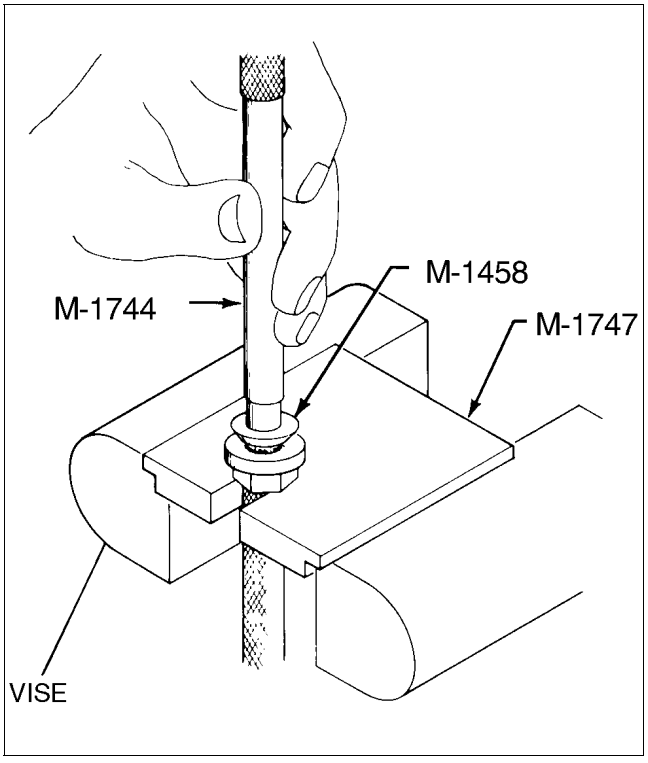

Figure 74-23. Driving Tool

HARNESS ASSEMBLY INSTRUCTIONS

— Note —

HP S/N's 3246001 & up use spark plugs with 5/8"-24 harness connectors while TC S/N's 3257001 & up use spark plugs with 3/4"-20 harness connectors.

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. (Refer to Figure 74-16.)
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. (Refer to Figure 74-17.)
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. (Refer to Figure 74-18.)
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. (Refer to Figure 74-19.)
7. On spark plug end of wire install M-1673 (HP only) / M-1462 (TC only) nut followed by M-1671 (HP only) / M-1459 (TC only) female taper hex ferrule. (Refer to Figure 74-20.)
8. After installation of nut and ferrule, bend and rotate silicone insulation as per Figure 74-21 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 (HP only) /M-1459 (TC only) over the M-1458 drive ferrule until tight. (Refer to Figure 74-22.)
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. (Refer to Figure 74-23.) Or, press into place using T-109 pressing tool.
11. For magneto end of wire, insert wire through hole in M-1568 harness cap so shielding is through hole as shown in Figure 74-24.
12. Install an M- 1458 male tapered drive ferrule over insulation and under shielding as in step 9, then drive ferrule into M-1568 harness cap using M-1744 drive tool, similar to step 10. (Refer to Figure 74-25.) 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. (Refer to Figure 74-26.)
14. On magneto end of wire, place M-3168 insulator sleeve over silicone insulation. On spark plug end of wire, use M-1677 insulator sleeve (HP only) or K-3300 insulator sleeve and washer (TC only). (Refer to Figure 74-27.)
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. (Refer to Figure 74-28.)

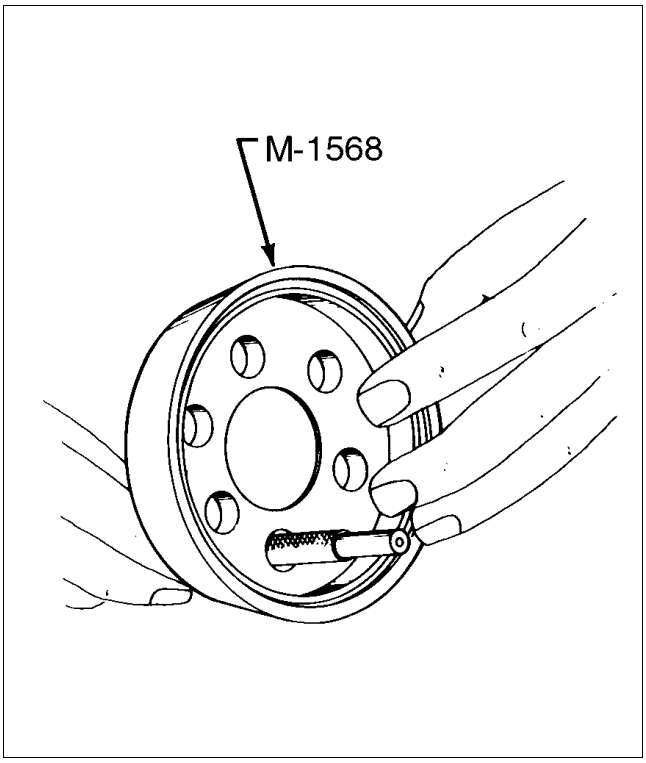

Figure 74-24. Installation in Harness Cap

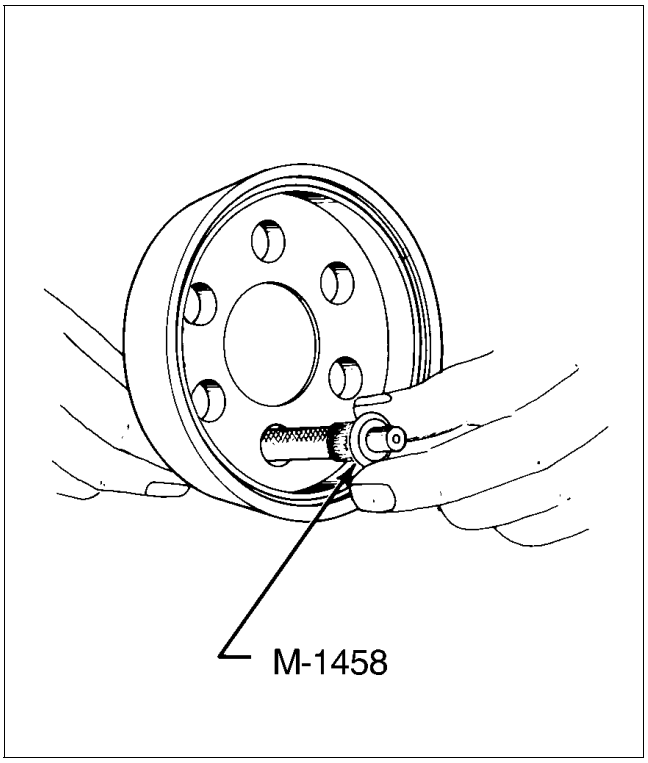

Figure 74-25. Securing Wire in Harness Cap

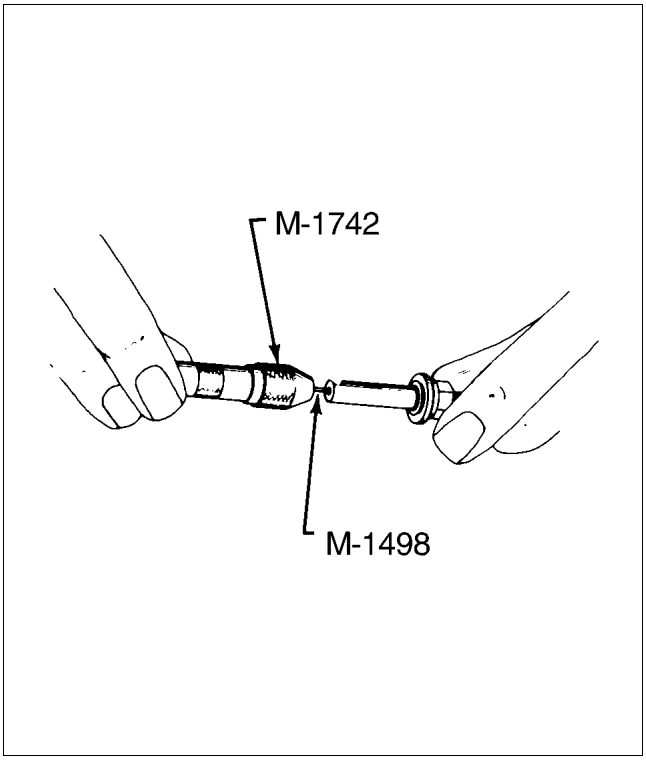

Figure 74-26. Installation of Electrode Screw

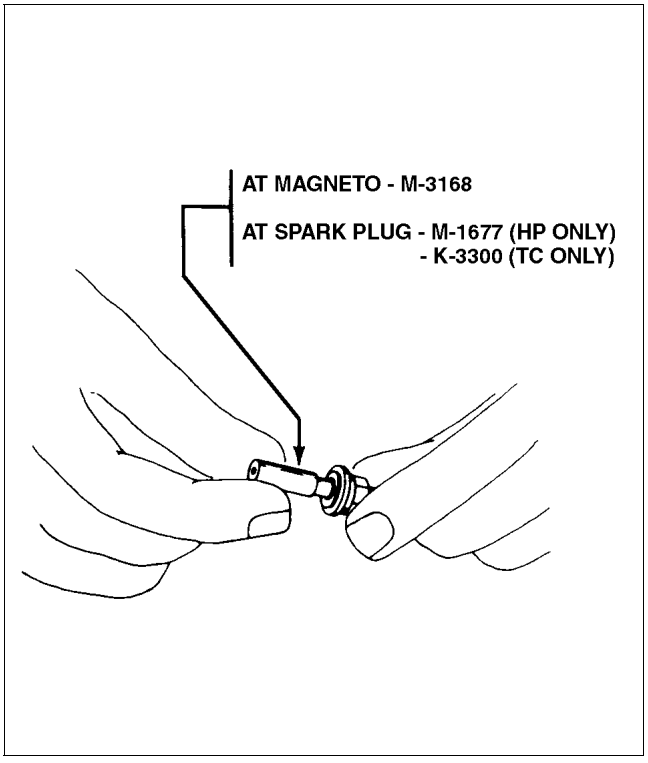

Figure 74-27. Installation of Insulator Sleeve

INSTALLATION OF HARNESS

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.

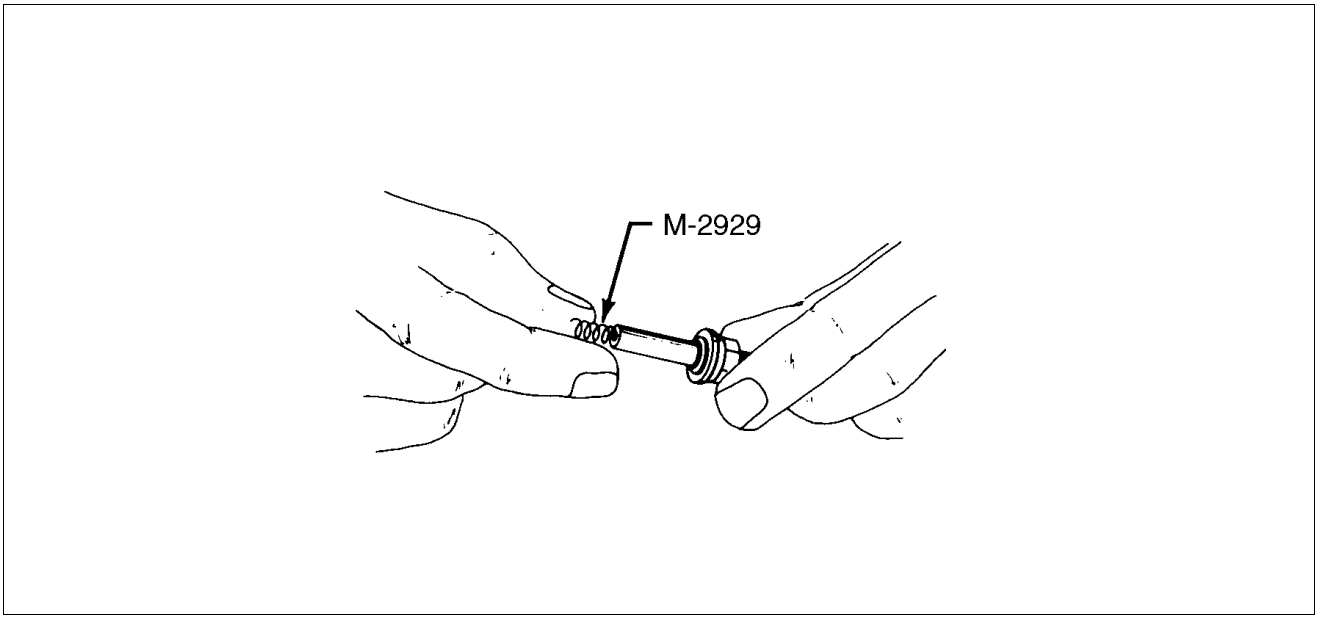

Figure 74-28. Installation of Spring

SPARK PLUGS

REMOVAL OF SPARK PLUGS (REFER TO FIGURE 71-29.)

— 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.

— continued on next page —

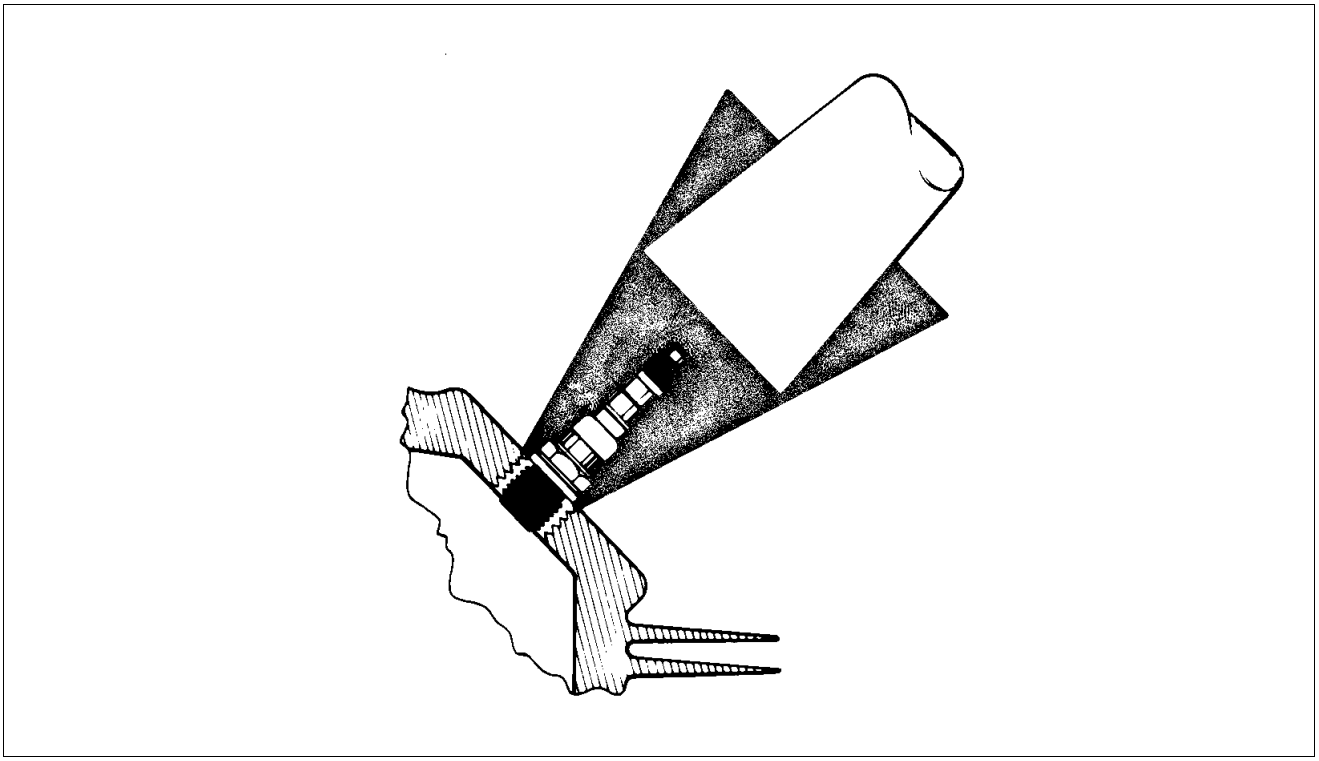

Figure 74-29. Removing Spark Plug Frozen to Bushing

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 74-29.) 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.

CHART 7402. COUPLING TORQUE

Application	Spark Plug Coupling Threads	Torque (In. - Ib.)
HP S/N's 3246001 & UP	5/8-24	90 - 95
TC S/N's 3257001 & UP	3/4-20	110 - 120

INSPECTION AND CLEANING OF SPARK PLUGS

1. Visually inspect each spark plug for the following non-repairable defects.

   a. Severely damaged shell or shield; threads nicked up, stripped, or 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 0.016 to 0.022 inch.

INSTALLATION OF SPARK PLUGS

— 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 420 inch-pounds.
3. Carefully insert terminal insulator in spark plug and tighten coupling nut.

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SWITCHING.

MAGNETO AND STARTER SWITCHES.

In HP S/N's 3246001 thru 3246017 only, the magneto switches and the starter switch are combined in a key operated switch located on the lower left of the instrument panel.

In HP S/N's 3246018 & up and TC S/N's 3257001 & up, the magneto switches and the starter switch are located in the overhead switch panel.

REMOVAL AND INSTALLATION.

Refer to Chapter 39 for removal and installation procedures.

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CHAPTER

77

ENGINE INDICATING

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CHAPTER 77 - ENGINE INDICATING

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL

Two significantly different engine instrumentation packages are installed in these aircraft.

HP S/N's 3246001 thru 3246087 only use traditional 3-inch analog display, electrically or mechanically actuated engine instruments. These instruments and their function are addressed in Section 77-10-00 and 77-20-00.

HP S/N's 3246088 & up and TC S/N's 3257001 & up use an electronic engine monitoring system by Flightline/Horizon which incorporates 2-inch analog display, electronically actuated engine instruments and a multi-function Digital Display Monitoring Panel (DDMP). This system is addressed in Section 77-40-00.

REMOVAL AND INSTALLATION

A. Engine Instruments

— CAUTION —

REPLACEMENT OF FUEL QUANTITY INDICATOR REQUIRES THAT THE INDICATOR BE CALIBRATED PER THE PROCEDURE GIVEN IN CHAPTER 28-40-00.

(1) Remove instruments as follows:

(a) From front of instrument panel, loosen the larger of the two screws next to the instrument. (No need to remove screw completely.)

(b) Pull instrument out to gain access to connector on back of instrument.

(c) Twist connector on back of instrument to disconnect connector from instrument.

(2) Install instruments as follows:

(a) Holding instrument in front of proper position at instrument panel, connect connector to back of instrument.

(b) Insert instrument completely into instrument panel.

(c) Tighten screw.

B. Digital Display Monitoring Panel (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up)

(1) Remove DDMP as follows:

(a) From front of instrument panel, loosen four screws securing DDMP to the instrument panel.

(b) Pull DDMP out to gain access to connectors on back of DDMP.

(c) Twist connectors on back of DDMP to disconnect connectors from DDMP.

(2) Install DDMP as follows:

(a) Holding DDMP in front of proper position at instrument panel, connect connectors to back of DDMP.

(b) Insert DDMP completely into instrument panel.

(c) Tighten screws.

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POWER

A. Manifold Pressure Gauge (HP S/N's 3246001 thru 3246087 only)

The manifold pressure gauge is a vapor proof, absolute pressure type instrument. Pressure from the intake manifold of the engine is transmitted to the instrument through a line. A pointer indicates the manifold pressure available at the engine in inches of mercury.

CHART 7701. 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.

POWER (cont)

B. Tachometer Indicator (HP S/N's 3246001 thru 3246087 only)

The tachometer is connected to the engine accessory by a flexible cable and provides an indication of crankshaft speed in revolutions per minute. The instrument has a recording mechanism for recording the time that the engine is in actual operation.

CHART 7702. TROUBLESHOOTING TACHOMETER

Trouble	Cause	Remedy
No reading on indicator, either permanent or intermittent	Broken shaft.	Replace instrument.
	Loose cable connections.	Tighten cable.
Pointer oscillates excessively.	Rough spot on, or sharp bend in shaft.	Repair or replace.
	Excessive friction in instrument.	Replace instrument.
Indicator changes in climb.	Excessive clearance in speed cup.	Replace instrument.
Pointer goes all the way to stop, more noticeable in cold weather.	Excessive lubricant in instruments.	Replace instrument.
Pointer jumps at idle.	Speed cup hitting rotating magnet.	Replace instrument.
Tachometer cable breaks.	Cable bent too sharply.	Reroute cable.

POWER (cont)

C. Engine Oil Pressure Gauge (HP S/N's 3246001 thru 3246087 only)

The oil pressure gauge is part of the combination engine gauge which also includes the oil temperature gauge and the cylinder head temperature gauge. This gauge will indicate the amount of oil pressure available at the pressurized engine oil passage.

CHART 7703. TROUBLESHOOTING OIL PRESSURE GAUGE

Trouble	Cause	Remedy
Excessive error at zero.	Pointer loose on shaft. Overpressure or seasoning of bourdon tube.	Replace instrument.
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation	Air in line or rough engine relief.	Disconnect line and fill with light oil. Check for leaks. If trouble persists, clean and adjust relief valve.
Sluggish operation of pointer or pressure fails to build up.	Engine relief valve open.	Clean and check.

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TEMPERATURE

A. Oil Temperature Indicator (HP S/N's 3246001 thru 3246087 only)

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 provide a temperature indication of the engine oil in degrees Fahrenheit. The instrument has a temperature bulb located in the oil screen assembly, on the engine accessory section.

CHART 7704. TROUBLESHOOTING OIL TEMPERATURE INDICATOR

Trouble	Cause	Remedy
Instrument fails to show any reading.	Broken or damaged bulb, or open wiring.	Check engine unit and wiring.
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.

B. Exhaust Gas Temperature Gauge (HP S/N's 3246001 thru 3246087 only)

This instrument, which is commonly referred to as EGT, is used to aid 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.

1. Removal of EGT Probe and Gauge

   a. Disconnect wires from the EGT gauge at the instrument panel.
   b. Remove four bolts which secure the gauge to the instrument panel and remove the gauge.
   c. Remove wires from the wire harness going to the engine.
   d. Loosen the nut or clamp which secures the EGT probe to the exhaust system and remove the probe.

TEMPERATURE (cont)

2. Cleaning and Inspection of EGT.

   Unless mechanical damage is evident, broken glass, bent or broken pointer, or broken case, the following checks should be performed before removing the instrument.

   a. 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.
   b. 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.
   c. 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.

— CAUTION —

DO NOT CONNECT OHMMETER. IT WILL BURN OUT THE MOVEMENT OF THE METER.

3. Installation of EGT Probe and gauge

   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.
   c. Install the EGT gauge into the instrument panel and secure with four bolts.
   d. Connect the thermocouple wires to the rear of the EGT gauge.

CHART 7705. TROUBLESHOOTING EXHAUST GAS TEMPERATURE GAUGE (ALCOR)

Trouble	Cause	Remedy
Gauge inoperative.	Defective gauge, probe, or wiring.	Check probe and lead wires for chafing, breaks or shorting between wires and / or metal structure.
	Adjusting potentiometer turned off scale.	Recalibrate instruments.
Fluctuating reading.	Loose, frayed or broken electrical leads or faulty connections.	Clean and tighten connections. Repair or replace defective leads.

TEMPERATURE (cont)

C. Cylinder Head Temperature Gauge (HP S/N's 3246001 thru 3246087 only)

The cylinder head temperature gauge is part of the combination engine gauge which also includes the oil pressure gauge and the oil temperature gauge. This instrument measures the cylinder head temperature using a sender located in the #2 cylinder head. It is an electrical instrument and it is wired through the instruments circuit breaker.

CHART 7706. TROUBLESHOOTING CYLINDER HEAD TEMPERATURE GAUGE

Trouble	Cause	Remedy
Instrument shows no indication.	Power supply wire broken.	Repair wire.
	Defective instrument.	Replace instrument.
	Master switch off.	
Instrument goes all the way to upper stop.	Wire broken between sender and gauge.	Repair wire.
	Defective sender	Replace sender.

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INTEGRATED ENGINE INSTRUMENT SYSTEMS
(Engine Instrument and Digital Display Monitoring Panel (DDMP))
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up)

A. INTRODUCTION

The Engine Instrument and Digital Display Monitoring Panel (DDMP) form a complete state of the art engine monitoring system. Each analog instrument accepts signals from a variety of engine sensors. The DDMP communicates with each instrument via a digital interface, constantly receiving data regarding the status of each instrument parameter. In addition, the DDMP receives data directly from sensors that monitor Outside Air Temperature, Cabin Air Temperature, and Electrical System Parameters. The DDMP provides a digital readout of each parameter, continually monitors for out of range (exceedance) conditions, and utilizes the data provided for auxiliary functions including Fuel Management and, in HP S/N's 3246126 & up and TC S/N's 3257001 & up, Engine Percent Power Calculations.

B. TROUBLESHOOTING

The following error codes may be output by the DDMP.

"Error Showing Exceed Press SEL to Continue"
Might show up in exceedance mode if there is a problem reading the EEPROM. Try deleting exceedances through the aux. Comm port to reset the state of the EEPROM.

"Commun Error Err 256"
There was bad communication between the DDMP and the Instrument during calibration. Check the connection between the two.

"Data Not Valid Err 512"
The instrument data was invalidated by the DDMP. Instrument and sensor failures can invalidate data. Old data eventually is marked as invalid. Check that the input to the instrument and connection to the DDMP are working.

"Non-Valid Index Err 8"
The instrument was asked to calibrate to a point for which it cannot. For example, if a Seneca DDMP is mistakenly being used to calibrate a Saratoga fuel gauge - the Saratoga instrument cannot calibrate 61 gallons.

"Write Fail Bit Err 16"
There was an error in the instrument's attempt to write to it's own EEPROM.

"Command Disabled Err 128"
The command the instrument was asked to perform is disabled.

"Sensor Overflow Err 2"
The raw sensor input is causing an overflow. The sensor signal is carefully offset and scaled in the instrument; check for correct input to the instrument.

There are a few messages indicating that the available range of trim for Fuel Quantity, MAP, TIT, either null or span has been exceeded. Check that the input to the instrument is correct for the adjustment being made. (See Chart 7708)

"DDMP FAIL OP SYS SHUTDOWN CODE 1"
This appears only if the OS attempts to interrupt itself. This could happen if a periodic timer value was corrupted (and as a result ran too fast) or the task that is running is taking too long to complete its job. This is a protection against non-terminating loops in the task code.

(continued on Page 77-20)

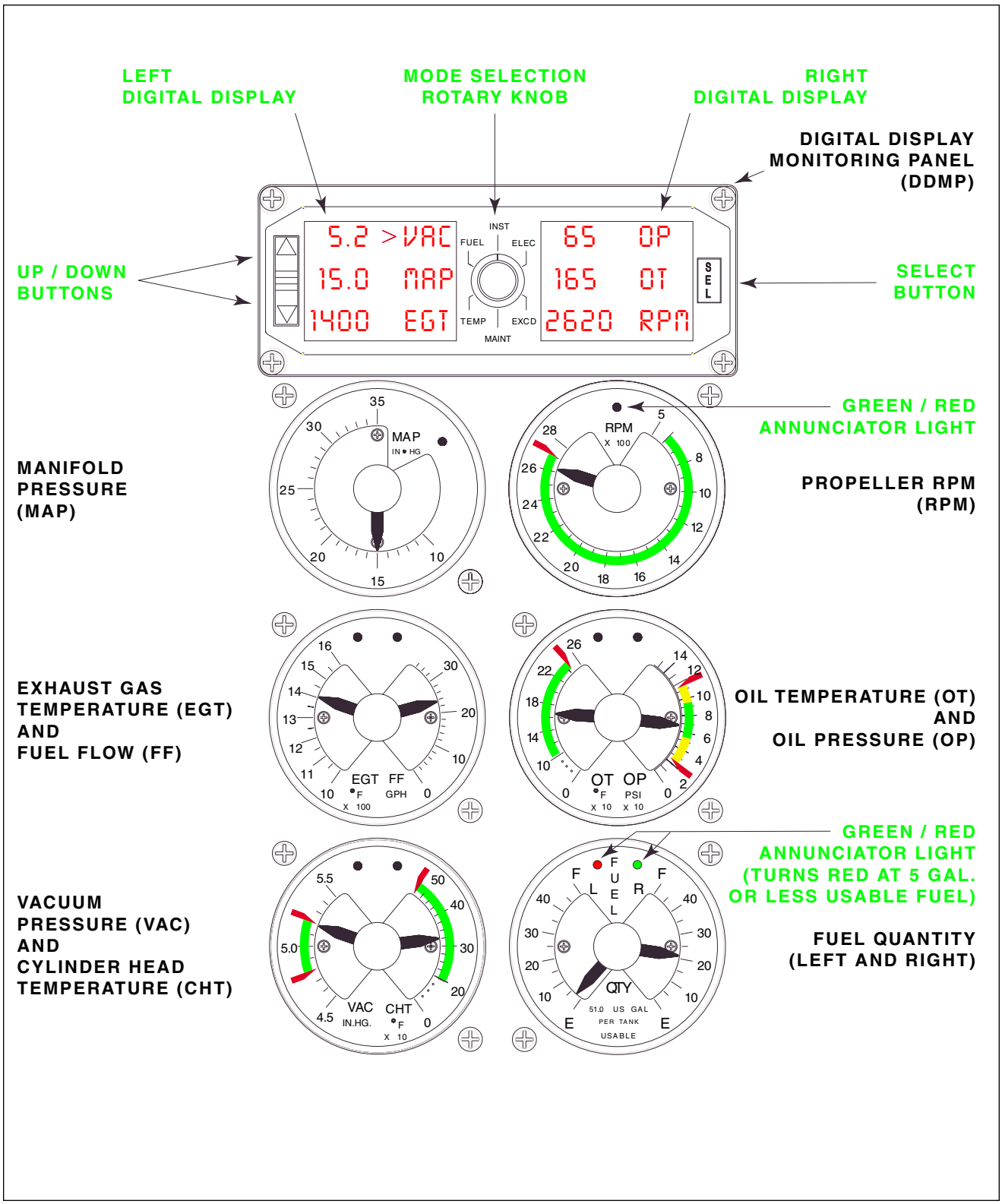
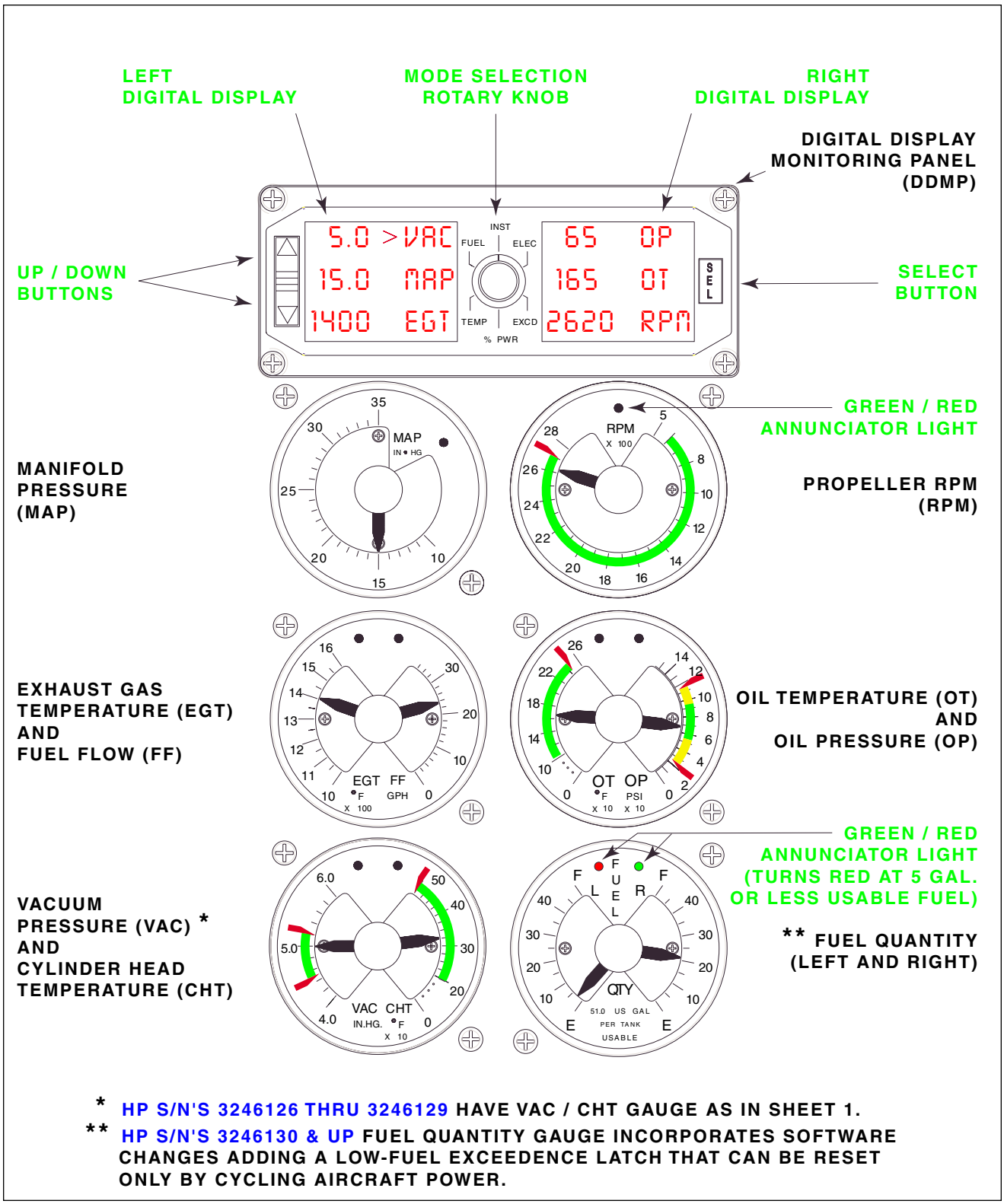


Figure 77-1. Engine Instruments and Digital Display Monitoring Panel (Sheet 1 of 4)
(Saratoga II HP S/N's 3246088 thru 3246125)



* HP S/N'S 3246126 THRU 3246129 HAVE VAC / CHT GAUGE AS IN SHEET 1.

** HP S/N'S 3246130 & UP FUEL QUANTITY GAUGE INCORPORATES SOFTWARE CHANGES ADDING A LOW-FUEL EXCEEDENCE LATCH THAT CAN BE RESET ONLY BY CYCLING AIRCRAFT POWER.

Figure 77-1. Engine Instruments and Digital Display Monitoring Panel (Sheet 2 of 4)
(Saratoga II HP S/N's 3246126 & up)

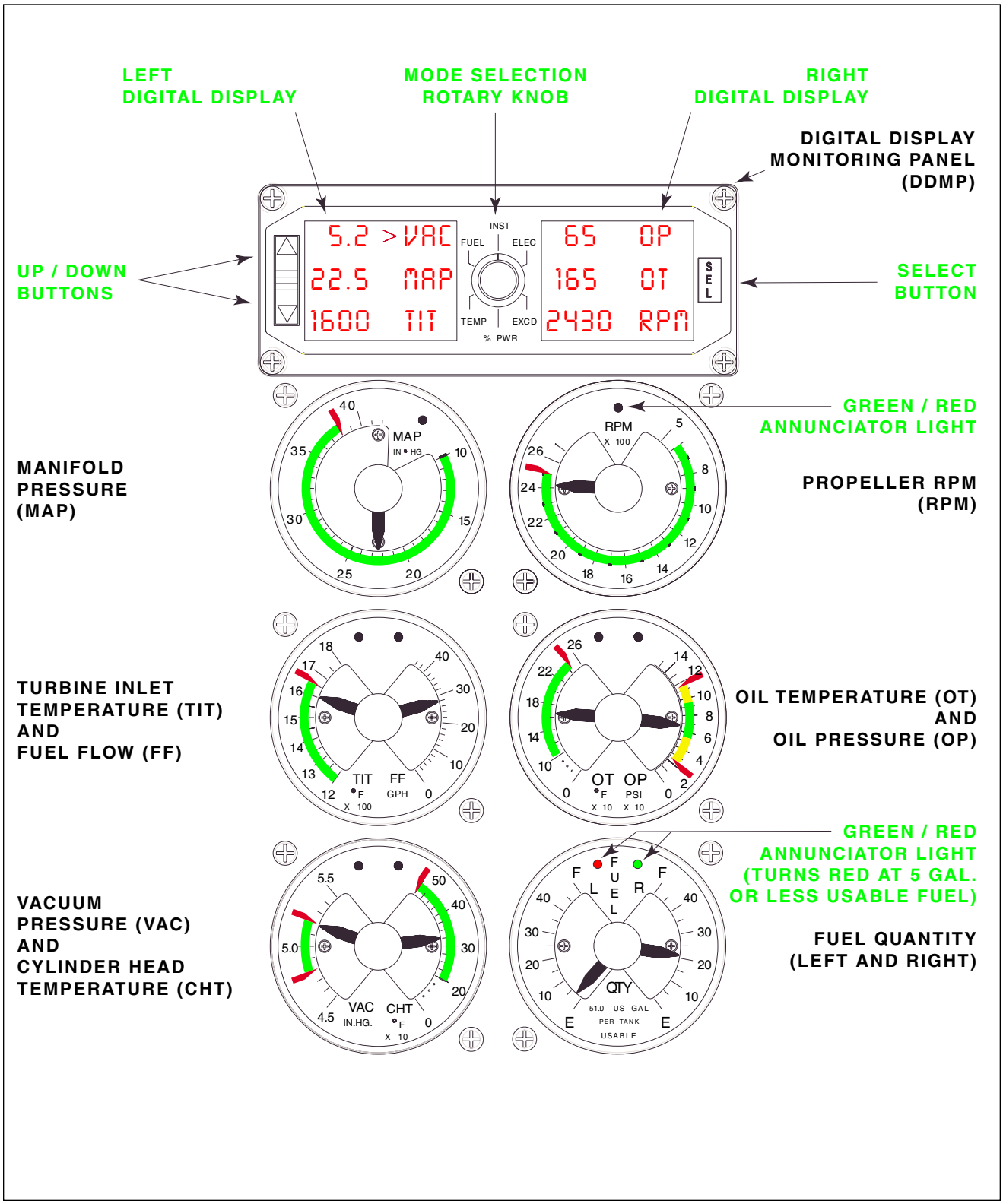
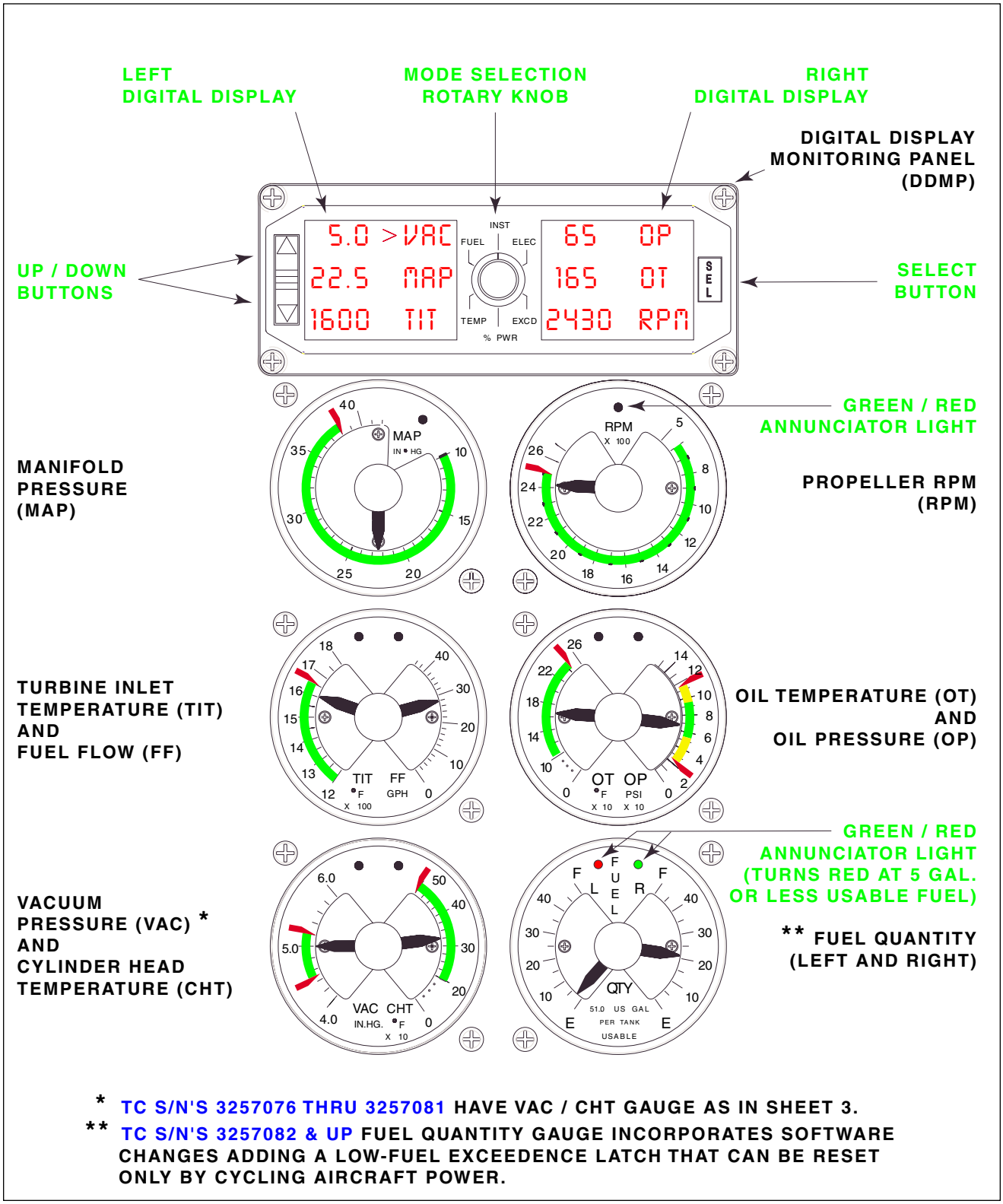


Figure 77-1. Engine Instruments and Digital Display Monitoring Panel (Sheet 3 of 4)
(Saratoga II TC S/N's 3257001 thru 3257075)



* TC S/N'S 3257076 THRU 3257081 HAVE VAC / CHT GAUGE AS IN SHEET 3.

** TC S/N'S 3257082 & UP FUEL QUANTITY GAUGE INCORPORATES SOFTWARE CHANGES ADDING A LOW-FUEL EXCEEDENCE LATCH THAT CAN BE RESET ONLY BY CYCLING AIRCRAFT POWER.

Figure 77-1. Engine Instruments and Digital Display Monitoring Panel (Sheet 4 of 4)
(Saratoga II TC S/N's 3257076 & up)

B. TROUBLESHOOTING (cont.)

""DDMP FAIL OP SYS SHUTDOWN CODE 2"

This message appears when a task has been "blocked" too long. The OS has a prioritization scheme built in which selects the most important task waiting to be run and the runs it. If a lot of high priority task requests happen they could conceivably preempt a lower priority task from running. The system is designed for this not to happen but this message is the result of the "catch-all" code to deal with this occurrence, should it arise.

To summarize, the two Op Sys Shutdown messages (above) are indications of some kind of software timing problem; either a piece of software is taking too long to execute (CODE 1) or waiting too long to be executed (CODE 2).

CHART 7707. TROUBLESHOOTING ENGINE INSTRUMENT AND DIGITAL DISPLAY MONITORING PANEL

(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up)

SYMPTOM	SOLUTION
Red LED Flashing on Instrument (4 times per second)	• Input sensor providing erroneous information. Check input sensor.
Red LED Flashing on Instrument (2 times per second)	• Self test has determined problem within the instrument. Cycle power and check if instrument resets.
Instrument pointer parked off scale	• No status LED. Instrument not receiving power. Check power connection and circuit breakers. Cycle power to determine if instrument self test is initiated. • Red LED flashing 4 times per second. Input-sensor providing erroneous information. Check input sensor. • Red LED flashing 2 times per second. Self test has determined problem within the instrument. Cycle power and check if instrument resets.
"----" appears on DDMP display in Temperature or Electrical Mode	• Check sensor inputs
"----" appears on DDMP display in Instrument Mode	• Indicates Sensor, Instrument, or Communications Failure. Use status LED on Instrument to determine cause and verify as described above. • If status LED is off, and instrument appears to be operating properly, Run Self Test to check communications.
"----" appears on DDMP in % Power Mode	• If weight on wheels, DDMP functioning properly • Check MAP, RPM and Fuel Flow Instruments for proper operation. • Check communications using Self Test • Check Pressure Altitude in the DDMP Maintenance Mode. • Check OAT display in Temperature Mode
"----" appears on DDMP in Fuel Mode	• Verify a valid file load was entered. • Check Fuel Flow Instrument for proper operation. • Check communications using Self Test. • Check GPS Input
Instrument Fail message on DDMP following Power On Self Test. i.e "RPM FAIL"	• Verify power to instrument. • Check connection between Instrument and DDMP • Run self test from Maintenance Mode

C. ANALOG INSTRUMENTS

(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up)

The system uses 2-inch round analog engine instruments with either a single or dual pointer configuration. Instrument readings are displayed using a familiar rotating pointer against a fixed scale plate. An in-line pointer configuration is provided to minimize parallax and maximize viewing angle.

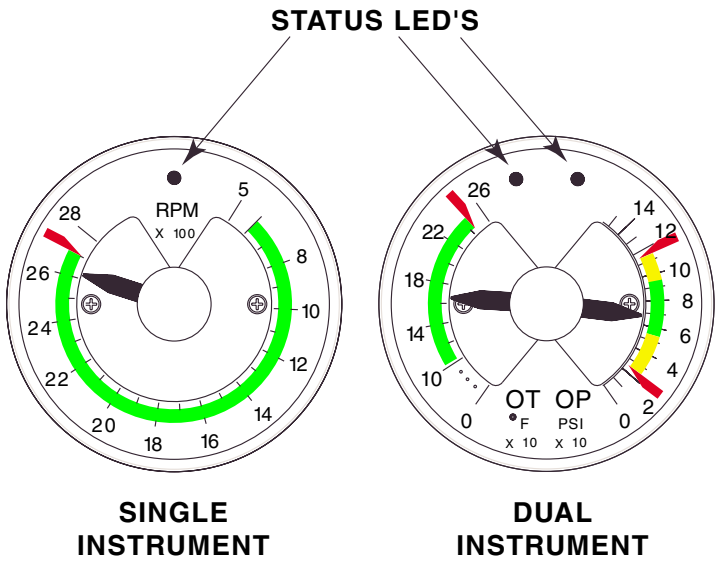


Figure 77-2. Single Instrument / Dual Instrument (Typical)

1. Instrument Self Test

Each instrument is microprocessor based and performs a power on self test, a continuous self test, and a continuous sensor validity test. A two color (green/red) status LED is provided for each instrument. Upon initial power up, each instrument performs a power on self test. During this test, and prior to assuming normal operation, the status LED glows red then green and the pointer is driven to the full scale position, followed by the off scale zero position. The alarm audible alert is energized for one second at the end of the power on test.

2. Instrument Status LED

The status LED provides an instant indication of the instrument status as follows:

- No LED Indication: Instrument is functioning normally. (If pointer is parked off scale low, no power to instrument)
- Green LED glows constantly: The instrument is being displayed in digital form on the DDMP.
- Red LED glows constantly: The parameter being measured is in an exceedance condition. (An Alarm Message is also displayed on the DDMP. See DDMP: Alarm Mode)
- Red LED flashes quickly (4 times per second): The input sensor has failed, or is providing erroneous information.
- Red LED flashes slowly (2 times per second): Self Test has identified a problem within the instrument. Instrument Failure.

D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up)

The DDMP continuously monitors each analog instrument via a digital communications link. Direct sensor inputs are provided for Outside Air Temperature, Cabin Air Temperature, and Electrical System Inputs. A Global Positioning System input allows the DDMP to communicate with the aircraft GPS system to provide enhanced fuel management capabilities. The DDMP operates in one of six operating modes as explained below, and continuously monitors for exceedance conditions in the background. In the event that an exceedance condition is detected, an exceedance message will temporarily override the display of the selected mode of operation.

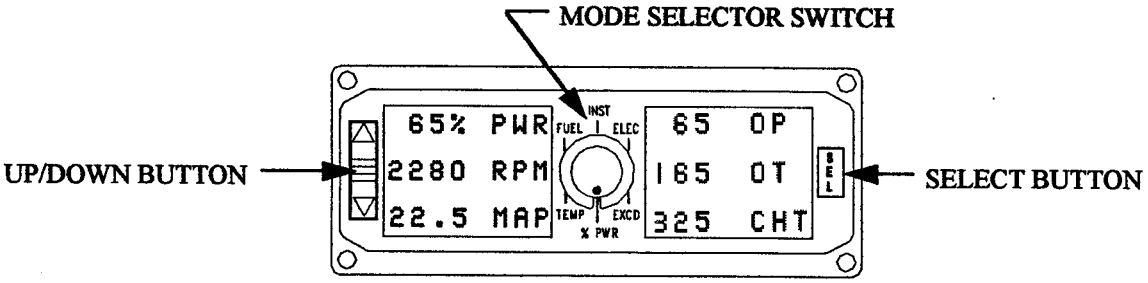


Figure 77-3. Digital Display Monitoring Panel (DDMP) (Typical)

1. Self Test

Upon power on, the DDMP will perform an internal self test, and will test communications with each of the instruments. If failure codes are displayed, or the system does not appear to be functioning properly, see the error codes, and instructions on initiating a self test from a power on state.

2. DDMP Controls

The operating mode of the DDMP is selected using the rotary Mode Selector Switch located at the center of the instrument. Within a given mode, a cursor ">" is moved throughout different display locations to provide an easy to understand user interface. The Up, Down and Select buttons are used in a multi-function manner as described in the following sections.

3. Alarm Mode

The DDMP goes into the Alarm Mode if an exceedance or instrument failure is detected. In the Alarm Mode, the alarm overrides the current DDMP display and a display similar to one of the following is shown:

(Continued)

D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

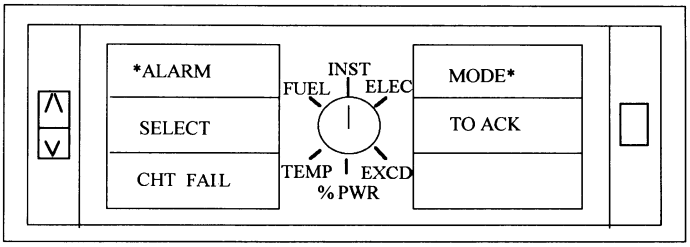


Figure 77-4A. Instrument Failure Condition (Typical)

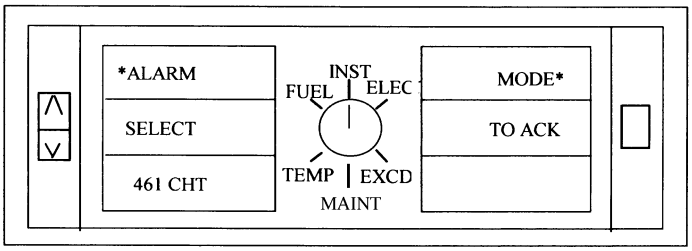


Figure 77-4B. Instrument Exceedance Condition (Typical)

The instrument will be identified on the side of the DDMP corresponding with instrument failure.

To return to normal operation, press the SELECT button to acknowledge the alarm. The DDMP will return to normal operation, and will not return to the ALARM MODE unless a new exceedance is detected. If an exceedance is still occurring when it is acknowledged, the Red LED will continue to glow on the instrument in exceedance, the DDMP will continue to record the exceedance, but no Alarm Message will appear on the DDMP until a new alarm condition occurs. To view the current exceedance on the DDMP, simply turn the Mode Selector Switch to "EXCD" (See DDMP: EXCEEDANCE MODE).

The following alarm conditions may occur:

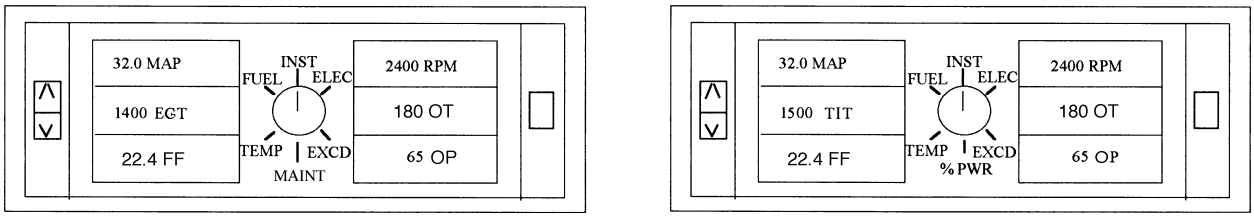
CONDITION	VISUAL ALARM	AUDIBLE ALARM
Instrument Exceedance	DDMP Display Red LED Glows on Instrument	Horn until acknowledged
DDMP Exceedance	DDMP Display	Horn for 3 seconds
Instrument Failure	DDMP Display Red LED flashes twice per second on insturment	Horn for 3 seconds
Sensor failure	DDMP Display Red LED flashes four times per second on instrument	Horn for 3 seconds

D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

4. Instrument Mode

In the Instrument Mode, each of the DDMP's two displays can be setup to display any three of the analog instrument values in a digital form. The left hand DDMP display can display any three of the instruments in the left column of instruments, plus the Left Fuel Quantity. The right hand DDMP display can display any three of the instruments in the right column of instruments, except for the Left Fuel Quantity.

To use the Instrument Mode, turn the Mode Selector Switch to "INST." On initial power up, the DDMP will default to the following screen:



Saratoga II HP (Typical) Saratoga II TC

Figure 77-5. Instrument Mode

To change the configuration, use the SELECT button to move the cursor to the location of the display you wish to modify. Press the UP or DOWN buttons to scroll through the options for that display. Continue as above to select the configuration for the remaining five displays as desired. After completing your configuration, the DDMP will default to that configuration until power is turned off.

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D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

5. Electrical Mode

In the Electrical Mode, the DDMP displays Alternator Current, System Voltage, and Battery Charge Current. To access the Electrical Mode, turn the Mode Selector Switch to "ELEC." The following display will appear:

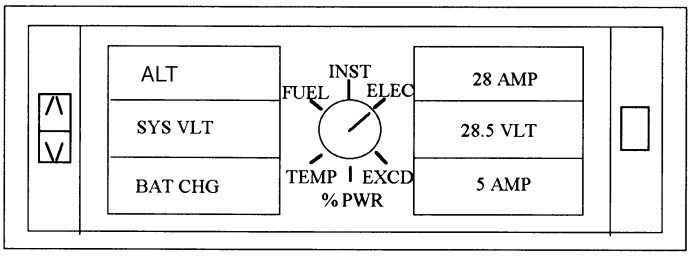

Figure 77-6. Electrical Mode (Typical)

— Note —

A special maintenance mode is accessed from the Electrical Mode using a button sequence password. The UP, DOWN, and SELECT buttons serve no other purpose in the electrical mode. If a button is inadvertently pressed, an error message "INVALID KEY SEQUENCE SEL TO CONTINUE" will appear. Press SELECT to continue.

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D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

6. Exceedance Mode

Each instrument continually monitors its input for out of limit, or exceedance conditions, and alerts the DDMP to such conditions. Over 200 exceedance events are stored in the DDMP memory. The exceedance mode is used to view and/or delete the exceedances that are stored in memory.

To view exceedances, turn the Mode Selector Switch to "EXCD." The DDMP automatically defaults to the most recent or current exceedance. A display similar to the following will appear:

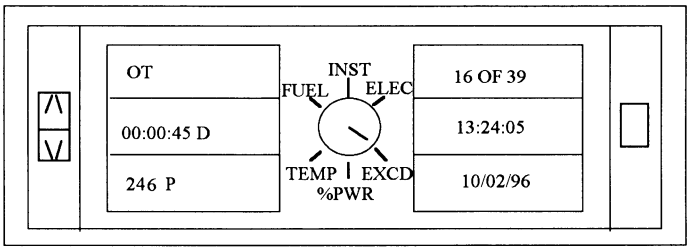

Figure 77-7A. Exceedance Mode - Viewing (Typical)

To view additional exceedances, use the UP or DOWN buttons to scroll through the exceedances stored in memory.

To delete exceedances, press the SELECT button and the following screen appears:

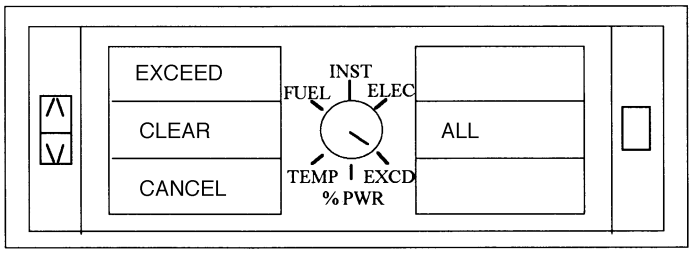

Figure 77-7B. Exceedance Mode - Deleting (Typical)

Press the UP button to move the cursor to CLEAR ALL and press SELECT to delete all exceedances. Move the cursor back to the CANCEL position if you decide not to delete all exceedances.

After SELECT is pressed, the DDMP will default back to the original exceedance screen. If the exceedances were deleted, the message NO EXCEEDS will appear, otherwise the original exceedance screen will appear.

(Continued)

D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

6. Exceedance Mode (continued)

The following abbreviations are used in the Exceedance Mode:

LO VLT	Low System Voltage
HI VLT	High System Voltage
MAP	High Manifold Pressure
RPM	High RPM
TIT	High Turbine Inlet Temperature
CHT	High Cylinder Head Temperature
OT	High Oil Temperature
LOP	Low Oil Pressure
HOP	High Oil Pressure
LO VAC	Low Vacuum
HI VAC	High Vacuum
LFQ	Low Left Fuel Quantity
RFQ	Low Right Fuel Quantity

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D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

7. Percent Power Mode (HP S/N's 3246126 & up; TC S/N's 3257001 & up)

The DDMP displays the current Percent Power in 5% increments, and makes recommendations of desired MAP and Fuel Flow settings based on the current RPM to achieve the pilot's desired power setting.

To display the current Percent Power, turn the Mode Selector Switch to "% PWR." A display similar to the following will appear.

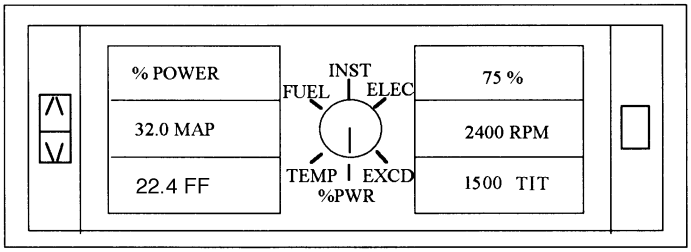

Figure 77-8A. Current Percent Power (Typical)

To estimate new engine settings for a given % Power, press the SELECT button. The DDMP rounds the current settings to the nearest 5% Power and displays the following.

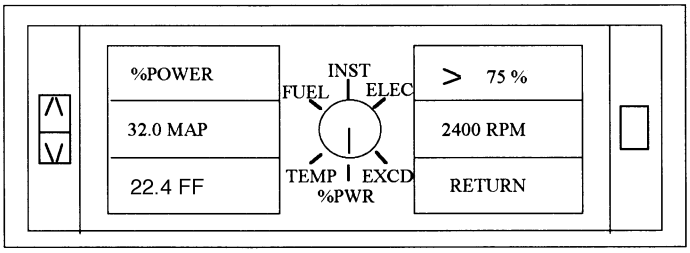

Figure 77-8B. Calculating Percent Power

Press the UP or DOWN button to change the % Power setting and the DDMP estimates new MAP and FF settings for the desired % Power and current RPM.

If the selected % Power is not obtainable at the current RPM setting, the DDMP will change the RPM to the nearest value within the range of the desired % Power. To select a new RPM value, press the SELECT button to move the cursor to the RPM position. Using the UP or DOWN button, select the desired value.

(Continued)

D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

7. Percent Power Mode (HP S/N's 3246126 & up; TC S/N's 3257001 & up) (continued)

Adjust the engine MAP and FF settings to the recommended values and press SELECT two more times to return to the actual % Power screen.

The Percent Power function is only enabled when the aircraft is airborne. If the Percent Power Mode is entered while on the ground, or if an attempt is made to calculate estimated engine settings based on a combination of Fuel Flow, RPM, MAP, and Static Pressure values that are out of range, "----" will appear on the display.

8. Temperature Mode

In the Temperature Mode, the DDMP displays Outside Air Temperature and Cabin Air Temperature. Turn the Mode Selector Switch to "TEMP" and the following display appears:

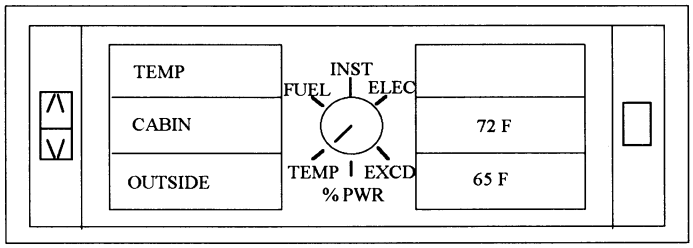

Figure 77-9. Temperature Mode (Typical)

Press the SELECT button to toggle between Degrees Fahrenheit and Degrees Celsius.

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D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

9. Fuel Mode

All fuel management functions are based on total usable fuel available, therefore it is very important to visually verify and input accurate fuel loadings.

— Note —

Usable fuel load entries are the combined total of all fuel tanks and not a per tank value.

— CAUTION —

ALL OF THE FUEL CALCULATIONS ARE BASED ON THE MANUAL ENTRY OF THE PROPER FUEL LOAD AFTER REFUELING. FUEL LOAD MUST BE MANUALLY ENTERED INTO THE DDMP FOR IT TO FUNCTION PROPERLY. THERE IS NO CONSISTENCY CHECKING BETWEEN THE ENTERED FUEL LOAD AND THE ACTUAL FUEL QUANTITY.

After entering the fuel load, the DDMP performs all fuel calculations based on information from the Fuel Flow Instrument. To enter the Fuel Mode, turn the Mode Selector Switch to "FUEL." The following screen will be displayed:

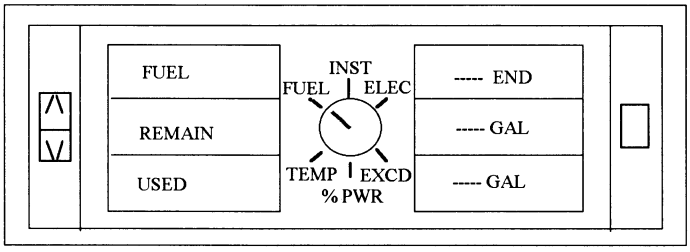

Figure 77-10A. Fuel Remaining (Typical)

Press SELECT to view the next screen.

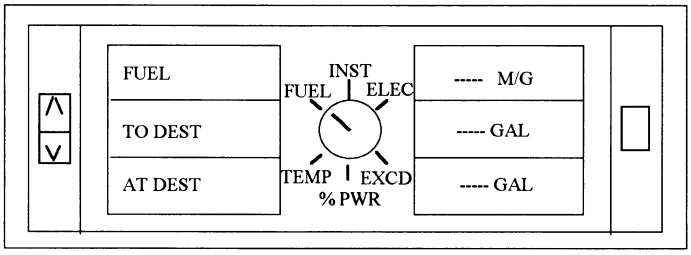

Figure 77-10B. Fuel To Destination (Typical)

Press SELECT to view the next screen.

D. DIGITAL DISPLAY MONITORING PANEL (DDMP)
(Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up) (continued)

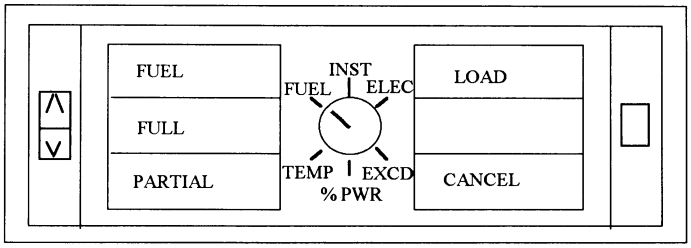

Figure 77-10C. Fuel Load Entry (Typical)

Press SELECT to return to the first screen.

— Note —

Fuel load is the total fuel for both tanks, not a per tank value.

To enter a fuel load, use the Up/Down arrows to position the cursor next to "FULL" or "PARTIAL" and press Select. "FULL" defaults to 102 gallons (maximum usable fuel) and allows the pilot to decrease the fuel loading to lower fuel loading values if desired. "PARTIAL" defaults to 0 gallons and allows the pilot to increase the fuel loading value to any value up to maximum usable fuel (102 gallons). Pressing Select again will bring up the fuel loading confirmation window. Choose yes or no using the Up/Down arrows then press Select to enter. If the fuel loading window has been selected in error, the CANCEL option can be chosen using the Up/Down arrows then the Select button to terminate the fuel loading sequence.

Press SELECT when the proper value has been entered.

Using the UP button move the cursor to YES and press SELECT to accept the new value or press SELECT to reject the new value.

After SELECT the display will revert back to the first Fuel screen.

E. RS-232 INTERFACE (Saratoga II HP S/N's 3246088 & up; Saratoga II TC S/N's 3257001 & up)

An RS-232 interface is available to connect to the DDMP. It can be used to connect the ship's system to a computer to download exceedance data, or to connect a laptop system to log data during flight. The RS-232 connector is located under the pilot's side of the instrument panel.

CHART 7708. INTEGRATED ENGINE INSTRUMENTATION CALIBRATION (Sheet 1 of 2)

INDICATOR TYPE	SENSOR FULL SCALE OUTPUT (UNLESS NOTED)	CALIBRATION POINTS EACH INDICATOR SHALL MEET THE CRITERIA SPECIFIED BELOW WITH ITS APPLICABLE SENDER UNIT							
OAT	84.23 TO 121.32 OHMS (- 40 TO 55 °C)	TEST POINT MAXIMUM OHMS MINIMUM OIIMS	DEG C	-40 84.62 83.84	0 100.39 99.61	20 108.20 107.42	55 121.72 120.93		
CAT	- 1.527 TO 2.229 mV (- 40 TO 55 °C)	TEST POINT MAXIMUM DEG C MINIMLJM DEG C	DEG C	-40 -37 -43	0 3 -3	20 23 17	55 58 52		
VOLTS	10 TO 32 VDC	TEST POINT MA.XIMUM VDC MINIMUM VDC	VDC	10 10.2 9.8	16 16.2 15.8	22 22.2 21.8	28 28.2 27.8	32 32.2 31.8	
AMPS	- 50 TO 50 mV	TEST POINT MAXIMUM mV MINIMUM mV	AMPS	-99 -48.5 -50.5	-50 -24 -26	0 1 -1	50 26 24	99 50.5 48.5	
MAP [1, 3]	1.0 TO 5.0 VDC (O TO 25 PSIA)	TEST POINT MAXIMUM VDC MINIMUM VDC	IN HG(ABS)	10 1.811 1.761	20 2.597 2.547	30 3.383 3.333	38 4.012 3.962	42 4.327 4.277	
RPM [1, 4]	12.50 HZ TO 67.50 HZ (500 TO 2700 RPM)	TEST POINT MAXIMUM HZ MINIMUM HZ	RPM	500 13.05 11.95	1400 35.55 34.45	2000 50.55 49.45	2500 63.05 61.95	2700 68.05 66.95	
TIT [1]	26.978 TO 40.581 mV (1200 - 1800 °F)	TEST POINT MAXIMUM DEG F MINIMUM DEG F	DEC F	1200 1216 1184	1600 1616 1584	1650 1666 1634	1800 1816 1784		
FUEL FLOW [1]	0 TO 285.745 HZ (0 TO 44 GPH)	TEST POINT MAXIMUM HZ MINIMUM HZ	GPH	7.5 56.138 50.418	15 107.538 101.818	25 173.148 167.428	30 204.700 198.980	44 288.605 282.885	
OIL TEMPERATURE	84.5 TO 140.86 OHMS (NON~LINEAR)	TEST POINT MAXIMUM OHMS MINIMUM OFIMS	DEG F	0 84.90 84.10	140 112.78 111.78	180 121.79 120.79	245 137.53 136.53	260 141.46 140.26	
OIL PRESSURE	1.0 TO 4.867 VDC (0 TO 145 PSIG)	TEST POINT MAXIMUM VDC MINIMUM VDC	PSI	0 1.039 0.961	25 1.706 1.628	55 2.506 2.428	95 3.572 3.494	115 4.106 4.028	145 4.906 4.828
CHT	60.09 TO 143.8 OHMS (NON-LINEAR)	TEST POINT MAXIMUM OHMS MINIMUM OHMS	DEG F	100 61.34 59.59	200 78.00 76.27	300 96.79 95.39	400 119.21 117.61	500 144.70 142.90	
VAC [5, 6]	4.000 TO 4.667 VDC (4.5 TO 5.5 IN HG)	TEST POINT MAXIMUM VDC MINIMUM VDC	IN HG	4.5 4.020 3.980	4.8 4.220 4.180	5.0 4.353 4.313	5.2 4.487 4.447	5.5 4.687 4.647	
VAC [5, 7]	3.667 TO 5.000 VDC (4.0 TO 6.0 IN HG)	TEST POINT MAXIMUM VDC MINIMUM VDC	IN HG	4.0 3.686 3.646	4.4 3.953 3.913	5.0 4.353 4.313	5.4 4.620 4.580	6.0 5.020 4.980	

— Note —

Fuel Quantity calibration specifications and procedures are in Section 28-40-00.

CHART 7708. INTEGRATED ENGINE INSTRUMENTATION CALIBRATION (Sheet 2 of 2)

INDICATOR TYPE	SENSOR FULL SCALE OUTPUT (UNLESS NOTED)	CALIBRATION POINTS EACH INDICATOR SHALL MEET THE CRITERIA SPECIFIED BELOW WITH ITS APPLICABLE SENDER UNIT							
MAP [2]	1.786 TO 3.752 VDC (10 TO 35 IN HG ABS)	TEST POINT MAXIMUM VDC MINIMUM VDC	IN HG(ABS)	10 1.806 1.766	2.0 2.592 2.552	30 3.378 3.338	35 3.772 3.732		
RPM [2, 8]	12.50 HZ TO 70.00 HZ (500 TO 2800 RPM)	TEST POINT MAXIMUM HZ MINIMUM HZ	RPM	500 13.08 11.93	1400 35.58 34.43	2000 50.58 49.43	2500 63.08 61.93	2700 68.08 66.93	2800 70.58 69.43
EGT [2]	22.255 TO 36.166 mV (1000 TO 1600 °F)	TEST POINT MAXIMUM DEG F MINIMUM DEG F	DEG F	1000 1016 984	1200 1216 1184	1400 1416 1384	1600 1616 1584		
FUEL FLOW [2]	0 TO 238.601 HZ (0 TO 36 GPH)	TEST POINT MAXIMUM HZ MINIMUM HZ	GPH	7.5 55.374 51.186	15 106.694 102.658	25 172.204 168.368	30 203.707 199.970	36 240.991 236.211	
FUEL QUANTITY		SEE SECTION 28-40-00							REF. 100930 M

NOTES

1. TC S/N's 3257001 & up.
2. HP S/N's 3246088 & up.
3. When the MAP indicator receives a signal from 37.1 IN HG to 38.9 IN HG, the digital indicator will snap to 38 IN HG. The analog MAP indicator will continue to display the actual IN HG.
4. When the RPM indicator receives a signal from 2460 RPM to 2540 RPM, the digital indicator will snap to 2500 RPM. The analog RPM indicator will continue to display the actual RPM.
5. When the vacuum indicator receives a signal below 3.0 IN HG (3.000 VDC), the digital indicator will snap to 0 IN HG.
6. TC S/N's 3257001 thru 3257081 only; HP S/N's 3246088 thru 3246129 only.
7. TC S/N's 3257082 & up; HP S/N's 3246130 & up.
8. When the RPM indicator receives a signal from 2660 RPM to 2740 RPM, the digital indicator will snap to 2700 RPM. The analog RPM indicator will continue to display the actual RPM.

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CHAPTER

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EXHAUST

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CHAPTER 78 - EXHAUST

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GENERAL

A. Inspection of Exhaust System (Refer to. Figure 78-1)

— 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 the cabin heat will be in use.

— CAUTION —

WHEN REMOVING OR INSTALLING COUPLING CLAMP, SLIDE CLAMP OVER END OF PIPE BEFORE ASSEMBLY. EXCESSIVE SPREADING CAN LEAD TO PREMATURE FAILURE OF CLAMP.

— Note —

It is recommended that all airplanes be fitted with a new muffler at or near 1000 hours of service life.

Removal of the tail pipe and stacks are required for inspection of the muffler baffles. Remove or loosen all exhaust shields, cabin heat shroud, heat blankets, etc., as required to permit inspection of the complete system. Perform the necessary cleaning operations and inspect all external surfaces for dents, cracks and missing parts. Pay particular attention to welds, clamps, supports and support attachment lugs, slip joints, stack flanges and gaskets. Inspect internal baffles or diffusers for any cracks, warpage or severe oxidation are cause for replacement of muffler or tail pipe assembly.

If any component is inaccessible for a thorough visual inspection, accomplish one of the following:

1. Perform a submerged pressure check of the muffler and exhaust stack at 2 psi air pressure.
2. 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 on must be replaced.

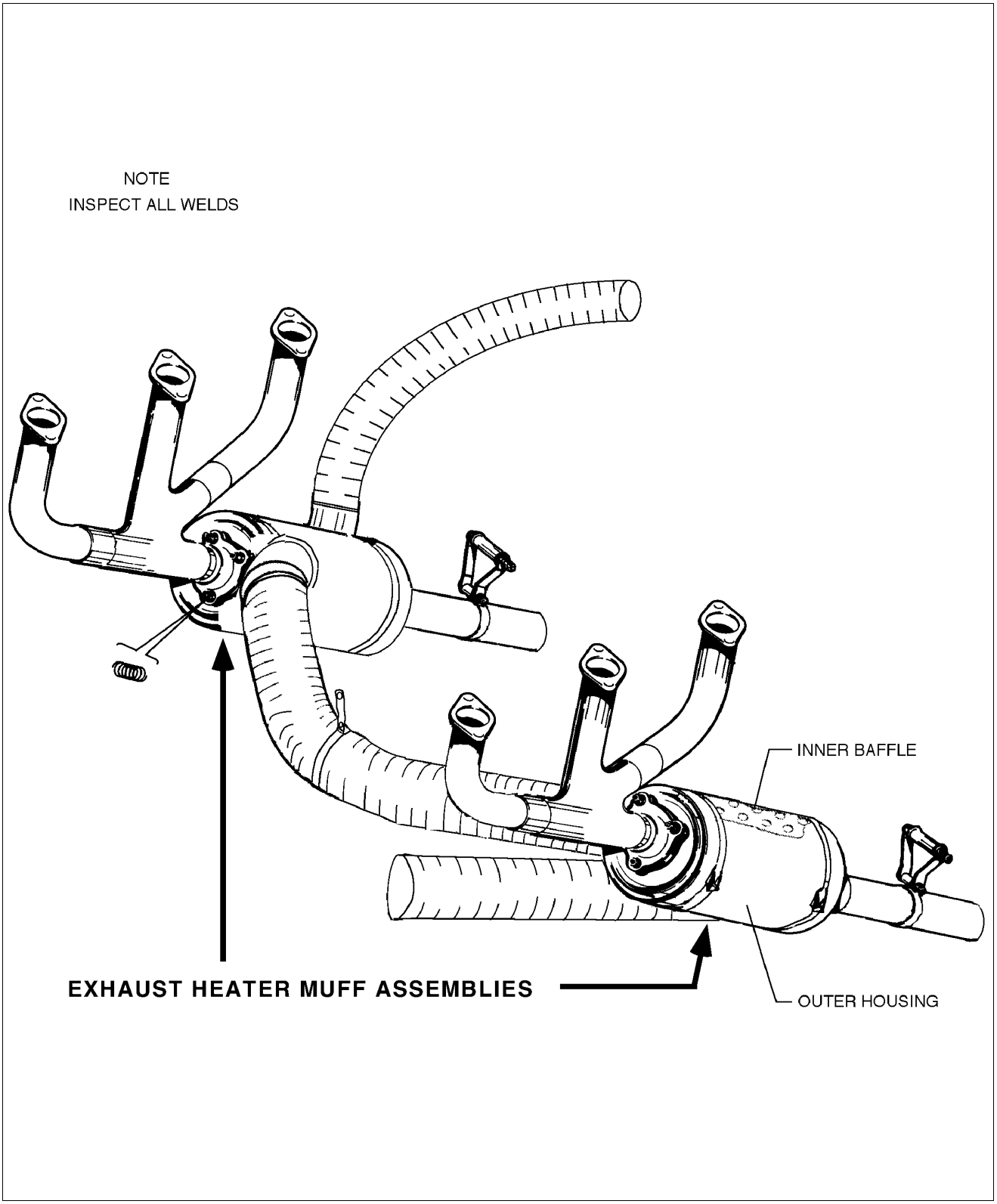

Figure 78-1. Exhaust System Inspection Points (Sheet 1 of 2) (HP S/N's 3246001 & UP)

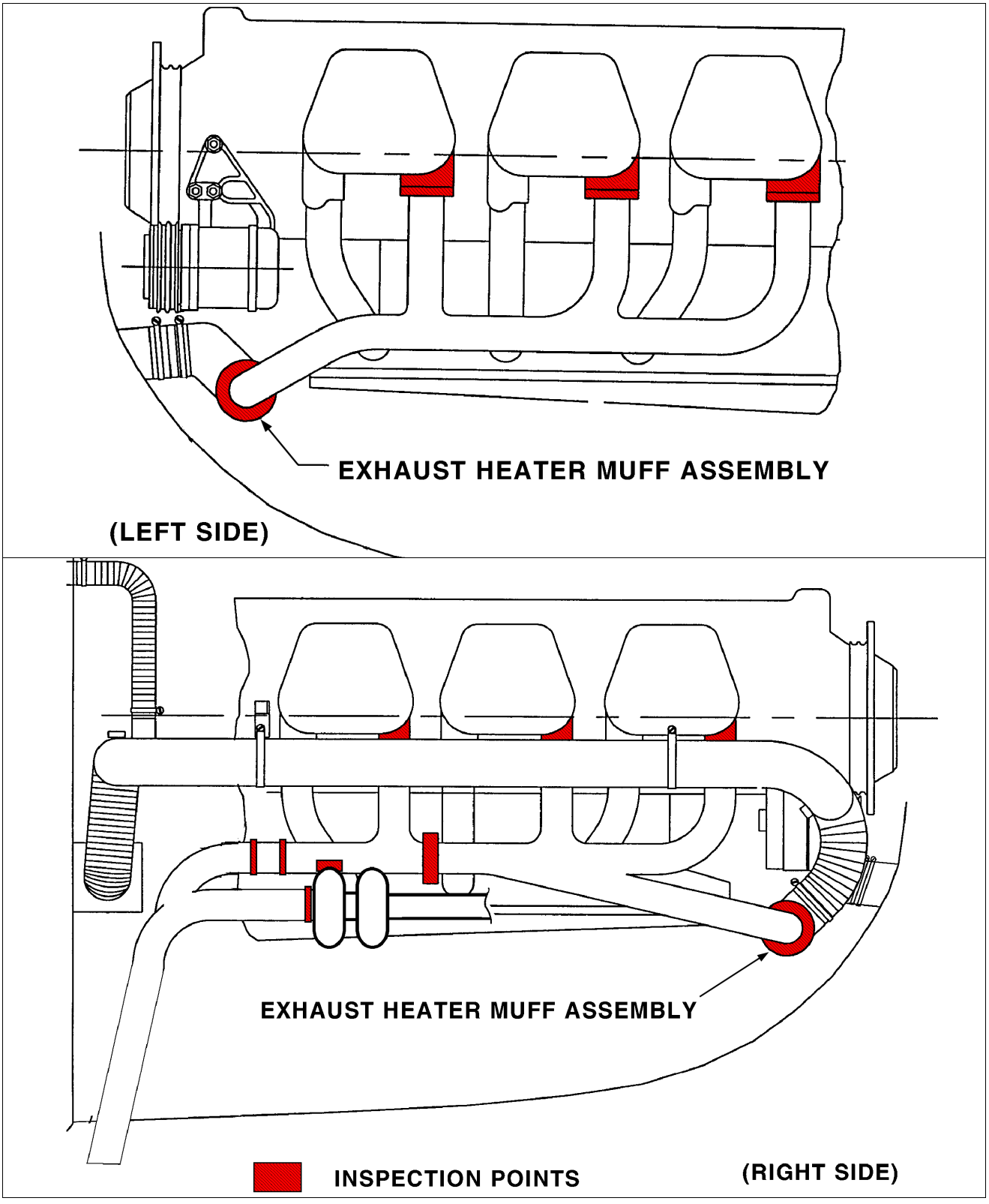

Figure 78-1. Exhaust System Inspection Points (Sheet 2 of 2) (TC S/N's 3257001 & UP)

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CHAPTER

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OIL

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CHAPTER 79 - OIL

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DISTRIBUTION

Oil Cooler

Installation of Oil Cooler

a. When installing fittings in the oil coolers, care should be used to prevent excessive torque being applied to the cooler. When a rectangular fitting boss is provided, backup wrench should be used, employing a scissor motion, so that no load is transmitted to the cooler. When the oil cooler has a round fitting boss. care should be taken not to permit excessive torque on the fittings.
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. If fitting cannot be positioned correctly using a torque of 10 - 15 foot-pounds, another fitting should be used.
e. When attaching lines to the cooler, a backup wrench should be used.
f. After installation, inspect the cooler for distorted end cups.
g. Run-up engine. After run-up, check for oil leaks.

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INDICATING

Oil Pressure Sensor

1. Removal of Oil Pressure Sensor

   Access to the sensor unit is gained by reaching up under the instrument panel. Removal is accomplished by the following:

   a. Disconnect the two electrical leads.
   b. Unscrew the sensor unit from the bulkhead fitting.
   c. Catch spillage and cover hole to prevent foreign matter from entering oil line.

2. Installation of Oil Pressure Sensor

   a. Seal sensor unit pipe threads with thread sealant tape.
   b. Screw the sensor unit into the bulkhead fitting.
   c. Reconnect the two electrical leads.
   d. Perform operational check.

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CHAPTER

80

STARTING

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CHAPTER 80 - STARTING

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL

A. Description and Operation (Refer to Figure 80-1)

The gear reduction starting motor consists of six major components: Commutator End Head Assembly, Armature, Frame and Field Assembly, Gear Housing, Pinion Housing, and Drive Assembly. When the starting circuit is energized, battery current is applied to the starting motor terminal. Current flows through the field coils, creating a strong magnetic field. At the same time, current flows through the brushes to the commutator, through the armature windings to ground. The magneto force created in the armature combined with that created in the field windings begins to turn the armature.

The gear cut on the drive end of the armature shaft extends through the gear housing, where it is supported by a roller bearing. The gear mates with the teeth of the reduction gear that drives the shaft, and the shaft is keyed to the reduction gear. The drive is held in position on the shaft by a “spiral” pin and, the shaft is supported in the gear housing by a closed end roller bearing and in the pinion housing by a graphtized bronze bearing.

When the armature turns the reduction gear, the drive pinion meshes with the flywheel ring gear by inertia and action of the screw threads within the sleeve. A detent pin engages in a notch in the screw threads which prevents demeshing if the engine fails to start when the starting circuit is de-energized.

When the engine reaches a predetermined speed, centrifugal action forces the detent pin out of the notch in the screw shaft and allows the pinion to demesh from the flywheel.

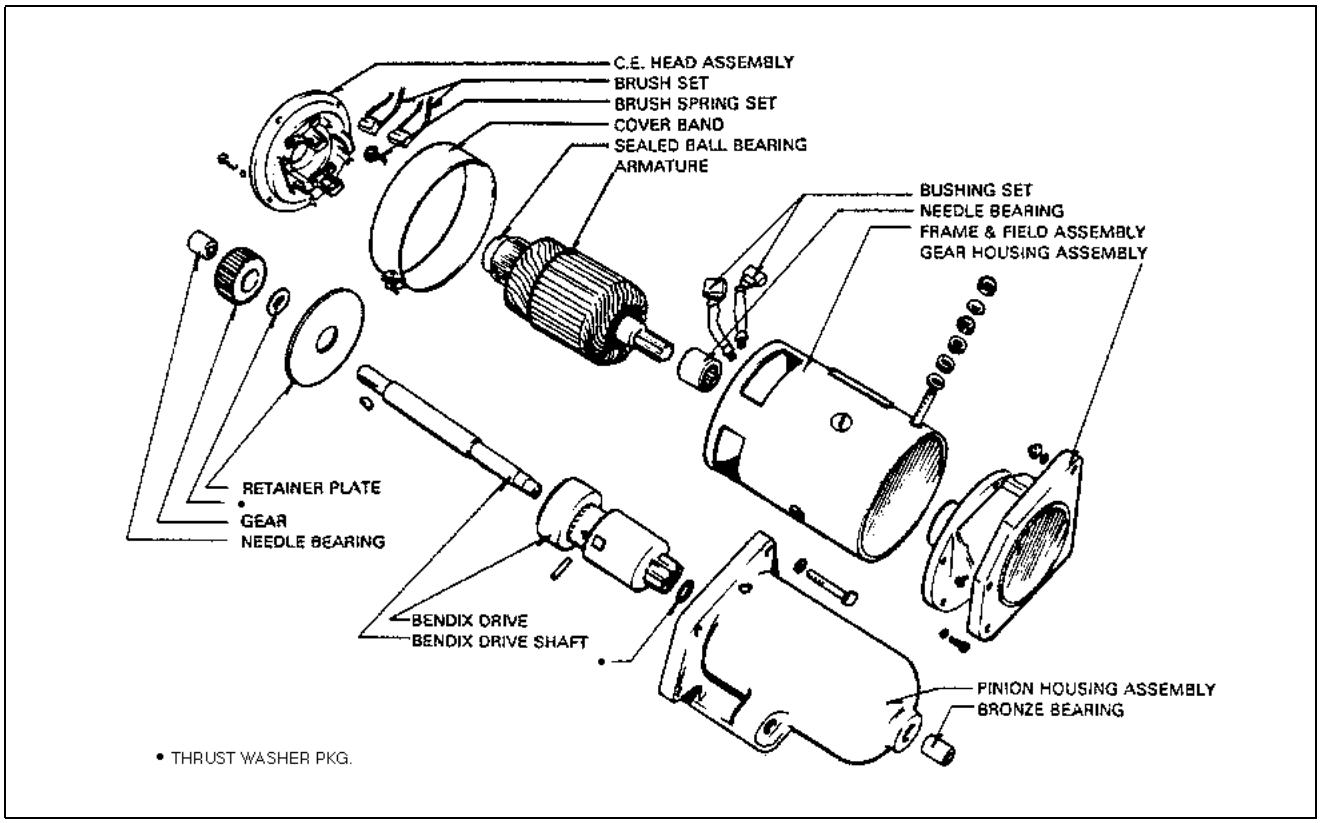

Figure 80-1. Exploded View of Gear Reduction Starting Motor (Typical)

GENERAL (cont)

B. Troubles peculiar to the starting system are listed in Chart 8001, along with their probable causes and suggested remedies.

CHART 8001. TROUBLESHOOTING STARTER (1 of 2)

Trouble	Cause	Remedy
Motor fails to operate.	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to electrical wiring diagram and check all wiring.
	Defective starter solenoid or control switch.	Replace faulty unit.
	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 cloth moistened with undoped gasoline (gasoline having no anti-knock additives). A new brush should be run in until at least 50 percent seated: however, if facilities are not available for running in brushes, then the brush should be properly seated by inserting a strip of number 000 sandpaper between the brush and commutator, with the sanded side next to the brush. Pull sandpaper in the direction of rotation, being careful to keep it in the same contour as the commutator.

— Note —

Do not use coarse sandpaper or emory cloth. After seating, clean thoroughly to remove all sand and metal particles to prevent excessive wear. Keep motor bearing free from sand or metal particles.

CHART 8001. TROUBLESHOOTING STARTER (2 of 2)

Trouble	Cause	Remedy
Motor fails to operate. (continued)	Dirty commutator	If commutator is rough or dirty, smooth and polish with number 0000 sandpaper. If too rough and pitted, remove and turn down. Blow out all particles.
	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good condition.
	Grounded or open field circuit.	Test, repair if possible or replace with a new part.
Low motor and cranking speed.	Worn, rough, or improperly lubricated motor or starter gearing.	Disassemble, clean, inspect, and relubricate, replacing ball bearings if worn.
	Same electrical causes as listed under "Motor fails to operate".	Same remedies listed for these troubles.
Excessive arcing of motor brushes.	Binding, worn, or improperly seated brush or brushes with excessive side play.	See information above dealing with this trouble.
	Dirty commutator, rough, pitted, or scored.	Clean as outlined above.
Excessive wear and arcing of motor brushes.	Rough or scored commutator.	Remove and turn commutator down on a lathe.
	Armature assembly not concentric.	Reface commutator.

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CRANKING

A. Maintenance of Starting System

The starting circuit should be inspected at regular intervals, the frequency of which should be deter mined by the amount of service and the conditions under which the vehicle is operated. It is recommended that such inspection be made at each 100 hours and include the following:

The battery should be checked with a hydrometer to be sure it is fully charged and filled to the proper level with approved water. A load test should be made to determine battery condition. If dirt and corrosion have accumulated on the battery, it should be cleaned with a solution of baking soda and water. Be sure none of the solution enters the battery cells.

The starting circuit wiring should be inspected to be sure that all connections are clean and tight and that the insulation is sound. A voltage loss test should be made to locate any high-resistance connections that would affect starting motor efficiency. This test is made with a low-reading voltmeter while cranking the engine or at approximately 100 amperes, and the following limits should be used:

a. Voltage loss from insulated battery post to starting motor terminal - 0.3-volt maximum.
b. Voltage loss from battery ground post to starter frame - 0.1-volt maximum.

— Note —

If voltage loss is greater than the above limits, additional tests should be made over each part of the circuit to locate the highresistance connections.

No lubrication is required on the starting motor except at the time of overhaul. Then lubricate the entire shaft under Drive, fill grooves in armature shaft at drive end and pack gear box with 1.3 - 2.0 ounces of Lithium Soap Base Grease or equivalent.

The starting motor should be operated for a few seconds with the ignition switch off to make sure that the pinion engages properly and that it turns freely without binding or excessive noise. Then the engine should be started two or three times to see that the pinion disengages properly when the engine is turned off.

1. Overhaul of Starting Motor

If during the above inspection any indication of starting motor difficulty is noted, the starting motor should be removed from the engine for cleaning and repaired

2. Removal of Starting Motor

To remove the starting motor from the engine, first disconnect the ground cable from the battery post to prevent short circuiting. Disconnect the lead from the starting motor terminal, then take out the mounting bolts. The motor can then be lifted off and taken to the bench for overhaul.

CRANKING (cont)

3. Disassembly of Starter Motor

   a. Remove the frame screws from the commutator end head and pull end head and armature from frame. Lift the brushes and lock in elevated position with brush springs. Use a puller to remove the end head from the armature. Use special bearing puller to remove the sealed ball bearing from the armature shaft.
   b. Remove the frame screws that secure the gear housing to the frame. Remove bolts and nuts holding the gear housing to the pinion housing and separate the two units. Pull shaft from pinion housing. Do not lose the steel spacer that is located on the pinion end of the shaft. Remove reduction gear, woodruff key and steel spacer from shaft.
   c. Turn the pinion until it locks in the extended position. Locate "spiral" pin and use a punch to remove. Slide drive assembly off the shaft. Do not attempt to disassemble the drive and do not dip it in cleaning solvent.
   d. To remove the roller bearings from the gear housing, use an arbor press and the correct bearing arbor. DO NOT HAMMER OUT. Each part should be cleaned and inspected for excessive wear or damage. Bearings should be checked for proper clearance and evidence of roughness or galling. Oil and dirt should be removed from insulation and the condition of the insulation checked.

4. Brushes

   Check the brushes to see that they slide freely in their holders and make full contact on the commutator. If worn to half their original length or less, they should be replaced.

5. Armature.

   a. Check the commutator for uneven wear, excessive glazing or evidence of excessive arcing. If only slightly dirty, glazed or discolored, the commutator can be cleaned with 00 or 000 sandpaper. If the commutator is rough or worn, it should be turned in a lathe (ref. Figure 80-2). The armature shaft should be inspected for rough bearing surfaces and rough or damaged splines.
   b. To test the armature for grounds, a set of test probes connected in series with a 110-volt light should be used. Touch one probe to a commutator segment and the other to the armature core. If the test lamp lights, the armature is grounded and should be replaced.
   c. To test for shorted armature coils, a growler is used (ref. Figure 80-3). The armature is placed on the growler and slowly rotated by hand while a steel strip is held over the core so that it passes over each armature core slot. If a coil is shorted, the steel strip will vibrate.
   d. A quick check for opens can be made by inspecting the trailing edge (in direction of rotation) of the commutator segments for excessive discoloration. This condition indicates an open circuit.

6. Field Coils.

   a. Check the field coils for grounds (ref. Figure 80-4) by placing one test probe on the frame and the other on the starter terminal. Be sure the brushes are not accidentally touching the frame. If the lamp lights, the fields are grounded. Repair or replace.
   b. Inspect all connections to make sure they are clean and tight and inspect insulation for deterioration.

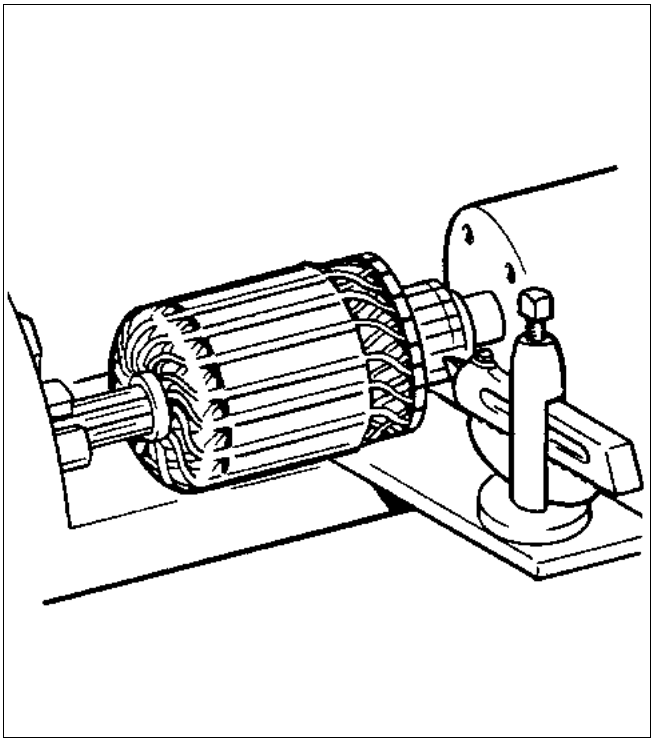

Figure 80-2. Turning Starting Motor Commutator

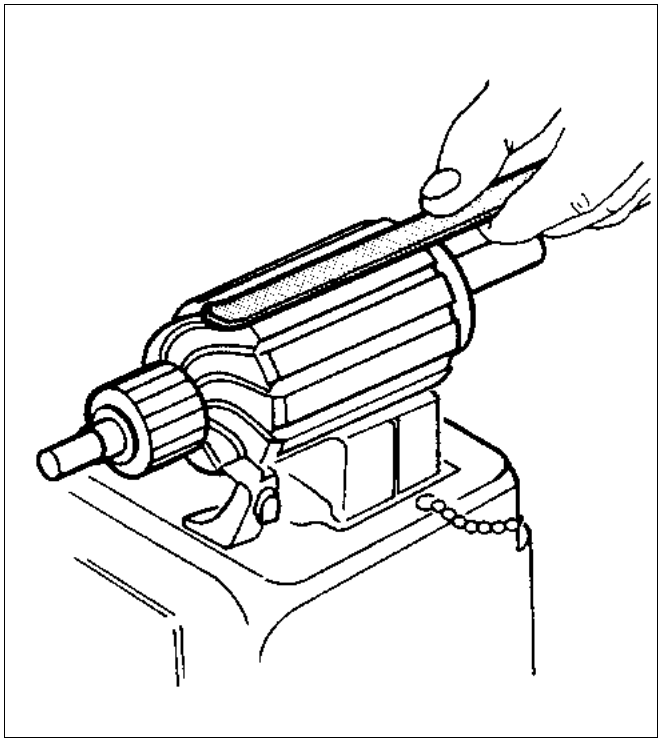

Figure 80-3. Testing Motor Armature for Shorts

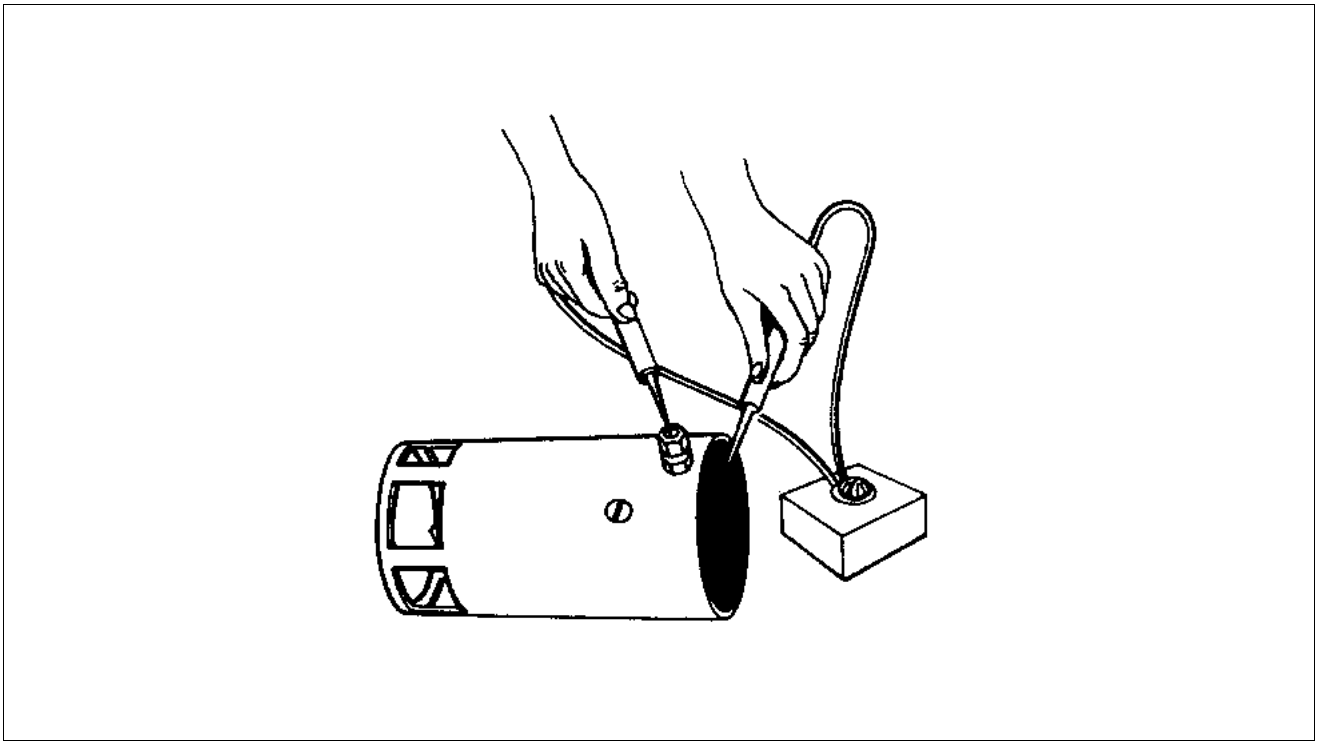

Figure 80-4. Testing Motor Fields for Grounds

CRANKING (cont)

7. Test Brush Holders

   a. To test brush holders, touch one test probe to the brush plate and the other to each brush holder.
   b. The test lamp should light when the grounded brush holders are touched and should not light when the insulated brush holders are touched.

8. Gear and Pinion Housing

   Inspect housings for cracks and bearings for excessive wear. Remove rust, paint or grease from mounting surfaces.

9. Bendix Drive

   The Drive should be wiped clean with a dry cloth. The pinion should turn smoothly in one direction and should lock in the other direction. Replace drive if it fails to check as above or if the pinion teeth are excessively worn or damaged.

10. Assembly of Starting Motor

    a. When assembling the starting motor, always use an arbor press and the proper bearing arbor for installing graphitized bronze and roller bearings. The shaft should have a thin film of Lubriplate No. 777 or equivalent on the Bendix portion of the shaft. End play should be .005 - .050 of an inch.
    b. New brushes should be properly seated when installing by wrapping a strip of 00 sandpaper around the commutator (with the sanding side out) 1-1/4 to 1-1/2 times maximum. Drop brushes on sandpaper covered commutator and turn the armature slowly in the direction of rotation. Dust should be blown out of the motor after sanding.

— Note —

The spring tension is 32 to 40 ounces with new brushes. This tension is measured with the scale hooked under the brush spring near the brush and the reading is taken at right angles to the line of force exerted by the brush spring.

    c. Check the position of the pinion to be sure the unit will mesh properly with the flywheel ring gear. See specifications for unit for correct dimensions (ref. Chart 8002, Starting Motor Service Test Specifications).

11. Bench test

    a. After the starting motor is reassembled, it should be tested to see that the no-load current at a certain voltage is within specifications as given in Chart 8002, Starting Motor Service Test Specifications. To make this test, connect as shown in Figure 80-5, if current is too high, check the bearing alignment and end play to make sure there is no binding or interference. Two or three sharp raps on the frame with a rawhide hammer will often help to align the bearings and free the armature.
    b. If no difficulty is indicated in the above test, a stall torque test may be made to see if the starting motor is producing its rated cranking power. Make test connections as shown in Figure 80-6.

CRANKING (cont)

CHART 8002. STARTING MOTOR SERVICE TEST SPECIFICATIONS

Motor Model	MZ-4206	MHB-4016	149-24PM
Min Brush Tension Max Brush Tension	32 oz 40 oz	32 oz 40 oz	32 oz 48 oz
No-Load Test (75° F:) Volt Max Amps Min rpm	 10 75 l600	 20 35 1300	 23 40 1000
Stall Torque Amps Min Torque, ft lbs Approx Volts	 560 37.5 4.0	 260 Maximum 27 14	 270 27 18

c. If torque and current are not within specifications, check the seating of the brushes and internal connections for high resistance. If these checks are made and found to be in good order, replace frame and field assembly and retest starter.

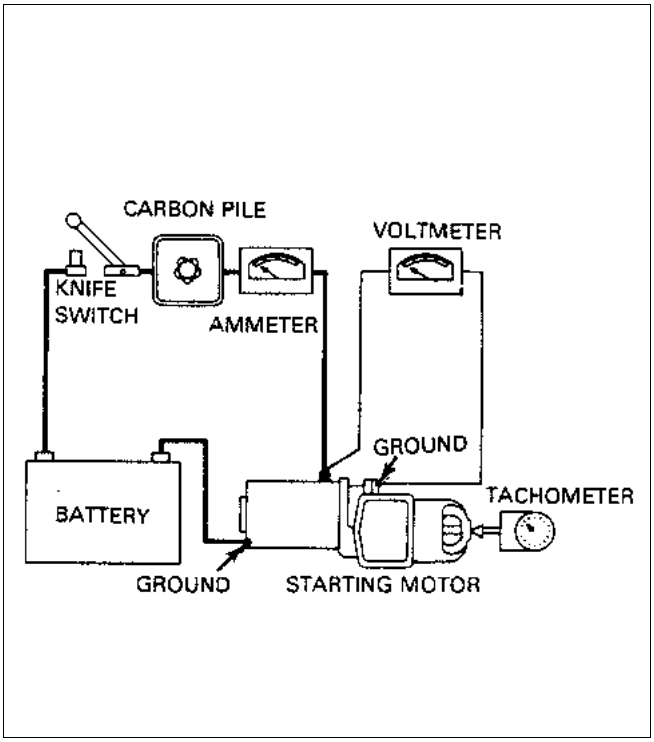

Figure 80-5. No-Load Test Hook-up

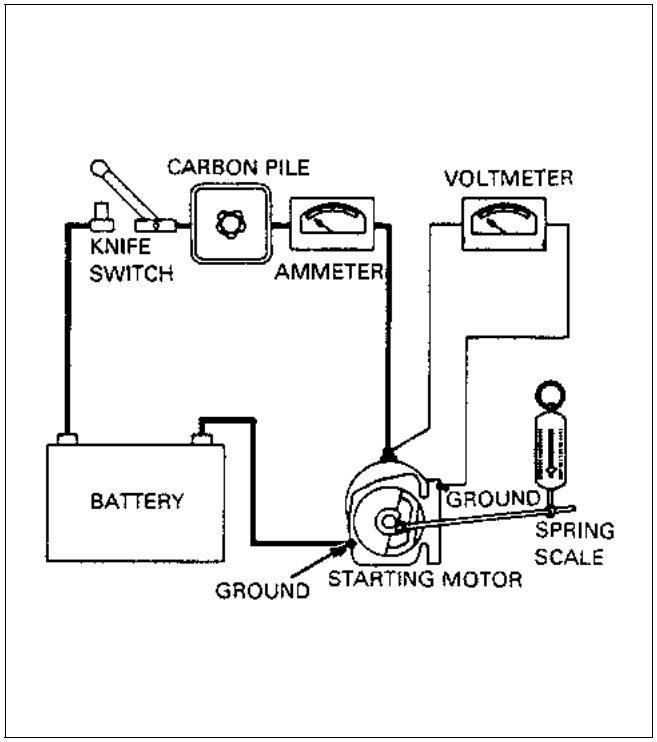

Figure 80-6. Stall-Torque Hook-up

CRANKING (cont)

12. Starting Motor 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 either opening or closing voltages are not to specifications, replace the solenoid.

B. Starting through External Power Receptacle with Airplane's Battery nearly depleted

1. 14 Volt D. C. System

Use the following procedure for starting with a 12 volt battery for external power when the airplane's battery is nearly depleted:

a. Position master switch OFF.
b. Position all electrical eqipment OFF.
c. Connect ***red*** lead of the Piper External Power (PEP) cable to the ***positive*** post of an external 12 Vdc battery.
d. Connect ***black*** lead of PEP cable to the ***negative*** post of an external 12 Vdc battery.
e. Plug PEP cable into fuselage external power receptacle.
f. Position master switch ON.
g. Start engine using normal starting procedure.
h. Reduce power to lowest possible rpm.
i. Disconnect PEP cable from fuselage external power receptacle.
j. Check master switch is ON and check ammeter.

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CRANKING (cont)

2. 28 Volt D. C. System

Use the following procedure for starting with a 28 volt external power supply when the airplane's battery is nearly depleted:

— CAUTION —

CARE SHOULD BE EXERCISED WHEN SHIPS BATTERY IS DEPLETED. IF THE BATTERY SWITCH IS POSITIONED ON, THE EXTERNAL POWER SUPPLY CAN BE REDUCED TO THE LEVEL OF THE AIRPLANE'S BATTERY.

a. Position battery master switch OFF.
b. Position alternator switch OFF.
c. Position magneto switches OFF.
d. Check that all electrical switches are positioned OFF.
e. Plug a standard 28 Vdc external power source into fuselage external power receptacle.
h. Start engine using normal starting procedure.
i. After engine starts:

(1) Reduce power to lowest possible rpm.
(2) Disconnect external power cable from fuselage external power receptacle.
(3) Position battery master and alternator switches ON. Check ammeter for electrical output.

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CHAPTER

81

TURBINES

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CHAPTER 81 - TURBINES

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GENERAL.

— WARNING —

THE USER IS RESPONSIBLE FOR REFERRING TO THE APPLICABLE VENDOR PUBLICATION(S) WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT. (SEE INTRODUCTION, PAGE 4.)

A. ENGINE TURBOCHARGER.

A turbocharger on the engine is operated by the engine exhaust gases. The exhaust gases drive a turbine wheel which is coaxial with a compressor impeller. Induction air entering the compressor impeller is compressed and flows to the engine induction distribution system and subsequently to each cylinder. The amount of induction air compression is a function of engine power - low power = low compression; high power = high compression. Excessive pressure and flow above the established limit is expelled by the overboost valve.

The turbocharger control system consists of a hydraulically activated wastegate bypass valve, a sloped controller and turbocharger. Automatic wastegate control of the turbocharger provides a constant manifold pressure from sea level to critical altitude.

The turbocharger system requires little attention between turbo overhauls. However, it is recommended that the items outlined in the Inspection Report in Chapter 5 be checked during required inspection intervals. Should trouble occur, refer to the Troubleshooting Table in this section and seek out the possible cause. Do not break the clamp seal joining the turbine and compressor units.

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GENERAL (cont).

B. TROUBLESHOOTING.

Troubles peculiar to the turbocharger are listed in Chart 8101 along with their probable causes and suggested remedies.

CHART 8101. TROUBLESHOOTING TURBOCHARGER

Trouble	Cause	Remedy
Waste gate won't close completely.	Broken linkage.	Repair linkage and adjust wastegate to open or closed position.
	Improper adjustment.	Re-rig actuator control.
Turbine won't come up to speed.	Worn or coked bearings.	Replace or overhaul turbocharger.
	Damage to turbine or compressor wheel.	Replace or overhaul turbocharger.
	Exhaust leaks.	Repair leaks.
Excessive noise or vibration.	Improper bearing lubrication.	Supply required oil pressure. Clean or replace oil line; clean oil strainer. If trouble persists, overhaul turbocharger.
	Leak in engine intake or exhaust manifold.	Tighten loose connections or replace manifold gaskets as necessary.
	Dirty impeller blades.	Disassemble and clean.

— continued on next page —

GENERAL (cont).

CHART 8101. TROUBLESHOOTING TURBOCHARGER (cont)

Trouble	Cause	Remedy
Engine will not deliver rated power.	Clogged manifold system.	Clear all ducting.
	Foreign material lodged in compressor impeller or turbine.	Disassemble and clean.
	Excessive dirt build-up in compressor.	Thoroughly clean compressor assembly. Service air cleaner and check for leakage.
	Leak in engine intake or exhaust.	Tighten loose connections or replace manifold gaskets as necessary.
	Rotating assembly bearing seizure	Overhaul turbocharger.
	Waste gate butterfly not closing.	Butterfly shaft binding. Check bearings.
	Turbocharger impeller binding, frozen or fouling housing.	Check bearings. Replace turbocharger.
Critical altitude lower than specified.	Waste gate valve sticking.	Clean and free action. Check actuator system.
Engine surges or smokes.	Clogged induction duct.	Check induction duct for restrictions to air flow.
	Bootstrapping.	Operate engine within range outlined in operation manual.

— Note —

Smoke would be normal if engine has idled for a prolonged period.

GENERAL (cont).

CHART 8101. TROUBLESHOOTING TURBOCHARGER (cont)

Trouble	Cause	Remedy
High deck pressure. (Compressor discharge pressure.)	Waste gate sticking closed.	Butterfly shaft binding. Check bearings. Replace waste gate valve or correct actuator rigging.
Oil in induction housing.	Engine idles too slow, turbo doesn't turn allowing oil to leak from compressor seal.	Increase engine idle speed to a maximum of 700 RPM, if turbo still smokes, it must be replaced. Check interconnect control for proper adjustment. Note: New turbo may smoke for a short period of time.
	Turbine oil bearing check valve not closing at engine shut down.	Check spring actuated check valve at turbo oil inlet fitting.
White exhaust.	Leaking oil seal in turbine (coked oil drain passages.)	Clean drain passages. It is sometimes necessary to overhaul or replace turbo.
	Engine idles too slow, turbo not turning.	Increase engine idle speed to a maximum of 700 RPM, if turbo still smokes, it must be overhauled or replaced. Check interconnect control for proper adjustment.

GENERAL (cont).

C. TURBOCHARGER NOMENCLATURE.

Many unfamiliar terms may appear on the following pages of this manual. An understanding of these will be helpful, if not necessary. in performing maintenance and troubleshooting, The following is a list of commonly used terms and names as applied to turbocharging.

TERM	MEANING
Supercharge	To increase the air pressure (density) above or higher than ambient conditions.
Supercharger	A device that accomplishes the increase in pressure.
Turbo-supercharger	More commonly referred to as a “Turbocharger” this device is driven by a turbine. The turbine is spun by energy extracted from the engine exhaust gas.
Compressor	The portion of a turbocharger that takes in ambient air and compresses it before discharging it to the engine.
Turbine	The exhaust driven end of the turbocharger unit.
Wastegate	The wastegate is a butterfly type valve in the exhaust by-pass which, throughout its travel from open to closed, allows varied amounts of exhaust pressure to by-pass the turbine, controlling its speed, hence the output of the compression.
Ground Boosted or Ground Turbocharged	These phrases indicate that the engine depends on a certain amount of turbocharging at sea level to produce the advertised horsepower. An engine that is so designed will usually include a lower compression ratio to avoid detonation.
Deck Pressure	The pressure measured in the area downstream of the turbo compressor discharge and upstream of the engine throttle valve. This should not be confused with manifold pressure.
Manifold Pressure	The pressure measured downstream of the engine throttle valve and is almost directly proportioned to the engine power output.
Normalizing	If a turbocharger system is used only to regain power losses caused by decreased air pressure of high altitude, it is considered that the engine has been “normalized.”

GENERAL (cont).

Overboost	An overboost condition means that manifold pressure is exceeding the limits at which the engine was tested and FAA certified and can be detrimental to the life and performance of the engine. Overboost can be caused by malfunctioning controllers or improperly operating wastegate in the automatic system or by pilot error in a manual controlled system.
Overshoot	Overshoot is a condition of the automatic controls not having the ability to respond quickly enough to check the inertia of the turbocharger speed increase with rapid engine throttle advance. Overshoot differs from overboost in that the high manifold pressure lasts only for a few seconds. This condition can usually be overcome by smooth throttle advance.
Bootstrapping	This is a term used in conjunction with turbo machinery. If you were to take all the air coming from a turbocharger compressor and duct it directly back into the turbine of that turbocharger, it would be called a bootstrap system and if no losses were encountered, it would theoretically run continuously. It would also be very unstable because if for some reason the turbo speed would change, the compressor would pump more air to drive the turbine faster, etc. A turbocharged engine above critical altitude (wastegate closed) is similar to the example mentioned above, except now there is an engine placed between the compressor discharge and turbine inlet. Slight system changes caused the exhaust gas to change slightly, which causes the turbine speed to change slightly, which causes the compressor air to the engine to change slightly, which in turn again affects the exhaust gas, etc.
Critical Altitude	A turbocharged engine's wastegate will be in a partially open position at sea level. As the aircraft is flown to high altitude (lower ambient pressures) the wastegate closes gradually to maintain the preselected manifold pressure. At the point where the wastegate reaches its full closed position, the preselected manifold pressure will start to drop and this is considered critical altitude.

NOTES:

1. Refer to the latest revision of Lycoming Service Bulletin No. 369 for recommended engine inspections after any Overspeed or Overboost conditions.

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TURBO - SUPERCHARGER.

A. REMOVAL OF TURBOCHARGER. (Refer to Figure 81-1.)

1. Remove the engine cowling. (Refer to Chapter 71.)
2. Remove the turbocharger compressor and turbine assembly by the following procedure:

   a. Disconnect the oil supply and return lines from the center section of the turbo.

— CAUTION —

WHEN REMOVING OR INSTALLING COUPLING CLAMPS, SLIDE CLAMP OVER THE END OF THE PIPE BEFORE ASSEMBLY/ DISASSEMBLY. EXCESSIVE SPREADING CAN LEAD TO PREMATURE CLAMP FAILURE.

   b. Disconnect the air ducts from the compressor inlet and outlet, and the exhaust system from the turbine inlet and outlet.
   c. Disconnect the tailpipe support bracket at the turbocharger and remove the tailpipe and wastegate assembly.
   d. Remove the bolts that attach the turbocharger to the mounting bracket and remove the turbocharger assembly.

B. TURBOCHARGER LUBRICATION SYSTEM PRIMING.

Immediately prior to mounting the unit, prime the lubrication system as follows:

1. Invert turbocharger and fill center housing with new clean oil through oil drain.
2. Turn rotating assembly by hand to coat bearings and thrust washer with oil.
3. Coat threads of attaching bolts or studs with high temperature thread lubricant.

— Note —

If the turbocharger is to be installed on a new or newly overhauled engine, operate the engine with a separate oil filter in the oil supply line to the turbocharger during the first hour of operation. This must be done to ensure that no metal particles are carried from the engine into the turbocharger lubrication system.

C. INSTALLATION OF TURBOCHARGER.

1. Position the turbocharger assembly in the mounting bracket and secure with mounting hardware.
2. Carefully align exhaust system with the turbo inlet.
3. Carefully position the exhaust tailpipe and wastegate assembly to the turbocharger outlet.
4. Install coupling clamp and while tightening the coupling clamp nuts, gently tap around the periphery of the couplings with a soft mallet while shaking the tailpipe. This will distribute the band tensions evenly. Continue tightening the clamp nuts until a torque of 40-50 inch pounds is reached on the turbocharger to tailpipe clamp and 80-90 inch pounds on the bypass coupling. Safety the clamp nuts.
5. Connect the induction tube to the compressor outlet and the diverter box assembly to the compressor inlet.
6. After installing turbocharger, flush oil through oil inlet line and ensure that line is clean and unobstructed.

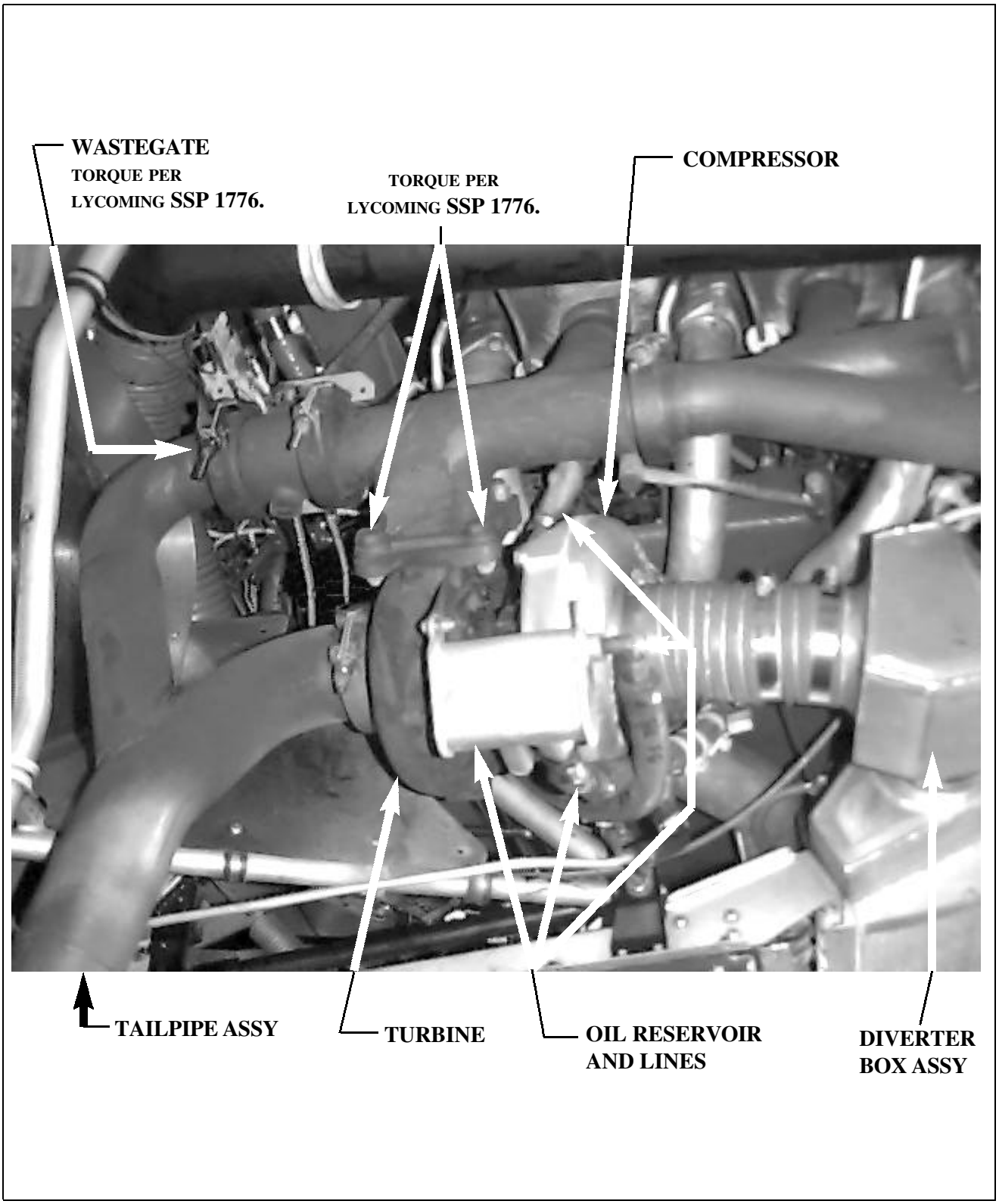

Figure 81-1. Turbocharger Installation

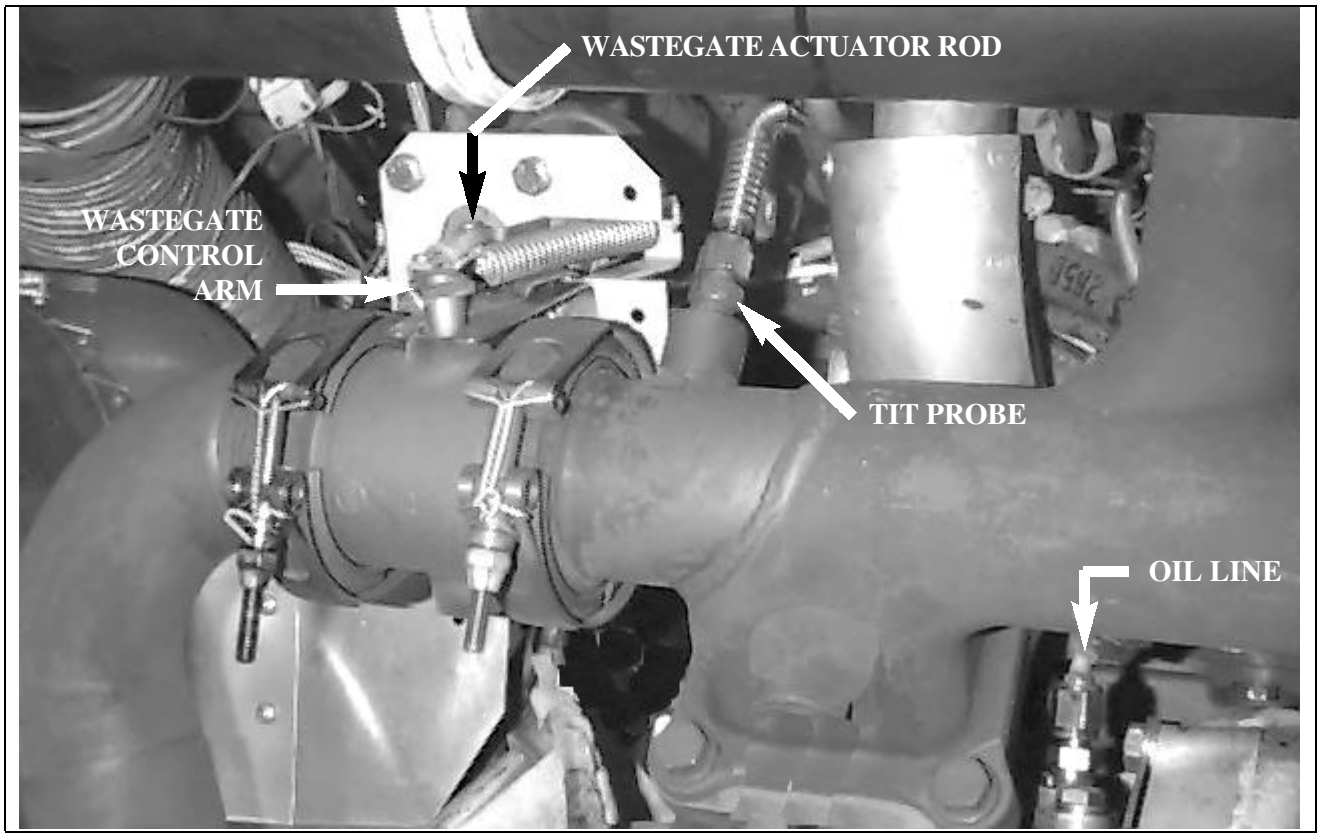

Figure 81-2. Wastegate Installation

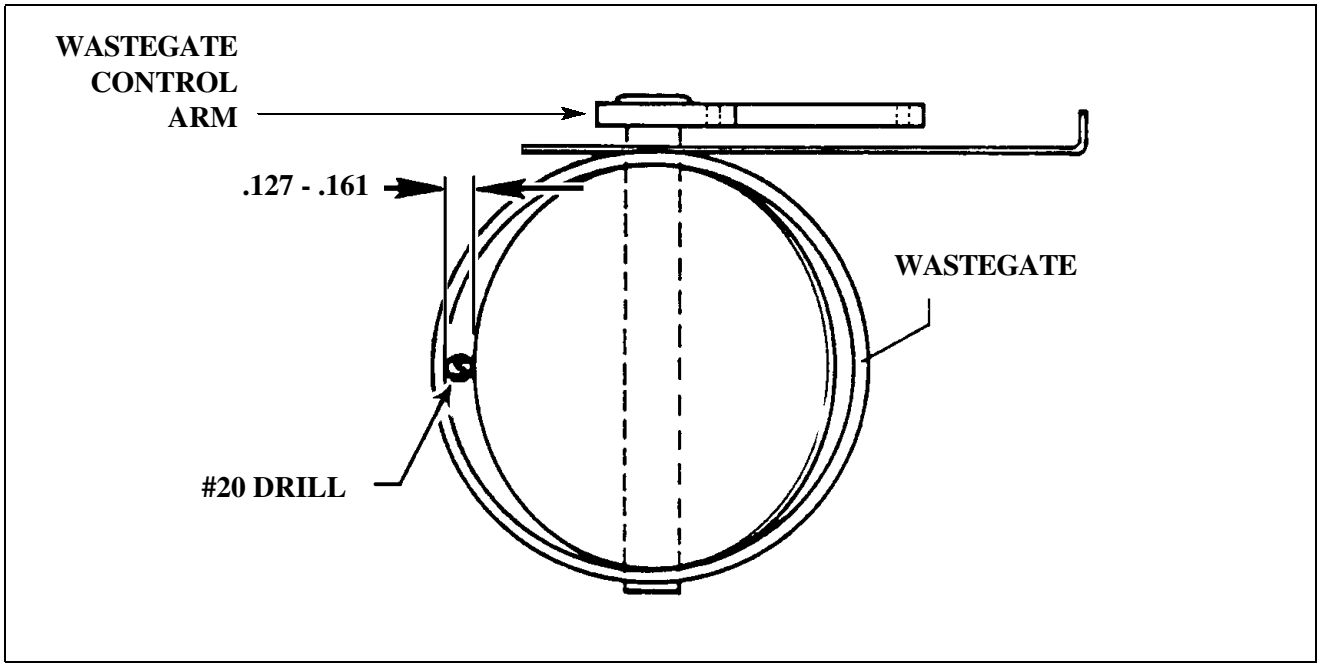

Figure 81-3. Wastegate Adjustment

TURBO - SUPERCHARGER (cont).

7. Fill engine and oil inlet line with new, clean lubricating oil, and connect line.
8. Connect the oil supply and return lines to the turbocharger center section.
9. Install the engine cowling. (Refer to Chapter 71.)

D. EXHAUST WASTEGATE ASSEMBLY

1. REMOVAL.

   a. Remove engine cowling. (Refer to Chapter 71.)
   b. Remove the nut, bolt and washers securing the wastegate actuator rod to the wastegate control arm.
   c. Remove V band clamps securing wastegate to exhaust transition and tailpipe.

2. INSTALLATION.

   a. Install wastegate assembly with gasket between exhaust transition and tailpipe.
   b. Secure wastegate with V band clamps and torque clamps to specifications given in Lycoming Special Service Publication (SSP) 1776, Table of Limits.
   c. Secure the wastegate actuator rod to the control arm with the appropriate washers, bolt and nut.

— Note —

The wastegate valve should be lubricated with Mouse Milk or WD-40 at the butterfly pivot points every 50 hours. Mouse Milk may be purchased from: Worldwide Aircraft Filter Corp., 1685 Abram Ct., San Leandro, CA 94577.

3. ADJUSTMENT. (Refer to Figures 81-2 and 81-3)

   The exhaust wastegate (butterfly) valve is mechanically linked to the actuator by means of the wastegate actuator rod. The wastegate may be adjusted as follows:

   1. Remove the engine cowling as described in Chapter 71.
   2. Remove the clamp securing the tailpipe assembly to the wastegate and separate wastegate and tailpipe assembly (separate sufficiently to allow access to the butterfly valve within the wastegate).
   3. Place the throttle in the near-full open position.
   4. Place the shank end of a #20 drill bit between the inner wall of the wastegate assembly and the butterfly valve (Refer to Figure 81-3.)
   5. With the throttle now in the full-open position (against the stop) a slight drag should be felt when the drill bit is moved in an in and out motion. Should the throttle control arm not contact its stop, or should the drill bit be too loose, adjust the actuator rod end to obtain the proper clearance.
   6. Place the tailpipe assembly in position and secure with the appropriate clamps.
   7. Install upper and lower cowling as described in Chapter 71.
   8. Flight test the aircraft to determine critical altitude (12,000 feet minimum) at MAX power of 2500 RPM and 38 inches Hg.
   9. If the above criteria is not met, further ground adjustment of the wastegate will be required.

TURBO - SUPERCHARGER (cont).

E. TURBOCHARGER DECOKING.

Mouse Milk lubricant may be used for decoking the turbine and compressor drive shaft by the following procedure:

1. Disconnect the oil inlet and outlet lines from the turbocharger and allow all oil to drain.
2. Cap the outlet port on the turbocharger.
3. Pour the Mouse Milk into the oil inlet port of the turbocharger and allow the unit to soak overnight.
4. Drain all Mouse Milk from the turbocharger and flush the unit with engine oil.
5. Prime the turbocharger in accordance with Turbocharger Lubrication System Priming.

F. THROTTLE CONTROL STOP LIMITS.

The adjustment of the throttle control stop limits is limited to just checking that the throttle control arm contacts the full open stop before the turbo wastegate contacts the fully closed stop.

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GRIDS 4L18 THRU 4L24
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AIRPLANE MAINTENANCE MANUAL

CARD 5 OF 5

PA-32R-301

Saratoga II HP

(S/N's 3246001 AND UP)

PA-32R-301T

Saratoga II TC

(S/N's 3257001 AND UP)

THE NEW PIPER AIRCRAFT, INC.

PART NUMBER 761-879 **February 16, 2004**

Published by
Technical Publications

2926 Piper Drive
Vero Beach, Florida 32960
U.S.A.

Member
General Aviation
Manufacturers Association

AEROFICHE REVISION STATUS

Revisions to this Maintenance Manual (P/N 761-879) published June 24, 1996 and reissued July 1, 1997 are as follows:

Revision	Publication Date	Aerofiche Card Effectivity
ORG950712	June 24, 1996	1, 2, 3, and 4
CR970701	July 1, 1997	1, 2, 3, 4, and 5
PR990715	July 15, 1999	1, 2, 3, 4, and 5
PR011215	December 15, 2001	1
PR020331	March 31, 2002	1
PR040216*	February 16, 2004	1, 3, and 5

*** PARTIAL REVISION OF MAINTENANCE MANUAL 761-879**

Revisions appear in Aerofiche Cards 1, 3, and 5. Accordingly, discard your existing Cards 1, 3, and 5 and replace them with these three cards dated 02/16/04.

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

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INTRODUCTION

TABLE OF CONTENTS / EFFECTIVITY

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INTRODUCTION

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-32R-301/301T Saratoga II HP and TC 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).

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-32R Parts Catalog P/N 761-880, 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.

Be sure to supply the correct serial number information in any correspondence or communication concerning your airplane.

EFFECTIVITY

This maintenance manual is effective for PA-32R-301 Saratoga II HP airplanes serial numbers 3246001 and up and PA-32R-301T Saratoga II TC airplanes serial numbers 3257001 and up.

This encompasses the following model years:

— Note —

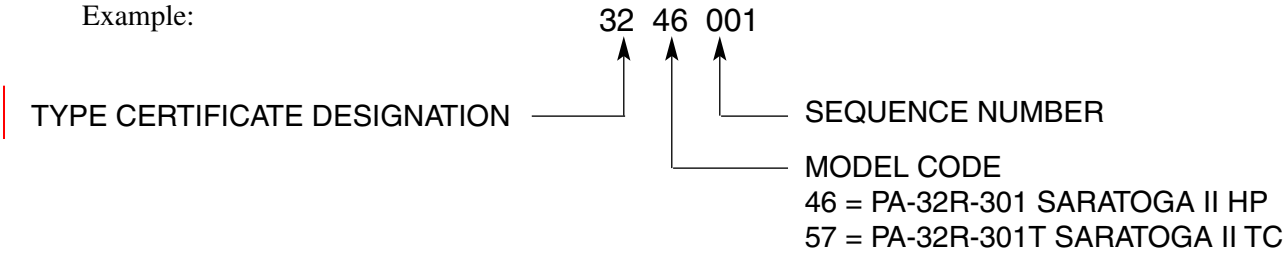
The following is provided as a general reference only.

PA-32R-301 Saratoga II HP:	Model Year	Serial Numbers
	1995	3246001 thru 3246017
	1996	3246018 thru 3246059
	1997	3246060 thru 3246087
	1998	3246088 thru 3246125
	1999	3246126 thru 3246153
	2000	3246154 thru 3246165
	2000.5	3246166 thru 3246181
	2001	3246182 thru 3246203
	2002	3246204 thru 3246209
	2003	3246210 thru 3246217
	2004	3246218 and up

PA-32R-301T Saratoga II TC:	Model Year	Serial Numbers
	Prototype	3257001
	1998	3257002 thru 3257075
	1999	3257076 thru 3257123
	2000	3257124 thru 3257155; less 3257144
	2000.5	3257156 thru 3257198; and 3257144
	2001	3257199 thru 3257266
	2002	3257267 thru 3257296
	2003	3257297 thru 3257338
	2004	3257339 and up

SERIAL NUMBER EXPLANATION

Example:



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

PAGINATION

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

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 List of Illustrations for all fiche in this set.
(3) A complete List of Charts for all fiche in this set.

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 illustrations, or list of charts.

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

Original and Reissue:	None	
Revisions:	First:	Revision Indication (1R Month-Year)
	Second:	Revision Indication (2R Month-Year)
	Subsequent revisions follow with consecutive numbers such as 3R, 4R, etc.	
Added Subject:		Revision Identification, (A Month-Year)
Deleted Subject:		Revision Identification, (D Month-Year)

INDEXING

Each System/Chapter begins with an individual Table of Contents.

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.

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.

SUPPLEMENTARY PUBLICATIONS

The following is a list of publications providing servicing, overhaul and parts information on various components on the PA-32R-301/301T airplanes, which you should use to supplement this manual.

A. Piper Publications:

(1) Parts Catalog - P/N 761-880

(2) Progressive Inspection Manuals (50 hour):
P/N 761-881 (pending) for the SARATOGA II HP (S/N's 3246001 & up), and
P/N 761-896 (pending) for the SARATOGA II TC (S/N's 3257001 & up).

(3) Periodic Inspection Report Forms:
P/N 230-1047 for the SARATOGA II HP (S/N's 3246001 & up), and
P/N 230-2047 for the SARATOGA II TC (S/N's 3257001 & up).

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.

AIR CONDITIONING COMPRESSOR:

Vendor:
York Industries
1750 Toronita Street
York, Pennsylvania 17402
(717) 846-1988

(or)

Sanden International (USA), Inc.
601 South Sanden Blvd.
Wylie, TX 75098-4999
(972) 442-8400
http://www.sanden.com

ALTERNATOR

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

AUTOFLIGHT:

Vendor(s):
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 76067-9236
PH - (940) 325-9406
www.s-tec.com

BRAKES:

Vendor:
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

ELECTRONIC FLIGHT DISPLAY SYSTEM (EFDS)

Vendor:	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

EMERGENCY LOCATOR TRANSMITTER:

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

ENGINE:

Vendor:	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:	IO-540- ..... - K1G5, ... ENGINES - P/N PC-615 TIO-540-AH1A ENGINES - P/N PC-615-12	
Operators Handbook:	O-540, IO-540 SERIES - P/N 60297-10 TIO-540 Series - P/N 60297-23	

— 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.

ELECTRIC FUEL PUMP:

Vendor(s):	Parker Hannifin Corp. Airborne Division 711 Taylor Street Elyria, Ohio 44035 PH - (800) 382-8422	(or)	Weldon Pump 640 Golden Oak Parkway Oakwood Village, OH 44146 PH - (216) 232-2282
	http://www.parker.com/cleveland/Universe/book.pdf		

FUEL CELLS:

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

GEAR LOCKING ACTUATORS, NOSE GEAR DOOR ACTUATOR, HYDRAULIC PUMP, AND ALL HYDRAULIC COMPONENTS:

Vendor:	Parker Hannifin Corp. (See Brakes, above)

HI-LOK FASTENERS AND TOOLS:

Vendor:	Hi-Shear Corporation 2600 Skypark Drive Torrance, California 90509 (213) 326-8110	PH - (213) 326-8110

LIGHTS - NAVIGATION/STROBE LIGHTS STANDBY/MAP:

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

MAGNETOS:

Vendor:	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	

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

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

OXYGEN SYSTEM: (TC only)

Vendor:	Scott Aviation 2225 Erie Street Lancaster, New York 14086 http://www.scottaviation.com/	PH - (716) 683-5100

PROPELLER:

Vendor:	Hartzell Propellor Inc. One Propellor Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH - (937) 778-4379 FAX - (937) 778-4321
Standard Practices:	Manual No. 202A	
Overhaul and Maintenance:	Manual No. 113B	
Aluminum Blade Overhaul:	Manual No. 133C	
Propeller Owner's Manual and Logbook:	Manual No. 115N	

PROPELLER GOVERNOR:

Vendor:	Hartzell Propeller Inc. One Propellor Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH - (937) 778-4379 FAX - (937) 778-4321
Governor Maintenance:	Manual No. 130B	

STANDBY ATTITUDE INDICATOR:

Vendor:	Mid-Continent Instruments Co., Inc. 9400 E. 34 TH Street N. Wichita, KS 67226 http://www.mcico.com/index.html	PH - (316) 630-0101 FAX - (316) 630-0723
Installation Manual and Operating Instructions:	Manual No. 9015762	

STARTER:

Vendor:	Sky-Tec 350 Howard Clemmons Rd. Granbury, Texas 76048 http://www.skytecair.com	PH - (800) 476-7896 FAX - (817) 573-2252

VACUUM PUMPS:

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

VACUUM REGULATORS:

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

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SYSTEM / CHAPTER INDEX GUIDE (cont)

— Note —

For Vendor Publications, see Introduction - Supplementary Publications.

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2102	Troubleshooting Air Conditioning System	1I21
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7402	Coupling Torque	4H11
7701	Troubleshooting Manifold Pressure Gauge	4H21
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7703	Troubleshooting Oil Pressure Gauge	4H23
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CHARTS & WIRING DIAGRAMS

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CHAPTER 91 - CHARTS AND WIRING DIAGRAMS

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GENERAL

This chapter contains miscellaneous charts which are applicable to various chapters and systems covered in this manual. All electrical schematics are also included herein.

A. Torque Requirements

The torque values given in Chart 9102 are derived from oil-free cadmium-plated threads and are recommended for all airframe installation procedures where torquing is required, unless otherwise noted in sections where other values are stipulated. Engine torque values are found in the latest revision of Lycoming Overhaul Manual, and propeller torque values are found in Chapter 61 of this manual. Chart 9101 lists the torque values for flared fittings of various sizes and material.

— CAUTION —

DO NOT OVERTORQUE FITTINGS.

—Note —

When flared fittings are being installed, check that the male threads are properly lubricated. Torque the fittings in accordance with Chart 9101.

CHART 9101. FLARE FITTING TORQUES

TORQUE — INCH-POUND						
TUBING OD INCHES	ALUMINUM - ALLOY TUBING FLARE - AND 10061 OR AND 10078		STEEL TUBING FLARE AND 10061		HOSE END FITTING AND HOSE ASSEMBLIES	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1/8	– – –	– – –	– – –	– – –	– – –	– – –
3/16	– – –	– – –	90	100	70	100
1/4	40	65	135	150	70	120
5/16	60	80	180	200	85	180
3/8	75	125	270	300	100	250
1/2	150	250	450	500	210	420
5/8	200	350	650	700	300	480
3/4	300	500	900	1000	500	850
1	500	700	1200	1400	700	1150
1 1/4	600	900	– – –	– – –	– – –	– – –
1 1/2	600	900	– – –	– – –	– – –	– – –
1 3/4	– – –	– – –	– – –	– – –	– – –	– – –
2	– – –	– – –	– – –	– – –	– – –	– – –

GENERAL (cont)

1. Calibrate the torque wrench periodically to assure accuracy, and recheck frequently.
2. Unless otherwise specified, torque all nuts to the applicable torque in Chart 9102. If the nut (or bolt) is listed but not its mating fastener, use the lower torque in Chart 9102 for the listed nut (or bolt).

— Note —

If normal operation requires movement between any of the components being clamped together, tighten the nut (or bolt) enough to insure intended operation of the assembly.

3. Bolt and nut threads should be clean and dry unless otherwise specified. If the threads are to be lubricated, reduce the recommended nut torque given in Chart 9102 (plus the friction drag torque) by 50%.
4. For thread sizes 10 through 7/16, add the friction drag torque (in Chart 9102) for all self-locking fasteners. For non-self locking fasteners, assume the friction drag torque to be zero.
5. 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.

6. 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.

7. 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.
8. 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 Manual AC 43.13-lA

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 9102A for sizes 8 through 7/16 to the recommended torque from Chart 9102 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 9102.
2. Castellated and Non-Self Locking Nuts - Use only the torque given in Chart 9102. 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 9102 and 9102A.
5. Refer to the latest revision of Lycoming Service Table Limits, SSP1776, for torques on parts used on Lycoming engines.
6. A maximum of two AN960 washers may be added under bolt heads or nuts to correct for variations in material thickness within the tolerances permitted.
7. Self-Locking Fasteners - Limitations of the use of self-locking nuts, bolts and screws including fasteners with non-metallic inserts are as follows:
   a. Fasteners incorporating self-locking devices shall not be reused if they can be run-up using only fingers. They may be reused if hand tools are required to 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.

FRICTION DRAG TORQUE FOR GIVEN BOLTS

BOLT SIZE	FRICTION DRAG TORQUE (IN. -LB.)
8 (course thread)	15
10	18
1/4	30
5/16	60
3/8	80
7/16	100

CHART 9102.
RECOMMENDED NUT TORQUES
(1 of 2)

COARSE THREAD SERIES

BOLTS
Steel Tension

AN 3 THRU AN 20
AN 42 THRU AN 49
AN 73 THRU AN 81
AN 173 THRU AN 186
MS 20033 THRU MS 20046
MS 20073
MS 20074
AN 509 NK9
MS 24694
AN 525 NK525
MS 27039

NUTS

Steel Tension	Steel Shear
AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679	AN 320 AN 364 NAS 1022 MS 17826 MS 20364

Nut-bolt size	Torque Limits in-lbs.		Torque Limits in-lbs.	
	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 9102. RECOMMENDED NUT TORQUES (2 of 2)

FINE THREAD SERIES

	BOLTS Steel Tension		**BOLTS Steel Tension**		**BOLTS Aluminum**	
	AN 3 THRU AN 20 AN 42 THRU AN 49 AN 73 THRU AN 81 AN 173 THRU AN 186 MS 20033 THRU MS 20046 MS 20073 MS 20074 AN 509 NK9 MS 24694 AN 525 NK525 MS 27039		MS 20004 THRU MS 20024 NAS 144 THRU NAS 158 NAS 333 THRU NAS 340 NAS 583 THRU NAS 590 NAS 624 THRU NAS 644 NAS 1303 THRU NAS 1320 NAS 172 NAS 174 NAS 517	**Steel shear bolt** NAS 464	AN 3DD THRU AN 20DD AN 173DD THRU AN 186DD AN 509DD AN 525D MS 27039D MS 24694DD	
	NUTS Steel Tension	**Steel Shear**	**NUTS Steel Tension**	**Steel Shear**	**NUTS Alum. Tension**	**Alum. Shear**
	AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679	AN 320 AN 364 NAS 1022 MS 17826 MS 20364	AN 310 AN 315 AN 363 AN 365 MS 17825 MS 20365 MS 21045 NAS 1021 NAS 679 NAS 1291	AN 320 AN 364 NAS 1022 MS 17826 MS 20364	AN 365D AN 310D NAS 1021D	AN 320D AN 364D NAS 1022D

Nut-bolt size	**Torque Limits in-lbs.**		**Torque Limits in-lbs.**		**Torque Limits in-lbs.**		**Torque Limits in-lbs.**		**Torque Limits in-lbs.**		**Torque Limits in-lbs.**	
	Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
8-36	12	15	7	9					5	10	3	6
10-32	20	25	12	15	25	30	15	20	10	15	5	10
1/4-28	50	70	30	40	80	100	50	60	30	45	15	30
5/16-24	100	140	60	85	120	145	70	90	40	65	25	40
3/8-24	160	190	95	110	200	250	120	150	75	110	45	70
7/16-20	450	500	270	300	520	630	300	400	180	280	110	170
1/2-20	480	690	290	410	770	950	450	550	280	410	160	260
9/16-18	800	1,000	480	600	1,100	1,300	650	800	380	580	230	360
5/8-18	1,100	1,300	660	780	1,250	1,550	750	950	550	670	270	420
3/4-16	2,300	2,500	1,300	1,500	2,650	3,200	1,600	1,900	950	1,250	560	880
7/8-14	2,500	3,000	1,500	1,800	3,550	4,350	2,100	2,690	1,250	1,900	750	1,200
1-14	3,700	4,500	2,200	3,300	4,500	5,500	2,700	3,300	1,600	2,400	950	1,500
1-1/8-12	5,000	7,000	3,000	4,200	6,000	7,300	3,600	4,400	2,100	3,200	1,250	2,000
1-1/4-12	9,000	11,000	5,400	6,600	11,000	13,400	6,600	8,000	3,900	5,600	2,300	3,650

CHART 9103. 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 9104. CONVERSION TABLES (1 of 5)

1. These charts contain the various conversion data that may be useful when figuring capacities, lengths, temperatures, and various weights and measures from the English system values to the metric system values or back again.

2. The English system is in use by England and the United States. All other countries use the metric system .

3. Procedure for Converting Inches to Millimeters. (Refer to Chart 9104, Sheet 4)

   a. Example: Convert 1.5 inches to millimeters.

      (1) Read down inches column to 1. inches.
      (2) Read across top inch column to 0.5.
      (3) Read down and across to find millimeters (1.5 inches is 38.10 millimeters).

4. Procedure for Converting Fahrenheit (°F) and Celsius (°C) (Centigrade) Temperature. (Refer to Chart 9104, Sheet 2).

   a. Read number in middle column, if in degrees Celsius (°C), read Fahrenheit equivalent in right-hand column. If in degrees Fahrenheit (°F). read Celsius equivalent in left-hand column.

      (1) 70°F = 21.11°C.
      (2) 30° C = 86.0° F.

CHART 9104. CONVERSION TABLES (2 of 5)

CENTIGRADE - FAHRENHEIT CONVERSION TABLE

Example: To convert 20°C, to Fahrenheit, find 20 in the center column headed (°F - °C); then read 68.0°F, in the column (°F) to the right. To convert 20°F, to Centigrade; find 20 in the center column and read -6.67°C, in the (°C) column to the left.

°C	°F - °C	°F	°C	°F - °C	°F
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
- 45.6	-50	-58.0	115.56	240	464.0
- 40.0	-40	-40.0	121.11	250	482.0
- 34.0	-30	-22.0	126.67	260	500.0
- 38.9	-20	-4.0	132.22	270	518.0
- 23.3	-10	14.0	137.78	280	536.0
- 17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
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 9104. CONVERSION TABLES (3 of 5)

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 9104. CONVERSION TABLES (4 of 5)

INCHES TO MILLIMETER

INCHES	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
					MILLIMETER					
0.000		0.0025	0.0050	0.0076	0.0101	0.0127	0.0152	0.0177	0.0203	0.0228
0.001	0.0254	0.0279	0.0304	0.0330	0.0355	0.0381	0.0406	0.0431	0.0457	0.0482
0.002	0.0508	0.0533	0.0558	0.0584	0.0609	0.0635	0.0660	0.0685	0.0711	0.0736
0.003	0.0762	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	0.0965	0.0990
0.004	0.1016	0.1041	0.1066	0.1092	0.1117	0.1143	0.1168	0.1193	0.1219	0.1244
0.005	0.1270	0.1295	0.1320	0.1346	0.1371	0.1397	0.1422	0.1447	0.1447	0.1498
0.006	0.1524	0.1549	0.1574	0.1600	0.1625	0.1651	0.1676	0.1701	0.1727	0.1752
0.007	0.1778	0.1803	0.1828	0.1854	0.1879	0.1905	0.1930	0.1955	0.1981	0.2006
0.008	0.2032	0.2057	0.2082	0.2108	0.2133	0.2159	0.2184	0.2209	0.2235	0.2260
0.009	0.2286	0.2311	0.2336	0.2362	0.2387	0.2413	0.2438	0.2463	0.2489	0.2514

INCHES	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
					MILLIMETER					
0.00		0.025	0.050	0.076	0.101	0.127	0.152	0.177	0.203	0.228
0.01	0.254	0.279	0.304	0.330	0.355	0.381	0.406	0.431	0.457	0.482
0.02	0.508	0.533	0.558	0.584	0.609	0.635	0.660	0.685	0.711	0.736
0.03	0.762	0.787	0.812	0.838	0.863	0.889	0.914	0.939	0.965	0.990
0.04	1.016	1.041	1.066	1.092	1.117	1.143	1.168	1.193	1.219	1.244
0.05	1.270	1.295	1.320	1.346	1.371	1.397	1.422	1.447	1.473	1.498
0.06	1.524	1.549	1.574	1.600	1.625	1.651	1.676	1.701	1.727	1.752
0.07	1.778	1.803	1.828	1.854	1.879	1.905	1.930	1.955	1.981	2.006
0.08	2.032	2.057	2.082	2.108	2.133	2.159	2.184	2.209	2.235	2.260
0.09	2.286	2.311	2.336	2.362	2.387	2.413	2.438	2.463	2.489	2.514

INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
					MILLIMETER					
0.0		0.254	0.508	0.762	0.016	1.270	1.524	1.778	2.032	2.286
0.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
0.2	5.080	5.334	5.558	5.842	6.096	6.350	6.604	6.858	7.112	7.366
0.3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
0.4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
0.5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
0.6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
0.7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
0.8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
0.9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

INCHES	0.00	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
					MILLIMETER					
0.		2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86
1.	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26
2.	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66
3.	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06
4.	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46
5.	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86
6.	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.26
7.	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66
8.	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06
9.	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46

— Note —

See Chart 9104, Sheet 1 for instructions on how to use this chart.

CHART 9104. CONVERSION TABLES (5 of 5)

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 9105. LIST OF CONSUMABLE MATERIALS (1 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
ABS-Solvent/ Cements		Solarite, #11 Series	Solar Compounds Corp.
Adhesive		EC 801 EC 807 EC 1357 Scotch Grip 210	Minnesota Mining and Manufacturing Adhesive Coating and Sealers Division
	Neoprene Rubber	3M EC 1300L	
Anti-Galling Solution	MIL-A-907	Ease-Off	Taxacone Company
Anti-Seize Compound (Graphite Petrolatum)	MIL-T-5544	Armite Product	Armite Laboratories
		Anti-Seize Compound	Exxon Oil Company
		Royco 44	Royal Lubricants Co.
Anti-Seize Compound (White Lead Base)	TT-A-580 (JAN-A-669)	Armite Product	Armite Laboratories
Anti-Seize Thread Compound “HIGH TEMPERATURE”		Fel-Pro C5-A	Fel-Pro Incorporated
Buffing and Rubbing Compounds		Automotive Type DuPont #7	DuPont Company
		Ram Chemical #69	Ram Chemicals
Compound for Polishing		Mirror Glaze	Mirror Bright Polish Co., Incorporated
Plexiglas Polish and Cleaner	P-P-560	Part Number 403D	Permatex Co., Inc. Kansas City, Kansas 66115
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.
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

CHART 9105. LIST OF CONSUMABLE MATERIALS (2 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Epoxy Patching Compound		Solarite #400	Solar Compounds Corp.
Gasket Cement		Permatex No. 2	Permatex Company, Inc.
Grease, Actuator		2196-74-1	Dukes Astronautics Co.
Grease, Aircraft Instrumentation, Gear and Actuator Screw (Temp. Range - (100°F to +250°F)	MIL-G-23827A (See Note 1)	Supermil Grease No. A72832	Amoco
		Royco 27A	Royal Lubricants Co.
		Shell 6249 Grease	Shell Oil Company
		RR-28	Socony Mobil Oil Co.
		Castrolease A1	Burmah-Castrol LTD.
		Low-Temp. Grease E.P.	Texaco Incorp.
		5114 E.P. Grease AV55	Standard Oil of Calif.
		Aeroshell Grease 7 Braycote 627S	Shell Oil Company
		Mobil Grease 27	Mobil Oil Corporation
Grease, Aircraft Instrumentation, Gear and Actuator Screw (Temp. Range - 65°F to +250°F)	MIL-G-3278	B.P. Aero Grease 31B Unitemp E.P.	B.P. Trading Limited Texaco Incorporated
		RPM Aviation Grease 5, Supermil Grease No. 8723	Standard Oil of Calif.
		Aeroshell Grease 7A	Shell Oil Corporation
		Royco 78	Royal Lubricants Company
		L-1212	Sinclair Refining Co.
		1916 Uni-Temp Grease	California Texas Oil Corporation

CHART 9105. LIST OF CONSUMABLE MATERIALS (3 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, Ball and Roller Bearing	MIL-G-18709	Regal ASB-2 Formula TG-10293	Texaco Incorporated
		Andok B	Exxon Company, U.S.A.
		Code 1-20481, Darina Grease 1 XSG-6213 Code 71-501, Darina Grease 2 XSG-6152 Code 71-502, Alvania Grease 2 XSG-6151 Code 71-012, Cyprina Grease 3 XSG-6280 Code 71-003	Shell Oil Company
Grease, General Purpose Wide Temperature	MIL-G-81322	Marfax All Purpose	Texaco Incorporated
		Aeroshell No. 6	Shell Oil Company
		Mobil Grease 77 or Mobilux EP2	Mobil Oil Corporation
		Shell Alvania EP2	Shell Oil Company
		Royco 22	Royal Lubricants Company
		Mobil Grease 28	Mobil Oil Corporation
		Aeroshell No. 22	Shell Oil Company
Grease, High Temperature	MIL-G-3545C	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

CHART 9105. LIST OF CONSUMABLE MATERIALS (4 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Grease, Aircraft General Purpose	MIL-G-7711	Regal AFB2 Regal Starfak Premium	Texaco Incorporated
		PED 3040	Standard Oil of Calif.
		Aeroshell Grease 6	Shell Oil Company
		Royco II	Royal Lubricants Company
Grease, Lubricating, Molybdenum Disulfide, Low and High Temperature	MIL-G-21164	Aeroshell Grease No. 17	Shell Oil Company
		Royco 64C	Royal Lubricants Co.
		Castrolease MSA (c)	Burmah Castrol LTD.
Grease, Lubricating, Plug Valve, Gasoline and Oil Resistant	MIL-G-6032	Royco 32	Royal Lubricant Company
		Castrolease PV	Burmah Castrol LTD.
		Parker Fuel Lube 44	Parker Seal Company
		B.P. Aero Grease 32	B.P. Trading Limited
		L-237	Lehigh Tenneco Chemicals Co., Inc.
		Rockwell 950	Rockwell International
Grease, Waterproof, High and Low Temperature		Aero Lubriplate	Fiske Brothers Refining Company
"Hot Melt" Adhesive Polyamids and "Hot Melt" Gun.	Stick Form 1/2 in. diameter, 3 in. long		Sears, Roebuck and Company or most hardware stores.
Hydraulic Fluid	MIL-H-5606	Brayco 756D	Bray Oil Company
		TL-5874	Texaco Incorporated
		PED 3565	Standard Oil Company of California

CHART 9105. LIST OF CONSUMABLE MATERIALS (5 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Hydraulic Fluid (continued)	MIL-H-5606	Aircraft Hydraulic Oil AA	Texaco Incorporated
		RPM Aviation Oil No. 2 Code PED 2585 PED 3337	Standard Oil Company of California
		3126 Hydraulic oil (uniuisyo)	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-25567C	ALPHA 73 Oxygen Leak Detector Type 1	U.S. Gulf Corporation
		Leak Tec #16-OX	American Gas and Chemical Co. LTD.
Loctite	MIL-S-22473 Grade AA	Loctite 290	Loctite Corporation
	MIL-S-22473 Grade H and HV	Loctite 222	
Methylethylketone	Fed. Spec. TT-M-261		Local Supplier
Molybdenum Disulfide	MIL-M-7866	Molykote-Type G (Paste)	Dow Corning Corp.
		Molykote - Type 2 (Powder)	

CHART 9105. LIST OF CONSUMABLE MATERIALS (6 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Oil, Air Cond., R12	Piper P/N 197-650	PMS-L2000	
		Frigidaire #525	Virginia Chemical
		Suniso #5	Sun Oil Company of Pennsylvania
		Texaco Capilla "E"	Texaco Incorporated
Oil, Air Cond., 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	

CHART 9105. LIST OF CONSUMABLE MATERIALS (7 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Sealant, Fuel Tank Sealing (continued)		PR 1321-B 1/2, Access Panel Sealant	
		PR 1560 MK, Primer (Anti-Bacteriological Coating)	Products Research Company
		BJO-0930, Phenolic Balloons	Union Carbide Plastics Division
		ERL-2795, Epoxy Resin	
	Class A-2	22LA-0340 Polyamid Hardener Thiokol MC-236	
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 Weatherstripping, etc)	
		G.E.-SS-4004 (Primer) RTV-88 with RTV-9811	General Electric Silicone Products Department
Sealant, Window & Airframe	Piper P/N 279-063	Bostik Chem-Calk 915 (Polyurethane); or,	
	Piper P/N 279-058	Bostik 1100FS (Urethane); or,	
	Piper P/N 179-853	3M Weatherban 606 (Acrylic); or, 3M Weatherban 101 (Polysulfide); or,	Minesota, Mining & Mfg., 3M Center
		PR-307 (Polysulfide);	Product Research Company
Sealing Compound, Gasket and Joint		Tite-Seal	Radiator Specialty Co.
Sealer		PR 1321 B-1/2	Products Research Company

CHART 9105. LIST OF CONSUMABLE MATERIALS (8 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Silicone Compound	MIL-S-8660 (MIL-C-21567)	DC-4, DC-6 Compound	Dow Corning
		G-624	General Electric Co. Silicone Products Department
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.
Tape, Vinyl Foam, Type 2, l/8 in. x 1 in.	Piper P/N 189-721	V510 or V740 Series; or,	Norton Tape Division
		VF-1100 Series; or,	Pres-On Products, Inc. Addison, IL 60101
		V1500 Series	Gaska Tape Inc. Elkhart, IN 46515-1698
Toluol	TT-M-261		Local Supplier
Trichlorethylene	MIL-T-7003	Perm-A-Clor	Dextrex Chemical Industries, Inc.
		Turco 4217	Turco Products, Inc.

CHART 9105. LIST OF CONSUMABLE MATERIALS (9 of 9)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Teflon Tape	.003" x .5" wide/-1		Minnesota Mining and Manufacturing Company
			Shamban W.S. and Co.
	.003" x .25" wide/-2		Johnson & Johnson, Inc. Permacel Division
Thread Sealant for High Pressure Oxygen System	MIL-T-27730	Permacel 412	Johnson & Johnson, Inc. Permacel Division
Vinyl Foam	1 in. x 1/8 in.	530 Series, Type I	Norton Tape Division
Vinyl, Black Plastic	2 in. x 9 mil. and/or 1 1/2 in. x 9 mil.		

NOTE: Take precautions when using MIL-G-23827 and engine oil. These lubricants contain chemicals harmful to painted surfaces.

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CHART 9106. Vendor Information (1 of 3)

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 Chamical 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

CHART 9106. VENDOR INFORMATION (2 of 3)

Loctite Corporation
777 N. Mountain Road
Newington, CT 06111
800-243-8160
In CT 800-842-0225

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

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

CHART 9106. VENDOR INFORMATION (3 of 3)

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

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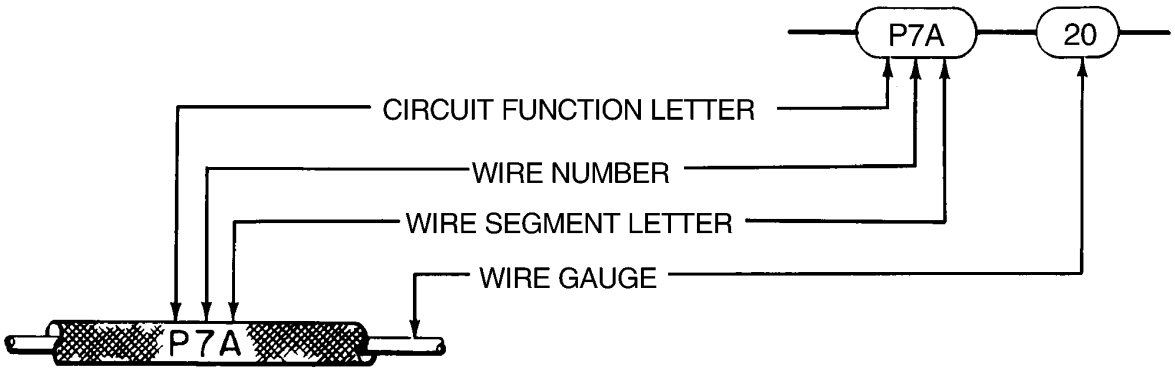
CHART 9107. ELECTRICAL WIRE CODING



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 9108. Electrical Symbols (Old Style) (1 of 3)

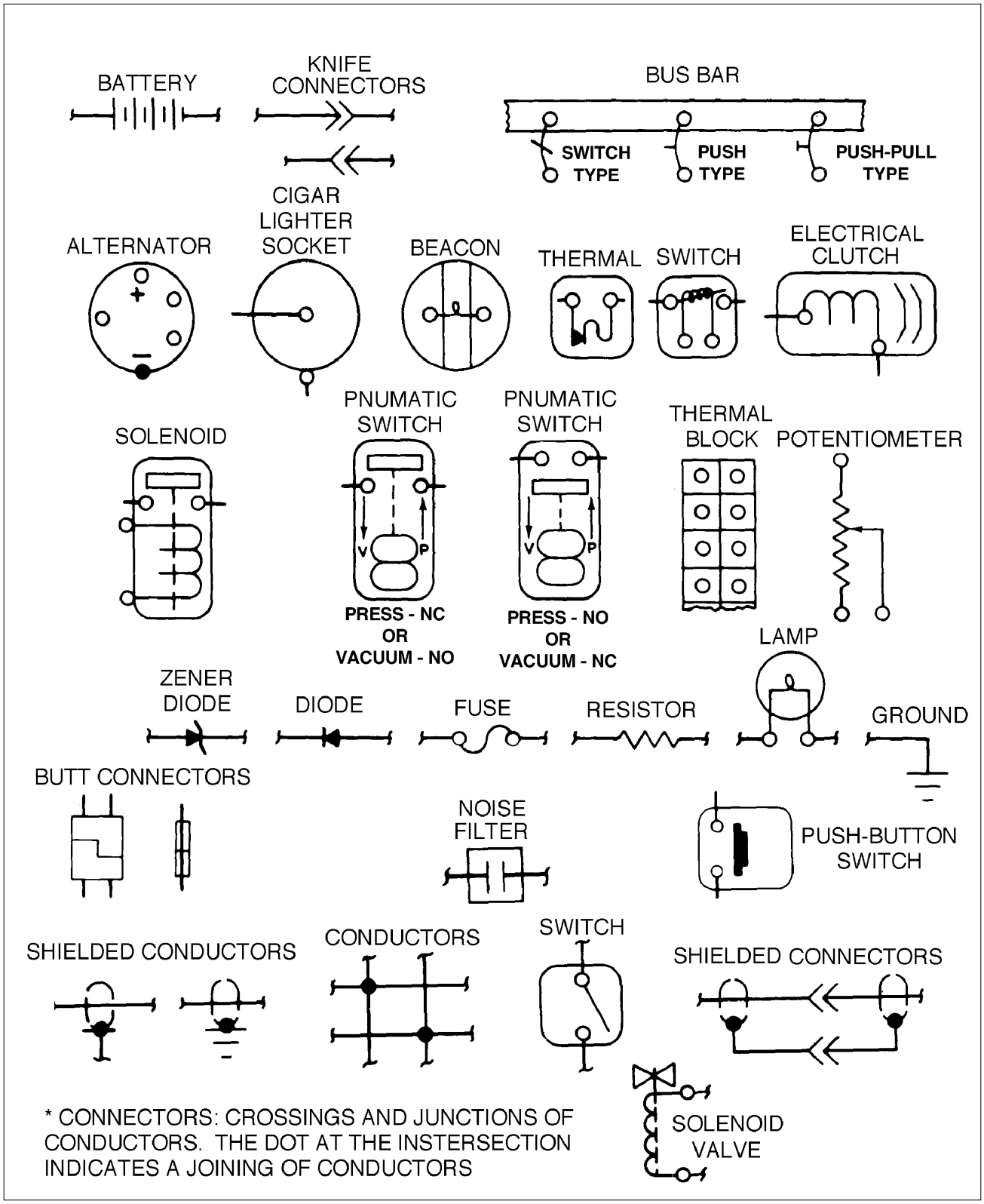


CHART 9108. ELECTRIC SYMBOLS (New Style) (2 of 3)

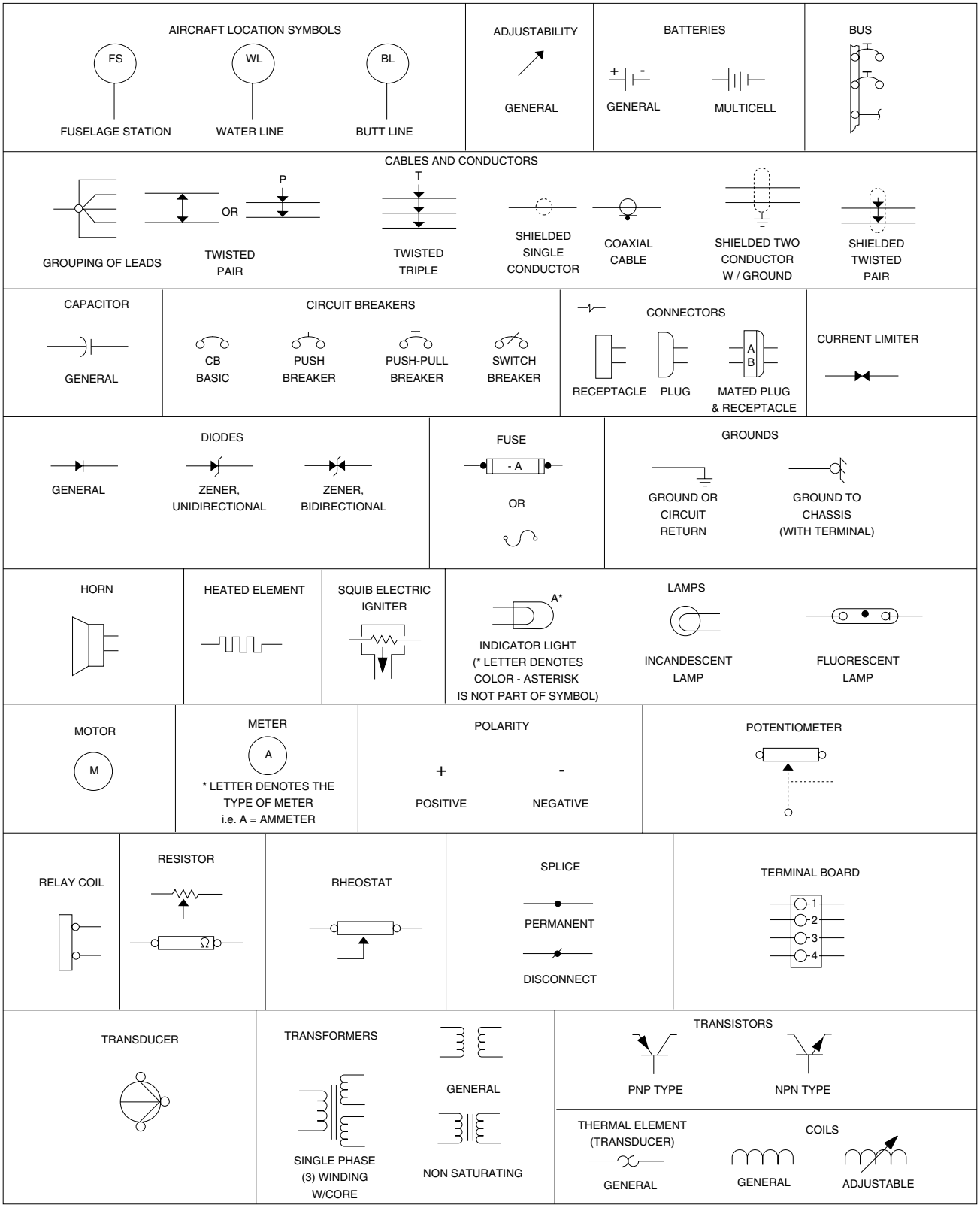
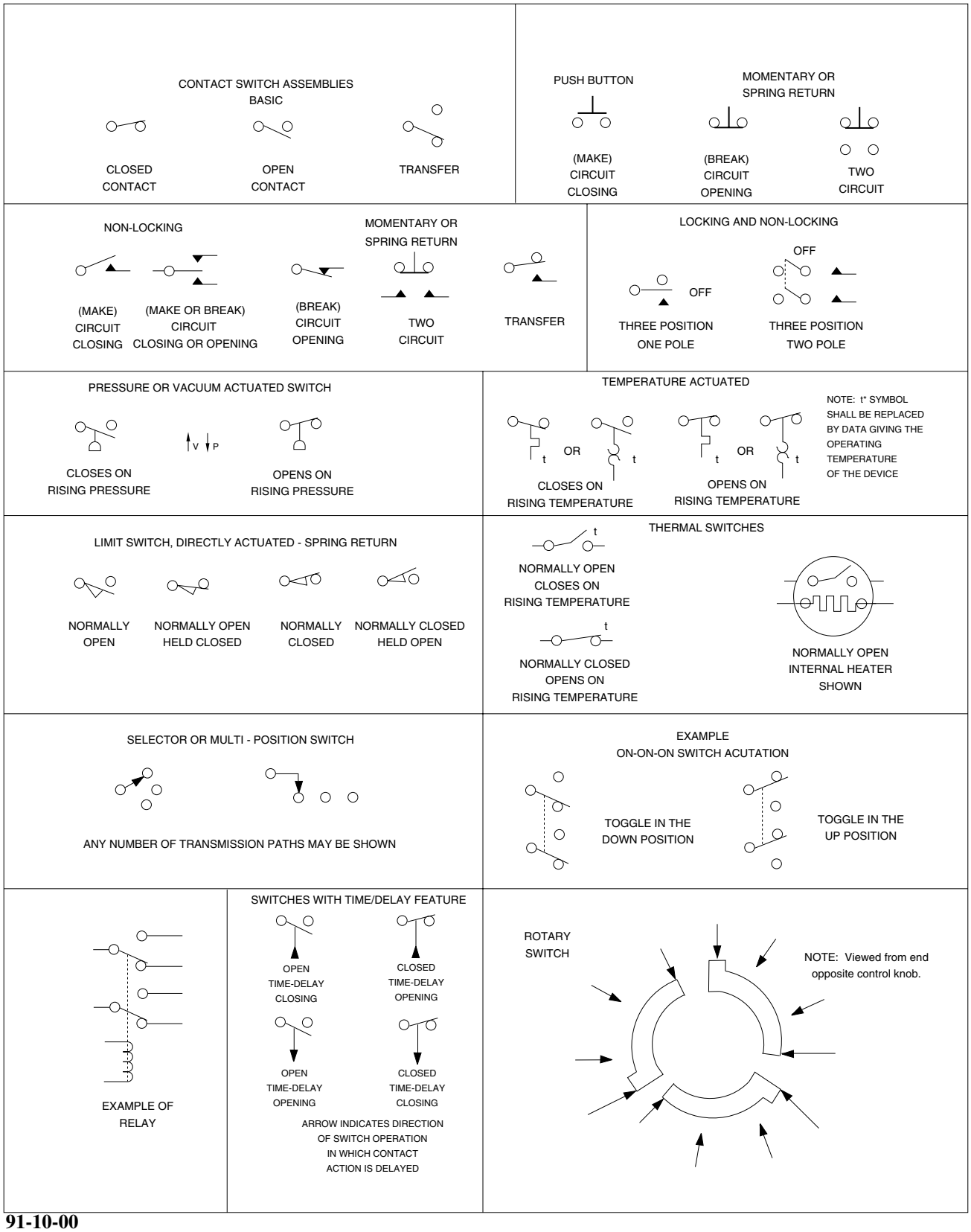


CHART 9108. ELECTRIC SYMBOLS (New Style) (3 of 3)



ELECTRICAL SCHEMATIC INDEX

ELECTRICAL SCHEMATIC INDEX (cont)

ELECTRICAL SCHEMATIC INDEX

ELECTRICAL SCHEMATIC INDEX (cont)

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ELECTRICAL SCHEMATIC INDEX (cont)

ALPHABETICAL INDEX

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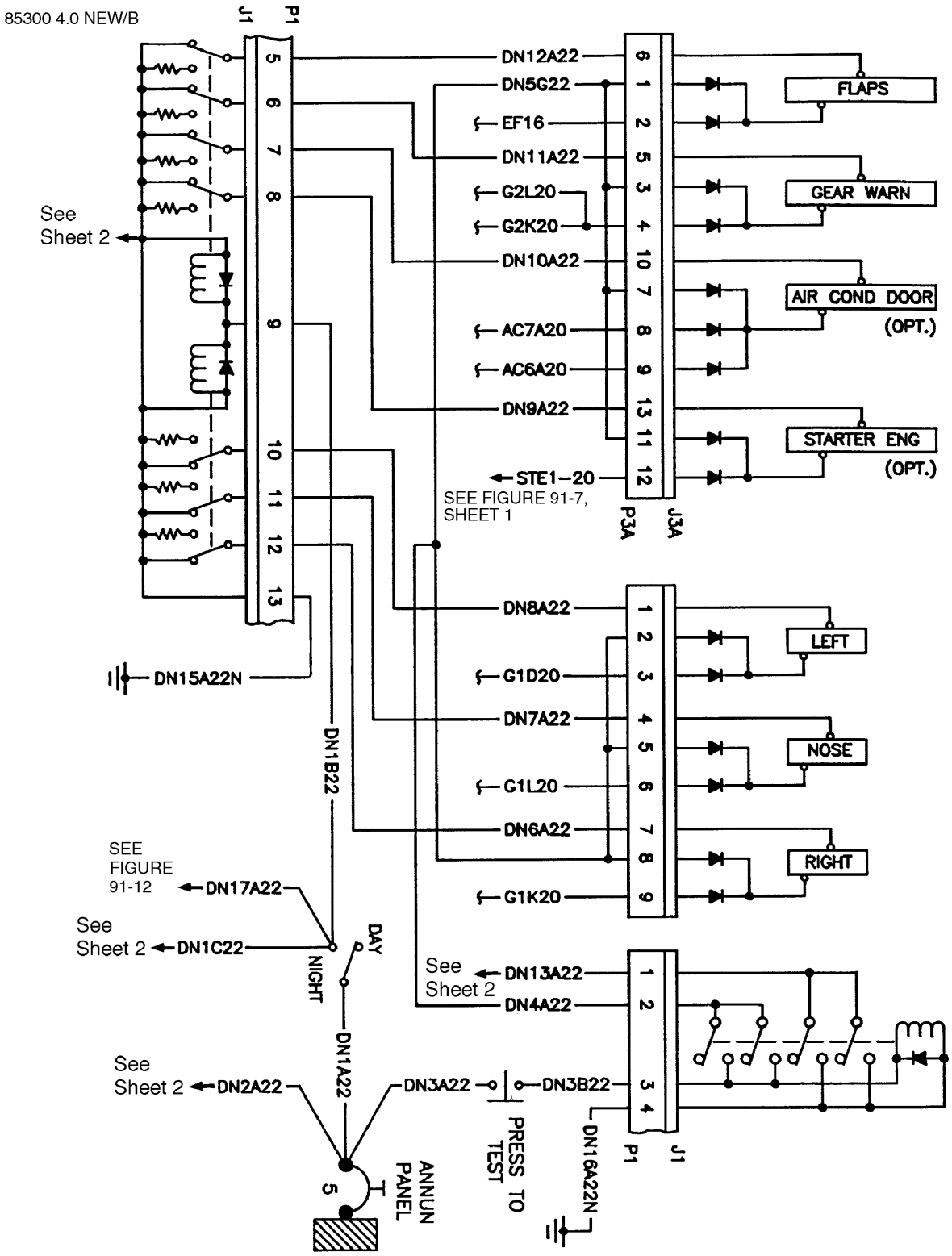
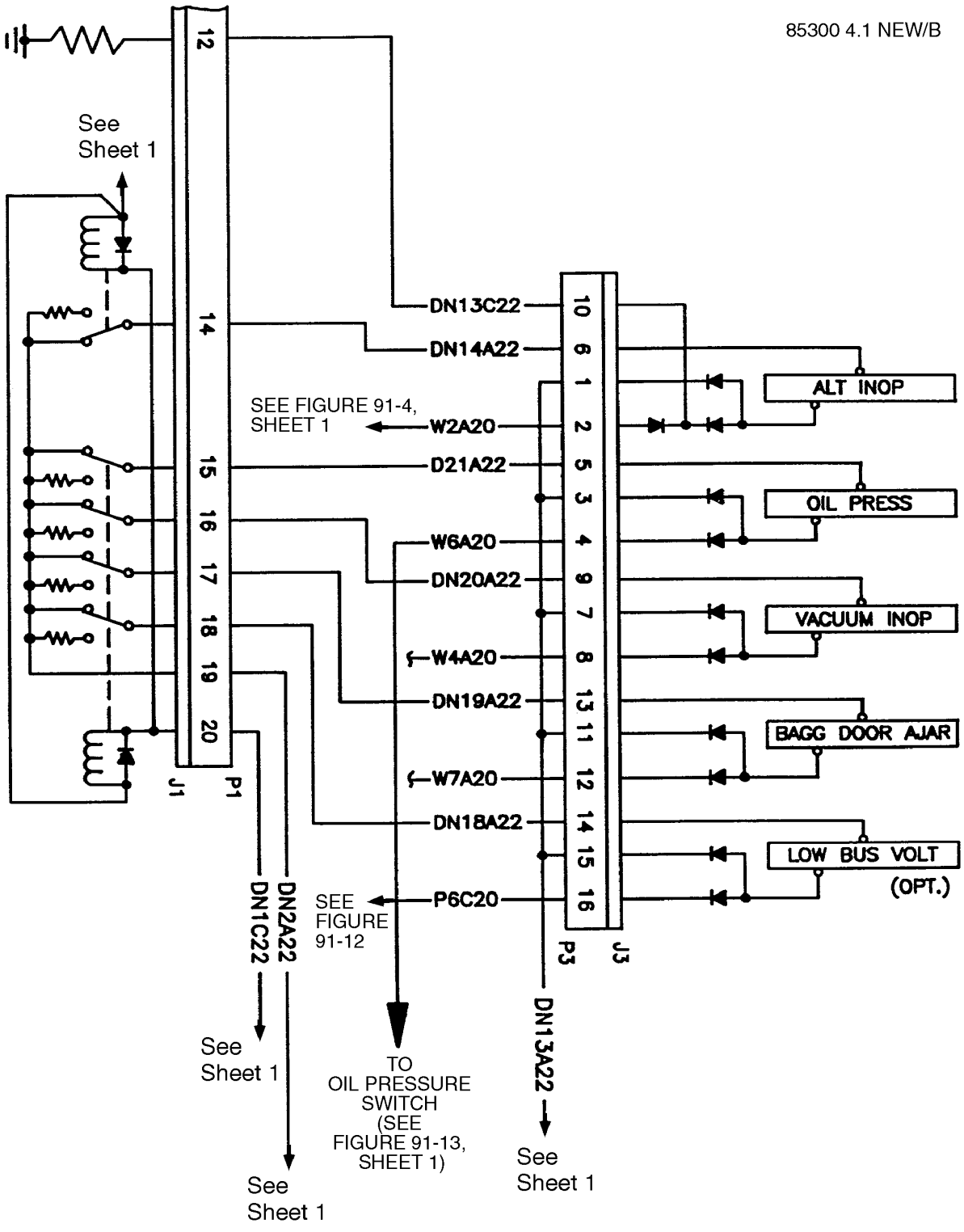
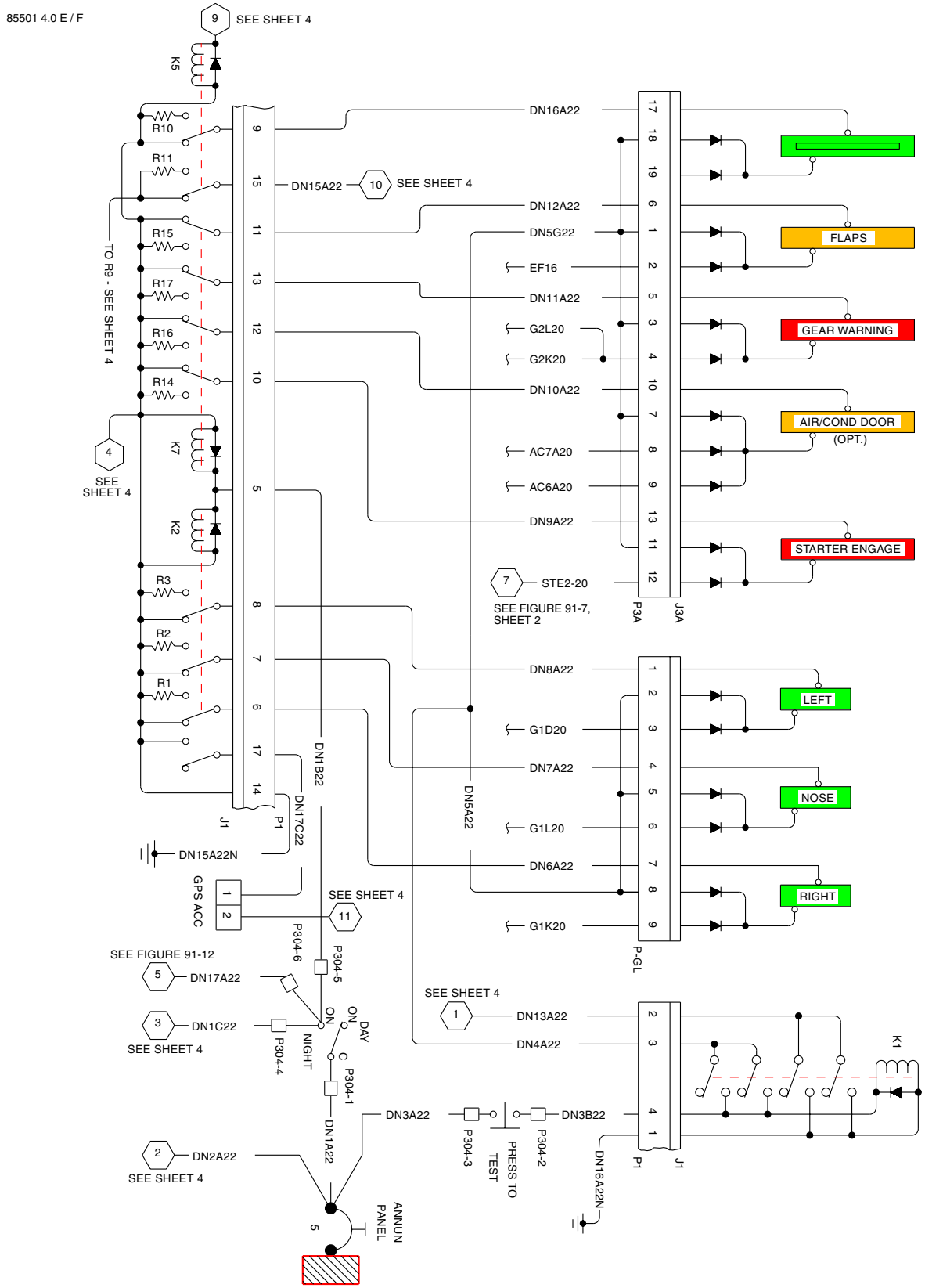


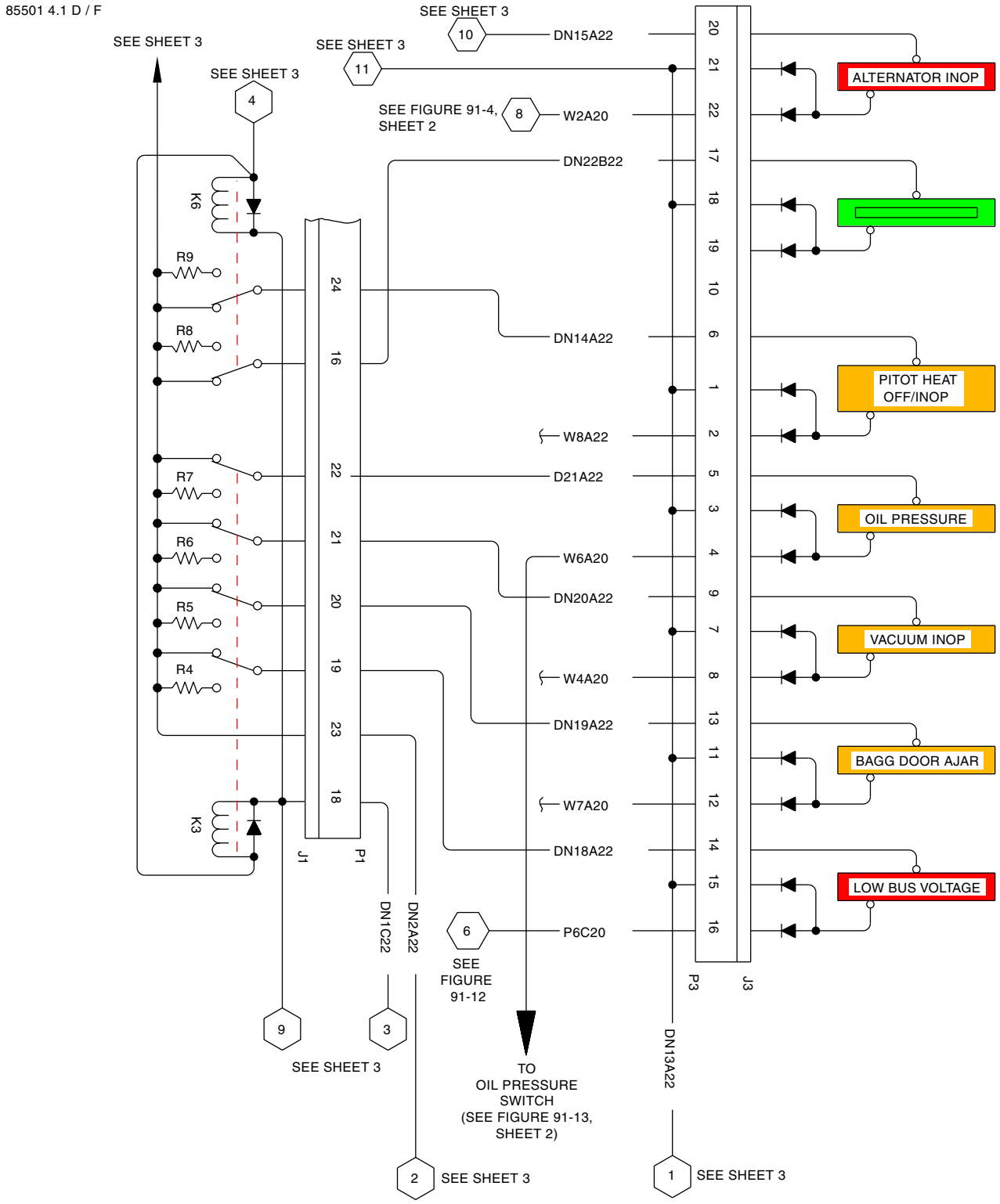
Annunciator (HP S/N's 3246001 thru 3246017 only)
Figure 91-1 (Sheet 1 of 9)



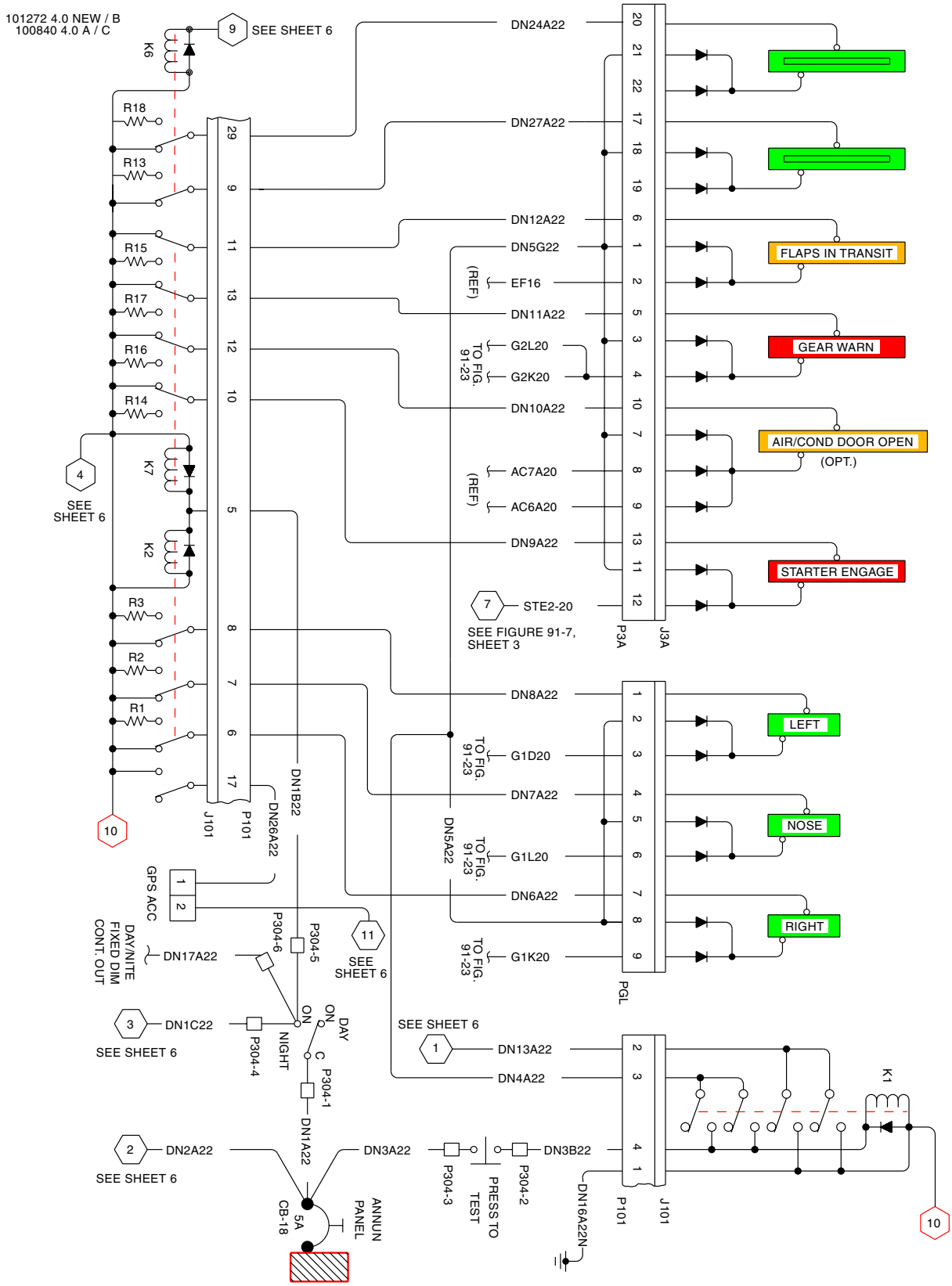
Annunciator (HP S/N's 3246001 thru 3246017 only)
Figure 91-1 (Sheet 2 of 9)



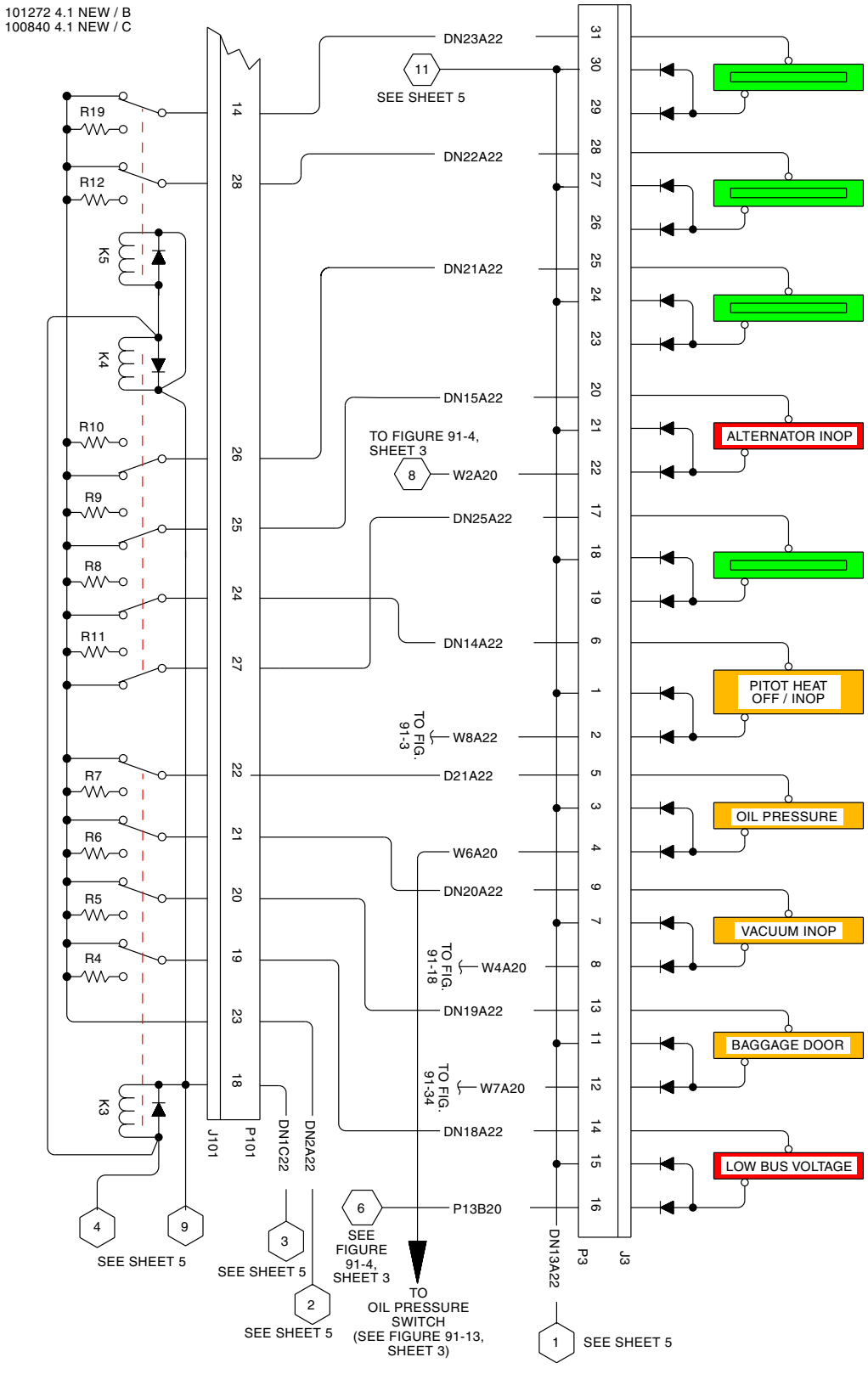
Annunciator (HP S/N's 3246018 thru 3246087 only)
Figure 91-1 (Sheet 3 of 9)



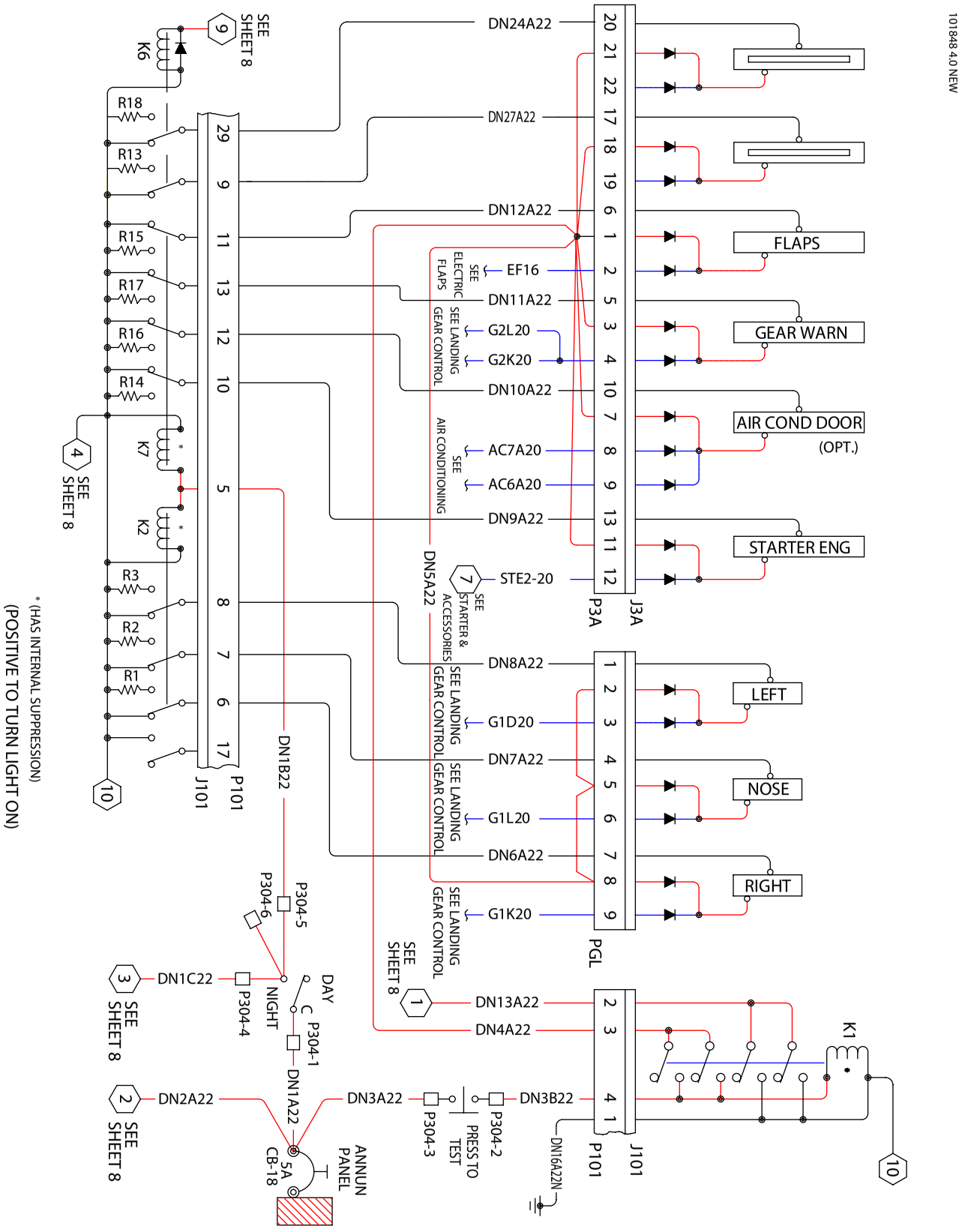
Annunciator (HP S/N's 3246018 thru 3246087 only)
Figure 91-1 (Sheet 4 of 9)



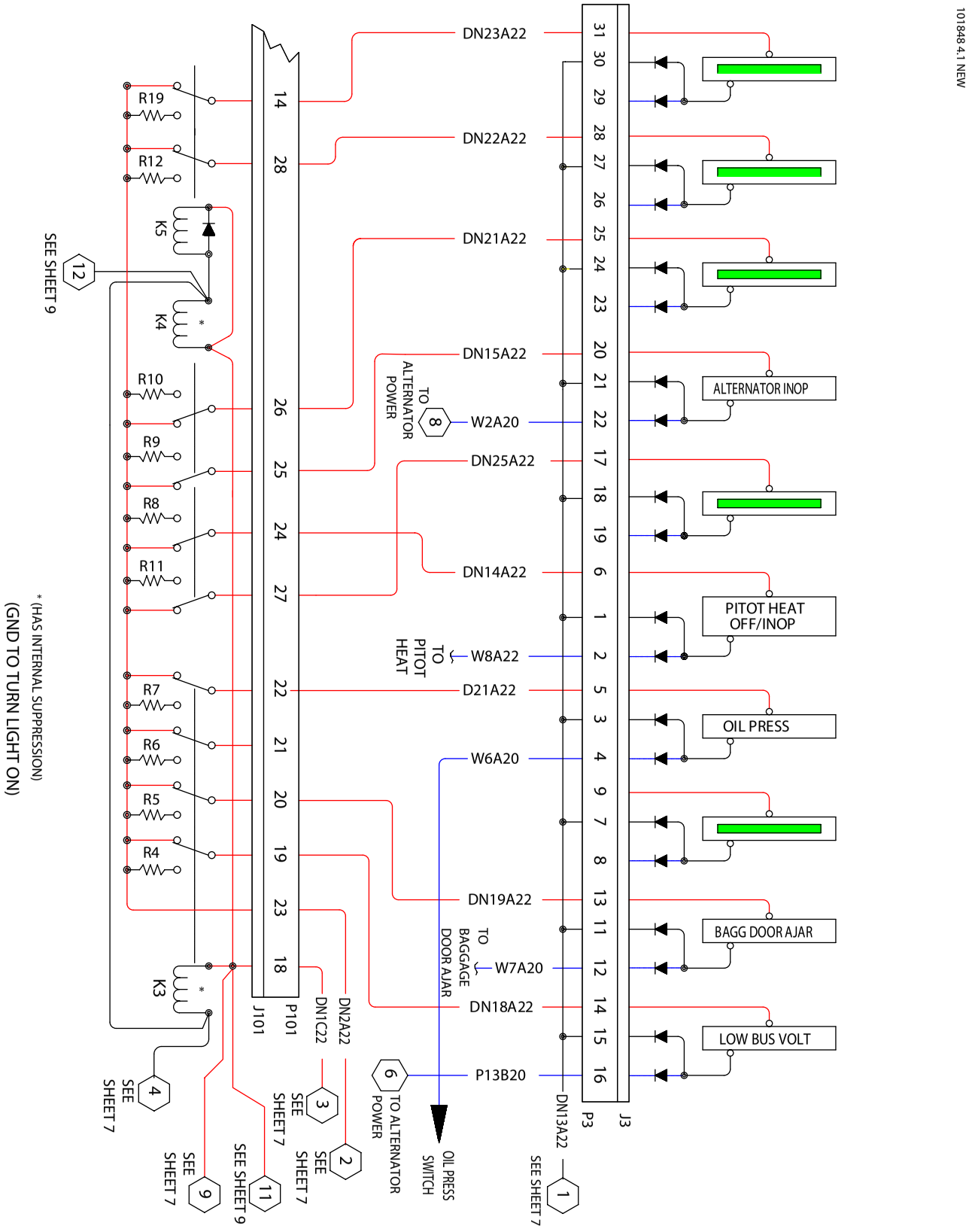
Annunciator (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-1 (Sheet 5 of 9)



Annunciator (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-1 (Sheet 6 of 9)

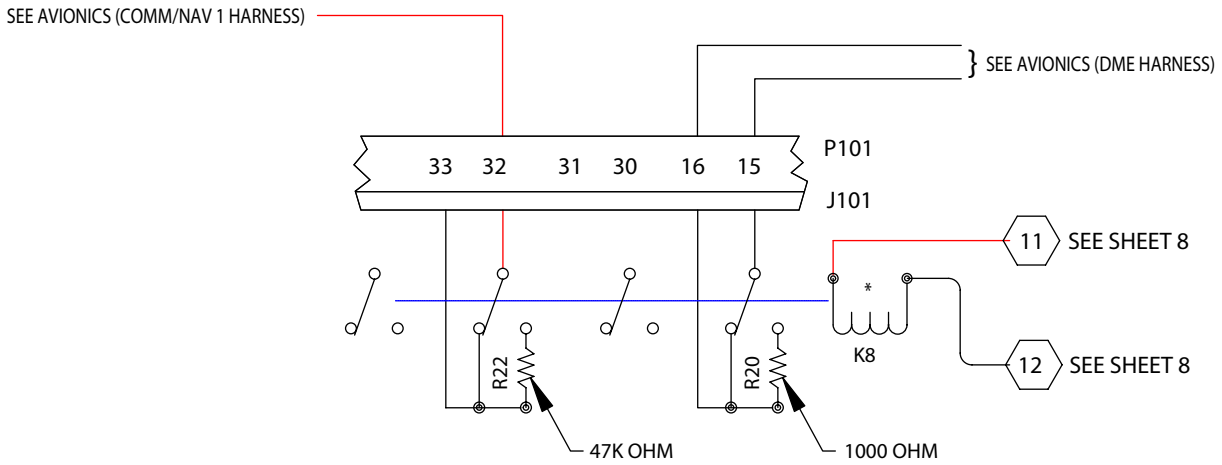


Annunciator (HP S/N's 3246218 & up; TC S/N's 3257339 & up; w/Entegra option)
Figure 91-1 (Sheet 7 of 9)



Annunciator (HP S/N's 3246218 & up; TC S/N's 3257339 & up; w/Entegra option)
Figure 91-1 (Sheet 8 of 9)

101848 4.2 NEW



* (HAS INTERNAL SUPPRESSION)

Annunciator (HP S/N's 3246218 & up; TC S/N's 3257339 & up; w/Entegra option)
Figure 91-1 (Sheet 9 of 9)

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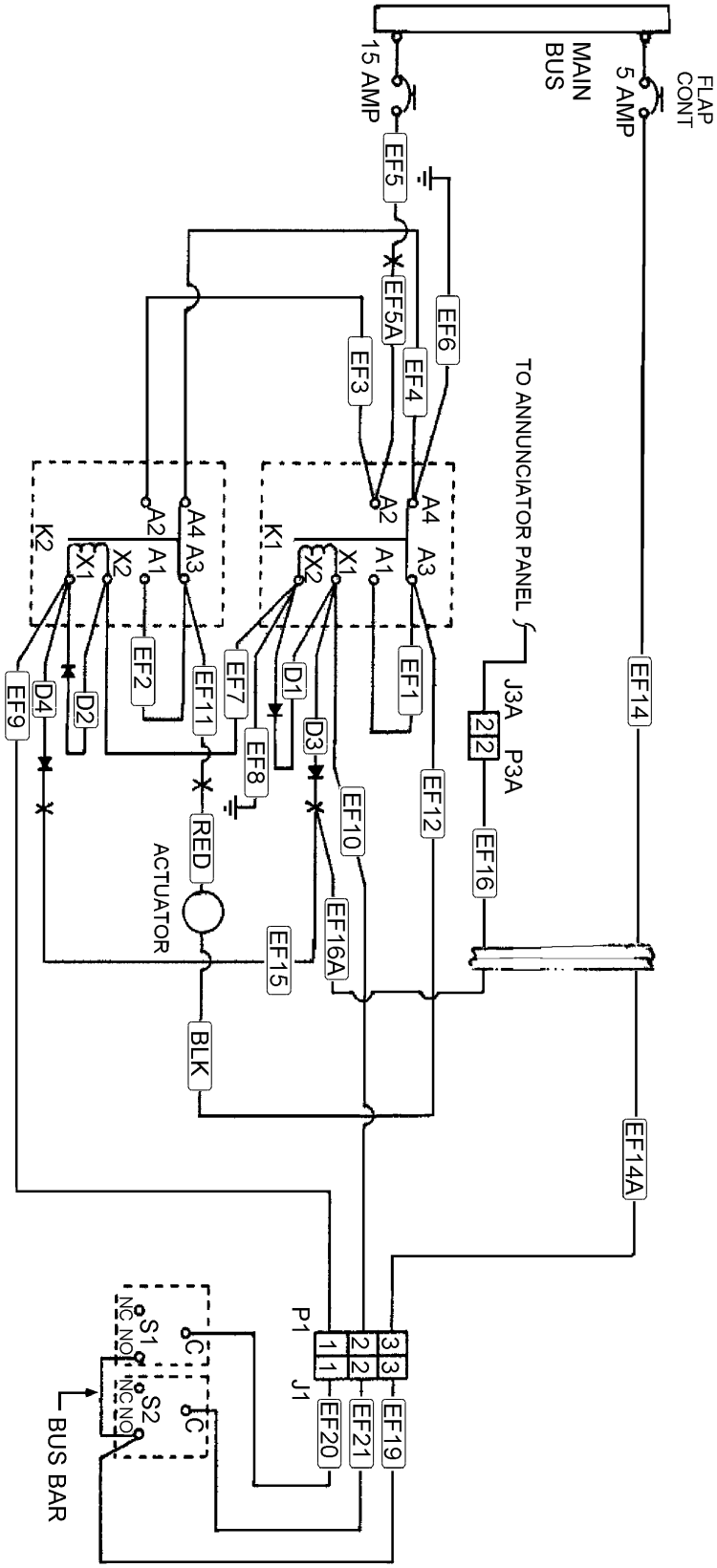
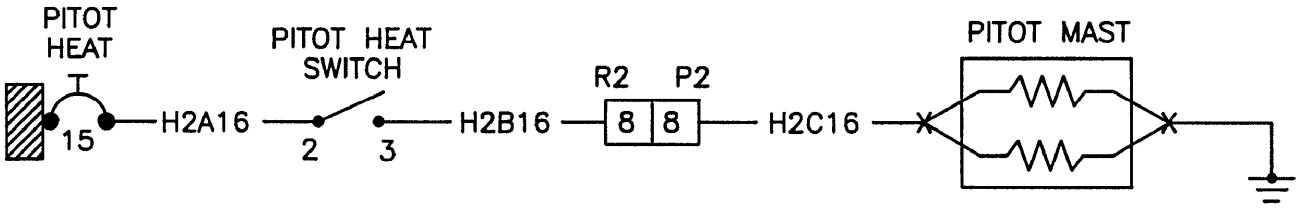


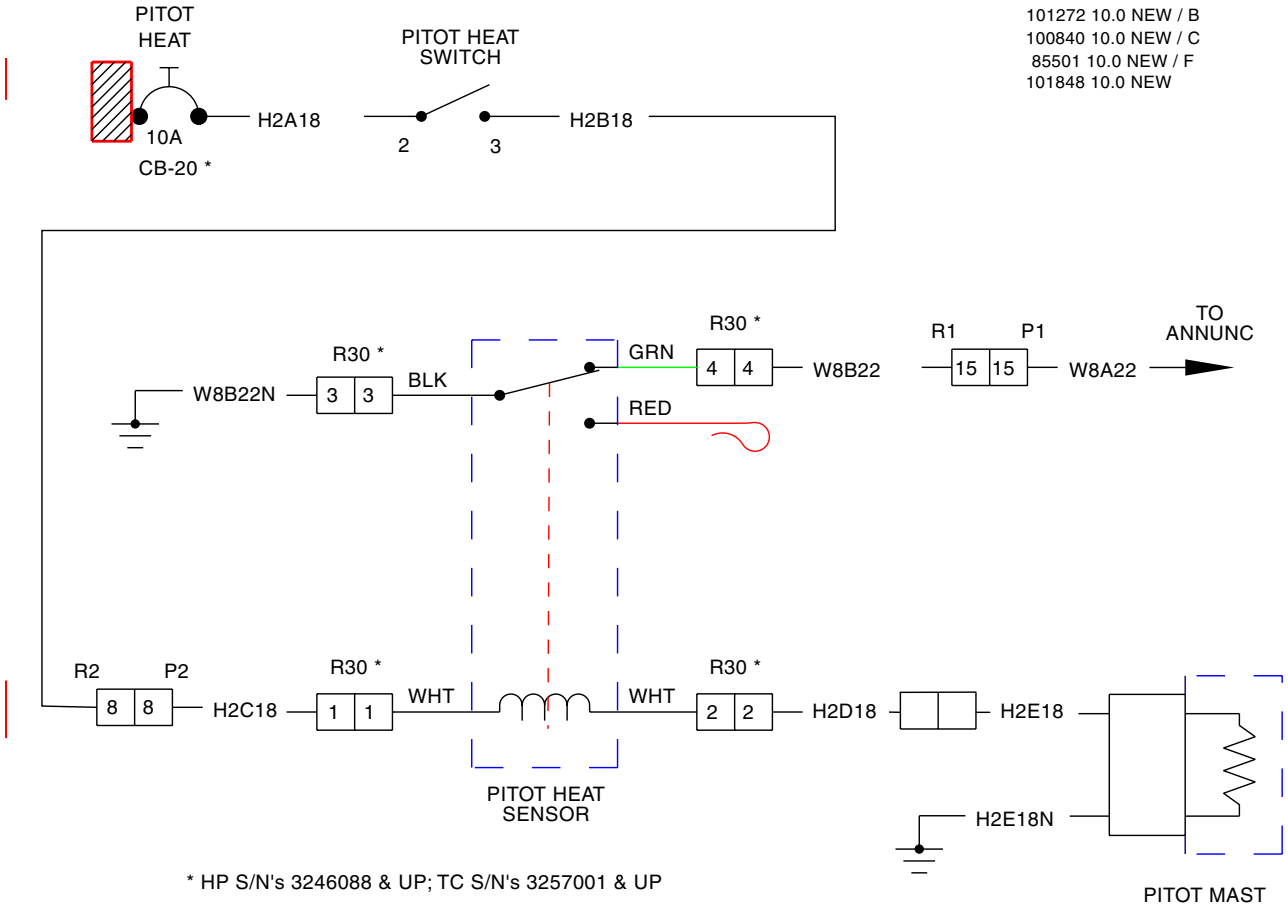
Electric Flaps
Figure 91-2

85300 10.0 NEW/B



HP S/N's 3246001 thru 3246017 only

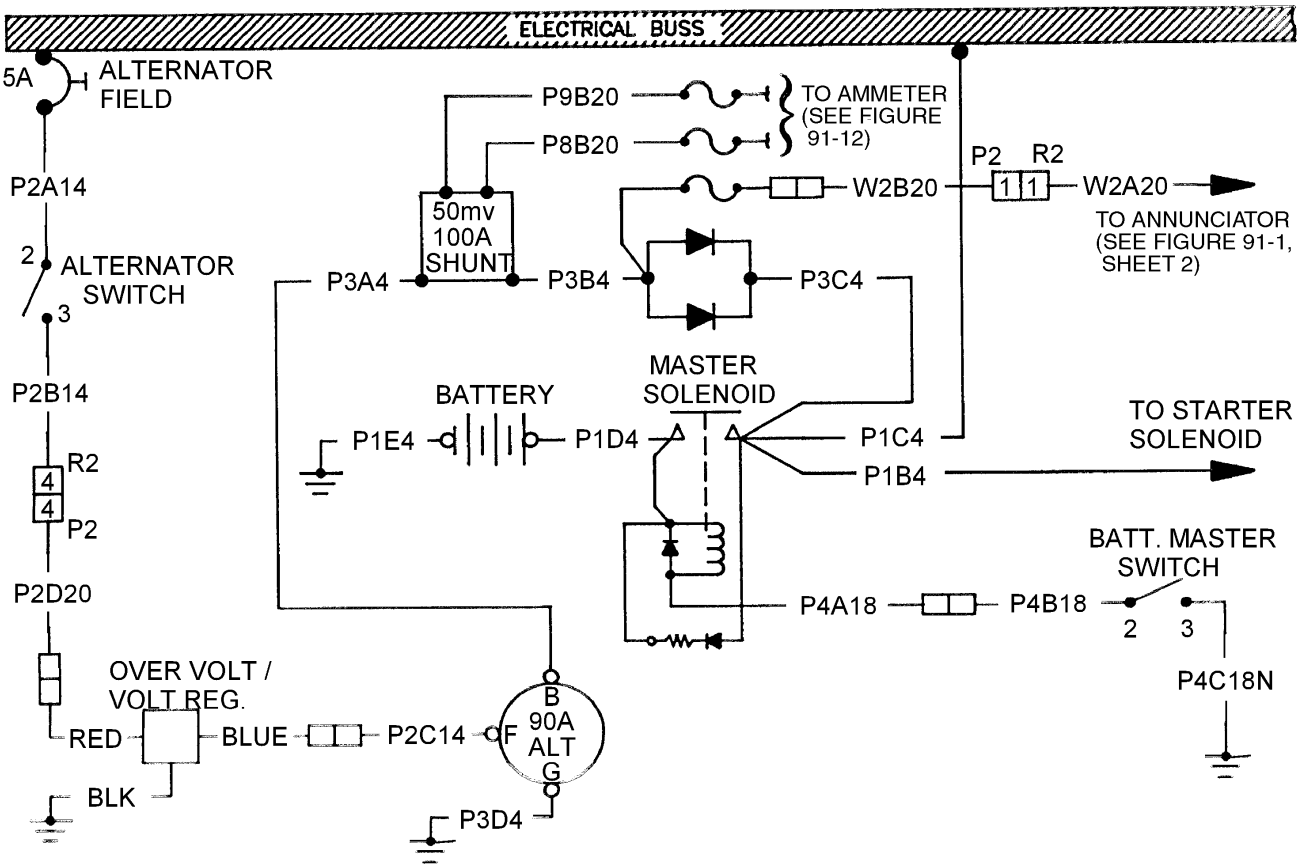
101272 10.0 NEW / B
100840 10.0 NEW / C
85501 10.0 NEW / F
101848 10.0 NEW



HP S/N's 3246018 & up; TC S/N's 3257001 & up

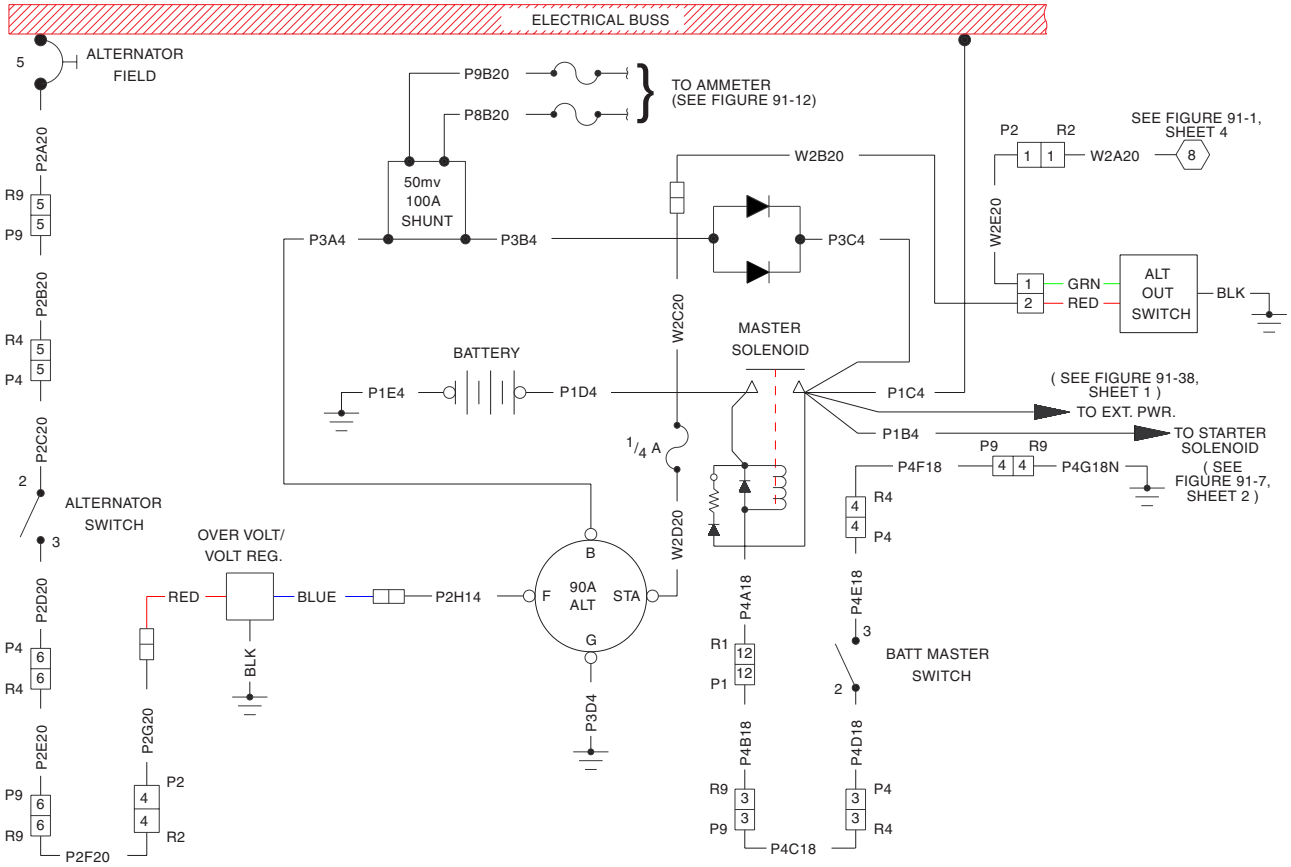
Pitot Heat
Figure 91-3

85300 2.0 NEW / B

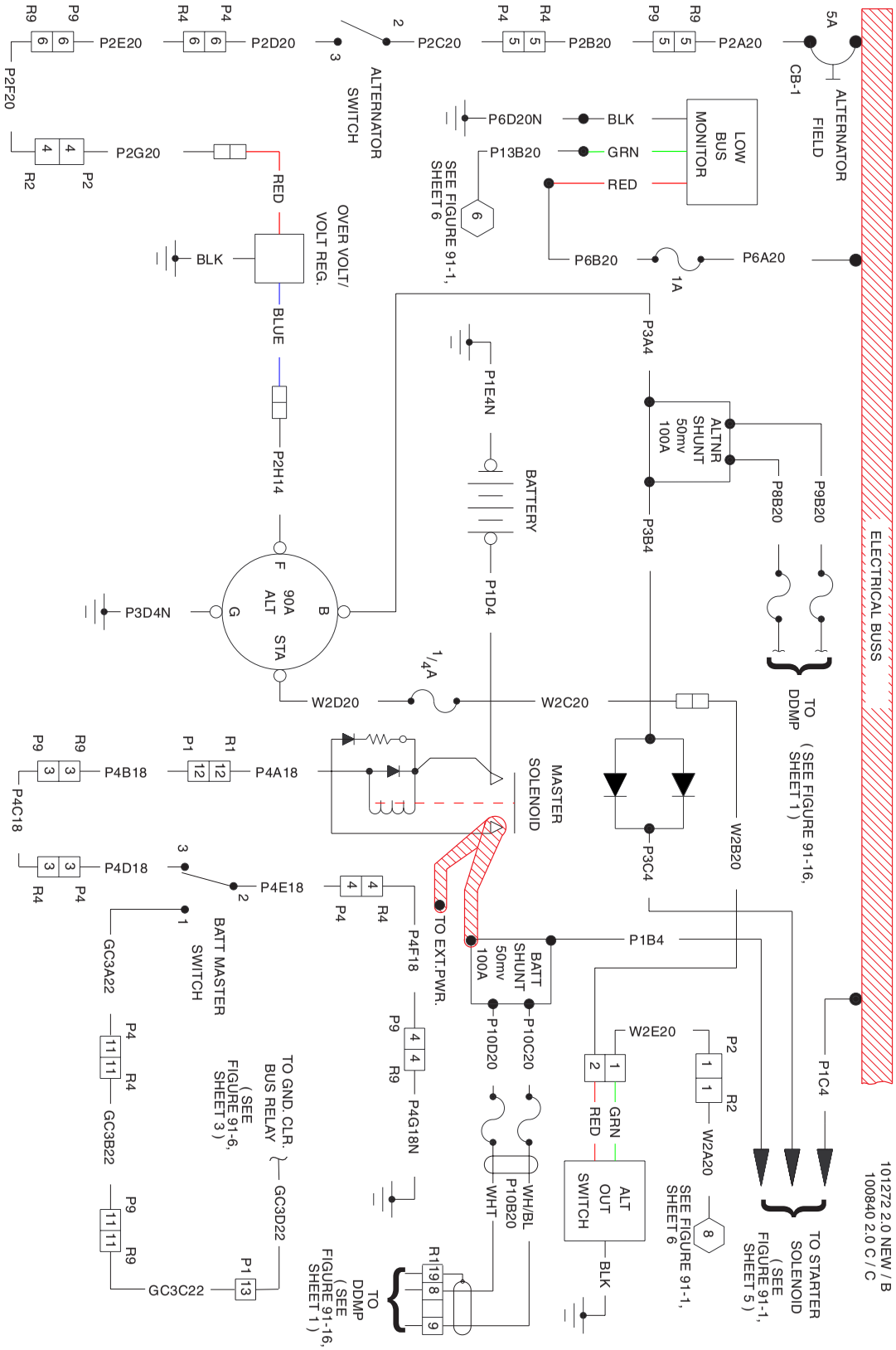


Alternator Power (HP S/N's 3246001 thru 3246017 only)
Figure 91-4 (Sheet 1 of 4)

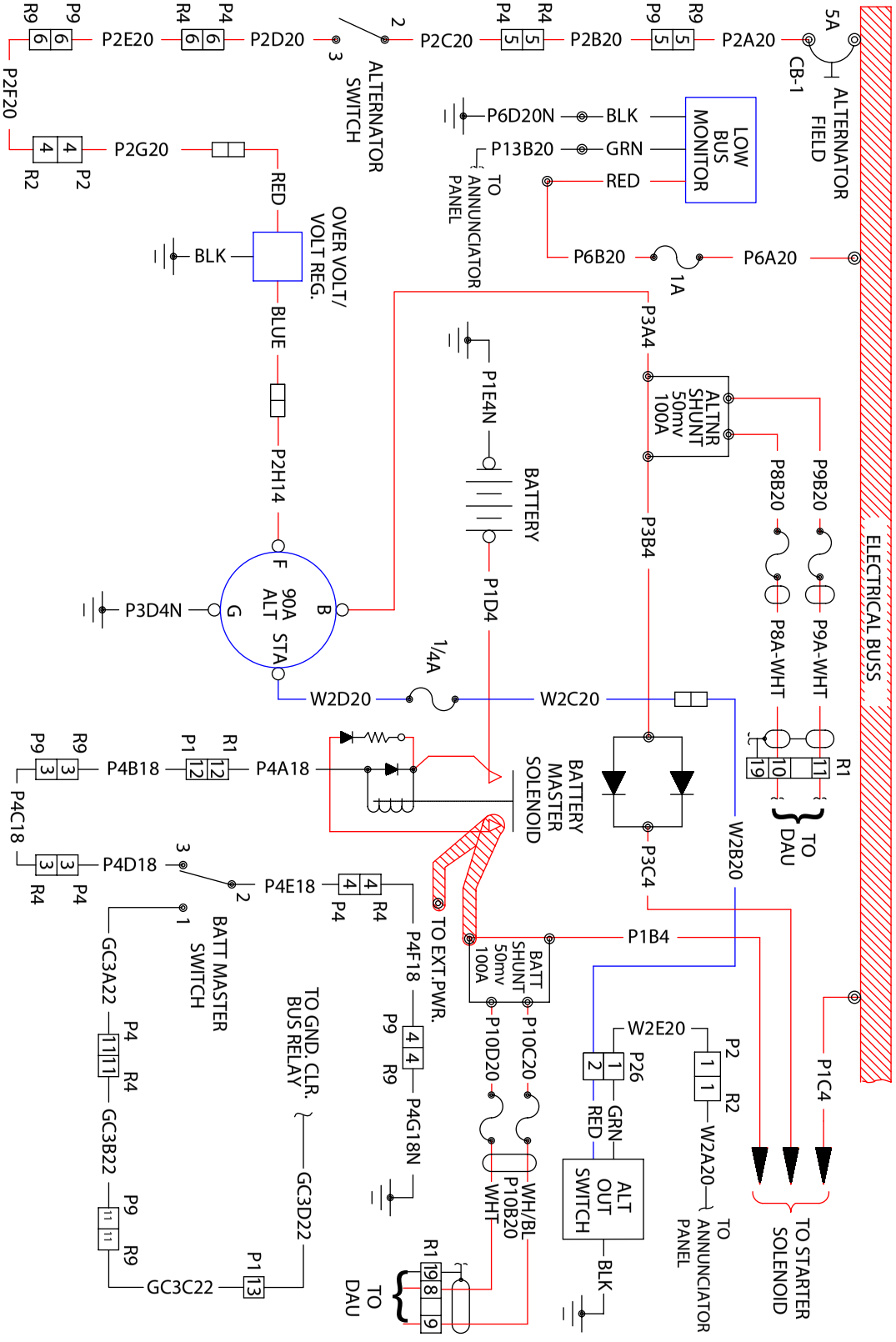
85501 2.0 F / F



Alternator Power (HP S/N's 3246018 thru 3246087 only)
Figure 91-4 (Sheet 2 of 4)



Alternator Power (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-4 (Sheet 3 of 4)



Alternator Power (HP S/N's 3246218 & up; TC S/N's 3257339 & up; w/Entegra option)
Figure 91-4 (Sheet 4 of 4)

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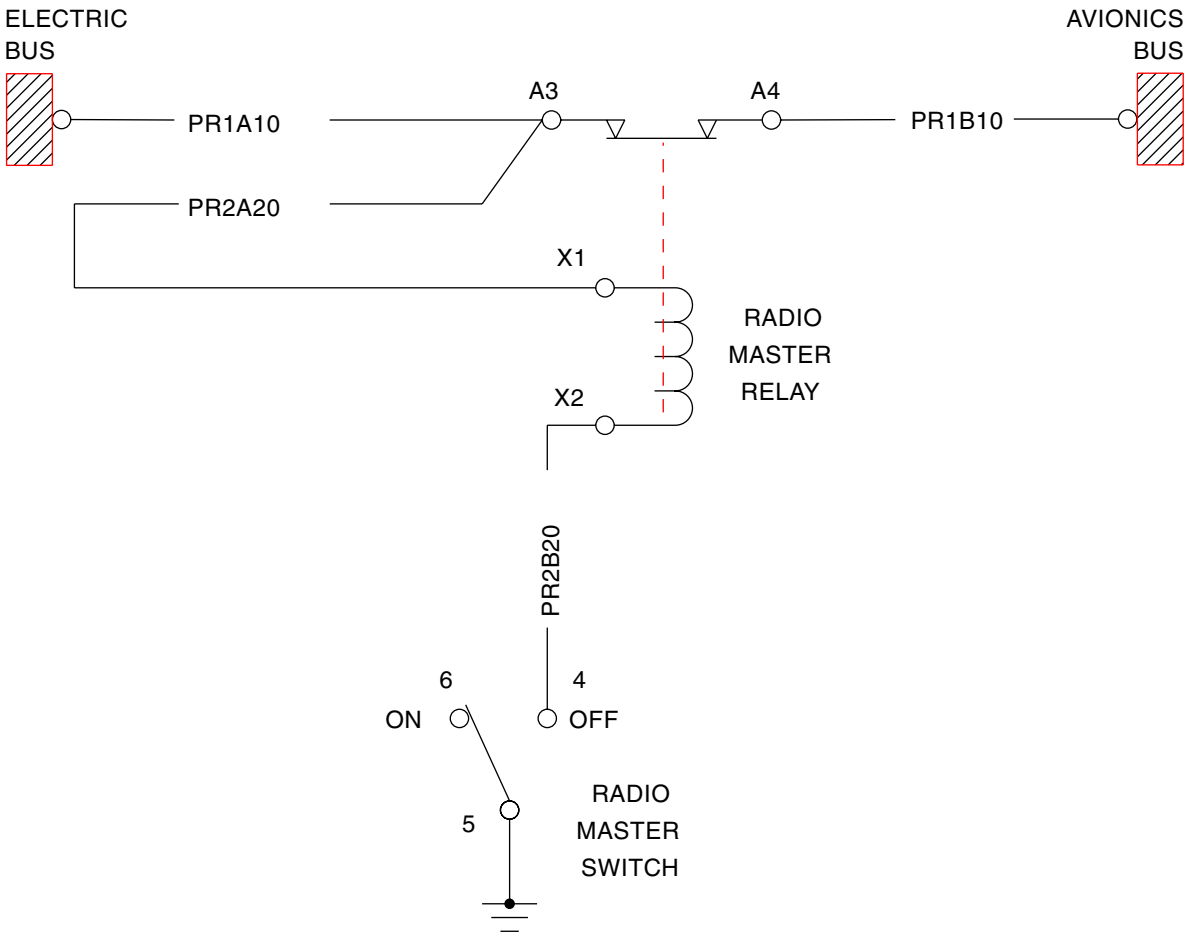
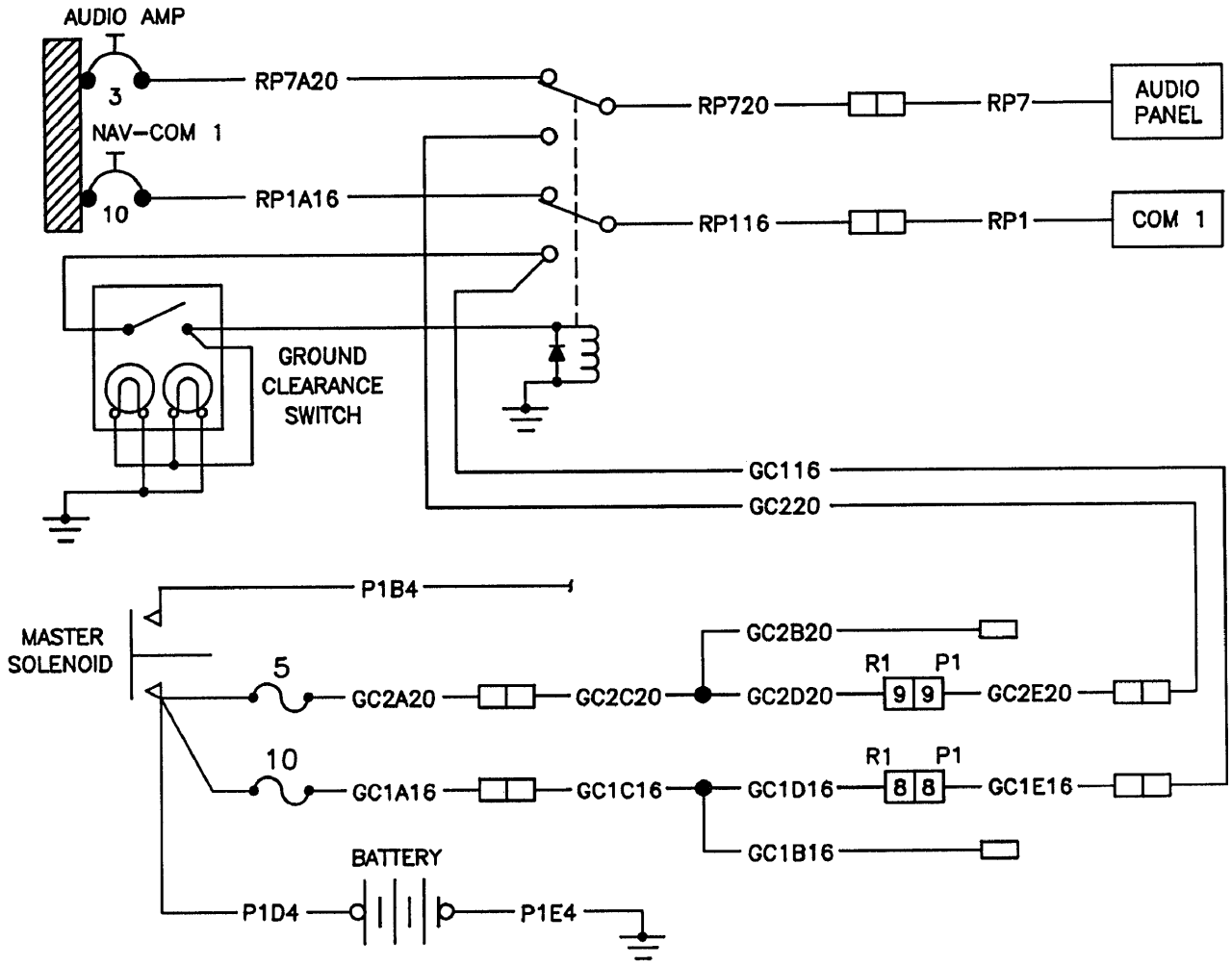
85300 15.0 NEW / B
85501 15.0 NEW / F
100840 15.0 NEW / C
101272 15.0 NEW / B
101848 14.0 NEW

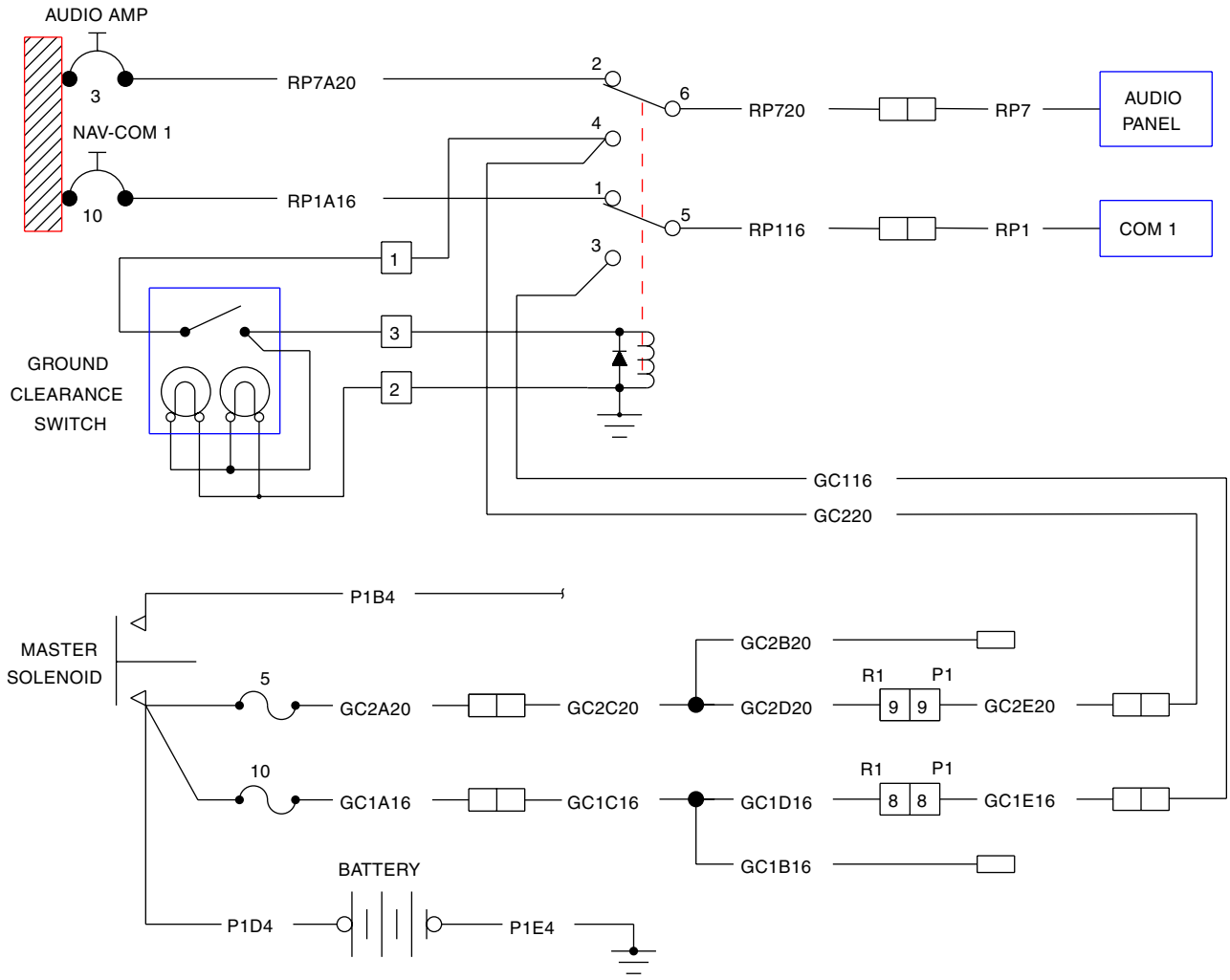


Radio Master Switch
Figure 91-5

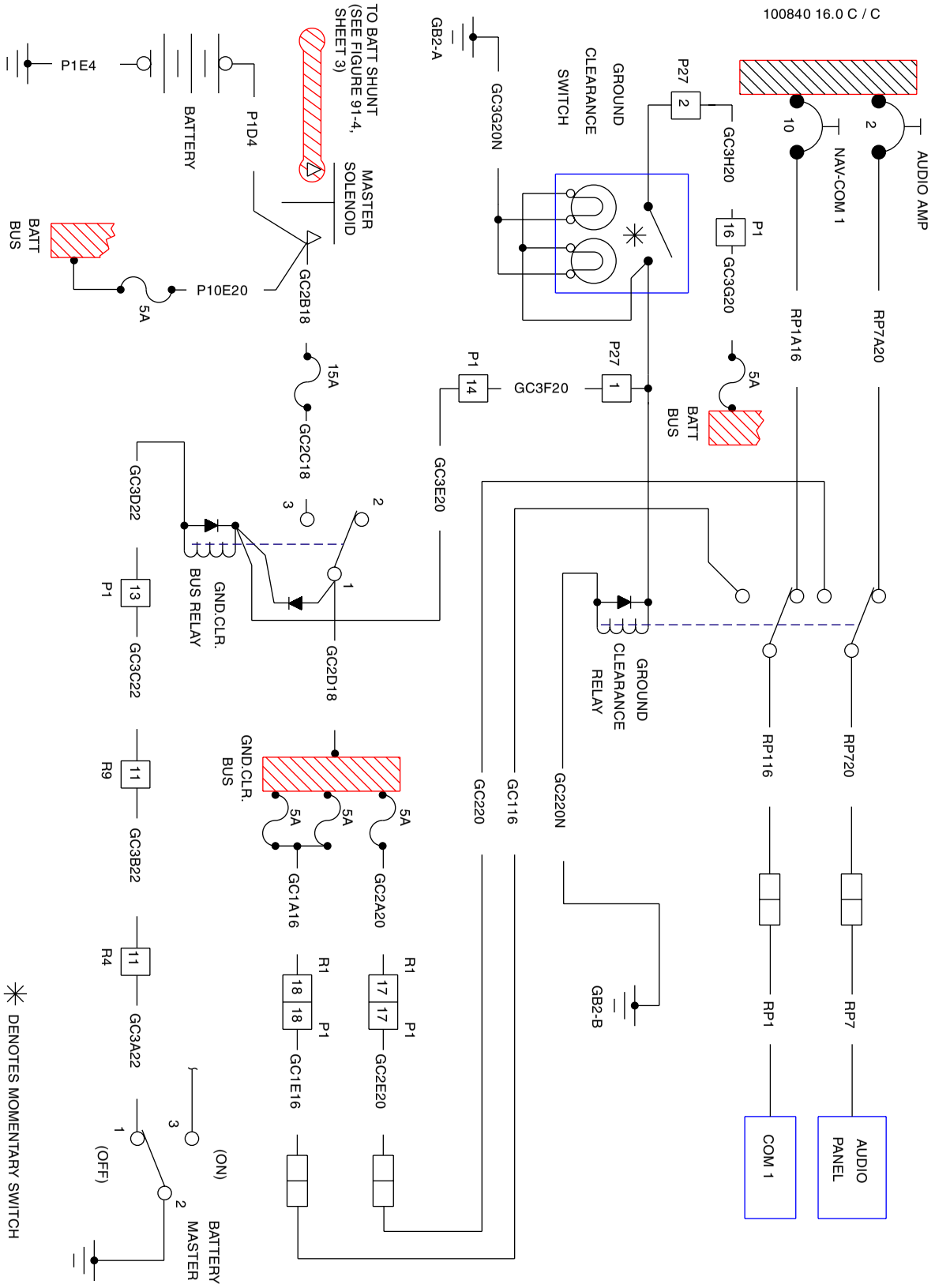
85300 16.0 NEW / B



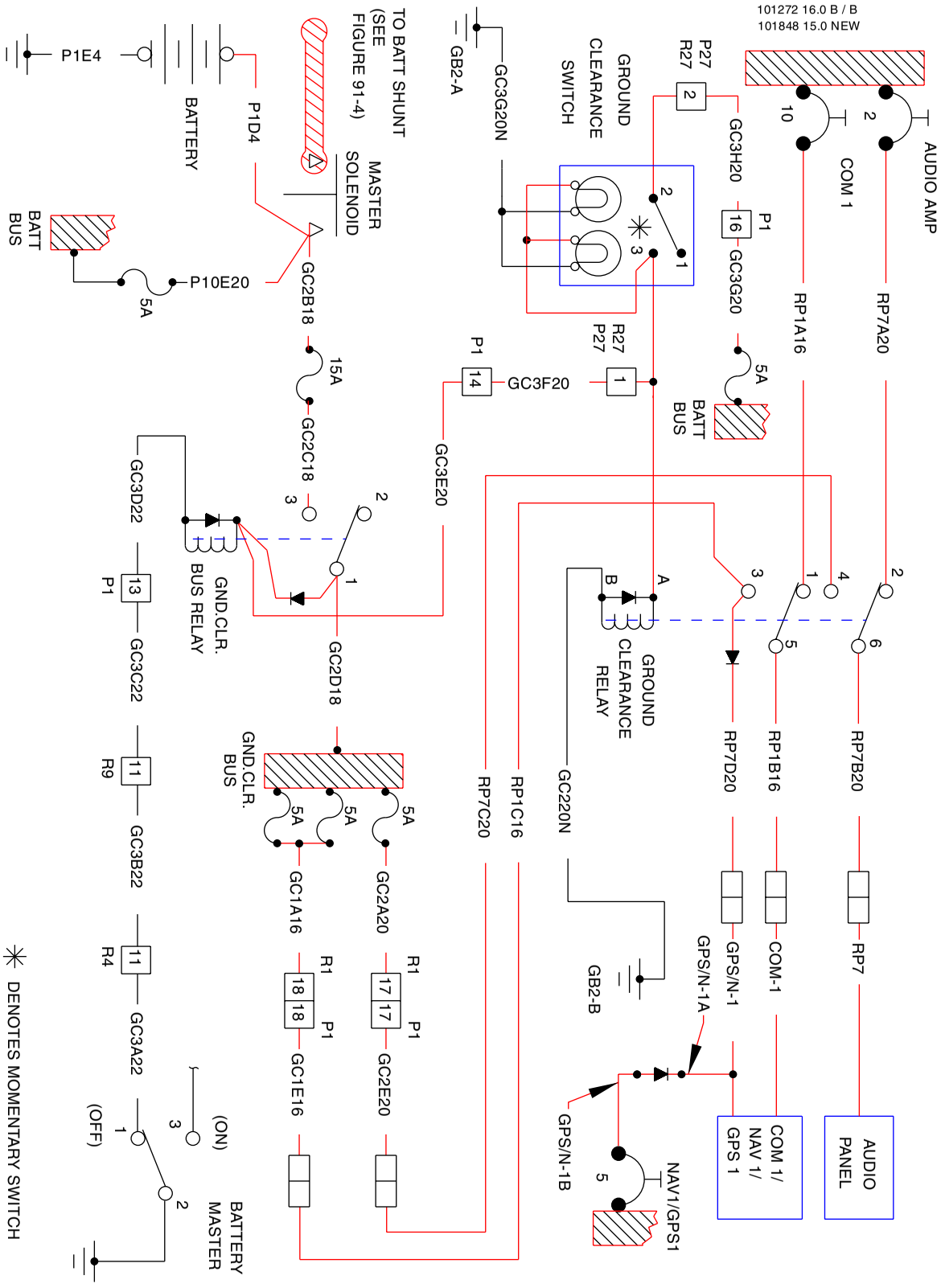
Ground Clearance (HP S/N's 3246001 thru 3246017 only)
Figure 91-6 (Sheet 1 of 4)



Ground Clearance (HP S/N's 3246018 thru 3246087 only)
Figure 91-6 (Sheet 2 of 4)

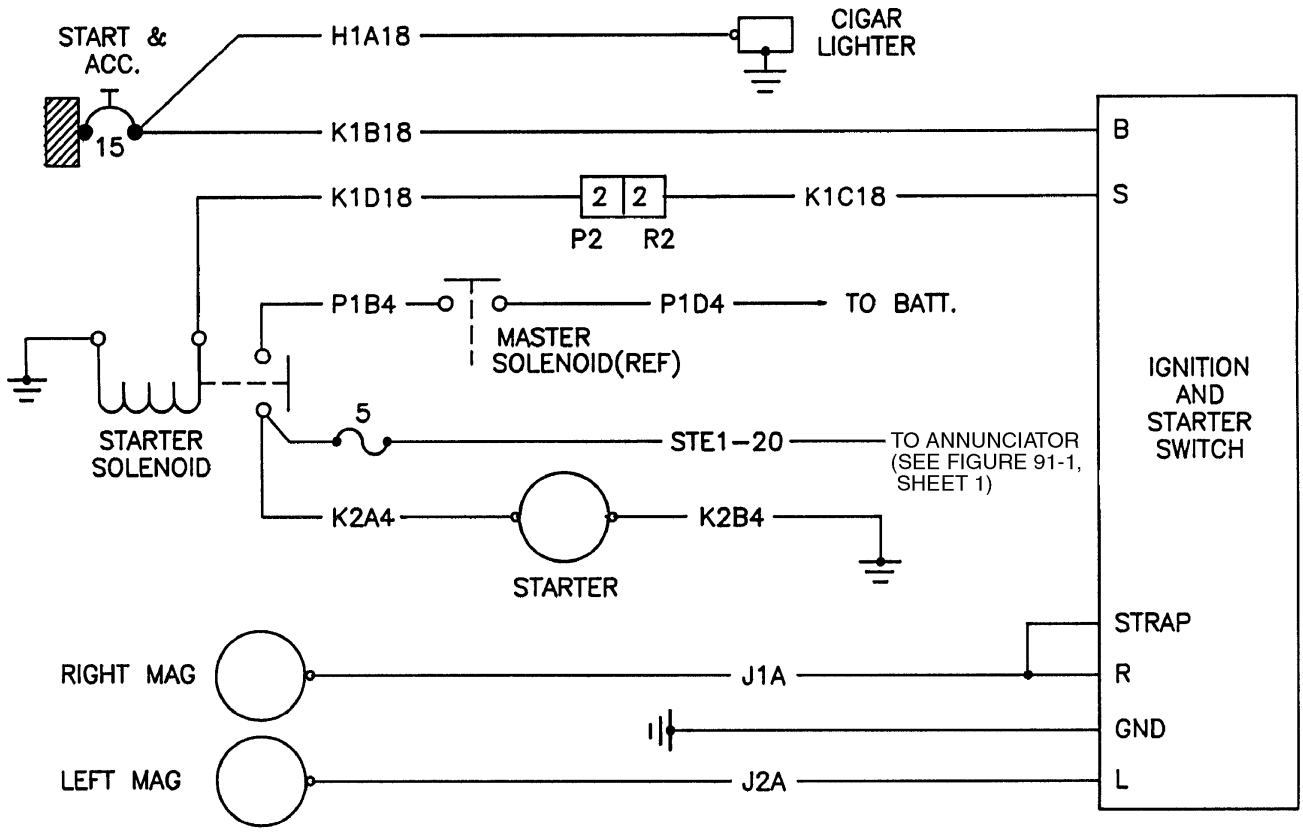


Ground Clearance (HP S/N's 3246088 thru 3246125 only; TC S/N's 3257001 thru 3257075 only)
Figure 91-6 (Sheet 3 of 4)

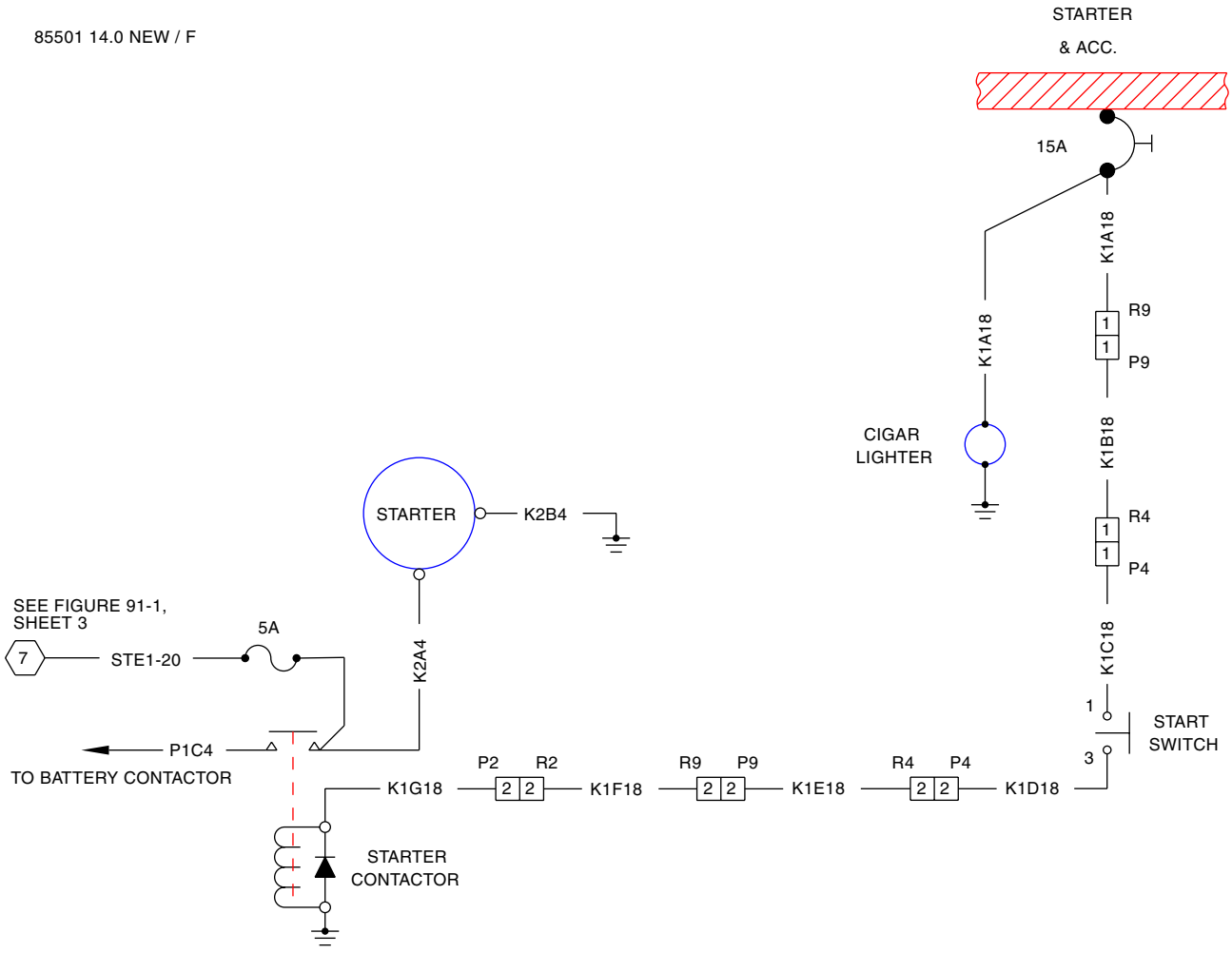


Ground Clearance (HP S/N's 3246126 & up; TC S/N's 3257076 & up)
Figure 91-6 (Sheet 4 of 4)

85300 14.0 NEW / B

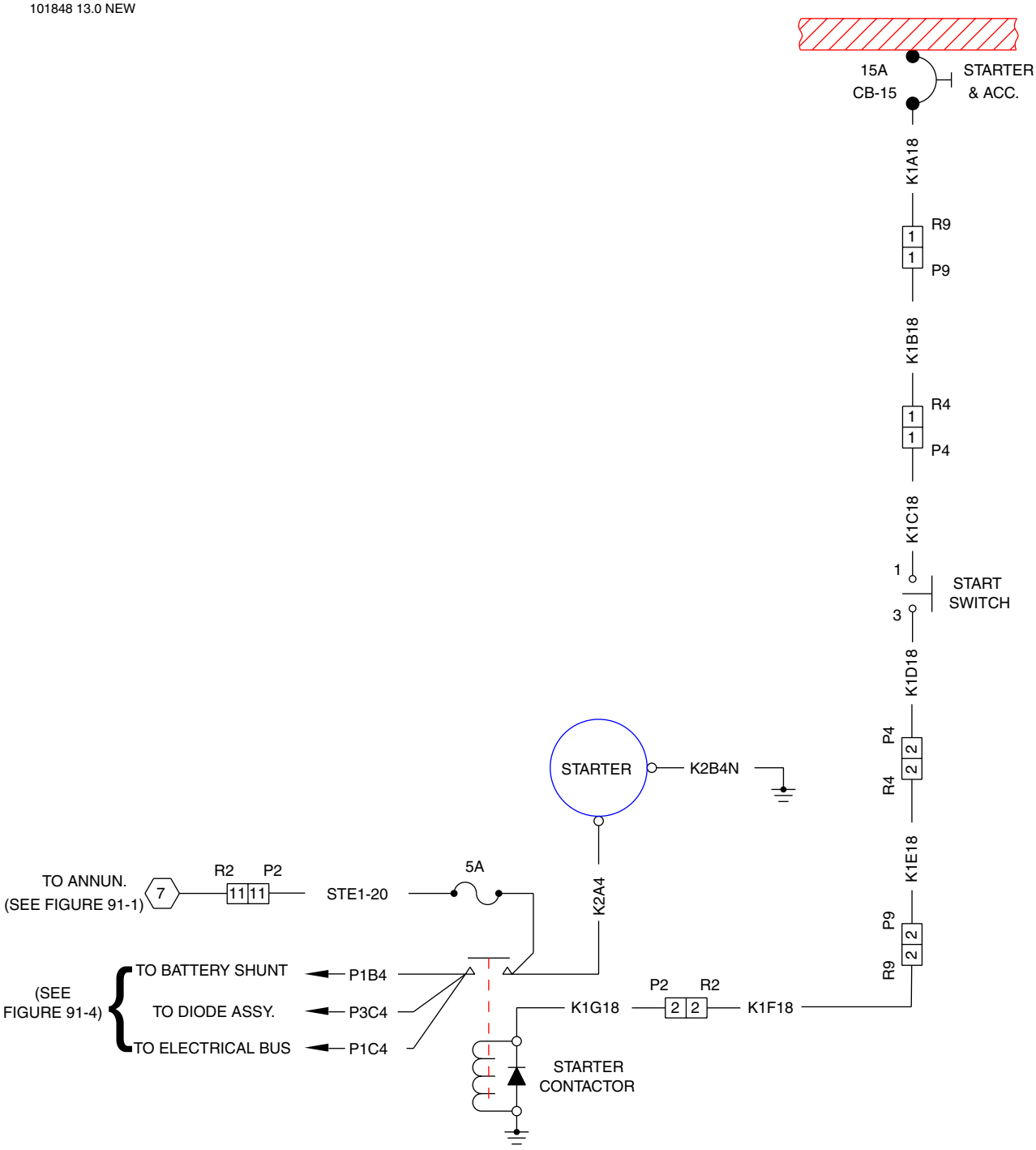


Starter and Accessories (HP S/N's 3246001 thru 3246017 only)
Figure 91-7 (Sheet 1of 3)



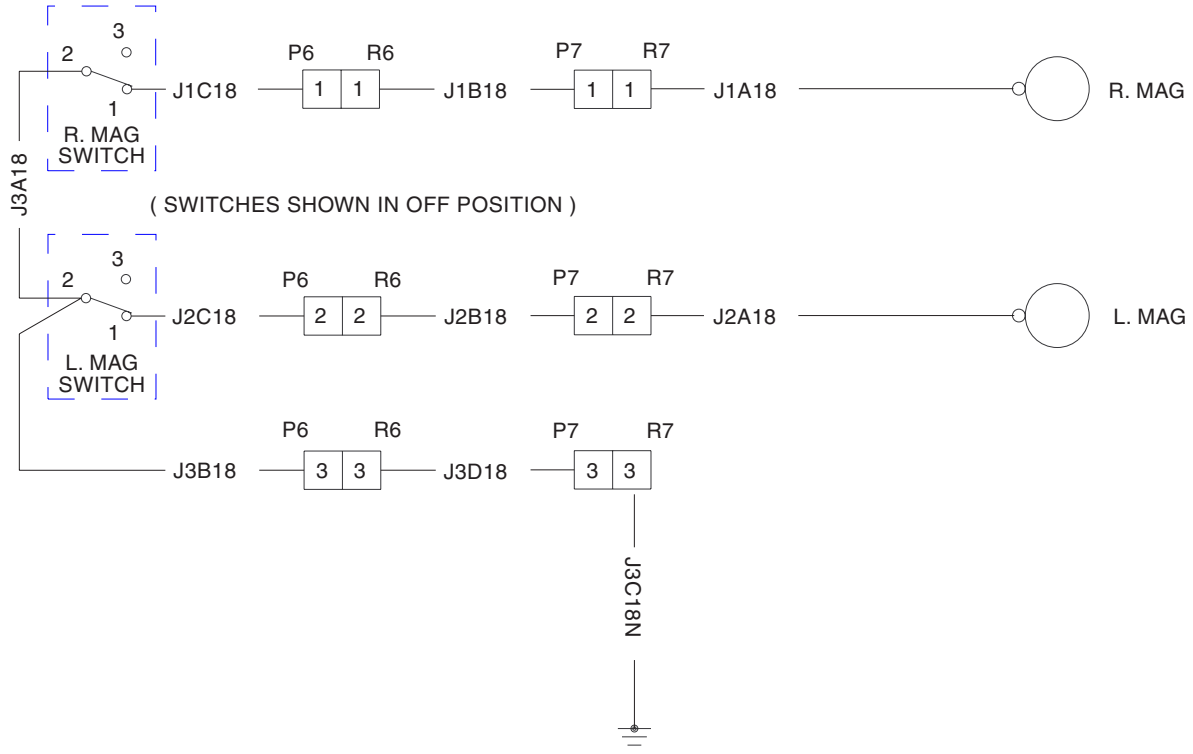
Starter and Accessories (HP S/N's 3246018 thru 3246087 only)
Figure 91-7 (Sheet 2 of 3)

100840 14.0 C / C
101272 14.0 NEW / B
101848 13.0 NEW

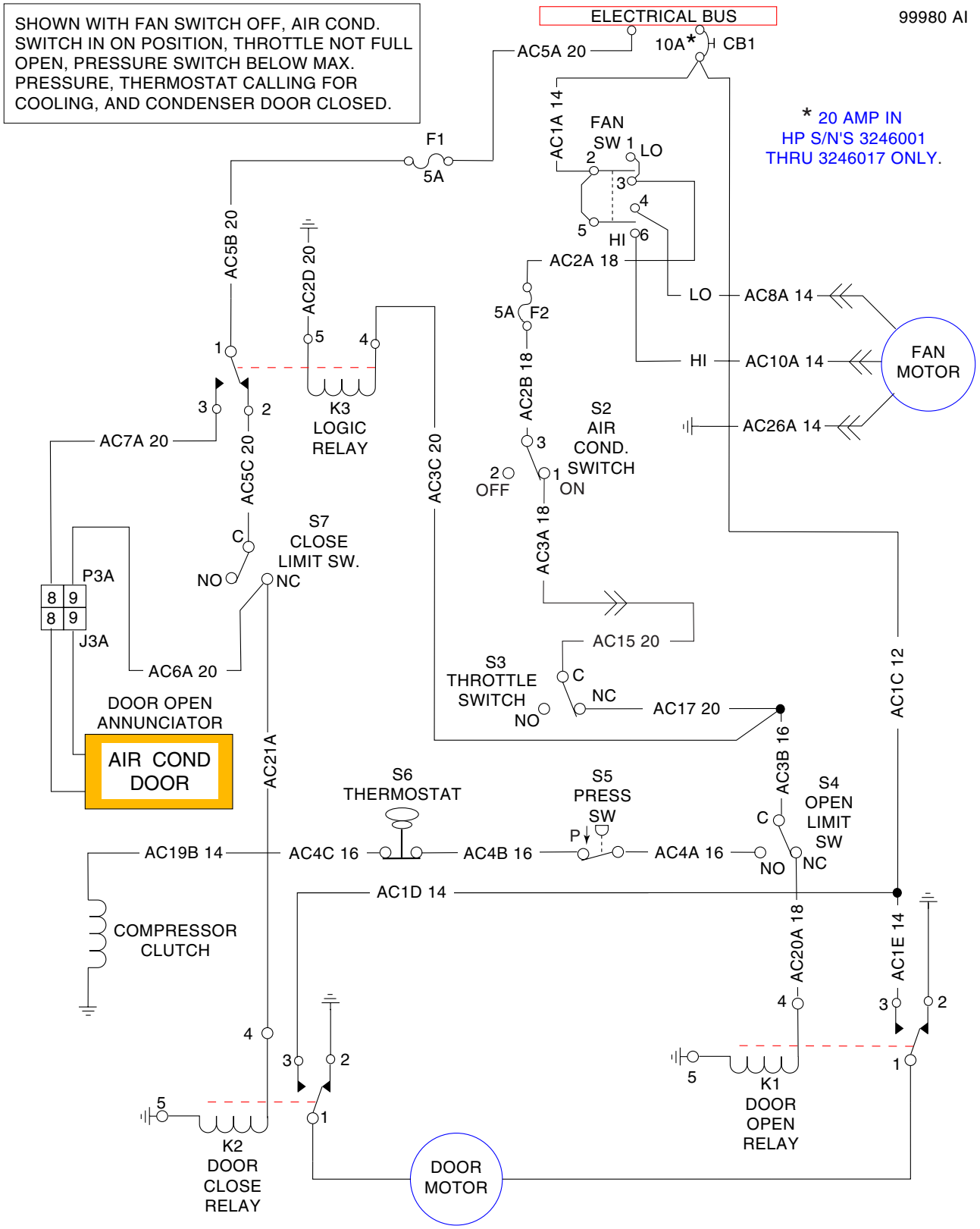


Starter and Accessories (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-7 (Sheet 3 of 3)

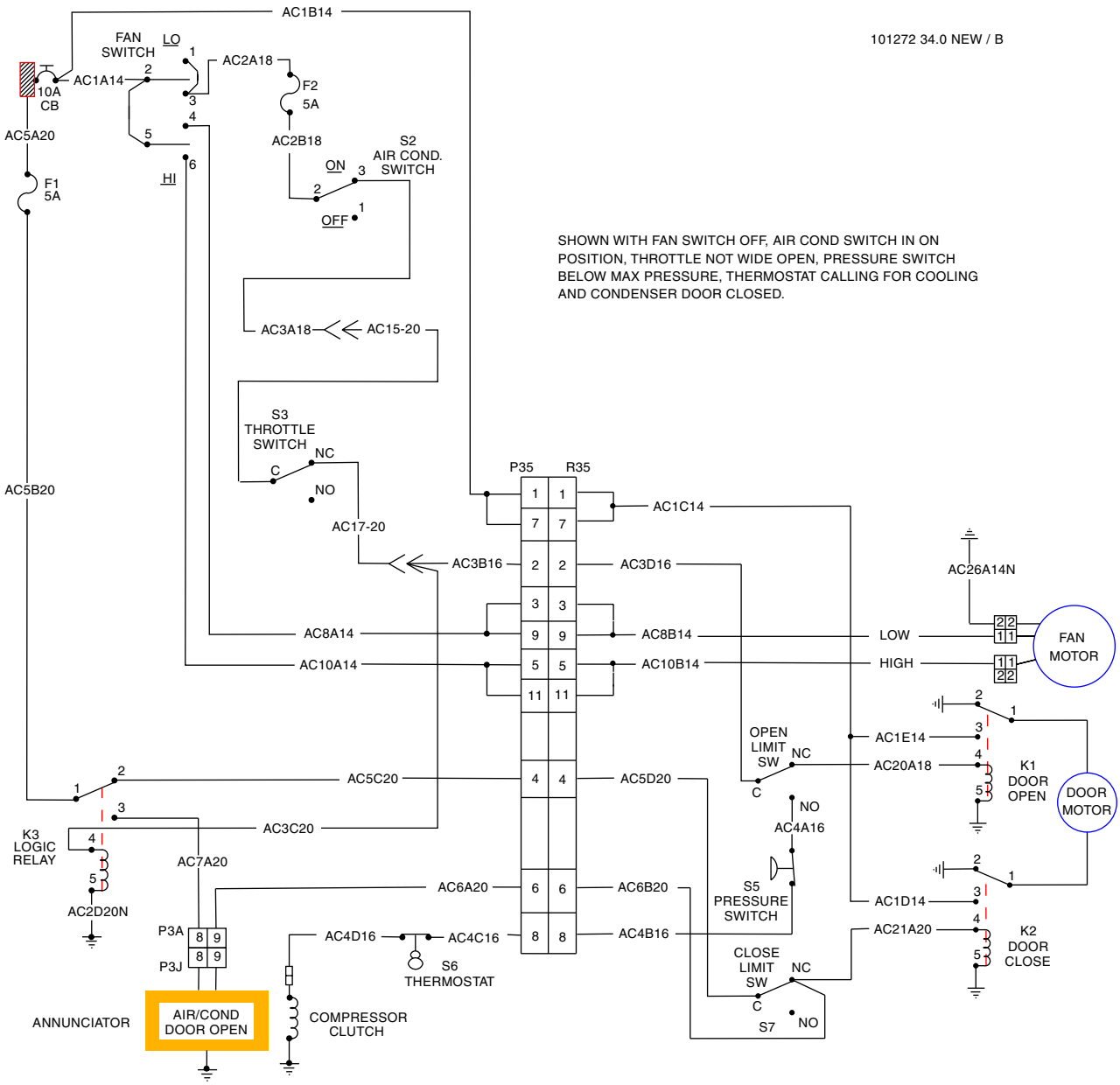
101272 28.0 NEW / B
100840 28.0 NEW / C
85501 28.0 NEW / F



Magneto Switch (HP S/N's 3246018 & up; TC S/N's 3257001 & up)
Figure 91-8



Air Conditioning (HP S/N's 3246001 thru 3246125 only; TC S/N's 3257001 thru 3257075 only)
Figure 91-9 (Sheet 1 of 2)



Air Conditioning (HP S/N's 3246126 & up; TC S/N's 3257076 & up)
Figure 91-9 (Sheet 2 of 2)

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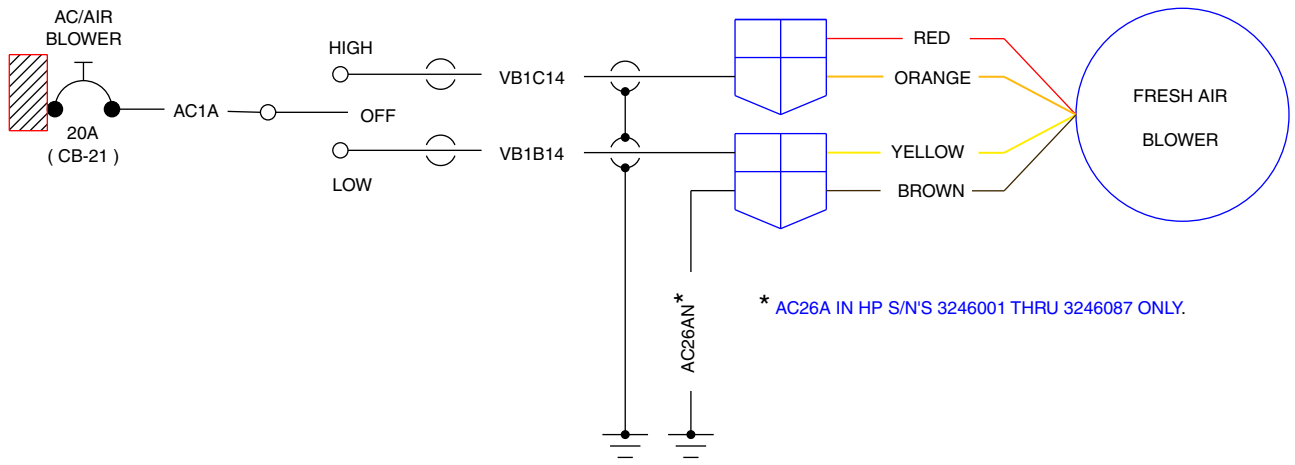
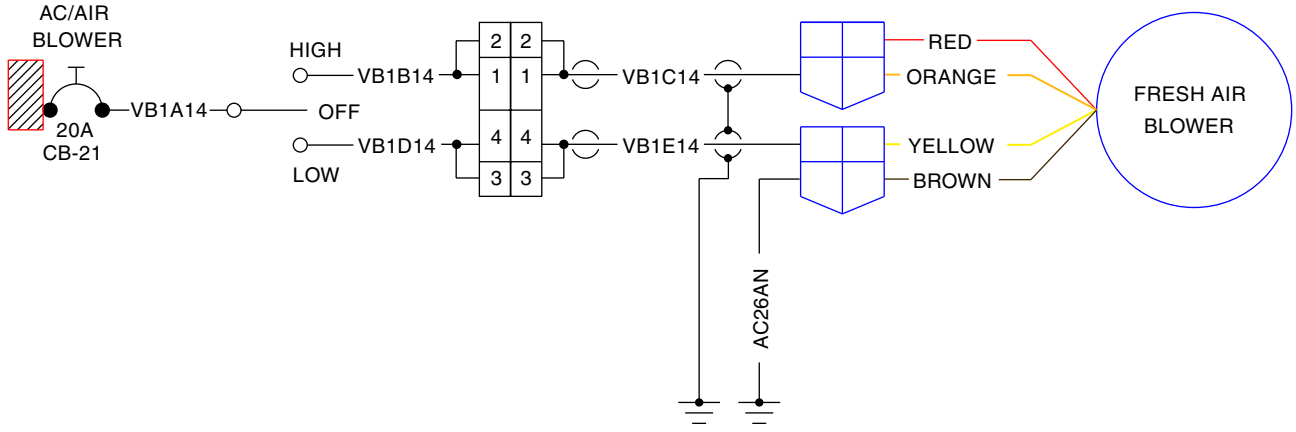
100840 13.0 B / C
85501 13.0 NEW / F
85300 13.0 NEW / B



HP S/N'S 3246001 THRU 3246125 ONLY; TC S/N'S 3257001 THRU 3257075 ONLY

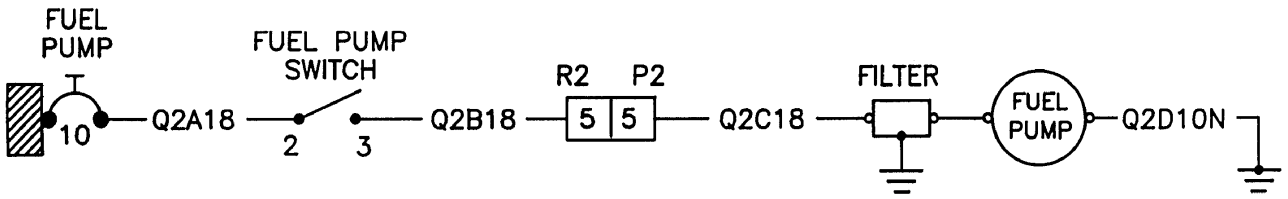
101272 13.0 NEW / B



HP S/N'S 3246126 & UP; TC S/N'S 3257076 & UP

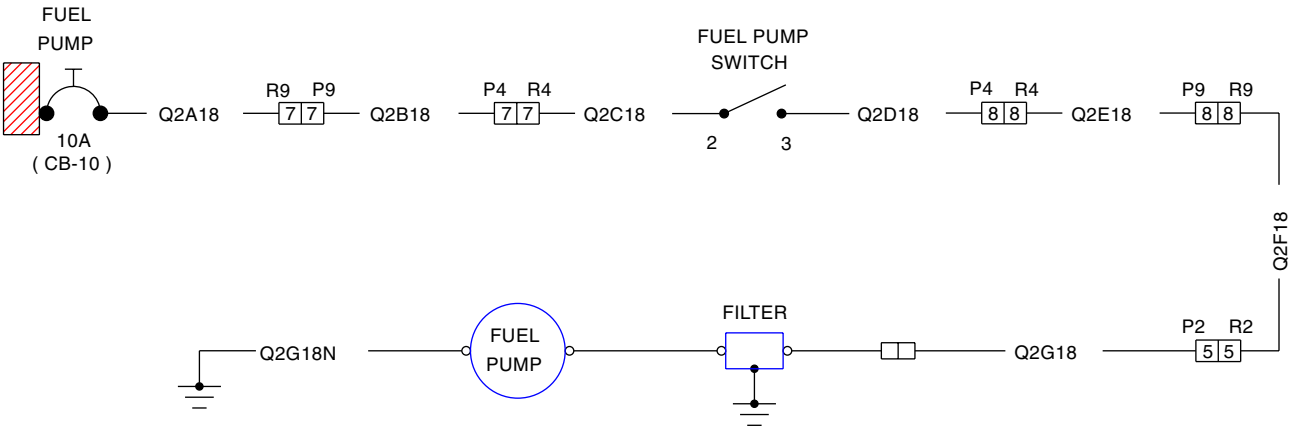
Ventilation Blower
Figure 91-10

85300 8.0 NEW / B



HP S/N's 3246001 thru 3246017 only

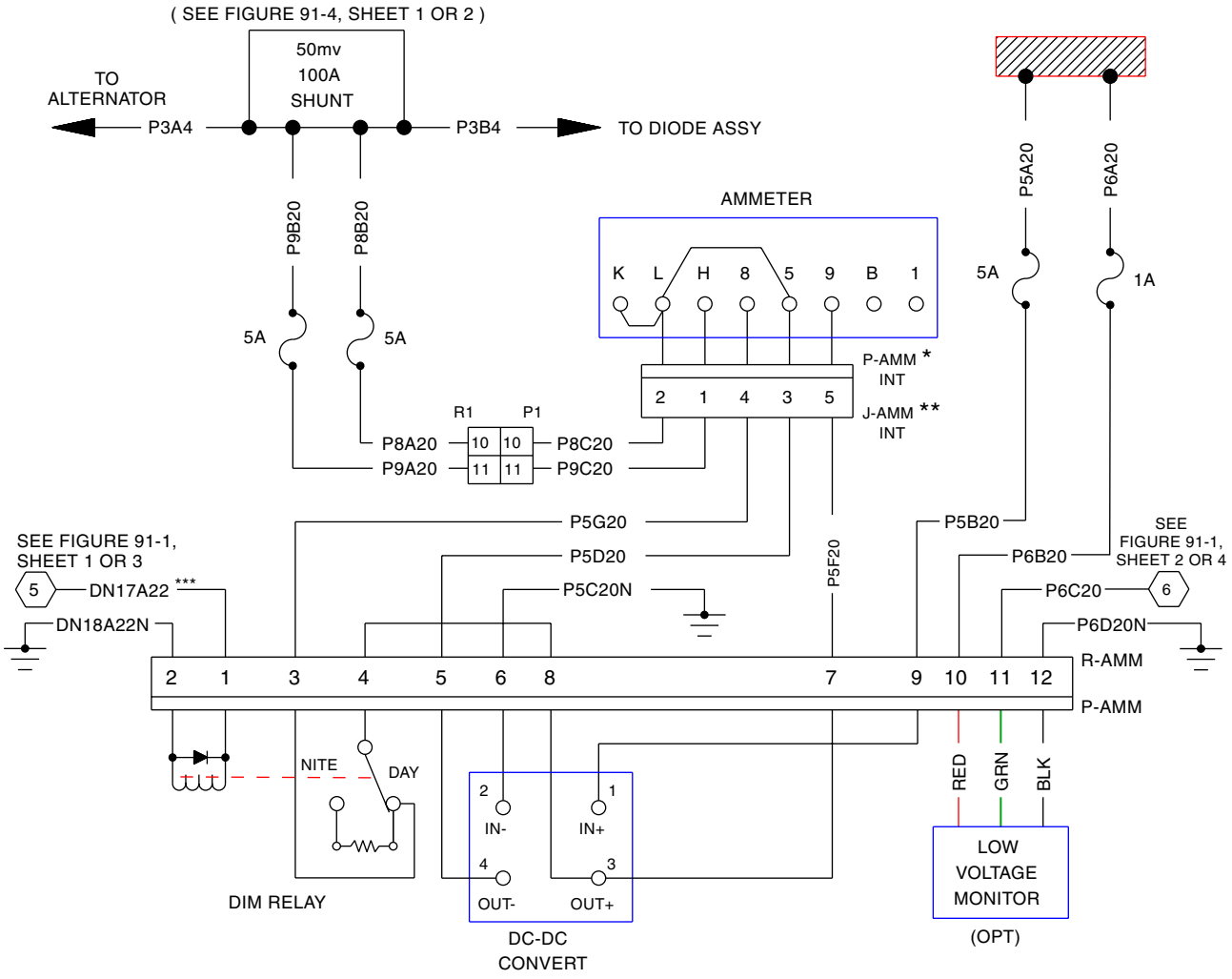
85501 8.0 NEW / F
100840 8.0 NEW / C
101272 8.0 NEW / B
101848 8.0 NEW



HP S/N's 3246018 & up; TC S/N's 3257001 & up

Fuel Pump
Figure 91-11

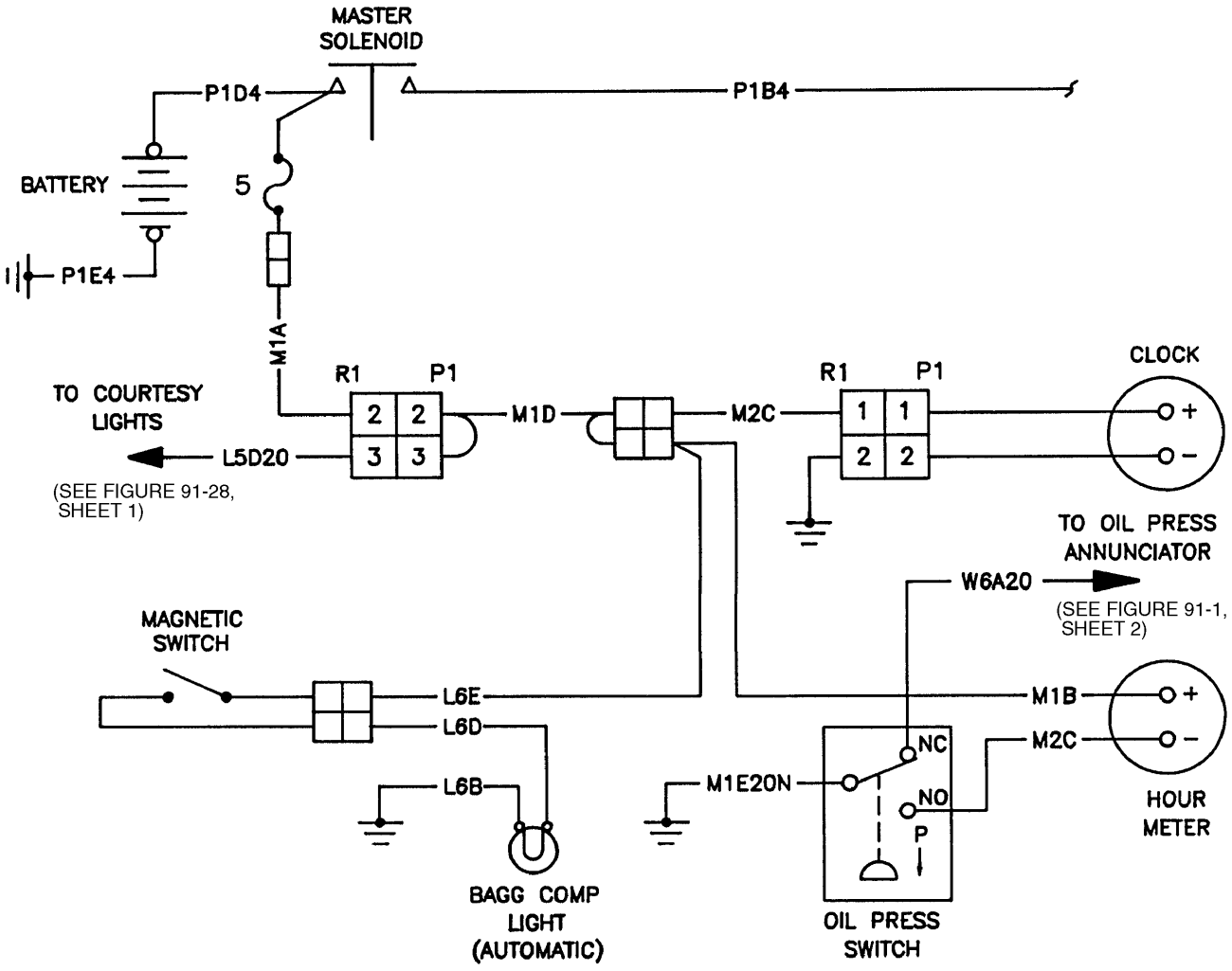
85501 3.0 C / F
85300 3.0 NEW / B



IN HP S/N'S 3246001 THRU 3246017 ONLY: * J-AMM
** P-AMM
*** DN17B22

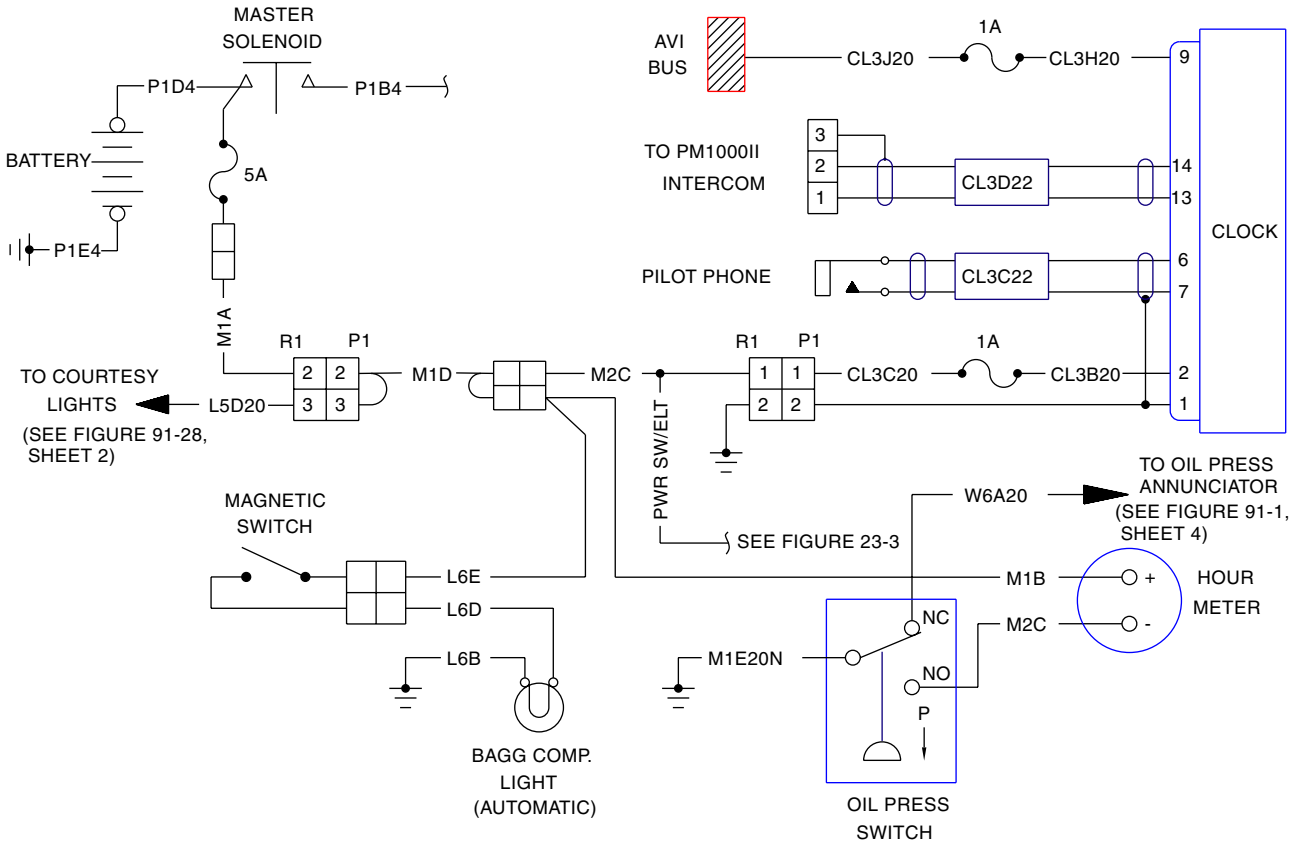
Ammeter / Low Voltage Monitor (HP S/N's 3246001 thru 3246087 only)
Figure 91-12

85300 17.0 NEW / B



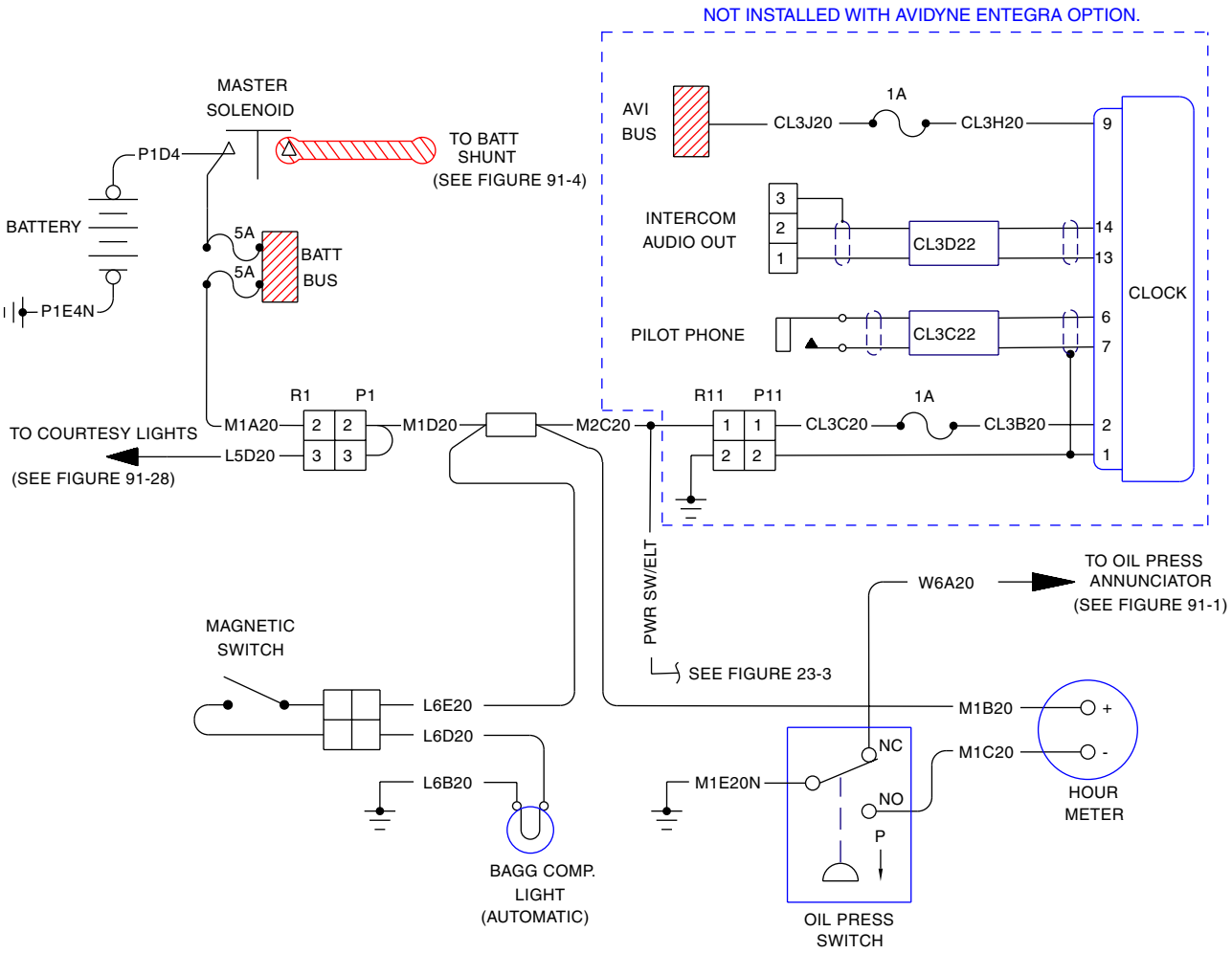
Clock, Hour Meter, and Baggage Compartment (HP S/N's 3246001 thru 3246017 only)
Figure 91-13 (Sheet 1 of 3)

85501 17.0 A / F



Clock, Hour Meter, and Baggage Compartment (HP S/N's 3246018 thru 3246087 only)
Figure 91-13 (2 of 3)

101848 16.0 NEW
101272 17.0 NEW / B
100840 17.0 B / C



Clock, Hour Meter, and Baggage Compartment (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-13 (Sheet 3 of 3)

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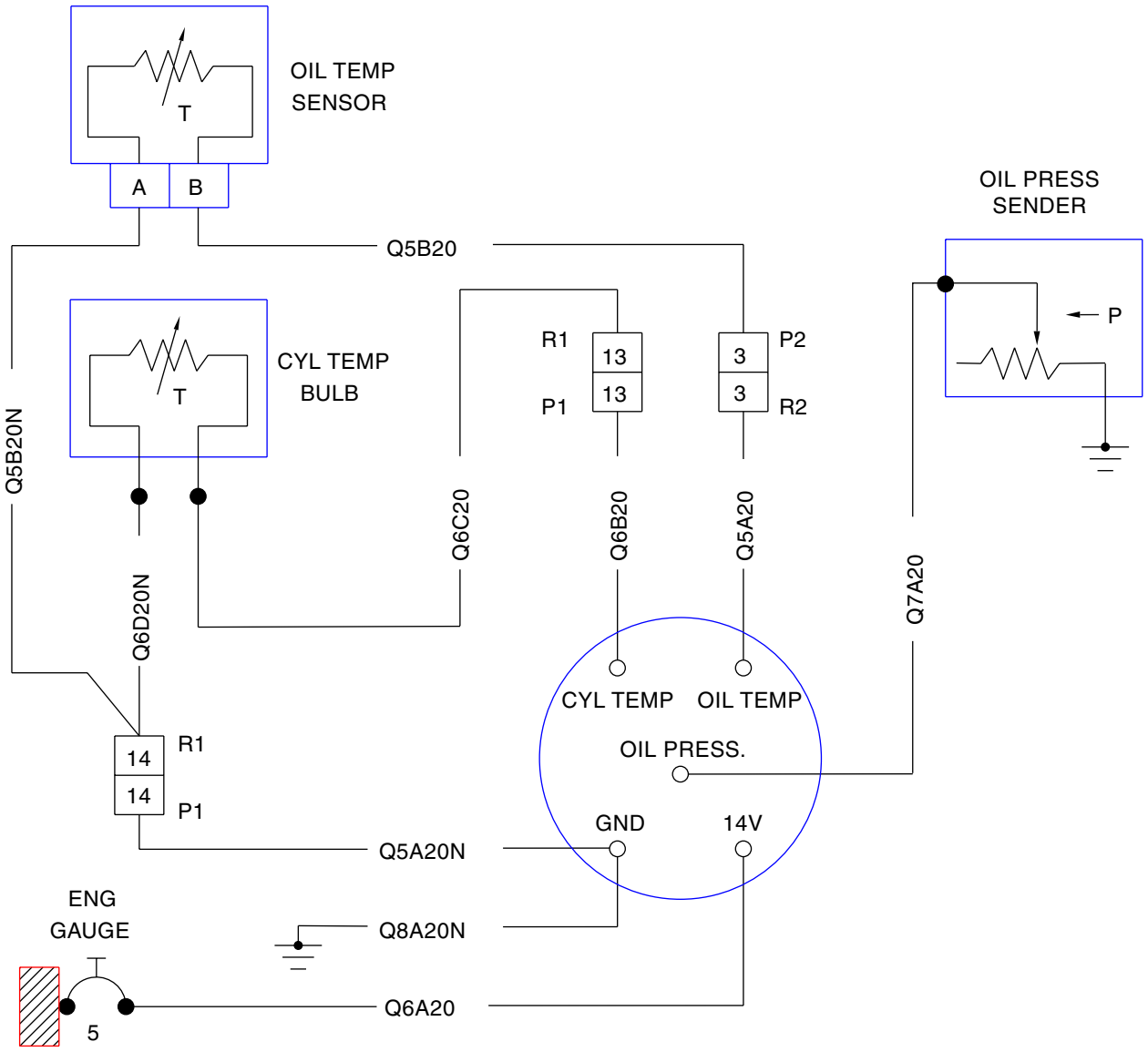
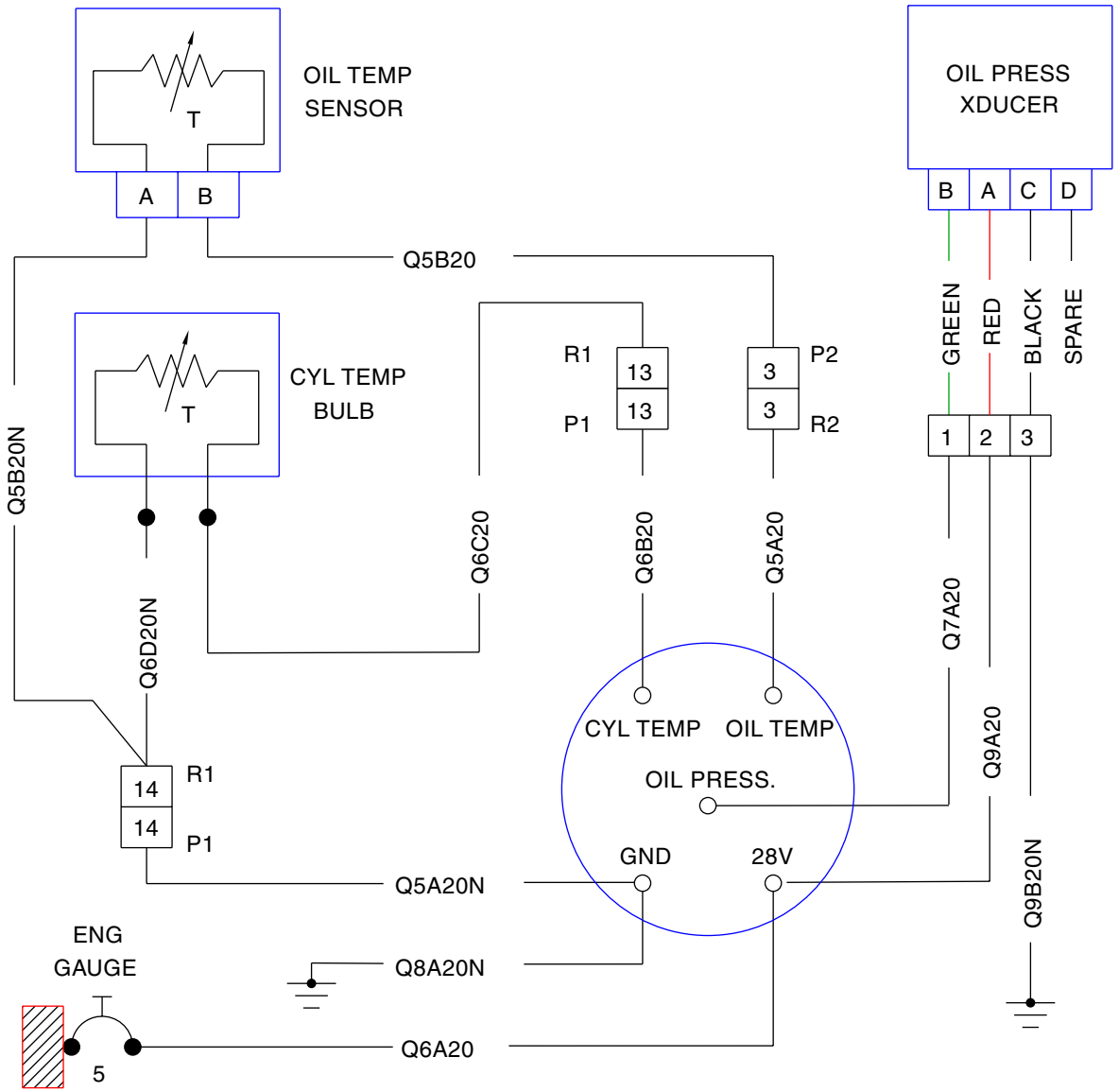
85300 6.0 NEW / B

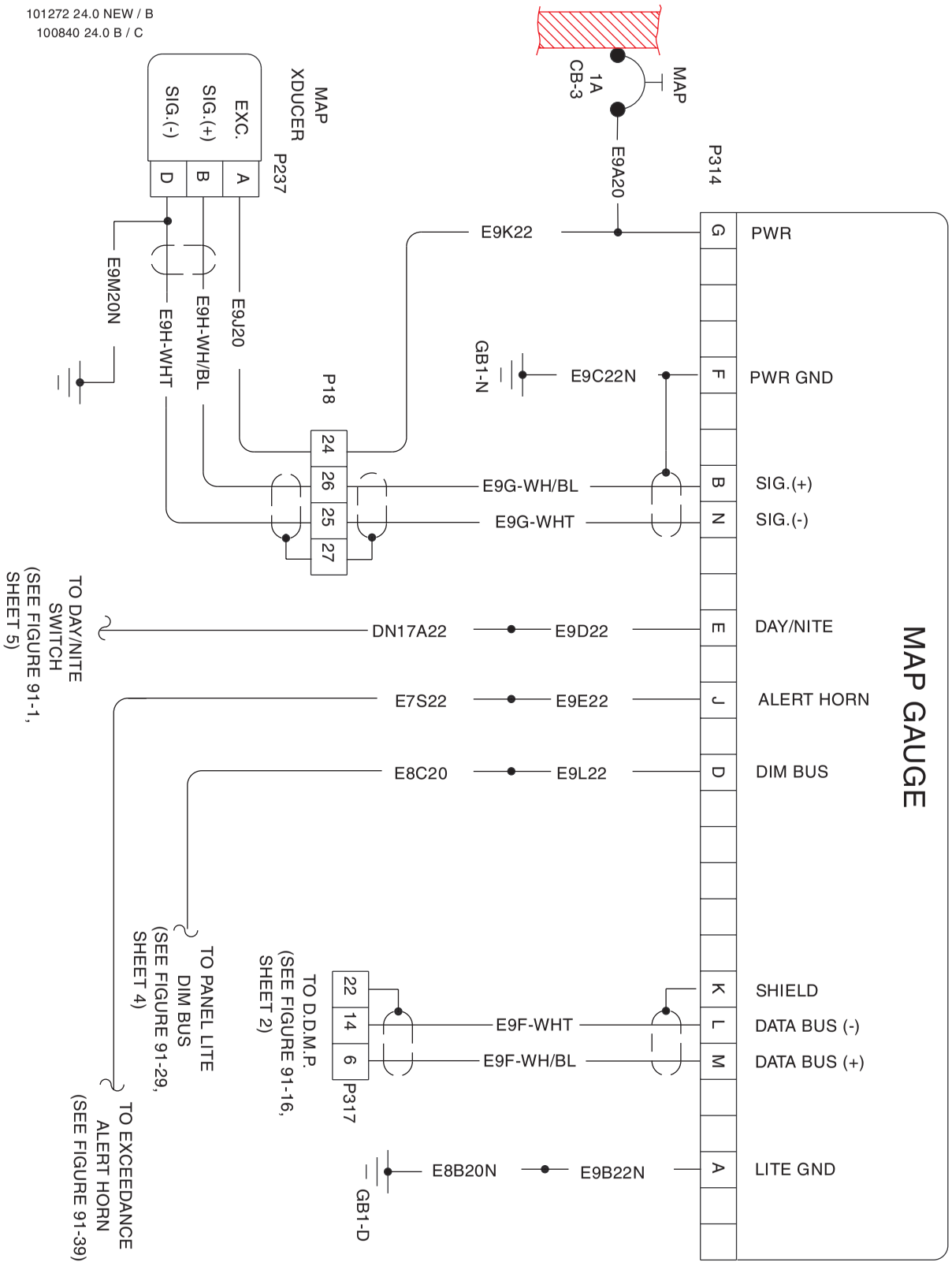


Engine Gauge (HP S/N's 3246001 thru 3246017 only)
Figure 91-14 (Sheet 1 of 2)

85501 6.0 A / F



Engine Gauge (HP S/N's 3246018 thru 3246087 only)
Figure 91-14 (2 of 2)



MAP Gauge (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-15

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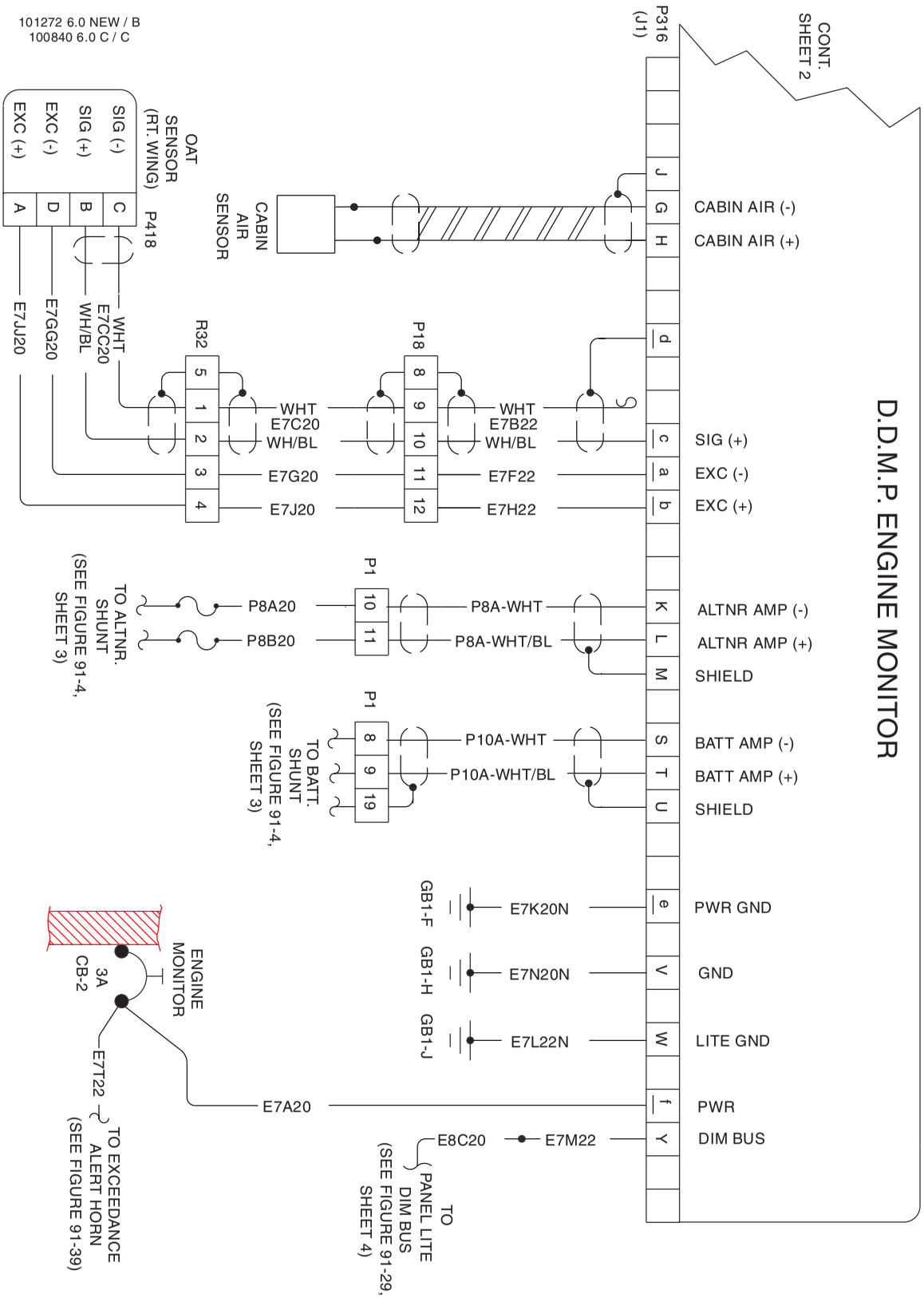
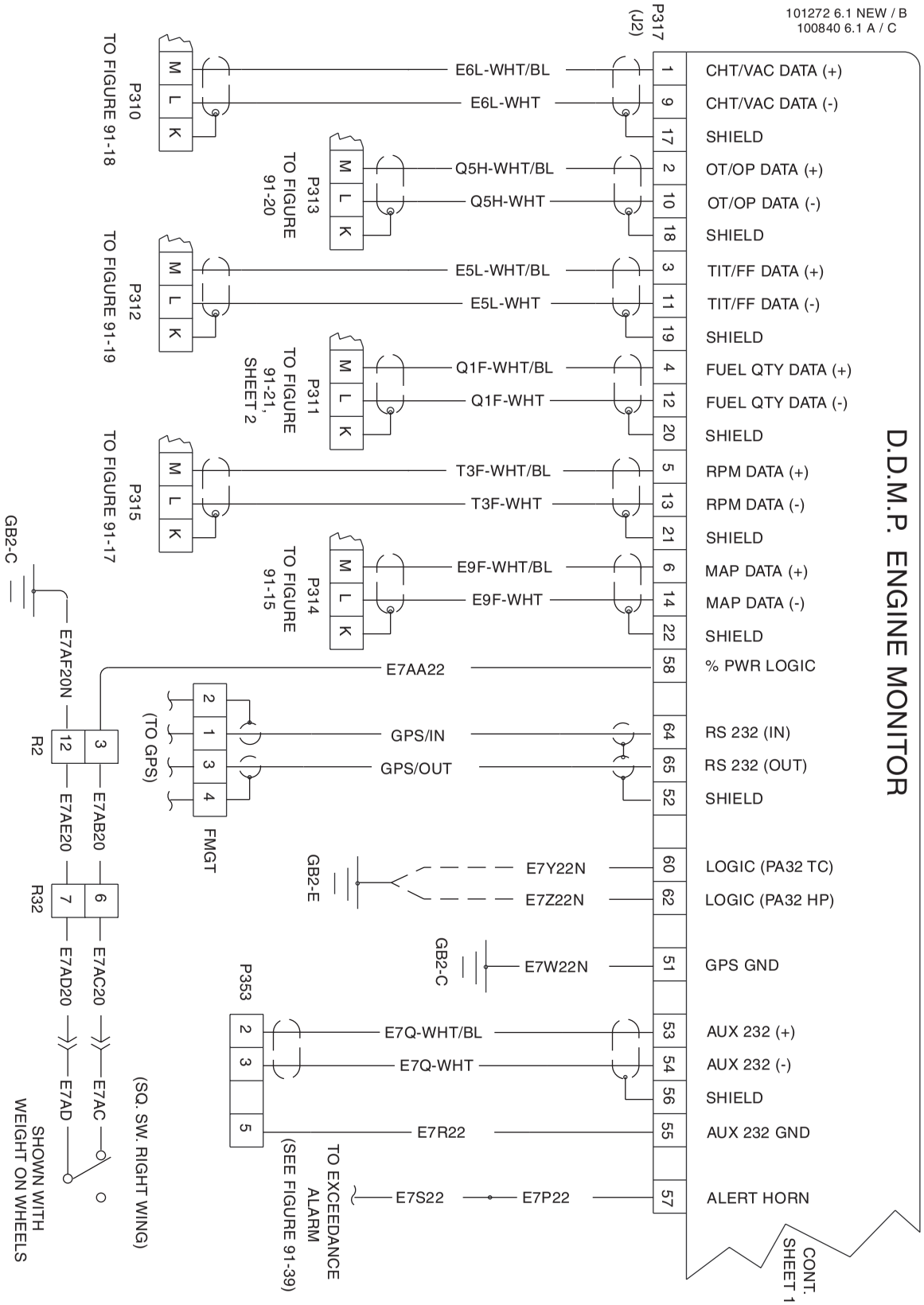
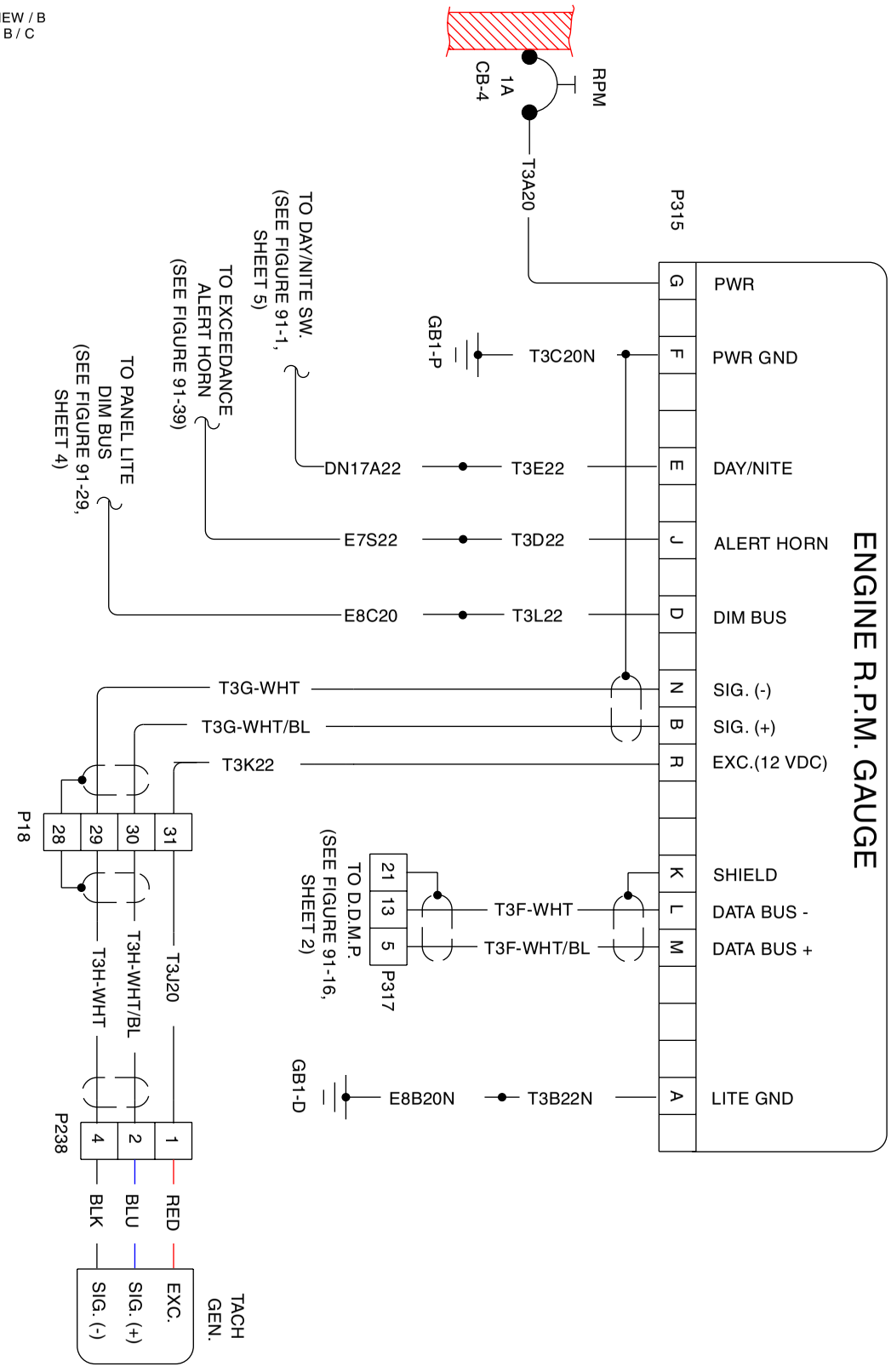


Engine Digital Display Monitoring Panel (DDMP) (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-16 (Sheet 1 of 2)

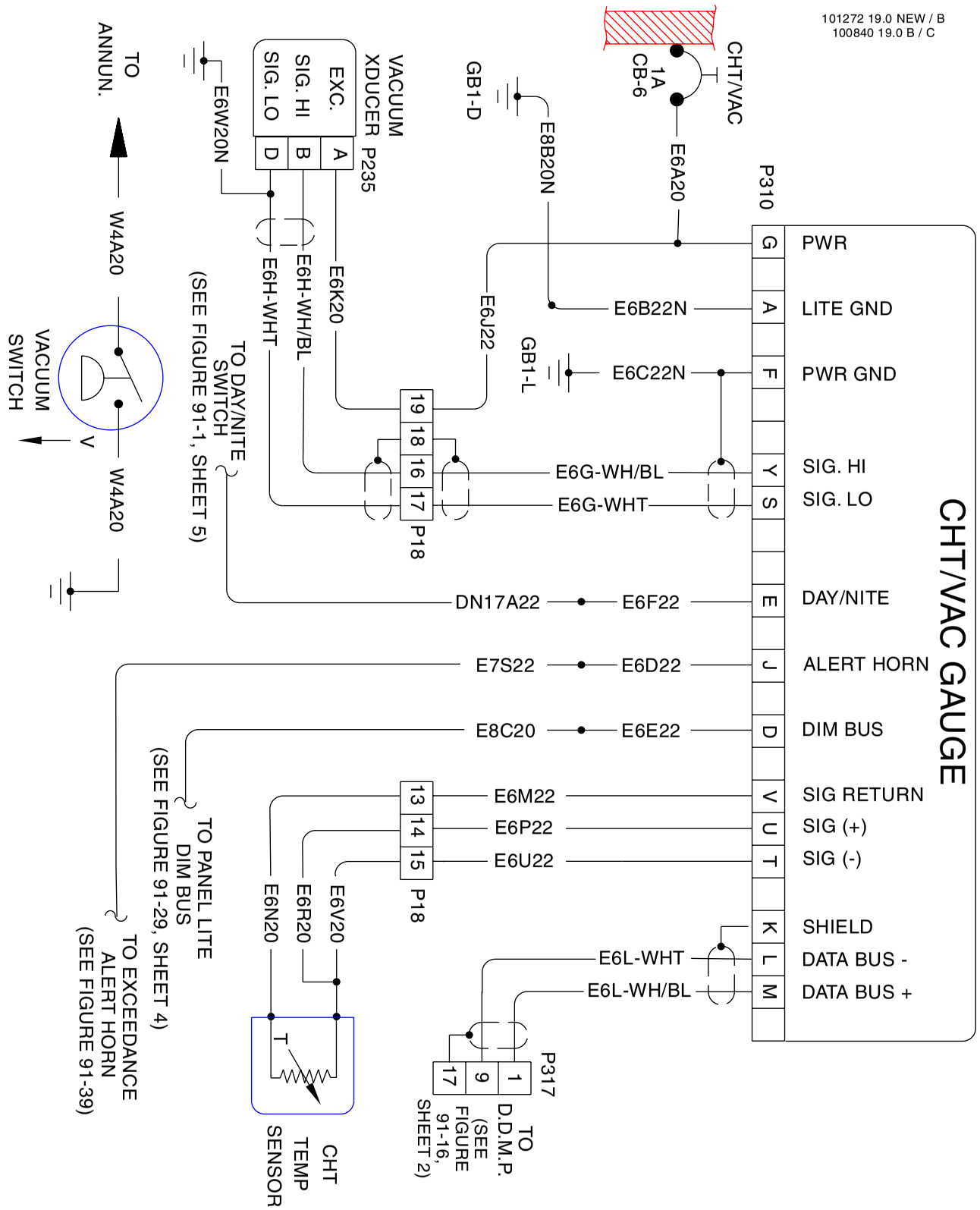


Engine Digital Display Monitoring Panel (DDMP) (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-16 (2 of 2)

101272 31.0 NEW / B
100840 31.0 B / C

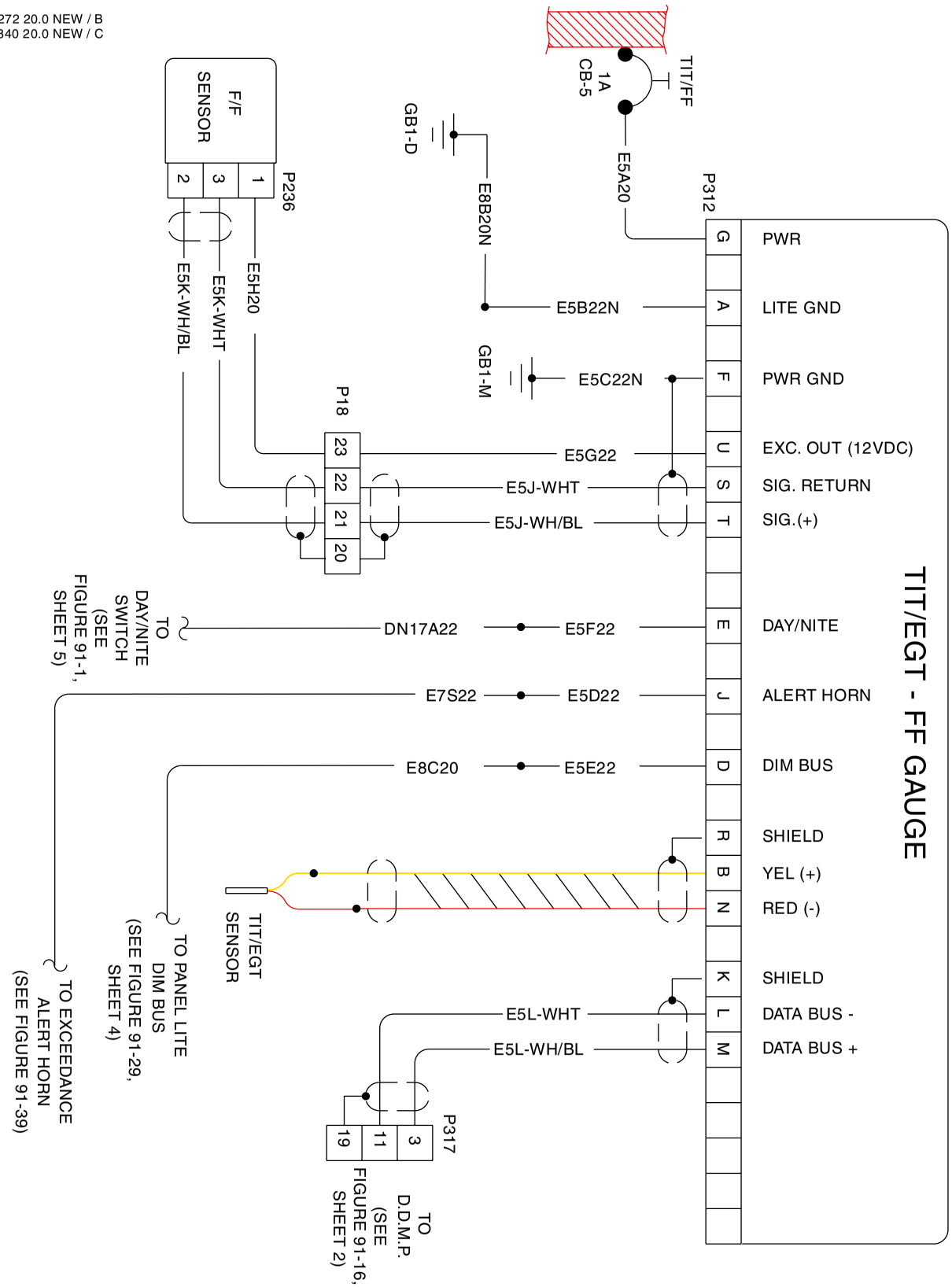


Engine RPM (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-17



CHT / VAC (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-18

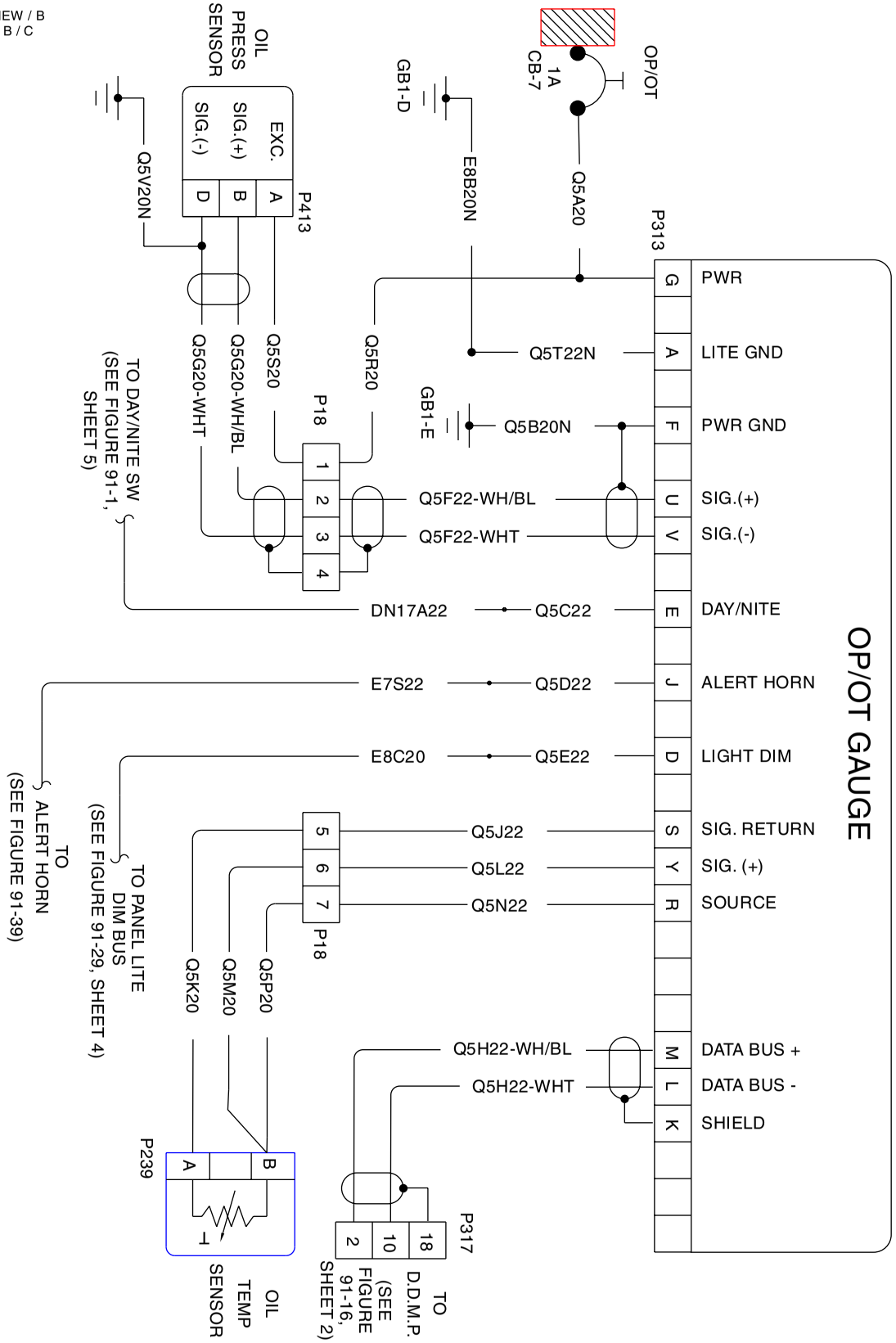
101272 20.0 NEW / B
100840 20.0 NEW / C



TIT / FF or EGT / FF (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-19

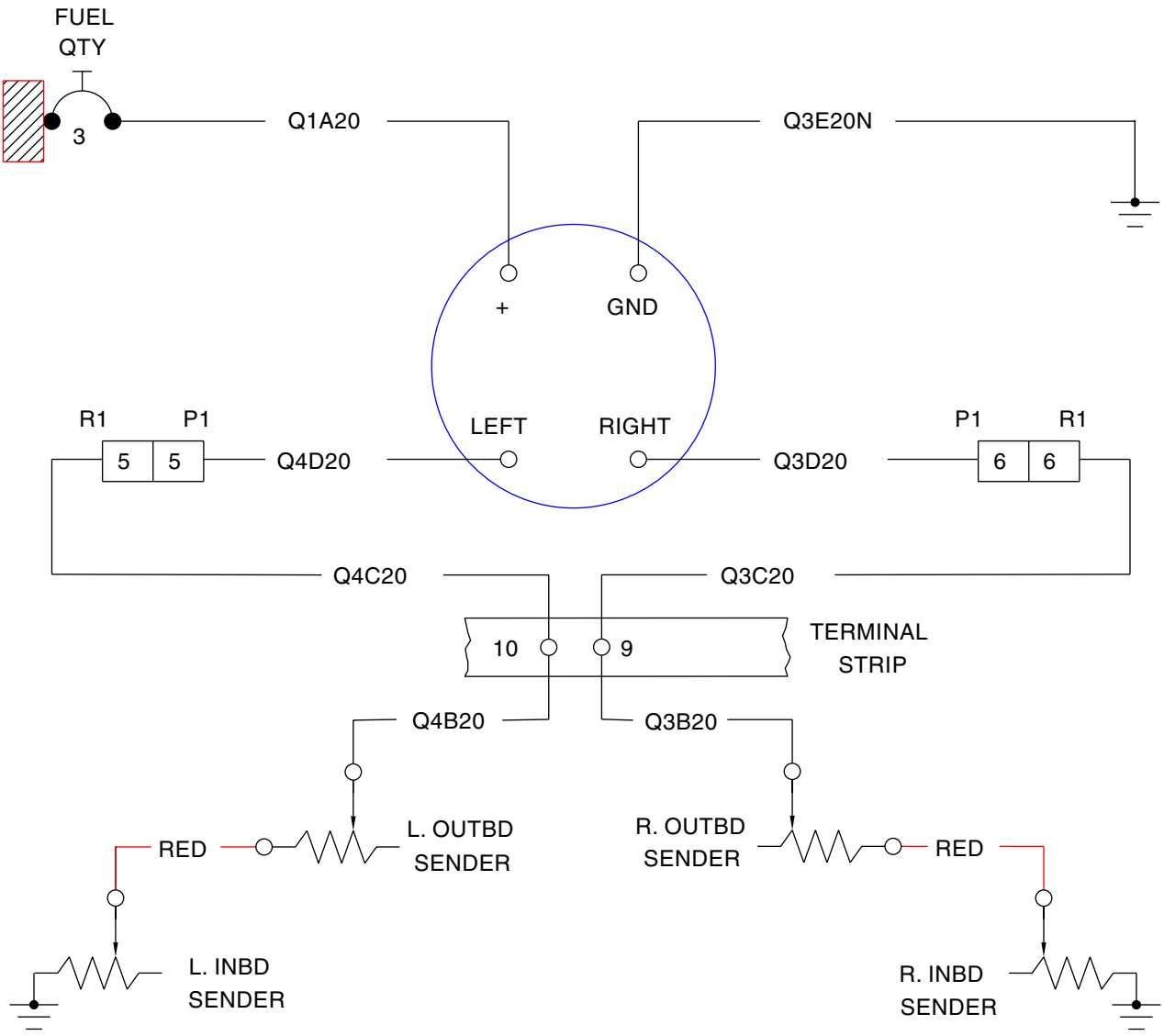
5F22

101272 3.0 NEW / B
100840 3.0 B / C

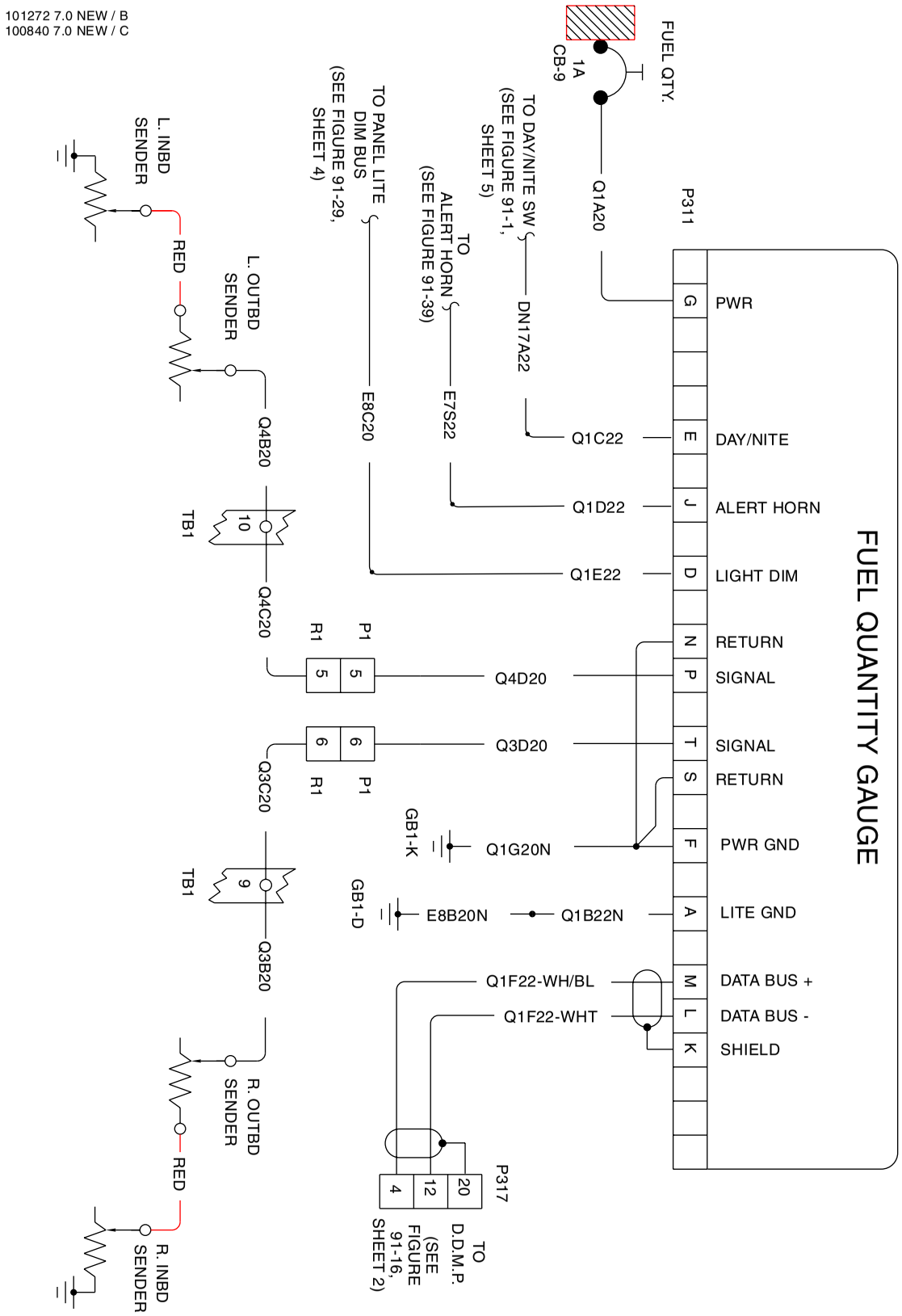


Oil Pressure / Oil Temperature (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-20

85501 7.0 NEW / F
85300 7.0 NEW / B

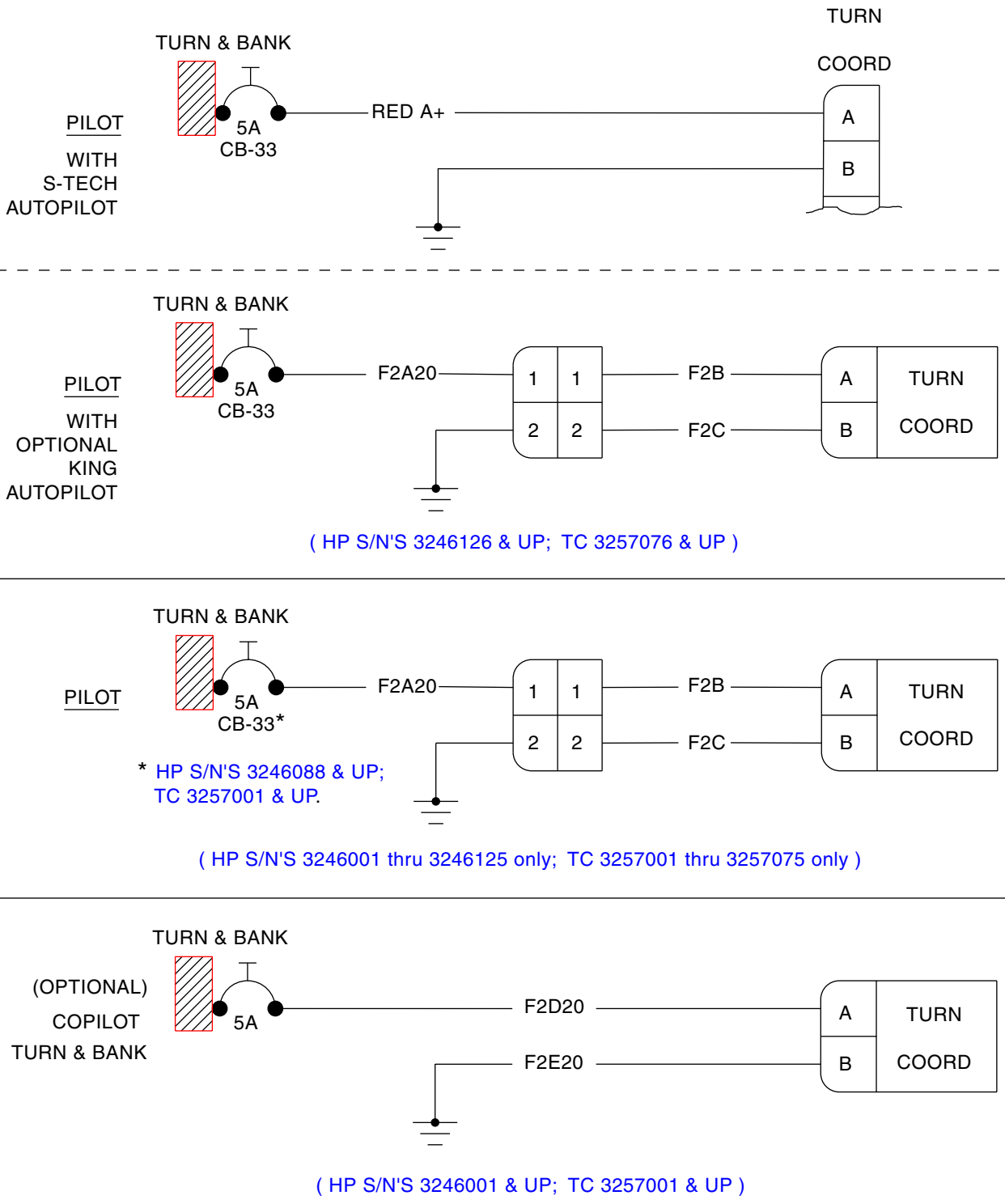


Fuel Quantity (HP S/N's 3246001 thru 3246087 only)
Figure 91-21 (Sheet 1 of 2)

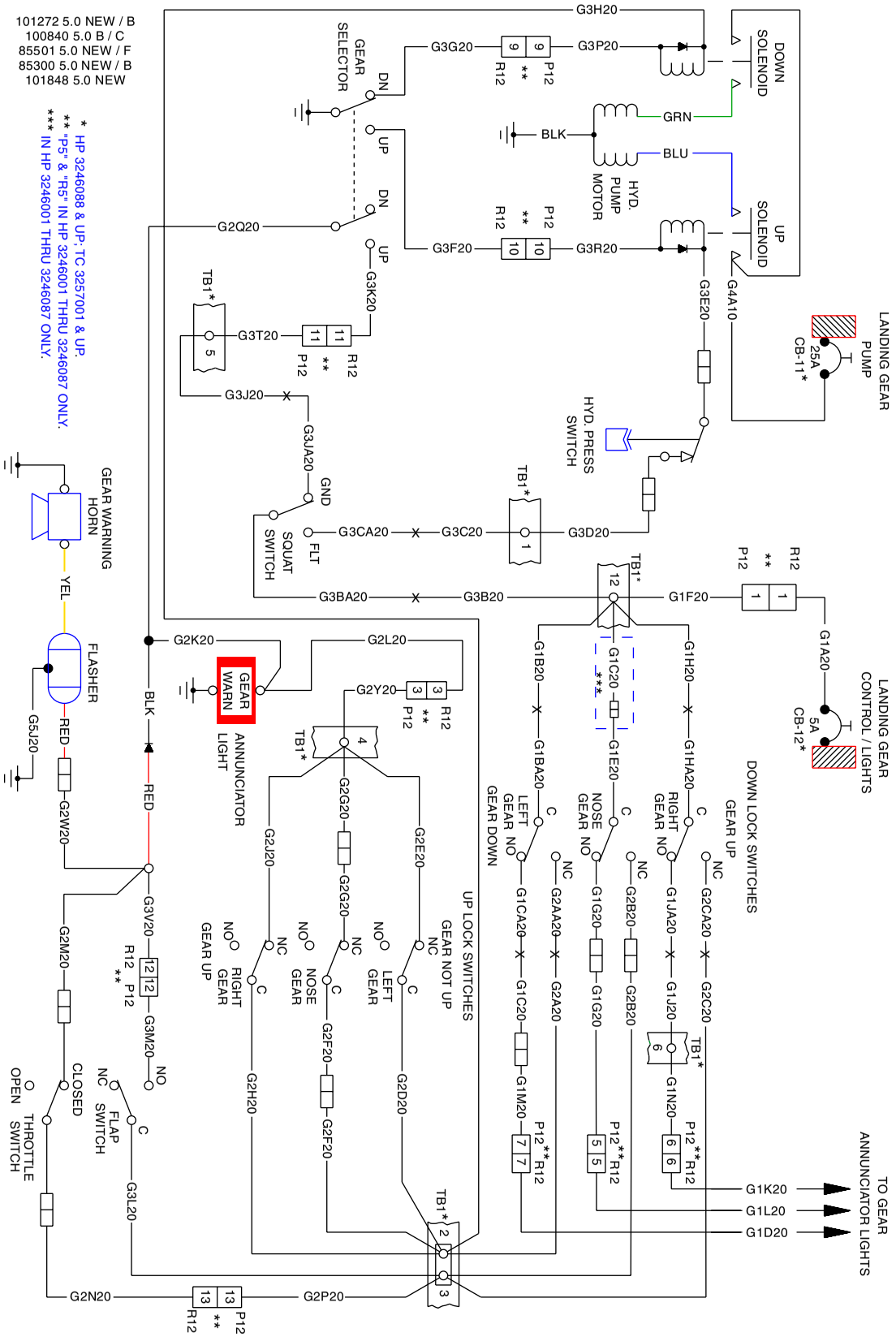


Fuel Quantity (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-21 (Sheet 2 of 2)

101272 12.0 NEW / B
100840 12.0 NEW / C
85501 12.0 NEW / F
85300 12.0 NEW / B

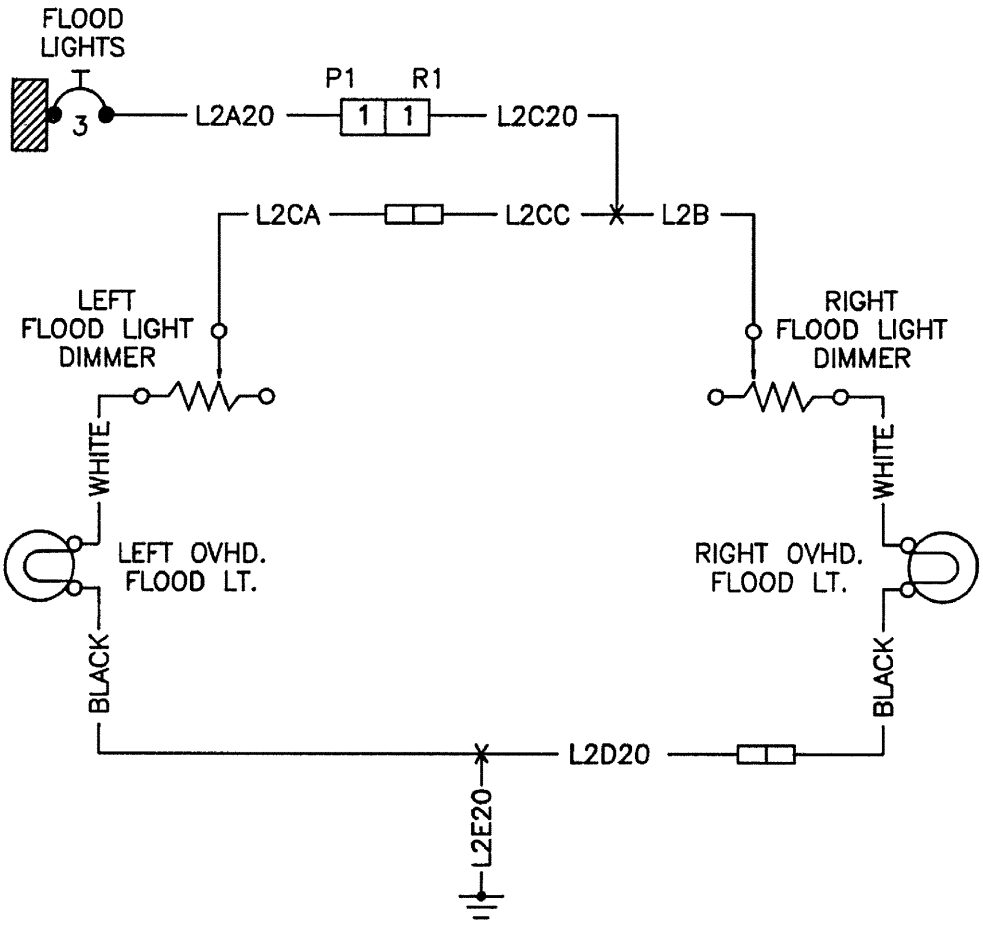


Turn and Bank
Figure 91-22



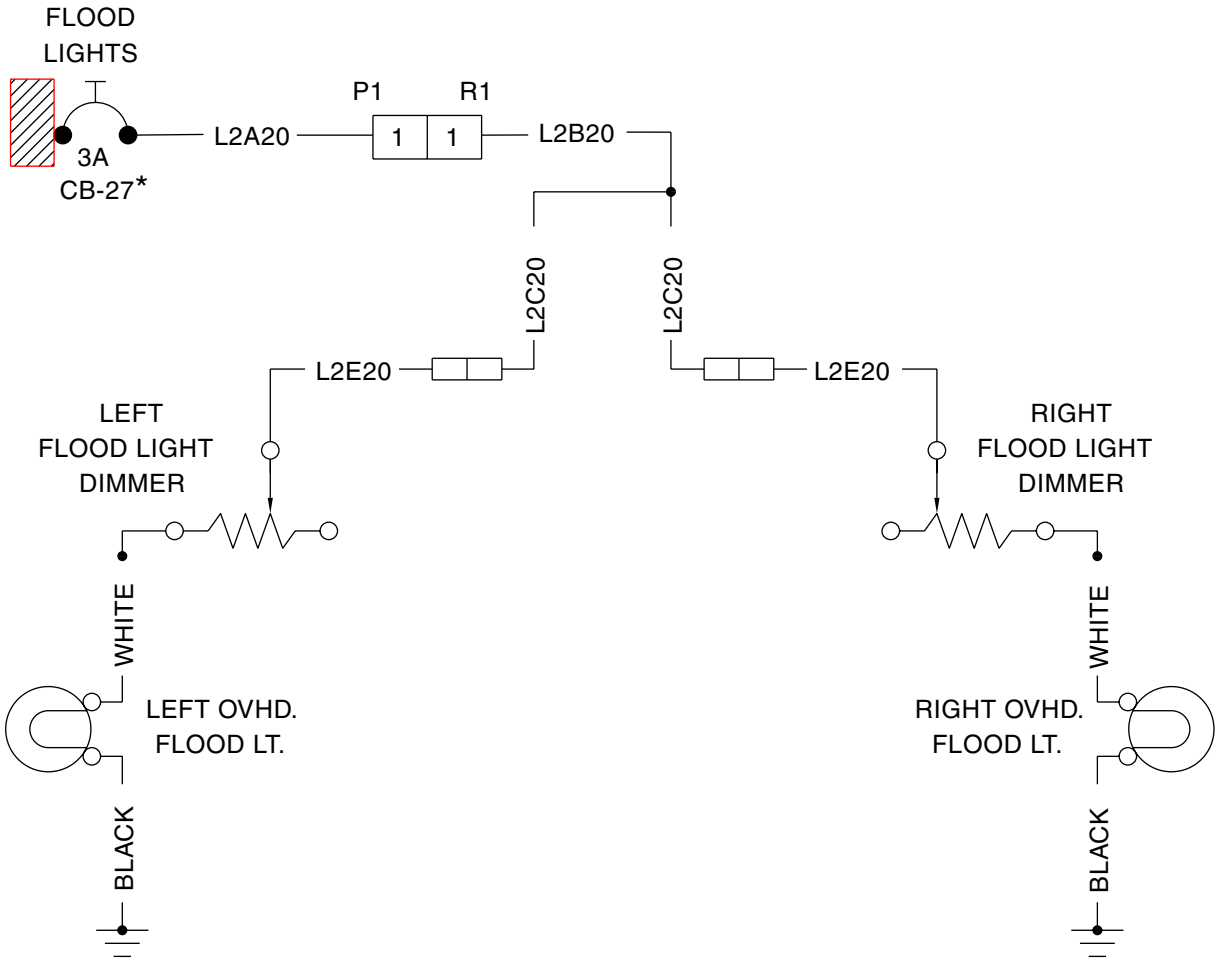
Landing Gear
Figure 91-23

85300 22.0 NEW / B



Flood Lights (HP S/N's 3246001 thru 3246017 only)
Figure 91-24 (Sheet 1 of 2)

101848 21.0 NEW
101272 22.0 NEW / B
100840 22.0 NEW / C
85501 22.0 NEW / F



* HP S/N'S 3246088 & UP; TC 3257001 & UP.

Flood Lights (HP S/N's 3246018 & up, TC S/N's 3257001 & up)
Figure 91-24 (Sheet 2 of 2)

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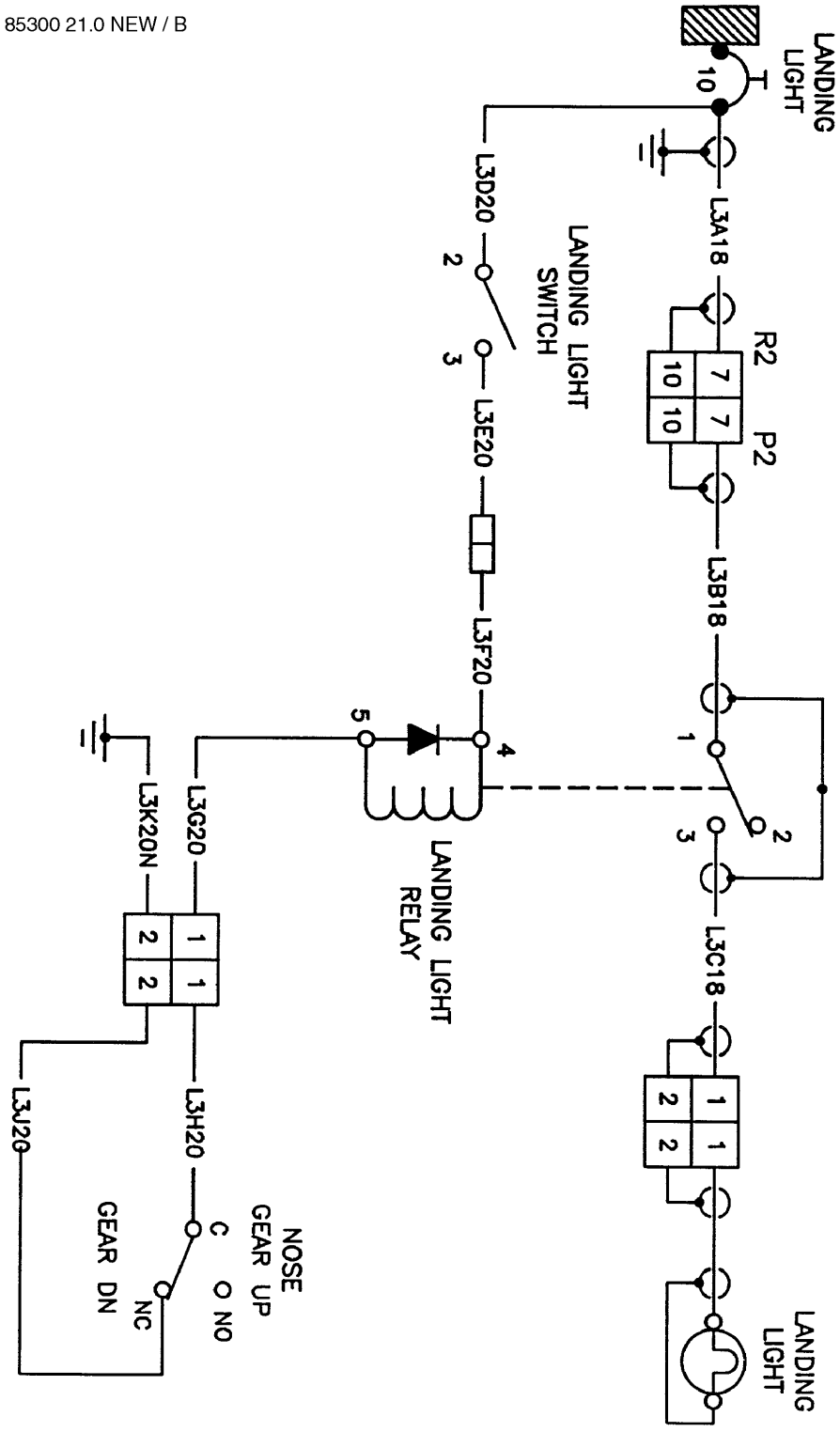
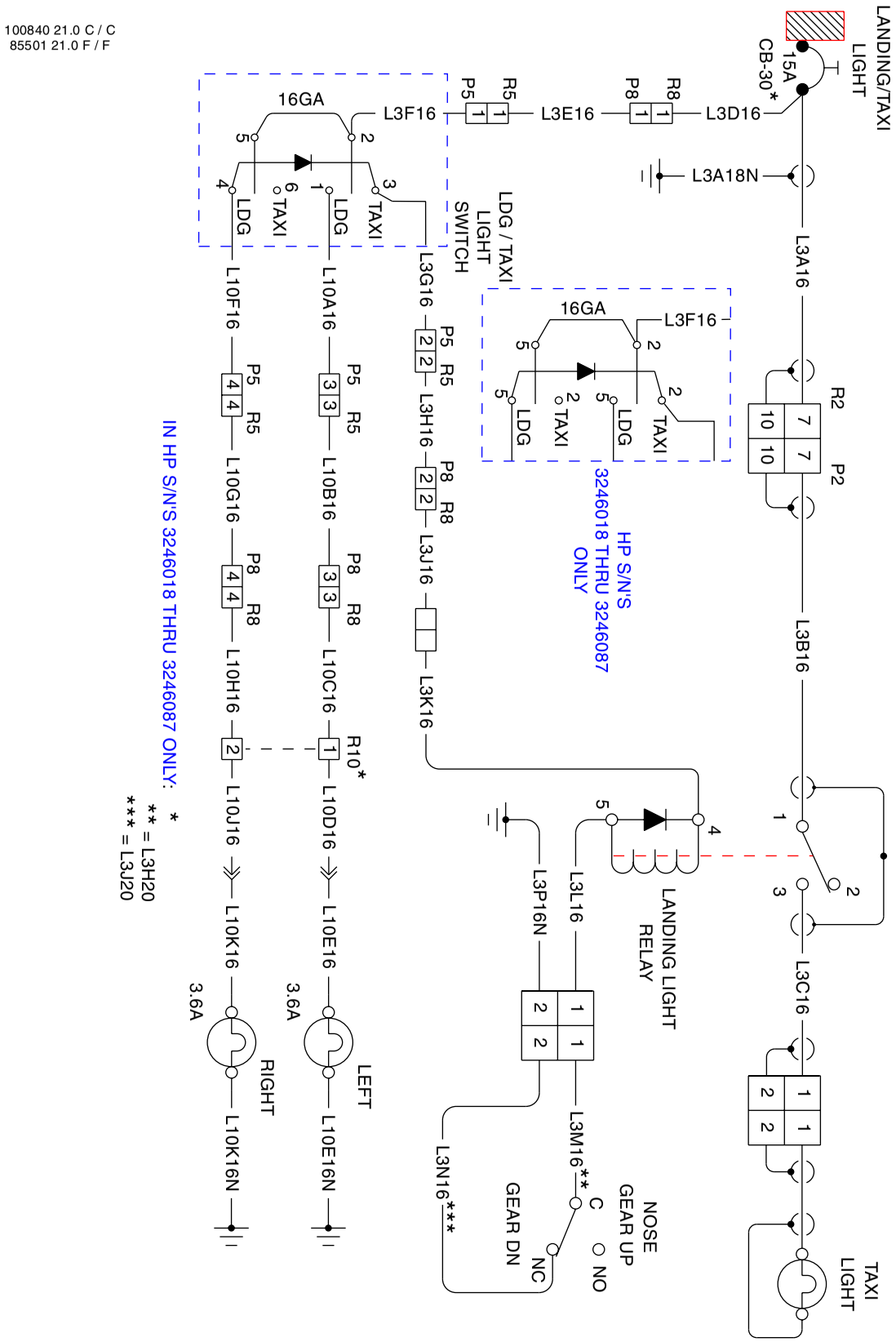
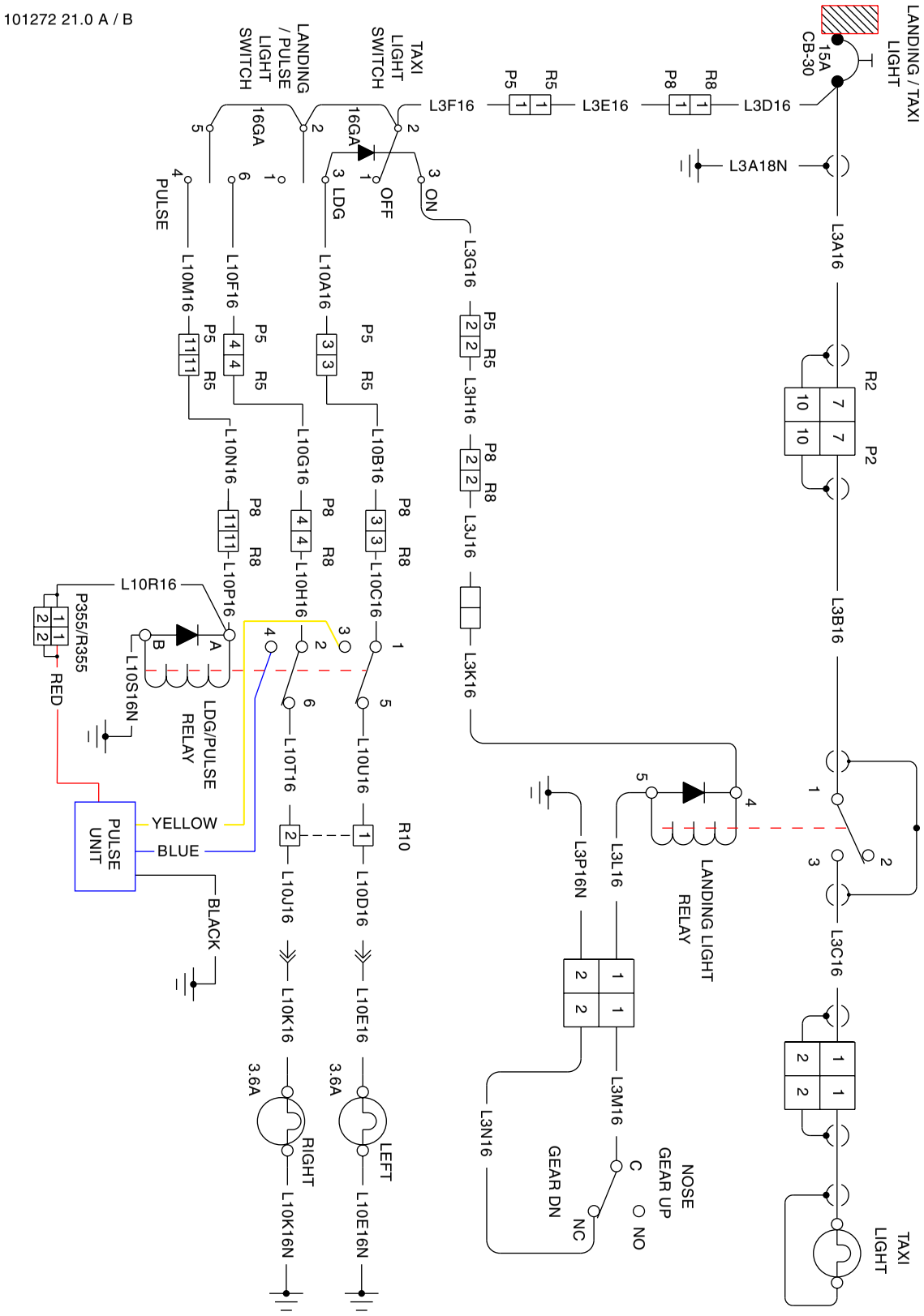


Landing (/ Taxi) Light(s) (HP S/N's 3246001 thru 3246017 only)
Figure 91-25 (Sheet 1 of 3)

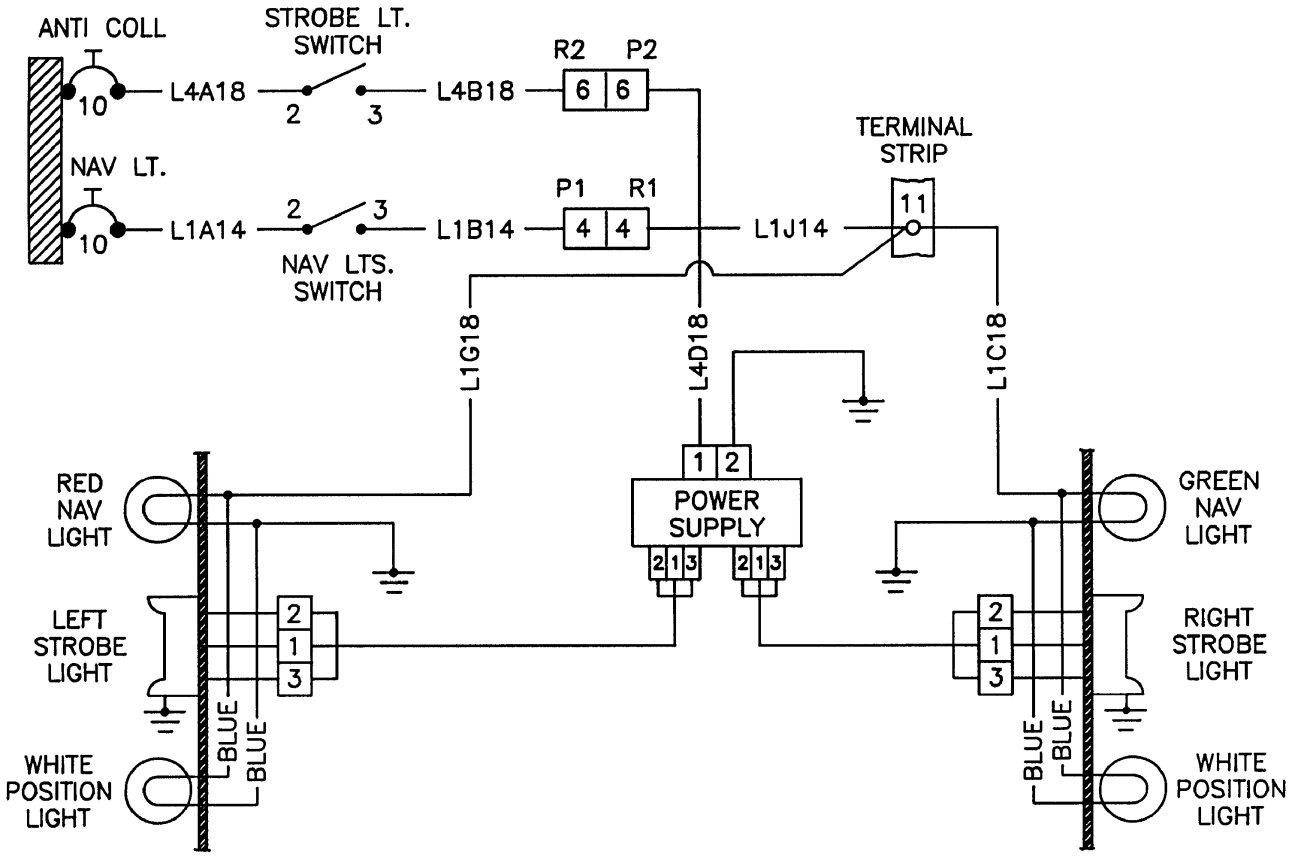


Landing (/ Taxi) Light(s) (HP S/N's 3246018 thru 3246125 only; TC S/N's 3257001 thru 3257075 only)
Figure 91-25 (Sheet 2 of 3)



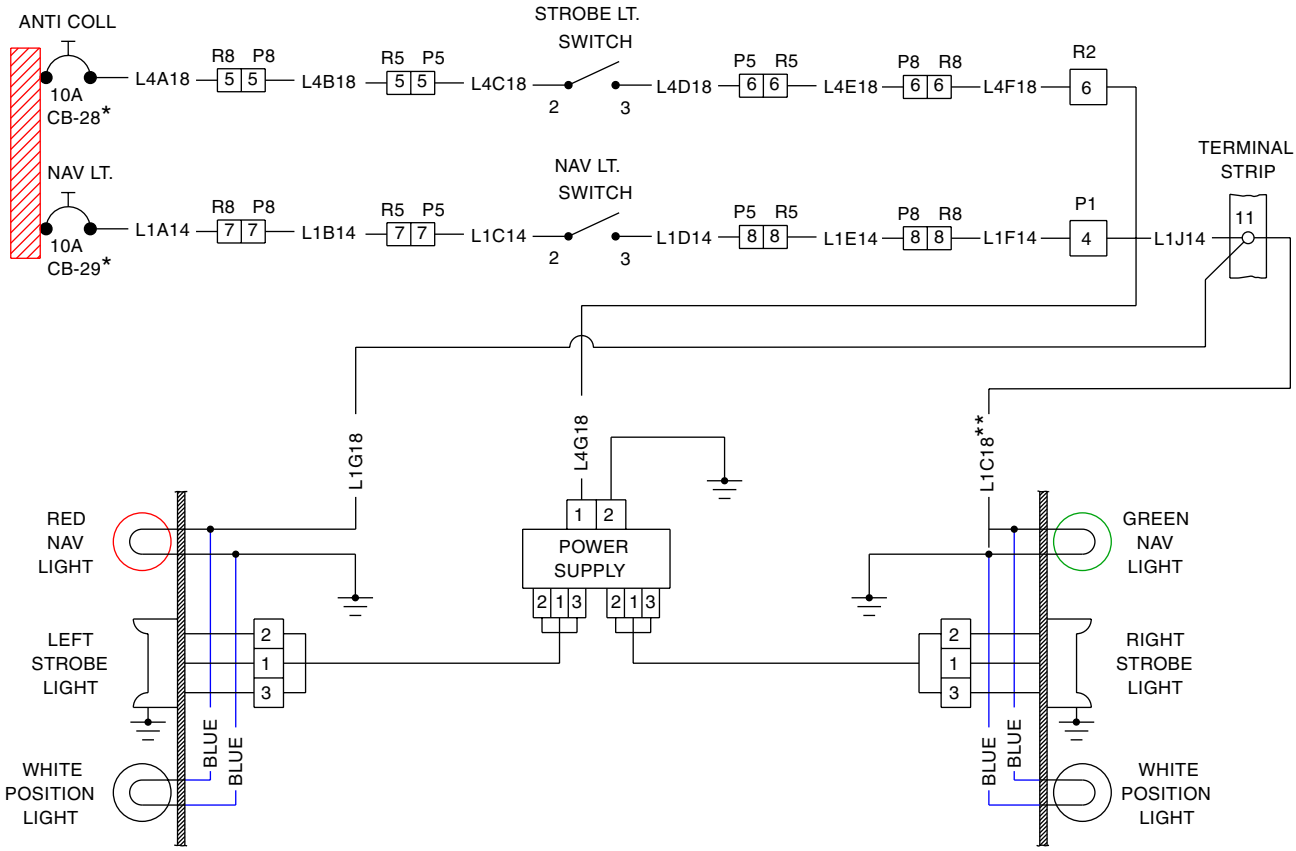
Landing (/ Taxi) Light(s) (HP S/N's 3246126 & up; TC S/N's 3257076 & up)
Figure 91-25 (Sheet 3 of 3)

85300 23.0 NEW / B



Navigation and Strobe Lights (HP S/N's 3246001 thru 3246017 only)
Figure 91-26 (Sheet 1 of 2)

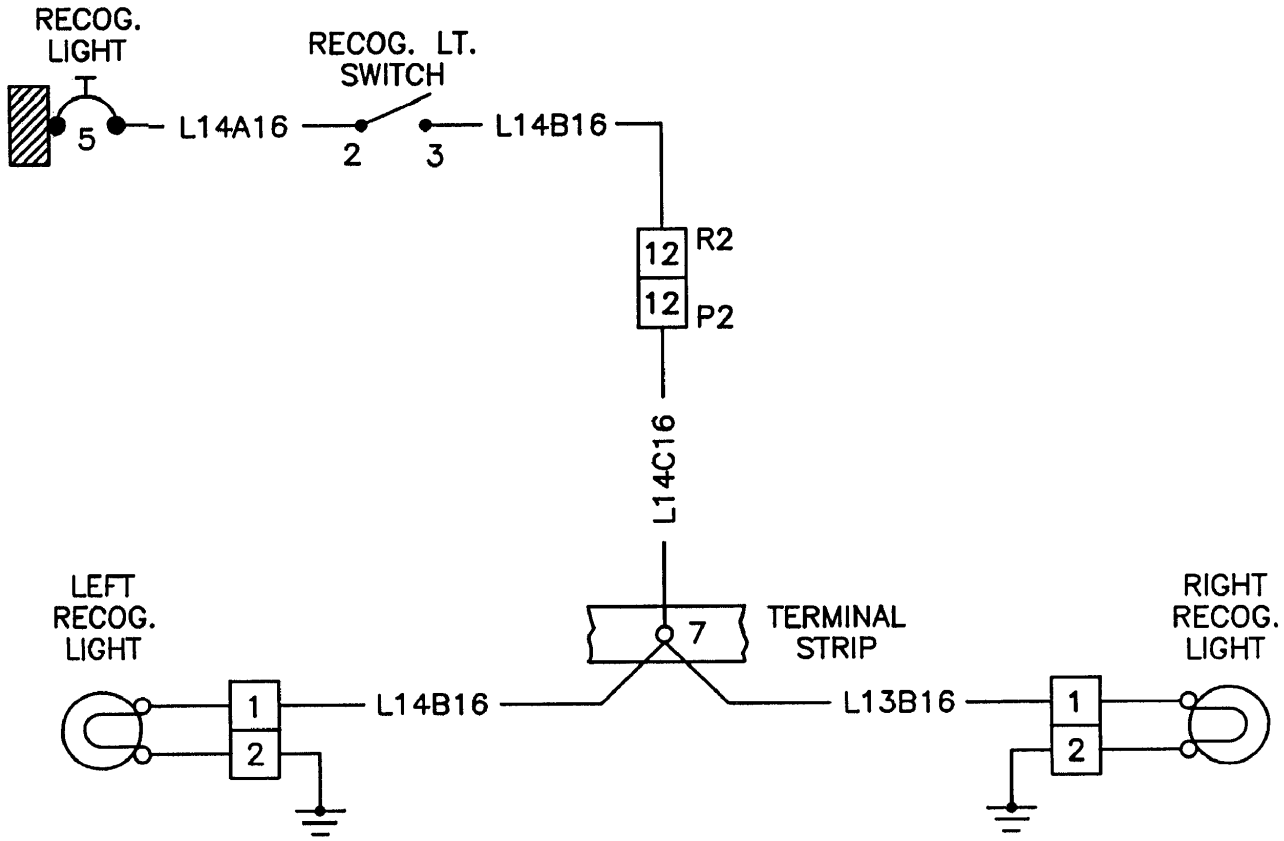
101272 23.0 NEW / B
100840 23.0 C / C
85501 23.0 NEW / F



IN HP S/N'S 3246018 THRU 3246087 ONLY: *
** = L1H18

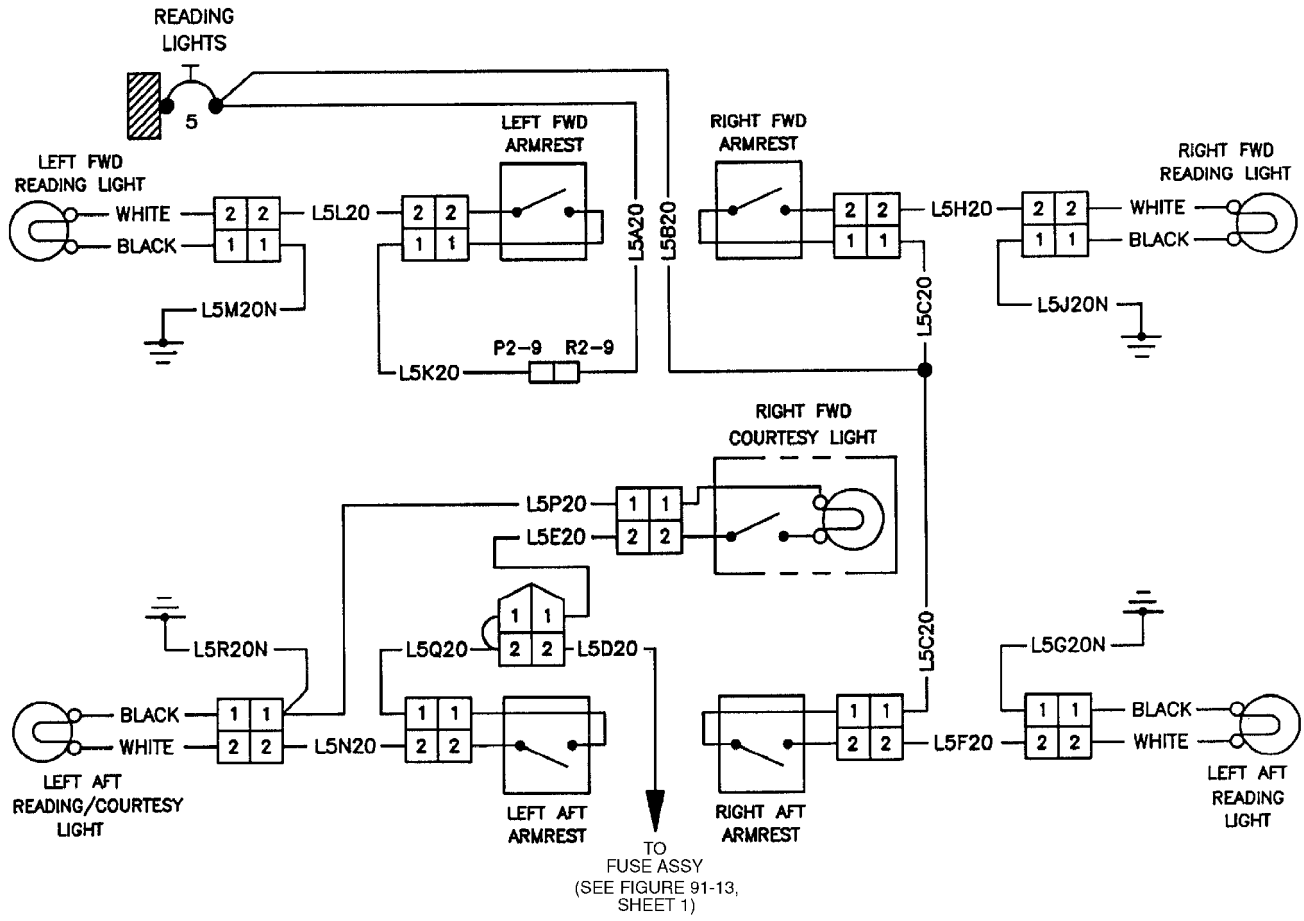
Navigation and Strobe Lights (HP S/N's 3246018 & up, TC S/N's 3257001 & up)
Figure 91-26 (Sheet 2 of 2)

85300 20.0 NEW / B



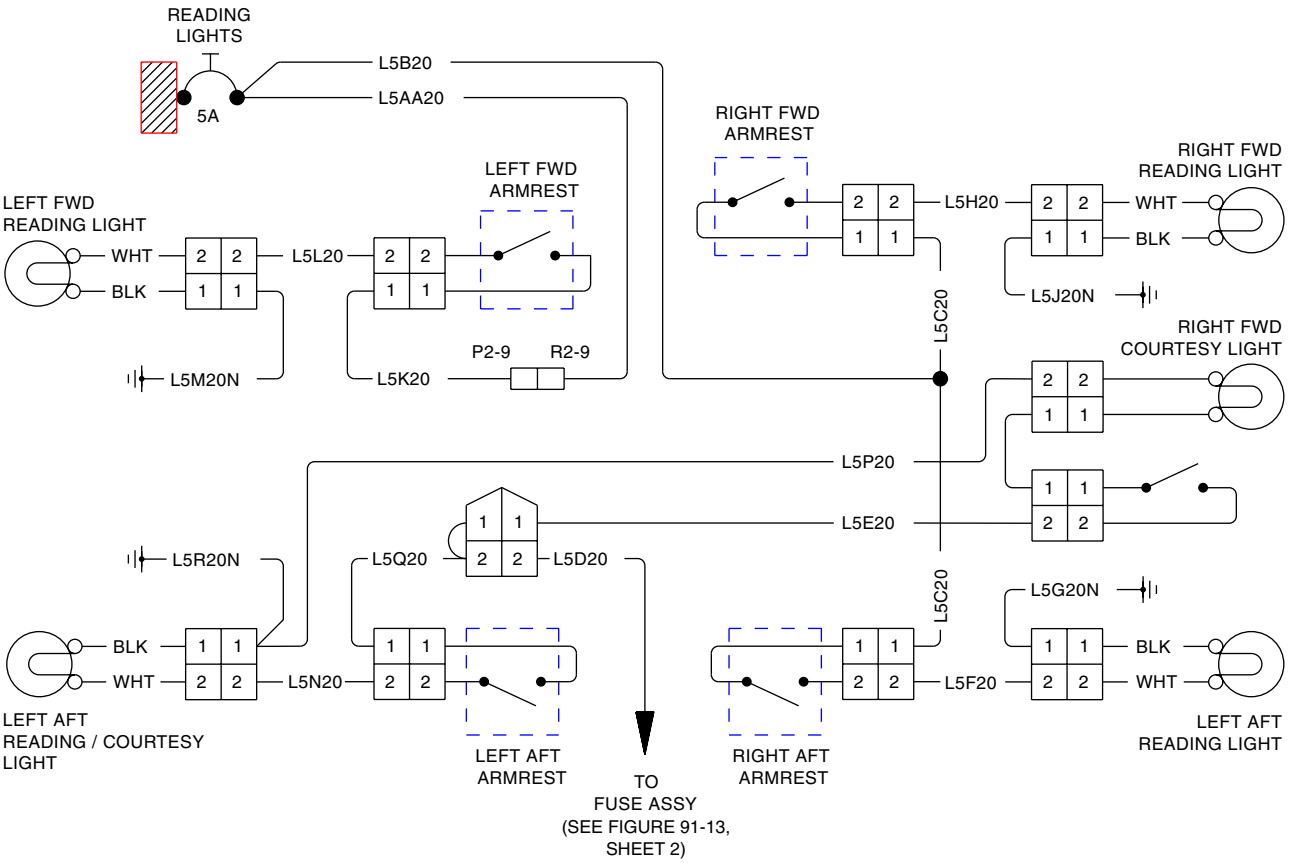
Recognition Lights (HP S/N's 3246001 thru 3246017 only)
Figure 91-27

85300 26.0 NEW / B



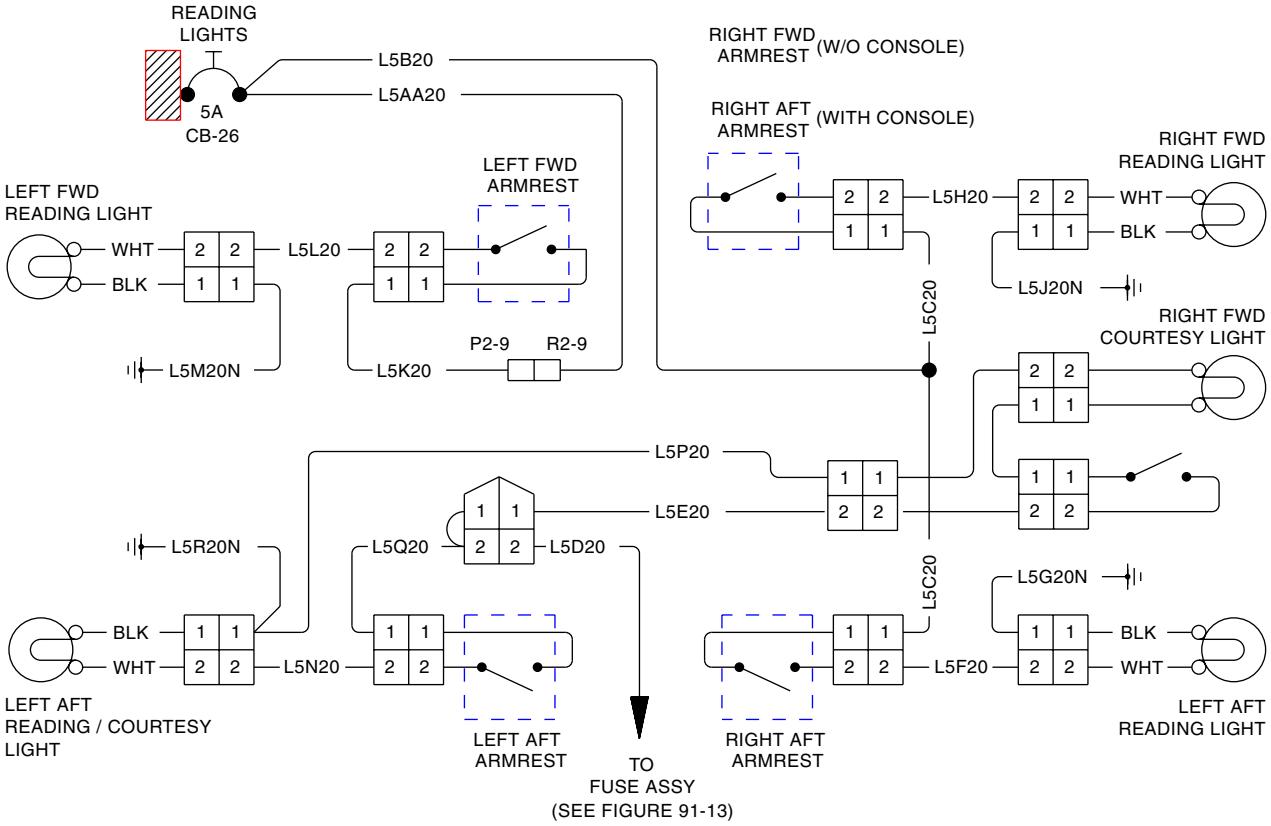
Courtesy / Reading Lights (HP S/N's 3246001 thru 3246017 only)
Figure 91-28 (Sheet 1 of 3)

85501 26.0 C / F



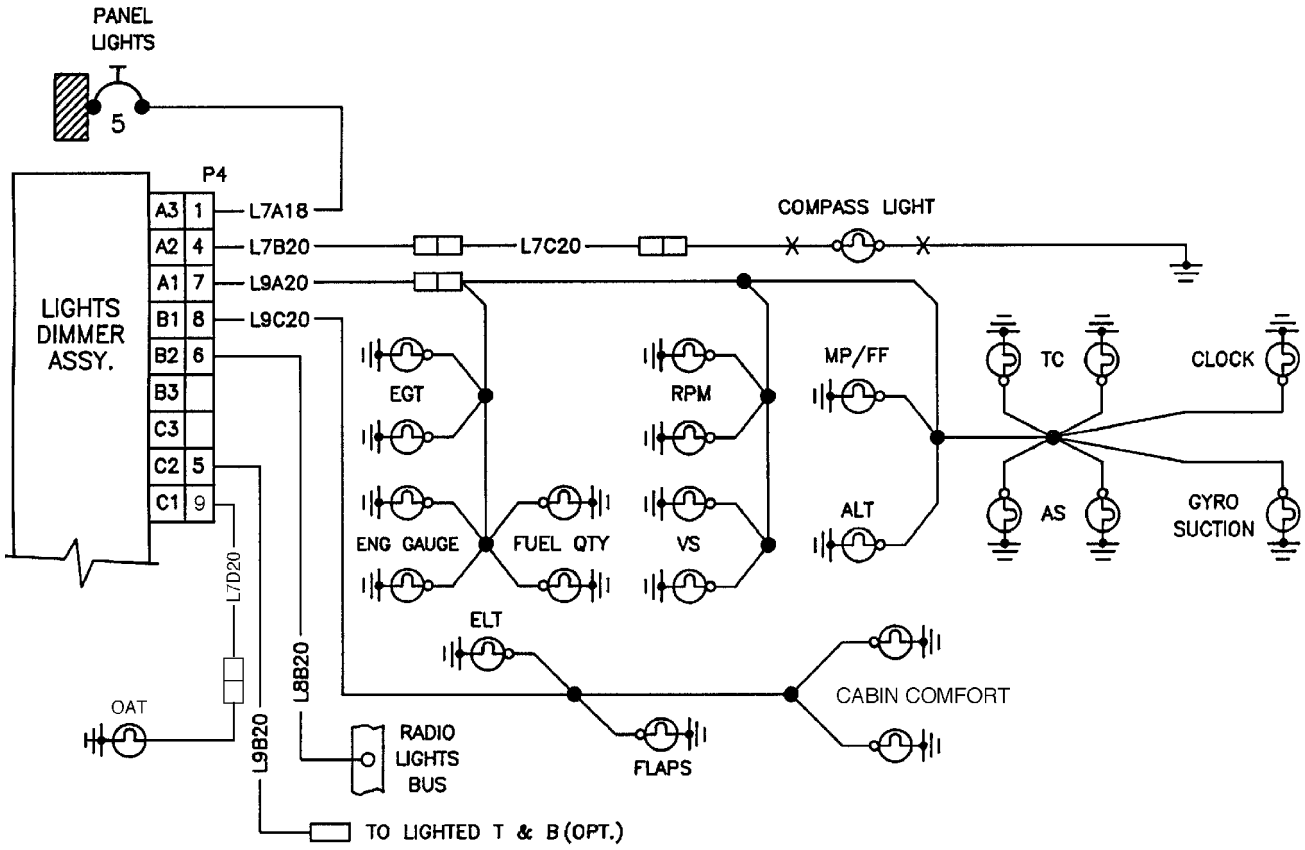
Courtesy / Reading Lights (HP S/N's 3246018 thru 3246087 only)
Figure 91-28 (Sheet 2 of 3)

101272 26.0 NEW / B
100840 26.0 A / C
101848 25.0 NEW



Courtesy / Reading Lights (HP S/N's 3246088 & up, TC S/N's 3257001 & up)
Figure 91-28 (Sheet 3 of 3)

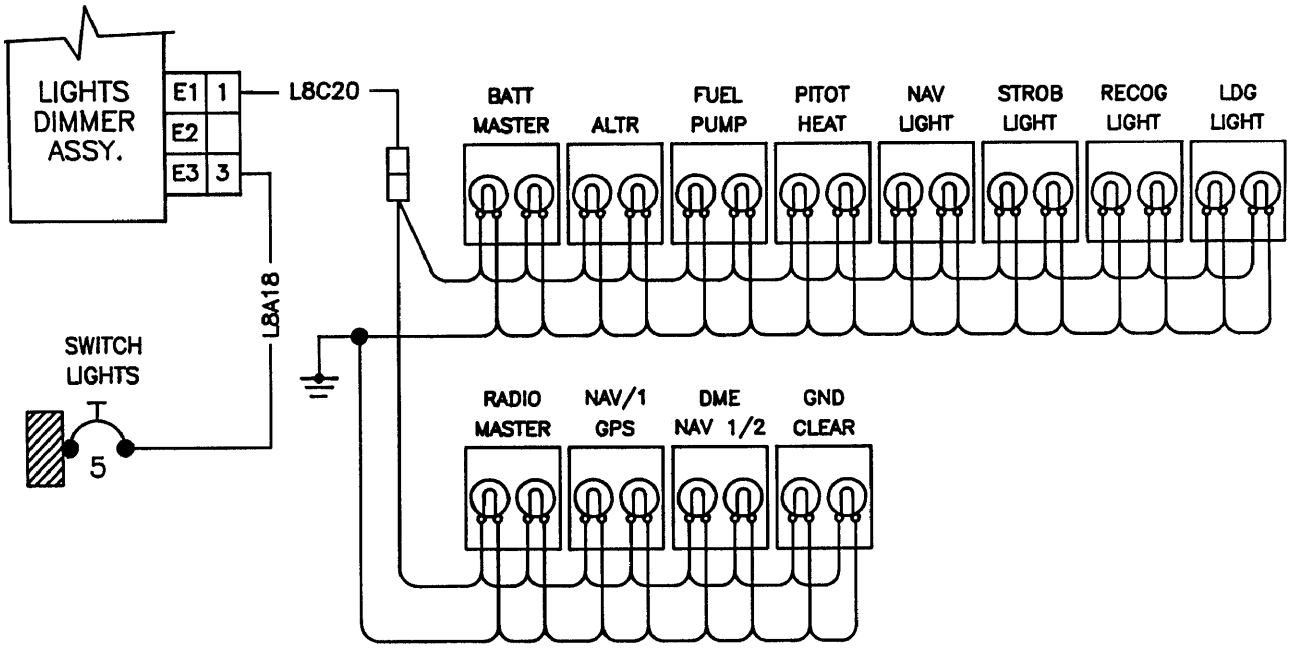
85300 24.0 A / B



POST LIGHTS

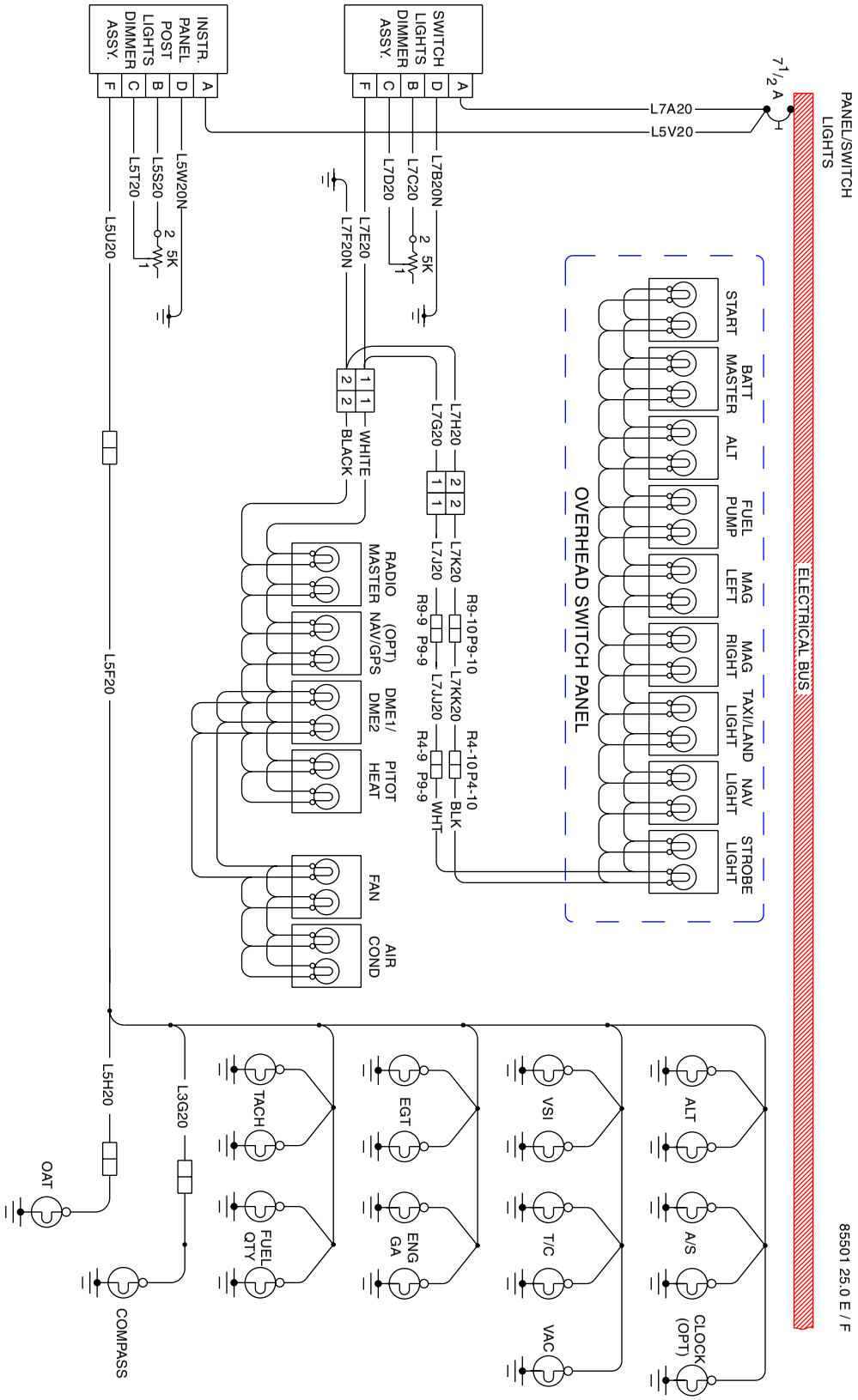
Panel and Switch Lights (HP S/N's 3246001 thru 3246017 only)
Figure 91-29 (Sheet 1 of 5)

85300 25.0 NEW / B

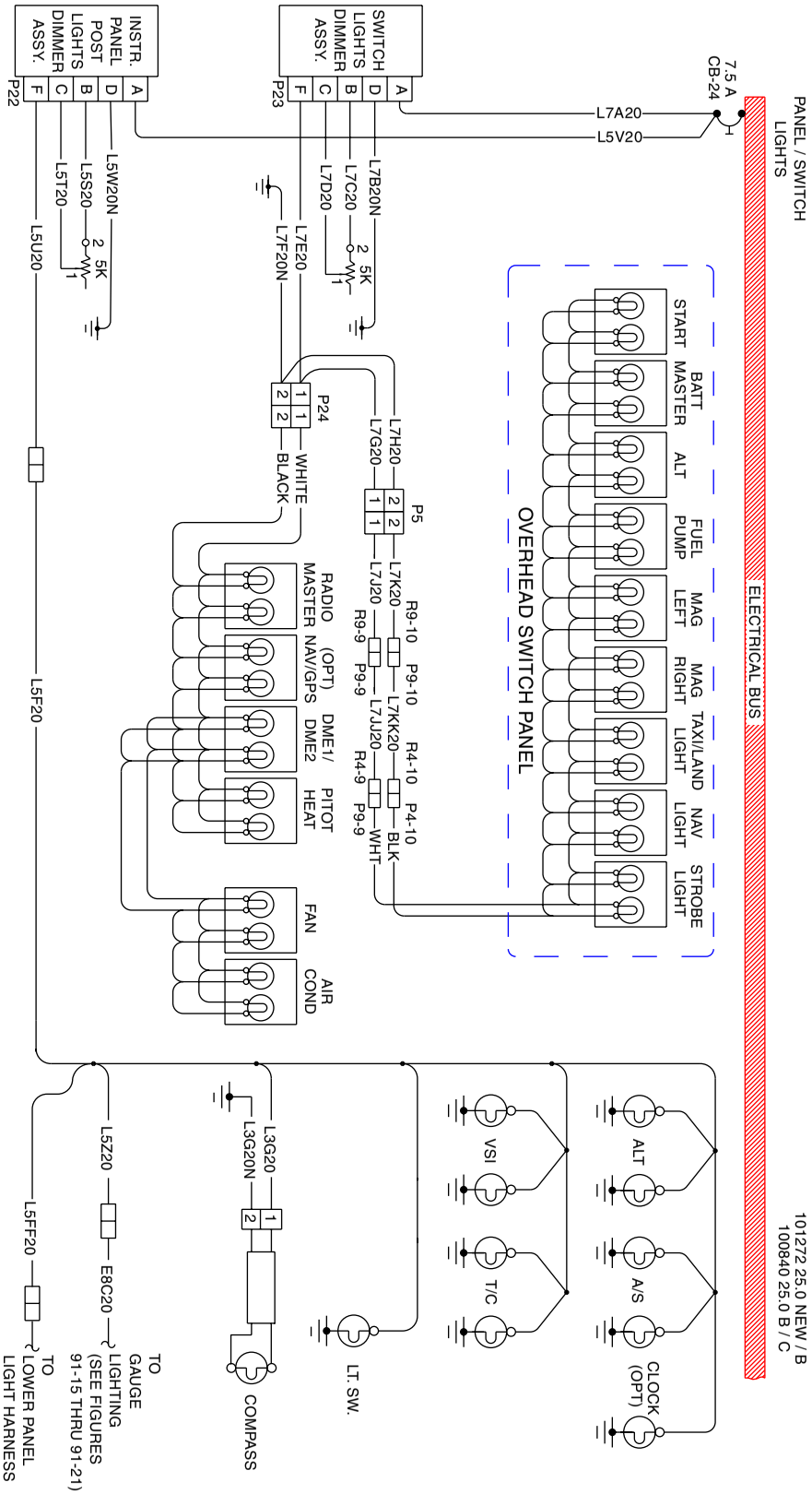


SWITCH LIGHTS

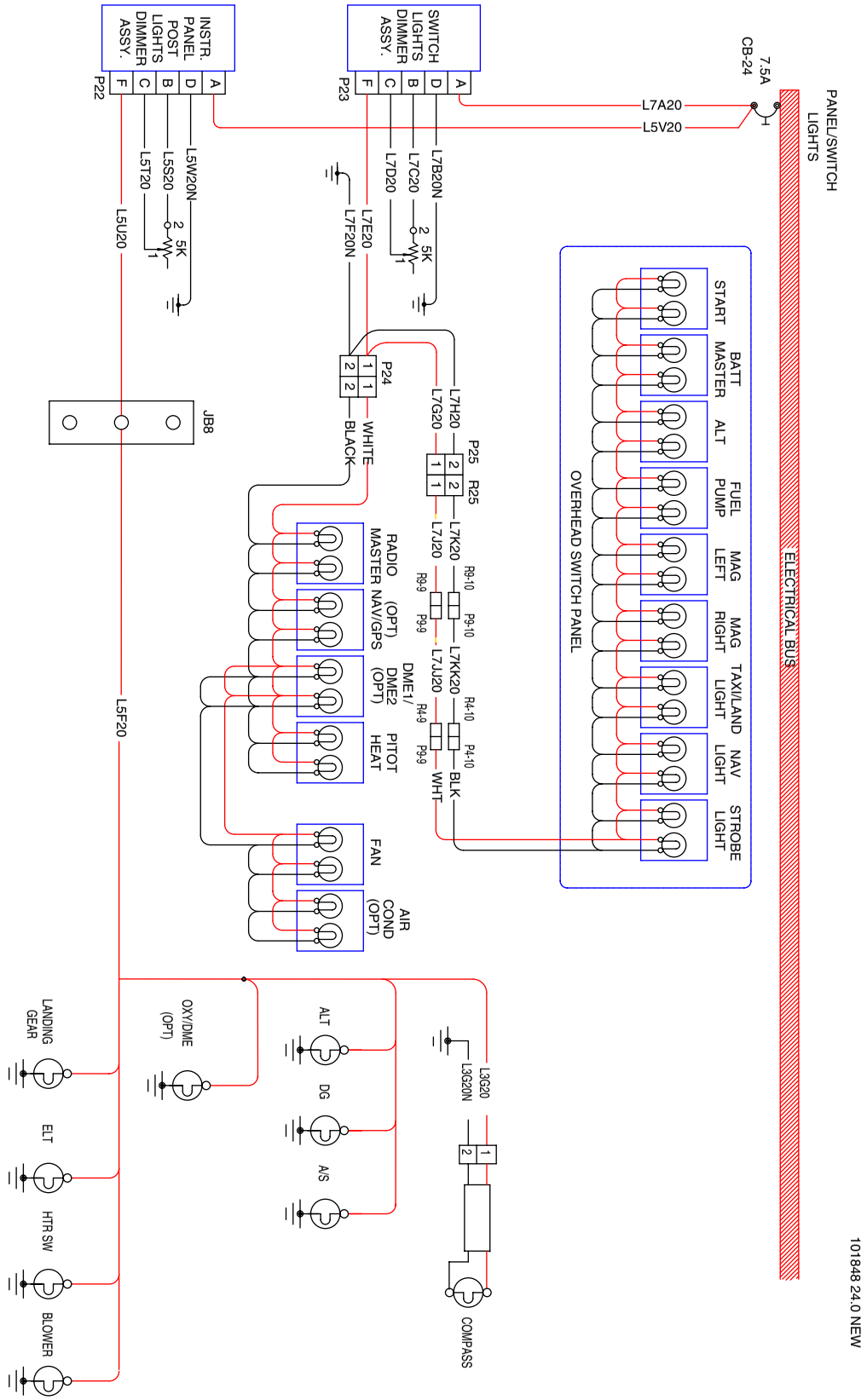
Panel and Switch Lights (HP S/N's 3246001 thru 3246017 only)
Figure 91-29 (Sheet 2 of 5)



Panel and Switch Lights (HP S/N's 3246018 thru 3246087 only)
Figure 91-29 (Sheet 3 of 5)



Panel and Switch Lights (HP S/N's 3246088 & up, TC S/N's 3257001 & up)
Figure 91-29 (Sheet 4 of 5)



Panel and Switch Lights (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-29 (Sheet 5 of 5)

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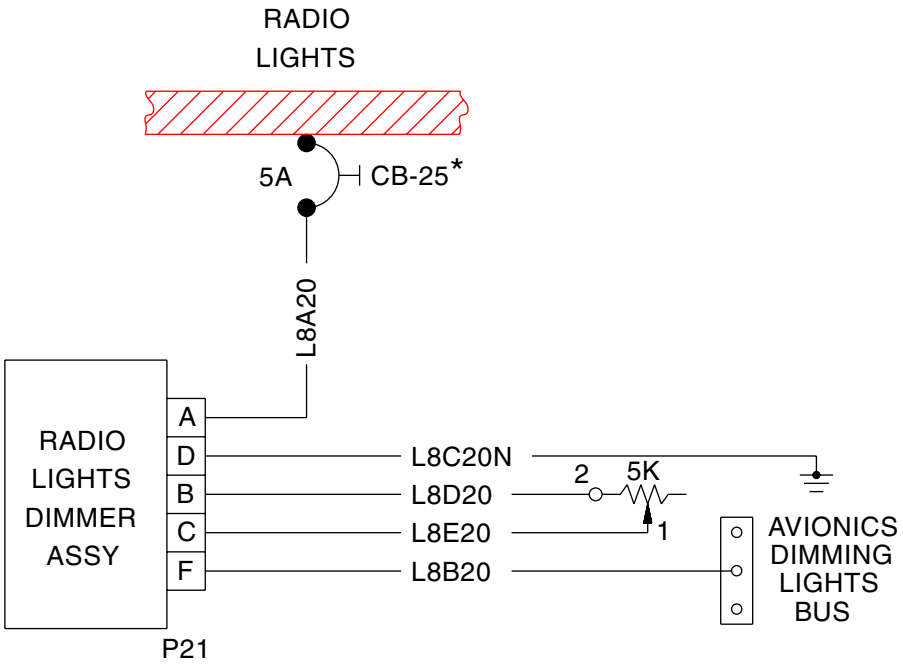
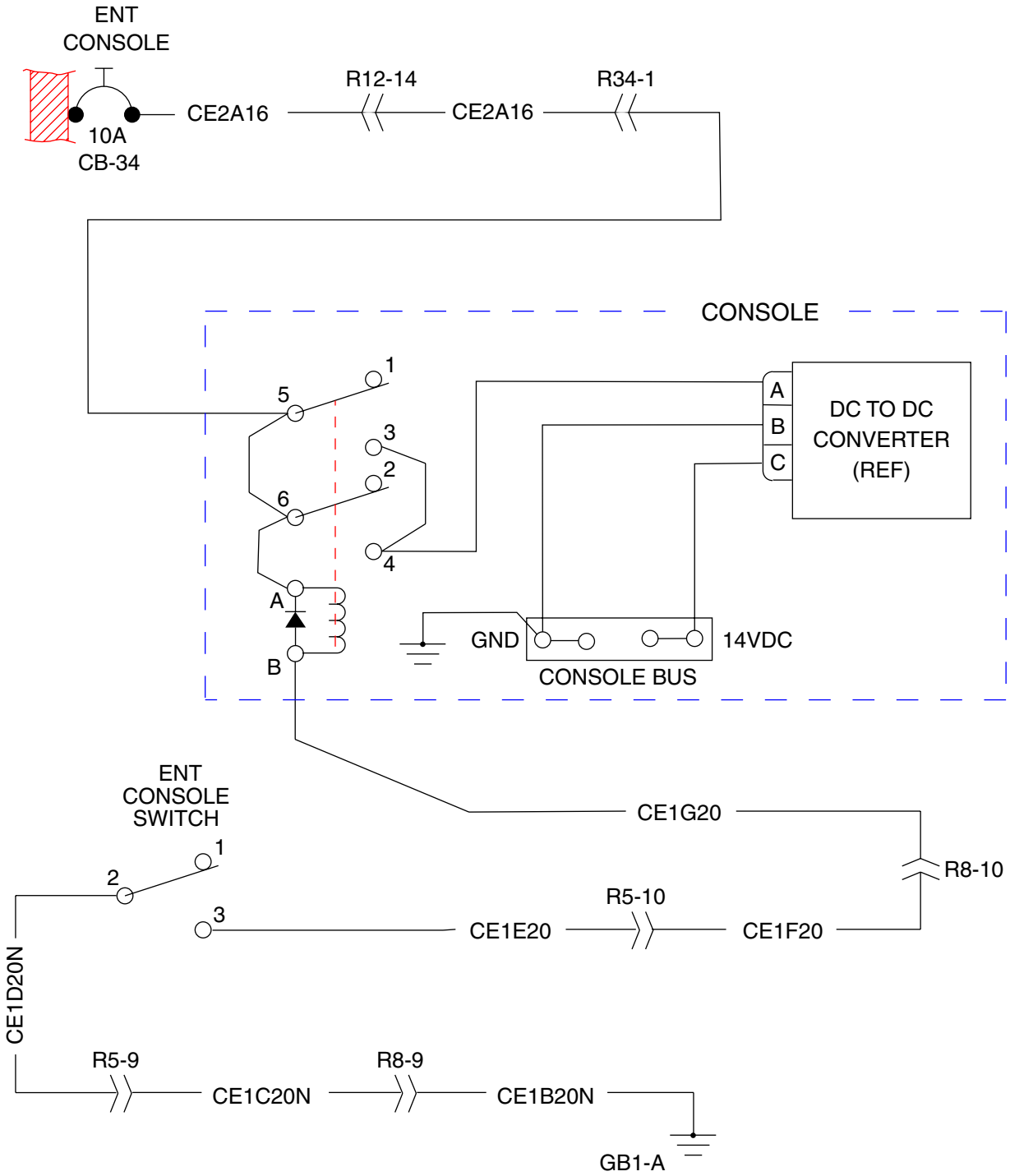
101848 27.0 NEW
101272 29.0 NEW / B
100840 29.0 A / C
85501 29.0 NEW / F



* LESS HP S/N'S 3246018 THRU 3246087.

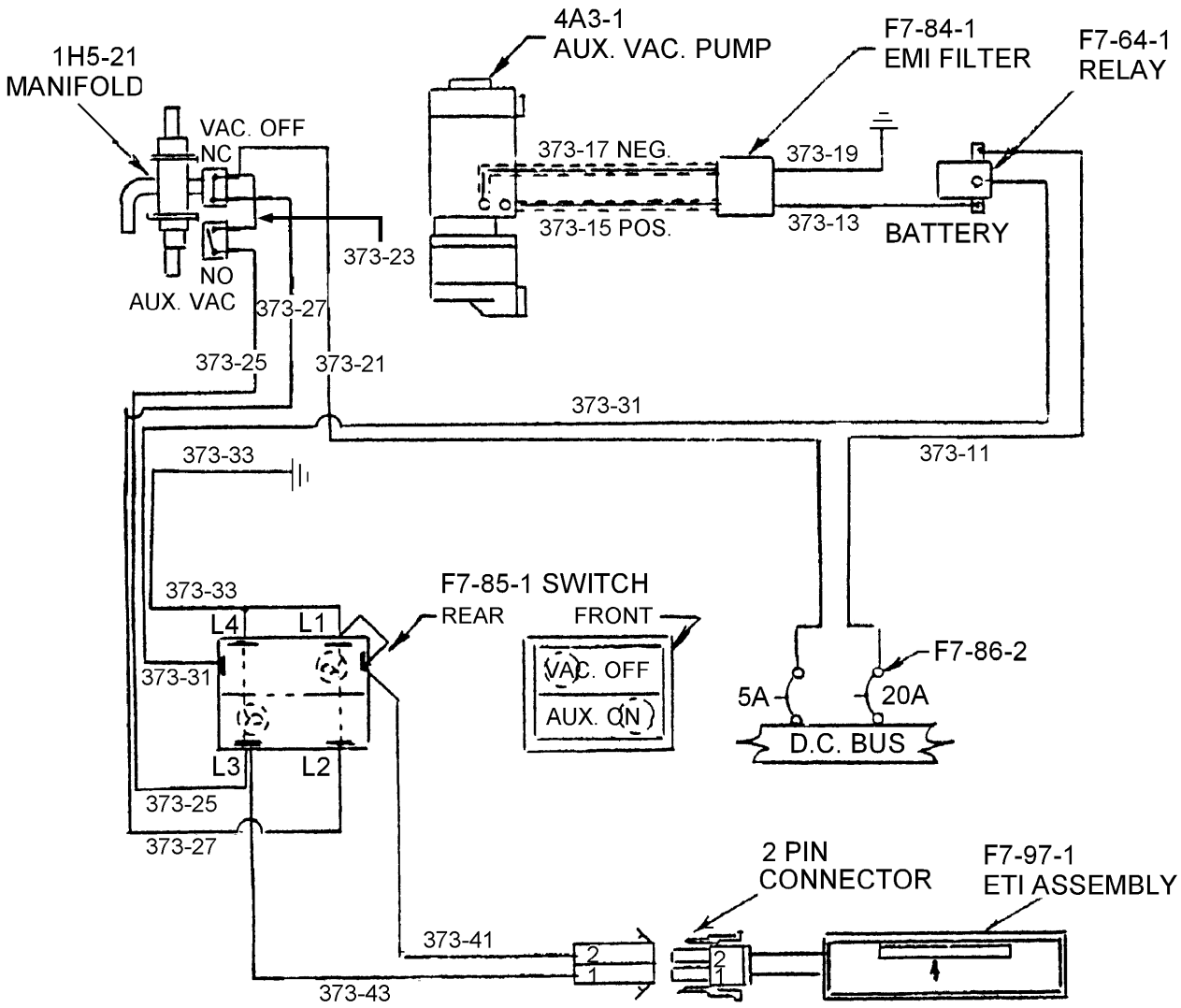
Radio Lights (HP S/N's 3246018 & up, TC S/N's 3257001 & up)
Figure 91-30

101272 33.0 NEW / B
100840 33.0 NEW / C

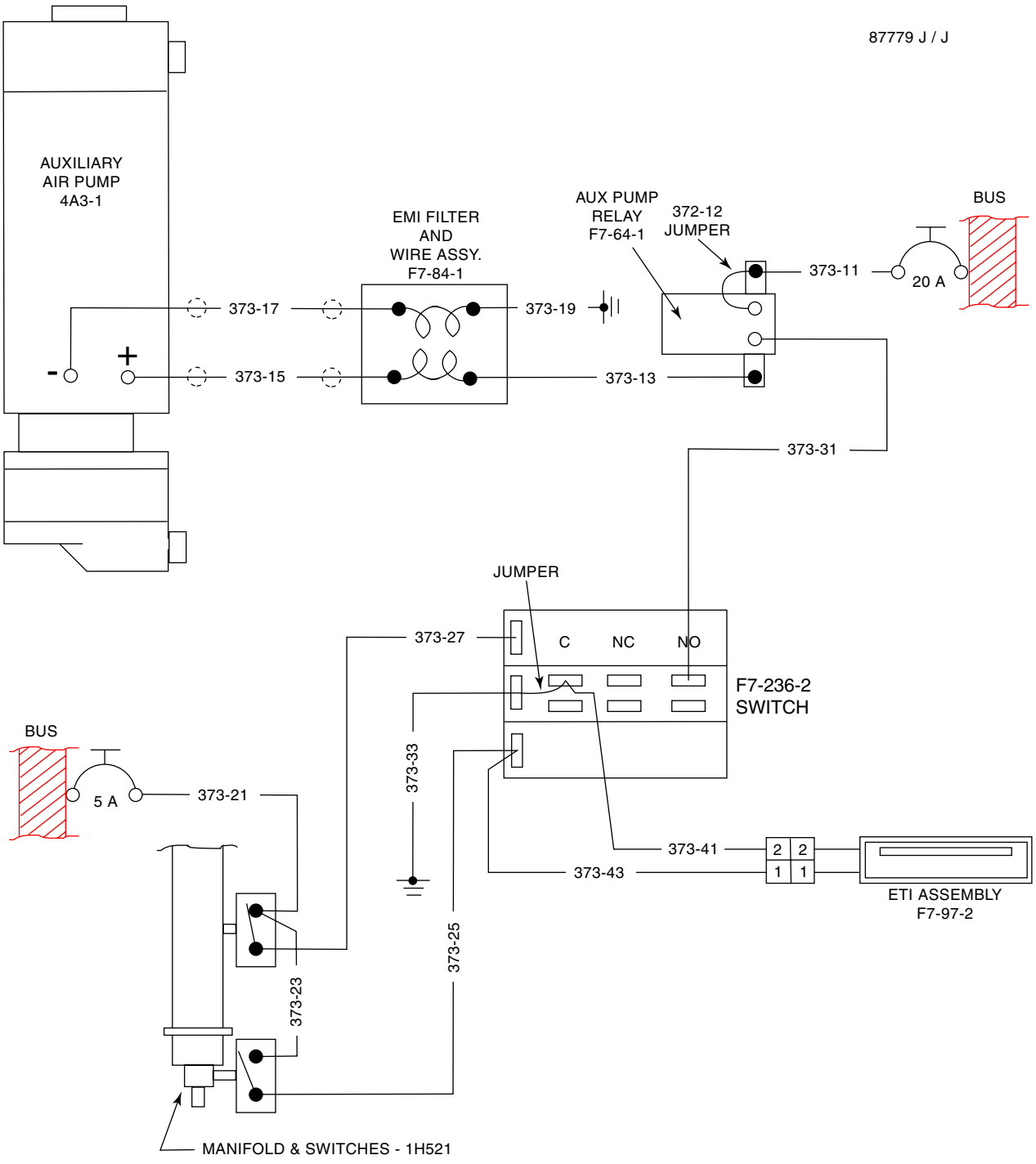


Entertainment Console (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-31

87779 E

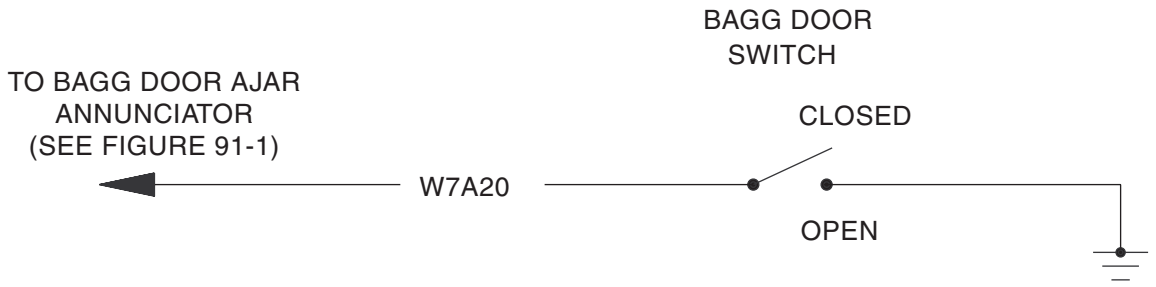


Standby Vacuum System (HP S/N's 3246001 thru 3246017 only)
Figure 91-32 (Sheet 1 of 2)



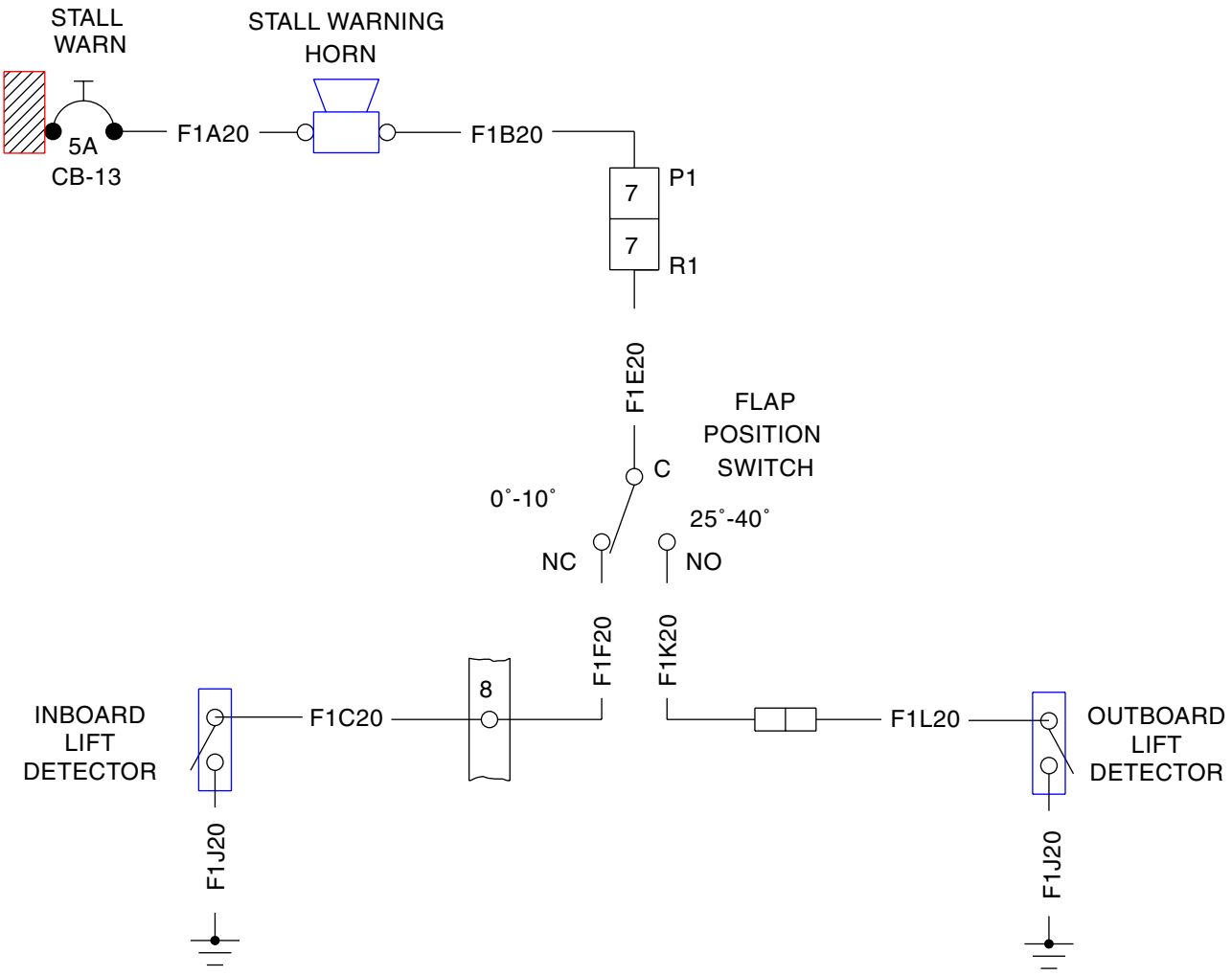
Standby Vacuum System (HP S/N's 3246018 & up; TC S/N's TC S/N's 3257001 & up)
Figure 91-32 (Sheet 2 of 2)

101272 18.0 NEW / B
100840 18.0 NEW / C
85501 18.0 NEW / F
85300 18.0 NEW / B



Baggage Door Ajar
Figure 91-33

101848 9.0 NEW
101272 9.0 NEW / B
100840 9.0 B / C
85501 9.0 NEW / F
85300 9.0 NEW / B



Stall Warning
Figure 91-34

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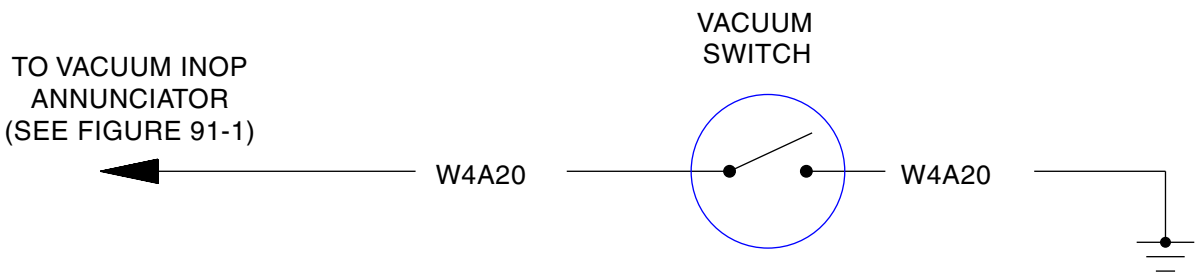
85501 19.0 NEW / F
85300 19.0 NEW / B

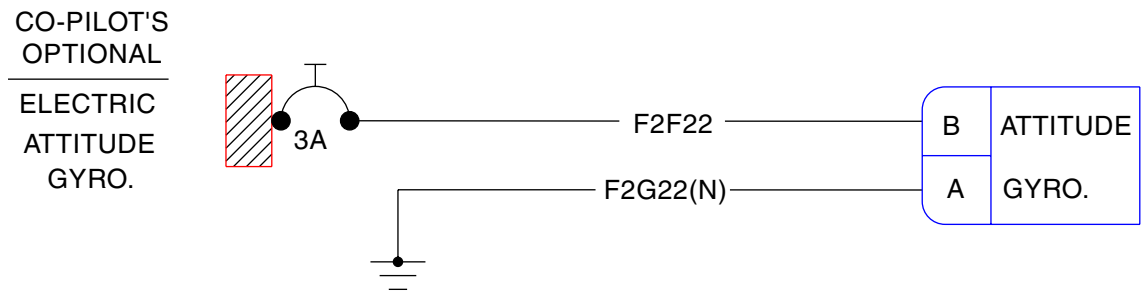


Vacuum Inop (HP S/N's 3246001 thru 3246087 only)
Figure 91-35

85501 11.0 NEW / F
85300 11.0 NEW / B

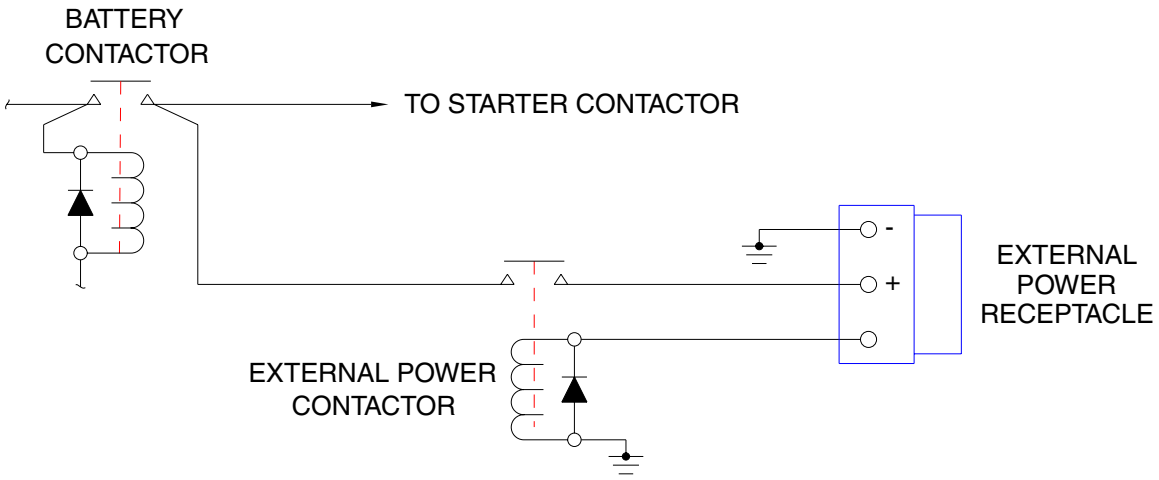
ELT (HP S/N's 3246001 thru 3246087 only)
Figure 91-36

101272 27.0 NEW / B
100840 27.0 B / C
85501 27.0 NEW / F
85300 27.0 B / B



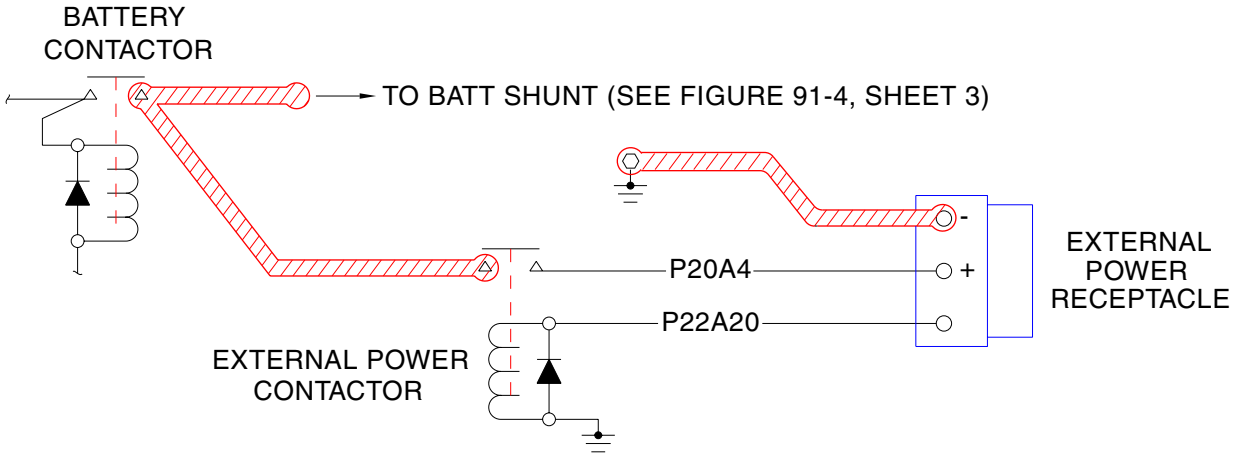
Electric Attitude Gyro (Co-Pilot's, Optional)
Figure 91-37

85501 30.0 NEW / F



HP S/N'S 3246018 THRU 3246087 ONLY.

101272 30.0 NEW / B
100840 30.0 NEW / C



HP S/N'S 3246088 & UP; TC 3257001 & UP.

External Power
Figure 91-38

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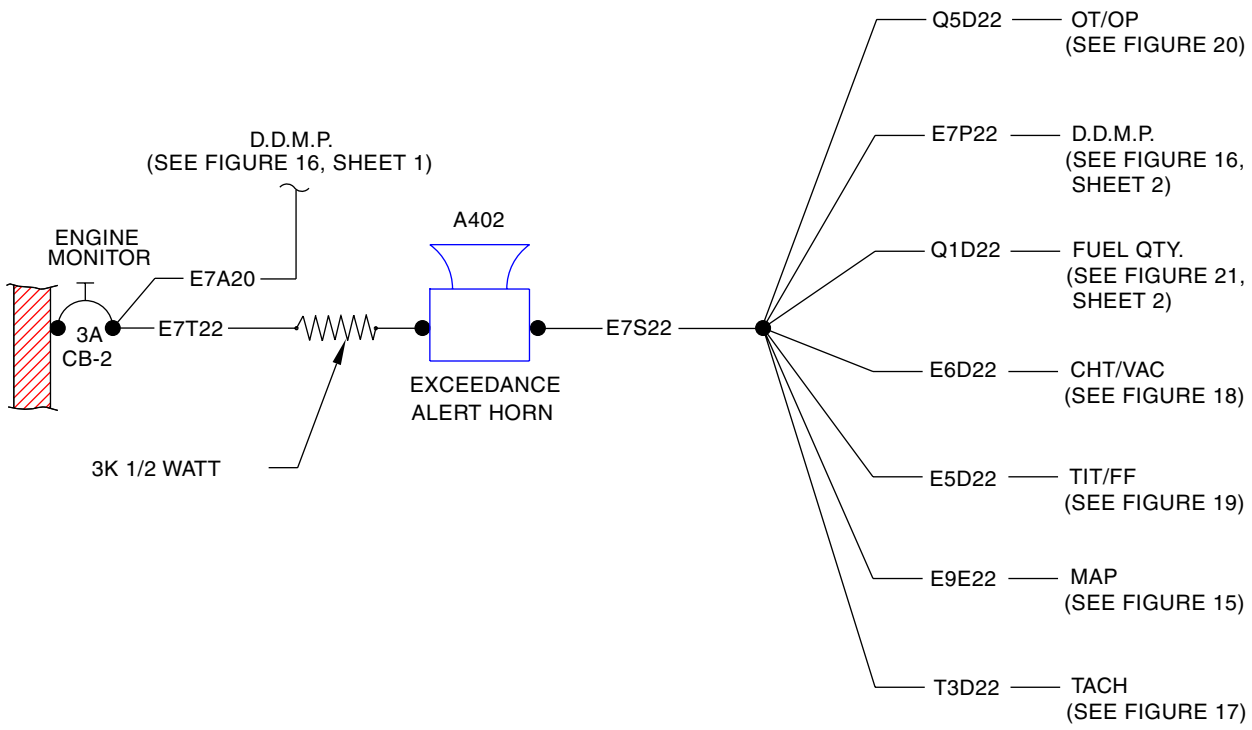
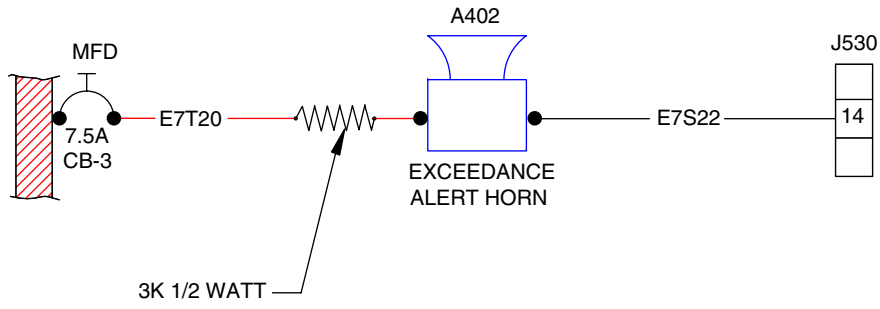
101272 32.0 NEW / B
100840 32.0 NEW / C



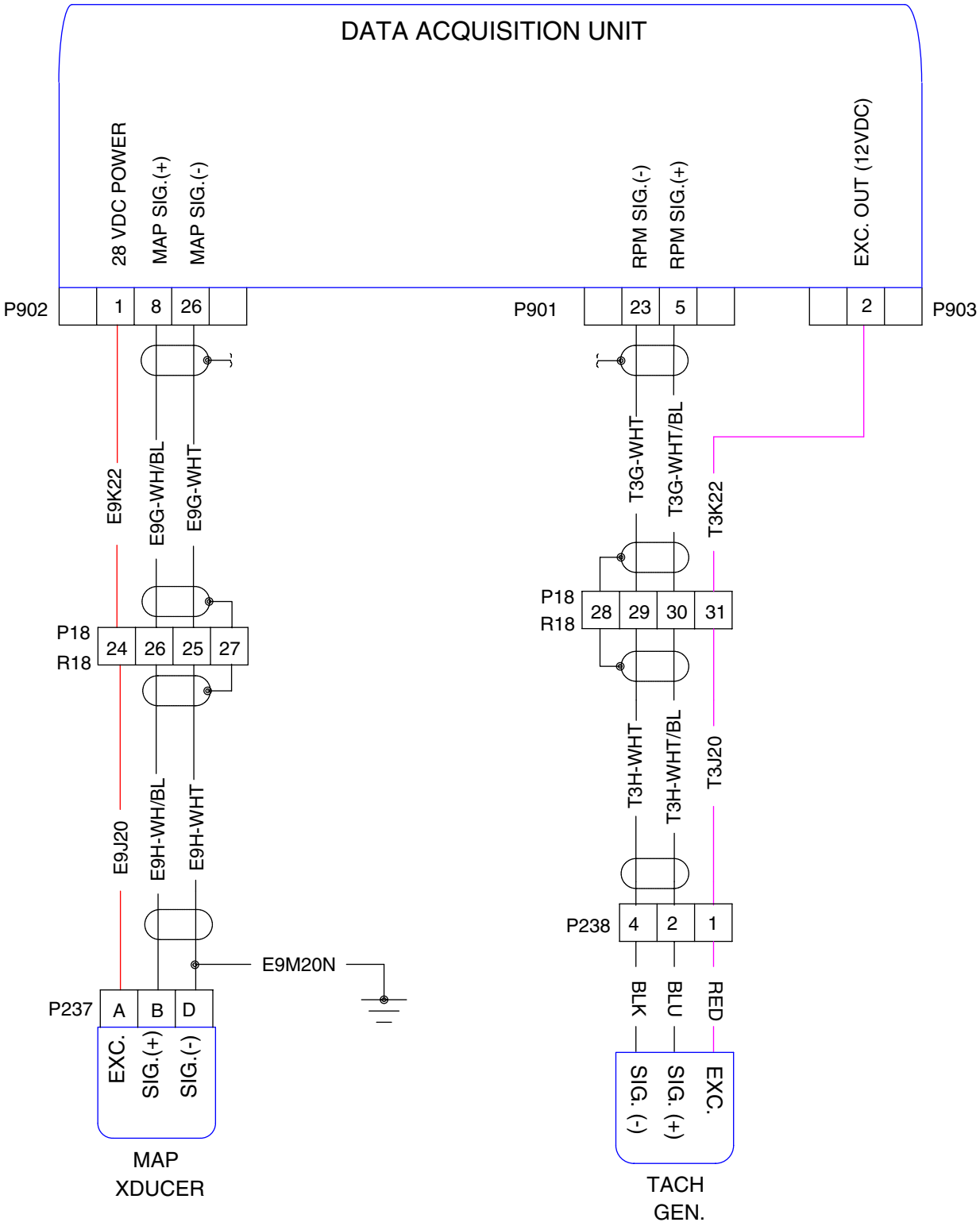
101848 29.0 NEW



HP S/N's 3246218 AND UP; TC S/N's 3257339 AND UP; WITH ENTEGRA OPTION

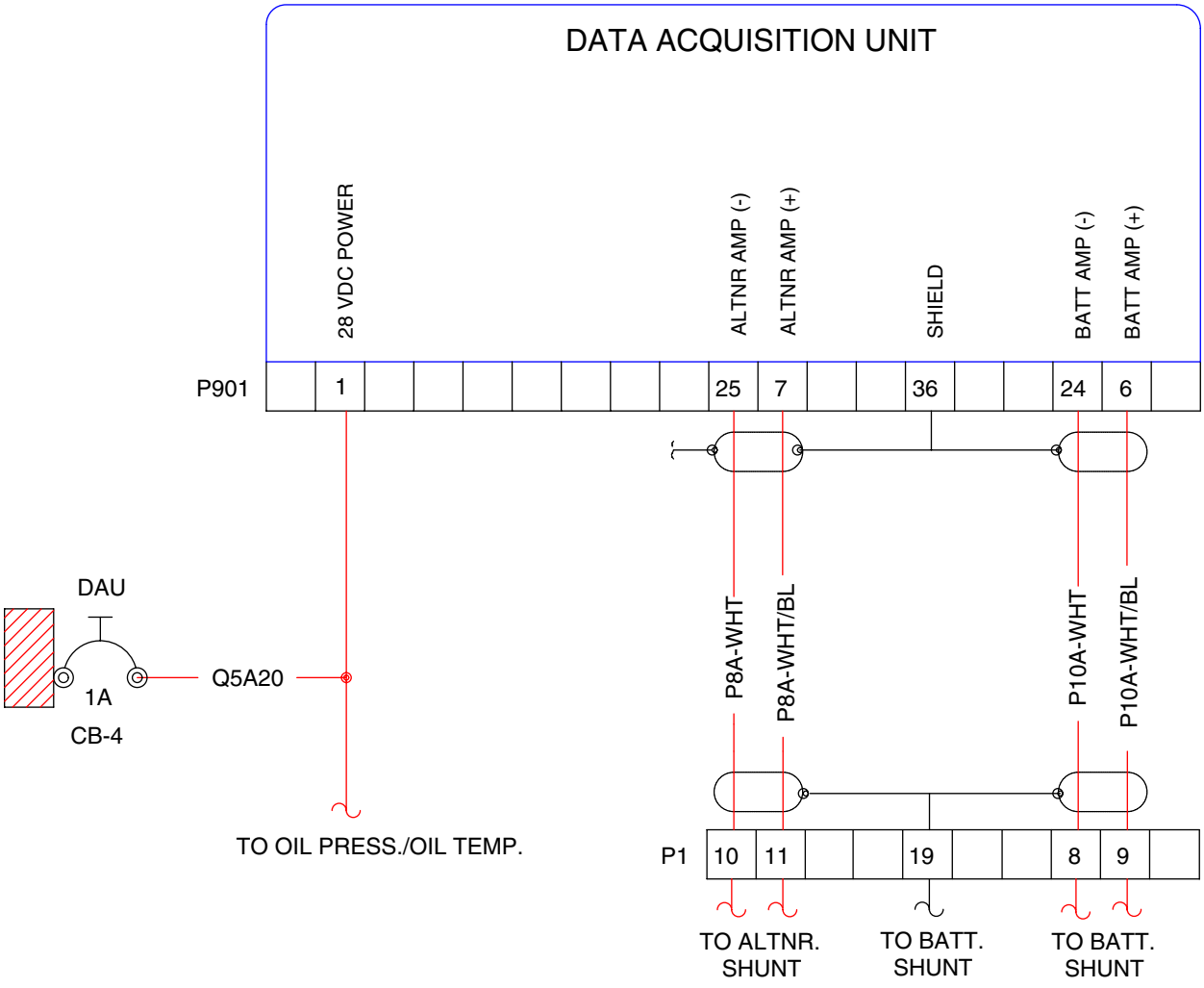
Exceedance Audio Alert (HP S/N's 3246088 & up; TC S/N's 3257001 & up)
Figure 91-39

101848 23.0 NEW



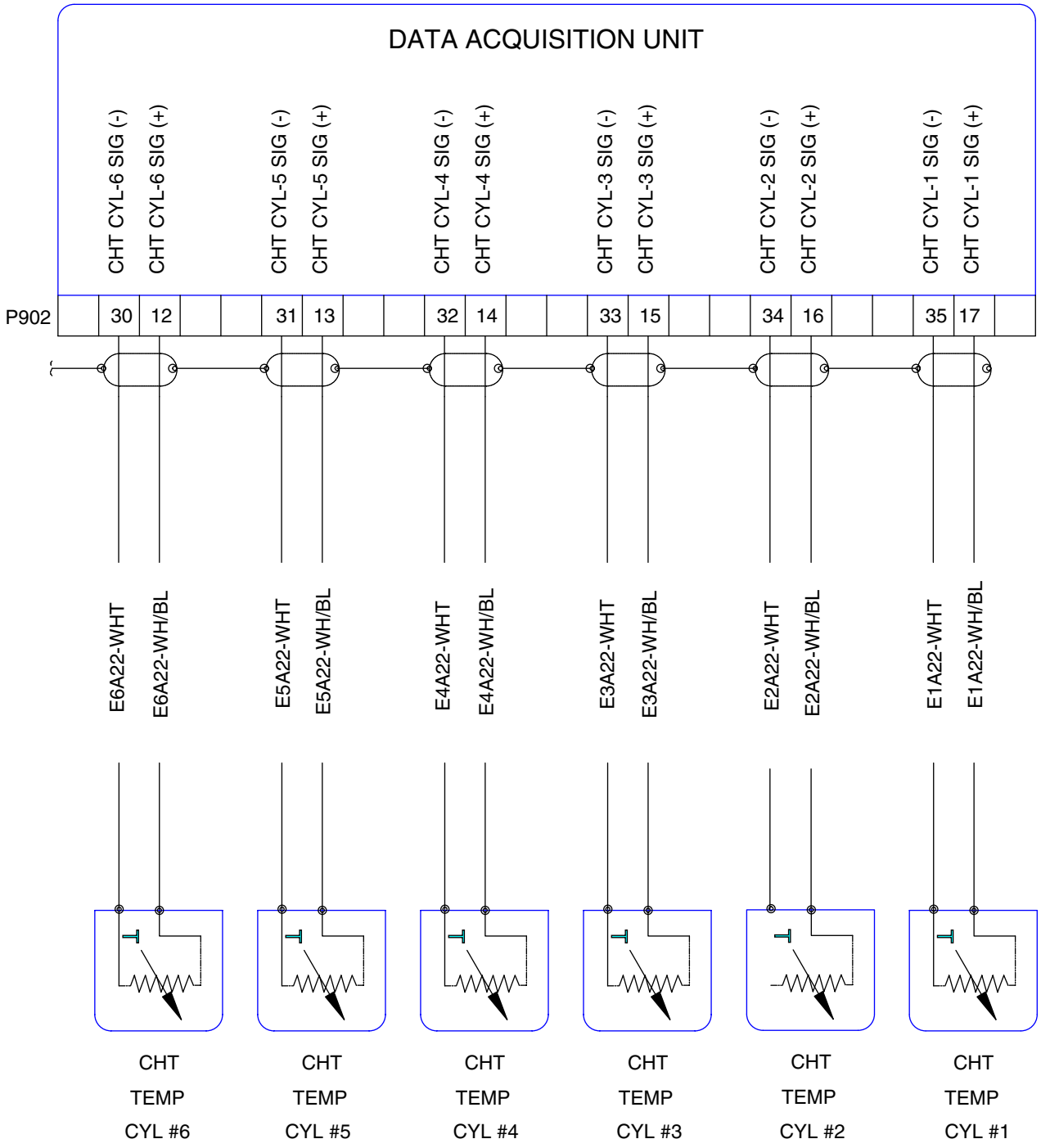
MAP / RPM (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-40

101848 6.0 NEW



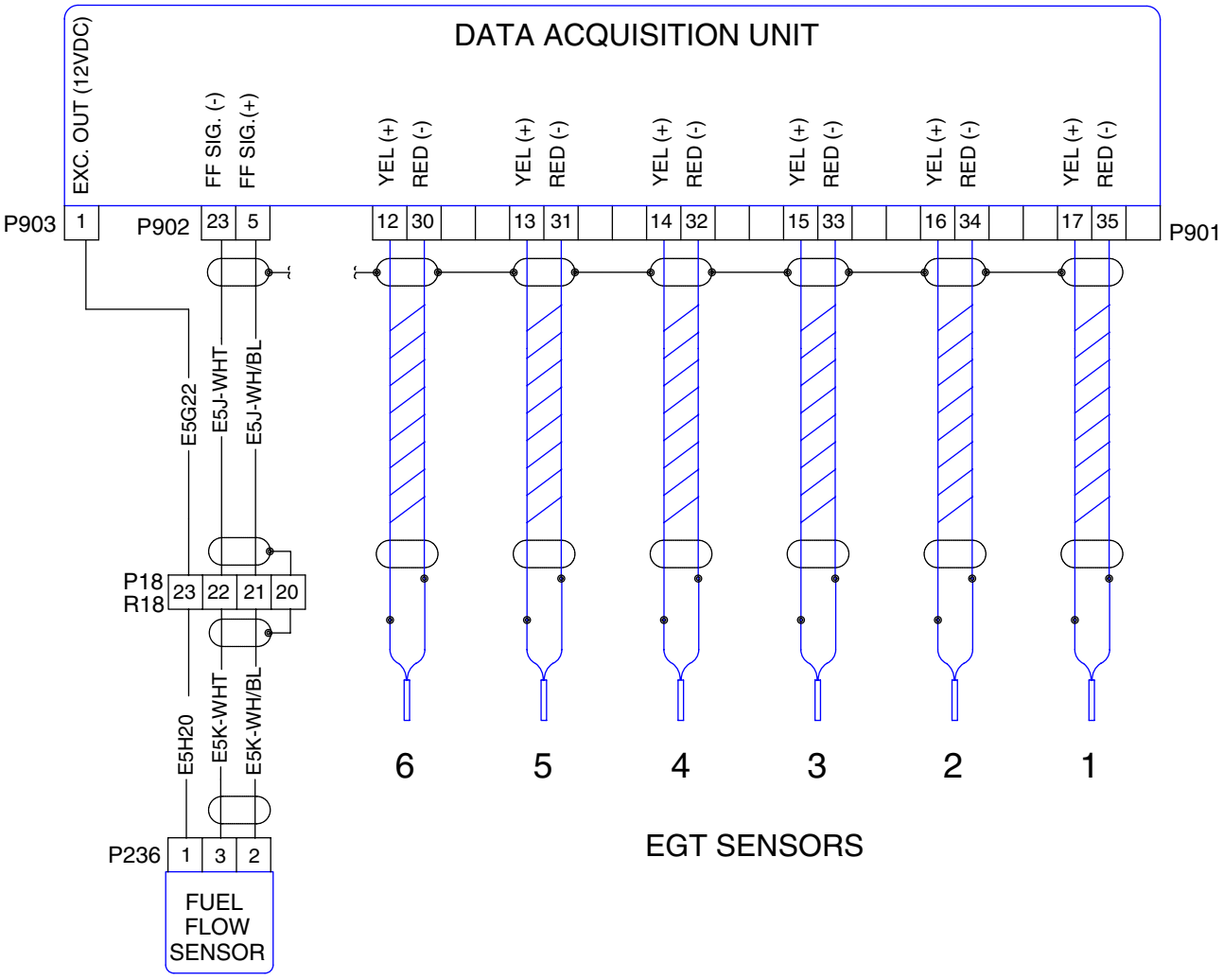
Data Acquisition Unit (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-41

101848 18.0 NEW

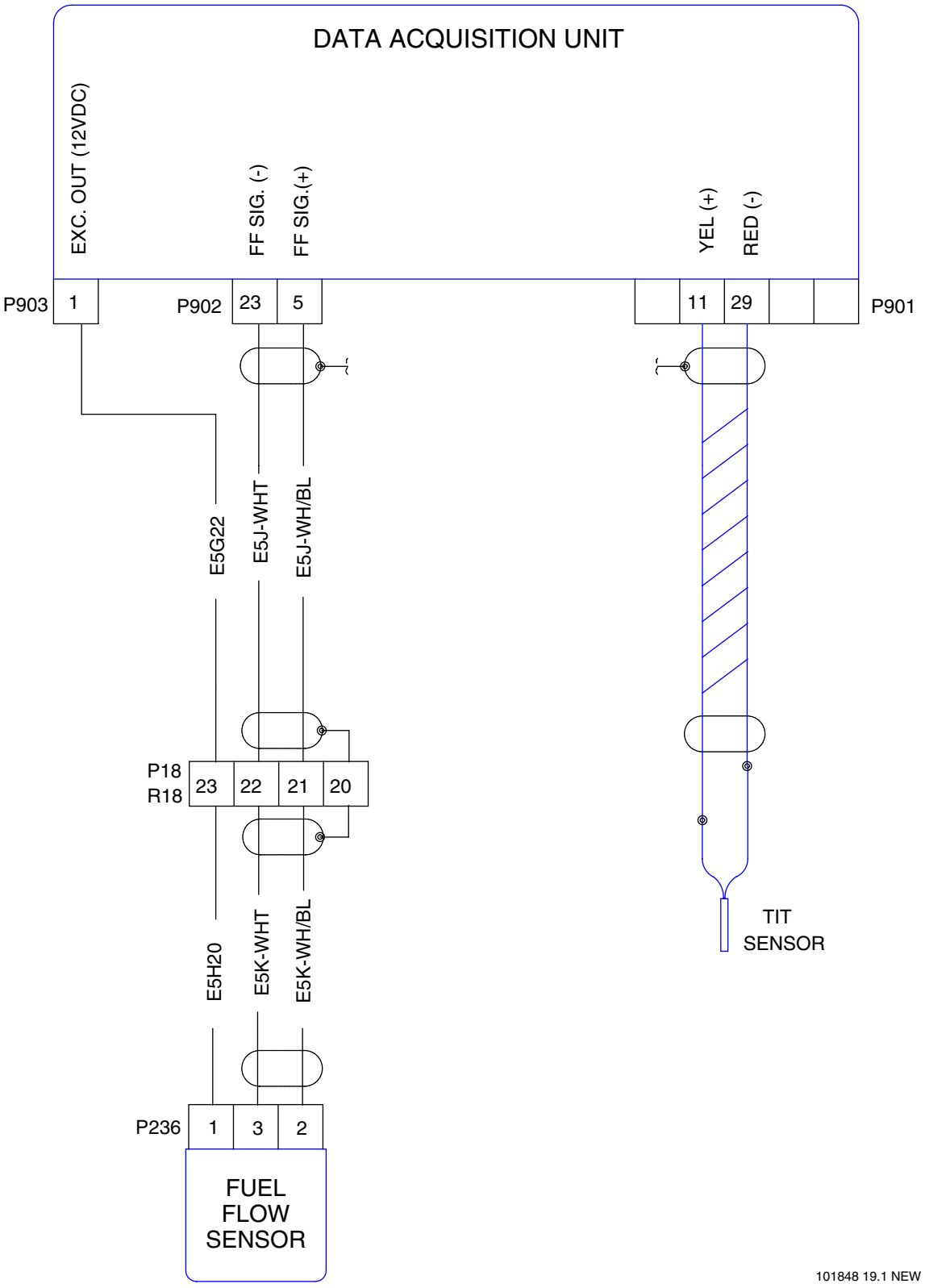


CHT (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-42

101848 19.0 NEW

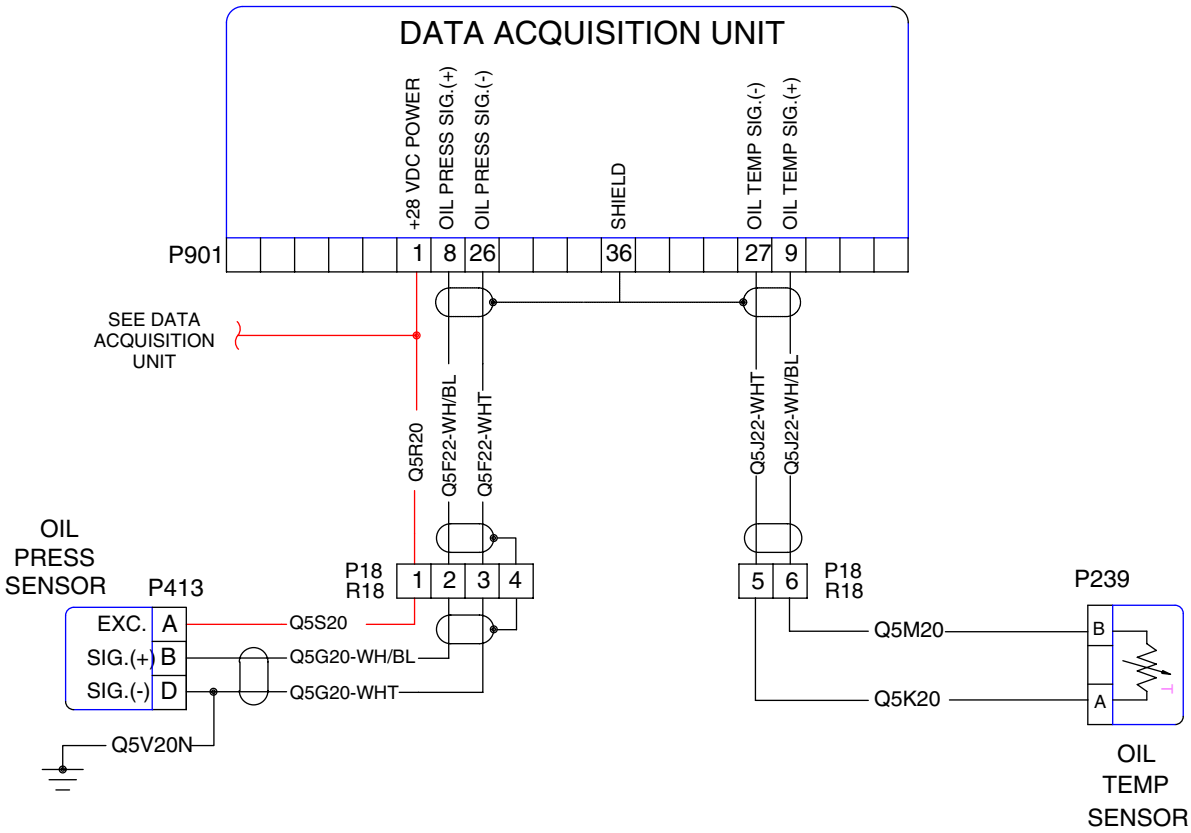


EGT / Fuel FLow (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-43



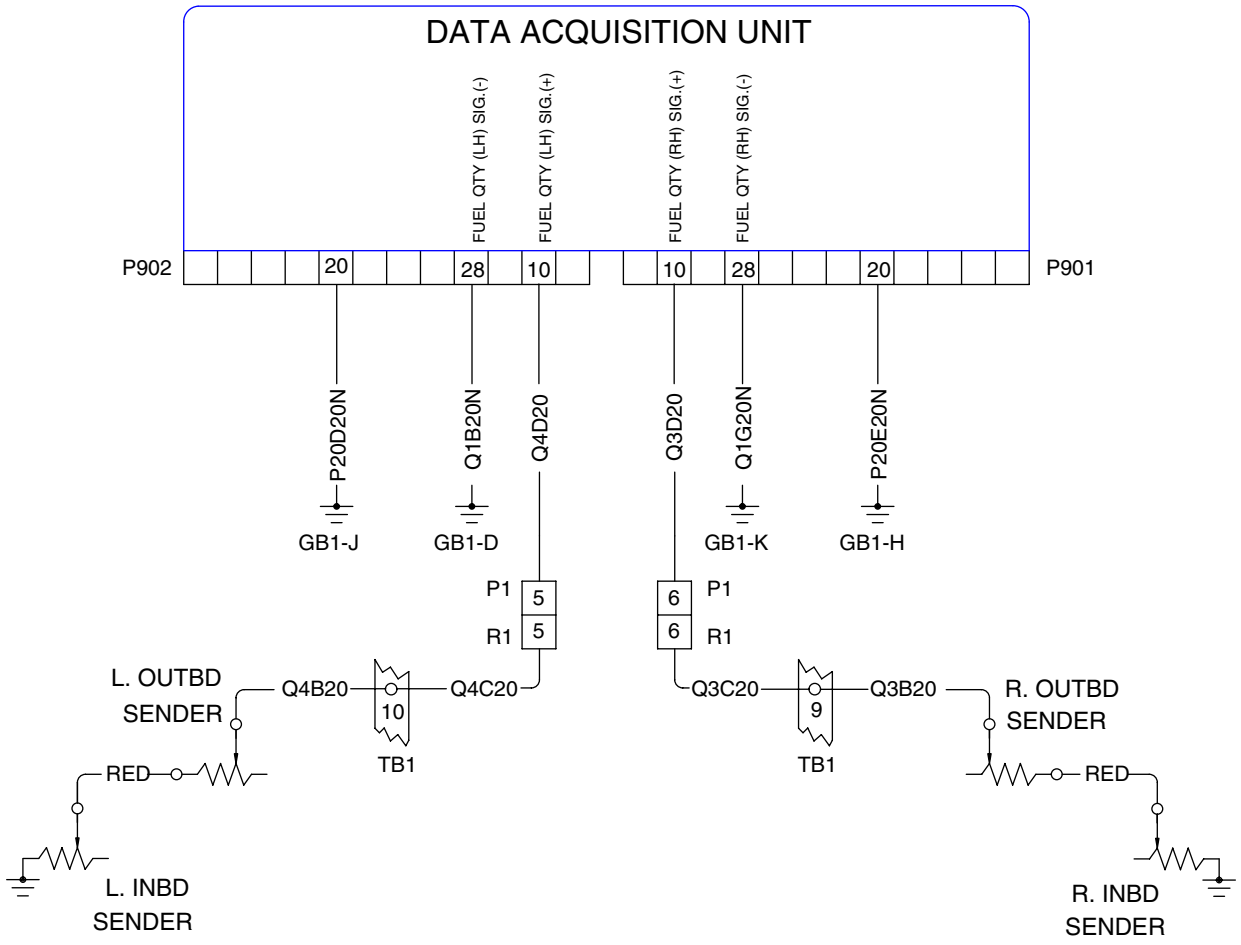
TIT / Fuel Flow (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-44

101848 3.0 NEW



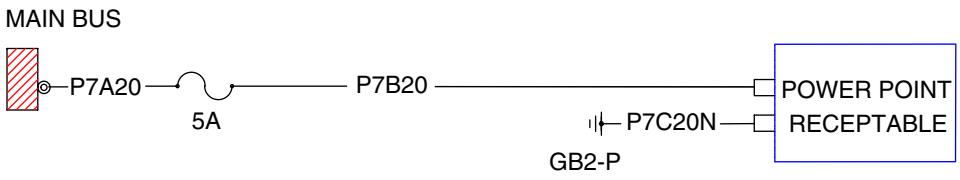
Oil Pressure / Oil Temperature (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-45

101848 7.0 NEW



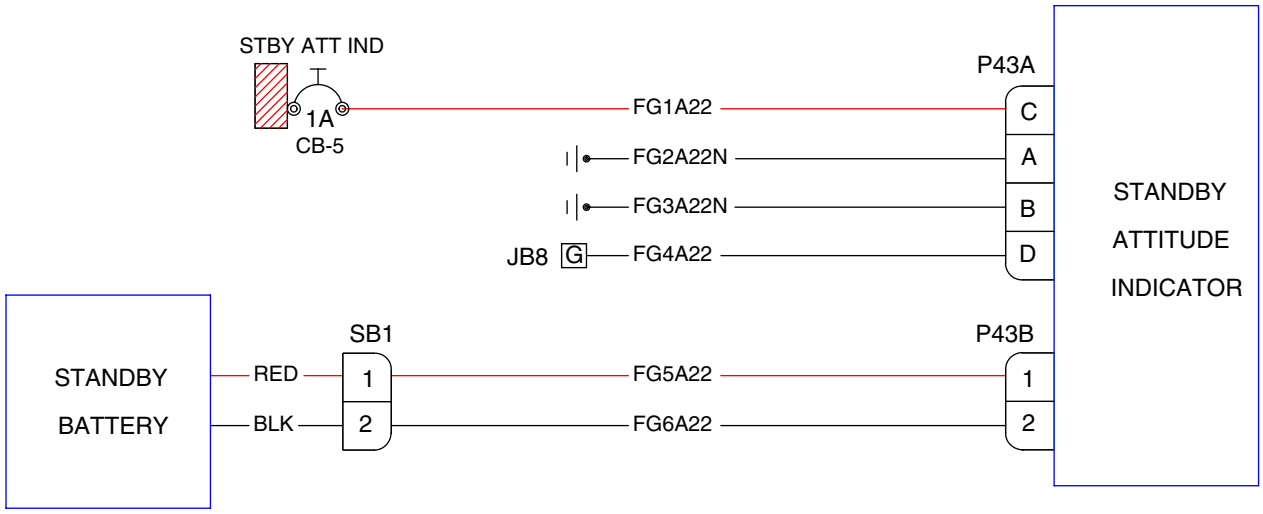
Fuel Quantity (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-46

104141 34.0 NEW/A
104406 34.0 NEW/E
101848 31.0 NEW



Power Point (HP S/N's 3246154 & up, TC S/N's 3257124 & up)
Figure 91-47

101848 11.0 NEW



Standby Attitude Indicator (HP S/N's 3246218 & up, TC S/N's 3257339 & up; w/Entegra option)
Figure 91-48

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GRIDS 5H20 THRU 5H24
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CHAPTER

95

SPECIAL PURPOSE EQUIPMENT

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CHAPTER 95 - SPECIAL PURPOSE EQUIPMENT

TABLE OF CONTENTS / EFFECTIVITY

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GENERAL

A. Tire Balancer (ref. Figure 95-1)

1. Tire Balancer Building Instructions

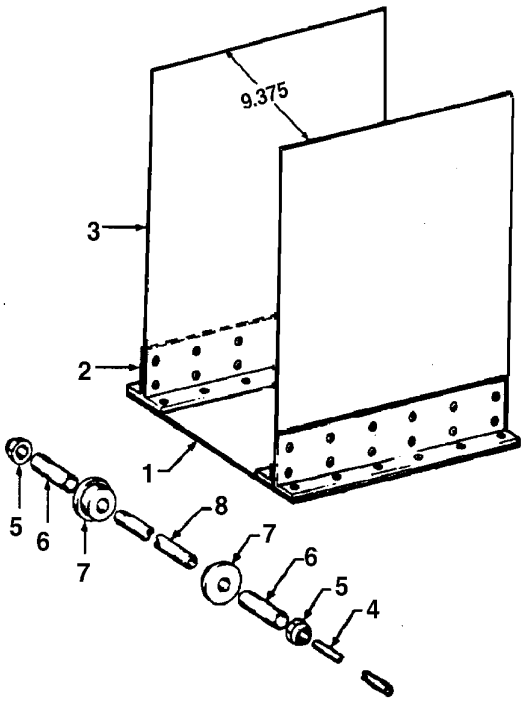
a. Chamfer top edges of -3 sides, leaving 1/16 inch flat on top of the inboard edge. Rivet -2 tee's to -3 sides using AN 470-AD5 rivets, with 2 inch spacing, and using AN 426-AD5 rivets (2 inch center to center) to secure -2 tee's to -1 base. If tee extrusion is unavailable, heavy angle extrusion could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

b. 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.

c. The -6 spacers were made from 1/2 inch aluminum tubing, the two lengths of spacers are suitable for balancing most any aircraft wheel.

d. 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.

e. 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.



The following list of material were used in making the balancer:

-1	1 ea. Base	12 x 11	0.190 2024 T3 clad aluminum alloy
-2	2 ea. Tee	2.5 x 2 x 11	0.190 2024 T4 extruded aluminum alloy
-3	2 ea. Sides	14 x 11	0.125 2024 T3 clad aluminum alloy
-4	1 ea Axle	0.125 x 10.25	4130 steel, normalized
-5	2 ea. Nuts	AN 365-624	
-6	2 ea. Spacer	0.50 X 2.25	5052-0 aluminum tubing
	2 ea. Spacer	0.50 X 1.25	5052-0 aluminum tubing
-7	2 ea. Bushing	1.480 X 1.625 X 1.00	Richlight, phenolic or aluminum
	2 ea. Bushing	2.240 X 1.37 X 1.00	Richlight, phenolic or aluminum
-8	1 ea. Pipe	1/8 X 9.3	Black steel pipe
*	2 ea. Bearings	Save two of each sice worn wheel bearings from previous inspections	

Figure 95-1. Tire Balancer Fixture

GENERAL (cont)

B. Control Surface Balancing Tool (ref. Figure 95-2)

1. Balancing Control Surface (For Step by Step instructions ref. Chapter 55)

a. Ensure that the control surface is in its final flight configuration, static wicks, trim tabs, trim tab pushpull 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.
c. 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.
d. Adjust the movable trailing edge support to fit the width of the control surface, then tighten the set screw on the trailing edge support.
e. Adjust the trailing edge support vertically until the beam is parallel with the control surface chordline.
f. Remove the tool from the control surface and balance the tool itself by adding or removing nuts or washers from the beam balance bolt. When balancing the tool, the movable weight must be at the bar's hinge centerline.
g. After balancing tool, reattach it to the control surface, but keep the beam positioned 90 degrees from the control surface hinge line.
h. Determine balance control surface by sliding movable weight along the balance beam.
i. Read the scale when the bubble in the level has been centered. Since the movable weight weighs threepounds, every inch it is moved from the center of the beam equals three inch-pounds of force.

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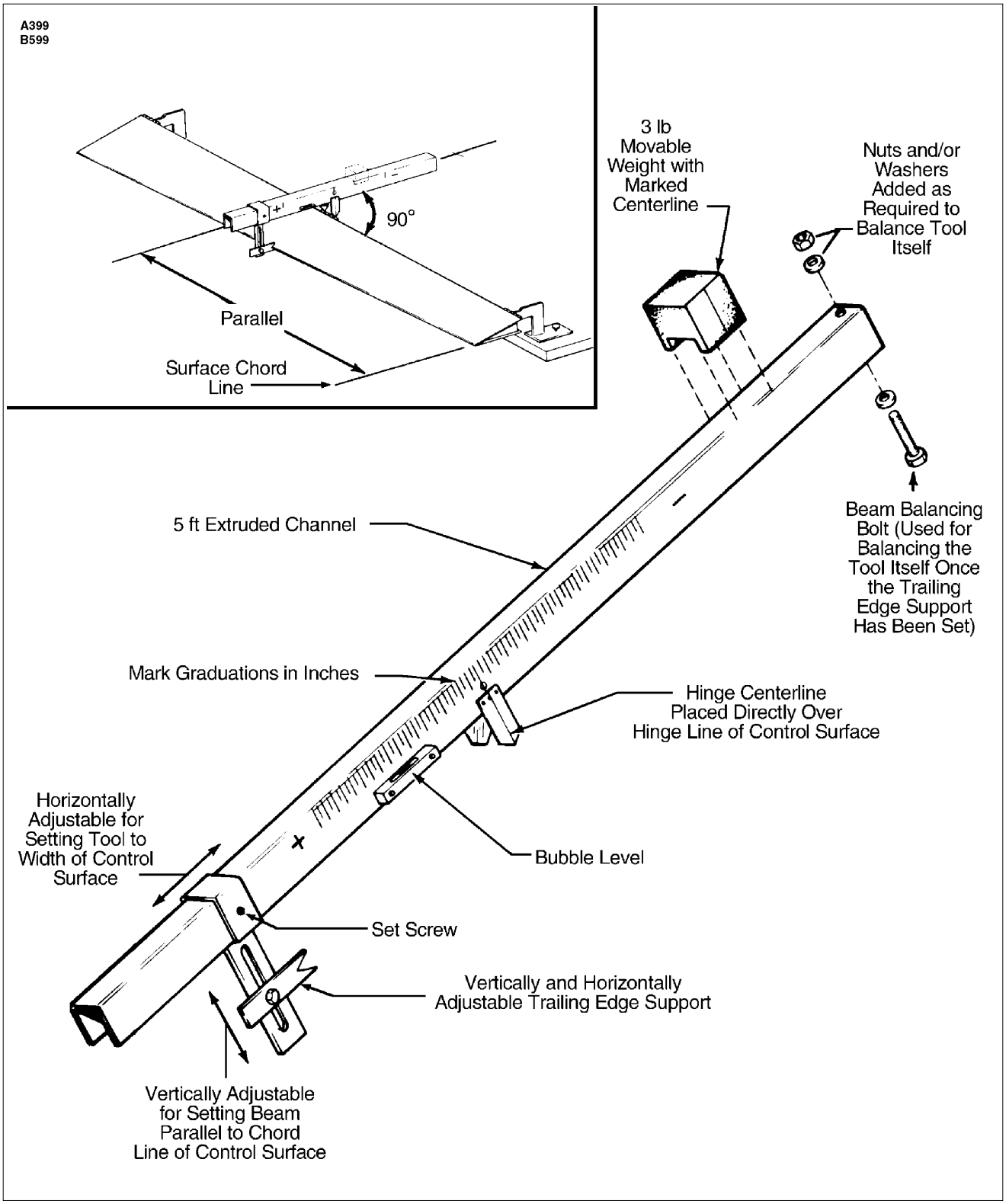

Figure 95-2. Control Surface Balancing Tool

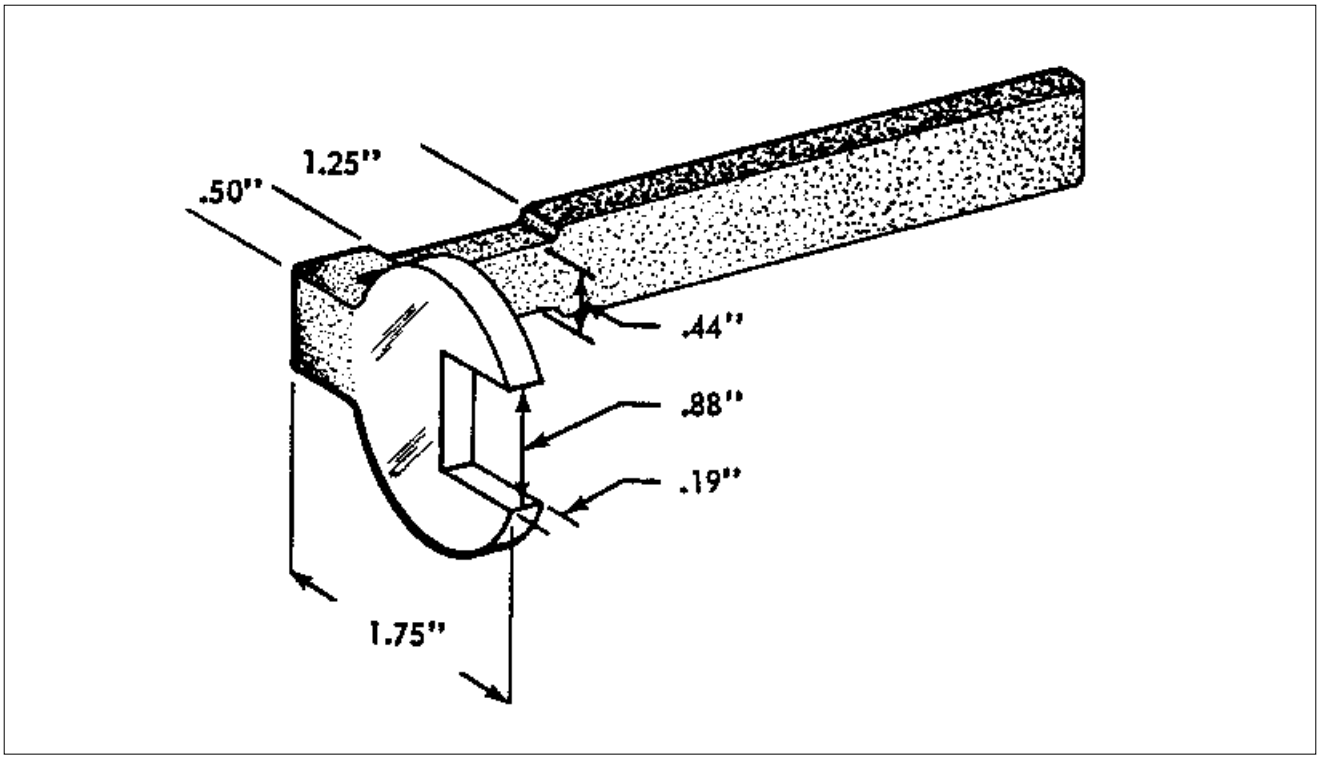

Figure 95-3. Fabricated Tool for Baggage Door Lock

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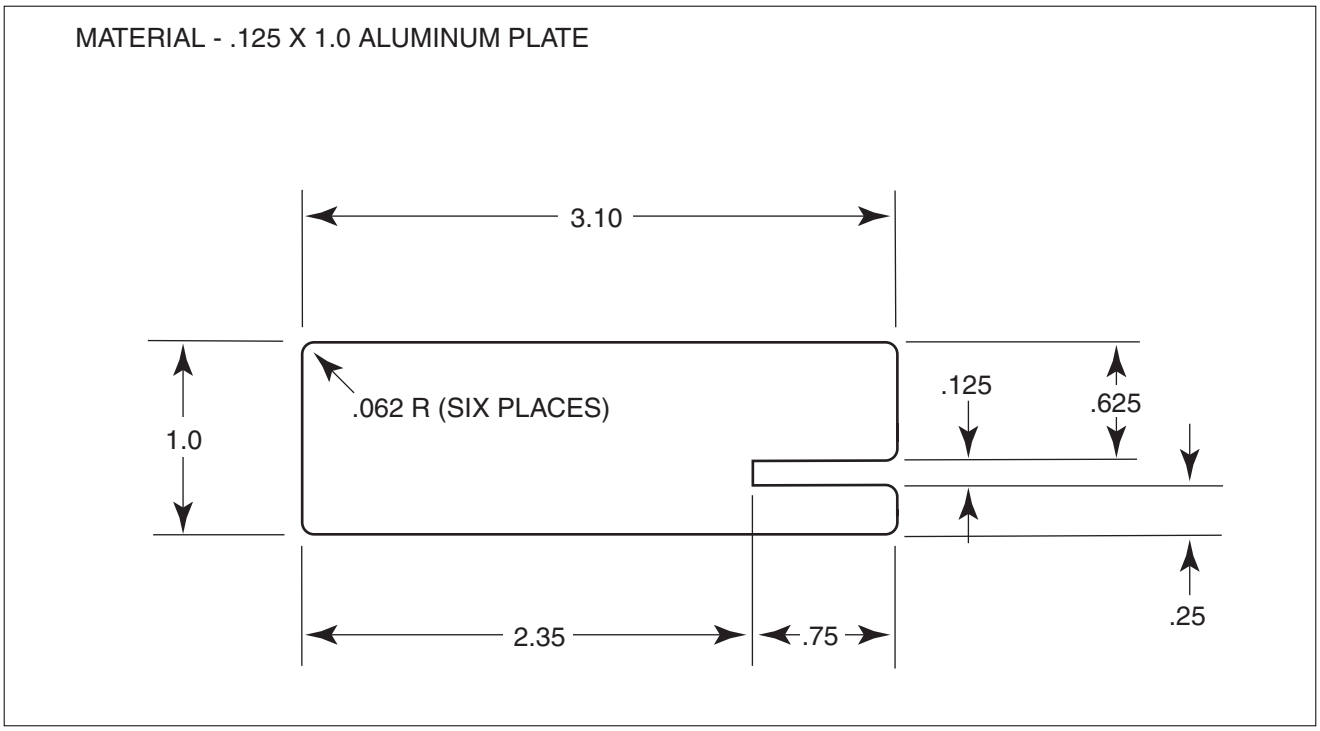

Figure 95-4. Fabricated Aileron Bellcrank Rigging Tool

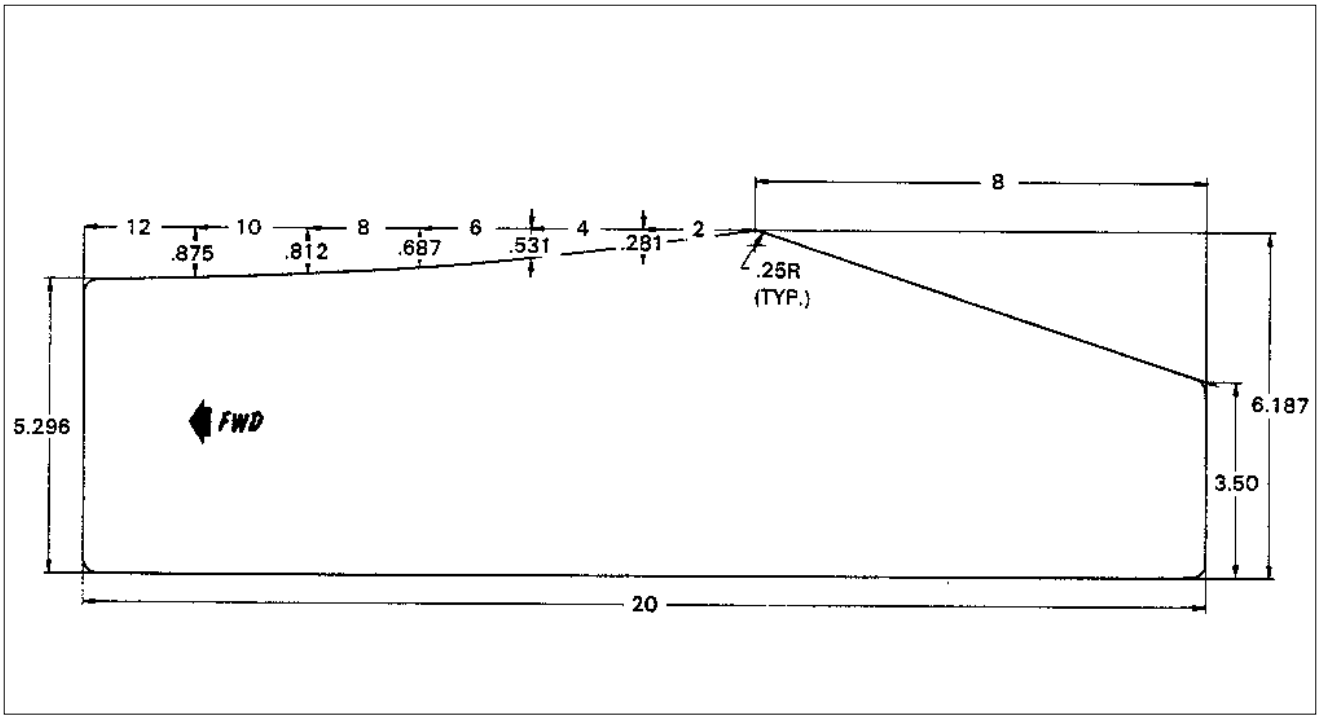

Figure 95-5. Fabricated Rudder Rigging Tool

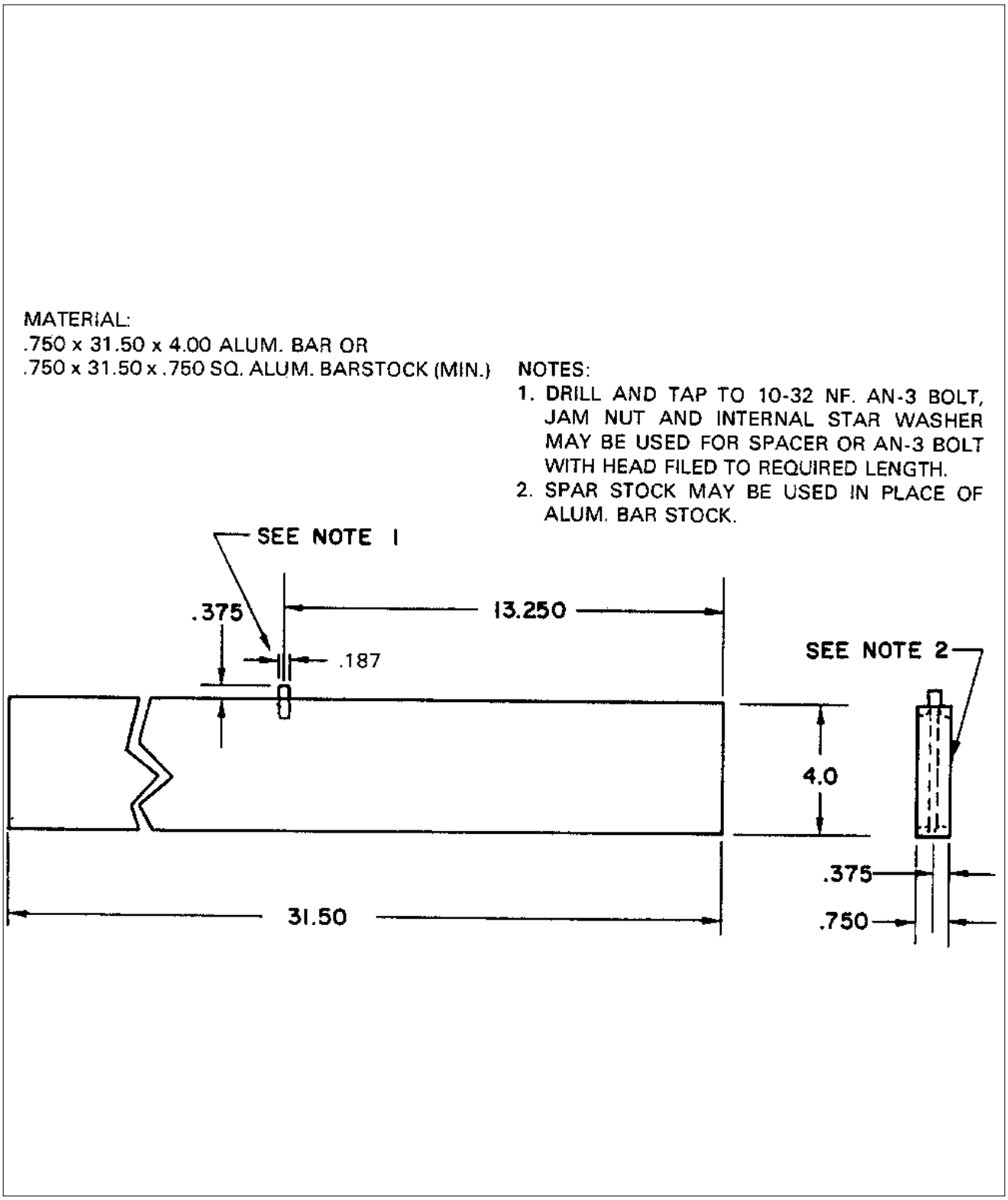

Figure 95-6. Fabricated Aileron and Flap Rigging Tool

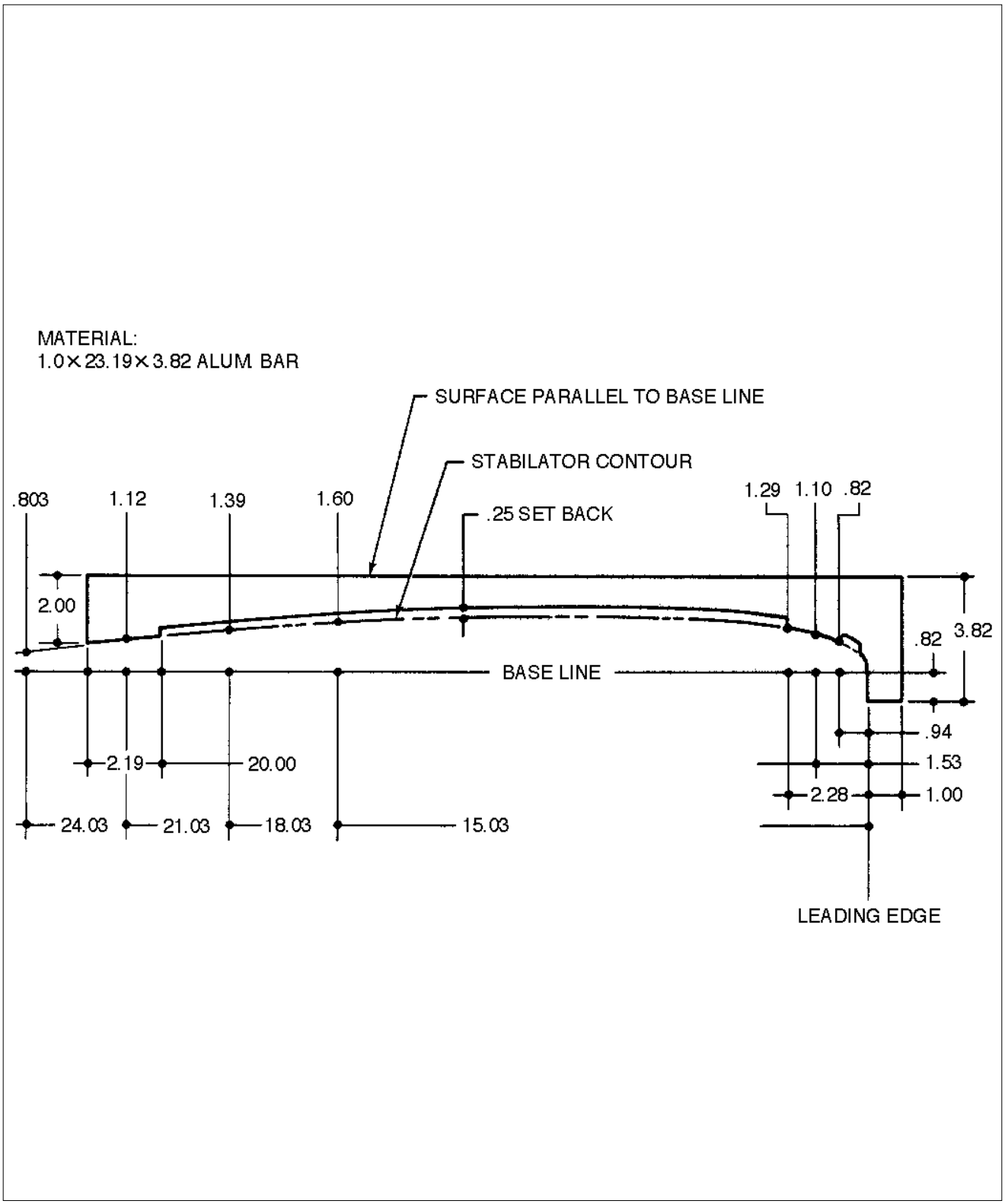

Figure 95-7. Fabricated Stabilator Rigging Tool

GRIDS 5I12 THRU 5I24
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APPENDIX

1

AUTOFLIGHT

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APPENDIX 1

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
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APPENDIX 1 - AUTOFLIGHT

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APPENDIX 1 - CONTENTS

S-TEC SYSTEM 55/55X

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. S-TEC System 55

   This system was adopted in 1999 and is installed in:

   A. Saratoga II HP S/N's 3246126 thru 3246181 only.

   B. Saratoga II TC S/N's 3257076 thru 3257198 only.

2. S-TEC System 55X

   This system was adopted in 2001 is installed in:

   A. Saratoga II HP S/N's 3246182 and up.

   B. Saratoga II TC S/N's 3257199 and up.

3. Description (See Figure 1.)

   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.

   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:

   A. Panel Mounted:

      Programmer/Computer, Turn Coordinator, Annunciator, D.G. or HSI, and Steering Horizon.

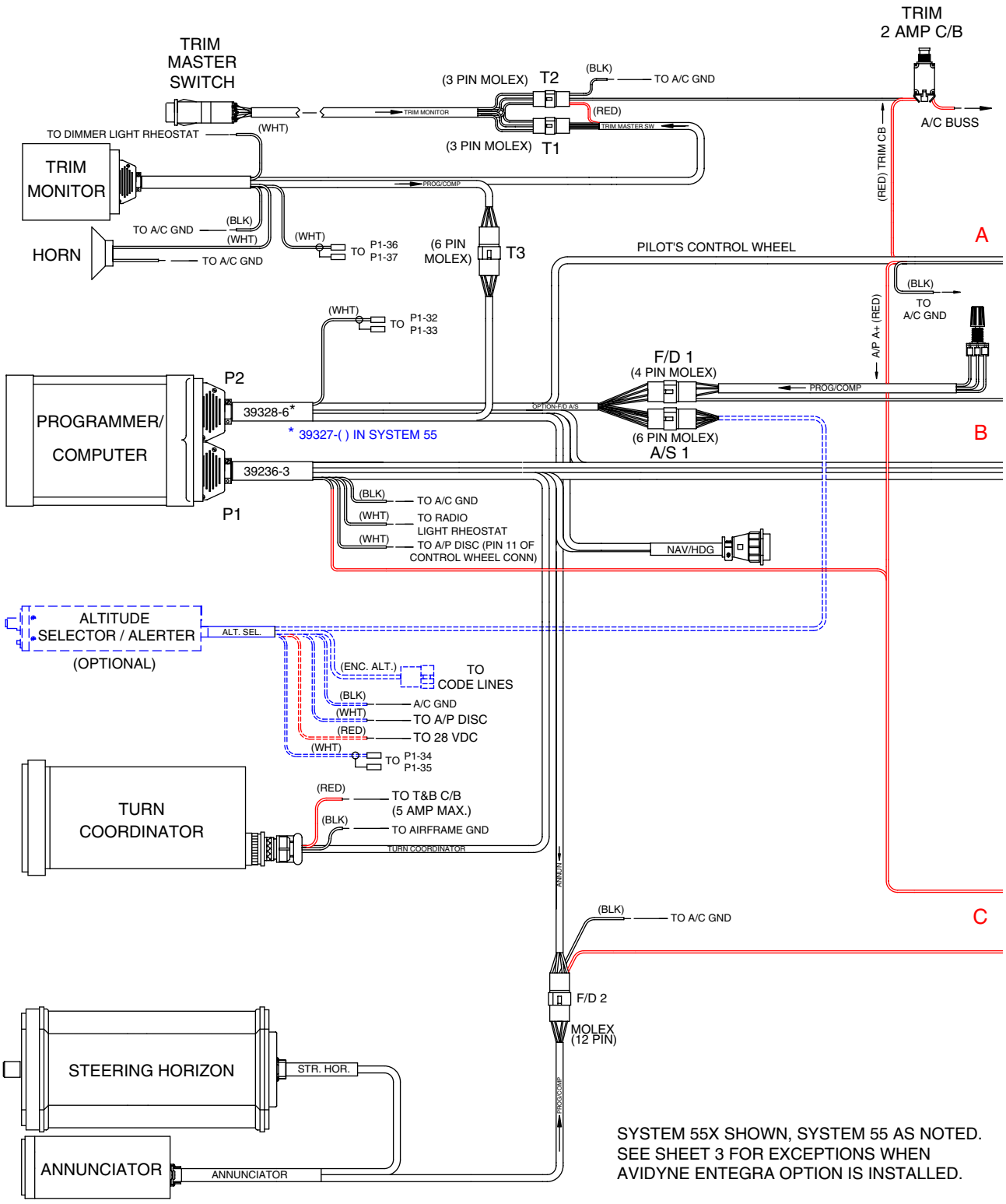
   B. Remote Mounted:

      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.

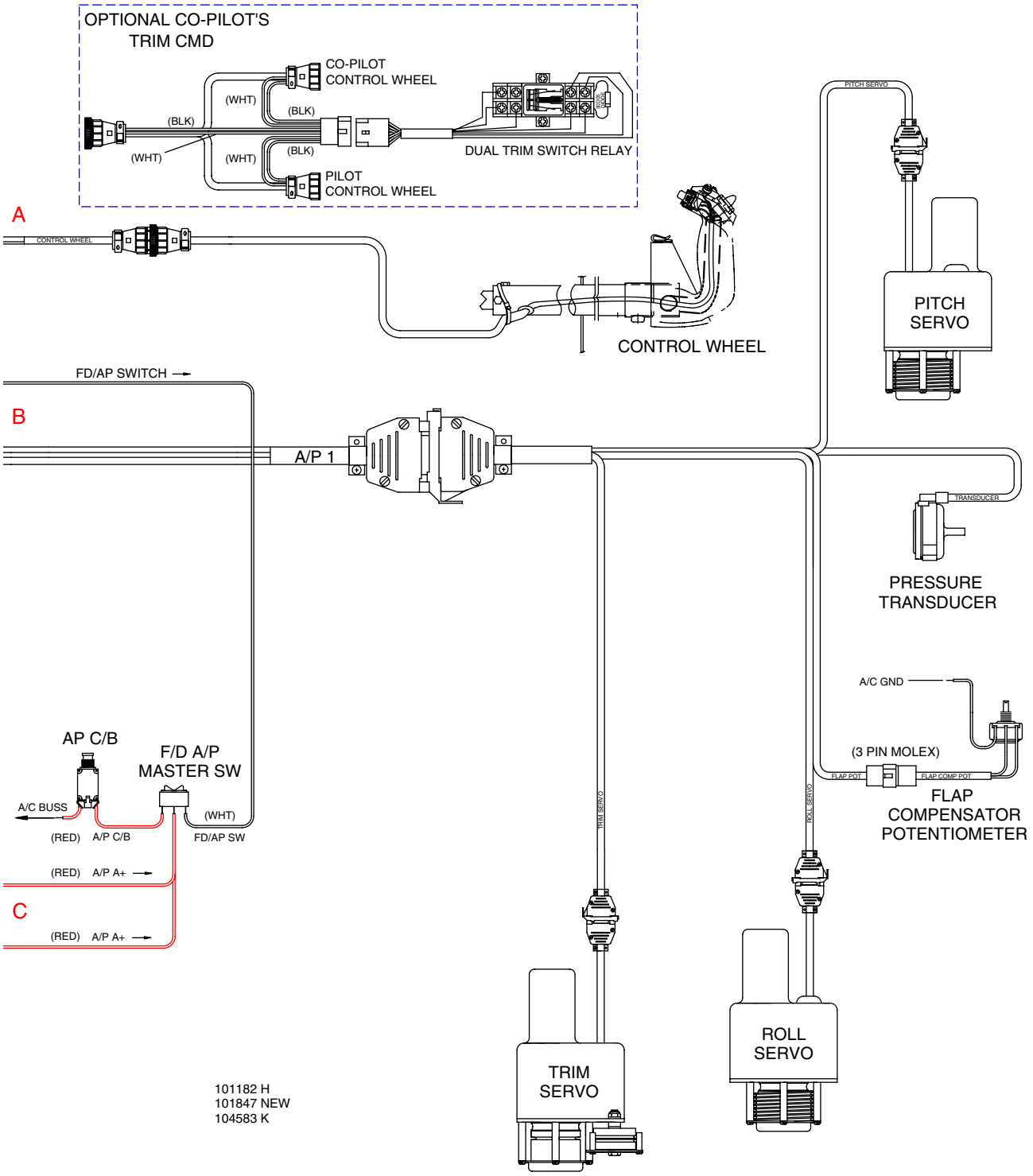
4. Troubleshooting

   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.



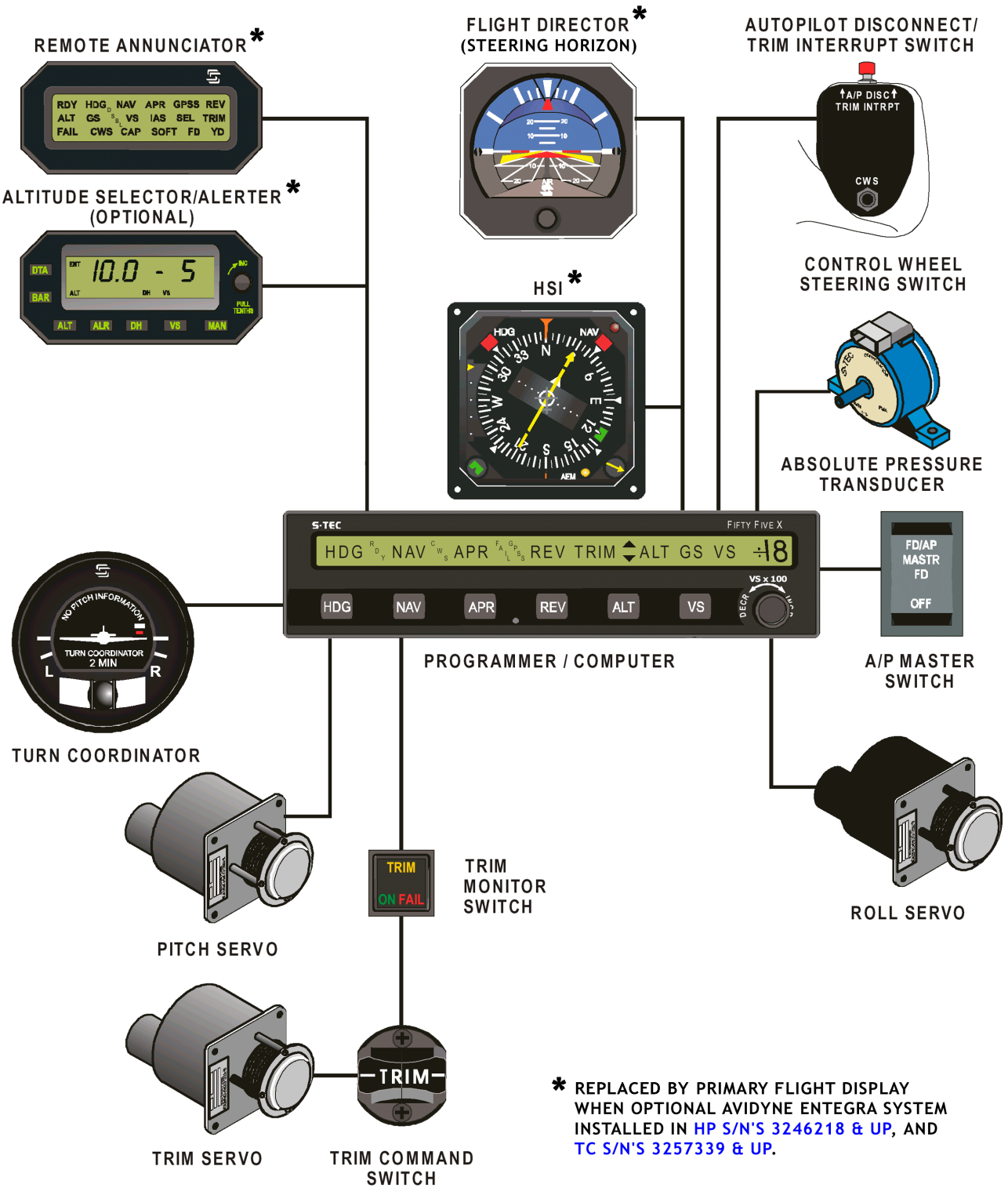
Effectivity
3246126 & up
3257076 & up

System 55/55X Autopilot Installation
Figure 1 (Sheet 1 of 3)



System 55/55X Autopilot Installation
Figure 1 (Sheet 2 of 3)

Effectivity
3246126 & up
3257076 & up



Effectivity
3246126 & up
3257076 & up

System 55/55X Autopilot Installation
Figure 1 (Sheet 3 of 3)

5. 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.

6. 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.

7. 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.

8. Post-Maintenance Operational Checkout (Ref. S-TEC Report No. 81191, Rev. 1.)

Complete the following checkout procedure after any maintenance to the system is performed.

NOTE: The Systems 55/55X incorporate a SELF-TEST that requires a 100% pass rate before the autopilot can be engaged.

NOTE: For airplanes equipped with the optional Avidyne Entegra Electronic Flight Display System, (see 34-20-00) references below to the remote annunciator, flight director and HSI are to those functions in the Primary Flight Display (PFD).

A. Apply aircraft power.

B. Avionics Master Switch — ON

C. 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.

D. Trim Master (ON / OFF) Switch — ON

E. HDG and VS switches — PRESS / RELEASE

Ensure that HDG and VS illuminate on the Fifty Five X annunciator.

F. VS Knob — ROTATE CW

Pitch control (i.e. - the control yoke) should move slowly out (pilot may have to assist a heavy yoke).

G. VS Knob — ROTATE CCW

Pitch control should move slowly in.

H. A/P DISC Trim Interrupt Switch (on control yoke) PRESS

Verify the autopilot disconnects.

I. HDG Mode ENGAGE

J. 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.

K. REV Mode button PUSH

Roll control should respond opposite to the course arrow and CDI left / right needle inputs.

L. 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.

M. Trim Master (ON / OFF) Switch OFF

N. Manual Electric Trim Test:

(1) Trim Master (ON / OFF) switch ON

(a) Move each segment of the Manual Electric Trim Command Switch FWD and AFT.
Trim should not run.

(b) Move both segments of the Trim Command switch FWD.
Trim should run nose down.

(c) Move both segments of the Trim Command switch AFT.
Trim should run nose up.

(2) Re-trim aircraft for takeoff and check controls for freedom of movement. Be sure the autopilot and trim servos are dis-engaged.

O. Flight Director Test:

(1) Autopilot Master Switch SELECT FD

Note the roll, pitch and trim servos are disengaged. The steering bar should be in view on the attitude indicator.

(2) 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.

(3) 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.

(4) Autopilot Master Switch — SELECT FD / AP

The servos should re-engage.

(5) Trim Master ON / OFF Switch — ON

(6) 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.

9. 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.

10. Component Locator

See Figure 2.

11. Trim Monitor (See Figure 2.)

The trim monitor is mounted on the left side of the fuselage under the instrument panel.

A. Removal

(1) Disconnect autopilot harness.

(2) Remove screws (4) holding trim monitor to mounting bracket and remove trim monitor.

B. Installation

(1) Place trim monitor in position on mounting bracket and secure with screws (4).

(2) Connect autopilot harness.

(3) Perform Post-Maintenance Operational Checkout, above.

12. Pressure Transducer (See Figure 2.)

The pressure transducer is located on the forward side of the pilot's instrument panel below the control wheel shaft.

A. Removal

(1) Remove the Ty-Rap and disconnect the transducer from the static-system by removing the flexible hose.

(2) Disconnect the autopilot harness.

(3) Remove screws and washers (2 ea.) and remove transducer.

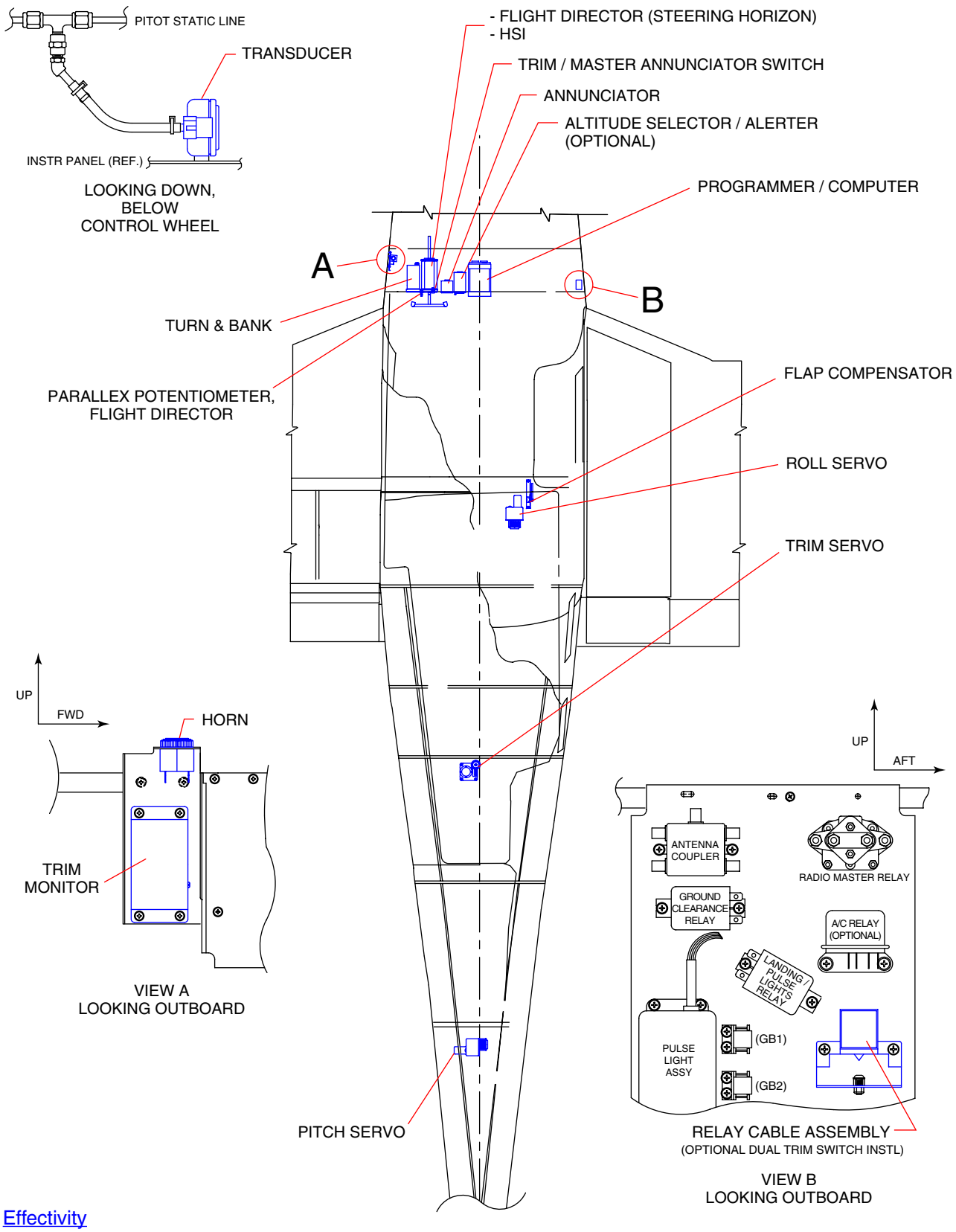
B. Installation

(1) Place transducer in position. Secure transducer to instrument panel with screws and washers (2 ea.)

(2) Connect the transducer to the static system by sliding the flexible hose over the hose barb. Then position and tighten Ty-Rap.

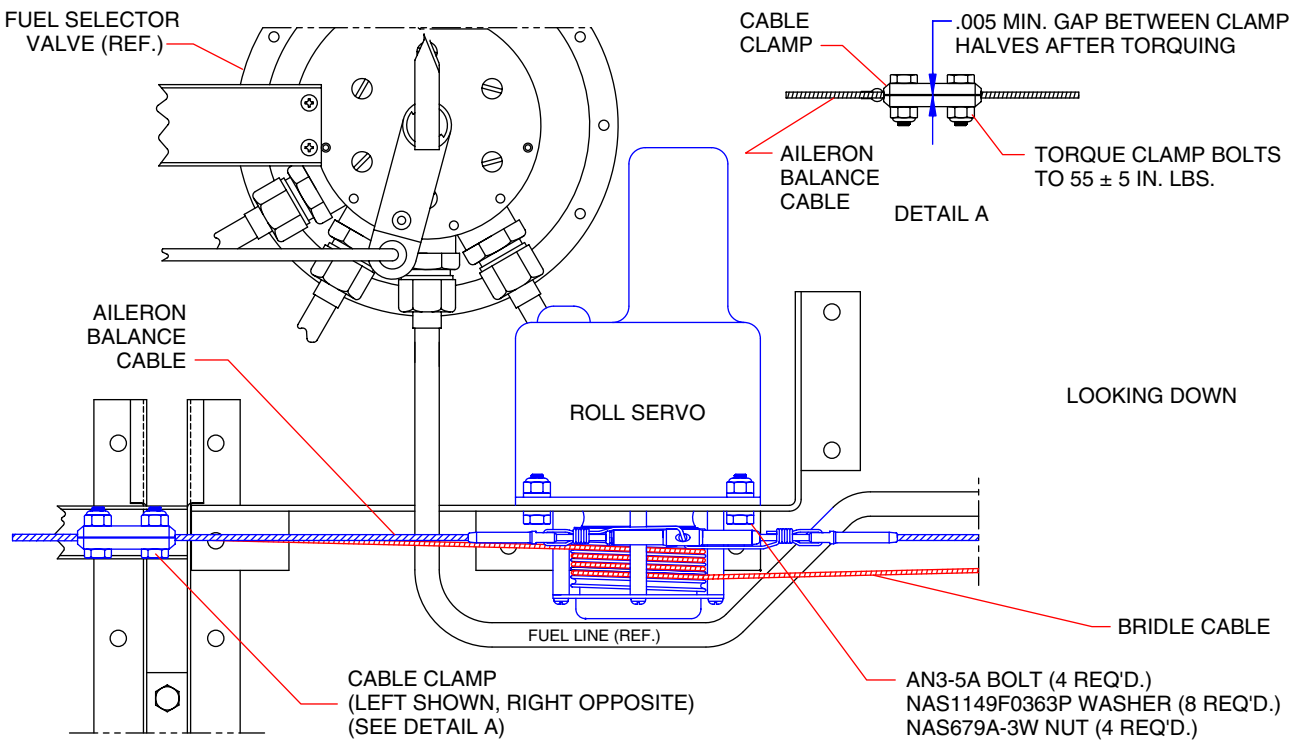
(3) Connect the autopilot harness.

(4) Perform Post-Maintenance Operational Checkout, above.



Effectivity
3246126 & up
3257076 & up

Component Locator
Figure 2



Effectivity
3246126 & up
3257076 & up

Roll Servo Installation
Figure 3

13. Roll Servo (See Figures 2 and 3.)

The roll servo is mounted underneath the right aft facing passenger seat or the entertainment cabinet, whichever is installed. A bridle cable and clamps attach the servo capstan to the aileron balance cable.

A. Removal

(1) Remove the aft facing passenger seat or entertainment cabinet, whichever is installed.

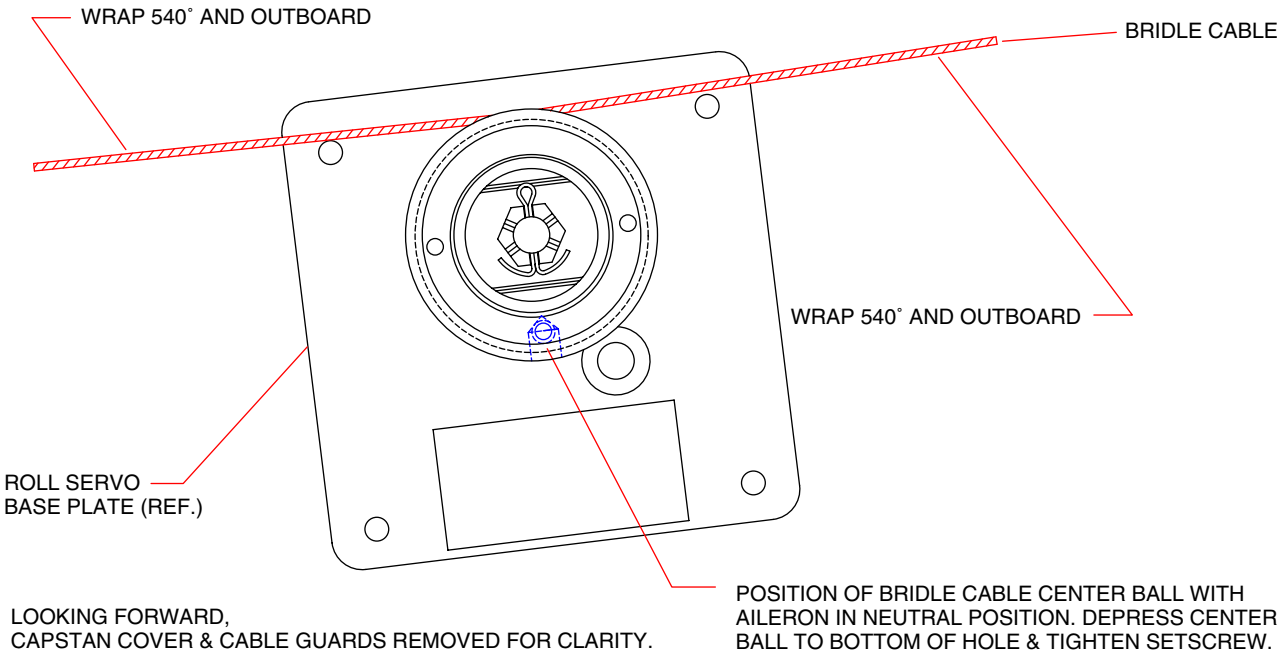
(2) Remove adjacent carpet.

(3) Remove screws securing floor panel and remove panel.

(4) Disconnect autopilot harness.

(5) Remove nuts and bolts (2 ea.) securing each cable clamp (2) and remove cable clamps from aileron balance cable and autopilot bridle cable.

(6) Remove nuts and bolts (4 ea.) and washers (8 ea.) securing roll servo to mounting bracket and remove roll servo with attached bridle cable.



Effectivity
3246126 & up
3257076 & up

Roll Servo Capstan Wrapping
Figure 4

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 and secure by use of 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 center-ball setscrew as shown in Figure 4.

(7) Replace cable guards and capstan cover, secure with screws (4).

(8) Position servo as shown in Figure 3 and install and secure nuts (4 ea.) , washers (8 ea.) , and bolts (4 ea.) holding servo to mounting bracket.

(9) Position cable clamps (2) as shown in Figure 3 and tighten nuts and bolts (2 ea.). Adjust cable clamps in or out along the airleron cable to obtain a bridle cable tension of 15 + 10, -2 lbs (System 55X) or 15 ± 2 lbs (System 55). Torque cable clamp bolts to 55 ± 5 in. lbs.

(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 27-10:

(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), above, reveal the aileron controls out of rig, repeat steps (1) thru (9).

(15) Connect autopilot harness.

(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 aft facing passenger seat or entertainment cabinet, whichever was installed.

14. Trim Servo (See Figures 2 and 5.)

The trim servo is located on the centerline just aft of the cabin rear closeout panel. The left stabilator trim cable wraps around the servo idler pulley and servo capstan.

A. Removal

(1) Remove rear seats. Remove cabin rear closeout panel. Remove baggage compartment carpet and floor.

(2) Tie a pull rope to the left trim cable exposed beneath the baggage compartment floor and tie-off the pull rope to structure aft.

(3) Tie a pull rope to the left trim cable aft of the turnbuckle in the rear fuselage aft of the trim servo and tie-off 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.

(4) Slack-off the turnbuckle in the left trim cable segment aft of the trim servo sufficient to relieve tension on the left trim cable as it wraps around the trim servo idler pulley and capstan.

(5) Disconnect the autopilot harness.

(6) Remove the capstan cover and cable guards (4) by removing the retaining screws (4).

(7) 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.

(8) Remove the remaining bolts, nuts, and washers (3 ea.) securing the trim servo to its mounting bracket and remove the trim servo.

B. Installation

(1) Adjust trim servo clutch torque per Servo Clutch Torque Adjustment, below.

(2) With the capstan cover and cable guards removed, position the trim servo as shown in Figure 5. Secure with bolts, nuts, and washers (3 ea. - i.e. - aft two and forward 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 the mounting plate/cable guard/bolt assembly aside.

(4) Drape the slack left trim cable over the servo capstan.

CAUTION: IN STEPS (5) THRU (9), BELOW, USAGE OF LEFT AND RIGHT IS RELATIVE TO 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 towards you and to your left.

(6) Holding the trim cable in that position, install the capstan cover and cable guards as shown in Figure 5.

(7) Hold the idler pulley aft of the trim servo and to the right of the aiplane's left trim cable. Move the idler pulley left to the left trim cable and capture the trim cable in the bottom cable groove on the left of the idler pulley.

(8) Keeping the trim cable in the bottom groove, slide the idler pulley forward along the trim cable, left of the servo capstan, and bring it approximately to its installed position (See Figure 5). At this point, the aft portion of the trim cable should be routed left, around the front, and to the right of the idler pulley and to the left, around the rear, and to the right of the capstan.

(9) Holding the idler pulley in this position, reach down and pull the forward portion of the trim cable over the idler pulley and seat it in the top cable groove on the idler pulley. The left trim cable should now be routed as shown in Figure 5.

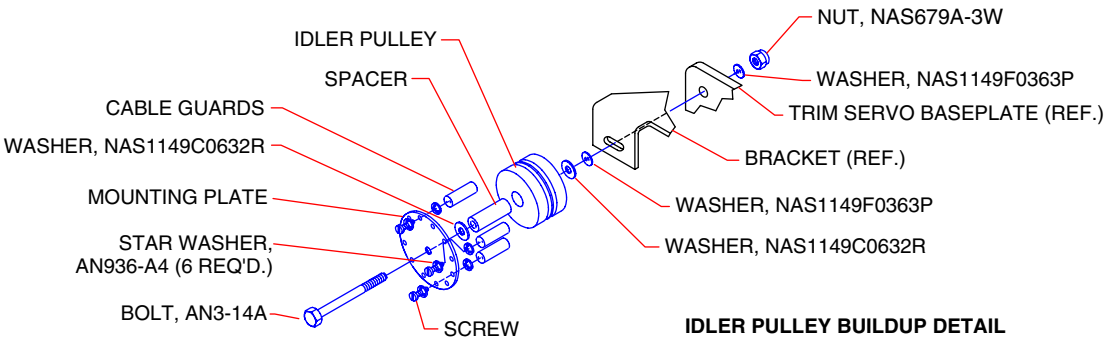
(10) Place the spacer inside the idler pulley.

(11) Position the mounting plate/cable guard/bolt assembly as shown in Figure 5 and slide the bolt through the spacer inside the idler pulley.

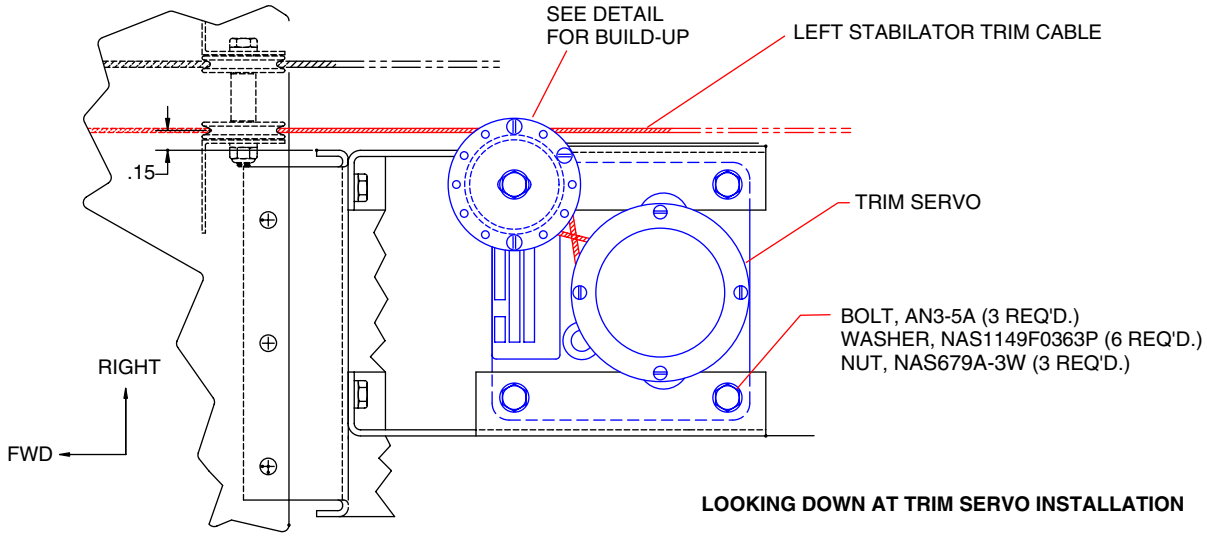
(12) Place a washer over the bolt end and put the bolt through the trim servo mounting bracket and baseplate. Secure with a nut and washer, taking care to ensure that the cable guards are positioned, and the left trim cable is routed, as shown in Figure 5.

(13) Take up the slack in the left trim cable with the turnbuckle and remove the pull ropes.

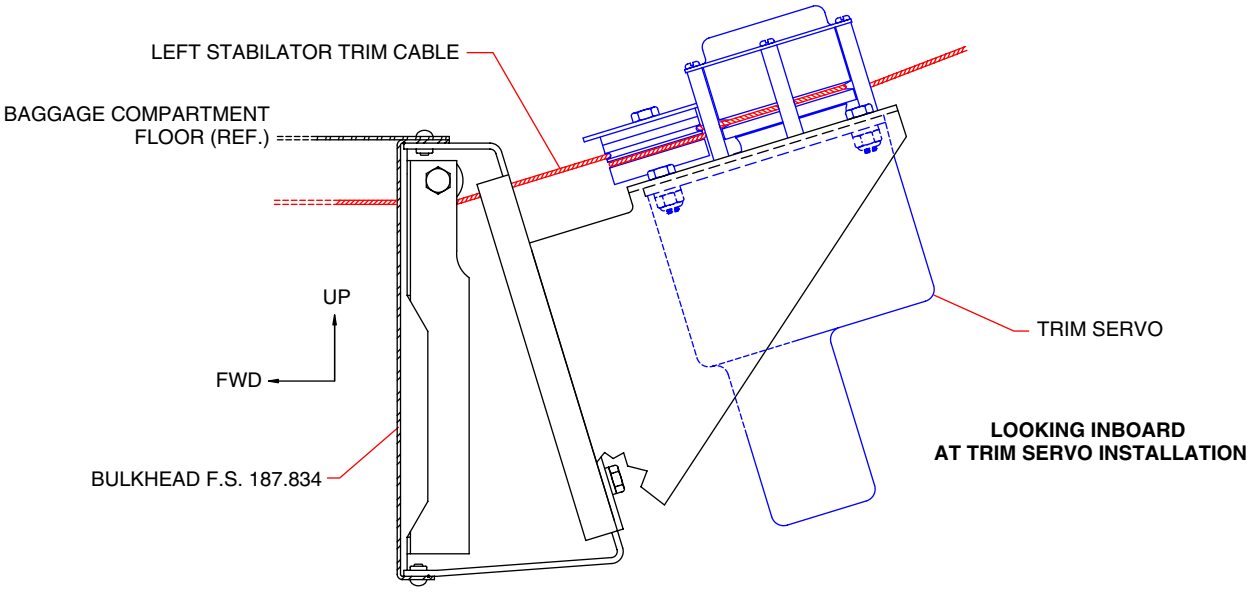
(14) Rig stabilator trim per Stabilator Trim Rigging and Adjustment, 27-30-00.



IDLER PULLEY BUILDUP DETAIL



LOOKING DOWN AT TRIM SERVO INSTALLATION



**LOOKING INBOARD
AT TRIM SERVO INSTALLATION**

Trim Servo Installation
Figure 5

Effectivity
3246126 & up
3257076 & up

(15) Connect the autopilot harness.

(16) Perform Post-Maintenance Operational Checkout, above.

(17) Check elevator trim controls for free and correct movement.

(18) Reinstall baggage compartment floor and carpet, and cabin rear closeout panel.

(19) Reinstall rear seats.

15. Pitch Servo (See Figures 2 and 6.)

The pitch servo is located in the aft fuselage just aft of F.S. 259.00. A bridle cable and clamps attach the servo capstan to the upper and lower stabilator cables.

NOTE: The bridle cable routing, pulley buildup, and capstan wrapping and alignment differ between the System 55 / early System 55X (see Figure 6, Sheet 2) installations and current System 55X (see Figure 6, Sheet 1) installations.

A. Removal

(1) Attach a tail stand under the tail skid.

(2) Remove the cabin rear closeout panel.

(3) Crawl into the tailcone until the pitch servo is accessible.

(4) Disconnect 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

NOTE: The bridle cable routing, pulley buildup, and capstan wrapping and alignment differ between the System 55 / early System 55X (see Figure 6, Sheet 2) installations and current System 55X (see Figure 6, Sheet 1) installations.

For enchanced accessiblity, the early System 55X installations (S/N's listed below) can be upgraded to the current System 55X configuration by replacing the following parts:

HP S/N's 3246182 thru 3246204 only; and,
TC S/N's 3257199 thru 3257296 only

	Original Factory Installed Part	Authorized Field Replacement Part
Bridle Cable	S-TEC P/N 7002-7	S-TEC P/N 7002-48
Spacer	S-TEC P/N 44234	S-TEC P/N 4407-14
Washer	N/A	NAS1149F0363P

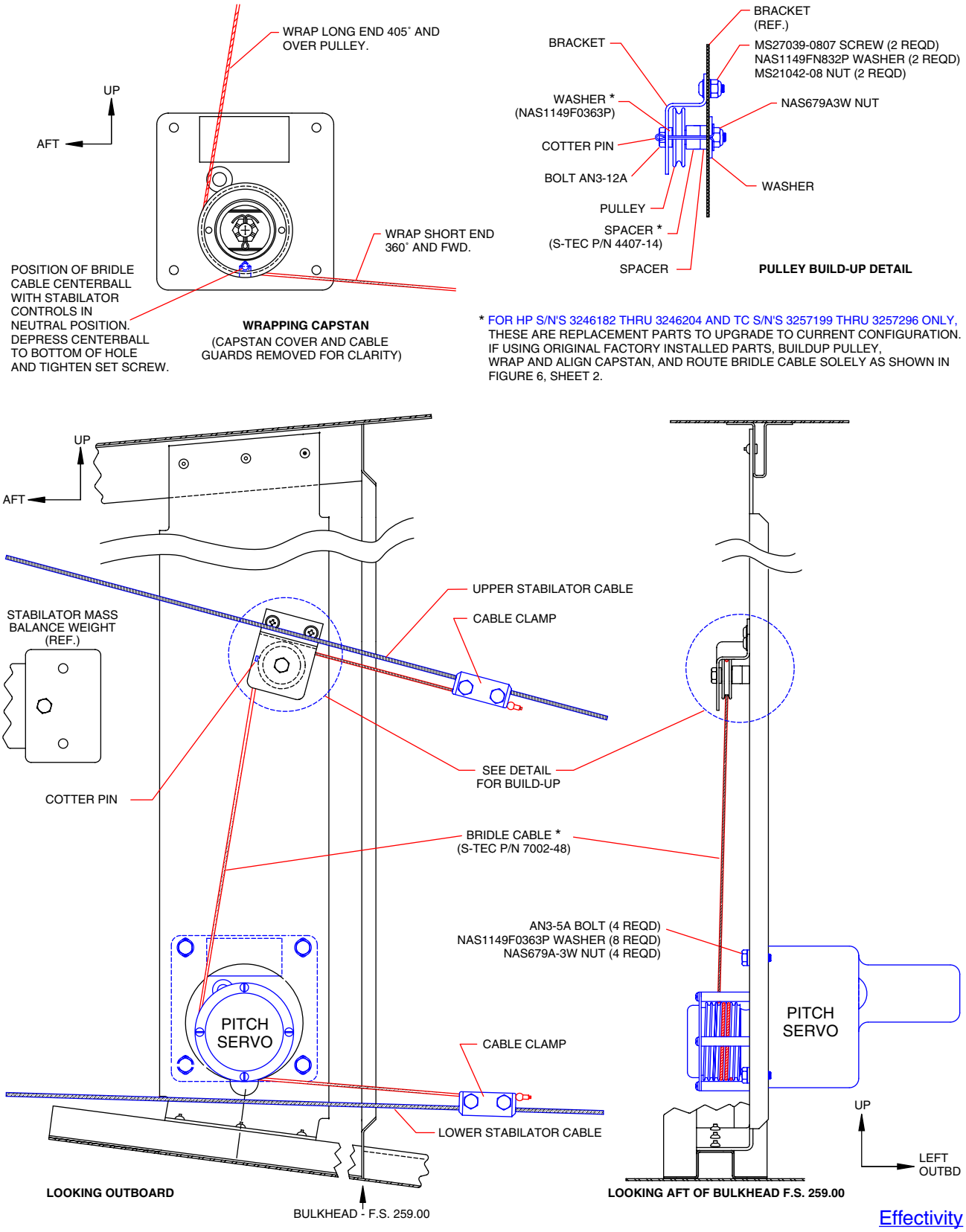
(1) Rig stabilator controls per Stabilator Controls Rigging and Adjustment, 27-30-00.

(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.

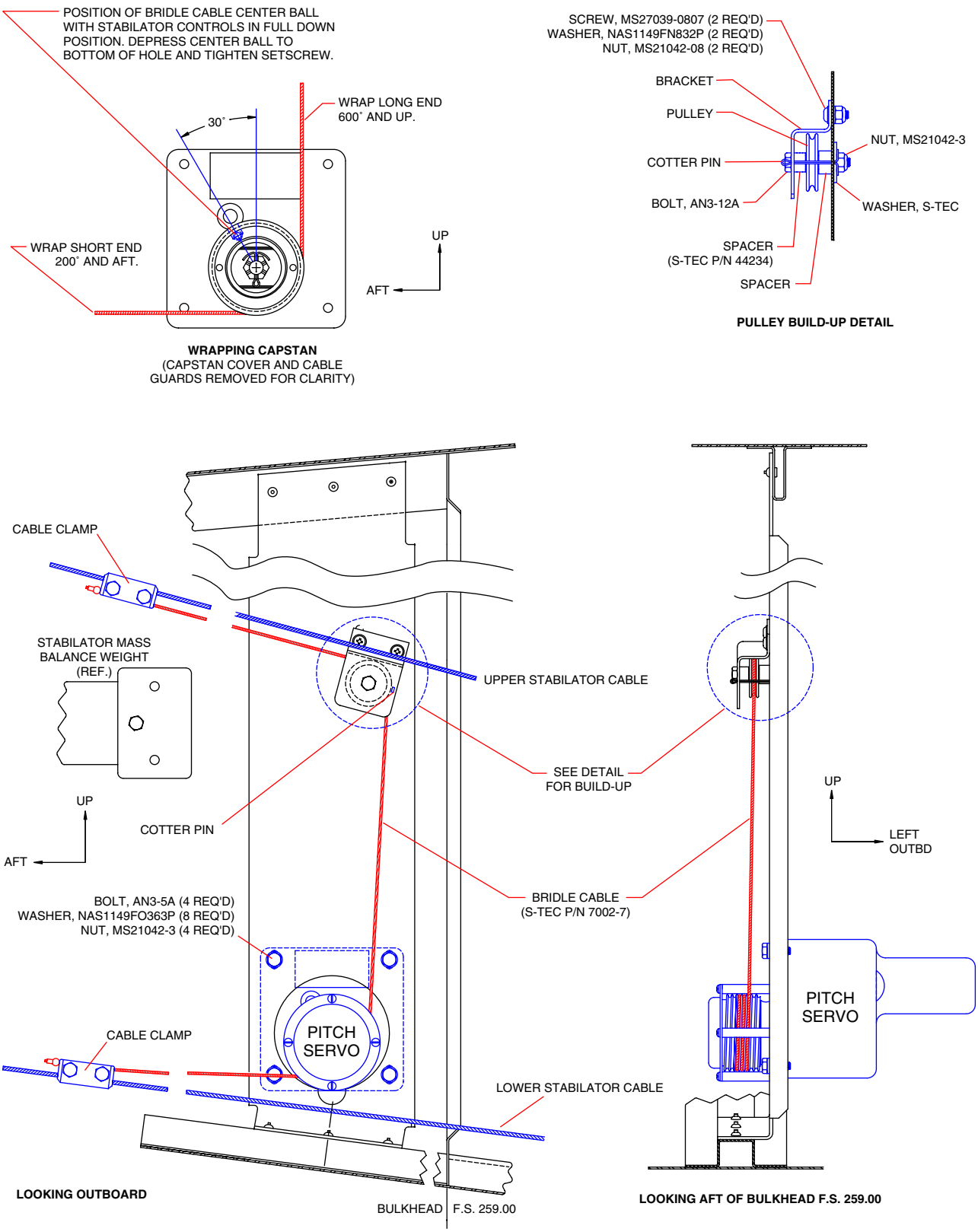
(4) Wrap autopilot bridle cable, align capstan, and tighten center-ball setscrew as shown in Figure 6.

NOTE: The capstan is wrapped and aligned differently on the System 55 (see Figure 6, Sheet 2) and System 55X (see Figure 6, Sheet 1). Verify serial number effectivity for your airplane.



Pitch Servo Installation
Figure 6 (Sheet 1 of 2)

Effectivity
3246182 & up
3257199 & up



Effectivity
3246126 thru 3246181
3257076 thru 3257198

Pitch Servo Installation
Figure 6 (Sheet 2 of 2)

(5) Replace cable guards and capstan cover, secure with screws (4).

(6) Position pitch servo as shown in Figure 6 and secure with bolts, nuts, and washers (4 ea.).

(7) Lead upper portion of bridle cable through pulley as shown in Figure 6. Reinstall cotter pin.

NOTE: The bridle cable is routed differently on the System 55 (see Figure 6, Sheet 2) and System 55X (see Figure 6, Sheet 1). Verify serial number effectivity for your airplane.

(8) Position cable clamps (2) as shown in Figure 6 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 (System 55) or 15 + 10, -2 lbs (System 55X). Torque cable clamp bolts to 55 ± 5 in. lbs.

(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.

16. Servo Clutch Torque Adjustment (See Figure 7 and Chart 1.)

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 7.

(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.

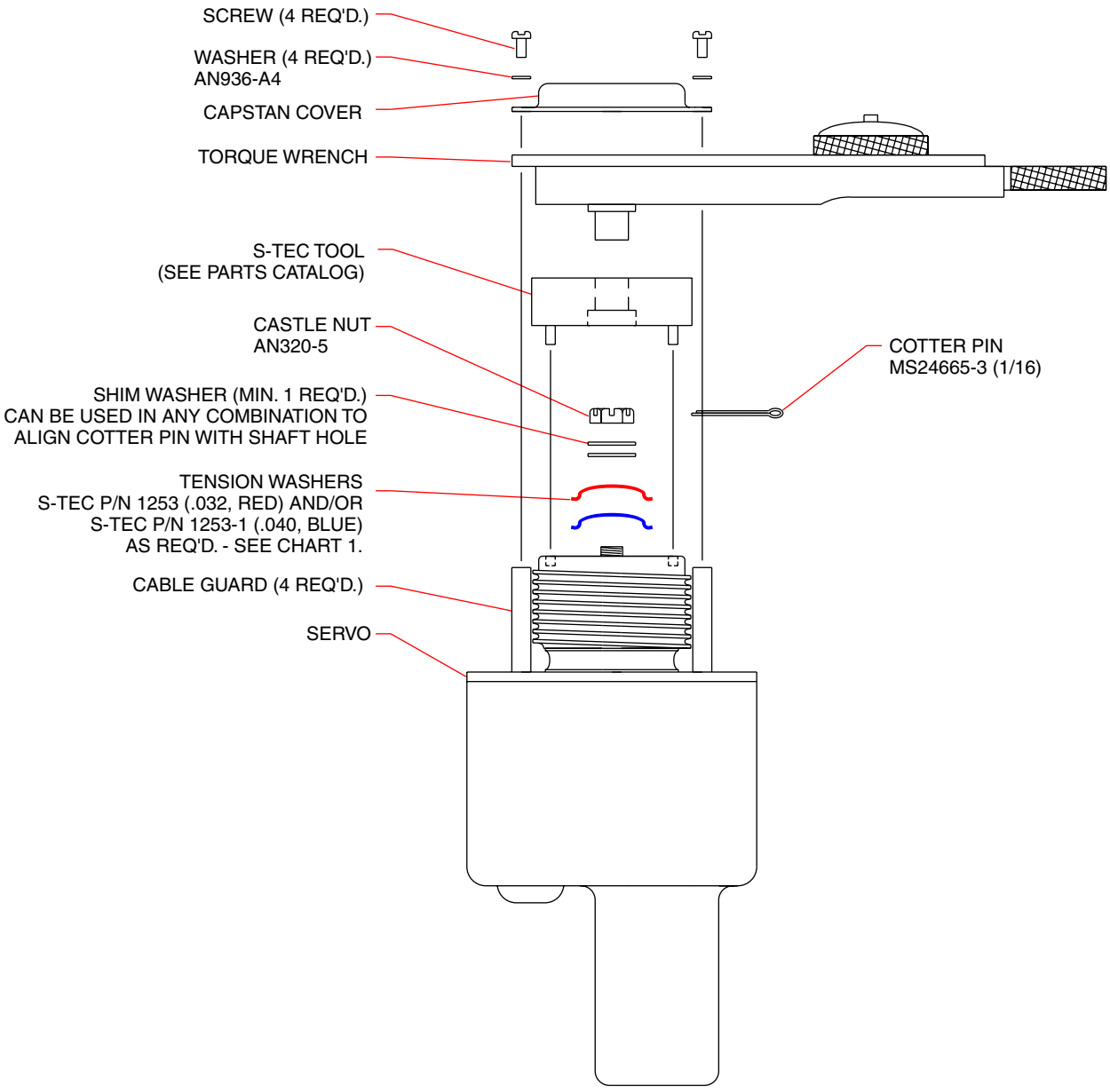
F. Replace tension washers as required (see Chart 1).

G. Replace shim washers and castle nut.

H. Tension castle nut so that capstan torque is as specified in Chart 1.

CHART 1
SERVO CLUTCH TORQUE

SERVO	TORQUE (In. Lbs.) System 55	TORQUE (In. Lbs.) System 55X	WASHERS REQUIRED System 55	WASHERS REQUIRED System 55X
Roll	40 ± 2	40 ± 2	One .032; Two .040	One .032; Two .040
Pitch	44 ± 2	44 ± 2	One .032; Two .040	One .032; Two .040
Trim	20 ± 2	27 ± 2	Two .040	Three .032



Effectivity
3246126 & up
3257076 & up

Servo Clutch Torque Adjustment
Figure 7

17. Flap Compensator (See Figure 8.)

A flap compensator potentiometer is mounted underneath the right aft facing passenger seat or the entertainment cabinet, whichever is installed. The pot is mounted on a bracket just aft of the wing spar box and outboard of the fuel selector valve. The arm of the pot is linked to the flap troque tube by a cable assembly.

Adjustment

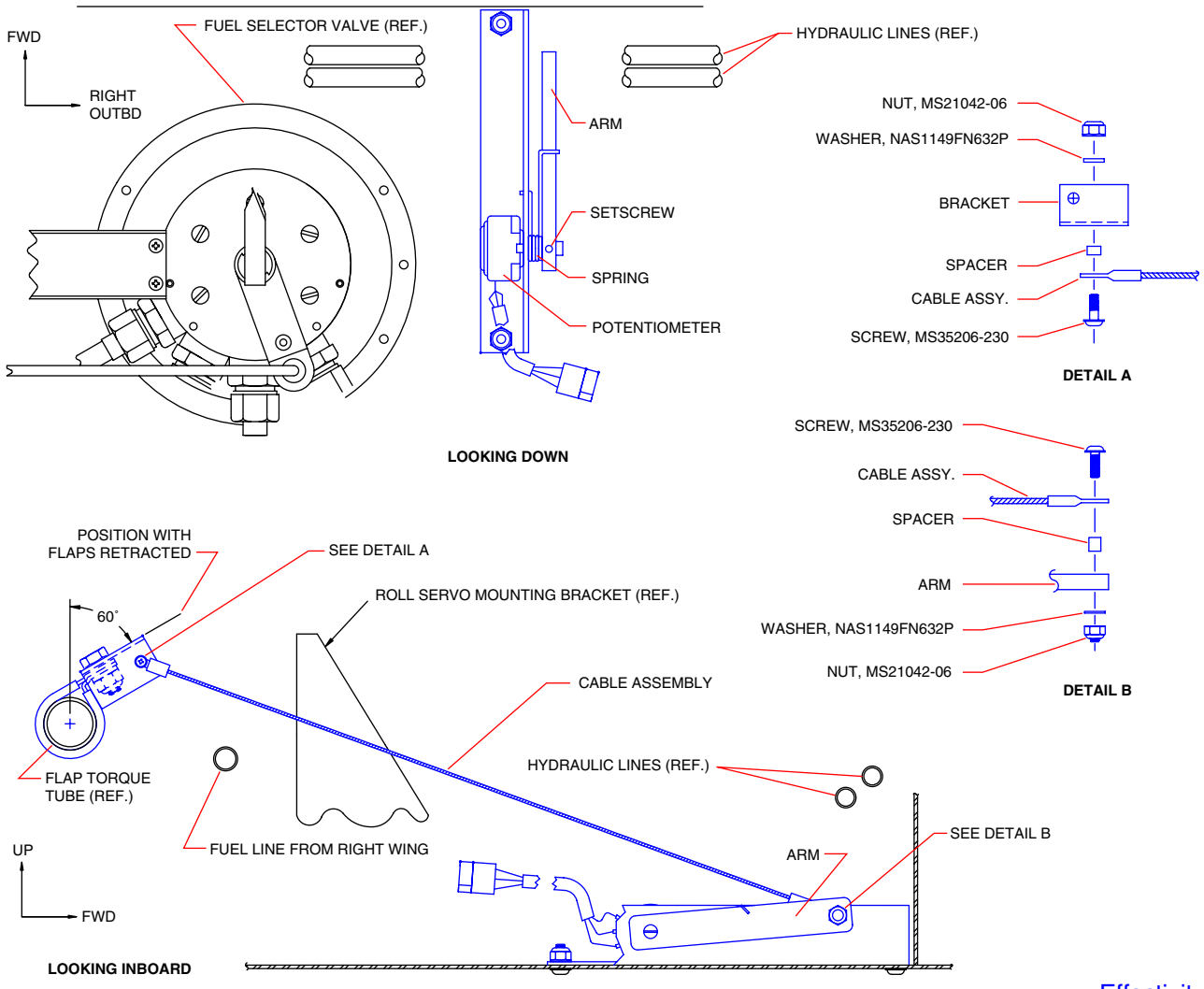
(1) With flaps in the full up position and set screw loose, turn A/P master switch ON.

(2) Connect a digital voltmeter (3 1/2 digit) between airframe ground and center terminal (wiper) of potentiometer (pot).

(3) Turn pot shaft clockwise to stop. Voltmeter should read 5.00 vdc.

(4) Turn pot shaft slowly counter-clockwise until voltage just starts to decrease from 5.00 volts.

(5) Tighten set screw and recheck wiper voltage for 4.95 to 5.00 vdc.



Flap Compensator Installation
Figure 8

Effectivity
3246126 & up
3257076 & up

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APPENDIX

2

ELECTRONIC FLIGHT DISPLAY SYSTEM

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APPENDIX 2

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
APP2-List of Effective Pages	1	Feb 16/04			
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APPENDIX 2 - ELECTRONIC FLIGHT DISPLAY SYSTEM

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APPENDIX 2 - CONTENTS

ELECTRONIC FLIGHT DISPLAY 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.

The Avidyne Entegra Electronic Flight Display System (EFDS) is available as an option in HP S/N's 3246218 and up and TC S/N's 3257339 and up.

1. Description

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. Standard primary flight instruments (i.e. - airspeed, electric attitude indicator, and altimeter) provide redundancy. (See Figure 1.)

The EFDS 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.

Avidyne Entegra Instrument Panel (Optional)
Figure 1

Effectivity
3246218 & up
3257339 & up

2. 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.

A. Primary Flight Display (PFD)

Use 700-00006-0XX PFD & 700-00011-000 Mag/OAT ICA, Avidyne Document No. AVPFD-174, Revision 00-C, September 12, 2003, with the following exceptions:

(1) In para 6, Troubleshooting Information, in the chart where it says “OAT (Optional),” cross out “optional.” The OAT is standard in the Piper installation.

(2) In para 7.2 and Figure 7, where the standard Avidyne installation describes alignment pins and retaining clips on the sides of the PFD, the Piper installation uses a single alignment pin on the top of the PFD engaging a slot in the upper rear cross bracket (see Sheet 1, Figure 2.)

(3) In para 7.5.4.2, in the “Main RS232 Configuration Page” chart, for CHNL 3 under GNS-430 No 2, both Input and Output should read “Crossfill” instead of “Off.”

(4) In para 7.5.5.2, below the heading “S-Tec System 55x Autopilot Unit,” insert the following:

“If the PFD is replaced, the IRU calibration and Magnetometer calibration must be completed before continuing with the following steps.”

(5) In para 7.5.6.2, below the heading “Magnetometer Calibration Procedure,” insert the following:

“Complete the IRU calibration procedure before proceeding.”

B. Multifunction Display (MFD)

Use 700-00004-0XX-() Multifunction Display ICA, Avidyne Document No. AVMFD-167, with the following exceptions:

In para 2, items 7 and 8 are standard in the Piper installation.

C. Data Acquisition Unit (DAU)

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.

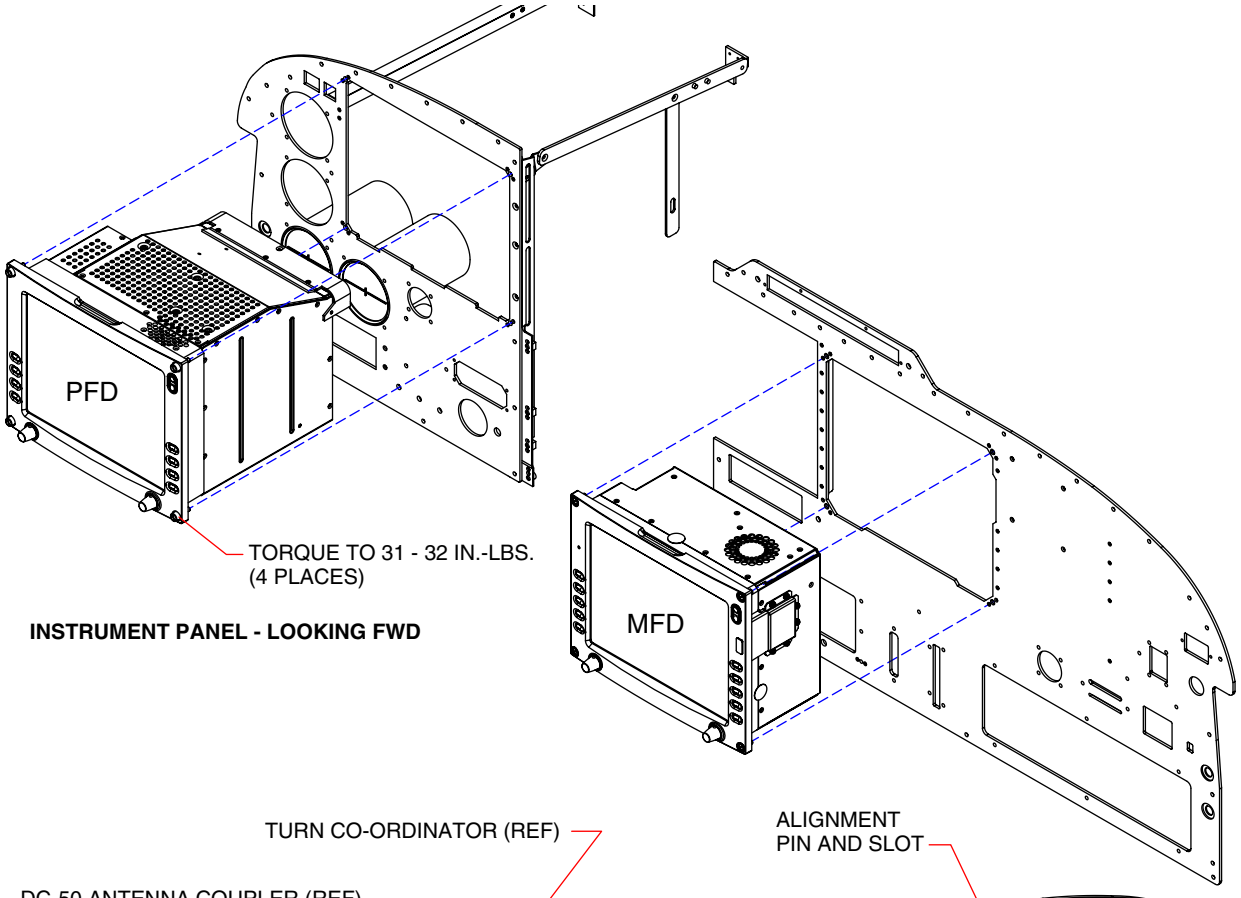
(2) In para 6, in “Table 4 - DAU Sensor Compatibility,” parameter “VAC” is not used in the Piper installation.

D. Magnetometer/OAT Sensor Assembly

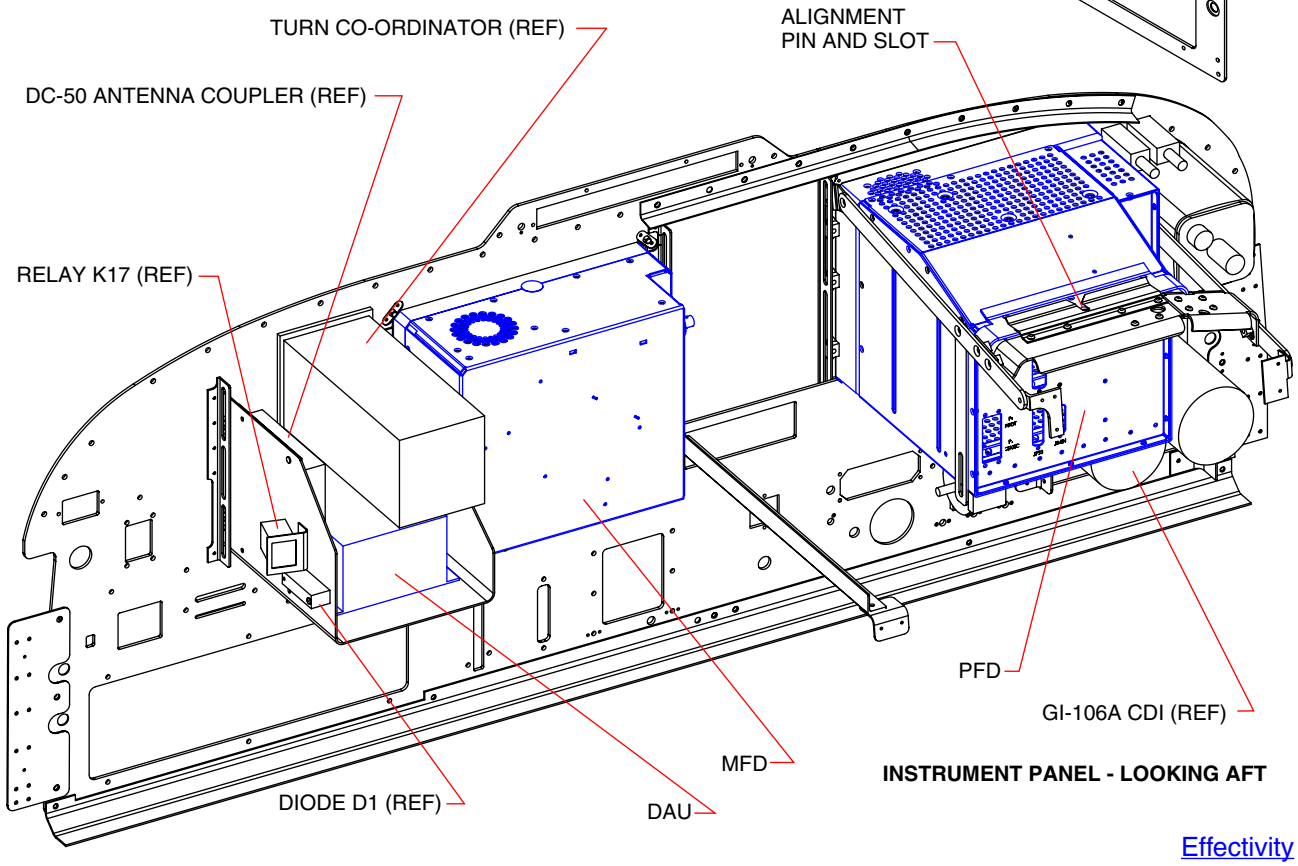
See information under Primary Flight Display, above. Removal and installation instructions are provided under “Magnetometer/OAT Sensor Assembly,” below.

3. Component Locator

See Figure 2.



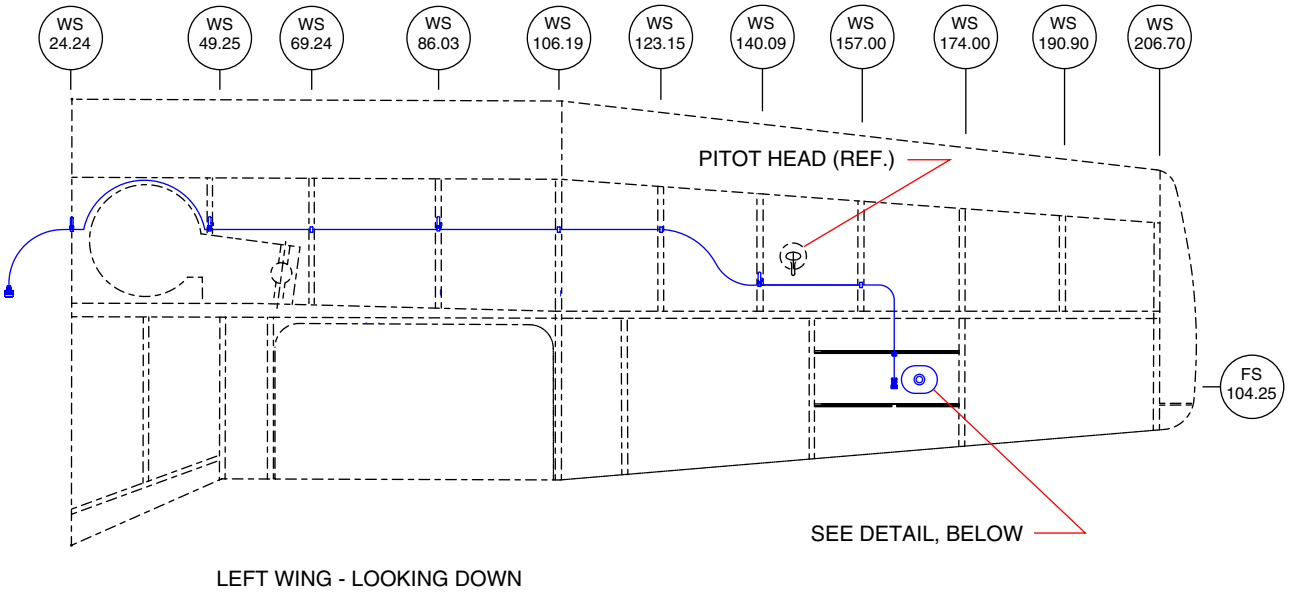
INSTRUMENT PANEL - LOOKING FWD



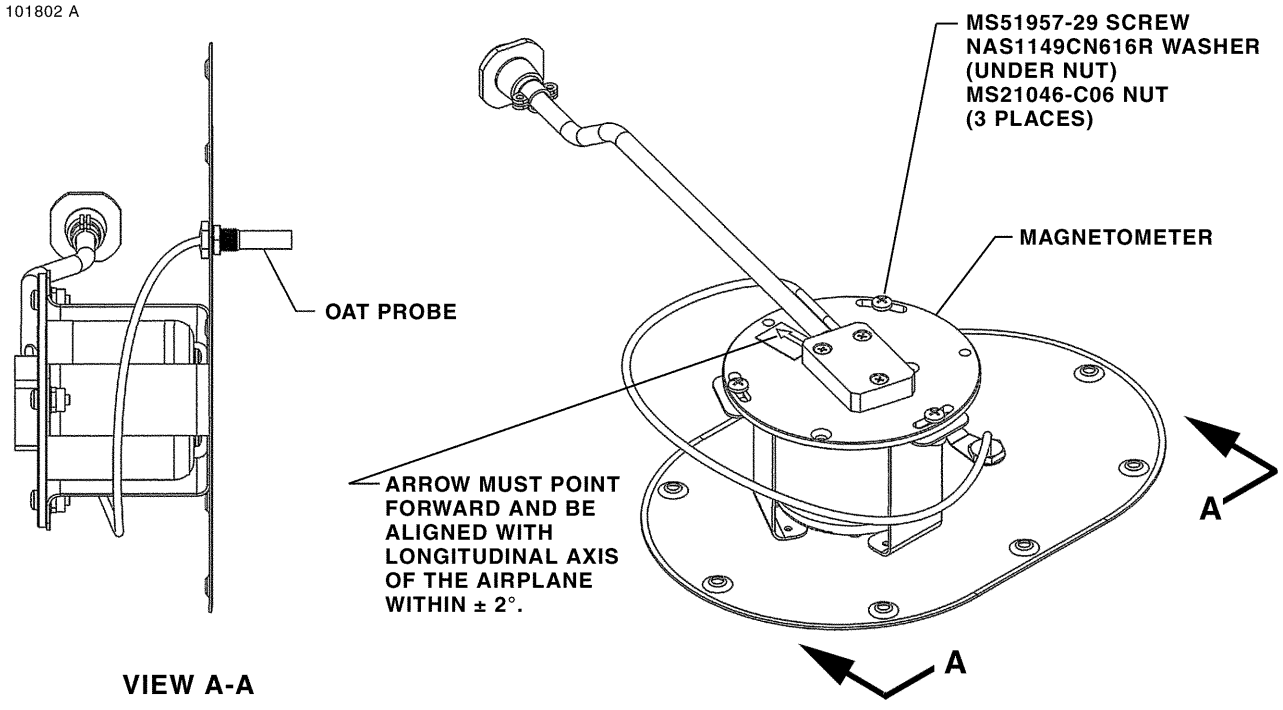
INSTRUMENT PANEL - LOOKING AFT

Component Locator
Figure 2 (Sheet 1 of 3)

Effectivity
3246218 & up
3257339 & up



LEFT WING - LOOKING DOWN



VIEW A-A

Effectivity
3246218 & up
3257339 & up

Component Locator
Figure 2 (Sheet 2 of 3)

4. Magnetometer/OAT Sensor Assembly (See Figure 2, Sheet 2.)

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.

A. Removal

(1) Remove eight (8) screws and support cover plate with your hand.
(2) Drop cover plate down sufficient to reach inside and disconnect the wiring harness.
(3) Remove cover plate - Mag/OAT sensor assembly.

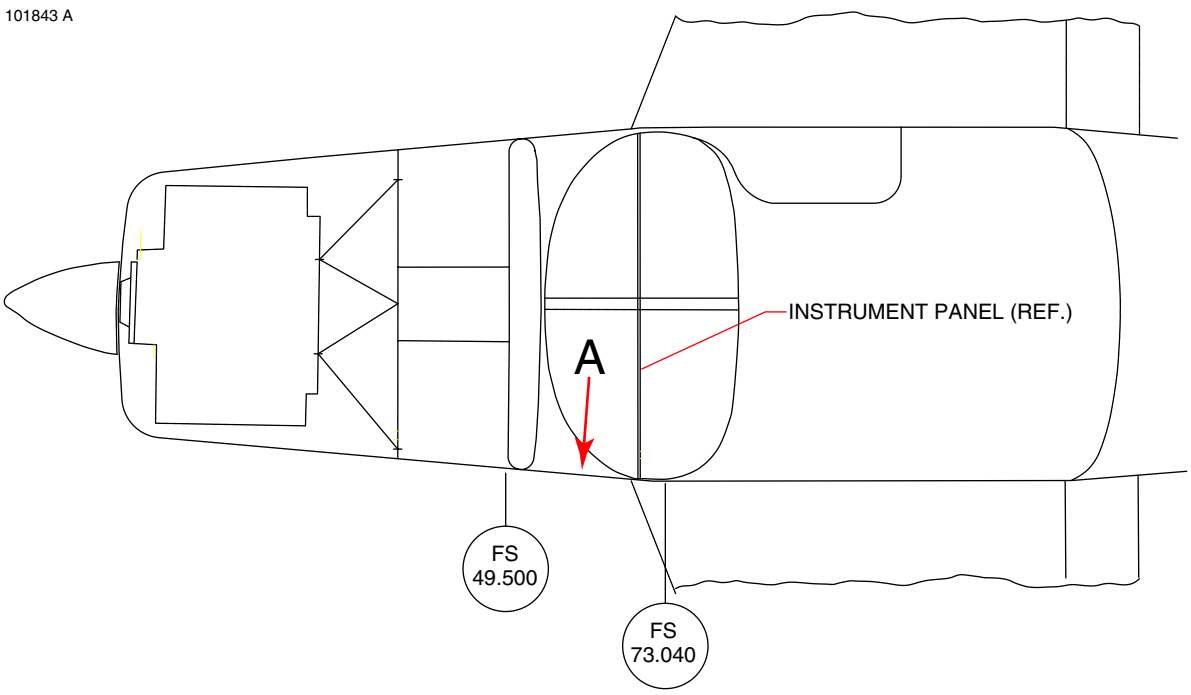
B. Installation

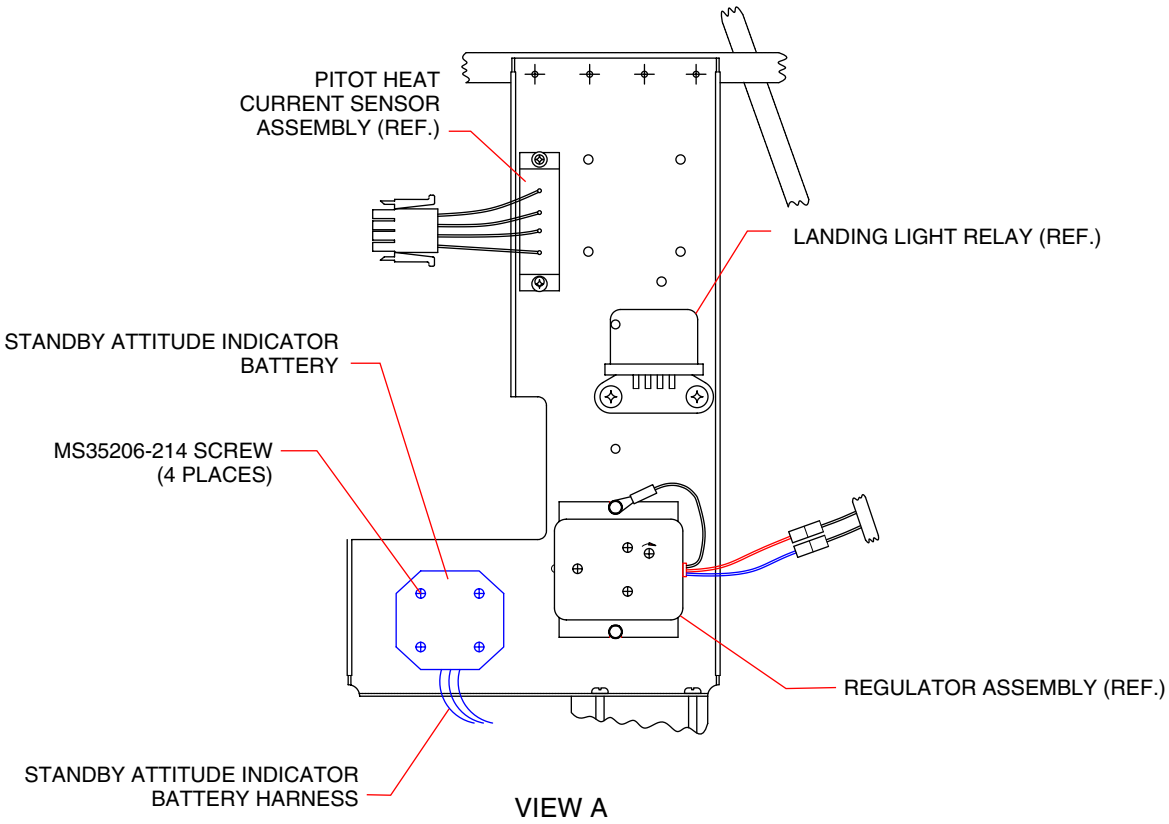
(1) Prior to installation, the arrow on the magnetometer must be aligned with the longitudinal axis of the airplane:
  (a) Install the cover plate - Mag/OAT sensor assembly upside down with the arrow pointing forward. Secure with two (2) screws.
  (b) Loosen the three (3) screws holding the magnetomer to its mounting brackets.
  (c) Align the arrow. Arrow must point forward and be aligned with the longitudinal axis of the airplane within ± 2°.
  (d) Tighten the three (3) magnetometer mounting screws.
  (e) Remove the two (2) screws holding the cover plate - Mag/OAT sensor assembly the wing.
(2) Connect the Mag/OAT sensor assembly wiring harness.
(3) Position the cover plate - Mag/OAT sensor assembly in the access hole with the arrow on the magnetometer pointing forward.
(4) Secure with screws (8).

5. Standby Attitude Indicator

In HP S/N's 3246218 & up and TC S/N's 3257339 & up with the optional Avidyne Entegra Electronic Flight Display System installed, an electric standby attitude indicator is installed to the left of the Primary Flight Display (PFD).

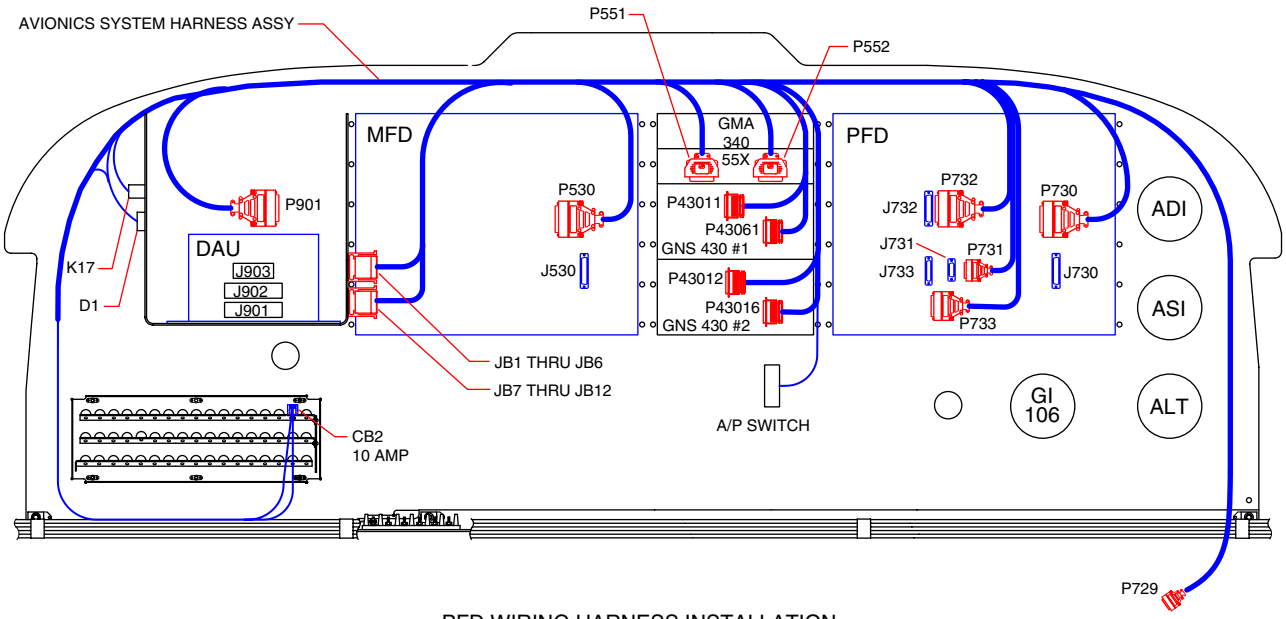
Other than removing and replacing the unit itself (see 39-10-00), the only line replaceable part is the emergency power battery which is located under the instrument panel mounted to a bracket on the left side of the fuselage. See Figure 2, Sheet 3.



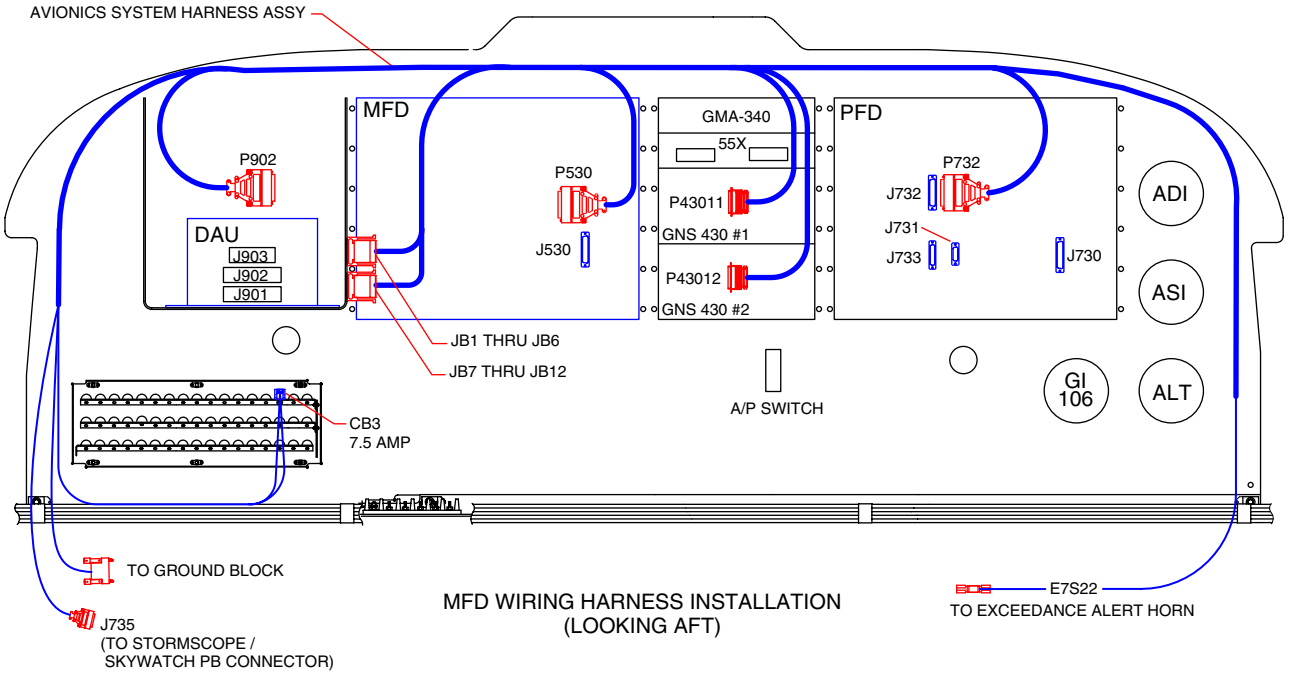


Effectivity
3246218 & up
3257339 & up

Component Locator
Figure 2 (Sheet 3 of 3)



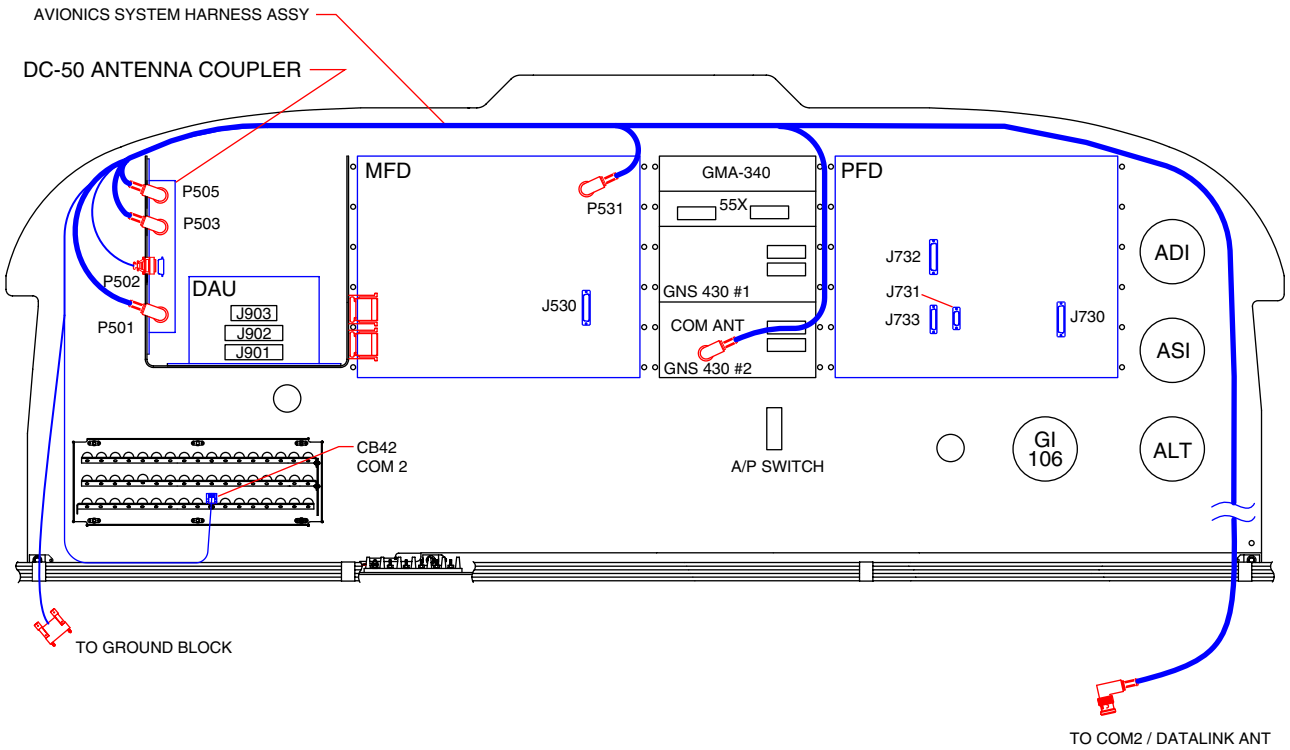
PFD WIRING HARNESS INSTALLATION
(LOOKING AFT)



MFD WIRING HARNESS INSTALLATION
(LOOKING AFT)

Wiring Harness Installation
Figure 3 (Sheet 1 of 2)

Effectivity
3246218 & up
3257339 & up



ANTENNA COUPLER WIRING HARNESS INSTALLATION
(LOOKING AFT)

Effectivity
3246218 & up
3257339 & up

Wiring Harness Installation
Figure 3 (Sheet 2 of 2)

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GRIDS 5K18 THRU 5L24
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